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ECOLOGICAL ECONOMICS AS A TOOL FOR RESOURCE BASED NATURE CONSERVATION MANAGEMENT IN ESTONIA

ÜLLAS EHRLICH

TARTU UNIVERSITY
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Institute of Geography, Faculty of Biology and Geography, University of Tartu, Estonia.

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ABSTRACT

The present thesis discusses the resource-based management of Estonian nature conservation (i.e. the protected areas, seminatural habitats and coastal zone) using ecological economics as a tool of study. Finding out the nature values that need protection, their evaluation and elaboration of proper management tools is only possible when using the methods of both economics and geography.

The total area of protected territories in Estonia with various protection regimes is over 10% of the whole mainland territory. The restrictions are aimed at limiting the use of nature resources, i.e. connected with direct consumption of resources (e.g. felling of timber, mining for mineral resources) on the protected area but allow the utilization of specific non-use (non-utilitarian) nature resources.

The regional distribution of protected territories with various regimes and restrictions to economic activity is analysed and compared with regional material welfare on county level. Although analyses did not establish any correlation between the welfare of inhabitants and the share of protected areas within the county at the present moment, the exploitation of non-use resources conceals in itself a great potential of social and economic development in the future.

The thesis presents a methodology of optimal zoning and resource based management funding of protected territories. The problem of zoning of a protected territory is solved as an optimisation task where the objective is to maximise availability of the nature resource potential of the protected territory and preserve the natural resources on this territory. The funding in Estonia for protected territories takes into account the total area of the reserve, structure by land-cover units, tourist load, and additional functions put on the manager of the area. The theoretical funding is compared to the actual funding and significant differences have been found in some cases. The methods are not specific to Estonia only and can be applied to any type of protected territories.

The theses also examines the maintenance cost and social value of Estonian seminatural communities (wooded meadows, wooded pastures, dry meadows, coastal meadows, alvars, floodplain meadows). Seminatural communities are ecologically, biologically and socially valuable communities, the area of which has rapidly diminished in recent years, both in Estonia and in the whole Europe. Estonia has according to the EU Habitats Directive (92/43/EEC) an obligation to preserve the different types of seminatural habitats. A precondition for their preservation is annual maintenance, which in the contemporary economic environment can be achieved only with subsidies, which in turn presumes a precise estimation of the maintenance and restoration costs. The maintenance costs depend on community. The maintenance costs of mown communities are: wooded meadows ca 2000 kroons/ha/year; dry meadows 322 kroons/ha/year; floodplain meadows 615 kroons/ha/year. An average restoration cost of the degraded seminatural communities is estimated at 3400 kroons per hectare. The

social value of Estonian seminatural communities mostly consists of non-use values. A contingent valuation study was conducted to identify these values and on the basis of this, a total demand function for the maintenance of seminatural communities of Estonia prepared, which was used for the identification of the willingness of the Estonian working-age population to pay for the preservation of seminatural communities. The total annual demand in Estonia for seminatural communities as environmental goods is 130 million kroons, which would enable to cover the annual costs of maintenance of ca 100,000 hectares.

In connection with the transition to market economy, a very strong anthropogenic pressure has become noticeable in recent years on the use of the coast by both domestic and international capital, the influence of which is often negative on the aesthetic value of the coast, biological diversity and other nature values. A detailed analysis of land coverage of the Estonian 200m coastal zone is presented based on the CORINE Land Cover (CLC), protected areas and administrative division data of Estonia. The length of the Estonian coastline (incl. islands) is 3794 km. The 200m zone of Estonian coast is very diverse. Out of the 34 CORINE land cover classes detected in Estonia 30 are represented in the 200m coastal zone. Three dominating land cover classes in the 200m coastal zone in Estonia are inland marshes, coniferous forest and natural grassland with a total share of 47%. 23.8% of the 200 m coastal zone is under protection, which is twice as more as Estonian average territory protected.

To find ways and preconditions for sustainable management of seminatural communities in the coastal zone the experience gained during Väinameri Project was analysed. The project makes an attempt to create a system that will maintain itself, involve active people, and be economically sustainable. Around 50 enterprises and about 100 people have been indispensably involved in the project, and several new enterprises were established as a direct result of the project. The main conclusion is that biodiversity can be an important component of development, which does not necessarily contradict economic prospects and social aims.

ORIGINAL PUBLICATIONS

The thesis is based on the following papers, which are referred to in the text by the relevant Roman numeral and included as appendices at the end of the thesis:

I **Ehrlich, Ü.**, Habicht, K., Krusberg, P., 1999. Territories with Limited Economic Utilisation as a Factor of Economic and Social Development. In: Ülo Ennuste and Lisa Wilder (Eds.) Harmonisation with the Western Economics: Estonian Economic Developments and Related Conceptual and Methodological Frameworks. Tallinn, 303–327.

II **Ehrlich, Ü.,** Habicht, K., 2001. Non-Use Value and Maintenance Costs of Estonian Ecological Seminatural Communities. In: Ü. Ennuste and L. Wilder (eds.). Factors of Convergence: A Collection for the Analysis of Estonian Socio-Economic and Institutional Evolution. Tallinn, 227–263.

III **Ehrlich, Ü**.; Krusberg, P. & Habicht, K., 2002. Land cover types and ecological conditions of the Estonian coast. – Journal of Coastal Conservation, EUCC; Opulus Press Uppsala, 8: 109–117.

IV Kull, A., Idavain, J., Kull, A., Oja, T., **Ehrlich, Ü.**, Mander Ü., 2007. The changing landscapes of transitional economies: the Estonian coastal zone. In: Mander, Ü., Wiggering, U., Helming, K. (eds). Multifunctional land use: Meeting future demands for landscape goods and services. Springer, Heidelberg, Berlin, pp. 327–340.

V **Ehrlich, Ü**. and Kokovkin, T., 2005. Economical Activities as Means of Coastal Nature Conservation: Estonian Experience. In: E. Özhan (ed.). Proceedings of the Seventh International Conference on the Mediterranean Coastal Environment. October 25–29, MEDCOAST 05, Kusadasi, Turkey, 151–162.

VI **Ehrlich, Ü.,** Oja, T., 2004. Planning of protection zones and management costs in protected coastal areas. In: C. A. Brebbia, J. M. Saval Perez & L. Garcia Andion (eds.) Coastal Environment V, incorporating Oil Spill Studies, WIT Press 27–34.

Author's contribution

Publication I: The author generated the research topic and is responsible for data collecting; participated in data analysis and is fully responsible for writing of the manuscript.

Publication II: The author generated the research topic and is responsible for data collecting; participated in data analysis and is responsible for writing of the manuscript.

Publication III: The author generated the research topic and is responsible for data collecting; participated in data analysis and is fully responsible for writing of the manuscript.

Publication IV: The author is partially responsible for data collection and analyses.

Publication V: The author is partially responsible for data collection and analyses, and for writing of the manuscript.

Publication VI: The author generated the research topic and is responsible for data collection and analyses, and partially responsible for writing of the manuscript.

1. INTRODUCTION

Natural landscapes have become a tight resource in most of the West-European countries, the administration and management of which has become an issue of increasingly more concern. The principle that it is purely economically expedient to keep a certain amount of land in its natural state has become (besides ecological arguments) topical especially in connection with the general recognition of the sustainable development paradigm after the adoption of the Rio de Janeiro convention at the UNO Environment and Development Conference in 1992.

Ecosystems that are fully loaded in terms of biodiversity will be at their most resilient and productive, playing their full part in the global biogeochemical processes on which the global economy is based. More particularly, they will be able to provide the widest possible array of resources to regional and local economies (Smith, 1996).

Worldwide, humanity has heavily transformed ~40–50% of the ice-free land surface; co-opted ~50% of accessible, renewable freshwater; fully exploited or overexploited ~65% of marine fisheries; increased the carbon dioxide concentration in the atmosphere by ~30%; increased the rate of fixation of atmospheric nitrogen by more than 100% over natural terrestrial sources; and driven ~25% of bird species to extinction (Vitousek et al., 1997). Unfortunately, relative to the other forms of capital, ecosystem capital is poorly understood, scarcely monitored and – in many important cases – undergoing rapid degradation and depletion. Often the importance of ecosystem services is widely appreciated only upon their loss. The situation today demands a more improved capability for characterizing ecosystem services, in ecological and economic terms. This would make possible the weighing of the full social costs and benefits of alternative polices and courses of action (Daily, 2000).

The multidimensional approach to the nature conservation, pointed out also the Pan-European Biodiversity and Landscape Strategy (The Pan-European…, 1996) states in the principles of the Pan-European Ecological Network an integrating of ecological considerations into a relevant socio-economic sector (Külvik, 1988; Remm, et al., 2002). The Strategy stresses that the aim is not total conservation but synergic response in sectors like land-use planning, regional development, agriculture, forestry, fisheries, transport and tourism.

Sustainability as a category of economic and social development is defined in two different ways, which are known as weak and strong sustainability (Turner, 1999). Weak sustainability requires the maintenance of the total capital stock composed of: manufactured or reproducible capital; human capital, or the stock of knowledge and skills; natural capital: exhaustible and renewable resources, together with environmental structures, functions and services − over time with the implicit assumption of infinite substitution possibilities between all forms of capital. The Hartwick Rule (Hartwick, 1978) lays down that the

rent obtained from exploitation of the natural capital stock by the current generation should be reinvested as reproducible capital, which forms the future generations` inheritance. This inheritance transfer should be at a sufficient level to guarantee non-declining real consumption (well-being) over time. From the weak sustainability perspective a key requirement will therefore be increased efficiency of research and development, i.e. new knowledge properly embodied in people, technology and institutions.

From the strong sustainability perspective, some elements of the natural capital stock cannot be replaced (except on a very limited basis) by man-made capital and therefore there is a concern to avoid irreversible losses of environmental assets. Some of the functions and services of ecosystems in combination with the abiotic environment are essential for human survival; these are life support services and cannot be replaced. We might therefore designate those ecological assets which are essential in either sense as being critical natural capital (Pearce, et al., 1990). The strong sustainability rule therefore requires that we at least protect critical natural capital and ensure that it is a part of capital bequest. As for a large part of the world development based on strong sustainability seems to be lost forever, it is still possible in Estonia.

One of the major economic preconditions for sustainable development is the utilisation of non-use values (values which are not based on direct physical consumption) of natural resources, which presumes a somewhat untraditional approach to natural resources (Page, 1991; Braat & Steetskamp, 1991). The subject has been treated comprehensively in the USA (e.g. Bartlett, 1984; Alward et al., 1992; Matulich & Donnelli, 1984) where the utilisation of non-use value of nature has been changed into an effectively functioning and profitable branch of economy.

One of the founders of nature protection science in Estonia, E. Kumari, states that the issues of nature protection are interdisciplinary involving both natural and social sciences (Looduskaitse 1973, p. 151). Yet the comprehensive handbook “Looduskaitse” (*Nature conservation*) (Looduskaitse, 1973) which deals with many aspects of nature conservation, only vaguely touches the relation of economics and nature protection. Being a former research object mostly for natural scientists, nature conservation in Estonia achieved a new theoretical level thanks to studies by J. Eilart (1976), who pointed out the social and cultural aspects of nature conservation.

It is characteristic of the non-utilitarian values of nature that the benefit gained from them is indirect and distributed to the whole society. Yet, at the same time the preservation and availability of non-utilitarian values presumes restriction of economic activities connected with physical consumption of nature resources (e.g. mining of minerals, timber-based forest industry), which brings upon a direct decrease of owner’s monetary benefits. The decisions that have to be taken for utilitarian or non-utilitarian usage of nature resources should be based on relevant environmental and ecological economic analyses (Peskin, 1991; McCollum, et al., 1992; Dixon, 1986; Loomis, 1986; Brookshire,

et al., 1983). At the beginning of 1990, steps were taken to conduct such theoretical analysis also for Estonia (Habicht, 1987; Habicht, 1990; Habicht, 1992; Ehrlich, 1995). Economic development intensifies resource utilization, which increases economic and political pressure on the utilitarian exploitation of nature resources. Yet, for the society as a whole the usage of such resources in a non-utilitarian way would be both socially and economically far more valuable in longer perspective and often also in monetary terms.

The social and economic evaluations of nature's non-utilitarian values (and especially its monetary equivalent) allows to compare the social and economic effectiveness of competing and often excluding-each-other uses of nature resources and to come to an optimal utilization solution. Furthermore, in some cases like protection of seminatural grasslands, management is a precondition and tool for their conservation. In such way the environmental and ecological economics can serve as a valuable tool for solving problems where at first glance the material welfare of habitants and the protection of biodiversity are opposing.

In addition to the Estonian Nature Conservation Act, and Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC) and Directive on Wild Birds (79/409/EEC), Estonia has taken international obligations ratifying: Rio de Janeiro Convention on Biological Diversity (1992); Berne Convention on Conservation of European Wildlife and Natural Habitats (1979); Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat (1971). The mainland area of different types of protected areas in Estonia is 542,446 ha (http://eelis.ic.envir.ee/) covering more than 12% of the territory of Estonia. According to the Nature Conservation Act (2005) there are additional restrictions on economic activities (e.g. real estate development) in the coastal zone. The present thesis is concentrating on issues concerning the areas where the utilitarian usage of resources is restricted by the Estonian law and international obligations; and it also deals with communities (seminatural grasslands) that need management in order to be preserved.

Given the above, the thesis based on six papers (I–VI), has the following objectives:

- Point out the non-utilitarian (non-use) values of nature, which serve as an argument for the establishment of protected territories and act as a basis for the limiting and/or restriction of the utilitarian resource consumption. Also, the non-use values of nature as a subject of economics will be compared to the utilitarian values (I);
- Analyse the zonal structure of Estonian protected areas and their division between the counties using GIS based methods. Also the correlation between the habitants welfare and existence of protected area on the county level will be studied (I);

- Develop a methodology to enable zoning of protected areas in a way that guarantees the best expression of nature resource potential on the territory (VI);
- Develop a methodology to provide arguments for state budget based funding and also to take into account the resources to be managed (VI);
- Study the cost of management on seminatural grasslands and the monetary equivalent of non-market values using the contingent valuation method. The seminatural grasslands have been selected as the object of study because these are one of the most endangered habitat in the present economic situation (II);
- Analyse Corine Land Cover Classes on the 200m of Estonian coastal zone, an area which experiences the biggest economic pressure. The level of protection of land cover classes are also studied (their belonging amongst the protected areas and division between counties) (III, IV);
- Study the relationship between economy and nature protection in the coastal zone, also the tools and concepts how to make nature protection supporting economic activities sustainable (V).

