CHAPTER 6

CHAPTER 6 WETLAND VEGETATION

6.1 Condition of Wetland Vegetation

6.1.1 Distribution

(1) Basic classification

The vegetation of the study area is classified into 8 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.

It may be controversial that the inundated grasslands occupy the place with other categories in the same classification order. In fact the inundated grasslands consist of a mixture of some wet herbaceous vegetation types, and it overlaps in phytosociological context with other categories such as fen vegetation. LWC is the only place in Latvia where the inundated grasslands distribute to huge extent and it is an important element which characterizes LWC. So, it is decided that the inundated grasslands are classified from other vegetation types. It is tentatively defined here that the inundated grasslands are wet grasslands which have a certain inundated period with a comparatively thin or no peat layer contrary to bogs and fens which have a thick peat layer.

Forests are classified into three types by dominant species, namely, coniferous, deciduous (small-leaf), and broad-leaved forests. A boundary of each vegetation type is not always clearly recognized especially in case of a bog and a coniferous forest in LWC. These two types of vegetation often distribute adjacently with transitional open wood which gradually change its tree density. So, the transitional open woods (shrub bogs) are included into raised bogs and transitional bogs category.

(2) Distribution of vegetation type

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 6.1.1.

Raised bogs and transitional bogs are distributed intermittently in the whole study area. Larger bogs are found in northeastern part of the area on the right bank of the Aiviekste river. Fens mainly distribute at the backyard of the Aiviekste river and its tributaries. These wet vegetation have still wide distribution around Lake Lubana although much of them have been drained for agriculture and forestry. Inundated grasslands are distributed mainly along the Aiviekste river and the shore of the lake.

Forests are distributed in the northwestern part in large extent and the southeastern part of the study area. A mass of coniferous forests occupies in the northwestern part and

surrounds bogs. The deciduous forests are also located in the northwestern part and outer side of bogs. The broad-leaved forests are found in a few places in small patches.

Dry grasslands and agriculture lands are distributed mainly along the western and eastern boundary of LWC where the elevation are relatively higher and drainage system seem to work better than other areas. Water bodies mainly consist of Lake Lubana and adjacent fishponds. Rivers and small natural lakes are also the component of water bodies.

6.1.2 Characteristics of Vegetation

(1) Raised bogs and transitional bogs

This vegetation is characterized by the dominance of a sphagnum layer. Raised bog relies on only precipitation for its water supply. A thick peat soil has been developed below the sphagnum layer. On the other hand the transitional bog is treated with both precipitation and ground water. The typical species are *Sphagnum fuscum, S.rubellum, S.magellanicum, S.angustifolium,* and *Eriophorum vaginatum* (cotton grass), *Carex limosa* (sedge sp.).

(2) Fens

Fens are mainly characterized by *Pragmites australis* (reed). Some *Carex* (sedge) species also form fen communities. A thick peat layer derived from dead plant is developed in the area. Topographically, the fens distributes low and flat areas in LWC where the groundwater level seems to be constantly high and surface water is tolerant to be dehydrated. When the accumulation of peat is not disturbed, a fen succeeds to a transitional bog, then to a raised bog in long term.

(3) Inundated grasslands

Inundated grasslands are characterized by annual inundation. Only LWC has the huge extent of the inundated grasslands in Latvia. The annual flood is essential for maintaining the grasslands by disturbing an invasion of bush species in natural ecosystem. A periodical mowing in the areas plays the other important roll in maintaining present extent of the grasslands. *Phalaroides arundinaea* is dominant in a typical inundated grassland community.

(4) Coniferous forests

Pinus sylvestris (scots pine) and *Picea abies* (norway spruce) are dominant species of a coniferous forests in LWC. It grows well up to about 20m high with closed canopy in comparatively dry part of the study area. The structure of the forests is rather simple and usually has two underlayers. Shrub-sapling layer is rather sparse with sporadic *Juniperus communis* (common juniper), *Salix cinerea* (grey willow). Herb and moss layer consists of *Vaccinium* (cranberry) species and etc. Artificial coniferous forests in a drained land have similar structure as mentioned above.

(5) Deciduous forests (small-leaf forests)

Betula pubescens (white birch) is dominant species in deciduous forests. These forests are sometimes called as "small-leaf forest" in Latvia to distinguish from a broad-leaved forest. They are recognized as secondary vegetation which appear in the earlier stage of plant succession. Rather thick shrub-sapling layer is developed with *Sorbus* (rowan) species and *Rubus* (raspberry) species and etc.

(6) Broad-leaved forests

These forests consist of broad-leaved deciduous trees such as *Quercus robus* (english oak) and *Alnus glutinosa* (black alder). The distribution of the forests is very limited. Because this type of forests is regarded as natural stand and some birds of prey nest in this forest, it is considered an important vegetation in LWC.

(7) Dry grasslands and agriculture lands

Dry grasslands are basically secondary vegetation and usually exist under strong human influence in LWC. Periodical grass cutting or grazing is essential for their existence. Agricultural lands, when those are used for grazing or hey making in a cropping rotation, have almost the same botanical component as dry grasslands.

(8) Water bodies

Lake Lubana and nearby fishponds are very shallow water bodies with only a few meters deep. *Typha angustifolia* (bulrush) and *Pragmites australis* (reed) grow in shallower places along the shores.

6.1.3 Relation with Hydrology

(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 6.1.2. 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 ground water is low. Fens occupy lower flat area. Inundated grasslands are along a river where an influence of flood 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 its water supply. Annual flood, surface water, and ground water are not acceptable for their survival. On the other hand, fens accept an annual flood. Wet ground condition which fens require can be guaranteed either by inflow surface water or ground water. 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 for a 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 15.2.2~15.2.4. 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 a 10-year flood. 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 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 can tolerate periodical inundation.

6.1.4 Impact by Human Activities

(1) Influence of drainage system

There are many drainage canals in LWC which were dug for reclamation and tree plantation. Such drainage made ground moisture conditions dryer and cause plant succession towards a dry type community. Though little data on groundwater level is available in the study area, some influence of drainage can be observed in the field. Figure 6.1.3 shows the areas where forest belts along drains are observed. Those forest species could be assumed to invade into the areas after a dryer soil condition is created by drainage. It is also observed that water brownish in color, is leaking from bogs through some drains.

(2) Agricultural activities

Table below shows one example of cropping rotation in the Lubana lowland. Although not all farmers follow this cropping rotation, it can be seen that grasslands are converted into farmlands periodically.

Example of Cropping Rotation

Year	Crops
1st	Potatoes
2nd	Rye, Wheat (winter)
3rd	Rye, Wheat (summer)
4th	Grassland
5th	Grassland
6th	Grassland

Source: personal contact, Gaigalava Township Office,1999

Considering the present economic depression related to agricultural activities, the abandoned area seems to be increased. Figure 9.1.2 shows the extensive abandoned areas where are once drained and any agricultural activities such as mowing and farming are not operated at present to a huge extent. The abandoned areas are mainly found in places far from dwelling areas.

Mowing was common activity in LWC before economic situation deteriorated and played an important roll in maintaining some inundated grassland communities. These inundated grasslands were used for mowing with the construction of drainage. Although the drainage created an unsuitable hydrological condition for survival of inundated grasslands, the mowing compensated it by disturbing plant succession and helped maintaining the plant community. Nowadays those inundated grasslands are abandoned but the drainage still functions. Consequently, the dryer ground condition causes plant succession towards bush/forest communities. Pioneer species such as *Salix* (willow) and *Betula* (birch) species form narrow forest belts along the ditches and shrubs began to invade into the grasslands.

(3) Silvicultural activities

Pinus sylvestris (scots pine), *Picea abies* (norway spruce), and *Betula pubescens* (White birch) are dominant forest tree species in LWC. According to the Forest Research Institute, it takes about 100 years for pines and about 80 years for birches from planting to harvesting in and around LWC. Although they can physiologically adapt to wet ground condition, somewhat dry soil condition of approximately 1.0m deep is required if they are expected to grow up to commercial log size. Since most of the lands in LWC were originally under a wet soil condition except some undulating hills, the construction of drainage have been carried out to reclaim lands for sylviculture. The drainage is also necessary for using heavy machinery such as tractors and tracks. At present drainage networks are well established in the existing forestry areas. They have about 1.5m depth and are distributed about 50m in intervals.

Figure 6.1.4 shows forest areas where some intensive activities such as dense drainage system and cutting are widely observed. A forest mass in the northern part is suffered from dense drainage systems. In some other forest stands in the south part of LWC, relatively intensive exploitation can be observed.

(4) Gathering

Activities of berry and mushroom picking are common in and around LWC. These activities seem to be mainly for recreation and subsistence for local people. Some harvests are sold at local markets. No clear evidence is observed that such activities cause degradation of the vegetation, though many people go into the field during the harvest seasons.

(5) Fire

Wildfire is observed in and around LWC during the field survey. In a dry year, even the surface of a bog (the surface of a dried sphagnum layer) is scorched. But the impact on wet vegetation such as bogs and fens seems to be not so serious at all because the under-layer just below the surface is always fairly wet and the fire cannot penetrate inside. The vegetation which are easily affected by fire are drained agricultural lands and drained forest lands because of the constantly dry ground conditions.

The wildfire is often started by careless hikers or local people, although natural phenomena such as lightning were the main cause of the fire historically. Fire detection in the beginning stage is very important and effective for preventing damage by the fire. Once the fire has expanded it is very difficult to extinguish until sufficient amount of rainfall comes.

6.2 Important Plant Species and Communities

6.2.1 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 follows. (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.

6.2.2 Essential Vegetation for Bird and Wildlife

Among mammal species recorded LWC, 7 species are listed in the Red Data Book of Latvia or the EU Habitat Directive (see Table 5.1.2). 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 depending on the amount of their prey and possibly extend 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.

6.2.3 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.

A 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. They do not seem to have huge demand for commercial industry. Dried sphagnum is used for an adiabatic material of local houses, but the demand is limited.

6.2.4 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.

6.3 Evaluation of Wetland Vegetation

6.3.1 Methodology

An evaluation of the ecosystem of LWC is carried out by the following steps. First, LWC is evaluated and classified by the dominant vegetation type. The criterion is based on naturalness and intensity of human disturbance. It consists of five grades. (Primary evaluation)

Next, the information of sites for important species is selected and mapped for evaluating preciousness and diversity of the ecosystem. Distribution of rare and protected plant, nesting site for important birds and habitat of endangered mammals and other wildlife can be used for the criteria. But the information of the rare and protected plant species is very limited, and the data for habitat of wildlife is also insufficient. Then nesting and breeding site for important birds and habitat of aquatic mammals are used as criteria this time.

The information is overlaid on the primary evaluation map. The criteria for preciousness and diversity are added on the primary evaluation. An area where some sites concentrate is recognized as an important area and be raised a rank of the evaluation grade. Extent of the vegetation and continuity of the sites are also considered. Then, the secondary evaluation map is developed. (Secondary evaluation)

6.3.2 Result of Primary Evaluation

The primary evaluation consists of five grades as shown in the following table. The result of primary evaluation is shown in Figure 6.3.1 as primary evaluation map. Areas of high grade (5 and 4) distribute intermittently in LWC. A mass of forest in the northwestern part of LWC is mostly ranked in the grade 2 because of the exploitation and dense drainage. Areas of grade 1 occupy the fringe of LWC.

Criteria and Vegetation Type for Primary Evaluation

Grade	Criteria	Vegetation type and features
5	Natural or semi-natural with national and international importance	Raised/Transitional bogs, and Broad-leaved forests
4	Other Natural or semi-natural vegetation	Raised/Transitional bogs slightly disturbed, Coniferous and Deciduous forests (intensive exploitation or dense drainage is not observed)
3	Secondary vegetation sustained by periodical flood or tolerant of flood	Raised bogs disturbed, Fens, lake, and Inundated grasslands
2	Secondary vegetation established after human disturbance, and Artificial vegetation under less human disturbance	Coniferous and Deciduous forest (exploitation or dense drainage is observed, small patches), fishponds, and Dry grasslands/Agricultural lands (abandoned)
1	Artificial vegetation with intensive human disturbance	Dry grasslands/Agricultural lands (intensive farming)

6.3.3 Result of Secondary Evaluation

Distribution map of nesting and breeding site for birds presented in Figure 5.2.1 and habitat of aquatic mammals is prepared as overlaying information (see Figure 6.3.2). The

ecosystem of LWC is totally evaluated (see the table below and Figure 6.3.3). 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. So, 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.

6.4 Protection of Wetland Vegetation

6.4.1 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.

6.4.2 Ecological Planning

Figure 6.4.1 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 but for those disturbed 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 Lubana Lake 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 6.4.1 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 6.4.1 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.

6.4.3 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 also not 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 groundwater 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.

6.4.4 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 to 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.

