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Development of National Ecological Networks in the Baltic Countries in the framework of the Pan-European Ecological Network

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The publication is the synthesis report based on the national reports on "Development of national ecological networks in Baltic countries in the framework of Pan-European Ecological Network – a concept and implementation in pilot areas".

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From the Publisher

In the beginning 1990s, a new initiative began to develop which took into account the need to create an integrated pan-European system concerned with the conservation of the natural heritage of the whole continent. Hence, the concept of ecological networks is becoming increasingly important in international conservation and land use policies. A particularly rapid breakthrough in policies and practices of nature conservation can be witnessed throughout Europe.

The idea of the ecological network was first suggested in the Netherlands in the 1980s, and in the 1990s it was accepted as a part of the national plan for nature conservation by the Dutch government. In the beginning of nineties the concept of the ***E****uropean* ***Eco****logical* ***Net****work (EECONET) gained much attention as a pan-European approach to preservation of the natural heritage of Europe. As the result of Dutch Government initiative and sponsorship, in 1993 IUCN – The World Conservation Union began to implement a programme aimed at widening the EECONET to countries of Central and Eastern Europe. The main objective was to work out the concept of national ecological networks and national plans for conservation of nature in individual countries. The first part of this international programme has been implemented in Poland, Hungary and the Czech and Slovak Republics.*

The concept of European Ecological Network was born not only because nature does not respect borders, but mainly because the unintegrated local methods of conserving it have limited results and the natural heritage of Europe is both endangered and progressively being destroyed. Despite international initiatives such as the Bonn and Bern Conventions, there is a growing realization of the need to create a wholly integrated pan-European system for the conservation of nature which would take into account not only the international character of ecological processes and what threatens them, but which would also concern itself with the need to create a platform for international co-operation, thus ensuring effective realization of promises given in international agreements and conventions.

The programme does not attempt to intervene in the ecological policy of individual countries. It aims at supporting them. It does not question the internationally acclaimed achievements of countries, their traditions and experiences in the conservation area. It does not undermine the specific local solutions or systems. The programme attempts to combine into one united pan-European system these territories, which by virtue of their habitats and mutual ecological relatedness constitute the natural heritage of Europe.

The increasing environmental threats of a continental and global kind require that a territorially unified pan-European system for conservation of nature be accepted, allowing the individual countries' efforts to be combined into one system which would safeguard the preservation, reproduction and growth the natural resources on the whole continent. The European Ecological Network represents the process of integration of European policy on environmental conservation by means of the integration of local methods of nature conservation and by means of introducing the problems of ecology into areas such as international co-operation, e.g. the support of economic growth, especially of agriculture, forestry, transport, tourism – in general of those sectors which directly influence the state and conservation of the natural heritage.

In November 1993, at the International Conference "Conserving Europe's Natural Heritage – Towards a European Ecological Network" in Maastricht, organized by the Ministry of Agriculture, Nature Management and Fisheries of the Netherlands and Ministry for Environment and Regional Policy of Hungary, under the auspices of the European Commission, the General-Secretariat of the Council of Europe and by IUCN – The World Conservation Union, participants gave their full approval of the concept of EECONET in the Conference Declaration.

The implementation of EECONET was reported at the Ministerial Conference in Sofia in 1995 and it was adopted by the 54 member states of the UN Economic Commission for Europe as the Pan-European Ecological Network, the Action Theme 1 of the Pan-European Biological and Landscape Diversity Strategy (PEBLDS).

By adopting the PEBLDS in 1995, the development of the Pan-European Ecological Network became the priority nature conservation strategy in Europe. According to the Strategy, completion of the Pan-European Ecological Network is foreseen in 2005.

The World Conservation Congress at its 1st Session in Montreal, Canada, 14–23 October 1996 called for the further development of ecological networks at national, regional and intercontinental level (Congress Resolution 1.38).

In support of the implementation of international agreements and conventions, in particular the PEBLDS, IUCN continues assisting the Central and East European countries in developing and implementing national ecological networks. As results, the three-years project was implemented in the Baltic Countries in period 1999–2001.

The presented book is the synthesis of the full national reports prepared in Estonia, Latvia and Lithuania. In addition, there are separate reports made available in English and national languages, which cover the national parts of the Baltic Ecological Network within these countries.

The achieved results of the project contribute to implementation of several international initiatives having global, European and regional scope, e.g. the Biodiversity Convention, the Convention on Wetlands of International Importance (Ramsar Convention), the Convention of the Conservation of Migratory Species of Wild Animals (Bonn Convention) and the Pan-European Biological and Landscape Diversity Strategy (PEBLDS).

The core areas and ecological corridors of the National Ecological Networks meet the criteria of various international agreements and conventions. They therefore should be regarded as priority areas for nature conservation. By making a regional vision for the Baltic Countries, the project provides basic information for physical planning of nature conservation on a regional, national and local level.

While developing the recommendations provided, especially regarding landuse, the authors met the criteria laid down in the EU's conservation directives and regulations – in particular Habitats and Birds Directives and Rural Development Regulation. Thus the results of the project provide information for the designation of NATURA 2000 sites within the countries as well as recommendations regarding active conservation measures as agri-environmental programmes.

The publication is addressed to governmental institutions, international organisations, sponsors and non-governmental bodies interested in nature conservation. It can be used to establish priorities for actions aimed at working out the methods of biodiversity protection by using the concept of ecological network.

It is believed that the presented results of the project and the recommendations being put forward will enable active and efficient contribution to the development of the Pan-European Ecological Network.

The project has had international dimension involving scientists and conservationists from Estonia, Latvia and Lithuania. More than 50 experts from those three countries have been contributing to this grate transboundary work. While sharing their ownership of the results with broad public, I would like to express on behalf of IUCN the appreciation and gratitude to all of them.

Zenon Tederko
Director
IUCN Office for Central Europe

Executive summary

The establishment of ecological networks has become one of the most promising applications through which ecological principles and biodiversity conservation requirements are integrated into spatial planning procedures and land use practices. By adopting the Pan-European Biological and Landscape Diversity Strategy in 1995, the development of ecological networks (the Pan-European Ecological Network) became the priority nature conservation strategy in Europe. The current account provides an overview and analysis of the social, economic and legal preconditions for the development of ecological networks in Baltic States (in Estonia, Latvia and Lithuania) in the framework of the Pan-European Ecological Network. In this context the experience in classical nature conservation, as well as the controversial impacts of social and economical re-structuring, are also discussed.

The existing national approaches to ecological networks: Estonian "network of ecologically compensating areas" and Lithuanian "nature frame" as well as landscape planning traditions, are analysed in comparison with the Pan-European approach to ecological networks. International requirements for the development of national ecological networks are analysed on the basis of relevant nature conservation conventions, programmes and other initiatives, and in the context of the current accession process to the European Union. This requires the approximation of national nature conservation legislation with relevant EU directives and the establishment of the Natura 2000 Network. The latest methodological approaches for the designation of ecological networks are compared and analysed, based on (provisional) national reports prepared in the framework of the project "Development of national ecological networks in Baltic countries in the framework of Pan-European ecological network". In this context, as the designation of ecological networks will be based on Geographical Information Systems, an overview on available digital databases in Baltic States is also given. The overview of Estonian, Latvian and Lithuanian national ecological networks, as well as ecological networks of pilot areas – Järva county (Estonia), Kuldiga district (Latvia) and Klaipėda district and Neringa city (Lithuania), are

presented. Baltic co-operation is discussed, because it plays an important role for ensuring that the developed network will be coherent and uniform throughout the region and compatible in border zones. Finally, the role of public acceptability and the need for effective public awareness are discussed.

Chapter 1

Introduction

The concept of ecological networks is becoming increasingly important in international conservation and land use policies. A particularly rapid breakthrough in policies and practices of nature conservation can be witnessed throughout Europe. The initial concept of a European ecological network (EECONET) as a conservation model was published by Bennett (1991). The ecological network was then seen as one of the principal means through which the Pan-European Biological and Landscape Diversity Strategy (PEBLDS) can maintain and enhance the natural diversity of the continent (Rientjes and Drucker, 1996). However, more solid definitions and criteria of the Europe-wide ecological network as a biodiversity conservation tool have become available more recently. According to Bennett (1998), the Pan-European Ecological Network (PEEN) is seen as a coherent assemblage of areas representing the natural and semi-natural landscape elements that need to be conserved, managed or, where appropriate, enriched or restored in order to ensure the favourable conservation status of the ecosystems, habitats, species and landscapes of European importance across their traditional range.

The World Conservation Congress at its 1st Session in Montreal, Canada, 14–23 October 1996 called for the further development of ecological networks at national, regional and intercontinental level (Congress Resolution 1.38). An international agreement, endorsed by the 54 member states of the UN Economic Commission for Europe in Sofia, 1995, foresees completion of the Pan-European Ecological Network in 2005. A recent report by Bennett and Wit (2001) comprises a worldwide review of 38 ecological networks that are currently being developed or implemented. These include the Mesoamerican Biological Corridor in Central America, the East Asian–Australasian Shorebird Site Network, the Maine Wildlands Reserve Network in the US and the Heart of Russia in Central Russia. The main ideas of ecological networks can be found in a number of contemporary international policy documents on spatial planning, like the European Regional/Spatial Planning Charter (1983), the European Spatial Planning Perspectives (1999), Guiding Principles for Sustainable Spatial Development of the European Continent (2000).

Based on considerable progress in landscape ecology and increased knowledge in ecological requirements of species, the concept of ecological networks, as a more complex approach to environmental and nature conservation problems, was developed in the 1970s. Since then the concept has been developed and implemented for several purposes, and by several authorities and scientific institutions throughout the world, e.g. Estonia and Lithuania were among the first countries in Europe where the basic principles of ecological networks were developed. The concept (of ecological networks) has gained much support, because it provides a practical solution on how to harmonise biodiversity conservation and environmental protection considerations with economic land use practices.

The current IUCN project report provides a framework for the development of such a system, by using and developing the concept of ecological networks for Baltic States and their integration into the Pan-European system. In the end of 1998, two IUCN projects, co-ordinated by Dr. Zenon Tederko and Dr Anna Liro on "ECONET development in CEEC" and "Development of national ecological networks in Baltic countries in the framework of Pan-European Ecological Network" – were started. One of the goals of the project was to create operational concepts for national ecological networks (NECONETs) in Baltic countries, as well as strategies for their implementation. Since the development and implementation of an ecological network is an important issue for national nature conservation policy in Estonia, Latvia and Lithuania, this project was carried out in close co-operation with the Ministries of Environment.

The main chapters of the report provide an analysis of the preconditions and methodological approaches for the development of ecological networks in the Baltic countries in the framework of the Pan-European Ecological Network (PEEN). For Estonia and Lithuania the establishment of the PEEN required a thorough analysis of the existing approaches to ecological networks and designation methodologies, in order to be sure that European and regional biodiversity conservation aspects are adequately considered. Latvia had the task of developing their own national approach, taking into account both the national and European nature conservation interests.

Although the aim of this thesis is to compare the development of ecological networks in Baltic countries (Estonia, Latvia and Lithuania), it also gives a general review about the origins and theoretical background of the concept of ecological networks. The concept of ecological networks has attracted a lot of attention and an enormous volume of literature concerning it has been produced. In this thesis the origins of the theory of ecological networks, and different national approaches and implications are analysed on the basis of selected information given in the list of references. We tried to integrate different national (*inter alia* experiences of former IUCN ECONET Projects and European initiatives) concerning nature protection as a conceptual and operational framework for designing the national ecological network in the Baltic States.

In order to define the context in which the networks are developed, the project report provides:

- a brief overview (analysis and comparison) of natural, economic and social conditions in the Baltic States, covering basic biodiversity and land-use information, changes in landscapes, the influence of ongoing social and economic restructuring (mainly privatisation), and long-term experience in classical nature conservation;
- an overview on the existing approaches to ecological networks and experience in landscape planning;
- an analysis of existing legal instruments (international and national) for implementing ecological networks. In the Baltic States the development of ecological networks in the framework of the PEEN is closely related with accession to the European Union, and requires approximation of national nature conservation legislation with relevant EU directives and establishment of the Natura 2000 Network. Also, the Baltic States have signed several nature conservation conventions that may require change in national nature conservation policies;
- an analysis of relevant projects and databases. The Baltic States are involved in a variety of nature conservation programmes that may provide information, and/or set additional requirements for the development of ecological networks;
- a comparison of provisional methodological approaches for the designation of ecological networks currently being developed in the framework of the Working Programme for implementation of the Pan-European Ecological Network;
- an analysis on the role and current state of Baltic co-operation in developing common concepts and criteria for designation of ecological networks;
- an analysis on the role of public awareness to ensure political acceptability and public support to the implementation of the networks.

We hope that the results of the project will contribute to the development of the Pan-European Ecological Network, and the Estonian, Latvian and Lithuanian governments will be ready for a long-term process of their implementation.

Chapter 2

Theoretical concepts and practical applications of ecological networks

Since the 1970s the concept of ecological networks has been developed by several authorities and by several scientific institutions throughout the world. This development has been simultaneous, often independent, and therefore known by different names. These include **nature frame** in Lithuania, **network of compensative areas** in Estonia, **territorial system of landscape territorial stability** in Czech Republic and Slovakia, **green belts** and **protected nature areas systems** in Russia, **greenways** in USA, Australia and Portugal etc.

The concept of ecological networks developed as a response to fragmentation of land, and the restructuring and intensification of land use. It gained much support, probably because of an intuitive feeling of its beneficial functions and effectiveness. Unlike other approaches dealing with environmental problems by separate media (water, air, soil), different types and sources of pollution, or nature conservation issues by protection of single species and habitat types, the concept of ecological networks provides a more complex approach to nature conservation and environmental protection issues. It is an attempt to harmonise economic land use practices with environmental protection and nature conservation goals by the maintenance or establishment of an interlinked spatial structure of natural and semi-natural ecosystems/areas.

The main presumption of the concept, is that it is particularly important to maintain or re-establish a sufficient network of natural areas throughout agricultural, industrial and urban areas. This network would fulfil several functions. By providing refuges/habitats to local species driven away from neighbouring areas, this network of predominately native vegetation is a strong support for their survival. On the banks of lakes and rivers natural vegetation stabilises banks, filters sediments and nutrient run-off and prevents pollution and eutrofication of water bodies, at least during the vegetation period. On roadsides, and around urban and industrial areas, it filters noise and the spread of pollutants, and provides a cleaner and more healthy environment for people. It also prevents erosion on slopes and wind erosion on sandy areas, and provides possibilities for recreational activities in close surroundings to human settlements etc.

Some authors (e.g. Kavaliauskas, 1995) have suggested that the origins of the concept date from as early as the 18th century, when the idea of an "ideal city" and the general aspiration for Romanticism, radically changed the principles of urban planning. Models of integrated "green belts" then became a necessary part of urban structure. Others see the start in the development of green-belt systems for recreational purposes in metropolitan areas, both in the USA (Little, 1990) and in Europe (e.g. in Berlin, Prague, London, Budapest, Copenhagen) in the first part of the 20th century, or in the initiatives to create protected areas' systems. Külvik *et al.* (2002) pointed out that development of the idea of territorial ecological networks is largely based on **the central place theory** of J.H. von Thünen (1823), W. Christaller (1933) and A. Lösch (1954).

Flooded meadow in spring

As a result of specific geographical, natural, economic political and social conditions, and different scientific and planning traditions, the concept has developed differently in various countries and regions. Ecological networks have been designed mainly for abiotic purposes such as regulating fluxes of water, energy and materials (Bridgewater, 1988; Mander, *et al.* 1988, 1995; Kavaliauskas, 1994, 1995, 1996), or, more often, for biotic purposeslike the maintenance of biodiversity (Brandt, 1995; Van Zadelhoff and Lammers, 1995; De Blust *et al.*, 1995; Burkhardt *et al.*, 1995). According to Jongman (1995), and Jongman and Kristiansen (1998), it is possible to distinguish two main approaches to ecological networks: ecostabilisation and bioecological, and landscape ecology. Ecological and geographical backgrounds have provided the nec-

essary theoretical basis for both of these. Land use is considered to influence the functioning of ecosystems as a whole, their capacity for 'self-purification' and the carrying capacity of the landscape (Mander *et al.*, 1988; Kavaliauskas, 1995). It also affects habitat quality for wild species and the potential for dispersal and migration that are vital for the survival of populations especially in fragmented landscapes (Jongman and Kristiansen, 1998).

In the Baltic countries methodologies for defining ecological networks at national level differ substantially from each other. The main sources of discrepancies are various historical experiences, natural conditions, and differences in existing legal and administrative bases.

In compiling the methodology of ecological networks in the Baltic countries the following common principles were considered:

- aims and objectives of ecological networks;
- historical experiences in designing ecological networks in the Baltic countries;
- natural values and environmental conditions;
- threats to the National Ecological Network, especially resulting from the land use policies;
- existing initiatives in nature conservation and spatial planning;
- available data resources;
- technical possibilities in applying GIS technologies;
- existing legal, economic and administrative basis for implementation of the National Ecological Network;
- the use of the guidelines and principles of the Pan-European Ecological Network, with the aim of approximating national concepts of Ecological networks at the Baltic regional and European level.

2.1. Aims and objectives of developing the ecological networks in the Baltic countries

The ecological network is a coherent system of natural and/or semi-natural landscape elements configured and managed with the objective of maintaining or restoring ecological functions as a means of conserving biodiversity, while also providing appropriate opportunities for the sustainable use of natural resources (Bennett, 1991). The ecological network model has become internationally interpreted quite flexibly so that the aims and objectives of various networks differ. The Baltic countries have considered the goals of the Pan-European Ecological Network (PEEN). The "guidelines for the development of the PEEN" provide guidelines on objectives and characteristics of PEEN, and on the process through which the Network will be developed, implemented, evaluated and adapted. According to the guidelines the goal of the network is to ensure a favourable conservation status of the ecosystems, habitats, species and land-

scapes of European importance. In order to achieve this, it will be necessary to ensure:

- the conservation of the characteristic ecosystems and the natural habitats and landscapes of European importance across their traditional ranges;
- the sustainable use of semi-natural landscapes of European importance;
- the maintenance of viable populations of species of European importance across their traditional range;
- the maintenance of the environmental processes on which these ecosystems, habitats, species and landscape depends.

Achieving these objectives in PEEN does not infer that the entire continent will be protected in its natural condition. Rather the task is to focus conservation actions on those areas of the countryside, and those species communities, that harbour the biological and landscape diversity that is crucial to achievements of one or more of these four objectives at the European scale. If the PEEN objectives are oriented to nature conservation in a broad sense, then aims and objectives of national ecological networks in Baltic countries have wide scope. For example, in Latvia the main task of the ecological network is to promote sustainable development on a territorial basis (Caring for Earth, 1991), fulfilling the following functions:

- ensuring the protection of habitats important for species migration, nesting, breeding and resting;
- protecting species and populations that are highly sensitive to human intervention;

One aim of ecological networks is the sustainable use of semi-natural landscapes of European importance

- regulating and cleaning the water cycle, protecting wetlands and forest;
- averting natural disasters (floods, storms), protecting watershed forest, riverside and coastal wetlands and forests;
- conserving suburban woodland that contributes to improving urban air quality and microclimate;
- protecting areas with aquifer feeding zones and the main discharge locations;
- providing income for the population and work in tourism.

Analysing the Lithuanian project we can conclude that long-term objectives are quite similar to PEEN:

- to preserve natural and semi-natural ecosystems, habitats and landscapes of national and European importance;
- to maintain viable populations of animal plants, and fungi in Lithuania and Europe;
- to secure sustainable use of species and their habitats;
- to restore valuable ecosystems and habitats.

In short-term objectives we find some broader declarations than PEEN. For example:

- to incorporate ecological network schemes into national system of territorial planning so as to ensure sustainable development and sustainable use of natural resources in Lithuania.

Other short-term objectives have strong similarities to PEEN:

- to help the implementation of Bern, Ramsar, Bonn and Biodiversity Conventions, EU Birds (79/409 EEC) and Habitats (92/43 EEC) Directives, Pan-European Biological and Landscape Diversity Conservation Strategy and Lithuanian Biodiversity Conservation Strategy and Action plan, as well as other international agreements and commitments;
- to form a territorial network of valuable nature areas in Lithuania based on international principles and criteria and to secure a proper conservation of it;
- to co-ordinate Lithuanian ecological network with Lithuania's protected areas system, scheme of Lithuanian nature frame, and international networks (Emerald, Natura 2000);
- to secure the stability and further vitality of individual species populations and the preservation of the gene pool, by establishing appropriate protected territories and ecological corridors linking these areas.

In Estonia the methodology for designating the green network (ecological network) states that the main objective of planning is first and foremost, to guarantee the naturally and environmentally grounded space structure, which should guarantee sustainable development in the whole country. It is not to define a large-scale 'green surface' and leave it out of economic use. The following main purposes were stated:

- to shape the spatial structure of natural areas in the most reasonable way considering the ecological, environmental protection, economical and social aspects;

- to complete functionally the network of protected areas, connecting them into a complete system with natural areas;
- to protect valuable natural habitats and preserve the migration routes of wild animals, and valuable landscapes;
- to soften, compensate, and forestall the anthropogenic impact on nature, to contribute to sustainable development strategy;
- to offer the possibility of nature-friendly management, living styles and recreation by ensuring spatial accessibility to natural areas;
- to promote nature conservation outside protected areas;
- to minimise future conflicts of interest incorporating different sectors (forestry, agriculture, transport, recreation) through spatial planning;
- to guide settlement and land use;
- to preserve the natural self-regulation ability of the environment;
- to support international and transboundary co-operation.

Ecological networks support the preservation of valuable habitats

According to all methodologies the development of ecological networks is a process in which several sequential stages can be distinguished, e.g.:

- analysis of the initial nature conservation problems;
- identification of well-defined objectives of the network;
- defining the methodological approach for the designation of an ecological network and the criteria for identification of its structural elements;
- analysis of existing databases, identifying the location of relevant data and possible gaps;

- identification of potential core areas, ecological corridors, buffer zones and restoration areas when needed as part of ecological networks;
- designation of implementation strategy.

2.2. National approaches and experience in ecological networks

Estonia and Lithuania were among the first countries in Europe where the basic principles of ecological networks were developed. Estonian "network of ecologically compensating areas", developed by Jagomägi (1983) as well as the Lithuanian "nature frame", established by Kavaliauskas (1995, 1996) were accepted among the first analogous concepts in Europe. Although, according to Jongman and Kristiansen (1998), the Baltic approaches to networks are intended mainly for ecostabilising purposes, in reality both have a wider scope. Developed from Rodoman's (1974) purely theoretical concept of polarized landscapes, the Baltic approaches have been applied to functional zoning of landscapes for several purposes (including environmental, economic and social). Built on the networks of protected areas (as core areas of the ecological networks) and interlinked by natural and semi-natural landscapes, they both support maintenance of valuable habitats as well as migration and dispersal of species. Although the PEEN has a continental scope, its implementation depends to a great extent on national and regional initiatives, and should be built on national nature conservation legislation and policies. Therefore, although the Baltic approaches are wider and not totally compatible with the ecological network in a Pan-European sense (designed mainly for European biodiversity conservation purposes), theoretical and methodological experience, as well as supporting legal systems and planning traditions, provide strong bases for further action.

2.2.1. Development of the approach to ecological networks in Estonia

Several recent scientific reviews (Jongman and Smith, 2000; Bennett and Wit, 2001) have noted that the Estonian "network of ecologically compensating areas" was among the innovative ecological network concepts in Europe. The studies in 1960s and 1970s, represent a multi-functional approach to ecological networks which is based on a strong land-use planning tradition, with wilderness and areas of conservation value as core areas – interlinked by natural and semi-natural landscapes. At least two regional level undertakings of landscape planning from that period are known: 1) Jaan Eilart, the eminent conservationist, worked out a proposal for riverside green corridors in the Tartu region; 2) Heino Luik and Veljo Ranniku, the experts of the National Conservation Agency, compiled the scheme of buffering natural areas in the industrial Northeast Estonia. Both approaches have used landscape elements as ecologically connecting corridors and buffering barriers.

In the early 70s researchers of the University of Tartu proposed the concept of functional zoning, including the idea of ecological networks. As a notion of approval of the concept, state authorities have supported the elaboration by the planning institutions (Institute of Building Research, State Project Institute of Amelioration, State Project Institute of Rural Building) of functional zoning maps at the national and regional levels.

Rivers are important ecological corridors in towns

In 1979–1981, the University of Tartu developed a territorial conservation planning methodology. For this purpose a next generation concept of the ecological network – namely the network of compensating areas was worked out, as the Estonian equivalent of ecological network (Figure 1), (Jagomägi, 1983). This network was defined as an ecological infrastructure of cultivated landscape, which is able to compensate and buffer human impact, or in other words, influence the flow of matter, energy and information through the landscape as an obstacle, accumulator, filter and buffer. In this way, the network was considered to have a variety of functions: 1) saving material and energy; 2) minimising pollution; 3) recycling resources; 4) providing refuges for wildlife; 5) giving possibilities for migration of biota; 6) acting as a barrier or filter for fluxes of material and energy; 7) supporting framework of human settlements; 8) providing recreation areas; 9) compensating outputs from human society.

At the same time, spatial planners began a parallel practical exercise. This resulted in a plan of national compensating areas (1:200,000) with an explanatory appendix. Different thematic maps (maps on geology, climate, soils,

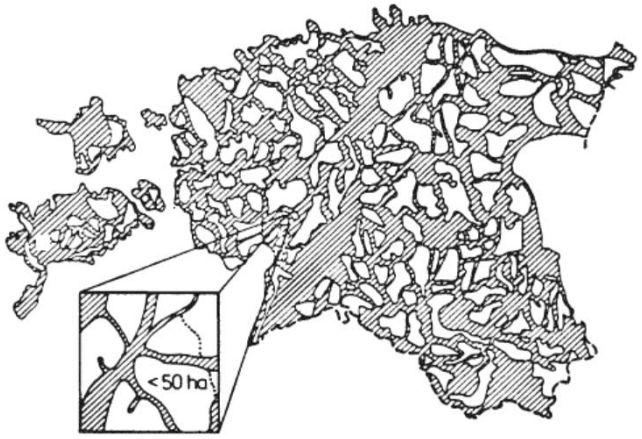


Figure 1. Estonian network of ecologically compensating areas (*Jagomägi, 1983*)

hydrology, forests, land use, roads, etc.), as well as topographical maps and paper copies of satellite images were used. Simultaneously, during the late 70s and early 80s the methodology for the delineation of ecological networks on a micro-scale (land amelioration areas) was developed (J. Jagomägi, Ü. Mander, Ü. Sults). In the synergy of theoreticians and practitioners the concept developed further onto a more detailed level – a district level application. In 1983-88 the networks of compensating areas (1:100,000) were designed for North-Eastern Estonia and North-Western Estonia, the Tallinn hinterland, Hiiumaa and Saaremaa islands (Figure 2). These maps were intended to be used as spatial reference information for development programmes until 2005. Later the concept was developed and its different aspects have been discussed by several authors (Mander *et al.,* 1995; Külvik and Sepp, 1998; Sepp and Mikk, 1998; Sepp *et al.*, 1999).

The 1990s brought radical changes in political, social and economical conditions in Estonia. Despite a wide range of research and implementation capabilities in the country, the ecological network concept was not implemented in environmental protection practice after regaining independence. Only in the mid-nineties new legislation and modes of policy-making brought the chance to bring the ecological network ideology into the public process (Sepp *et al*., 1999). Moreover several legal acts supported the concept of an ecological network. For example the Act on the Protection of Coastal Areas (1994) and the Water Act (1994), prohibiting all building activities within 200 m of the coast line and lake shores, provided the first pieces of legal background for designing an ecological network as a part of county spatial planning processes. The concept of ecological network in spatial planning has continued to be developed and its different aspects have been discussed by several authors (Mander *et al.,* 1995; Külvik and Sepp, 1998; Sepp *et al.*, 2001; Külvik *et al.,* 2002; Remm *et al.,* 2002).

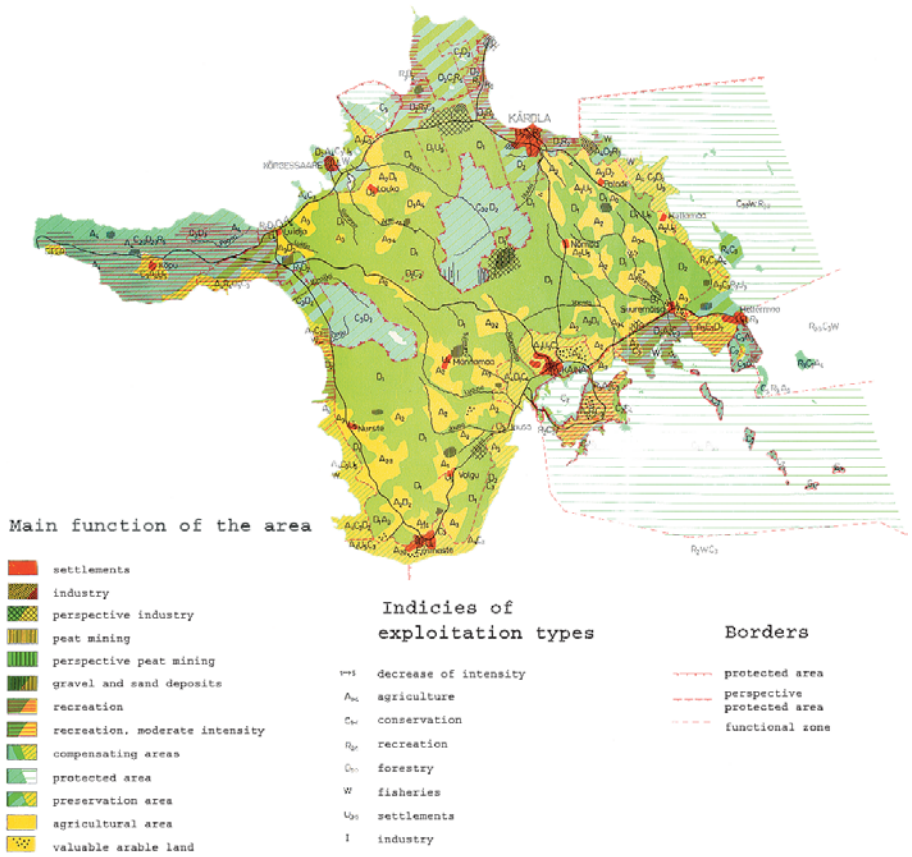


Figure 2. Network of compensating areas in practical planning: functional zoning scheme at a district level – Hiiumaa Island, designed in 1987

The rapid growth of worldwide attention regarding ecological networks has resulted in intensified international communication. Two joint projects with foreign participation have advanced the concept in Estonia. First was the project led by the World Conservation Union (IUCN) on "*Development of ecological networks in the Baltic countries in the framework of Pan-European Ecological network",* in period of 1998–2001.