In addition to the publications given above more research findings concerning the topics discussed in present thesis have been published in: Ehrlich, 1995b; Ehrlich, 1999; Ehrlich, Habicht, 2003.

The topics listed above have been elaborated further in: Tenno et al., 2007, co-authored by the author of the current thesis.

2. ECOLOGICAL ECONOMICS OF TERRITORIAL NATURE CONSERVATION

2.1. Nature values of protected territories

The general theoretical assumption is that economic values are a monetary expression of social values, understood as patterns of behaviour and beliefs held by society to be important to its welfare (Sessom & Henderson, 1994; Povilanskas et al., 1998). Therefore economic value of environmental goods is a measure of the relative importance which individuals attach to environmental goods and services, which are also referred to as values of nature (Dixon & Sherman, 1991; Economics for...,1992; Groot, 1992). The economic value of environmental goods can be conventionally divided into use- and non-use values. *Use value*, as the name implies, stems from actual physical use of the resource in some way, participating in an activity based on the availability of natural resources, or site-specific environmental conditions. *Non-use value* implies no use of the resource at all. One possible division of the nature values is presented in Table 1 (see also I: 307, Table 1). The list of values is not exhaustive. A more detailed classification of ecosystem services is given by Daily (2000).

Table 1. Non-use values of nature and their expressions

Non-use Value of Nature	**Expressions of the Value**
General ecological	Provision of water and air circulation Purification of water and air Prevention of soil erosion Preservation of pure water resources Regulation of water regime Provision of condition for life (global life preservation)
Biotic regulation	Preservation of genetic resources Protection of species Provision of multiplicity of ecological systems
Recreational	Creation of recreational and tourism facilities
Psycho-social	Creation of opportunities for cognition of existence and option values
Cultural-historical	Preservation of historical structure of landscapes
Educational and scientific	Creation of opportunities for educational and research work
Aesthetic	Creation of opportunities for perceiving the beauty of landscapes and natural objects

The comparison of use and non-use values is established in Table 2 (I: 308).

Table 2. Comparison of use and non-use values

Characterization of use values	Characterization of non-use values
Direct physical consumption of nature resources	Do not presume direct physical consumption
Give direct economic profit	Do not give direct economic profit in general
Subject to market rules	Do not subject to market rules (*market failure*)
Benefits are usually local	Benefits are rather global than local
Have an impact on living standard	Have an impact on quality of life
Relatively easy to express in monetary terms	Relatively difficult to measure and express in monetary terms

2.2. Social and economic impact of protected territories

With the establishment of a protected area the regime on the protected territory shall be modified with legal instruments and it will be different from the regime on the neighbouring territories regulated with universal legislation. The new regime modifies the utilisation of resources on the territory and establishes a new use of nature potential specific for the protected area.

The restrictions are aimed at limiting the use of nature resources i.e. connected with direct consumption of the resources (e.g. felling of timber, mining for mineral resources) on the protected area and allow the utilization of specific non-use goods of the protected area. At the same time, the regime must grant the preservation of the protected area in the desired state but also enable its participation in socio-economic processes and compensate for the economic loss from limiting the use of resources. Stevens et al. (1994) have stated that non-use values can potentially become an important source of revenue for conservation and preservation in a protected area.

Leaving certain parts of the territory into a state where utilization of non-use values of nature is favoured does not raise suspicion on the global scale. According to the model by E. and A. Odum (Reimers & Stilmark, 1978) the utilisation of the whole territory reduces the output to the minimum, i.e. to 25% of possible output. The maximum output is gained with the utilisation of 40% of the territory, while natural ecological systems survive at 60%. Though this model illustrates the economic effect of natural territories under the maintenance of ecological equilibrium in one particular ecological system, we must still consider that the optimal relationship between the economically used territories and natural territories depends on the latitude and ecological type (I: 308). Smith (1996) comes to a conclusion that ecosystems that are fully loaded in terms of biodiversity will be at their most resilient and productive, playing their full part in the global biogeochemical processes on which the global

economy is based. More particularly, they will be able to provide the widest possible array of resources to regional and local economies.

The aim of the study (I) was to find out what is the current material welfare of people in the counties of Estonia with the bulk of the established (and projected) nature reserves. This might serve as the ground for drawing conclusions about the significance of the development of economic activity based on the reserves in economically backward regions and the need to avoid negative effects of current/future restrictions established/to be established in the reserves on possibilities of improving material welfare of people. Two indicators calculated on the basis of information of the Statistical Office published in 1997 have been selected to characterise the material welfare of people in different counties and separately in Tallinn. First − the sum of average monthly gross wages per capita in the county as a ratio to the average of Estonia − c (%). Secondly − the average monthly net income per household member in counties as the ratio to the average indicator of Estonia − d (%) (I: 311–314). Both indicators varied in a wide range from 138% of the average of Estonia in Tallinn to 51–65% of the average in Põlva, Valga and Võru Counties (I: Tables 3, 4).

To get information on the distribution of protected territories and their zones, digital map data from different sources were processed using geographic information system (GIS) software ArcView (*Environmental Systems Research Institute, Inc.*). Data sources include the following map layers:

- Administrative boundaries of Estonia at scale 1:50000 (Sagris, Krusberg, 1997)
- Nature protection areas boundaries at scale 1:10000.

All layers have attributes describing objects included in these layers. Elementary areas were got by logical intersecting these layers. After the operation every new object (elementary area) in the new map layer will have attribute data from input layers. Due to the different scales of data sources the resulting map had many small slivery polygons along the boundaries common for two or more input layers, which were excluded from further analysis. The authors estimate that the errors of the analysis are within the range of 3% to 5% (I: 316).

The structure of protected areas across Estonian counties according to the authorization of their economic use is established in (I: 317, Table 5). The percentage of protected area from county's territory was (in declining order): Läänemaa 20.5; Valgamaa 13.9; Ida-Virumaa 13.1; Harjumaa 12.7; Viljandimaa 12.0; Võrumaa 11.6; Tartumaa 11.6; Hiiumaa 11.5; Lääne-Virumaa 10.1; Jõgevamaa 8.6; Järvamaa 7.3; Pärnumaa 6.7; Raplamaa 6.4; Saaremaa 4.0 (I: Table 6; Fig 3,4).

The generalised share of protected territories is established in Figure 1.

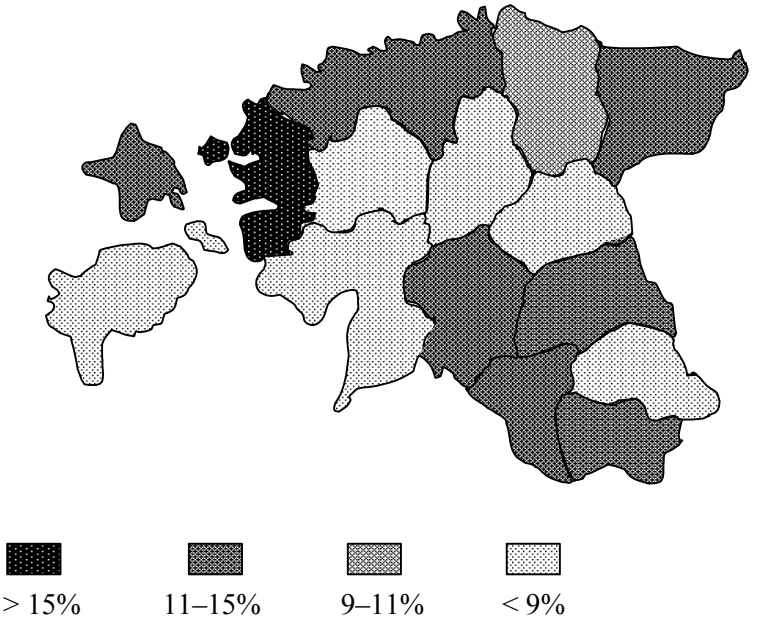

Figure 1. Share of protected territories in the area of county, %

The counties where the average monthly net income per household member, characterising the material welfare of people, is lower than the average of Estonia and the share of protected areas F is higher than the average of Estonia (10.1%), are: Valgamaa, Ida-Virumaa, Viljandimaa, Võrumaa, Hiiumaa, Tartumaa and Läänemaa (I: Fig.5).

If we would point out a theoretically strict correlation between proportion of protected territory in a county and inhabitants' material welfare, then all other economic conditions in these counties must be equal. Such situation is impossible in practice (I: 322).

The real situation is illustrated by correlation fields (I: Fig. 6–9). The real situation is illustrated by correlation fields based on data of material welfare and proportion of protected territories to the county territory for all 15 Estonian counties. Detected correlation coefficients indicate only weak correlation ($r<|3|$).

An analysis reveals that existence or absence of protected areas on the territory of a local community evidently does not cause any automatic impact on material welfare of inhabitants. Local community may be relatively prosperous without protected areas and poor when protected areas dominate on the territory. But protected area with possibilities for tourism and other non-use values is one factor that may have significant influence on material welfare.

The international experience shows that although the creation of protected territories and restriction of utilitarian use of nature resources may have a locally negative impact, i.e. loss of jobs (Bezdek, 1993); in many cases, cost-benefit analyses have provided strong support for conservation and preservation, enabling most projects to overcome the first obstacle (Dharmaeratne et al., 2000). However, the net benefits which are taken to be the consumer surplus accrued to the affected population, could be quite large if the benefiting population from the project is considered as the total population in the country. Although welfare of the society as a whole is increased when a resource is allocated to a use with higher net benefits (Dharmaeratne et al., 2000).

Studies carried out in several Central and South American countries have indicated that for 50–70% of the tourists, protected areas were an important factor choosing their destination (Boo, 1990). The greatest increase of ecotourism has been observed in countries having the greatest number of protected areas (UNEP, 1994).

In Estonia protected areas with different restrictions for economic utilization and therefore availability of non-use values, on the one hand, and possibilities for nature tourism, on the other hand, may have significant influence on development and material welfare on the level of local community (I: 322).

2.3. Zoning of protected territories

Ecologists have long debated the optimal size and number of reserve sites under a fixed area and budget. So far, however, the discussion has focused on the question what number and size of reserve sites maximizes ecological benefits without taking economic aspects into consideration (Groeneveld, 2005). Recently, economists have contributed to this debate, adding such aspects as land price (Polasky et al., 2001) and cost effectiveness analyses of timber production and nature conservation (e.g. Rohwender et al., 2000), which are examples of integrated ecological-economic analyses of optimal reserve design. R. Gronewald (2005), analyzing economic considerations on the optimal number of reserve sites pointed out three optima: the ecological indicator (e.g. species richness), social indicator (maximizes social welfare under a given total reserve area) and economic optimum, which also take into account that land transactions can partly offset conservation costs.

Possibilities for management of protected areas as territories designated primarily for protection of natural resources depend on the state of these resources and their natural potential serving as the basis for their non-utilitarian use, which can be divided into several sub-potentials from general ecological to recreational (VI: Table 1). As a protected territory is not as a rule a homogenous territory, the division based on natural differences of its parts into zones (zoning) with different protection (and the ensuing management) regimes must

guarantee preservation as well as maximum possible utilisation of the natural potential of this territory, serving thus as a starting point for the management of this protected territory.

Therefore, the zoning of a protected territory represents an optimisation task where the objective (objective function) is to maximise availability of the sub-potentials of the protected territory with the restriction of protecting and preserving the natural resources on this territory (Ehrlich & Habicht, 2003; VI: 28). Of fundamental importance in preparing a management plan is zoning of the protected territory, its division into zones with different protection and management regimes. This in turn arises from the treatment of natural potential of the protected territory. Protected territory, an area with targeted use and fixed borders, can be characterised by the resources found there. Of greatest significance are natural resources, the utilisation of which is determined by biological and intellectual needs of people and their ability to consume the resources. We can use the term '*natural potential of the territory'* to evaluate the natural resources on a territory (Dmitrievski, 1974). Therefore, protected territory can be discussed as a territorial complex with a legally established different use of the natural potential from similar neighbouring territories under the market economy conditions. The purpose of the established restrictions is to limit the utilitarian use of natural resources, i.e. the use connected with direct consumption of the resources on the protected territory (e.g. felling of timber, mining for mineral resources), and provide an opportunity to use specific non-utilitarian goods of the protected territory. Since the social value of protected territories depends directly on their being known, an inexpediently established and unreasonably rigid protection regime may considerably reduce the social value of the protected territory. Therefore, especial carefulness is needed in establishing restrictions to people's movement on a protected territory. This may be done in the vicinity of objects not tolerating any disturbance (e.g. eagle's nest), but not "just in case". Vice versa, as discussed, value of a protected area can be increased by offering better ability to consume certain potentials by visitors. Considering the social value of protected areas, what D. Cosgrove (1998) has said about landscapes can be translated to protected and exposed nature – it is a holistic combination of different functions having a meaning, expressing a sense of harmonious, social and aesthetic unity, and reflecting collective memory.

In dividing protected territories into zones with different regimes (strict nature reserve, special management zone, limited management zone) the territories should be regarded as consisting of relatively homogenous areas (parcels), which will thereafter be grouped into zones, according to their specific features. The primary purpose of grouping is the requirement that each parcel must have such regime that would provide the best usability of the sub-potential of the protected territory. And each part potential may be valorised-emphasised differently, giving them different coefficients of relative importance. The actual usability of subpotentials is also different under every

regime, in each parcel, dependent primarily on its natural characteristics, regime requirements and socio-economic burden. In the methods below this has been taken into consideration in the usability ratings of the sub-potentials presented in Table 3. (VI: 30).

Coefficients of relative importance ($A = (A_1, \ldots, A_m)$) of sub-potentials (i=1,…,7) and ratings or regimes (j=1,2,3) in any parcel. Columns 4, 6, 8 present a mn-matrix of usability ratings of sub-potentials i under regimes j in parcel k, columns 5, 7, 9 a mn-matrix of valorised usability ratings of sub-potentials i under regimes j in parcel k. B_j as a total of column j presents aggregate valorised usability of sub-potentials under regime j in parcel k.

