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LOSS OF VALUE OF THE SZIGETKÖZ WETLAND DUE TO THE GABCIKOVO-NAGYMAROS BARRAGE SYSTEM DEVELOPMENT: APPLICATION OF BENEFIT TRANSFER IN HUNGARY

CASE STUDY: HUNGARY

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FOREWORD

This report was contributed as a national case study to an OECD project on the Applied Evaluation of Biodiversity, being carried out by the Working Group on the Economic Aspects of Biodiversity. It does not necessarily reflect the views of individual OECD Member countries or of the OECD Secretariat. It is published under the responsibility of the Secretary General.

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LOSS OF VALUE OF THE SZIGETKÖZ WETLAND DUE TO THE GABčIKOVO-NAGYMAROS BARRAGE SYSTEM DEVELOPMENT[1]: APPLICATION OF BENEFIT TRANSFER IN HUNGARY

by

Marjainé Zsuzsanna Szerényi, Eszter Kovács, Sándor Kerekes and Mónika Kék

Executive Summary

This case study describes the calculation of the loss of values of an important wetland area in Hungary using the method of benefit transfer.

The Szigetköz wetland is situated at the North-Western part of Hungary on the side of the River Danube. The construction of a barrage system between Hungary and Slovakia and especially the diversion of water from the main riverbank caused considerable damage to the valuable ecosystem of the Szigetköz wetland.

An Austrian contingent valuation study was used as a basis for the benefit transfer. The Austrian survey calculated the willingness to pay for a wetland (similar to Szigetköz) as an area for a future national park with and without a hydroelectric power station.

The findings were adjusted to the Hungarian case, taking the differences of the two situations into account (e.g. the GDP of the two countries, the territory of the wetland area and the estimated rate of degradation). The NPV (net present value) of the loss of value using the discount rate of 2% and 3,5% was calculated. As a result, the value of the loss is between 42-252 Billion HUF at 2% discount rate and 24-144 Billion HUF at 3,5% discount rate.

Ecosystem or species studied: riverbank wetland

Valuation method(s) used: benefit transfer

1. The authors thank Mr. Stale Navrud for all his valuable comments. The last phase of research was implemented through the funds provided by the Government Commissioner's Secretariat for the Danube, the Prime Minister's Office. We would like to thank the Secretariat for allowing us to publish the data contained in this study.

Main lessons learned: The findings of the benefit transfer were used in cost-benefit analyses of different possible alternatives of the Gabcikovo-Nagymaros barrage system. It is a great step toward a much broader economic analysis including the estimation of the natural capital invested. The results showed that although Hungary's investment into the project was of a smaller scale in terms of material assets, but a rather significant part of its natural capital has been invested.

Due to the known deficiencies of the benefit transfer method, the results might be tested with an original WTP survey.

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1. General Description

1.1 Description of the ecosystem[2]

Szigetköz is the largest extension flood area of almost natural status left in the entire Upper Danube Valley, a wetland habitat of outstanding importance. Various habitats had been formed here, because of geological, geo-morphological, climatic, water-balance and soil related endowments. These diverse habitats are responsible for the high levels of biodiversity in the studied area (Szabó et al., 1997; p.1). As a wetland, Szigetköz is significant not only for the preservation of different levels of biodiversity, but also because it is suitable for the filtration of anthropogenic environmental loads, such as nitrogen and heavy metal contamination. Wetland habitats are being protected all over the world because they can provide these types of valuable ecological services (Szabó et al., 1997; Mészáros, 1996). Throughout Europe, governments directing significant intellectual and financial resources to maintain existing and restore degraded or nearly destroyed wetlands (Szabó et al., 1997).

Variety is provided by the diversity of plant communities. The flood plain is fragmented by the branches of former valleys with some ridges and hills built from the sand of the valleys by the dominant Northwest winds. The features of this terrain and the valley branches helped prairie, forest steppe, forest, marsh-water, marshy meadow and meadow ecosystems be created. (Szabó et al., 1997). Table 1 shows the distribution of terrestrial habitats in Szigetköz prior to intervention. The most significant values of the Szigetköz ecosystem are the following:

- high biological diversity;
- unique flora and fauna;
- characteristic mosaic arrangement of habitats (Mészáros, 1996).

Table 1 **Review of terrestrial habitats in Szigetköz**

Habitats	Area size (ha)
Habitats of the riparian corridors, willow and poplar groves on the active flood area	6,500
Hardwood groves on the active flood area	200
Hardwood fringing forests on the areas protected by dikes	1,500
Wetland on the active flood area	2,800
Wet meadows and hayfields	2,600
Dry forests and meadows	1,100
Total:	**14,700**

2. Our general description of the ecosystem under examination and the impact produced by the Gabčikovo-Nagymaros Barrage System was originally based on the personal consultation conducted with Dr. Mária Szabó, assistant professor, Dept. of Natural Geography, ELTE University of Budapest. We have also used studies on the monitoring activities supervised by Dr. Szabó. Our expert in zoology was Dr. Ferenc Mészáros, director of the Zoological Department, Hungarian Museum of Natural Sciences. Dr. Zoltán Alexay (assistant professor, Széchenyi István College), the local expert of Szigetköz also provided tremendous help.

