



World Conservation Union

East European Programme

Environmental Status Reports: 1993

Volume Five:

Estonia

Latvia

Lithuania



IUCN EAST EUROPEAN PROGRAMME



Environmental Status Reports: 1993

Volume Five

Estonia
Latvia
Lithuania

This One



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FOREWORD

This volume, the fifth in the series of IUCN East European Programme Environmental Status Reports, looks at the current situation in three of the former Soviet Republics: Estonia, Latvia and Lithuania.

Much has been made of the appalling environmental legacy of air, soil and water pollution in these countries. Governments, with the help of bi-lateral and multi-lateral programmes, are slowly beginning to address these problems. However, in the difficult economic conditions being experienced by the three states, nature conservation is very near the bottom of the list of priorities that their governments are seeking to address. This is partly the result of, and is compounded by, low environmental awareness amongst the general public. A particular cause for concern is land reprivatization, given the absence of either appropriate legislation or an adequate administrative framework (or both) to ensure protection and sustainable use of the rich and well-preserved wetlands, grasslands and forests that have long since disappeared from most of Western Europe.

This volume is the result of contributions from many experts in these countries, compiled by national IUCN focal points, and therefore authoritatively describes the current status of natural resources and the legislative and administrative framework that governs their use.

It is hoped that this publication will alert national authorities, the general public and the donors to the importance of conservation of living natural resources for the well-being and economic security of present and future generations in the Baltic States. It will act as a baseline document against which to measure future change.



The Baltic States

ACKNOWLEDGEMENTS

The compilation of a body of information such as that appearing in this volume requires the skilled coordination of a large number of individuals. The compilers of the three National Environmental Status Reports have benefited from a network of experts, scientists, researchers, translators and typists, and others who remain anonymous, but without whom this work would have been impossible.

The initial format and guidance for the preparation of the National Status Reports was devised by the members of the IUCN East European Programme Advisory Group and the East European (EEP) Secretariat.

All three reports were sub-edited by T. Rajamets and the Nature Conservation Bureau Ltd., with the assistance of R. Hoskins. Overall coordination was by T. Rajamets.

IUCN EAST EUROPEAN PROGRAMME

Environmental Status Report 1993

ESTONIA

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INTRODUCTION

According to archaeological finds, Estonia has been inhabited for some 10,000 years at least. However, the first tribes of hunters and fishermen could have settled in this area much earlier, perhaps even before the last Ice Age, but remains from this period will have been removed by the ice. The ancestors of Estonians arrived here about 5,000 years ago, mingling with the tribes living on the land.

Due to its geographical location between the East and West, on the sea coast (Figure 1), Estonia has been ruled by different foreign powers for seven centuries. Since the beginning of the 13th century when the Germans occupied the land, it has been ruled by the Germans, the Swedes, the Danes and the Russians, until after World War I and the October Revolution in Russia the country declared independence in 1918.

Between 1918 and 1940, the Republic of Estonia was an independent state fighting its way to the European market and reaching a rather high living standard. For the first time in history, Estonia had a status similar to that enjoyed by Latvia and Lithuania, its neighbours in the south, with which it signed a cooperation treaty in 1934. Incidentally, the law

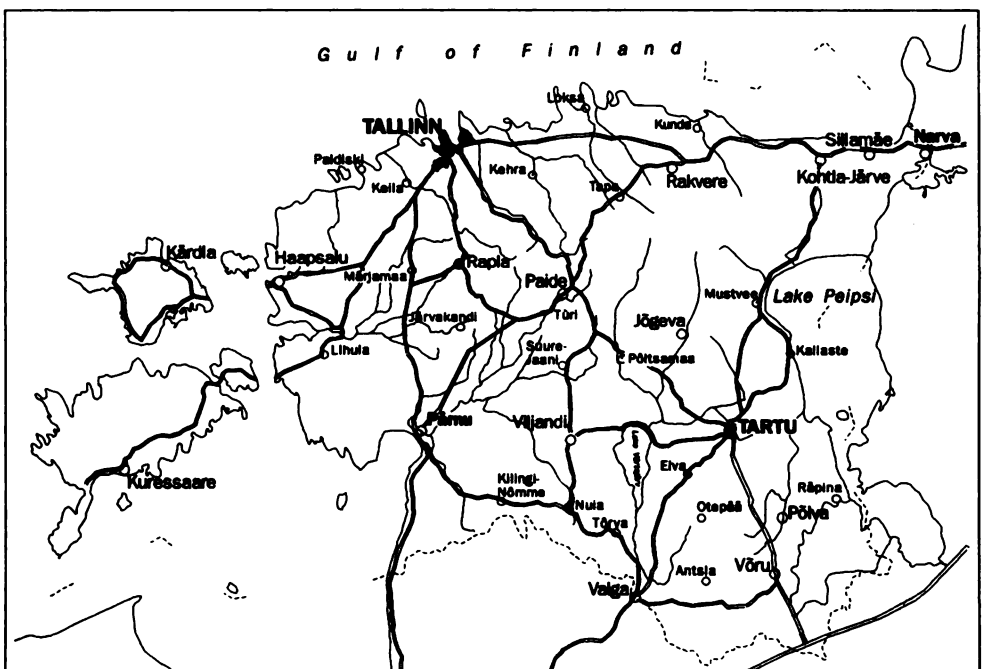


Figure 1: General map of Estonia

concerning minority nations in Estonia, approved in 1920, was considered one of the most democratic in Europe at that time.

In the summer of 1940, as a consequence of the Hitler-Stalin pact signed on 23 August 1939, the Soviet Army occupied Estonia and on 6 August 1940, the country was incorporated into the Soviet Union as the Estonian Soviet Socialist Republic. Having become part of a huge totalitarian state, Estonia was no longer able to decide upon its development. The whole economy was centralized under Moscow's control. Industrialization was the dominant change in towns, especially in northern Estonia, and collectivization (formation of state and collective farms) in rural areas.

On 16 November 1988, the Declaration of the Sovereignty of the Estonian SSR was passed, which marked the beginning of the 'new awakening', a peaceful struggle to regain independence. In May 1989, the country declared economic independence; on 30 March 1990, the newly elected Supreme Council stated that the Soviet power in Estonia had been illegal from the moment of its establishment and proclaimed the restoration of the independent Estonian Republic. On 20 August 1991, the Supreme Council of the Republic of Estonia approved a resolution in which it affirmed national independence and resolved to restore diplomatic relations with other states. At present Estonia is a member of the United Nations and has been recognized or recognized anew by most of the states in the world.

Unlike most states, the population of Estonia does not coincide with the number of citizens. The latter, mostly descendants of the citizens of the Estonian Republic as in June 1940, comprise about 70% of the population. The balance is given by a prevalently non-Estonian population, persons who have moved to Estonia during the post-World War II period according to the USSR policy of colonization and due to large shifts in the labour force (in 1945-1950 alone, net migration into Estonia was 240,000). Changes in the population within the last half-century are illustrated by the graphs in Figure 2.

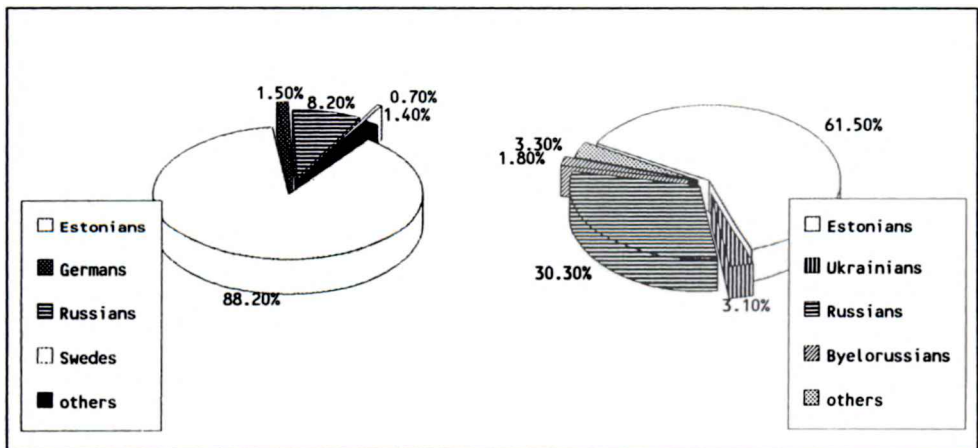


Figure 2: Ethnic composition of the Estonian population in 1934 (left) and 1989 (right). In 1989 the number of citizens was only 70% of the number of inhabitants.

The Gross National Product (GNP) of Estonia was over 13 billion SUR in 1991, making nearly 8.7 thousand roubles per capita. Since the Estonian economy has been quite isolated from the world market, the value cannot be translated correctly into convertible currency. It has been estimated, however, that the GNP per capita is similar to that of Poland.

The economic structure which was developed by the mid-sixties has preserved its main proportions until now (Figure 3). Industry is the leading employer (over 40% together with construction), with light industry (textile, clothing and footwear) and the food industry

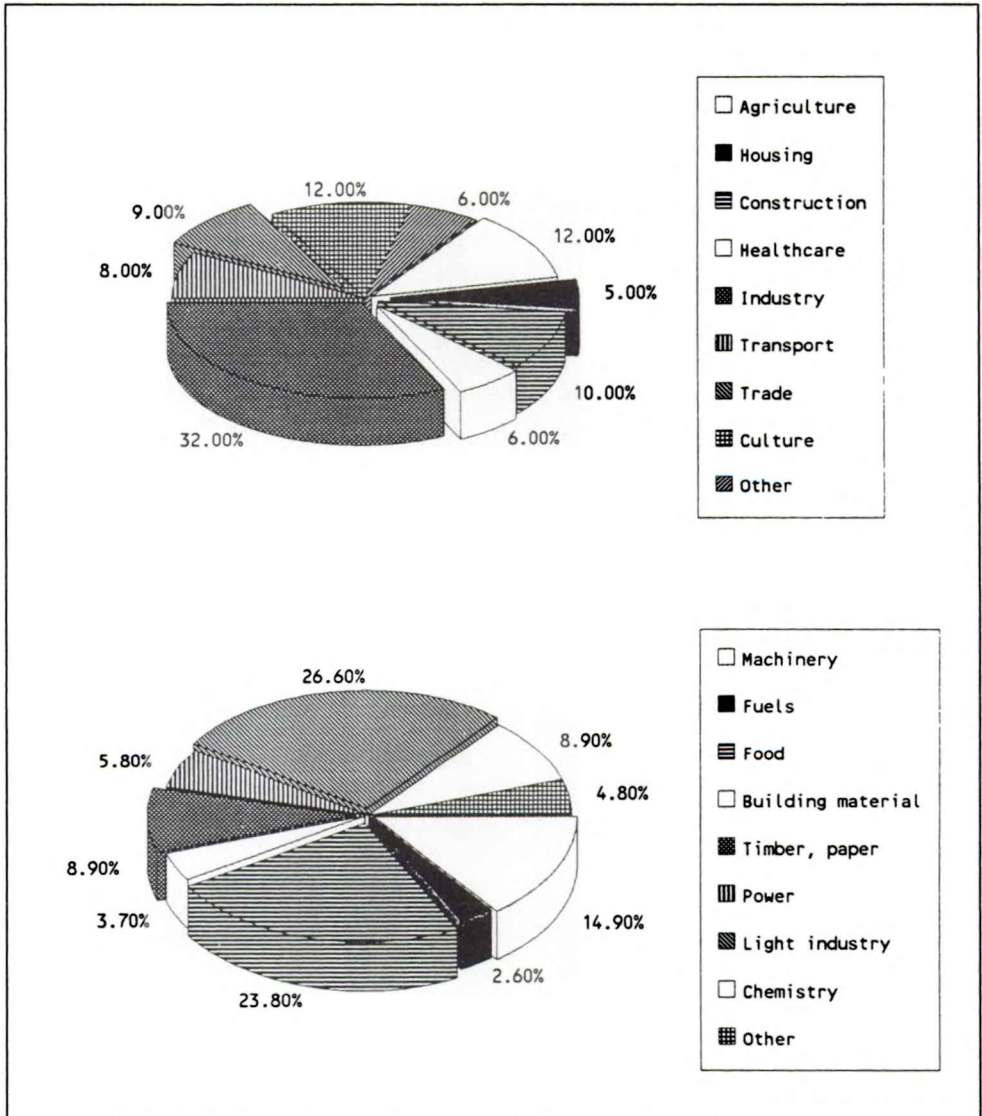


Figure 3: Employment structure (top) and industrial output in Estonia in 1989.
(Source: The Baltic States, 1991 and National Report of Estonia to UNCED 1992).

providing roughly half of the industrial output. Engineering production includes instruments, oil and gas processing equipment, etc. Power production and chemical industry based to a large extent on local oil shale resources is of importance. Wood processing and pulp and the paper industry utilize forest resources. Estonian agriculture specializes in cattle breeding. Table 1 presents some figures for principal industrial products.

Table 1: Principal industrial products

(Source: The Baltic States, 1991)

	Unit	1980	1988
Electric energy (incl. power station consumption)	million kWh	18,898	17,627
Oil shale	million tonnes	31,334	23,307
AC electric motors	units	309,200	248,100
Excavators	units	2,251	2,054
Air cooling equipment (for oil industry)	million SUR	34.0	45.8
Mineral fertilizers (calculated for 100% active agent content)	'000 tonnes	267.9	245.0
Sulphuric acid (as monohydrate)	'000 tonnes	506.2	654.2
Varnishes, paints, solvents	tonnes	3,744	3,831
Timber products	'000 m ³	2,530	2,700
Plywood	'000 m ²	30.3	32.9
Fibreboard	'000 m ²	3,813	16,777
Chipboard	'000 m ³	100.2	184.4
Cellulose	'000 tonnes	86.5	94.2
Paper	'000 tonnes	93.1	94.6
Skis	'000 prs	885	986
Cement	'000 tonnes	1,213	1,200
Bricks	million units	267.0	253.5
Roofing	'000 m ²	34,369	37,639
Window glass	'000 m ²	1,987	1,855
Textiles	million m ²	206.3	238.5
Footwear	million prs	5.8	6.8
Meat	'000 tonnes	155.3	185.5
Butter	'000 tonnes	30.4	32.5
Cheese	'000 tonnes	12.1	17.4
Tinned food	million tins	317	355
Wine and spirits	million litres	22.3	13.7
Cigarettes	million	4.456	4.735

In the post-war period, until 1990, the main part of industry in Estonia was ruled by the USSR ministries in Moscow. In recent years the following changes have been taking place:

- like other post-socialist states, Estonia is currently in the period of transition from planning to implementing a market economy;
- decision-making has shifted from the former USSR (Moscow) to Estonia (Tallinn); part of the responsibilities are (or will be) delegated to the local level;
- as a result of the ownership reform which is currently under way, private and municipal ownership of land is being restored instead of the former state monopoly; this leads to changes in management.

Since 1988 there have been remarkable changes in ownership relations, with the legalization of new types of enterprises: small state enterprises, cooperative ventures, private enterprises, joint-stock companies, joint ventures and private farms. During 1988-1990 nearly 20,000 new enterprises were founded. By the beginning of 1992 the number of private farms exceeded 7000. This rash of new small enterprises provide only a small percentage of new investment and employment but their share of hard currency earnings has been estimated at about 40%.

Another important shift towards a market economy was the liberalization of prices in 1991-1992, followed by the issuing of a national currency.

The most important of the numerous reforms aiming at facilitating the transition process include: privatization of industry, agricultural land and housing. Acceleration of these processes has become critical in the conditions of a deepening crisis exacerbated by rapid changes in trade relations with the former Soviet republics, an unprecedented (over a hundredfold) increase in the price of imported fuel, a deficit of convertible currency, a decrease in the production of industry and agriculture, and subsequent decrease in the standard of living.

Thorough reforms are necessary to overcome the crisis in the Estonian economy. It should be restructured, modernized, connected with the world market; the quality of production has to be considerably improved. In order not to overexploit natural resources in the race towards achieving quick profits, well-oriented and flexible methods and measures are needed, both legislative and economic (financial). Readjusting to rapidly changing conditions is currently the major concern for all decision-makers.

CHAPTER 1: INVENTORY OF NATURAL RESOURCES

1.1 Post-glacial Development of the Natural Resources of Estonia

Southern Estonia was freed from continental ice about 13,000 years ago. The ice cover retreated from the north-western part of the republic approximately 11,000 years ago. As regards its climate, Estonia belongs to the mixed-forest subregion of the temperate zone which is characterized by a relatively warm summer and a moderately mild winter. Since the annual amount of precipitation exceeds evaporation roughly twofold, the climate is excessively damp. The Estonian climate changed significantly during the Late- and Post-glacial periods.

Immediately after the retreat of the ice sheet, vast areas of Estonia were covered with big ice-dammed lakes and peculiar periglacial conditions came to dominate in this area. The cold waters of proglacial lakes were practically lifeless and on the land scanty, tundra-like vegetation prevailed. In Allerød time (about 11,800-10,800 BP) the whole Baltic area experienced considerable warming.

At the beginning of the Holocene a relatively quick warming of the climate took place. At the beginning of the Boreal (about 9,000 BP) the mean annual temperature was rather similar to that of the present, and at the end of the period it was already a bit higher. The climatic optimum about 5500-6500 years ago was characterized by the culmination of thermophilic vegetation, the mean annual temperatures exceeding the present values by 1-2°C. The culmination was followed by a decrease in temperature and an increase in humidity. Two periods of short-term warming about 4000 and 1000 years ago were again replaced by periods of cooling. A deep cooling (the so-called Little Ice Age) took place quite recently, from the 16th to the 19th centuries. Long-term instrumental observations, initiated in the second half of the 18th century, and the historical records offering some alternate sources of information for studying changes in the Estonian climate (rye harvest, ice break-up in Tallinn harbour, etc.), demonstrate that a gradient of 0.8-0.9°C per hundred years is a natural trend of air temperature rise in Estonia.

Geographically, the development of Estonia has been strongly influenced by the Baltic Sea. The joining of local ice-dammed lakes into the Baltic Ice Lake about 12,000 years ago and the reunion of the latter with the ocean approximately 10,200 years ago (the formation of the Yoldia Sea) were complicated processes which triggered off profound changes in natural conditions over the area. A new isolation from the ocean about 9,300 years ago (Ancylus Lake) and reunion with the ocean (Litorina Sea 7,600-4,000 BP, Limnea Sea from 4,000 BP up to the present) led to clear changes in the ecosystem and in the salinity of water.

Estonia has been inhabited for at least the last ten thousand years, and all the data show a very dense settlement dependent on the Baltic Sea evolution. Communities of early hunters



Plate 1: Erratic boulders off the coast of northern Estonia in Lahemaa National Park (*Photo: Jüri Pere*)



Plate 2: Oil shale mining in north-eastern Estonia (*Photo: Jüri Pere*)

IUCN – The World Conservation Union

Founded in 1948, IUCN – The World Conservation Union – brings together States, government agencies and a diverse range of non-governmental organisations in a unique world partnership: some 720 members in all, spread across 120 countries.

As a union, IUCN exists to serve its members – to represent their views on the world stage and to provide them with the concepts, strategies and technical support they need to achieve their goals. Through its six Commissions, IUCN draws together over 5,000 expert volunteers in project teams and action groups. A central secretariat coordinates the IUCN Programme and leads initiatives on the conservation and sustainable use of the world's biological diversity and the management of habitats and natural resources, as well as providing a range of services. The Union has helped many countries to prepare National Conservation Strategies, and demonstrates the application of its knowledge through the field projects it supervises. Operations are increasingly decentralised and are carried forward by an expanding network of regional and country offices, located principally in developing countries.

IUCN – The World Conservation Union – seeks above all to work with its members to achieve development that is sustainable and provides a lasting improvement in the quality of life of people all over the world.

East European Programme

IUCN's long history of activity in Eastern Europe provided the foundations for an integrated East European Programme, established in 1987. The aims of the Programme are to promote environmentally sound planning in accordance with the aims of the World Conservation Strategy and the Report of the World Commission on Environment and Development, to participate in international conservation affairs and to promote and support the application of restoration ecology. The Programme has built up an unparalleled store of information on conservation issues in eastern, central and south-eastern Europe. Dissemination of this information is being carried forward through the EEP Report and Research Series.

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IUCN
The World Conservation Union

Lithuania

Vulnerable

Ischnura pumilio
Coenagrion armatum
Cicindela maritima
Calosoma inquisitor
Calosoma sycophanta
Carabus coriaceus
Xylodrepa quadripunctata
Gnorimus variabilis
Osmoderma eremita
Netocia lugubris
Ergates faber
Semblis phalenooides
Coenonympha hero
Brenthis daphne
Maculinea teleius
Lysandra coridon
Endrosa kuhlweini
Hyphoraia aulica
Thyria jacobaea
Mamestra dysodea
Blepharita bathensis
Xanthia citrargo
Ipimorpha contusa
Andrena nasuta
Meliturga clavicornis
Dasypoda argentata
Megachile maacki
Anthophora plagiata
Bombus pomorum

Rare

Capnopsis schilleri
Labidura riparia
Carabus nitens
Polyphylla fullo
Papilio machaon
Oeneis jutta
Reverdinus flocciferus
Zygaena ephialtes
Zygaena angelicae
Synanthedon mesiaeformis
Synanthedon vespiformis
Synanthedon conopiformis
Cucullia balsamitae
Dicycla oo
Mesoligia literosa
Plusia zosimi
Asthena anseraria
Semiothisa carbonaria
Seleucus cuneiformis
Scolia hirta
Crossocerus imitans
Podalonia luffii
Pseudepipona herrichii
Colletes nasutus

Andrena curvungula
Andrena suerinensis
Lasioglossum alinense
Lasioglossum prasinum
Melitta wankowicz
Tetralonia macroglossa
Bombus semenoviellus
Bombus confusus

Indeterminate

Pyrrhosoma nymphula
Nehalonia speciosa
Anax imperator
Carabus menetriesi
Epicnaptera arborea
Cherosotis cuprea
Callopietria juventina
Apamea lithoxylea
Pseudepipona herrichii
Andrena florivaga

Restored

Parnassius mnemosyne

CRUSTACEA

Endangered

Triops cancriformis
Euritemora lacustris
Pontoporeja affinis

Vulnerable

Limnocalanus grimaldii macrurus
Mysis oculata relicta
Pallasea quadrisphinoza

ANNELIDA

Vulnerable

Hirudo medicinalis f. serpentina

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Tyto alba
Alcedo atthis
Picus viridis
Lanius excubitor
Panurus biarmicus

Indeterminate

Ixobrychus minutus
Tadorna tadorna
Aythya nyroca
Falco tinnunculus
Porzana parva
Crex crex
Haematopus ostralegus
Asio flammeus
Athene noctua
Glaucidium passerinum
Dendrocopos leucotos
Anthus campestris
Lanius minor
Acrocephalus paludicola
Luscinia svecica

AMPHIBIANS

Indeterminate

Triturus cristatus
Bombina bombina

Restored

Bufo calamita

REPTILES

Endangered

Emys orbicularis
Coronella austriaca

FISH

Extinct or probably extinct

Acipenser sturio
Abramis ballerus

Endangered

Petromyzon marinus
Alosa fallax

Rare

Coregonus lavaretus holsatus nat. platelensis

Indeterminate

Salmo salar
Salmo trutta trutta

INVERTEBRATES

MOLLUSCS

Extinct or probably extinct

Margaritifera margaritifera

Vulnerable

Arion empiricum
Limax maximus
Unio tumidus

INSECTS

Extinct or probably extinct

Megaplectes monticola
Xylocopa valga

Endangered

Barachycercus pallidus
Ephemerella karelica
Leucorhaenanthus maximus
Anax parthenope
Lucanus cervus
Ceruchus chrysomelinus
Peltis grossa
Boros schneideri
Cerambyx cerdo
Philopotamus montanus
Apatania zonella
Hipparchia statilinus
Lasiommata petropolitana
Brenthis hecate
Clossiana frigga
Clossiana thore
Hamearis lucina
Lycaena helle
Arctia villica
Ammobiota festiva
Zygaena achilleae
Epicnaptera arborea
Thaumatopoea pinivora
Photodes brevilinea
Phibalapteryx virgata
Baptria tibiale
Rheumaptera subhastata
Aspilates gilvaria
Chariaspilates formosaria
Andrena rugulosa

Lithuania

LICHENS

Extinct or probably extinct

Arctoparmelia centrifuga
Evernia divaricata
Hypogymnia vittata
Solorina spongiosa
Usnea scabrata

Endangered

Lobaria pulmonaria
Lasallia pustulata
Umblicaria deusta
Umblicaria polyphylla
Usnea glabrata

Indeterminate

Cladonia caespitica
Usnea glabrescens
Usnea lapponica

VERTEBRATES

MAMMALS

Extinct or probably extinct

Mustela lutreola

Endangered

Halichoerus grypus

Rare

Dryomys nitedula
Glis glis
Lepus timidus

Indeterminate

Myotis dasycneme
Myotis brandtii
Barbastella barbastella
Nyctalus noctula
Nyctalus leisleri
Pipistrellus pipistrellus
Eptesicus serotinus
Eptesicus nilssonii
Vespertilio murinus
Eliomys quercinus
Sicista betulina
Lutra lutra

Restored

Bison bonasus

BIRDS

Extinct or probably extinct

Circetus gallicus
Aquila clanga
Aquila chrysaetos
Falco peregrinus
Lagopus lagopus

Endangered

Gavia arctica
Milvus milvus
Haliaetus albicilla
Falco columbarius
Coturnix coturnix
Pluvialis apricaria
Calidris alpina
Galinago media
Bubo bubo
Picoides tridactylus
Galerida cristata
Emberiza calandra

Vulnerable

Podiceps nigricollis
Mergus serrator
Milvus migrans
Lyrurus tetrix
Tetrao urogallus
Tringa glareola
Tringa totanus
Philomachus pugnax
Numenius arquata
Limosa limosa
Columba oenas
Coracias garrulus
Upupa epops
Picus canus

Rare

Podiceps griseigena
Botaurus stellaris
Ciconia nigra
Anser anser
Anas strepera
Anas acuta
Anas clypeata
Mergus merganser
Pandion haliaetus
Pernis apivorus
Circus pygargus
Aquila pomarina
Grus grus
Porzana porzana
Sterna albifrons
Aegolius funereus

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BRYOPHYTES

Extinct or probably extinct

Ricciocarpus natans
Sphagnum subfulvum

Endangered

Drepanocladus lycopodioides
Sphagnum molle
Trichocolea tomentella

Rare

Bryum sschleicheri
Ctenidium molluscum
Pogonatum nanum
Thuidium minutulum

Indeterminate

Fontinalis dalecarlica
Sphagnum subnitens

ALGAE

Extinct or probably extinct

Lychnothamnus barbatus
Tolypella prolifera

Rare

Chara baueri
Chara galioides

FUNGI

Extinct or probably extinct

Dictyophora duplicata
Porphyrellus porphyrosporus
Psathyrella caput medusae
Rhodotus palmatus

Endangered

Sarcosoma globosum
Choiromyces meandriformis
Dendropolyporus umbellatus
Gomphus clavatus
Grifola frondosa
Mutinus caninus
Tricholoma inocyboides

Vulnerable

Boletopsis leucomelaena
Boletus fechtneri
Clavariadelphus pistillaris
Funalia trogii
Ganoderma lucidum

Hygrocybe ovina

Lactarius acerrimus

Langermannia gigantea

Peziza ammophila

Pycnophorus cinnabarinus

Ramaria aurea

Suillus placidus

Trichoglossum hirsutum

Trichloma apium

Tricholoma batschii

Rare

Aurantiporus croceus

Boletus aereus

Boletus erythropus

Calocybe ionides

Conocybe intrusa

Discina perlata

Entoloma madidum

Fomitopsis rosea

Geastrum indicum

Gymnopilus spectabilis

Hericium coralloides

Hygrophorus russula

Inonotus dryadeus

Inonotus dryophilus

Lactarius repraesantaneus

Lactarius scrobiculatus

Lactarius volemus

Lepiota cortinarius

Lepiota fuscovinaceae

Lepiota hystrix

Lepiota liliaceae

Lepiota subalba

Leucopaxillus tricolor

Melanophyllum eyrei

Morchella conica

Morchella elata

Ptychoverpa bohemica

Rhodocybe truncata

Russula aurata

Sparassis crispa

Spongipellis spumeus

Trametes gibbosa

Verpa digitaliformis

Xerocomus rubellus

Indeterminate

Amanita regalis

Leccinum decipiens

Lepista sordida

Phallus hadriani

Russula laurocerasi

Trichaster melanocephallus

Tricholoma subsejunctum

Tricholoma ustaloides

Lithuania

Gladiolus imbricatus
Glyceria striata
Gymnadenia conopsea
Helictotrichon pratense
Holcus mollis
Huperzia selago
Hydrilla verticillata
Iris sibirica
Laserpitium latifolium
Lathyrus laevigatus
Liparis loeselii
Listera cordata
Lunaria rediviva
Malaxis monophyllos
Mentha longifolia
Najas marina
Nuphar pumila
Nymphaea alba
Orchis mascula
Orchis morio
Peplis portula
Pinguicula vulgaris
Platanthera chlorantha
Primula farinosa
Prunella grandiflora
Prunus spinosa
Pulsatilla patens
Radiola linoides
Salix lapponum
Salvia pratensis
Scabiosa columbaria
Sesleria caerulea
Silene chlorantha
Silene lithuanica
Trifolium lupinaster
Vicia lathyroides

Rare

Agrimonia procera
Aira praecox
Alisma lanceolatum
Allium vineale
Androsace filiformis
Arctium nemorosum
Astragalus cicer
Astrantia major
Beckmannia eruciformis
Botrychium multifidum
Bromus benekenii
Bromus erectus
Calamagrostis pseudophragmites
Campanula bononiensis
Carex brizoides
Carex ligerica
Carex muricata
Carex paupercula

Carex rhizina
Centaurea phrygia
Cerastium sylvaticum
Ceratophyllum submersum
Cnidium dubium
Colchicum autumnale
Conioselinum tataricum
Corydalis intermedia
Cruciata laevipes
Dactylis polygama
Dianthus borbassii
Dracocephalum ruyschiana
Elatine hydropiper
Equisetum telmateia
Eriophorum gracile
Fragaria moschata
Gagea pratensis
Galium triflorum
Glyceria nemoralis
Hypericum hirsutum
Hypericum montanum
Juncus gerardii
Koeleria delavignei
Montia fontana
Nasturtium officinale
Neottianthe cucullata
Poa remota
Pulsatilla nigricans
Pyrethrum corymbosum
Quercus petraea
Rubus corylifolius
Salix myrtilloides
Schoenus ferrugineus
Scolochloa festucacea
Seseli annuum
Sherardia arvensis
Stachys recta
Succisella inflexa
Taraxacum palustre
Tragopogon gorskianus
Trifolium rubens
Triglochin maritimum
Veronica hederifolia
Vicia pisiformis

Indeterminate

Alopecurus arundinaceus
Cerastium brachypetalum
Geranium lucidum
Hypericum humifusum
Juncus capitatus
Najas minor
Potamogeton meinshausenii

APPENDIX 1: LIST OF SPECIALLY PROTECTED SPECIES IN LITHUANIA

VASCULAR PLANTS

Extinct or probably extinct

Aldrovanda vesiculosa
Aphanes arvensis
Botrychium simplex
Caldesia parnassiifolia
Gladiolus palustris
Groenlandia densa
Hydrocotyle vulgaris
Pedicularis kaufmannii
Polystichum aculeatum
Rubus arcticus
Taxus baccata
Trapa natans

Endangered

Agrostemma githago
Allium angulosum
Asplenium trichomanes
Aster tripolium
Botrychium matricariifolium
Botrychium virginianum
Betula nana
Carex davalliana
Carex heleonastes
Centaurium littorale
Centunculus minimus
Cephalanthera longifolia
Cephalanthera rubra
Coeloglossum viride
Cruciata glabra
Cyperus flavescens
Dactylorhiza cruenta
Dactylorhiza majalis
Dentaria bulbifera
Dianthus armeria
Dianthus superbus
Drosera intermedia
Epipogium aphyllum
Erica tetralix
Eryngium maritimum
Festuca altissima
Gentianella uliginosa
Glaux maritima
Gratiola officinalis
Gymnadenia odoratissima
Hammarbya paludosa

Hedera helix
Herminium monorchis
Hordelymus europaeus
Isoetes lacustris
Isopyrum thalictroides
Juncus stygius
Lathyrus pisiformis
Lepidotis inundata
Lobelia dortmanna
Melittis melissophyllum
Myrica gale
Myriophyllum alterniflorum
Nymphoides peltata
Orchis militaris
Orchis ustulata
Pedicularis sceptrum-carolinum
Pedicularis sylvatica
Saxifraga hirculus
Schoenus nigricans
Swertia perennis
Teucrium scordium
Tofieldia calyculata
Veratrum lobelianum
Vicia dumetorum
Viola stagnina
Viola uliginosa

Vulnerable

Ajuga pyramidalis
Allium scorodoprasum
Allium ursinum
Alyssum gmelinii
Arenaria procera
Arnica montana
Baeothryon caespitosum
Cirsium heterophyllum
Cladium mariscus
Corallorhiza trifida
Corydalis cava
Cyperus fuscus
Dactylorhiza baltica
Dactylorhiza maculata
Dactylorhiza russowii
Epipactis atrorubens
Festuca psammophila
Gentiana cruciata
Gentiana pneumonanthe
Gentianella amarella

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Later developments have unveiled the existence of some other problems, such as in the decision-making process, overall management and international financing as well as more specific items, among them environmental risk and environmental impact assessment, international environmental law, multilateral and bilateral sources for project funding and the establishment of long-, medium- and short-term strategies. It is the common understanding that Lithuania has to create a reliable environmental management system which would allow many general problems to be solved.

Until quite recently Lithuania, as well as other republics of the former USSR, was kept from making decisions and was free from the responsibility for the consequences of decisions made by somebody in Moscow. In a way this was a convenient situation, but it has left traces of inertia. Today it is necessary to work hard to improve the situation.

International cooperation should, firstly, help Lithuanian people understand that the country is part of our common world; secondly, that in thinking globally we must act locally, since no one will solve our problems for us. Wise and balanced decisions have to be made and for that one has to learn much. The legal system must become an effective instrument in environmental protection.

Lithuania is ready to make its commitments in environmental protection by signing or acceding to international agreements, but in most cases limitations arise due to financial problems, say for example, for membership fee payments.

Lithuania is neither a developed, nor a developing country, it is a country 'in transition to a market economy'. This term was adopted after signing the Climate Change Convention and Convention on Biodiversity at the Rio de Janeiro Conference in 1992. It is our common task to make this painful transition process as short as possible. International assistance and cooperation can contribute to achieving this goal.

CHAPTER 4: OPPORTUNITIES FOR REGIONAL AND INTERNATIONAL COOPERATION

Before independence was restored in March 1990, there was practically no cooperation between Lithuania and other countries in the field of environmental protection.

The first contacts with colleagues abroad not only concerned environmental issues, but also had a political aspect, as Lithuania was not officially recognized before the coup in Moscow failed in August 1991. The closest ties at that time were established with the Environmental Ministries in Denmark, Sweden, Poland, Bavaria in Germany and the State of Wisconsin in the USA.

At the same time, the Environmental Protection Department sought participation in international environmental organizations, first of all, the Baltic Marine Environment Protection Commission (HELCOM). Lithuania's attempts to join it were supported by every member-state of this organization except the former Soviet Union. However, with the support of their western neighbours, all three Baltic states could, in their capacity as independent experts, successfully take part in the work of the High Level Task Force, which was created by the Ronneby Conference (September 1990). This allowed the Baltic States to work on an equal basis with the HELCOM member-states.

Another opportunity for Lithuania to remind others of its existence was the Dobriř Conference of the Ministers of Environment which took place in Czechoslovakia in June 1991. After long discussions, Lithuania was admitted in the capacity of a special guest. This was a significant achievement. Several months later, when the Soviet Union collapsed and the former republics were free to act on their own, Lithuania was not a newcomer in European environmental circles. Official environmental cooperation agreements were very quickly signed with Denmark, Poland, Finland and Sweden. The preparation of a similar agreement with Germany is under way. The first agreement, with Denmark, was signed on September 4 1991, less than a fortnight after the recognition of Lithuanian's independence by the world community.

It must be noted that the Environmental Protection Department is a recipient of assistance through international cooperation. Lithuania faces numerous problems in every field of environmental activity: surface water protection, waste water treatment, air protection, hazardous and household waste management, etc. In such a situation, priorities had to be decided and sewage water treatment and waste management were given the most emphasis. Time showed this was the right judgement. Today the Environmental Protection Department works together with foreign partners on solving these problems: the Danish Environmental Protection Agency is financing the preparation of a hazardous waste treatment system for Lithuania and Sweden's financial assistance helped design the waste water treatment plant in Kaunas.

environmental management principles, the geographical distribution of land management programmes and the environmental protection regime, while at the same time ensuring the maintenance and stability of environmental quality.

Research work in the area of environmental protection and nature utilization in Lithuania is carried out as a uniform scientific/technological programme, aimed at creating a system of environmental quality and natural resources utility control in the Republic. The programme is confirmed for the period up to 1995 and includes plans for the investigation of major environmental problems and recommendations to improve the present-day situation. The first part of the programme covers environmental hot spots at a regional level which are usually given much attention on an international scale, including the contamination of water bodies, mass forest die-back, ecological problems in the nuclear power plant region (Ignalina) and standards for nature protection and exploitation and the scientific basis for specialized ecological studies.

Another part of the programme is devoted to the creation of an ecological monitoring system. Existing services and institutions will have to be reorganized to form a uniform and integrated system. Much attention will be devoted to the creation of a uniform information network and data base for personal computers.

The third part of the programme foresees economic, juridical and humanitarian measures, technical means and methods for the analysis and control of pollutants and contaminated biological systems, technologies for rendering solid and toxic pollutants harmless and the industrial use of toxic wastes.

The fourth part of the programme is devoted to ecological optimization and the establishment of a protective system for the Lithuanian landscape. A system of measures to maintain Lithuania's biogeographical stability, to minimize the exploitation of nature and to protect its natural potential will be set up, depending upon the new economic situation in the Republic of Lithuania. The programme also includes the establishment of an optimal system of protected areas.

These studies are carried out under the coordination of the Environmental Protection Department. In 1991, The Environmental Protection Department funded over 70 research projects, comprising all the problems included in the programme. Throughout 1992, studies have been carried out on the Baltic Sea, Kuršių Bay, inland waters, forest damage, the impact of Ignalina NPP, control of and modifications to the monitoring system for point and non-point pollution sources, the environmental quality regulation system and the landscape ecological optimization system.

It is foreseen that from 1993 much attention will be devoted to a special project on the ecological monitoring system, especially to analysis and prognosis.

- Pre-school programmes. To examine the problems of ecological education for pre-school children, preparing a cognitive and practical programme of learning through positive emotions toward the environment.
- Secondary schools. To prepare textbooks and programmes for secondary schools, linking issues of environmental protection with topics addressed in traditional curriculum subjects.
- Higher education. To restructure the existing programmes of institutions of higher education (universities, special secondary schools, technical schools and colleges) introducing ecological studies, sustainable development and issues pertaining to environmental protection as curriculum subjects.
- Re-qualification. To review and introduce re-qualification programmes to instruct specialists from various industries and firms on new environmental technologies and to strengthen the national capacity for the development of new and innovative environmental protection measures.

Though the current programmes for environmental education are limited, they do provide planners with the basis for an expanded ecological awareness programme. Lessons on the environment are currently part of teaching plans for grades 1-4, with a more detailed ecology course following in grade 10. In secondary school programmes, classes on chemistry, biology and physics establish a link between environmental issues and the more traditional curriculum subjects. The main directions for increasing ecological education in secondary schools were approved in new programmes for teaching biology and geography, especially an ecogeographical course for grades 5-6: 'The Earth as man's home'.

It is of vital importance that students are provided with opportunities to widen their theoretical and practical knowledge of the environment, supplementing existing programmes with other innovative and interesting forms of education. A substantial step has been made in this direction with the establishment of the National School for Young Researchers, School of Young Geographers in Vilnius Pedological University for upper grade class pupils.

On the university and technical school level, general ecological principles (human and social ecology, biogeography, sociology, enforcement of environmental protection, land management, public environmental protection activities) and lectures on other subjects are offered. Students of Vilnius and Kaunas Universities, Kaunas Technological and Vilnius Technical Universities studying sciences are encouraged to undertake research on the state of the environment.

Research work in the field of environment protection, land use and landscape management in Lithuania is carried out by specialized research institutes and laboratories, among them the Geography, Geology, Botany, Ecology, Hygiene, Architecture and Construction, History, Historical Monuments Preservation Institutes and specialized departments of the Vilnius, Kaunas and Klaipėda Universities and Agricultural Academy. Today, applied biogeographical studies have become very important, as they define the structure of Lithuania's landscape and

One of the main elements in the land management system - land use and improvement projects - are to be implemented by the following stages:

1. The principle scheme for land use and improvement projects must be viewed as an integral part of the Overall Land Management Scheme of the Republic of Lithuania.
2. Regional land use and improvement programmes are viewed as part of regional land management plans.
3. Detailed land use and improvement projects must be set up for agricultural land areas.

During the current transitional state of the economy, preliminary and complex land use projects are under way which foreshadow means of land-ownership transformation, land allotment and regulation of land privatization, depending upon its distribution.

The methodological principles of land use and improvement are secondary to the regime of use and protection of separate land management zones. Depending upon this, the following functional zone groups are singled out:

- conservation areas with a strict management regime;
- conservation areas with less intensive management regimes;
- protected and rehabilitated zones;
- agricultural zones within a natural framework;
- industrial agricultural zones;
- other industrial zones.

3.3 Education and Science

The aim of ecological education is to encourage respect for sustainable lifestyles, based on an awareness of their relationship with the environment.

To achieve these aims the following guidelines will be adhered to:

- introduction of environmental education programmes in all grades and at all levels of education;
- encouragement of national traditions of respect for nature in cultural and educational policies;
- broadening support for public and non-governmental environmental organizations and encouraging their formation in areas where environmental awareness is low.

As part of its statutory remit, the Environmental Protection Department is actively involved in promoting educational reforms aimed at enhancing public awareness of environmental issues. Together with the Ministry for Culture and Education, the Environmental Protection Department has set forth the following priorities in the formation of an ecological education system:

The privatization programme concerns forest land as well as farm land. Forest land of not more than 25ha in area will be given back to its former owners. Not more than one-third of Lithuania's woodlands will be privatized. Forests in health-resorts, the Baltic Sea protective zone (up to 7km), cities, recreational areas, forests for research purposes, nurseries and water bodies of over 5ha in area will not be privatized.

After the former Soviet military troops are withdrawn from Lithuania, it will be necessary to restore the severely damaged environment. Experience from eastern European countries shows that the cost of environmental damage inflicted by the Soviet military amounts to hundreds of millions of dollars.

3.2 Land Management

Land management includes planning for human activities and environmental management aimed at the formation of optimal land use systems and a healthy cultural landscape. It integrates many other areas, such as geography, biology, economics, sociology and landscape architecture.

The fundamental criteria for the implementation of land management tasks to provide a basis for the formation of optimal, scientifically-based land use systems, are the following:

- **ecological requirements** for the maintenance of conditions necessary for natural diversity and human existence;
- **psychological requirements** to create and maintain conditions for a psychologically-favourable environment;
- **socionomic requirements** to protect the cultural value of the environment
- **ergonomic requirements** to create favourable physical conditions for human activity;
- **economic requirements** to effectively use areas of economic significance and increase their capacity;

The recommended land management principles are as follows:

- **functional complexity**, i.e. the need to coordinate the interests of all types of possible land use;
- **regional conditions**, i.e. the need to differentiate programmes undertaken depending upon natural and social differences;
- **historical continuity**, i.e. the need to develop environmental management traditions based on earlier land management principles and structures;
- **biogeographic community**, i.e. the need to maintain a uniform management of areas within the same biogeographic systems;
- **social expediency**, i.e. the need to socially motivate all projects.

- establishment of an environmental education system;
- promotion of cooperation with global and regional organizations.

National environmental protection policies are founded on the following principles:

- the integration of environment and development;
- environment protection must be a matter of concern and obligation for every citizen;
- the provision of comprehensive and timely information on the state of the environment must be guaranteed;
- international agreements must be respected and incorporated into national legislation.

An immediate task for the Government of Lithuania is land reform: privatization of land, the elimination of collective farms, and renting non-privatized land to agricultural and other firms. Land reform will implement the right of Lithuania's citizens to the ownership of land by returning expropriated land in accordance with the procedures and terms established by law, and through land purchase.

Land reform in Lithuania started in 1991 with the Law on Land Reform, the Law on the Procedure and Conditions for the Restoration of Ownership Rights of Citizens to Surviving Immovable Property and others. It will be implemented in accordance with the schemes of land use planning and in pursuance of land relations, taking into consideration the interests of individuals and businesses who wish to acquire land, and the recommendations of the agrarian reform agencies. The process of land reform must embrace legal, economic, and ecological principles, land use planning decisions, the preparation, coordination and approval of land reform schemes, and legal registration of land ownership or land leases.

Now that the privatization process has started, it is most important to preserve and augment the state's ecological variety which is still unaffected by large-scale land improvement. One such juridical step is the Lithuanian Government resolution No. 344 'On Special Requirements for Land and Forest Use', dated May 12, 1992 and the Lithuanian Republic Government resolution No 174 'On Obligatory Requirements for the Use of Privatized Objects within Protected Areas', dated March 15, 1992. Requirements are most stringent; a farm may even be closed down. The documents of land owners and land users will contain entries indicating what changes of landscape are not allowed and the land use limitations introduced in protected areas. Land deeds issued to new landowners will include a clause specifying land and forest use requirements. Both individual farmers and agricultural communities will be obliged to undertake management to reduce the contamination of the environment and water bodies and protect valuable landscapes, vegetation and wildlife. Erosion is expected to stabilize with the privatization of land, as cultivated fields will be reduced in size and new farms with gardens and other surrounding vegetation will appear.

Discussions on whether the land inside protected areas may be returned to former owners or, in other cases, sold, are still under way. The existing laws, however, apply only to land in protected areas, in which human activity is forbidden. Other land in protected areas may be privatized, provided the owner follows the land-use restrictions set by the authorities.

CHAPTER 3: ENVIRONMENTAL TRENDS AND PRIORITY INITIATIVES

3.1 State Priorities

Development of the national economy, land reform and demilitarization are of primary importance to Lithuania.

The basis for further national economic development is a new structural policy based on a hierarchy of national priorities and a state regulatory system. The principles underlying this new policy are as follows:

- increased specialization of the economy and participation in the process of international labour division;
- a multi-channelled supply system which takes into account price fluctuations and the supply and demand of raw materials and other resources in the world market;
- priority given to the production of goods for export;
- the introduction of innovative processes, advanced and resource-conserving technologies;
- optimal use of local resources;
- reduction and limitation of extensive production and assimilation of intensive production;
- creation of an infrastructure for the development of market relations.

This economic reform must not cause further environmental destruction. Therefore, environmental protection policies are aimed at establishing limits for environmental quality, based primarily on European Standards. As a result of setting these limits, out-dated technologies will gradually have to be replaced.

The Government aims to prevent the deterioration of environmental quality, to improve the interaction of human activities and natural systems and to promote a transition to sustainable development. To achieve these goals, Lithuania will focus on several areas which have so far been neglected:

- reorganization of environmental legislation;
- review of current environmental standards;
- implementation of the territorial environment protection system;
- creation of an effective Environmental Impact Assessment process;
- introduction of economic incentives;
- improvement of monitoring systems;

- establish, finance and supply programmes, plans and projects for environmental protection of national significance, and finance research works;
- conduct the registration of state national resources and, within the limits established, distribute national resources to users;
- arrange ecological education and instruction;
- prepare draft projects of norms and standards of environmental quality and promote the introduction of ecologically safe technology and production by the users of natural resources;
- coordinate activities of the bodies of state power and local authorities (governments) concerning the utilization of natural resources and environmental protection.

The Department of Conservation of Historic Properties is responsible for the conservation and preservation of cultural monuments (archaeological sites, memorials, buildings, etc.) and the management of historical national parks. *The Department of Cultural Heritage* controls the state and use of cultural monuments. *The Forest Ministry* is responsible for the management of forests and national parks.

Local authorities (governments), implementing the policy of environmental protection on their territories, shall:

- organize the implementation of laws on environmental protection and decisions of the Environmental Protection Department and the Government of Lithuania in the field of environmental protection, and within the limits of their jurisdiction, adopt decisions concerning the utilization of natural resources and environmental protection ascribed to them by the Government of Lithuania and supervise their implementation;
- prepare, approve and implement the programmes, plans, and projects for environmental protection and utilization of natural resources in the territory under their jurisdiction;
- form and have at their disposal local government environmental protection funds, establish the amount of subsidies allocated for environmental protection, and document the necessity of subsidizing projects from the state budget;
- within established limits, distribute the national resources which are at their disposal;
- in agreement with the Government of Lithuania and Environmental Protection Department, establish norms on their own territory which are more stringent than state standards if they wish, and may create local protected natural areas and monuments.

- measures to combat contamination of the Baltic Sea;
- waste management.

Laws on land and land resources regulating the use of natural deposits and preventing them from being exploited irrationally are in preparation.

2.6 Administration

The state administration of environmental protection in Lithuania is carried out by the Environmental Protection Department, the Government and local authorities (governments and municipalities; Figure 15).

The Environmental Protection Department, subordinated to the Supreme Council of Lithuania, in shaping and implementing the state policy of environmental protection shall:

- prepare and, in conjunction with the Government, submit for approval to the Supreme Council the main trends of the policy of environmental protection and utilization of natural resources, as well as long-term state programmes related to the protection of the environment and utilization of natural resources; approve of proposals for environmental protection which are of national significance, as well as other projects of environmental protection, and provide the mechanism for their implementation;
- prepare draft laws on environmental protection and adopt legislative acts concerning issues of environmental protection and utilization of natural resources;
- approve the limits of the natural resources utilization, provide for the registration of natural resources and terms of their utilization;
- submit proposals to the Supreme Council of Lithuania, concerning the establishment of protected areas; approve the legislative acts and standards of environmental protection;
- coordinate economic activity projects and carry out the state ecological examinations; coordinate and implement international treaties and obligations of Lithuania on the issues of environmental protection and utilization of natural resources; and, upon the authorization of the Supreme Council or the Government of Lithuania, sign such treaties;
- carry out state control of the utilization of natural resources and environmental protection and control the implementation of international treaties and obligations;
- organize and coordinate scientific research works in the field of environmental protection; organize ecological monitoring;

The Government of Lithuania, implementing the national policy of environmental protection, shall:

- prepare and, in conjunction with the Environmental Protection Department, submit for approval to the Supreme Council of Lithuania, programmes and proposals of national significance related to the utilization of natural resources and environmental protection;

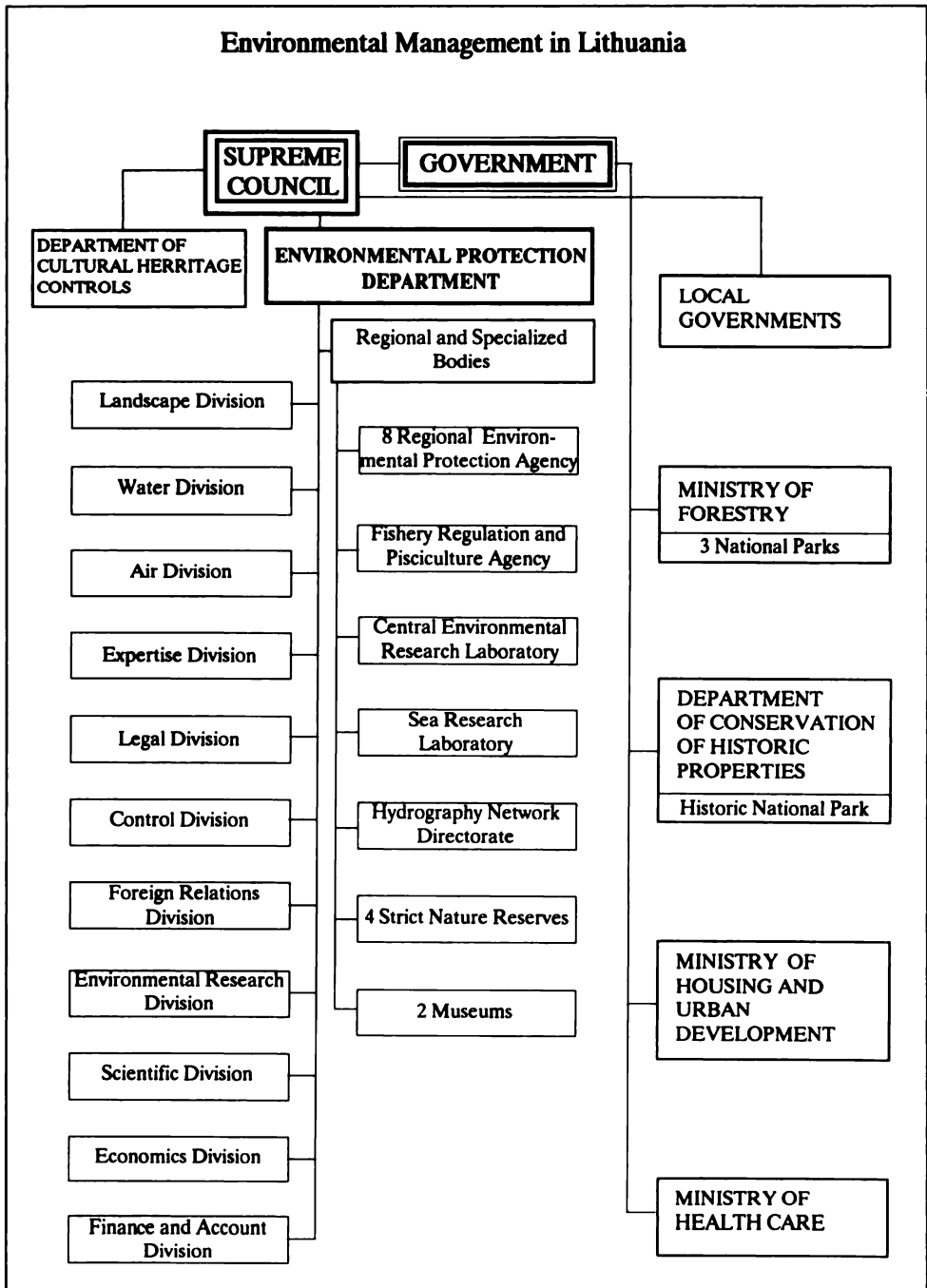


Figure 15: Administration set-up for environmental management in Lithuania

Lithuania

Protection Department and must receive its approval before municipal governments are allowed to issue prospective business licences.