Table 3. Coefficients of relative importance of sub-potentials and ratings or regimes(i=1,…,7; j=1,2,3) in any parcel

i	Sub-potentials, i	Coefficients of relative importance, A_i	Ratings, a_{ij}					
			Regimes, j =1, 2, 3					
			j =1		j = 2		j = 3	
1	2	3	4	5	6	7	8	9
1	General ecological	A_1	$a_{1\,1}$	$a_{1\,1}*A_1$	$a_{1\,2}$	$a_{1\,2}*A_1$	$a_{1\,3}$	$a_{1\,3}*A_1$
2	Biological regulation	A_2	$a_{2\,1}$	$a_{2\,1}*A_2$	$a_{2\,2}$	$a_{2\,2}*A_2$	$a_{2\,3}$	$a_{2\,3}*A_2$
3	Recreational	A_3	$a_{3\,1}$	$a_{3\,1}*A_3$	$a_{3\,2}$	$a_{3\,2}*A_3$	$a_{3\,3}$	$a_{3\,3}*A_3$
4	Psycho-social	A_4	$a_{4\,1}$	$a_{4\,1}*A_4$	$a_{4\,2}$	$a_{4\,2}*A_4$	$a_{4\,3}$	$a_{4\,3}*A_4$
5	Cultural-historical	A_5	$a_{5\,1}$	$a_{5\,1}*A_5$	$a_{5\,2}$	$a_{5\,2}*A_5$	$a_{5\,3}$	$a_{5\,3}*A_5$
6	Educational and scientific	A_6	$a_{6\,1}$	$a_{6\,1}*A_6$	$a_{6\,2}$	$a_{6\,2}*A_6$	$a_{6\,3}$	$a_{6\,3}*A_6$
7	Aesthetic	A_7	$a_{7\,1}$	$a_{7\,1}*A_7$	$a_{7\,2}$	$a_{7\,2}*A_7$	$a_{7\,3}$	$a_{7\,3}*A_7$
	Total			B_1		B_2		B_3

In the first stage of the calculations, optimal regime $r(k) \in J$ is found for each parcel k, where the aggregate usability of sub-potentials in this parcel has maximum value. However, doing so the strict reserve regime will probably not be the best in any of the parcels as sub-potentials of the protected territory except general ecological and biological regulation are not used in the reserve, and the aggregate usability of sub-potentials will be small. The parcel which will become a reserve must be large enough to justify itself for fulfilling its specific functions (VI).

2.4. Funding of protected territories

The main indicator in this is the constant funding base rate *a* of protected territories, kroons per hectare. The base rate may be corrected by a special condition index of increasing or decreasing funding for the management of protected territory, j = 1, 2, …, n, where n is the number of special conditions for particular protected territory. A larger or smaller than average need for funding results from the difference of the area of managed territory from the average and from the higher or lower share of the territory (land cover type or protection zone) that requires special maintenance in the total area of the protected territory. This may be a protection zone or some other territory with specific conditions with higher or lower management costs than the base rate. Further, relative area of the territory (u_i), structure (r_i), and tourist load (v_i) are considered as variation coefficients of base rate *a* for funding of a managed territory. Management costs include constant costs that do not depend on the area of managed territory, and variable costs, the size of which is proportional to the area of managed territory. The share of constant costs in the management costs of an average sized managed territory (*q*) is expert estimated to be 0.33. For a managed territory of average size $\hat{S}$ the management costs are equal to $a\hat{S}$, and for a managed territory with the area of S_i, the costs are $qa\hat{S}+(1-q)aS_i$ that makes per unit of area $a(q\hat{S}/Si+1–q)$. The change of base rate therefore can be calculated as $a(q\hat{S}/Si+1-q)-a$ or $aq(\hat{S}/Si-1)=au_i$, where the variation coefficient u_i of the base rate a indicates the relative area of the managed territory $u_{i=} q(\hat{S}/Sj-1)$.

The structure of the managed territory is the share of the area s_{ij} of territories with special conditions j (different from average management costs) in the area of protected territory i ($p_{ij} = s_{ij} / S_i$) where the size of p_{ij} is highly variable, e.g. between 23–90 in forests.

Coefficient k_j indicates the estimated change in the management costs of a protected territory with a special condition j compared to the base rate (e.g. if $k_j = 0.1$, then change is 10%, if $k_j = 1.0$, then 100%, if $k_j = 1.5$, then 150%). The estimated values for k are equal to 0.2 for agricultural areas, 0.7 for forests, 0.1 for seminatural grasslands and –0.6 for marshes and swamps.

The base rate *a* changes on a protected territory *i* under the influence of its structure by coefficient r_i, which is a sum of $p_{ij}\, k_j$ over all *j*. The additional load from tourism, which depends proportionally on the area of managed territory, has been taken into account with coefficient v_j (from –0.1 to +0.3), which is estimated to characterise the difference of tourist load on territory i from average. Summing up the variation coefficients of the base rate, we get the corrected base rate aR_i , where $R_i = 1 + u_i + r_i + v_i$. Thus, the annual area-dependent amount of funds needed for financing a protected territory i is: $C_{i=} a\, R_i S_i$ (in kroons).

The funding base rate a of protected territories can be found on the basis of the need to equalise (cover) the funds needed for all protected territories. A_1 is a total over all C_i or total over $S_i R_i$.

It has been recommended to take into consideration and reward the following additional functions of managers, irrespective of the area of managed territory, need for concluding contracts; direct involvement/occupation of the manager in tourism, providing education on the nature; need for water transport etc.

Denoting the estimate of the manager's additional function *j (j = 1, 2, ..., n)* on protected territory i *(i = 1, 2, ..., m)* in points as P_{ij}, total of all P_{ij} over all values of *j* becomes an aggregate estimate of the manager's all additional functions on protected territory *i* in points, and double total of P_{ij} over both *j* and *i* is an aggregate estimate of all loads on all protected territories under discussion in points. Funding (d) per one rating point is expressed as a ratio of A_2 to aggregate estimate of all loads on all protected territories under discussion in points. Funding (*d*) per one rating point is expressed as a ratio of A_2 to aggregate estimate of all loads in all territories, and annual funding D_i , depending on the managers' additional functions on i-th protected territory, is funding per rating point multiplied by aggregate estimate of managers' all functions.

Total funding for protected territory i equals to the sum of Ci + Di where total over all Wi equals to A (VI: 32,33).

Comparing the actual funding of the protected territories in 2000 to the calculated 'planned' funding according to the proposed methods we can see large differences. The ratio of planned to actual funding varies from 43.4% to 471%.

Figure 2 (Ehrlich, 2006) illustrates the situation after the protection reform in 2005, during which 8 nature protection regions were formed, which took the management tasks over from former nature protection area managers.

Differences in theoretically calculated and practical financing are still significant for some nature protection regions. The ratio of theoretically calculated funding to actual (2005) was for Harju-Rapla region 144%; Hiiu-Lääne region 80%; Ida-Viru region 105%; Järva-Lääne Viru region 150%; Jõgeva-Tartu region 62%, Pärnu-Viljandi region 126%; Põlva-Valga-Võru region 95%; Saare region 95%.

An Excel-based software application (Ehrlich, 2006), based on theoretical concepts presented in (VI), allows the State Nature Protection Centre to bring the financing gradually into accordance with the theoretical grounds.

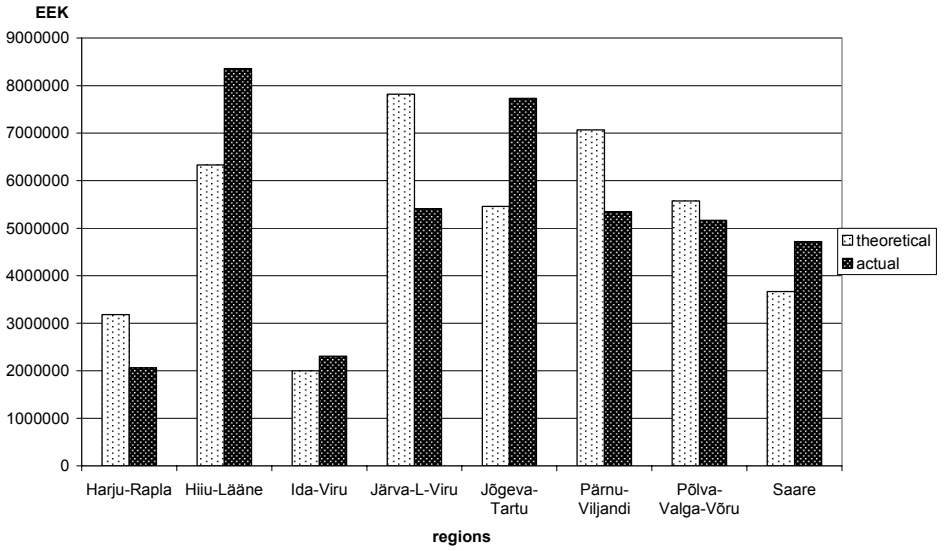

Figure 2. Theoretical funding necessity and actual funding of protected area managers

3. ECONOMICS OF ECOLOGICAL COMMUNITIES: A CASE STUDY OF ESTONIAN SEMINATURAL COMMUNITIES

3.1. Seminatural ecological communities of Estonia

Seminatural communities are traditional landscapes that developed by the action of scythe, axe, fire, and grazing (Luhamaa et al., 2001). They persist only until moderate human activity (mowing, grazing, brush cutting, cutting of birch whisks, etc,) goes on. When it stops, then seminatural communities overgrow with bushes and become covered with woods within 5–20 years. In the event the traditional rural landscape is used in an uniform manner, seminatural communities are stabilised communities or plagioclimax, which is essentially quite similar to a natural climax (Zobel, 1982).

The area of seminatural communities peaked in Estonia at the end of the 19th and at the beginning of 20th century, when it amounted to 1.8 million hectares (more than 50% of the agricultural land and ca 40% of the total territory of Estonia). Though the area of seminatural communities in Estonia has dramatically decreased over the last century (Figure 1) (Pork, 1979; Ratt, 1985; Kukk and Kull, 1997; Sammul *et al*., 2000) (II: 233), the overall situation in the EU Member States is even worse (compared with Estonia), due to the long-lasting intensive agriculture. Estonia has the largest seashore meadows, floodplain meadows and probably also wooded meadows (Leibak and Lutsar, 1996; Kukk and Kull, 1997).

There is no universal and exhaustive classification of seminatural communities. Different authors treat them differently, depending on the natural conditions and approach. One possible classification (Luhamaa et al., 2001; Talvi, 2001) suitable also for economic analyses is (in brackets is given the area in hectares of high value of corresponding community) (Kukk, 2001) (III: 235): coastal meadows (5250), alvars (9300), wooded meadows (3100), floodplain (riparian) meadows (13100), dry meadows. A more detailed classification is given by Paal (1997, 2000). The meadow associations are considered valuable primarily due to the extraordinary diversity of life there. One can find a lot of endangered and protected plant, animal and fungus species there (Palo, 1997; Pedmanson *et al*., 1997; Kukk and Kull, 1997). The Estonian vegetation has been thoroughly studied on seminatural communities (e.g. Pork, 1979; Krall et al., 1980; Masing et al., 2000) and especially on alvars (Pärtel, 1999a, 1999b).

3.2. Management and restoration costs

For economic analysis one possibility is to divide natural associations according to measures needed for their management. In market economy it may take place as follows:

1) normal economic (market) regulation (without special interposition);
2) restriction of economic activities;
3) donation of economic activities (Ehrlich, 1999).

This division is not absolute but depends on general economic and market situation. Restriction and donation are two contrary economic administrative measures for biodiversity preservation. Their common quality is that they both are a deviation from market economy and they both need monetary expenditures. Seminatural grasslands belong to the third group. Their management is unprofitable in the current economic situation (Ehrlich, 1995; Estonian Seminatural...).

The maintenance cost of seminatural communities in Estonia has been studied in respect of floodplain meadows (Ehrlich, 1996). II was the first attempt to calculate the maintenance costs of the main Estonian seminatural communities and the detailed structure of these costs, which can serve also as the basis for determining the land maintenance subsidies.

The main ways of maintenance of seminatural communities are mowing and pasturing. Mowing is the method of maintenance on floodplain meadows, wooded meadows and dry meadows, pasturing on seashore meadows, alvars and wooded pastures. In order to discuss the maintenance of seminatural communities it is reasonable to analyse the maintenance cost and its structure separately.

Mowing and hay-making as impermanent works do not presume presence of a local structure engaged with agricultural production. In principle, machinery, labour force and finances are sufficient. The structure and cost of the whole mowing and hay-making process are easy to determine.

Grazing is, unlike mowing, a continuous process, which presumes presence of a local agricultural production − cattle at least − and the respective infrastructure. So-called nature protection cattle that move from spot-to-spot are also possible but they have not been used in Estonia and we do not discuss their hypothetical cost in this paper. Therefore, we cannot talk about the total cost of maintenance of the pastured communities but about an unreceived owner's income compared with grazing on a good cultivated pasture. The information provided below is based on the actual costs of maintenance of seminatural communities, which have been found during the questioning of production farms mostly in Lääne and Pärnu County, but also in other regions of Estonia (II: 236).

The average maintenance costs of dry and floodplain meadows are given in II: 238–242, Tables 3–7. The calculations are based on the operating costs of tractors and mowers actually used for that work in Estonia (e.g. Claas and Zetor). The main cost articles considered are: depreciation, insurance, cost of fuel, cost of repair, salary and tractor transportation. The cost of one tractor and mower working hour in 2001 was 245 kroons (hereafter we consider only the maintenance costs without manager's profit). Because from the nature protection and ecological point of view it is considered inadmissible to leave the mown hay lying, which would essentially deteriorate the quality of the ecological system, the mowing costs are increased by the costs of raking and putting hay into barns, the average maintenance cost of dry meadows is 322 kroons/ha and that of floodplain meadows 615 kroons/ha. Wooded meadows are more variable by vegetation than other seminatural communities, the tree coverage may vary within the range of some thirty percent, and the amount and thickness of brushwood is different. Therefore, for the maintenance of wooded meadows it is necessary to use both small tractors and brush cutters depending on particular conditions, according to which the maintenance costs of wooded meadows vary between 1615 and 2105 kroons/ha (II: 239).