The flora in Szigetköz include 1010 species and 80 plant communities, of which 60 are natural, and 15 are of relic nature of outstanding value (Mészáros, 1996). The significance of the ecosystem of Szigetköz is also proved by the fact that 20% of all plant species and 30% of all animal species under protection in Hungary can be found here (Mészáros 1996). The most characteristic representatives of the fauna include, in the first place, vermin, articulata, aquatic mollusks, amphibia and birds (Alexay, 1999).

1.2 Sources of the degradation of the ecosystem in Szigetköz

The source of the damage and degradation of the wetland area in Szigetköz is undisputedly the water barrage project on the Danube jointly launched by Hungary and Czechoslovakia. Below the key events of the construction project are described. A detailed description is to be found in Chapter 2.

- The bilateral contract on the construction of the Gabčikovo-Nagymaros Barrage System (GNBS)[3] was signed in 1977 by the Prime Ministers of Hungary and Czechoslovakia. Construction was started in 1978. Two elements of this system, the dam at Dunakiliti and the power station at Gabčikovo are located in Szigetköz or in its immediate neighbourhood. In order to mitigate the foreseen damaging consequences of the decreased water supply of the future operation, a water supplementing system was built in 1987-89 (Alexay, 1999).

- In 1989, the Hungarian Party stopped the construction of the Nagymaros barrage system and later demolished the built elements. The Slovakian Party insisted on the completion of the project and in October 1992 blocked the Danube riverbed at Dunacsúny (West from Dunakiliti). The fill-up of the reservoir began and the river was diverted into an operational channel. By applying the so-called variant "C",[4] the role of the Dunakiliti dam was substituted, and the facility at Gabčikovo was put into operation (iid, 1999). As a consequence the water level dropped in the old Danube riverbed and the wetland area started to dry out.

- In June 1995 an underwater weir[5] was constructed in the large Danube riverbed in order to dam up the water coming from the reservoir and to facilitate the water supply of the branch system by gravitation (Alexay, 1999).

Certain steps of the dam project have brought about significant changes in the wetland ecosystems of Szigetköz that can only slightly be mitigated by the aforementioned supplementary measures.

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3 The river Danube is a border river between Hungary and Slovakia where the barrage system was planned. The system – according to the original plan - included on the upper part of the Danube: a dam and reservoir at Dunakiliti (Hungary), a hydropower plant in Gabčikovo (Czechoslovakia) and a connecting operational channel; on the lower part of the Danube: another hydropower plant in Nagymaros (Hungary). The main aim was the generation of electrical power, and at the same time the improvement of flood control safety and provisions for international waterways.

4. The so-called variant "C", in essence, means that the Gabčikovo project would be implemented only on Slovakian territory, thus offering a substitution for the dam to be built at Dunakiliti; this alternative does not include either the barrage at Nagymaros (iid, 1999).

5 The underwater weir is a simple underwater dam made of gravel, which raises the water level by 3-4 meters and provides more water for the branch system, thus for the wetlands.

1.3 Main objective of the evaluation of the deterioration of the Szigetköz wetland

In 1998 the research team of the Department for Environmental Economics and Technology of the Budapest University of Economic Sciences was commissioned by the Government Commissioner for the Danube, of the Prime Minister's Office to prepare a study on the loss of the natural capital in Szigetköz.[6] The task included the further specification of the formerly pursued estimation of the capital value of Szigetköz and the creation of its methodological foundation.

By that time the water management and ecological experts concluded that a desirable compromise would be the so-called meandering"[7] alternative to make the Szigetköz wetland habitats most similar to its status before the dam construction.

In our analyses, the estimation of the impact of two alternatives was considered: a) how great is the loss of value generated by the implementation of variant "C" and b) how great loss of value would occur in the case of the meandering alternative being implemented.

In the present study, the findings of the most recent estimation are presented, but, where it is necessary, reference is made to former findings.

2. Cause and Source of Changes that have occurred in the Ecosystem

The obvious source of recent damage and degradation of the wetland areas in Szigetköz is the barrage system project on the Danube jointly launched by Hungary and Czechoslovakia.[8] The bilateral contract on the construction of the Gabčikovo-Nagymaros Barrage System (GNBS) was signed in September 1977 by the Prime Ministers of Hungary and Czechoslovakia. Two elements of this system, the

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6 The research team, has been commissioned many times to participate in preparing economic calculations on the barrage system. For the first time in 1994 (see: Kerekes et al., 1994), when the Ministry of Foreign Affairs gave commissions concerning the estimation of the Hungarian claim for damage as a preparation for the lawsuit at the Court of the Hague. It quickly became clear, that the traditional economic and legal concept of damage cannot be used in relation with GNBS. For that reason, we tried to give an estimation of the loss of value in natural capital within the limits of the scientific knowledge available at the time. After the decision was declared by the Court of the Hague, the claim to measure the environmental damage of the Hungarian Party was again raised in the negotiations with the Slovak Party. The Assistant Secretary of State of the Ministry for Environment commissioned us to prepare the background material of the estimation. The study was completed in March 1998 (Kerekes et al., 1998), and its findings were discussed with Slovak environmental experts in two rounds of negotiation.