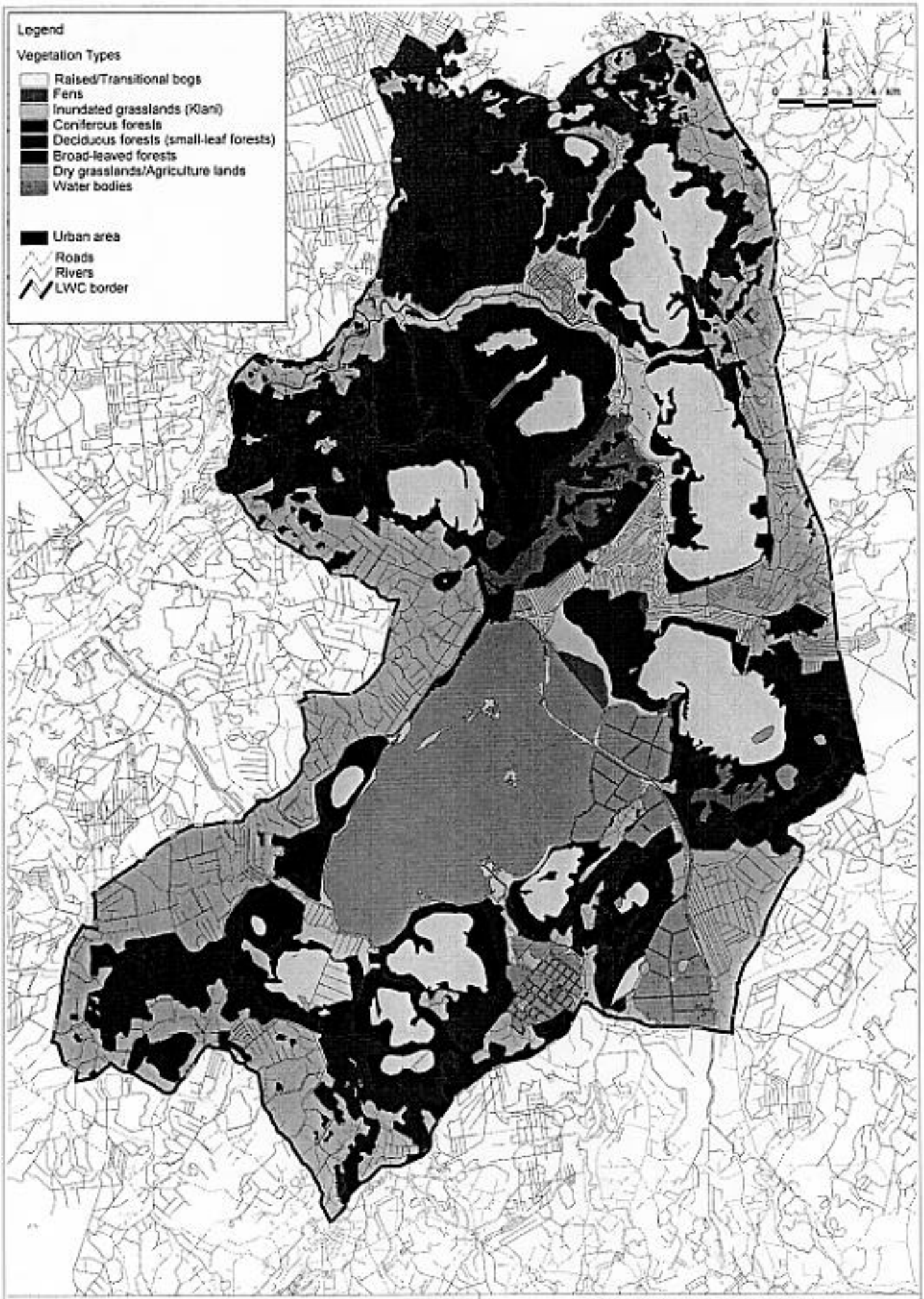

Figure 6.1.1 Vegetation Map

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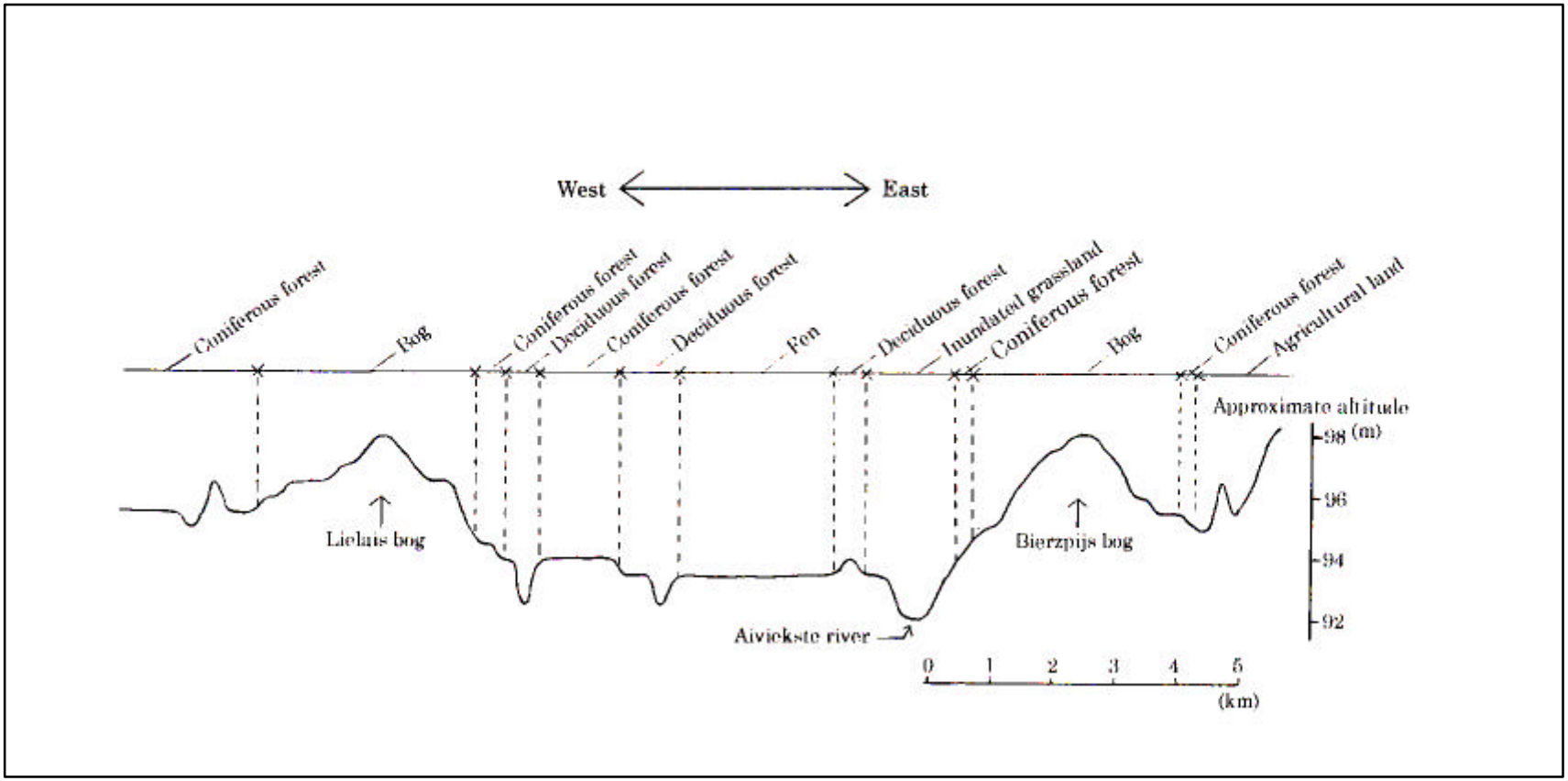

Note: Location of this cross section is shown in Figure 6.1.3.

Figure 6.1.2 Typical Cross Section of LWC

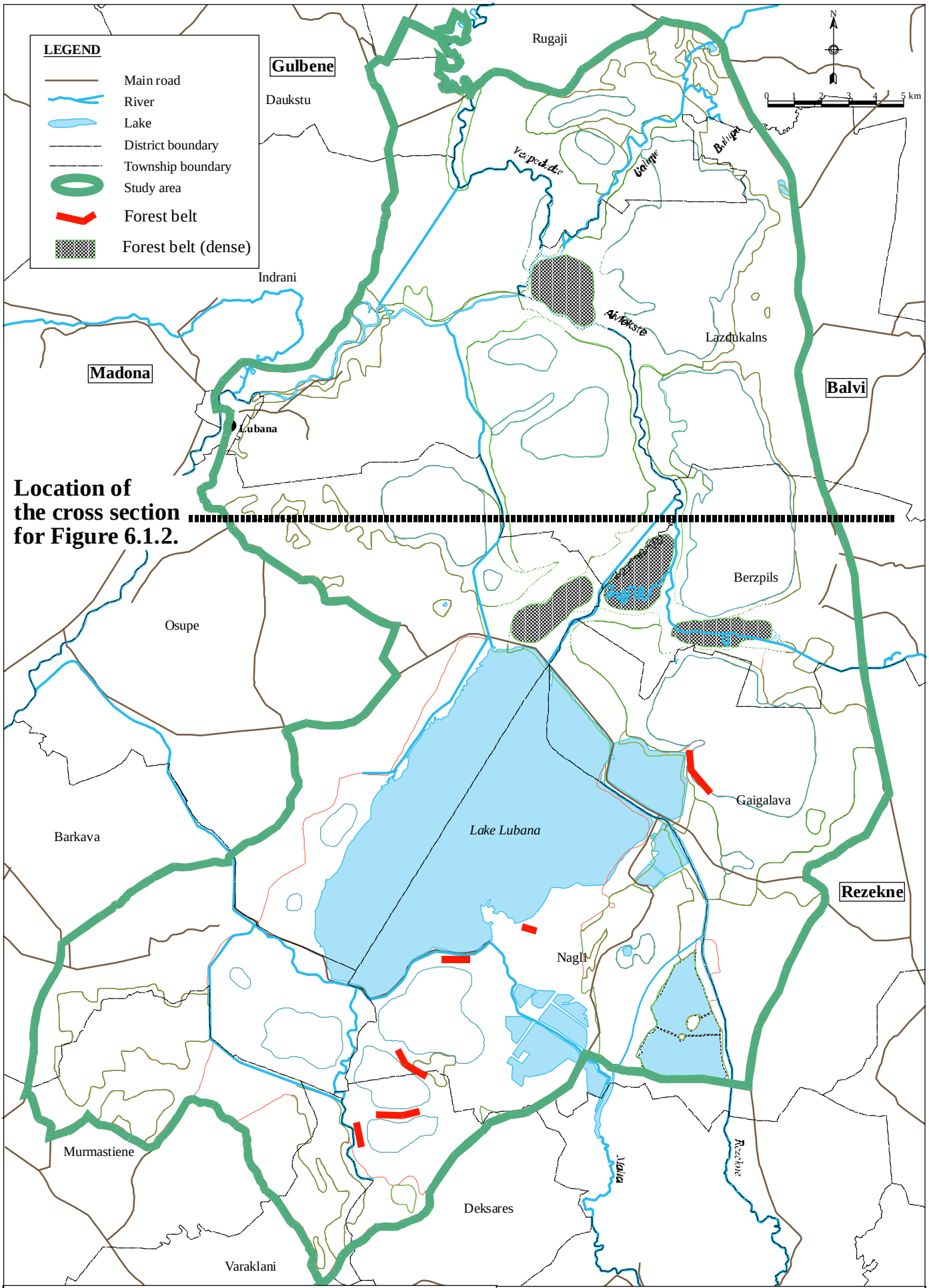

Figure 6.1.3 Forest Belt along Drainage

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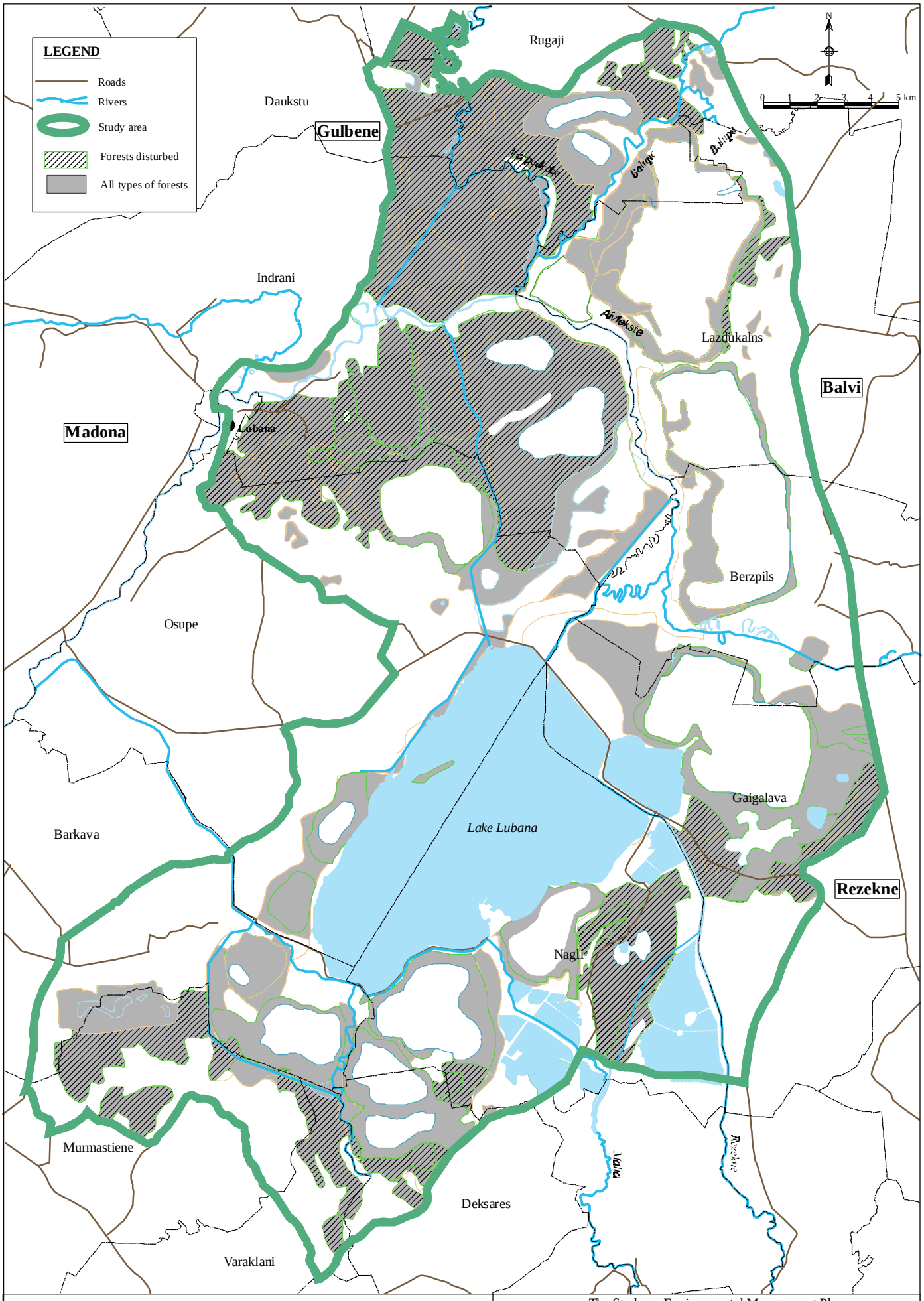