The communities maintained with pasturing are seashore meadows and wooded pastures where cattle are pastured, and alvars that are pastured with sheep. The maintenance costs of pastured seminatural communities in this work are based on unreceived owner's income compared with grazing on cultivated grasslands. The procurement price of milk used in the calculation (price level in 2000) was 2 kroons/ha. However, it should be considered that it is an extremely conjuncture-sensitive indicator. Large farmers estimate that the average daily milk yield loss per cow, compared with the cultivated pasture, is 6 litres (12 kroons) both from seashore meadows and wooded pastures. This is increased by the fall of milk procurement price due to the decline of quality (percentage of fat) by 10 kroons per cow both from seashore meadows and from wooded pastures. The economic loss from reduced growth of an heifer was estimated at 6 kroons per day. Thus, the unreceived income from cattle grazing on 1 hectare of wooded pasture is 1680 kroons per year and on seashore meadow 2520 kroons per year, which is higher per hectare than in communities maintained by mowing (II: 241).

Average restoration costs were (with fencing where necessary) for floodplain meadows 4000 kroons, alvars 2755 kroons, wooded pastures 3220 kroons, seashore meadows 4600 kroons. An essential single cost in restoring the pastured communities is the fencing. An estimated length of the fence is 100m per hectare and the cost of the fence 20 kroons per running metre (II: 243).

3.3. Economic valuation

Economic value of environmental goods is a measure of relative importance which individuals place on resources of nature. The economic value of environmental services has been divided into two categories: use and non-use values (Krutilla, 1967).

The fact that economic benefits of seminatural ecosystems has not been defined and recognised in Estonia up until recently has made the maintenance of seminatural communities uncompetitive in comparison with other necessities for decision-makers in financing from the state budget and from other sources.

Analyses of the benefits of seminatural communities in Europe have mostly involved seminatural wetlands (Andreasson-Gren, 1995; Dister et al., 1990; Elofsson, 1993; Farber, 1988; Folke, 1991; Shabman et al., 1978) where they use mostly indirect valuation methods. In Estonia, the use value of seminatural wetlands (floodplain meadows, seashore meadows) has been evaluated so far using indirect valuation methods (Gren et al., 1996; Ehrlich, 1999). Examples of the direct valuation method may be found in studies by Hanley & Craig (1991) and Bateman et al. (1993) (II: 229).

Use values can be estimated by using direct and indirect methods, while non-use values can be estimated only by using direct methods (Andreasson-Gren, 1995). The most important values of seminatural communities are represented in the following table (Gren et al., 1996; II: 245).

VALUES OF SEMINATURAL GRASSLANDS			
Harvest values	**Life-support values**	**Recreational values**	**Biodiversity**
– hay – grazing land for cattle and sheep – fish	– nutrient cleaning – waste assimilation – flood protection – biodiversity	– bird watching – bathing – sport fishing and hunting – beautiful wetland nature scenery	– functional diversity – resilience – information – genetic pool
RELEVANT ECONOMIC VALUATION METHODS			
– single market models – multi market models	– travel cost methods – contingent valuation methods – hedonic model	– the same as for harvest and recreational values – preventive costs – replacement costs	– all other methods and models – risk models

Relevant for the estimation of seminatural community services are (Gren et al., 1996):

- Ecosystem models which relate the different ecosystems to their production of environmental services;

- Models describing the linkages of the seminatural communities in question to other ecosystems and the human society;
- Economic models describing households' decisions about the use of environmental services for estimating the value of their consumption of ecosystem services.

Such models for seminatural communities are not available and therefore it is practically impossible to estimate many services in money terms (II: 245).

The nutrient retention in controlled conditions of Estonian biological communities has been thoroughly studied (e.g. Mauring et al., 2001; Mander et al., 2000; Mander & Mauring, 1994; 1997). Monetary evaluation studies in Europe regarding seminatural communities is carried out mostly for seminatural wetlands. For instance, estimated for annual value of wetlands per hectare in Gotland is EUR 223 (Folke, 1991), in Stockholm region EUR 390 (Gren, 1993), Danube floodplains EUR 383 (Andreasson-Gren, 1995) and in Po River delta EUR 1300 (Tomasin, 1991). Preliminary studies of monetary evaluation of Estonian seminatural wetlands has been carried out for river Emajõgi floodplain (Gren et al., 1996, Ehrlich, 1999).

According to James (1994), environmental goods are entirely unpriced, their values may be derived by direct questioning techniques known as contingent. The contingent valuation method (CVM) for the valuation of environmental goods was first used by Davis (1963 a) in a study of hunters in Maine. However, it was not until mid-1970s that the method's development began in earnest (Brookshire et al., 1976; Randall et al., 1974). Since then, the method has become the most widely used and most controversial of all environmental valuation techniques. Comprehensive accounts of the method may be found in Mitchell and Carson (1989), Hanley and Spash (1993) and Bateman and Willis (1995) (II: 247).

Although there are authors who have expressed doubts about the application of some aspects of the contingent valuation (Eberle & Hayden, 1991; Harrison & Lesley, 1996; Nunes & van den Bergh, 2001), just during the last decades the method has gained more ground due to the lack of suitable alternatives (Diamond & Hausman, 1994) especially for estimating economic value of certain territories (mainly protected areas) (Franco et al., 2001; Hadker et al., 1997; Lee & Han, 2002; Scarpa et al., 2000; White & Lovett, 1999), as well as communities and ecosystems (Amigues et al., 2002; Holmes et al., 2004; McDaniels & Roessler, 1998; Pate & Loomis, 1997; Rekola & Pouta, 2004; Turpie, 2003) and certain biological species (Bandara & Tisdell, 2003; Giraud et al., 1999; Kotchen & Reiling, 2000). The method is an important tool in finding arguments for restoration of communities (Spash, 2000). The method is widely used also in fields not so directly linked with nature protection for finding out monetary equivalent of non-market values (Aakyla, 1999; Nomura & Akai, 2004; Wagner et al., 2001).

There is no standard approach to the design of a contingent valuation (CV) survey. In most cases the CV survey contains three parts: 1) simulated market scenario of availability of the surveyed environmental good upon which valuation is contingent; 2) "willingness to pay" (WTP) (for the surveyed environmental good) or "willingness to accept" (the loss of the surveyed environmental good) question, which is presented in a certain form; 3) sociometric questions about the respondent. The survey is distributed to a random representative selection of respondents.

Natural and seminatural communities are specific environmental resources, the economic evaluation of which differs considerably from the evaluation of the quality of environment (e.g. purity of water and air). A problem that inevitably arises in the economic evaluation of communities is the current situation of the object to be evaluated as well as the description of possible changes. The value of Estonian seminatural communities was determined in the questionnaire with the help of "the general comprehensibility principle", which presumes that the introducing text was comprehensible to all respondents. The composition of the random sample (total number of respondents was 474) serving as the basis of the contingent valuation study, is in detail characterised in (II: Table 10). The arithmetical mean, median and mode WTP were used for the description of WTP of the respondents, who were divided into groups by their sociometric features. The median WTP of the sample is regarded as the most truthful for identifying the average WTP, because it eliminates the extreme cases. The mean, median and mode WTP by sociometric features is established in: (II: Table 11). The following regression model was constructed to find the impact of the sociometric indicators of the respondents on the WTP:

$$\ln(WTP)=a_0+a_1\ln(INC)+a_2 DUMMY(SEX)+a_3\ln(EDU)+a_4 DUMMY(NATION)+a_5\ln(AGE)+\varepsilon$$

where:
INC – respondent's monthly income (kroons)
SEX – respondent's gender (0–female, 1–male)
EDU – respondent's education (1–primary, 2–secondary, 3–secondary-special, 4–university, 5–academic degree)
NATION – respondent's nationality (0–non-Estonian, 1–Estonian)
AGE – respondent's age (years)
ε – error term
Results of the regression analysis are presented in: (II: Table 12.)

On the whole, the regression is statistically significant (F–statistics-based). A relatively small R–squared (analysed factors explain the 10% dynamics of independent variable) is still significant for the cross-section data. Analysis of t-Statistic indicates that statistically significant in the regression are the respondents' income and age. Other indicators do not significantly influence the willingness to pay (II: 255). An aggregate WTP of the working-age population was

calculated on the basis of data which characterise the size of groups with different WTP (II: Table 13).

The hypothetical WTP can be approximately found from the demand curve (Figure 7). For that purpose, sections corresponding to the size of different WTP groups of working-age population have been represented on the x-axis on Figure 7, beginning from the group with the highest and ending with the smallest but still positive WTP. Now, a vertical line can be drawn from the middle of each section and the length of this line corresponds to the average WTP of the respective WTP group. Thus, every WTP group and its average WTP on Figure 7 is characterised by a point (x, y). These points can be depicted on a line and equation of this line $y = ae^{-bx}$ represents the dependence of y on x. The function y = f(x) was found using the EViews 3.0 software. Taking this line as a demand curve and integrating the equation of this line, we get an approximate overall WTP of the working-age population, which is 128.65 million kroons. Taking 1220 kroons as the annual average maintenance cost of 1 hectare of seminatural grassland, we can see that the aggregate annual WTP of the working-age population, if this sum of money is really paid, would cover the maintenance cost of approximately 100,000 hectares during a year (II: 257, 258).

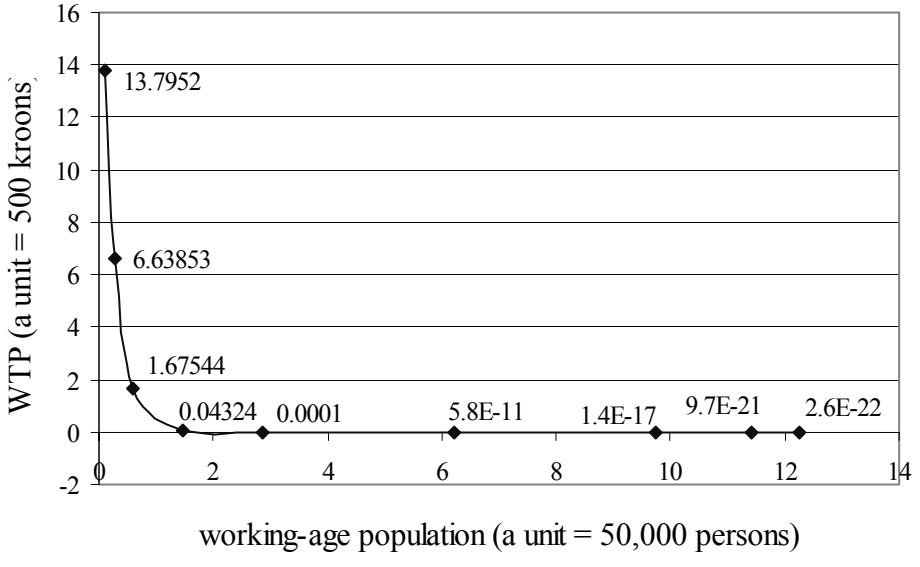

Figure 3. Total Demand Function for Maintenance of Seminatural Communities

4. ECOLOGICAL ECONOMICS OF COASTAL ZONE

4.1. CORINE Land Cover Classes of coastal zone

Remote sensing and GIS analyses are widely used in land cover mapping and for analyzing economy (Darvin et al., 1996), landscape (e.g. Zharikov et al., 2005; Ayad, 2005) and vegetation (Acosta et al., 2005). In Estonia the satellite images have been used for studying agricultural land use units (Peterson & Aunap, 1998), vegetation types of marshes (Aaviksoo, 1995; Aaviksoo et al., 2000); the changes of land cover classes on protected areas (Aaviksoo & Muru, 2001; Muru & Aaviksoo, 2001) and the changes in forested areas (Peterson & Püssa, 2001). Remote sensing as a tool for vegetation mapping on Natura 2000 areas has been analysed by Aaviksoo (2005).

In the coastal zone a transition from maritime to continental ecosystems occurs, which ensures a variety of ecotopes, high biological diversity and the potential to supply multiple services (ecological, economic and social) (IV). The Baltic Sea with its long coastal zone is one of the most endangered oceans in the world (Jansson and Dahlberg 1999, op. cit. IV). The southern coast of the Baltic Sea in Poland, Lithuania, Latvia, and Estonia is among the most sensitive cluster of European coastal zones in both socio-economic and ecological terms (IV). The Estonian Baltic Sea coastline is 3794 kilometres long (incl. islands) (III; IV). The coastal landscape is variable – from coastal meadows and grassland on West-Estonian coast to a 50m high limestone cliff in North-Estonia. For historical reasons, the Estonian coast is more natural and relatively little influenced by human activity than in many other European countries. In connection with the transition to a market economy, a very strong anthropogenic pressure has become noticeable in recent years on the use of the coast by both domestic and foreign capital, the influence of which is often negative on the aesthetic value of the coast, biological diversity and other nature values (III: 109).

By law, coastal zone is defined as a 200 m wide buffer starting from the mean sea water level line. The aim of analysis of land cover units in the 200m coastal zone was to identify coastal natural resources (both location and quantity), which is a precondition for identifying their market and non-market values, and examine protected areas on the coast and evaluate adequacy of nature protection measures to preserve coastal communities (Ehrlich et al., 2001). Corine Land Cover (CLC) makes results comparable with other European regions as compilation of CLC data has been completed in almost all Europe.

The database is compiled using the following existing and publicly available data sources: CORINE Land Cover database; administrative division database; nature protection areas database. All these databases (layers) are built up using the geographic information system (GIS) principles, i.e. in this case all three

data layers hold area-type (polygon) data and with every polygon certain descriptive (attribute) data are stored. Data processing was performed using GIS software ArcInfo (*Environmental Systems Research Institute, Inc*.). After logically joining these layers, the result included 'elementary' polygons each having attributes defining land cover type, administrative unit, protection zone type, etc. To get coast zone, a buffer polygon was generated around the sea coastline and added to the resulting database using union operation (III: 10). The administrative division database is compiled by the Estonian Land Board, which is responsible for geodetic, cartographic and cadastral works in Estonia. Administrative boundaries are kept in different nominal scales (1:10000, 1:50000 and 1:250000), for the project 1:50000 scale data were chosen because these fit the best with CLC data. The nature protection areas database is managed by the Estonian Environment Information Centre with their boundaries conforming to the 1:10000 scale. To harmonise the scale of protection areas boundaries with other databases some generalization was made before joining these databases. Due to the different scales and sources of initial data, boundaries of same features in different databases are usually not identical. Especially vulnerable is the coastal zone because both CLC and administrative databases include sea coastlines, plus these parts of nature protection areas where the boundaries run along the coastline. It can be estimated that errors of the analysis are around 5% (III: 111).