7. The so-called "meandering" version, in essence, means that, although artificial structures would be placed, the natural river branches would be used to reach the appropriate water level, on the one hand, and the water flow relation close to the former status, on the other. The water dammed up at suitable points of the main riverbed by blocks and dams is conducted into a branch, then returned into the main riverbed, then again into the flood plain branch. From an ecological standpoint this alternative seems to be the best solution, as it creates a constant contact between the main stream and the flood plain branches, provides water flow in the branches, and allows free movement for aquatic animals on almost the entire territory (Alexay, 1999).

8. Changes that have taken place in the status of the Danube and the Szigetköz date back 100 years. It began with river regulation, followed by building barrages on the upper section of the Danube, resulting in a significantly deeper main riverbed (Alexay, 1999). The unfavourable processes affecting the wetland habitats began long before the current project of investigation. Yet the Gabčikovo-Nagymaros is playing an significant role in this negative change. From an ecological standpoint, drastic changes have taken place within an extremely short period of time.

dam at Dunakiliti and the power station at Gabčikovo, are located in Szigetköz, or nearby, thus the construction had a direct impact on the region (Alexay, 1999). Most of the river branches and islands Northwest of Dunakiliti were eliminated during the construction, and forests were cut down on the site of the preparatory buildings set up for the construction purposes and on the territory of the dam. In order to mitigate the detrimental consequences of decreased water supplies after the barrage system was put in operation, a water substitution system was built in 1987-89. On the protected side and in Lower Szigetköz, there was no change due to the construction of the dam.

In 1989, Hungary stopped the construction of the Nagymaros barrage system and even had demolished what had been built so far. The situation of the original investment plan was further deteriorated by the fact that the Hungarian government did not approve of the completion of the dam at Dunakiliti and the fill-up of the its reservoir, which made it impossible to put the Gabčikovo barrage into operation. In response, Slovakia blocked the riverbed of the Danube at Dunacsúny in October 1992 and began to dam-up the reservoir and divert the river into an operation channel. By this so-called variant "C", the role that Dunakiliti was to play was substituted, and the operation of the Gabčikovo project was started (iid, 1999). After the riverbed was blocked, the rate of flow decreased to 10% of the median water rate, and through the open branches, the subsidiary branches became empty. On the protected side, channels became totally dry, and the water table decreased by 2-3 meters. In order to prevent any further damage, it seemed to be advisable to implement the water substitution system built earlier. Owing to the disputes over the different water substitution plans, the flood plain branches could not receive the necessary quantity of water for 2.5 years, and the dry status of the area became constant, increasing the ecological damage. (Alexay, 1999).

In June 1995, the underwater weir constructed at 1843 river km in the large Danube riverbed was put into operation to dam the water coming from the reservoir and to facilitate the water supply of the branch system by gravitation (Alexay, 1999). By the construction of the underwater weir however, no high flood levels can be reached, therefore its construction did not solve the problem of water supply for the marches and the moorish meadows on the protected side, therefore, the flora and fauna of these areas suffered the highest rate of damage (Alexay, 1999).

In 1998, a special fish channel was built at Cikolasziget with the intention to restore the relationship between the branch system of Szigetköz and the main branch.

In the planning phase of the project, until 1994, it was not considered important how and to what extent these changes affected the natural environment. It is then perhaps not surprising that the initial economic calculations, not well-founded otherwise, do not even mention the impacts exercised on the natural capital.

3. Impacts exercised on the Ecosystem

Based on the findings of the monitoring[9] conducted in the region since 1987, the variant "C" of the Gabčikovo-Nagymaros Barrage System resulted in a rapid and drastic deterioration of the habitats in some places. Due to desiccation, the flood area's ecological potential[10] has undergone significant changes.

9. Originally, phyto-cenology, flora and vegetation level monitoring was conducted in the area, and an ecological monitoring was added to this in 1993, through which anatomic and population level indications of sensitive indicator species were examined. In practice, this facilitated the follow-up of ecological changes occurring with varied „speed" on the different biological organisation levels (Szabó et al, 1997).

10. The ecological potential is a performance potential arising from the individuals of the plant and animal species, from the totality of these individuals (the population), and from the features of their habitats. In the course of evolution, the ecological potential is being changed by the environment, but it can also be

The large habitat diversity began to show the signs of becoming homogenous and the most valuable communities and populations of nearly undisturbed vegetation began to deteriorate, become overgrown with weeds, and die (Szabó et al., 1997). Water demanding species started to decrease in number, while the draught resistant species' coverage began to increase (Szabó et al., 1997). These negative impacts affected the habitats and vegetation units tied to water in Middle Szigetköz.

Due to farming, forestry and an increasingly arid climate, the flood area ecosystem in Szigetköz has been partly degraded. Yet, in a number of habitats, especially in the area between the dams, the so-called foreshore, it has been preserved in a nearly natural status. Annual monitoring conducted since 1987 gives straightforward evidence that Szigetköz had most of its ecological potential preserved until the time when the bulk of the water of the Danube was diverted into an operation channel.

