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*Leszek Trząski* [*], *Vladimir Mana*[**]

# MONETARY VALUE ASSESSMENT OF BIOTOPES IN THE BOBREK RIVER VALLEY, SOSNOWIEC – A METHODOLOGY PROPOSAL FOR POLAND

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**Abstract**

The Czech methodology for estimating the financial value of biotopes was demonstrated in Poland for the first time. The case study area – 60 ha complex of wetlands established partially as a result of mining subsidence – is situated in the Bobrek River valley, the city of Sosnowiec. Due to flood protection needs, river regulation aimed at draining the valley is planned. As a consequence, unfavourable transformation of biotopes will occur and their value coefficient will decrease by about 12,8%. Assuming the case study area is situated in the Czech Republic, estimated biotope value decreases by 540 000 Euros.

Deficiency in methodology of financial evaluation of biotopes is a source of serious problems in Poland; the controversy about the future of the Bobrek River in Sosnowiec is just one of them. It is concluded that the demonstrated example is a good starting point for a discussion about the development of biotope value assessment method in Poland on the base of the Czech one. An objective biotope assessment should deliver a good tool of decision support for decision makers responsible for nature protection and can also be supportive for a social dialogue, especially if needs of spatial development and that of nature protection seem to be in conflict.

## Zastosowanie wyceny wartości pieniężnej siedlisk w dolinie rzeki Bobrek w Sosnowcu – propozycja metodyczna dla Polski

**Streszczenie**

Na przykładzie 60-hektarowego fragmentu doliny rzeki Bobrek w Sosnowcu zademonstrowano możliwość finansowej wyceny siedlisk przyrodniczych przy zastosowaniu metody opracowanej w Republice Czeskiej. Stwierdzono, że w wyniku planowanej regulacji rzeki, prowadzącej do osuszenia terenów zalewowych w dolinie, wartość siedlisk wyrażona w punktach zmniejszy się o 12,8%. Gdyby przyjąć współczynnik przeliczania wartości punktowej na finansową, stosowany w Republice Czeskiej, wartość siedlisk zmniejszyłaby się o 540 000 euro. Podstawą oceny jest diagnoza aktualnego stanu siedlisk przyrodniczych, wykonana w wyniku wizyt terenowych, skonfrontowana ze stanem docelowym, przewidywanym na podstawie szczegółowej analizy dokumentacji projektowej oraz wiedzy przyrodniczej autorów artykułu.

Przykład doliny Bobrka wskazuje, że przystępując do procesu decyzyjnego, należałoby oczekiwaną utratę wartości siedlisk przyrodniczych wliczać w koszty przedsięwzięcia. Wprowadzenie wyceny siedlisk pomogłoby w Polsce zapobiegać konfliktom i ograniczać straty środowiskowe. Przedstawiony przykład może być dobrym punktem wyjścia do wypracowania metody maksymalnie dostosowanej do polskich realiów. W rezultacie mogłoby powstać narzędzie wspierające w podejmowaniu decyzji podmioty odpowiedzialne za zarządzanie środowiskiem. Mogłoby ono także służyć debacie społecznej wówczas, gdy ujawnia się konflikt między potrzebami rozwoju gospodarczego i potrzebami ochrony przyrody.

[*] Główny Instytut Górnictwa.
[**] The University of Ostrava.

Należałoby przeprowadzić w Polsce pracę badawczą obejmującą co najmniej:
- przełożenie obowiązującej w Polsce taksonomii zbiorowisk roślinnych (prawie 500 syntaksonów) na język morfologicznego opisu siedlisk (przypuszczalnie około 200 rodzajów),
- przypisanie każdemu rodzajowi siedlisk współczynnika wartości wyrażonego w punktach,
- przeprowadzenie co najmniej kilkudziesięciu studiów przypadku w celu oszacowania finansowych kosztów działań rewitalizacyjnych związanych ze stworzeniem, w miejsce istniejącego, siedliska o większej wartości punktowej,
- określenie wielkości nakładów finansowych odpowiadających podniesieniu wartości 1 $m^2$ o 1 punkt.