Secondly, the European Centre for Nature Conservation (ECNC) led project "*An indicative map of the Pan-European Ecological Network (PEEN)*" analyzed the Estonian national level GIS data reflecting the natural status of an area. It showed a reasonable similarity between the GIS generated "suitability map" for ecological networks, and the expert-made ecological network map existing earlier (see Figure 3) (Remm *et al.,* 2002).

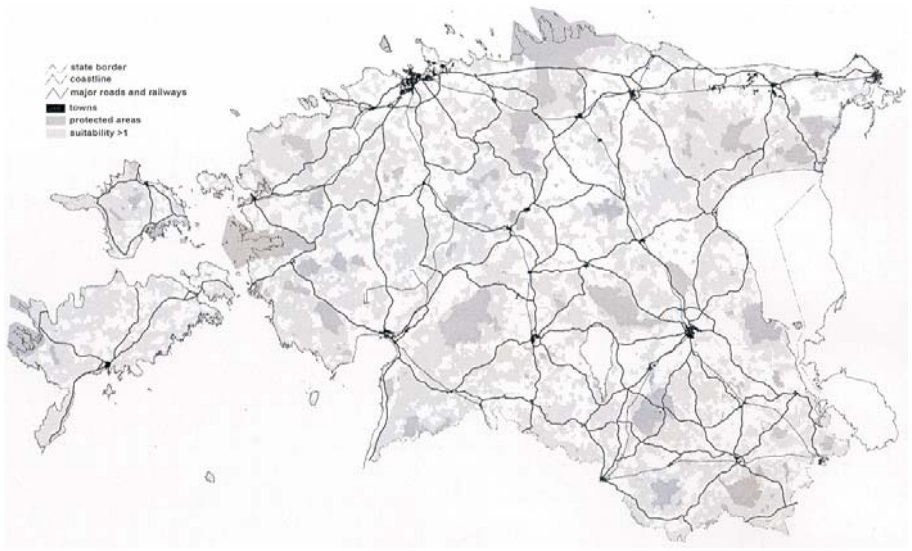


Figure 3. Protected areas and non-protected areas suitable for ecological network according to their present natural state (*adopted from Remm* et al*., 2002*)

2.2.2. The history of ecological network planning in Latvia

In contrast to other Baltic countries, no national approaches or concepts to ecological networks have been elaborated in Latvia. However, this does not mean that Latvia is lacking in ecological planning traditions and experience. In 1990 a working group at the 'Pilsetprojekts' planning institute (G. Poltoraks, K. Ramans, A. Melluma and others) developed a "Complex territorial scheme of nature protection in Latvia", as a first attempt to carry out a comprehensive analysis and summary of factors influencing natural resources. More than 20 thematic overview maps, including a map of the system of particularly protected nature areas in Latvian SSR, were prepared in the framework of the project. This was also the first time the concept of an ecological network was introduced. Based on the spatial structure of forested areas, an "axis of ecological activities", in contrast to "priority areas for urban development", was designated on a map.

After renewal of independence in Latvia, the planning of ecological networks started at local level – in spatial planning of cities and Pagast district. Natural compensating territories (parks, forest parks, forests, rivers and lakes) were identified in the physical plans of Rīga, Jūrmala and Babīte Pagast (Rigas attistibas plāns, 1995), which form a united structure. One of the principles applied in the allocation of land use objectives was to designate ecological corridors. As a result, a joint network of green structures was created within the spatial structure of the territorial plans of both cities to ensure their preservation of biological and landscape diversity, promotion of improvement of urban microclimates and creation of the visual impression of 'green' cities.

Black Stork (*Ciconia nigra*)

Elaboration of a development plan for Kuldiga district in 1998 was the second attempt to introduce the concept of ecological networks at a local level and by territorial planning procedures. As a result a conceptual map in the scale of 1:75,000 was prepared, showing existing protected areas and other territories with significant nature values (but not yet protected), as well as recommendations for the location of ecological corridors. Within the frame of the project, recommendations were prepared for the creation of ecological corridors. Since at that time there was no concept of an ecological network at the national level, nor any criteria or methodology for developing it, the idea of such a network remained unimplemented.

2.2.3. The history of ecological network planning in Lithuania

The idea of Lithuania's nature frame was raised in early 1980s. An important practical step forward was made with preparation of Integrated Nature Conservation Scheme (1986). Since then the concept of a nature frame has become a universal concept for the conservation and protection of Lithuania's natural landscapes. In 1988 the Vilnius University projected the nature frame on a national level in the scale of 1:300,000. Topographic localisation of the Nature Frame was based mostly on analysis of migration links of natural landscape elements (first of all, hydrography) and an estimation of relief within the nature complex.

According to the concept, the main functions of the nature frame were:

1) to ensure that links between separate protected areas are protected;

2) to protect natural landscapes and natural recreation resources;
3) to neutralise the impact of economic activities in territories with intensive use;
4) to optimise the structure of anthropogenic landscapes by creating conditions for restoration of forests, and by regulating the trends and intensity of agricultural activities and urban development.

The nature frame, as a land management system, is composed of three meta-functional subsystems (Figure 4):

1) geo-ecological watersheds, which are the territorial belts between different geosystems;
2) areas of inner stabilisation (areas of conservation and biodiversity significance), which are fulfilling functions of ecological compensation inside the separate geosystems;
3) migration corridors (linear territories like river beds, valleys, pit-grooves, etc.), which fulfil the functions of geodynamic exchange and biological information flow.

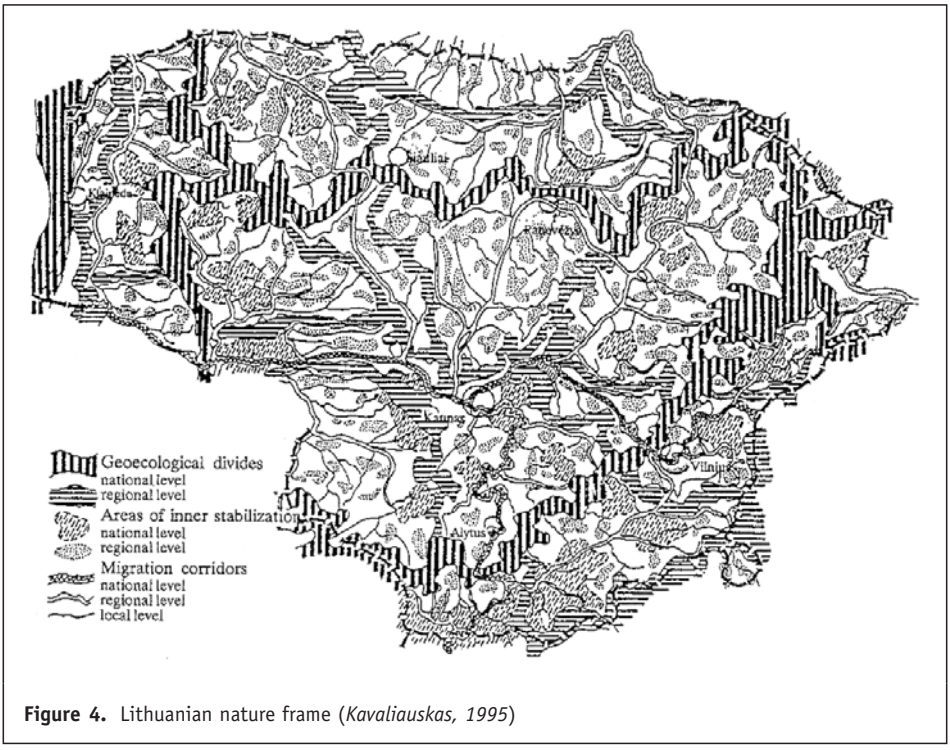


Figure 4. Lithuanian nature frame (*Kavaliauskas, 1995*)

In 1993 the "Land Management Department" of Vilnius University projected the nature frame on a regional level for all 44 administrative districts at a scale 1:50,000 (Kavaliauskas, 1995). This was done by considering: 1) the degree of landscape cultivation and 2) the difference in geochemical activity of the soils

that emphasised the need to develop differentiation in land management regimes, and a new system of land management zones. These projects are considered as the basis for the detailed planning of agricultural areas on a local level, at a scale of 1 : 10,000. It seems that a comprehensively developed nature frame lacks instruments for implementation and development to make it real. So far forestry is the only economic activity in the use of land that is legally affected by the nature frame.

The Lithuanian Nature Frame connects areas with various purposes, e.g. strict nature reserves, managed reserves, national and regional parks, protection zones and protected sites of natural resources. The purpose is to ensure natural connections between the different categories of protected areas (conservation, preservation, restoration and integration). The Nature Frame includes all natural and semi-natural ecosystems, covering about 60% of the Lithuanian territory in total. The concept has now been enshrined in the 1992 Law on Environmental Protection (as amended in 1996) and the 1993 Law on Protected Areas. However, the present network of protected areas does not cover all species and ecosystems, and their diversity, which ideally should be protected.

Chapter 3

Natural environment of the Baltic States

The natural conditions of the Baltic States (Estonia, Latvia and Lithuania) are determined by the countries' location at the eastern coast of the Baltic Sea in the north-western part of the East European Plain. The development of the landscape has been strongly influenced by glaciers, which formed a typical landscape of lowlands and uplands. The coastal areas were transformed by fluctuations of sea-level in the Baltic Sea. Thanks to relatively flat relief and humid temperate climate, characterised by intensive cyclonic activity from North Atlantic, the Baltic States are rich in inland waters and mires. Also, dependent on relief characteristics, vegetation, inland waters and the distance from the coast, the area has remarkable meso- and microclimatic variety. Some basic facts about the Baltic States are given in Table 1.

Table 1. Selected facts about the Baltic States *(after BEF, 2000)*

Characteristics	Estonia	Latvia	Lithuania
Area (km^2)	45,227	64,589	65,301
Population (th. inhabitants)	1,439	2,424	3,707
Density (inhabitants/km^2)	32	38	57
Urban (%)	69	69	68
Rural (%)	31	31	32
Highest point (m)	Suur Munamägi, 318	Gaiziņš, 311	Juozapines, 294
Coastline (km)	~3,800	~500	~98
Islands/islets (total number)	~1,500	–	–
Lakes total number/area (%)	~1,400/~5.0	3,052/~1.8	2,833/~1.5
Rivers total length (km)	31,153	38,000	63,700
Mires[1] (% of country's territory)	22.3	9.9	7.4

[1] Mires are classified as peatland areas where the layer of peat is at least 0.3–0.4 m thick. However this area partly overlaps with forest land.

The long Estonian coastline is characterised by the Baltic Glint

There are several unique landscape formations especially in the coastal area of the Baltic region. The Estonian long coastline is characterised by the Baltic Glint, following the northern coast, and about 1,500 islands and islets. In Latvia the coastal areas are characterised by freshwater lagoons (Lake Engure, Lake Pape, etc.) important as nesting sites for birds. The most significant formations in Lithuania are the Curonian Lagoon and the Curonian Spit (BEF, 2000).

3.1. Habitats and species[1]

Thanks to variable natural conditions the Baltic States are rich in species and habitats and the biodiversity is remarkably well preserved (Appendix 1). Several species, threatened on a European scale, are abundant in the Baltic States (e.g. beaver, wolf, otter, black and white stork, corncrake, lesser spotted eagle, cranes, etc.). This is probably due to relatively low human population density and to a lack of economic development during the Soviet period and to long--term nature conservation traditions starting from the beginning of the 20th century. The preservation of bogs, wooded meadows, wetlands, forests and several other landscape types, mostly destroyed in the rest of Europe, and the establishment of an extensive system of protected areas (Figure 5) have been possible

[1] The information on species and habitats diversity is greatly based on Estonian biodiversity strategy and action plan (EME and UNEP 1999), Republic of Lithuania. Biodiversity conservation strategy and action plan (EPMRL 1998) and National report on biological diversity: Latvia (LMEPRD and UNEP 1998), and selected to indicate both the characteristic features of the region, and the similar and different features of the republics.

through the joint efforts of nature conservation activists and dedicated scientists, and support from the general public.

National biodiversity reports conclude that when compared to other regions with similar areas situated between 54th and 59th northern latitudes, the diversity of flora and fauna in the Baltic States is one of the richest in the world (EME and UNEP, 1999; EPMRL, 1998; LMEPRD and UNEP, 1998). The main reasons for it are quite similar:

- diversity of current and post-glacial climatic conditions;
- the existence of both islands (Estonia) and continent;
- the influence of the Baltic Sea;
- long coastline and large number of inland waters;
- diversity of soils (simultaneous occurrence of limestone and sandstone as a base for the formation of soils, and the resulting incidence of neutral, lime-rich and lime-poor soils);
- varying surface forms and water regimes determined by young and developing post-glacial relief;
- transition of biogeographic regions and coexistence of species of boreal coniferous and nemoral broad-leaved forests;
- extension of a large number of species distribution range borders to the territory of the Baltic States;
- large proportion of natural landscapes (see Figure 6);
- retention of traditional land use methods until the middle (and in many cases until the end) of the 20th century, extensive maintenance of semi-natural habitats and the limited role of alien tree species in forestry (after EME and UNEP 1999).

The proportion of forests and wetlands increases in a northerly direction because of the intensity and traditions of land use, and is the highest in Estonia. In contrast the share of agrarian habitats increases in the opposite (southerly) direction

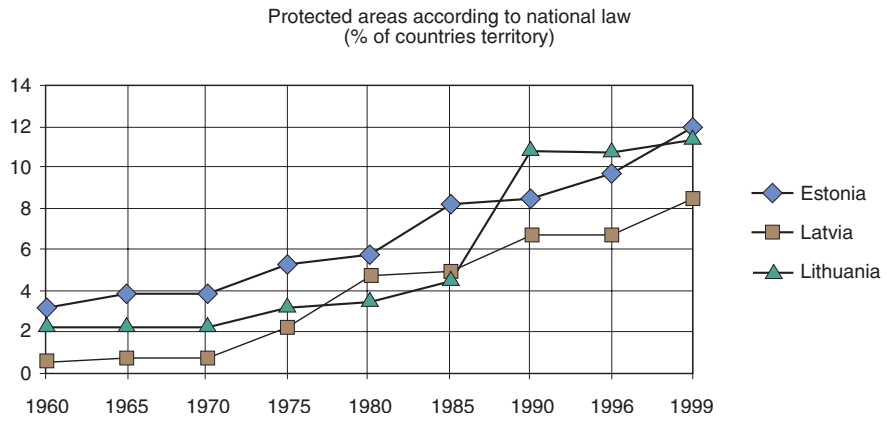


Figure 5. Protected areas according to national law, percentage of the national territory *(BEF, 2000)*

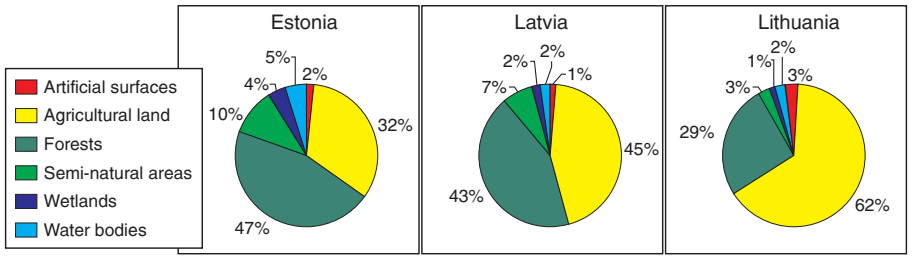


Figure 6. Land cover types in Baltic countries according to CORINE land cover

and is highest in Lithuania (Figure 6). On a global scale the Baltic States have a relatively high level of forest biodiversity, and as a result of geographical location, there are features of both taiga and broadleaved forests. For instance, in Estonia altogether 22 site-types and 71 forest types have been identified. The most important types include dry pine forests on sandy soils, temperate spruce forests, transitional swampy forests, dry heath pine forests, bog pine forests, fen birch forests, species-rich swampy black alder forests, floodplain forests and alvar forests (Lõhmus, 1984). Coniferous tree species (pine and spruce) dominate Baltic forests. However the share of deciduous/broadleaved trees increases in southerly direction (Table 2).

The highest percentage of old forest stands (over 100 years) is in Latvia and the lowest in Lithuania (Figure 7). However, in Lithuania old forest stands are the most diverse and evenly distributed among all dominant tree categories, includ-

There are thousands of lakes in the Baltic countries

Table 2. The dominant tree species in Baltic forests, percentage of total volume of wood in forests *(after Hallanaro and Pylvänäinen, 2002)*

Tree species		Estonia	Latvia	Lithuania
Spruce	*Picea*	25.2	17.9	24.0
Pine	*Pinus*	39.0	36.7	37.0
Other conifers				0.1
Alder	*Alnus*	4.3	7.3	10.0
Birch	*Betula*	27.0	22.2	19.0
Beech	*Fagus*		9.4	
Ash	*Fraxinus*		0.6	2.0
Aspen	*Populus*	2.0	5.5	5.0
Oak	*Quercus*		0.4	2.0
Other broadleaves				.9
Others			2.5	

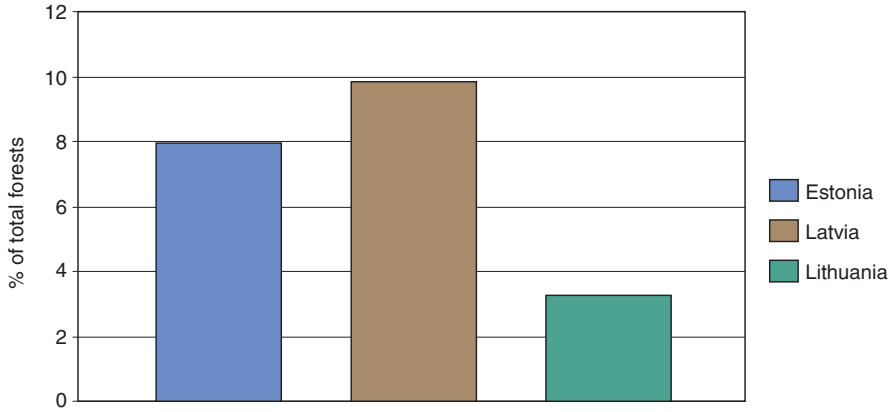


Figure 7. Forest stands older than 100 years in the Baltic States *(BEF, 1998)*

ing a high proportion of old oak stands. In contrast in Latvia and Estonia, the majority of old stands (more than 95 per cent) are predominantly pine or spruce, due to the fact that they are the most northerly of the three Baltic States, and the climatic conditions are less favourable for oak (BEF, 1998).

Despite drainage activities (Figure 8), wide areas of valuable wetlands remain, mostly in Latvia and Estonia, where the share of total peatlands makes up 22.3% and 9.9% respectively of the countries' territories. Mires are represented by fens (eutrophic mires), transitional (mesotrophic) mires and bogs (oligotrophic mires) (Figure 9).

Undisturbed coastal areas (wetlands, lagoons and lagoon lakes) provide important resting and feeding sites for migratory birds. Coastal waters are internationally important wintering sites for waterfowl and fish spawning grounds. Accord-

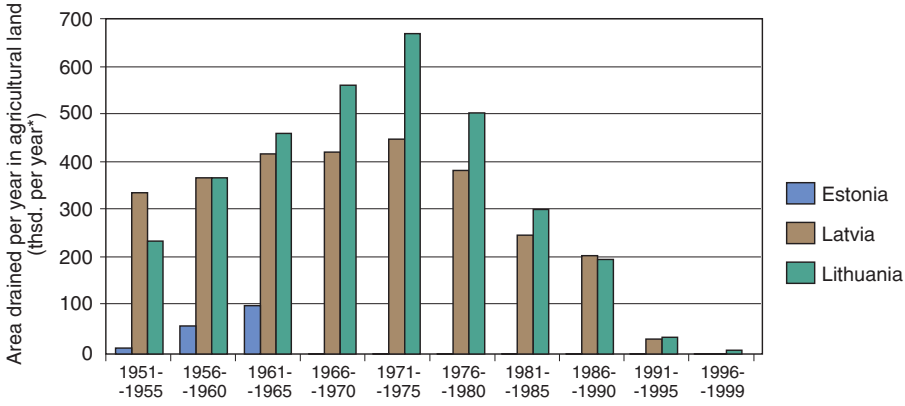


Figure 8. Area drained per year in agricultural land *(BEF, 2000)*

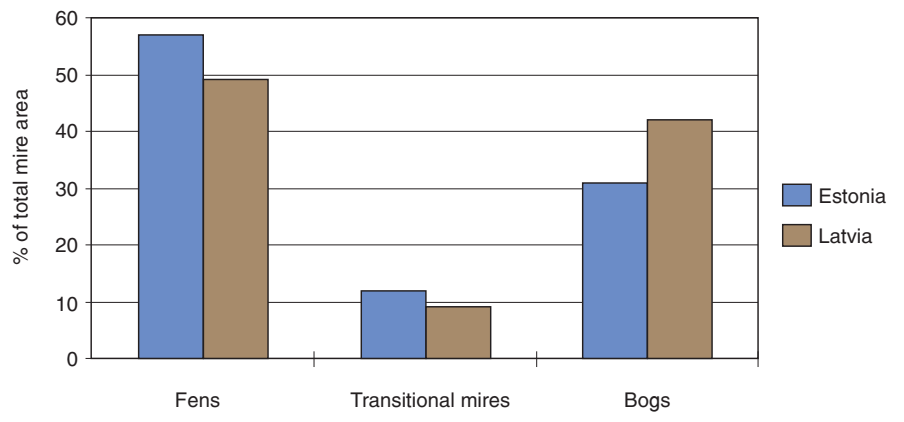


Figure 9. Comparison of Estonian and Latvian mires *(Data source: EME and UNEP, 1999; LMEPRD and UNEP, 1998)*

ing to recent data, the Gulf of Riga holds 24% of European population of Red-throated Diver *(Gavia stellata)*, 23% of Long-tailed Duck *(Clangula hyemalis)*, 36% of Velvet Scoter *(Melanitta fusca)* (LMEPRD and UNEP, 1998). The Bay of Matsalu (in western Estonia) holds 15% of European population of Steller's Eider *(Polysticta stelleri)*, and is one of the most significant migratory resting and feeding site for the Finnoscandic population of Lesser White-fronted Goose *(Anser erythropus)* (Heredia *et al.*, 1996).

Natural meadows, mainly found in river flood plains and along the coast, and semi-natural meadows that have formed as a result of long-term land use (grazing and mowing), have great importance in protection of biodiversity. Unfortunately, during the last 50–60 years the area of grasslands has decreased significantly. A unique type of habitat known as alvar, fragile plant communities on

Old broad-leaved forest

limestone, is wide-spread on the Estonian islands as well as in northern Estonia (EME and UNEP, 1999). Lithuania is famous for its valuable sandy habitats at Curonian Spit. Sandy areas, with the exception of sea beaches and those of major rivers, are mainly of secondary origin, having emerged as a result of economic activities (former military training grounds, open continental sands). These ecosystems are both unusual and rare. Negative impact on sandy ecosystems is mostly due to the overgrowth of open sand stretches, planting with forest crops for economic use, or intensive recreation.

All the Baltic States are relatively rich in inland waters, but Estonia has the largest area of water bodies of the three Baltic States (Table 1). One lake, Lake Peipsi, accounts for 54 per cent of the total area of Estonian inland waters (BEF, 1998). Aquatic habitats are represented by oligotrophic, mesotrophic, eutrophic, hypertrophic and dystrophic lakes. An extensive river network is a strong support for the survival of aquatic species. During the last decade, the eutrophication of water bodies has significantly decreased due to reduced use of fertilisers (Figure 10).

The distribution of **plant** species among various ecosystems is uneven. Most of the species are found in forests and meadows; less in various wetlands, freshwater habitats and sandy areas. According to Kukk and Kull (1997) about 690 species, some of them very rare, have been recorded in the Estonian meadow flora. The respective number for Lithuanian meadow flora is 555 species (EPMRL, 1998). Species richness of certain wooded meadows, preserved under long-term traditional land use in western Estonia, is one of the highest in the world. The number of vascular plants is as high as 76 species per square metre.

Coastal areas provide important resting and feeding sites for migratory birds

It is characteristic that many plant species are at the boundary of their distributional range in the Baltic States. In Estonia alone the number of such plant species is as high as 538 (EME and UNEP, 1999). The Baltic flora is rich in paleoendemic species. For example, the Lithuanian flora includes several Ice Age relicts: *Betula nana, Baeothryon caespitosum, Cladium mariscus, Carex paupercula, Lobelia dortmanna, Isoetes lacustris, Swertia perennis* as preboreal relicts; *Cephalanthera rubra, Gratiola officinalis, Isopyrum thalictroides, Melitis melissophyllum, Viola stagnina* as subboreal relicts; *Bromus benekenii,*

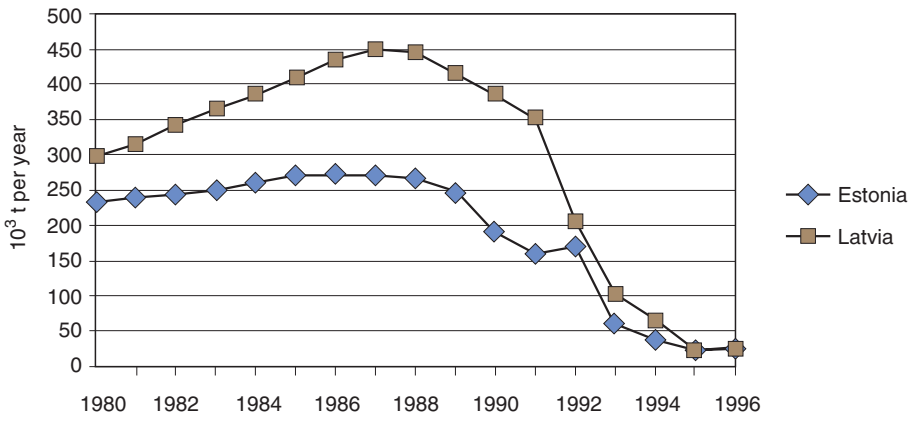


Figure 10. Supply or sale of mineral fertilisers *(BEF, 1998)*

Lunaria rediviva

Carex heleonastes, Gagea pratensis, Gymnadenia odoratissima, Lunaria rediviva, Teucrium scordium, and *Tofieldia calyculata* as atlantic relicts.

It is also characteristic that, during the last century, many vascular plants, lichens and bryophytes have become extinct or very rare. For example the Estonian flora has lost *Alisma lanceolatum, Blechnum spicant, Botrychium lanceolatum, B. simplex, Carex rhynchophysa, Cochlearia officinalis, Crassula aquatica, Eleocharis ovata, Erica tetralix, Juncus anceps* and several other species (Külvik, 1996).

Fungi species are found in virtually all habitats. However the majority occur in forests, fewer in meadows, water bodies, wetlands and sandy areas. Fungi species have been insufficiently studied, but the species diversity of macromycetes, including that of lichens, has been more thoroughly studied than that of micromycetes.

Invertebrates make up the naturally greatest macrogroup, of which most of the smallest, particularly protozoa, insects, helminths and coelenterata have been insufficiently studied (see Appendix 1; Table 18). There are many rare, relict and endangered species of various climatic periods (subarctic, boreal, atlantic, subboreal). Several invertebrate species are under nature protection, e.g. the Freshwater Pearl Mussel *(Margaritifera margaritifera)* and Common Red Ant *(Formica rufa)* in Estonia, or designated as Red Data species in Latvia and Lith-

uania (Appendix 1; Table 19, Table 22) (for an overview see EPMRL, 1998; EME and UNEP, 1999; LMEPRD and UNEP, 1998).

Vertebrates are the most thoroughly studied taxonomic group (Table 3). Numbers of most migratory fish species (e.g. the Atlantic Salmon *(Salmo salar)*, the Sea Trout *(Salma trutta trutta)*, the Vimba Bream *(Vimba vimba)*) have declined during the past decades, mainly due to hydro-technical construction and the pollution of spawning areas. Most freshwater fish are also spread in the brackish coastal waters of the Baltic Sea (EME and UNEP, 1999).

Some amphibians species are relatively widespread such as Grass Frog *(Rana temporaria)*, Moor Frog *(R. arvalis)*, Common Toad *(Bufo bufo)*, and Smooth Newt *(Triturus vulgaris)*, while others are more or less rare e.g. (Crested Newt *(Triturus cristatus)*, Common Spadefoot *(Pelobates fuscus)*, Natterjack Toad *(Bufo calamita)*, Green Toad *(Bufo viridis)*), or sporadic (Edible Frog *(Rana esculenta)*, Pool Frog *(R. lessonae)*).

Many bird species have declined in numbers, so that a large number of species have been included in the Red Data Book. On the other hand, some species, whose abundance is decreasing in western Europe, have increased in numbers in the Baltic States, e.g. the White Stork *(Ciconia ciconia)* and White-tailed Eagle *(Haliaeetus albicilla)* in Estonia (EME and UNEP, 1999). The populations of several gull and passerine species are increasing as they often become urban inhabitants. Several mammal species, strictly protected elsewhere in Europe, have increased their populations during the last 50-60 years and are considered as game animals in the Baltic States (e.g. Wolf *(Canis lupus)* and Brown Bear *(Ursus arctos)*) (Maran, 1998).

The Baltic populations of many species threatened on European or World level represent a significant part of the total populations, and therefore changes in their status in the Baltic States can have major impact to their global survival. For example, 750–1,000 pairs of Black Stork (*Ciconia nigra*) nest in Latvia,

Table 3. Number of vertebrate species in the Baltic States

Taxon	Recorded number of species		
	Estonia[1]	Latvia[2]	Lithuania[3]
Mammals	64	69	70
Birds/breeding	332/222	320/223	321/213
Reptiles	5	7	7
Amphibians	11	13	13
Fishes	74	95	96
Total	486	504	507

[1] Data source: Estonian biodiversity strategy and action plan (EME and UNEP, 1999).

[2] Data source: National report on biological diversity: Latvia (LMEPRD and UNEP, 1998).

[3] Data source: Republic of Lithuania. Biodiversity conservation strategy and action plan (EPMRL, 1998).

Natterjack Toad (*Bufo calamita Laurenti*)

constituting ~10% of the world population (Strazds *et al.*, 1994). The globally threatened bird species in the Baltic state are Corncrake (*Crex crex*) in all Baltic States (in Estonia alone 10,000–25,000 pairs), Aquatic Warbler (*Acrocephalus paludicola*) in Latvia and Lithuania, and Lesser White-fronted Goose (*Anser erythropus*) in Lithuania (Heredia *et al.,* 1996). Other important populations are the Greater-spotted Eagle *(Aquila clanga)* (20–30 pairs nest in Estonia), Lesser--spotted Eagle *(Aquila pomarina)*, White-backed Woodpecker *(Dendrocopos leucotos)*, Great Snipe *(Gallinago media)* (500–700 pairs in Estonia), Common Crane *(Grus grus)*, Beaver *(Castor fiber)*, Otter *(Lutra lutra)*, Wolf *(Canis lupus)*, Lynx *(Felis lynx)* (EPMRL, 1998; EME and UNEP, 1999; LMEPRD and UNEP, 1998).