- Each business is required to monitor constantly the impact of their actions on the environment, making this data readily available to the Environmental Protection Department and municipal governments.
- Taxes and duties are levied on the usage of natural resources and the discharge of pollutants.

The economic mechanism of environmental protection set forth in the Law on Environmental Protection of the Republic of Lithuania and other legal acts consists of:

- taxes for the utilization of natural resources;
- taxes for environmental pollution;
- regulation of crediting;
- state subsidies;
- pricing policies;
- economic sanctions and compensation for damage;
- other ecological taxes and measures.

The Law on Taxes on State Natural Resources serves to increase the responsibility of users of natural resources for the effective and economic utilization of the national wealth at their disposal. Revenue accumulated from such taxes will serve to offset state expenditure required to monitor the use and state of the supply of natural resources. The Law on Pollution Tax will impose mandatory fees on all persons, businesses or organizations whose activities contribute to the pollution of the environment, thereby implementing the 'polluter pays' principle. The introduction of low-waste technologies and the output of ecological production shall be promoted by tax reduction, credit privileges and state subsidies.

The legislative framework adopted in January 1992 has paved the way for a series of statutes now being drafted by the Parliament. These new laws will seek to address specific areas of concern, such as:

- protected areas;
- biological diversity;
- protection and use of forests;
- protection and use of soil;
- protection and use of coastal areas and the shelf seas;
- air protection;
- water resources protection;

2. **territorial links**, requiring the connection of future network sections based on their geology;
3. **regional representation**, requiring the preservation of the full range of landscapes (the genetic bank);
4. **technological adequacy**, requiring sufficient area to enable the implementation of protective measures;
5. **consistency of implementation**, through monitoring and progress reports.

In the Lithuanian situation it is most important to coordinate the development of natural and cultural landscape protection.

2.5 Environmental Legislation

Perhaps the most neglected area of national development under the Soviet rule was respect for and understanding of legal norms. Statutes providing for environmental protection were rare. The few laws which attempted to set guidelines for a rational exploitation of natural resources were seldom implemented, but used rather as declaratory documents.

The formation of a national legal system for environmental protection has just started. The areas of primary importance are:

- defining a system for the adoption of sound environmental legislation;
- defining relationships between agencies within the environmental protection system, as well as their ties with the Government and municipalities;
- establishment of procedures for the enforcement of environmental legislation;
- adoption of national legislation in accordance with international agreements.

On January 21, 1992, The Lithuanian Parliament passed a law 'On the Protection of the Environment in the Republic of Lithuania'. This serves as a statutory framework to facilitate the issuance of supplementary necessary legislation and establishes the principles for environmental protection. The main objectives of this law are:

- to ensure an ecologically sound environment;
- to reduce the damaging effects of human activities upon the environment;
- to guarantee the right of Lithuania's inhabitants to a healthy, secure and clean environment and to preserve typical Lithuanian landscapes and biological diversity.

The following guidelines have been set out in this legislation to facilitate the implementation of the Environmental Impact Assessment principle and the 'polluter pays' principle:

- Every economic unit intending to engage in economic activities shall prepare and submit to the Environmental Protection Department documentation on the conceivable impact of its actions on the environment. This impact study is reviewed by the Environmental

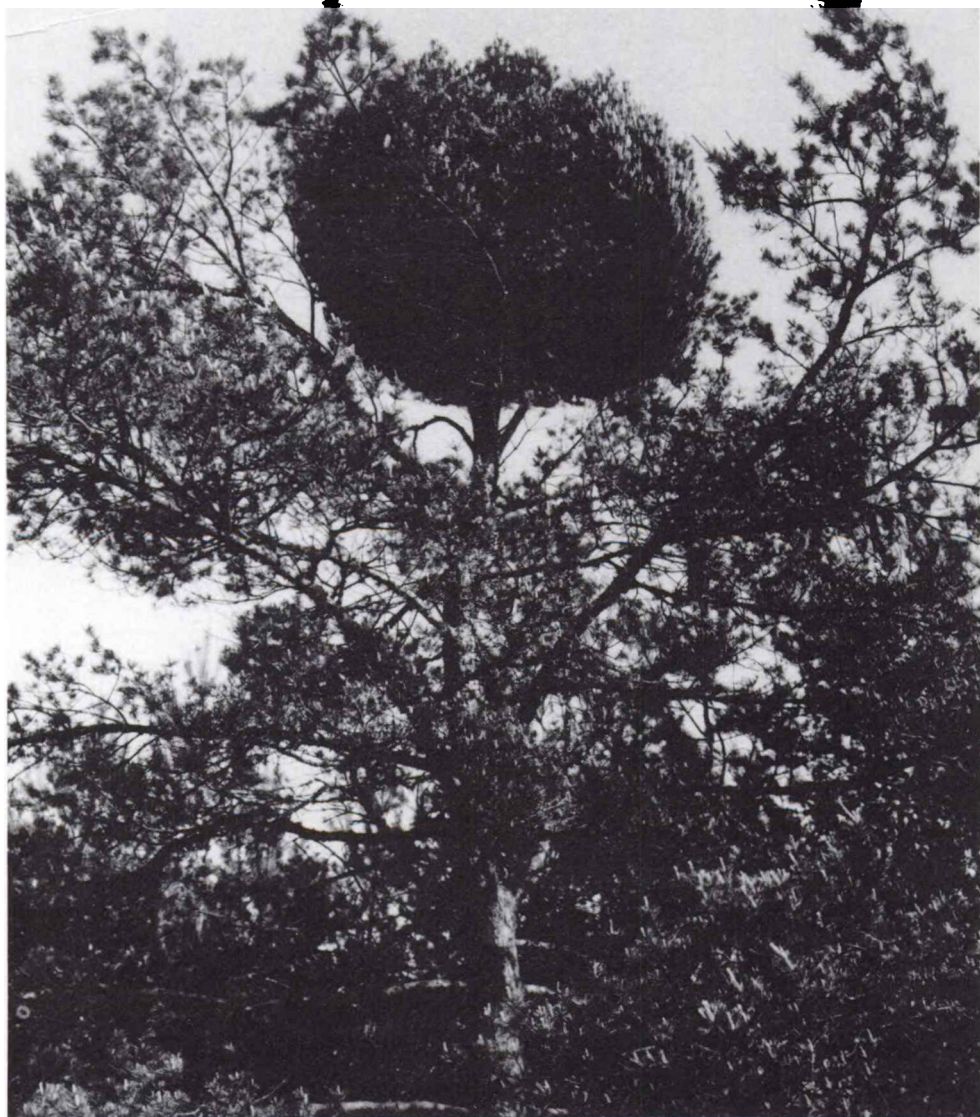


Plate 12: Raganos Sluota (witch's broom), a natural monument

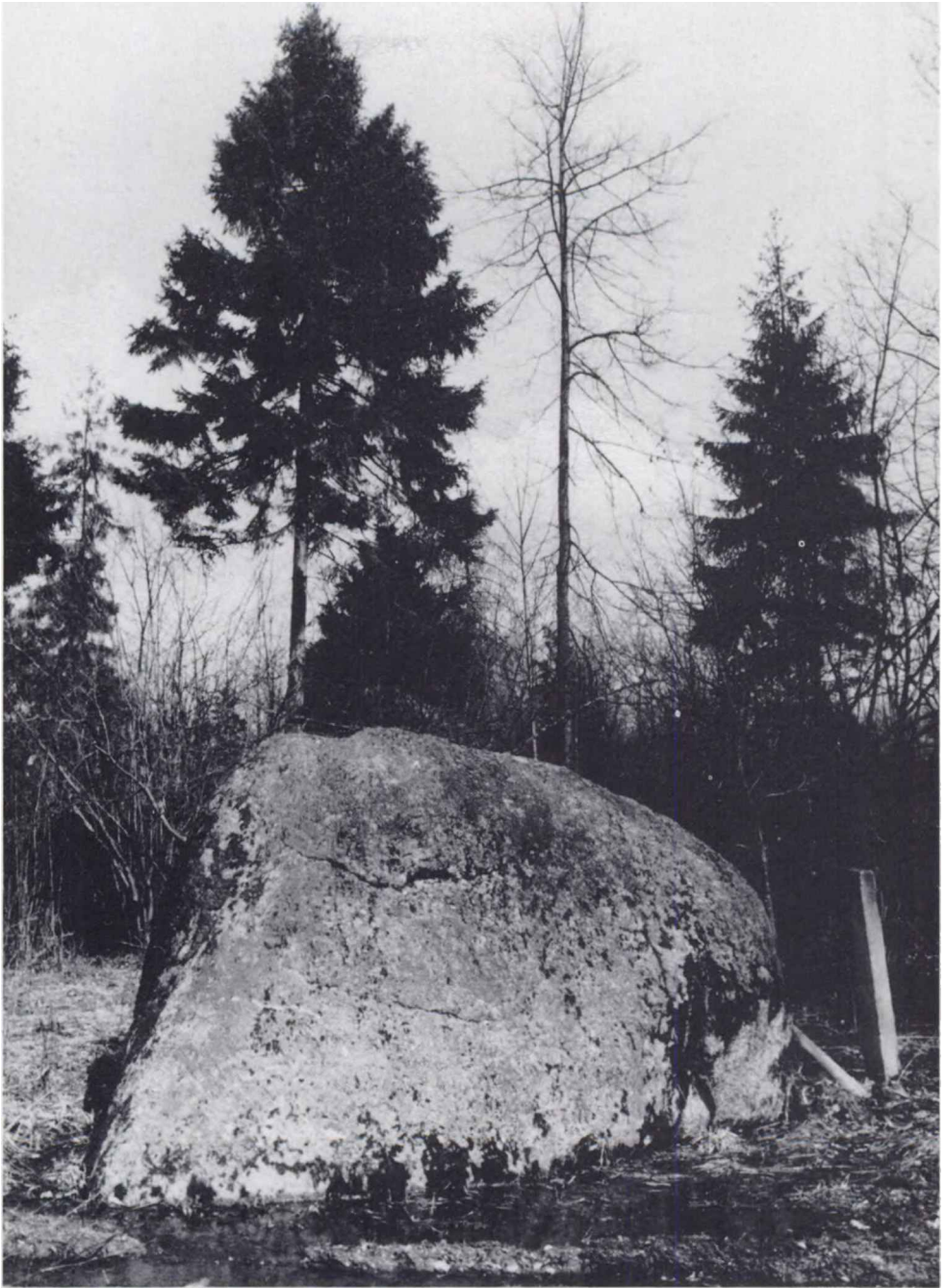


Plate 11: The Barbaros Stone, a natural monument



Plate 10: Kulalių Geological Conservation Reserve

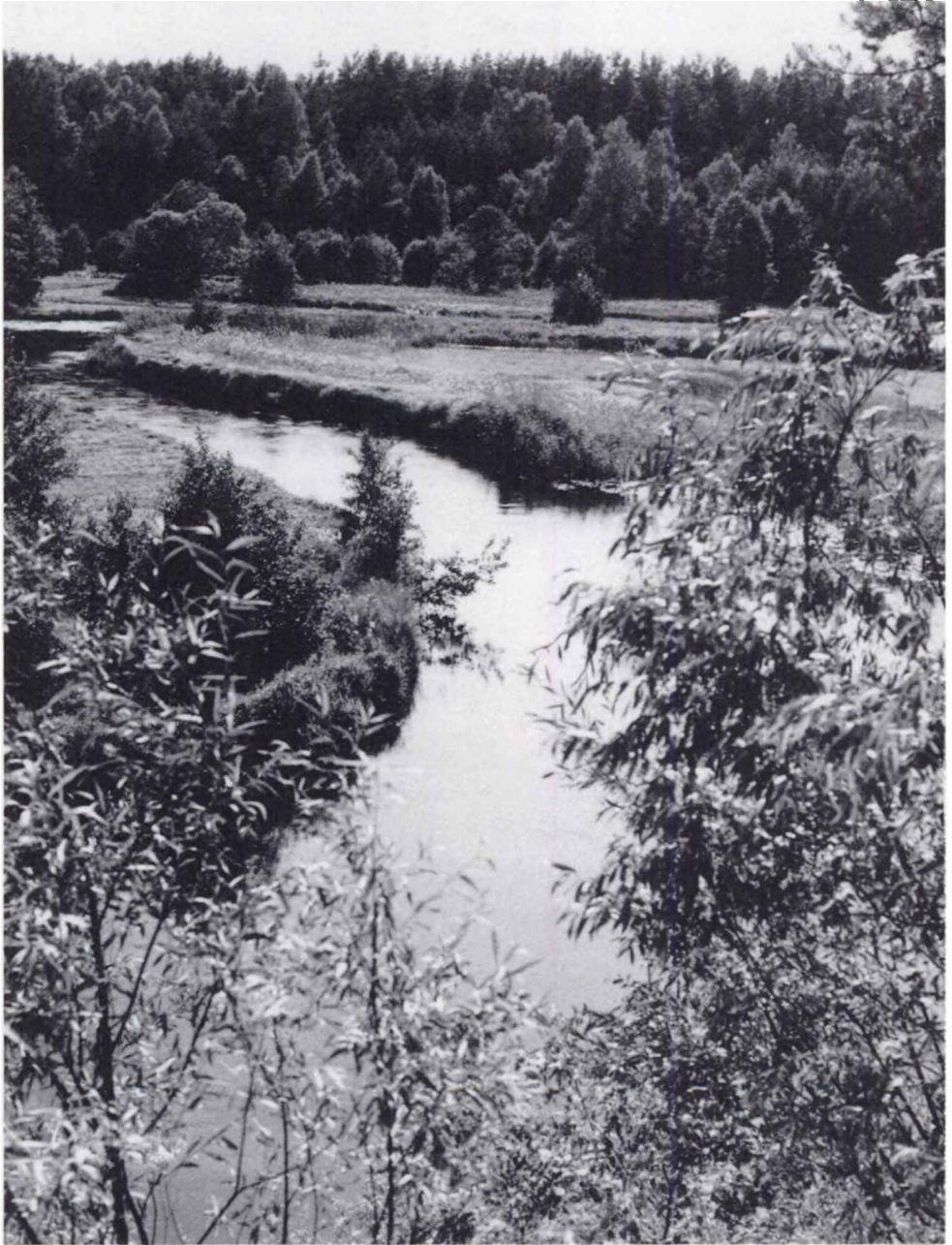


Plate 9: Žeimena River, Aukštaitija National Park.

- to carry out scientific research;
- to provide suitable conditions for ecotourism;
- to develop traditional rural activities, etc.

A regional park is a new category of protected area in Lithuania. Its territorial structure and its main aims are similar to those of national parks. A site selected for a national park area should meet the following requirements:

1. to represent the most important types of picturesque landscape;
2. to represent ethno-cultural regions of Lithuania;
3. to be ecologically stable.

Areas selected for regional parks should meet the following requirements:

1. to represent valuable regional landscapes;
2. to form a uniform complex from conservation, ecological, recreational and economic viewpoints.

Nature conservation reserves, in which economic activity (agriculture, forestry, recreation, etc.) is limited to varying degrees, play a significant role in the system of protected areas. Conservation reserves in Lithuania include landscape, geological, hydrographical and hydrological, pedological, botanical, zoological and other types. Geological and geomorphological reserves are established for the protection of the lithosphere; hydrological and hydrographical reserves for the protection of the hydrosphere; pedological reserves for the protection of soil types; and landscape reserves for the protection of the overall natural or natural-cultural landscape. Various types of zoological nature conservation reserves have been established especially for wildlife protection, though habitats and sites for various species are protected in other reserves as well.

Besides these reserves, there are 70 special waterfowl reserves (covering 11,000ha) and 22 black grouse (*Tetrao tetrix*) leks (3,900ha). Valuable natural landscape objects, such as hillocks, tumuli, outcrops, springs, stones, trees, etc. are classified as natural monuments.

One of the important activities of territorial conservation is forest management (forestry planning). Areas inhabited by valuable species are excluded from industrial use for ten years ahead.

Each strict nature reserve, national park and nature conservation reserve has special regulations for its conservation and protection issued by the Government. The network of Lithuanian protected areas will be developed according to the long-term strategy set by the Landscape Management Group of Vilnius University under the guidance of Dr P. Kavaliauskas.

In creating the system of protected areas, the following principles were observed:

1. **functional development**, requiring the creation of a full complex of protected areas in agreement with all territorial landscape protection trends and aimed at preserving natural complexes and varieties of landscape;

Table 8: List of protected areas, 1993

Name of protected area	IUCN category	Number	Area ha	Percentage of national area
Strict nature reserves:	I	4	23,548	0.4
Čepkeliai (1975)			10,590	
Kamanos (1979)			4,300	
Viešvile (1991)			3,216	
Žuvintas (1937)			5,442	
National parks:	II	5	140,983	2.0
Aukštaitija (1974)			30,289	
Dzūkija (1991)			55,880	
Kuršių nerija (1991)			26,394	
Trakai (historic) (1991)			8,300	
Žemaitija (1991)			20,120	
Regional parks:	V	30	380,880	5.8
Natural monuments:	III	688	-	-
geological		164	-	
trees		304	-	
estate parks		220	-	
Nature conservation reserves:	IV	290	176,113	2.7
landscape		72	65,878	
geological		10	638	
geomorphological		46	23,699	
hydrogeological		1	3,981	
hydrological		2	17,048	
hydrographical		35	12,373	
pedological		12	1,421	
botanical		65	10,957	
zoological		27	8,618	
botanical/zoological		20	31,500	
Total		1017	721,524	10.9

preservation, restoration, recreation and other zones are consolidated by a uniform programme of protection and restricted use. The main tasks of state parks are as follows:

- to protect valuable landscape complexes and components;
- to restore damaged landscape complexes and components;
- to sustain stability of ecosystems;

geochemical land systems, barriers and biodiversity. The nature framework must cover approximately 50% of the total land area, or between 40 and 60% of the different regions of Lithuania, in order to ensure sustainable development in the regions.

Protected areas are included in the natural framework as autonomous units protected in order to preserve nature's variety and act as ecological stabilizing factors. Their purpose is to preserve the different types of landscape, help obtain scientific data on man's impact upon the environment, provide opportunities for ecological training and education, and to preserve cultural (historical, archaeological, etc.) features. The current network of protected areas in Lithuania includes four strict nature reserves (IUCN category I), five national parks (IUCN category III), 30 regional parks (IUCN category V), 290 nature conservation reserves of different types (IUCN category IV) and 688 natural monuments (Figure 14 and Table 8). More than 100 nature conservation reserves and 30 regional parks were established in September 1992.

Three of the strict nature reserves have been established to protect marsh lands and the fourth (and newest) to protect a small river basin. Economic activity of any kind is prohibited in strict nature reserves.

National and regional parks form a group of state parks. The purpose of state (national and regional) parks is to protect the most valuable territories of Lithuania from a natural, cultural and recreational standpoint. They are complex protected areas in which conservation,

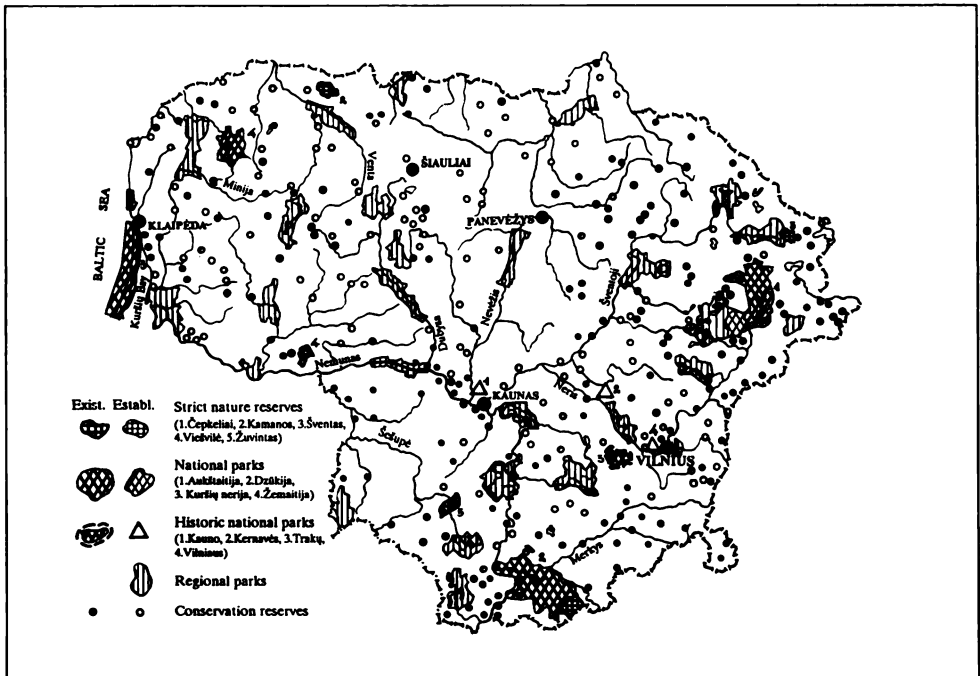


Figure 14: Existing and proposed protected areas in 1992

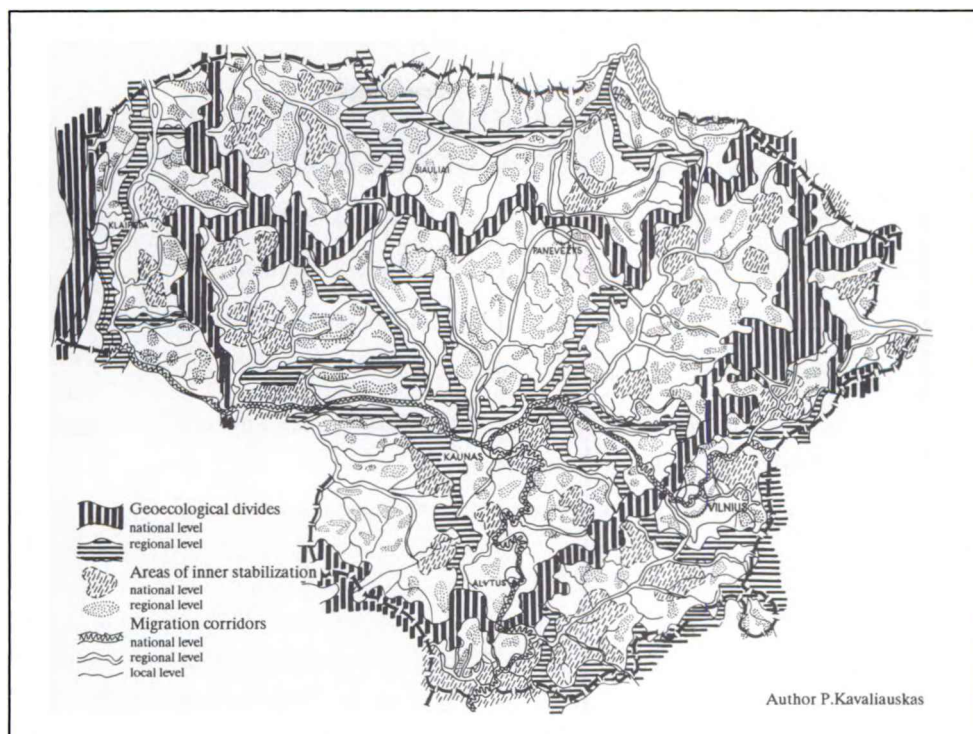


Figure 13: The nature framework for Lithuania

This is the basis for the land management nature framework, which includes three metafunctional systems:

1. **geoecological divides** - land belts separating different large-scale geosystems;
2. **migration corridors** - areas of intense biological activity;
3. **areas of inner stability or buffer zones.**

This combination provides the background for territorial protection and enables the geoecological regulation of all functions within the natural environment.

However, the nature framework is not just a network of green areas, but includes a number of categories of land use: strict nature reserves, managed reserves, national and regional parks, various conservation and recovering areas, recreation and forestry areas and regulated farming areas. They all have in common the prohibition or limitation of urban and industrial activities.

The nature framework is implemented by projects at state, regional and local levels. The structure of the nature framework at lower levels will be more detailed, recognizing the different ecological subdivisions of major natural habitats (waters, bogs, forests, agrarian land) and their regime of protection. The geoecological potential of these areas is determined by their geophysical, geochemical and biological landscape structure, especially by existing

- to stop the use of ozone-depleting substances (CFCs) by 1995, replacing them by less harmful alternatives (e.g. CFC 22);
- to ban the use of leaded gasoline, introducing MTBE instead by the end of 1992;
- to reduce water consumption by the introduction of water meters;
- to complete the construction of waste water treatment facilities in major urban areas;
- to introduce small-scale waste water treatment facilities in rural areas;
- to implement systems improving the quality of drinking water in rural areas;
- to create a system for hazardous waste management;
- to evaluate, reduce and eliminate the damaging environmental impact of dumping sites and other polluted areas;
- to create facilities for secondary waste management and processing.

2.4 Territorial Protection

Attention today is primarily concentrated on the problems of environmental pollution, and protected areas are being given insufficient attention. Now that land reform and privatization is taking place this attitude must change. Territorial or site-based protection must become one of the main components of the Government's regional policy. This is based on the formation of an interrelated system of zones with important ecological functions.

Such a territorial structure, called a **nature framework**, is one of the two main strategies in land management zoning (Figure 13). The other is an urban framework, which represents areas of great economic and technical activity and most developed landscapes. The nature framework represents land systems with stable ecology, where the natural landscape character of and least developed areas are conserved. This is a land management zone where forestry, recreation and conservation interests have priority.

The nature framework must be formed by actively selecting essential sites and areas according to their geoecological position within the natural landscape. This selection is based on a site's geosystemic location combined with an analysis of lateral migration possibilities and its actual position in the relief of the landscape.

This analysis divides such areas of great geoecological importance into:

1. entrances into geosystems or natural windows - higher zones of specific natural activity and sensitiveness (upper reaches of rivers, hilly lakelands, boglands, littoral, karst, etc.);
2. migration channels or natural corridors - lower zones (valleys and gullies);
3. buffers of geosystems or natural filters - intermediate zones allowing migration exchange;

All these zones must be conserved as natural landscape zones. They will help consolidate the network of nodes and axes which separate the different geosystems on the various levels.

The Environmental Protection Department will require industries and private households to reduce water consumption by imposing a water tax and other more stringent limitations. Enterprises are compelled to acquire water meters to implement these requirements.

Water preparation technologies will be implemented to supply uncontaminated artesian ground-water. Regulations will be established to reduce the non-point contamination of water bodies.

The National Waste Management Program is aimed at setting up temporary toxic waste storage sites, the construction of waste management centres (incineration plants, physical/chemical treatment plants and special landfill sites), the introduction of a state-run waste register system, registration of old dumping sites, and preparation of legislation and projects to improve sanitation. State-funded research work will also contribute to the overall waste management system, involving the entire process from waste production to processing and disposal, which is under way in Lithuania. The Law on Waste Management, supplemented by other rules and regulations, will regulate the registration, collection, assortment, transportation, recycling, treatment and disposal of waste. Regulations will also set out the fundamental principles of waste management, giving priority to recycling.

Economic incentives will play an important role in both general environmental policy and waste management. The use of waste as secondary raw material will grow due to increasing prices of imported raw materials during the transitional period to a market economy. Legislation on land use and natural resource taxes have a direct influence on the costs of dumping sites. Requirements for the use of dumping sites have become more stringent.

With the aim of protecting soil and increasing its quality, soil-protective land cultivation is being favoured through the application of anti-erosive crop rotation and the planting of vegetation preventing soil erosion. The following activities are planned in the field of soil quality studies and protection for the period 1992-1995:

- to establish state control to prevent soil degradation and pollution ;
- to promote studies on heavy metals (especially Cd), toxic and the migration of radioactive substances in soil;
- to create and implement advanced agricultural technologies.

The following measures towards the improvement of environmental quality have been set out:

- to implement the requirements of the Geneva Convention on long-range trans-boundary air pollution it is essential to produce less sulphurous (up to 2.5%) petroleum and replace its use, where possible, with natural gas;
- to implement the requirements established for the installation of treatment facilities in thermoelectric power plants;
- to replace outdated industrial technologies with environmentally-friendly ones;

As emissions are insufficiently treated, town planning and other measures are used to protect the atmosphere and landscape. For example, zones are defined according to the probability of environmental pollution and the resistance of natural systems to air contamination, and pollution sources are separated from inhabited areas and recreational territories.

One goal is to implement the regulations set out in the Geneva Convention on long-range trans-boundary air pollution. Sulphur dioxide emissions from stationary sources of pollution must decrease by 30% and nitrogen oxide emissions by 50% by 1993 in comparison with 1980 levels.

A detailed list of means to reduce transport emissions will be included in the Transportation and Environmental Protection Program now under way. Catalytic converters, used with lead-free gasoline, will be introduced to reduce CO and NO_x emissions. Ethyl-free petrol production will start in 1992. This will lead to a partial reduction in transport emissions. Standards for motor vehicle emissions have been established for nitrogen oxides, hydrocarbons and carbon monoxide. A tax system stimulating a reduction in fuel consumption as well as emissions will be developed in 1992 and implemented in 1993. At the same time, assessment of motor vehicle quality and control will be implemented, as well as measures to reduce traffic in Lithuania's major cities. However, there is currently a lack of emissions control equipment. Measures to protect surface waters from contamination can be grouped as follows:

- enhancement of natural treatment processes by the formation of natural ecological frameworks, protective belts and zones;
- reduction of the volume of contaminated water which reaches bodies of open water through improved technological processes;
- waste water treatment.

According to the Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea Area, Lithuania should reduce pollution of the Baltic by organic, biogenetic substances (nitrogen and phosphorous) and heavy metals by 50%. To achieve these objectives, waste water treatment plants will be built in all cities and district centres, giving priority to major industrial cities such as Vilnius (where biological treatment will be introduced in 1993), Kaunas, Klaipėda, and Šiauliai and the resort community of Palanga. Town and settlement sewage networks will be connected to the treatment plants. After the construction of biological treatment facilities in the four biggest cities (Vilnius, Kaunas, Klaipėda and Šiauliai) the water quality of many rivers and the Kuršių Bay and the Baltic Sea will improve by as much as 75%. Discharge of organic pollutants will be reduced by 67% (or 39,800 tonnes per year). With the reconstruction of waste water treatment plants in major industrial cities, water contamination from concentrated pollution sources should decrease by 62%. In 1991 the Environmental Protection Department established national regulations for the construction of rainwater treatment plants. Fines for water pollution are also imposed.

reserves, with a specific regime aimed at protecting typical Lithuanian landscapes, its waters, vegetation and wildlife). However, the network of this type of protected areas underwent considerable changes in the early 1970s and 1980s and has been developed according to a long-term strategy since 1984. At that time the Čepkeliai nature reserve and the first national park were established in Lithuania. Another four national parks were established in 1991.

Many scientific studies and regional plans on territorial protection in Lithuania have been made, but for many reasons were never applied.

During the post-war decades of Soviet occupation, a extreme technocratic environmental management strategy emerged which led to the current ecological crisis. The national economy was developed regardless of nature or landscape requirements. For example, during this period two sizeable fertilizer plants were built in Lithuania, and other giant new projects were undertaken, including the construction of a large thermoelectric plant in 1961, and, in 1980, the Ignalina nuclear power station. A number of smaller industrial projects, including numerous metalwork and machinery plants and chemical factories were also built during this time. The environmental impact of these undertakings was never investigated or made public.

Only in the 1980s were ecological issues brought into focus and attempts made to limit economic development to meet environmental needs. Unfortunately, the first attempts at legislation were not effective. With a strengthening of the position of environmental management in the mid-1980s, a change took place towards more moderate technocratic strategies which complied with environmental protection requirements. Today these trends are developing further.

2.3 Protection of Environmental Quality

Environmental protection can be divided into two equal areas: general environmental quality and territorial (or site-based). The first one considers the health of the environment, whereas the second is responsible for the protection of natural and cultural diversity, and maintaining landscape structure. The overall quality of the environment depends on the health of the air, water and soil.

Lithuania's industrial enterprises use treatment facilities such as ventilation, filters and wet, thermal and/or thermal/catalytic methods for dust and gas treatments. However, the majority of industries have no facilities to retain and neutralize their emissions. Filters may catch particulates, but they are of little help in removing sulphur dioxides and nitrogen compounds. To decrease the environmental impacts of air pollution, major thermal power plants have to comply with certain requirements, namely the installation of filters to retain sulphur dioxides and nitrogen oxides.

In recent years, requirements for industries have been set to neutralize volatile organic compounds. Some industries have already installed such facilities, but difficulties have arisen with funding as well as with the quality of treatment technologies available.

When a more favourable situation emerged (after M. Gorbachev's coming to power), the nation rallied round the powerful movement of Sąjūdis. Its greatest victory was the proclamation of the Act on the Re-establishment of Independence, March 11 1990. The Republic of Lithuania became a member of the UN on September 17 1991.

2.2 History of Environmental Protection

Lithuania has a centuries-old tradition of landscape preservation, dating from the proclamation by the heathen culture of certain forests, trees, animals, etc. as holy and untouchable. For example, holy woods are mentioned in the Salyno Agreement of 1398. According to the Agreement, hunting, felling, unnecessary wandering and treading of paths were forbidden in these forests, which were reserves of a kind. In the feudalist epoch, hunted fauna was well managed (see the Statutes of Lithuania of 1529, 1566 and 1588 as well as other documents) and more attention was devoted to the protection of forests. Environment protection was, therefore, viewed as an issue of vital importance.

As the evolution of Lithuania as a state was interrupted by complete incorporation into the Russian Empire in 1795, and again in the 20th century into the Soviet Union, environmental issues were totally neglected by foreign administrations which showed little interest in the protection of occupied territories.

Until the 19th century, nature protection problems, as viewed today, were at a rudimentary stage. A Decree On Forest Protection was promulgated in 1919. In 1925, the Law on Hunting was adopted and corrected in 1935. In the period between the two World Wars, nature protection was a matter of concern for such outstanding men as P. Matulionis, who compiled hunting rules and regulations protecting spawning fishes, and Professor T. Ivanauskas, who suggested the idea of nature reserves as far back as 1933 and regretted that Lithuania had no law on nature protection.

The establishment of the Žuvintas nature reserve took place in 1937. In 1946, the Hunting and Fishing Rules were confirmed. Thirteen hunting reserves were established in 1948 and in 1954, 149 hunting preserves were designated. At that time attempts were made to protect waters and the atmosphere through legislation. Belts to protect rivers and green zones in cities were introduced in 1949.

In 1957, a body for overall nature protection - the Nature Protection Committee (today the Environmental Protection Department) with regional state nature protection inspections, was established at the Republic Council of Ministers. It was subordinated to its counterpart in Moscow and until 1990, environmental as well as any other development policies were determined and regulated from Moscow.

The Nature Protection Law was adopted in 1959 and creation of the present day network of new types of protected areas started. In 1960 the first nature conservation reserves were established, based on the data presented by several scientific institutions (25 landscape reserves, 27 landscape/historical, six ornithological, 11 botanical/zoological and 15 botanical

were made to restore independence, however, the uprisings of 1794, 1830-31 and 1863 were suppressed and followed by a stringent police regime, increasing Russification, the closure of Vilnius University (1832) and a ban on the printing of Lithuanian books (1864).

Printing of books in Lithuanian was started in Prussia (Lithuania Minor). They were then secretly brought to Lithuania. The year 1883 saw the publication of the first Lithuanian newspaper *Aušra*. The most outstanding leaders of the national liberation movement were Dr J. Basanavičius and V. Kudirka. The ban on Lithuanian printing was lifted in 1904.

During World War I, Lithuania was occupied by the German army in 1915. The international situation, however, was favourable to Lithuania, and on 16 February, 1918 it proclaimed the Act of Independence. During the first years of independence the situation in Lithuania was complicated. Lithuania was engaged in fighting on three fronts: against the Red Army, the Polish army (Lithuania failed to regain the Polish-occupied Vilnius region), and the Bermondtsky army (units of Russian and German troops).

Between 1920 and 1923 the Republic of Lithuania was recognized by the major countries of the world. On May 15, 1920, the Constituent Seim (parliament) of Lithuania began its work. Following a military coup on December 17, 1926, the leader of the Nationalist (Tautininkų) party, A. Smetona, became President.

The 22 years of independence saw progress in all spheres of life. First signs of oncoming war came with the Polish Ultimatum to Lithuania (1938) and the annexation of the Klaipėda (Memel) region by Germany. A complicated international situation forced Lithuania to sign an agreement with the USSR on October 10, 1939, by which Lithuania was given back the city of Vilnius taken over by the Red Army during the Soviet-Polish war. In return, however, 20,000 Soviet military personnel were deployed in Lithuania.

On June 14, 1940, the Soviet government issued an ultimatum to Lithuania, demanding the formation of a new Lithuanian government and permission to station additional Red Army troops in the country. The Lithuanian government submitted to the Soviet demand, 100,000 Soviet troops moved into Lithuania on June 15 and President A. Smetona left the country. The so-called People's Seim proclaimed Lithuania a Soviet Socialist Republic on July 21, 1940. On August 3, the Lithuanian SSR was officially incorporated into the USSR. Most Western states, however, (except Germany and Sweden) did not recognize Lithuania's unilateral incorporation into the USSR. During the mass deportation campaign of June 14-18 1941 about 7,439 families (12,600 people) were deported to Siberia without any investigation or trial.

After the beginning of the German-Soviet war on June 22, 1941, Lithuania became one of the general districts in the German occupational administrative unit, Ostland. About 200,000 Lithuanian Jews were massacred by the Nazis and their collaborators.

In 1944 the Red Army forced the Nazis out of Lithuania, and Soviet order was re-established in the occupied territory. Lithuania's annexation, its intensive forced Sovietization and repressions gave rise to a resistance movement. Guerrilla warfare, with the ultimate goal of independence, continued from 1944 to 1953.

CHAPTER 2: INSTITUTIONAL STRUCTURE AND LEGISLATIVE FRAMEWORK

2.1 Historical Background

In the 7th-2nd centuries BC, the present territory of Lithuania was inhabited by the Balts. The Lithuanians were the only Balts to succeed in forming their state during the medieval period, when Lithuania was united by Duke Mindaugas following the invasion of Baltic lands by the Teutonic and Livonian Orders. Mindaugas was crowned King of Lithuania in 1253.

Grand Duke Gediminas (ruler from 1316-41) started a grand period in Lithuania's history. His dynasty ruled the Grand Duchy of Lithuania until 1572. During the 13th to early 15th centuries, the Lithuanian state expanded eastwards. During the rule of Grand Duke Algirdas (1345-77), its territory almost doubled. At the same time, Lithuania continued its struggle against the Teutonic and Livonian Orders.

As a result of the Kréva Treaty (1385), Lithuania was united with Poland by the marriage of the Grand Duke of Lithuania Jogaila (Jagiello) to the Queen of Poland Jadvyga in 1386, with the Grand Duke thus becoming the King of Poland. One of the conditions of this Union was Lithuania's conversion to Christianity (1387).

Lithuania's independence under the union with Poland was restored by Grand Duke Vytautas. During his rule (1392-1430) the Grand Duchy of Lithuania became one of the largest states in Europe, covering present-day Byelorussia, the greater part of the Ukraine and some West Russian lands (Smolensk). The united Polish-Lithuanian army, led by Jogaila, and Vytautas defeated the Teutonic Order in the Battle of Žalgiris (Tannenberg, or Grünwald) in 1410. This victory ended the medieval Germanic drive to the east.

Political rapprochement between Lithuania and Poland was a slow process. Even after the Lublin Union (1569) when *Žecpospolita*, 'a commonwealth of two nations', was formed, Lithuania remained a separate state connected with Poland by rather loose ties of federation. The Grand Duchy of Lithuania retained its territory, legislation, treasury and the army. The ruler (the King and Grand Duke of Lithuania), the Seimas (parliament) and senate were elected commonly.

The 16th century was marked by a more rapid development of agriculture, growth of towns, the spread of humanist ideas and the Reformation, book-printing, the establishment of Vilnius University (1579) and the Lithuanian Codes of Law (the Statutes of Lithuania).

During the 17th and 18th centuries the whole commonwealth underwent an economic, social and political crisis which was deepened by the wars with Sweden, Russia and Turkey. The lands of the weakened state were divided three times (in 1772, 1793 and 1795) by Russia, Prussia and Austria. In 1795 most of Lithuania became part of the Russian Empire. Attempts

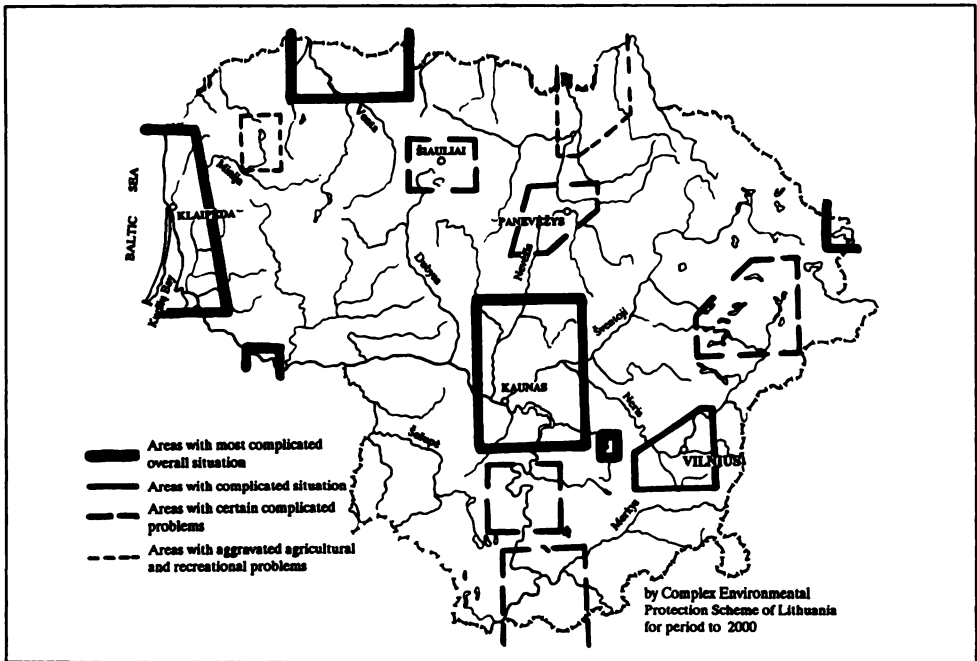


Figure 12: Environmental conflicts in Lithuania

- areas with certain serious problems (Šiauliai, Panevėžys, Aukštaitija, Alytus, Dzūkija);
- areas with aggravated agricultural and recreational problems (Žemaitija and the karst region).

The Kaunas area has the most complex and acute environmental problems. It covers about 4,000km² where examples of all types of environmental impacts can be found. The natural environment in this area can only be protected by the introduction of advanced technologies and by the application of construction engineering measures.

scrub and natural grasslands, the natural barriers which prevented water pollution have disappeared. Out of 63,700km of rivers, large and small, about 13,000km have remained unregulated. The largest rivers, such as the Nemunas, Neris, Šventoji, Dubysa, Venta, etc., are among those un-regulated, however, the number of smaller natural rivers is low. Having been canalized, these rivers have lost their value as natural regulators of the water level.

The natural environment is often damaged by the excavation of minerals and ground water extraction. Considerable areas are allocated annually for quarries, whereas the old ones take time to restore and their numbers are increasing. 4,400ha of land are occupied by pits formed by open cast mining. As a result, vast land areas have been considerably damaged. Established land taxes encourage the users of natural deposits to more rapidly reinstate these damaged areas, however these measures are insufficient. A programme for the reclamation of damaged areas will be prepared, though its implementation may be hindered by economic problems and lack of funds.

During the Soviet period, over 30 large pig-breeding farms (complexes) and numerous cow complexes were built in Lithuania. They cause serious contamination of the environment, ground and surface waters.

Throughout the post-war period, many high-rise apartment buildings have been constructed in Lithuania. As a result, cities cover a comparatively small area of land. However, Lithuania's road network is extensive and comprises a large area.

The Soviet army units occupy 70,000ha of Lithuania's territory and have caused a tremendous amount of damage to the environment. 60,000ha of forests (1% of the total territory) have been destroyed by military units. Activities carried out by the Soviet military (construction, felling of trees, etc.) destroy the landscape and pollute the environment. For example, 1.5 thousand ha of forest were cut down to construct an airport.

Today, two-thirds of Lithuania's territory is intensively used by man, particularly the Middle Lithuanian Lowland, Pajūrio Plain and Southeastern Plain. Conflicts over environmental protection arise from the excessive and uneven distribution of anthropogenic activities and lack of coordination in the development of the national economy. Possibilities for natural regeneration are being lost and the landscape potential weakened.

The main environmental hot-spots are as follows: the state of Kuršių Bay and the lower reaches of the Nemunas River; the rivers Nevėžis and Venta; the Drūkšiai and Elektrėnai water bodies; air protection in the industrial regions of Elektrėnai, Mažeikiai, Jonava, Kėdainiai, Naujoji Akmenė, Kaunas and Vilnius; the karst region of Biržai; vegetation and wildlife protection in industrial regions and near major towns; environmental protection in cattle breeding complexes; noise levels in towns; and recreation developments on the Baltic coast and near lakes, etc. The following problem areas have been identified on the basis of existing and forecast environmental conflicts (Figure 12):

- areas with the most serious and complex overall situation (Kaunas, Pajūris, Mažeikiai);
- areas in a serious state (Vilnius);

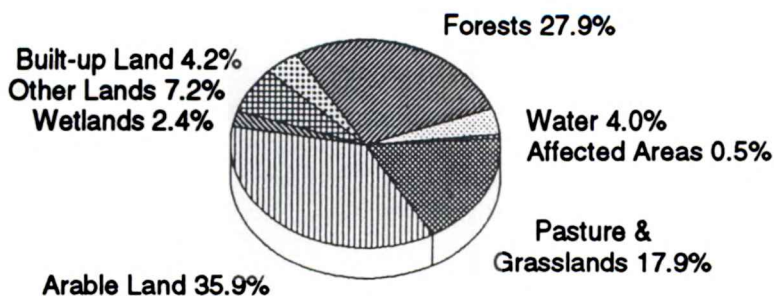


Figure 10: Land use, 1990

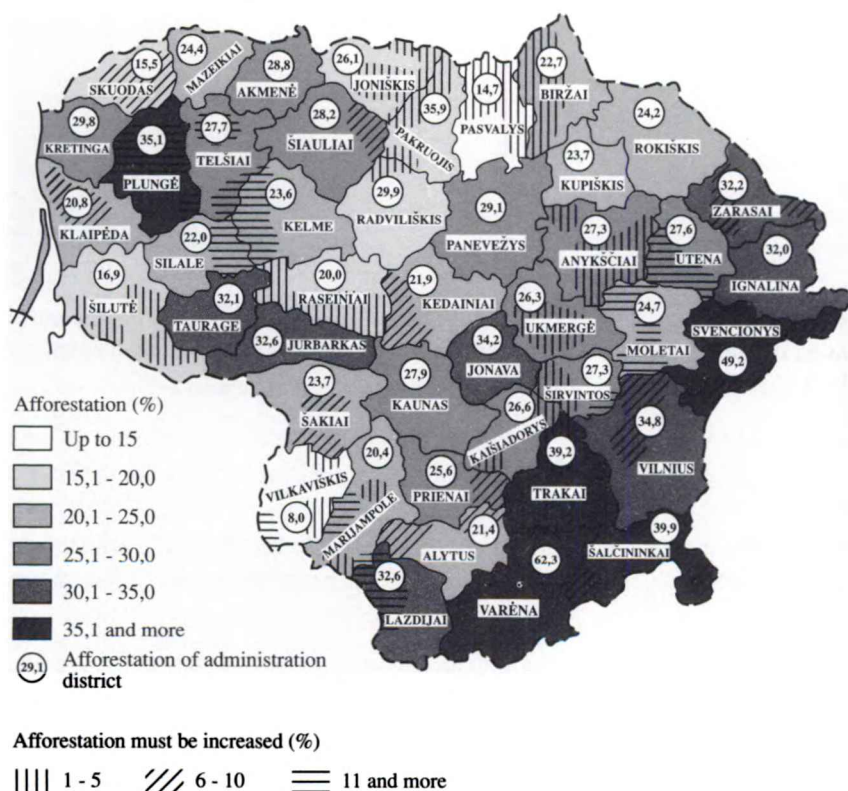


Figure 11: Afforestation in Lithuania

Table 7: Animal species listed in the Lithuanian Red Data Book

	Categories						Total
	0	1	2	3	4	5	
Mammals	1	1	-	3	12	1	18
Birds	5	12	14	21	15	-	67
Reptiles	-	2	-	-	-	-	2
Amphibians	-	-	-	-	2	1	3
Fishes	2	2	-	1	2	-	7
Molluscs	1	-	3	-	-	-	4
Insects	2	29	29	31	10	1	102
Crustaceans	-	-	3	3	-	-	6
Leeches	-	-	1	-	-	-	1
Total	11	49	50	56	41	3	210

Key: 0 = extinct or probably extinct; 1 = endangered; 2 = vulnerable; 3 = rare; 4 = indeterminate; 5 = restored.

1.7 Landscape

Lithuanian landscape units are defined by climatic conditions, relief characteristics, soil structure, hydrography, forest vegetation and anthropogenic influence. The system of landscape units includes a taxonomic hierarchy with five levels: (1) environs, (2) sub-region, (3) regions, (4) districts, (5) belts. Eight landscape belts, 18 districts, 45 regions and 108 sub-regions have been identified. Environs can be defined under more detailed studies. Figures 10 and 11 present land use and afforestation patterns in Lithuania.

Before World War II, private farms with gardens and orchards dominated the landscape. Land reclaimed for intensive use (12,900 ha) covered only a small part of the territory. The post-World War II period of Soviet occupation, when collectivization policies, forced resettlement programmes and rapid industrialization started, severely affected the rural landscape. Large-scale agricultural activities took place under the Soviet management system.

About 80% of land in Lithuania with an excess water content has now been drained. A certain economic benefit was achieved, however the damage rendered to the landscape was irretrievable. Expansion of arable lands led to the destruction of a multitude of small forests and areas of scrub; out of a total of 450,000ha of wetlands and peat areas 250,000ha were drained, of the 223,000 individual farms which had to be removed, 115,500 were destroyed together with their gardens and planted trees, and numerous natural meadows were cultivated. The total amount of drained and cultivated land accounted for 2,657,000ha (40.7% of the total territory or almost 80% of all wetlands). Having destroyed the greater part of wetlands,

a decrease in the catch of valuable fish, but the catch of roach, stickleback and ruff has grown. The abundance of carp and eel depends on the standards of breeding. A considerable reduction of burbot, vimba and barbel has been observed. Over the last 40 years sturgeon and blue bream have completely disappeared.

Twenty-five species of mammals and birds, such as elk, red deer, wild boar, fox, hare, badger, racoon dog, wolf, lynx and wild duck, are hunted in Lithuania, and these species have been registered over a 50-year period (Table 6).

Table 6: Game species statistics

Species	1975		1980		1990	
	counted	hunted	counted	hunted	counted	hunted
Moose	8,850	3,269	7,500	2,015	6,900	2,699
Red deer	3,650	152	7,300	1,059	13,455	3,404
Wild boar	17,000	9,684	14,000	8,785	23,800	23,110
Wolf	130	61	290	152	350	120
Fox	13,900	1,398	9,400	830	9,800	5,166
Wildfowl	140,000	16,379	200,890	10,460		22,976

Together with the revision of lists for the different systematic groups, research is also being carried out on the ecological requirements of different species and other important factors. A considerable deterioration in fauna has been observed as a result of man's activities. Large-scale land drainage during the last 50 years and other anthropogenic pressures have had a particularly serious impact. Most natural habitats have been destroyed, and new areas of agricultural monocultures are only inhabited by a few specialized species. Habitat loss and change have been the main factors causing the decline and extinction of species, but another major threat is the negative impact of chemicals.

