MONETARY EQUIVALENT OF NON-MARKET VALUE OF HABITATS AS AN ECONOMIC ARGUMENT FOR THEIR FINANCING: CASE OF ESTONIAN SEMI-NATURAL PLANT COMMUNITIES

Üllas Ehrlich
Sirje Pädam
***Koidu Tenno**[*]*

Abstract

Semi-natural habitats are scarce environmental goods. Biological values of semi-natural plant communities have been studied more thoroughly than economic values in Estonia. The fact that the economic benefits are not defined makes the maintenance of semi-natural plant communities uncompetitive in comparison with other needs financed through the state budget and from other sources. Estonia's traditional landscape and unique biodiversity will be threatened unless sufficient resources are allocated for the management of semi-natural plant communities. Inclusion of a number of semi-natural plant communities in the Natura 2000 network provides potential for monetary support. The purpose of this paper is to estimate the benefits and costs of increasing habitat protection in Estonia. This is the first time an original valuation study is used in a cost benefit analysis in the Baltic countries. It is demonstrated that the monetary equivalent of the non-market value of Estonian semi-natural plant communities estimated with the Contingent Valuation method justifies increases in financial support for habitat management.

Introduction

The traditional landscape of Estonia is characterized by agricultural fields, grasslands, wetlands and forests. Some landscapes are natural, while others are a result of long-term human activity. Semi-natural plant communities (e.g. meadows and grasslands) were developed by scythe, axe, fire and grazing and these landscapes can persist only with support of human activity (mowing, grazing, brush cutting, etc). For thousands of years rural inhabitants used these

[*] Tallinn University of Technology, Tallinn, Estonia; Yllas.Ehrlich@tv.ttu.ee; Sirje.Padam@tv.ttu.ee; Koidu Tenno@tv.ttu.ee

landscapes as hayfields and pastures. Large areas of former agricultural land have been abandoned or are under-utilized and as a result many semi-natural plant communities are reverting to scrub land and eventually into forest.

The semi-natural plant communities are a prerequisite for richness in biodiversity and for migrating birds. Biodiversity in Estonia is considered to be one of the richest in the world situated north of the 57th parallel. The flora consists of approximately 5,000 different plant species and 3,500 mushrooms, of which a large number are protected. Vertebrates number approximately 500 species and invertebrates about 11,000. The Estonian Red Book contains 1,318 rare and endangered species, which includes 401 species located within forest habitats, 314 in water bodies and 114 in grasslands. Estonia's semi-natural plant communities also support a number of internationally rare indigenous bird species such as Corn Crake (Crex crex), Dundlin (Calidris alpina schinzii), Black-tailed Godwit (Limosa limosa), Avocet (Recurvirostra avocetta), Ruff (Philomachus pugnax).

The Natura 2000 network plays an essential role in nature conservation in the European Union. The Government of Estonia submitted its proposals for the Natura 2000 network in May 2004. In all, 509 natural habitats and 66 bird areas extending to 1.4 million hectares of Estonian territory were proposed to protect 60 different habitat types, 51 animal and plant species and 136 bird species (Ministry of Environment 2005). However, many Natura 2000 sites require active management to maintain and often to restore favourable conservation status of habitats and species at the sites which constitute the network. In order to preserve habitat value, about 20,000 hectares of semi-natural plant communities are in urgent need of investments in infrastructure and equipment.

This paper has been divided into two parts. The first part discusses the value of conserving semi-natural plant communities and presents a contingent valuation study that was carried out in Estonia to estimate the willingness to pay for preserving this landscape type. In the second part, a cost benefit analysis is carried out based on an inventory of the feasibility of conservation and investment needs to restore semi-natural habitats in Estonia's Natura 2000 network.

1. Value of semi-natural plant communities

The Estonian semi-natural plant communities decreased substantially during the latter half of the 20th Century. The principal reasons for this have been cited as loss of traditional farming activities such as mowing, extensive grazing and drainage, especially in floodplains and coastal grasslands (Ministry of Agriculture 2004).

Table 1. Area of Estonian semi-natural plant communities, based on estimates, 1950's and 2000

	1950's in hectares	2000 in hectares
Wooded meadow	800,000	1,500
Alvar	44,000	9,000
Alluvial meadow	100,000	15,000
Wooded pasture	200,000	3,000

Source: Ministry of Agriculture 2004

The large extent of habitats requiring maintenance goes far beyond the finance available. Unless more resources are made available, large areas will be threatened and could ultimately be lost. Besides their importance as ecosystems, the landscape type that is made up of semi-natural plant communities is recognized as a significant component of the national identity.