Figure 6.1.4 Forests Disturbed

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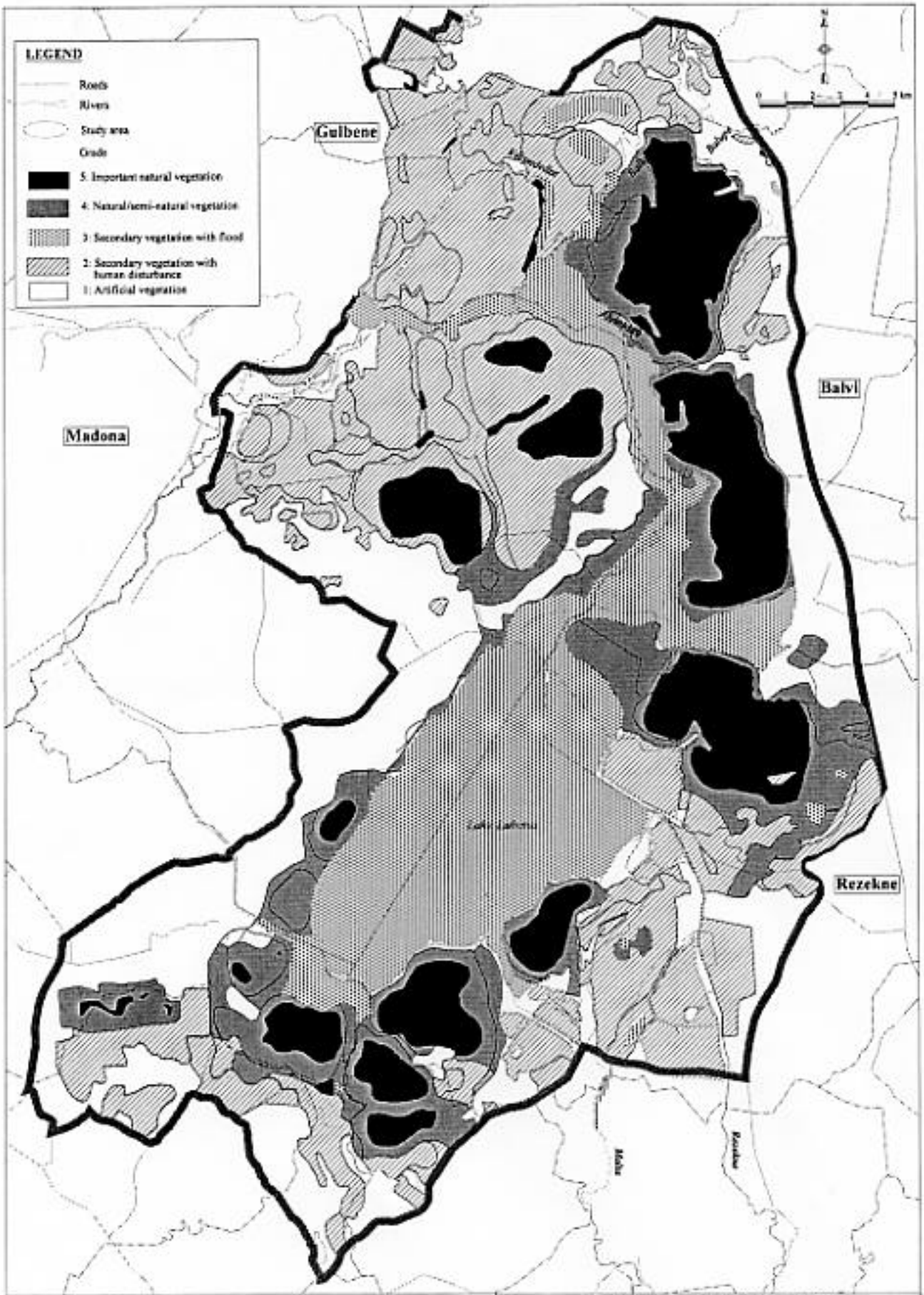

Figure 6.3.1 Preliminary Evaluation Map

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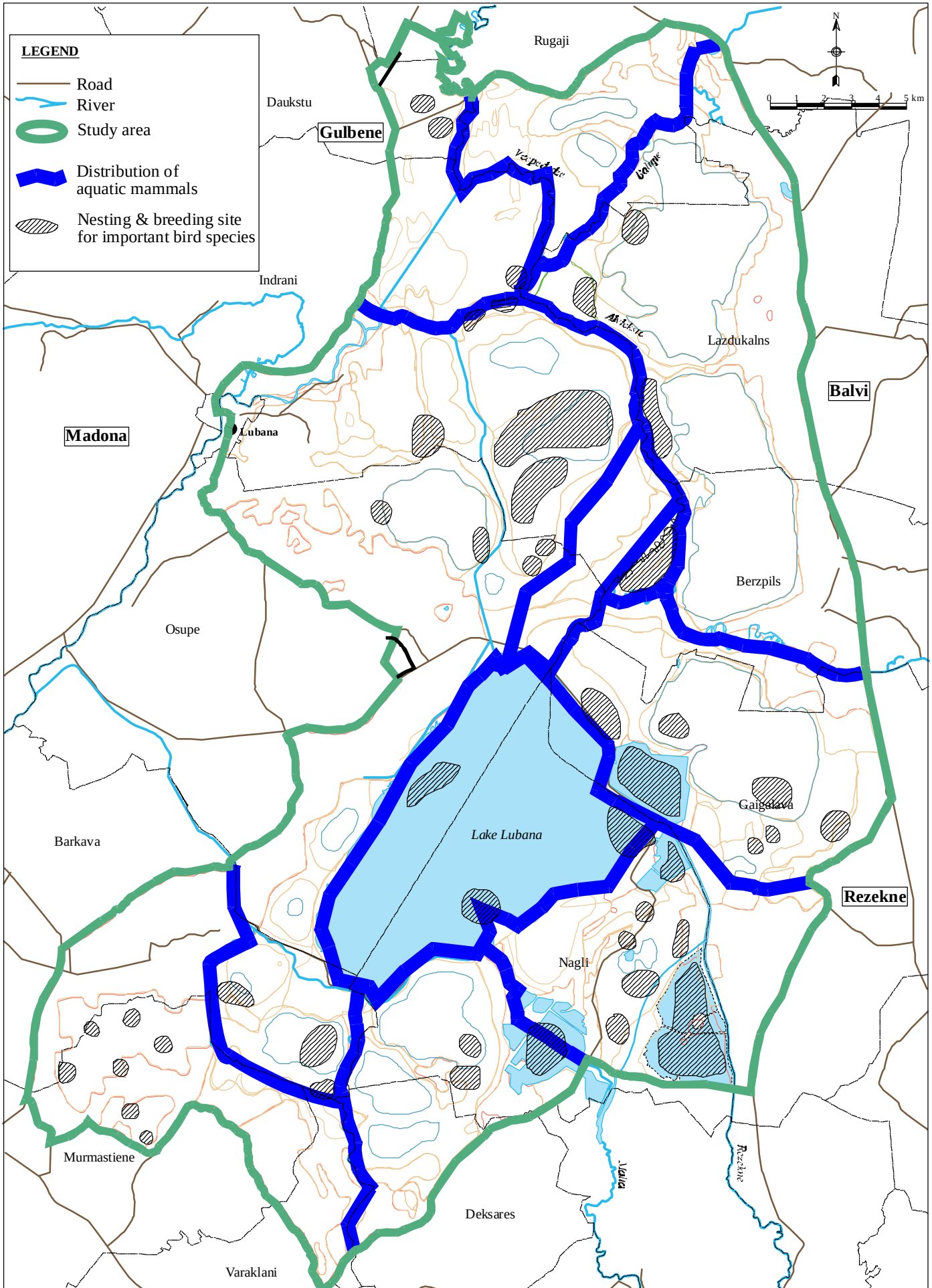

Figure 6.3.2 Habitat for Wildlife

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for Lubana Wetland Complex in the Republic of Latvia

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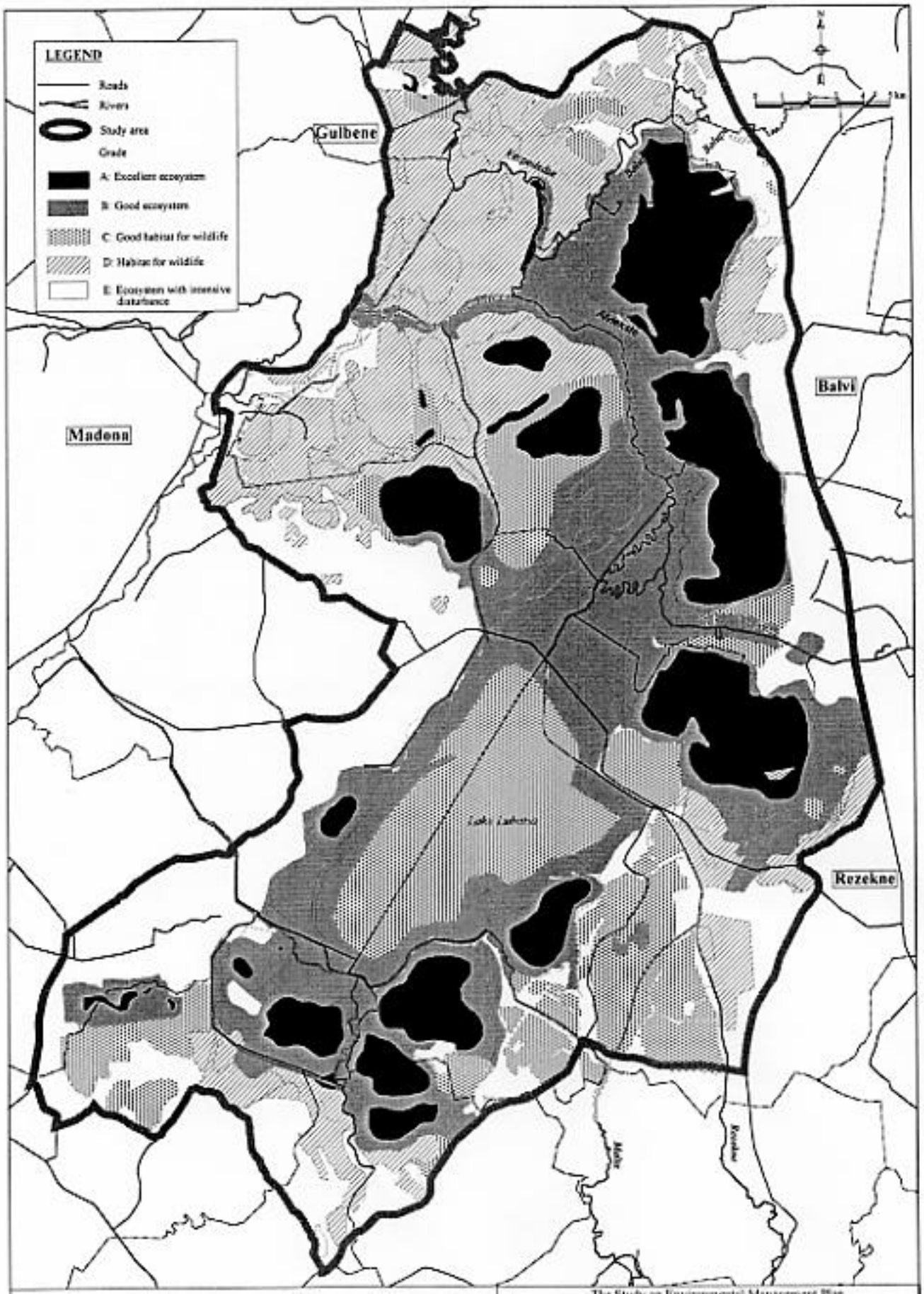