The results of analysis of the CORINE 200 m zone land cover classes for Estonia are presented in (III: Table 2). The land unit with the largest area in the zone is inland marshes (4.1.1.1) with ca 7900 ha, accounting for 16.6% of the zone area. Beaches overgrown with reeds is the tendency of the last decades, which is due to the decreasing mowing and grazing. As it has happened all over Estonia, the area of natural grasslands has diminished in the coastal zone (II, IV). A certain number of marshes overgrown with reeds are, however, indispensable as habitats, but extensive overgrowing with reeds reduces openness of the beaches and with this their aesthetic and recreational value. The second largest land cover class by total area is the coniferous forest (3.1.2), which is represented in the coastal zone with 7156 ha (15% of the zone area) and the third largest are the natural grasslands (3.2.1) with 7147 ha (15% of the zone area). The three first land cover classes are followed by transitional woodland/scrub on mineral land (3.2.4.1) with 4717 ha (9.9% of the zone area) and beaches, dunes and sands (3.3.1) with 4512 ha (9.5% of the zone area). The five largest land-use units cover 76% of the total 200 m coastal zone. The total area of the following land cover classes is also over 1000 hectares: moors and heathland (3.2.2) with 3305 ha, land principally occupied by agriculture, with significant areas of natural vegetation (2.4.3), mixed forest (3.1.3) with 2501 ha, broad-leaved forest (3.1.1) with 2043 ha.

4.1.1. Protected areas in the coastal zone

Data on the protected land units in the 200 m coastal zone are established in (III: Table 2). The largest protected land cover class in the coastal zone is natural grasslands (3.2.1) with 2094 hectares, accounting for slightly over 29% of the total area of the respective land cover class in the coastal zone. The existence of these land cover classes depends on regular management, and management in turn requires subsidization (Ehrlich, 1997; 1999). As Estonian practices demonstrate it is easier to obtain subsidization of management in protected areas than in other areas. The second largest land cover class in the coastal zone by total area under protection is the coniferous forest (3.1.2) with 1933 hectares (27% of the total area of the respective land cover class in the 200m zone) and the third largest is the inland marshes (4.1.1.1, 1379 hectares). These are followed by beaches, dunes and sands (3.3.1) with 1303 hectares and transitional woodland/scrub on mineral land (3.2.4.1) with 1125 hectares. The major protected land cover classes in the coastal zone are water bodies (5.1.2) – 60%, followed by coastal lagoons (5.2.1) with 59.2% and salt marshes (4.2.1) with 57.5%. Good protection of coastal water bodies and lagoons enables them to fulfil the nature protection task as a stopping and breeding place for waterfowl. The artificial surfaces that belong in the protected zone are non-irrigated arable land (2.1.1, 28.5%) and discontinuous urban fabric (1.1.2, 15.5%).

Of the 200 m coastal zone the total of 23.8% is protected territories, which is over two times more than the total coverage of Estonian protected territories in percent (Table 2). In Estonian coastal zone 8% of the artificial surfaces, 21.6% of agricultural areas, 26.4% of forests and semi-natural areas, 18.7% of wetlands and 56.6% of water bodies are under protection.

4.1.2. Distribution of the coastal zone land cover classes by counties

The county-wise distribution of CLC classes that are situated in the 200 m coastal zone are represented in (III: Table 3). The counties are geographically arranged, following the coastline from East to West (Fig. 1b). In the easternmost county − *Ida-Virumaa* − where a substantial part of the 200 m coastal zone includes coastal cliffs, the most dominating land cover class is mixed forests (313), occupying 29% of the area of the 200 m zone of the county, and more than 19% of the mixed forests of the coastal zone of Estonia. A relatively big role is played by non-irrigated arable land (211) covering 27% together with land principally occupied by agriculture (243). Unlike in the rest of the counties, the importance of coniferous forests (312) is small. Inland marshes (4111) and beaches, dunes and sand (331) are land cover classes that are also very slightly represented. At the same time, half of the 42 hectares of Estonian coastal zone mineral extraction sites (131) are situated in Ida-Virumaa

county as the main mining region of Estonia. Coniferous forests (312) with their 35% coverage area form the predominant land cover class in *Lääne-Virumaa* county, while land principally occupied by agriculture (243) and inland marshes are following with 17% and 15% of the coastal zone area of the county, respectively. The importance of natural grasslands (321) is negligible. The coastal zone of *Harjumaa,* as the most densely populated county of Estonia, is encompassing lots of land cover classes, none of which are having great dominance. Similarly to Lääne-Virumaa county, the most widely distributed land cover class is coniferous forests (312) with its 17%, followed by beaches, dunes and sand (331) with 12% – which is pointing at favourable recreation possibilities – and land principally occupied by agriculture (243) with 10%.

As expected, Harjumaa has the greatest coverage of artificial surfaces, like discontinuous urban fabric (112) (55%) and industrial or commercial units (49%). As for port areas (123), a little more than half of that respective land cover class of the whole country is situated in Harjumaa. But even in Harjumaa artificial surfaces do not constitute more than 16% of the county's coastal zone area as a whole. On the other hand, human impact on the coasts of Harjumaa – as the county surrounding the capital city – is undoubtedly the biggest. One of the insular counties – *Hiiumaa* – is the most forested one in the whole Estonia. Coniferous forests (312) occupy the largest share (24%) of the coastal zone land cover classes. Natural grasslands (321) with 20% and transitional woodland scrub on mineral land (3241) with 15% are following. On the Estonian biggest island *Saaremaa* there are three dominating land cover classes: inland marshes (4111) with 18%, moors and heathlands (322) with 16% and natural grasslands (321) with 13%; coniferous forests (312) and beaches, dunes and sand (331) occupy just a little less, confirming the maintained diversity of the coastal zone of Saaremaa. Overwhelming part of Estonian coastal zone moors and heathlands (322) are situated in Saaremaa. Generally speaking, the replacement of opened landscapes with reedbeds (inland marshes) and juniper bushes is the greatest danger to the coasts of Saaremaa. In *Läänemaa* county, natural grasslands (321) with 27% and inland marshes (4111) with 26% are nearly equally represented. In combination with coniferous forests (312) (12%) they occupy almost 2/3 of the coastal zone of the county. In Läänemaa county (Matsalu Nature Reserve) the largest compact coastal pastures (CORINE land cover class natural grasslands (321)) are located. The coastal zone of the county is also an important feeding and resting site of European standard. Discontinuous urban fabric (112) is considerably well represented among other artificial landscapes. In Pärnumaa county inland marshes (4111) have an overwhelmingly largest territory (37%), while land principally occupied by agriculture (243) and natural grasslands (321) are both following with 13%. Intensive overgrowing with reeds due to dropping of grazing is taking place in Pärnumaa county as well (III: 115).

4.2. Economic activities as means of coastal nature conservation

At present, the most important socio-economic aspects of sustainability issues in the Estonian coastal zone are: the marginalisation of rural areas, low investment rates, a high unemployment rate, the abandonment of agricultural lands, the lack of land use concepts, land ownership changes, conflicting nature conservation, the development of coastal fisheries and tourism, and high potential for ecotourism integrating the islands and coasts. In order to avoid further marginalization and maintain natural diversity in coastal regions, there is a great need for supplementary activities to assure employment and the land should acquire additional surplus value through multifunctional land use. Some of the abandoned agricultural land is converted to forest (appr. 2%). This may, however, have a secondary impact, as in several cases old over-grown wooded meadows and natural grasslands are planned for forestation instead of hay-making. This can lead to a decrease of biodiversity and the loss of beautiful views (IV). Thus it can be stated that the decreasing of nature value of Estonian coastal zone has evident social reasons.

Under current economic conditions, protection of seminatural communities today is possible only by subsidizing their maintenance (II). Since 2001, land maintenance subsidies are paid for mowing and grazing on protected territories and on potential protected territories. Approximately 19 million kroons is earmarked for that purpose in the budget of the Ministry of Environment annually.

It is especially important that the projects and development activities that are undertaken for the protection of nature values of coastal zone would not be separately funded each time but would make the traditional economic activities in the coastal zone self-financing, guaranteeing thereby their sustainability.

4.2.1. The Väinameri Project

The aim of the Väinameri Project is to restore and maintain the valuable coastal landscape, increase and sustain natural values, increase the attractiveness of the area, and to create better living conditions for rural people in sparsely populated areas. This goal can be achieved by improving the conditions for a sustainable agriculture based on the existing high natural values and the current low use of fertilizers and chemicals (V:155).

The organizational structure of the Väinameri Project is rather complicated, with a large number of partners involved (V: Fig. 4). Major acknowledgement should go to World Wildlife Foundation (WWF) Sweden for elaborating the overall ideology of the project, as well as for their overall support and the backing of the project. In 2000–2003, WWF-Sweden applied for additional aid

from SIDA, the Swedish International Development Agency. All project costs (incl. salaries for experts, study tours etc.) were app. EUR 0.5 million. The national co-coordinator was NGO *Arhipelaag* acting as an engine for the project in the Väinameri area. Apart from the above-mentioned participants, there is a very essential group of local people who have been sustaining the success of the project in their land, farms, enterprises, shops. Although these people are the beneficiaries of the project, they have provided its most tangible results. And, when the project is formally completed, they will carry on the ideas and concepts elaborated during the project (V: 154).

The basic concept is close-to-earth quality production, with nature conservation as an added value. By purchasing "naturally grazed meat" the customer not only pays for a good quality product but also for conservation, thus helping to maintain a coastal agricultural landscape. The development of small-scale tourism based on natural values, cultural heritage and local handicraft production will create additional job opportunities for local residents. The natural resources gained while maintaining the landscape can be used as material in handicraft production. Thus, development of sustainable agriculture, small-scale tourism and regional production of both agricultural products and handicrafts will directly benefit both nature and local residents. Apart from the biodiversity and landscape-related targets, the Väinameri Project is also aimed at socio-economic results, such as: 1) creating a viable coastal countryside society; 2) supporting strong families with multiple livelihood options; 3) networking of people; 4) encouragement of voluntary co-operation of individuals. The main constraint in the project area is insufficient economic resources available to the key stakeholders and a poor understanding of the issues related to coastal and semi-natural habitat management in the community. Therefore, the Väinameri Project aimed to emphasize both the conservation value of the habitats and the diverse countryside economy. This should have allowed the project to overcome the obstacles posed by insufficient financial resources available to rural people.

The Väinameri Project was successful because the lands were under reclamation and new management models were expected. The Väinameri Project acted as a promoter of rural improvement through the following activities: assistance to purchasing small-scale machinery, tools and electric fences; creation of pure breed beef cattle stocks; branding/labelling, and marketing of local handicraft products; creation of nature trails, watching towers and demonstration sites; study tours to Sweden, and in regions of Estonia; lectures and consulting by high-level experts; encouraging creation of societies for farmers, artisans and entrepreneurs; maintenance of information exchange and networking among local inhabitants.

The basic concept of the Väinameri Project is so called *food-chain*, referring to the sequence of organisms that are mutually related through nutrition and being the object of nutrition. The first level should operate sustainably, taking into account the natural values (Fig. 5). The second level production should

proceed from local skills, thereby ensuring both product quality and diversity of income sources. The third stage should exhibit links between the product, natural and cultural values, i.e. customer service should be of educational nature, ensuring respect for the region and increasing the dignity of local people. This type of model is based on consumer preferences. Consumer choices and the value she/he places on goods influence the first and second level processes, and that in turn affects landscape features and the conservation of natural values.

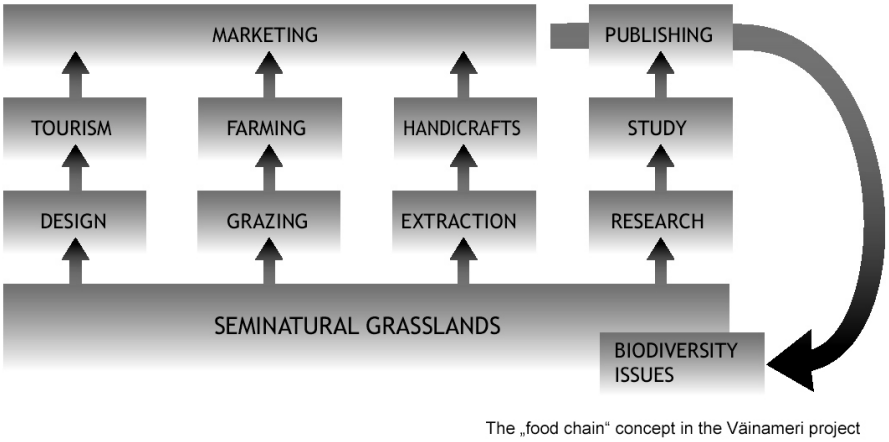

Figure 4. The *food chain* concept in the Väinameri Project

The Väinameri Project strives for a holistic approach to the management of coastal ecosystems, and was built on the following assumptions:

- environmentally friendly cattle farming is essential to ensure high biological and cultural values, and diversity in agricultural landscapes;
- prospects for sustainable agricultural production in unfertilized semi-natural grasslands are good. Both the interest in diversification of products and the demand for healthy and safe food are constantly increasing. Results of several polls show that locally produced goods are of high priority to Estonian consumers;
- diversification of work opportunities and wise use of natural resources is necessary to achieve sustainable rural development;
- directed subsidies involving environmentally friendly commitments are a strong force towards achieving environmental objectives ensuring more sustainable development;
- consumer selection of food products is a strong and important force for agricultural policies and can mediate conservation of biologically valuable areas (V: 157–158).

4.2.1.1. Activities and initiatives of the project

Increased cultivation of naturally unfertilized grasslands is necessary for maintaining the area's biological values. The main goal of the project is to ensure the long-term cultivation of these area to maintain the area's rich biological diversity. This can only be done by offering farmers and their families possibilities for survival. Increasing competence in animal husbandry, breeding and business economics are therefore of the utmost importance. This part of the project aims to develop efficient production units and production networks, quality production (meat, wool), ensure availability to market, and evaluate the effects on nature. The project includes the following activities to achieve the desired results in the grassland management tasks:

- increased cultivation of naturally unfertilized grasslands is necessary to maintain the area's biological values;
- establishment of high-quality beef cattle and sheep herds;
- increased grazing of coastal grasslands;
- creation of model pastures and demonstration areas;
- education and study visits;
- indicator species survey.

The influence of the project on the landscape management is summarized in Table 4.