1.1. The value of the environment

Value, according to economic theory, relates to the utility individuals derive from goods and services. The choices individuals make reflect their preferences and concerns. When individuals make a choice, either in relation to what to buy or how to spend their time, they appraise the value they will receive from a particular choice. Many goods are not subject to market transactions and they can be enjoyed for free, e.g. bird watching and walking in a forest. Through human choices the value of these activities can be assessed. In his seminal paper, Krutilla went even further by suggesting that people receive utility from natural assets just because they exist (Krutilla 1967). Thus, utility may originate from the pure knowledge of conservation of a certain wilderness area.

Stemming from Krutilla's work, it is now widely held that the value of the environment can be divided into two broad categories: use value and non-use value. While use value refers to the value people put on using the environment, either for exploitation purposes (logging, housing development) or indirect consumption for recreational intentions (bird watching, camping), non-use value relates to no use at all. It is commonly recognized that non-use values include, *existence value*, i.e. benefits derived from knowing that a resource exists, and *intrinsic value*, which relates to the benefit derived from maintaining landscape and biodiversity, independent of its usefulness to humans. A third category is usually added, *bequest value*, which relates to the wish to pass on the environment to future generations. Another kind of future value is *option value*, which presupposes a wish to preserve the environment for future use. While *bequest value* is classified as non-use value, *option value* is a use value. Since all these above mentioned types of economic values affect utility, they are relevant for the assessment of the value of the environment. Table 2 classifies the types of economic values that can be attributed to the benefits of semi-natural plant communities.

Table 2. The economic value of semi-natural plant communities and their expressions

Economic Value	**Category**	**Expressions of the Value**
Non-use value Existence value	General ecological	Provision of conditions for life (life conservation) Conservation of species
Non-use value Intrinsic value	General ecological	Provision of water and air circulation Prevention of soil erosion Preservation of pure water resources
Non-use value Intrinsic value	Biotic regulation	Conservation of species and genetic resources Provision of multiplicity of ecological systems
Non-use value Bequest value	Future value	Provision of biodiversity and pristine environment in the future
Use value Option value	Future value	Preservation to allow future recreation, logging, research, etc
Indirect use value	Human use of ecosystem services	Regulation of water, prevention of erosion etc. Purification of water and air
Indirect use value	Recreational	Supply of recreational services (e.g. bird watching) Opportunities for tourism (e.g. hiking and camping)
Indirect use value	Educational and scientific	Opportunities for educational and research work
Indirect use value	Cultural-historical	Preservation of historical structure of landscapes
Indirect use value	Aesthetic	Recognizing beauty of landscapes and natural objects
Direct use value	Agricultural	Pasture Harvest of hay

Only direct use value can be observed in the market. The other values have to be determined by other means. Valuation methods are usually divided into two approaches: direct methods and indirect methods. Direct methods seek to infer individuals' preferences of environmental quality directly, by asking them to state their preferences for the environment. In contingent valuation surveys, for example, this might consist of asking people either their maximum willingness to pay (WTP) for an increase in environmental quality, or their minimum willingness to accept compensation (WTAC) to forgo such an increase. Respondents might instead be asked about their maximum WTP to avoid a decrease in environmental quality, or their minimum WTAC to accept this reduction.

The indirect approach estimates the value by studying human behavior in complementary markets, i.e. money spent on travelling to a natural park (travel cost method) or how the local environment affects housing prices in urban areas (hedonic model). Use values can be estimated by direct and indirect methods. However, since human behavior is a prerequisite for the travel cost and hedonic approaches they cannot elicit non-use values. Non-use values can be estimated only by using direct methods (Andreasson-Gren 1995).

1.2. Contingent valuation of semi-natural habitats

The reason for choosing the contingent valuation method for estimating the value of semi-natural habitats in Estonia is that non-use values make up an important part of their total economic value (Ehrlich et al. 1999), (Ehrlich and Habicht 2001).

The contingent valuation method (CVM) was first used by Davis (1963) for valuing environmental goods used in a study of hunters in Maine, USA. Since then, the method has become the most widely used 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 (1999).

There is no standard approach to the design of a contingent valuation survey. Nevertheless, virtually every application consists of several well-defined elements. First, a survey must contain a scenario or description of the (hypothetical or real) policy or program the respondent is being asked to value or vote upon. Next, the survey must contain a mechanism for eliciting value or a choice from the respondent. These mechanisms can take many forms, including the so-called open ended questions (“What is the maximum amount you would be willing to pay …?”). Finally, contingent valuation surveys usually elicit information on the socio-economic characteristics of the respondents (age, sex, race, income, education, etc).