Figure 6.3.3 Secondary Evaluation Map

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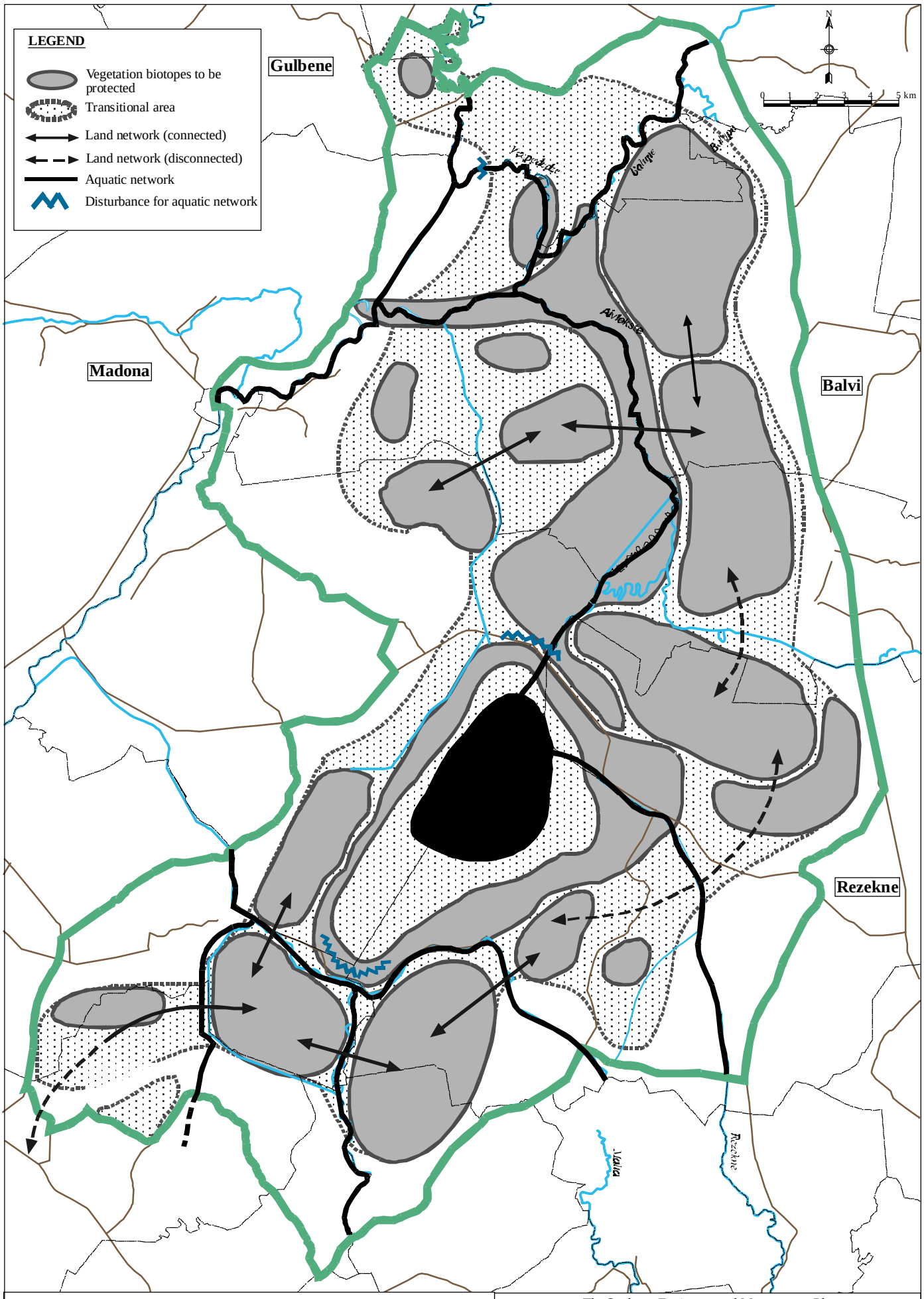

Figure 6.4.1 Delineation of LWC for Vegetation Biotope

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CHAPTER 7

CHAPTER 7 PREPARATION OF BIOTOPE MAP

7.1 Biotope Map of the Study Area

7.1.1 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, and they were dealt with 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: Fens are characterized by reed with constantly high groundwater level. A thick peat derived from dead plant of reed is developed in the area. Topographically, fens distribute where water flow of an annual flood is not so fast for disturbing accumulation of peat in LWC.

Inundated grasslands (Klani): Inundated grasslands are 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 forests (small-leaf) and Broad-leaved forests: Reflecting vegetational difference, deciduous forests (small-leaf) and Broad-leaved forests are dealt separately. Faunal characteristic of the latter, however, is unclear because the area is limited in LWC.

Dry grasslands and Agricultural lands: These include a land with vegetation cover, including natural grasslands, 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.

7.1.2 Distribution of Biotopes

The distribution of biotopes in LWC is shown in the biotope map of Figure 7.1.1. 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.

(1) 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 of inundated grassland is rapidly changing by abandoning of hay making. In the near future, this may affect bird species like great snipe that breed in such a place. On the other hand, a population increase is remarkable in some waterbirds 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 reflect naturalness of vegetation. It is certain that big trees are their favorable nesting places. Bird species living bushes or forests seem not to be so much affected. Therefore, it is concluded that priority places for bird conservation are bogs and fishponds because the former is a vulnerable habitat and the latter is serving a core of waterbird distribution.

(2) 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.

(3) Reptiles and Amphibians

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

(4) Fishes

Fish composition and abundance in Lake Lubana is changing due to flood measures and commercial fishery activities. In particular, construction of watergates 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.

7.2 Detailed Biotope Map of the Model Area

7.2.1 Purposes

1) Application to decision-making

The detailed biotope map is prepared to use as a decision-making tool to formulate conservation measures. The biotope map and biotopes found through the biotope mapping process described below offer policy-makers fundamental and indispensable information on the current conditions of the nature and the human impacts. At the final evaluation stage, decision-makers are required to decide which biotopes should be preserved or conserved, and what measures should be taken to prevent negative human impacts and to maintain positive human influences based on the biotope map. Through the entire process of biotope mapping, decision-makers can increase their credibility and accountability to the public due to the clear and systematized decision-making process integrated.

2) Standardization of ecological monitoring procedures

Usually, the monitoring for such ecological features as botany, zoology, ornithology, ichthyology, and entomology is separately conducted without integrated and visualized maps attractive to the ordinary citizens. Through the biotope mapping process described

below, one can integrate the ecological monitoring as a standardized method. The detailed biotope map can be used as an output for the ecological monitoring and be kept as digitized data forever. Consistent and continuous data collection and storage are possible through the biotope mapping proposed here.

3) Specification of educational and eco-tourism resources

Wise use of wetlands can be materialized only through precise and detailed research work to specify natural resources for sustainable development. Educational and eco-tourism resources should be specified to activate the local wise use of wetlands. For environmental education, both natural and artificial resources have the potential to help schoolchildren think of sustainable development. For eco-tourism, such natural resources as bird watching and angling should be focused on.

4) Formulation of biotope mapping process

For scientific analyses, digital maps have good potential. Spatial analyses by GIS and remote-sensing technologies offer two dimensional and 3D presentations impossible by hard copy of maps. The biotope mapping process systematized and applied by the help of GIS and remote-sensing provides scientific researchers with the directions of their outputs.

7.2.2 Model Area Selection

(1) Typical inland wetlands

To apply the mapping method to the other areas in LWC, the criteria of selection should include typicality. Generally, typical inland wetlands contain rivers, lakes, seasonal floodplains, marshes/swamps, and raised bogs. The model area holds all of these in a map as shown in Figure 7.2.1. The Rezekne river with an average flow rate passes through the model area to the north, while Lake Lubana is lying in the west of the model area where fish wintering is seen in the winter. In the north of the area, the Gomelis marshy grassland where a lot of waterfowls mate, rest, and feed during the spring migration period is designated as a seasonally protected nature territory. Fen is seen in the north, whilst raised bog gives a hint of naturalness in the northeast of the model area.

(2) Rich biodiversity

Rich biodiversity is essential from the ecological viewpoint. Wetlands often provide habitats refuges for endangered, rare, and vulnerable species, and maintains its biodiversity. Indigenous bird, mammal, and fish species are valued in the natural ecosystem. The Kvapani fishpond, located in the center of the model area, affords important habitats waterfowls, waders, and gulls, while some endangered raptors exploit the fishpond as their hunting place. Such mammal species as otter and beaver might be trudging in and around the model area through which a lot of watercourses penetrate. The local people enjoy angling in the fishpond, expecting to catch pike or pikeperch.

(3) Fluctuated water level conditions

Water and ecosystem correlate to each other. Wetlands makes substantial contributions to flood mitigation since it can contain tons of water during the flood season. Contained water forms a special condition for vegetation typical for wetlands. Gomelis located in the north of the model area is famous for its function as flood mitigation during the flood season and forms a vast land for migrating waterfowls. The southern half of the Idena fishpond is dried up due to the stagnant aquaculture around Lake Lubana, impacts of which are researched in the course of this study.

(4) Visible human impacts

Visible human influences on the ecosystem of the model area shed the light on correlation between humans and the environment. To formulate proper conservation measures for sustainable development, one cannot fail to study the human impacts on the natural ecosystem. LWC shows a feature of typical human-made wetlands. Aquaculture development, agriculture, and quarrying of sand are the main human activities in the model area, while man-made structures are highlighted by dykes, roads, drainage systems, and fishponds in the area. The model area is expected to tell many stories on the history of nature and human society.

(5) Abundant educational and eco-tourism resources

To protect wetlands from such careless development activities as peat excavation, the cultural and social value of wetlands should be explained to the public through environmental education and eco-tourism. Adjacent to the Kvapani fishpond, the Environmental Management Center (EMC) that will house an educational function is recommended. While bird watching is placed as the main attraction for eco-tourism, the fishpond exemplifies a positive human impact on the natural ecosystem increasing habitats for waterfowls for educational purposes. As waterfowls prefer the narrower and shallower water bodies than Lake Lubana, the fishpond attracts many species of birds.

7.2.3 Distribution of Biotopes

The detailed biotope map consists of 14 biotopes as shown in the next table and Figure 7.2.1. Raised and transitional bogs can be found in the northeastern part of the model area, where is 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. While, 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 are mainly cultivated in agricultural lands, and the dry grassland are 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	Dry grasslands/Agricultural lands
12	Dry grassland	
13	Water bodies	Lake, rivers, and canals / Fishponds
14	Bare ground and others	Urban area