Table 4. The project's influence on landscape/grassland management

Area grazed yearly	Appr. 2000 ha
Area cleaned from bushes	110 ha
Area mowed yearly	Appr. 2800 ha
Number of cattle related to the project (i.e. pure breed and crossings)	Appr. 500
Number of sheep related to the project	Appr. 400
Number of bush cutters	18
Number of chainsaws	8
Length of electric fence	Appr. 60 km
Study tours (number of participants)	7 (74)

Besides grassland management the Project achievements include also local handicraft industry and nature tourism development, which are with agriculture important preconditions for the Project results to be sustainable.
The Väinameri Project has been chosen by WWF programme *One Europe More Nature* (OEMN) as one of four demonstration sites and a good example of rural development and nature conservation. In conclusion, the main achievements of the Väinameri Project are:

- increased number of visitors to the area and income from local production;
- maintained and restored biodiversity;
- shifts in the approaches to balanced ecosystem management, agricultural and regional development policies;
- increased awareness in Estonia and neighbouring countries;
- creation of complete production chains (meat, handicraft, tourism) including international links, capacity building of local authorities for enterprise support, thus giving the project a more market-oriented base.

The main message from the project is that biodiversity can be an important component of rural development, which does not necessarily contradict to economic prospects and social aims of rural communities (V: 159–161).

5. DISCUSSION

The aim of establishing and maintaining the protected areas (objects) is to preserve the landscapes, habitats, species of plants and animals and particular objects which the decision-makers value enough to justify in our present economic situation the expenses needed for their protection. This brings upon the need to compare the benefit of non-use value (non-utilitarian value) of nature's diversity with the actual costs, which emerge when the utilitarian usage of resources is restricted. What are the conclusions/decisions reached in this comparison depends on how highly the decision-makers value the protected areas and objects. The value of protected areas taken into account by the decision-makers can be viewed as consisting of three parts: a) direct economic value, which can be measured in monetary terms gained from the practical usage of nature recourses of these areas; b) indirect economic impact of protected areas (areas of restricted utilitarian nature resource usage), which can only be measured by the expression of indirect economic effect; c) non-use value of protected areas and objects, which appears in several interwoven ways (e.g. aesthetical, psycho-social, educational and scientific value).

To be able to compare and find the common denominator for the non-utilitarian value and the other values (including use value), it has to be expressed as a monetary equivalent of the non-use value. Detecting the monetary equivalent for non-use value along with the management of territories bringing up a new nature resource potential (which is based on non-use values) is an essential question of study in ecological economics.

As the protection of species, habitats and ecosystems is in fact a territorial phenomenon, the tasks of ecological economics can only be solved with geographical methods, eg carrying out the quantification of protected nature resources, which presumes the analysis of territorial units by a GIS-based method. Also, the outlining of protection activities for the types of habitats in need of protection like seminatural communities, and zones with higher risk of resource utilization conflict like the coastline, can only be carried out by joining the research methods of both economics and geography. Therefore the nature conservation management is in fact a bordering science where the components of economics and geography are closely intertwined.

To get information on the distribution of protected territories and their zones, digital map data from different sources was processed using geographic information system (GIS) software ArcView. The analysis of Estonian protected areas detected that the protected territories are distributed unevenly between counties. If, for instance, the consumptive economic activity in Läänemaa is restricted on 20% of the territory, then in Põlvamaa the protected territories account for less than 5% of the area of the county. Yet, based on experiences of other countries where nature protection has been developed into an effective branch of economy one can claim that the territories with the

limited consumptive resource utilization (protected areas) are not simply excluded from the economy but can effectively participate in the economy and thereby exert a positive effect on material welfare through the utilisation of non-use values. The problem is especially valid as the regional differences in the material welfare level are large in Estonia and the opportunities offered by the consumption of non-use values should be seized. Although the correlation analysis based on data on material welfare and proportion of protected territories to the county territory for all 15 Estonian counties, detected no significant correlation, special attention should still be paid to the counties where the monthly average net income per household member (the characteriser of material welfare of people), is lower than the average of Estonian, and the area of protected territories forms a larger part than on the average in Estonia. Such counties are Valgamaa, Ida-Virumaa, Viljandimaa, Võrumaa, Hiiumaa, Tartumaa and Läänemaa.

There are two preconditions for changing the protected areas into significant factors of economic development: a) creating a protection regime that maximises the nature resource potential; b) development of a well-grounded funding system, which takes into account the managers real tasks and the amount of nature resources to be managed. The elaboration of solutions for these two preconditions has been one of the significant tasks of the current thesis.

Possibilities for management of protected areas as territories designated primarily for the protection of natural resources depend on the state of these resources and their natural potential serving as the basis for their nonutilitarian use, which can be divided into several subpotentials from general ecological to recreational. As a protected territory as a rule is not a homogenous territory, the division of its parts into zones (zoning) with different protection (and the ensuing management) regimes based on natural differences must guarantee preservation as well as maximum possible utilisation of the natural potential of this territory, serving thus as a starting point for the management of this protected territory. Therefore, the zoning of a protected territory represents an optimisation task where the objective (objective function) is to maximise availability of the sub-potentials of the protected territory with the restriction of protecting and preserving the natural resources on this territory.

Obviously, no arguments can arise from the empirical truth that the distribution of the state budget funded management costs of protected territories between the managed territories satisfies the need the better, the more the area and specific features of these territories have been taken into account. The present thesis set the task to elaborate and present methods for planning management costs of protected territories that would be fairly applicable also if the managed territories and the number of factors taken into consideration change and the coefficients for estimating the impact of the latter are revised. The methods take into consideration the area and structure of protected territories, share of constant costs in total costs, and manager's additional functions that vary across protected territories and which

may depend or not depend on the area of the managed territory. Differences in theoretically calculated and practical financing are still significant for some nature protection regions. The ratio of theoretically calculated funding to actual (2005) was for Harju-Rapla region 144%; Hiiu-Lääne region 80%; Ida-Viru region 105%; Järva-Lääne Viru region 150%; Jõgeva-Tartu region 62%; Pärnu-Viljandi region 126%; Põlva-Valga-Võru region 95%; Saare region 95%.

The ecological economics of communities are dealt in the present thesis at the example of Estonian seminatural communities, which are very valuable from the nature protection point of view, but are most threatened in the present economic situation. The Estonian seminatural communities discussed in the paper (wooded meadows, wooded pastures, dry meadows, coastal meadows, alvars, floodplain meadows) are a valuable natural resource, the utilisation value and hence also the area of which has dramatically declined during the past 50 years as a result of qualitative and quantitative changes in agriculture. At the same time, seminatural communities are a deficient resource in all Europe, the non-use value of which has been rising constantly. A precondition for the existence of seminatural communities is their continuous (recommendably annual) maintenance. The present economic environment does not ensure the use of seminatural communities and hence, their preservation. The principal methods of maintaining the communities discussed in this paper are grazing (wooded pastures, coastal meadows, alvars) and mowing (wooded meadows, dry meadows, floodplain meadows). The target of subsidisation is different in the case of mown and pastured communities. In the case of pastured community, it is unreceived owner's income compared with grazing on a good cultivated grassland, in the case of mowing – the whole process of work. The unreceived owner's income from the maintenance of pastured communities studied by us, compared with a good grassland, is: wooded pastures 1680 kroons/ha/year; coastal meadows 2520 kroons/ha/year; alvars 345 kroons/ ha/year. The maintenance costs of mown communities are: wooded meadows ca 2000 kroons/ha/year; dry meadows 322 kroons/ha/year; floodplain meadows 615 kroons/ha/year. An average restoration cost of the degraded seminatural communities is estimated at 3400 kroons per hectare. In order to motivate the funding needs for the preservation of seminatural communities, we need to know besides the size and structure of the maintenance costs also their social value which nowadays consists mostly of non-use value. In order to estimate the non-use value of Estonian seminatural communities, a contingent valuation study was performed, in the process of which the willingness to pay of the Estonian population for the preservation of seminatural communities in Estonia was found. The regression model constructed on the basis of these results leads to a conclusion that the willingness to pay is essentially influenced by age and income. The impacts of nationality, education and gender on the willingness to pay, however, are small. In order to find out the willingness to pay, a total demand function was constructed. The calculations performed on the basis of this function indicate that the aggregate willingness to pay of the Estonian

working-age population for the preservation of seminatural communities is nearly 130 million kroons[7]. This can be interpreted as the monetary equivalent of non-use value of Estonian seminatural communities, which would enable to cover the annual costs of maintenance of ca 100,000 hectares of seminatural communities or the restoration costs of nearly 38,000 hectares.

Due to the increasing expansion of economic activities, urbanization, resource use and population growth, coastal zones are among the most vulnerable ecosystems on our planet. For reasons caused by history, the coast in Estonia is more natural and relatively less influenced by human activity than in many other European countries. In connection with the transition to a market economy, a very strong anthropogenic pressure has become noticeable in recent years on the use of the coast by both domestic and international capital, the influence of which is often negative on the aesthetic value of the coast, biological diversity and other nature values.

On this territory the law stipulates various restrictions on economic activity and utilization of resources with the purpose to protect the coast, e.g. on the erection of new buildings directly not connected with the coast, clear cutting of woods, etc. An aim of the study was to compose an original database and analyse the land cover in the whole 200 m wide coastal zone based on the CORINE Land Cover (CLC) nomenclature using CORINE Land Cover layer, the administrative divisions layer and the nature protection areas layer. The 200 m zone of Estonian coast is very diverse, according to CLC classes. Out of the 34 CLC classes – which is the total number in Estonia – 30 are represented in the 200 m coastal zone. Three larger land cover classes, which occupy more than 7000 hectares in the 200 m coastal zone, are inland marshes, coniferous forests and natural grasslands. The location of land cover classes varies across counties. In the coastal zone of North-Estonian counties the dominating land cover class is coniferous forests (3.1.2), followed by land principally occupied by agriculture (2.4.3), mixed forests (3.1.3) and beaches, dunes and sand (3.3.1), which all occupy a considerably smaller area. On the other hand, in the coastal zone of western Estonia (including the islands) the dominating land cover class is inland marshes (4.1.1.1), followed by natural grasslands (3.2.1). The Estonian coastal zone is generally in good natural condition. The proportion of artificial surfaces throughout the zone is merely 4.7%, agricultural landscapes cover only about 10%. In the coastal zone, after pasturing and mowing ceased, the alvars and sea-shore meadows were replaced by inland marches (mostly reedbed areas) (16.6%, 4.1.1.1), and transitional woodland/ scrub (9.9%, 3.2.4.1). Thus, due to ceasing of pasturing and mowing seminatural communities have been replaced by natural communities and not by artificial surfaces (4.7%, CLC classes 1.1–1.4) or agricultural areas (10.4%, CLC classes 2.1–2.4), i.e. the conditions were not significantly influenced by direct human activity. Of the 200m coastal zone 23.8% is under protection, which is twice as high a value as the Estonian average. As CORINE land cover classes are considered to be the land cover classification standard throughout

Europe, it gives a good opportunity for further comparative analyses of the coastal zones in different countries and regions.

As the seminatural habitats are one of the dominating habitats in the coastal zone, it is essential to work out a concept which would allow to implement projects which would not need a constant subsidisation of management, but are sustainable. The semi-natural coastal plant communities that developed during thousands of years have today become a high priority for nature conservation. Continued preservation requires ongoing human activity. The possibilities to create sustainable management in the coastal zone is viewed at the example of Väinameri Project. The basic concept is close-to-earth quality production, with nature conservation as an added value. By purchasing "naturally grazed meat" the customer not only pays for a good quality product but also for conservation, thus helping to maintain a coastal agricultural landscape. It will result in an increased number of visitors to the area and income from local production. The main experiences obtained from the Väinameri Project that verify the homogeneity of nature protection and regional development objectives are: maintained and restored biodiversity; shifts in the approaches to balanced ecosystem management, agricultural and regional development policies; increased awareness in Estonia and neighbouring countries; creation of complete production chains (meat, handicraft, tourism) including international links, capacity building of local authorities for enterprise support, thus giving the activity a more market-oriented base. It can be concluded that the biodiversity can act an important component of rural development, which does not necessarily contradict the economic prospects and social aims of rural communities.

6. CONCLUSIONS

The main non-use values of nature, serving as an argument for nature conservation are: general ecological, biological, recreational, aesthetic, psycho-social, educational and scientific value. Compared with use values, non-use values do not presume direct physical consumption, do not give direct economical profit in general, do not subject to market rules (*market failure*), benefits are rather global than local, also they make an impact rather on quality of life than on living standard and they are relatively difficult to measure and express in monetary terms.

The protected territories in Estonia are distributed unevenly between counties (from app. 5% in Põlvamaa to over 20% in Läänemaa). Although the correlation analysis based on data on material welfare and proportion of protected territories within the county territory for all 15 Estonian counties, no significant correlation was detected. The counties where the monthly average net income per household member is lower than the average of Estonian, and the area of protected territories forms a larger part than the average in Estonia are Valgamaa, Ida-Virumaa, Viljandimaa, Võrumaa, Hiiumaa, Tartumaa and Läänemaa.

The current thesis provided solutions for two substantial problems which have to be dealt with in order to implement efficient management of nature conservation and for the expression of nature resource potential of protected areas. First, a regime that maximises the nature resource potential of protected territories was created; second a well-grounded financing system, which takes into account the managers real tasks and the amount of nature resources to be managed was developed. The ratio of theoretically calculated funding to actual (2005) was for Harju-Rapla (nature conservation) region 144%; Hiiu-Lääne region 80%; Ida-Viru region 105%; Järva-Lääne Viru region 150%; Jõgeva-Tartu region 62%; Pärnu-Viljandi region 126%; Põlva-Valga-Võru region 95%; Saare region 95%.

The present economic environment does not ensure the traditional agricultural use of seminatural ecological communities which is an important precondition for their preservation. Subsidation rates (kroons/ha/year) for most important seminatural communities detected within the thesis are: wooded pastures 1680; coastal meadows 2520; wooded meadows ca 2000; dry meadows 322; floodplain meadows 615. An average restoration cost of the degraded seminatural communities is estimated at 3400 kroons per hectare. According to the *contingent valuation method* it was found out that the annual aggregate willingness to pay of the Estonian working-age population for the preservation of seminatural communities is nearly 130 million kroons. This can be interpreted as the monetary equivalent of non-use value of Estonian seminatural communities.