Semi-natural plant communities are heterogeneous resources consisting of a multitude of various functions. A problem that inevitably arises when appraising the value of semi-natural habitats relates to the vast variety of characteristics to be evaluated, as well as the description of possible changes. Usually it is not possible to use quantitative parameters other than the number of species and the area of the community for the description. And obtaining a suitable collection of qualitative characteristics may prove a difficult task.

The value of Estonian semi-natural plant communities was determined in the survey questionnaire with the help of “the general comprehensibility principle,” which presumes that the introducing text was comprehensible to all respondents. The questionnaire contained a control question to check whether respondents are familiar with semi-natural plant communities. In addition, replies were based on personal interviews with respondents, thus allowing for follow-up questions.

In the current study, a “discrete choice” format was used for the contingent valuation questionnaires. The discrete choice format was presented in the form of a table with discrete bid intervals: 0; 1-10 EEK; 11-30 EEK; 31-100 EEK; 101-300 EEK; 301-500 EEK; 301-2,000 EEK; 2,100-4,000 EEK; 4,001-10,000 EEK and over 10,000 EEK. Each respondent had to choose an interval, which best corresponded to her or his maximum willingness to pay and financial abilities. The payment was described as an annual voluntary contribution for preserving Estonian semi-natural habitats. The questionnaire was distributed to a random sample of 437 residents in Estonia to find out their willingness to pay for the protection of semi-natural habitats in Estonia.

Ordinary Least Square (OLS) regressions were carried out to find the impacts of socio-economic variables on the WTP. On the whole, the regression is statistically significant (F-statistics based). A relatively small R-square showing that the analyzed factors explain 10 percent of dynamics of independent variables, is assessed being significant for cross-section data. Based on t-statistics, income and age are statistically significant. Gender, education and nationality (Estonian, Non-Estonian) did not significantly influence the WTP responses. See Equation 1, t-values are shown in brackets.

$$\ln(WTP)=a_0+a_1\ln(INC)+a_2\text{dummy}(SEX)+a_3\ln(EDU)+a_4\text{dummy}(NAT)+a_5\ln(AGE)+\varepsilon \qquad (1)$$

	a_0	$a_1\ln(INC)$	$a_2$dummy(SEX)	$a_3\ln(EDU)$	$a_4$dummy(NAT)	$a_5\ln(AGE)$
Coefficients	6.01	0.92	-0.03	-0.06	0.20	-087
t-Statistic	(8.27)	(5.21)	(-0.15)	(-0.22)	(0.93)	(-4.46)

R^2=0.10; F-stat 8.25

An aggregate WTP of the working-age population was calculated on the basis of data given in Table 3, which characterize the size of groups with different WTP.

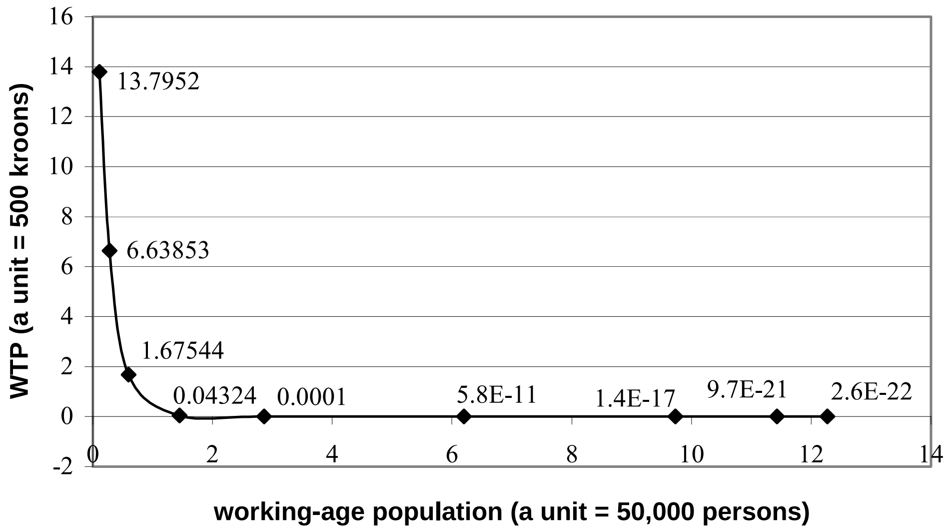
Table 3. WTP Groups and Estonian working-age population