3.2. Habitat trends and threats

The Soviet period (1940-91) brought about changed land uses and landscapes. The principal trends, as described by many authors, e.g. Mander and Palang (1994), Mander *et al*. (1996), etc., were similar for the whole region:

1) overall decrease in agricultural land and increase in forested land (in Estonia and Latvia);

White Stork (*Ciconia ciconia*)

2) continuing decline in natural grasslands (in all Baltic States); and
3) simplification and/or polarisation of landscape structure (in all Baltic States).

During this extremely short time-period, the patchy mosaic type of landscape, characterised by small fields, grasslands and woodlots, was re-organised and replaced by extensive fields and extensive forests. Cultivated lands were transformed from small to large units especially because of wider use of industrial methods in agriculture. It has resulted in contrary tendencies in land use and loss of valuable habitats. Meadows, marshes and fens have been drained for cultivation, and some decades later been abandoned. Meadows rich in species have been cultivated into grasslands, while others have been afforested or overgrown with scrub. Water bodies have eutrophied caused by increasing use of fertilisers. By 1998 the percentage of arable lands (incl. sown lands) in Estonia and Latvia was the same as the European average, whereas Lithuania has still one of largest portion of arable lands (Figure 11) (BEF, 2000).

The expansion of beaver has increased biological diversity in forests, creating new habitats for many wild species. By building dams on rivulets and land reclamation ditches the beaver floods meadows and forests creating a peculiar complex of ecological conditions. Gnawed-off trees decay on the ground and those flooded by water die standing. In Latvia it is believed that the increase of the black stork and crane populations nesting in forests during the 1980s is mainly due to beaver activity (Strazds, 1994). However, during recent years the abundance of beavers has reached carrying capacity.

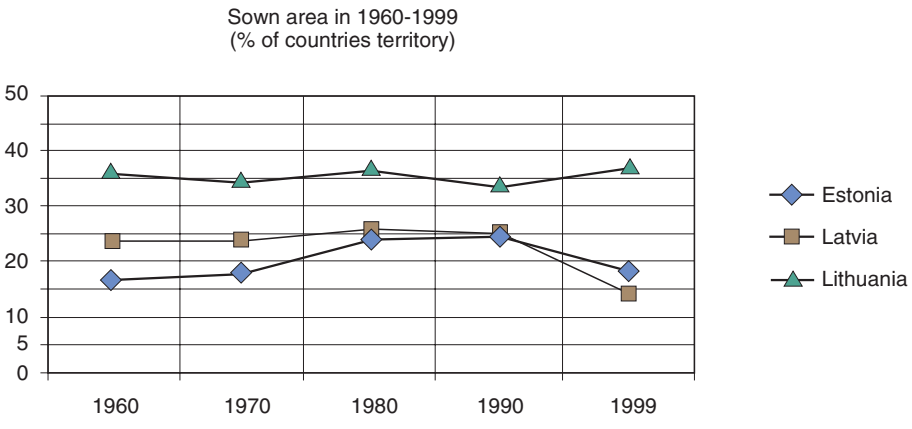


Figure 11. Sown area in 1960–1999

Recent political and economic changes have caused considerable changes in human interaction with nature. Intensive utilisation of forest resources has started as a result of the fact that almost half of forest areas are becoming privately owned and many private forest owners regard it as a source of quick income. The proportion of old stands, which are the most important for threatened plants and animals, have particularly decreased. Forestry activities can also indirectly affect animal populations by disturbance during reproductive periods.

The expansion of beaver has increased biological diversity in forests

Due to land reform and the development of recreational activities, pressure is also increasing on coastal areas. On other hand, agricultural development is experiencing significant decline, which reduces the pressure from agriculture activities on landscapes (e.g. decrease of fertiliser and pesticide use), but also results in loss of valuable agro-habitats. Most semi-natural grasslands and former pastures are becoming overgrown with brush, as farmers quite often have no capacity to continue grazing and grass cutting and traditional agriculture practices are unprofitable.

3.3. Conclusion

Based on information provided by national biodiversity reports, national biodiversity indicators are high in all Baltic States because of diverse natural conditions. Biodiversity is remarkably well preserved mainly due to low population density and inhibited economic growth during the Soviet period. In Estonia and Latvia vast natural areas (forests and wetlands) still exist, and in all Baltic States anthropogenic impacts have not yet affected the areas of high biodiversity value, to the same degree as in western Europe.

Compared with the preconditions in western Europe, the natural preconditions for a well-functioning ecological network in Baltic States are fairly good, and the designation of these networks could be based on existing natural areas. In contrast to other European countries it seems that there is no need to restore already spoilt areas, because it is more important to protect existing areas with high natural value. In other words, in the Baltic context (esp. in Estonia and Latvia) the main objective is not so much the establishment of ecological networks but preservation of the already existing and well-functioning network of natural and semi-natural areas in the new social and economic conditions.

The Soviet period landscape changes – polarisation of landscapes to huge fields and forests and simplification of landscape structure – are similar in all three Baltic countries, and may facilitate the designation of ecological networks on macro (national) levels and probably on meso (county) levels. On micro (farm) level the landscape structure has generally impoverished, making the designation of networks on this level more complicated.

Ongoing social and economic restructuring (mainly privatisation) has controversial impacts on land use and landscape structure. In theory, the re-establishment of small farms has a potential to increase the diversity of agricultural landscapes. In practice, large proportions of agricultural land are currently untended, which may lead to degradation and unification of traditional rural landscapes. Orientation towards short-term economic profits has caused increased pressure on coastal and forested ecosystems and other areas with high market value.

All three Baltic States have long-term traditions in classical nature conservation and have established extensive protected area systems. Re-evaluation of existing

protected areas systems in European (and global) context may require a certain shift from conservation of local rarities to maintenance of viable ecosystems (wetlands, forests, coasts) and populations of international importance. Also, nature conservation principles and protected area systems need rearrangement due to the current changes in ownership and economy (Sepp *et al*., 1999).

Chapter 4

Nature protection system

Although the legal and policy systems relevant to nature conservation and development of ecological networks in the Baltic countries are rather different, there are also plenty of similar features. There are several reasons for this:

- the natural conditions and general biodiversity characteristics are similar, and consequently similar conservation strategies can be used;
- political and social transition phases pose similar problems (e.g. controversial impacts of privatisation, changes in land use, increased pressure to coastal and forested ecosystems) and need for new legislation, etc.;
- similar problems related with accession to the EU and the required approximation of national legislation with European nature conservation standards;
- all three Baltic States have ratified similar nature conservation conventions and are involved in similar international programmes, etc.

The main environmental problems, as stated in national environmental policy documents (the *Estonian National Environmental Strategy*, approved in 1997 (EME, 1997); the *National Environmental Policy Plan for Latvia*, approved in 1995 (LMEPRD, 1995); and the *Lithuanian Environmental Strategy*, approved in 1996 (EPMRL, 1996)), are quite similar for all three Baltic countries (Table 4). So also are the policy goals which support the preservation of biodiversity and landscapes.

For the development of ecological networks it is important to create effective legal, administrative, planning and economic measures to protect and improve existing networks of natural areas. One of the priority purposes of the new nature conservation legislation is to find a balance between private ownership rights and nature conservation considerations and to define the degree to which the property rights are subordinated to environmental concerns (Veinla, 1996).

Table 4. Primary environmental problems according to the environmental policy documents of the Baltic States *(Kratovitš, 2001)*

Estonia	Latvia	Lithuania
1. air quality	1. transboundary pollution	1. water quality
2. past pollution	2. water quality	2. air quality
3. degradation of landscape	3. risks caused by economic activities	3. waste management
4. water quality	4. past pollution	4. (hazardous) waste management
5. aquatic ecosystems quality	5. impact of transport on the environment	5. physical pollution (radiation, thermal pollution and noise)
6. hazardous waste management	6. impact of agriculture on the environment	6. inappropriate land-use and forest structure optimisation
7. depletion of landscape and biodiversity	7. depletion of biodiversity	7. depletion of landscape and biodiversity
8. degradation of the cultural environment	8. landscape degradation	8. insufficiency of protected areas

4.1. National legal and policy instruments

Systems of protected areas are established by means of national nature conservation legislation.

- In Estonia, the *Act on Protected Natural Objects (1994, amended in 1998, 1999, 2001)* distinguishes between four types of protected areas: **national parks**, **nature reserves**, **protected landscapes (landscape reserves)** and **programme areas**. The Act also defines three types of zones in protected areas: strict nature reserves, special management zones and limited management zones (see also Appendix 2).
- In Latvia, the *Law on Specially Protected Nature Territories (1993, amended in 1997)* groups protected areas into seven categories: **state nature reserves**, **national parks**, **nature reserves**, **nature parks**, **natural monuments**, **protected landscape areas** and, **biosphere reserves.** Depending upon their category the protected areas may be divided into several zones (see also Appendix 3).
- According to the *Law of Protected Areas (1993 currently being amended)*, Lithuania's system of protected areas consists of four general categories:

1) **conservation areas** (strict nature or culture reserves, protected landscape objects, reserves of different kind);
2) **preservation areas** (protective zones of various purposes);
3) **recuperation areas** (sites where resources are protected or restored) and
4) **integration areas** (national and regional parks as well as biosphere monitoring areas). The categories 1 and 4 together are known by the name of partic-

Air quality is one of the primary environmental problems in the Baltic States

ularly protected areas and have the greatest significance in nature conservation sense. All protected areas of natural character as well as other ecologically important and natural or semi-natural areas, which provide for general landscape stability, shall be combined into a joint system of land management and ecological compensation zones by the **nature frame**.

The nature frame combines areas of various purpose: strict nature reserves, managed reserves, state parks, protection zones and protected sites of natural resources, various recreational, forestry and limited agrarian activity zones (see also Appendix 4).

The protection of species is also differently arranged in the Baltic States.

- In Estonia, the protection of species is arranged via lists of species under State protection and reserves for endangered species. The *Act on Protected Natural Objects (1994, amended in 1998, 1999, 2001)* divides protected species into three categories (Protection categories I, II and III) according to the strictness and specific features of protection requirements.
- In Latvia, the *Law on Protection of Species and Habitats (2000)* contributes towards ensuring bio-diversity through the conservation of habitats and of wild fauna and flora characteristic of Latvia. It also regulates protection, management and monitoring of wild species and habitats. It facilitates the conservation of populations and habitats according to the economic and social conditions, as well as to cultural traditions and regulates the designation of Specially Protected Species and Habitats.

Lesser Spotted Eagle (*Aquila pomarina*)

- In Lithuania, the *Law on Protected Animal, Plant and Fungi Species and Communities (1997)*, sets up the protection of rare and endangered species and communities. The Ministry of Environment issues the Lithuanian Red Data list and special regulations for the management of sites/habitats of protected species and communities. The *Law on Protection and Use of Wildlife (1997)*, and the *Law on Wild Plant Protection (1999),* are legal instruments for the protection of wild species by their trade, hunting and fishing regulations, alien species control, etc.

4.1.1. Estonia

Estonian legislation supports the establishment of an ecological network. Although the general concept of ecological networks (network of compensating areas) is embedded in the spatial planning legislation, the system through which these networks will be designated and preserved, is not fully established. However, the new legislation and environmental policies (the Estonian National Environmental Strategy, the Estonian Environmental Action Plan and "Estonia – vision 2010" as a long-term strategy) gradually extend the support for establishing and maintaining an ecological network, at all hierarchic levels.

The *Act on Sustainable Development (1995, amended in 1997)* lays down the principles of the national strategy and provides the legal basis for implementing the principles of sustainable development. This Act contains special articles concerning ecological networks, i.e., ecological considerations at spatial planning and developmental planning.

The *Act on Protection of Natural Objects (1994, amended in 1998, 1999, 2001)* is one of the main legal instruments concerning nature conservation. This Act determines the nature of protection and the procedure for the taking into protection of territories (landscapes), single objects of nature (geomorphologic features), plant, fungi and animal species. It determines the rights and responsibilities of land owners, land users and other persons in regard to protected natural objects and regulates the introduction and reintroduction of protected species, etc. By setting the general framework for designating protected areas, and for working out their protection rules, territorial zoning and management plans, the Act provides a strong legal support for preservation of core areas of the ecological network.

The *Act on Protection of Marine and Freshwater Coasts, Shores and Banks (1995)* stipulates the principles for using and protecting the Estonian coast and shoreline. The Act is very important for preserving ecological corridors along the coastline, lake-shores and river banks.

Spatial planning, including settlements, industry and their infrastructure which exert an impact on a considerable share of natural areas, is organised by the *Act on Planning and Building (1995, amended in 1996, 1999)*. The Act provides the legal background for designing an ecological network as a part of county spatial planning process. The county plan has legal power in Estonia. The county spa-

Dactylorhiza ruthei (Category I) is under nature conservation in Estonia

tial plan is considered to be the main development plan, which sets the legal framework for land use and other activities. The main tasks of the second phase of county planning (period 1999-2001) include:

- the design of the green network at county level (planners are using a term "green network" instead of "ecological network");
- the definition of valuable cultural/historical landscape elements.

Consequently, by 2001 each of the 15 counties must prepare an ecological network map as one of the layers of spatial planning. For that reason, at least two methodologies will need to be elaborated; one for designing green networks and the other for defining valuable cultural landscapes (Sepp, 1999).

The *Act on Wildlife Protection (1998)* sets a legal basis for the protection and preservation of migratory routes. All activities like construction and planning of roads, communication lines or rebuilding should take into consideration the existing migratory routes of wildlife.

The other laws and regulations which could indirectly support ecological network principles, include the Act on Forestry (1998, amended in 1999), the Act on Hunting Management (1994), the Act on Land Improvement (1994), the Act on Water (1994, amended in 1996), and the Act on Fisheries (1995, amended in 1996, 1998, 2000).

Several environmental policies, like the Estonian National Environmental Strategy and the Estonian Environmental Action Plan, are oriented towards the development of ecological networks in Estonia. The *Estonian National Environmental Strategy*, approved in 1997, sets a goal to ensure the preservation of viable populations of local plant and animal species, natural and semi-natural communities and landscapes typical of Estonia (EME, 1997). It also sets short-term and long-term tasks:

Tasks by the year 2000

- To improve the protection of plant and animal species, their habitats and landscapes in accordance with revised legislation, bearing in mind international agreements and European Union requirements.
- To improve the existing network of nature reserves in accordance with EU recommendations in order to ensure protection of ecosystems.

Tasks by the year 2010

- To establish a network of nature reserves corresponding to EU recommendations where zones of strict protection have to cover up to 5% of the terrestrial area of Estonia.

The *National Environmental Action Plan*, approved in 1998, includes several activities related to an ecological network (EME, 1998). The short-term actions (1998–2000) for improving the legal and institutional capacity for managing

protected areas, nature objects, landscape conservation and planning, include *inter alia* the development of the *Landscape Act,* which is designed:

- to set the principles for landscape planning including the design of an ecological network;
- to define the elements (areas) of an ecological network;
- to give a legal basis for landscape monitoring.

Medium- and long-term actions (2001–2006) foresee the development and implementation of the ecological network concept and related Geographical Information System (GIS), viz.:

- methodological materials on the implementation of the ecological network at the local and regional levels, and training in this field;
- updating and planning the ecological network concept at the national and regional levels;
- regular courses on protection and sustainable use of biodiversity and landscapes for nature resources management;
- economic analysis on ecological network implementation;
- implementation of a Geographical Information System (GIS) for analysing the landscape and ecological network.

The long-term strategy *"Estonia – vision 2010"* contains a chapter on "green networks" and a schematic map of an Estonian green network. According to it "an ecological network is a coherent system of extensively used areas in a comparatively good natural state that helps to maintain biodiversity and stability of

The International core area according to the vision "Estonia 2010". Wetland in the mouth of River Emajõgi

the environment. It consists of bigger core areas and narrower corridors connecting them. Biotopes with suitable area and location of natural and environmental importance, as well as areas acting as buffers against external environmental influences, are suitable for being enlisted as core areas. The large range of forests and wetlands guarantees sufficient compensation for human activities. The core areas are linked with corridors that are comprised of linear elements in the landscape, e.g. river valleys and valley flats, as well as interconnected parts of forests and coppices. Corridors bind the core areas into a structural whole, making the spread of species and exchange in the genotype of the association possible, thus undoing local damage to nature and recreating biodiversity" (Terk, 1999).

The National Agri-Environmental Program supports the development and preservation of ecological networks at local (farm, agricultural enterprise) level. Currently the project on *"Development of an Agri-environmental Scheme for Estonia"* is on-going (Sepp, 1999), and the project/program is intended:

- to maintain and protect valuable natural, semi-natural wildlife habitats, landscapes and their elements, which are associated with small biotopes such as ponds, hedges, stone heaps, stone walls, etc.;
- to maintain, protect and improve the visual appearance of the farm by maintaining, protecting and improving all farm and field boundaries, including hedges and stone walls;
- to maintain and encourage extensive crop production methods on all cultivated land by: 1) leaving at least a 3 metre wide unsprayed and "headland" on all cultivated fields (this must be increased to 10 meters when the field boundary is lake or river) and 2) leaving an additional 1 metre uncultivated field margin on all cultivated fields over 8 ha in size. These methods are intended to encourage perennial vegetation.

The other policies relevant for preserving or developing ecological networks are the *Estonian Forest Policy (1997)*, the *Estonian Forestry Development Plan (2001)* and the *Estonian biodiversity strategy and action plan* (EME and UNEP, 1999).

4.1.2. Latvia

Although there is no long-term experience with ecological networks, in general the relatively new Latvian legislation provides a good support and favourable preconditions for their development. Latvia has the opportunity to develop its own national approach according to Pan-European guidelines and national preconditions, and to introduce it into national legislation and spatial planning procedures. Environmental policies: the *National Environmental Policy Plan for Latvia (1995)* and the *National strategy on protection of biological diversity (2000),* are oriented towards the protection of existing biodiversity and landscape characteristics. The *Concept of National Spatial Plan (1998)* provides a framework for the development of ecologically sound spatial planning system.

The *Law on Environmental Protection (1991, amended 1997)* determines the general environmental protection objectives i.e. to ensure preservation of the genetic basis for nature and the diversity of biotopes and landscape. The Law defines the rights of residents to a qualitative environment, the methods of implementation and control, competencies of administrative authorities, enforcement mechanisms and sanctions and other issues related to environmental protection.

The Law on the Environmental Impact Assessment (1998) defines procedures, goals, objects of assessment and other related aspects. Projects, plans, building or reconstruction works are defined in the law and related rules for which an environmental impact assessment is required before approval.

The *Law on Specially Protected Nature Territories (1993, amended in 1997)* defines the categories of protected areas, procedures for their establishment and protection, and other related aspects.

The Regulations on Protection and Use of Specially Protected Nature Territories (1997) define the land-use regulations in these areas. This legal act is the basis for planning different activities in specially protected nature areas. Detailed regulations for each area, depending on specific conditions and needs, are developed in individual nature protection plans and individual regulations for each territory.

The Baltic Sea coastline is protected by several legal Acts

The *Law on Protection of Species and Habitats (2000)* contributes towards ensuring bio-diversity through the conservation of habitats and of wild fauna and flora characteristic of Latvia. It also regulates protection, management and monitoring of wild species and habitats. It facilitates the conservation of populations and habitats according to economic and social conditions, as well as to cultural traditions and it regulates the designation of Specially Protected Species and Habitats.

The *Law on Protection Belts (1997)* establishes protected belts on the coast of the Baltic Sea and Gulf of Riga, along water-bodies and watercourses, around natural and cultural monuments, and also forest protective belts around towns and cities. It regulates their status and protection. The coastal protective zone is divided into a 300 m zone landwards and 300 m zone seawards from the mean tide line, and into a restricted terrestrial belt up to 5 km. The width of protection belts along or around inland water bodies depends on their length and size and varies between 10 to 500 m. This law is important for the protection of non-fragmented coastal and riparian biotopes as constituent parts of an ecological network protection.

The other laws and regulations which could indirectly support ecological network principles are the Territorial Planning Regulation (1994), the Law on Forest Use and Management (1994), the Hunting Act (1995), and Hunting Regulations (1995).

Several environmental policies could also support development of ecological networks in Latvia. The *Concept of National Spatial Plan (1998)* determines the goals, objectives, structure and guidelines for National Spatial Plan and the spatial/physical planning process in Latvia. As one of the goals of environmental protection, the rational use of territory and nature resources and the management and protection of nature have been set out. Protected nature territories of national significance, including territories of nature network, should be specified in the National Planning process. The *National Environmental Policy Plan for Latvia (1995)* declares that falling biological diversity is a priority problem requiring immediate solutions and defines a complex of activities for the protection of internationally important wetlands and characteristic landscapes of Latvia.

4.1.3. Lithuania

In Lithuania the concept of a "nature frame" has influenced planning development and has been adopted in national legislation. It is integrated in the *Law on Environment Protection (1992)*, in the *Law on Protected Areas (1993)*, and in the *Law on Territorial Planning (1995)*. It has also been included in the national planning system.

Law on Environment Protection (1992, amended 1996) sets responsibilities between Lithuanian Parliament (Seimas), Government, Ministry of Environ-

ment, other ministries, county administrations and municipalities. According to the Law, the Ministry of Environment submits to the Government of the Republic of Lithuania the projects for establishment of state-owned strict reserves, other reserves, national parks, natural monuments and other protected areas of natural character, including the nature frame (Lithuanian network).

The *Law on Protected Areas (1993, recently being amended)* sets a legal background for all protected areas and nature frame. The aim of the Law is to regulate social relations in connection with protected areas. The Law applies to land and water areas as well as landscape features to which, owing to their value, a specific protection and use regime set by the state applies. The Law states that the registration, preservation and management of cultural landscape features shall be regulated by the laws of the Lithuanian Republic on the preservation of culture values as well as by other regulatory documents. Protected areas shall safeguard the preservation of natural and cultural heritage complexes and features, the ecological balance of the landscape, biodiversity and genetic resources and the restoration of natural resources. Also it shall provide conditions for cognitive recreation, research and environmental status monitoring and shall promote the preservation of natural and cultural heritage. According to the law, all protected areas of natural character as well as other ecologically important and natural or semi-natural areas, which provide general landscape stability, shall be combined into a joint system of land management and ecological compensation zones by the nature frame (see Appendix 4). Recently the Law on Protected Areas has been amended. The article on the nature frame is also amended. It establishes that ecological networks are a part of the nature frame.

The *Law on Territorial Planning (1995)* is the main legal instrument for establishing protected areas, the nature frame and ecological networks. According to the Law on Territorial Planning, territorial planning is a process and a set of procedures for regulating and planning the purpose and use of land. It sets priorities for environmental and monument protection and other conditions, and for developing a system of land and water use. This covers residential areas, industry and infrastructure, the regulation of population employment, and for determining the rights of natural and legal entities engaged in the development of the territory. The law distinguishes 3 types of territorial/spatial planning in Lithuania: master, special and detailed planning.

Master planning – comprehensive planning for establishing the priorities, objectives and strategy in the use of a territory;

Special planning – planning aimed at formulating programmes, conditions and solutions of development and management of one or several types of activities and land areas;

Detailed planning – planning of parts of municipality territory for establishing the conditions, rights and obligations in using a plot of land and developing an activity in it.

In terms of their importance, the following levels of territorial planning have been distinguished:

- the national level of the Republic of Lithuania (for territorial planning and its documents which shall be approved by the Seimas, the Government);
- the county (for territorial planning and its documents which shall be approved by the county governor or by public authorities);
- the municipality (for territorial planning and its documents which shall be approved by the municipality).

The *Law on Forest (1994)* sets a legal background for forest management, protection and use. According to this law, all forests are divided into 4 groups.

The first group includes forests in strict nature reserves or strict nature reserve zones of national or regional parks, where all forest cutting activity is prohibited.

Special management forests are second group of forests and are divided into two categories. Forests of category A are called ecosystem protection forests which are aimed at protecting and restoring forests in nature reserves (botanical, zoological, botanical – zoological). Clear cutting in this category of forests is prohibited. Forest category B is recreational and occurs in resort areas, where forest management is limited.

The third group of forests covers forests in buffer zones of protected areas, e.g. water buffer zones in some nature reserves such as geomorphological, geological, etc. Clear cutting is allowed but limited.

Sustainable forest management plays an important role in nature conservation

The fourth group includes forests of economic use. All types of cutting are allowed in this group of forests. The Ministry of Environment issues special forest management rules or guidelines and forest management rules in protected areas. The latter sets detailed forest management activities in each type of protected area.

The *Law on Protected Animal, Plant and Fungi Species and Communities (1997)* lays down the protection of rare and endangered species and communities. The Ministry of Environment issues the Lithuanian Red Data list and special regulations for the management of habitats of protected species and communities.

The *Laws on Protection and Use of Wildlife (1997)*, and *Wild Plant Protection (1999)* are legal instruments for the protection of wild species from trade, hunting and fishing and alien species control, etc. According to the law, the Ministry of Environment issues different regulations that set out detailed use and protection of wildlife.

Among other policy instruments there are two documents which are most important for biodiversity protection, the *National Environmental Strategy of Lithuanian,* adopted by the Ministry of Environment in 1996, and *Lithuanian Biodiversity Strategy and Action Plan,* adopted by the Ministries of Environment and Agriculture in 1998. These two legal instruments are considered to provide a framework for forthcoming environmental and biodiversity protection programmes in Lithuania. According to the *Action Plan* to implement the *National Environmental Strategy (1996)*, the following laws and regulations are currently being prepared:

- Regulations on the Protection of Wetlands;
- Regulations on the Management, Control and Protection of Public Green Spaces in Cities and Towns;
- Regulations on the Import and Export of Live Nature Objects and Resources;
- Supplementary legislation to the Fisheries Law (for the regulation of the use of other wildlife resources);
- Regulations on the Preservation of Coasts and Rules on the Recreational Use of Beaches and Dunes.

4.2. International agreements, initiatives and programmes

After the restoration of independence in 1991 the Baltic States signed and ratified several international conventions on nature conservation. As some of the conventions (Bern, Ramsar and Helsinki) are directly focused on the designation of sites of international importance, they are relevant for development of ecological networks (Table 5).

Table 5. Ratification of/accession to some of the nature conservation conventions *(after Kratovitš, 2001)*

Title of the convention	Place and date of signature	Estonia	Latvia	Lithuania
Convention on Wetlands of International Importance Especially as Watertfowl Habitats	Ramsar, 1971	1993	1995	1993
Convention on the Conservation of European Wildlife and Natural Habitats	Bern, 1979	1992	1997	1996
Convention on Biological Diversity	Rio de Janeiro, 1992	1994	1995	1996
Convention on International Trade in Endangered Species of Wild Flora and Fauna	Washington, 1973	1993	1997	–
Convention of the Conservation of Migratory Species of Wild Animals	Bonn, 1979	–	2001	–
Convention on the Protection of the Marine Environment of the Baltic Sea Area	Helsinki, 1974/1992	1995	1994	1997
Convention on the Protection and Use of Transboundary Watercourses and International Lakes	Helsinki, 1992	1995	1996	–

All three Baltic States have ratified the Convention on Biodiversity, and have adopted the Pan-European Biological and Landscape Diversity Strategy (PEBLDS), in Sofia 1995, as an European response to support implementation of the convention (see also Table 6).

By adopting the PEBLDS the Baltic States have agreed to establish the Pan--European Ecological Network (PEEN), as a main tool for implementing the strategy. The PEEN is seen as an instrument for the conservation of species and habitats of European and/or global importance, by maintaining or re-establishing a structure of necessary landscape elements. These should only be developed on the basis of existing national approaches and relevant national legislation. Most of the legal acts in the Baltic States are relatively new and only a few old provisions from the Soviet period are in force, so that existing legislation does not necessarily meet the logic of international acts (Maran, 1998). As stated by Bouwma (1998), it is possible that a network based only on national initiatives will not address problems that are of European concern, because regional interests can easily be seen as more important than international.

The obligations coming from international agreements are gradually being introduced into national legislation and the policies of different sectors. Lithuania, Estonia and Latvia, respectively in 1998, 1999 and 2000, have already compiled their national strategy and action plan for the implementation of the Convention on Biological Diversity.

Table 6. The Pan-European Biological and Landscape Strategy *(after Council of Europe* et al.*, 1996)*

The strategy addresses all nature conservation considerations under one European approach and promotes the introduction of biological and landscape diversity considerations into social and economical sectors. The strategy reinforces the implementation of existing measures and identifies additional actions that need to be taken over the next two decades. It also provides a framework to promote a consistent approach and common objectives for national and regional actions.

The PEBLDS lays down four strategic goals:

1. To reduced the threats to Europe's biological and landscape diversity;
2. To increased the resilience of European biological and landscape diversity;
3. To strengthen the ecological coherence of Europe;
4. To assure public involvement and awareness concerning biological and landscape diversity issues.

The strategy elaborates these goals into six specific objectives which should be achieved within twenty years:

1. Conservation, enhancement and restoration of key ecosystems, habitats, species and features of the landscape through the creation and effective management of the Pan-European Ecological Network;
2. Sustainable management and use of Europe's biological and landscape diversity;
3. Integration of biological and landscape diversity conservation and sustainable use objectives into all sectors;
4. Improved information on, and awareness of, biological and landscape diversity issues;
5. Improved understanding of the state of Europe's biological and landscape diversity and the processes that render it sustainable;
6. Assurance of adequate financial means to implement the Strategy.

The specific actions to be undertaken through the strategy are to be developed in four successive five-year action plans, the first for the period 1996-2000. This action plan identifies 12 action themes as follows:

0. Pan-European action to set up the strategy process;
1. Establishing the PEEN;
2. Integration of biological and landscape diversity considerations into other sectors;
3. Raising awareness and support with policy makers and the public;
4. Conservation of landscapes;
5. Coastal and marine ecosystems;
6. River ecosystems and related wetlands;
7. Inland wetland ecosystems;
8. Grassland ecosystems;
9. Forest ecosystems;
10. Mountain ecosystems;
11. Action for threatened species.

Furthermore, the Baltic States have been involved in several international projects intended to facilitate approximation of national nature conservation policies with international standards. Some of these are already accomplished, while others are still underway. For example CORINE programs, "National Inventories of Internationally Important Species and Habitats in Relation to EU Direc-

There are many Ramsar sites in the Baltic countries

tives" projects sponsored by Danish Environmental Protection Agency (DEPA), projects on inventories of important habitats and the establishment of habitat networks funded by the Dutch Government, etc. The data collected and spatial data bases (GIS-based) established in the framework of these programs, are also relevant for the designation of ecological networks. They could ensure that international nature conservation considerations are taken into account in their development.

Some internationally acknowledged inventories are common for all Baltic States such as the CORINE Biotopes project, the CORINE Land-Cover survey and the identification of Important Bird Areas (IBAs). As these inventories use unified methodologies or common criteria for the identification of important sites, they are relevant for the development of national ecological networks in the Baltic States.