The most vulnerable area where use and non-use resource utilisation is in conflict is coastal zone of Estonia. The 200 m zone of Estonian coast is very diverse, according to Corine Land Cover (CLC) classes. Out of the 34 CLC classes – which is the total number in Estonia – 30 are represented. Three larger land cover classes, which occupy more than 7000 hectares in the 200 m coastal zone, are inland marshes, coniferous forests and natural grasslands. The location of land cover classes varies across counties. Out of the 200m coastal zone 23.8% is under nature protection, which is almost twice as much as the Estonian average. As the seminatural habitats are one of the dominating habitats in the coastal zone, it was essential to work out a concept which would allow to implement projects which would not need a constant subsidisation of management, but are sustainable. The basic concept is close-to-earth quality production, with nature conservation as an added value. The biodiversity can act an important component of development, which does not necessarily contradict the economic prospects in the coastal zone.

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SUMMARY IN ESTONIAN

ÖKOLOOGIA ÖKONOOMIKA KUI VAHEND LOODUSKAITSE RESSURSIPÕHISEKS HALDAMISEKS EESTIS

Majanduslikus mõttes on Eesti loodus Euroopa kontekstis defitsiitne keskkonnakaup, mille bioloogilist ja ökoloogilist väärtust on küll pikka aega uuritud, kuid millel senini praktiliselt puudub majanduslik (rahaline) ekvivalent. Nagu paljude inimtegevuse aladega, nii on ka looduse säilitamisega seotud kulud ja tulud. Asjaolu, et tulud on defineerimata ja teadvustamata, muudab säilitamise konkurentsivõimetuks nii territooriumi teiste ressursside ekspluateerimist taotlevate majandusharudega kui ka rahastamisotsuste tegemisel.

Keskkonna mitteutilitaarseid väärtusi iseloomustab sageli ka tõsiasi, et nendest lähtuv tulu on abstraktne ja jaotub kogu ühiskonnale. Samas eeldab mitteutilitaarsete väärtuste säilimine või tekkimine loodusressursside füüsilise tarbimisega seotud majandustegevuse (näit. metsalangetamine jne.) piiramist, mille tagajärjeks on omaniku rahalise tulu vähenemine. Põhjendatud otsuste tegemine loodusressursside utilitaarseks või mitteutilitaarseks tarbimiseks eeldab konkreetsele majandussituatsioonile vastavate keskkonnaökonoomiliste analüüside olemasolu. Küll aga süveneb majanduse arenedes ressursikasutuse intensiivistumisega tugev majanduslik ja poliitiline surve looduse utilitaarseks kasutuselevõtuks. Ometi võib looduse mitteutilitaarsete väärtuste tarbimine olla ühiskonnale võrreldes utilitaarse tarbimisega sotsiaalmajanduslikult hoopiski väärtuslikum. Selle põhjendamine on eesti keskkonnaökonomistidele alanud sajandil tõeliseks väljakutseks.

Käesolev töö põhineb kuuel publikatsioonil (I–VI), mille eesmärkideks oli: analüüsida looduse mitteutilitaarseid väärtusi ning võrrelda neid ökoloogia ökonoomika aspektist looduse utilitaarsete väärtustega (I), analüüsida elatustaseme sõltuvust kaitsealade osakaalust Eesti maakondades (I), töötada välja metoodika kaitsealade ressursipotentsiaali maksimeerivaks tsoneerimiseks ning objektiivseid kriteeriume arvestavaks finantseerimiseks (VI), selgitada välja Eesti poollooduslike koosluste majandamiskulud ning mitteutilitaarse väärtuse rahaline ekvivalent tingliku hindamise (*contingent valuation*) meetodil (II), analüüsida Eesti rannikutsooni kui erinevate (konkureerivate ja välistavate) ressursikasutusviiside konfliktipiirkonna maakatte struktuuri ja looduskaitsealuse territooriumi osakaalu (III, IV) ning Eesti rannikutsooni sotsiaalmajanduslikke aspekte koos majanduslikult jätkusuutliku arengu võimalustega (IV, V).

Kaitstavate alade (objektide) rajamise ja hooldamise eesmärgiks on säilitada neid maastikke, kooslusi, taime- ja loomaliike ning üksikobjekte, mille väärtust peavad otsustajad küllalt suureks, et meie tegelikus majanduslikus situatsioonis nende kaitsmiseks vajalikke kulutusi lugeda õigustatuks. See tähendab vajadust

kõrvutada looduse mitmekesisuse mitteutilitaarset väärtust (so. väärtust, mis ei põhine ressursside vahetul füüsilisel tarbimisel) reaalsete kuludega, mis tekivad utilitaarse ressursikasutuse piiramisest. Millisele tulemusele/otsusele sellise kõrvutamisega jõutakse, oleneb sellest, kui kõrgelt väärtustavad otsustajad kaitset vajavaid territooriume ja objekte. Loodusressursse (või väärtusi) võib liigitada mitmeti. Üheks, ka käesolevates teesides kasutatud võimaluseks on eristada väärtusi vahetu füüsilise tarbimise järgi, jagades need utilitaarseteks ja mitteutilitaarseteks, mis on sisuliselt suures osas kattuv ingliskeelses kirjanduses laialt levinud jaotusega kasutus- ja mittekasutus-väärtuseks (I). Looduse põhilised mitteutilitaarsed väärtused on: üldökoloogiline, bioloogilise regulatsiooni, puhkemajanduslik, psühho-sotsiaalne, kultuurilis-ajalooline, hariduslik ja teaduslik ning esteetiline väärtus. Utilitaarsetest väärtustest eristab neid vahetu füüsilise kasutatavuse puudumine, allumatus turuseadustele (*non-market values*), pigem globaalne kui lokaalne kasulikkus, mõju pigem elu kvaliteedile (vastandina utilitaarsetele ressurssidele, mis mõjutavad rohkem elatustaset) ning asjaolu, et neid ei saa klassikalise majandusteaduse meetoditega uurida ning nende väärtust on raske rahas väljendada. Just looduse mitteutilitaarsetele väärtrustele rahalise ekvivalendi leidmine on üks ökoloogia ökonoomika ees seisevatest ülesannetest.

Selleks, et mittekasutusväärtus oleks ühemõõtmelisena võrreldav ja summeeritav teiste (ka kasutus-) väärtustega, tuleb seda väljendada mittekasutusväärtuse rahalise ekvivalendina. Mittekasutusväärtustele rahalise ekvivalendi leidmine koos uute, utilitaarse majandustegevuse piiramise tõttu tekkivate loodusressursipotentsiaali kandvate territooriumide haldamise ja majandamise korraldamisega ongi ökoloogia ökonoomika üheks keskseks uurimisobjektiks. Et nii liikide, koosluste kui ka ökosüsteemide kaitse puhul on sisuliselt tegemist territoriaalse fenomeniga, siis on keskkonnaökonoomika ees seisvaid ülesandeid võimalik lahendada vaid koostöös geograafiliste meetoditega. Nii eeldab kaitsealauste loodusressursside kvantifitseerimine geoinformatsioonisüsteemide (GIS) kasutamist territoriaalsete üksuste analüüsil (I, III, IV, VI). Ka kaitset vajavate koosluste (näit. poollooduslikud kooslused) haldamine (II) ja kõrgendatud ressursikasutuse konflikttsoonide, nagu rannik (III, IV), kaitse kavandamine saab toimuda ainult majanduslike ja geograafiliste uurimismeetodite tihedas interaktsioonis. Seega on looduskaitse majandamise ja haldamise uurimisel ökonoomika ja geograafia komponendid tihedalt põimunud.

Kaitsealade loomisega kaasnev utilitaarse ressursikasutuse piiramine tähendab kohalikule elanikkonnale eelkõige tõkendeid nende utilitaarsel ressursikasutusel baseeruvas majandustegevuses. Samas tuleb majanduslikult suhteliselt mahajäänumates piirkondades püüda ära kasutada neid võimalusi, mida pakub kaitsealade piirangutega kooskõlas olev mitteutilitaarsel ressursikasutusel põhinev turism ja rekreatsioon. Kaitsealade külastatavuse baasil moodustuv majanduslik efekt loetakse summeeruvaks otsesest, kaudsest ja indutseeritud efektist. Otsene efekt tekib rekreantide kulutuste arvel transpordile, ööbimisele, toidule

jne. Kaudse efekti põhjustavad kohalike otseste teenuste pakkujate vajalikuks osutuvad ostud. Ahelreaktsioonina toob otsese ja kaudse efekti toimel kasvanud tööhõive ja perekonna sissetulek kaasa üldise nõudluse kasvu toodete ja teenuste järele, millest moodustub reaktsiooni indutseeritud majanduslik efekt. Seega on oluline teada, milline on elanikkonna materiaalne heaolu neis maakondades, kus kaitsealade osakaal on Eesti keskmisega võrreldes suhteliselt suurem ja elatustase madalam. Just nendes maakondades on kaitsealadel baseeruva majanduse arendamine eriti aktuaalne, et muuta see oluliseks arengufaktoriks. Maakondadeks, kus kaitsealade osatähtsus ületab Eesti keskmise, kuid materiaalne heaolu on keskmisest madalam, on Läänemaa, Lääne-Virumaa, Tartumaa, Valgamaa, Viljandimaa ja Võrumaa. Tõsiasi, et teostatud regressioonanalüüs ei tuvastanud materiaalse heaolu sõltuvust kaitsealuse territooriumi osakaalust maakondlikul tasandil, näitab, et looduskapitali mitteutilitaarne komponent ei ole küll majandusarengu takistuseks (negatiivse korrelatsiooni puudumine), kuid samas ei ole seda veel suudetud transformeerida ka teistesse kapitali vormidesse, mida näitab positiivse korrelatsiooni puudumine.

Kaitsealuste territooriumide muutmisel olulisteks majandustegureiks on eeldusteks: a) loodusressursipotentsiaali maksimeeriva kaitserežiimi ja b) põhjendatud, korraldaja tegelikel ülesannetel ja hallatavatel loodusressurssidel põhineva finantseerimissüsteemi väljatöötamine, mis on olnud käesoleva töö üheks oluliseks ülesandeks. Kaitsealade jaotamisel erineva režiimiga tsoonideks (näit reservaat, sihtkaitsevöönd, piiranguvöönd) tuleks vaadelda ala koosnevana suhteliselt homogeensetest piirkondadest (partsellidest), mis seejärel, vastavalt oma eripärale, grupeeruksid tsoonideks. Grupeerimise esmaseks põhimõtteks on nõue, et igas partsellis kehtestuks selline režiim, mis võimaldaks kaitseala loodusressursipotentsiaali parima kasutatavuse-realiseerumise. Seejuures võib iga osapotentsiaali erinevalt väärtustada-tähtsustada, andes osapotentsiaalidele kaaludeks erinevad väärtushinded. Et kaitsealade mitteutilitaarsete ressursside tarbimisest tulenev sotsiaalne ja majanduslik väärtus on otseses seoses nende tuntusega, võib ebaotstarbekalt kehtestatud (Eesti kontekstis eelkõige põhjendamatult range) kaitserežiim kaitsealade sotsiaalset väärtust oluliselt vähendada. Teesides esitatud metoodikat (VI) kasutades on võimalik seda ohtu vältida.

Kaitsealade funktsioonide täitmise oluliseks eelduseks nii loodusliku mitmekesisuse säilitamisel kui mitteutilitaarse looduskapitali tootmisel on kaitsealade haldajate (korraldajate) riigieelarveline finantseerimine vastavalt tegelikult hallatavatele ressurssidele. Teesides esitatavas metoodikas on finantseerimise maht esitatud olenevana, esiteks – hallatava maismaa-pindala suurusest, struktuurist CORINE maakatteklassiti ja turismikoormusest, teiseks – haldaja muutuvaist eriülesannetest (lisafunktsioonidest), mis otseselt ei sõltu hallatava territooriumi suurusest (VI). Välja töötatud metoodika põhjal on leitud kõikide Eesti looduskaitseregioonide teoreetiliselt põhjendatud finantseerimisvajadus, mis võrreldes 2005. a regioonide tegeliku rahastamisega erineb – teoreetiliselt põhjendatud finantseerimise suhe tegelikku eelarvesse jääb vahemikku 144%–62%.

Koosluste ökoloogia ökonoomikat käsitletakse töös Eesti poollooduslike koosluste kui looduskaitseliselt väga väärtuslike, kuid momendi majandussituatsioonis kõige ohustatumate näitel (II, III). Poollooduslike koosluste majandamist ei saa stimuleerida üldiste, kogu põllumajandust kui majandusharu puudutavate meetmetega. Poollooduslikke rohumaid kasutav põllumajanduslik tootja on kultuurrohumaade kasutajaga võrreldes majanduslikult vähem konkurentsivõimeline, mistõttu poollooduslike koosluste säilimise peamiseks abinõuks on sihtotstarbelised rahaeraldised (subsiidiumid) konkreetseteks tegevusteks. Subsiidiumide põhjendatud mahtu on erinevate poollooduslike koosluste puhul võimalik majandamiseks tehtavatest kulutustest (niidetavad kooslused) ja saamatajäänud omanikutulust (karjatatavad kooslused) lähtuvalt välja arvutada. Eestis levinumatest poollooduslikest kooslustest on nende säilitamiseks vajalikud iga-aastased kulutused hektari kohta järgmised: luhaniidud 615 krooni, rannaniidud 2520 krooni, puisniidud 2000 krooni. Poollooduslike koosluste ühe hektari keskmisteks taastamiskuludeks on 3400 krooni.

Eesti poollooduslike koosluste mittekasutus- (mitteutilitaarne) väärtus selgitati välja tingliku hindamise *(contingent valuation*) meetodi abil, küsitledes representatiivse valimi maksevalmidust (*willingness to pay)*. Tulemused ekstrapoleeriti Eesti tööealisele elanikkonnale. Sotsiomeetrilistest näitajatest olid maksevalmiduse suhtes statistiliselt olulised vanus ja sissetulek ning ebaolulised rahvus, sugu ja haridustase. Kogunõudlusfunktsiooni *(total demand function*) põhjal arvutatud Eesti tööealise elanikkonna aastane maksevalmidus poollooduslike koosluste majandamiseks on ca 130 miljonit krooni, mis on interpreteeritav Eesti poollooduslike koosluste mittekasutusväärtusena.