In the 20th century some species (sika deer, Siberian roe deer and desman) were introduced, but unsuccessfully. The racoon dog has spontaneously spread through the Republic. Up to 10,000 pheasants are released every year for hunting purposes and almost all of these are taken. The winters in Lithuania are too severe for their survival.

The 1976 edition of the Lithuanian Red Data Book contained 31 species of animal. Bird lists were also compiled identifying rare, endangered and protected species. Strategies for their conservation have been drawn up and have already been implemented in part. The new Red List, adopted in 1991, lists 210 species, as shown in Table 7.

Research on species composition, state, productivity and the desirable and existing means of protection in Lithuania is currently being carried out by the Environmental Protection Department, its institutions (strict nature reserves, nature research stations), institutes of the Academy of Science and other research centres.

Lithuania

in 1991 through the joint efforts of naturalists in the Academy of Sciences and other scientific centres. These include 501 threatened animal, plant and fungi species (see Appendix 1). The second edition of the Lithuanian Red Data Book was published in 1992. Table 5 summarizes the numbers of threatened plant species in Lithuania. A considerable proportion of these threatened plant species and communities are protected within reserves, the vegetation of which is quite well studied.

Table 5: The numbers of threatened plant species on Lithuanian Red Data Lists

	Categories						
	0	1	2	3	4	5	Total
Plants							
Angiosperms	9	52	56	60	7	-	184
Gymnosperms	1	-	-	-	-	-	1
Sporophytes-vascular	2	5	1	2	-	-	10
Mosses	-	2	3	4	2	-	11
Charophytes	2	-	-	2	-	-	4
Subtotal	14	59	60	68	9	-	210
Fungi							
Macrofungi	4	7	15	34	8	-	68
Lichens	5	5	-	-	3	-	13
Subtotal	9	12	15	34	11	-	81
Total	34	120	125	158	61	3	501

Key: 0 = extinct or probably extinct; 1 = endangered; 2 = vulnerable; 3 = rare; 4 = indeterminate; 5 = restored.

1.6.3 Fauna

Lithuania's wildlife is typical of coniferous and broad-leaved deciduous woods, though arctic and steppe species also occur. The species composition of the Lithuanian fauna is known only for vertebrates, while lists of many invertebrate taxa are still being updated and need more precise definition.

The use of animal resources in Lithuania is limited, for the whole fauna is owned by the state. Limits for the use of commercial species are determined after annual evaluations. About 20 tonnes of garden snails are collected from natural habitats every year. Of the 99 fish species recorded in Lithuania, only 15% of them, such as roach, bream, ruff and perch, are commercially important. Lithuania's inland waters yield approximately 3,900-4,500 tonnes of fish annually (mainly roach, bream, sparring, smelt and pike). The last 25 years has seen



Plate 7: Exploitation of mineral resources



Plate 8: Exploitation of peat

Trans-boundary air pollution and local emissions pose an increasing threat to the forests. In 1990, about 68.4% of forests (especially pine forests) were affected. Pine, oak and ash stands are often damaged by hoofed animals. Increasing recreational activity also damages forests.

1.6.2 Flora

Forests, wetlands and grasslands containing rare and threatened species of flora and fauna cover one-third of the land area. Agriculture has the greatest impact on grasslands, wetlands and the water ecosystems, especially through the reclamation of wetland, as well as the use of fertilizers and chemical substances. Degradation processes affect 75% of mires. As a result of land reclamation, 10-25% nitrogen and 1-10% phosphorous are discharged into Lithuania's waters via the soil. Over the last 30 years, the water clarity of lakes and rivers has decreased, whereas their mineralization has increased two-fold, accelerating eutrophication. Only some 15% of Lithuanian water courses are unregulated. The transformation processes of natural or semi-natural vegetation in Lithuania are similar to those in western Europe. They include a decrease in the variety of natural habitats and an increase in areas of uniformity and synanthropy of plant cover as well as an increase in the number of species that are becoming rare and threatened.

The area covered by natural grasslands has decreased from 19.6% in 1956 to 6.5% in 1980. Most of the seasonally flooded meadows with extremely rich flora and fauna have been turned into cultivated meadows. Wetland vegetation is very sensitive to human activity too. Unfortunately, about 3 million ha of Lithuania's territory (80% of all wet areas) have been drained, most wetlands, scrub and natural meadows have been destroyed and about 13% of fish, 25% of amphibians and reptiles, 50% of waterfowl, 33% of water mammals and 16% of Lithuanian plant species have become extinct or very rare.

Lithuanian plant communities fall into 221 associations, 67 of which are of nature conservation interest. There are over 2,000 species of vascular plants (of which 1,220 are native). About 400 alien plant species, 400 species of mosses, 450 species of algae, about 2,500 species of fungi and 400 species of lichens occur in Lithuania.

About 500 plant species can be used for medical purposes and 31 species of wild plants are collected for food. About 300 species of edible mushrooms are known, but traditionally only 25 species are picked (including chanterelle and boletus). About 40.8 tonnes (between 26.1 and 65.1 tonnes) of plant biomass are gathered annually for pharmaceutical industries. About 979 tonnes of fruit and berries and 380 tonnes of mushrooms are picked for the food industry and for market. The rapidly increasing export of some mushroom species, especially the chanterelle (*Cantharellus cibarius*), is posing a considerable danger to forest ecology.

The first list of protected plant species was compiled by the Institute of Botany and the Society of Botany in 1962. Compilation of the Lithuanian Red Data Book was started in 1976 and the first edition appeared in 1981. The Environmental Protection Department has been responsible for its compilation and updating since 1990. New Red Data Lists were prepared

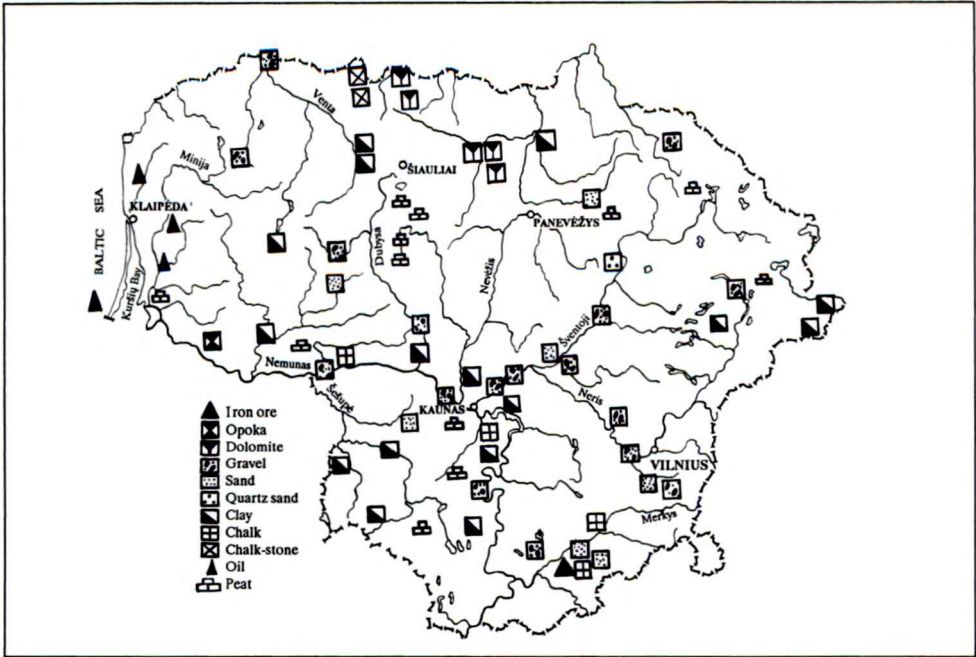


Figure 8: Mineral resources

Woodland cover has been decreasing from the beginning of the 2nd millennium until the middle of the 20th century, reaching a minimum in the fifties. Statistical data for the period 1956-1988 indicate that the total afforested area in Lithuania has increased from 22.6% to 27.9% as a result of afforestation of devastated areas and arable land.

In recent years, about 8.000ha of forest have been felled annually to produce 3.2 million m³ of timber. The amount of timber used per capita is 1.5 times greater than that in western countries, whereas the volume of production is less.

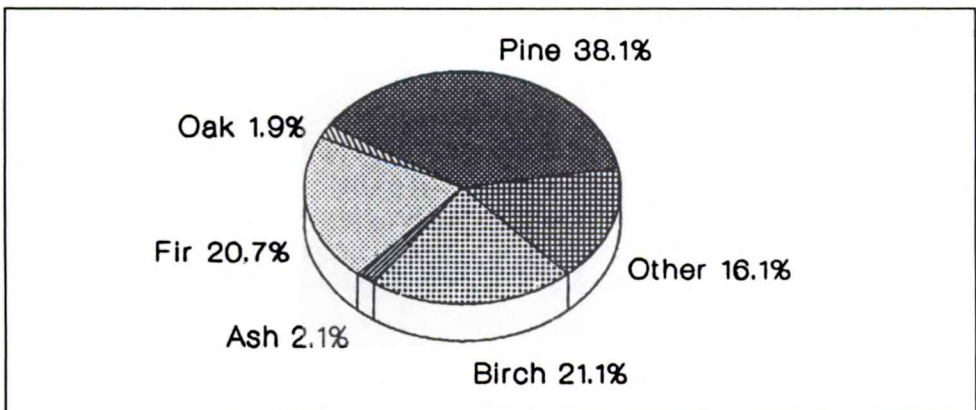


Figure 9: Forest composition, 1990

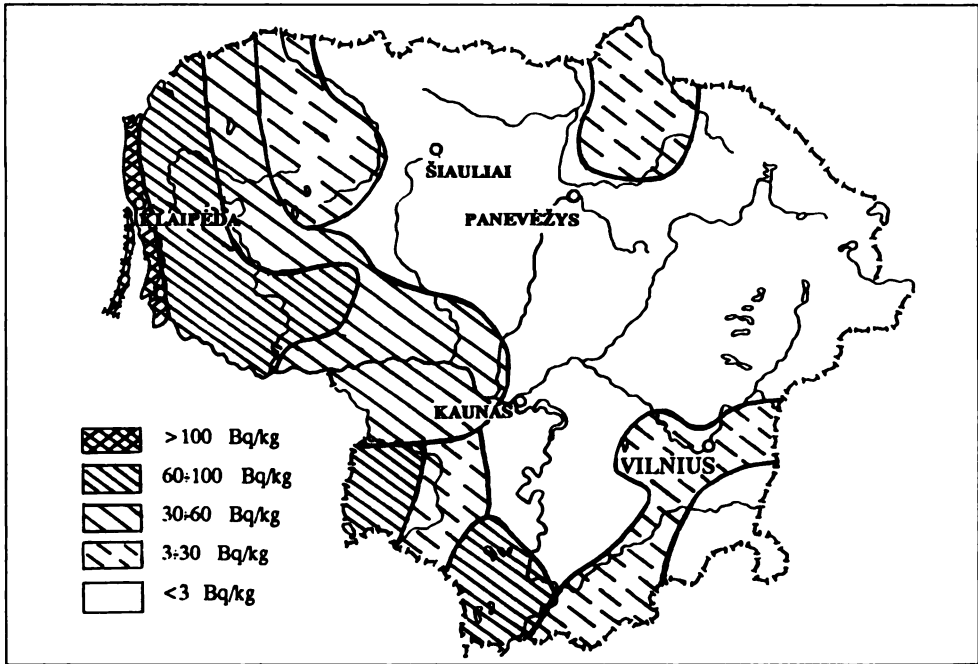


Figure 7: Distribution of Caesium¹³⁷ in the soil

Table 4: Resources of mineral deposits

Resource	Unit	Explored resources	Mined per year
Gravel	million m ³	471	15-17
Sand	million m ³	153	3.7-3.9
Sand for glass	million tonnes	8	0.1
Limestone	million tonnes	291	6.8
Dolomite	million m ³	106	1.2-1.4
Clay	million m ³	102	3.4
Opoca	million tonnes	34	0.1

The total area of woodlands is 19,134km² (1988 data). Woodlands are unevenly distributed throughout the country, with most forests situated in the south-east and west. Forests play an important role in maintaining the ecological balance. Young and middle-aged forests are predominant. This lack of balance between the age groups is due to excess felling and an inadequate programme of reforestation. Forests in Lithuania fall into two main groups according to their functions: those of economic importance constitute approximately 68% of the forest area and those with a special role (nature reserves, national parks, wind breaks, water protection belts, recreation zones, etc.) comprise 32%.

Intensive farming is causing the amount of organic material in the humus to decrease. Soil fauna and bioactivity have declined because of the low quality of fertilizers and pesticides used. The application of pesticides in Lithuania is decreasing (in 1988, 4.06kg/ha were used and in 1990 only 3.27kg/ha, of which herbicides amounted to 2.7kg/ha in 1988 and to 2.20kg/ha in 1990). Pesticides such as NTA and Dalapon are still in use.

Mechanical land cultivation also leaves its traces. The use of heavy wheeled tractors increases soil density and degrades its fertility. Soil erosion has intensified in many areas, air humidity decreased, the natural biogeochemical processes preventing water pollution are either destroyed or slowed down and the hydrological balance has changed.

Near main highways, the harmful effect of transport emissions upon the environment has considerably increased (car emissions include carbon and nitrogen monoxides, benz(a)pyrene, lead and dust). Up to 1991, tetraethyl lead was added to car fuel, therefore lead concentrations in soils within 10-25m of highways - especially along the trans-Lithuanian highway - exceed its MAC by 10 to 20 times. MACs are found at a distance of 100-150m from these roads (the maximum permissible lead concentration in soil is 30mg/kg). In such soil, the amount of benz(a)pyrene also exceeds its MAC 10 to 20 times. Contaminated belts along the roads with intense traffic (Vilnius/Kaunas, Kaunas/Marijampolė, Kaunas/Jonava/Kėdainiai, Panevėžys/Šiauliai/Kuršėnai, Šiauliai/Pasvalys, Klaipėda/Palanga) may stretch for 300m along both sides of the road. These areas represent 8-10% of the country's land area.

After the Chernobyl accident, a large part of Lithuania was contaminated by radioactive substances. As a result, radionuclides, mainly Ce137 isotopes, are found in the soil (Figure 7). Their highest concentrations have been recorded in coastal areas and in south-western Lithuania.

1.5 Mineral Resources

Lithuania harbours ample resources of raw materials for construction: gravel, sand, sand for glass production, limestone, dolomite, clay for brick and cement production (Table 4 and Figure 8). In addition, considerable deposits of anhydride, (of which 100m tonnes have been explored, the forecast being over 1000 billion t), geothermal energy resources, some oil deposits and large iron ore resources have been found in Varėna District.

1.6 Biological Resources

1.6.1 Forests

Lithuania is located in the zone of mixed coniferous/broad-leaved forests, so the main type of natural vegetation is forest. Woodlands (18,000 separate areas) cover 27.9% of Lithuania's territory. 38.1% of Lithuania's wooded area are pine forests, 20.7% spruce forests and 21.1% birch forests (Figure 9). There are tracts of white alder, black alder, aspen, while ash and oak are very scarce. Mires cover about 4.9% of total area (fens: 71%, peat bogs: 22% and transitional mires: 7%).

material, thus intensive eutrophication creates an even greater shortage of oxygen in the deep water layers of the Baltic Sea.

1.4 Soils

Lithuanian soils are very diverse. 35% of the territory are turfy podzols. 25% of the farmland is on sand, 33% on sandy loam, 34% on clay loam, 2% on clay and 6% on peat. The most fertile soil is in the Middle Lowland.

The main factors influencing soil quality are erosion, application of fertilizers and pesticides, and pollution. As a consequence of land reclamation and the destruction of individual farms and their vegetation cover, wind and rain has caused erosion to start in vast arable land areas, affecting 15% of cultivated land (Figure 6). Another 38% of land is susceptible to erosion. Even in slightly hilly fields the annual amount of soil washed away reaches 20-25 t/ha, and up to 120 t/ha in highly eroding areas.

Large amounts of fertilizers are used in agriculture. In 1990, 324kg of nitrogen, phosphorous and potassium fertilizers were applied per hectare of arable land. Nitrogen fertilizers are mainly applied in agriculture, whereas phosphorus and potassium fertilizers are insufficiently used. It should be noted that the combinations of fertilizers used are not very effective. Fertilizers contain 35% of active substances; the remaining 65% contain heavy metals and other substances. Today there is a trend towards a decrease in the use of mineral fertilizers and an increase in the application of organic ones.

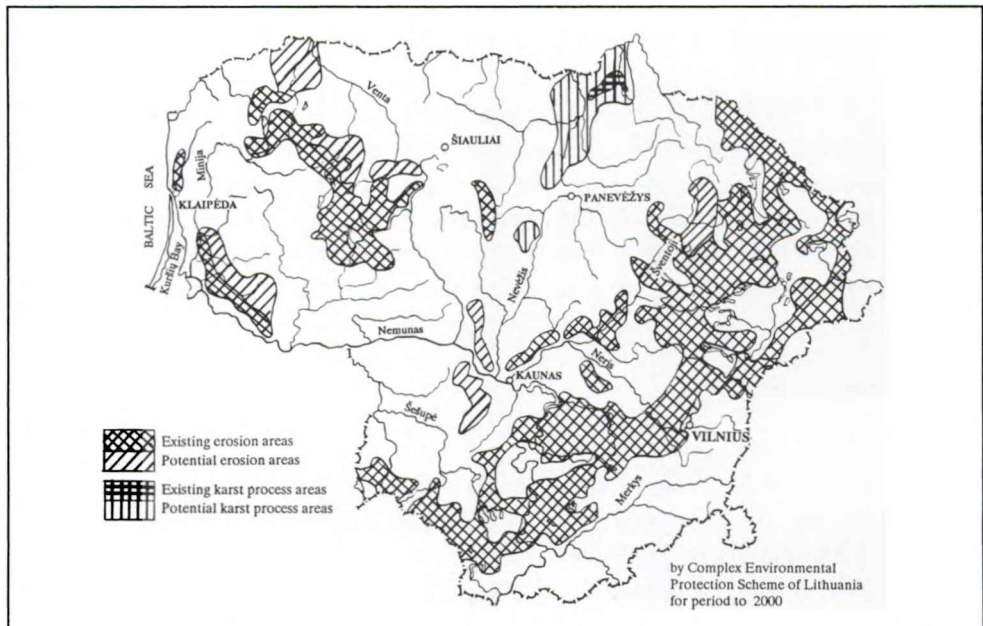


Figure 6: Soil erosion and karst areas

Centralized management is the main reason for the extensive water pollution in Lithuania. Efforts have been made to collect waste water from all industries into a common network, purifying them in municipal waste water treatment plants. However, these municipal facilities are overloaded and too few to treat all polluted water.

Small towns and industries are equipped with waste water treatment plants, whereas major cities in Lithuania have no treatment facilities. The two largest cities, Vilnius and Kaunas, account for approximately 50% of the pollutants discharged into water bodies. The best situation is in Panevėžys and Marijampolė, where treated water meets standard requirements.

Another problem with water purification is the inefficiency of the existing waste water treatment plants. Only 58% of all treatment facilities operated effectively in 1990. 75% of the inefficient plants are in the smaller towns. The main reasons are poor construction quality, a lack of trained staff and overloading of the treatment plants.

It is difficult both to estimate and purify the pollutants discharged into water bodies from non-point sources. There are many different pollution sources, such as storage sites for manure, oil products, agrochemicals, toxic solutions, eroding soils and increased run off from drained land. Ecologically-unsound agricultural activities and a low sanitary level contribute most to water contamination.

1.3.4 The Baltic Sea and Kuršių Bay

The water quality of the Baltic Sea is affected by that of the Nemunas basin and other rivers. Consequently, 85% of the Kuršių Bay area and 45% of the Baltic Sea coastal area are heavily polluted. Kuršių Bay receives all waste waters from inland cities and industries located along the Nemunas river throughout Lithuania. In 1989 the mean mercury concentration of the bottom sediments of Kuršių Bay was 0.34mg/kg, phenol levels were 3.4-14.9mg/kg, DDT 4.26-21.25mg/kg and HCH 70.95mg/kg. The coastal waters of the Baltic Sea are well saturated with oxygen. Seasonal oxygen concentrations and changes in oxygen saturation are usually investigated in the surface layers of the Baltic Sea. However, in the deeper layers, especially at depths of 100m or greater, the oxygen concentration either decreases to 0.6-0.8mg/l or vanishes completely. Sulphur hydrogen is formed here, with an estimated concentration of 1.10-3.27mg/l in 1986-1990. Stagnation in the depths of the Baltic Sea is intensified by eutrophication (excess fertilization by nutrients) in Kuršių Bay and coastal areas. In Kuršių Bay, the maximum levels of ammonia ions and nitrites exceeds their MAC by 1.2-2.7 and 2.4-8.8 times respectively. In coastal areas the maximum concentrations of nitrites are 1.1 above the MAC.

Kuršių Bay and the lower layers of the Baltic Sea contain large amounts of phosphorus compounds, average concentrations being 0.085-0.125mg/l. In the Gothland and Bornholm deeps these concentrations have stabilized in many areas. However, they are high enough to cause phytoplankton blooms. Large amounts of oxygen are required to break down this plant

Lithuania's other surface waters are contaminated by organic substances and nutrients (Table 3). The amount of organic substances (by BOD₅) in 68% of the sampling sites is 2.0-4.0mg O₂/l and in 19% of sites 4.0-6.0mg O₂/l.

Table 3: River contamination (mean annual concentration mg/l), 1991

	O ₂	BOD ₅	Ammonia ions	Nitrites
Nemunas at the Byelorussian border	11.86	4.66	0.35	0.016
Nemunas above Kaunas	10.19	2.47	0.34	0.021
Nemunas below Kaunas	10.70	4.02	0.39	0.051
Nemunas above Sovietsk	12.04	4.53	0.36	0.018
Nemunas below Sovietsk	11.18	6.68	0.52	0.036
Nemunas estuaries	10.37	3.85	0.29	0.012
Neris above Vilnius	1.68	3.22	0.27	0.009
Neris below Vilnius	10.12	7.87	0.92	0.018
Mūša before Kulpė	10.67	2.58	0.42	0.021
Mūša below Kulpė tributary	4.01	18.44	6.25	0.071
Kulpe below Šiauliai	0.76	68.30	10.29	0.128
Sidabra below Joniškis	1.87	73.52	13.09	0.081
Venta at the Latvian border	9.96	2.55	0.27	0.011

The amount of nitrogen in inorganic compounds is over 1mg/l in samples from 62% of sampling stations and phosphate levels higher than 0,05mg/l are detected in 77% of sites. Their concentrations are high enough to cause intense eutrophication in the most important rivers and their major tributaries (Nemunas, Neris and Nevėžis).

Industry, sewage and agriculture are the main polluters of surface waters. Preliminary calculations indicate that surface waters receive 40% of the total pollutants discharged from non-point sources. Approximately 350-550kg of different chemicals are discharged annually from 1ha of drainage systems as a result of primitive agricultural practices and the excessive use of mineral fertilizers. Outdated technologies, ineffective machinery and unbalanced application of fertilizers affect water sources. The composition of fertilizers used in agriculture is ineffective, with crops taking up only 15-25% of the phosphorous fertilizers applied. Large amounts of water are contaminated because of excessive water use and the lack of waste water treatment plants.

In 1990 4,040 million m³ of waste water was discharged from industries and municipal sewage systems, of which 3,594 million m³ were relatively clean and the remaining amount (0.446 million m³) contaminated. Only 22% of this polluted water met standard requirements after treatment.

1.3.3 Water quality

Water monitoring is carried out by the hydrometeorological services at about 88 stations in 46 rivers, five lakes and two water reservoirs in 122 sampling sites. The duration of these observations ranges from 180 years in the largest river Nemunas and 10-20 years in smaller rivers.

There are some exceptionally clean rivers and lakes ($BOD_5 < 2.0 \text{ mg O}_2/\text{l}$) in the relatively clean areas of Lithuania. The concentrations of oil products in them is often below 0.05 mg/l and copper and zinc concentrations $0.002\text{-}0.012 \text{ mg/l}$, but the rivers Kulpė and Sidabra of the Mūša basin are heavily polluted (Figure 5).

During the last 25-30 years, lakes have accumulated nitrogen and phosphorus compounds and organic substances, leading to an oxygen deficit and increased water mineralization. Depending upon the amount of phosphorus and organic substances present, lakes can be divided into:

- **clean** (up to 0.1 mg/l of organic substances), located in the wooded and rural landscape of eastern Lithuania;
- **slightly contaminated** (0.1 to 0.2 mg/l of phosphorus, 10 to 20 mg/l organic substances), which occur in sparsely populated landscapes, near small towns and settlements;
- **contaminated** ($>0.2 \text{ mg/l}$ of phosphorus, $>20 \text{ mg/l}$ of organic compounds), located close to large cattle breeding farms (complexes) and big cities.

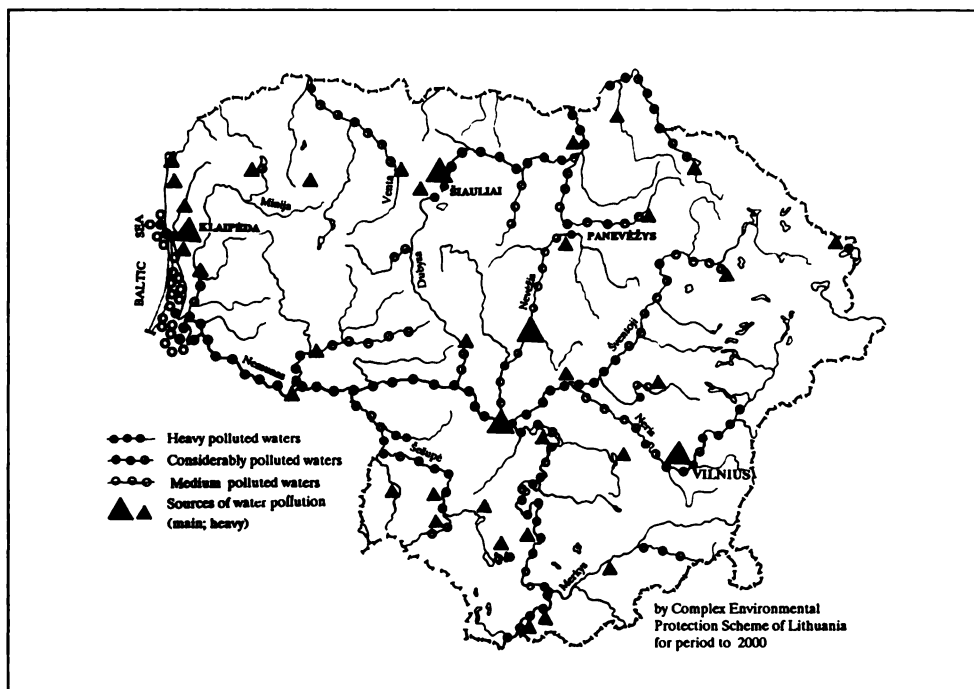


Figure 5: Surface water pollution

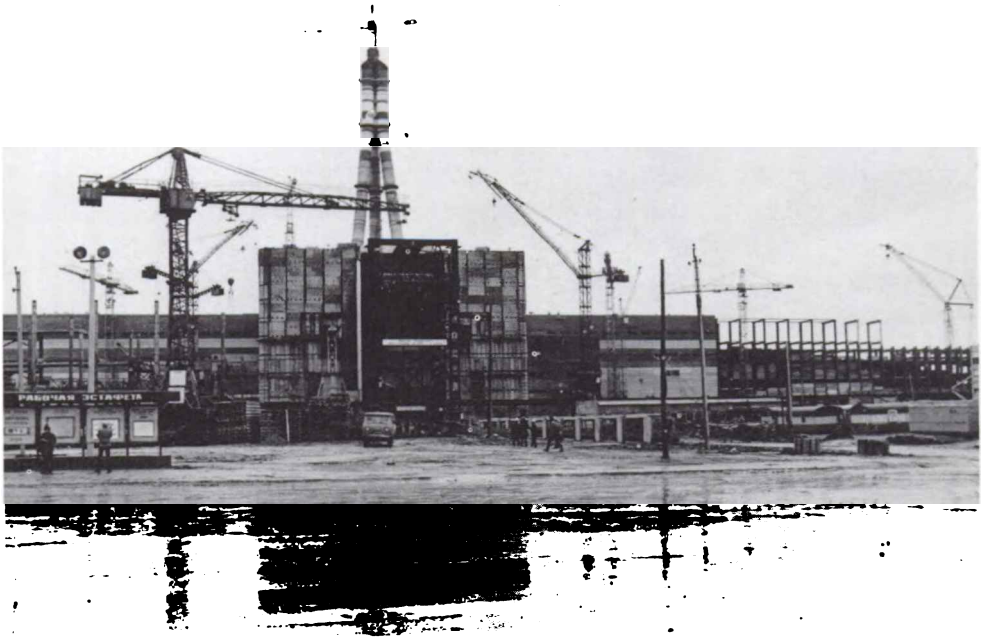


Plate 5: Ignalina nuclear power plant

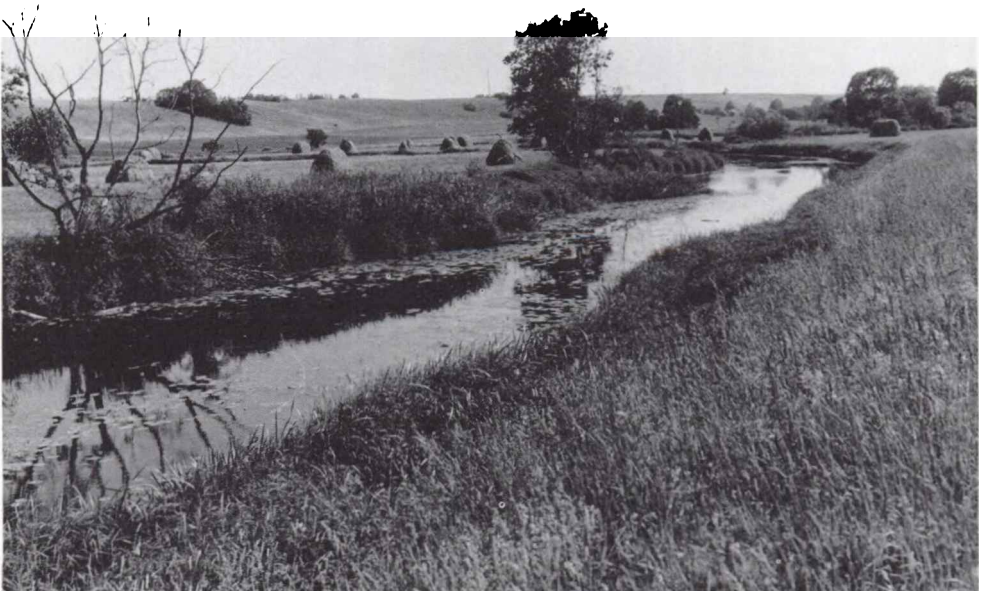


Plate 6: Typical agricultural habitat of Lithuania

400 reservoirs (ponds) of over 5ha have been built in Lithuania. The Kaunas Lagoon is the largest reservoir (63.5km²). It was formed by damming the Nemunas River after the construction of a hydroelectric power plant. There are more than 10,000 smaller ponds.

Surface water is used to meet the needs of industry, agriculture, fishery and recreation. 290m³ per capita are consumed every day, whereas in western European countries the consumption of water amounts to 140-180m³ daily.

The Kuršių Bay of the Baltic Sea is a shallow water body (average depth 3.7m) with a level sea-bed. The greatest depths of up to 7m are in Klaipėda Straits and along the northern part of the Kuršių spit. About 22.13km³ of water are discharged annually from rivers into the Kuršių Bay. Due to such an ample supply the water in the lagoon is fresh and its average water level is above that of the open sea.

1.3.2 Ground water

Annual ground water resources constitute 1.2 billion m³, of which 0.5 billion m³ (or 41.7%) are consumed. The regional stock of fresh ground water is 3.2 million m³ daily. Known water resources in 1991 amounted to 1,954,000m³ daily, which comprised 61.1% of regional ground water stock. Ground water is used for drinking and to satisfy household demands.

Of the 19 types of mineral water explored in the Republic, 15 belong to the nitrogen water group and four to the nitrogen-bromium water group. Known resources amount to 4,480m³ daily.

Discharges from industrial, agricultural and municipal sectors have destroyed the natural hydrochemical background of ground waters due to excess amounts of various organic substances, nitrogen and metal compounds. In the karst region (Biržai and Pasvalys districts), deep ground water contamination with organic substances, ammonia, nitrates and nitrites, arriving from cattle breeding complexes and over-fertilized fields, is increasing. Even though ground water quality meets sanitary requirements, it contains 0.5-1.0mg/l of iron, and in many cases up to 2-3mg/l. Therefore, in some areas it is necessary to construct facilities to remove this load. Intensive agricultural activities have affected the quality of ground water, which is used for drinking purposes in rural areas. Water from 51% of wells does not meet hygiene requirements and 41.5% is not suitable for use because of its chemical composition. Ground water contains large amounts of organic substances, oil products, nitrates, nitrites, ammonia, pesticides and detergents, etc. The hardness of drinking water has increased. However, these wells are the only possible sources of drinking water available.

Contamination of ground water by radioactive substances has become a serious ecological problem in the region of Ignalina's nuclear power plant. It has been determined that the concentration of tritium in ground water amounts to 2000-5500 TU in the non-technological radioactive waste storage region of the power plant, (whereas the background concentration is 10-40 TU).

it is 1.3mg/m^3 . When southerly, southwesterly and southeasterly winds prevail, the concentration of SO_2 transported amounts to 2mg/m^3 in winter and 6mg/m^3 in summer. NO_x concentration has not been investigated. Due to acid rain (pH 3.46-6.92) acidification is a problem.

1.3 Water Resources

1.3.1 Surface water

Lithuania lies at the outer edges of the last glacial ice sheet and has a dense and quite intricate hydrographic network. The average river density is 0.99km/km^2 (in the Middle Lowland it is 1.45km/km^2 , and 0.45km/km^2 in the sandy Southeastern Plain). Lithuania contains over 29,900 watercourses of more than 250m in length, with a total length of 63,700km. There are 758 rivers more than 10km long, 18 of which are longer than 100km: Nemunas - 937km, Neris - 510km, Venta - 350km, Sešupė - 298km, Sventoji - 246km and Minija - 213km. 71.5% of Lithuania's territory is within the Nemunas River catchment area, and only its northern part belongs to the basins of rivers Mūša/Nemunėlis (13.4%), Venta (8%), Daugava (2.4%). Some smaller rivers discharge into the Baltic Sea (4.1%). The Nemunas is a tributary of Lithuania's largest inland water body, Kuršių (Curonian) Bay.

The water basin in Lithuania is characterized by the following: 738mm of rainfall, 512mm of evaporation and 236mm of flowing water, the water flow coefficient being 0.32. Annual average water resources amount to 26.1km^3 , of which 15.3km^3 are derived from the country's land area and 10.8km^3 is transit (cross boundary) water flow. 9.6km^3 of local and transit water flow can be utilized annually.

Lithuania's rivers are not fast-flowing. At the lower reaches of the Nemunas River the average discharge for several years is $665\text{m}^3/\text{s}$, that of the Neris River is $189\text{m}^3/\text{s}$. There are 155 rivers, large and small, with an average annual flow of over $1\text{m}^3/\text{s}$. The water supply of Lithuanian rivers is varied and determines the type of annual water flow. Spring floods and low summer and winter levels maintained by ground water are typical of most Lithuanian rivers. The natural annual water flow distribution is very uneven. About 40% of the average annual flow in the Nemunas River is melted snow, 25% rainfall and about 35% ground water. Depending upon their geological conditions, climate and riverbed type, these proportions may vary considerably in other rivers.

Lithuania lies in one of Europe's most abundant lake districts. There are 2,833 lakes exceeding 0.5ha which occupy an area of 876km^3 (1.5% of Lithuania's territory). About 1,600 lakes are smaller than 0.5ha. The majority of lakes are in the north, within the hilly moraines of the Baltic Highlands, in the Aukštaičių Upland. Lithuania's largest lake Drūkšiai (44.8km^3), deepest Tauragnas (60.5m) and longest Asveja (21.9km) also lie in that area. The Žeimena River basin has 528 lakes, making up 6.4% of the river basin. The Žemaičių Upland and some areas in the Middle Lowland and Medininkų Upland have no lakes. The larger lakes are connected to rivers, whereas the majority of smaller ones have no surface outlets.

Benz(a)pyrene (B(a)P), dust and nitrogen dioxide considerably affect atmospheric quality. The main annual concentrations of B(a)P in 1990 ranged from 0.4 up to 3.2mg/m³. The mean annual concentrations of nitrogen dioxide and dust ranged from 0.02 up to 0.07mg/m³ and from 0.1 up to 0.3mg/m³ respectively. The air of most cities is not as heavily contaminated by sulphur dioxide: mean concentration is approximately 0.01mg/m³. In winter the SO₂ concentration in the air increases, but does not exceed its MAC. A similar situation is found with carbon dioxide: the mean annual concentration amounts to 1-2mg/m³; however, maximum values in certain cases exceed 22mg/m³.

Air pollution from other substances is small; only average and maximum concentrations of formaldehyde are about twice the MAC. Increased amounts of ammonia and H₂S in the air are recorded in Klaipėda. Average concentrations of these hazardous admixtures vary up to the set limit, whereas maximum values may sometimes exceed the MAC by 1.5 times. The concentrations of other air pollutants in towns do not exceed the limits set.

Air pollution is highest in the regions of Vilnius/Elektrenai, Kaunas/Jonava/Kėdainiai, Mažeikiai /Naujoji Akmenė as well as near the towns of Klaipėda, Šiauliai and Panevėžys (Table 2). In the towns of Vilnius, Kaunas, Šiauliai, Klaipėda, Panevėžys and Alytus, emissions from transport constitute over a half of the total amount of air pollution. A precarious ecological situation has been observed in Mažeikiai, N. Akmenė, Kėdainiai, Jonava and Elektrenai where the industrial giants have an adverse effect on the environment within the range of 3-5km. Meteorological conditions unfavourable to the dispersion of hazardous substances make the ecological situation there especially dangerous. Over the last five years, air pollution in the cities has decreased, but the concentration of dust and nitrogen dioxide has grown considerably.

Observations of air quality are made in Vilnius, Kaunas, Klaipėda, Šiauliai, Kėdainiai, Jonava, Panevėžys and other cities which have large concentrations of industry.

Table 2: Air pollution in the main cities and industrial centres, 1990 (mg/m³)

	Dust		SO ₂		NO ₂		CO		B(a)P	
	mean	max.	mean	max.	mean	max.	mean	max.	mean	max.
Vilnius	0.1	1.4	0.01	0.07	0.03	0.27	1.0	22.0	1.3	4.5
Kaunas	0.3	1.2	0.01	0.04	0.06	0.20	2.0	9.0	1.9	9.2
Klaipėda	0.1	0.8	0.01	0.12	0.03	0.20	1.0	6.0	0.8	3.6
Šiauliai	0.3	1.5	0.01	0.04	0.07	0.22	-	-	3.2	8.6
Kėdainiai	0.2	1.2	0.01	0.07	0.02	0.14	-	-	0.4	1.8
Jonava	0.1	1.0	0.01	0.12	0.02	0.11	-	-	0.9	2.0

It is difficult to distinguish between pollutants transported from Western Europe and those emitted in Lithuania. However, it has been determined that the mean monthly concentration of SO₂ in winter (when northeasterly winds prevail) is 3mg/m³ and in summer

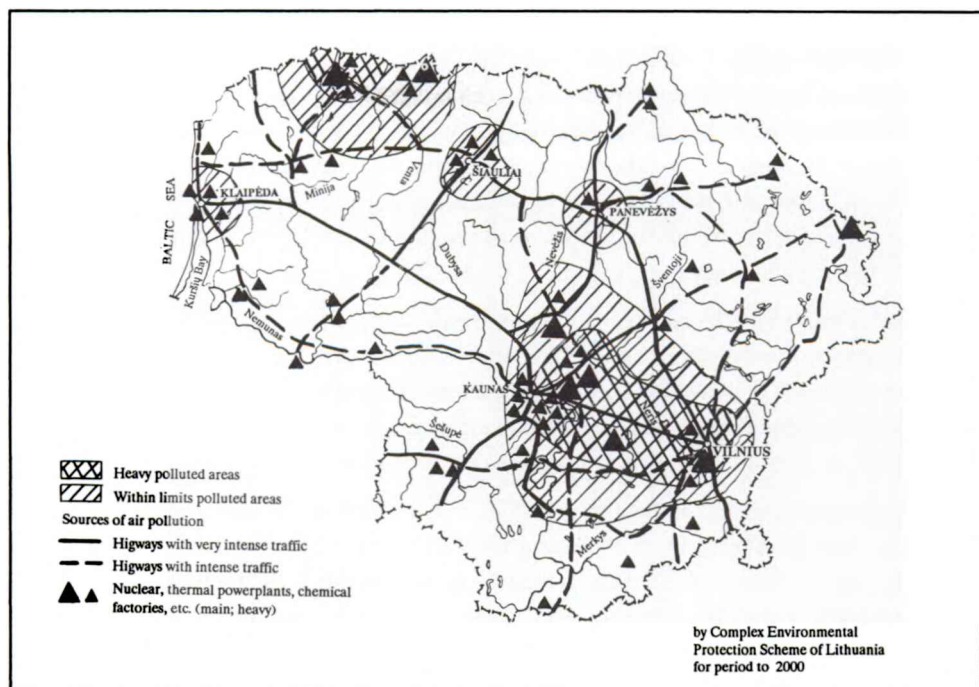


Figure 4: Sources of air pollution

amounts of sulphur dioxide, ammonia and organic dust are present and the air contains aerobic bacteria, *Staphylococci* and *Streptococci*, and has an unpleasant odour.

The concentration of air pollutants usually varies within determined permissible limits. In certain cases the formaldehyde and ammonia concentration in Klaipėda was 1.5 times in excess of their maximum allowable concentrations (MAC). The mean and maximum concentration of metals (Fe, Cu, Ni, Pb, Cr, Zn) in the air did not exceed the MAC.

Table 1: Annual rates of discharge of atmospheric pollutants

	1,000 t/year	%
CO	443	44
SO ₂	188	19
Hydrocarbons	112	11
NOx	65	7
Coarse particles	40	4
Other pollutants	182	15
Total	1,030	100

More than 70,000 air samples are tested annually. Samples are taken at 20 stationary sources to determine the concentrations of dust, sulphur and nitrogen dioxides. Other pollutants, such as carbon monoxide, formaldehyde, phenol, nitrogen monoxide, fluorine hydrogen, sulphates, ammonia, sulphur hydrogen, benz(a)pyrene and metals are determined according to the programmes for each town.

The main air polluters are transport and industry (energy and construction materials, oil processing and chemical industries) (Figures 3 and 4). Every year approximately 1m tonnes of pollutants are discharged into the atmosphere in Lithuania (Table 1), 60% of which are emitted by cars and trucks (including 80% of CO emissions, 60% of hydrocarbons and 48% of NO_x emissions) and 40% from other sources.

The energy industry is one of the main point sources of air pollution. The basic reason is the use of low-grade fuel. Oil fuel used in energy production energy contains 2.5-4.0% sulphur. The main polluter is the largest thermal power plant in Lithuania, Elektrenai, located between two major Lithuanian cities, Vilnius and Kaunas. It annually consumes 2m tonnes of oil fuel, emitting approximately 80,000 tonnes of pollutants, composed of: 85.2% sulphur anhydride and 12.7% nitrogen oxides. Pollution also stems from seven smaller thermal power plants and from boilers which use fuel oil due to the shortage of natural gas.

Of all the industrial enterprises, construction materials, oil processing and chemical industries emit the greatest amount of pollutants into the atmosphere (chemical and fertilizer industries emit 4,600 tonnes of carbon oxides, 2,000 tonnes of nitrogen oxides and 1,800 tonnes of sulphur anhydrides). For example, the Akmene cement factory produces 3.4 million tonnes of cement per year and emits about 60,000 tonnes of pollutants (mainly dust). The oil refinery emits about 62,000 tonnes of pollutants. In addition to CO, NO_x, SO₂ it also discharges phenol, xylol and acetone. Because of the lack of reliable treatment, almost all the pollutants mentioned here are emitted directly into the atmosphere.

Air pollution from cattle breeding farms (complexes) and poultry factories has recently been increasing. They affect an area with a radius of over 5km, within which increased

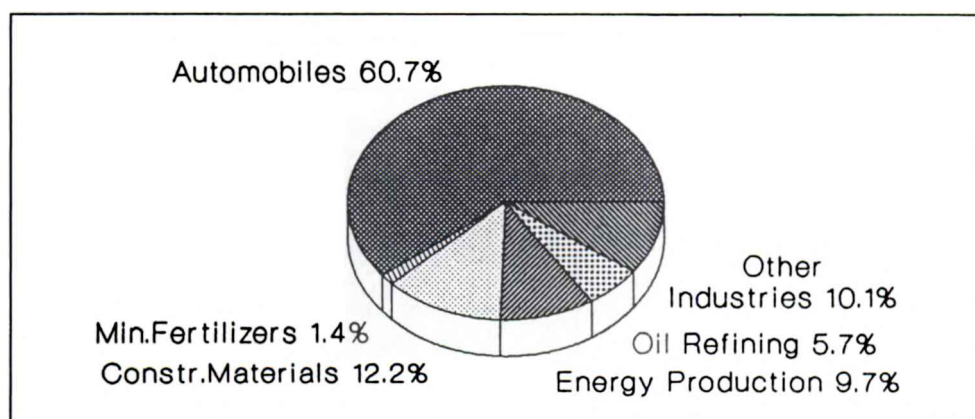


Figure 3: Sources of atmospheric emissions, 1990

Lithuania

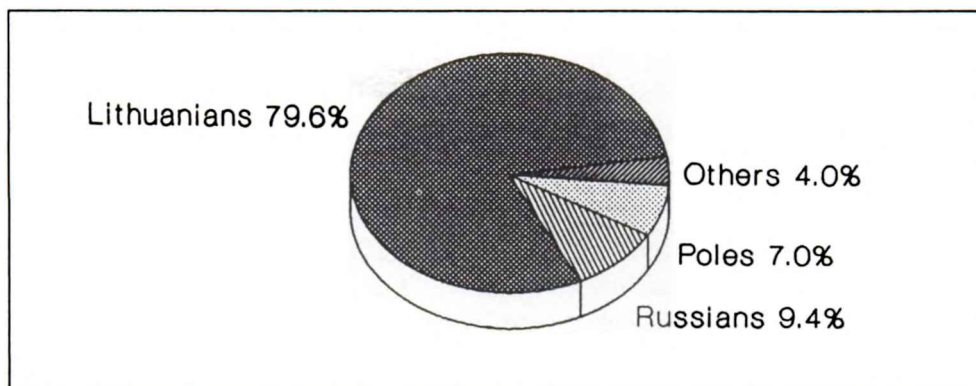


Figure 2: Ethnic composition

technological and engineering level of enterprises lagged far behind the standards of Western Europe. Rapid industrialization was carried out along the lines of intensive development, accompanied by the manpower migration from other regions of the USSR as well as migration of the rural population to towns.

During 1949-52 a forcible agricultural collectivization was carried out in Lithuania. Abolition of private ownership and establishment of collective farms ruined its production capacity. Its pre-war level was reached only by the end of the 1960s. Mechanization, electrification and chemicalization of agriculture in 1960-1990 enabled the farmers to nearly double their output. Intensification of agricultural production, however, caused additional ecological problems.

Great damage to the Lithuanian economy was inflicted by the USSR economic blockade in 1990. Over a period of 10 months more than 50% of enterprises reduced their production, which caused losses amounting to 338 billion roubles. Less grain, potatoes, sugar beets and vegetables were grown on the farms, and less fodder was stored as compared with 1989.

As of 1989, industrial output (in wholesale prices) amounted to 13.7 billion roubles (60% of which was made by output of means of production, 39.7% by production of consumer goods). The major part of industrial output in 1989 was through the machine-building and metal-working industry (25.7%), the food-processing industry (21.9%) and light industry (20.8%). In 1989, 604 self-supporting industrial businesses were in operation; of these, 90 were production and scientific amalgamations.

1.2 Air

Prevailing meteorological conditions in Lithuania are favourable for the dispersion of air pollutants. However, there is significant pollution from large industrial enterprises and vehicles.

well as during its fights for independence. During the years 1940-1958, the country lost one-third of its population. These losses arose through forced deportations (29,923 families were exiled to Siberia in 1941-52) by the Soviets before and after World War II and through executions by both the Nazis and the Soviets during World War II. With the advance of the Soviet Army in 1944, many Lithuanians were forced to emigrate to other countries. Altogether, about 1 million Lithuanians live outside Lithuania.

After World War II, as a result of forced collectivization and land reclamation projects by the Soviets, the rural population of Lithuania decreased steadily. In the period between 1959 and 1990 the urban population increased from 39% to 68%.

In 1990, the male and female population was 47.4% and 52.6% respectively. 57% of the inhabitants are of working age, while 24% are younger and 19% older. 30.2% are employed in industry, 17.6% in agriculture, 11.9% in construction and 9.8% in education, culture and the arts.

68.0% of men and 58.9% of women of marriageable age are married. The birth rate began to decline in 1961 and was 1.5% in 1989. The death rate was 1.03%, with 1.07% among babies up to one year of age. The natural increase was 0.48%. There has been a net migration into the country since 1958, totalling 237,000 in the period 1958-1989 (28,500 people moved into Lithuania from the USSR in 1989 alone). Life expectancy in Lithuania is 72.4 years (67.7 for men and 76.6 for women in 1989).

Lithuanians are the indigenous and most numerous inhabitants (Figure 2). In 1989, they numbered 2,924,000, with 65% living in towns. The Roman Catholic religion is dominant. Ethnographic and language peculiarities distinguish the Žemaičiai and Aukštaičiai, the latter divided into Dzūkai and Suvalkiečiai. In origin and language, Lithuanians belong to the Baltic group of the Indo-European family of nations. Russians (344,500) make up the largest ethnic minority group in Lithuania. 90% of Lithuania's ethnic Russians live in urban areas. Most of them speak native Russian as their primary language. The majority of Lithuania's 258,000 Polish inhabitants live in south-eastern Lithuania, 58% of them in towns. The majority of the local Poles speak a dialect of the Byelorussian language. There are also Byelorussians (63,200), Jews (10,300), Ukrainians (44,800), Latvians (4,200), Gypsies (2,700), Germans (2,058), Tatars (5,135), Karaites (289) and peoples of other national origins living in Lithuania.