Individual WTP, EEK		Respondents		Proportion of Estonian working-age population
Interval	Average	Number	%	
1	2	3	4	5
4001-10000	7,000.5	7	1.6	11,100
2001-4000	3,000.5	3	0.7	4,800
501-2000	1,250.5	18	4.1	28,500
301-500	400.5	35	8.0	55,600
101-300	200.5	48	11.0	76,500
31-100	65,5	168	38.4	266,900
11-30	20.5	54	12.4	86,200
1-10	5.5	53	12.1	84,100
0	0	51	11.7	81,300
	Total	**437**	**100.0**	**695,000**

Note: 1. The respondents who stated their WTP to be >10,000 EEK are contingently included in the group with WTP 4001-10,000 EEK. 2. Working-age population according to labor force survey.

A demand curve was approximated to the above data, see Figure 1. Sections corresponding to the size of different WTP groups of working-age population (Table 3 column 5) have been represented on the x-axis on Figure 1, starting with the group with the highest and ending with the smallest but still positive WTP.

Figure 1. Demand for conservation of semi-natural plant communities



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 (Table 3 column 2).

Thus, the calculation of curve y = f (x) is based on:

X	0.10	0.28	0.60	1.45	2.86	6.20	9.73	11.43	12.27
Y	14	6	2.5	0.8	0.4	0.13	0.04	0.01	0

Figure 1 is in the scale where 1 unit on the x-axis corresponds to 50,000 people and on the y-axis to EEK 500. Thus, every WTP group and its average WTP is characterized by a point (x, y). These points can be depicted by the equation (2):

$$y = ae^{-bx} \qquad (2)$$

The parameters a and b were estimated using the EViews 3.0 software, t-values and R square are shown in brackets.

$$a = 22.145, \qquad b = 4.303 \quad (R^2 = 0{,}989) \qquad (3)$$
$$(14.52) \qquad (10.56)$$

Taking the estimated demand curve and integrating the equation, an approximate overall WTP is received for the working-age population.

$$WTP_{gr}\int_{x_1}^{x_2} ae^{-bx}dx = \frac{a}{-b}(e^{-bx_2} - e^{-bx_1}) \qquad (4)$$

Since $x_1 = 0$ and $x_2 = 12.27$, then

$$e^{-bx_1} = 1, \text{ and } e^{-bx_2} = \frac{1}{e^{bx_2}} \cong 0$$

$$WTP_{gr} = \frac{a}{b} = \frac{22.145}{4.303} = 5.146 \qquad (5)$$

Consequently, on the scale of Figure 1 the result corresponds to:

$$5.146*50,000*500=128.65 \text{ million EEK} \qquad (6)$$

The annual aggregate willingness to pay of the Estonian working-age population to enable preservation of semi-natural communities is estimated at EEK 128.65 million. Dividing by the working-age population gives an average WTP of EEK 185.

The received estimate can be used to derive the per hectare value by dividing EEK 128.65 million by approximately 31,000 hectares (according to the inventories described below) of semi-natural habitats on Natura 2000 areas. The average willingness to pay for conservation of an additional hectare of semi-natural habitats is thus EEK 4,150 annually.

2. Cost-benefit analysis of extending semi-natural habitat conservation

The County Environmental Departments in Estonia are responsible for management and protection of Natura 2000 sites which do not belong to any of the national parks or other protected areas employing administrative staff. In order to find out the investment needs for increasing the area of managed semi-natural habitats, all 31 protected area managers were interviewed by the authors (Ministry of Environment 2005).

Based on collected information it was possible to calculate the costs of maintenance, and to specify the investment needs in infrastructure and equipment.

2.1. Maintenance and restoration costs

The principal ways of maintaining semi-natural communities are mowing and pasturing. Mowing is the method of maintenance on floodplain meadows, wooded meadows and dry meadows; pasturing is mainly used on seashore meadows, alvars and wooded pastures. Mowing and pasturing may be replaced by each other to a limited extent without any negative impact on habitat quality.

It was estimated that an average annual maintenance cost at EEK 1,200 per hectare would be representative for the mechanic works of semi-natural habitat conservation. However, seashore meadows, wooded pastures and alvars are most effectively maintained with pasturing. The maintenance cost, if compared to income from cattle on cultivated pasture, indicates a loss in per hectare income ranging between EEK 1,680 and 2,520. The foregone income from sheep is estimated at about EEK 350 per hectare. To account for a combination of mowing and grazing an average annual maintenance cost of EEK 2,000 per hectare is used in the cost-benefit analysis.