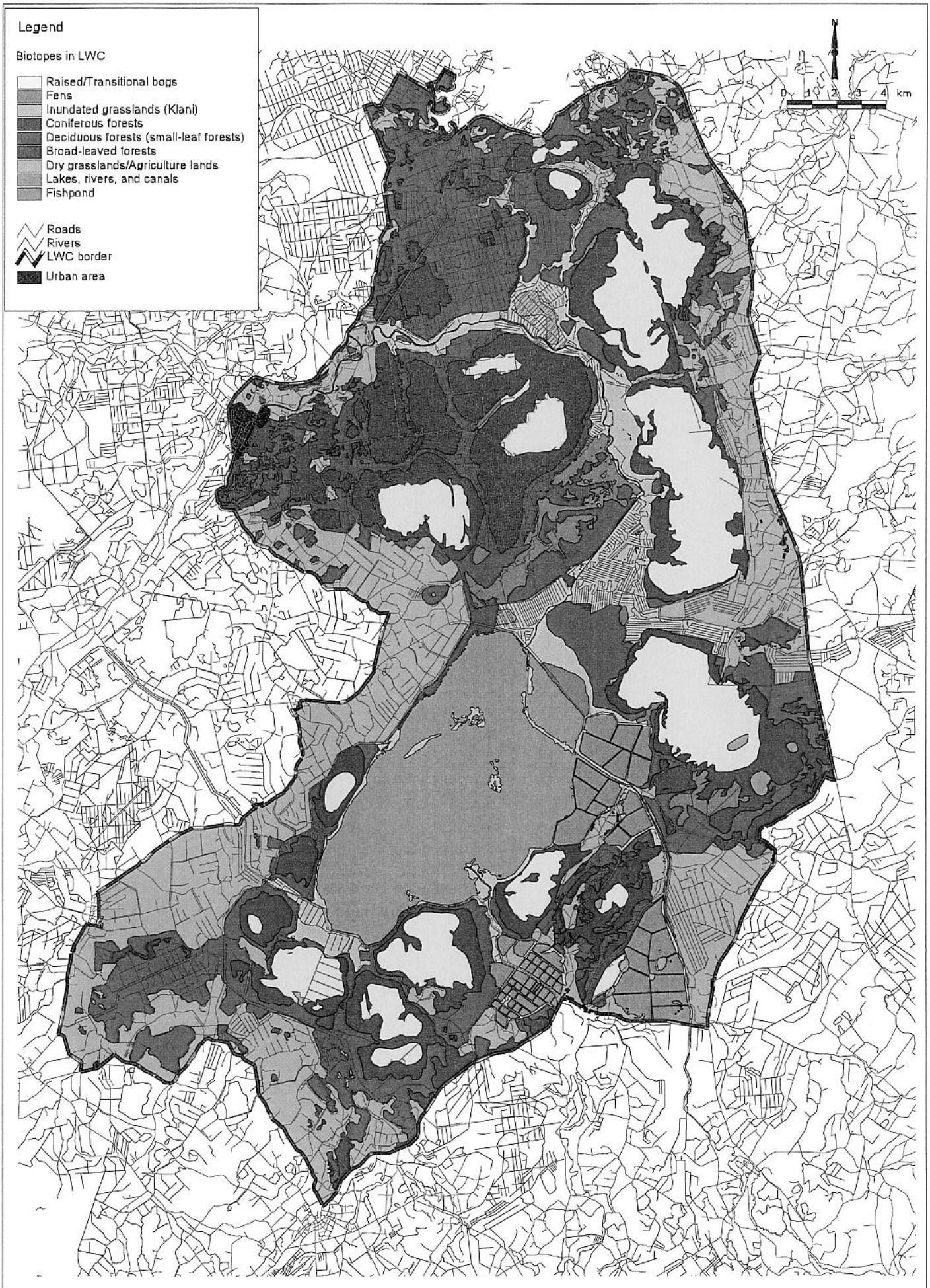

Figure 7.1.1 Biotope Map in LWC

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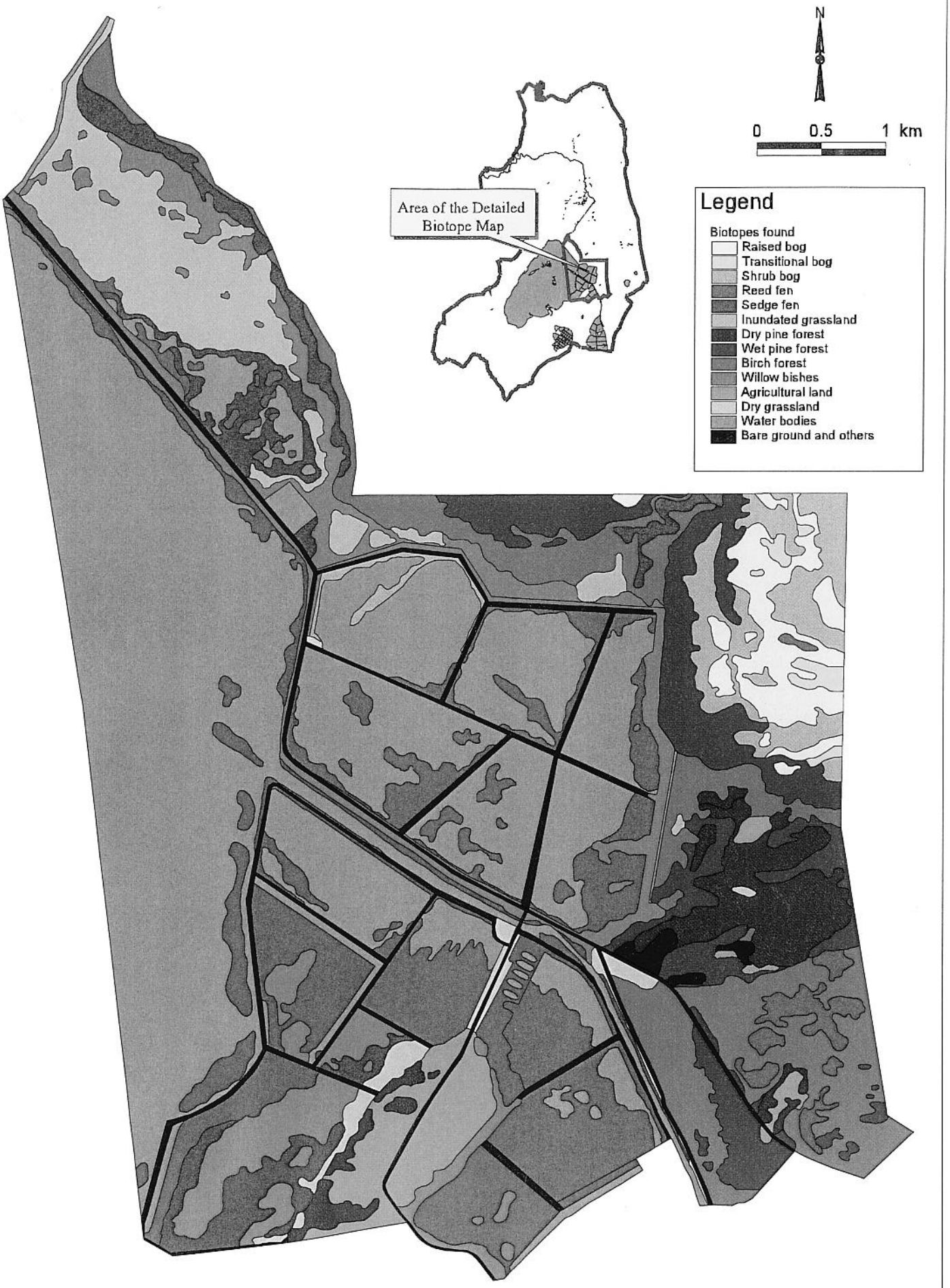

Figure 7.2.1 Detailed Biotope Map in LWC

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CHAPTER 8

PART II REGIONAL DEVELOPMENT AND LAND USE

CHAPTER 8 GUIDELINE FOR REGIONAL DEVELOPMENT

8.1 Future Socioeconomic Frame

8.1.1 Target Socioeconomic Frame and Rationale

(1) Development objectives of European Union (EU)

The European Agreement or the Association Agreement, signed on June 12, 1995 in Luxembourg, gained effect on February 1, 1998. Latvia has become an officially associated state of EU. This agreement forms an association with the main goals to provide adequate framework for political dialogue, gradually create free trade area between EU and Latvia, promote, reciprocally, expansion of trade and support transition of Latvia to the market economy. Implementation of the agreement considerably raises internal and external competition. Latvia continues to implement a focussed policy aimed at integration into EU. This is proved by a series of internally initiated activities and also by the active involvement of the state in the fulfillment of pre-accession obligations identified for the 11 EU candidate states. In preparing the Perspective of Development of the Territory of Latvia, it was recommended to take into account the following development objectives that are shown to EU member-states and that try to combine general development, balance and preservation objectives:

a) Development of economy and environment which should be based on independent, stable and balanced structure of the region and based on other advantages of EU, e.g. the diversity of religious peculiarities.

b) Sustainable regional development that lessens the present inequality in economic or environmental conditions in the sphere of transport, services and urban functions, therefore ensuring guaranteed equal possibilities and elimination of social differences.

c) Balanced and decentralized urban system with different social, economic, cultural and scientific functions, that will eliminate concentration of inhabitants in one place and creation of outlying districts in some other place.

d) Friendly-to-environment and effective transport network connecting towns and communications that will promote elimination of differences between countries of European Union and their economic development including concern for communications in outlying districts.

e) A network of vacant regions that ensures preservation of natural resources and functioning of protected areas and preservation of natural resources for future generations.

(2) Medium term economic strategy in the context of accession to EU

In March 1998 the government approved the medium term economic strategy in the context of accession to EU. This document outlines priorities of economic policy of Latvia and most important government activities until the year 2003. The strategy establishes that the most important goal of economic policy of Latvia is to achieve stable, balanced, and sustainable growth. This means that economic policy plans to achieve:

a) permanent and continuing growth of GDP,

b) balanced economic and social development,

c) increase of employment,

d) gradual elimination of territorial disproportion,

e) growth of well-being of residents of the state, and

f) protective attitude towards environment and effective use of resources.

In the medium term, Latvia will basically get oriented towards a higher level of economic integration with the EU countries and countries in the process of integration within EU. Alongside with further liberalization of foreign trade, safeguarding measures will be accepted in the internal market which do not contradict EU requirements and exports will be promoted both by expanding information support of exports and perfecting the mechanism of export crediting and guarantees. It is also planned over the medium term to reorganize, develop, and consolidate environment protection institutions to implement and introduce standards corresponding to the EU requirements and to realize investment projects of potable water, waste management, etc., and promote development of best available technologies.

(3) Rural development approaches of Latvia

The following are development approaches for rural area, proposed in “Rural Development Program in Latvia” (MEPRD, 1998). From the point of view of these rural development approaches, planning of rural districts, towns and townships is of special importance, since at this level specific development problems can be solved best in line with the interests of inhabitants, landowners and land users. During the development procedure of LWC, these approaches should be observed as much as possible, although some of the approaches are practical only on national or regional levels but not on district or township levels.

a) to increase competitiveness and export potential of agriculture, to promote development of agricultural and forestry production which spares natural resources,

b) to support non-agricultural entrepreneurship and service sector as an important part of rural economy, which creates new alternative jobs, occupations and income outside agricultural production and processing, and facilitates inflow of money into rural areas,

c) to promote development of the less developed areas and regions,

d) to retain rural settlements network, rural environmental and landscapes for recreation, tourism and future generations,

e) to promote co-operation and co-ordination of activities between ministries,

f) to publicize and popularize the policy of rural development both in the country, achieving its acceptance in society and government, and in international scale (in EU institutions, governments of EU member states, international organizations) confirming efficiency of this policy and competitive advantages of Latvia accessing to EU; and

g) to prepare to use resources of EU Structural & Cohesion Funds, specifying the rural development program and preparing projects that confirm readiness to make an effective use of these resources.

(4) Development goal common in the 4 districts concerned

The overall development goal of the four districts is to reach higher and more equitably distributed levels of economic development in Latvia. This goal is expected to be attained by bringing the districts from a socio-economically below-average district to at least an average or even an above-average one in Latvia.

The existing development plans covering the districts generally show the following development approaches to obtain this:

- production and recycling of agricultural, forestry and fishery goods is to be developed for local market and export;
- traditional countryside way of living is to be saved;
- extraction and recycling of natural resources such as forests, swamps and clay is to be developed, simultaneously protecting important environment; and
- problem of the unemployment is to be solved by increasing working places for the local residents.

8.1.2 Future Socioeconomic Frame

On the basis of the medium term economic strategy and other documents of the government, the Ministry of Economy (MOE) in cooperation with the University of Latvia and the Riga Technical University is developing the long term strategy of economic development of Latvia. Its time perspective is development of national economy until the year 2025. Its main task is to analyze and forecast long term growth factors, connect theoretical conclusions with practical steps of their implementation in economic policy to achieve growth which will be friendly to environment and resources, stable, comprehensive, diversified and balanced from the viewpoint of the development of national economy.

(1) Long term economic growth prospects of Latvia

Since finalization of the long term strategy of economic development is scheduled in September 2000, an authorized long-term national socioeconomic prediction has been available only in the Report on Economic Development of Latvia (MOE, December 1998). In this report, the basic scenario (BS) and accelerated scenario (AS) of the Latvian economy were modeled for the period until 2025 on the basis of analysis of growth factors. The summary of the both scenarios is presented in the next table. Taking into account the changeable and unstable economic situation, BS is more realistic than AS which demands perfect achievement of the internal growth factors and favorable external market conditions.

National Economic Growth Data in the Long Term

(Unit : % / year)

Years	1996~2000		2001~2005		2006~2010		2011~2015		2016~2020		2021~2025	
Scenarios	BS	AS	BS	AS	BS	AS	BS	AS	BS	AS	BS	AS
GDP Growth Rate	4.0	4.5	5.0	6.3	4.8	6.6	4.4	5.9	4.1	5.2	4.0	5.0
Unemployment Rate	15.7	15.7	14.3	13.4	10.8	7.9	5.9	5.0	5.0	5.0	5.0	5.0
Capital Growth Rate	3.3	4.1	4.4	5.3	4.5	4.8	4.3	5.3	4.4	5.2	4.8	5.0
Industrial Growth Rate	5.1	5.7	5.5	6.8	4.1	5.9	3.6	5.1	3.3	4.4	3.3	4.2

Source: Report on Economic Development of Latvia (MOE, December 1998)

BS reflects economic development assuming that in the starting period until 2003, the medium term economic strategy in the context of accession to EU (accepted by the Latvian Government in March 1998) has been implemented and after this period (2003~2025) the tendencies declared in the strategy will be maintained. It foresees less investments and does not rely much on the favorable external economy during the whole period.

The GDP growth is supported by changes in the number of employed persons and labor productivity. It is foreseen that the Latvian GDP can increase by reducing its unemployment rate, because the population of Latvia goes down every year. Secondly, there is a high number of economically active population, 88 % of all people at work-capable age. Therefore, the number of employees as a positive GDP growth factor will function, and the natural level of unemployment (5 % of economically active population) will be reached after 2016.

The labor productivity growth as another GDP growth contributor is secured by capital increase and technological innovation. It is forecasted that at the beginning of the period, technological changes can ensure higher increase of GDP, which will get smaller in the following years. Increase of capital secures the GDP growth by 3.5 % every year on the average. Such growth of capital requires that investments in the fixed capital constitute 19~20 % of GDP.

(2) Future socioeconomic frame for LWC

As there has been no prediction on the future social and economic situation for LWC, its socioeconomic frame is established here by estimating the future figures for the socioeconomic indicators available around LWC (Table 8.1.1) based on the above mentioned national prediction for economic growth rates under BS. The socioeconomic indicators and their 1998 levels, which are almost common with the national economic growth data, are selected from the set of multiple indicators on socioeconomic development as shown in the next table. They have been adapted by the Latvian Government since July of 1997 to evaluate development status on the city/district basis. This evaluation is based on the Law on Specially Supported Regions approved in May 1997.