Due to the construction of the underwater weir the water supply of the habitats in the vicinity was slightly improved (in a circle of about 3-4 kms), but in essence this was true only for a relatively small area falling outside the foreshore. The ecological status of the flood plain with the most significant natural values has not improved at all in spite of the permanent water substitution. This conclusion is also supported by the data of the sample areas in Middle Szigetköz in 1995-96. Improvement can only be expected from a significantly higher water rate of the Large Danube (approx. 800 m3/sec) (Szabó et al., 1997).

A significant consequence of the dam project is the lack of regular flooding of the foreshore that is highly important both in the flood plains of the Great Danube and the Mosoni Danube, primarily in the Middle Szigetköz. Water substitution by the construction of the underwater weir has brought about some improvement on areas far from the Great Danube, but as we approach the riverbed of the Danube, this favourable impact is decreased or even comes to an end, and this is what has brought about the destruction of the white willow and black poplar groves along the river bank. The lack of floods has also resulted in a significant restructuring of the soft stem vegetation in the flood plains. At the same time, the number of original protected plant species characteristic to flood plain forests (e.g.: Senecio paludosus, Leucojum aestivum,) has decreased, and certain species (e.g.: Cardamine amara) have completely disappeared (personal information from Szabó).

The bush willow and white willow groves on the Great Danube flood plain in the Middle Szigetköz have suffered lasting damage, the rate of destruction reaching 50-60% in some places. As a response to the construction of the underwater weir, only white willow is still sprout, but it was of little help to other tree species (personal information from Szabó).

The wet meadows and forests along the Danube have not received sufficient quantities of water since the time the Danube was diverted, and as a result, they have been largely damaged. The lack of mowing also has an unfavourable impact, converting the wet meadow rich in species before the diversion of the Danube into an area fully covered by weeds. Water demanding species characteristic to the meadow are pushed to the background (e.g.: occurrence of plantago altissima is only sporadic) (personal information from Szabó).

The protected side, falling outside the dam, was also affected unfavourably by the diversion of the river: it affected mainly the willow and poplar fringing in lower lying areas of forests. The wet meadows, flood area moorish meadows and fresh hayfields have become covered by weeds and homogenised, although prior to the diversion of the river, they were treasurers of rare species. Most of the

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changed in the course of ontogenesis (Environment Protection Lexicon, Akadémia Kiadó Budapest, 1993, p.: II./147.).

reed marshes exhibit poor growth, and some have been overtaken by weeds (personal information from Szabó).

In the restoration of the Szigetköz to its original status, the guiding factors are water supply and water dynamics. It is not enough to provide sufficient supplies of water. The river must also reach the flow speed and water level fluctuations like those previous to the diversion (Alexay, 1999).

Apart from the unfavourable changes in flora, the negative processes can also be observed in the fauna. The decrease in the number of species and individuals of mollusks on the diverted part of the Old Danube is obvious. Draught-resistant bird species from the protected side continue to establish colonies on the flood plain (Mészáros, 1996). According to Mészáros (1996), two protected dragon fly species under the scope of the Bern Convention (Aeshna viridis, Leucorrhinia pectoralis) have disappeared from this area (owing to the short time scale, we cannot speak about extinction at that time). Due to the diversion, the number of different types of water decreases and variety can even be fully eliminated that will make most of the aquatic fauna uniform-like (Mészáros, 1996).

4. Impacts exercised on the Economy and Social Welfare

As it has been shown, the Szigetköz wetland is one of the types of habitat that are becoming more and more rare not only in Hungary, but also all over Europe. Consequently, any negative changes occurring in its state are a loss to both the Hungarian population and the population of Europe. In our assessment, the impacts realised in relation with to welfare of the Hungarian population have primarily been quantified on the basis of the data and information available and the high rate of uncertainty characteristic anyway.

In the assessment of Szigetköz, both the methods applied, as well as the rate and irreversibility of the changes occurring in the ecosystem have a high rate of uncertainty. First these uncertainties are explored, and assessment cases are described only after having received knowledge on the uncertainties.

4.1 The role of information and uncertainty in the valuation process

4.1.1 Uncertainty inherent in environmental impacts

In the valuation of the changes in the value of flora and fauna, our starting point is the transformation and degradation of the plant communities and the fauna characteristic to the region. It is ultimately important to show the relevant uncertainty factors that are the following (personal information from Mária Szabó):

- The decrease in the number of individuals in the population of a species should not lead us to the conclusion that this species will become extinct in that place in future. Every species has a specific population cycle characteristic only to this species, which means that the number of individuals may decrease (or increase) even if the environmental factors are unchanged. That is, a species showing a decreasing tendency does not necessarily mean that extinction is imminent or will happen. But: If the number of individuals of a plant species with high water demand decreases due to habitat desiccation, the extinction of that species from this habitat can almost be taken for granted.

- The international rule is that a species can be considered extinct in an area, if not a single individual is found for 50 years (In Mészáros' view (1996), it is 15 years).

- The number of individuals of any species in the future depends on the original conditions, like the initial number of individuals, the genetic variability of the species, the changes in the ecological factors, and the competition relations with other species.

- The rate of irreversibility of the changes cannot be easily estimated because it depends on a number of factors:

  - In cases of plant species strongly tied to water, the future changes in the process and its reversibility are fundamentally defined by how long the given habitat is left in a desiccated status. The longer the duration, the higher the probability of irreversibility.