The CORINE (**CO**o**R**dinated **IN**formation on the **E**nvironment of Europe) **programme** in the Baltic States was funded by the EU PHARE programme. Currently all three Baltic States have accomplished both of its projects, the CORINE Biotopes project and the CORINE Land-Cover survey. **The CORINE Biotopes** project was aimed at identifying internationally important sites. The CORINE Biotopes database is standardised according to EU norms and provides most recent and comparable data/information to ensure that the developed ecological networks will be coherent and uniform throughout the Europe. **The CORINE Land-Cover** survey based on analysis of satellite images provides information on spatial distribution of natural and semi-natural areas, i.e., areas

relevant to the designation of ecological networks. The original scale of the digital CORINE Land-Cover maps is 1 : 100,000.

The Important Bird Areas (IBAs) initiative aims to promote the conservation of sites that are of major importance for the conservation of Europe's avifauna. In the Baltic States the inventories of IBAs, accomplished by national ornithological societies, are currently underway. In 1989 eight IBAs in Estonia were included in the list of European IBAs. The Estonian list of IBAs was revised and updated in 1996–1997, and an additional 35 new IBAs were proposed for designation to BirdLife International's secretariat. Currently in **Estonia** 43 IBAs cover 4,756 km^2 (Ots and Kalamees, 2000). In **Latvia** 58 areas (covering 10,865 km^2) are included in the European IBAs list (Racinskis, 2000). In **Lithuania** IBAs (altogether 35 sites, covering 3,177 km^2) are also considered as potential parts of the developed ecological network (Raudonikis *et al.*, 2000).

All the Baltic States have signed and ratified the European Agreement and are currently associated members of the EU and applicants for full membership. Therefore, in the Baltic context, the development of ecological networks is closely related to accession to the EU. This requires approximation of national nature conservation legislation with relevant EU regulations, particularly with the Nature Directive (92/43/ECE) and the Bird Directive (79/409/ECE), and establishment of Natura 2000 network. By the time of accession to the EU, a list of Natura 2000 areas must be created, supplemented by an extensive database. Areas for the Natura programme are selected from among the existing protected areas, important bird areas (IBA), Ramsar areas, as well as protection-worthy wetlands, forest and meadow associations.

Chapter 5

Methodology of designation of National Ecological Networks in the Baltic Countries

5.1. Terminology of ecological networks

Since the 1970s the concept of ecological networks has been developed by several authorities and by several scientific institutions throughout the world. Common environmental challenges but different scientific and planning traditions have led to a situation where many similar issues have emerged that have been expressed in different scientific terms and a variety of contexts of understanding. Ecological networks are all designed and based on certain concepts, within scientific and planning traditions, mediating specific values, traditions, and power relations. Specific concepts have been always selective and usually are valid only under specific circumstances. Therefore national terminologies of ecological networks have been fairly specific in each country, especially in the 1980s (e.g. Miklós, 1989, Kavaliauskas, 1994, De Bulst *et al.*, 1995). The country-specific history of the concepts and applications of ecological networks has brought about its own terminology use in the Baltic States. In Lithuania terms "nature frame" is used as a synonym of ecological networks. One of the key terms applied in Estonia is *system of ecologically compensating areas*, which is defined as parts of the ecological infrastructure that balance disparities between the natural and anthropogenic systems (Jagomägi, 1983; Jagomägi *et al.,* 1988; Mander *et al.*, 1988; Kavaliauskas, 1995). The use of this term was inspired by the *polarized landscape* idea, bringing together the territorial development of nature and human culture.

The Dutch introduced the term "ecological network" in the early 1990s (Ministry..., 1990). It is now acknowledged worldwide and used as a synonym of different ecological networks (Table 7).

Since the late 1990s a new term, *"green network*", as a synonym of "ecological network", has been taken into use in spatial planning in Estonia. From an ecological point of view, the concept of the green network simplifies the complex nature of the theoretical concept of ecological networks, but at the same time is a much wider approach, including other infrastructures (transport, settlements

Table 7. Overview of terms of "ecological networks" used in the Baltic counties

Estonia	Latvia	Lithuania
1. System of ecologically compensating areas – used in spatial planning in 1980s; 2. Green network – term in spatial planning since 1997; 3. Ecological network – used in nature conservation (network of protected areas, NATURA 2000 etc)	Ecological network – used since 1990s in spatial planning and natures conservation	Nature Frame – used in spatial planning in 1980s and 1990s; Ecological network – used in spatial planning and nature conservation since mid 1990s.

etc.) as well as social and economic aspects. Infrastructure is understood as a structure that supports the functioning of some basic system (ecosystem, economic system etc.). Infrastructures help to bring about and maintain basic systems. The selection and naming of infrastructures is comparatively open. It depends either on the understanding or the object we consider important, or the system under observation, or its hierarchical stage. In spatial planning the infrastructure could be considered mostly as a territorial phenomenon, e.g. industrial, ecological, social and administrative infrastructure on the basis of their basic structures. Ecological infrastructure is usually regarded as a spatial sub-structure, manipulation of which should allow appropriate reductions, or replacement, of non-natural inputs (e.g. in landscape planning and ecology), in agricultural economy

5.2. Functional-spatial structure of Ecological network

Ecological networks in the Baltic countries are a constituent part of the Pan-European ecological network. Therefore its main structural elements and their functions are the same as those the Pan-European. Whatever its scale (from regional or continental) an ecological network consists of the following elements (Benett, 1991; Bischoff and Jongman, 1993; van Opstal, 1999): core areas (or biocentre), ecological (or biological) corridors, buffer (protective) zone, restoration (re-naturalisation, or nature development) area, and stepping stones. Each structural element has its functions, and the whole complex makes the ecological network as a functioning system (Bennett, 1991; Buček *et al.*, 1996; Liro, 1995).

The Network is built up from three functionally complementary components (Figure 12, Table 8):

- "core areas" to provide the environmental conditions required to conserve important ecosystems, habitats and species populations;

- "corridors" to interconnect the core areas where species benefit from the opportunity to disperse and migrate;
- "buffer zones" to protect the network from the potentially damaging impacts of activities outside the network, such as pollution or land drainage.

Because of the extent to which ecosystems in Europe have degraded, the goal of conserving biodiversity cannot be achieved only through actions that preserve nature in its existing condition. It will also be necessary in certain cases to restore damaged habitats. In developing ecological networks, "restoration areas" where environmental conditions must be improved, must therefore be identified.

Table 8. Different categories distinguished in the national networks developed

PEEN	Estonia	Latvia	Lithuania
Core area	International, national and local core areas	International, national and local core areas (biocentres)	International, national and local core areas
Corridor (stepping stones)	National and local corridors	International, national and local corridors, stepping stones	National and local corridors, stepping stones
Buffer area	No	Yes	Yes
Restoration area	No	Yes	Yes

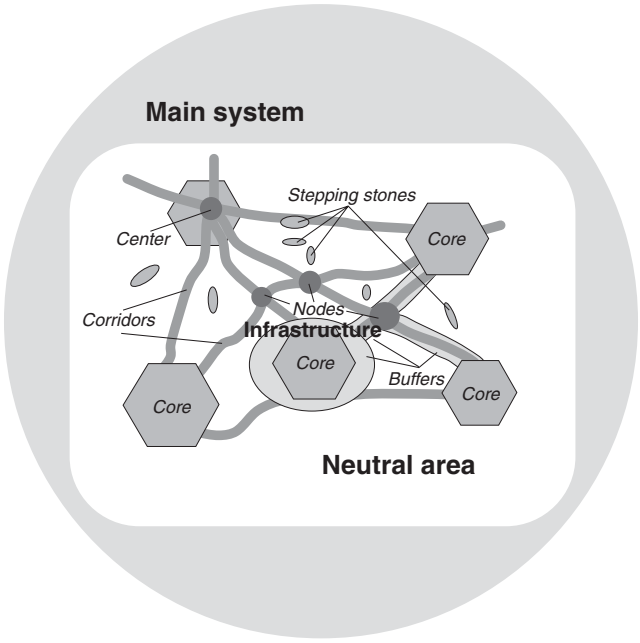


Figure 12. Theoretical structural elements of ecologically compensating infrastructure *(Jagomägi and Sepp, 1999)*

Small islands are important stepping stones

5.2.1. Core areas

Ideally, core areas will contain substantial representatives from characteristic European natural and semi-natural habitat types across their traditional range and at different stages of ecological succession. They will hold viable populations of species of European importance and the natural environmental processes on which these habitats and species populations depend, and landscapes of European importance.

The conservation of international core areas are secured through:

- the full implementation of the various existing international instruments that provide for the protection of valuable sites in Europe and
- policies and programmes of national and regional authorities.

In the Baltic projects, core areas were considered as areas that are designated for the protection of valuable ecosystems, animal and plant species and their communities. They are ecologically integrated territories (corresponding with conditions of soil, water regime and climate in that locality) which comprise natural, nearly natural or semi-natural ecosystems distinguished by high biodiversity, remarkable size, low anthropogenic pressure and connected by ecological corridors and surrounded by buffer zones. In Lithuania core areas were divided into unique, representative, simple, and complex. The unique zones contain ecosystems unique within the region or country; representative ecosystems of the region or country; simple zones containing ecosystems of one type only; com-

plex zones comprising several types of ecosystems. Larger and more valuable core areas make central zones, while smaller and of less values core areas make linking zones. In creating a system of ecological networks, core areas may be designated as existing ones, or may be planned for and formed in appropriate places in the near future. The size of the core area is different for each territorial level. Core areas are identified at European, national, regional, and local levels respectively.

5.2.2. Ecological corridors

The corridors are intended to ensure that species populations have adequate opportunities for dispersal, migration and genetic exchange. Species populations require access to a sufficiently large area of appropriate habitat. Migratory animal species need to be able to travel between their breeding grounds and overwintering areas, and opportunities should be available for genetic exchange between different local species populations. Interconnectivity, where appropriate, can be provided in various ways, through linear landscape features, through a series of smaller features or through a broader landscape matrix in which there are opportunities for compatible forms of land use.

Many different definitions of corridors exist. Saunders and Hobbs (1991) define a corridor as a linear feature of vegetation, which differs from the surrounding vegetation and connects at least two different patches which where connected in historical times. According to the Pan-European Biological and Landscape Diversity Strategy the main purpose of corridors in the Pan-European Ecological Network is to provide connectivity for species during migration and to facilitate dispersal between core areas. In Europe, ecological corridors are often the result of human intervention in nature: hedgerows, stonewalls, landscapes with small forest, canals and regulated rivers. Others such as coastlines and watercourses are predominately natural (Bouwma *et al*., 2001). At the European scale as well as in the Baltic, major rivers are important corridors and form the backbone of most national ecological networks.

Jongman and Troumbis (1995) and Bennett (1999) distinguished three different types of corridor based on physiognomic structure: linear, stepping stone and landscape. According to structure and composition, ecological corridors are divided into continuous and fragmented, monotypic and polytypic. *Continuous corridors* make solid links between core areas, while *fragmented ones* ("stepping stones") consist of separate, isolated steps located at a reasonable distance from each other, so that species can overcome this distance. Continuous corridors can have linear parameters, i.e. narrow belts (belts of plantations, streams, etc.), and non-linear ones (wide belts of plantations, forest patches, etc.). Monotypic corridors consist of uniform or very similar ecosystems or communities (plantations), while polytypic – of different ecosystems or communities. The significance of the latter as corridors for individual species is lower. Corridors also can be of different levels (European, regional and local). The nature of eco-

logical corridors and their efficiency in interconnecting remnants and in permeating the landscape depend on the habitat site they originate from and the land use mosaic within they are embedded and of which they consist (Forman, 1983).

Ecological corridors are multifunctional in both an ecological and societal sense, because they function in the wider landscape. They can encompass natural landscape features as well as a variety of human landscape features from more natural to more cultural, classified as (Jongman, 2002):

- Landscape linkages, large linear protected areas between large ecosystems including undisturbed rivers;
- conservation corridors, less protected and in many cases with recreational functions, often along rivers;
- greenbelts, protected natural lands surrounding cities to balance urban and suburban growth;
- recreational corridors, linear open spaces with intensive recreational use;
- scenic corridors, primarily protected for its scenic quality;
- utilitarian corridors, canals and power-lines that have an utilitarian function but serve natural and recreational functions as well;
- trails and designated routes for hikers and outdoor recreation having a function as well as being a natural corridor.

From an ecological point of view, "stepping stones" are very important, and by their functions are very close to the core areas or ecological corridors. They are

Rivers are important ecological corridors

a kind of intermediate element. "Stepping stones" are small isolated areas that could function as core areas to individual species, as well as fragmented corridors. But due to their small size or improper distance, they cannot be designated as core areas, and because of the long distances between them, "stepping stones" cannot serve as corridors. Usually "stepping stones" are areas that by spatial parameters (width or length) and distance, do not correspond to the requirements of the core area. For this reason, they have particularly high significance for local ecological networks.

5.2.3. Buffer zones

Buffer zones are intended to protect the core areas and corridors of the PEEN from the effects of potentially damaging external influences. To an important extent, the need for and the configuration of buffer zones will be directed at the needs of the most sensitive species, the nature of the most intensive impacts and the characteristics of the surrounding landscapes. Buffer zones will often offer a reasonably wide scope for other land uses and may offer important conservation benefits in themselves.

The concept of buffer zones is rather old (Wright and Thompson, 1935). The literature offers a number of definitions, related to the approach used for their design within the framework of spatial planning and management. IUCN defines a buffer zone as a zone peripheral to a national park/reserve where restrictions are placed upon resource used or special development measures are undertaken to enhance the conservation value of the area. Within the framework of an ecological network strategy, the definition of a buffer zone should integrate both landscape and functional attributes. A definition based on the ecological function(s) of the buffer zone should focus on its main management objectives (Miklos, 1996; Council of Europe, 2000):

- protection, to protect from harmful human activities;
- interaction, to sustain positive landscape interactions;
- diffusion, to sustain natural and man-made flows in the landscapes.

5.2.4. Nature restoration areas

Nature restoration areas can be defined as areas in which nature will be an important land use, but that can include other forms of land use as well depending on objective restoration. In the EECONET declaration (Maastricht, 1993) the principle of restoration and redevelopment was identified as one of the nine principles for the European Ecological Network (EECONET) (Bennett, 1991). Nature restoration areas can be additional in PEEN, completing the potential ecological network. In the Baltic States restoration is less urgent than in Western Europe. In future, they should potentially become core areas or ecological corridors, but due to current financial or other constraints they can not be designated as core areas or ecological corridors. Restoration areas are similar to planned

core areas, but the latter are being created, while restoration areas are re-naturalised or recovering themselves. In the national networks developed in the region only Lithuania has identified nature restoration areas.

5.3. Levels of Ecological network

One of the important geographical aspects of ecological networks is their hierarchy. Very often ecological networks are defined as a 'hierarchical multilevel system'. Also, in designing and managing them we must consider different levels. From the territorial point of view, the following levels are usually distinguished: European, regional and local.

The **European level** comprises core areas and corridors of large size and length of European importance that can serve for the conservation of European biological and landscape diversity. Usually in each country there are few of them, and they are made up of big complexes of different ecosystems, joining them in a European context. The **regional level** is applied to the conservation of biological and landscape diversity at the level of a certain region (country or county). At the regional level, ecological networks ensure that the protection of biological and landscape diversity and other nature values of national importance are developed. At the regional level, ecological network can be developed for a county or bio-geographical region, or even several administrative districts. **Local ecological networks** are developed usually for an administrative district, city, or other territory, with the purpose of preserving local nature values. Each level has different scale and size. In the Baltic countries when developing ecological network on local level, it is recommended to use a scale of 1:10,000, on regional level – 1:50,000 (for biogeographical region or county), for the whole country – 1:200,000 (or 1:300,000).

Legal Acts usually define the designation and management levels of ecological networks. For example in Estonia the Planning and Building Act defines four planning levels – national, county, comprehensive and detailed planning levels. Corresponding to the levels of planning, ecological network design principles vary as given in Table 9.

A hierarchical approach is essential to optimise the planning process in order to choose a sufficient but not too detailed a level. At the same time it should be remembered that the planned (studied) distribution is only part of a bigger spatial system at a higher level. The aim of ecological network planning is to sift out those parts of the territory that call for a similar approach on the given level (core areas, corridors, etc.). Therefore it is important to take the hierarchical structure into consideration. Metaphorically, an ecological network is everything from garden to the planet Earth. The (morphometric) hierarchical level of the ecological network elements derives from the level of planning which defines the area of core areas, the width of strip-like structures, the density of the net-

Table 9. Comparative hierarchical levels of spatial planning and ecological network design *(adopted from Külvik* et al*., 2002)*

Planning level	Spatial planning task	Ecological network design
National plan	Prepared for the generalised strategic treatment of the territory of the country, outlining of measures guiding and shaping the spatial development of the country, and setting up of tasks for subsequent activities	Determines core areas of international and national level (>100 km^2) and corridors (width >10 km) (e.g. forest and wetland massifs). Defining areas ought to be made according the European and international nature conservation priorities, e.g. PEEN, Natura 2000, EMERALD, etc.
County plan	Prepared for the whole territory of the county or a part thereof. The purpose is a generalized treatment of the development of territory of the county, defining the development conditions of the settlement and the location of main objects of infrastructure	Determines core areas (10 100 km^2) and connecting corridors between these areas (e.g. natural river valleys, semi-natural recreation areas for local settlements; width 0,5–10 km)
Comprehensive plan	Prepared for the territory of a rural municipality or city. The purpose is to define the main directions and conditions for the development of the territory of the town or community, to prepare the base to compose the detailed plan for the areas and cases where detailed planning is mandatory and prepare the base to adjust the land use and constructing criteria for areas where the detailed planning is not mandatory	Determines small habitats, woodlots, wetlands, grassland patches, ponds (<10 km^2) and connecting corridors (stream banks, road verges, hedgerows, field verges, ditches; width <0,5 km). The ecological elements of agricultural landscapes and ecologically valuable areas are additionally defined via national agri-environmental programme (Rural Development Regulation, 99/1257/EEC 0).
Detailed plan	Prepared for a smaller part of a city or rural municipality and is the basis for construction activities in the short term. The purpose is to guide the land use and construction criteria in towns and small towns and in other areas and cases where detailed planning is mandatory	

work. Table 10 presents the tested version of the given hierarchy, which was partly analysed in Estonia. The numerical values of structural elements of ecological network can't always be used one-to-one. It is important to consider the sizes and mosaic of natural areas of country (county). Also it should be observed that the hierarchical structure should remain in place.

Table 10. Hierarchical levels and planning the ecological network in Estonia

Human centred and administrative levels	Level	Range of area (km)	Central areas of green network	The diameter of core areas (km)	The diameter of corridors (km)	Distance between the elements of network, 'size of the loops' (km)
Districts, small group of counties, group system of settlement	G_6	100…150	National-large	30… 50	10… 20	min 10… 15 max 30… 50
County, big group of parishes	G_7	30…50	National-small	10… 20	3… 5	min 3… 5 max 10… 15
Small group of parishes, large town	G_8	10…15	District (county) large	3… 5	1… 2	min 1… 2 max 3… 5
Parish, town, a part of large town, big group of villages	G_9	3 … 5	District (county) small	1… 2	0.3 0.5	min 0.3–0.5 max 1… 2

5.4. Development principles and criteria of Ecological Network

The ecological network model has been under development in Europe as a practical conservation tool since the 1980s. During that time, a range of programmes and proposals has been initiated. Various national and regional networks have been developed, especially in Central and Eastern Europe. Important discrepancies can be observed in these networks, because different criteria and selection procedures of network elements, as well as the disparity in map scales, have used. At the same time the decision on the nature and application opportunities of selection criteria is one of the most decisive elements of the ecological network application procedure.

While selecting valuable territories suitable for ecological networks, and especially for core areas, the conservation value of the area is usually defined. For this, territorial evaluation is applied. Territorial evaluation is understood as the definition of conservation value for certain territories and the preparation of conservation and management measures for conservation of individual species, communities and their habitats. For designation of structural elements of ecological networks two types of criteria are usually appropriate: qualitative (indicating ecological values) and quantitative (e.g. size of core areas, width of ecological corridors or other morphometrical parameters). Various international con-

ventions and agreements use different criteria on the basis of which international areas are designated. 'Criterion' is often a rather broad term, e.g. naturalness, biodiversity, threat, representativeness, uniqueness, etc., that can not be directly measured without further specification (Jongman and Kristiansen, 1988, 2001). For instance, in Article 1 of the Habitats Directive it is specified "to contribute towards ensuring biodiversity through the conservation of natural habitats and of wild fauna and flora" (criterion naturalness), and in Annex I the natural habitats to be protected are specified (Bouwma, 1999). Very often concrete site-selections do remain for the *ad hoc* expert-decisions.

Guidelines of the Pan-European Ecological Network propose four groups of broad design principles (Council of Europe, 1999:-

First, the conserved areas of each particular habitat type and landscape should extend as far as possible over the traditional range of the habitat.
Second, the areas should ideally be as large as possible, be as many as possible, contain viable populations of the most vulnerable species and accommodate the essential physical environmental processes and biotic interactions on which their biological diversity depends.
Third, in determining their interrelationship, areas that conserve a particular type of habitat should be as close together as possible and the landscape between these areas should facilitate dispersal by organisms where this capability is important to the survival of species.
Fourth, in order to protect environmental quality, any human activities within the areas conserved and the interconnecting landscapes should be compatible with the need to maintain the appropriate environmental conditions and the areas should be buffered from the potentially damaging effects of eternal activities.

5.5. Development principles and criteria of Ecological Network in the Baltics

In designing ecological networks, ecological evaluation criteria were used in all Baltic projects, as well as indicator species and habitats used as indicators for defining structural elements. Besides this, developing ecological networks considered general and special principles for designating elements. The following four general principles were applied for determining the location and configuration of ecological networks.

First, the territory to be protected should consists of separate habitats or landscape elements and have potential to be expanded in order to include more than those elements to be protected.

Secondly, the territory should be appropriate (ideal) by being big enough, containing a sufficient number of protected territorial elements, viable populations

of rare and endangered species, and having natural processes which influence biodiversity, undisturbed.

Thirdly, separate elements should have links with each other, i.e. they should be close to each other, thus enabling dispersion of species.

Fourthly, any kind of human activities in protected territorial elements should not disturb natural processes, and these protected territorial elements should be surrounded by buffer zones reducing potential impact. Also, the development of ecological networks must take into account their aims and objectives.

In general the definition of the structural elements of ecological networks in Baltic State is based on:

the morphometry of the elements of ecological network (in core areas – size of the area, width of strip-like structures);

- the value criteria of nature or environmental protection (quantitative and qualitative criteria – endangered habitat, unprotected underground water area, unique singular object, etc.). Recommended criteria of protected or valued areas and objects are presented in corresponding Acts (Act on Protected Natural Objects, The Habitats Directive, Bird Directive etc.) or documents that form the basis for inventories (the inventory of Estonian wetlands, IBA-s, Ramsar sites, CORINE Biotopes, etc.);
- ecological, environmental and landscape peculiarities;
- the habitat preferences of species, location of dispersal and migration corridors, etc.

Large bogs functioning as core areas

5.5.1. Main principles of designating core areas

Van Opstal (1999) formulated the following requirements of the criteria and application of the criteria for the selection of sites as core areas;

- the criteria should be explicit, accessible and open to verification in all stages of the procedure of selection sites as core areas;
- the criteria should be logical and systematic;
- the criteria should be based on the needs of species and ecosystems for nature conservation measures These needs should be based on formalised, generally accepted criteria;
- the criteria should be applied over all of the territory to all relevant sites.

Habitat size and quality are issues that have long been discussed at the national level in Europe. Internationally and nationally important core areas consist of territories with rare, protected or endangered species and plant communities, as well as of territories with high concentrations of plant and animal species, which are important for the conservation of biodiversity at the national level. For example:

- old forest stands – areas with a large proportion of old forest habitats, of special importance for the conservation of rare and endangered communities and species;
- wetland ecosystems – wetland areas with rare and endangered communities, of major importance for the preservation of biodiversity and landscape diversity;

Wooded meadows have high biodiversity

- grassland ecosystems – areas with important, biologically diverse, and unimproved grasslands, of major significance for the conservation of rare and endangered communities of species and providing a major contribution to the area's landscape diversity;
- freshwater ecosystems – lakes, rivers and other freshwater bodies and watercourses with rare or endangered aquatic species and aquatic communities, and which are of major significance for the preservation of biodiversity;
- marine ecosystems – the part of the sea that is important for the natural rejuvenation of fish resources and as a habitat for rare and endangered species and communities.

In national networks in the Baltic countries different assumptions were made regarding the sizes of a core areas. In Lithuania the size of the core area is dependent on the habitat of which the area consists (Table 11).

In practice, core areas consist of various ecosystems, comprising several types of habitats, so that the Estonian methodology does not define the size criterion by separate habitat types (Table 12).

It is also obvious that depending on natural conditions the size criterion is country-specific. For instance, the size criterion for Estonian and Latvian forests and Estonian wetlands could be much larger. Therefore, it seems unnecessary to develop unified size criterion for designating core areas in the Baltic States. As concluded by Bouwma (1999), the size criterion as recommended by Lithuanian experts could be used as guideline for identifying potential core areas, but variations (in both directions) are also accepted.

In Estonia core areas were formed on basis of:

- naturally or environmentally valuable areas which are fixed by international and national legal Acts (protected areas, Important Bird Areas – IBA, Ramsar sites, etc.);
- valuable nature areas identified from inventories;

Table 11. Recommended sizes of core areas for the main types of ecosystems in Lithuania

Types of ecosystems	Levels (ha)		
	European	Regional	Local
Forests	1000	500–1000	50–500
Standing water bodies	100	10	1–5
Running water bodies			
Meadows	100	10–50	1–5
Wetlands	500	10–100	0,5–5
Sand and other open areas	100	10	1–5
Parks and groves	100	10–50	1–10

Table 12. The recommended size of core areas by Estonian report *(Jagomägi and Sepp, 1999)*

Core areas	Average diameter
Global	1000 km
Euro large	300–500 km
Euro	100–150 km
Country large	30–50 km
Country small	10–15 km
Regional large	3–5 km
Regional small	1–2 km
Local first (I)	300–500 m
Local second (II)	100–200 m
Detail plan I	30–50 m
Detail plan II	10–20 m

- the size of natural areas (Figure 13, Appendix 5);
- clusters of valuable single nature objects and objects under nature and archaeological protection (inc. small protected areas);
- environmentally valuable areas (unprotected ground water areas, valuable landscapes etc.);
- constructed core areas in the place of low density of core areas. Planned core areas should guarantee the recommended density of core areas, which differs from region to region.

In Latvia, biocentres were selected according to the following principles:

- the biocentre must possess considerable biological potential, determined not only by the character of neighbouring biocoenoses, but also by its size or by the concentration of different habitats;
- the biocentre must represent all the typical landscapes of Latvia;
- the landscape structure provides connections between the biocentres.

In Latvia, biocentres selected in this manner were tested by comparison with the map of CORINE sites, Important Bird Areas and particularly with a map of protected natural areas. Such an approach allowed corrections to the limits of the core area and is expected to ensure their management in the future without reducing the biological and landscape diversity of the area.

According to Lithuanian methodology core areas should cover territories that contain:

- globally endangered species, endangered species at European level, species listed under categories 1–3 of the Lithuanian Red Data Book;
- species that are declining in numbers (due to various reasons) during last decades (during last 20–50 years);

Figure 13. Core areas in Estonia based on massiveness

- rare, endemic, relict or stenobiontic species in a narrow sense;
- species relevant to a majority of habitats and indicating their quality;
- species not rare in the territory of Lithuania, though rare in other European regions. In this case, Lithuania should contain important proportions of populations of these endangered in Europe species;
- species that during certain periods of their lives has great mobility or make long-distance migrations (anadromic species, diurnal and seasonal migrants; plants distributed through hydro- and zoochoria, etc.);
- representative natural and semi-natural habitats for Europe and the country;
- large ecosystems of European and national importance comprising large enough viable populations of important species;
- natural or nearly natural ecosystems present only in Europe and threatened with degradation or extinction;
- natural or nearly natural ecosystems present only in Europe rare within the continent;
- natural or nearly natural ecosystems characteristic of Europe and globally threatened with degradation or extinction;
- natural or nearly natural ecosystems that are not endangered world-wide, but are highly threatened in Europe. Core zones of regional and local level can be natural, nearly natural or semi-natural ecosystems estimated in the viewpoint of not European, but Lithuanian regions;
- semi-natural ecosystems characteristic exceptionally for Europe and threatened with extinction or degradation;

- ecotopes containing communities listed in Lithuanian Red data Book;
- ecosystems that occupy quite large territories and though containing no exceptional nature values has a potential reserve for their appearing and existence. High heteromorphy of ecosystem types characteristic to these ecosystems allows incorporating them, in one way or another, into system of ecological networks.

From a geographical point of view, core areas of European and regional level first of all have to be created in large enough areas of undamaged or the least damaged landscapes. According to the typology of Lithuanian landscapes, 9 types of little-changed landscapes are the most appropriate for search of such core areas:

- flat poorly-drained moraine loam and clay plains with spruce groves and mixed forests;
- flat poorly-drained clay limno-glacial plains with spruce groves and mixed forests;
- swamp ancient sandy alluvial plains with raised bogs;
- wooded masses of continental dunes in ancient alluvial plains;
- undulating and ridgy sandy ancient plains with coniferous forests;
- swamp sandy outwash plains;
- wooded continental dunes in sandy outwash plains;
- terrace sandy outwash plains with forests;
- very hilly boulder moraine uncultivated landscape.

Golden Eagle (*Aguila chrysaėtos*) needs large natural areas for nesting

Designation of core areas of all levels should cover the following landscape elements:

- undamaged large forest areas and single forests (not segmented, with undamaged surface, natural hydrographical network, without urbanised areas and lines of communication);
- undamaged wetlands with natural bog sides;
- non-regulated lakes with relatively natural catchments (i.e. in catchments, where forest and wetland landscapes prevail and there are no pollution points);
- complexes of natural meadows and shrubland;
- large dunes and other open sands;
- heaps of boulders.

5.5.2. Main principles of designation of ecological corridors

The corridors of ecological networks can be defined on the bases of map analysis by using different criteria and principles. Identification of ecological corridors is usually a second step after designation of core areas, because the location of ecological corridors depends very much on the location of core areas.