1.1.5 National economy

Lithuania is an industrial agrarian country. At 1989 prices, its gross national product amounted to 24.3 billion roubles and national income to 9.1 billion roubles. The value of all fixed assets (in comparable prices) in 1989 was 40.6 billion roubles (production assets accounted for 65.7% of the sum, non-production assets, 34.3%). As of 1989, 1,544,500 workers and employees worked in the national economy. With the integration of Lithuanian economy into the economic system of the USSR, it was developed according to the dictate of the centre and guided by the USSR strategic guidelines of economic development. The



Plate 3: Lithuanian river landscape

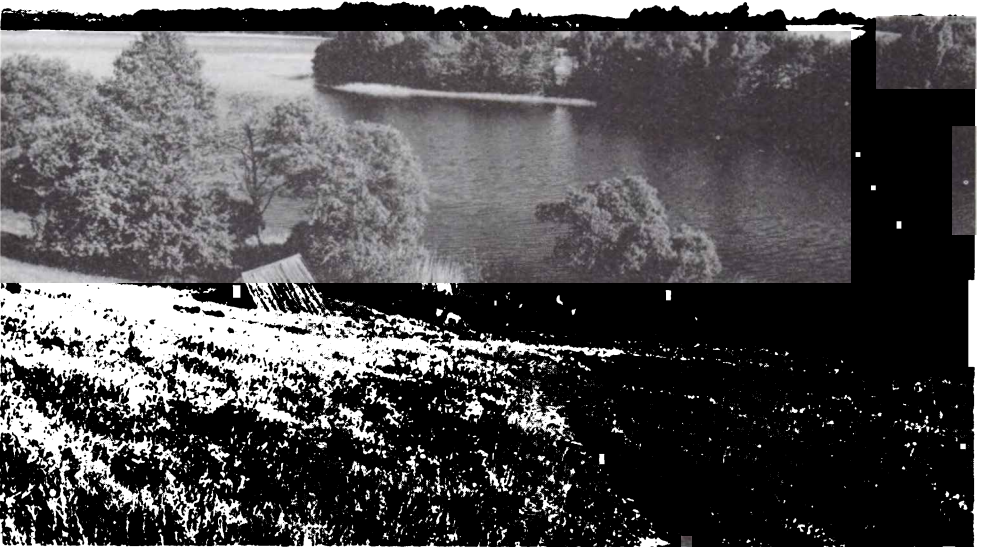


Plate 4: A lake in rural Lithuania

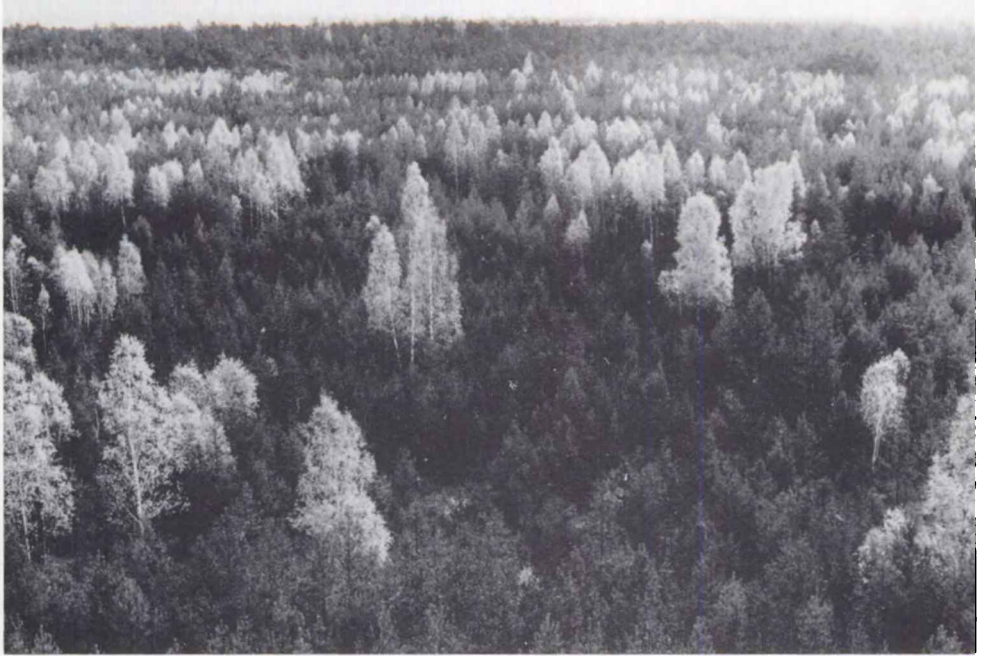


Plate 1: Lithuanian forest landscape



Plate 2: Lithuanian bog landscape

Lithuania

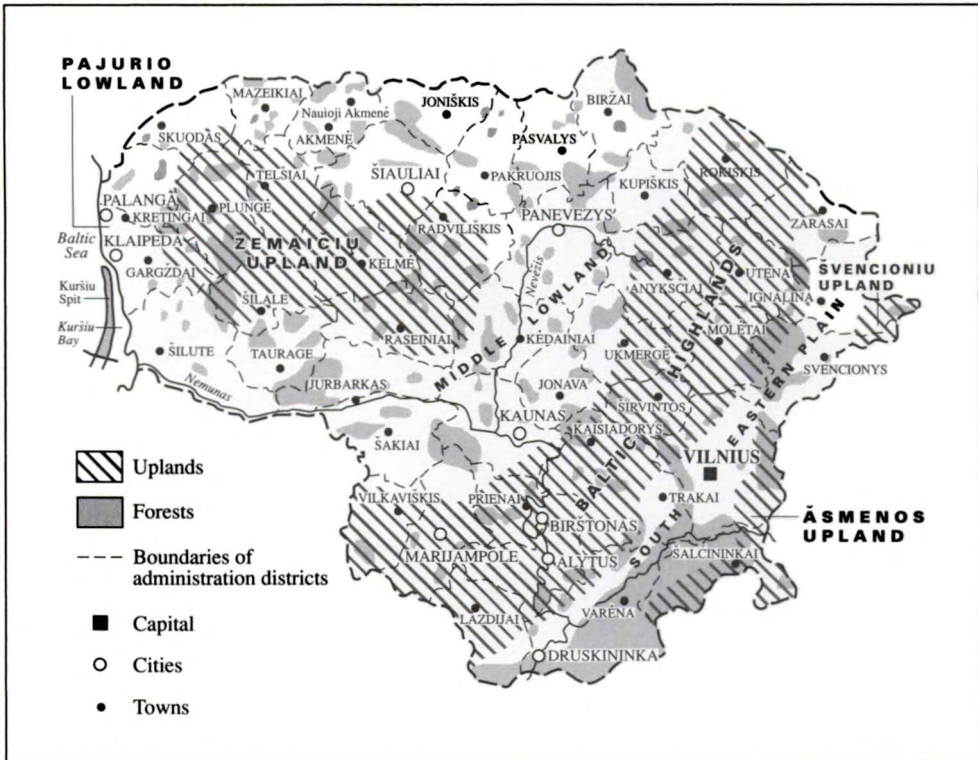


Figure 1: Map of Lithuania, showing administrative and geographical districts

Švenčionių Upland and the Medininkų Upland. The latter boasts the highest point of Lithuania, Juozapine Hill (294m).

1.1.3 Climate

The climate of Lithuania is transitional between maritime and continental. The mean annual temperature is 6.1°C, the average in January being minus 4.9°C and in July 17°C. The mean annual precipitation (75% in rain) varies from 540mm (Middle Lowland) to 930mm (south-west of the Žemaičių Upland). Westerly winds prevail. Annually, there are 40-100 foggy days and 15-30 days of sleet and snowstorms. Thaws are frequent. The growing season lasts from 169 days in the east of Lithuania to 202 days in the west.

1.1.4 Population

The population of Lithuania has grown from 2.8 million at the beginning of the century to 3.7 million at present. The average population density is 57 inhabitants per km². The current number and ethnic make-up of the population has been influenced by a number of factors. Lithuania suffered substantial population losses during the First World War (1914-1917), as

CHAPTER 1: INVENTORY OF NATURAL RESOURCES

1.1 Introduction

Geographically, Lithuania is situated at the centre of Europe (this central point lies 20km to the north of Vilnius, the capital). Thus, Lithuania is a Central European state of the Baltoscandian region. Lithuania covers 65,200km² and has a land border approximately 1,747km in length. Lithuania has the shortest length of Baltic Sea coast (94km) of the Baltic States.

1.1.1 Geology

Lithuania is situated in the western part of the East European platform. The western part of Lithuania lies over the Baltic sincline, and the eastern part over the Byelorussian anticline. Therefore, the crystalline base is at a depth of 1600-2100m in the west and 300-800m in the east. The sedimentary rock strata are terrigenous, carbonate and callogenic rocks from the Cambrian to Quaternary Periods.

The present-day landscape of Lithuania was originally formed not only by tectonic processes but also by glaciogenic, fluvio-glacial, limnoglacial, alluvial, elluvial and swamp-forming processes; however it has been most radically changed by man.

1.1.2 Relief

Lithuania lies on the western fringe of the **East European Plain**, in the middle and lower basin of the Nemunas River. Although considered a country of plains, Lithuania has a rich variety of landscapes with both lowland plains and hilly uplands (Figure 1). The uplands are formed from accumulations of glacial drifts and are about 80-100m higher than the plains. The **Pajūrio Lowland** stretches along the Baltic coast. It is 15-20km wide and has a maximum altitude of 50m. To the east of it, lies the **Žemaičių Upland**, with Medvėgalis at its highest point (234m), made up from the undulating Central Žemaičių Upland and the Eastern and Western Žemaičių Plateau (100m) on its outer edges. The Lowland of the Venta River middle reaches stretches to the north of the Highland. In central Lithuania, the **Middle Lowland** runs from the north to the south-west (up to 100km wide, 35-90m in altitude) and includes the lower reaches of the Nemunas River, Nevėžis and Mūša/Nemunėlis Lowlands and the Žiemgalės Plain. In the south and east of Lithuania lie the **Baltic Highlands** (up to 282m). A sandy **Southeastern Plain** encircles the highlands in the south-east. In the east of the country there are small stretches of the Lithuanian-Byelorussian morainic uplands: the

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IUCN EAST EUROPEAN PROGRAMME

Environmental Status Report 1993

LITHUANIA

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APPENDIX 3: LIST OF PROTECTED AREAS IN LATVIA

Name	Region	Area (ha)	Year of establishment
A. STATE NATURE RESERVES			
Slitere	Talsu	15,037	1921
Moricsala	Ventspils	818	1912
Grini	Liepajas	1,457	1936
Krustkalni	Madonas	2,902	1982
Teiči	Madonas, Jekabpils	19,047	1982
B. NATURAL PARKS			
Sisenu priedes	Alūksnes	50	1987
Tervete Forest	Dobeles	1,350	1957
Sauka	Jekabpils	5,377	1987
Riežupe	Kuldigas	418	1977
Gaizinkalns	Madonas	1,500	1957
Piejuras	Rīgas	1,629	1962
Beberbeku	Rīgas	302	1977
Dolessala	Rīgas	975	1987
Daugava	Stučkas	674	1987
Talsi Hilland	Talsu	2,827	1987
Daugavas loki	Daugavpils	10,500	1990
C. PROTECTED LANDSCAPE AREAS			
Veclaicene	Alūksnes	20,649	1977
Augšzeme	Daugavpils	20,419	1977
Vestiena	Madonas	25,877	1977
Ezernieki	Rezeknes, Kraslavas, Ludzas	23,541	1977
Vecpiebalga	Cesu	9,532	1987
Augšdaugava	Daugavpils, Kraslavas	52,000	1990

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INVERTEBRATES

Class I

Margaritana margaritifera

Prosopistoma foliaceum

Ergates faber

Gnorimus nobilis

Gnorimus octopunctatus

Osmoderma ermita

Agrodiaetus damon

Heliophobus kitti

Parnassius mnemosyne

Pericallia matronula

Class II

Hirudo medicinalis

Class III

Astacus astacus

Latvia

Vespertilio pipistrellus
Vespertilio nathusii
Vespertilio nilssoni
Vespertilio murinus

Class IV

Muscardinus avellanarius
Sicista betulina
Neomys fodiens
Sorex minutus
Sorex araneus

BIRDS

Class I

Branta leucopsis
Branta ruficollis
Milvus milvus
Aquila clanga
Aquila pomarina
Aquila chrysaetos
Haliaeetus albicilla
Circus gallicus
Pandion haliaetus
Falco peregrinus
Lagopus lagopus
Columba oenas
Bubo bubo

Class II

Gavia arctica
Gavia stellata
Botaurus stellaris
Ixobrychus minutus
Ciconia nigra
Tadorna tadorna
Anser anser
Cygnus cygnus
Cygnus bewickii
Circus cyaneus
Circus pygargus
Falco tinnunculus
Falco columbarius
Coturnix coturnix
Grus grus
Haematopus ostralegus
Pluvialis apricaria
Calidris alpina
Numenius phaeopus
Sterna albifrons
Nyctea scandiaca
Surnia ulula
Glaucidium passerinum
Strix nebulosa
Strix aluco
Picoides tradactylus

Lanius excubitor
Panurus biarmicus
Remiz pendulinus

Class III

Ardea cinerea
Falco subbuteo
Porzana parva
Crex crex
Numenius arquata
Asio flammeus
Aegolius funereus
Coracias garrulus
Alcedo atthis
Upupa epops

Class IV

Accipiter gentilis
Accipiter nisus
Buteo buteo
Buteo lagopus
Pernis apivorus
Circus aeruginosus
Circus macrourus
Falco vespertinus
Perdix perdix
Athene noctua
Asio otus
Tyto alba
Picus canus
Dendrocopos leucotos
Galerida cristata
Cinclus cinclus
Emberiza calandra

REPTILES

Class I

Emys orbicularis
Hyla arborea

Class II

Triturus cristatus
Coronella austriaca
Bombina bombina
Bufo calamita

Class III

Lacerta agilis

Class IV

Rana arvalis

Polygonatum verticillatum
Pulsatilla patens
Serratula tinctoria

Aristolochia clematitis
Armeria vulgaris
Asplenium ruta-muraria
Centaurea rhenana
Colchicum autumnale
Coronilla varia
Dactylorhiza cruenta
Dactylorhiza maculata
Diphasium complanatum
Diphasium trystachium
Epipogium aphyllum
Galium intermedium
Lilium martagon
Nymphaea alba
Nymphaea candida
Poterium sanguisorba
Rosa tomentosa
Tulipa sylvestris

FUNGI

Class I

Boletus junghuileus
Boletus erythropus
Clavariadelphus truncatus
Macrolepiota puellaris
Porphyrellus pseudoscaber
Strobilomyces floccopus
Trichaster melanocephalus
Tricholoma colossus
Xerocomus parasiticus
Xerocomus rubellus
Xerocomus rubinus

Class II

Clavariadelphus pistillaris
Grifola frondosa
Grifola gigantea
Grifola umbellata
Hericium clathroides
Langemannia gigantea
Otidea onotica
Ramaria aurea
Sparassis crispa

Class III

Gastrum campestrum
Gastrum coronatum
Gastrum sessile
Gastrum minimum
Gastrum pecinatum
Gastrum quadrifidum

Gastrum rufescens
Gastrum striatum
Gastrum triplex

Class IV

Coprinus dunarum

LICHENS

Class I

Bryoria bicolor
Cetrelia cetrarioides
Cladonia foliacea
Hypogymnia vittata
Labaria scrobiculata
Parmelia fuliginosa
Parmelia mougeotii
Peltigera venosa
Solorina saccata
Umbilicaria polyphylla
Usnea florida

Class II

Cystoloeus ebeneus
Parmelia elegantula
Parmelia omphalodes
Parmelia tiliacea

Class III

Lobaria pulmonaria

VERTEBRATES

MAMMALS

Class I

Halichoerus grypus
Pteromys volans
Glis glis

Class II

Ursus arctos
Mustela lutreola
Mustela nivalis
Mustela erminea
Eliomys quercinus
Myotis dasycneme
Myotis daubentoni
Myotis nattereri
Myotis mystacinus
Myotis brandti
Plecotus auritus
Barbastella barbastella
Nyctalus noctula

APPENDIX 2: LIST OF SPECIALLY PROTECTED SPECIES IN LATVIA

VASCULAR PLANTS

Class I

Aconitum lasiostomum
Asplenium trichomanes
Aster tripolium
Botrychium simplex
Cephalanthera rubra
Cotoneaster niger
Cypripedium calceolus
Equisetum telmateia
Erica tetralix
Eryngium maritimum
Euphorbia palustris
Fritillaria meleagris
Hedera helix
Lathyrus maritimus
Ligularia sibirica
Lycopodiella inundata
Ophrys insectifera
Orchis morio
Pinguicula alpina
Pentaphylloides fruticosa
Prunella grandiflora
Rhychospora fusca
Sorbus intermedia
Taxus baccata
Thesium ebracteatum
Tofieldia calyculata
Trapa natans
Veronica montana

Class II

Ajuga pyramidalis
Astrantia major
Betula nana
Carpinus betulus
Carex davalliana
Cladium mariscus
Corydalis cava
Delphinium elatum
Dianthus superbus
Dracocephalum ruyschiana
Gentiana pneumonanthe
Hammarbya paludosa
Herminium monorchis
Hordelymus europaeus

Lonicera pallasii
Malaxis monophyllos
Myrica gale
Neottianthe cucullata
Onobrychis arenaria
Orchis ustulata
Pedicularis sceptrum-carolinum
Polystichum aculeatum
Polystichum braunii
Pulmonaria angustifolia
Pyrus pyraister
Salix myrtilloides
Trifolium fragiferum
Viscum album

Class III

Alium ursinum
Anenome sylvestris
Aquilega vulgaris
Arctostaphylos uva-ursi
Chimaphila umbellata
Coeloglossum viride
Dactylorhiza baltica
Dactylorhiza russowii
Dactylorhiza incarnata
Daphne mezereum
Digitalis grandiflora
Epipactis atrorubens
Gentiana cruciata
Gladiolus imbricatus
Gymnadenia conopsea
Helianthemum nummularium
Huperzia selago
Iris sibirica
Isoetes lacustris
Jovibarbara sobolifera
Linnaea borealis
Liparis loeselii
Lobelia dortmanna
Lunaria rediviva
Lycopodium annotinum
Lycopodium clavatum
Malus sylvestris
Orchis mascula
Orchis militaris
Platanthera bifolia
Platanthera chlorantha

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Precipitation:	500-800mm average
Forest:	42% of territory, including 25% wet forests. Dominant species - pine, birch spruce
Mires:	10%
River Network:	density - 0.58 km/km ² Total number around 12,000 Major rivers - Daugava, Gauja Venta, Lielupe
Lakes:	Total number more than 3,000. 802 lakes with surface more than 0.1km ²
Soil:	mainly Podzolic (52%)
Flora:	Around 1,900 species (3,000 including algae)
Fauna:	1,300 species
Protected natural areas:	6.9% of the territory including: 5 Nature Reserves 1 National Park 5 Landscape Protected Areas

APPENDIX 1: GENERAL INFORMATION

Name:	The Republic of Latvia
Capital:	Riga 980,000 inhabitants
Area:	64,589km ² 442km - from North to South 210km - from West to East
Geographical latitude:	between 55°53.9' and 58°04'N
Geographical longitude:	between 20°59' and 28°20'E
Neighbours:	North - Estonia East - Russia South-east - Belarus South - Lithuania West - Baltic Sea and Riga Gulf coastline - 475km
Population:	2.6 million 71% urban
Language:	Latvian - Baltic group of Indo-European languages
Church:	approximately 2/3 Lutheran 1/3 Roman Catholic
Relief:	Plains - 74% Highlands - 26%
Elevation:	Median - 87m Maximum - 312m
Winds:	predominantly western and south-western
Average Temperature:	January: -7.5 to -2.5°C July: +16.5 to +17.5°C

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Bilateral projects as a part of bilateral agreements between corresponding bodies are aimed not only at legislation but also at strengthening administration, introducing environmentally sound production technologies, environmental monitoring, development of computer networks, waste management, sewage treatment, etc.

Agreements have been reached by the RLEPC and institutions of regional governments and ministries in Sweden (the Swedish Environmental Research Institute - IVL, the Radiation Protection Institute - SSI), the Netherlands (the Province of Overijssel) and the Federal Republic of Germany (the Environment Ministry of Baden-Württemberg). A special Latvian - Dutch project in one of the environmental hotspots in Latvia - environmental risk assessment and management in Ventspils - should be specially mentioned.

The first plenary meeting of the Baltic Assembly at the beginning of 1992 issued concrete recommendations for stronger and more coordinated cooperation on environmental issues among the three Baltic States.

Transboundary water and air pollution and the risk of industrial disasters and nuclear accidents have been considered as very important cooperation issues with the countries of the former Soviet Union. A bilateral agreement has been signed with the Ukraine and other treaties are under preparation.

Cooperation on environmental protection issues is considered as a very important part of agreement frameworks between partner cities abroad and in Latvia, e.g. Riga - Norrköping (Sweden), Riga - Bremen (Germany), as well as cooperation within the union of Baltic cities. An increasing number of national and international projects is also observed between non-governmental organizations at regional level (Coalition Clean Baltic, Eco-Baltic, etc.) as well as on a European scale with the World Conservation Union (IUCN) and the World Wide Fund for Nature (WWF).

CHAPTER 4: INTERNATIONAL COOPERATION

Since independence and renewed sovereignty on 4 May 1990, the Republic of Latvia has been very actively involved in international common environmental programmes, especially in the Baltic Sea region.

The first task faced by Environmental Protection Committee of the Republic of Latvia (RLEPC) is to study existing major environmental treaties, conventions and other legal instruments with the aim of signing and ratifying them, as well as to establish cooperation with international bodies and non-governmental organisations at different levels. Among the first steps in this direction was the December 1991 ratification, by the Supreme Council (Parliament) of Latvia, of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.

Latvia has been granted full membership of the Helsinki Commission and has also signed both Helsinki Conventions on the Protection of the Marine Environment of the Baltic Sea Area (1974 and 1992). The 1992 Rio de Janeiro Framework Conventions on Climate Change and Biodiversity have also been signed by Latvia. Currently under consideration are the Montreal Protocol (1987), the Vienna Convention (1985), the Geneva Convention (1979) and its Protocols, though Latvia faces certain financial restrictions.

As a result of political recognition and admittance of the Baltic States to the CSCE process, Latvia took an active part in the follow-up meetings of the Vienna and Sofia Conferences within the framework of CSCE initiatives. Latvia also signed two framework conventions elaborated by the United Nations Economic Commission for Europe (UN ECE) in Helsinki (1992) - the Convention on the Protection and Use of Transboundary Watercourses and International Lakes and the Convention of the Transboundary Effects of Industrial Accidents.

Development of national environmental standards is not possible with reorientation towards the use of EC environmental norms and regulations that also require the facilitation of real Latvian involvement in international cooperation on environmental problems. Latvia has actively participated in the Pan-European Ministerial cooperation process (Dobris Conference, 1991) and is strongly engaged in the preparation of the following steps.

Bilateral and multilateral cooperation in the field of environmental protection between Latvia and foreign countries is always growing, primarily with neighbouring Nordic countries - Sweden, Denmark and Finland. Comprehensive technical cooperation and joint workshops and conferences have been organized for the transfer of know-how and practical expertise to Latvia. Nordic countries assisted in facilitating the introduction of progressive environmental legislation and law enforcement procedures.

countries in Europe in terms of the value of the nature and biodiversity of vegetation and fauna. Protection and conservation of this natural heritage is strongly required by the Republic of Latvia 'Law on Environmental Protection' (1991) which, among others, defines the following nature conservation aims (Latvia Report to UNCED):

- preservation of nature's genebanks, biotope, and landscape diversity;
- preservation and harmonious (or sustainable) development of ecosystems;
- introduction of the achievements of scientific and technical progress into environmental protection and use of natural resources;
- coincidence of territorial, national and international interests concerning environmental protection and use of natural resources.

Nature conservation and other requirements are introduced in practically all of the laws and regulations passed by the Parliament of Latvia. The following laws are being drafted currently for the Parliament:

- On the Protection and Use of Animals,
- On the Protection and Use of Plants,
- On the Use of Forests,
- On the Use of Water Resources,
- On Air Protection,
- On Soil Protection,
- On Exploration of Underground Resources.

Particular nature conservation areas have been fixed as one of four main points in the Latvia State Programme 'Environmental protection'. Most attention has been paid to organizational and financial provision for the development of Nature Parks, as formerly a low level of the implementation of proposed ideas for nature conservation was characteristic. It is aimed that four out of ten Latvia's Nature Parks are to be developed according to global standards.

Presently the law 'On Specially Protected Nature Territories' is under preparation for passing by the Parliament of Latvia. The law aims:

- to determine the basic principles for the system of such territories;
- to determine the sequence of establishing and functioning of such territories;
- to determine the procedure of management, monitoring and registration of these territories;
- to combine state interests with international, regional and private interests to establish, conserve, manage and protect the specially protected nature territories.

Table 10: Average life expectancy at birth (in years)

Country	Year	Males	Females
Latvia	1989	65.2	75.2
Estonia	1988	66.6	75.2
Lithuania	1988	67.7	76.6
USSR	1988	64.8	73.6
Sweden	1988	74.4	80.0
Finland	1987	70.7	78.9
Germany	1988	72.3	79.1

Table 11: Infant mortality per 1000 live births

Country	Year	Mortality
Latvia	1990	13.5
Estonia	1989	14.7
Lithuania	1989	10.7
USSR	1989	24.7
Sweden	1989	5.8
Finland	1987	6.0
Germany	1988	8.0

1. to establish a wide spectrum of investigations into the relationships between health and environmental problems and to take necessary urgent measures;
2. to carry out obligatory and professional EIA and health risk assessment procedures related to former and present economic activities;
3. to develop training and upgrading in environmental science and management.

3.6 Protection of Areas and Species

One of the most important environmental actions corresponding to the national tasks for achieving sustainable development is effective protection of the variety of Latvia's unique biotopes for conservation of biological diversity.

Although there are several problem areas in Latvia which need urgent implementation of environmental protection measures, it is possible to consider Latvia as one of the richest

Sludge utilization or disposal is a very serious problem, as about 40% of the total sludge amount comes from industrial sewage purification facilities without having been dehydrated. There is a pilot solid waste incineration plant in Jelgava.

Certainly the geographical and administrative location, social conditions and living patterns are limiting factors for household and municipal solid waste per person which varies from 100-150kg/year in rural areas to 300kg/year in urban ones. Consequently the composition of the solid household waste is the following: paper and cardboard paper (26-55%), food residues (12-58%), sawdust and wood (2-19%), textiles (2-6%), glass (1-4%) and metals (1-3%) (Prols, 1992).

Pollution of soil and groundwater is taking place in areas of dumping sites with all the types of waste being deposited and mostly not isolated as required by environmental protection.

There is an urgent need for active policy towards waste management, to include such measures as:

1. waste disposal places organized following the conditions of landfills;
2. public education and awareness raising on waste management issues.

3.5 Ecological Situation and Human Health

Social and economical circumstances are certainly influencing the health of the population of Latvia. These circumstances result from imposed one-sided development and the ensuing over-urbanization, undeveloped infrastructure, ageing population, and so on.

Environmental protection and health problems seem to be mutually interconnected (investigation is being undertaken into this) as most of the population is living exactly where most of the environmental problems are concentrated; in major urban areas in the vicinity of industrial, as well as agriculture centres with intensive livestock enterprises and chemical storage areas. Air and water pollution in industrial areas, groundwater pollution in areas of major solid/hazardous disposal sites and major agricultural facilities require action on environmental protection measures in order to maintain both human and ecological health. In 1991 Latvia became a member of the World Health Organization.

Taking average life expectancy and infant mortality as indicators of health status, Latvia's situation is not favourable in comparison to other countries in the Baltic Sea area (Tables 10 and 11). The main reasons for infant mortality are prenatal pathology (41%), inborn anomalies (36%), infectious diseases, respiratory disease, poisoning, accidents and injuries. Adult death rates increased in the last decade, caused by lung cancer (30% increase) and cardio-vascular diseases. In the polluted industrial areas the incidence of respiratory diseases is higher. Polluted drinking water and poisoned food is causing different epidemics.

Serious measures of social and health care should be undertaken by responsible bodies including environmental bodies. Suitable measures would be:

ammonia or xylene and formaldehyde. Treatment facilities at stationary sources of pollution are reducing discharges by 76%. Although there are some enterprises with well-equipped production and air and water treatment facilities, there are many plants which do not have their own treatment facilities.

There is also an environmental impact caused by transboundary pollution. For example, water pollution of the river Daugava in Belarus or toxic waste discharged into atmosphere by the oil refinery and thermoelectric power station in Mazeikiai and the cement factory in Akmene, Lithuania.

In order to move towards realization of environmentally sounder industrial production the major tasks are:

1. to put into practice the Law on Taxes paid for use of natural resources and fines for discharge of waste into the environment;
2. to reconstruct and reorient industry and to implement modern processing technologies, corresponding to EIA requirements, including waste treatment facilities;
3. to develop Latvian equipment and facilities for environmental research, monitoring and waste treatment.

3.4 Waste Management

The total amount of different types of waste produced in Latvia in 1990 was (Latvia Report to UNCED 1992):

- municipal and household waste - 560,000 tonnes;
- non-toxic sludge from waste water treatment plants 386,000 tonnes;
- non-toxic industrial solid waste - 265,000 tonnes;
- hazardous industrial waste and toxic sludge from waste water treatment plants, hospitals and agriculture - 250,000 tonnes.

The content of non-toxic industrial waste in Latvia is subdivided as follows: construction material residue (36%), wood and sawdust (28%), spoilage and cardboard (8%), food residue (7%), ferrous and non-ferrous materials (5.3%) and glass (3.3%).

Hazardous industrial waste has such components as:

- inorganic waste - 61.2 %;
- organic waste (except solvents) not containing halogen and sulphur compounds -19%;
- waste containing oil products - 17% of total waste;
- other organic compounds -0.55%;
- organic waste containing halogen and sulphur compounds -0.2%;
- pesticides - 70 tonnes;
- other - 1.2%.

Around 100 different types of pesticides are used in Latvia with an average distribution of 3kg per ha of arable land. At the same time Latvia has no facilities for dealing with old and prohibited pesticides. In 1989 there were chemical fertilizers spread at 299kg per hectare.

A large number of agriculture pollution sources are located directly in the vicinity of water bodies (closer than the 200m protected zone). These include storage units for fertilizers, oil, etc. as only a few of them are constructed according to the water protection demands.

All of the pollution sources mentioned above, as well as non-point source pollution in Latvia mainly caused by agricultural activities, result in nutrient (nitrogen and phosphorus) leaching to water and in nitrogen emission to air, which is equal to or even higher the nutrient load than from point sources - municipal and industrial waste waters.

The present transformation of agriculture and privatization of land (there are already around 50,000 private farmers in Latvia) requires several serious steps for environmental protection:

1. elimination of the consequences of unsustainable agriculture impact on the environment and introduction of environmentally sound approaches;
2. stimulation of the use of preventive principles of environment impact;
3. equalization of the rights of private ownership and state protected nature territories as well as creation of supportive public opinion;
4. issue of certificates for agricultural products and implementation of rational application of agrochemicals and their storage.

3.3 Industrial Effects

During the post war period the tendency was for imposed development of manufacturing industry, determined by the interests of the former USSR and its military industrial complex. Machine-building, metal working, chemical and petrochemical industries were developed most rapidly. Currently the volume of industrial production is falling to less than half of former levels, due to the shortage of resources and raw materials, outdated technologies imported from the Soviet Union and former east-oriented market, as well as high transportation costs. To date only 10-12% of enterprises are producing goods for the Western market.

Local natural resources in Latvia are supplying the necessary feed stock for only 40% of industrial output. About 25% of industrial output is exported and the same amount imported for consumption in Latvia. Latvia's biggest urban areas are Riga, Liepaja, Ventspils, Valmiera, Daugavpils, Jelgava and Rezekne. Real development of industry in Latvia depends upon a scientific approach to the production processes, revitalization of production and a high technology output.

According to the type and location of industry there are varying elevated atmospheric concentrations of ammonia, pyridine, hydrogen chloride and isopropanol or phenol and

The disproportionate national economy that Latvia faces today is illustrated by the statistic that, since 1939, industrial production volume increased 59 times while agricultural production only increased by 1.3 times (see Figure 13).

Unmotivated industrialization and unlimited migration achieved at the expense of agriculture and social welfare resulted in the destruction of infrastructure, decline in living conditions, health care and environmental quality. Especially in urban areas there are heavily polluted surface water bodies, air and soil.

The recently started reconstruction and reorientation of the economic and sociopolitical situation in Latvia is influencing the environmental situation. There are also a number of basic reasons which in combination are contributing to the gravity of the problem and should be accounted for by accepting a Strategy for Environmental Protection in Latvia, these are:

1. forced and uncontrolled process of urbanization resulting in rapid increase of urban populations as well as hazardous location and concentration of industry;
2. forced collectivization and extensive development of agriculture;
3. shortage of both air purification and water treatment equipment and low efficiency of existing treatment facilities;
4. insufficient consideration of the utilization and conversion of both household and industrial waste (including toxic waste), uncontrolled formation of dumping sites.

3.2 Agricultural Influences

The mass deportations and forced collectivization of the postwar period destroyed the substantial level of efficiency and productivity in agriculture, which was self-sufficient and worthy of export. Since the start of Soviet occupation, the total area of agricultural lands has decreased by 31%. Although the volume of agricultural production had increased 1.3 times, crop production decreased by 3% and the agriculture of Latvia lost its former leading European role, in levels of annual average of grain production per capita, for example. The main branches of agriculture are plant and livestock breeding, but some former branches such as horse breeding, sheep farming, and apiculture are now less developed.

Agriculture yields constitute around 12% of the Gross National Product (see Figure 13) but also impact considerably on ecosystems. Currently there are radical changes going on in rural areas, especially due to the privatization process. In the autumn of 1992 the arable land which forms 45% of the total area of agriculture lands belonged to: reconstructed collective farms (46%); private farmers (25%); and rural and urban residents as private farm land (25%).

At present a decrease in the number of operating big collective farms can be observed. These are the main sources of environmental pollution in agriculture through leaking storage facilities for manure, silage, oil and pesticides, mineral fertilizers, workshops and food processing enterprises, as well as leaching and surface run-off from arable land.

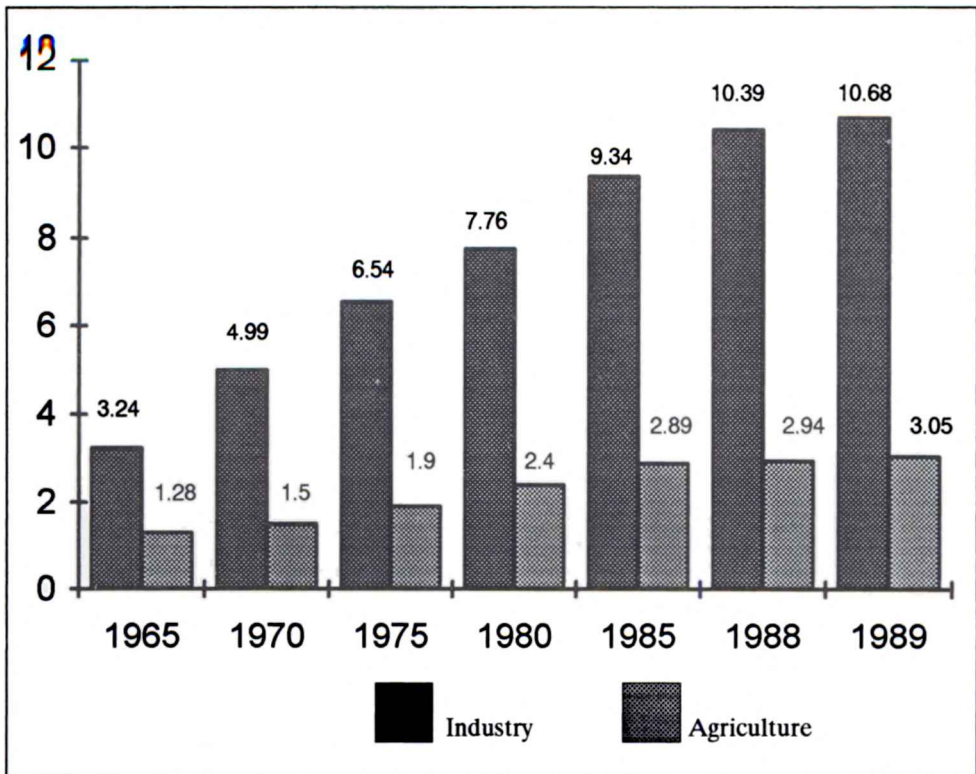


Figure 13: Industrial and agricultural production in billions of roubles
(Latvia Report to UNCED)

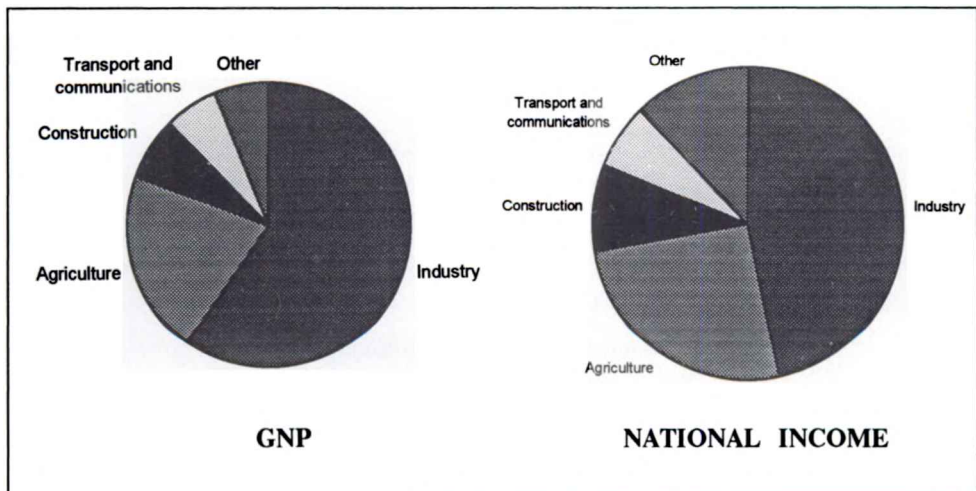


Figure 14: Gross National Product and national income in 1989
(Latvia Report to UNCED)

CHAPTER 3: ENVIRONMENTAL TRENDS

3.1 Economic Situation

The national economy of Latvia has always been dependent on biogeographical and sociopolitical conditions. The climate was favourable for the development of agriculture and the geographical location was advantageous for the development of trade and transport. A developed infrastructure combined with a limited number of natural resources led to the success of the processing industry (Table 9).

Table 9: Industrial output in 1980, 1985 and 1989

Type of industry	1980	1985	1989
Electricity generated (million kWh)	4681	4961	5801
Steel (thousand tonnes)	527	550	555
Peat for fuel (thousand tonnes)	1008	400	419
Synthetic fibres (thousand tonnes)	38.4	50.3	50.9
Synthetic resins and plastics (thousand tonnes)	31.7	35.0	37.9
Mineral fertilizers (thousand tonnes) 199	169	188	
Varnishes and paints (thousand tonnes)	59.0	54.2	53.2
Chipboard (thousand m ³)	149	131	226
Cellulose (thousand tonnes)	55.5	69.0	51.9
Paper (thousand tonnes)	131	167	138
Cement (thousand tonnes)	838	787	776

During the first period of Latvia's independence (1918-1940) circumstances stimulated such progress and led to a widely recognized standard of living and social welfare and to the development of education, culture and science.

One-sided industrial development in the postwar period was imposed upon Latvia by the ministries and authorities of the former USSR. Increased volume of production was achieved by building new plants or extending the former ones without taking into account local conditions, lack of raw materials and manpower. This policy of industrialization neglected the vital interests of the Latvian nation - production volume was growing through creation of new jobs immediately occupied by migrants and through importation of raw materials even from the Asian part of the former Soviet Union, but most of the production was exported to the Soviet Union.

local resources more effectively, as well as preventing further environmental degradation and ensuring an effective clean-up.

In spite of the environmental damage and unstable economy Latvia is facing today, a rich cultural heritage and biological diversity remains, thus providing the basic conditions necessary for achieving sustainable development.

The following actions of environmental protection are those required for implementation of the mentioned approaches (Latvia Report to UNCED 1992):

- development of environmental monitoring (in particular air quality monitoring);
- planning and establishment of waste disposal and utilization;
- municipal waste water treatment;
- introduction of environmentally sound technologies in wood processing, pulp and paper, building construction materials, leather, fabric dyes, sugar industries, etc.;
- development of the waste treatment industry (establishment of joint ventures);
- effective protection of the variety of Latvian unique biotopes for conservation of biological diversity;
- linkage of the Latvia's hydrometeorological network to the existing systems in Europe;
- ecological education.

The ongoing process of economical and sociopolitical reconstruction in Latvia makes certain restrictions to traditional (i.e. economic, technological and regulatory) incentives for environmental protection. The Law on Taxes for Environmental Pollution and Use of Natural Resources has been in place since 1991. The taxes are fixed on the base of intensity of harmful or harvesting activities and the selective impact of different pollutants and resources on ecosystems in Latvia and Baltic Sea Region. In order to decrease discharges and use of natural resources in the conditions of Latvia, the application of modern technologies and equipment might be very effective. Complete restoration of the legal system in Latvia is the most necessary step for full implementation of new environmental legislative acts and executive control over their implementation and standards of environment quality.

problem-oriented bilateral cooperation is flourishing, primarily with various institutions and state agencies from Nordic countries (see Chapter 4). There are joint research projects on Latvia's main river basins and the Riga Gulf investigation, waste management planning, and risk assessment.

During the last decade the number of different public and out-of-school environmental activities oriented towards raising public awareness and involvement is still growing, as is development of issue-oriented environmental education, on energy, health education, etc., organised by the main NGOs (see Chapter 2.1.), professional and inventors societies, Nature Houses, Culture Fund of Latvia, etc. The mass media (press, radio, TV) is currently paying much attention to nature and cultural/environmental issues, even creating special programmes. There is good cooperation between the main non-governmental institutions and the environmental education Department at the Environmental Protection Committee and some cooperation with the Ministry of Education.

In order to obtain real development of environmental education and training there is an urgent need to cope with the following major problems:

1. lack of a National Strategy on environmental education and awareness raising;
2. lack of appropriate curricula, programmes, terminology and textbooks for integration of environmental education into all subjects and levels of education;
3. insufficient level of interdisciplinary and interactive pre- and in-service training of environmental, administrative and industry decision-makers, teachers, etc.;
4. bridging the gap between academics, scientists and NGOs, the officials of state and local authorities and citizens, nature conservationists and local residents.

Various national and international networks on environmental education facilitate the collection, analysis, storage, translation and publicity, as well as distribution of, badly lacking resource materials and information.

During the last few years considerable work has been done in this field by the University of Latvia Ecological Centre which, with wide support and assistance, is developing information, training and a resource Clearing House, including a specialized library, on environmental education. There are also adapted translations as well as various self-designed resource materials - teaching aids, bulletins, proceedings, glossaries and books for formal and informal environmental education at all levels. For the first time annual environmental reports in Latvian are under preparation - the 'Environmental Education Yearbook '93' and 'Environment and Development, Latvia '93'. These, along with other activities and publicity, are serving as a real resource base for new quality in environmental education.

2.5 Priorities

In order to realize the main goal of Latvia - to reconstruct the economy towards a free market - it is necessary to decrease dependence on foreign resources and raw materials, utilizing

'Nature Studies' is the title of the course given to schoolchildren in classes 1-4. In the following classes of elementary school there is no special or comprehensive subject of environmental education. Pupils gain environmental knowledge and attitudes by studying such subjects as biology, geography, chemistry, and physics. Worthy of special mention are several school subjects based on the rich folklore and handicraft heritage of Latvia as they could be considered as belonging to environmental/cultural education. There are the first attempts at an integrated approach for environmental education which are often combined with the schools' practice of involving pupils in different practical out-of-class activities, such as gardening, fieldwork, case studies and issue-oriented excursions.

Students at secondary school (classes 9-12) have more opportunities to explore the environment in specific natural science subjects, as well as by choosing some of the optional studies, like 'Ecology' or 'Nature, Man, Society' which were actively introduced during recent years.

Environmental studies at the tertiary level are more widely represented at different universities and other higher educational institutions of Latvia. Formerly there were only several special or optional subjects within the traditional disciplines at several faculties, but during recent years many new specialization possibilities appeared in environmental education, including industrial ecology, environmental chemistry and special multidisciplinary courses in environmental science and management. There are also some opportunities to take part in foreign and international graduate and specially post-graduate interdisciplinary programmes such as EPCEM, TEMPUS, Baltic University, and the Central European University.

Parallel to the training of environmental specialists at university level, there is special vocational education available for environmental technicians and technologists, (in forestry, fish-farming, etc.). Currently there are also several in-service training courses and programmes for environmental specialists working in corresponding agencies and for school teachers.

In the autumn of 1991 the Environmental Science Council of Latvia was established as an independent coordination body, formed by lecturers and specialists involved in environmental protection, representing most of the higher education and research institutions of nature, social and humanitarian sciences. This interdisciplinary expert body also provides counselling and expertise for decision-making on various environmental and resource use issues.

Various environmental research work is carried out at the majority of institutes of the Academy of Science of Latvia which now are experiencing difficulties during the national transition period. There is a wide spectrum and number of different research institutes and departments at the universities, ministries, Environmental Protection Committee and nature conservation establishments also attempting interdisciplinary cooperation for exploration of environmental issues.

The cooperation, joint research projects and participation at the various international scientific programmes, (UNESCO MAB, Baltic Sea etc.) are rapidly growing. Wide and

reviewing and working on proposed environmental legislation, as well as implementing the inclusion of environmental protection issues in all legislative acts proposed by the Parliament.

2.3 Environmental Legislation

The Republic of Latvia Supreme Council, i.e. the Parliament of Latvia, as the present legislative authority, was elected under USSR law in April 1990 with direct participation of vast numbers of Soviet military servants and non-Latvian citizens. After the proclamation of independence it is seen as a temporary board.

All legislative acts in Latvia are passed by the Supreme Council and environmental legislation after preparation of laws by Standing Committee on the Environment of the Parliament. The Environmental Protection Committee (EPC) and the State Standard Centre of the Council of Ministers are the institutions in Latvia responsible for the drafting of environmental regulations and standards.

The basic principles and methodology of Environmental policy of Latvia are determined by the 'Law on Environmental Protection' of 1991. There are several other environmental legislation acts passed since 1990:

- Law on State Environmental Impact Assessments (1990);
- Law on Natural Resource Taxes (1990);
- Law on the Environmental Protection Committee of the Republic of Latvia (1990);
- Regulation on the Environmental Protection Inspectorate (1990);
- Regulation on the State Specially Protected Cultural/Historical Territory 'Livod Rand' (1991);
- Regulation on the Baltic Sea and Gulf of Riga Coastal Protection Regime (1990);
- Regulation on the creation of Northern Vidzeme's Regional Nature Protection Complex and Activities for the Organization of Biosphere Reserve (1990);
- Regulation on Private Home Construction in Connection with the Emergency Ecological Situation (1990).

A number of draft legislation acts and standards in preparation cover such environmental issues as hazardous and chemical substances, use of water and underground resources, and the protection of soil, air and natural objects.

2.4 Environmental Education And Science

Overcoming the remains of the recent 'political mind-set' and developing interdisciplinary, issue-oriented and interactive environmental education creates a real foundation for solving and preventing these complex environmental problems.

Water Reservoir and Ground Soil Protection Inspectorate.

The institutional framework for environmental protection in Latvia consists of other institutions alongside the EPC as the central environmental authority. These collect and disseminate information and also contribute to environmental policy development.

The Hydrometeorological Agency of the Council of Ministers of Latvia, having a central laboratory and six regional laboratories, is in charge of collection, analysis, and dissemination of meteorological, hydrological and environmental data as well as publishing of annual reports on freshwater and coastal water quality. Its findings on the concentrations of heavy metals and pesticides in water bodies are given in Figure 12.

The only National Park of Latvia, the Gauja National Park, is run under the Ministry of Forests. The Ministry of Forests and the Ministry of Agriculture manage the state and agricultural forests of Latvia.

The EPC, together with the State Standard Centre of the Council of Ministers, is responsible for the formulation of environmental standards.

The Parliament of Latvia supervises the work of EPC and its cooperation with other institutions in Latvia and abroad. It also has its own commission consisting of Members of Parliament - the Standing Commission on the Environment. The Commission has been

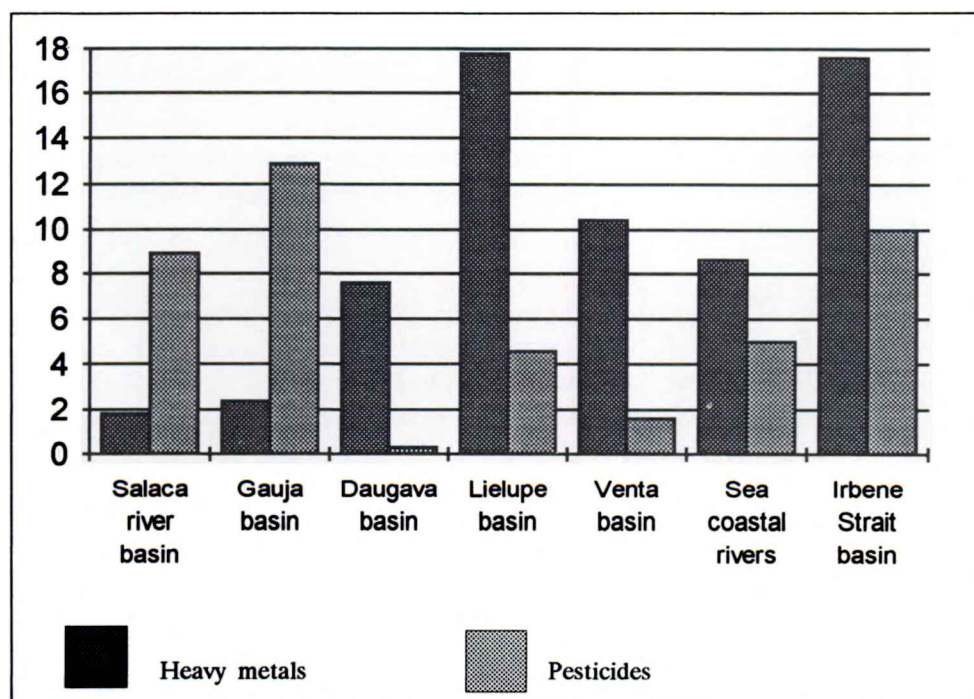


Figure 12: Heavy metals and pesticides in water bodies (% of concentrations above permitted maximum) (Hydrological Agency, 1991)

Latvia

Nowadays several specialized magazines and newsletters have been published in order to raise public awareness and involvement in nature and culture protection, as well as to interpret interdisciplinary science and education. These magazines and newsletters include: the weekly newspaper 'Elpa' (Breath) published since 1990; the quarterly bulletin 'VIDE' (Environment), published since 1991; the Calendar of Nature and History, published since 1962 and therefore the oldest; as well as others.

2.2 Institutional Framework

Latvia's central environmental authority is the Environmental Protection Committee (EPC), an institution reporting directly to the Parliament, which was established by 'The Law on the Environmental Protection Committee of the Republic of Latvia' in 1990. There are plans to transform the EPC to a Ministry after the parliamentary elections in June 1993.

Within the competence of the EPC is the overseeing of all environmental protection and natural resource problem areas. The main functions of EPC are:

- formulation and implementation, together with different governmental agencies, of unified policy for environmental protection and use of natural resources;
- carrying out State Environmental Impact Assessments and establishing environmental protection requirements;
- overseeing environmental protection and natural resource use in the whole territory of Latvia, the continental shelf, and Latvia's economic zone of the Baltic Sea area.

The Environmental Protection Committee, as the national agency in charge of both the development and implementation of environmental legislation, has nine regional EPCs responsible for all environmental matters in three or four administrative districts of Latvia. As a pilot investigation, the Ogre regional EPC is responsible for only one administrative district.

The functions of the regional branches of the EPC in Daugavpils, Jelgava, Liepaja, Madona, Ogre, Rezekne, Riga, Valmiera and Ventspils regions are monitoring, permitting inspections, enforcement and liaison with the Hydrometeorological Agency. In line with these functions, the regional EPC has departments of Statistics, Inspectorate, Environmental Impact Assessment and Laboratory Analysis.

The Environmental Fund at the EPC is established by 'The Law on Environmental Protection' 1991. This provides parallel financial means for environmental protection and nature conservation. The fund comprises all charges from economic activities which have harmful impact on the environment and taxes for the use of natural resources.

There are several administrative authorities in Latvia with responsibility for implementation of environmental policy on particular issues. They are:

- Baltic Sea Protection State Inspectorate,
- Forest and Hunting State Control Inspectorate,

The very first real social and ecological expertise conference, drawing in scientists, experts, officials and the public, was held by YEC in February 1988 over the plans to construct the underground in Riga. This was a kind of prototype for the citizens' Public Council which was later founded, simultaneously within the State Committee of Nature Protection.

After the first nationwide conference 'Green Logics' in September 1989, held by different green organizations in Latvia, it was decided to create political power to proceed further with environmental goals. In January 1990 the Green party of Latvia was organized, and after elections represented 3.5% of the Parliament of Latvia.

After the Declaration of Independence (4 May 1990) the following environmental laws were accepted by the new Supreme Council of Latvia:

1. Law on the Environmental Protection Committee of the Republic of Latvia;
2. Law 'On State Environmental Impact Assessments';
3. Law 'On Natural Resource Taxes';
4. Law 'On Environmental Protection';
5. Regulation on the State Environmental Inspection of Latvia.

The Law on Protected Nature Territories is prepared and under consideration for adaptation by the Supreme Council of Latvia.

During recent decades considerable work was done to establish a number of new areas of special protection and this territory increased from 315,155ha (4.9% of Latvia territory) in 1977 to 441,666ha (6.8%) in 1991. The following special Nature Reserves exist in Latvia at present:

1. Moricsala Nature Reserve (1912);
2. Slitere Nature Reserve (1921);
3. Grini Nature Reserve (1936);
4. Krustkalni reserve (1977);
5. Teici Nature Reserve (1982);
6. Regional Nature Protection Complex Ziemeļvidzeme (1990) and the Gauja National Park (1973).

Additionally there are the Culture Heritage Area Livod Rand, limited use areas, protected landscapes, nature parks and monuments in Latvia.

The Law 'On the Protection of Cultural Monuments' was issued in 1992. In the list of historical and cultural monuments published in 1984 we have 1,504 archaeological and 1,054 historical monuments, 531 monuments of architecture and urban building and 1,449 works of art.

body - the Committee of Protection and Rational Usage of Nature at the Council of Ministers. Since 1976 the regulation of the Council of Ministers 'About the Complex Programme "Protection of the Nature of the Latvian SSR and Rational Usage of the Nature Resources"' has been in force, and all nature protection responsibilities continued after 1965 to be divided to separate state ministries and departments who were simultaneously the users of natural resources and regulators of the corresponding laws. Monitoring of nature was carried out by the Department of Hydrometeorology and Environment Protection.