  - It also depends on the number of individuals of the population affected by the unfavourable change. The higher the number of individuals, the higher the probability of adaptation.

  - An essential aspect is the plasticity of the plant, that is, to what extent it is able to allocate its energies to root growth to seek out decreasing ground water. With respect to flood plain plants and wetland species, their root system plasticity is not known, because it has never been necessary to examine where the water supply for the vegetation can be considered optimal. The river diversion of this scale has caused unprecedented rapid and large-scale desiccation of the habitat.

4.1.2 Uncertainty inherent in the valuation method

Researches of the recent years show that none of the benefit transfer methods are able to show results that would satisfactorily substitute the findings of a preliminary assessment (those of a contingent valuation in the first place).

Ready et al. (1999) make a comparison of people's willingness to pay for similar problems in six European countries by using identical tools (questionnaire, survey environment, time). They believe that the differences in willingness to pay cannot be simply explained by the differences in the population; their final conclusion, however, is not a full rejection of the benefit transfer, rather they point out that the application of benefit transfer may transfer a lot of distortions into the results.

Bergland et al. (1999) were first to examine directly the potential to transfer benefits appraised in a given area to some other problems. An identical problem was examined in two regions of Norway at identical point of time by the contingent valuation method. Their findings show that the transfer of neither the valued WTP nor the so-called valuation function is reliable and may bring forth-distorted results.

Owing to the deficiencies of the benefit transfer method and the disputable nature of the applied assumptions, the estimation of the loss of value in the flora and fauna of Szigetköz contains a high rate of uncertainty.

Beyond applying the benefit transfer presented below, the valuation of the ecosystem changes generated by the barrage system, was also conducted on the basis of the summary valuation contained in the study published in Nature (Costanza et al., 1997). The process of calculation and the detailed results are not discussed, it is only noted that the results of the assessment were fairly similar to the results of the benefit transfer assessment (see details at: Kerekes et al., 1998, 1999).

Below the benefit transfer valuation and its findings are presented.

4.2 The method of assessment: Transposition of CVM research results by benefit transfer

4.2.1 Benefit transfer

In the estimation of the loss of value of Szigetköz, the so-called benefit transfer method[11] has been used. The benefit transfer method, refers to the transfer of available analysis results - in our case conducted as a contingent valuation[12] - to an area that can be considered similar to the one that the original analyses are relevant for. We presume that the available results give some sort of assessment of the characteristics of the area to be examined.

In general, the benefit transfer method can be used if the following conditions are met:

- the policy site intended to be examined is similar to the study site that will provide an answer based on the available findings;
- the presumed consequences of the change intended to be examined are similar to the consequences of the changes considered in the available findings;
- the valuation methods have been used with appropriate accurateness and consideration in the available studies;
- the necessary personnel and material conditions are not available, and there is not enough time to conduct an original examination.

The application of the method requires thorough consideration. It is especially important that the study site and the policy site should be as similar as possible: e.g. geographical and ecological characteristics, changes that have been occurred or might occur, the causes of the changes and the policy situation.

Lack of time and money were characteristic to the entire research phase. As a result, there was no way to conduct a primary assessment. Consequently, although it was a forced solution, it seemed advisable and inevitable to apply the benefit transfer method.[13]

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11. According to Navrud (2000) there are two main approaches to the benefit transfer method: a) the transfer of a unit value (simple unit transfer and unit transfer with income adjustment) and b) function transfer (benefit function transfer and meta-analysis). Since ecological impacts are rather cause and site specific, we used the method of direct benefit transfer, where we transferred the unit value from the study site to the policy site.

    Concerning the method, see also: Project and Policy Appraisal: Integrating Economics and Environment (OECD, 1996).

12. The contingent valuation method is a direct environmental valuation technique where people are directly approached and asked about their willingness to pay for a natural resource or an environment policy change (for details, see e.g.: Mitchell and Carson, 1989). This method has an especially important role in the preservation of habitats and biodiversity, as it is also able to give valuation characteristic to these assets, independent of their use.

13. The Prime Minister's Office, probably due to the proposal emphasised in this research - gave commission in Spring 2000 for a study to survey, by contingent valuation, the willingness to pay for the conservation of the natural capital in Szigetköz.

4.2.2 Surveys available for the application of benefit transfer

Unfortunately, valuation by contingent valuation of freshwater wetlands similar to Szigetköz has been documented in only a few case studies in the international technical literature. Examination of saltwater areas is much more frequent, but they cannot be compared to freshwater wetlands.

Two assessments are available on European wetland areas: a) a survey in East-England, carried out in the early 1990 on the conservation of " Broadland", a complex freshwater wetland area (Turner et al., 1993)[14] and b) a survey in Austria on saving a wetland area along the Danube by the creation of a national park (Kosz,1996). The Austrian survey has been chosen as a basis for the benefit transfer.

Survey in Austria (according to Kosz (1996)

A survey was conducted in Austria in 1993 to measure Austrian citizens' willingness to pay for the creation of a national park along the Danube.