In construction the first criterion considered is the situation of defined core areas. Also the general topographical situation as well as the location of competing infrastructures (transport, settlements etc.) play an important role. Starting from the significant core areas and on the basis of additional thematic maps the network is widened to the required level moving from the larger and more significant, to the smaller and less significant. Designation of ecological corridors depends also on existing or historic dispersal and migration corridors, as well as the existing topography of remaining ecosystems and topography of valuable geomorphological and hydrographic elements. In many cases the practical information available about organism movement is rather inadequate. In Lithuanian and Estonian methodology, we can find a list of recommended animal species which can be used for defining core areas and corridors, but only in Lithuania has the list been partly applied. More emphasis was placed on integrated analysis of abiotic factors in distinguishing ecological corridors. Size, form, distances, etc. of landscape elements were discussed separately in Lithuanian and Estonian projects. In Lithuanian methodology different criteria for recommended size, distances from each other etc have been used for each taxonomic category. This would possibly have been easier using differentiation of ecological networks according to types of ecosystems, starting with the general (aquatic, aquatic-terrestrial, terrestrial) and gradually moving to the more specific (forest, meadows, etc.). Baltic reports indicate that, remarkably, corridors as found in nature are not continuous structures, but, nevertheless, do support the movement of species. In reality, corridors also exist in areas of structurally isolated habitats, which migrating species utilise for rest and feeding. These functional corridors are designated as stepping-stones. Stepping stones provide conditions for the

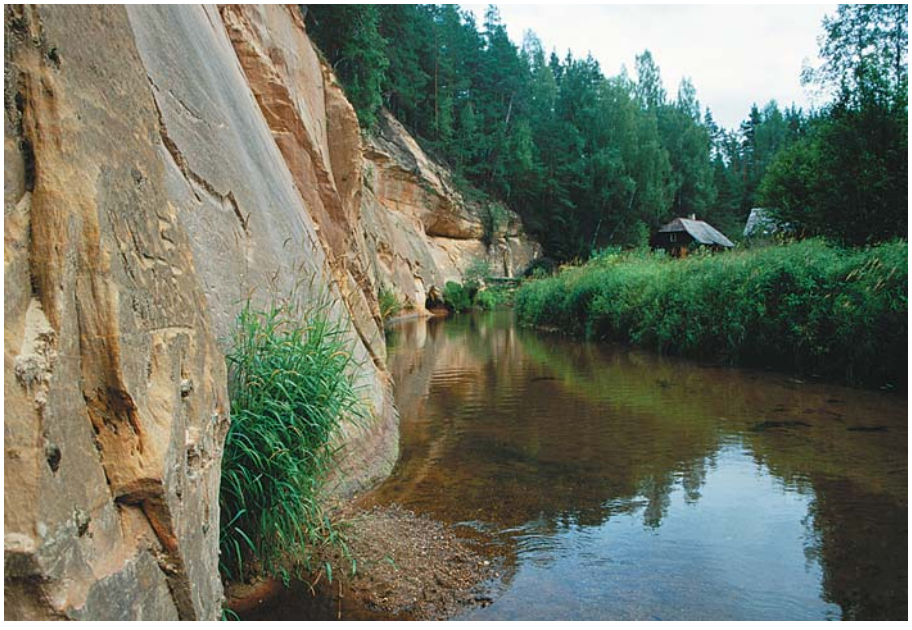
existence of many species of localised food chains and permit richer and more diverse food webs to develop in cultural landscapes. Each functional linking element increases the ecological stability and self-regulation of the landscape. Only in Lithuania are specific landscape elements used by migratory bird species designated at national level as stepping stones.

All three methodologies provide guidelines for the designation of ecological corridors. In principle the guidelines have similarities to those suggested by van Opstal (1999), who recommended consideration of:

- the existing distribution areas of species;
- the historical distribution areas of species;
- the ecological needs of species for which the corridors are established.

In Estonian methodology the following criteria were considered during the pre-selection of corridors:

- the location of core areas;
- the morphometry of natural areas (Table 10);
- corridors created by the implementation of legal Acts (for instance the *Coastal protection Act*, 1995 defines buffer zones for the water network) (Figure 14);
- the location of settlements and other infrastructures (transport etc.);
- relief (location of primeval valleys, river valleys, etc.);
- the landscape characteristics of the area;



The location of primeval valleys is important in designating ecological corridors

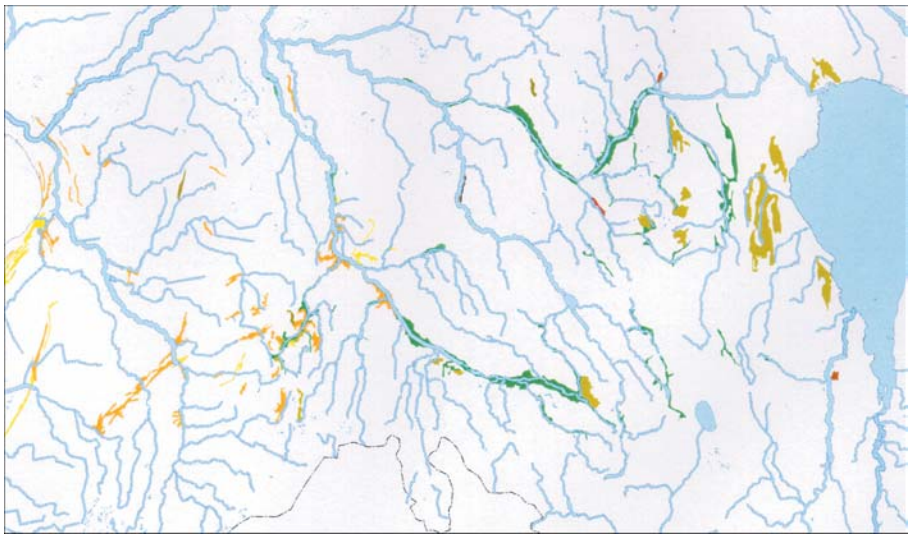


Figure 14. Defining ecological corridors in Estonia

- the location of valued areas from the natural, environmental and heritage point of view;
- the actual or historical presence of species dispersal and migration ways ("dispersal and migration corridors") (see Appendix 6);
- chains of singular and small nature objects which are under the protection or valuable.

In Latvia, corridors include linear corridor structures, as well as structures of mosaic landscapes with 'green islands'. They provide possibilities for the seasonal movement and migration of species, the spread of populations and natural links between them within their natural area of distribution, as well as suitable feeding conditions to maintain population viability. In forming corridors, spatial analysis was conducted of:

- migration routes of salmon fishes;
- bird migration flyways and feeding sites;
- migration routes of dry land species;
- forest belts and elements of mosaic structure within open agricultural landscapes;
- watersheds with wetlands;
- individual structures in the landscape: protective belts in the Coastal Lowlands; suburban woodlands; gardens and parks in towns; avenues and edges between fields in the countryside.

Internationally important corridors in Latvia were distinguished according to Paleo-arctic migratory path of birds, bats, butterflies and dragonflies and according to migration routes of fish species of EU nature conservation interest. Also,

according to set criteria, international networks of ecological corridors should connect all international biocentres.

In Lithuania the designation of ecological corridors was based on following principles: they should connect all core areas, should form a rather even network in the whole territory of the country, should reflect real migration and spread of individuals and species and should foresee directions for possible migration and spread. Ecological corridors were designated based on following criteria (see also Appendix 7:

- data on migration and spread of species provided by experts;
- linear water bodies linking core areas;
- forest massifs (belts) located between core areas;
- relief (hypsometry, slopes of river valleys);
- the most relevant landscape types according to national methodology.

According to their shape, ecological corridors could be divided into corridors having shape determined by landscape characteristics and linear ones. The first group was designated by drawing boundaries on the boundaries of forest massifs and slopes of river valleys. The second group was obtained by linking core areas by the shortest distances. These corridors are important for species that migrate using the shortest distances (e.g. lynx). There are also complex ecological corridors, some fragments of which are determined by landscape characteristics, while other parts are linear. Designated ecological corridors were divided according to different levels, so that core areas of European importance were linked by a network of corridors of European importance.

Ecological corridors were designated using landscape elements and types that from a biodiversity point of view are not as valuable as core areas. However they do provide all necessary conditions for organisms, and directly or indirectly create conditions for the long-term functioning of the ecosystems and populations protected in the core areas. For this reason, the following main requirements have to be met by the ecological corridors:

- habitats in the corridors must have sufficient area in order to provide a refuge for different species;
- distances between the core areas (length of the ecological corridors) should be such that they could be overcome by migrating animals and enable the drift of genes of non-migrating (settled) organisms;
- the corridors should be chosen so that they would not include natural or urban barriers that could prevent the migration of organisms or gene drift.

The designation of ecological corridors is mostly based on the assessment of the present structure of landscape – especially the dislocation of hydrographic elements important for species dispersion and migration, and the topography of ecosystems.

5.5.3. Main principles of designation of buffer zones

Buffer zones should ensure the protection of core areas and ecological corridors. Width, size and configuration of buffer zones are highly dependent on the **sensitivity** of ecosystems and individual species. Prior to designating these zones, it is necessary to assess anthropogenic impact, and on this basis their width, area and configuration is chosen. Habitats of buffer zones can increase the size of core areas, when similar habitats are joined. Buffer zones correct the form of core areas and ecological corridors. They can also serve as corridors (especially when "stepping stones" are present). This not only reduces anthropogenic impact, but also improves the living conditions of species and at the same time creates better conditions for conservation.

Latvian and Lithuanian methodologies suggest general guidelines for the designation of buffer zones. According to Latvian methodology the designation of buffer zones should be based on:

1) the structure of land use;
2) the flow of material and energy;
3) ecological factors. The size of the zone should be determined by landscape, ecological and anthropogenic factors.

Lithuanian methodology provides detailed guidelines for the designation of buffer zones and a long list of factors that should be considered:

- the links of separate species within the environment;
- the sensitivity of ecosystems and species to environmental impact;

Flooded meadows are important buffers

- the origin and intensity of the impact;
- the distance to the source of the impact and the possibilities of its transmission in the environment;
- the specificity of the structures of core areas and ecological corridors (specificity of conditions of existing ecosystems, biotopes and species populations);
- the duration (longevity, seasonal prevalence etc.) of preservation of the structures of core areas and ecological corridors;
- the scale of isolation of the structures of core areas (fully isolated, partly isolated, or just partly softened) from effects of external new negative factors;
- areas should serve the protection of the structures of core areas from potential impacts or recurring change, so that their processes could be normally restored (regulating of hydrological, micro-climatic state, etc.).

5.5.4. Main principles of designation of restoration (re-naturalisation) areas

In a Baltic context (especially in Estonia and Latvia) the designation of restoration areas seems less important. As concluded by Bouwma (1999), there are many areas with high natural values still left, and it is more important to protect what is there than to restore. Only Lithuanian methodology includes guidelines for designation of restoration areas. According to **Lithuanian** methodology restoration areas should be selected by taking into consideration the following:

- restoration areas should ensure normal functioning of ecosystems, support security at all levels of the structures of core areas, as well as their further development. (In future, they can potentially become new core areas or even ecological corridors);
- in order to preserve ecotopes or species in these areas, certain rehabilitation-restoration processes of ecosystems should take place;
- territories contain objects determining core areas, but existing ecological environments are disturbed;
- from geomorphological, hydrographic, and ecological points of view, territories have certain potential value, but currently are highly damaged;
- territories in the buffer zone, that are slowly self-recovering from present damage and will possibly fully recover in future;
- other territories that have potential ecological value.

Restoration areas at European and regional levels in Lithuania can be designated in:

- farming lands of especially low productivity which are very sensitive to anthropogenic impacts with low population density and without significant urbanisation;
- unused anthropogenic flooded meadows and polders.

For the designation of restoration areas at local level (in some cases also regional), the following landscape elements are used first of all:

- abandoned meadows;
- clearances;
- abandoned farmsteads, manor places, parks;
- abandoned quarries;
- abandoned long-term heads in river valleys;
- recovering small wetlands damaged by drainage;
- abandoned peatlands;
- emptied ponds;
- canalised sections of rivers and streams with features of physical and biological renaturalisation, not segmented by urbanisation centres and located upstream significant pollution sources.

When designating buffer zones for core areas, at the highest territorial level, the following landscapes should be included even though they can not ensure the functions of ecological corridors. Because of their geographical location and configuration they do not connect core areas, are not belt-shaped, but are compact territories etc):

- watershed areas of forests and wetlands that are relatively unsegmented;
- areas of slightly damaged forest landscapes of high ecological value with urbanisation points of low intensity;
- sections of optimal agricultural landscape unsegmented by urbanised areas, and areas that have high ecotonality and great abundance of elements to be protected;
- sections of slightly damaged woody landscapes and areas with low diversity of elements to be protected.

For the designation of buffer zones for core areas of high level, the following landscapes should also be used:

- wooded agricultural areas in all landscape types, which act as ecotones and extensive mosaics and are not segmented by continuous urbanisation;
- slightly damaged agricultural landscapes with low diversity of elements worth protection, without points of intensive urbanisation, not segmented by urbanisation.

For designation of buffer zones, the following landscape elements are used first of all:

- extensively used perennial grasslands and shrublands;
- unused agricultural areas with different degrees of anthropogenic modification, damaged forests, quarries with evident features of long-term re-naturalisation;
- protective areas with special purposes (e.g. water protection belts of drainage canals);

- small groves and glades that because of their location, area and configuration, are not suitable for designating core areas and ecological corridors, but are necessary for ensuring the continuity of buffer zones;
- little damaged lakesides and bogsides;
- areas of springs;
- areas of medium anthropogenic change (without urbanisation centres) necessary for ensuring the continuity of buffer zones, in which purposeful regulation of nature use is possible.

5.6. Data sources and technical issues

The methods that can be applied to developing ecological networks depend very much on the data available. According to all three methodologies, the designation of ecological networks is based, more or less, on GIS and existing digital databases. This means that the location of ecological networks, and their structural elements, were identified by overlapping digital maps (containing necessary information), which were stored in different layers in GIS.

The data must cover the whole planned territory and reflect as adequately as possible the ecological, natural and environmental protection values and characteristics of the planned area. Currently the digital map is not obligatory in the Baltic States in the case of planning, but is recommended. The advantage of the digital map is the possibility of making abstracts at a suitable scale of selected parts of map, analysing different map layers, easily correcting defective data etc. Digital maps and the data connected with them, provide simple options for treating and continually renewing data needed for planning.

The databases that were considered to be relevant for the designation of ecological networks were quite similar for all Baltic States. They included CORINE Biotopes and Land-Cover maps, the IBAs database and digital base maps. Information on the diversity of fauna and flora is still incomplete, particularly as regards communities and ecosystems (See Appendix 8). Information on plant and animal species has been collected over a period of years. However it is not complete and does not reflect the current status of flora and fauna. Therefore it was difficult to use data on species in the designation elements of ecological networks.

From databases in ArcView (in Latvian and Lithuanian projects) and MapInfo (in Estonia) maps of environments were prepared and printed out (Figure 15). The borders of core areas and corridors were drawn free hand on the printout. After visual analysis it was decided to designate core areas, dividing them into European and National level. This was done based on methodical recommendations, in which area, naturalness, uniqueness, and sufficient space for the existence of species, are the most important criteria. The borders of the structural elements of ECONET were drawn on easily recognized objects in the field, such

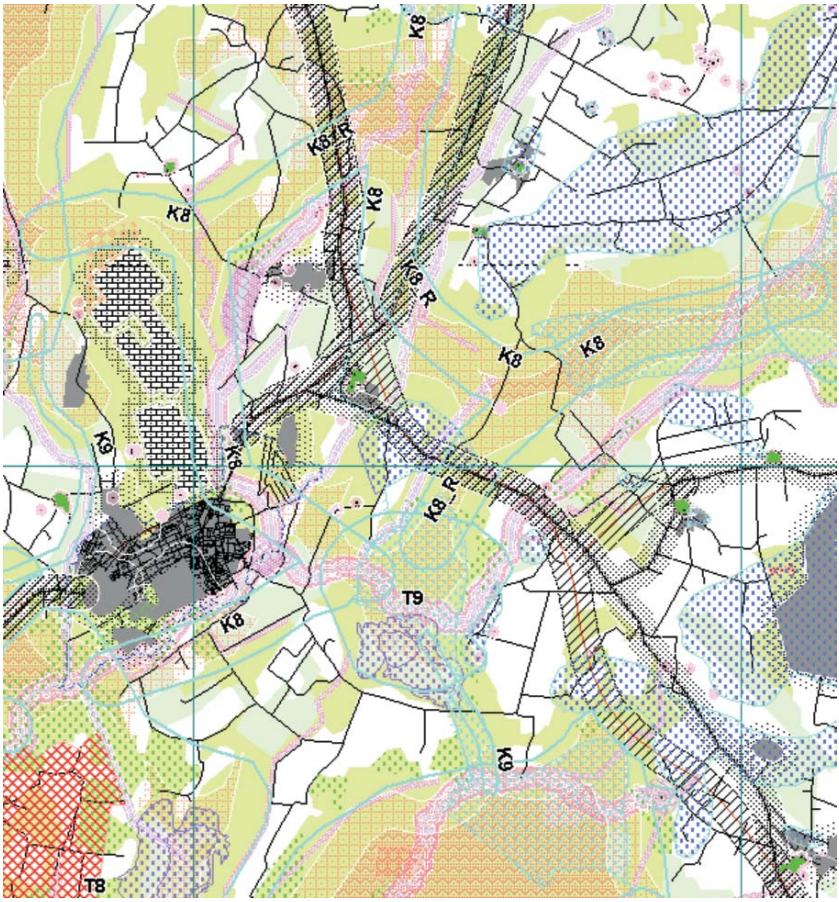


Figure 15. The result of intermediate stage in green network designation forming the basis for composing the final map. Legend of the map see Appendix 9

as roads, ditches, edges of forests etc. The borders of each structural element were made on different criteria. On the basis of the drawings on tracing paper, the borders of core areas and corridors were digitised on the open workspace in the computer, and a related database will be produced. An attributed GIS database was created after digitising and editing the boundaries of the structural elements of the ecological network and creating a topology of objects,. For this purpose, a special coding system was set up (see Table 13 and Table 14) allowing for the grouping of geo-objects to search for information by level, structural element (or its code), number and name. In other attribute fields of the database (*Interests*), information on presence of valuable species or communities in selected structural elements is presented. In other attribute fields (*Species*), information on valuable species is presented (list of species).

Table 13. Structure of GIS database of Lithuanian Ecological Network and coding of geo-objects

Attribute fields / Contents	Code string 5	Index string 12	Number string 7	Name string 75	Interests string 5	Species string 75
Core area of international (European) importance	10	ebr	E1-E29	…	T	…
Biocentre of the core area of international importance	11	ebio	E1b-E29b	…	T	…
Core area of regional (national) importance	20	nbr	N1-N53	…	T	…
Biocentre of the core area of regional (national) importance	21	nbio	N1b-N53b	…	T	…
Ecological corridor of international importance	12	ekr	KE1-KE49	…	T	…
Ecological corridor of regional (national) importance	22	nkr	KN1-KN64	…	T	…
Buffer zone	30	aps	A1-A12	…	T	…
Restoration area	40	atk	R1-R7	…	T	…
Stepping stone core area	50	jbr	JB1-JB10	…	T	…
Stepping stone ecological corridor	51	jkr	JK1-JK29	…	T	…
empty	99	n	n	n	n	n

Table 14. Structure of GIS database of Latvia Ecological

Attribute fields / Contents	Code	Number	Name
Biocentre of international level	11	BE1	…
Core area of the biocentre of international level	10	BE1_1	…
Corridor of international level	12	CE1	…
Biocentre of national level	21	BN1	…
Core area of the biocentre of national level	20	BN1_1	…
Ecological corridor of national level	22	CN1	…
Nature development area located in the biocentre	31	BE1_D1	…
Nature development area located in the corridor	32	CE1_D1	
Stepping stone	40	ST1	…
Empty	99	n	n

Chapter 6

Ecological Networks in the baltic coutries

6.1. National Ecological networks

6.1.1. Estonian green (ecological) network

As the result of the project the implementation scheme at the national level has been prepared and approved within the framework of the Planning and Building Act, by the long-term spatial strategy "Estonia – Vision 2010" (Estonian..., 2001b). The vision contains a chapter on "green networks" and a schematic map of the Estonian green network (see Appendix 10).

Due to the abundance of natural landscapes and landscapes in close to natural condition, the green network in Estonia does not have to be constructed but rather „developed" from reality and perception. As a result, the network is quite large in area, covering more than 50% of the territory. For identification of core areas two criteria were used in this work – the size of the area in natural condition and its conservation value. Core areas of international importance are compact natural areas with a territory of at least 100 sq/km. In Estonia these form 12 major core areas (predominantly forests and swamps). Core areas of national importance are natural areas with a territory of at least 15 sq/km. Major „green corridors" between international core areas traverse the core areas of national importance. Core areas of international importance are so large, guarded by protective measures and in the main located beyond the predictable concentration of economic interests, that there will be few problems with their survival. At a more detailed planning level, attention should be paid to the preservation of core areas of national importance and green corridors useable by wild animals.

The assessment of anthropogenic load on the green network and the study of concurrent conflicts show that strategic problems in the elaboration of the network as follows:

- maintaining the ecological network in the regions of high human activity – in the vicinity of settlements and highways;

- maintaining the continuity of networks in places where highways penetrate large compensatory areas. The issue here is traffic-induced development, which brings about an increase in population density of a comparatively wide corridor.

An important task is in maintaining the continuity of the network in places where major railroads and highways cut into large core areas. Conflicts may be anticipated in the following road sections: Narva road through Lahemaa National Park; Tartu road through central Estonia and Jõhvi-Tartu road through Alutaguse. In the conflict areas, in addition to protective measures, planning solutions must safeguard preservation of the natural condition of core areas and road crossings for wild animals. The environs of major towns, particularly of Tallinn, can be singled out as problem areas where anticipated constraints, resulting from expanding settlement and economic development, necessitate particularly careful planning of the green network and settlement.

The purpose of a national plan is to provide a generalised strategic treatment of the territory of the country, outlining measures for guiding and shaping spatial development of the country, and the setting up of tasks for subsequent activities. The national plan, EESTI 2010, has been approved and the action plan for its implementation adopted by Government Order No. 770-k of 19/09/00.

6.1.2. The Latvia Ecological network

The spatial structure of the ECONET in Latvia is based on analysis of landscape structure, biological values of the given territory and the drainage basins of water-bodies and watercourses. Analysis of landscape structure was conducted with the aim of:

- evaluating differences between landscapes and habitats at the regional and local scale and the factors that affect them;
- identifying landscape structures (matrices, corridors and patches), which are the basis for preserving biological diversity in a given territory;
- describing habitats and species within a given territory in order to identify ecosystems and habitats of national and international importance.

In Latvia, at the regional and the local scale, geomorphology is one of the main factors determining the basic properties of the landscape environment – its ecological character, visual features etc. (Bells and Nikodemus, 2000). Relief affects the diversity of landscapes, their structure and utilisation options. Thus, the character of relief as the determining factor is taken into account in the identification of basic units in landscape mapping (hills, undulating plain landscapes, flat plain landscapes). The next factor considered in mapping Latvia's landscapes is the dominant soil/parent material and its origin (sand, clay, calcareous clay, clay loam and loam). The soil/parent material determines the existing and potential vegetation. The internal structure of the landscape is determined by the character of the landscape cover, depending on the level of cultivation of the

land, with the dominance of either forest or field areas, or with an alternation of field and forest, forming a landscape mosaic.

At the national level, landscape analysis was based on a study of types of landscape lands and landscape areas. In the scheme for dividing the Latvian landscape into regions, landscape lands are distinguished in accordance with the traditional division into natural regions, based on major landforms – uplands and lowlands. They were also distinguished from the transitional belts around them – rises and dips. In other words, the division was based on the division of Latvia's surface relief into plains, hills, ranges of hills and landscapes with undulating relief. The major river valleys were distinguished separately. In order to determine the value of each functional element of landscape and its correspondence to a particular level of the ecological network, each element was analysed according to the following criteria:

- typicality and uniqueness of the habitat on the European, national and regional scale;
- the diversity of abiotic and biotic factors;
- threats;
- size;
- connections with other similar biocentres;
- legal protection.

Optimum locations for biocentres were identified by combining the information obtained in the course of landscape analysis with information about existing natural values. The most stable and valuable ecosystems from the perspective of biological and landscape diversity and the present areas of distribution of rare and endangered species and habitats were also identified.

Analysis of the drainage basins of water-bodies and watercourses is used in analysing species migration and in evaluating the potential risk to rivers and lakes from chemical pollution. Such approach makes possible:

- the completion of the state protected area system;
- the guarantee of stability of the ecological network;
- the planning of a network based on an assessment of biotic and abiotic factors and their functional relationship;
- the estimation of biological and landscape diversity of each landscape unit;
- clarification of optimal steps in setting up ecological network structure.

On the whole, national and international biocentres are located equally throughout the country. Biocentres represent almost all of the landscape types of Latvia, except intensively cultivated and urbanised landscapes.

Biocentres of Latvia can be classified after several features.

At the first, in terms of dominant landscape type, Latvia's biocentres can be classified as:

- coastal landscape biocentres;
- forest landscape biocentres;

- mire landscape biocentres;
- lake landscape biocentres;
- mosaic landscape biocentres;
- river landscape biocentres.

In terms of internal structure, Latvia's biocentres can be classified as:

- biocentres with a simple structure, comprising only one single core area, for example, the Krustkalni Hilly Forest, the Stikli Mire or the Venta River Valley biocentres;
- archipelago type biocentres, which comprise several core areas of one landscape type, for example, the Sauka – Sunakste Swamp Forest or the Aizkraukle Swamp Forest biocentres;
- biocentres with a complex structure, comprising several core areas of different landscape types, for example, the Lake Pape and Nida Mire or the Gauja River Valley biocentres.

Detailed descriptions, including geographical location, conservation status, physical-geographical features, ecological features, reasons for designation and indicator species communities and habitats found in the given area, were prepared for each element of the ecological network. Descriptions of biocentres (Appendix 11) are given mainly according to the information available in the CORINE Biotopes database. Information on Important Bird Areas (Racinskis and Stipniece, 2000), designated and potential Ramsar sites (Opermanis, 1998), HELCOM Baltic Sea Protected Areas (Coastal and Marine Protected Areas in the Baltic Sea Region, 1996), valuable mire areas (Pakalne *et.al.,* 1996). Habi-

Mire landscape biocentre, raised bog

tats are described using the Palearctic Habitat Classification, which was elaborated and used in the CORINE Biotopes project.

The Ecological Network at international level occupies 25% of the total are of Latvia. The Network at national level occupies 18%. The international and national level together occupies 43% of the territory of the Latvia (Table 15) (Appendix 12).

Table 15. The total area of the Ecological network of Latvia

Elements of the Ecological Network	% out of total area of Latvia
International level biocentres	14.1
– core areas	6.2
– buffer zones	7.9
International level corridors	10.6
International level Nature development area	0.1
National level biocentres	3.8
– core areas	0.8
– buffer zones	3.0
National level corridors	14.1
National level Nature development areas	0.2

6.1.3. The Lithuanian Ecological network

Lithuanian Ecological Network is based on Council of Europe *Emerald* and European Union *Natura 2000* networks, as well as the Pan-European Ecological network (*PEEN*). The Lithuanian ECONET, as a part of PEEN, has the following functional and spatial structure: core areas, buffer zones, restoration areas, ecological corridors and stepping stones. The Lithuanian ECONET has three levels: European, regional (national) and local. Designation of structural elements of Lithuanian ECONET was based on criteria of ecological network and application of indicator species, communities and habitats.

The main task was to prepare a map at a scale of 1:200,000. It is a detailed scale, and the map covers the whole territory of the Republic of Lithuania. The map must also reflect guidelines for designing ECONET at a district (local level). For these reasons, the map at a scale 1:200,000 was limited to the structural elements of the European and regional (national) levels. Generalisations were also applied to the design of maps, in order to show geo-objects composing the core areas and the main axes, and directions of ecological corridors, as well as ideas for their designation on the local level.

The map of the Lithuanian ECONET was made on the basis of concepts and principles for the development of Ecological Networks in Lithuania prepared during the phase 1 of this project. Principles and recommendations for develop-

ing Pan-European Ecological Network were taken into consideration as well. The example of the Polish ECONET was analysed in the course of this phase of the project. The Lithuanian national ecological network is composed of 82 core areas (29 core areas of European importance – 746266.03 hectares, and 53 core areas of national importance – 229753.39 hectares), 9 stepping stones core areas (6049.47 hectares), 7 re-naturalisation areas (9746.29 hectares) (Appendix 13). Other elements of the national ECONET include buffer zones (65280.75 hectares), ecological corridors (European ecological corridors – 100753.45 hectares, and national ecological corridors – 440349.80 hectares) and stepping stone ecological corridors (10797.90 hectares). The most valuable parts of the core areas were designated as biocentres (European biocentres occupy 32021.82 hectares and national biocentres – 137.48 hectares).

Detailed descriptions, including geographical location, conservation status, physical-geographical features, ecological features, reasons for designation and indicator species communities and habitats found in the given area, were prepared for each element (core area, corridor etc) of ecological network.

6.2. Designation of national ecological networks at regional level

6.2.1. Methodological aspects of ecological networks on regional level

Three ecological networks at county (district level) were compiled: Kuldiga district – Latvia;

Klaipëda district and Neringa city – Lithuania and Järva county – Estonia. The same methodologies were used for designating ecological networks at county level as in designing the national ECONETs. The digital map and database map at a scale 1:50,000 were prepared using similar data sources. The national ecological network in the pilot area was detailed in this scale. Special provisions of land and forest use (protection belts along water courses, roads, railways, settlements, etc.) were reflected in the designation of the local ecological network.

Pilot areas were selected according to following criteria:

- availability of data sources;
- project administration factors;
- natural factors;
- local political support;
- approved spatial plans.

The development of ecological networks will be hardly possible without public acceptance. It is obvious that the grandiose plans represented by ecological networks cannot be realised by means of restrictive laws without public support. Therefore, the projects at local level aimed at involving people in the ecological

network planning process and making them more aware of the possibilities and options open to them for influencing their surrounding landscapes. The possibility for people getting involved in planning procedures has increased remarkably with the introduction of democracy at the beginning of the 1990s. However, ordinary people are usually not yet aware of what is possible. Therefore, involving different interest groups, whose opinions and views on landscape maintenance differ, was considered to be crucial for the success of the projects.

There are two main groups of actors involved in landscape planning, management and policy. Land-owners or land users are a small, but influential group of people. For land-owners everywhere the landscape is an arena of everyday activities, something that has always been there and always will be. The landscape should be able to provide these people with the income necessary for survival. Therefore economic values of the landscape often define their behaviour patterns. Their major interest is to obtain income/profit/subsistence out of the landscape. Understanding their value systems and behaviour patterns is perhaps the most fruitful way to 'deconstruct' possible landscape changes.

Somewhat less influential, but a very heterogeneous group of actors, might be called 'experts'. This group includes experts, local government officials, politicians, scientists, NGO people etc. They differ from the previous group in that they usually possess no land, but mostly have some kind of specific interest concerning landscape. Some might be interested in creating a reserve, others in promoting tourism, a third in building a dam or cut a forest.

The problem for experts, i.e. those who are responsible for the planning process of ecological network, is how to avoid business. Experts belonging to the second category of actors, have their own clear visions about the values of ecological network. The task of the expert is to combine the values of all of the actors involved, including those of land owners and lay people, without being biased, and to find compromises between different group of interests.

The toleration and recognition of other opinions, and the ability to negotiate and search for common ground with someone representing a completely different or opposing view, is a mandatory requirement for designing ecological network in an open society. A situation must be reached where experts do not view the list of ecological network elements as an authority in its own right, but as an agreement between interested parties. In this sense an ecological network was valuable communication tool in county planning processes. For example in Estonia, where the current project was part of regular county planning, several meetings and seminars where organized. The aim was to increase public support for ecological networks and provide stakeholders with the necessary information. Among the participants were land- owners, foresters, representatives from each local authority and county government, farmers, environmental NGOs, developers and nature conservation specialists.