During those years the following laws and codes were issued by the Supreme Council: Codes about the Land (1970), the Water (1972), Forest (1978) and the Code of the Underground resources of the Earth (1976) as well as the Air Protection Law and the Law on the Protection and Usage of Animals.

In 1980 the Red Data Book of Latvia was accepted. The Red Data Book included 112 plant species, 20 lichen and 32 fungi species as well as 119 species of animals. 21 plant species are mentioned in the European Red Data Book. The Academy of Science of Latvia joined the international UNESCO programme 'Man and Biosphere' (MAB).

After public activities in Estonia to ban oil shale mining and in Lithuania to cancel the expansion of the Ignalina Nuclear Power Station, we can speak of the first step towards really wide and successful public environmental activity in Latvia - the struggle to stop construction of the Daugavpils Hydropower Station on the river Daugava in eastern Latvia (autumn 1986).

Based on the work of individual activists who carried the main weight of green work since the 1980s, mainly in nature and culture conservation, in 1987 the most active green non-governmental organizations (NGOs) were founded. The Environmental Protection Club of Latvia (VAK) is the biggest grassroot organization; other NGOs include the Youth Ecological Centre (YEC) which was later developed into the University of Latvia Ecological Centre, a professional NGO and member of IUCN since 1992. The Latvian Fund for Nature was established in 1991, and the Coalition for a Clean Latvia (consisting of three main environmental NGOs in Latvia) was founded in autumn 1992. During those years almost every new nature/environmental group became a local branch of VAK, unlike in Estonia and Lithuania where the Green Movements were formed as umbrella organizations. The international experience exchange among green groups also started to develop in 1987, based mainly on nature conservation and protection issues, firstly among neighbouring countries of Central and Eastern Europe.

Under pressure from environmental and sociopolitical activities in the country, the State Nature Protection Committee was established in 1988 and in 1990 was renamed the Environmental Protection Committee of the Republic of Latvia. Due to the situation under the occupation regime in 1988, a committee rather than a ministry was established and it is directly responsible to the parliament - the Supreme Council of Latvia. In 1990 the 'Complex Territorial Scheme for Nature Protection in Latvia' based on territorial principle was formulated.

CHAPTER 2: NATURE AND ENVIRONMENTAL PROTECTION

2.1 Environmental Protection History

We can find origins of nature conservation and protection in Latvia far back in history. The first natural objects to be particularly cared for were sacred oaks, stones and holy birch groves. A caring attitude towards nature and the necessity to live according to nature has been carried through the centuries by means of Latvian folklore and handicrafts, especially through Latvian Dainas - four-line folk poems collected and written only at the beginning of this century totalling two million.

In the 16th and 17th centuries the first laws and regulations appeared regarding the use of forests and the Baltic Sea dunes. The first law on the protection of cultural monuments in Latvia was made during 'Swedish times' in the 17th century. Protection was required for old burial grounds, buildings, castles, bastions and their ruins, as well as monasteries. The Island Mūrīcsala on the Usmas Lake became the first nature reserve in 1912.

Nature protection in the Republic of Latvia (1918-1940) was comprehensively and scientifically developed by different state and public organizations and was oriented towards preparing new protected areas and determining separate protected natural objects.

During this time a number of laws were issued, covering fishing, forest protection, protection of beavers and elks, etc. By 1936, 12 species of plants, two species of animals, five geological monuments (such as the National Park of Latvia, the National Park of Koknese), the nature reserve of Grini, 53 islands in 17 lakes and other objects were protected.

The protection of Latvian cultural values became a reality probably only in the period of the independent Republic of Latvia. The Law on the Maintenance of Monuments was issued in 1923. By 1940, 1,454 monuments had been listed as state protected objects and more than 35,000 archaeological, 8,000 manuscripts, 500 objects of religious art and 33,000 coins and medals had been collected.

Since the Soviet occupation of Latvia (1940) the nature of Latvia has been seriously damaged, due to extensive development of industry and agriculture, uncontrolled urbanization causing mass emigration and the consequent lack of consideration of local conditions and resources. Increasing public concern and involvement resulted in the establishment of the Society of the Nature and Monument Protection of Latvia in 1959 as a non-governmental organization created to control the observation of regulations and laws concerning nature protection and to organize conferences, exhibitions, competitions, excursions and publicity.

The law on nature protection in Latvia was made in 1959 and was improved in 1968. Between 1961 and 1965 nature conservation was carried out by a comprehensive special

Latvia

The oldest protected nature reserve, Moricsala, was founded in 1912 in the western part of Latvia. The protected area is 8.0km², including an 82ha island with a virgin centre - European mixed oak forest and Usmas Lake (702ha). There are more than 1,240 types of plants registered.

The Baltic coastal landscape with pine and spruce forest is preserved by Slitere Nature Reserve, established in 1921. Biotic communities of the Atlantic species *Erica tetralix* and *Myrica gale* are preserved in Grini Nature Reserve, founded in 1936. Both reserves are located on the western coastline of the Baltic Sea.

Two other Nature Reserves are situated in the mid-east of Latvia. The largest marsh area of Latvia, the habitat of very rare bird species, was declared the Teici Nature Reserve in 1982. The Krustkalni Nature Reserve was established in 1977, protecting a hilly landscape with rare species of coniferous and broadleaf trees.

The Gauja National Park covering 920ha was founded in 1973 to preserve nature in the ancient valley of the Gauja River, but is also rich in cultural and historical monuments. Forest covers about 60% of the territory of this park. The park is rich in natural ecosystems, vegetation - 650 plant species, and fauna - 48 mammal species and 160 bird species. There are many springs and caves, sandstone and dolomite cliffs.

A common form of protected areas in Latvia is protected landscape territory, aimed at conserving features of environment and landscape, biological diversity and historical heritage. Nature Parks are established in areas with picturesque landscape and high nature protection value. Being commonly used for recreation and tourism, Nature Parks require ongoing management and public service structures.

The conservation of the Baltic Sea and the Riga Gulf seaboard is secured with a 300m protected zone but the limit of the special protection belt is up to 3-5 km. In the area covered by this seabelt there are many protected natural objects - reserves and ornithological protected areas. The North Vidzeme Nature Protection Complex is the first to include plans for sustainable economic development along with the necessity of conserving coastal areas and features of the natural landscape, and protecting historical cultural heritage.

In 1990 the Regional Nature Protection Complex (member of IUCN) was created in the drainage basin of the Salaca River, Northern Vidzeme. This is an area of around 400,000ha (7% of the territory of Latvia) covering three administrative districts. The complex is important to the restoration of Baltic salmon breeding. Research and administrative investigations are being conducted into establishing a Biosphere Reserve inside the complex.

Certain problems concerning land privatization apply to the nature protected territories. According to the new legislation of Latvia, nature conservation priorities in special protected territories listed in parliamentary regulations are treated as equal to democratic rights for private land ownership. Practically all of the legislative acts passed after the proclamation of the Republic of Latvia include the necessary regulations for environmental protection.



Plate 5: Skujene in Vidzeme



Plate 6: A protected territory, the restricted landscape area 'Talsu Hilly' at the Bezdubena Lake.

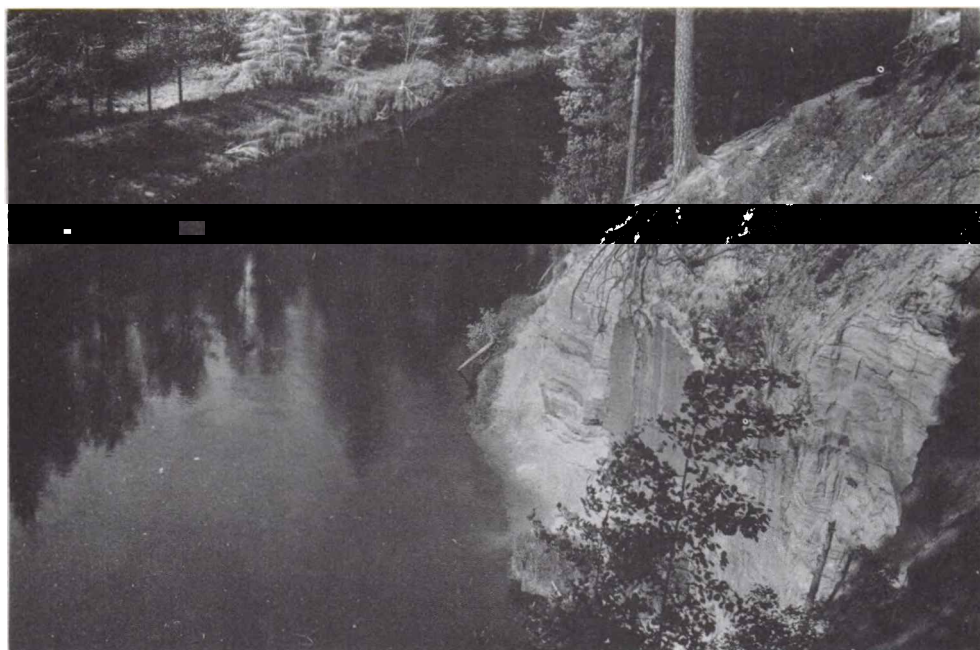


Plate 3: Nelku rocks on the River Salaca

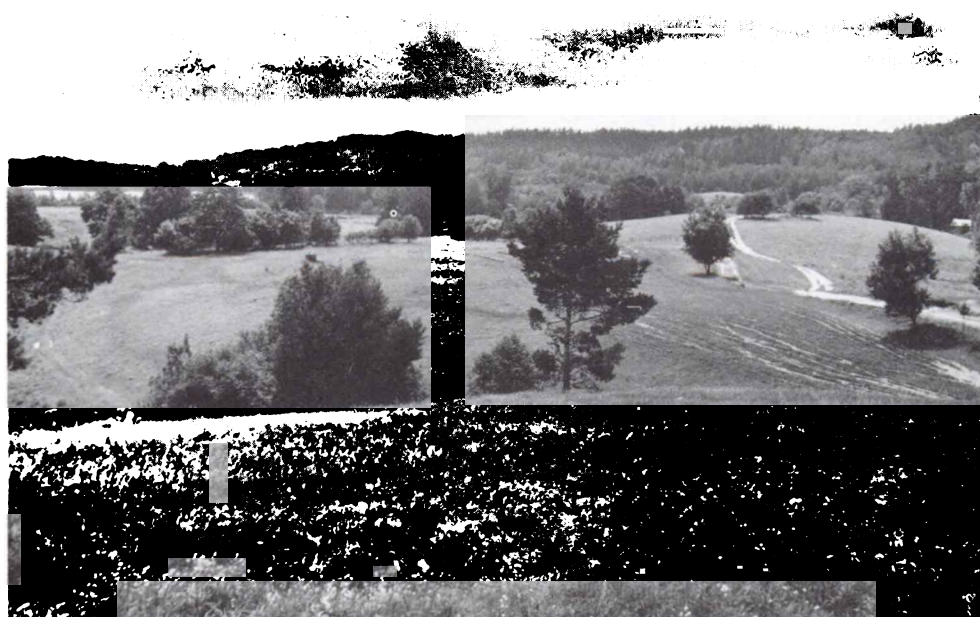


Plate 4: The Restricted Landscape Area of Veclaicene in Vidzeme



Plate 1: The Baltic Sea coast to the north of Ulmale



Plate 2: Landscape seen from the Lilaste High Dune, including the coast at Vidzeme

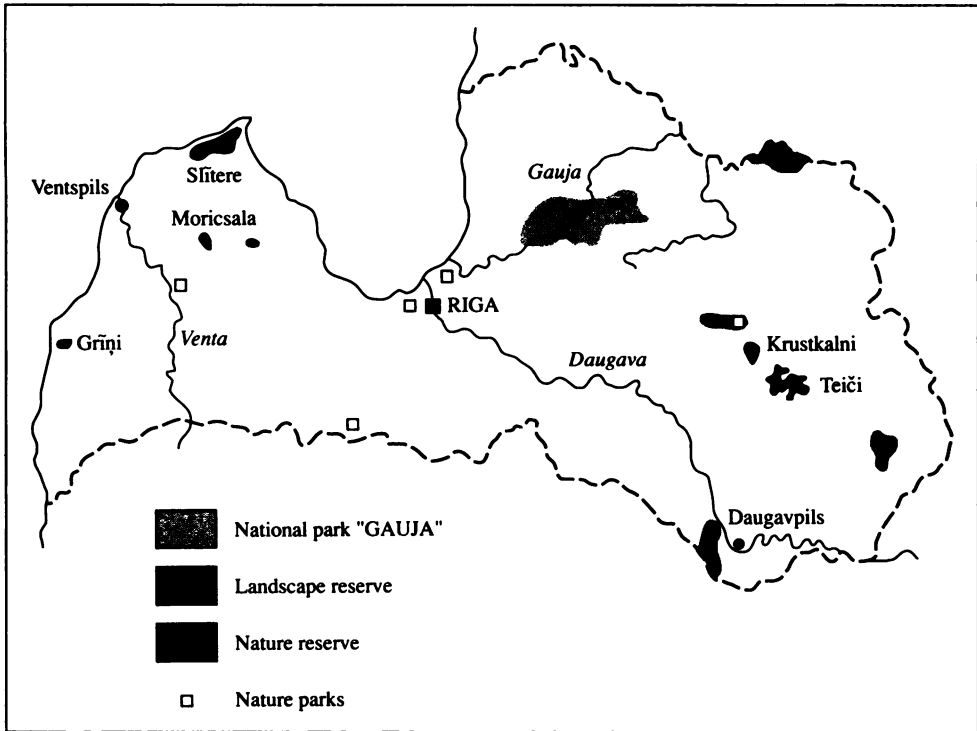


Figure 11: Nature conservation areas (NOPEF Latvia, 1992)

5 reserves

1 national park

40 complex nature reserves

15 zoo reserves

10 nature parks

6 protected landscapes

1 cultural heritage area

28 mire reserves

386 other objects; including 169 geological and geomorphological objects, parks and dendrological plantations, mill-ponds.

Protected areas are a suitable form of nature protection for Latvian conditions, which have been subdivided into smaller areas of complete and partial sanctuaries. Wide territories cover protected areas of bogs and river valleys. The biggest group of nature objects is nature monuments - particular trees, geological formations, country parks and others.

Assessment of the living resources of waterbodies of Latvia through investigation of hydrochemical, hydrobiological and fish samples in fresh waters has not been fully realized for various reasons.

Recently about 500 tonnes of fish were caught in lakes of Latvia and productivity of piscicultural fish ponds was about 3-3.5 thousand tonnes. Through ongoing tenure reform in Latvia, fishing in internal waters decreased greatly, so limiting the estimation of fish resources and control over them.

After definition of Latvia's sea-border, which hindered the maintenance of order in sea-fishery, Latvia is joining the regulations of the International Baltic Sea Fishery Commission.

1.6 Protected Areas

Nature conservation in Latvia has always been combined with the conservation of the national culture and has long traditions, however it was most successfully realized in the early 1920s and 1930s after the establishment of the Republic of Latvia.

The Law on Nature Protection in Latvia, passed first in 1959 and later in 1968, emphasized the promotion and exploration of protected natural objects. The list of protected natural objects was regularly extended, mostly with geological and geomorphological formations and ancient country parks. Conservation activities of habitats of rare and vulnerable species, peculiarities of landscapes of wide areas and biological diversity was growing. The new lists of protected natural objects were accepted in 1977 and 1987, representing different forms of protection according to diversity of natural objects.

The following categories are recognized as protected territories in Latvia - nature reserves, national parks, nature parks, nature monuments, nature preservation areas and protected landscape areas. Figure 11 shows the distribution of Latvia's nature conservation areas. The management of these territories aims to protect and conserve biodiversity, to secure scientific investigation and to preserve them for recreation and education.

Protected areas in Latvia are in three categories:

1. most valuable territories - a few areas of virgin lands or least anthropogenically influenced areas representing every type of biotope or group, as well as areas with different biotope complexes;
2. indispensable areas with very high national or international value;
3. areas with separate biotopes or groups of those with national or local values.

Several other nature territories are not mentioned here because of their lesser role in biodiversity conservation.

An area of 441,666 ha or 6.8% of the country's territory is accepted as nature protected areas and objects. Altogether around 600 particularly valuable objects are in Latvia, for example:

Latvia

Mires in Latvia cover around 6,400 km² and 10% of the territory. 75 mires are under state protection, including 14 mire reserves, 60 cranberry reserves and one botanical reserve. Several mire areas are located inside other nature protected territories. Teicu Nature Reserve was created to protect the biggest marshland in Latvia.

Natural meadows cover around 3% of land used for agriculture. Most of the grasslands in Latvia are unflooded and constantly being farmed. They become a unique habitat for different fauna and plant communities, with more than 360 plant species.

Particular vegetation is characteristic of the salty soils of seashore meadows, located in the coastal areas of the Baltic Sea, which have also very specific dune vegetation.

According to the North European geobotanical division, the territory of Latvia belongs to the West and East Baltic subprovinces of the Baltic geobotanical province. Not only climatic, but also certain floristic differences are observed in the western and eastern parts of Latvia, influenced by the Baltic Sea. The coastal lowland and western part of Latvia are richer in different plant species which are also particularly spread along the Daugava and Gauja River valleys to the east. The flora of Latvia comprises about 1,900 species, or nearly 3,000 if algae are included.

1.5.2 Fauna

The fauna of Latvia has evolved with climatic and vegetational changes after the withdrawal of glaciation and under increasing anthropogenic influences. Even during this short time period both extinction and reintroduction have taken place. Altogether in the territory of Latvia around 14 thousand species of animals are registered but unfortunately the fauna of Latvia has not been sufficiently explored and there should be more animal species recorded. 119 of these animal species are listed in the Red Data Book of Latvia.

The mammalian fauna of Latvia according to historical and genetic origins, and due to the geographical situation of Latvia, are homogeneous and more or less characteristic of fauna in the Eastern Baltics. There are now around 60 species of mammals.

Apart from certain industrial development and land cultivation, measures of animal protection have been sufficient to more or less retain native biological diversity in the forest, bog and dune ecosystems. At the same time, the intensification of agriculture and depletion of natural habitats have been the basic reasons for the decrease in numbers of several animals such as the badger, boar, wood-grouse and other birds.

The number of wild birds of the hen family has diminished as a result of the scientifically unfounded introduction of racoon dogs in the 1980s. American mink accidentally released from fur farms have displaced the native European mink in several areas.

Within the country's total area of 22,000ha, there are more than 360 protected areas and 15 zoological sanctuaries for the conservation of different protected animal species.

Around 20 of 60 animal species are recognised as hunting game in Latvia, as are 42 of 308 bird species which breed in or migrate through the country.

Alder fens cover 3-5% of all forested area. Around 63% of forests are state owned and managed by the state foresters, while 32% belongs to and is used by agricultural organizations. The species composition of state forest is given in Figure 9, and that for agricultural forest is given in Figure 10.

Coniferous trees (especially pine) are predominant; around 69% of the state forests, while birch trees are dominant in agricultural forests. Species composition is: pine 49.1%; birch 24.7%; spruce 19.5%; aspen 2.4%; black alder 2.3%; white alder 1.1%.

The average age of state forests is 50 years, with standing volume of 151.3 m³ per ha and mean annual growth of 3.2 m³ per ha, but with volumes harvested at 2.1 m³ per ha. Almost all woodland is divided by roads or ditches into 500 x 500 metre squares. 56% of the local woodland area is restricted in use.

Around 25% of Latvian woodlands are situated on waterlogged sites and could be classified as wet or swampy forest growing on wet mineral or peat soils, which is very rare in Europe, but 20% of all forested areas have already been drained. The population of beavers grew rapidly after their reintroduction in Latvia during last 70 years and their dams are now blocking drainage.

Latvia's average figure for timber volume is 5.11 million m³ per year, including 2.97 million m³ of coniferous trees, 2.1 million m³ of narrow-leaved trees and 0.04 million m³ of broad-leaved trees.

Defoliation level for pine, Latvia's principal forest tree, is quite high (26-40%). As the pine forests now suffer from acid rain, the planting activities are broadening. Spruce, the secondary forest tree species, suffers less from defoliation but is more vulnerable to bark damage caused by moose.

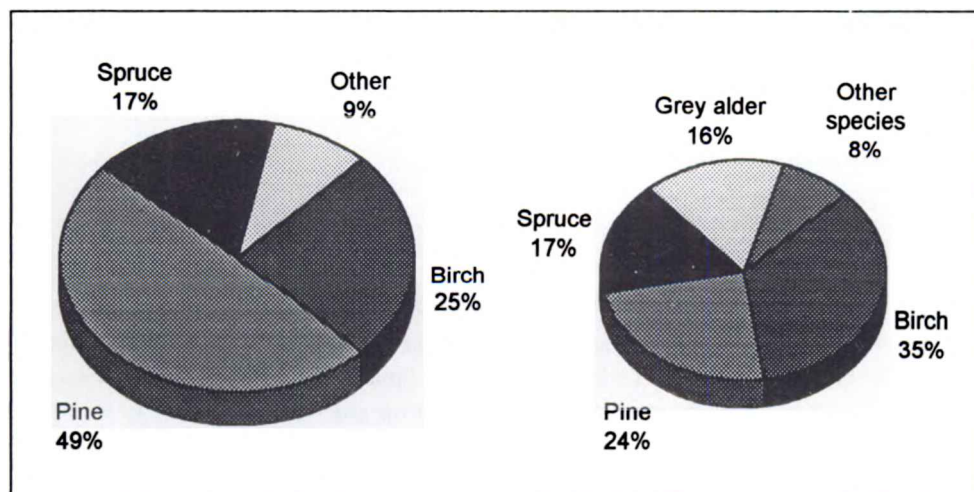


Figure 10: Composition of state forests (left) and 'agricultural' forests (right)
(Latvia report to UNCED)

Table 8: Important mineral resources

Type of mineral	Unit of measurement	Explored reserves	Estimated reserves	Annual output
Peat	mill.tonnes	530.7	71	4.6
Gypsum stone	mill.tonnes	52.2	718	0.425
Limestone	m. tonnes	89.6	1 362	1.6
Dolomite for the production of crushed stone	mill. m ³	107.3	26 021	2.3
Dolomite for the production of lime	mill.tonnes	9.1	-	0.8
Glass and foundry sand	mill.tonnes	5.4	4 738	0.026
Sand for the production of silicate products	mill. m ³	20.5	-	0.2
Cement clay	mill.tonnes	10.56	15 691	0.3
Brick clay	mill. m ³	54.6	-	-
Keramsit clay	mill. m ³	6.1	342	0.3
Gravel and sand for the production of concrete	mill. m ³	111.8	-	2.0
Gravel and sand for the railway construction	mill. m ³	22.9	43 294	0.1
Gravel and sand for the construction of roads	mill. m ³	15.1	-	0.4

1.5 Biological Resources

1.5.1 Vegetation

Latvia is in the northern part of a zone with mixed forest, and the most characteristic types of vegetation are forest, mires and grasslands. Flora favoured by the mild maritime climate and various types of soil is widely represented. Particular phytocenoses and rare plant species are protected under different categories of nature protection.

Woodland covers 2,788.9 thousand ha or 43% of Latvia. Forest cover has increased from 23% in 1928 to 36% in 1961 and is now 43%. This increase in forest cover is mainly due to the abandoning of around 1 million ha of agriculture land during the forced introduction of collective farming after 1947-1950. Swamp forests and shrubs cover former cultivated land.

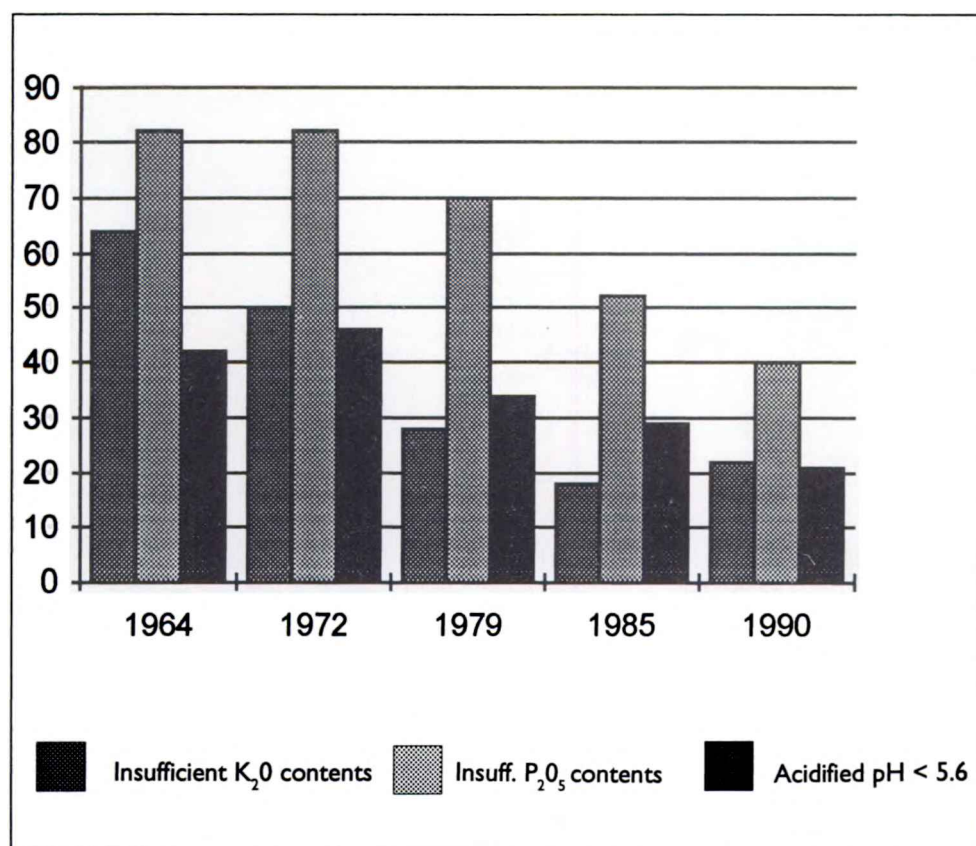


Figure 9: Soil characteristics according to use of agrochemicals (% area)
(Latvia Report to UNCED)

Peat is widespread in Latvia and most important of natural resources and is used mainly for agriculture and energy production. The richest of 5,800 peat deposits are situated in the eastern and north-eastern parts of Latvia. Data about the main types of useful minerals are presented in Table 8.

Crystalline magnetic iron ore, brown iron ore oil and complex ore have been found in Latvia. Oil has been found in the Courland Peninsula and beneath the Baltic Sea, but not yet exploited.

In the central part of Latvia there are gypsum and gypsum stone mines. The content of CaSO₄ H₂O₂ makes up to 88%. In the central and north-eastern and eastern parts of Latvia dolomite deposits are spread.

Northern and north-eastern Latvia have Devonian deposits of clay which are used for the production of tiles, clinker and drainage pipes. There is also glass and foundry sand quarrying.

Only limestone is spread in the south-western part of Latvia.

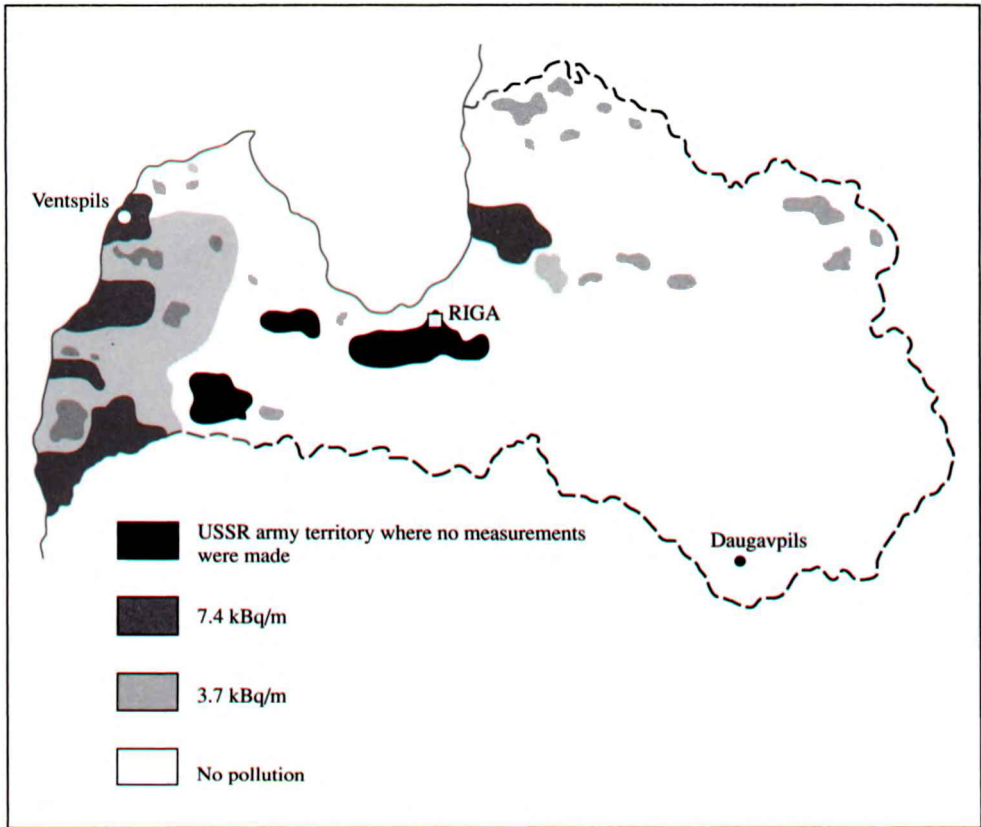


Figure 8: Intensity of surface pollution by Caesium¹³⁷ in 1989 (NOPEF Latvia, 1992)

Ventspils and Liepaja as coastal districts are subjected to wind erosion. Anti-erosion plantations (green belts) cover about 470km of these areas.

Soil compression, caused by high-power machinery and application of agrochemicals and manure, also decreases soil productivity.

Another serious problem is the disposal of vast amounts of municipal, toxic and other wastes, because until recently only one specialized pilot incineration plant was in use.

1.4 Mineral Resources

There are only a few useful minerals found in the territory of Latvia, which are mainly combined with the upper part of the sedimentary cover. Most of them are building materials such as limestone, dolomite, gravel, clay and sand. About 50% of the deposits are found in the Quaternary zone. Minerals are produced only from open mines, i.e. from pits which certainly cause degradation of land, especially turf mines, unsustainably destroying ecosystems. Total area of pits cover about 0.4% of the territory of Latvia and 75% of mines are on woodlands.

Table 7: Land use (Nordic Project Fund, 1991)

	Total in Latvia (thousand ha)	%
Agricultural land	2,570.2	40
including:		
fields	1,688.3	26
meadows	232.2	3.6
pastures	599.8	9.3
orchards	49.9	0.8
Forests	2,788.9	43
Brushwood	125.8	1.9
Bogs	317.8	4.9
Land under water	253.7	3.9
Land unfit for agriculture (roads, buildings, etc.)	391.7	6.1
Damaged land	10.6	0.2
Total area	6,458.9	100

The Law on Land Tenure Reform in Rural Areas of the Republic of Latvia (1990) requires revision of the management system in agriculture and regulation of land-use relations, as well as soil conservation and increased soil quality. The current level of nature protection and biological diversity will be maintained. Increased acidity of soils in Latvia has been caused in the last few years by precipitation of acid rain and the use of acid fertilizers. About 52% of cultivated lands in Latvia need calcination. Latvia has around 40% of land used in agriculture. Almost 7% of this land has acid soil (pH less than 5.6) which needs liming. More than 20% of land has soil which has increased moisture content or is excessively wet. About 31% of land has been drained and about 80% of the drained land is used in agriculture.

Nutrient leakage in wide areas of sand and sandy loam in agricultural lands is observed and is even intensified by large amount of fertilizers and manure used in Latvia and especially in these soils. Pollution of soil, as well as surface and groundwater resources, is caused mainly by agriculture run-off - from intensive livestock and poultry operations, pesticides, fuel and oil, and chemical storage facilities (Figure 8).

Land erosion is observed especially in intensively cultivated hilly areas, caused mainly by water, wind and flood as well as by use of unsuitable machinery and use as USSR military firing-grounds; altogether around 6% of the land.

total N) and surface discharge from urban areas (9% BOD, 13% total P, 15% total N) as well as agricultural run-off.

Measurements by the Hydrometeorological Agency of Latvia showed the Riga Gulf and the Baltic Sea coastal waters to be polluted. About 20% oxygen deficit is observed near the resort Jurmala. The volume of effluent discharge directly into the Baltic Sea was 37.612 million m³, 41% of which was untreated sewage. Figures for discharge of waste water are presented in Table 6.

Table 6: Discharge of waste water into water bodies in 1989

	Volume of waste water (million m ³)				
	Latvia	Daugava	Lielupe	Gauja	Venta
Total	579.35	382.04	66.61	24.20	31.09
including:					
polluted	257.43	190.16	23.99	11.40	3.43
treated to standard	109.78	38.22	26.27	8.25	5.14
cooling water (untreated)	212.14	153.66	6.35	4.40	22.52

The main sources of ground water pollutants are dumping sites, manure, mineral fertilizers; pesticides and other storage units as well as agriculture run-off, which have caused numerous highly polluted soil and groundwater layers.

According to the Law on Natural Resource Tax (1990) the use of natural resources and pollution discharges into the environment is now taxable.

1.3 Soil

The territory of the Republic of Latvia is situated in a zone of forests-meadows with derno-podzolic soils predominant. The turf podsoled soils prevail covering more than half of the total area of Latvia. Numerous wetland and marshland areas occupy the agriculturally exploitable lands.

In recent decades a decrease of the average contents of humus in soil has been observed. The average of humus in mineral soils is 1.75% but a quarter of the territory of Latvia has soils with humus content of less than 1.5%. Additionally, forest soils have comparatively low biological productivity.

The agriculture of Latvia is based mainly on arable farming and livestock breeding (Table 7). The main crops were food grain and potatoes. Increased use of concentrated fodder rather than increasing the productivity of natural meadows and pastures has been characteristic of livestock raising in Latvia.

Table 4: Largest lakes and reservoirs

Name	Height above sea level (m)	Area (km ²)	Catchment area (km ²)	Average depth (m)	Max depth (m)
Lakes					
Lubana					
(after regime regulation)	92.5	90.0	2 050	-	3.5
Razna	152.7	57.6	229	7.0	17.0
Engures	0.3	41.3	644	0.4	2.1
Burtnieku	39.5	40.0	2 290	2.2	3.3
Usmas	20.4	38.9	429	5.4	27.0
Liepajas	0.4	37.1	2 515	2.0	3.0
Babites	0.2	25.5	195	0.9	1.7
Water reservoirs on Daugava					
Riga	-	42.4	-	-	18
Plavinas	-	34.9	-	-	44
Kegums	-	24.0	-	9.5	16

Table 5: Water pollutants (1990)

BOD	(1,000 tonnes per year)	51.4
Oil products	"	0.62
Suspended substances	"	37.4
Iron	(tonnes per year)	158
Copper	"	3.8
Zinc	"	8.0
Nickel	"	1.2
Chrome	"	9.8
Phosphorus	"	1042
Nitrogen	"	8152

Only 10% of all the rivers in Latvia are classified as clean. 60% are temporarily polluted, 25% polluted and 5% contaminated. 75% of lakes already have an abnormally high eutrophication rate.

In 1991 the main water pollutants, (with percentage excess over the maximum permitted concentrations) were: nitrates (32%), organic matter (25%), oil products (19%). The main sources of this pollution are considered to be Municipalities (88% BOD, 78% total P, 80%

Table 3: Major rivers in Latvia

Name	Length (km)	Catchment area (km ² x 10 ³)	Basin
Gauja	452	7.79 (8.90**)	Gauja
Daugava	357 (1020*)	24.70 (87.90**)	Daugava
Ogre	188	1.73	Daugava
Venta	178 (346*)	7.90 (11.80**)	Venta
Iecava	136	1.17	Lielupe
Aiviekste	132	9.29	Daugava
Pededze	131 (154*)	1.52 (1.69**)	Daugava
Dubna	120	2.78	Daugava
Lielupe	119	8.80 (17.60**)	Lielupe
Maza Jugla	119	0.67	Daugava
Memele	116 (191*)	2.11 (4.05**)	Lielupe
Rezekne	116	1.16	Daugava
Malta	115	0.73	Daugava
Dienvidsuseja	114	1.21	Lielupe
Berze	109	0.92	Lielupe
Misa	108	0.97	Lielupe

Key

* total length of the river (including the length outside the borders of Latvia)

** total catchment area of the river (including the area outside the borders of Latvia).

Ground water from the Quaternary, Upper Devonian and Middle Devonian deposits up to 200m deep is widely used as drinking water but the Middle and Lower Devonian waters containing minerals from 3 to 45g/l are used as mineral drinking water. Very salty water (115-125g/l) is used for balneological purposes in the health resorts of Jurmala and Riga.

Discharge of waste water into water bodies

In 1989 the total volume of waste water discharge into water bodies was 579.4 million m³. 44% of the total volume was inadequately treated or not treated at all. There are no treatment plants in the territory of 30% of Latvian municipalities. Major pollutants in Latvia's waste waters are listed in Table 5.

While no state programme exists, there is no doubt that to reduce discharges of pollutants into the air the following measures should be realised: introduction of catalytic converters; construction of gas purification facilities for industrial plants and boiler-houses and modernization of technology in industry (firstly in the chemical and cement industries), energy production and restructuring of industry as a whole.

1.2. Water

One of the most serious environmental problems in Latvia is water pollution. Both water supply and waste water treatment are unsatisfactory.

Water consumption in industry decreased, but domestic needs increased during recent years. The total water consumption in 1990 was 712 million m³, including 45% from groundwaters. Industry annually consumes 35% of water, municipal services - 23%, agriculture - 26% and households - 11%.

Water resources from rivers are 32.8km³ a year or 12.3 thousand m³ per person a year. 47% of it is formed in Latvia but the rest is transit water from abroad. The catchment area of the biggest river in Latvia, The Daugava, yields 60% of all river water resources.

The total length of about 12,400 rivers and brooks of Latvia is 38,000km. The rivers of Latvia are mainly short with small catchment areas but there are 17 rivers (1%) exceeding 100km in length.

All rivers longer than 10km, as well as lakes with area exceeding 10ha have a defined 10m strong protection regime or 200m restricted activities coastal zone. Catchment areas of major rivers are given in Table 3.

The rivers are fed by underground water and atmospheric precipitation. River water contains mainly hydrocarbonates and calcium or sulphate and magnesium, due to the underground water supply. Mineralization of river water regularly does not exceed 0.3-0.5g/l.

Around 1.7% of the territory of Latvia is covered by 2,256 lakes and 796 artificial water reservoirs (Table 4). 16 lakes and water reservoirs have surface area greater than 10km².

Most of the lakes (about 70%) are shallow with an average depth of 1 to 5m, only 26 lakes are deeper than 10m. Most of the lakes are eutrophic, 10% are oligotrophic and there are some dystrophic lakes in bogs. Many lakes have a thick sapropel layer (up to 8m) on the bottom. Usually lakes are rich in waterfowl and are used for fish farming and industrial fishing.

Ground water

The territory of Latvia is a part of the Baltic artesian basin and the ground water level is dependant on the lithological composition of the rocks. The Quaternary, Devonian and Cambrian deposits have main water-bearing strata (aquifers). Total ground water resources are assessed to be 7.3 million m³ per day.

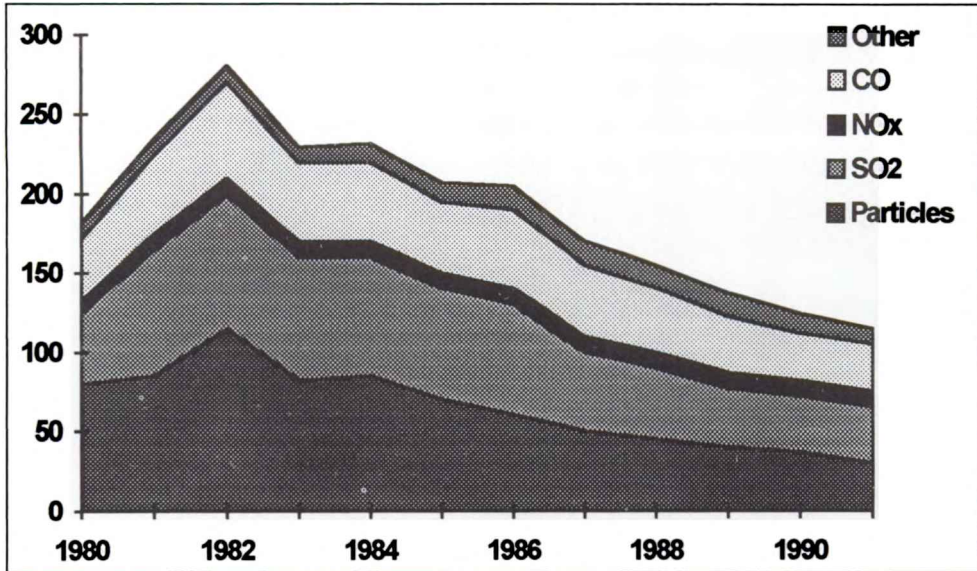


Figure 7: Emissions from stationary sources (thousand tonnes) (Source: Apene, 1992)

The recommendations of the Helsinki Commission (HELCOM) require the implementation of certain standards and monitoring systems, such as those adopted by Scandinavian countries, e.g. that assessment of environmental conditions must rely on instrumental measurements of emission. Air pollution control strategy in Latvia was based on setting standards for maximum permissible values of hazardous discharges and these standards have been developed for about 60% of industrial enterprises. There are 18 stationary ambient monitoring stations in eight cities of Latvia and 15 stations conducting episodic measurements.

The greatest part of environmental regulations of Latvia are in the planning stage. Capital investments into air protection measures have been small; there are only 40 gas purification facilities in operation in Latvia today.

The total discharge from all air pollution sources in Latvia (Figure 5) was 584,780 tonnes, which equates to 217kg per capita, in 1989. Motor vehicles caused 73% of the total amount.

The reduced nitrogen (ammonia) mainly originating from agriculture, and less oxidized nitrogen is responsible for deposition of nitrogen but the deposition of sulphur is dominated by long distance transport. All data available about emissions and air quality should be considered carefully as there are many uncertainties and inconsistencies.

Problems with local air pollution exist primarily in urban areas and around point sources (Figures 6 and 7). Measurements in urban air indicate high concentrations of carbon-monoxide, dust and ammonia as well as high concentrations of benzene, polyaromatic hydrocarbons and other toxic compounds. The current decrease in industrial emissions of pollutants observed in Latvia is the result of economic depression, as production output is now only 20% of its previous level.

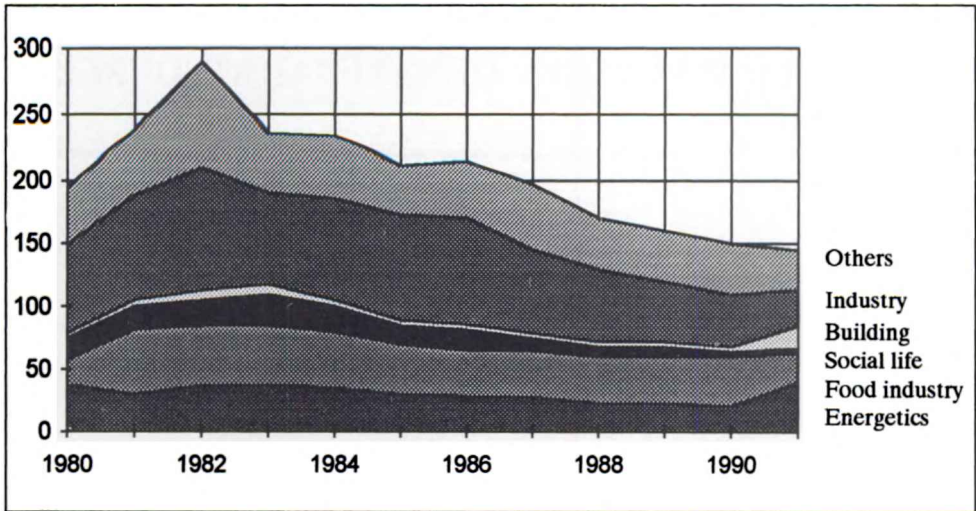


Figure 5: Distribution of emissions in Latvia (thousand tonnes/year) (Apene, 1992)

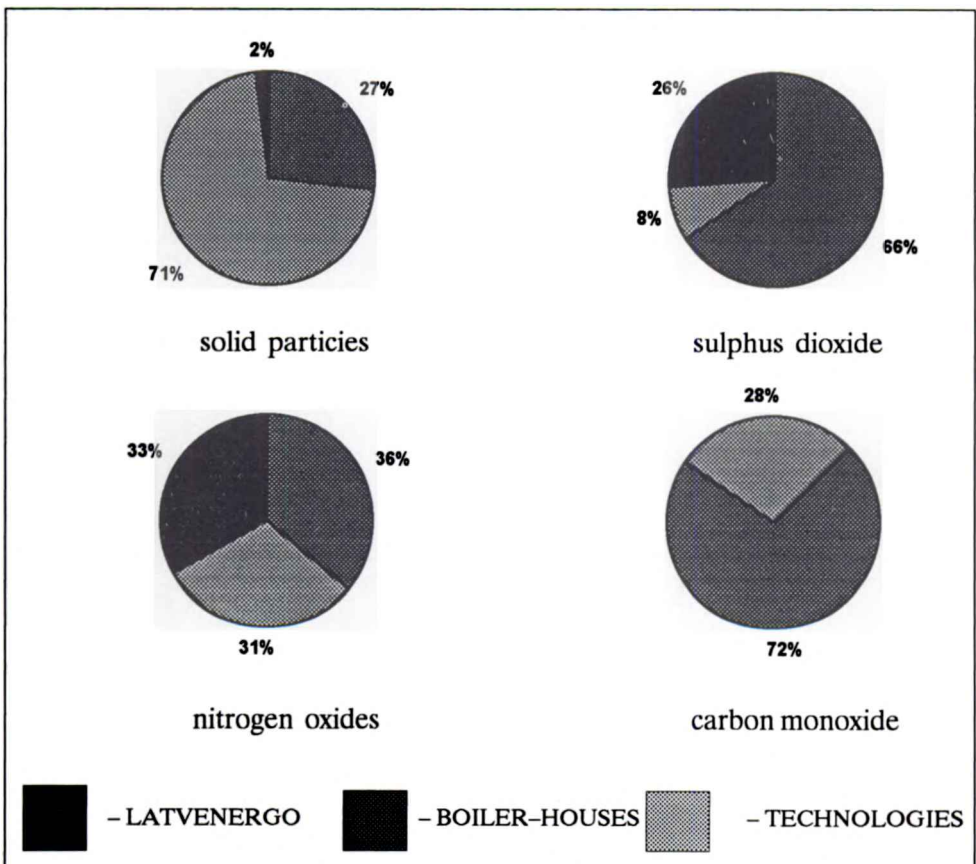


Figure 6: Distribution of emissions from stationary sources in 1991 (Apene, 1992)

CHAPTER 1: INVENTORY OF NATURAL RESOURCES

1.1 Air

There is a need to use European standards in Latvian legislation and to join most of the international organizations and conventions. Until now Latvia has signed only a few conventions due partly to financial reasons. The first to be signed was the Framework Convention on Climate Change (Rio, 1992).

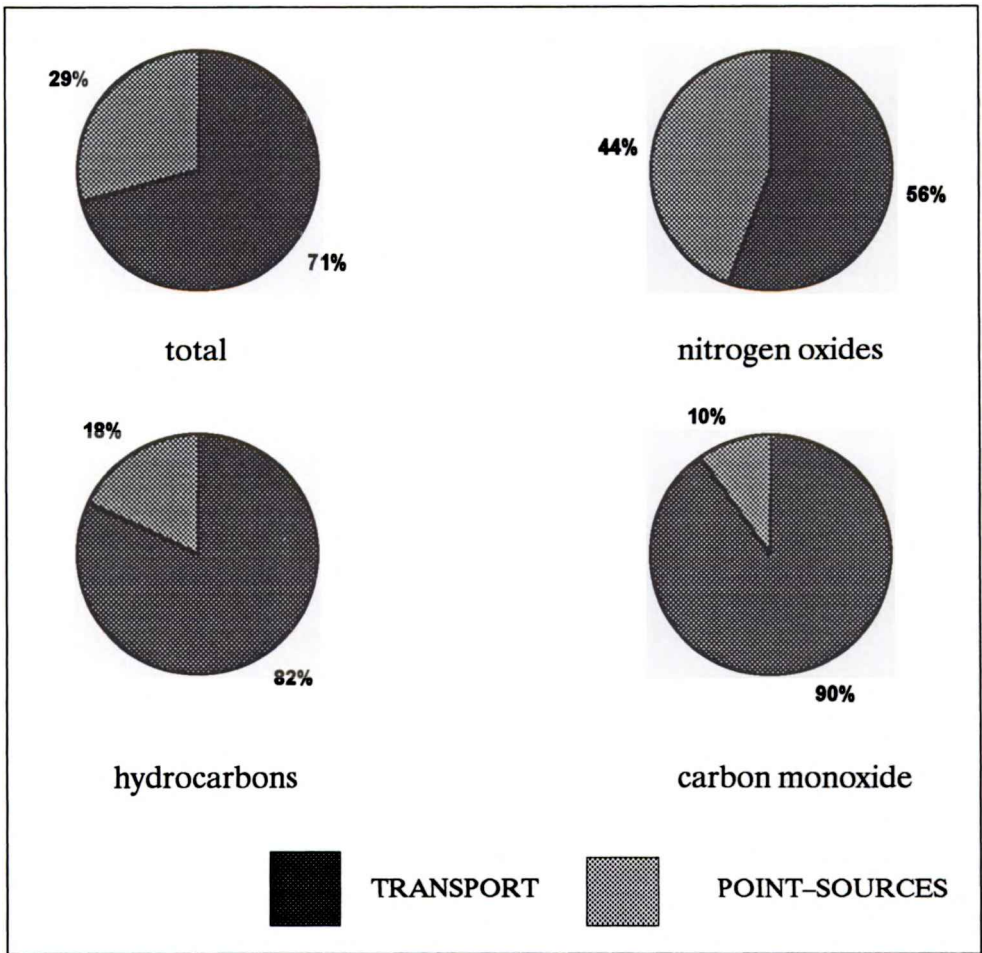


Figure 4: Air pollution in Latvia in 1991 (Apene, 1992)

The rate of uncontrolled urbanization and migration in Latvia has been very high in recent years. The urban population, mainly working in the voluntarily constructed industrial enterprises, constitute 71% of the total population, 61.3% of it living in Riga, occupying only 6% of the territory of Latvia (Table 2). The rural population decreased because of ineffective agriculture and poor socioeconomic conditions. Average density of population is 41 per km².

Table 2: Distribution of labour force in industry (thousands) in 1985, 1988 and 1989

Type of industry	1985	1988	1989
Electrical engineering	7.0	6.5	6.9
Machine building and metal work	160.6	6.5	6.9
Chemical and petrochemical	24.9	23.9	23.2
Timber, pulp and paper	37.6	36.9	33.8
Building materials	19.8	19.3	18.0
Light	81.9	74.3	70.0
Food	49.0	45.6	43.1
TOTAL	415.7	392.1	373.7

The disharmony between the production and social spheres, as well as unlimited use of natural resources and degradation of nature and landscape, have caused serious damage to Latvia's environment in many places. These areas are around Riga, Ventspils, Daugavpils, Olaine, Liepaja.