Perhaps one of the largest riparian wetlands of Europe can be found on the Vienna-Bratislava section of the Danube in Austria, and it provides habitats for a large number of threatened and special species. The plans for the creation of an internationally recognised national park (in accordance with IUCN recommendations) on 11,500 ha on part of the wetland, date back to several decades. Parallel with the national park plans, however, plans have appeared for the construction of a hydro-electric power station in the area, whose implementation would cause irreversible damage to the wetland, also decreasing the area of the national park to be created. Two plans were available concerning the site of the power station: one at Wolfsthal, the other close to Wildungsmauer; the latter one exactly in the middle of the wetland. The survey on the willingness to pay was conducted by the method of contingent valuation, and focused on the Austrian citizens' willingness to pay for three different implementation plans.

In our opinion, findings of the study conducted in Austria can be applied in the valuation of Szigetköz, for the following reasons:

- it evaluates a wetland situated along the Danube of outstanding importance in Europe that is very similar to the wetland habitats in Szigetköz;

- the survey conducted in Austria focused on the willingness to pay for the conservation of the wetland area as a national park (that is, the conservation function is at the forefront);

- while the problem in Austria was also associated with the construction of a hydro-power plant, it can be considered similar to the Hungarian decision-making situation;

[14] Broadland is considered an outstanding wetland in East-England, having three nature reserves on its territory, two of which are included in the Ramsar list. The objective of the WTP survey was to state the monetary value of the conservation of the wetland in the event that a program is realised to decrease the danger of flooding (for more details see Turner et al., 1993). The method of contingent valuation was used on two separate samples: users and non-users. Although the case in England regards a wetland like Szigetköz, we believe that the application of benefit transfer in that case would generate distortions, because a) although the survey is relevant to the structure and characteristics of a freshwater wetland, but not to a riparian wetland along the Danube; b) there are similarities in the land-use patterns of the two areas, but in England, recreation and agricultural use are dominant compared to conservation being the most important aspect in the Szigetköz; c) in England, the conservation strategy focuses on protection against inflow of sea water, which, in our opinion, cannot be adapted well to the Hungarian situation.

- with respect to the point of time of the survey (1993) it is close to the present;
- the Austrian economic indicators are probably close to the Hungarian conditions.

For the above reasons, we have used the findings of the Austrian survey in the Szigetköz case, by the method of benefit transfer.

The major characteristics concerning the willingness to pay for the national park in Austria can be summarised as follows:

- In the frame of the full project 952 Austrians over the age of 14 were surveyed (representative sample by random-quota procedure).
- Three alternatives were examined, one was on the creation of a national park, the other two were combinations of a national park of a much smaller area and a hydroelectric power station.
- The question asked was the following: How much are you willing to sacrifice annually for the implementation of the different alternatives?[15]

Table 2 contains a summary of the willingness to pay for the three alternatives.

Table 2 **Willingness of Austrian citizens to pay for the three alternatives**

Project	**average WTP (1993 ATS/person/year)**
Creation of the Donau-Auen national park on 11,500 ha territory	329.25
Hydro-electric power station and a 9,700 ha national park	122.21
Hydro-electric power station and a 2,700 ha national park	69.63

Source: Kosz (1996), p. 120

The findings show that the Austrian population most strongly supported the creation of the national park with the largest territory, as willingness to pay seemed to be the highest there. The creation of a national park together with a hydroelectric power station was less preferred.

In Szigetköz we are examining the conservation of the area's natural status pre-diversion and the loss of value due to the conditions created by the current and the meandering version. It is justified to consider from among the above instances of willingness to pay the plan with no hydroelectric power plant

[15] In the Austrian study open ended questions were asked, which usually result in lower WTP than close ended questionnaire surveys. In our case it means that the WTP most probably will not be overestimated. Another feature of the study is that earmarked yearly tax was used as a payment vehicle.

and with the largest territory. Thus, ATS 329.25/person/year[16] can be considered the average willingness to pay for the creation of the Donau-Auen national park.

4.2.3 Calculations relating to benefit transfer valuation

In order to transfer the Austrian willingness to pay on the Hungarian population, first we must make use of certain assumptions[17], that are as follows:

- the environmental sensitivity of the Austrian and Hungarian citizens is identical;
- the Austrian citizens' willingness to pay has not changed since 1993;
- any differences in the willingness to pay can mostly be explained by the different size of GDP per person and can be considered proportionate to that;
- willingness to pay in Hungary is also affected by the income generated in the black (grey) economy, therefore, that should also be added to the calculated GDP value for the legal economy (data from the National Bank of Hungary shows that it is min.12%);[18]
- willingness to pay changes in proportion to the size of the area (larger territory - higher WTP);
- willingness to pay decreases proportionate to the rate of degradation.

With attention to the above, the basis of the calculation is given by the percentage proportion of the average WTP in Austria in 1993 and the GDP per person (see: Table 3). We assume that this proportion is valid for Hungary in 1999. This assumption, however, can only be accepted with reservations, as Kriström and Riera (1996), when comparing the findings of researches conducted by contingent valuation method, came to the conclusion that their flexibility of income is smaller than 1. This means that experiences show that citizens of countries that have smaller income, are willing to use a higher proportion of their income for environmental protection objectives. On that basis we may say that the transfer of the Austrian results would definitely result in an underestimation.

16. This average contains the 0 bids, but does not contain the unrealistic high bids. If the highest bid were considered (ATS 36,000), the average would change to WTP ATS 414/person/year.