Socioeconomic Levels of the Four Districts in 1998

Indicators	Rezekne	Balvi	Madona	Gulbene	Average in four	National median
a. Industrial output (LVL/person)	93	176	280	246	199	434
b. Capital investments (LVL/person)	62	91	227	257	159	196
c. Unemployment rate (%)	28	22	13	10	18	11
d. Monthly gross wage (LVL)	80	92	92	92	89	104

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

Considering the low level of economic activities within LWC, it is assumed that the present situation of LWC is the same as or worse than that of Rezekne district which is in the worst economic situation among the four districts concerned. Therefore, the future socioeconomic frame for LWC is set up based on the present figures of Rezekne district applying the national economic growth rates of the basic scenario above mentioned, together with population and tourists prediction utilizing the past or assumed growth rates. The next table shows the calculated future socioeconomic frame for LWC up to 2010 as the target year of EMP.

Future Socioeconomic Frame for LWC

Socioeconomic Factor	Unit	1998/99	2000	2005	2010
a. Industrial output	LVL/person	93	103	134	164
b. Capital investment	LVL/person	62	66	82	102
c. Unemployment rate	%	28.0	15.7	14.3	10.8
d. Monthly gross wage	LVL/worker/month	80	87	110	140
e. Population	Persons	6,500	6,400	6,000	5,600
f. Potential tourists	Visitors	-	400	640	850

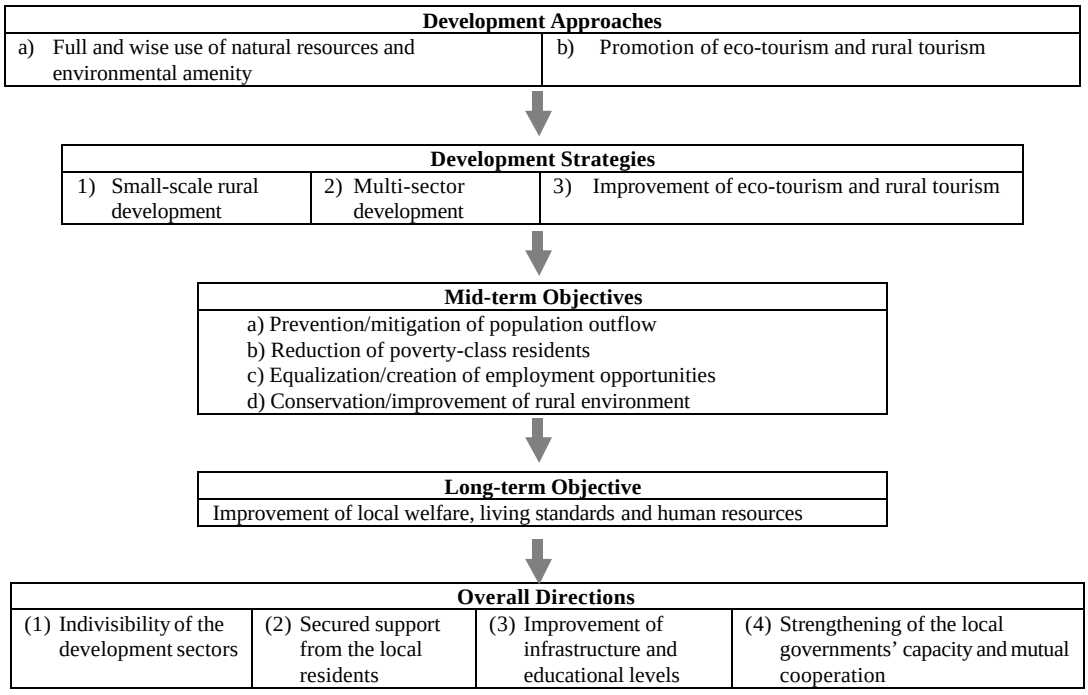
Note: 2005 figures of “Potential tourists” are averages between 2000 and 2010.

As for the monthly gross wage, it is assumed that it well connects with GDP so that the wage level growth rate is quite similar to that of GDP. Average annual growth rates of local population between 1996 and 1999 calculated with actual data (Table 8.1.2) are applied for the population projection. Potential eco-tourists to LWC are assumed to be more than 400 at present and 700~1,000 (850 on the average) within the future ten years. About 28 % are foreigners.

As there exists no socioeconomic growth prediction at the local level, the future socioeconomic frame for LWC is established assuming that the national growth rates can be applied everywhere in Latvia including the LWC area. In order to realize the expected economic growth, local environmental resources should be actively utilized in a wise-use manner for sustainable development. Indeed, eco-tourism and fishery rehabilitation projects are proposed in EMP, and they will contribute to economic growth in LWC. However, the future economic growth figures for LWC as established above might not be fully achieved because EMP does not include development projects of more profitable industrial sectors, potential of which has been unforeseeable at present.

8.2 Guideline for Regional Development

The development guideline includes development approaches, objectives, strategies, and directions, which are schematically expressed in the next flow chart. Development approach is a perspective of local people's interests. Development strategy is a body of coordinated priorities and actions. Strategy is thus for achievement of the objectives defined under the approaches using the existing resources and other advantages and strong sides of LWC.



Schematic Chart of Socioeconomic Frame for LWC

8.2.1 Approach and Strategy

(1) Development approaches and objectives

Fully considering the above-mentioned EU level, national and local development frameworks as well as environmental importance of LWC, development approaches and objectives are set out for LWC as follows:

Development approaches

a) Full and wise use of natural resources and environmental amenity in and around Lake Lubana as local heritages, to activate economic activities in LWC; and

b) Promotion of eco-tourism and rural tourism based on the existing agricultural, forestry and fishery industries, focusing on natural environment as well as rural landscapes in LWC.

Long-term objective

Improvement of local welfare, living standards and human resources by means of sustainable rural development in LWC

Mid-term objectives

- to prevent or mitigate population outflow phenomenon,
- to reduce number of the local residents in the poverty class,
- to equalize or create employment opportunities, and
- to conserve and improve the rural environment goods and services.

(2) Development strategies

LWC is located within the purely rural area mainly based on traditional agriculture, forestry, and inland fishery. The area is suffered from economic disturbance of these primary industries due to population outflow to urban areas, negative impacts from the nation-wide economic depression after the dependence from Russia in 1991. Under such circumstances, the local residents have been seeking stabilization of economic foundation as well as activation of local societies.

However, in LWC where conservation of the wetland ecology is another important theme, drastic conversion of the existing industrial structure necessitating land use change in a large scale is not an appropriate development direction. Besides, large-scale industrialization is not be acceptable in LWC, taking into account its unreality and foreseen adverse impacts on the natural environment.

Therefore, the following three strategies are proposed for development in LWC, which are in compliance with the existing land use and the development approaches above mentioned:

1) The image of development is to be **a small scale rural development**, which should be mainly based on the existing agricultural, forestry, and fishery activities;

2) **Multi sector development** should be directed by expanding or extending all the existing industries, not by focusing only on a certain sector such as agriculture, forestry, fishery or others selected out of them; and

3) **Eco-tourism and rural tourism** should be actively promoted, by wisely using natural resources, wetland and rural landscapes, as well as products and facilities of the existing primary industries.

8.2.2 Overall Directions

Based on the development approaches, objectives, and strategies proposed in the previous sections, the development in LWC can be envisaged to generally go toward the following directions.

(1) Indivisibility of the development sectors

Development in LWC will include different sector development that are inter-connected with each other. Identification and definition of problems within multiple sectors should be carried out with expertise.

(2) Secured support from the local residents

In order to achieve the development objectives, they have to be supported by the local residents through the local society's collaboration and publicity of the local governments' activities.

(3) Improvement of infrastructure and educational levels

To obtain even small or middle sized business support, minimum infrastructure conditions for entrepreneurship should be established. Involvement of foreign investment and modern technology requires experts of high qualification. So professional training and high-level education should be provided for the development.

(4) Strengthening of the local governments' capacity and mutual cooperation

LWC covers multiple districts and townships/town requiring territorial cooperation and coordination among these municipalities. In particular, they are essential to carry out an integrated management of Lake Lubana and the surrounding environment, and to reconstruct a water control system. In order to realize these in implementing the development activities, quality and effectiveness of the local governments' capacity for development planning, project implementation and consultancy should be improved. It will also contribute to formation of development institutions such as business development and support centers, and regional development agencies.

8.2.3 Necessary Actions for Regional Development in LWC

In order to achieve the development objectives in LWC, systematic and simultaneous actions are needed. For the future improvement of the socioeconomic level of LWC, it is essential to fully and wisely use natural resources and environmental amenity in line with the proposed three development strategies. Based on the analysis results on the existing resources and potential markets, it can be guided for the future development that the following actions should be taken for the existing or potential industries in LWC.

(1) Agriculture

As for the traditional production, effective rotations should be applied for the cultivation of cereal crops, peas, and potatoes, aiming at sustainable soil fertility and mitigation of soil structure depletion. Application of humus content will also consolidate soil fertility of the agricultural lands in LWC. Traditional livestock farming is to be continuously a main economic activity taking advantage of vast area of meadows and pastures surrounding Lake Lubana, since it provides employment opportunities and basic food supply for local residents. Further promotion of the on-farm processing of dairy products is recommendable in addition to the usual livestock products. As non-traditional income sources, mushroom cultivation as well as apple wine/cider production can be considered. Prospective mushroom species are champignon de Paris (*Agaricus bisporus*), shiitake (*Lentinus edodes*), and oyster mushroom (*Pleurotus species*). Although apples are produced in the small-scale orchards around LWC, farmers need to increase apple productivity and improve quality for promotion of wine/cider production.

Financial support is inevitable for the agricultural development, making a full use of and strengthening the existing financial systems for the public subsidies and saving-and-loan banks. Besides, technical and scientific backup is important to adopt the best cultivation and processing technologies from economical and environmental viewpoints so that quality of agricultural products and cultivation methods is in line with the EU requirements. It is, therefore, recommendable to establish pilot farms for demonstration of the non-traditional agriculture, which can be the base for training and testing of new technologies to adjust them to the local conditions. In order to effectively promote agricultural development in LWC together with these financial and technical supports, close cooperation among the local farmers by means of establishment of agricultural cooperatives or other types of collective organization is recommendable because such an organization can make use of scale merit and secure the local farmers with necessary seed material and market information.

(2) Forestry

Forestry is the most active sector in LWC at present, and should continue to be a key industry in the future as income sources for local residents. Additionally, afforestation on the abandoned or unutilized agricultural land can be proposed, as it is one of the major national forestry policies for creating additional income source in the long term. Planting

of pine, spruce, birch, and aspen is recommendable for the commercial purpose. If idle land is privately owned by local residents, they should be partially supported for afforestation through the existing financial systems such as the state subsidy program. Guarantees of long-term credits must be elaborated for private owners to regenerate and plant their forests. Technical training and consultation system on the local level must be consolidated for such land owners to grow trees and rationally use wood resources, as well. This system should have functions to improve wooden and non-wooden forest products toward international and EU quality requirements.

For sustainable and effective development in the future, environmental consideration and wood waste usage are important. Monitoring on forests in LWC is required to obtain objective information on the conditions of newly planted forests and their impacts on the local ecosystem. Legislative and institutional system should be therefore improved for supervision and management of state and private forests in LWC. It will also prevent wood stealing cases. Wood working activities using the wood waste such as furniture and handicraft making should be considered, as they will create further marketing possibilities for the local residents and tourists and can be conducted even during winter season as an additional income source.

(3) Fishery

Considering the national fishery policies and potential markets as well as the present inland fishery conditions in Lake Lubana and the fishponds, an important species of fishery development in LWC has been identified by the current study to be pike, which might be regarded as symbolic fish species to be produced and conserved in the future. Pike can be caught both commercially and recreationally for anglers, and is a target species of the National Board of Fishery (NBF) for artificial seed production aiming at restocking. This selection of pike as prospective fishery species is also based on the comparative analysis on marketable features between Lake Lubana where eco-tourism/rural tourism is proposed and Lake Razna already known nationwide as the center of eel production. Pikeperch is another target species due to its high market price and recreational demand, propagation of which should be done for fishery development in LWC.

Fish processing plants should be also promoted in order to add market values to fresh fish which does not have a market demand or gets spoiled fast. Such processed goods as smoked or dried fish can be marketed outside LWC and be sold to the tourists to Lake Lubana. Cooperatives such as a fishing club or union should be established to analyze potential markets, to improve fishing techniques, and to provide private fishermen and companies with other attractive supporting means. Rehabilitation of the old fishponds as well as market development including tourists can be also implemented effectively with mutual cooperation through such bodies.

(4) Tourism

For LWC with rich natural environment and rural atmosphere, eco-tourism and rural-tourism are prospective tourism forms. All the existing natural resources and products from agriculture, forestry and fishery can well serve tourists visiting LWC. In order to promote these two types of tourism, positive image of LWC with local interesting objects should be created by means of advertisement to potential tourists, developing tourism data base and information system, and printing the information brochure about possible recreational and environmental activities. Tourism cooperation with foreign countries such as Lithuania, Finland, Germany, Austria, Poland, and Russia is recommendable, especially taking advantage of the LWC's location close to the international roads connecting Riga and Moscow as well as St. Petersburg and Warsaw. At the same time, training of the manpower involved in the tourism services including foreign languages training is of crucial importance. Especially for rural-tourism, service training and accommodation facilities should be arranged for local residents who can offer their farms for tourists' needs.