Table 1: Population of Latvia according to nationality (percentage distribution) (Source: Mezs, 1992)

	1935	1992	1935	1992
Latvians	77.0	52.5	63.0	36.7
Russians	8.8	34.0	7.4	47.7
Belarussians	1.4	4.4	1.2	4.8
Ukrainians	0.1	3.4	0.2	4.7
Poles	2.5	2.2	4.1	1.8
Lithuanians	1.2	1.3	1.5	0.8
Jews	4.9	0.6	11.3	1.5
Other nationalities	4.1	1.6	11.3	2.0
Total	100	100	100	100

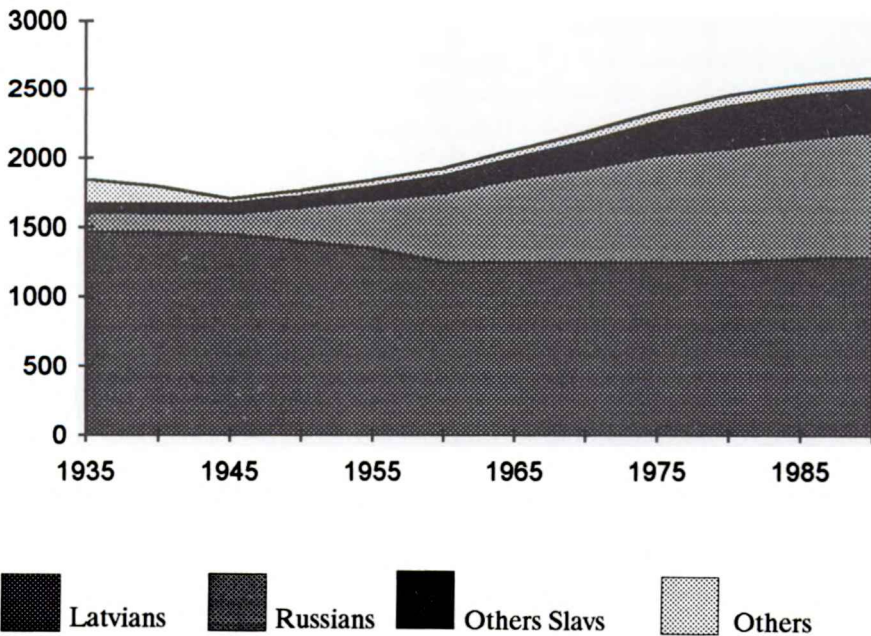


Figure 3: The ethnic structure of Latvia 1935-1989 (in thousands) (Mezs, 1992)

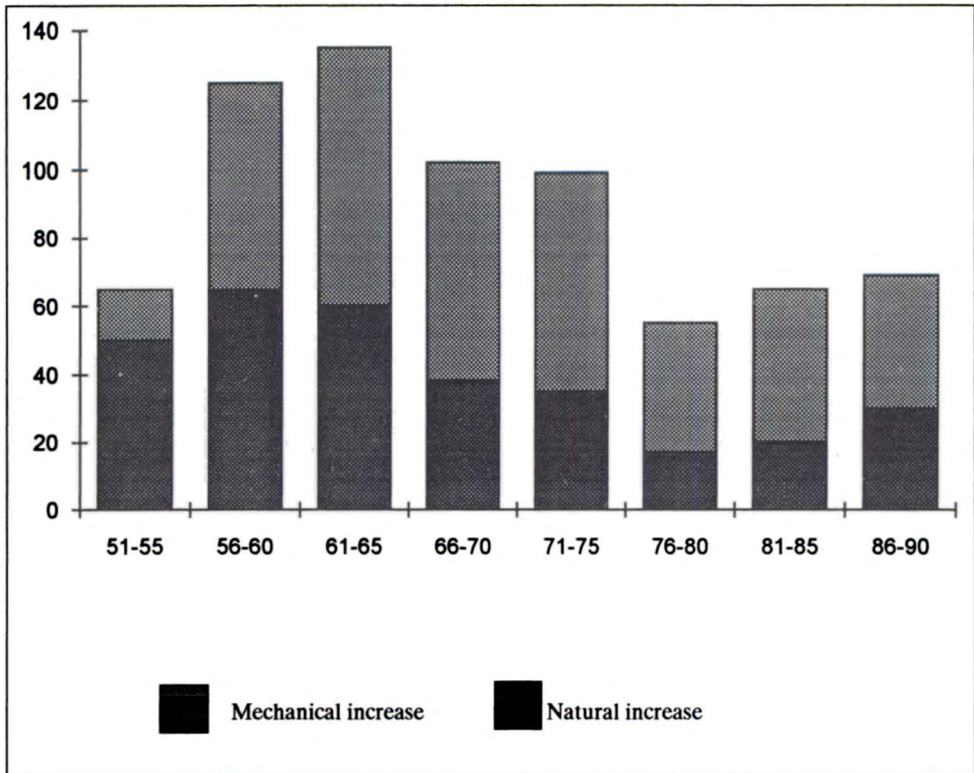


Figure 2: Population increase in Latvia 1951-1990 (in thousands) (Mecs, 1992)

decreased from the late 1950s to the 1980s and the increase in number of inhabitants in Latvia has been dominated by immigration during all of the period since World War II. Due to immigration, Latvia had the highest growth of population in all of Europe. The main flow of migration came from Russia, Belarus and Ukraine, especially felt after several deportations of numerous Latvian citizens. Altogether the estimated loss in the years 1940-1952 was 502,000 inhabitants of Latvia.

The result of the Soviet policy of colonization and russification is presented in Table 1 and Figure 3. The figures testify that Latvians approach the status of a national minority in their historical territory.

The Latvian language, affected by full isolation in administrative and business spheres, belongs to the Baltic branch of Indo-European languages as does Lithuanian. Presently the Latvian language is considered to be the state language, with Russian as the second language.

After the proclamation of the independence of Latvia, as during the short period of the first independence of Latvia, possibilities for development of national cultural societies appeared. Many schools opened in which, besides Russian, the languages of minorities in Latvia are taught, e.g. Belarussian, Ukrainian, Polish, Lithuanian, and Yiddish. The main church in Latvia is Lutheran but the Roman Catholic and Orthodox churches are also present.

Latvia

Only 10% of the territory is now covered by the country's mires, which have been drained and excavated for peat. The only habitat of cranberries is bogs. Water courses in rivers, lakes and seas have been influenced by the hydrological and hydrochemical processes in mires, also influencing the local climate.

There are more than 3,000 lakes in the country, mostly in the highlands, and 802 of them cover a surface area of more than 0.1 km², altogether 2-3% of continental waters. The largest is Lake Lubanas at 80 km², the deepest Lake Dridzis, at 65 m deep. The lakes in the coastline lowland are remnants of sea lagoons. Most of lakes are shallow, only 60 of them are deeper than 20 m. Lakes support floodplains, meadows, fens, as well as invertebrates and waterfowl. Nowadays fast eutrophication of the lakes is recognized.

Most of the rivers in Latvia belong to the Baltic drainage area. The density of the river network is 0.58 km/km². The total number of them is 12 thousand, with 777 rivers longer than 10 km. The major rivers of Latvia are the Daugava, Gauja, Venta and Lielupe. There are rivers with extraordinary ancient coulées which are under state protection.

The grasslands of Latvia were formed as a result of the felling of trees, permanent harvesting and grazing of animals. 40% of the plants are endangered or rare. Only 1% of the land in Latvia is covered by natural meadows.

The flora of Latvia includes around 1,900 species (3,000 with algae) and there are around 1,300 species of wild animals. There are around 300 wolves, 400 lynx, 4,000 otters and 50,000 beavers, as well as several thousand white-backed woodpecker, 500 pairs of the lesser spotted eagle, and around 1,000 pairs of black stork.

Since World War II, environmental disturbances have increased drastically because of the collectivization of agriculture, enormous immigration, industrialization, over-urbanization and the direct placing of the occupying army. In spite of some expenditure for nature conservation as well as scientific, legislative and administrative activities to eliminate the disturbances, several biologically threatened sites and regions have emerged.

The most anthropogenically damaged part of Latvia, caused mainly by urbanization and agriculture activities, is the Riga agglomeration and Zemgale plain (mid-south area). Damage is characterized by the degradation of landscape, biodiversity, natural resources and increased pollution levels. Other regions have less anthropogenic problems, differing from Estonia and Lithuania with more even distribution of the anthropogenic load. Regional and local peculiarities also have a certain influence on nature.

These differences in natural conditions determine the necessity for a more selective approach in creating a system of nature protection and conservation in Latvia, in which rich experience has been gained since the beginning of the century.

Population

The size of the population in Latvia at present is 2.6 million, 0.89 million (33%) of which are living in the capital city of Riga. The national growth of population (Figure 2) continually

(maximum height - 312 metres). Latvia's coastline, with sandstone outcrops and steep cliffs as well as sandy beaches, extends 475km along the Baltic Sea and Gulf of Riga. Half of this coastline remains undeveloped.

Soils in Latvia are predominantly podzolic (52%) but calcareous soils are also found. Swampy soils cover around 19% of the total territory of exploitable soils. Erosion also occurs as a problem. A few useful minerals have been produced from open mines.

The climate is influenced mainly by air masses from the Atlantic. The climate in Latvia is humid and mild. The weather of some 200 days a year is created by cyclones. Western and South-western winds are dominant and rapid changes of weather are common. The average temperature is 2.5-7.5°C below zero in January and 16.5-17.5°C above zero in July. Annual precipitation, 500mm in the plains and 800mm in the highlands, exceeds the rate of potential evaporation by 1.5 times (see Figure 1). Summers are rather cool and rainy, but winters warm. There are many cloudy days.

The territory of Latvia is situated at the transient natural region with European temperate hardwood forest and circumpolar boreal coniferous forest the most natural vegetation in Latvia. The dominant species are pine, spruce and birch, as well as oak and lime forests. Special protection is arranged for outstanding trees. 25% of the forests covering 43% of the territory of Latvia are wet forests.

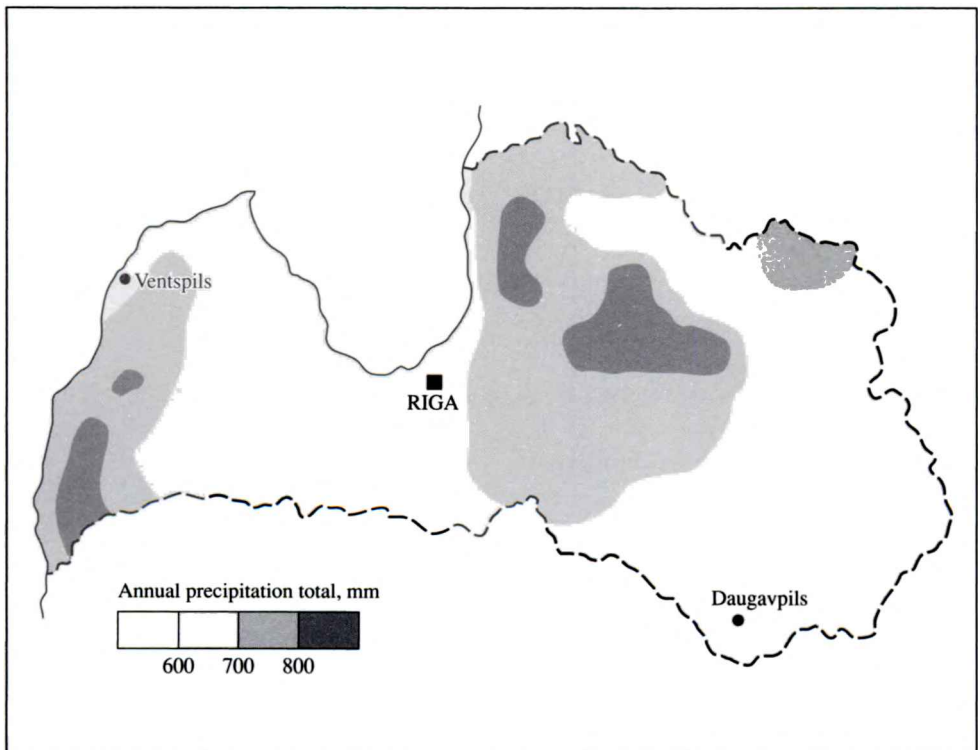


Figure 1. Rainfall in Latvia (*NOPEF Latvia, 1991*)

Latvia

In 1561 Livonia was divided: Courland became an autonomous duchy under the Polish crown. The other part was incorporated into Poland under the name Inflanty, but later the northern part of Vidzeme came under the Swedish crown by the Truce of Altmark (1629). During the 17th century the Duchy of Courland flourished due to economic reconstruction and trading, and the large fleet of war and merchant ships even secured two colonies - Tobago Island in South America and Gambia in Western Africa.

Peter I the Great got to 'break the window' to the Baltic Sea after merciless devastation of the territory, annexing Vidzeme from Sweden under the Peace of Nystad (1721). Latgale was annexed by the Russians at the first partition of Poland (1772), but the last part of Latvia - Courland - was not annexed until the third partition (1795). The peasants of Courland and Vidzeme gained personal freedom (in 1817 and 1819 respectively) but no rights to buy or own the land until the 1861 Russian Empire Land Law.

With the development of Latvian societies through education, wide publication of journals and textbooks in Latvian, and the accumulation of a rich national cultural heritage, the awakening of Latvians came, although still pressed by the German aristocracy and merchants from one side and the Russian administration from the other. The idea of an independent Latvian state was openly put forward as early as during the Russian Revolution of 1905.

Only at the end of the First World War did the Latvian People's Council proclaim independence, on 18 November 1918. The period of independence and national growth was short as, due to the secret agreement with Germany, Soviet troops occupied Latvia in 1940, followed by Latvia's incorporation into the USSR. After restoration of the Soviet regime and mass deportations of Latvians, enormous migration of Soviets and russification of Latvia began.

Extensive development of industry and agriculture, mass immigration of people and also rapid urbanization has now resulted in an economic crisis and pressure on the environment.

Nature

The nature of Latvia is determined by its geographical location in a region with mixed coniferous and deciduous forests in the western part of the East European plain on the eastern coast of the Baltic Sea. The land surface was formed in the quaternary glacial period and the littoral areas were formed more recently by several stages of the Baltic Sea development, with moraine, sand and clay sediments but mainly from fundamental rocks below them. There is also karst at the dolomite and gypsum distribution.

The Latvian landscape has been formed by the interaction of natural and man-made environments. The ancient human settlements already existed eleven thousand years ago and two thousand years later man's influence on nature began to be evident.

The land is undulating plains (median elevation - 87 metres) with fairly flat lowlands - 74% of the territory are plains, 26% highlands. The eastern part of Latvia is more elevated

INTRODUCTION

History

The Republic of Latvia was formed as an independent and sovereign state in 1918 and in the short period of time before the Soviet occupation in 1940 it achieved remarkable success in industry and agriculture, culture and education as well as other spheres. To understand the current socioeconomic and political conditions, the influences upon, and traditions of, nature conservation, we should look at Latvia's history.

The very first settlements in the territory of Latvia appeared around 9,000BC. The Latvians came from four ancient tribes - the Kurs (Couronians), Latgals (Latgallians), Zemgaels (Semigallians), and Selonians - as well as Livs from the Finno-Ugro group. The Finno-Ugro group lived in the territory of modern Latvia and, together with Lithuanians and Old Prussian tribes, formed the group of peoples known as the Balts which entered this territory around 2,000BC. The Latvian language belongs to the Baltic group of Indo-European languages. The ancient amber trade was the first historically documented connection between the Balts and the Mediterranean world, especially in the first two centuries AD. Expansion of the Slavs over eastern Europe reoriented the Balts towards their Scandinavian neighbours for trade and cultural relations.

In the 7th to 11th centuries Latvian tribes struggled against pressures from the Scandinavians and Russians. In the mid-12th century German expansion reached the Baltic territories. Germans called the country Livland, as the Livs inhabited the coastal areas (in Latin - Livonia). The German Order of the Knights of the Sword was founded in 1202 but after full defeat in 1236 by Lithuanians and Zemgals, they merged with the Knights of the Teutonic Order, establishing the Livonian Order. Only at the end of century did the Order succeed in conquering all of the Latvian tribal kingdoms, but the last Zemgals left for Lithuania unconquered and the Livonian Confederation was established. It was formed by the Teutonic Order, the archbishopric of Riga, and the free city of Riga which lasted for more than three centuries. The indigenous nobility was abolished and the rural population forced to pay tithes and taxes to their German conquerors. The city of Riga built in 1201 gained prosperity through joining the Hanseatic League in 1282. The Livonian Confederation covered the territory of modern Latvia and Estonia (inhabited by the Finno-Ugro tribes). The destiny of other Baltic tribes differed: the Old Prussians were conquered and assimilated but the Lithuanians saved their independent kingdom.

By the end of the Livonian Confederation in the 15th to 16th centuries Latvians became chattels of their landlords and we could consider this the time of formation of Latvians as a population. Reformation of the Catholic church in the 16th century allowed the establishment of the first Latvian schools and stimulation of the Latvian written language.

Latvia

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IUCN EAST EUROPEAN PROGRAMME

Environmental Status Report 1993

LATVIA

Compiled by

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Environmental Protection Committee

IUCN East European Programme, Cambridge, 1993

Estonia

YEAR	EVENT (author, organization, etc.)	RELEVANCY
1990	West-Estonian Archipelago Biosphere Reserve	The first Biosphere Reserve in Baltic Countries declared; largest in northern Europe on more than 400 islands of West-Estonia
1990	'Ancient Nature of Estonia'	The first parts of the data book of inanimate natural objects were compiled
1991	Estonian Fund For Nature	Parallel national organization to the WWF founded
1992	UNCED in Rio de Janeiro	Participation of the official Estonian delegation in the work of world-wide forum of environment; publication of 'National Report to UNCED 1992'
1992	Constitutional obligation to protect the environment	Approval of the new constitution which includes a paragraph concerning everyone's obligation to protect the environment

Environmental Status Report 1993

YEAR	EVENT (author, organization, etc.)	RELEVANCY
1973	Monograph 'Nature Conservation'	A world-wide monograph (836 pp., 296 ill.) edited by Dr. E. Kumari. Major influence on development of nature conservation in Estonia
1978	Estonian Ecological Conference	Ecological conference concerned with current ecological problems (follow-up conferences: 1982, 1985, 1988, 1991; initiator Prof. T. Frey and Prof. H. Trass)
1978	Estonian National Committee of the MAB	Association of Estonian ecologists and other environmentalists with UNESCO Man and Biosphere Program (first president Prof. H. Trass; at present Dr J. Martin)
1979	The first edition of the 'Red Data Book of Estonia'	First revision of Estonian living organisms from position of international Red Data Book principles
1983	The Tallinn Declaration	The declaration about harmony of nature and art adopted by IUCN international education forum
1987-1988	The 'Phosphorite war'	Hard political struggle against Soviet ambitions to exploit Estonian phosphorite deposits
1988	Estonian Green Movement	First nationwide environmental NGO organized; member of FoEI since 1989
1988	The Republican Environmental Programme	The first document concerning state environmental policy was adopted by Supreme Council
1989	'Environment '89'	First official realistic overview of Estonian environmental status published
1989	Conference 'Our Common Baltic Sea'	Initiation of the Coalition Clean Baltic at international conference of environmental NGOs in Pärnu
1990	Coalition Clean Baltic (CCB)	NGO environmental network of the Baltic Sea countries founded in Lohusalu
1990	Act of Estonian Nature Protection	A general law on nature and environmental protection

Estonia

YEAR	EVENT (author, organization, <i>etc.</i>)	RELEVANCY
1938	The second Nature Protection Law	The first act extended to include parks and greenery
1950	Puhtu Zoological-Botanical Reserve	First nature reserve after World War II, administered by the Institute of Zoology and Botany, Academy of Sciences
1951	Section of Nature Protection by the Naturalists' Society	Section re-established; conservation activities initiated
1955	Commission of Nature Protection founded by the Estonian Academy of Sciences	Scientific centre of activities in the field of nature protection (first chair Prof. E. Kumari; at present Prof. A. Järvekülg)
1957	The third Nature Protection Law	The first nature conservation Law on territory of previous USSR
1957	Government's executive decree of nature protection	Established (mainly: re-established) four state nature reserves and 28 other protected areas; re-established government institution of nature protection: The Nature Protection Board
1958	Student's Circle of Nature Conservation in Tartu	The first academic students' nature conservation organization founded (scientific supervision by J. Eilart)
1958	Nature protection as curriculum subject	Special nature protection courses introduced as part of the curriculum of Tartu University and Estonian Academy of Agriculture
1966	Society of Nature Protection	A popular organization of nature conservation and heritage with many thousand members was established (initiated by J. Eilart)
1966	The Ministry of Forest Management and Nature Protection	Forestry and nature conservation administrations joined
1971	Lahemaa National Park	First national park within the former USSR, meant for protection of both nature and traditional way of life on the north coast of Estonia

APPENDIX 1: CALENDAR OF EVENTS IN THE HISTORY OF NATURE PROTECTION IN ESTONIA

YEAR	EVENT (author, organization, etc.)	RELEVANCY
1851-1852	K.E. von Baer	Ideas on protection of the Lake Peipsi (Peipus) fish stock
1853	Naturalists Society	Centre of nature research and initiator of the nature protection measures founded
1869, 1878, etc.	C.R. Jakobson	Reflections on necessity of protection of forests and natural areas around farms
1879	G. Helmersen	Proposals to protect large glacial erratic boulders
1906	A. Toom	Initiated bird protection on Vaika Islets west of Saaremaa Island
1910	Vaika Ornithological Reserve	First Nature Protection Area in Estonia established
1913	A. Khrebtov	Established the Society of Nature Friends of Saaremaa; distribution in schools of 'instruction' of nature protection
1920	Special Commission of Plant Geography and Nature Monuments by the Naturalists' Society	Scientific centre for elaborating principles of nature protection and collecting data on items in need of protection (first chair Prof. F. Bucholtz)
1924-1930	Nature reserves	Establishment of new nature reserves (Harilaid, Linnulaht, Abruka, etc.)
1929	Proposal of Nature Protection Law	First attempt to enact nature protection law, proposed by Prof. A. Mathiesen
1935	State Nature Protection Council	First government institution for scientific direction of nature protection, chaired by Prof. T. Lippmaa
1935	Nature Protection Law	Nature protection law, initiated by Prof. T. Lippmaa, adopted by government
1936	State Inspector of Nature Protection	First government administrator on nature protection appointed (Dr. G. Vilbaste)

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under way already. The fields of cooperation include development of legislation; training of staff; problems related to hazardous waste, water and air protection; environmental, especially nuclear safety, etc. Existing contacts with the other Baltic states, Latvia and Lithuania, are continued as the problems they face are often similar. In contacts with Russia, problems related to the oil shale area and Lake Peipsi on the border are of high importance. One of our major concerns is currently environmental safety related to the retrieval of illegal foreign military forces from the territory of Estonia.

Estonia is currently on its way to becoming a member of a number of **international environmental organizations and conventions**. The consideration of the requirements of some already existing conventions, e.g. these of Ramsar (1971), Washington (1973), Gdansk (1973), Bonn (1979), Bern (1979), Geneva (1979), Vienna (1985), Basel (1989), has been discussed on the state level; a number of others are being considered. Of the international organizations, Estonia has joined the Intergovernmental Oceanographic Commission, the International Maritime Organization, and is currently in the process of joining the World Meteorological Organization, the World Conservation Union (IUCN) and the International Council for the Exploration of the Sea.

Estonia is ready and willing to participate in wide-ranging international cooperation for dealing with the most critical environmental problems, in spite of our current economic difficulties originating from the recent past. We have professional and experienced staff and are willing to become better informed about the experiences of the other countries. This would contribute to the efficiency of solving the problems common to the citizens of the world.

CHAPTER 4: OPPORTUNITIES FOR REGIONAL AND INTERNATIONAL COOPERATION

The geographical location of Estonia and the specific character of environmental problems are a relatively good basis for wide-scale international cooperation.

The regaining of independence in August 1991 created the possibility of taking part in cooperation programmes and activities at the sovereign state level. As a result, Estonia is now participating in the processes of environmental cooperation at different levels. At the global level this concerns the United Nations and the UNCED process. At the regional level contacts could conditionally be divided into these within Europe (e.g. through the UN ECE (of which Estonia is a member), the Council of Europe, the Commission of the European Communities) and within the Baltic Sea region (e.g. participation in the Baltic Marine Environment Protection Commission, HELCOM). Besides multilateral cooperation, Estonia is also a party to bilateral contacts.

Priority is given to **regional cooperation** with the states around the Baltic Sea. Within this region, Estonia has been, since 1992, a member of the Convention on the Protection of the Marine Environment of the Baltic Sea Area, in which its experts have been participating since its very beginning. Parallel to the signing of the new Helsinki Convention in April 1992, the Baltic Sea Environmental Declaration, which recognized the necessity to implement the Joint Comprehensive Environmental Action Programme, was approved. This programme, developed by the HELCOM *ad hoc* high level Task Force, aims at facilitating the restoration of the ecosystem of the Baltic Sea through the concerted efforts and activities not only of the states within the catchment area, but also of four international banks (the World Bank, the European Bank for Reconstruction and Development, the European Investment Bank, and the Nordic Investment Bank). Efficient coordination is especially necessary for coping with 'hot spots' in the relatively less-well-off areas, as the results have an impact on the state of the environment on a wider scale.

Although cooperation at the state level has only been possible since 1991, it would be wrong to say that no joint activities had been carried out before that. On the contrary. For example, for over a decade Estonian specialists have been actively participating in the working groups of HELCOM, although officially through the Soviet Union; the post of the Chairman of the HELCOM has for some years been held by Prof. Velner from Estonia. In a number of other international organizations our country was also represented through Estonians as members, independent experts or observers. Working contacts existed between experts and scientific institutes of Estonia and the neighbour states.

As regards **bilateral cooperation**, Estonia has signed agreements concerning environmental cooperation with Denmark, Finland, Sweden and Germany. With these agreements a framework has been established for particular projects, a number of which are

accumulated in landfills through decades. A considerable share of those is related to enterprises belonging to the military industrial complex or the military bases of the former USSR. Damage caused to nature and the environment by military activities is at present unidentified to a large extent.

Due to the radical changes in the economy, completely new nature conservation problems have arisen. Land and forest privatization as well as changes in land ownership means that conservationists must urgently take measures to set aside the most valuable territories and objects. This is necessary to adapt new cost-effective economical, juridical and administrative measures to protect the existing network of natural areas.

The means of carrying out environmental policies in practice include **promoting environmental awareness**, improving scientific and educational activities, facilitating public (especially youth) participation in the solving of environmental problems and encouraging the activities of non-governmental organizations .

At present one of the most acute questions regarding military pollution concerns the town of Paldiski. Only lately has it become known that two nuclear reactors have been operating in the Soviet submarine base (with a total capacity of 160 MW, according to available data). However, data concerning refilling times and radioactive waste management are not available as they are considered classified information of military importance. It is necessary that the military base be opened for international expert inspection.

In order to decommission the reactors and take them out of Estonia in a way which is safe for both public health and the environment, it is necessary to carry out **expert assessments** of the documentation at all stages of the decommissioning-project, the actual decommissioning, and the situation on the spot once the reactors have been dismantled and removed.

3.8 Priorities and Future Tasks

The main goal of environmental policy is the providing of preconditions for Estonia's long-term and sustainable development, safeguarding the state of the environment and natural resources necessary for this. The Estonian government considers the **development of the appropriate legislative basis, setting of environmental quality standards, and application of efficient economic measures** the priority objectives for achieving this.

The former USSR legislative acts and standards which have been used up to now do not facilitate the achievement of the aforementioned objectives as they fail to meet the needs of the developed society, differ from the ones used in the neighbouring and other European states, and are often based on different principles. Activities are under way for the development of legislation and criteria which would correspond to the ones used within the European Communities and foresee the gradual reaching of the aims.

The speed of reaching the higher environmental standards is determined by economic and technological possibilities. The priority objective in this sense is the reorientation of Estonian industry towards up-to-date low-waste and environmentally friendly technologies, in cooperation with industrially highly developed countries. This especially concerns the pulp and paper industry, the chemical and construction materials industry and energy production. The sparing and efficient utilization of our energy resources influences not only the state of the environment in our country and the neighbouring regions but the development of Estonia as a whole.

Considering that Estonia is joining regional organizations for the protection of the Baltic Sea, it is essential to guarantee treatment of industrial as well as domestic waste water according to safety requirements. In the case of the semi-enclosed Baltic Sea this means not only biological treatment but also removal of the nutrients phosphorus and nitrogen. The development of an efficient monitoring system which would provide results comparable to data from neighbouring areas and give a representative picture of the state of water and air environment, soils, sediments and wildlife, is also among the priorities.

The factors endangering public health and the state of the environment to the highest extent are currently industrial wastes, including toxic and radioactive substances, which have

Estonia

Military pollution within Estonia includes:

- pollution of surface water, groundwater and soils due to leakages from fuel pipelines (e.g. at the military airfields in Pärnu, Tapa, Tartu);
- pollution of and danger to bottom sediments and water via dumping of out-of-date explosives and weapons (including chemical ones) into the sea (unofficial data refer to such activities off the coast);
- noise pollution at the larger airfields (e.g. in Tartu and Pärnu, the second and fifth largest towns in Estonia);
- air pollution caused by the burning of aircraft fuel;
- mechanical damage caused to soils and landscape at the military training areas (e.g. within Kõrvemaa, between the National Park and the Kõrvemaa Landscape Reserve in the island of Pakri, not far from Paldiski);
- radioactive pollution (e.g. in the Sillamäe plant on the north-east coast and in the military port of Paldiski).

Problems encountered when coping with military pollution are largely due to lack of information. Data concerning military activities have been strictly classified information. Therefore we do not have a sufficient overview of military pollution and the damage it has caused; it is difficult (often impossible) to assess the scale of damage and choose appropriate measures.

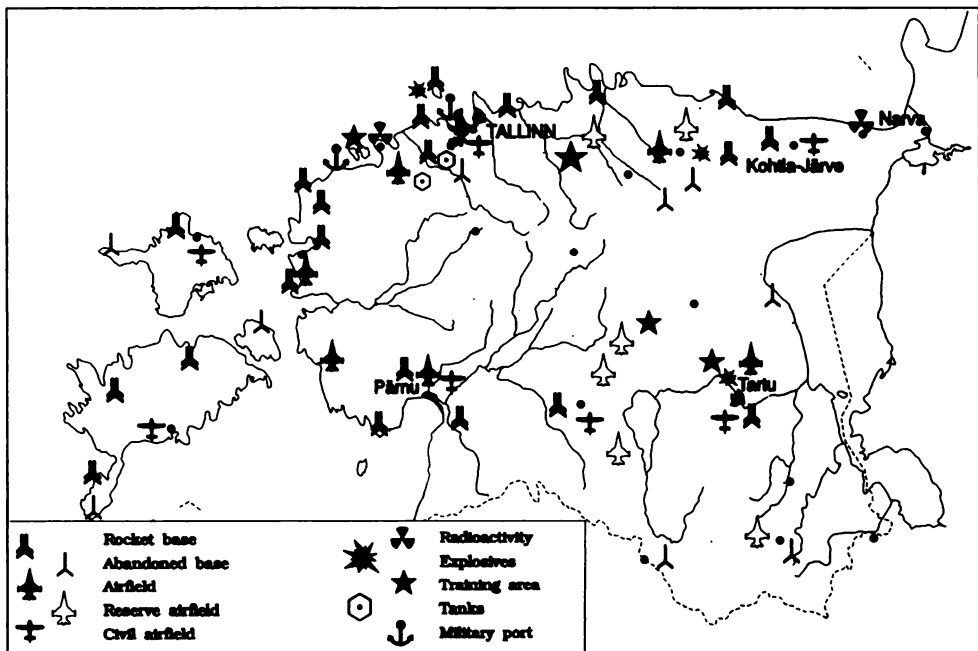


Figure 14: Russian military areas within Estonia

Due to a polluted environment and psychological stress, human life expectancy at birth is lower than the average for the climatic zone, being 74-75 years for women and 65-66 years for men. A relatively high frequency of suicides (nearly 30 cases per 100,000 inhabitants between 1980 and 1990) is also characteristic to Estonia. The number of physicians per 10,000 inhabitants was 41.1 in the beginning of the 1990s.

Unfortunately statistical data concerning relationships between the state of the environment and health are relatively scarce at present, and statistical treatment of these data is often unsatisfactory. Reasons for this include the following: for years data concerning this issue has been regarded as classified information and could not be published in full; the migration rate has been too high and a considerable share of immigrants come from areas with highly different environmental and cultural backgrounds and traditions.

Among causes of death, cardiovascular diseases account for 60.6%, cancer for 16.3%, accidents and other causes for 10.5% of the cases.

At detailed investigations in the most polluted area, north-east Estonia, the following health problems have been observed in children with a higher than average frequency:

- abnormal functioning of the cardiovascular system;
- allergies;
- baldness;
- anaemia;
- abnormalities in the development and health of bones.

In the same area the frequency of respiratory diseases in adults was 1.2 times higher, of cardiovascular diseases, 1.5 times higher and of premature birth, 1.7 times higher than in other regions. Adverse effects on human health can result from long-term exposure to PAH compounds and heavy metals emitted in various forms from oil shale processing plants and power plants.

Since a lot of questions concerning environmental and living conditions in Estonia as well as the dependence of public health upon these conditions are not yet clear, further research is necessary.

3.7 Military Safety

Priorities for the near future include the assessment of damage caused within territories which have been occupied by the former Soviet Army regiments. According to official data, these areas cover over 83,000ha (1.8%) in Estonia. As the army leaves the country, there is a need to assess the damage caused by military activities to surface- and groundwater, soils, landscapes, etc. Negotiations currently under way between Estonia and Russia (which has claimed jurisdiction over the former Soviet Army) include resolving complaints concerning compensation for damage caused during the military occupation of Estonia (Figure 14).

Table 9: Hazardous waste produced by Estonian industry in 1990 (in tonnes).

(Source: *Environment '90*)

Types of waste	Produced in 1990	Dumped in special sites
Waste of galvanic production	1,478	88
Waste and sediments containing chromium	8,384	31,383
Waste containing: vanadium	396	477
mercury	60	37
other heavy metals	646	10
arsenic	870	6,186
phosphorus	460,000	9,410,000
Waste and sediments containing fluorine	35,009	565,251
Waste from batteries and accumulators	575	63
Waste of inorganic acids	698	629
Alkaline waste	30,253	29,212
Waste containing asbestos	1,604	1,603
Waste containing sulphur compounds	203,800	1,222,901
Sludge from sewage treatment plants		
containing toxic substances	74,973	121,573
Utilized mixes from metal production	10,322	50
Waste and sediments from chemical and metal production	45,000	9,000,000
Waste and ash from oil-shale production	10,465,590	230,104,203
Acid gudrones	4 227	
Waste containing cyanic compounds	7	7
Waste of oil and oil products	10,278	2,434
Mud and sediments containing oil	3,130	5,365
Utilized dissolvents	243	1,708
Waste of paints and varnish	264	160
Waste containing phenols	2,584	37
Waste of surface-active substances	113	16
Utilized cooling liquids	991	405
Waste containing formaldehyde	948	879
Tar, pitch, resins	3,307	15,949
Poisonous chemicals and pesticides	12	65
Polyester resins	101	30
TOTAL	11,367,028	250,527,156

3.5 Waste

Reconstruction of the currently out-of-date industrial enterprises with inefficient production patterns and equipment, and the replacement of large farms with smaller ones alone do not solve the environmental problems of Estonia.

As a result of an inadequately planned economy, some 250 million tonnes of industrial, agricultural and domestic waste have been piled onto Estonian land. Another 15 million tonnes of waste are added to it yearly.

Waste materials of oil shale mining and processing cover thousands of hectares; there are waste heaps with relative heights exceeding 100m. They contain a number of compounds easily washed out by rain, including toxic heavy metals and organic compounds. The latter include large amounts of phenols which are washed into the Baltic Sea.

In Sillamäe, radioactive waste from the chemical and metal production plant which formerly belonged to the Soviet military industrial complex (and had earlier been dealing with uranium), has been dumped in a valley on the coast of the Gulf of Finland. The dump contains an estimated 1200 tonnes of uranium and 750 tonnes of thorium; the activity of the radium exceeds 7kCi. The radioactively polluted area covers over 100ha, and has an impact on the health of local inhabitants. Since the yearly amount of precipitation considerably exceeds evaporation, the washed-out toxic compounds can reach both the groundwater and the sea. Risk assessment needs to be carried out and a safe solution found for the conservation of the area. Swedish and Finnish experts are helping to deal with these problems.

In addition to those landforms, there are another 400 landfill sites for industrial and domestic waste (covering over 550ha in total) which in most cases do not meet environmental protection requirements, and which contain some highly toxic elements (e.g. mercury, arsenic).

Attempts at coping with the waste problem include the publishing of an inventory of hazardous waste produced by over 800 enterprises in 1990 (Table 9), the establishment of a waste tax within the system of pollution taxes, the compilation of the Waste Classifier for Estonia, and the development of the Waste Management Act in 1991. The goal is to find a safe way to re-use or store all types of waste.

Part of the industrial waste (e.g. paper, scrap metal) is re-used; a share of oil shale fly-ash from power plants is used in the production of building material and for liming fields. The first businesses dealing with re-use of hazardous waste have been established, e.g. a plant for the utilization of mercury lamps and some small-scale oil shale waste incineration plants. However, only a narrow range of waste materials is dealt with.

3.6 Public Health

In recent decades both the birth rate and death rate in Estonia have been relatively high compared with the rest of Europe, being between 14-16.5% and 11.6-12.6%, respectively. The natural growth rate for this period was 2.9-4.3%.

- Bottom sediments of the Purtse River which flows into the Gulf of Finland contain polycyclic arenes, some of which are carcinogenic, in concentrations up to 300 g/kg (the Maximum Permissible Concentration is 20g/kg).
- In the upper layers of the bottom sediments of some lakes in north-east Estonia the concentration of heavy metals exceeds the background levels more than a thousandfold (Figure 13). All the polluted sites are secondary sources of pollution, so-called 'chemical time bombs', causing problems for a long time after the removal of active pollution sources.

Mineral fertilizers and pesticides which have been used in large-scale agricultural production are another secondary source of pollution. Depending upon the mechanical structure and physical-chemical properties of soils as well as the self-purification capacity of the environment in a particular area, parts of the compounds or their permutations will continue to enter the water cycle for a long time.

Large amounts of water which fill in the abandoned mines will remain in direct contact with groundwater. There are already a number of closed oil shale and phosphorite mines in northern Estonia, some tens of kilometres from the Gulf of Finland. They contain an estimated 40 million m³ of water with high concentrations of chemical components such as toxic metals and organic compounds. These polluted reservoirs will continue 'feeding' the groundwater and the Baltic Sea with pollutants for decades. At present it is not possible to predict which processes and which new combinations of compounds will appear in this system.

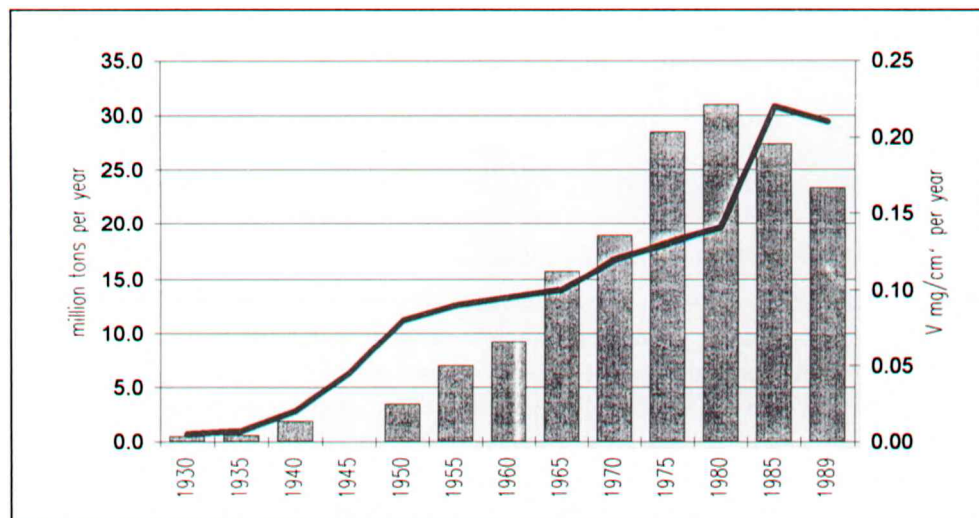


Figure 13: Production of oil shale and influx of vanadium into lake sediments in north-east Estonia. The total amount of mined oil shale is in direct correlation with the influx of some heavy metals into lake sediments. (Source: National Report of Estonia to UNCED, 1992)

between Kiviõli and Narva has caused the drying of a number of wells taking water from the Ordovician layer, and groundwater pollution with sulphates, phenols and other hazardous compounds. Due to overconsumption as well as mining activities in the neighbouring area, groundwater level has sunk dangerously in the Kurtna Landscape Reserve in north-east Estonia.

3.4 Soil and Sediments

Soil pollution is closely related to other environmental problems in Estonia, with air deposition and leaching from waste dumps accounting for a large share of pollutants.

Regional pollution can be detected around the industrial area in the north-east of Estonia. The main sources of pollution include wet and dry deposition of air pollutants originating from power plants, waste from the chemical and construction industries, leaching from oil shale ash used for liming of field soils and leaching from waste depots which contain ash from the thermal power plants, residues of oil shale processing and waste from chemical and metal production (including radioactive compounds in some places). The main pollutants include cement dust, phenols, benz(a)pyrene, sulphur and nitrogen compounds and some metals. The natural concentration of some elements (Pb, Cr, B, U) is high in this area, adding to external pollution loads. In some areas (Sillamäe, Maardu) radon originating from the surface is having a considerable effect on local radiation levels (reaching 5000 Bq/m³ in places, according to the measurements of the Estonian Building Research Institute). The stable compounds are especially dangerous as they enter the food chains, accumulating at the higher trophic levels.

In a large part of Estonia soils are damaged by the use of heavy agricultural machinery unsuitable for the local conditions. Land improvement activities which have been carried out over huge areas during the collectivization period have also influenced the structure and water and oxygen content of soils. Diffuse runoff of nutrients originating from (over-)use of mineral fertilizers has caused high concentrations of nitrogen-compounds in the soil and groundwater.

Due to changes in agricultural practice (re-establishment of small-scale farms), fertilizers, pesticides and other chemicals dangerous to soil quality will probably not be used intensively over the next few years. But this situation is bound to change, therefore measures to prevent overuse of chemicals need to be taken beforehand.

Areas with local soil pollution include those of the former Soviet Army territories (airstrips, training areas, areas around fuel pipelines); land under and around petrol (gasoline) stations and car-repair garages.

There are billions of tonnes of sediment in the bottom of rivers, lakes and bays. The upper layers of the sediment reflect industrial development which has mostly disregarded environmental problems for decades; they contain a number of compounds with varying degrees of toxicity, the concentration of which exceeds the background levels ten- to a hundredfold. Some examples follow.

Rakvere, as well as a number of smaller-scale biological treatment facilities in smaller settlements, have been put into operation in recent years.

Although there has been no considerable rise in phosphorus levels in the sea, long-term observations indicate a continuous increase in the phosphorus content of seawater in the Gulf of Finland. This demonstrates that phosphorus levels in the Gulf have not stabilized so far. Estimations calculated with the use of the FINEST model (based on equations of hydrodynamics and the model of water ecosystem) show that even if phosphorus levels are reduced by 50% in the years 1995-2000, stabilization can only be expected between 2020 and 2030.

However, some facts are encouraging. The concentration of a number of toxic pollutants such as PCBs, DDT, oil and oil products, which reached its peak in the 1970s, is steadily decreasing in the Baltic Sea. One of the results is the stabilization of the decrease of seal populations. The concentrations of DDT and polychlorinated hydrocarbons (including PCBs) in sea plants on the Estonian coast has decreased two to four times in 1983-1989.

Insufficient sewage treatment has considerably reduced the value of Estonian beaches as recreational resources. The sanitary-hygienic conditions of some beaches as assessed according to microbiological characteristics (*coli*-index) does not meet international requirements. Therefore a number of beaches have not been suitable for bathing and swimming in the last summers.

For reduction of point-source pollution, economic measures have been taken into use: water pollution taxes introduced in 1991 aim at encouraging polluters to take measures for protection of the environment. The solving of diffuse pollution problems is more complicated.

3.3 Groundwater

Groundwater suitable for drinking is one Estonia's most important natural resources. In 1991, the total consumption was 175 million m³, covering two-thirds of the demand for drinking water. In rural settlements and most of the towns, groundwater is the main source of water supply. Only in Tallinn and Narva does treated surface water contribute significantly to the amount of water consumed (260,000m³ in total) as the local groundwater reserves are unsufficient.

Due to pressure from human consumption, the state of groundwater in Estonia has worsened considerably in recent decades. Therefore the groundwater supply has to be reorganized in some places.

Nitrate pollution of the upper groundwater layers caused by runoff from fertilizers and carelessness in the management of agricultural stores has been detected within nearly half of the Estonia. This particularly affects the rural population who get most of their drinking water from shallow wells.

Groundwater pollution with oil products and other pollutants has been detected near Tapa, Jäeneda, Tamsalu, Väike-Maarja, Vasalemma, Rapla, etc. Oil shale mining in the area

One of the main decisions was passed in 1988, foreseeing a reduction in the level of sea pollution by 50% by 1995, especially with regard to heavy metals, organic compounds and nutrients.

Since the whole of Estonia lies within the Baltic Sea catchment area, all of its pollutants and their by-products will inevitably end up in the sea.

Most of the pollution originating from Estonian waters (Figure 12) is carried into the Gulf of Finland. This is one of the largest gulfs of the Baltic Sea, making up 7% of its water area, but is shallow and has quite a modest volume - approximately 1100km³. The pollution levels in the gulf are determined by the dominating currents - water masses mostly move eastward at the Estonian coast and westward at the Finnish coasts.

The mean annual flow from the mainland of Estonia into the Baltic is c. 475m³/s, sewage making up 17m³/s (3.5%) of this. What does the waste water contain?

Many towns and settlements lack sewage treatment facilities. Besides, only a few biological-chemical sewage treatment plants are currently in operation in Estonia. Therefore biological pollution equivalent to 44 thousand tonnes of biological oxygen demand (BOD) is carried into the Baltic Sea, in addition to some 285 tonnes of oil products and between 100-300 tonnes of phenols. The inflow of nutrients (nitrogen and phosphorus) is especially important for the coastal waters where eutrophication processes are increasingly intensive.

Environmental protection measures have been strengthened in most of the Baltic Sea states. In Estonia biological-chemical waste water treatment plants of the towns of Pärnu and

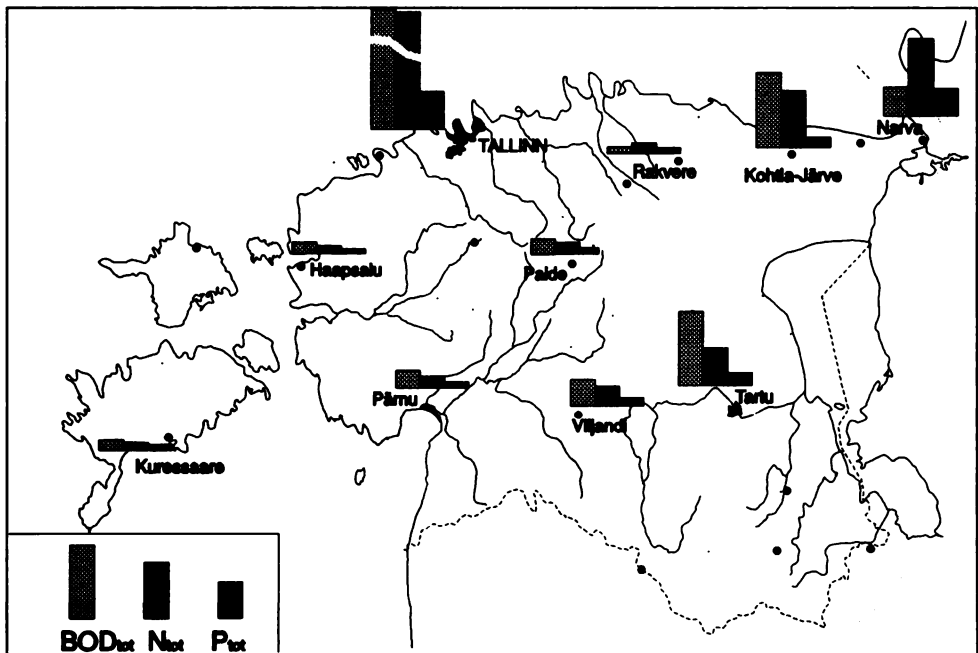


Figure 12: Water pollution levels discharged by Estonia.

pollution is the dominant kind of pollution as regards some heavy metals and toxic organogenic compounds.

As has already been mentioned, the impact of atmospheric pollutants imported from industrialized neighbour states via transboundary pollution can also be detected in Estonia. For example, high acidity (pH) of precipitation has been recorded in south-western and southern Estonia, regions which have no considerable air pollution sources of their own.

The time when states attempted to improve their atmospheric conditions by constructing higher chimneys is past. It is clear that the problem of clean air can only be solved through joint efforts. Changes in Estonian energy consumption have been proposed (Figure 11).

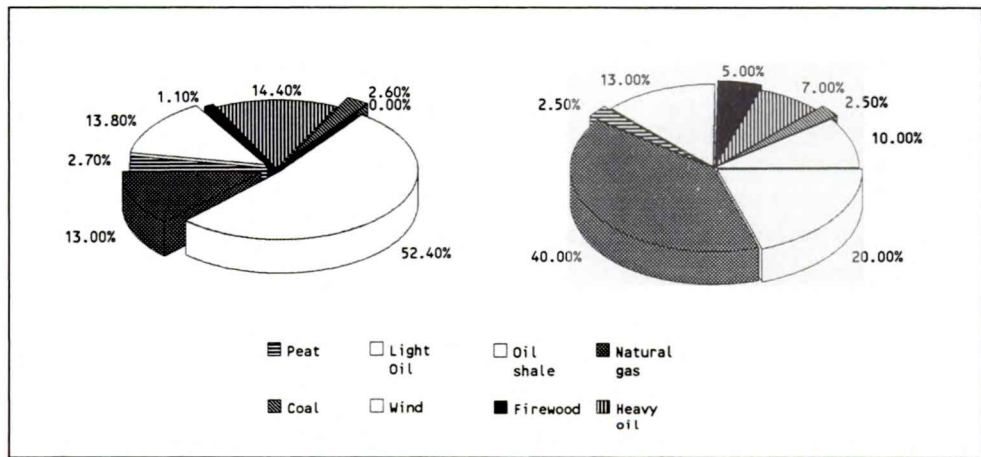


Figure 11: Energy consumption in Estonia in 1990 (left) and a proposed sustainable alternative for 2020 (right). (Source: *National Report of Estonia to UNCED, 1992*)

3.2 Water

The Baltic Sea is a semi-enclosed sea in the Atlantic Ocean, lying between central and northern Europe. Due to its hydrological regime (shallow water and restricted water exchange with the ocean), the sea is very sensitive to pollution. In the water catchment area of the Baltic Sea (with an area of 1,550,000km²) there are ten states, including regions with highly intensive industry and agriculture as well as large industrial, scientific and cultural centres with a population of over 70 million. The Sea has been feeding and connecting them for centuries: for instance, in the Middle Ages it was the trading route of the Hansa League, a trading and economic union of towns on its coasts. In the last few decades a new common problem has emerged - the need to worry and take care of the future state of the sea environment. The fact that the future of the sea is a problem shared by all countries on its coasts is demonstrated by the Baltic Sea Convention (Convention on the Protection of the Marine Environment of the Baltic Sea Area) approved in 1974, of which the Estonian Republic has been a member since 1992, and a new (1992) Helsinki Convention. According to this convention, Estonia adopted joint responsibility for the implementation of decisions.

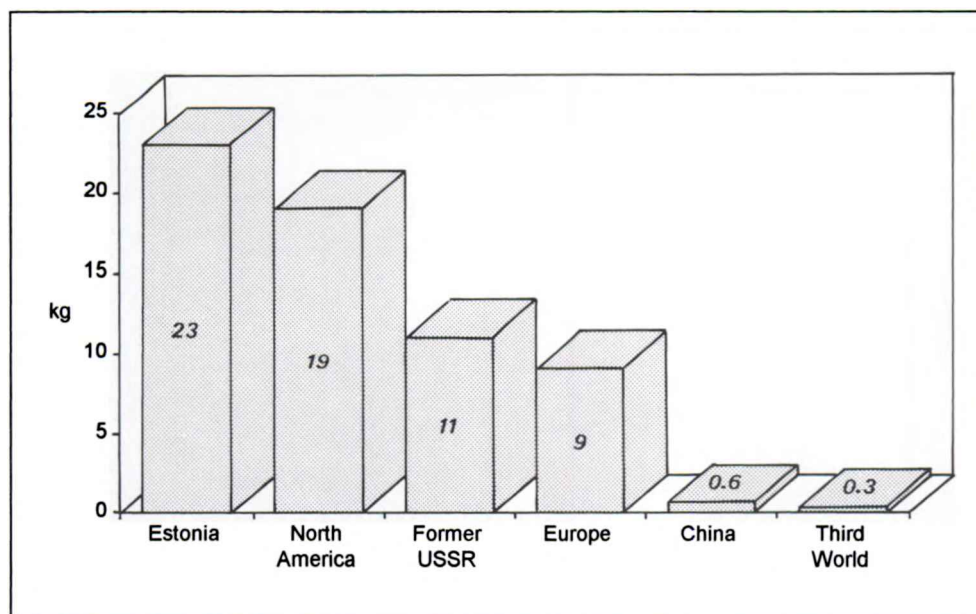


Figure 10: Production of CO₂ per capita
(Source: National Report of Estonia to UNCED, 1992)

100mg/m² to the total annual load of sulphur in southern Finland and up to 30 mg/m² in central Finland.

Serious environmental problems are caused by some 300,000 tonnes of dust emitted into atmosphere annually, approximately 200,000 tonnes of which originates from the chimneys of the power plants and contains mostly oxides of alkali and alkaline-earth metals, due to which the pH of precipitation is alkaline in the vicinity of the plants. In addition to this, fly ash contains heavy metals, including the toxic ones, in relatively high concentrations: for instance, some 50 tonnes of lead, 30 tonnes of mercury, 30 tonnes of zinc and 20 tonnes of copper are emitted annually.