17 These assumptions might lead to distortions and simplifications, but the available time and data made only the shown calculations possible.

18. Source: Internet, March 1999, home page of National Bank of Hungary.

Table 3 **Austrian results and the starting points calculated on the basis of those results**

	1993
GDP/person (ATS)	265,812[19]
WTP/person/year (ATS)	329.25
WTP in % of GDP/person	**0.12%**

The table shows that the ratio of the average WTP per person and the GDP per person in Austria in 1993 is 0.12%. For Hungary, the base figure to be used for the calculation of the GDP value per person in 1999 necessary for the calculation of the WTP per person valid in 1999. The GDP for Hungary was estimated as HUF 11.565 bn. Further on, however, we shall not use the official GDP/person value (HUF 1,146,000), but a figure corrected with an estimated income from the grey and black economy. The estimate of the National Bank of Hungary shows that the size of illegal economy is minimum 15% of the legal economy. Thus, the corrected value of GDP: 1,146,000 x 1,15 = HUF 1,138,000. By considering the corrected GDP/person value and the accepted 0.12% ratio of WTP/person and GDP/person, the WTP per person per year can be calculated for Hungary. The results are summarised in Table 4.

Table 4 **Process of WTP estimation in Hungary and its results**

	1999
official GDP/person (HUF)	1,146 thousand
corrected GDP/person (HUF)	1,318 thousand
WTP in the % of GDP/person	0.12%
WTP/person/year (HUF)	**1,581**[20]

The aggregate willingness to pay (applying it to the whole of Hungary) was calculated considering the population above the age of 14.[21]

When multiplying the annual WTP with the size of the solvent population above the age of 14, we find that:

HUF 1,581 x 8,326,000 persons = HUF 13.17 bn

It should also be considered that the Hungarian area under examination is somewhat larger than the area in Austria (wetland in Szigetköz: 14,700 ha as against the area in Austria:11,500 ha). In case we assume that WTP changes proportionately with the size of the area, then the HUF 13.7 bn can be corrected in accordance with the difference of the areas.

19. Value calculated from the ratio of the annual GDP provided by ÖSTAT and the actual population.

20. Value of bid calculated with attention to highest bid (ATS 36,000), converted to Hungarian conditions: (ATS 414 is 0.15% of the GDP/person) 1,318,000 x 0.0015 = HUF 1,977.

21. The size of the population over the age of 14 in 1999 was estimated to be approx. 8,326,000 (Hungarian Central Statistical Office). Although the number of households could also be used for the aggregation, we followed the calculation method of the Austrian study.

Thus, the aggregated Hungarian WTP for the conservation of Szigetköz in its original status is:

14,700/11.500 x 13.17 = **HUF 16.83 bn**

Loss of value can be estimated on the basis of the conversion of wetland areas into valueless associations of weeds, where the rate of degradation can be calculated. Here, only the changes in acreage proportions can be considered, the restructuring, however, cannot be shown in our calculations, that is, we cannot show how the composition of species has changed within the individual habitat compared to the status prior to diversion. We cannot tell whether the old or the new composition represents the higher value, but it is clear that what we have today is not identical with the old composition.

As we assume that WTP proportionately decreases with degradation, for that reason, in Table 5, a review of the degradation indicators for the alternatives examined is given.

Table 5 **Rate of degradation that has occurred or presumed to have occurred in the habitats of Szigetköz**

	1992: before diversion	**1999: variant "C"**	**Prediction: Meandering alternative**	
			small and medium water level	High water level
Size of wetland areas (ha)	13,600	10,300-10,500	10,800-11,000	12,500
Decrease of wetland areas compared to their decrease before 1992 (%)		23-25	20-21	8

The percentage values on the decrease of wetland areas clearly point out that the currently operating version of variant "C" and the small and medium water level case of the meandering solution are rather close to each other. The difference between the two were even less, if we could consider the significant potential the current variant "C" has from an ecological standpoint that could be further exploited by using further technical solutions on the section between Ásványráró and Szap.

Instead of using the actual figures in Table 5 on the actual and estimated rate of degradation, we intend to use a scale through which we can decrease the uncertainty of the estimation of the loss of value. Thus, the rate of degradation generated by the impact of variant "C" is placed between 20-30%, eventual implementation of the meandering version for small and middle water level is considered a 15-25% rate of degradation, while for high water level, a 5-15% scale is considered (See: Table 6).

Table 6 **Change in value estimated for the different alternatives**

	variant "C"		**Meandering with small and medium water level**		**Meandering with high water level**	
Rate of degradation (%)	20	30	15	25	5	15
WTP decrease due to degradation (bn HUF)	3.4	5.1	2.5	4.2	0.8	2,5
Loss of value by using a 2% discount rate (bn HUF)	168.3	252.5	126.2	210.4	42.1	126.2
Loss of value by using a 3.5% discount rate (bn HUF)	96,.2	144.3	72.1	120.2	24.0	72.1

The detailed process of calculation is shown through the 20% rate of degradation of variant "C".

The initial aggregate WTP is HUF 16.83 bn. It is assumed that WTP linearly decreases with degradation, therefore a 20% rate of degradation results in the following WTP decrease:

16.83 x 0.2 = HUF 3.37 bn.