Czeską metodę finansowej oceny siedlisk przyrodniczych można zaadaptować na polskie warunki. W tym celu niezbędne jest ścisłe powiązanie klasyfikacji siedlisk naturalnych, półnaturalnych i antropogenicznych istniejących w Polsce z odpowiadającymi im syntaksonami, wskaźnikowymi gatunkami roślin i morfologicznymi cechami siedlisk. Wobec podobieństwa klimatu, uwarunkowań geomorfologicznych, jak i trendów w użytkowaniu terenów, polska klasyfikacja siedlisk i ich wartość punktowa będzie najprawdopodobniej podobna do czeskiej. Dotyczy to szczególnie południowej części Polski, w tym terenów dotkniętych działalnością górnictwa.

Czeskie zasady konwersji punktacji na wycenę finansową mogą okazać się w pełni stosowalne w Polsce, jednakże zasadniczym wyzwaniem będzie przełożenie ich na specyficznie polskie procesy decyzyjne, zwłaszcza związane z wyborem sposobu, zakresu i techniki rekultywacji dla zagospodarowania terenów czasowo wyłączonych z użytkowania.

## 1. DESCRIPTION OF THE BOBREK SITE PROBLEM

The Bobrek site, named after the local river, is a part of the city of Sosnowiec. The area of 60 ha is situated close to both urbanized as well as reclaimed land, between river kilometer 7.665 and 8.800. The channel of the Bobrek River is straightened and the left bank is embanked along the whole river stretch. The site, the axis of which is the Bobrek River, is a part of natural floodplain. The site had been under influence of mining for a long time, both as a subsidence area and as a place of waste rock landfilling. Underground coal excavation in the river valley entailed formation of ponds and water-logged area in the place of formerly existing meadows and marshes. After several years, the place appeared a good habitat for wildlife, however at the same time a big dumping site of waste rock was established in the vicinity.

The local mining company is obliged, by legally valid court sentence, to make local flood events impossible and one of activities should be the river regulation. According to the current technical project, the regulation method is radical deepening of the river channel (the level of the channel bed should be lowered by 4.5 m) and channelization (formation of trapezoid structure) of the river stretch 1 km long. The target of regulation is drainage of riparian area so that the problem of flood events for some buildings situated in the vicinities should be alleviated. However, the regulation will also result in loss of natural advantages.

As a result of natural valorisation carried out a few years ago, appearance of settlements deserving protection was stated. The Bobrek site is an important habitat for water birds and for wading birds. Location of Bobrek site is illustrated in Fig. 1.

The local government of Sosnowiec City wants to protect wetlands of the Bobrek valley, however there still does not exist a detailed conception for target land development. It is in opposition to the present project and it expects an honest report on the influence on the environment for different variants of the regulation. Neither the self-government or the mining subject nor the Bobrek river administrator examined the

possibility of combining requirements of flood control with conservation of nature and the landscape. The analysed land spreads through several dozen small, not used agricultural plots, largely private. A few nearby private properties stay in the range of flood waters; these properties are inundated by groundwater. Possibility of repurchase of these properties was not under consideration and the financial value of them is unknown for decision makers.

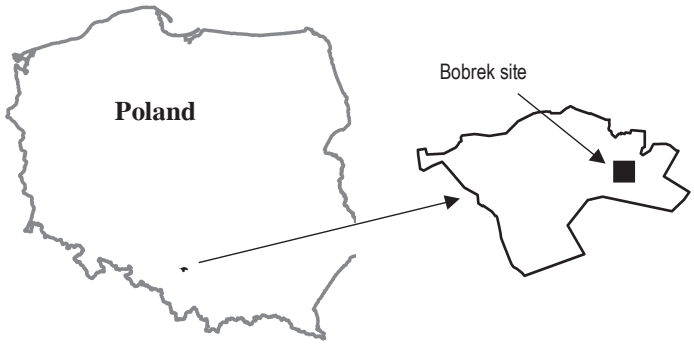


**Fig. 1.** Location of case study area; on the left – Sosnowiec on the map of Poland, on the right – the Bobrek site in city Sosnowiec

**Rys. 1.** Położenie obszaru badań; po lewej – Sosnowiec na tle mapy Polski, po prawej – fragment doliny Bobrka w Sosnowcu

The main problem for decision makers is how to weigh wetland preservation in the Bobrek valley against protection of surrounding properties from flood events and, maybe, how to find the equilibrium point between flood protection and preservation of wetland. A useful criterion for this should be the financial estimation of ecological loss resulting from planned regulation.