Some 90% of the pollutants remain within 30km of the pollution sources through dry and wet deposition. Within this area the annual deposition is approximately 70g of fly ash, 200mg of lead, 135mg of mercury, 115mg of zinc and 80mg of copper per square metre. Besides inorganic compounds, the stationary pollution sources of north-east Estonia annually emit more than 8000 tonnes of organogenic substances, including over 5000 tonnes of hydrocarbons, some 2000 tonnes of benzene, 1000 tonnes of toluene, and other toxic compounds. The impact of these large amounts of pollutants is reflected in Estonia via eutrophication of water-bodies, degradation of bog areas, changes in the structure of natural plant communities, as well as worsening of the state of public health.

Since due to prevailing winds the main share of atmospheric emission (and therefore airborne pollutants) is transported in the direction of the Gulf of Finland, atmospheric

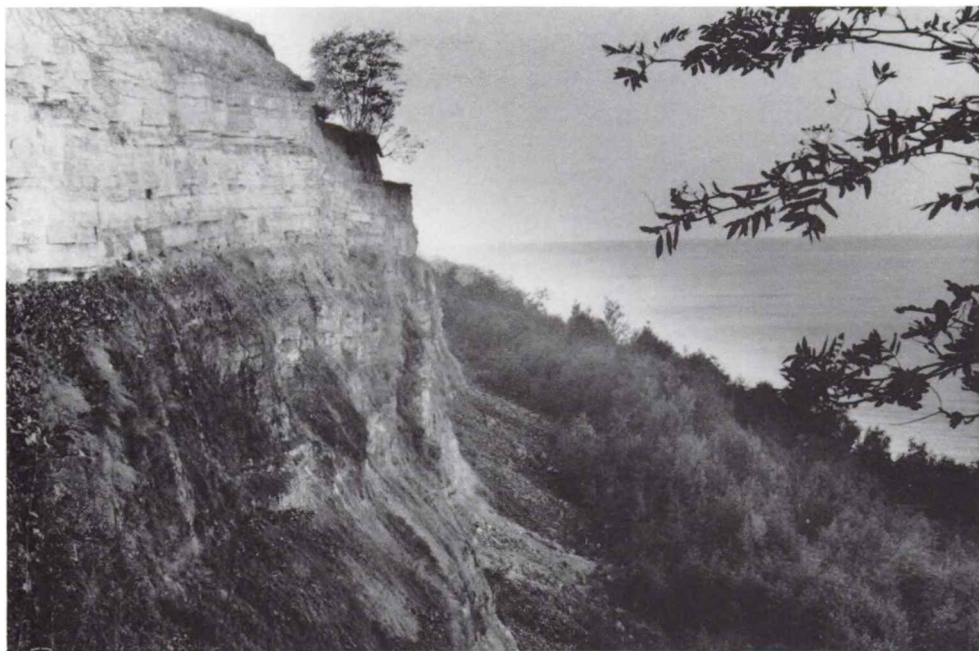


Plate 7: Estonia's highest cliffs - Valaste, northern Estonia (*Photo: Jüri Pere*)



Plate 8: The Baltic power plant near Narva (north-east Estonia). Disposal of alkaline shale ash mixed with water in special reservoirs. (*Photo: Jüri Pere*)

CHAPTER 3: ENVIRONMENTAL TRENDS AND PRIORITY INITIATIVES

3.1 Air

Atmosphere, being the most unstable of all geospheres, unites the environmental problems of all countries because of its natural laws. The fatal effect of this was demonstrated in April, 1986, when the radioactive isotopes released into the atmosphere by the accident in the Chernobyl Nuclear Power Plant (Ukraine) were detected in central Sweden within 60 hours. Since the dominating winds in Estonia are south-westerly and southerly, the 'imported' air pollution originates from central and Eastern Europe (e.g. Poland and the former East Germany), the 'export' in its turn is a considerable pollution source for north-western Russia and Finland.

As for some air pollutants, Estonia is the worst polluter of the region of the Gulf of Finland. Hundreds of thousands of tonnes of SO₂, NO_x and solid particles are annually emitted from stationary sources (Table 8).

Table 8: Yearly emissions of the main air pollutants originating from stationary sources in Estonia, 1986-1990 (in thousands of tonnes)

	1986	1987	1988	1989	1990
Solid pollutants	294.1	300.5	278.5	262.0	302.1
SO ₂	210.	6210.0	208.8	209.6	207.8
NO _x	24.6	24.3	24.0	23.1	21.7
TOTAL	605.6	614.3	588.3	576.2	610.9

Approximately 75% of the main pollutants is emitted by the Baltic and Estonian Thermal Power Plants (in north-east Estonia, at the Russian border) which rank among the ten biggest sources of air pollution in Europe. The power plants are heated with local oil shale of low calorific and high ash content and use out-of-date gas cleaning equipment; desulphurization equipment is lacking. Since the chimneys of the power plants are relatively high (150-200m), the radius of the polluted area is considerable. The most dangerous pollutants are SO₂ and NO_x which due to the granite bedrock and low buffering capacity of the environment in the Scandinavian countries contribute significantly to the increase of acidity of the environment. Carbon dioxide emissions are shown in Figure 10.

In the near vicinity of the power plants the annual sulphur deposition is 5g/m². The amount of sulphur deposited by Finland is at least 19,000 tonnes a year, contributing

Estonia

- necessary protection resorts,
- references to primary sources (literature).

2.8.2 The Estonian Natural Heritage Data Book

In 1985 compilation of this data book reporting on inanimate natural objects in Estonia began. This data base includes information about various geological outcrops, relief forms, karst areas and phenomena, springs, large scattered boulders, etc. The following features are described: name, address, map, description, significance, current position in terms of nature protection, recommendations for protection, earlier descriptions or surveys.

The Natural Heritage Data Book is a valuable source of information for science, nature protection, natural and cultural heritage, education, tourism and a wide range other consumers. The compilation of the Data Book is led by the Commission of Nature Protection of the Academy of Sciences and carried out by the Institute of Geology of the Academy of Sciences.

established protection for all the species in the book, it brought along contradictions in the list of species that had been under protection so far.

The collapse of the USSR opened up the possibility to restore the international principles and arrangement of the Red Data Book. The supervisor of the Red Data Book is the Nature Conservation Commission of the Academy of Sciences, while the legal and scientific functions that have been in force so far are now separated and research and the advisory aspect have been retained. The protection of species is arranged through the lists of species under state protection and the reserves for endangered species. At present the materials of the Red Data Book are in the stage of a project. The species in the Red Data Book are classified into six categories (see also Table 7):

- 0 Extinct* - perished species that have not been found during the last 40 years although documents proving their earlier occurrence exist.
- I Disappearing* - species the preservation of which in the nearest future is questionable if no resort is put into effect to remove the endangering factors, also species that have not been found during the period of over 40 years.
- II Vulnerable* - species the preservation of which in the nearest future is questionable if no resort is put into effect to remove the endangering obstacles: also species that have not been found during the period of less than 40 years;
- III Rare* - species that are very sparse or present in a limited number of sites.
- IV Insufficiently known* - species that essentially belong to the Red Data Book but due to insufficient investigation are impossible to classify (categories 1-3);
- V Out of danger* - species that earlier used to belong to the former categories but due to the applied arrangements to protect them or for some other reason are out of danger while situation requires continuous monitoring.

Animal or plant species are entered into the Red Data Book with the following data:

- the name in Estonian and Latin,
- systematical data,
- category of protection,
- the map of distribution with the presentation of habitats,
- a short biology and description of reproduction,
- distribution,
- number and changes in time,
- applied protection resorts,
- occurrence of species in protected areas,

Table 6: Distribution of Red Data Book plant and animal species

	Red sheet	White sheet	Grey sheet	TOTAL
Plants	42	101	12	155
Animals	32	70	2	104
TOTAL	74	171	14	259

Categories

Red sheets:	Endangered species
White sheets:	Vulnerable and rare species
Grey sheets:	Indeterminate species
Green sheets:	Species out of danger

Table 7: Distribution of species by Red Data Book categories

GROUP	CATEGORY						Total
	0	1	2	3	4	5	
Mammals		4		7	6		17
Birds	1	12	8	19	4	1	45
Fishes		2					2
Amphibians		2		2	1		5
Reptiles				1			1
Invertebrates	2	2	6	5	1	4	20
Pteridophyta	3	9	4				16
Gymnospermae			1				1
Angiospermae	14	37	32	42	6	5	136
Bryophyta	15	2	2	9	2		30
Lichens	19	1	5	16	2		43
Algae	1		2	2			5
Fungi	1	1	3	6		1	12
TOTAL	50	41	44	75	10	6	226

species and 104 animal species which have been entered on sheets of three different colours and meanings as shown in Table 6.

With the enforcement of the Red Data Book Act in May 1983, the keeper (the Ministry of Forestry and Nature Conservation) of the Red Data Book was also appointed. As the legislation of the Red Data Book of the USSR (superior to Estonian legislation) automatically

cycling of landscapes; thus, every change in land-use structure and intensity of these areas should be based on competent and expert ecological evidence;

- many new ideas for the use of buffer ecosystems (wastewater treatment in artificial wetlands, forests for energy, production of raw materials like reed-grass, cat's-tail seeds, etc.) make their creation and maintenance attractive both from an ecological and from an economic point of view; therefore, the compensatory areas of multiple use will be, on all hierarchical levels, a normal element in the sustainable development of the biosphere.

2.7 Species Protection

The legislation for species protection is considered to have started in the years 1934 and 1935 when the laws for game and nature preservation were passed, though respective tendencies could be noticed already in the 1920s when the nature protection section at the Nature Research Society was set up. The whole system was demolished in World War II. In spite of the Soviet occupation after the war, restoration of nature conservation legislation, based on the previous system, was begun. In 1957 the Law of Nature the Protection of Nature of the ESSR was passed. With this law 50 rare plant species, nine decorative plant species, many of the bird species, two species of mollusc, two species of ant, one reptile (the slow-worm) and about 20 mammal species were taken under state protection. Their protection was arranged by respective prescripts. Later only a few changes were made in the list of the protected species.

At the beginning of the 1980s species protection unfortunately lost its hitherto existing form (lists of protected species in legislation) since the central institutions of the USSR demanded the protection of all species through the Red Data Book. By now protection through the lists of species has once more become the basis of protection while the Red Data Book has retained its former suggestive and advisory essence.

2.8 The Estonian Data Books

2.8.1 The Estonian Red Data Book

The compiling of the Estonian Red Data Book was begun in 1975 on the initiative of the well-known ornithologist Prof. Erik Kumari. The lists and the data of the finds were compiled by the Commission of Nature Conservation of the Academy of Sciences (as the main coordinator), the Institute of Zoology and Botany of the Academy of Sciences, the Estonian Forest Institute, Tartu University and some other Estonian scientific institutions. The manuscript of the Red Data Book was completed by the end of 1979 as a team work of 26 authors. At first the Red Data Book was composed of four copies for official use only.

In 1982 the popular issue of the Estonian Red Data Book was published and in addition to the official species descriptions of the Red Data Book it contained the species of animals and plants under national protection. The first Estonian Red Data Book embraces 155 plant

- to receive and make harmless all that is unsuitable for populated areas: polluted water, air and solid wastes;
- to recycle and regenerate resources;
- to provide refuges for wildlife populations, and to conserve genetic resources;
- to disperse concentrations of plants and animals (including man), and also air and water;
- to provide recreation areas for people;
- to be a barrier, filter and/or buffer in material, energy, and information flows through a landscape;
- to be a support-framework for the system of settlements in the region.

Thus, their function is to compensate for and balance the inevitable outputs of human society. A system of compensating areas can be observed as a subsystem, an integral part, or an ecological infrastructure of the main ecosystems (fields, settlements, forests) in the cultural landscape.

There are various components in this multi-tiered system of compensating areas. First, naturally, all conservation areas, but also large forests, swamps, coastal seas and other large natural communities should belong to the higher levels of this system. On the middle levels, extensively used agricultural lands such as meadows in margin lands or areas of alternative (ecological) agriculture form the network of compensating areas. There are also many compensatory ecosystems at lower levels, such as sections of woodland and small islands of forest, riverbanks, strips of forest alongside water bodies, hedges along roads and field margins, shelterbelts, the banks of ditches with their diverse wildlife, and stone walls (as traditional elements of landscapes in limestone plateaus), etc.

Among the most essential compensatory factors of rural landscapes is the range and diversity of the many different habitats, which can be seen as edge effects in different ecotones, which occur at various levels in both space and time. As a result of the considerable contribution of ecotones to the functioning of the landscape, the density of the ecotone grid has been used as a criterion for the evaluation of the ecological diversity of landscapes. For example, for every newly established beneficial element in the landscape, the minimal value of the parameter (i.e. edge index) was recommended to be 25 metres per ha.

At present major changes are taking place in Estonian social and economic life. This turbulence, mostly resulting from the process of privatization, is influencing the stability of landscapes as well. Therefore, the following recommendations for ecological management of rural landscapes have been made:

- on all hierarchical levels, the network of compensating ecosystems as an ecological infrastructure should be maintained and supplemented, because this is the cheapest way to maintain the ecological stability of landscapes;
- the most relevant elements in the ecological infrastructure are coastal and riparian biotopes, i.e. land/water ecotones which play a multifunctional buffering role in material

2.5.10 Bays, headlands and coastal lakes

Harilaid Headland

County: Saaremaa. Established 1957. Area 1.6km².

Linnulaht Lake

County: Saaremaa. Established 1957. Area 3.35km².

Käina Bay

County: Hiiumaa. Established 1971. Area 12.8km².

2.6 Landscape Management

Of all measures relating to environmental management in Estonia, most attention has been paid to the management of rural landscapes. Among all activities, land reclamation is traditionally the most powerful tool for changing the structure of rural landscapes. After World War II four periods of major influence on nature in Estonia can be pointed out:

- beginning of large-scale agricultural improvement in 1950-1960, resulting in intensive degradation of wetland ecosystems;
- maximal development of big agricultural improvement projects in 1960-1970, meliorative reconstruction of former drained lands, massive decrease in the ecological diversity of the landscape;
- large-scale agricultural improvement in 1970-1980 with some elements of landscape management (storage ponds on rivers, recreation areas) linked to the aesthetic appearance of the landscape;
- meliorative reconstruction of fields in 1980-1990, with respect to the ecological diversity of landscapes (maintenance of wetlands, establishment of water-protection buffer zones and strips).

At the present time, the most important principle in the planning and management of rural landscapes is the maintenance and/or creation of optimal diversity of landscape patterns. This can be realized with the help of a multilevel system of compensating areas and ecological infrastructure of territories.

A system of compensating areas is similar in meaning to an ecological framework, a natural framework, zones of ecological equilibrium, areas of virgin nature of a polarized landscape, and areas of ecological preference, advanced by different schools of ecological landscape management.

The term 'compensation' is given a broad meaning and compensating areas have the following functions:

- to accumulate matter and energy, in the first place the kind of energy in the dispersion of which man is involved;

Estonia

Lindi

County: Pärnumaa. Established 1981. Area 6.02km².

Loosalu

County: Raplamaa. Established 1981. Area 8.67km².

Luusaare

County: Lääne-Virumaa. Established 1981. Area 5.2km².

Mahtra

County: Raplamaa. Established 1981. Area 5.45km².

Marimetsa

County: Läänemaa. Established 1981. Area 41.90km².

Meelva

County: Põlvamaa. Established 1981. Area 18.27km².

Meenikunnu

County: Põlvamaa. Established 1981. Area 17.57km².

Õrdi

County: Viljandimaa. Established 1981. Area 50.43km².

Palasi

County: Raplamaa. Established 1981. Area 5.83km².

Parika

County: Viljandimaa. Established 1981. Area 14.72km².

Piiumetsa

County: Järvamaa; Raplamaa. Established 1981. Area 5.82km².

Sämi-Kuristiku

County: Lääne-Virumaa. Established 1981. Area 13.39km².

Sirtsu

County: Ida-Virumaa; Lääne-Virumaa. Established 1981. Area 28.53km².

Tudu-Järvesoo

County: Läänemaa-Virumaa. Established 1981. Area 6.03km².

Tuhu

County: Läänemaa. Established 1981. Area 27.7km².

Valgeraba

County: Viljandimaa. Established 1981. Area 24.86km².

Valgesoo

County: Põlvamaa. Established 1981. Area 3.40km².

Võhandu River Valley

County: Põlvamaa. Established 1964. Area 7.5km².

Piusa River Valley

County: Võrumaa. Established 1965. Area 7.2km².

2.5.9 Mires (fens, bogs and swamps)

Muraka

County: Ida-Virumaa. Established 1957. Area 122.74km².

Nätsi and Võlla

County: Pärnumaa. Established 1957, extended 1981. Area 97.72km².

Nehatu

County: Läänemaa. Established 1957. Area 4.1km².

Virussaare Hump

County: Pärnumaa. Established 1957. Area 0.42km².

Aela and Viirika

County: Raplamaa. Established 1981. Area 26.02km².

Agusalu

County: Ida-Virumaa. Established 1981. Area 76.75km².

Avaste

County: Pärnumaa; Raplamaa. Established 1981. Area 41.88km².

Emajõe-Suursoo

County: Tartumaa. Established 1981. Area 184.24km².

Keava

County: Raplamaa. Established 1981. Area 15.77km².

Kellamäe

County: Võrumaa. Established 1981. Area 6.71km².

Kikerpera

County: Pärnumaa; Viljandimaa. Established 1981. Area 47.0km².

Kuresoo

County: Pärnumaa; Viljandimaa. Established 1981. Area 119.27km².

Läänemaa-Suursoo

County: Harjumaa; Läänemaa. Established 1981. Area 97.13km².

Laukasoo

County: Harjumaa. Established 1981. Area 21.41km².

2.5.6 Wooded meadow and forests

Järvselja Forest Quarter

County: Tartumaa. Established 1923. Area 0.19km².

Tagamõisa Wooded Meadows

County: Saaremaa. Established 1957. Area 1.3km².

Virtsu-Laelatu-Puhtu

County: Läänemaa. Established 1957. Area 36.09km².

Abruka Woods

County: Saaremaa. Established 1957. Area 1.03km².

Halliste wooded meadows

County: Pärnumaa. Established 1957. Area 2.65km².

Koiva Riverplain Wooded Meadows

County: Pärnumaa. Established 1957. Area 1.7km².

Mihkli Oak Grove

County: Pärnumaa. Established 1957. Area 0.91km².

2.5.7 Nature Parks

Haanja

County: Võrumaa. Established 1979. Area 91.63km².

Situated in the highest part of the country in the surroundings of the hill of Suur-Munamägi (318m, the highest peak in the Baltic states). In the primeval valley of Rõuge there is a chain of seven lakes, among them the deepest lake in Estonia (Rõuge Suurjärv, 38m). Initially a landscape protected area but was reorganized into a nature park in 1991.

2.5.8 Nature monuments

Ahja River Valley

County: Põlvamaa. Established 1957. Area 10.4km².

Kaali Meteorite Craters

County: Saaremaa. Established 1957. Area 0.5km².

Pirita River Valley

County: Tallinn. Established 1957. Area 5.5km².

Saka-Ontika-Toila Glint

County: Ida-Virumaa. Established 1957. Area 8.9km².

Tilleorg Valley

County: Põlvamaa. Established 1957. Area 1.9km².

A richly forested area with picturesque lakes and varied surface relief of eskers and kames. This area is associated with many of the legends about the giant Kalevipoeg, the legendary hero of Estonian Folklore.

Vooremaa

County: Jõgevamaa; Tartumaa. Established 1964. Area 99km².

One of the most representative drumlin complexes in Europe. The drumlins of up to 25m in height stretch from north-west to south-east. In the interstitial troughs between the farmed drumlins could be found marshes and numerous lakes, the biggest of which is Lake Saadjärv.

Islets near Hiiumaa Island

County: Hiiumaa. Established 1971. Area 3.13km².

A chain of islets in the sea between the West Estonian Archipelago and the mainland. The islets are rising from the sea and so represent different stages of development. Belongs to the Biosphere Reserve of the West Estonian Archipelago.

Karula

County: Valgamaa; Võrumaa. Established 1979. Area 103.18km².

A typical moraine landscape of rounded hills interspersed with numerous small lakes.

Otepää

County: Valgamaa. Established 1979. Area 230.31km².

The central part of the Otepää Heights. There are numerous lakes in the area, including Lake Pühajär (Holy Lake) which is one of the most outstanding beauty spots in Estonia. The vicinity of the town of Otepää is a well-known centre of tourism.

Paganamaa

County: Võrumaa. Established 1979. Area 11.07km².

An area rich in lakes and various glacial relief forms.

Kurtna

County: Ida-Virumaa. Established 1987. Area 25.41km².

A varied relief dominated by kames and eskers. There are a great number of small lakes in the area which is mostly covered with forest and heath.

2.5.5 Historical-Cultural Protected Areas

Rebala

County: Harjumaa. Established 1987. Area 24.95km².

2,000 year-old archaeological monuments (burial grounds, primeval fields) and the landscape influenced by karst phenomena.

The **Viidumägi Nature Reserve** (Viidumäe Riiklik Looduskaitseala) in Saaremaa county, (11.94km²) is first and foremost a botanical reserve where many rare plants flourish in the favourable conditions provided by the mild maritime climate and a striking variety of habitats (the elevation of Viidumägi, its western slope and fenlands rich in springs, dunes, etc). The reserve was founded in 1957 and enlarged to some extent in 1979. This reserve belongs to the Biosphere Reserve of the West Estonian Archipelago.

The **Endla Nature Reserve** embraces (Endla Riiklik Looduskaitseala), 81.62km² in Järvamaa, Jõgevamaa, Lääne-Virumaa counties. The district comprises seven bog massifs of the Endla bog system in central Estonia. The area is relatively little affected by human activities and several rare plant and animal species can be found there. The reserve includes many copious springs at the foot of the Pandivere Uplands. The Endla bog system is one of the most thoroughly studied nature complexes in Estonia. The area was designated as a mire protected area in 1981. It was reorganized as a nature reserve in 1985.

2.2.3 Areas recognized/designated under national/international agreements

The **Biosphere Reserve of the West Estonian Archipelago** (Lääne-Eesti Saarestiku Biosfääri Kaitseala), 15,600.74km² (including the sea area of 11,562.96km²), embraces a part of the Baltic Sea with the larger islands of Saaremaa (Ösel), Hiiumaa (Dagö), Vormsi (Worms), Muhu (Mohn) and Ruhnu (Runö). Administratively this area belongs to Hiiumaa, Läänemaa and Saaremaa counties. The reserve was set up to protect, preserve and investigate the biological diversity of the region and to maintain its stability. It is included in the International List of Biosphere Reserves. The Biosphere Reserve was founded in 1989 and certified by UNESCO-MAB in 1990. The core zones of the Biosphere Reserve often coincide with other protected areas.

The **Pandivere Hydrological Protected Area** (Pandivere Riiklik Veekaitseala) in Järvamaa and Lääne-Virumaa counties embraces 3,508.72km². It was set up on the initiative of the authorities of two counties to protect phreatic- and surface water and rivers starting in the Pandivere upland. The protected area was founded in 1988, at first as a local protected area. In the same year it was reorganized into a state protected area.

2.2.4 Landscape Protection Areas

Kõrvemaa

County: Harjumaa; Järvamaa. Established 1957. Area 217.2km².

A wooded area, noteworthy for its varied surface relief (terminal moraines, eskers, kames, Sandurs, etc.). The area is well known thanks to the novels by the Estonian writer Anton Hansen-Tammsaare whose birthplace is now protected as a cultural monument. The protected area was extensively enlarged in 1971.

Neeruti

County: Lääne-Virumaa. Established 1957. Area 8.58km².

Alvars overgrown with juniper bushes are characteristic of the limestone plateau. Till plains, often intermittent with alvars, are common in the more elevated parts of the plateau. These areas with relatively fertile soils were already densely populated in the distant past. Evidence of primeval settlement is given by the most extensive fields of burial mounds found in Estonia so far.

In the Kõrvemaa area various relief forms of glacial origin (kames, radial eskers, fluvioglacial deltas, limnoglacial plains, etc.) are found. Many lakes and bogs in the sparsely populated area are surrounded mainly by forests.

Several interesting architectural ensembles such as the manors of Palmse, Sagadi, Vihula and Kolga, coastal villages, etc. lie within the boundaries of the National Park. In the coastal villages of Lahemaa we can find age-old maritime traditions as well as numerous peculiarities in the way of life, speech, folklore and folk art of the local people.

2.5.2 State Nature Reserves

The Vilsandi Nature Reserve (Vilsandi Riiklik Looduskaitseala) in Saaremaa county comprises Vilsandi Island and about 100 islands and islets of the western coast of Saaremaa Island. Its area is 10.94km². The main purpose of the reserve is to protect seabird colonies (more than 7,000 nesting pairs) on these young islands with sparse vegetation. The most valuable representative of the local bird fauna is the common eider (more than 2,000 nesting pairs at present). The reserve was first established as the Vaika Bird Sanctuary in 1910. In 1957 it became the Vaika Nature Reserve which was enlarged and reorganized to become the Vilsandi Nature Reserve in 1971. An environment monitoring project is under way in the Vilsandi reserve and a monitoring station will be set up there. This reserve belongs to the Biosphere Reserve of the West Estonian Archipelago.

The Matsalu Nature Reserve (Matsalu Riiklik Looduskaitseala), 397km² (including the sea area accounting for 263km² of the reserve's area) in Läänemaa county embraces the Matsalu Bay on the western coast of Estonia, its environs and a number of islets. The reserve was set up in 1957.

The central part of the reserve is made up of extensive reed beds in the inner reaches of the bay. The shores are lined with meadows, pastures and in places with woods. Matsalu enjoys wide fame for its extremely rich bird population of about 250 bird species. During the spring migration it is visited by over a million geese and ducks and up to 100,000 swans. The pride of the reserve are the greylag geese, of which over 200 pairs nest. A common breeding bird at Matsalu is the coot (over 1,000 pairs). Gull colonies are abundant on the sea islands. Since 1975 the Matsalu State Nature Reserve of 486.34km² has been listed as a Wetland of International Importance.

The Nigula Nature Reserve (Nigula Riiklik Looduskaitseala) in Pärnumaa county (27.71km²) comprises the Nigula peat bog and forest areas and surroundings. The Nigula peat bog is a typical large west Estonian bog. The characteristic flora and the bird fauna of Estonian peat bogs are well represented here. The reserve was founded in 1957.

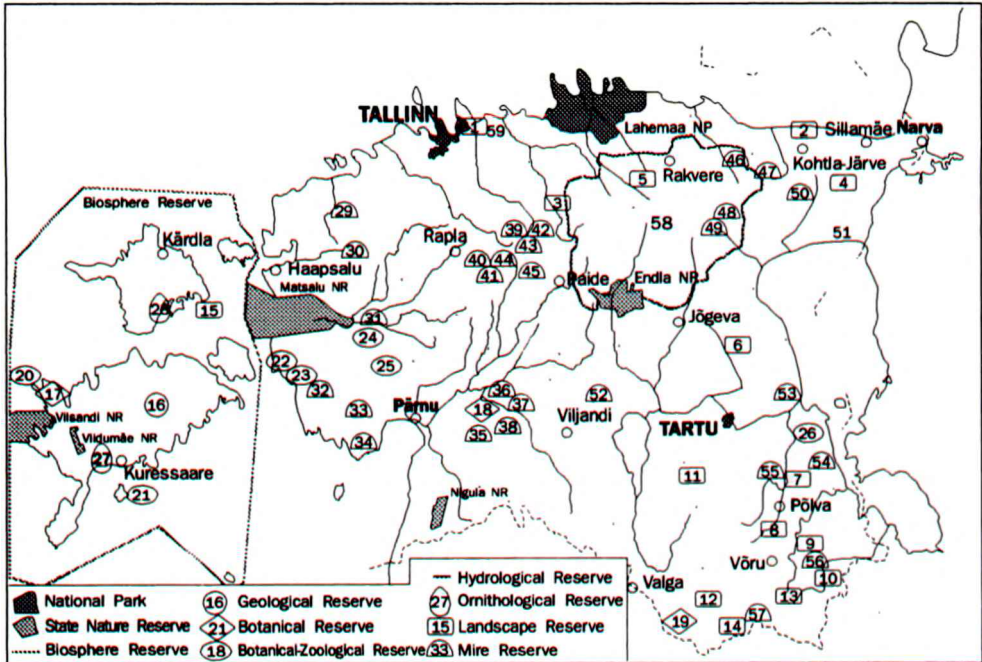


Figure 9: Estonia's most important protected areas

Key

1. The valley of the Pirita river
2. The Saka-Ontika-Toila glint
3. Kõrvemaa Landscape Protected Area
4. Kurtna Landscape Protected Area
5. Neeruti Landscape Protected Area
6. Vooremaa Landscape Protected Area
7. The valley of the Ahja river
8. Valley Tilleorg
9. The Valley of the Võhandu River
10. The valley of the Piusa river
11. Otepää Landscape Protected Area
12. Karula Landscape Protection Area
13. The Haanja Nature Park
14. Paganamaa Landscape Protected Area
15. Islets near Hiiumaa Island
16. The meteorite craters of Kaali
17. The wooded meadows of Tagamõisa
18. The wooded meadows of Halliste river floodplain
19. The wooded meadows of Koiva river floodplain
20. Harilaid headland
21. The Abruka wood
22. Laelatu wooded meadows and Puhtu ornithological station
23. Nehatu mire
24. The oak grove of Mikhli
25. Virussaare firm land islet in the Lavassaare mire
26. The Järvselja Forest Reserve
27. Lake Linnulaht
28. Bay of Käina

29. Läänemaa Suursoo mire
30. Marimetsa mire
31. Avaste mire
32. Tuhu mire
33. Nätsi-Võlla mire
34. Lindi mire
35. Kikepera mire
36. Kuresoo bog
37. Valgeraba bog
38. Ördi bog
39. Mahtra mire
40. Keava mire
41. Palasi mire
42. Laukasoo mire
43. Aela-Viirika mire complex
44. Loosalu mire
45. Piiumetsa mire
46. Sämi-Kuristikum mire
47. Sirtsu mire complex
48. Tudu-Järvesoo mire
49. Luusaare mire
50. Muraka mire
51. Agusalu mire
52. Parika mire
53. Emajõe Suursoo floodplain
54. Meelva mire
55. Valgesoo bog
56. Kellamäe mire
58. The Pandivere Hydrological Protected Area
59. Rebala Historical-Cultural Protected Area

In 1980 the Helsinki Convention came into force and the Governing body of the Convention, the Baltic Marine Environment Protection Commission (**The Helsinki Commission**) was established. From the very beginning of its activities, according to the Helsinki Commission research projects, the Estonian research institutes and universities have taken part in investigations of the Baltic Sea environment, at first as a part of the Soviet Union programme but now as a Member State of the Convention.

2.5 Protected Territories

At the present time remarkable changes are taking place in the system of protected territories. The latest figures (1990) show that the total number of protected sites and objects is over 1880 with a total area of 2270km² (Figure 9). The territories of utmost importance are characterized as follows.

2.5.1 National parks

The Lahemaa National Park (Lahemaa Rahvuspark), the first protected area of this category in the Baltic States, was established in 1971. Its territory in Harjumaa and Lääne-Virumaa counties was enlarged in 1973 and 1991, and now the park covers a land area of 649.11km² plus a marine area (the Gulf of Finland) of 471.00km². The name *Lahemaa* ('bay land' in Estonian) originally denotes the central part of the north Estonian coastal flats, several bays (Kolga, Hara, Eru and Kasmu) and headlands (Juminda, Pärismepe, Kasmu and Vergi). The territory of the Lahemaa National Park extends (partially) to other landscape regions, such as the north Estonian and the north-east Estonian Limestone Plateau south of the Glint and to the Kõrvemaa further inland.

The coastal area, including several islands, originally formed part of the bed of the Gulf of Finland, which gradually rose above sea level. The dominating relief forms are of marine origin: terraces, coastal barriers, scarps and beach ridges; sand dunes also occur. The surface cover consists mostly of stony till or sand-and-gravel deposits with marine sands, especially at the mouths of the rivers. Stone fields and big scattered boulders are characteristic of this area. Stretches of marshland occur here and there; a few coastal lakes can also be found. The greater part of the zone is covered with coniferous forests. Along the shore there is a broken line of coastal meadows. Human settlements are concentrated mainly at the seaside.

The north Estonian Glint, running through the Lahemaa National Park, is divided into many sections, the so-called Glint headlands separated from each other by Glint bays. The highest point of the Glint in the Lahemaa National Park is 30-32m, whereas the margin of the limestone plateau reaches 45-66m above sea level. At the edge of the limestone plateau there are canyon-like valley sections of the Valgejõgi and Loobu rivers with small waterfalls (at Nõmmeveski, Vasaristi and Joaveski). Under the cliff, wet with the oozing water from the springs, there is a stretch of broad-leaved forest.

to create a basis for environmental standardization, to apply new technologies of environmental mapping and to support environmentally sound technologies specially connected with oil-shale mining and processing.

In this period the Academy of Sciences of the USSR made some attempts to draw up all-union ecological programmes. Many of the research institutes and universities of Estonia were included as participants in different areas of this large-scale programme.

Since 1986 state funding policies changed dramatically while the political and administrative collapse of the USSR has led to a necessity for the initiation of a national approach to environmental problems as part of the governmental policy of an independent state.

Due to uncertainties in the funding policy of science and the modernization of the science and education system, the elaboration of some large-scale environmental programmes has not so far been possible. However, the first valuable document concerning state environmental policy was adopted by the Supreme Soviet in 1988 as a conception including an important part of scientific goals in this field. During 1990 and 1991 a commission of the Estonian Academy of Sciences worked on a new co-ordination programme and recommendations for ecological research as a guide for future development of scientific policy. The main research areas of this programme include conservation of ecosystems, conservation of mineral resources, environmental impact on human health, social ecology and environmental education.

2.4.3 International scientific programmes

The **International Biological Programme (IBP)**, the first scientific programme in Estonia also containing some projects related with environmental problems, was adopted in 1968 by the Estonian Academy of Sciences. Seventeen research institutes and other establishments were involved in this programme. The co-ordination unit, the Estonian Republican Committee of IBP, was formed as a governing body for the Estonian National Programme, which has operated about 10 years.

In the Estonian SSR the Republican Committee for **Man and Biosphere (MAB)** was set up in 1978 as the first organization coordinated by UNESCO. The Republican Committee was reorganized into the National Committee in 1990 while now it is connected with the Estonian National Commission for UNESCO. From 1978 to 1990 the Estonian Programme for MAB was involved in 11 internationally coordinated projects and conducted one national project EST-MAB 15 'The history of interaction between Man and Nature'.

The main role of the Estonian MAB Programme and the Committee has been organizational and publishing, supporting international contacts and information exchange through conferences and publications as well as accelerating the advance and solution of ecologically and environmentally important research topics (e.g. organization and research support of the West Estonian Archipelago Biosphere Reserve).

Considerable work in promoting the understanding and protection of nature is carried out by numerous nature reserves which have through decades played the role of 'green' islands within the conditions of increasingly intensive economic development.

The state system of ecological schooling has been based on school regulations and the school curriculum. Natural science as a subject had been previously taught in Estonian schools, but in the second half of the nineteenth century the first Estonian textbooks were compiled using Estonian scientific terminology (four textbooks by Juhan Kunder).

The educator Johannes Käis was a notable patron of progressive innovation in schools from 1920 to 1940. He wrote a number of instructions and didactic papers on natural sciences for all school levels. School gardens and special forest districts were established where it was possible to acquaint children with nature.

A very important role was played by three so-called Naturalists' Centres, later Youth Nature Centres, in our bigger towns. They are out-of-school hobby centres for pupils interested in nature and are financed by the state.

Special courses for nature and environmental protection in the establishments of higher education were introduced in the 1970s, in particular at the departments of biology and geography at Tartu University.

2.4.2 National scientific programmes

In 1978 an alternative scientific authority was established to deal with environmental problems - the Estonian Council of Ecology. Its main task has been the co-ordination of research in various topics reported in every third year at the Estonian Conferences on Ecology. These include environmental problems in terrestrial, freshwater, marine, farming and human ecology, as well as applied and theoretical ecology. In 1991 the 5th Conference was held. All the abstracts published make up seven volumes including 417 abstracts. The leading topics are the following:

- Research into Estonian natural ecosystems (1978);
- Ecological aspects of environmental protection in Estonia (1982);
- Current tasks of applied ecology in Estonia (1985);
- Ecology and society (1988);
- Ecology and energetics (1991).

In 1986 a new type of scientific-technological state-programme was created for environmental research and protection, entitled 'Rational utilization of natural resources and environmental protection'. The programme covered seven research and technological areas, and the main goals were to study the migration and accumulation of pollutants in different terrestrial and aquatic ecosystems, to work out a conception for environmental monitoring, to create a national data bank of information concerning environment and the utilization of natural resources, to elaborate and implement the methodology of environmental assessment,

2.4 Education and Science

2.4.1 General environmental education

The teaching of how to conserve nature has always occupied an important place in Estonian national tradition. This is reflected in proverbs, folklore, folk traditions and customs. As most people come from the country, where the natural landscape has been preserved, and are only for the first generation of townspeople, they have retained a close contact with country folk. Old customs such as berry-picking and mushroom-gathering with the whole family, going fishing and hunting, spending holidays in natural surroundings, especially near waterbodies, have been preserved.

The beginning of ecological education started with the printed word, mostly with newspapers and calendars of the last century, later mainly with the help of magazines, popular science books and textbooks.

During the post-war period, starting from the end of the 1950s, radio was the main source of new ideas on the preservation of natural scenery. Quiz games on nature preservation, familiarizing people with birdsong and popularizing environmental protection should be particularly noted (F. Jüssi being the popularizer and the author of the corresponding records).

Recently, taxonomic guides for the identification of plants (owned by every twentieth citizen), ornithological guides, reference books and encyclopaedias where natural science constitutes an important part have been published in great numbers (on average a set in each family). Many nature photo albums are being published.

The role of television in raising ecological awareness has grown sharply during the last decades. Films introducing local nature should be specially noted, for example Rein Maran's films about animals unfamiliar to people (spiders, common vipers, frogs, etc.). Estonian documentary films have gained international recognition.

In 1920 the Nature Protection Section of the Estonian Naturalists' Society was the first public organization introducing nature protection. Tartu students' nature protection club (established 1965), with its numerous local branches, has taken care of parks and set up nature trails (Jaan Eilart's summary on nature trails in Estonia appeared in 1986). In 1955 the Estonian Nature Protection Commission of the Academy of Sciences of the ESSR, which has published a number of topical collections and albums, was established by E. Kumari.

During recent years several politically oriented green organizations who publish their own newspapers and bulletins have been founded.

There is the 30-year tradition of Nature Protection Day and Nature Protection Month, which are dedicated to different topics each year. Recent highlights have included rare plant species, soils and mineral resources.

- updating of information system;
- establishment of stipendia and awards related to nature and environmental protection, financing of contests and competitions;
- development of environmentally friendly technologies and equipment, and scientific research.

Fifty per cent of the finances paid to the Environmental Fund remain in the local fund of the district from which the payment originated; the remaining 50% is directed to the national fund (Figure 8).

Decisions regarding the use of the national fund are made by the Board which consists of representatives of national and district environmental authorities, the Ministry of Finance, the Ministry of Economy, non-governmental nature protection organizations and scientists. Decisions regarding the use of local funds are made by the district boards, the members of which are appointed by the district authority and approved by the district council.

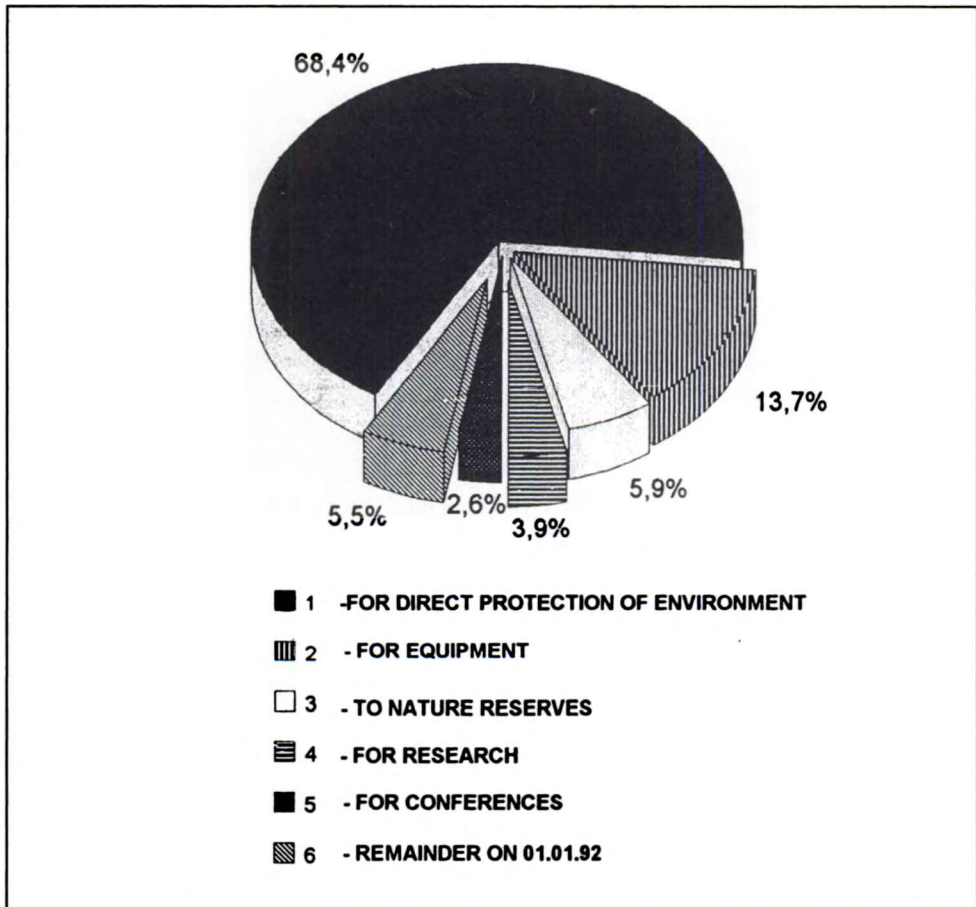


Figure 8: How the Environmental Fund was used in 1991.

Air pollution taxes depend not only on the particular pollutant but also on the character of the polluted area. The latter is calculated as an area of a circle with the radius of 80-fold-height of the pollution source. Direct taxes have been established for six polluting substances: SO₂, CO, non-toxic dust, oil shale fly ash, ash, and NO_x as calculated per NO₂. Taxes for other pollutants are calculated based on the Maximum Permissible Concentrations of the respective substances.

Taxes for waste are based on the toxicity class of the particular types of waste. Pollution exceeding the permitted (licenced) amounts, and waste deposition are taxed progressively in relation to the level of toxicity.

Enterprises investing into environmental protection measures, which lead to reduction in pollution of waste of at least 25%, are relieved of pollution taxes in the amount of 1.5-fold value of the investment.

Resource charges are channelled to the state and local (regional) budgets. Depending on the resource under question, the ratio paid to the state budget constitutes 30 to 80% of the total charge. Taxes paid for excess pollution remain in the local budget. Regular pollution taxes are paid to the Estonian Environmental Fund.

According to the 'polluter pays' principle, reduction of pollution and prevention of or compensation for damage caused to the environment are the responsibility of the polluter.

The national and environmental authorities and the environmental monitoring system are financed from the state budget, the local authorities from the local budgets. The construction of environmental protection facilities of national or regional importance is financed from the state or local budget.

In addition to financing from budget, an outside-budget system of financing has been created with the establishment of the the **Estonian Environmental Fund** in 1983. Since then fines for violation of environmental legislation, payments for damage caused to the environment, and taxes for excessive production losses of mineral resources were channelled into the Fund, in the average amount of approximately 1.2 million roubles (SUR) per year. Since the application of resource charges and pollution taxes in 1991, the taxes are also paid into the Environmental Fund. In 1991 this amounted to 56 million roubles (SUR).

According to its statute, the fund which is outside the state budget is used for:

- additional financing of national, regional and local environmental programmes and measures;
- strengthening of the material basis of nature and environmental protection;
- improvement of the environmental monitoring system;
- ecological cooperation with other countries;
- training of staff;
- activities aimed at raising of public environmental awareness;

'Everyone shall be obligated to preserve human and natural environment and to compensate for damages caused by him or her to the environment. The procedures for compensation shall be determined by law'.

The framework for environmental legislation is provided by the **Law on the Protection of Nature in Estonia**, approved on February 23, 1990, in which the main principles are laid down. A separate chapter deals with international cooperation in the field of environmental protection and research.

Most of the **criteria for environmental quality** which are currently in use are based on the 'Maximum Permissible Concentrations' (MPC) system, developed in the former Soviet Union. They concern the concentration of pollutants in atmospheric air, drinking water, water in natural water-bodies, soils, etc. There are several problems with these standards. There are too many of them (e.g. over 1300 MPCs for water pollutants), which makes it practically impossible to analyse all of the substances. A considerable share of the MPCs are very strict, practically unachievable - this has led to disregard towards criteria as such. It is hard to restore respect for regulations once it has been lost, therefore the standards (MPCs) in a number of areas should be revised and brought into better compliance with the practical possibilities, in order to make them gradually stricter as technical possibilities are developed. This is already being done in some fields (e.g. water quality).

Another aim is to develop new standards which would be based on the same concepts as the ones currently in use in the rest of Europe (e.g. permissible amounts of pollutants per unit of production) in order to provide better incentives for polluters.

The system of economic measures aimed at improving the management of the environment and natural resources was established with government regulation from February 13, 1990, '**On the system of charges and taxes in nature management**' and is continuously being improved, taking into account feedback arising from its implementation. The core of the system consists of taxes for the use of natural resources, pollution charges, and fines for violation of environmental legislation, which support the Environmental Fund (founded in 1983) for financing environmental activities.

The aim of resource taxes is to provide economic incentives for rational and efficient utilization of natural resources (including full exploitation of the deposits); of pollution charges - to stimulate reduction of pollution, and to provide financing for environmental protection measures.

Resource charges are established for use of mineral resources - oil shale, natural building materials, peat - and water. They are based on the volume of resource used, not the actual production, in order to reduce production losses.

Pollution taxes concern air and water pollution and waste generation. The taxes are based on the amounts of pollutants (emitted substances).

Water pollution taxes have been established for the following pollutants: BOD, suspended solids, oil products, phenols, total phosphorus, total nitrogen, sulphates and fats.

- environmental impact assessment of projects of national importance;
- management of the network of protected areas;
- organization of training of staff;
- promoting of environmental education;
- coordination of international cooperation in the field of environment.

The Forest Department and the Fisheries Department are responsible for their respective problems. The Chief Inspector with his office performs the reinforcement function.

Since 1990 the district environmental departments have been relatively independent from the Ministry (not in direct subordination), being part of local government. They are responsible for issuing licences and permits for use of natural resources and permits concerning permissible amounts of pollutants, control over polluters and environmental impact assessment of projects within their territory.

As scientific institutions are being reorganized in Estonia, some research institutes are already changing their status and focusing upon the needs of governmental authorities; the proportions of academic and state institutes are changing. The current trend is towards state institutes which should provide the state authorities with required data and assist in the development of policies, and better integration of scientific institutions with universities. It will certainly take time to achieve these aims but the first steps have already been made. Examples of this include the Institute of Fisheries Research as well as the Institute of Meteorology and Hydrology which obtained their current positions through thorough reorganization (their research areas were formerly controlled by the Moscow institutions), and the reorganization under way in the Tartu University and the Estonian Agricultural University.

2.3 Environmental Legislation

The legislation currently in force in Estonia consists of a great variety of legislative acts of different origin and background. Part of these have been compiled and approved in recent years within the Republic of Estonia, during and after independence was regained. Some of these acts are based on legislation of the Republic of Estonia which were in force before 1940. Another part have been approved during the Soviet colonization period (1940-1941; 1944-1990) and are mostly based on corresponding USSR acts, regulations, etc.

Currently legislation in Estonia is being improved in order to be in accord with changes in ownership and the transition period in economy. These ongoing changes are of high importance for all environmental activities as most of the problems are closely related to ownership and property matters.

The new **Constitution of the Republic of Estonia**, to be approved in 1992, contains a paragraph referring to environmental protection. In Article 53 it is stated:

natural objects, 222 boulders and (scattered) stone fields, 335 old trees, 55 plant species, 186 animal species, 46 parks, etc. were taken under protection.

Social life in the field of nature protection became more lively (Students Nature Protection Circle, 1958) and the teaching of nature protection at the institutions of higher education (Tartu University and Estonian Agricultural Academy since 1958) was started. Since 1966 a mass-organization for nature protection, the Society for Nature Protection, has been in action.

As it was the policy of the Soviet system, alongside the growth of an active nature protection movement among the people, an expansion of the state administration took place and activities were centralized. The power hierarchy suppressed initiatives and the free propagation of information (on accumulation of pollutants, emitted elements, etc.) Scientists and amateurs often faced insurmountable difficulties in getting access to these materials. Secrecy hindered the protection of nature and the environment from developing, as was the case in other fields of life.

Problems of environment protection became acute in the 1970s. Conferences on Estonian ecology which have been held since 1978 when new and hitherto hidden facts were presented about the terribly high level of water, soil and air pollution in north-east Estonia. The fight for a clean environment and against the ambitions of the Soviet Empire to exploit Estonian natural resources (big phosphorite reserves) completely ignoring the principles of environment protection, culminated in the 1980s with the so-called 'phosphorite war' in 1986-1988. The conflict, which was of a clearly political character, resulted in the victory of Estonian nature protectors.

In spite of having been isolated from the system of ecology and nature protection of the free world, Estonia was able to start cooperating with several international organizations (MAB, IUCN, WWF) in the 1980s.

2.2 Institutions

Environmental authorities in Estonia include the **Ministry of the Environment** with its subdivisions and 19 **District Environmental Departments** which act as a part of regional authorities. Thus over 250 environmental officers and experts over the country are making their contribution to the resolution of environmental problems.

The Ministry is responsible for:

- the development of environmental legislation and criteria;
- development of policies and strategy;
- coordination of management of natural resources, environmental protection activities and related scientific research;
- organization of monitoring of the state of the environment;

Vaika. In 1910 the Naturalists' Society of Riga rented these islets and made them an ornithological reserve. This year is considered to be the beginning of classical nature protection in Estonia. The first nature protection organization was founded by A. Khrebtov in 1913 in Saaremaa. It started registering natural monuments and compiled a circular of nature protection for schools in Saaremaa.

In 1918 Estonia became independent. In 1919 Tartu University became an Estonian University and since that time has been at the centre of the Estonian nature protection movement. A special commission for solving the problems of plant geography and natural monuments was founded by the Naturalists' Society at Tartu University in 1920, efficiently headed by F. Buchholtz (1872-1924). The commission applied to state institutions with proposals for nature protection. Its members, J. Piiper, H. Riikoja, H. Bekker, O. Daniel, A. Mathiesen (guiding the work of the commission from 1924), P. Thomson, G. Vilberg-Vilbaste, and later T. Lippmaa and others collected different scientific data about perspective reservations, boulders, old trees and rare species of flora and fauna with the help of volunteers. The Vaika nature reserve came under the control of Tartu University. As early as 1929, A. Mathiesen (1890-1955) drew up proposals for the first law of nature protection, but due to the political situation of that time it was never passed. It was a success in 1935 on the initiative of T. Lippmaa (1892-1943), who headed the national Nature Protection Board (council). The post of the (national) State Inspector of Nature Protection was established in 1936 and G. Vilbaste (1885-1967), one of the most honoured and active proponents of research into nature, occupied the office.

By the end of thirties a modest nature protection system demanding few expenses and appropriate to the time had been formed. The work was based mainly on voluntary activists. Forty-seven reserves, mostly small in area, had been set up, 80 parks rich in trees, 40 woodlands, 202 old trees and a number of rare plant and fauna species had been taken under protection.

2.1.3 Period of occupation

Estonia's period of independence lasted for only 22 years. It was followed by the Soviet (1940-1941 and 1944-1991) and German (1941-1944) occupations. The culture and science of Estonia suffered great losses. A large number of the scientists who had gained fame and international authority during the period of independence, people dealing with nature protection among them, were deported to Russia, were dismissed from work, were killed in the war or fled to the West. Nevertheless, work in the field of nature protection was started even in this repressive political situation though it bore fruit only more than ten years after the end of World War II. The most important event was the passing of the Law of Nature Protection in 1957 that was prepared by the nature protection commission of the Academy of Sciences of Estonia (founded in 1955) with Prof. E. Kumari and Prof. E. Varep at its head. The important break-through of putting natural areas under protection saved many a natural rarity and landscape from the intrusive urbanization. As a result of this law four national nature reservations supplied with the scientific personnel and 26 preserves were founded, 34

CHAPTER 2: INSTITUTIONAL STRUCTURE AND LEGISLATIVE FRAMEWORK

2.1 Historical Background

2.1.1 *Foregoing period*

The scientific investigation of Estonian nature started only in the second half of the 18th century - later than in the neighbouring countries of Finland, Sweden and others (see Appendix 1 for a summary of historical events relevant to nature conservation). The first papers were simple, practical surveys of the flora, fauna and geology (by the enlightened A.W. Hupel, Linné's disciple J.B. Fisher and others). Tartu University, which opened in 1632 and reopened in 1802, soon became the scientific centre of northern Europe and Russia (to which Estonia then belonged). The mostly German-born natural scientists of those times (C.F. Ledebour, A. Bunge, E.R. Trautvetter, A. Willkomm and others) paid little attention to Estonian nature. Nevertheless, it is interesting to see, for example, a discussion about Russian steppes and the necessity of protecting their flora in one of Ledebour's articles from 1836. Karl Ernst von Baer, who was born in Estonia and graduated from Tartu University, was the first to evaluate the decrease of the fish stock in Lake Peipsi from an ecological point of view, in 1851-52.