The amount of WTP in Austria was understood for an indefinite time scale, meaning that every citizen is willing to sacrifice the given sum, in all further years, for the maintenance of a national park. Thus, by applying the formula of perpetual annuity[22], and a 2%, and 3.5% discount rate, the present values of the loss in value will be as follows:

d=2%[23] present value: HUF 3.37 bn/0.02 = HUF 168.31 bn

d=3.5% present value: HUF 3.37 bn/0.035 = HUF 96.17 bn

Table 7 **Summary of value loss calculated by benefit transfer**

	Variant "C"	**Meandering version**	
		at small and medium water level	**at high water level**
at 2% discount rate (HUF bn)	168 - 252	126 - 210	42 - 126
at 3.5% discount rate (HUF bn)	96 - 144	72 - 120	24 - 72

22. If a project is intended to be maintained in the long run (as in the case of a hydroelectric power plant), the benefits and costs accrued can be considered on a long time horizon. In case the earnings (and expenses) are even, the project cash flow can be calculated with the help of the formula applicable to perpetual annuity in the following way: PV = C/r, where C stands for earnings (expenses), r for the value of discount rate (see: Brealey-Myers (1993); p. 33). If the wetland is damaged, we shall be deprived of a certain proportion of the earnings - proportionately to the rate of degradation, This is why we used the formula applicable to perpetual annuity.

23. In the article used as the basis of benefit transfer (Kosz, 1996), the author takes position in favour of a 2% discount rate, as all variants contain components that can be characterised by long term ecological sensitivity, whose change can be considered irreversible.

The question may be raised whether Hungarian people would be really willing to pay for the conservation of Szigetköz, or, whether the sum derived from GDP is excessive or not. We try to answer these questions on the basis of Hungarian examples.

CSERGE[24] and the Department of Environment Economics, Budapest University of Economics conducted a large scale survey on WTP (number of interviewees close to 2000) in 1995-1997 (the interviewing was done in 1995). They applied the contingent valuation method in a survey of the water quality improvement of the Lake Balaton (Mourato et al., 1997). The findings of the survey clearly show that the Hungarian adult population is sensitive to the environmental issues and is willing to pay HUF 3,900 per annum to preserve the environment. The WTP sum derived through the application of the benefit transfer method is far behind the sum of HUF 3,900 per annum. Szigetköz may have smaller significance than Lake Balaton, it is not so well-known as Lake Balaton, often referred to as a national symbol. Yet we still believe that the sum of HUF 1,581 is below the presumable WTP (not to speak about the fact that the transfer of WTP for Balaton in 1995 for the year of 1999 (adjustment by inflation, or increase proportion to higher GDP) would result in an even higher figure).

Another survey conducted in the Bükk National Park in 1996 in Hungary provided similar results. Findings show (for details see: Szerényi, 1998) that Hungarian people visiting the park would be willing to pay HUF 1,426 per year for the conservation of the third largest national park, the Bükki Natonal Park. (This survey shows only the WTP of those using the park, and it was lower than the result of the survey conducted in the circle of users and non-users (that is, the Hungarian population) for Lake Balaton. Thus, the conclusions that we can draw are similar to the ones described above.

The WTP surveys conducted so far in Hungary give clear evidence that the WTP of HUF 1,581 calculated by the method of benefit transfer is probably below the actual WTP. Therefore, the calculation of the loss of value of Szigetköz on the basis of this WTP results in underestimation.[25]

5. Environmental Policy Steps on the Basis of the Findings

The findings of the estimations have been used in cost-benefit analyses. The primary objective was to create a well-founded tool encompassing the costs and benefits, in a broad sense, of all the alternatives of the Gabčikovo-Nagymaros Barrage System to enable us to find solutions for disputed issues in the negotiations with the Slovak experts, and to be a help for us in an eventual second court case in the Hague. Compared to the former economic calculations, the changes in the natural values not considered that are now included in the analyses a great step forward. As a result, it became clearly evident that the incorporation of natural capital depreciation in cost-benefit analysis brings forth utterly different results than when only the costs and benefits in a narrower sense are included. Although in terms of material assets (concrete, structures, labour), Hungary's investment in the project was small, the sacrifice in part of the wetland areas in Szigetköz meant that significant part from our natural capital has been "invested".

6. Conclusions Relevant from the Aspect of Environmental Policy

The changes that have been generated by the Gabčikovo-Nagymaros Barrage System in the natural capital of Szigetköz and the loss of value estimation generated as a result are, by all means, a milestone in the area of environment and nature protection policies. The monetary values of changes in the

24. The Centre for Social and Economic Research on the Global Environment, U.K.

25. This statement of us, made in 1999, may be verified by the CVM research on Szigetköz, launched in summer 2000.

flora and fauna in the course of the cost-benefit analyses and in the foundation of our position in the negotiations with the Slovak Party significantly change our position in reaching a settlement. This is a warning pointing to the fact that the transformation changes in the natural capital must be included both on the side of costs and of benefits as they represent high value. Perhaps this case will launch a favourable process in Hungary that will call the attention to the importance of factors and impacts that so far have been considered “non-quantifiable,” and to the necessity of considering the changes in the value of natural capital in specific decision-making.

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