Proposed eco-tourism in LWC include various types of environmental and recreational activities, and rural tourism activities will additionally include farming and forestry experience. These activities necessitate building of the facilities specific to eco-tourism and rural tourism in addition to basic infrastructure for telecommunication and transportation. In particular, angling facilities at Lake Lubana and the fishponds are essential. Release of popular angling species such as pikeperch will contribute to increase the number of anglers visiting LWC. Financial and institutional support is needed for tourism development including establishment of these facilities. Special financial backup must be provided to local residents and farmers who are involved in rural tourism, making use of the existing financial supporting system such as the Special Action for Pre-accession in Agriculture and Rural Development (SAPARD) Program, because they are supposed to manage landscape beauty of their pastures and old orchards in addition to provision of services and good-quality accommodation to tourists at their farm lands. Considering that important factors attracting rural tourism are waterfront siting and basic infrastructure, Nagli or Idena areas have a high potential to be bases for rural tourism in LWC.

8.2.4 Implication with the Environmental Management Plan

Summarizing the contents of the development guideline, the following are important factors from the development side to be considered for implementation of EMP.

(1) Full and wise use of natural and environmental resources in LWC

It is essential to make use of any resources in LWC to improve the living standard of the local people. For example, idle arable land should be used for development such as afforestation for forestry activities, eco-tourism and rural tourism should be actively introduced targeting the LWC naturalness and the existing primary industries. But this

direction is in accordance with sustainable development concept ignoring adverse impacts on the environment.

(2) Multi-sector development based on the existing industries

The primary industries with a long history such as agriculture, forestry and fishery should be continued simultaneously, neither terminating all these activities nor specializing a specific industry. This implies that the present land use for these industries will not change in principle to expand the natural area. On the other hand, it is not intended to introduce exotic industry such as heavy industry and mass tourism. The area should aim at small-scale rural development based on the land and environment.

(3) Improvement of local welfare and living standard

Socioeconomic level represented by employment rate, wage, and education level in LWC should reach the national average. On this purpose, the development side will require local manpower, expertise, budget and institutional privileges in introducing non-traditional primary goods or processing methods, and in training local residents for eco-tourism and new productive technology. This requisite has a possibility to bring about financial or institutional conflicts with implementation of the proposed conservation projects. However, it is also a fact that financially rich communities can easily promote environmental conservation in contrast.

8.3 Fishery Development Plan

The guideline for regional development as described above is neither detailed development plans nor concrete projects. But, in addition to the eco-tourism development plan, a fishery development plan among the other primary industries is prepared because of the following reasons:

(1) Related local townships and people are all curious at the future fishery development, expecting the fishery development directions in more detail.

(2) Inland fishery in lakes and fishponds are relatively peculiar to LWC which has the nationally largest lake, Lake Lubana. In this context, inland fishery technology to be domestically introduced has been limited in comparison with agriculture and forestry which are common nationwide.

(3) Fish productivity in LWC is important not only for commercial fishery, but also for birds and eco-tourism which are a major target area in EMP. Fishery resources are, therefore, the key factor for both environmental conservation and development in LWC.

8.3.1 Concept on Fishery Development

Substantial national policy on commercial fishery is to conform fishing capacity to fish resources available, to ensure sustainable management and use of fish resources, to attain competitive fish products for local and international market, and to secure integration of the Latvian fisheries into the EU Common Fishery Policy. In accordance with the national policy, five strategies are introduced by the Government, namely 1) to manage fish resources and fisheries effectively, 2) to promote competitive fish products in domestic and international market, 3) to develop new international market, 4) to conduct fish restocking and aquaculture program, and 5) to establish education and research system on fishery. In addition, the angling or recreational fishing is also recognized as an important part of fishery sector in Latvia, though it is under the researching phase of new development forms.

In line with the national policy mentioned above, it is recommended to set a site specific concept on fishery in LWC, and it is presumed "**Lake of Pike**". This concept is induced from the viewpoint of relative publicity of Lake Lubana in contrast to Lake Razna known by eel production. Pike and pikeperch must be the most important and symbolic fish species to be produced and conserved in LWC. Since they are the highest trophic level endemic predator and caught by both commercial and recreational fishery with high economic value, their proper resource management surely contributes to conservation of other fish species and natural environment of LWC. Moreover, pike is a target species of NBF for artificial seed production aiming at restocking. Hence this concept should be taken into consideration in relevant development and conservation activities, particularly for eco-tourism development.

8.3.2 Direction of Fishery Development

(1) Prospect of commercial and recreational fishing

Although LWC is one of the important freshwater fish production areas, the production amount is negligibly small compared with the national fishery production. Moreover, considering people's general preference, demand of ordinary freshwater fishes like carp species seems not to increase in near future. Therefore, following the LWC's concept on fishery, development direction of commercial and recreational fishery must be set forth for maximum and sustainable exploitation of pike, pikeperch and some other valuable fishes, such as perch, tench and ide.

According to the study of LFRI, the annual potential fish catch of Lake Lubana is indicated to be 15 kg / ha or 120 tons, amongst which pike 40 tons, breams 30 tons, roach 10 tons, and other fishes 40 tons. The present fishery production of the lake, approximately 60 tons/year could be duplicated by proper resource exploitation. About pike, present production level of about 27 tons can be increased to about 1.5 times without artificial propagation measures, though more examinations are required to estimate catch of anglers and effect of fry restocking activities. An establishment of organization of fishermen and anglers with local-specific regulations is strongly recommended in order to

solve various inter and inner problems effectively and rationally, because these fishing sub-sectors intend to use same resources.

(2) Prospect of aquaculture

Governed by competitive relations under market economy, traditional carp culture at the Nagli fish farm seems difficult to continue its operation. One of the national aquaculture development strategies is to introduce competitive culture species such as crayfish and eel. However, it has been appeared that culture of crayfish is not suitable for LWC because of the nature of bottom soil, being acid and inclusive of peat. Aquaculture of eel could be a similar situation as crayfish, meaning that it is possible to grow technically but competitiveness to other locality is a great question.

On the other hand, seed production of pike and pikeperch could have significant potential in LWC. Availability of their wild broodstock is a given heritage in this locality. Fry of those species is demanded not only from Lake Lubana but also from other lakes in the Latgale region and other parts of the country for restocking purposes. Other endemic fishes like tench could also be reproduced for restocking. Development direction of aquaculture should not be for increase of market-size carp production, but for seed production of pike, pikeperch, and some other potential species. This would be maximized when demand from recreational fishing is increased. Present carp culture ponds particularly for the Oreniesi-drabaki ponds (Nagli fish farm No. 2 in Figure 3.4.5) can be used as charged angling ponds in future.

(3) Strengthening of fishery resource management activity

Basic information required for proper fishery resource management such as aquatic environment, fish ecology and fishery activities, is substantially lacked in LWC at present. LFRI conducted a productivity and control fishing survey for quick resource assessment in 1997, but LFRI has no plan to carry out additional study for Lake Lubana. Several numbers of fish inspection officers are appointment in Rezekne and Madona REBs, but they are not mandated for field investigation nor fishery development activities. It is necessary to establish a new institutional set-up that is responsible for monitoring of aquatic environment and for fishery resource management of LWC.

(4) Promotion of fish fry restocking activity

LFRI is not recommended fish fry restocking activity for Lake Lubana because of its relatively good conditions of fish reproduction. However, considering that fishing pressure is going to be increased for particular target species such as pike and pikeperch in order to meet with market demand, fry restocking activity will play an important role for effective use of the lake. Moreover, fry restocking activities could promote fishermen‘s participation to resource management and enhance awareness of the local people. Thus, it is recommended to implement fish fry restocking program as a resource propagation measure associated with other conventional legislative measures.

(5) Promotion of recreational fishing

There is a promising demand for fishing of pike and pikeperch from anglers of Latvia as well as overseas. Although LWC embraces rich natural resources, there are few service facilities and promotion activities. In addition to these dynamic fishing activities, Lake Lubana is known as a winter fishing place. For the benefits of anglers, a series of attractive facilities should be constructed. The facilities need to include angler‘s huts providing various services, fishponds for charged angling, and place for renting fishing boats. Development of souvenirs based on the concept of “**Lake of Pike**” also will support acceptance of anglers and other visitors.

(6) Promotion of eco-tourism

Eco-tourism must be developed based on accurate knowledge on fish and aquatic ecology. A series of fishery related activities in LWC such as fish unloading, artificial fry production and restocking or fish processing can provide informative knowledge to eco-tourists. Facilities for exhibition and explanatory purposes should be established in order to improve fishery related knowledge as well as aquatic ecology for eco-tourists. Facilities like educational aquarium, fish hatchery and fish processing would meet the objectives of eco-tourism from the fishery sector.

(7) Improvement of post-harvest activity and promotion of processing

In order to improve present non-systematic post-harvest and marketing activities of local fishermen, a series of supportive facilities should be installed around the lake including access roads to fish unloading places. These facilities should be maintained and managed by fishermen‘s groups or cooperatives. Fish processing activities should be promoted in order to produce competitive fish products. Pike and pikeperch have high demand in a form of filet. A series of conventional processing methods, smoke, dry, canning can be applicable for carp species. These products could be sold strategically by a single organization which have a specific marketing brand, “**Lake of Pike**”.

(8) Encouragement of fish control activity

Present fish control activities by Rezekne and Madona REBs seem not enough to restrict expansion of recent illegal fishing. In order to support the activity of fish inspectors, necessary equipment for routine patrol such as vehicle, boat and snowmobile should be deployed specifically in LWC.

8.3.3 Institutional and Regulative Measures

(1) 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 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.

(2) 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 incentive for them to formulate an organization. Possible people who join the fishermen's organization are the licensed fishermen (60 persons, Table 8.3.1), their family members and assistants, and employees of the Nagli fish farm (56 persons). Few information is 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.

(3) Introduction of angling license system

The angling license 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 angling license aside from common angling card as a budget source for specific fishery resource management and propagation activity. According to the regulation, 30% of the sales obtained from public lakes such as Lake Lubana is transferred to the Fish Fund, and 70% is disposed for the purposes of restocking of fingerings and improvement of angling services that will be implemented by designated

angling organizer. Introduction of this system would be essential for operation of hatchery and other activities on fishery resource management in LWC.

(4) Future balance of commercial fishing and angling

In near future, when number of angler 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.

8.3.4 Proposed Projects for Fishery Development

For the fishery development in LWC, the fish hatchery development project and the angling promotion project are proposed as below. Table 8.3.2 shows facilities and equipment with their initial costs required for implementation of these fishery development projects in LWC. The total cost for these facilities and equipment is estimated at about 414,000 LVL without any contingency.

(1) Fish hatchery development project

A construction of new hatchery complex is required in LWC for production of fish fry for restocking to natural waters and for release to fish angling ponds. Besides, a hatchery educational aquarium and some demonstration facilities about fish reproduction are necessary for eco-tourism development. A series of earthen ponds for brood-stock and juveniles are also included in this hatchery complex. A possible site of the fish hatchery complex is the wintering pond area of the Nagli fish farm. The target production scale of the hatchery is preliminary given as follows.

Target Production Scale of the Hatchery

Fish species	Target production	
	Swim-up larvae or eggs	5-10 g size juveniles (no.)
Pike	5 mil.	250,000
Pikeperch	3 mil.	150,000
Other species	2 mil.	100,000
Total	10 mil.	500,000

(2) Angling promotion project

Angling is considered to be a substantial and important core of future regional development of LWC from viewpoint of wise use of natural resources. Considering current management situation of fishponds, several angling ponds should be opened by rehabilitation of a part of present aquaculture ponds of the Nagli fish farm. For promotion of angling activities in LWC, supporting facilities such as angler's huts available for car park, watching tower, fishing lots, and rental boats will be required around the lake from fishing management viewpoint.

8.4 Recommendations

In order to reach the economic growth with the nationally predicted rate in LWC, it is recommended to consider development projects at the regional or district level, regarding LWC as part of a larger project area. For example, further development in LWC can be carried out within the framework of the development plan for Latgale region prepared recently. Development directions in the plan such as rural tourism and information technology are to be expanded to LWC.

The guideline on regional development for LWC is proposed also as a major component of EMP, which aims at integration between wetland conservation and local development of LWC. So the proposed conservation projects and development directions should continue to be fed back to each other to improve EMP. In this sense, contents of the development guideline will be further revised if necessary, based on the future findings from the environmental conservation side as well as inevitable requisites for the water level management.

Because of the importance of wetland ecology and eco-tourism potentials in LWC, it is allowed within the development guideline neither to construct industrial enterprises that pollute atmosphere, waters, groundwater and soil, nor to apply production and land use methods which damage the surrounding ecosystems. Although these adverse impacts will not be anticipated as far as the proposed development approaches and strategies such as "small-sized rural development" are taken, the following environmental measures have to be considered jointly with tourism infrastructure projects and environmental projects proposed under the EMP framework:

1) Improvement of wastewater treatment facilities and sewage system to protect Lake Lubana and rivers in LWC from further water pollution and eutrophication;
2) Prevention of over-capacity visitors damaging tourism objects, biological variety, protected forest and rural landscapes;
3) Establishment of collection and treatment system of domestic, tourist and industrial solid wastes in LWC; and
4) Restriction on vehicle usage and promotion of horse-riding and bicycle services to prevent noise and air pollution.