The ideas of nature protection can be found in some of the other works of the scholars and professors of Tartu University in the second half of the last century (C.A. Schultz, investigator of natural resources of Russia; A. Middendorff, propagator of nature protection in polar regions, G. Helmersen, initiator of the protection of boulders, F. Faltz-Fein, founder of the Askania-Nova nature reserve in southern Russia and others).

In 1853 a Naturalists' Society was founded in Tartu, which organized a comprehensive research programme of Estonian nature in the course of which many rare and extraordinary natural phenomena became evident.

Public figures, writers and journalists of the period of National Awakening were the first among non-naturalists to understand the necessity of economical utilization and protection of natural resources. The most outstanding figure of the last century was C.R. Jakobson who proposed the foundation of the Estonian society for bird protection in 1880 following the example of Finland.

2.1.2 *The start of organized nature protection in Estonia*

At the beginning of this century there was a rapid growth of interest in the geology and natural history of the Estonian western islands, especially the birds and flora. The caretaker of the Vilsandi lighthouse, A. Toom (1883-1946), organized bird protection on the islands of

Large-scale drainage carried out in recent decades, coupled with dry years (or even years of drought), have brought about considerable lowering of the water level in lakes and the depletion of flow in streams and springs, even drying up during the low-water period. About 300 water reservoirs (making up c.1.5% of the land area) have been constructed for regulating water flow.

According to the results of typological analysis, most of the lakes in Estonia are either dystrophic (36.6%) or eutrophic (36.4%). The former type represents the final stage of lake development in our climatic zone, while the latter together with alkalitrophic and dystrophic lakes represent the intermediate stage. A number of lakes are damaged at present, mostly through eutrophication processes due to the runoff of agricultural fertilizers. Therefore lake renovation has become a typical problem calling for scientifically based and economically feasible solutions.

The whole land surface of Estonia is within the Baltic Sea catchment area. Most of the 420 rivers are short, the longest being the Pärnu River (144km). Only three rivers have an average runoff exceeding 50m³/s at the river mouth: Narva (connecting Lake Peipsi and the Gulf of Finland) - 399 m³/s, Emajõgi (connecting Lake Võrtsjärv and Lake Peipsi) - 72 m³/s, Pärnu - 64m³/s.

The construction of dams dates back to the 13th century. However, larger-scale river reclamation activities have only been carried out since the 19th century in order to improve the water regime of agricultural areas. As a result of intensive reclamation in post-war years the natural river system has been drastically changed in places (for example, the estimated length of artificial canals and dredged parts of rivers and streams accounts for 77% of the total length of the flowing water bodies within the catchment area of the Kasari River).

Table 5: The numbers of some game species and the game bag (given in brackets) over the last four decades

	1955	1970	1985	1991/1992 ¹
Moose <i>Alces alces</i>	800 (2)	9600 (2070)	11,000 (5164)	15,000 (6372)
Red deer <i>Cervus elaphus</i>	-	-	450 (57)	1300 (103)
Roe deer <i>Capreolus europaeus</i>	5000 (9)	42,400 (2359)	39,000 (8117)	60,000 (9246*)
Wild boar <i>Sus scrofa</i>	600 (-)	4900 (1009)	9500 (5760)	16,000 (7043*)
Brown bear <i>Ursus arctos</i>	110 (206)	180 (1)	500 (24)	800 (48)
Wolf <i>Canis lupus</i>	800 (206)	9 (9)	100 (88)	400 (85)
Lynx <i>Felis lynx</i>	240 (-)	80 (22)	580 (60)	1000 (67)
Raccoon dog <i>Nyctereutes procyonoides</i>	400 (23)	4800~ (4931)	3900~ (5724)	7200~ (2650*)
Otter <i>Lutra lutra</i>	800 (-)	650 (3)	400 (-)	1000 (-)
Beaver <i>Castor fiber</i>	-	-	900 (24)	3500 (195*)
Muskrat <i>Ondatra zibethica</i>	-	-	37,000 (666)	30,000 (159*)
Badger <i>Meles meles</i>	1300 (88)	4200 (573)	1800 (46)	2500 (3)

Key

¹ The numbers of game species in 1992, the game bag in 1991

~ Very approximate estimation

* the real number is probably at least 30% higher



Plate 6: Nest of golden eagle *Aquila chrysaetos* (Photo: Paul Pere)

Reptiles (*Reptilia*) are represented by five species (including the widely distributed viviparous lizard *Lacerta vivipara*, the adder *Vipera berus*, the grass snake *Natrix natrix*). The slow-worm *Anguis fragilis* is included in the list of protected animal species; additionally, the still rarer sand lizard *Lacerta agilis* will be added in this list.

Out of 329 bird species 226 have bred in Estonia (208 regularly). Additionally, many species occur as transit migrants and/or as winter visitors (e.g. Bewick's swan *Cygnus columbianus*, long-tailed duck *Clangula hyemalis*, redpoll *Carduelis flammea*, common scoter *Melanitta nigra*. Many species have declined in numbers (e.g. great snipe *Gallinago media*, willow grouse *Lagopus lagopus*, roller *Coracias garrulus*, peregrine falcon *Falco peregrinus*). Therefore, a comparatively large number of species have been taken under state protection (146) or included in the Red Data Book. Conversely, some species decreasing in western Europe have increased in numbers in Estonia, e.g. the white stork *Ciconia ciconia*, which is an object of study for many Nordic and western ornithologists visiting Estonia. The populations of several gull and passerine species are increasing as they often become urban dwellers. The Estonian bird fauna is protected and thoroughly studied in state nature reserves and local bird sanctuaries. Bird hunting has been remarkably reduced in this century. At present game birds are represented by many ducks, geese and some waders.

Sixty-eight mammal species have been recorded in Estonia, five of them having been introduced (the raccoon dog *Nyctereutes procyonoides*, the American mink *Mustela vison*, the muskrat *Ondatra zibethicus*, the red deer *Cervus elaphus* and the sika deer *Cervus nippon*). The European beaver *Castor fiber* became extinct in the mid-19th century but a population has existed in Estonia again since the 1950s, thanks to its reintroduction into north-west Russia.

Twenty-one mammal species have been given state protection; however, the Red Data Book of Estonia includes 37 mammal species. The endangered mammal species in Estonia are the European mink *Mustela lutreola*, the flying squirrel *Pteromys volans* and three species of dormice (*Gleridae*).

At present, 17 mammal species are hunted as game: moose *Alces alces*, wild boar *Sus scrofa* and roe deer *Capreolus capreolus* are the most important commercially. Thanks to the reasonable hunting policy, ineffective forest management and other factors, the numbers of several mammal species strictly protected elsewhere in Europe, have increased remarkably during the last 60 years (Table 5), and they are included in the list of game animals in Estonia (e.g. wolf *Canis lupus*, lynx *Felis lynx* and brown bear *Ursus arctos*).

1.5.4 Inland waters

There are over 1,400 lakes in Estonia, the largest being Lake Peipsi (3555km²) at the Russian border in the East and Lake Võrtsjärv (270km²) in central Estonia. The deepest, 38m, is Rõuge Suurjärv in the south-east. The lakes vary to a great extent, having a rich fauna and flora with a number of rare species normally typical of Arctic-alpine, Atlantic and other regions.

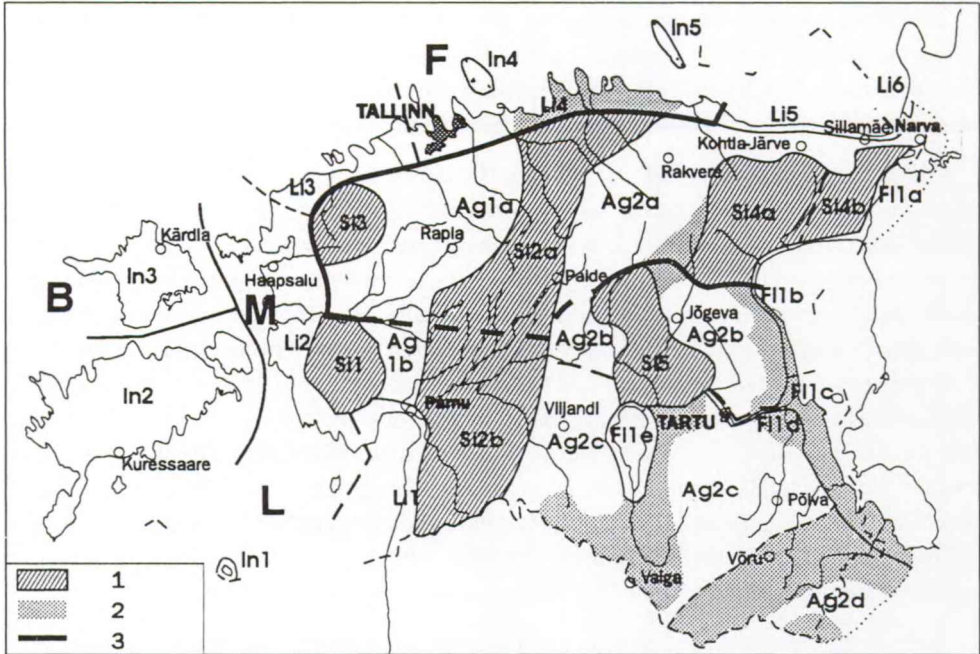


Figure 7: Zoogeographical map of Estonia (compiled by J. Küli)

Key

- 1 - Natural landscape areas.
- 2 - Major forested areas.
- 3 - Dividing line between European and Siberian faunas.

ESTONIA MARITIMA

B = Läänemeri (Baltic Sea); **F** = Soome laht (Gulf of Finland); **L** = Riia laht (Gulf of Riga); **M** = Väinameri.

In - Estonian islands In1 = Ruhnu; In2 = Saare-ja Muhumaa; In3 = Hiiumaa; In4 = Prangli; In5 = Vaindloo-Uhtju.

Li - coastal areas Li1 = edelarannik (SW coast); Li2 = läänerannik (W coast); Li3 = looderannik (NW coast); Li4 = põhjarannik Soome lahe läänesaos (N coast, Western part of the Gulf of Finland); Li5 = põhjarannik Soome lahe idaosas (N coast, Eastern part of the Gulf of Finland); Li6 = Ingeri e. kilderannik.

ESTONIA CONTINENTALIS

FI - rivers and lakes FI-1a = Narva jõgi (River Narva); FI-1b = Põhja-Peipsi (northern end of Lake Peipsi); FI-1c = Lõuna-Peipsi (southern end of Lake Peipsi); FI-1d = Emajõgi (Mother River); FI-1e = Võrtsjärv (Lake Võrts).

Si - natural landscapes Si1 = Sootaguse; Si2 = Vahe-Eesti (Estonia intermedia); Si2a = Kõrvemaa; Si2b = Jõemaa (= Soomaa); Si3 = Vihterpalu; Si4 = Alutaguse; Si4a = Lääne-Alutaga; Si4b = Ida-Alutaga; Si5 = Jõetaguse.

Ag - agricultural landscapes Ag1 = Lääne-Eesti kultuurmaastik (W Estonia); Ag1a = Loode-Eesti (NW Estonia); Ag1b = Pärnu; Ag2 = Ida-Eesti kultuurmaastik (E Estonia); Ag2a = Pandivere; Ag2b = Kesk-Eesti (central Estonia); Ag2c = Lõuna-Eesti (S Estonia); Ag2d = Kagu-Eesti (SE Estonia).

Western Palearctic fauna In1; In2; In3; Li1; Li2; Li3; Li4; FI-1b; FI-1c; FI-1d; FI-1e; Si1; Si2b; Ag2b; Ag2c; Ag2d.

Eastern Palearctic fauna In4; In5; Li5; Li6; FI1a; Si2a; Si3; Si4; Ag1a.

Invertebrates form the greatest macrogroup - 11,597 known species. There are many rare, relict and endangered species of various (subarctic, boreal, atlantic, subboreal) climatic periods among Protozoa, Nemanthelminthes, Annelida, Mollusca and Arthropoda. Zoogeographically, Estonia is situated on a transitional area of Western and Eastern Palearctic regions, with Western Palearctic species dominating (Figure 7). The development of this fauna has been influenced particularly by the Baltic Sea, and, of course, by various types of inland waterbodies.

The richest with respect to the species composition in invertebrate groups are insects - nearly 10,000 species (including Coleoptera, about 3050 species; Lepidoptera, 1787; Diptera, 2113 species). Several invertebrate species are under state protection, e.g. the freshwater pearl mussel *Margaritifera margaritifera*, the common red ant *Formica rufa* and the Roman snail *Helix pomatia*. Also included in the Estonian Red Data Book are the crayfishes *Pallasea quadrispinosa* and *Gammarus duebeni*, 27 invertebrate species (including the swallowtail butterfly *Papilio machaon*, *Asilus crabroniformis* and *Aeschna serrata*), an Estonian endemic crustacean *Ilyodromus estonicus*), four mollusc species and six annelid species (e.g. the medicinal leech *Hirudo medicinalis*).

The checklist of Estonian **vertebrates** consists of 487 species. This figure includes the vertebrates which spread into Estonia naturally and eight wild-breeding introduced species.

Cyclostomes (*Cyclostomata*) are represented by three species. Two species (the river lamprey *Lampetra fluviatilis* and the brook lamprey *L. planeri*) are common while the sea lamprey *Petromyzon marinus* has been found occasionally.

Fish fauna (*Pisces*, 71 species) includes only one chondrosteian fish species. The Atlantic sturgeon *Acipenser sturio*, one of the protected fish species, has not been recorded in Estonian waters since 1971. Of teleost fishes, 31 marine species include the most important commercial fishes (the Baltic herring *Clupea harengus membras*, the Baltic sprat *Sprattus sprattus balticus*), and also several saltwater species which appear only rarely in Estonian brackish coastal waters. Numbers of most migratory fish species (the Atlantic salmon *Salmo salar*, the sea trout *Salmo trutta trutta*, the Vimba bream *Vimba vimba*) have been declining during the past few decades, mainly due to hydrotechnical constructions and the pollution of spawning grounds. Most freshwater fishes (about 30 species) are also distributed in the brackish coastal areas of the Baltic sea. The protected teleosts (the wels *Silurus glanis*, the grayling *Thymallus thymallus* and the asp *Aspius aspius*) are distributed only in freshwaters. Besides the Baltic Sea, commercial fisheries are well developed on our largest lakes, Peipus (Peipsi) and Võrtsjärv.

There are 11 species of **amphibians** (*Amphibia*) in Estonia; however, the occurrence of the marsh frog *Rana ridibunda* in Estonia is doubtful. All these species are included in the Red Data Book. Some species are relatively widely distributed (the common frog *Rana temporaria*, the moor frog *R. arvalis*, the common toad *Bufo bufo* and the smooth newt *Triturus vulgaris*); others are more or less rare or sporadic (the crested newt *Triturus cristatus*, the common spadefoot *Pelobates fuscus*, the natterjack toad *Bufo calamita*, the green toad *Bufo viridis*, the edible frog *Rana esculenta* and the pool frog *R. lessonae*).



Plate 4. Pine forest in Lahemaa National Park (*Photo: Jüri Pere*)

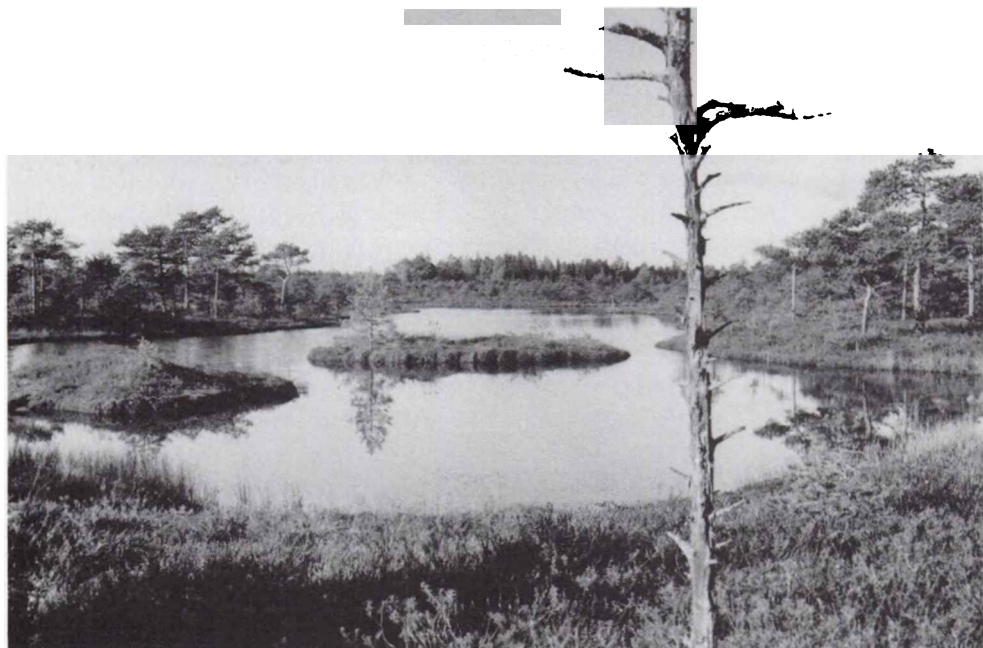


Plate 5. Bog landscape with a lake (*Photo: Jüri Pere*)

of natural meadows were changed. Some of them were cultivated into grasslands, others were afforested and a considerable number were overgrown with scrub. This has been a loss to our flora. A number of presently common species will probably become rare or die out in the future. Eighty-three species are in danger of extinction already. Some plant communities (e.g. the *Melampyrum nemorosum* - *Scorzonera humilis* association in which 163 species were recorded on 100m² in 1951!) are in danger of extinction; they have only remained within a few nature reserves. Alvar meadows, communities typical of Scandinavia, are mostly treeless and meadow-like in Estonia, with a very interesting mosaic flora and vegetation of a continental character, sometimes called 'pseudosteppes'. In recent decades they have become overgrown with pine and juniper because sheep, which used to keep them in a stable condition, are not grazed in most of these areas any more.

How can the floristically and ecologically very interesting meadow vegetation be saved? There are three possible ways:

- establishment of nature reserves in the areas where meadows have still remained;
- restoration of meadows, especially wooded meadows rich in species, by cutting a part of the tree and shrub layer as has been successfully done in the island of Saaremaa;
- restoration of the private system in agriculture, which could have a positive influence on the restoration of traditional nature management characters, including the use of meadows.

Mires (fens, bogs, swamps)

Mires cover approximately 9150km² or 21.5% of Estonia. If water-logged areas where the peat layer is less than 30cm are included, 31% of Estonia could be considered to be covered by mires. Fens (eutrophic mires) make up 57%, transitional (mesotrophic) mires 12%, and bogs (oligotrophic mires) 31% of the area under mires. Estonian mires are deep-layered; hundreds of bogs have peat layers thicker than 5m.

In the last few decades, over 700,000ha of water-logged meadows, fens and traditional mires have been drained. As the agricultural use of these areas did not often prove successful, a part of this land is presently covered with young forests and shrubs of low value. The fauna and flora have been damaged, many rare species and communities have lost their natural habitats and bogs important for freshwater reserves have been destroyed. Fortunately, due to the abundance of all kinds of mires, large areas of economic and/or scientific importance have been maintained. At present there are 30 mire reserves with a strict protection regime in Estonia.

1.5.3 Fauna

The results of zoological research have demonstrated a very rich composition of faunal groups in Estonia. 12,084 species are known and 28,000 species are actually supposed to inhabit the country (see Table 4).

Estonia

- Decrease in the average age of the needles of coniferous trees (the average age of pine needles is only 2.1 years in north-eastern Estonia and 2.8 years in southern Estonia; the corresponding value in unpolluted areas would be 4-5 years).
- Appearance of the first signs of damage caused to forests by acid rain. At present such damage has been detected on over 3200ha of forests.
- Appearance of new forest pests and diseases.

Forest management activities have become wider in scope since the 1960s when the responsibility for forest management and nature protection was given to one ministry. The multiple use of forests, including hunting, landscape design, planting of 'green belts' around towns, the recultivation of mined areas, gained attention. Areas that had fallen out of agricultural use were added to forest lands. The protection of forests (e.g. along waterways) gained importance and felling activities were reduced to an intensity twice as low as that of the Nordic countries.

As the pollution rate could not be reduced, activities were aimed at increasing the role of forests and other natural areas as the factors stabilizing the environment, increasing biological diversity and compensating for the anthropogenic load on the environment.

In recent years cooperation with northern neighbours (especially Sweden and Finland) in the area of forest management has become more active. More suitable technologies and equipment for our forests have been introduced. However, techniques of forest exploitation are still wasteful and in places far from optimum. As forests become more important to the economy, new incentives appear for improving management practice. The goal is to maintain and improve forest management activities within and after the current changes in ownership and economy.

Grasslands

Some of the vegetation types most characteristic of Estonia are grasslands, meadows and natural or seminatural pastures. In 1939 they covered 24.5% of the land area, but during the last 40-50 years the area of grasslands (meadows and pastures) has decreased to less than 20%.

Soviet agricultural policy was characterized by the concentration of all kinds of management into large collective farms, and by a disregard of natural agricultural resources. Relatively highly productive natural and semi-natural grasslands surrounding individual farms were abandoned and overgrown with brush and young forests.

Meadow communities, often rich in species (690 species, some of them very rare, have been recorded in the meadow flora) are beautiful patterns in our countryside, adding to the few colours of our northern landscape. Especially bright are forest meadows with their dense herb layer rich in orchids and single old oaks, ash and limes, etc. During the collectivization period after World War II, when different agricultural measures were introduced, large areas

pollution - 38 macrolichen species have become extinct during the last five decades. Lichens are extensively used in Estonia as the litmus organisms for air pollution levels in ecological monitoring.

1.5.2. Main types of vegetation

According to official data, 40.1% of Estonia is covered by forests and forest lands (young forest plantations, open woodlands and bogs covered with trees). The total standing volume of forests constitutes 264 million cubic metres, the average standing volume being 144 solid metres per hectare. In 1991, 3.01 million solid metres of timber were produced (1.14% of the total standing volume).

Eighty-seven native and over 500 introduced tree and scrub species have been recorded in Estonia. The main tree species in forests are pine *Pinus silvestris* - in 41% of forests, birch *Betula pendula* and *B. pubescens* - in 28%, spruce *Picea abies* - in 23%, grey alder *Alnus incana* - in 4%, aspen *Populus tremula* - in 2%, common alder *Alnus glutinosa* - in 1%, broad-leaved trees (e.g. oak, ash, lime, elm) - all in 1% of fine deciduous forests.

Estonia belongs to the temperate hardwood-coniferous forest zone. Twenty-two site-types and 71 forest types have been distinguished.

The most important are dry pine forests on sandy soils, temperate spruce forests, hardwood-spruce mixed forests, transitional (mesotrophic) swampy forests, dry heath pine forests, bog (oligotrophic) pine forests, fen (eutrophic) birch forests, species-rich swampy common alder forests, as well as river bank forests and alvar forests.

Forest management in Estonia has a long history. The first edict prohibiting the felling of forests was put into force in the islands as early as 1254; forest keepers were introduced in 1696 and the first regulation concerning management was implemented in 1782. Forest plantations have been cultivated since the last century. Between the two World Wars Estonia had a developed forest management with timber products constituting a considerable share of overall production.

The main processes taking place in Estonian forests during the last 40-50 years include:

- Impoverishment of the typological composition of forests. Due to drainage, intensive felling, air pollution, etc., some forest types, e.g. swampy common alder forests (*Filipendula* and *Dryopteris* types), boreonemoral hardwood-spruce forests (*Hepatica*-type), and alluvial river-bank forests are currently rare or on the verge of extinction.
- Forests have become younger (the average age being 49 years). The area of mature forests has decreased; the area of middle-aged and young forests has increased.
- Damage caused to forests by heavy machines, damage of the above-ground vegetation (mosses, lichens, herbs, dwarf shrubs) and, parallel to this, a serious litter problem in forests.



Plate 3: *Oxytropis pilosa*, a leguminous arctic-alpine plant (Photo: Jüri Pere)

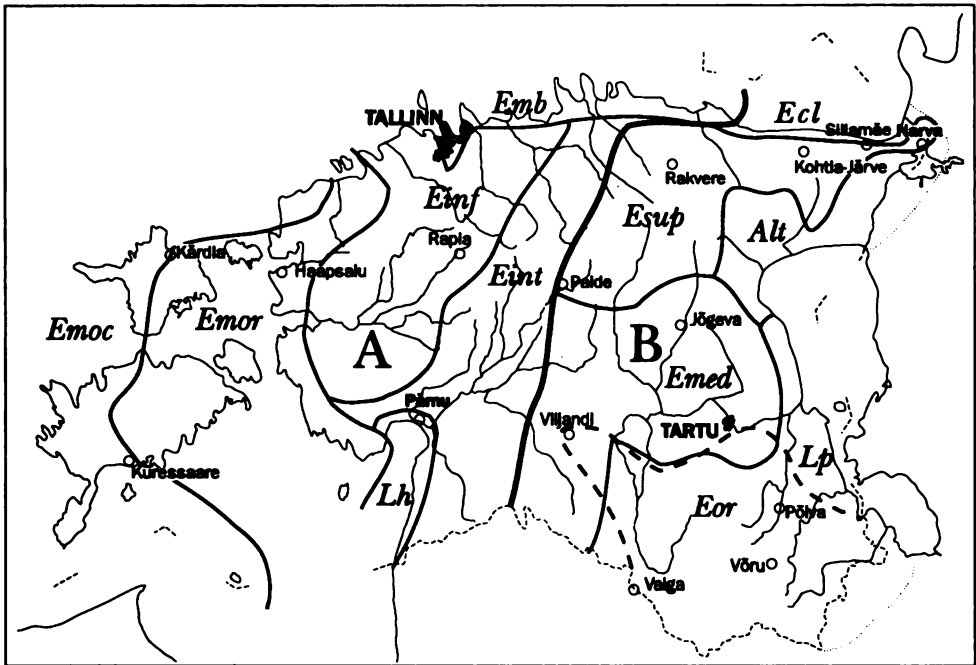


Figure 6: Phytogeographical map of Estonia (after T. Lippmaa, 1935; amended by J. Eilart, 1963 - dotted curve)

Key

A - Central European Province; **B** - Eastern European Province;

Emoc - *Estonia maritima occidentalis* (characterized by many suboceanic species, seashore halophilous communities, alvars, species-rich wooded meadows, dunes, etc.);

Emor - *Estonia maritima orientalis* (many nemoral species associated with broadleaved forests, alvars, western-type bogs, few suboceanic species);

Emb - *Estonia maritima borealis* (Arctic-alpine relics, dry, sandy pine forests, halophilous communities, dunes);

Lh - *Litorale heademeesteense* (dunes, bogs, halophilous communities);

Ecl - *Estonia clivosa* (caliculous meadows, rich deciduous forests on the foot of glint);

Elmf - *Estonia inferior* (species-rich meadows, caliculous fens, alvars, bogs, less forests);

Eint - *Estonia intermedia* (large bogs, swampy forests, dry pine forests in northern part, species-poor meadows, some subarctic relics, no pontic and suboceanic relics);

Esup - *Estonia superior* (spruce forests, eastern-type bogs, some western species occurring here on eastern border);

Alt - *Alutagia* (swampy forests, bogs, eastern species occurring on the eastern border);

Emed - *Estonia media* (spruce forests, swampy forests, floodplain fen-grasslands);

Eor - *Estonia orientalis* (dry pine forests, species-poor meadows, many eastern pontic and pontosarmatic species);

Lp - *Litorale peipsiense* (lake-shore wet meadows).

The south-westernmost corner of the country, largely under the administration of the Russian Federation since World War II, is distinguished by T. Lippmaa as **Esar** - *Estonia sarmatica* (many pontic and pontosarmatic species, dunes, heaths, etc).

(c. 12,000 years ago), Dryas-period (arctic relicts), from the preboreal, boreal, atlantic and subboreal periods, is large.

Estonia is traversed by an important European biogeographical borderline (Figure 6) which divides the country into two provinces. The western part of the land belongs to the Mid-European province, with Ordovician-Silurian limestone bedrock with alvars, supporting calciphilous fens, species-rich forest meadows and broad-leaved forests. Numerous calcicolous species dominate the plant communities. The eastern part belongs to the East European province, with acid soils on Devonian sandstone bedrock supporting acidophilous plant communities and predominantly pine forests.

Many plant species are on their distribution border in Estonia (so-called margin species). It has been established that 251 higher plants species in Estonia are at their northern, southern, eastern or western limits: on the **northern** margin 71 species (e.g. *Cladium mariscus*, *Heliochrysum arenarium*, *Berula erecta*), on the **eastern** margin 50 species (e.g. *Juncus subnodulosus*, *Litorella uniflora*), on the **south-eastern** margin 32 species (e.g. *Cornus sucica*, *Cochlearia danica*), on the **southern** margin nine species (e.g. *Botrychium lanceolatum*, *Carex glareosa*), on the **south-western** margin 14 species (e.g. *Carex brunnescens*, *C. globularis*), on the **western** margin 16 species (e.g. *Chamaedaphne calyculata*), on the **north-western** margin 59 species (e.g. *Arenaria procera*, *Trisetum sibiricum*).

Over the last century many vascular plants, lichens and bryophytes have become extinct in the flora of Estonia or have become very rare. Extinct in the flora are *Alisma lanceolatum*, *Blechnum spicanti*, *Botrychium lanceolatum*, *B. simplex*, *Carex rhynchophysa*, *Cochlearia officinalis*, *Crassula aquatica*, *Dactylorhiza sambucina* (reintroduced!), *Eleocharis ovata*, *Erica tetralix*, *Galium schultesii*, *Geranium columbinum*, *Hypericum humifusum*, *Juncus anceps*, *Melica ciliata*, *Orchis coriophora*, *Scrophularia auriculata* (17 species).

Bryophytes make up a very important component in the ecosystems of Estonia, especially in forests and mires. Out of the known 507 species 350 belong to the order *Bryales*, 120 to *Hepaticae*, 37 to *Sphagnales*. More than 100 moss species in Estonia are rare and endangered, and 21 species are extinct.

Algae (together with *Cyanophyta* which are transferred to *Bacteria* as *Cyanobacteria* in modern times) is a species-rich macrogroup in Estonian biota: at present we know more than 2500 freshwater, marine, soil and aerophilous algae species. One species of *Phaeophyta*, *Waerniella lucifuga*, is extinct.

Fungi is the largest macrogroup in the ancient plant kingdom. In Estonia there are 3461 species. The largest groups of mushrooms are *Agaricales* (772 species), *Aphylllophorales* (388), *Uredinales* (275) and *Helotiales* (225). We know of 300 edible species among our mushrooms (production 35,000 tonnes per year). Fifteen species are poisonous. 157 species grow on firs, 121 on pine.

Lichen-flora consists of 786 species while its composition is made up of many very rare arctic-alpine, nemoral, xerocontinental and oceanic species. Lichens suffer severely from air

Table 4: Composition of the flora and fauna of Estonia

Macrogroups	Determined no. of species	Probable no. of species
FUNGI	3,461	6,000
ALGAE (+CYANOBACTERIA)	2,500	3,000
LICHENS	786	850
BRYOPHYTES	507	600
VASCULAR PLANTS	1,560	1,600
PLANTS	5,353	6,000
INVERTEBRATA	11,597	27,000
Protozoa	346	700
Porifera	3	6
Coelenterata	8	11
Ctenophora	1	1
Plathelminthes	304	400
Nematoda	451	1,000
Nemertinea	4	10
Priapulida	1	?
Annelida	130	230
Bryozoa	7	15
Mollusca	136	150
Arthropoda	10,206	24,000
VERTEBRATA	487	
Cyclostomata	3	
Pisces	71	
Amphibia	11	
Reptilia	5	
Aves	329	
Mammalia	68	
ANIMALS*	12,084	28,000
TOTAL	20,898	39,000

* Data from Dr Kaupo Elberg, Prof. Hans Trass and Prof. Toomas Saat.

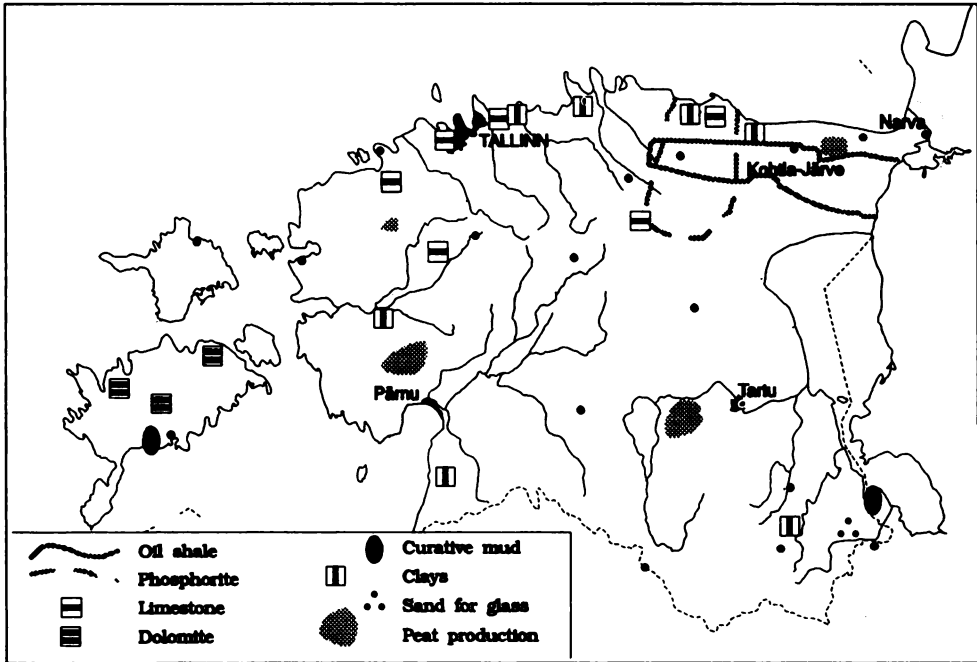


Figure 5: Deposits of mineral resources in Estonia

1.5.1 Flora

In 1984 the final volume of the 11-volume *Flora of Estonia* was published. This work describes 2028 species, of which 1416 are native wild plants. If the microspecies of groups such as *Hieracium* and *Taraxacum* are added, the native flora of Estonia would comprise 1560 species (Table 4). Largest genera are *Taraxacum* - 163 species, *Hieracium* - 147 species and *Carex* - 76 species.

The flora of Estonia is composed of different phytogeographic groups: **arctic and arctic-alpine species** (e.g. *Carex glareosa*, *Pinguicula alpina*, *Poa alpina*, *Selaginella selaginoides*, *Cerastium alpinum*), **European species** (e.g. *Carex ornithopoda*, *C. davalliana*, *Tofieldia calyculata*), **Euro-Asian species** (e.g. *Ligularia sibirica*, *Primula farinosa*), **Circumpolar and circumboreal species** (e.g. *Lonicera coerulea*, *Betula nana*, *Drosera anglica*), **subatlantic species** (e.g. *Juncus subnodulosus*, *Hedera helix*, *Anacamptis pyramidalis*), **Eurosiberian species** (e.g. *Quercus robur*, *Mercurialis perennis*, *Ulmus montana*), **continental species** of Europe, Siberia and Eurasia, or **pontic and pontosarmatic species** (e.g. *Koeleria polonica*, *Astragalus arenarius*, *Silene tatarica*, *Pulsatilla patens*). Many plants belong to the **naturalized species** (e.g. *Glyceria maxima*, *Acorus calamus*, *Impatiens parviflora*, *Elodea canadensis*).

Only few species are **endemic** in the Estonian flora (e.g. *Rhinanthus osiliensis*, *Saussurea esthonica*, *Alchemilla strigulosa*, some microspecies of *Taraxacum* and *Hieracium*), while the number of **relicts** from various climatic periods, beginning with the Late Pleistocene

Curative mud has been used since the beginning of the 19th century. Although Estonia borders on the sea, the usable deposits of sea mud are not numerous. The reserves of the three major deposits (Haapsalu, Kuressaare and Käina) are estimated to be 3.7 million tonnes. The explored deposits of lake muds (gyttja) occur in 121 lakes. The largest deposits of curative mud are situated at Värskä (45 million tonnes). Lake mud can be used not only for medical purposes but also as fertilizer, fodder for livestock, fuel, etc. Total reserves of lake mud are estimated at 2.5-3 billion m³.

Mineral water with varying degrees of mineralization and balneological properties is in use in many parts of Estonia. The total yield of the five larger mineral water aquifers of Häädemeeste, Ikla, Kärđla, Kuressaare and Värskä is 4,700 m³ per day.

Estonia's mineral resources altogether make up a considerable wealth. We ought to use this wealth reasonably without causing a negative impact on the environment.

Deposits of the most important mineral resources - oil shale, phosphorite, dictyonema (alum) shale, and carbonate rocks - are located in the northern and north-eastern part of Estonia (Figure 5; Table 3). Peat and sand-gravel resources are distributed relatively evenly over the whole country and can be found to some extent in practically all districts.

Table 3: Mineral resources

Resource	Unit	Explored resources	Mined in 1991
Oil shale	million tonnes	3,800	19.6
Phosphorite	million tonnes*	750	-
Limestone, dolomite	million m ³	250	3.1
Sand, gravel	million m ³	150	6.9
Peat	million tonnes	2,400	1.8
Lake mud	million tonnes	120	0.001
Sea mud	million tonnes	3.7	0.005

*as calculated per P₂O₅

1.5 Biological Resources

Estonia is rather rich in renewable natural resources. Forests cover over 40% of the land; open, brushy and wooded grasslands 20%; mires (fens, swamps, bogs) 21%. A total of 8814 species of fungi and plants and 12,070 species of animals are already known; the probable number is estimated at about 38,000.

by January 1, 1992. Most of it has been reforested and 110 hectares returned to agricultural use; however, it is far from being of top quality.

The commercial reserves of oil shale currently mined in Estonia are estimated at 3,800 million tonnes, whereas outside the contours of commercial reserves, 3,900 million tonnes of lower quality oil shale have been suggested. The Tapa field is considered to hold some 2,500 million tonnes of lower quality shales at a depth of 50-180 metres. The thickness of the commercial seam reaches 2-3 metres. In view of the current level of output and related losses (27.8% in mines and 12.7% in quarries), the commercial reserves of oil shale will be exhausted in 50-60 years.

The phosphorite reserves of the Maardu, Raasiku, Kehra, Tsitre, Toolse, Rakvere and Aseri fields in north Estonia are of economic importance. The largest and most promising deposits occur in the Rakvere phosphorite field, extending over an area of more than 1000km². The thickness of the seam is 4-8 metres (max. 11 m), and the reserves are supposed to be about 750 million tonnes of P₂O₅. However, the opening of new mines at that site is complicated by several ecological and economic factors. In 1987, the government of the republic decided not to proceed with mining phosphorite in Estonia this century.

Dictyonema argillite (alum-shale) which is rich in uranium (average 80-120, max. 300-450 grams per tonne), contains about 20% of organic matter and several valuable microelements (Mo, V, Cu, Pb, Sr, Th, Re). It covers an area of 12,000km², and the thickness of the seam is 3-6 metres. Its oil yield (3-5%) and calorific value (6.1-6.7 MJ/kg) are rather low, and the shales are not used at the present time.

Mires (fens, bogs, swamps) which partly coincide with forest areas, occupy about 21.5% of Estonia. Peat deposits of commercial importance occur over an area of 477 thousand hectares. Estonian peat reserves are estimated at 2.4 billion tonnes, of which commercial reserves constitute 657 million tonnes. The mean annual output is about 1.8 million tonnes used for soil improvement, animal litter and making briquettes. A proportion of the product (some 110,000 tonnes in 1991) is exported as a substrate for horticulture.

Estonia's natural reserves of building materials are practically unlimited. The commercial reserves of 57 limestone and dolomite deposits are estimated at about 750 million m³. Limestone is used as raw material in producing lime (0.2 million tonnes), cement (1.2 million tonnes), glass (10,000 tonnes) and building stone; it also finds application in the chemical, pulp and paper industries. Dolomite is suitable for making facing stones. Of the total annual output (3.1 million m³), the greater part is used in construction.

Clay deposits occur all over Estonia. Clay is used for the production of cement (0.2 million tonnes), and in the ceramics industry (170,000m³). Refractory clay has been found only in the Devonian clay deposit at Joosu.

There are about 900 deposits of building sand and gravel. Prospective reserves amount to 250 million m³; total reserves are estimated at about one billion m³. In several regions the reserves are almost exhausted. The only glass and foundry sand deposit is located at Piusa in Upper-Devonian sandstone with reserves of about 4.5 million tonnes.

for 170-185 days, the period of active plant growth (average temperature over 10°C) is 120-130 days long in most of Estonia. The climatic conditions of Estonia are favourable for the formation of mobile humus as well as for intensive biological action and turnover of substances in the plant-soil system.

Geologically, Estonia consists of three vertical complexes: a crystalline base, with Paleozoic rocks above it, and uppermost, loose Quaternary deposits.

The crystalline base lies at a depth of 110-800m below the sea level and does not directly participate in soil formation. The Paleozoic sedimentary cover is divided into three great series. The Vendian and Cambrian blue clays and sandstones crop out on the narrow northern coast between the North-Estonian Escarpment (glint) and the contemporary Gulf of Finland. Nearly 50% of Estonian bedrock consists of Ordovician and Silurian limestones, marls and dolomites which are exposed in alvars and represent an immediate soil-forming material there. However, the limestone debris is an important constituent in tills of the Quaternary age. South of the Pärnu - Puurmani - Mustvee line there is a region of 'Old Red' Devonian sandstone.

The Quaternary deposits on the Paleozoic cover constitute the main mother material for soil formation. Three types of tills prevail amongst them: white pebble till in northern and western Estonia, yellow-grey calcareous till in central Estonia and red-brown till with highly variable calcareousness in southern Estonia. Varved clays and Holocene sediments occur mainly on the West-Estonian Lowland, but also in the depressions of the so-called High Estonia. The frequent occurrence of two-membered deposits consisting of underlying tills and different cover formations are characteristic of Estonia in general. Also coarse, glaciofluvial, aeolian and mire deposits form the soil-forming rocks here.

The character and trend of soil formation depend essentially upon the calcareousness and texture of the Quaternary deposits formed previously from the crumble of local Paleozoic limestones, dolomites, sand- and siltstones in combination with the crystalline weathering products of Fennoscandian origin.

1.4 Mineral Resources

In spite of its small area and a rather simple geological structure, Estonia is rich in mineral resources. The world's largest exploited deposits of oil shale in the north-east of Estonia support the generation of electricity (80% of the total mined) and the chemical industry (20%). Phosphorite deposits are the largest in Europe. In terms of the total output of minerals (more than 70 million tonnes annually, or over 50 tonnes per capita) Estonia, particularly its north-eastern part, ranks among the regions with advanced mining industry, which has brought about acute ecological problems. As a result of oil shale mining alone, the area of the quarries covered with waste rocks increases by several hundred hectares annually, and about 10 million tonnes of oil shale ash is added to the Earth's surface every year. In 1991, 10 million tonnes of oil shale were produced in mines and 9.6 million tonnes in quarries. Out of the total area of 10,000 hectares spoilt by mining activities, 8330 hectares were reclaimed

The Pandivere Upland and central Estonian Plain have an undulating or level relief, a fertile carbonate till cover, and they are largely under cultivation. Drumlins lying north-west to south-east, quite long (2-5km) and wide and mostly covered with fields, are typical of Vooremaa. Smaller drumlins are more typical of the Türi Drumlin Area. The interstitial troughs contain moist grasslands, swamps and lakes.

South Estonia has the greatest variety of landscapes. The Sakala Upland (heights reaching 90-110m) and the Plateau of south-east Estonia have a relatively flat surface topography intersected by numerous ancient valleys. Outcrops of the red Devonian sandstone which forms the bedrock of south Estonia occur at many points on the banks of rivers in these valleys. The landscape has a fertile till surface cover and is for the most part cultivated. Maximum heights in the upland areas reach 317.6m (Suur-Munamägi, the highest spot in the Baltic States) in Haanja, 217m in Otepää and 137m in Karula. These areas are characterized by extremely diverse surface relief with hills of various shapes (rounded hills, eskers, kames), with relative heights of mostly 10-25m, covered with a mosaic of forests and fields, surrounded by bogs and small lakes. The Valga and Hargla Depressions and Palumaa Area are predominantly level and richly forested.

The locality types (landscapes) can be divided according to landform and genesis (Table 2). Here the locality is assumed to be a natural (territorial) complex formed in the area of one morphogenetic type of relief.

Table 2: The distribution of Estonian locality types (after Arold, 1991)

Content	Distribution (%)	Content	Distribution (%)
Limestone plains	3.2	Alluvial plain	0.8
Valley in limestone or sandstone	0.7	Coastal plain	10.1
Escarpment in limestone or sandstone	0.2	Bog plain	16.9
Abraded till plain	19.0	Technogenic plain	0.1
Drumlin field	2.2	Glacial aggraded hillocky relief	2.1
Till plain	15.3	Kames covered by till	0.4
Glaciofluvial plain	2.4	Kames	1.7
Glaciolacustrine plain	22.4	Eskers (esker systems)	0.7
Lacustrine plain	1.0	Dunes (dune systems)	0.5
		Technogenic relief	0.1

1.3 Climate, Geology and Soils

The climate of Estonia is Atlantic-continental in origin and characterized by warm summers and moderately mild winters. It means that the prevailing moist situation often alternates with one or more dry periods during the vegetative season. The mean annual air temperature is 4-6°C and the mean annual precipitation is 500-600mm. The vegetative period lasts mostly

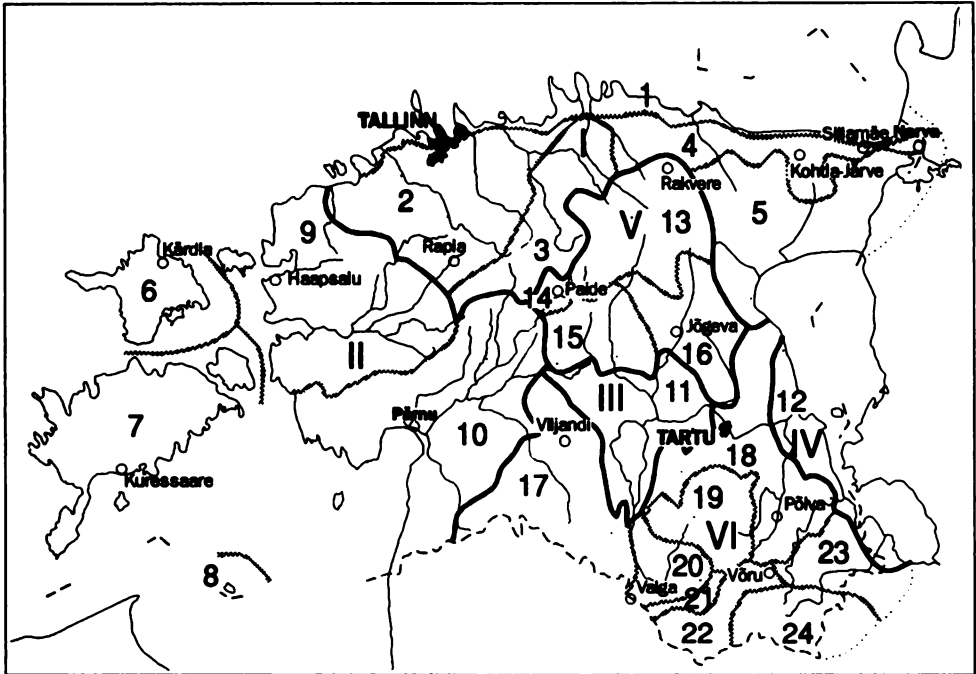


Figure 4: Landscape regions

Lower Estonia: I North Estonia. 1 North-Estonian coastal plain; 2 North Estonian Plateau; 3 Kõrvemaa; 4 North-east Estonian Plateau; 5 Alutaguse. II West Estonia: 6 Hiiumaa Island; 7 Saaremaa Island; 8 Ruhnu Island; 9 West-Estonian Lowland; 10 Pärnu Lowland. III Võrtsjärve Basin: 11 Võrtsjarve Lowland. IV Peipsi Basin: 12 Peipsi coastal lowland. V Estonian Water Shed: 13 Pandivere Upland; 14 Türi Drumlin Field; 15 Central Estonian Plain; 16 Vooremaa. VI South Estonia: 17 Sakala Upland; 18 South-east Estonian Plain; 19 Otepää Upland; 20 Valga Depression; 21 Karula Upland; 22 Hargla Depression; 23 Palumaa Area; 24 Haanja Upland.

emerged from under the sea relatively recently. They have a sandy or very stony surface cover and are for the most part overgrown with forest. The Kõrvemaa and Alutaguse areas are badly drained plains intersected by numerous end moraines left by the ice sheet. Most of the area consists of forests, fens and bogs.

The landscape regions of the West-Estonian islands (Saaremaa, Hiiumaa, Ruhnu) and the Western Estonian Lowlands are characterized by limestone bedrock and numerous alvars overgrown with junipers. Areas with a thicker till layer have been turned into fields. The relatively mild climate enables many plant species to grow here whose area of distribution does not reach further to the east. Grasslands are abundant, there are innumerable islands and islets and reed-beds occur on the coast (e.g. at Matsalu Bay). The coastal areas of the Pärnu Lowland and islands in the Gulf of Riga are either stony or covered with sand dunes. Farther inland there are fertile varved clay plains as well as extensive forests and wetlands.

The low area surrounding Lake Peipsi (3555km²) on the east border and the basin of Lake Võrtsjärve are covered with large forest and bog (mire) areas. Dune systems, drumlins and kame fields can also be found in places.

and fishermen were situated close to the bodies of water which, due to the neotectonic uplift, were greatly different from those of the present. Owing to the intensive uplift of the Earth's crust, the width of Estonia's coastal area exceeds 130km, and ancient coastal forms occur at various levels. Since the neotectonic uplift in the north-western part of the country was much more intense than in the south-western and north-eastern areas, synchronous coastal formations and the corresponding shorelines and old settlements there are considerably higher than elsewhere in Estonia.

In the geological past, Estonia was richer in lakes. In the Early Holocene they numbered about 5,000, of which only one-third have survived to the present day. Big changes have also occurred in the river network.

Although the beginning of primitive land tillage in Estonia dates back to the Stone Age, more serious interrelations between nature and man started at the beginning of the Bronze Age about 3,500 years BP, when land cultivation gained importance alongside hunting and fishing. The early evidence of draining lake shores and swamps by means of ditches dates from the 14th-15th centuries. Today, more than a million hectares of land have been drained, the water table of about 300 lakes is regulated, about 150 water reservoirs (making up 1.5% of Estonia's area) have been constructed and the natural river regime has been completely destroyed in several regions. For example, in the drainage area of the Kasari River the length of artificial canals and dredged river channels accounts for 77% of the total length of streams.

1.2 Nature Zonation and Landscape Types (Figure 4)

The orographical and paleogeographical evolution of Estonia have been decisive factors in the development of the Estonian landscape. The bedrock geology, the nature of the surface layer and the surface topography as well as human activity over several millennia have also had an important influence.

The territory of the republic falls into two parts: Lower Estonia and Upper Estonia. The former comprises the lower coastal areas, the islands of the Moonsund Archipelago and inland depressions, which remained inundated during the Late and Post-glacial periods by water from the Baltic Ice lake and the Baltic Sea. Upper Estonia embraces the more elevated part of Estonia, like the higher areas surrounding the Haanja, Karula and Otepää uplands in the south, the Sakala Upland in central Estonia, and the Pandivere Upland in the northern part of the country.

The typical landscapes of north Estonia are the north-Estonian and the north-east Estonian Plateaux. In these areas the limestone bedrock rises as a rule near the surface, forming extensive alvars in some places. The more fertile areas covered with calciferous till are mostly cultivated, while extensive meadows and wetlands occur in the low-lying sections. In places, karst processes have influenced the creation of specific landforms, e.g. small caves, karst wells and dolines. Due to oil shale resources mined from under the limestone layer, the technogenic impact on the landscape as well as on the surface and the groundwater regime is considerable in north-east Estonia. The coastal plains of north Estonia