## 2. DESCRIPTION OF ASSESSMENT METHOD

The description of value as a sum of money is intelligible to people. It also enables dialogue between authorities responsible for nature protection and decision makers or local communities. It should also prompt decision makers to take into consideration environmental problems in investment decision process, especially if there exists a real conflict between spatial development and nature conservation needs. On the other hand, expected increase of the financial value of biotopes should decrease the calculated cost of any revitalization activities.

In order to assess the financial value of the Bobrek site the method elaborated as part of research project funded by the Czech Ministry of Environment (Seják, Dejmal 2003) was implemented. The methodology is compatible with the biotope mapping system for European Habitat Directive 92/43 implementation (natural biotopes) (Katalog… 2001). However, this method also includes two new groups of biotopes: highly impacted and artificial. The two groups include several dozen types of biotopes (Seják, Dejmal 2003).

The assessment procedure consists of three steps: habitat identification, validation (scoring in points) and conversion to financial value. Identification and scoring procedures do not depend on economy: they are based on scientific knowledge about the functioning of ecosystems and their succession (Katalog… 2001; Seják, Dejmal 2003).

## 3. SCORING PROCEDURE

The methodology is based on eight ecological criteria: four inner criteria (a–d) and four outer ones (e–h):
a/ biotope maturity,
b/ biotope naturality,
c/ structural diversity,
d/ species diversity,
e/ rarity of biotope (e.g. in the Czech Republic),
f/ rare, diagnostic species (e.g. in the Czech Republic),
g/ sensitivity of biotope,
h/ qualitative and quantitative endangerment of biotope.

Each criterion (from a to h) can be assessed from 1 to 6 points.

The assessment algorithm of any biotope is:

$$\text{Total score} = (a + b + c + d) \cdot (e + f + g + h)/576 \cdot 100.$$

As a consequence, each type of biotope has its own value coefficient, between 3 and 100 points per $m^2$. The more mature, natural, complex, rare, sensitive and endangered is a biotope, the higher is its coefficient. The highest coefficient is attributed to natural habitats which are characterised by the highest degree of complexity and stability, and thus are closest to climax plant communities. The final result of biotope assessment is a product: area [$m^2$] × coefficient. The total score illustrates relative importance of biotope types according to European and Czech priorities for nature protection.

According to the classification proposed by Winpenny (1995), conversion procedure developed in the Czech Republic belongs to restitution cost and preventive expenditure category. It is similar to the method developed in early 1990s in Land Hesse (Richtlinien… 1992). However, identification and scoring methodology is different than that of Hesse: types of biotopes are much more numerous according to the Czech method, and also scoring criteria are more complex. The Hesse method was incorporated into regional law regulations as well as into strategic and operational programs. Financial evaluation of biotopes has been an important tool for decision makers in the USA, Australia and New Zealand for at least two decades. In 1980s and early 1990s several methods were tested in European countries, especially in Finland, France, Germany, Norway, Netherlands, Switzerland and Great Britain. Starting from mid 1990s, methodology studies were carried out in Italy, Austria, Spain, Portugal, and also in Slovakia (Seják, Dejmal 2003).

The coefficient of conversion developed in the Czech Republic is based on 136 case studies the aim of which was to examine the cost of implemented revitalization

projects (Seják, Dejmal 2003). In the Czech Republic: 1 point = 13 Crowns = 0,4 € (according to the rate in September 2007). The same conversion factor was assumed for the needs of this paper.

## 4. IDENTIFICATION OF BIOTOPES

Several years ago, as a result of natural inventory investigation, the Bobrek site was described in detail. It appeared the most important wetland area of Sosnowiec both from botanical and ornithological view point (Waloryzacja… 1999). It is also a very important element of landscape mosaic in East part of the city, which includes protective forest, a large soil protection zone, and local ecological corridor of the Bobrek River.