While planning public campaigns for increasing public support for ecological networks, it is necessary to take into account several aspects. For example, it

seems fruitful to stress the multi-functional nature (e.g. the environmental protection, recreational, etc. purposes) of ecological networks. Initiatives that are intended to increase recreational opportunities, environmental health conditions and life-standards may find greater support from the general public. Biodiversity conservation requirements can be promoted based on "flag-ship species" with a high cultural and public appeal. By protecting such species and their habitats, the habitats of many other (less attractive) species will also be protected. It is also remarkable that many people still believe that protection always entails prohibitions, restrictions and non-activity. However, many important semi-natural habitats and landscapes need management in form of, *inter alia*, traditional farming practices. This kind of training and information also needs to be promoted and disseminated.

6.2.2. Ecological network in Järva county – Estonia

In Estonia the pilot project in Järva county was also the pilot project for the second phase of country planning. In 1999, the Government decree for the second phase of county planning (1999–2002) on defining environmental conditions for the development of land-use and settlement structure, was issued (Government..., 1999). The main tasks of the second phase of county planning include the design of green networks and defining valuable cultural/historical landscapes. By December 2002, each of the 15 counties of Estonia is obligated to prepare a map of ecological networks on a scale of 1:50,000, as one of the layers of thematic spatial planning.

The pilot area, Järva County, is situated in the central and northern part of Estonia and with its area of 2622.8 sq. km, makes up 5.8% of the Estonian territory. The central- and eastern part of Järva County lies on Pandivere Upland and the southern part on Central Estonian Plain. About 9% (more than 24 000 ha) of the county's territory is under environmental protection, but if the Pandivere water protection area is also included, more than half of the territory is covered by protected areas. The largest protected areas are Kõrvemaa Protected Landscape Area and Endla Nature Reserve. Forest occupying 120,000 ha (46% of the territory) of Järva County. Currently there are 54 protected areas and 59 protected single objects in Järva County. From the point of view of species protection it is most important to protect the habitats of I category (*Aquilia chrysaetos, Aquilia pomarina, Ciconia nigra*) and II category species (*Tetrao urogallus*). The main rivers in Järva County are the upper course rivers of the Pärnu, Põltsamaa and Jägala river basins. Järva County is quite poor in lakes which here are relatively small (for example Endla Lake (287 ha), Sinijärv (45.8 ha), Männikjärv (17.6 ha), etc.). There are many protected springs: Aravete springs, Esna springs, Jäneda springs, Roosna-Alliku springs etc. Järva county has 43,537 (01.01.2002) inhabitants, 14 rural and 2 urban municipalities. The biggest towns are Paide (area 1,090 ha, population 9,649) and Türi (area 979 ha, population 6,870).

Ural Owl (*Strix uralensis*)

The objective of planning the green network at a county level is not to define a large-scale 'green surface' and leave unused, but, first and foremost, to guarantee the naturally and environmentally grounded space structure. This is based on the location of different infrastructures and needs analysis, using the conditions and necessary environmental measures of structural elements of the green network, so as to guarantee sustainable development in whole county.

The structural elements of the green network (core areas areas, corridors etc) are defined according to the methodology described in chapter 5. Methodologically it was practical to pay attention to core areas and corridors of four sizes creating a frame for the analysis and inter-level connections (Table 16). The main stages of designing ecological networks in county spatial planning were:

- developing the concept and methodology;
- data gathering and analyses;
- designing the green network;
- analysis of the green network together with other infrastructures, road network, settlements etc.;
- setting restrictions and conditions;
- public hearings;
- correction of design;
- approving the plan.

Morphometric indicators (area, diameter and shape) were considered when ascribing initial stages to the areas. Next came the value of the objects situated there. A sophisticated structure of signs demanded great skill and practice in

map reading and parallel computer inquiries, while computing the value of areas. The analysis moved from the more general to the more specific. First, the biggest core areas were determined and marked (1T); after that 2T, 3T and 4T core areas. After distinguishing core areas, corridors between the core areas were or will be specified.

Table 16. Relations between hierarchical levels and stages of core areas and corridors

Sign	The stage of green network	The range of area	Index of core area	Diameter of core area	Index of corridor	Diameter of strip-like structures
G_6	County big	100... 150 km	1T	30–50 km	1K	10... 20 km
G_7	Country small	30... 50 km	2T	10–20 km	2K	3... 5 km
G_8	District (county) big	10... 15 km	3T	3–5 km	3K	1... 2 km
G_9	District (county) small	3... 5 km	4T	1–2 km	4K	300... 500 m

On the basis of drawings on tracing paper, the borders of core areas and corridors will be digitised on the open workspace of the computer, and a related database formed. Every polygon is given an ID, a preliminary name and a range of structural elements.

In the Estonian project, because the pilot area was a part of regular spatial planning of the county, necessary land use conditions and limitations were also set (restrictions, codes of practice, environmental measures, regimes etc.). While planning the green network, it is important to determine and reach agreement on the list of land use conditions which apply. This should include their planning context and their content, which should be acceptable to different interests groups and politicians and which follow the traditions of management of the environment. Generally the conditions of use can be treated as:

- restrictions, which are directed to anticipate and resolve the conflicts resulting from the operation of the green network;
- requirements to change the intensity and restrictions of activities;
- opposition from conflicting interests and activities, which tend to reduce effectiveness and wholeness;
- measures to solve or reduce conflicts and antagonisms, which deal with the functioning of the green network.

During the discussion about the methodology of the green network it transpired that the list of conditions of use, obvious and respected by public, was missing and was, in essence, the example list. This meant that the specifics of a thematic plan had to be developed while composing the methodology. It relied above all on the possibilities and planning traditions prescribed in legislation. It was considered that the elements of a green network at county level are mostly within

large areas so that their conditions of use need to be formulated with sufficient generalization. At the same time the necessary constructive detail level had to be considered (see Appendix 14).

In the pilot area, the structure and functioning of the green network can be considered good at present. There are only a few areas where one or another green network element needs to be established, strengthened or reconstructed. In most cases we tried to preserve the existent structure and condition of structural elements with planning. In the thematic planning of the green network in Järva, County attention focused on aspects that guarantee the functioning of the network, and which most of all, influence the probable or defined changes.

6.2.3. Ecological network of Kuldiga District – Latvia

Landscape diversity in Kuldiga District at the regional level is a consequence of its geographical location between the Coastal Lowlands and the uplands of Kurzeme (West Kursa and East Kursa Uplands), the prominent valleys of the Venta and Abava, as well as the historical development of the area.

The West Kursa Uplands show a considerable variety of natural conditions. Dominant in the Alsunga-Edole area (Kurmale Hills), in the Laidi-Sieksate area (Bandava Hills) and the Embute area are hills and ranges of hills of medium height. The western part of the West Kursa Uplands forms the well cultivated Apriki Plain.

Plains dominate the Kursa Lowlands, forming the central part of Kuldiga District. Up to the early 1990s, no major changes were observed in the forest landscape, but with changing economic conditions great changes are now occurring. Logging and the transport of timber is leading to ecological and visual degradation of the forest landscape. Major historical changes took place in the landscape of Kuldiga District during the Soviet era, when land improvement work was undertaken on both agricultural land (65% of all agricultural land) and forest land. As a result, fields were amalgamated and roads and drainage ditches divided up the forest landscape. In many landscapes, the characteristic linear structural elements of the historical landscape (roads, avenues, lynchets etc.) disappeared, and the mosaic landscape characteristic of Latvia was significantly altered. The disappearance of the mosaic landscape in mixed forest/farmland areas hastened the invasion of fields and pasture by woody species, resulting in marked simplification of the landscape. At the present day, a typical mosaic landscape remains only in the landscape areas of the West Kursa Uplands in the Edole Hills and Central West Kursa Uplands Hills.

The Rivers Venta and Abava, and their tributaries, are very important for the landscape cover of Kuldiga District. These include landscape elements preserved over many centuries: hillforts, castle complexes, manors, churches, the structure of individual farmsteads, country and forest roads, and the many small graveyards on hills, characteristic only of Kurzeme. In terms of its culture-his-

torical landscape elements, Kuldiga District is one of the richest and most interesting districts of Latvia. The utilisation of these landscapes in the Soviet era coupled with present day issues of unclear land ownership and lack of finance, has led to a situation where most of them are in a critical condition, and their degradation is continuing.

As the national methodology was derived from testing the chosen planning approach at regional level, there is no differences in the ECONET planning process between national and regional level. The planning of the structure of the ecological network for Kuldiga District made use of the same methodological approach as the planning of a national-level structure, except in greater detail. Landscape analyses were made using the landscape space level. 'Landscape space' is the 3rd and most detailed level of Latvia landscape classification. Landscape space is similar to landscape area – land cover type and structure, in areas where land-cover is the dominant feature of the landscape and geomorphological features, where earth surface forms dominate, but in greater detail than in landscape areas.

Information on Specially Protected Nature Territories, Important Bird areas, CORINE Biotopes sites and Salmon rivers, were used in the designation elements of ecological networks. Information on Specially protected forest sites, not accessible to the planning of national level networks because of lack of data, were also used. In addition accessible, but unmapped information on the distribution of plant, bird, mammal and invertebrate species beside the protected areas, was used.

Black Grouse (*Tetrao tetrix*)

The elements of the structure (biological centres, corridors) were classified into different levels of importance – international, national and regional – based on the importance of habitats or landscapes (extent, level of biological and landscape diversity, representativeness and uniqueness, the occurrence of endangered and rare species, culture-historical importance, the ecological functions of landscape elements or landscapes and other factors).

Ecological network in Kuldiga District (Appendix 16)

National level biocentres in Kuldiga District include landscapes with a high degree of biological and landscape diversity. Kuldiga District has three national level biocentres, characterised by continuous forest, major rivers and large lake landscape – Mengenes forest biocentre [BE 8] and river landscapes – Letiza and Skervelis River Valley biocentre [BE 5], Venta River Valley biocentre [BN 2].

National level biocentres in Kuldiga District cover 5% (Table 17) of the total area of the district, approximately one third of which belongs to core areas. Almost all of the national level biocentres, except Venta River Valley biocentre, meet the criteria for inclusion in the European national network.

The hydrological net of Kuldiga district is so well developed that almost all corridors consist of salmon rivers. Corridors of mosaic landscape and structures with 'green islands', providing for species seasonal movement and migration, are designated only in the regional level ecological network. The corridors of the River Venta [CE 10, 11, 12, 13] and the River Abava [CE 19] are designated at European level. The valleys are characterised by considerable biological and landscape diversity and are important for salmon migration. These corridors also connect important international level biocentres.

In Kuldiga District, national level corridors cover 12% of the total area of the district (Table 17). Regional level biocentres and corridors in Kuldiga District were selected according to the same principles and criteria as nationally important biocentres. In many cases, nationally important corridors include biocentres of regional importance. Regional level biocentres in Kuldiga District occupy 2% of the area of the district, while regionally important corridors take up 13%.

Findings from current project are included in a Kuldiga District Spatial Plan.

Table 17. The total area of ecological network in pilot area

Elements of the Ecological Network of Kuldiga district	% out of the total area of the district
National level core areas	5
National level buffer zones	13
National level corridors	12
Regional level core areas	2
Regional level corridors	13

6.2.4. The local ecological network of Klaipėda district and Neringa city – Lithuania

The pilot area – Klaipėda administrative district is situated in western part of Lithuania, on the Baltic Sea coast. Its area is 1377.5 sq. km. The district lies in Nemunas delta and West Žemaičiai Plains and West Žemaičiai Plateau. The area is quite homogenous, with relief of medium large hills on the West Žemaičiai Plateau. The central and western part of Klaipėda district is a flat plain that occupies almost half of the area. The relief of the river valleys is the most dynamic. Up to 30–40 m per hectare per year of soil can be removed. In other places, vulnerability to erosion is not great. The density of the river network is not high and can reach up to 1 km/km^2. Forests occupy 20.8% of the Klaipėda district, which is lower than the national average.

The area contains few natural inland waters, except rivers and streams. Ponds formed due to the damming of rivers and lakes or in quarries also contribute to the number of open inland waterbodies. In total, there are 11 lakes, 29 ponds and 24 rivers in Klaipėda district. Rivers and streams of the Klaipėda district lie within the basins of one of 3 rivers: Minija, (middle part) Akmena-Dangė (lower part) and Smiltelė (the whole basin). The King Vilhelm canal dug in the end of the 19th century and located in Minija and Dreverna rivers' basins, is worth mentioning separately. In the Middle Minija basin, almost all streams are natural. It contains the particularly important basin of Veiviržas. The lower Akmena--Dangė basin is distinguished by a small number of tributaries, while almost the whole of the Smiltelė stream is canalised and only part of it remains natural.

There are several protected areas in Klaipėda district and Neringa city. These are Curonian Spit National Park, Pajūris Regional Park, Lūžija Botanical Managed Reserve, Svencelė Telmathological Managed Reserve, Minijos Senslėnio Landscape Managed Reserve, Veiviržas Landscape Managed Reserve, Veiviržas Ichthyological Managed Reserve, Minija Ichthyological Managed Reserve, Graumena Hydrographic Managed Reserve and Ablinga Geomophological Managed Reserve. The district contains the third largest Lithuanian city, Klaipėda, with its seaport. Other major towns are Gargždai (the administrative district centre) and Priekulė. In Neringa city, 4 towns are found: Nida, Juodkrantė, Pervalka and Preila.

For the designation of local Ecological networks, the same methodology was used as in designing the national ECONET. The digital map and database map at a scale 1:50,000 was prepared using similar data sources (Appendix 17). The national ecological network in the pilot area was also detailed at this scale. Special provisions of land and forest use (protection belts along water courses, roads, railways, settlements, etc.) were reflected in the design of the local ecological network.

The local ecological network in Klaipëda district and Neringa City comprises 43 core areas (224323.19 hectares), 7 renaturalisation areas (1153.87 hectares),

8 stepping stones core areas (1195.57 hectares). Ecological corridors occupy 7765.73 hectares, buffer zones – 18686.19 hectares, stepping stones ecological corridors – 515.91 hectares. The total area of the ecological network is 253640.46 hectares. This represents 34.93% of the area of the district. The ecological network comprises 70% of existing protected areas.

Chapter 7

Conclusions

This project allows the following conclusions to be drawn:

1) The rapid growth of international attention concerning ecological networks, and intensified communication in the 1990s, has triggered off the harmonization of national concepts into internationally accepted approaches (EECONET, PEEN). Additionally, country-specific terminology related to ecological networks used during the last decade, has changed into a more universal language, especially in spatial planning and nature conservation practice.
2) Compared with western Europe, the natural preconditions for a well-functioning ecological network in the Baltic States are fairly good. Based on information provided by national biodiversity reports, the national biodiversity indicators are high in all Baltic States because of diverse natural conditions. Because of the low population density and inhibited economic growth during the Soviet period, biodiversity is remarkably well preserved. In Estonia and Latvia vast natural areas (forests and wetlands) still exist, and in all Baltic States anthropogenic impacts have not yet affected the areas of high biodiversity value to the same degree as in western Europe.
3) All three Baltic States have long-term traditions in classical nature conservation and have established extensive protected areas systems. Re-evaluation of existing protected areas systems in a European (and global) context may require a certain shift from the conservation of local rarities to the maintenance of viable ecosystems (wetlands, forests, coasts) and populations of international importance. Also, nature conservation principles and protected area systems need rearrangement as a result of current changes in ownership and economy.
4) Existing national approaches: Estonian "network of ecologically compensating areas" and Lithuanian "nature frame", are accepted as among the first analogous concepts to those in Western Europe. They represent multi-functional approaches to ecological networks. Built on the networks of protected areas (as core areas of the ecological networks) and interlinked by natural

Coastal meadow

and semi-natural landscapes, they were designed both to support the maintenance of valuable habitats and the migration and dispersal of species. Although the Baltic approaches are not totally compatible with the ecological network in a Pan-European sense, (European nature conservation priorities have not been (sufficiently) considered in their designation) the theoretical and methodological experience, and planning traditions provide strong bases for further actions.

5) National legislation supports (but so far insufficiently) the establishment of ecological networks in the framework of the PEEN. In the Baltic States the development of ecological networks in the framework of the PEEN is closely related to accession to the EU, requiring approximation of national nature conservation legislation with relevant EU directives (mainly the Habitat Directive and Bird Directive). Several international nature conservation conventions and programmes set additional requirements for the development of ecological networks. Areas designated under international conventions (Emerald sites, Ramsar areas, BSPAs) and programmes (IBAs, CORINE Biotops) should be included in national ecological networks.
6) In Estonia the concept of ecological networks (network of compensating areas) is embedded in the spatial planning legislation, though the system through which these networks will be preserved and maintained, is not fully established. However, new legislation and environmental policies (the Estonian National Environmental Strategy, the Estonian Environmental Action Plan and "Estonia – vision 2010" as a long-term strategy) gradually tend to extend the support for establishing and maintaining ecological networks at

all of their hierarchic levels. In Estonia the second phase of county planning (period 1999–2002) includes also the designing of green networks at county level. Consequently, by the end of 2002 each of the 15 counties must prepare a map of ecological networks as one of the layers of spatial planning.

7) The concept of the Lithuanian national ecological network was the first work of this kind in the country. Principles and criteria for the designation the network allowed its inclusion in the Master plan of Lithuania. The map with a database, contains valuable information about important natural areas and their natural links. The results of this project received very positive evaluation from the Ministry of Environment, and hopefully will be implemented in the near future.

8) The implementation of an ecological network in Latvia is linked to the preparation and approval of physical plans at various levels. The provision of physical plans in Latvia is envisaged by the Cabinet of Ministers Regulations No. 423. on Physical Plans (5.12.2000.). Article 2 of the Regulations states that 'the physical plan as approved and passed represents the legal basis for decision-making with regard to land use'. The preparation of physical plans in Latvia takes place at national, regional and local level. The regulations stipulate that the ecological network must be included in physical plans. Presently, the inclusion of the ecological network into physical plans is hindered by:
   - lack of political will to implement the ecological network;
   - lack of clarity regarding the use of areas included in the ecological network (legal aspect);
   - insufficient compensatory mechanism for landowners who manage their properties in accordance with the requirements for maintaining landscape and biological diversity;
   - lack of specialists familiar with ecological network planning methodology.

9) The maintenance of ecological networks is necessary for ecologically balanced development within Baltic States, as well as for the implementation of principles of sustainable development, the maintenance of landscape and biodiversity and the application of the European Habitat and Bird Directives (Natura 2000 areas). The development of National Ecological Networks provides a tool for setting priorities for the protection of biodiversity, and the start of integration of general and cross-sectoral policies. It also begins the application of the concepts of European and Regional Ecological Networks.

10) The designation of national ecological networks in the Baltic States is based on both existing approaches and landscape planning traditions, and international obligations related with EU Habitats and Birds Directives, nature conservation conventions and other agreements. Therefore, national networks differ slightly between each other: Latvian and Lithuanian networks were established for bioecological and ecostabilising purposes, while the Estonian approach tries to integrate bioecological, environmental and landscape aspects in the designation of ecological networks.

11) According to all methodologies the development of ecological networks is a process in which several sequential stages can be distinguished:
   - the analysis of initial nature conservation problems;
   - the identification of well-defined objectives for the network;
   - the definition of the methodological approach for the designation of ecological networks and the criteria for the identification of its structural elements;
   - the analysis of existing databases, identifying the location of relevant data and possible gaps;
   - the identification of potential core areas and ecological corridors, and buffer zones and restoration areas if needed;
   - the designation of an implementation strategy.

12) The criteria for designation of ecological networks (and its structural elements) took into account both common criteria and guidelines for the establishment of PEEN and the natural characteristics of the Baltic States. For the designation of core areas, the qualitative criteria of naturalness and biodiversity together with size criterion were used. Location and character of ecological corridors depended on the location and habitat character of core areas. The designation of restoration areas is considered less important in Baltic States (especially in Estonia and Latvia). As a result improved criteria and methodologies have developed, so that the coherence of conservation actions across Baltic has strengthened.

13) According to all three methodologies the designation of ecological networks is based, more or less, on GIS and existing digital databases. The databases that are considered to be relevant for the designation of ecological networks include similar databases for all Baltic States such as CORINE Biotopes and Land-Cover maps, IBAs database, digital base maps, etc.; or specific databases on distribution of species and habitats, etc. However, the projects revealed some problems. The first is related to the designation of the network, particularly ecological corridors. There is insufficient data on the migration of animal species, especially large mammals, in Lithuania, Latvia and Estonia. Therefore, the landscape approach on the national scale was mainly used for the designation of corridors. However, in future species migration routes should be considered while designating ecological corridors.

14) Baltic cooperation in the development of ecological networks (at all levels) between governmental and non-governmental institutions was beneficial for several reasons, but especially for the exchange of ideas and experience, and for considering aspects of regional and transboundary compatibility. The establishment of ecological networks is practically impossible without public support or against people's will. Therefore, public awareness and the dissemination of information among all stakeholders is a crucial factor for successful implementation of ecological networks.

Ecological networks do not recognize borders between countries. But in methodologies transboundary compatibility should be considered

15) The challenge of the ecological network approach is to integrate ecological principles, biodiversity and landscape conservation requirements into spatial planning procedures, as well as to other land use practices. At the same time the lack of coherence between policies for nature conservation and spatial planning, represents a key impediment for the implementation of the ecological network in Baltic States. There is an urgent need for the elaboration of an integrated cross-sectoral implementation strategy for ecological networks in the Baltic States.

16) Adoption of the ecological network approach makes it possible to emphasise, appreciate and purposefully employ the broadly environment-shaping impact of protected areas as well as of areas in natural or close-to-natural condition. Additional possibilities are created of balancing the harmful influence of society on nature, taking account of the conservation interests and the requirements of natural biotic communities. Opportunities for generating a highly valuable living environment will improve.

17) For the future development of green corridors and ecological networks, as a strategy for developing and maintaining multi-functionality in the European landscape, we can draw some conclusions:
- implementation of green corridors ecological networks at all levels is possible through the integration of nature conservation objectives into the economic sectors of agriculture, forestry and tourism;
- instruments for implementation should be developed especially at the local and regional levels, the landscape is the integration level;

- we can learn much from European experience and exchanges; it is important to exchange and share experiences and disseminate results;
- trans-disciplinary research programmes are important contributions towards understanding the value and function of landscape diversity, its perception and the conservation of nature within Europe.

18) Key Results of applying the Ecological Network approach in Spatial Planning to
- establishing an inter-linked territorial structure of valuable areas include:
- minimising loss or damage to areas of biodiversity and landscape importance;
- integrating conservation and environmental measures and instruments;
- promoting nature conservation outside protected areas;
- contributing to a sustainable development strategy;
- minimising future conflicts of interest and costs of restoration;
- integrating different sectors through spatial planning;
- detecting potential conflict areas (i.e. precautionary principle) earlier;
- preventing loss or damage to potential Natura 2000 sites;
- key contributions to a sustainable development strategy for Europe;
- minimising future conflicts of interest;
- raising the profile of Candidate Countries' contribution to European natural heritage;
- augmenting national and foreign support for biodiversity priorities;
- supporting international and transboundary co-operation and
- offering the possibility of nature-friendly management, living style and recreation, as we as ensure spatial accessibility of natural areas,
- guiding of settlement and land use.

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Appendix 1

General biodiversity information in the Baltic States

Table 18. Number of natural species and distribution of categories under protection in Estonia *(Külvik, 1996; Sepp and Mikk, 1998)*

Group	Recorded Number of Species	Under monitoring procedure	Protection Category		
			I	II	III
FLORA					
Vascular plants	1,560	X	22	122	41
Bryophytes	525	X		23	2
Lichens	786				
Algae (+Cyanobacteria)	2,500	X			
FUNGI	3,461				
FAUNA					
Vertebrates					
Mammals	64	X	2	15	12
Birds/breeding	332/222	X	7	36	179
Reptiles	5	X		1	4
Amphibians	11	X		4	7
Fishes	74	X		2	2
Invertebrates					
Arthropoda	12,000	X			26
Molluska	155	X	1		
Bryozoa	7				
Annelida	143	X		1	
Priapulida	1				
Nemertini	4				
Nematelminthes	451				
Plathelminthes	304				
Ctenophora	1				
Coelenterata	8				
Porifera	3				
Protozoa	346				

Table 19. Number of Wild Species and Their Status in Latvia *(LMEPRD and UNEP, 1998)*

Taxon	Number of Described Species	Number of Additional Estimated Species	Number of Species in the Latvian Red Data Book
FUNGI	4,000		38
PLANTS			
Vascular plants	1,678		320
Ferns	49		23
Mosses	497		203
Lichens	492		34
Algae	2,680		
ANIMALS			
Vertebrates			
Mammals	69		19
Birds	320		79
Reptiles	7		4
Amphibians	13		5
Fishes	95		15
Lampreys	3		
Invertebrata			
Protozoa	~200	140	
Spongia	5		
Cnidaria	7		
Ctenophores	1		
Nematelminthes	~450	1500	
Plathelminthes	~280		
Annelida	90	350	1
Mollusca	178	11	29
Crustacean	280	30	2
Arachnida	1,000	5,000	4
Insecta	15,000	5,000	131
Myriapoda	40		
Bryozoa	8		
Linguatulida	1		
Tardigrada	?	50	
TOTAL	18,047	12,081	907

Table 20. The Number of Plant and Fungi Species in Lithuania *(EPMRL, 1998)*

Systematic Categories	Number of Known Species
PLANTS	
Flowering Plants (*Magnoliophyta)*	1,328
Coniferous Plants *(Pinophyta)*	3
Club Mosses (*Lycopodiophyta*)	7
Horse Tails (*Equisetophyta*)	8
Ferns (*Pteridophyta*)	21
Mosses (*Bryophyta*)	320
Liverworts *(Hepaticae)*	106
Horn-mosses (*Anthocerotae*)	3
Total	**1,796**
FUNGI	
Myxomycota	120
Zygomycota	100
Chytridiomycota	30
Ascomycota	700
Basidiomycota	2,500
Deuteromycota	2,200
Lichens	400
Total	**6,050**

Table 21. Number of Wildlife Species in Lithuania *(EPMRL, 1998)*

Systematic Categories or Animal Groups	Exact or Approximate Number of Species Known
Mammals (*Mammalia*)	70
Birds (*Aves*)	321
Reptiles (*Reptilia*)	7
Amphibians (*Amphibia*)	13
Fishes (*Pisces*)	96
Cyclostomata	3
Insects (*Insecta*):	~15,000
Dragon-flies (*Odonata*)	57
Hymenoptera:	
Braconidae	~200
Ichneumonidae	~450
Digger wasps	145
Dipterous (*Diptera*)	~2,000
Moths (*Lepidoptera*):	2,217
daily butterfly	1,200
Microlepidoptera	1,017
Beetles	1,800–2,200
Ants	>40
Arachnids	~200
Mollusks	~170
Rotatoria	300
Porifera	6

Table 22. Number of Species Listed in the Lithuanian Red Data Book *(EPMRL, 1998)*

Groups of Organisms	Number of Species
PLANTS	
Flowering Plants	184
Gymnosperms	1
Pteridophytes	10
Mosses	11
Stoneworth Algae	4
Total	**210**
FUNGI	
Micromycetes	68
Macromycetes	13
Total	**81**
ANIMALS	
Mammals	18
Birds	67
Rodents	2
Amphibians	3
Fishes	6
Cyclostomata	1
Mollusks	4
Insects	102
Crustaceans	6
Gnathobdellae	1
Total	**210**
Total	**501**

Appendix 2

Categories of protected areas in Estonia (Act on Protected Natural Objects 1994)

National Park

Objective: a protected area of special national importance for the preservation, protection, investigation and promotion of awareness of the natural and cultural inheritance. It includes ecosystems, examples of biological diversity, landscapes, national culture and is subject to sustainable nature management.

Zones: strict nature reserves[1], special management zones[2] and limited management zones[3].

Designated by the Parliament.

Nature Reserve

Objective: an area protected for its nature conservation or scientific value set aside for the preservation, protection and investigation of natural processes and endangered or protected plant, animal and fungus species and their habitats, inanimate objects, as well as landscapes and natural monuments.

Zones: strict nature reserves and special and limited management zones.

Designated by the Government of Estonia.

Protected landscape

Objective: an area of natural or cultural heritage value, which is rare or typical for Estonia and is established for nature conservation, cultural or recreational

[1] A strict nature reserve (corresponds to IUCN management category I) is an area of land or water in its natural state and free from the direct impact of human activity, where preservation of natural associations resulting only from natural processes is guaranteed.

[2] A special management zone (corresponds to IUCN management category IV) is an area of land or water protected to preserve the resulting or created natural and semi-natural associations.

[3] A limited management zone (corresponds to IUCN management category V) is part of a protected area used for economic purposes where the restrictions established by the authority, which has taken the object under protection, must be taken into account.

purposes. Parks, arboreta and botanical gardens, which have been taken into protection, are also considered protected landscapes.

Zones: special and limited management zones.

Designated by the Government of Estonia.

Programme area

Objective: managed under a local, national or international program for monitoring, investigative or educational purposes as well as combining conservation and management of natural resources.

Zones: strict nature reserves, special, limited and general management zones.

Designated by the Government of Estonia.

Appendix 3

Categories of protected areas in Latvia (LMEPRD and UNEP, 1998)

State Nature Reserves

Objective: preservation of untouched, or minimally changed by human activities, areas, to protect and study rare or typical ecosystems or their components.

Zones: strict regime zone, regulated regime zone, buffer zone.

National Parks

Objective: to protect nature, preserve cultural and historical heritage, as well as to organise scientific research, education and recreation which is restricted, due to the objective of protecting nature and cultural surrounding.

Zones: strict regime zone, restricted nature zone, landscape protection zone, cultural/historical zone and neutral zone.

Nature Reserves

Objective: preservation of areas which are minimally changed or altered in specific respects by human activity, rare and endangered species, cultural landscapes characteristic or unique to the various regions of Latvia, or exceptionally beautiful places in nature.

Nature Parks

Objective: representation of a district's natural, cultural and historical characteristics and provision of opportunities for public recreation and education.

Zones: not determined, but may be designated.

Natural Monuments

Protected Landscape Areas

Objective: to preserve peculiar or diverse landscape and particular beauty, to protect and preserve the cultural surroundings and landscapes characteristic for

Latvia in all their diversity, as well as to ensure the preservation of an environment suitable for public recreation and tourism.

Zones: not determined, but may be designated.

Biosphere Reserve

Objective: to ensure preservation of the biodiversity of nature and promote a sustainable social and economic development of the territory.

Zones: restricted nature zone, landscape protection zone and neutral zone.