Table 8.1.1 Socioeconomic Indicators to Identify Special Support (in 1997 and 1998)

Indicators	Source	Date/Year	Unit	Riga City	Daugavpils City	Rezekne City	Rezekne Distruct	Balvi District	Madona District	Gulbene District
a. Resident Population	(1)	Jan.1/1998	persons	805,997	116,530	41,069	41,962	31,529	47,600	29,197
	(2)	Jan.1/1999		796,732	115,450	40,557	41,485	31,036	47,423	28,998
Production Indicators										
b. Industrial Output	(1)	1997	1,000 Ls	955,784	92,363	41,937	4,018	5,258	11,534	6,954
	(2)	1998		1,046,413	95,238	35,018	3,874	5,455	13,301	7,139
c. Industrial Output per capita (= b/a x 1,000)	(1)	1997	Ls	1,186	793	1,021	96	167	242	238
	(2)	1998		1,313	825	863	93	176	280	246
d. Score of c (= ranking No. x weight 1.0) *	(1)	1997	points	1	7	4	32	28	24	25
	(2)	1998		2	6	5	32	27	22	24
e. Capital Investment	(1)	1997	1,000 Ls	298,727	15,617	3,715	1,121	1,196	4,130	2,907
	(2)	1998		532,576	29,296	7,589	2,590	2,830	10,772	7,443
f. Capital Investment per capita (= e/a x 1,000)	(1)	1997	Ls	371	134	90	27	38	87	100
	(2)	1998		668	254	187	62	91	227	257
g. Score of f (= ranking No. x weight 1.0) *	(1)	1997	points	2	10	18	33	32	22	16
	(2)	1998		2	8	20	33	31	13	7
h. Active Enterprises **	(1)	Jan.1/1998	enterprises	31,017	1,640	612	247	235	490	360
	(2)	Jan.1/1999		28,347	1,673	679	232	230	489	358
i. Active Enterprizes per 1,000 inhabitants	(1)	1997	enterprises	38	14	15	6	7	10	12
(= h/a/1,000)	(2)	1998		36	14	17	6	7	10	12
j. Score of i (= ranking No. x weight 1.0) *	(1)	1997	points	1	10	9	32	30	22	16
	(2)	1998		1	10	7	32	30	23	16
k. Total Scores of Production Indicators (=d+g+j)	(1)	1997	points	4	27	31	97	90	68	57
	(2)	1998		5	24	32	97	88	58	47
Social and Demographic Indicators										
l. Umemployment Rate ***	(1)	Jan.1/1998	%	3.1	7.7	11.8	29.0	21.6	13.1	9.9
	(2)	Jan.1/1999		4.8	10.6	15.7	28.2	22.1	12.5	10.2
m. Score of l (= ranking No. x weight 2.0) *	(1)	1997	points	2	30	50	66	60	52	40
	(2)	1998		2	34	54	66	60	44	30
n. Personal Income Tax	(1)	1997	1,000 Ls	60,049,746	8,113,561	2,287,202	787,863	853,495	1,591,087	1,115,270
	(2)	1998		72,098,760	7,911,074	2,597,238	845,661	920,799	1,711,878	1,202,745
o. Personal Income Tax per capita (= n/a x 1,000)	(1)	1997	Ls	75	70	56	19	27	33	38
	(2)	1998		90	69	64	20	30	36	41
p. Score of o (= ranking No. x weight 2.0) *	(1)	1997	points	4	6	14	66	58	50	38
	(2)	1998		4	10	14	66	58	50	38
q. Demographic Burden ****	(1)	Jan.1/1998	persons	668	638	642	951	877	887	791
	(2)	Jan.1/1999		640	612	615	913	839	846	747
r. Score of q (= ranking No. x weight 1.0) *	(1)	1997	points	5	3	4	33	29	31	18
	(2)	1998		5	3	4	33	28	30	17
s. Persons with Education per 1,000 inhabitants *****	(1)	1989	persons	769	670	659	428	451	507	524
t. Score of s (= ranking No. x weight 1.0) *	(1)	1997	points	1	5	6	32	30	20	17
u. Monthly Average Wages and Salaries	(1)	1997	Ls	137.7	99.5	98.3	74.3	82.3	83.3	84.3
	(2)	1998		154.0	106.0	106.0	80.0	92.0	92.0	92.0
v. Score of u (= ranking No. x weight 1.0) *	(1)	1997	points	2	9	12	33	28	27	25
	(2)	1998		2	15	16	33	27	26	25
w. Inhabitants per km^2	(2)	Jan.1/1999	persons	2,595	1,604	2,386	16	13	14	15
x. Score of w (= ranking No. x weight 1.0) *	(2)	1998	points	1	3	2	24	31	29	25
y. Total Scores of Social and (=m+p+r+t+v)	(1)	1997	points	14	53	86	230	205	180	138
Demographic Indicators (=m+p+r+v+x)	(2)	1998		14	65	90	222	204	179	135
z. **Grand Total Scores** (=k+y)	(1)	1997	points	18	80	117	327	295	248	195
	(2)	1998		19	89	122	319	292	237	182
Overall Ranking of z ******	(1)	1997	—	1	7	9	33	31	26	21
	(2)	1998		1	6	10	33	31	25	21

Notes : * For the indicator concerned, 7 cities and 26 districts forming the whole Latvia were ranked in better order from No.1 to No.33.

** Active enterprises were counted also besed on information about activity cessation.

*** It is a ratio of unemployed persons to economically active population, who offer thir work for the production of goods and services.

**** Population under and over working age per 1,000 population of working age.

***** They are persons with higher and secondary education per 1,000 inhabitants at age of 18 and older.

****** This ranking shows overall socioeconomic levels, indicating that cities or districts with the higher No. need more special support for their develop

Source : (1)Administrative Districts and Major Cities of Latvia : statistical yearbook (CSB, 1998)

(2)Administrative Districts and Major Cities of Latvia : statistical yearbook (CSB, 1999)

Table 8.1.2 Estimated or Projected Future Population in LWC

Township/ Town	Actual Population in Whole Townships/Town				Annual Growth Rate (%)	Projected Population in Whole Townships/Town						Whole Area	Actual/Projected Population Density in Whole Townships/ Town (/km²)				Study Area	Estimated/Projected Population in LWC			
	1996	Share	1999	Share	1996-99	2000	Share	2005	Share	2010	Share	(km²)	1999	2000	2005	2010	(km²)	1999	2000	2005	2010
Total	18,044	100%	17,320	100%	-1.36	17,088	100%	15,993	100%	14,996	100%	2,272	7.6	7.5	7.0	6.6	814	6,554	6,465	6,046	5,665
Rezekne District																					
1 Gaigalava	1,247	6.9%	1,213	7.0%	-0.92	1,202	7.0%	1,148	7.2%	1,096	7.3%	193	6.3	6.2	5.9	5.7	94	591	585	559	534
2 Nagli	700	3.9%	687	4.0%	-0.62	683	4.0%	662	4.1%	641	4.3%	138	5.0	4.9	4.8	4.6	133	662	658	638	618
3 Deksare	998	5.5%	976	5.6%	-0.74	969	5.7%	933	5.8%	899	6.0%	103	9.5	9.4	9.1	8.7	21	199	198	190	183
Balvi District																					
4 Ragaju	1,968	10.9%	1,872	10.8%	-1.65	1,841	10.8%	1,694	10.6%	1,558	10.4%	318	5.9	5.8	5.3	4.9	50	294	289	266	245
5 Lazdukalns	1,328	7.4%	1,225	7.1%	-2.66	1,192	7.0%	1,042	6.5%	911	6.1%	195	6.3	6.1	5.3	4.7	80	503	489	428	374
6 Berzpils	1,246	6.9%	1,107	6.4%	-3.87	1,064	6.2%	874	5.5%	717	4.8%	128	8.6	8.3	6.8	5.6	59	510	491	403	331
Madona District																					
7 Lubana Town	2,197	12.2%	2,131	12.3%	-1.01	2,109	12.3%	2,005	12.5%	1,906	12.7%	3	710.3	703.1	668.3	635.2	2	1,421	1,406	1,337	1,270
8 Varaklani	1,080	6.0%	1,046	6.0%	-1.06	1,035	6.1%	981	6.1%	930	6.2%	99	10.6	10.5	9.9	9.4	12	127	125	119	113
9 Indrani	1,240	6.9%	1,222	7.1%	-0.49	1,216	7.1%	1,187	7.4%	1,158	7.7%	343	3.6	3.5	3.5	3.4	125	445	443	433	422
10 Ospe	1,657	9.2%	1,604	9.3%	-1.08	1,587	9.3%	1,503	9.4%	1,424	9.5%	224	7.2	7.1	6.7	6.4	134	960	949	899	852
11 Barkava	1,901	10.5%	1,798	10.4%	-1.84	1,765	10.3%	1,608	10.1%	1,466	9.8%	188	9.6	9.4	8.6	7.8	54	516	507	462	421
12 Murmastiene	1,052	5.8%	1,027	5.9%	-0.80	1,019	6.0%	979	6.1%	940	6.3%	175	5.9	5.8	5.6	5.4	38	223	221	213	204
Gulbene District																					
13 Dauksti	1,430	7.9%	1,412	8.2%	-0.42	1,406	8.2%	1,377	8.6%	1,348	9.0%	165	8.6	8.5	8.3	8.2	12	103	102	100	98

Sources : Towns and Civil Parishes in the Administrative Districts of Latvia:
A Collection of Statistical Data, Parts 1 & 2 (CSB, 1998); and Number of Inhabitants in Regions,
Towns and Townships of Latvia: Statistical Bulletin (CSB, 1999)
Note : The estimated figures, especially total figures, in the teble are not always equal to the calculated ones due to round-off processing.

Table 8.3.1 Number of Licensed Fisherman and Length of Net Registered

Length of net (m)	No. of licensed fisherman				Cumulative length of net (m)			
	Nagli	Gaigal.	Osupe	Total (%)	Nagli	Gaigal.	Osupe	Total (%)
100>	8	-	7	15 (25 %)	555	-	450	1,005 (6 %)
100-299	2	3	18	23 (38 %)	425	700	2620	3,745 (22 %)
300-499	2	2	8	12 (20 %)	760	800	2400	3,960 (23 %)
500-699	1	1	2	4 (7 %)	600	500	1100	2,200 (13 %)
700-899	1	-	1	2 (3 %)	750	-	700	1,450 (8%)
900-1099	2	-	-	2 (3 %)	1,975	-	-	1,975 (11%)
1100-1299	-	-	-	0 (0 %)	-	-	-	0 (0%)
1300-1499	-	-	-	0 (0 %)	-	-	-	0 (0%)
1500	1	-	1	2 (3 %)	1,500	-	1500	3,000 (17%)
Total	**17**	**6**	**37**	**60 (100 %)**	**6,565**	**2000**	**8770**	**17,335 (100%)**

Note : Data for Nagli and Gaigalava are those of 2000, while for Osupe, 1999.
Source: REM of Rezekune and Madona

Table 8.3.2 List of Facility and Equipment for Fishery Development

Project	Specification	Unit	Cost (LVL)	Type
(1) Fish Hatchery Complex of the Nagli Fish Farm Area			314,700	
1) Hatchery complex			209,900	
a) Hatchery building	1 story, RC	m2	120,000	B
b) Incubator	100-l.	set	5,000	E
c) Tanks for larvae	FRC 500-l.	set	20,000	E
d) Tanks for juveniles	FRC 3 m3	set	35,000	E
e) Water intake pump	1 m3/min	set	5,000	E
f) Heating unit	Water heater	set	8,500	E
g) Elevated tank	5 m3	set	3,500	E
h) Water checker	portable type	set	1,700	E
i) Rearing equipment	Net, filter, grass equipment, etc.	set	6,700	E
j) Aerator		set	4,500	
2) Educational aquarium with demonstration area			60,000	
a) Educational aquarium with demonstration	1 story, RC	m2	40,000	B
b) Glass tanks	500-l. for exhibition	set	15,000	E
c) AV equipment	Video, TV monitor	set	5,000	E
3) Outdoor ponds			44,800	
a) For broodstock	WD 2.5 m, 1 ha. (pond rehabil'n)	set	16,800	C
b) For juveniles	WD 1.5 m 0.5 ha (pond rehabil'n)	set	28,000	C
(2) Angling Supportive Facility and Equipment of the Lake and River			99,200	
1) Rehabilitation of ponds			14,200	
b) Rehabilitation of pond and facilities		set	10,000	C
c) Fishing wharf	Wooden	set	2,200	B
d) Watching tower	Wooden with light	set	2,000	B
2) Facility for Anglers			85,000	
a) Angler's hut	1 story, 1 place	m2	20,000	B
b) Wooden pier	Wooden piar, 20 m	set	10,000	B
c) Boat for rent	Wooden without engine	set	30,000	E
d) Fishing rot for rent	Rot and reel	set	15,000	E
e) Parking lot	Gravel, 200 m2 x 5 places	m2	10,000	C
Grand Total			413,900	

Note: B: building work, C: civil work, E: equipment