Seoses majanduse arenguga suureneb surve loodusressursside utilitaarseks kasutuselevõtuks. Nagu kogu maailmas, nii on ka Eestis eriti terav majanduse ja looduskaitse konflikt rannikutsoonis, kus utilitaarne ja mitteutilitaarne ressursikasutus sageli teineteist välistavad. Ajaloolis-poliitilistel põhjustel on suur osa Eesti rannikust paljude Euroopa riikidega võrreldes suhteliselt heas looduslikus seisukorras, mistõttu on just seal olevad mittekasutusväärtused, nagu näiteks looduslikust üldilmest tulenev esteetiline väärtus, kogu Euroopa kontekstis defitsiitne ja erilist tähelepanu eeldav loodusressurss. Vaatamata sellele, et Eesti seadusandlus kehtestab utilitaarsele ressursikasutusele rannikutsoonis mitmeid kitsendusi (näiteks piirangud kinnisvaraarendusele jms.), on rannikutsoon ikkagi väga tugeva majandusliku surve all ja selle looduslik ilme degradeerub kiiresti. Teesides analüüsitakse Eesti 200 m rannikutsooni struktuuri CORINE maakatteklasside põhjal maakondade kaupa ning looduskaitsealuse territooriumi osakaalu 200 m rannikutsoonis, kasutades CORINE Land Cover`i (CLC) administratiivse jaotuse ja kaitsealade andmekihte (IV). Eesti rannikutsoon on väga mitmekesine, 34-st CLC maakatteklassist on seal esindatud tervelt 30. Kolmeks suurimaks klassiks on kalda- ja rannaroostikud (*inland marshes, 4.1.1*.), okasmetsad ja poollooduslikud rohumaad. Suured on ka maakondadevahelised erinevused. Kui Põhja-Eestis on valdavad okasmetsad, millele järgnevad põllumajanduslikud alad, siis Lääne-Eestis on ülekaalus

kalda- ja rannaroostikud ning poollooduslikud rohumaad. Ranniku veel suhteliselt head looduslikku seisukorda näitab tehisalade (4,7% tsooni kogupindalast) ja põllumajanduslike kõlvikute (10%) tagasihoidlik osakaal. Mitmesuguste kaitsealade koosseisu kuulub rannikutsoonist üle 23 %, mis on ligi kaks korda kõrgem Eesti keskmisest näitajast.

Üheks võtmeteguriks rannikutsooni traditsioonilise ilme säilimisel (eriti Lääne-Eestis ja saartel) on poollooduslike koosluste olemasolu, mis, nagu eelpool mainitud, eeldab iga-aastast subsideerimist (II). Kuna poollooduslikud kooslused on rannikutsoonis ühed domineerivamatest, siis on otstarbekas töötada välja kontseptsioon ja rakendada praktilisi projekte, mille puhul nende majandamine ei nõuaks pidevat subsideerimist, vaid oleks jätkusuutlik. Selleks olevaid võimalusi analüüsitakse teesides Väinamere projekti näitel (V). Tulemustest järeldub, et majandustegevus ja looduskaitse eesmärgid on edukalt ühitatavad ja võivad anda koos rakendatuna sünergeetilise efekti, millest võidavad nii looduskaitse kui kohalik sotsiaalmajanduslik areng. Kui viimane saavutab piisava stabiilsuse, muutub rannikutsooni traditsiooniline, poollooduslikke kooslusi ja seeläbi ka ranniku üldilmet säilitav majandamine kohaliku mahepõllumajanduse osana majanduslikult jätkusuutlikuks.

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CURRICULUM VITAE

I. Üldandmed

1. Ees- ja perekonnanimi	ÜLLAS EHRLICH
2. Sünniaeg ja -koht	9.detsember 1963, Tallinn
3. Kodakondsus	eesti
4. Aadress, telefon, *e-mail*	Sisaski 31, Tallinn 10914, Eesti tel.: 5210435 e-mail: yllas.ehrlich@tv.ttu.ee
5. Praegune töökoht, amet	Tallinna Tehnikaülikooli (TTÜ) majandusuuringute teaduskeskus, erakorraline teadur

6. Haridus

1982	Tallinna 3. Keskkool
1989	Tartu Ülikool, bioloogia-geograafia teaduskond, bioloogia osakond, bioloog-geneetiku diplom
1995	Tartu Ülikool, Geograafia Instituut, MSc. inimgeograafias
1997–	Tartu Ülikool, Geograafia Instituut, doktorant

7. Keelteoskus

Eesti, inglise, vene, soome (passiivne), saksa (passiivne)

8. Töökogemus (teenistuskäik)

1990–1994	Eesti Teaduste Akadeemia Majanduse Instituut, nooremteadur
1994–1997	Eesti Majanduse Instituut, teadur
1997–2005	Eesti Majanduse Instituut, vanemteadur
2005–	TTÜ majandusuuringute teaduskeskus, teadur
Õppeained:	TTR0040 keskkonnaökonoomika, TTR1050 looduskasutuse ja keskkonnakaitse ökonoomika

II Teaduslik ja arendustegevus

1. Peamised uurimisvaldkonnad

Keskkonnaökonoomika, ökoloogia ökonoomika, energeetika ökonoomika, keskkonnapoliitika.

2. Saadud uurimistoetused ja stipendiumid

1995–1996 ETF granti nr 1552 “Majandus piiratud majandustegevusega territooriumidel” grantihoidja

1996 WWF joint research project ”Economic Valuation of Flood Plains and Coastal Wetlands in Estonia”, Expert of Economy

1996–1997 RSS Research Grant No.1244/1997 “Evaluating Externalities of Seminatural Ecosystems in Estonia: A Case Study of Virtsu-Laelatu-Puhtu Nature Reserve”, Grant holder

1997 PHARE ACE programme research project Contract No. P96-6141-R “Baltic Coast: Economic Valuation as a Tool in Coastal Conservation Policy in the Baltic States”, Expert of Economy

1998–2000 Sihtfinantseeritava teadusteema “Eesti loodusvarade potentsiaali ja energiaressursside kasutamise sotsiaalmajanduslik hindamine: teoreetilised alused ja rakendamisvõimalused” (0340327s98) põhitäitja

1997–1999 ETF granti nr 2869 “Eesti looduse mitteutilitaarsete ressursside ökonoomika” grantihoidja

2001–2004 Sihtfinantseeritava teadusteema “Eesti loodusressursside jätkusuutliku kasutamise modelleerimine ja sotsiaalmajanduslik hindamine” (0341764s01) põhitäitja

2000–2002 ETF granti nr. 4187 “Eesti biodiversiteedi ökonoomika” grantihoidja

2002 PHARE project No GF/ 2716-01-4354 “Assessment of Capacity building needs for Biodiversity and Participation in Clearing House Mechanism in Estonia” subcomponent: “Analyse of Management Measures for Seminatural Communities”, alamkomponendi autor

2004–2006 ETF granti nr 5926 “Eesti energiasektori jätkusuutliku arengu trajektoorid konvergentsiks Euroopa Liiduga: ökoloogilised eeldused ja sotsiaalmajanduslikud võimalused” põhitäitja

2005– Sihtfinantseeritava teadusteema “Subregionaalse sotsiaal-majandusliku institutsionaalse mudeli tüübi evolutsioon: Eesti majandussüsteem Läänemere äärises” (0142697As05) projekti “Eesti ökoloogiliste ja energeetiliste ressursside kasutamise modelleerimine Läänemere äärises” põhitäitja

3. Muu teaduslik organisatsiooniline ja erialane tegevus (konverentside ettekanded, osalemine erialastes seltsides, seadusloome jms.)

1995 International Conference on Northen Wilderness Areas, December 7–9, 1994, Arctic Centre, University of Lapland, Rovaniemi, Finland. “Nature protection during transition to a market economy in Estonia”

1998	Conference “Global-Local Interplay”, Pärnu, 1.–4. okt. 1998. “A non-market value component of biodiversity in the structure of life quality and Estonian's integration into European Union”
1999	The Joint Conference Land-Ocean Interactions: Managing Coastal Ecosystems. Nov.9–13. Antalya, Turkey. “Ecological Economics of Coastal and Riparian Seminatural Grasslands (A Case Study of Estonia)”
2000	Eesti Keskkonnastrateegia 2001–2003 väljatöötamine, majandus-ekspert
2001	MEDCOAST 01, The Fifth International Conference on the Mediterranean Coastal Environment, 23–27 October, Hammamet, Tunisia. “Estonian Coast: Structure of Land Cover and Level of Protection”
2003	Sixth International Conference on the Mediterranean Coastal Environment, October 7–11, 2003, Ravenna, Italy. “Management of Protected Areas: Optimisation of Restrictions and Administration Expenses”
2004–2005	Osalemine Eesti Looduskaitse Arengukava väljatöötamisel
2005	Evaluation of the Project “River Emajõgi and River Võhandu Catchment Area Water Management” (REF N°: 2004/EE/16/C/PE/007), majanduse põhiekspert
2005	Seventh International Conference on the Mediterranean Coastal Environment. October 25–29, MEDCOAST 05, Kusadasi, Turkey. “Economical Activities as Means of Coastal Nature Conservation: Estonian Experience”
2005–2006	Technical Assisstance for Conservation of Protected Areas. Natura 2000: Identification of future investment needs for nature protection sector related to efficient management structure (EuropeAid/119560/D/SV/EE; FM 2003/EE/16/P/PA/012), majandusekspert

III. Erialane enesetäiendus

1994 Sept.–Dec. Teadur Arktika Keskuses Rovaniemis, Soome.

IV. Ühiskondlik tegevus

Eesti Teaduste Akadeemia Looduskaitse Komisjoni liige

CURRICULUM VITAE

I. Personal data

1. Name	ÜLLAS EHRLICH
2. Birth date and place	December 9, 1963, Tallinn, Estonia
3. Citizenship	Estonian
4. Address, telephone, *e-mail*	Sisaski 31, Tallinn 10914, Estonia tel.: 5210435 e-mail: yllas.ehrlich@tv.ttu.ee
5. Current employment	Centre for Economic Research at Tallinn University of Technology, extraordinary researcher

6. Education

1982 Tallinn Secondary School No. 3
1989 Tartu University, Faculty of Geography and Biology, BSc.
1995 Tartu University, Institute of Geography, MSc. (human/economic geography)
1997– Tartu University, Institute of Geography, PhD studies

7. Language skills

Estonian, English, Russian, Finnish (passive), German (passive)

8. Research and professional experience

1990–1994 Institute of Economics of Estonian Academy of Sciences, Junior Researcher
1994–1997 Estonian Institute of Economics, Researcher
1997–2005 Estonian Institute of Economics, Senior Researcher
2005– Centre for Economic Research, Tallinn University of Technology (Centre for Economic Research Legal successor of Estonian institute of Economics)

Teaching: TTR0040 Environmental economics, TTR1050 Nature resource and environmental protection economics

II Scientific activities

1. Research fields

Environmental economics, ecological economics, nature conservation managements, energy economics, environmental policy.

2. Received grants and supports

1995–1996	ESF Research Grant No. 1552 “Economics in Territories with Limited Economic Utilization”, Grant holder
1996	WWF joint research project ”Economic Valuation of Flood Plains and Coastal Wetlands in Estonia”, Expert of Economy
1996–1997	RSS Research Grant No.1244/1997 “Evaluating Externalities of Seminatural Ecosystems in Estonia: A Case Study of Virtsu-Laelatu-Puhtu Nature Reserve”, Grant holder
1997	PHARE ACE programme research project Contract No. P96-6141-R “Baltic Coast: Economic Valuation as a Tool in Coastal Conservation Policy in the Baltic States”, Expert of Economy
1998–2000	SF0340327s98 “Socio-economic evaluation of the Estonian natural resource potential and utilization of energy resources: theory and application options”, Principal investigator
1997–1999	ESF Research Grant No.2869 “Economics of Non-utilitarian Resources of Estonian Nature”, Grant holder
2001–2004	SF0341764s01 “Modelling and Socio-Economic Evaluation of the Sustainable Use of Estonian Natural Resources”, Principal investigator
2000–2002	ESF Research Grant No.4187 “Economics of Estonian Biodiversity”, Grant holder
2002	PHARE project No GF/ 2716-01-4354 “Assessment of Capacity building needs for Biodiversity and Participation in Clearing House Mechanism in Estonia” subcomponent: "Analyse of Management Measures for Seminatural Communities", Author of sub-component
2004–2006	ESF Research Grant No. 5926 “Sustainable development trends of the Estonian energy sector for convergence with the European Union: ecological preconditions and socio-economic outlooks”, Principal investigator
2005–	SF0142697As05 “Evolution of the Subregional Socio-economic Institutional Model Type: Estonian Economic System in the Baltic Rim”, Principal investigator

3. Other professional activities

1995	International Conference on Northen Wilderness Areas, December 7–9, 1994, Arctic Centre, University of Lapland, Rovaniemi, Finland. “Nature protection during transition to a market economy in Estonia”
1998	Conference “Global-Local Interplay”, Pärnu, 1.–4. okt. 1998. “A non-market value component of biodiversity in the structure of life quality and Estonian’s integration into European Union”
1999	The Joint Conference Land-Ocean Interactions: Managing Coastal Ecosystems. Nov.9–13. Antalya, Turkey. “Ecological Economics of

	Coastal and Riparian Seminatural Grasslands (A Case Study of Estonia)"
2000	Development of Environmental Strategy of Estonia 2001–2003, expert of economy
2001	MEDCOAST 01, The Fifth International Conference on the Mediterranean Coastal Environment, 23–27 October, Hammamet, Tunisia. "Estonian Coast: Structure of Land Cover and Level of Protection"
2003	Sixth International Conference on the Mediterranean Coastal Environment, October 7–11, 2003, Ravenna, Italy. "Management of Protected Areas: Optimisation of Restrictions and Administration Expenses"
2004–2005	Participating in development of Nature Protection Strategy
2005	Evaluation of the Project "River Emajõgi and River Võhandu Catchment Area Water Management" (REF N°: 2004/EE/16/C/PE/007), main expert of economy
2005	Seventh International Conference on the Mediterranean Coastal Environment. October 25–29, MEDCOAST 05, Kusadasi, Turkey. "Economical Activities as Means of Coastal Nature Conservation: Estonian Experience"
2005–2006	Technical Assisstance for Conservation of Protected Areas. Natura 2000: Identification of future investment needs for nature protection sector related to efficient management structure (EuropeAid/119560/D/SV/EE; FM 2003/EE/16/P/PA/012), expert of economy

III. Professional training

1994 Sept.–Dec. Researcher in the Arctic Centre in Rovaniemi, Finland

IV. Other relevant activities

Member of Commission for Nature Conservation of Estonian Academy of Sciences.

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