Appendix 4

Categories of protected areas in Lithuania (Law on Protected Areas 1993, currently being amended)

Conservation areas, in which unique or characteristic natural or cultural landscape complexes, features and biodiversity are protected. In these areas, economic and recreational activities shall be either limited or prohibited with respect to the protection objectives. This category shall include strict reserves, managed reserves and protected landscape features:

Strict reserves, among them small strict nature reserves, set up for the protection and investigation of natural or cultural Lithuanian landscape complexes which are valuable from the scientific point of view. Economic activities shall be prohibited there;

Managed reserves, set up for the protection of natural and cultural heritage complexes, ensembles and localities valuable from the scientific and cognitive points of view. Economic and recreational activities shall be regulated and limited there.

Protected landscape features: individual or compact groups of elements of natural or cultural heritage to which a specific protection regime is applied due to their scientific, historic, artistic or cognitive value.

Preservation areas, in which certain types of economic, recreational and other activities shall be limited with the aim of avoiding adverse impacts upon protected nature and cultural heritage complexes and features, or avoiding negative impacts of anthropogenic origin upon the environment. Protection zones are attributed to this category.

Recuperative areas are those in which economic, recreational and other activities shall be limited and regulated for the purpose of the recuperation, increase and protection of natural resources. Protected natural resource sites shall be attributed to this category.

Integrated protected areas shall be protected integral-purpose areas in which conservation, preservation, recreation and economic zones are combined according to an integrated protection, management and use programme. State parks

(both national and regional) as well as biosphere monitoring areas (biosphere reserves and biosphere grounds) shall be attributed to this category:

State parks, set up in areas valuable from the natural and cultural points of view for which an organisational structure shall be developed to implement programmes for their protection, management and use;

Biosphere monitoring areas, set up for the purposes of organising global and regional ecological monitoring and nature protection experiments by applying a special protection regime provided by a scientific programme.

Lithuanian nature frame. The purpose of the nature frame is as follows:

to create an integral system of natural ecological compensation zones and ensure natural connections between areas of conservation and protection, and protected areas of recuperative and integrated purpose;

- to protect natural landscape and recreational resources of nature;
- to provide conditions for forest restoration;
- to optimise the agrarian landscape structure from the geoecological point of view and to control the development of agrarian activities;
- to control the urban and anthropogenic landscape development.

Appendix 5

Selecting core areas on the ground of size in Estonia

Selecting core areas on the ground of size requires suitable primary information and computer data processing, e.g. generalisation of graphical elements, generating buffers, uniting thematic layers, generalisation of data and identifying massifs. The first step is to define potential areas suitable for the green network. This can be based on grouping CORINE land cover types (Table 23).

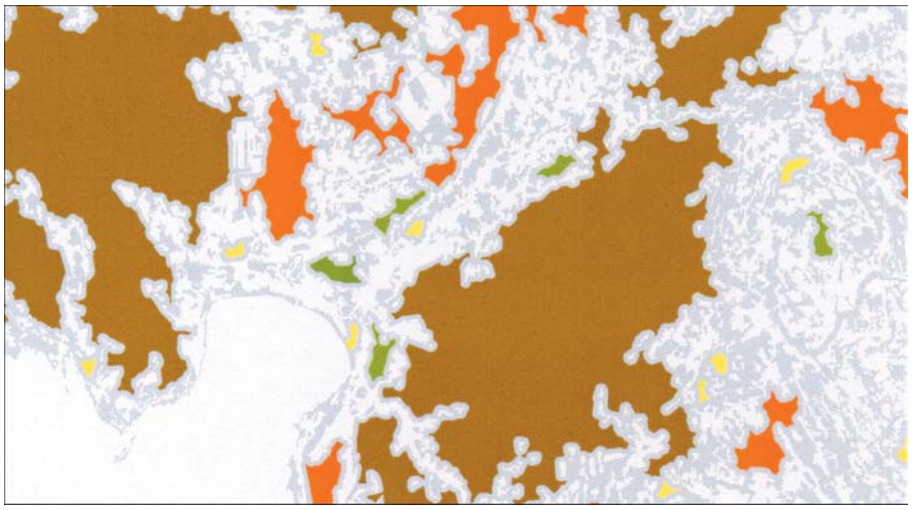


Figure 16. Core areas defined by size (brown – international core areas; red – national core areas; green – county large core areas; yellow – county small core areas)

Next stages in distinguishing massivs of natural areas are:

- separating small glades (small field areas, less than 20 ha) from extensive forests or complexes of natural areas;
- erasing of small forests;
- choosing by the criteria of size and determining the hierarchy of core areas:

National-large the diameter of core areas 30... 50
National-small the diameter of core areas 10... 20
District (county) large the diameter of core areas 3... 5
District (county) small the diameter of core areas 1... 3

Table 23. CORINE land cover classes and green network

Code	Class of land use	Green network	
		Suitable areas	Exclusive areas
Artificial surfaces			
111	Continuous urban fabric		+
112	Discontinuous urban fabric		
121	Industrial or commercial units		+
122	Road and rail network and associated land		
123	Port areas		+
124	Airports		+
131	Mineral extraction areas		
132	Dump sites		+
133	Construction sites		+
141	Green urban areas	+	
142	Sport and leisure facilities	+	
Agricultural areas			
211	Non-irrigated arable land		
222	Fruit trees and berry plantations		
231	Pastures		
242	Complex cultivation patterns		
243	Land principally occupied by agriculture, with significant areas of natural vegetation		
Forest and semi-natural areas			
311	Broad-leaved forest	+	
312	Coniferous forest	+	
313	Mixed forest	+	
321	Natural grasslands	+	
322	Moors and heathland, shrubs	+	
3241	Transitional woodland/scrub on mineral land	+	
3242	Transitional woodland/scrub on mire	+	
331	Beaches, dunes, sands	+	
333	Sparsely vegetated areas		
334	Burnt areas		
Wetlands			
4111	Inland marshes	+	
4112	Open fens and traditional bogs	+	

Code	Class of land use	Green network	
		Suitable areas	Exclusive areas
4121	Open lawn and pool communities	+	
4122	Peat extraction areas		
421	Salt marshes	+	
Water			
511	Water courses	+	
512	Water bodies		
521	Coastal lagoons		
523	Sea and ocean		

Appendix 6

Zoological points in identifying the structural elements and forming a green network in Estonia

Key habitat:	Settlement	Garden	Park	Wooded meadow	Field, cornstack	Meadow, haystack	Strip of bushes	Ruins, caveas, stone fences	Tree holoows, alleys, buildings	Heath	Clearing, burnt area	Young stand	Old coniferous forest	Old mixed forest	Old deciduous forest	Flowing waterbody in forest	Flowing waterbody in open landscape	Marsh, mire	Monotonuous massive forest	Monotonuous massive field	Mosaic cultural landscape	Fresh water ody	Coastal sea	Corridors	Linear	Cut	Landscape
Key spieces																											
Western Hedgehog (*Erinaceus europaeus*)	X	X	X	X																	X				X	X	
Eastern Hedgehog (*Erinaceus concolor*)	X	X	X	X																	X				X	X	
Common Mole (*Talpa europaea*)		X	X	X	X	X																					X
Common Shrew (*Sorex araneus*)							X						X	X	X										X		
Pygmy Shrew (*Sorex minutus*)				X		X									X											X	X
Masked Shrew (*Sorex caecutiens*)													X	X				X									
Least Shrew (*Sorex minutissimus*)				X		X									X											X	X
Water Shrew (*Neomys fodiens*)																X	X								X		
Daubenton's Bat (*Myotis daubentoni*)		X	X					X	X							X	X					X			X		X
Bond Bat (*Myotis dasycneme*)									X													X				X	X
Brandt's Bat (*Myotis brandtii*)		X	X						X																		X
Whiskered Bat (*Myotis mystacinus*)		X	X					X																			X

continue

Key habitat:	Settlement	Garden	Park	Wooded meadow	Field, cornstack	Meadow, haystack	Strip of bushes	Ruins, caveas, stone fences	Tree holoows, alleys, buildings	Heath	Clearing, burnt area	Young stand	Old coniferous forest	Old mixed forest	Old deciduous forest	Flowing waterbody in forest	Flowing waterbody in open landscape	Marsh, mire	Monotonuous massive forest	Monotonuous massive field	Mosaic cultural landscape	Fresh water ody	Coastal sea	Corridors	Linear	Cut	Landscape
Key spieces																											
Natterer's Bat (*Myotis nattereri*)			X					X																			X
Brown Long-eared Bat (*Plecotus auritus*)																					X						X
Common Noctule (*Nyctalus noctula*)			X						X													X			X		X
Common Pipistrelle (*Pipistrellus pipistrellus*)			X						X													X			X		X
Nathusius`Pipistrelle (*Vespertilio nathusii*)			X																								X
parti-coloured bat (*Vespertilio murinus*)									X				X	X	X												X
Northern Bat (*Vespertilio nilssoni*)																					X						X
Flying Squirrel (*Pteromys volans*)													X	X	X												X
Red Squirrel (*Sciurus vulgaris*)	X	X	X						X				X	X	X						X				X	X	X
European Beaver (*Castor fiber*)						X	X							X	X	X	X					X			X		
Common Dormouse (*Muscardinus avellanarius*)				X		X									X	X										X	X
Garden Dormouse (*Eliomys guercinus*)				X		X		X							X	X										X	X
Northern Birch Mouse (*Sicista betulina*)				X			X								X	X											
Brown Rat (*Rattus norvegicus*)	X	X																							X	X	
Black Rat (*Rattus rattus*)	X	X																							X	X	
House Mouse (*Mus musculus*)	X	X																							X	X	
Striped Field Mouse (*Apodemus agrarius*)		X	X	X		X									X						X				X	X	X
Yellow-necked Mouse (*Apodemus flavicollis*)		X	X	X		X									X						X				X	X	X
Harvest Mouse (*Microtus minutus*)					X	X												X							X		
Muskrat (*Ondatra zibethica*)																X	X					X			X		
Northern Water Vole (*Arvicola terrestris*)		X	X	X		X											X								X	X	X

continue

Key habitat:	Settlement	Garden	Park	Wooded meadow	Field, cornstack	Meadow, haystack	Strip of bushes	Ruins, caveas, stone fences	Tree holoows, alleys, buildings	Heath	Clearing, burnt area	Young stand	Old coniferous forest	Old mixed forest	Old deciduous forest	Flowing waterbody in forest	Flowing waterbody in open landscape	Marsh, mire	Monotonuous massive forest	Monotonuous massive field	Mosaic cultural landscape	Fresh water ody	Coastal sea	Corridors	Linear	Cut	Landscape
Key spieces																											
Bank Vole (*Chletrionomys glareolus*)													X	X	X										X	X	X
Noot Vole (*Microtus oeconomus*)						X												X							X		
Common Vole (*Microtus arvalis*)					X	X																			X	X	X
Sibling Vole (*Microtus levis*)						X																				X	X
Field Vole (*Microtus agrestis*)						X																			X	X	X
Mountain Hare (*Lepus timidus*)										X	X	X	X	X				X									X
Brown Hare (*Lepus europaeus*)					X	X	X							X	X						X						X
Pine Marten (*Martes martes*)													X	X	X												X
Beech Marten (*Martes foina*)		X	X					X		X	X														X	X	
Western Polecat (*Mustela putorius*)																X	X				X				X		
European Mink (*Mustela lutreola*)																X									X		
American Mink (*Mustela vison*)																X	X								X		
Common Stoat (*Mustela erminea*)								X	X	X	X	X													X	X	
Least Weasel (*Mustela nivalis*)		X	X					X	X																X	X	
Eurasian Badger (*Meles meles*)																					X						X
Wolverine (*Gulo gulo*)													X	X	X	X											X
European Otter (*Lutra lutra*)																X									X		
Brown Bear (*Ursus arctos*)													X	X	X												X
European wolf (*Canis lupus*)											X	X	X	X	X	X	X	X			X						X
Red Fox (*Vulpes vulpes*)						X	X			X	X										X				X		X
Racoon Dog (*Nyctereutes procyonoides*)							X				X	X				X	X								X		X

continue

Key habitat:	Settlement	Garden	Park	Wooded meadow	Field, cornstack	Meadow, haystack	Strip of bushes	Ruins, caveas, stone fences	Tree holoows, alleys, buildings	Heath	Clearing, burnt area	Young stand	Old coniferous forest	Old mixed forest	Old deciduous forest	Flowing waterbody in forest	Flowing waterbody in open landscape	Marsh, mire	Monotonuous massive forest	Monotonuous massive field	Mosaic cultural landscape	Fresh water ody	Coastal sea	Corridors	Linear	Cut	Landscape
Key spieces																											
Lynx (*Lynx lynx*)													X	X	X	X											X
Grey Seal (*Halicoerus grypus*)																							X				X
Ringed Seal (*Phoch hispida*)																							X				X
Harbour Porpoise (*Phocaena phocaena*)																							X				X
Wild Boar (*Sus scrofa*)											X	X	X	X	X						X				X	X	X
European Elk (*Alces alces*)													X	X	X												X
Red Deer (*Cervus elaphus*)			X	X										X	X						X						X
Silka Deer (*Cervus nippon*)														X	X												X
Roe Deer (*Cervus *capreolus*)					X	X								X	X						X						

Appendix 7

Additional criteria for designating ecological corridors in Lithuania

While choosing ecological corridors, it is recommended that the following are considered:

- they ensure mobility of species, and migrations;
- contain habitats big enough, because the latter must be able to harbour separate species;
- distances between separate habitats are 'affordable' for migrating individuals;
- corridors do not contain barriers that migrating individuals can not overcome;
- configuration, size and length of corridors and the structure of habitats correspond to the biological needs of individual species (i.e., species preferring bigger space will not be able to migrate or use narrow corridor etc.);
- besides linking function, corridors must also have a buffer function, especially the "stepping stones" present in the corridors;
- corridors are specific for individual systematic groups or species.

For localising ecological corridors, both the general and special principles of their natural importance should be followed. General principles are:

- one bigger natural or semi-natural landscape element is more valuable than several small, fragmented ones of the same type, if the total area in both cases is equal;
- out of several adjacent natural or semi-natural elements of the same landscape, the ones that together with core areas or other elements of ecological network would form less fragmented system are more valuable;
- in an agricultural landscape, promising ecological corridors are those of linear form, since they cover more ecotones and habitats (these are field plantations, groups of trees, groves, small wetlands, ponds, etc.).

Special principles for designating ecological network include natural and semi-natural elements of agricultural landscapes:

- distribution areas with high level mosaics of habitat conditions and plant diversity;

- groves of local trees and bushes (especially mixed spruce, oak, willow, lime, birch, alder, aspen);
- medium dense or thin growing groves, where tree stands interchange with forest meadows or clearings;
- groves of umbelliferous plants and plots with nectarous plants (especially buckthorn, raspberries), because insects concentrate in them;
- territories with permanent and seasonally drying-up (not later than June 15) water bodies with shallow and unshaded shores suitable for amphibians, at least in part of the shoreline;
- territories with meadows of different humidity, especially floodplain meadows, where from the point of view of succession, ecosystems are nearly stable;
- river valleys and drainage channels with grass rich meadows on the slopes.

The main landscape units connecting core areas and the most relevant for ensuring the functions of ecological corridors on the highest territorial level are:

- relatively natural (wooded) unbroken terrace river valleys;
- natural landscapes of sea-coast plains (wooded and swampy dunes of sea--coast plain, complexes of river delta);
- watershed sections of relatively unsegmented forests and wetlands;
- sections of slightly damaged wooded landscape of great ecological value that are unsegmented by urbanised areas;
- sections of agricultural landscapes unsegmented by urbanised areas, with high ecotonality and abundance of elements to be protected, connecting other landscapes of ecological corridors and not dominating in ecological corridors;
- sections of slightly damaged wooded landscapes with low diversity of elements to be protected;
- medium anthropogenic flooded meadows, including polders.

Ecological corridors of all levels have to include the following landscape elements:

- relatively natural segments of rivers and their valleys with oxbow complexes that are not segmented by urbanisation centres;
- wetland cascades, swamp synclines, old valleys and low valleys and their strings in agricultural and damaged forest landscape;
- oxbows;
- unused shipping canals;
- canalised riverbeds in wooded or slightly anthropogenic landscapes;
- main amelioration canals connecting relatively natural landscape elements;
- ponds in valleys;
- relatively undamaged and medium fragmented strips of forests and groves;
- lakes connecting other elements of migration corridors;
- plantations of special purpose;
- strips of different degrees of anthropogenisation with evident features of long-term re-naturalisation;
- continuous belts of plantations in urban and heavily anthropogenic territories.

Appendix 8

Maps and digital databases used in planning of ecological networks in the Baltic countries

In Estonia the following information sources and databases were utilised:

- the digital map of valuable bird areas;
- the map of Important Bird areas;
- the map of Ramsar sites and information on potential ones;
- the map of valuable wetlands of I, II and III category;
- the map and database of the CORINE Biotope sites;
- the map of heritage conservation;
- he map of The Estonian Forest Conservation Area Network;
- the map of valuable landscapes;
- the map of hydrological net of Estonia;
- the information on protected belt around inland waters;
- information on salmon rivers;
- the map of valuable meadow communities;
- the map of valuable habitats of forests (key biotopes);
- the basic map of Estonia;
- the topographic map;
- information on particularly protected species and areas, and on biological diversity of important habitats;
- the CORINE Land Cover map;
- existing spatial planning maps of different scales.

In Latvia in the process of planning the ecological network of national and international level, the following information sources and databases were utilised:

- the Latvian Landscape map;
- the map of Specially Protected Nature Territories;
- the map of Ramsar sites and information on potential ones;
- the map of HELCOM BSPA;
- the map of Important Bird areas;
- the map and database of the CORINE Biotope sites;
- the map of protected belt around the Baltic Sea and Riga Gulf;

- the map of hydrological net of Latvia;
- the information on protected belt around inland waters;
- information on salmon rivers;
- information on valuable wetlands;
- information on particularly protected species and areas, and on biological diversity of important habitats;
- the CORINE Land Cover map;
- the basic map of Latvia;
- the topographic map.

Additionally were used a for defining conflicts and influence zones between the potential green network and other infrastructures:

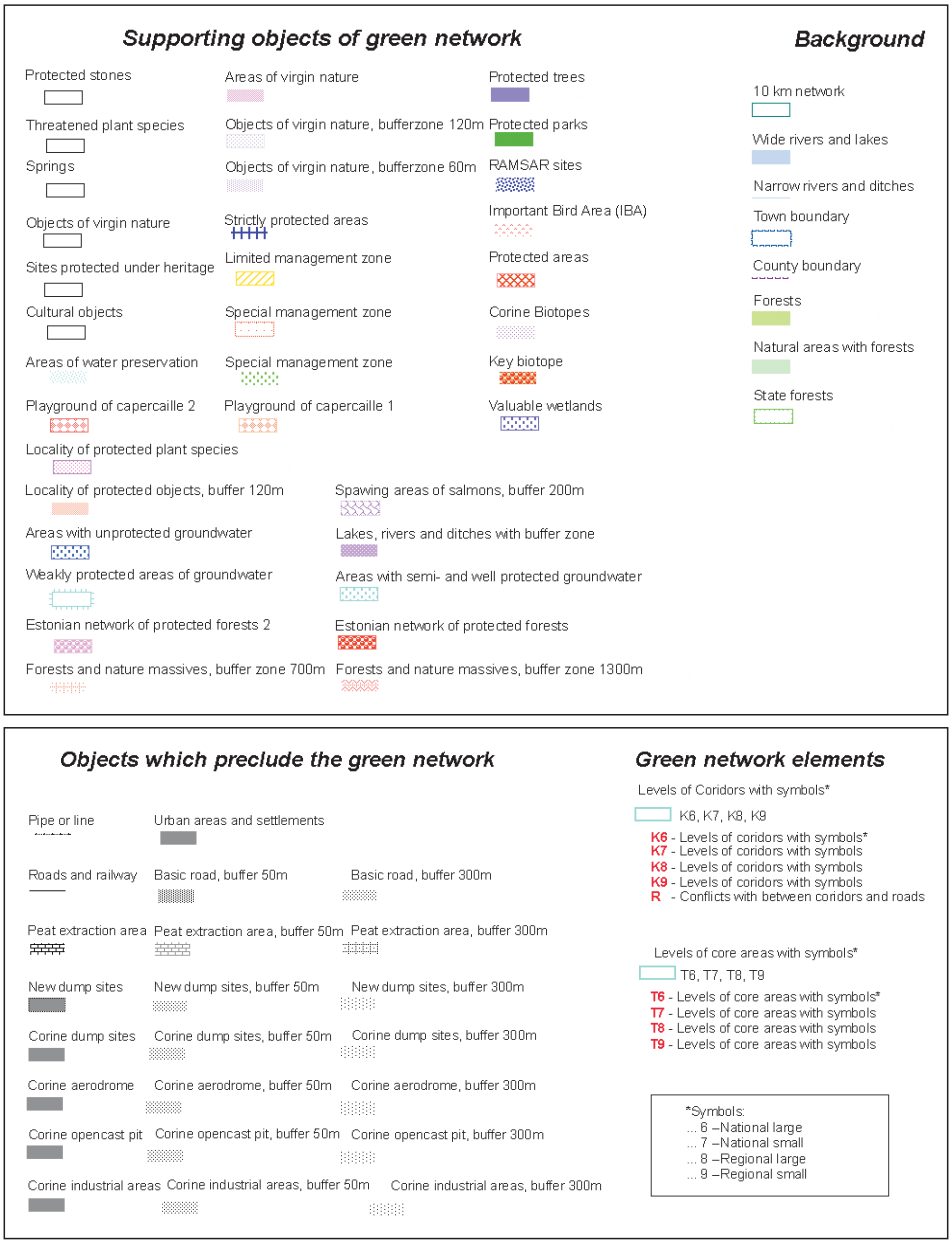
Layer of data	**Base**
Network of roads	Roads Act, existent planning, expert opinion
Railway	Railways Act, existent planning, expert opinion
Electricity lines	Width of protection zones around power, gas and district heating systems, Estonian Government Decree of 20.01.1999, No. 22. Existing planning, expert opinion
Gas tubes	Width of protection zones around power, gas and district heating systems, Estonian Government Decree of 20.01.1999, No. 22. Existing planning, expert opinion
Communication lines	
Mineral resources	Earth Crust Act, list of mineral deposits of national relevance, register of mineral resources, planning
Waste water treatment facilities	Planning
Land improvement systems	Ministry of Agriculture
Big industrial production sites, industrial and/or trade territories	CORINE land cover types, planning
Waste dumps	CORINE land cover types, planning, waste register
Areas with dense settlement	Basic map of Estonia, CORINE land cover types
Ports, airports	Planning, CORINE land cover types
Uncultivated areas	County inventories, Ministry of Agriculture
State forests, forest categories	Estonian Forest Survey Centre, Ministry of Environmental Protection
Swimming places	Planning, expert opinion
Military polygons	Planning, Ministry of Defence

In Lithuania the following cartographic materials and GIS based maps were available:

- digital base maps in scale 1:200,000;
- digital soil maps in scale 1:300,000 at the Institute of Geography;
- digital lithology maps in scale 1:300,000 at the Institute of Geography;
- digital forest site maps in scale 1:300,000 at the Institute of Geography;
- digital maps of relief types in scale 1:300,000 at the Institute of Geography;
- digital maps of relief morphometry in scale 1:200,000 at the Institute of Geography;
- digital protected areas maps in scale 1:200,000 at the Ministry of Environment;
- digital protected areas maps in scale 1:50,000 at the Ministry of Environment;
- CORINE land cover database, maps in scale 1:100,000;
- digital nature frame maps in scale 1:200,000 at the State Land Survey;
- wetland and peatland maps in scale 1:300,000.

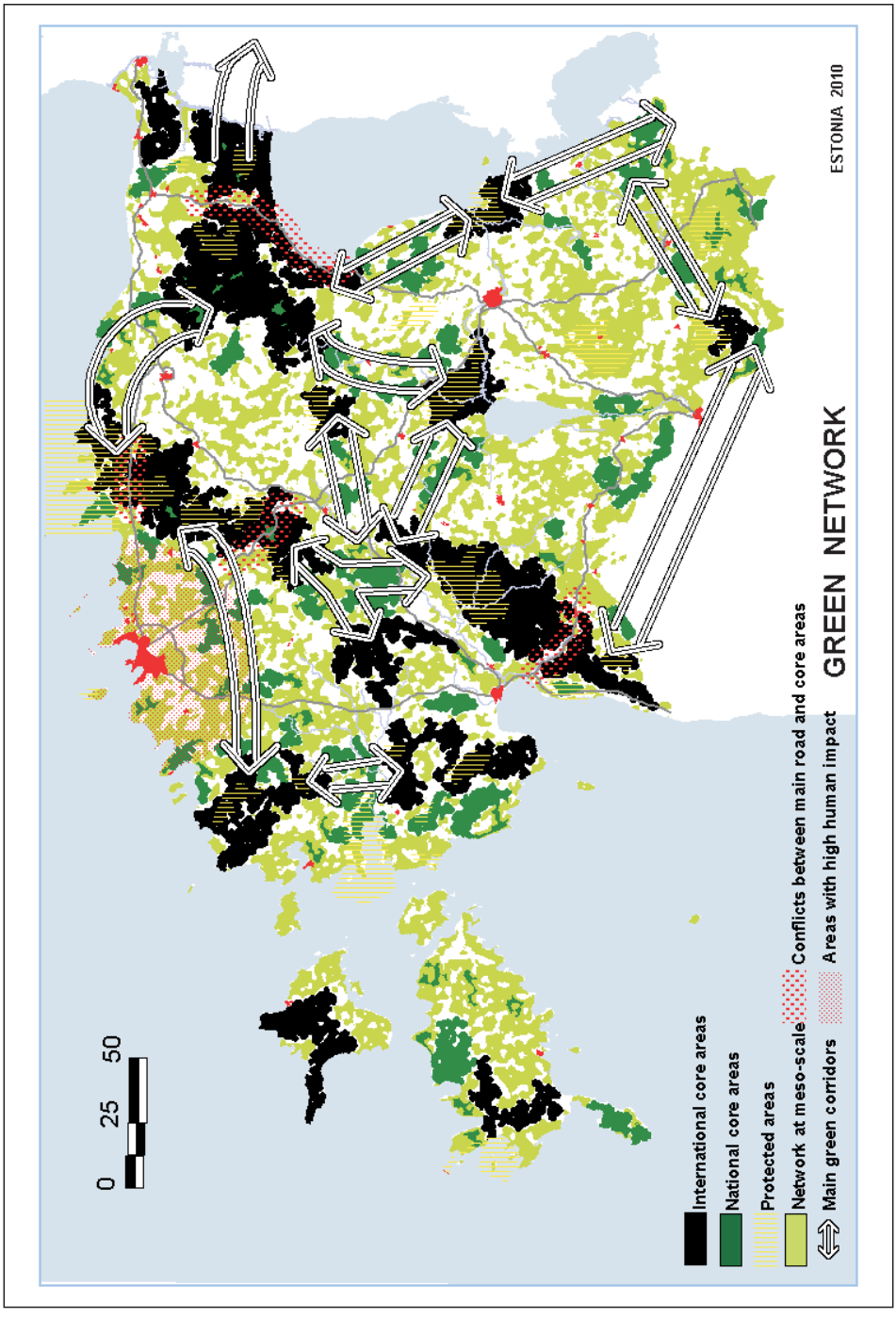
Appendix 9

Legend of the intermediate map for designing ecological network in Estonia



Appendix 10

The Estonian Green Network



Appendix 11

Example of description of biocentres in Latvia

NORTHERN MIRES AND RIVER SALACA

Status:

International biocentre [BE 14]

Landscape character:

The Northern Mires and River Salaca biocentre has a wide variety of landscape types: raised bog landscapes, plain forest landscapes and river landscapes. Agricultural land in this biocentre lies mainly along the River Salaca. The landscape of the Salaca Valley is among the unique landscapes in Latvia.

Structure of the biocentre:

Northern mires and the River Salaca biocentre have a complicated interior structure. 6 large core areas in the mires and one in the Valley of the Salaca River are designated. The total area of the biocentre is 339,322 ha, of which 38% covers core areas.

Main values:

The Kodu-Kapzemes Mire together with Ollas Mire, Pirtsmeza Mire and Nigula Mire (located in Estonia) forms one of the largest mire complexes in whole Baltic region. Beside the Teici and Lubans biocentre, the Northern Mires are considered to be a good representative example of natural wetlands, characteristic of the Baltic biogeographic region.

The greatest part of the biocentre is covered with raised bogs. The largest of them, Kodu-Kapzemes, Pirtsmeza, Ollu are open raised bogs or overgrown with sparse *Pinus sylvestris*. Bogs comprise large bog lakes, bog pool labyrinths and hummock-hallow complexes. Small mineral islands within the bog are covered with *Pinus sylvestris* forests. Transition mire vegetation

characterised by *Carex lasiocarpa* and *Carex rostrata* communities occur on the bog margins and on the shore zones of lakes. Occasionally rather dense stands of *Phragmites australis* are found. Typical species for active raised bog habitats (included in the Annex I of Council Directive 92/43/EEC), are found. For instance, *Sphagnum fuscum*, *Sphagnum magellanicum* and *Sphagnum rubellum*, *Eriophorum vaginatum, Calluna vulgaris, Rubus chamaemorus, Oxycocus palustris, Empetrum nigrum* and *Andromeda polifolia. Rhynchospora alba* and *Carex limosa* communities are found in bog hallows. Kodu-Kapzemes and Pirtsmeza bogs are original open concentric raised bogs. Olla Mire differs from the other mires found in the biocentre, due to its peculiar species composition, having together species of western and north/north-eastern distribution in Latvia – *Betula nana* and *Trichophorum caespitosum*. Both mentioned plant species are also included in the Red Data Book of Latvia.

The mires are surrounded and separated by wet mixed forests, where *Picea, Betula, Alnus* and *Populus* stands dominate. Lowland nemoral *Populus tremula* woods, East European swamp *Alnus glutinosa* woods, Boreal globe sedge *Pinus sylvestris* fen woods, Central European *Pinus sylvestris* forests, Athyrium *Picea abies* forests, *Pinus sylvestris* mire woods, Sedge sphagnum *Betula* woods also occur.

The valley of the Salaca river is deep and unregulated, with Devonian sandstone outcrops and caves. The caves are important as wintering places for several bat species, including *Eptesicus nilssoni, Myotis dasycneme, Myotis brandtii, Myotis mystacinus* – bat species protected in Latvia. The slopes and terraces of the valley are overgrown with *Picea abies*, *Alnus glutinosa, Fraxinus excelsior, Quercus robur* forests. Occasionally extensively managed grasslands, mainly of Mesophile type, occur. The following protected plant species there are recorded *Allium ursinum, Dactylorhiza incarnata, Dactylorhiza maculata, Gymnocarpium robertianum, Lunaria rediviva, Platanthera chlorantha, Primula farinosa, Crepis praemorsa*.