If semi-natural plant communities are abandoned, they revert to scrub land and eventually to forest. Restoration can take several years since biological quality improves over a number of years. Semi-natural plant communities that have been un-mown for a number of years and which are reverting to scrub land must undergo regular maintenance in order for their ecological quality to be raised to former level. The average restoration cost of the main types of semi-natural communities ranges between EEK 2,500 and 4,600 per hectare per year.

Compared with maintenance, the restoration of semi-natural communities is more labor and time consuming, therefore, more costly than general maintenance works. The duration of abandonment influences the input of labor required for restoration of all semi-natural communities. Especially sensitive are wooded meadows, the restoration cost of which increases after more than 5 years of abandonment by almost 50 percent. To account for restoration costs in the cost-benefit analysis, a factor of 1.5 is multiplied to average maintenance costs during the first five years of restoration.

2.2. Investments in infrastructure

The inventory of Natura 2000 sites shows that the existing capacity of infrastructure i.e. roads to semi-natural habitats in many cases are accessible only during dry summers. Small bridges are rotten and cannot carry modern tractors etc. Managers of Natura 2000 areas at County Environmental Departments and at national parks collected information about investment needs for access infrastructure to semi-natural communities (Ministry of Environment 2005). The result of this inventory showed that if additional access roads and bridges will be built it is possible to maintain 4,660 hectares. The total investment costs into infrastructure were estimated at EEK 32,434,000. The appraisal of infrastructure investments is set to 30 years, which is common for infrastructure projects (Heatco 2005).

All roads to be restored or improved are unpaved. The Estonian Road Administration uses a rate of EEK 5,500 per kilometer as annual maintenance cost for undertaking routine maintenance, grading, spot re-gravelling and re-surfacing.

2.3. Investments in equipment

Another problem related to maintenance concerns equipment. The inventory found that in many cases tractors are older than 15 years and need to be replaced to continue maintenance of semi-natural communities.

The calculation of the need to invest into equipment was made separately for each Natura 2000 site (Ministry of Environment 2005). The identified total investment cost into equipment is EEK 109,811,100 and would make it possible to enlarge the area of semi-natural habitats by 14,669 hectares. The time horizon of investments in equipment is 15 years, which is acceptable as equipment lifetime.

For those semi-natural plant communities which are in need of investments in both infrastructure and equipment, the restored hectares were allocated between infrastructure investment and investments in equipment based on per site information. Since these investments cannot be easily separated, the overall appraisal period is set to 30 years for both kinds of investments. This implies that after 15 years, re-investments need to be made in equipment.

2. 4. Cost benefit analysis

Two scenarios were constructed for the cost benefit analysis. Scenario 1 represents a "do nothing" alternative. In Scenario 1 the assumption is that there will be no further investments in infrastructure and equipment. Maintenance continues at sites that do not depend on investments, which results in a decline of semi-natural plant communities from 9,667 hectares in 2007 to 3,702 hectares in 2036.

Table 4. Hectares of semi-natural plant communities per scenario

	2007			2021			2036		
	Infra	Equip	Total	Infra	Equip	Total	Infra	Equip	Total
Scenario 1	2,332	7,335	9,667	1,842	4,227	6,069	1,317	2,385	3,702
Scenario 2	2,332	7,335	9,667	4,664	14,670	19,334	4,664	14,670	19,334

Scenario 2 assumes investments in infrastructure and equipment, thus making it possible to preserve all Natura 2000 semi-natural habitat sites. The territory that can be restored through infrastructure investment is 3,347 hectares (4,664-1,317=3,347) and through investment in equipment it is possible to add another 12,285 hectares (14,670-2,385=12,285). If all identified investments are carried out in 2007, total area is expected to double after five years of restoration works.

The annual benefits related to conservation of semi-natural communities were estimated at EEK 4,150 per hectare. These benefits include non-use values and indirect use values. However, to receive total economic value, income from production of hay needs to be added. Productivity of semi-natural communities varies between 1 and 4 tons of hay per hectare. The market price of hay is EEK 670 per ton (transport costs included). Assuming that average productivity is low rather than high gives a moderate estimate of the direct use value equal to EEK 670 annually per hectare.

Table 5 shows the result in the present value of the cost benefit calculation.