The mire and surrounding forests, support a large number of breeding birds. One of few *Aquila chrysaetos* nest sites in Latvia is found within the habitat as well as one of the highest densities of breeding *Tringa glareola*. It supports bird species of EU conservation interest, listed on Annex I of Council directive 79/409/EEC. For instance, *Circus pygargus, Falco columbarius, Gavia arctica, Pandion haliaetus, Grus grus, Philomachus pugnax, Ciconia nigra, Pluvialis apricaria*, as well as *Numenia arquata, Lanius excubitor, Numenius phaeopus, Picoides tridactylus, Picus canus, Strix uralensis, Asio flammeus, Lanius collurio, Caprimulgus europaeus, Tetrao urogallus, Tetrao tetrix* included in the Latvian Red Data Book. River Valleys provide breeding places for the protected species *Alcedo atthis* and *Mergus merganser*. In the Pirtsmeza mire besides threatened bird species there are also colonies of *Larus argentatus* and *Larus canus*.

The northern Mires biocentre is of great importance for migratory birds. Thousands of *Anser fabalis* and *Anser albifrons* use the mires for resting during autumn migration.

Vast, relatively unmodified, forest areas together with wetland areas, support vital populations of *Lynx lynx, Lutra lutra. Ursus arctos* are also recorded.

The River Salaca, with its tributaries, supports the largest population of wild *Salmo salar* in East Baltic. *Lampetra fluviatilis, Coregonus lavaretus, Cobitis taenia, Cotus gobio,* all of EU conservation interest, are recorded.

In the valley of the river several invertebrate species are found, which are included in the Latvian Red Data Book. For instance, *Segmentina nitida, Ancylus fluviatilis, Theodoxus uviatilis, Unio crassus*.

The rare and threatened plant species *Dactylorhiza incarnata, Platanthera bifolia* and *Primula farinosa* are also recorded.

Designation status:

The entire Biocentre falls within North Vidzeme Biosphere Reserve. Kodu--Kapzemes and Soka Mires are located in the nature reserve zone of the Biosphere Reserve. The Salaca River core area is included in the Salaca Nature Park. All other core areas are located in nature reserves – Lielpurvs, Niedraju-Pilkas, Dzerves, Limsanu, Pirtsmeza nature reserves. Olla, Pirtsmeza and Soka Mires are designated as IBA's. Several CORINE Biotopes sites are designated within the territorry as well. Kodu-Kapzeme and Olla Mires together with Estonian Nigula Mire is a perspective Latvian – Estonian transboundary Ramsare site.

Appendix 12

The Latvian Ecological Network

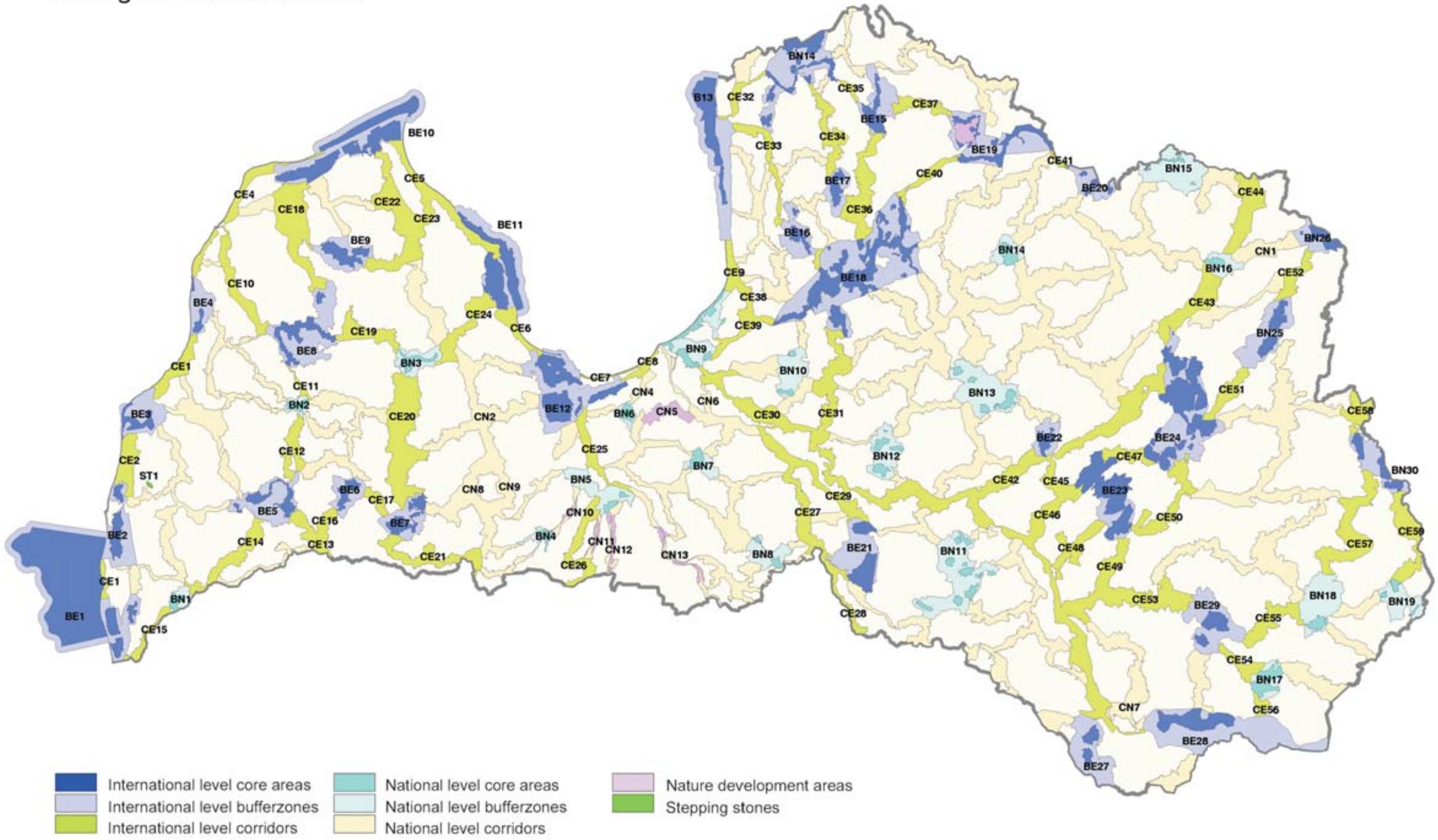
Attribute fields Contents	Number
Biocentre of international level	BE1
Core area of the biocentre of international level	BE1_1
Corridor of international level	CE1
Biocentre of national level	BN1
Core area of the biocentre of national level	BN1_1
Ecological corridor of national level	CN1
Nature development area located in the biocentre	BE1_D1
Nature development area located in the corridor	CE1_D1
Stepping stone	ST1
empty	n

BIOCENTRES

Coastal landscape biocentres

LAKE PAPE AND NIDA MIRE International biocentre [BE 1]
LAKE LIEPAJA International biocentre [BE 2]
GRINI FOREST International biocentre [BE 3]
FOREST AND GRASSLANDS OF UZAVA International biocentre [BE 4]
SLITERE International biocentre [BE 10]
LAKE ENGURE International biocentre [BE 11]
KEMERI International biocentre [BE12]
LAKE BALTEZERS AND SURROUNDING FORESTS International biocentre [BN 9]
SALACGRIVA COASTAL AREA International biocentre [BE 13]

Ecological network of Latvia



Forest landscape biocentres

MANGENE FORESTS International biocentre [BE 8]
ZVARDE FORESTS International biocentre [BE 7]
TERVETE FOREST National level biocentre [BN 4]
JELGAVA FOREST National biocentre [BN 5]
BALDONE FOREST National biocentre [BN 7]
SKAISTKALNE FOREST National biocentre [BN 8]
TAURKALNE – ZALVE FORESTS International biocentre [BE 21]
KATLESI FOREST National biocentre [BE 26]
KANGARU ESKER RIDGES FOREST National biocentre [BN 10]
MEZOLE HILLY FOREST National biocentre [BN 14]
KRUSTKALNI HILLY FOREST International biocentre [BE 22]
JAUNANNA FOREST National biocentre [BN 16]

Mire landscape biocentres

NORTHERN MIRES AND RIVER SALACA International biocentre [BE 14]
TEICI MIRES International biocentre [BE 23]
STIKLI MIRE International biocentre [BE 9]
DUNIKA MIRE National level biocentre [BN 1]
CENA MIRE National biocentre [BN 6]
AUGSTROZE MIRE International level biocentre [BE 17]
LIELAIS AND PEMME MIRE International biocentre [BE 16]
ORLOVA – STOMPAKI MIRE International biocetnre [BE 25]
KREICI – ZABOLOTJE MIRE International biocentre [BE 30]

Lake landscape biocentres

SATINI FISH PONDS International biocentre [BE 6]
LAKE BURTNIEKS AND RUJA FISHPONDS International biocentre [BE 15]
LUBANS LOWLAND International biocentre [BE 24]
LAKE RUSONS AND LAKE CIRITIS International biocentre [BE 29]
EZERNIEKI National biocentre [BN 18]
LAKE DRIDZIS AND LAKE SIVERS National biocentre [BN 17]
LAKE SVENTE AND LAKE MEDUMI International biocentre [BE 27]

Biocentres of river valleys

LETIZA AND SKERVELIS RIVER VALLEYS International biocentre [BE 5]
VENTA RIVER VALLEY National biocentre [BN 2]
LOWER COURSES OF RIVERS IMULA AND AMULA National biocentre [BN 3]
GAUJA RIVER VALLEY International biocentre [BE 18]
NORTHERN GAUJA International biocentre [BE 19]
DAUGAVA RIVER VALLEY International biocentre [BE 28]

Biocentres of mosaic landscape

AIZKRAUKLE SWAMP FOREST National biocentre [BN 12]
VESTIENA National biocentre [BN 13]
GAUJIENA International biocentre [BE 20]
VECLAICENE National biocentre [BN 15]
SAUKA – SUNAKSTE SWAMP FOREST National level biocentre [BN 11]
ISTRA National biocentre [BN 19]

CORRIDORS

Linear river corridors

LINEAR WETLAND CORRIDORS
LINEAR FOREST BELT CORRIDORS
MOSAIC CORRIDORS
STEPPING STONES

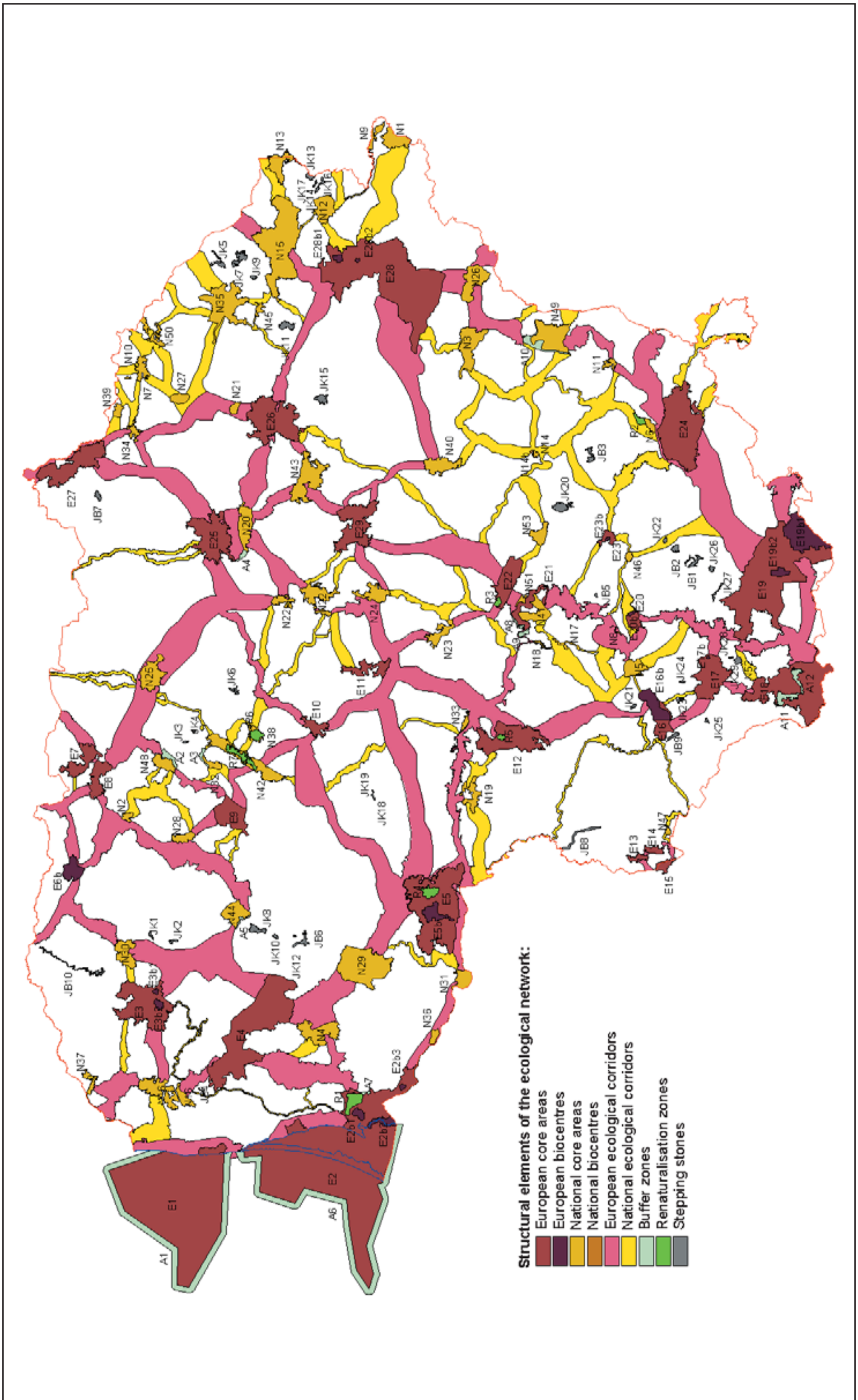
NATURE DEVELOPMENT AREAS

Appendix 13

The Lithuanian Ecological Network

Core areas of European importance:

E1. Pajūris
E2. Kuršių
E3. Žemaitija
E4. Žemaičić Plateau
E5. Viešvilė Forests
E6. Kamanos strict Nature reserve
E7. Žagarė
E8. Mūšos Tyrelis
E9. Kurtuvėnai
E10. Pravirėulio Tyrelis
E11. Dotnuva Forests
E12. Kazlų Rūda forests
E13. Vištytgiris
E14. Drausgiris
E15. Vištytis
E16. Žuvintas Strict Nature Reserve and Bukta Forest
E17. Meteliai
E18. Veisiejai
E19. Dzūkija
E20. Punia Wood
E21. Kauno Marios
E22. Pravieniškės–Būda forests
E23. Mergiškių hills
E24. Rūdninkai Wood
E25. Žalioji Wood
E26. Šimonys Wood
E27. Biržai Wood
E28. Aukštaitija
E29. Taujėnai Forests


Structural elements of the ecological network:
European core areas
Europeal biocentres
National core areas
National biocentres
Europeal ecological corridors
National ecological corridors
Buffer zones
Renaturalisation zones
Stepping stones

Core areas of national importance:

N1. Adutiškis
N2. Agailiai Forest
N3. Asveja
N4. Ašva-Tenenys
N5. Balbieriškis Forest
N6. Baltoji Vokė
N7. Beržuona and Vyžuona Interstream Area
N8. Birštonas Rock Exposure – Žemaitkiemis
N9. Birvėta Fish Farm
N10. Čedasas Lake and its environs
N11. Daubėnai Landscape Reserve
N12. Dysnai
N13. Drćkšiai
N14. Dūkštos Oak-wood
N15. Gražutė
N16. Grūšlaukė Forest
N17. Išlaužas
N18. Jiesia Landscape Managed Reserve
N19. Jotija
N20. Juosta
N21. Kepurinė
N22. Krekenava Forests
N23. Labūnava Forests
N24. Lančiūnava Forests
N25. Pakruojis
N26. Meškerinė
N27. Notigalė
N28. Paežeriai
N29. Pagramantis
N30. Plinkšiai
N31. Rambynas
N32. Rėkyva
N33. Ringovė
N34. The Upper Rovėja Forest
N35. Sartai
N36. The Old Rusnė
N37. Skuodas
N38. Sulinkiai
N39. Suvainiškis Telmatological Reserve
N40. Šešuoliai Forest
N41. Dubrava
N42. Tyruliai
N43. Troškūnai

N44. Varniai
N45. Vasaknos Fish Ponds
N46. The Middle Verknė
N47. Vygreliai Lake Complex
N48. Vijoliai
N49. Vilnius
N50. Upper Reaches of Vyžuona
N51. Rumšiškės
N52. Kučiuliškės
N53. Strošiūnai Forest

Stepping stones core areas:

JB1. Daugai
JB2. Daugai Fish Ponds
JB3. Galvė and Skaistis
JB4. Kartenalė Entomological Reserve
JB5. Kašonys
JB6. Šilalė Fishponds
JB7. Širvėna Lake and Environs
JB8. Širvinta River Valley
JB9. Žaltytis

Renaturalisation zones:

R1. Aukštumala
R2. Baltoji Vokė
R3. Didysis Raistas
R4. Laukesa
R5. Novaraistis
R6. Sulinkiai
R7. Tyruliai

Appendix 14

Examples of land use conditions and restrictions, which were used in green network planning in Estonia

Assuming that conditions of use can be prescribed at three levels (national, county and local) the principles of preservation of national core areas and corridors must be harmonized. These should include for example:

- conserve the wholeness of the core areas;
- conserve the wholeness of the corridor;
- the per centage of natural areas should not be allowed to fall below 90%;
- avoidance certain infrastructures (highways, waste dumps, military polygons);
- exclusion of certain intended purposes (industrial land, dump sites area, mining industry area);
- assure the minimal width of corridor (for example 2 km);
- avoidance of certain land use or management types;
- avoidance of certain resources (extraction of mineral resources and earth substance, restrictions of water use etc.).

A more generally formulated list includes:

- necessity of strengthening green infrastructures (establish stepping stones), tunnels for frogs etc.
- reserve as recreational area;
- reserve as protected area;
- wetland in creation (old polders);
- preservation of opened landscapes;
- avoidance of certain land use or management types means avoidance of functions;
- favouritism of certain land use or management types it means also their functions;
- avoidance of certain resources (extraction of mineral resources and earth substance, restrictions of water use etc.);
- area where detailed planning is mandatory;

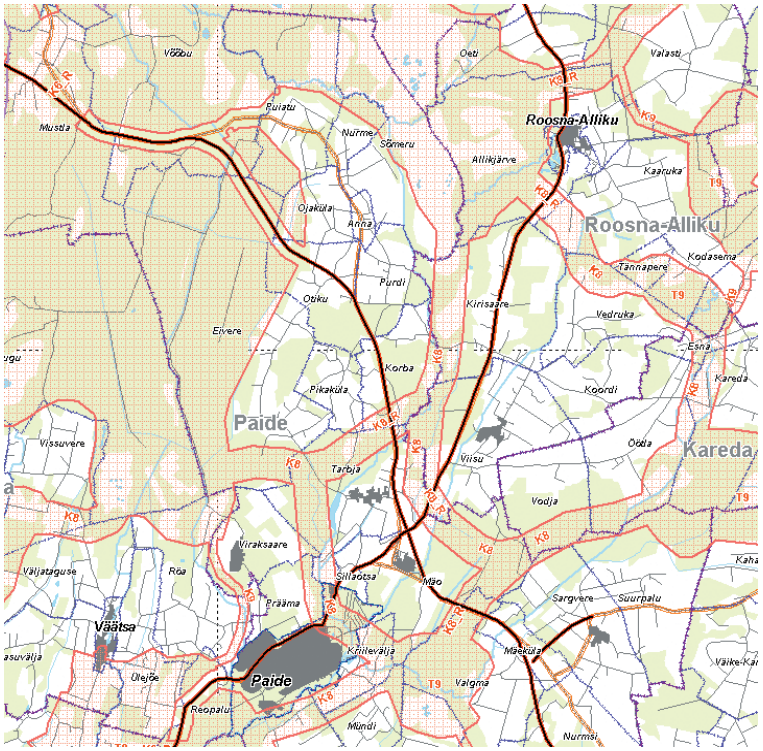
- conditions of land use are defined within the comprehensive plan of the municipality or with the regional plan (management plan of river basin etc.);
- normalizing of construction density and size;
- composing of suggestions of landscape ward/protection (valuable landscapes);
- additional defining of forest functions (protection forest, protected forest);
- conflict of the action areas of the core area (corridor) and infrastructure;
- potential conflict areas.

Example of more detailed conditions of use which direct the land use, necessary environmental measures and conflicts are:

- area under afforestation;
- area under amelioration;
- wetland in creation (old polders);
- preservation of open landscapes;
- areas what can be used for expanding the settlement;
- areas where the directing of settlement is avoided;
- exclusion of certain intended purpose;
- corridor in creation;
- core area in creation;
- the interval of the distance between buildings, lots;
- the size and height distance of buildings, lots, etc.

Appendix 15

An example of the map of Ecological network in Järva county – Estonia



Legend

Wide river and Lake

Urban area and Settlements

Village and Hamlet boundary

Town boundary

County boundary

Small roads

Main roads

Railway

Rivers and ditches

Forest

Green network

K6 - Levels of coridors with symbols*
K7 - Levels of coridors with symbols
K8 - Levels of coridors with symbols
K9 - Levels of coridors with symbols
R - Conflicts with between coridors and roads

T6 - Levels of core areas with symbols*
T7 - Levels of core areas with symbols
T8 - Levels of core areas with symbols
T9 - Levels of core areas with symbols

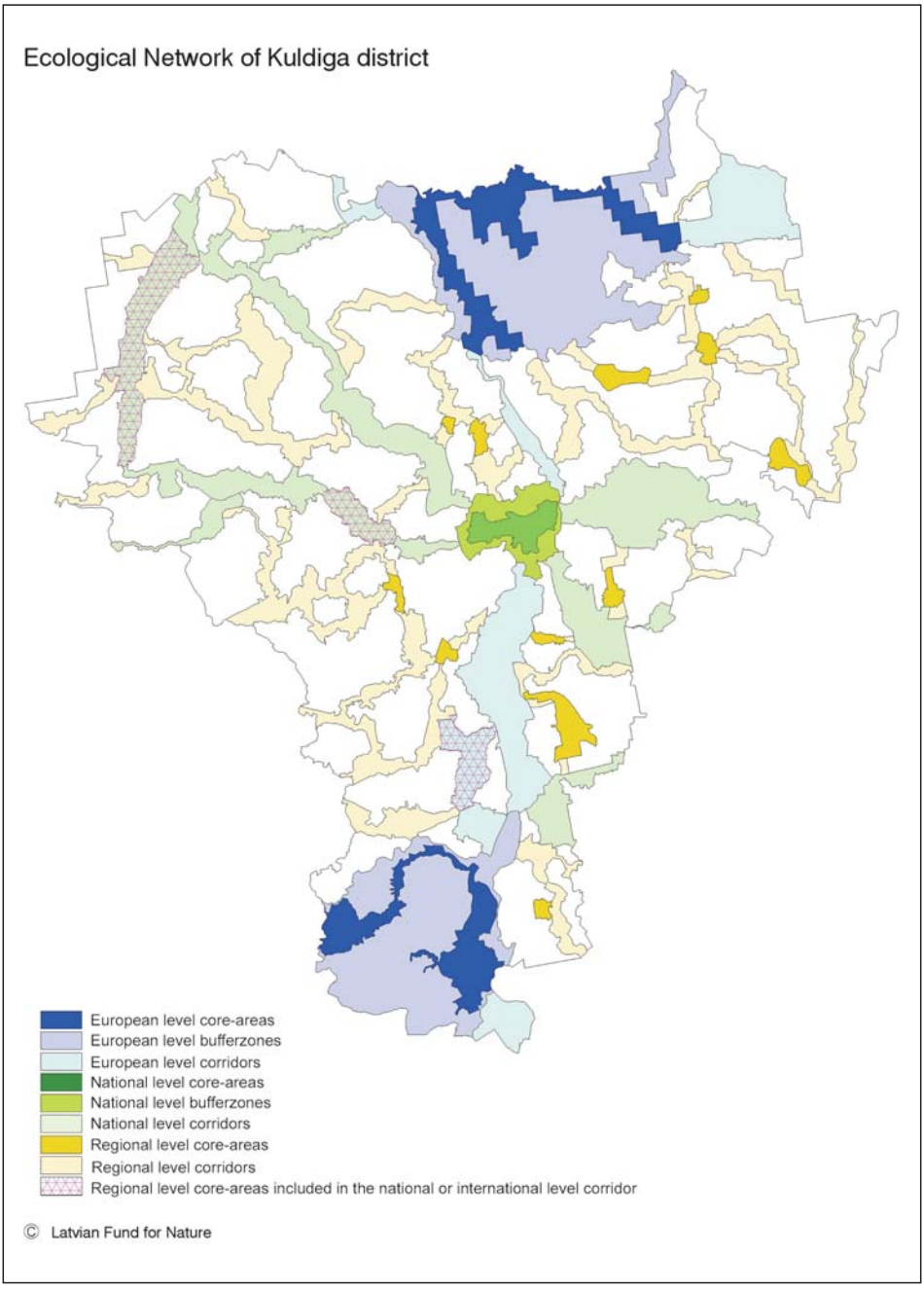
*Symbols:
... 6 –National large
... 7 –National small
... 8 –Regional large
... 9 –Regional small

Local names:

Saueaugu — Hamlet
Järva-Jaani — Village
Türi — Town

Appendix 16

Ecological network of Kuldiga district – Latvia



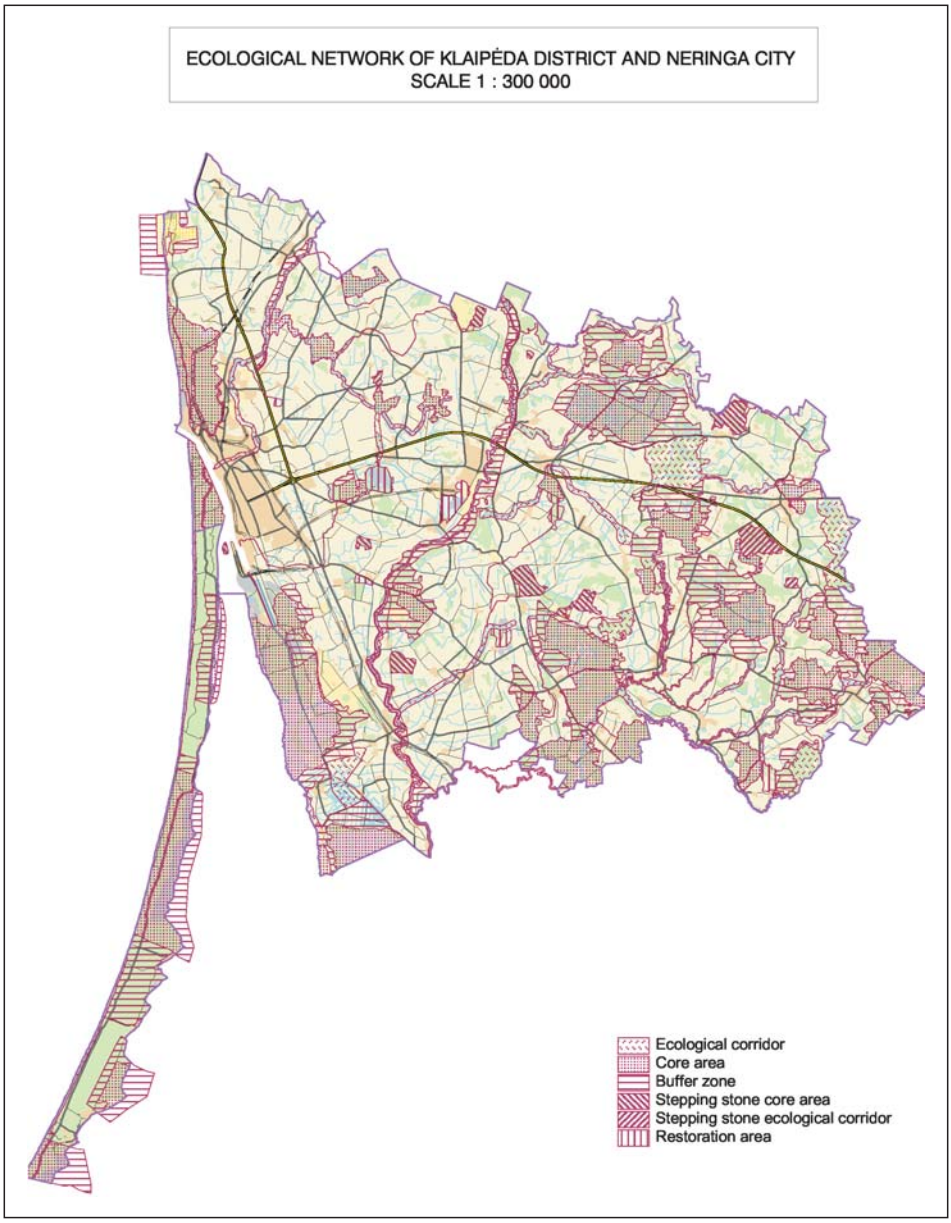
Appendix 17

Ecological network of Klaipėda district and Neringa city

Local Core areas:

V1 Šaipiai
V2 Lapieniškių Forest
V3 Šakiniai Forest
V4 Žvejonė River
V5 Smilgynai Forest
V6 Smilgynai bushes
V7 Baukštkaralė Forest
V8 Ąžuolija Forest
V9 Dauparai Peatbog
V10 Rudagalviai Forest
V11 Šalpė at Toliotai
V12 Brožiai Lake Complex
V13 Lužija
V14 Lagoon Coast between Alksnynė and Juodkrantė
V15 Naujininkai Wood
V16 Šiūraičiai Forest
V17 Stonaičiai Forest
V18 Svencelė Bog
V19 Lagoon Coast at Svencelė
V20 Medžių Būda and Bulvikis Hill
V21 Kliošiai Forest
V22 Eketė Quarry and Radailiai Forest
V23 Naglis Strict Nature Reserve
V24 Southern part of the Curonian Spit National Park
V25 Smiltynė
V26 Šernai Forest
V27 Minija River
V28 Vėžaitynė Wood
V29 Ažpurviai Forest

V30 Padumbliai and Piliakalnis Forest Complex
V31 Kapstatas Lake
V32 Liepaičiai Forest
V33 Dauskiai Forest
V34 Udrėnai Forest
V35 Mataičiai Forest
V36 Bareikiai Forest
V37 Danė River
V38 Veiviržas river



Renaturalisation areas:

VR1 Gargždai Quarries
VR2 Dauparai Peatbog
VR3 Kiduliai and Kelvėtai
VR4 Tauralaukis Quarry
VR5 Ketveragai Quarries
VR6 Poškai Quarry
VR7 Ąžuolija Forest

Stepping Stones Core Areas:

VJB1 Lieknas Forest
VJB2 Lėbartai Forest
VJB3 Stragnai Forest
VJB4 Genaičiai Forest
VJB5 Tvėrupio Valley
VJB6 Anužiai Forest
VJB7 Utriai bog
VJB8 Kiaulės Nugara Island