Table 5. Present value in million EEK, 2005 value, interest rate 5%

	Scenario 1	Scenario 2	Scenario 2 – Scenario 1
Investment	0.0	226.3	226.3
Maintenance	227.5	647.2	419.7

Infrastructure maintenance	0.0	6.9	6.9
Sum of costs	**227.5**	**880.4**	**652.9**
Non-market value	472.1	1,199.5	727.4
Harvest of hay	76.2	193.6	117.4
Sum of benefits	**548.3**	**1,393.1**	**844.8**
Benefits – Costs	**320.8**	**512.7**	**191.9**

The calculation shows that the benefits from conservation and additions of new areas justify the investments and additional maintenance costs of Scenario 2. Relating benefits to costs shows a ratio of 1.6, implying that benefits exceed costs by 60 percent.

Conclusions

For the first time in the Baltic countries, a contingent valuation study is used as an input for a cost benefit analysis. The economic value of Estonian semi-natural plant communities was estimated with the help of the contingent valuation method based on a random sample of working-age residents in Estonia. The statistical estimations show that the average annual willingness to pay for habitat preservation amounts to EEK 185. Expressed per hectare, the estimated value is EEK 4,150. This value was used as an input in the cost benefit analysis of investments to restore semi-natural habitats in Estonia's Natura 2000 network. The results show that the benefits of enlarged restoration exceed costs by about 60 percent. The policy implication is that additional expenditure is justified for increasing the area of semi-natural habitats. Even though the paper does not suggest how financial resources should be collected, it shows that it is efficient to enlarge conservation.

The contingent valuation study reveals the willingness to pay for conservation and indicates the size of the potential monetary contribution. However, one potential disadvantage of the contingent valuation method is that it may lead to biased results. If respondents believe that their answers may be used to affect government policy, this could lead them to intentionally understate or overstate their willingness to pay to achieve the desired policy result. But, on the other hand, a direct method such as the contingent valuation method is the only option for measuring non-use values of environmental resources. The conducted survey was designed with great care in order to minimize the influence of strategic responses. This was achieved by conducting personal interviews, inclusion of a "non-response" option and a reminder for respondents to consider their budget constraint.

The results of the cost benefit analysis may be sensitive to changes in assumptions. Calculations show that using a shorter appraisal period or a higher interest rate does not change the overall conclusion. If applying an appraisal period of 15 years, benefits exceed costs by 50 percent and by 40 percent with application of an interest rate of 10 percent.

References

Andreasson-Gren, I.-M. (1995), "Economic Evaluation of Danube Floodplains", A WWF International Discussion Paper. Switzerland.

Bateman, D. W. and K. G. Willis (eds.) (1999), *Valuing Environmental Preferences. Theory and Practice of the Contingent Valuation Method in the US, EU and Developing Countries.* Oxford University Press Inc., New York.

Davis, R. K. (1963), "The Value of Outdoor Recreation: An Economic Study of the Maine Woods". Ph. D. Dissertation. Harvard University, Department of Economics, MA, U. S.A.

Ehrlich, Ü., K. Habicht and P. Krusberg (1999), "Territories with Limited Economic Utilisation as a Factor of Economic and Social Development", [in:] *Harmonisation with the Western Economics: Estonian Economic Developments and Related Conceptual and Methodological Frameworks,* Ü. Ennuste and L. Wilder (eds.), Tallinn, pp. 303-327.

Ehrlich, Ü., K. Habicht (2001), "Non-Use Value and Maintenance Costs of Estonian Ecological Semi-natural Communities". [in:] *Factors of Convergence: A Collection for the Analysis of Estonian Socio-Economic and Institutional Evolution*, Ü. Ennuste and L. Wilder (eds.), Tallinn, pp.227-263.

Hanley, N. D. and C. L. Spash (1993), *Cost-Benefit Analysis and the Environment*. Edgar Elgar Publishing Limit.

Heatco (2005), "Developing Harmonised European Approaches for Transport Costing and Project Assessment", Deliverable 2 State-of-the-art in project assessment, December 2005, EU project, Contract No. FP6-2002-SSP-1/502481.

Krutilla, J. V. (1967), "Conservation Reconsidered", *American Economic Review*, Vol. 57, pp. 777-786.

Ministry of Agriculture (2004), "The National Development Plan for the Implementation of the Structural Funds" – Single Programming Document – 2004-2006 Programme Compliment (draft as of 08.01.04).

Ministry of the Environment (2005), "Conservation measures for Natura 2000 semi-natural habitats", Tallinn.

Mitchell, R. C. and R. T. Carson (1989), "Using Surveys to Value Public Goods: the Contingent Valuation Method", Washington, D. C.: Resources for the future.