On the 12th of September 2007 the Bobrek site was the place of field investigation oriented to identification of current biotope status. Aerial photographs of the Bobrek site were also studied. Total area of the Bobrek site and area of each biotope was enumerated with use of ArcInfo software.

Complex ecosystems related to water and wetland habitats are in the middle of self-establishment. There occur plant and animal communities similar to these of natural habitats. Terrestrial ecosystems are rather typical to the initial stage of ecological succession in post-mining areas of Poland. The result of reclamation activities (afforestation) on the older part of spoil-heap is quite good. According to natural inventory (Waloryzacja… 1999) and the author's observation, there live about 25–30 nesting bird species, several dozen breeding/migrating ones, 5 amphibian and 2 reptilian species, as well as about 200 vascular plant species. According to on-site interviewers, there also live a dozen fish species.

Current distribution of identified biotopes is illustrated in Fig. 2.

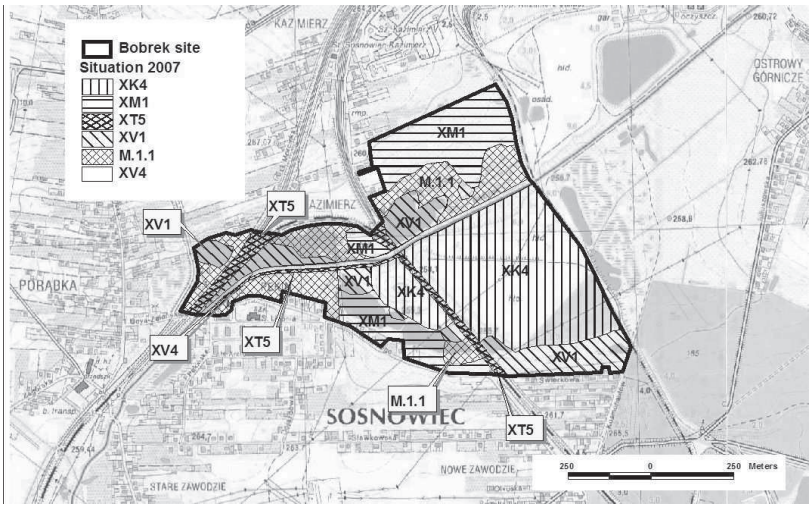


**Fig. 2.** Current distribution of biotopes

**Rys. 2.** Aktualne rozmieszczenie siedlisk

There were identified six types of habitats (biotopes), according to the Czech methodology (Seják, Dejmal 2003) as follows:

1. Reed and tall-sedge beds (code M1.1)

Eutrophic or, less commonly, mesotrophic communities of perennial plants, a succession phase of biotope transformation from natural water reservoirs (but also of anthropogenic ones, like fish ponds with well developed littoral zone) to alder wetlands.

2. Surface vegetation of new water reservoirs (code XV.1)

Specific standing water biotopes in reservoirs without flow. Such biotopes appear, for example, in post mining areas after revitalization of urban landscape, or in newly built fish ponds.

3. Regulated local stretches of streams (code XV.4)

Biotopes established in streams, the channel morphology of which was heavily modified by local regulation activities. For example, in trout zone or grayling zone, typical regulation methods lead to loss of morphological heterogeneity, to increase of flow amplitude between draught and flood periods and to longitudinal gradient reduction of river bed. Typical establishment consequence of a series of weirs is increase of sedimentation of mineral substance as well as of detritus, and gradual disappearing of pools and riffles. Other typical problems are resulting from embanking of lowland rivers. River courses are narrow and there is no possibility to develop natural habitats. Another problem resulting from embankment is reduction of retention capacity in alluvial zone and, as a consequence, increase of flood risk.

4. Communities of perennial plant species on scarps (along transportation tracts) and embankments (code XT5)

Biotopes of compacted substrates (mainly natural ones, like waste rock, gravel, soil), sometimes covered by the layer of arable soil. There are artificial habitats with plant cover established as a result of planned human activities (not self-established). The role of vegetation is, first of all, mechanical stabilization of the ground surface. In case of embankments established for flood protection, embankments of dry polders, dry (outer) scarps of fish ponds, and some others – the plant cover is periodically removed or grazed.

5. Water-logged, abandoned ruderal sites (code XM.1)

Degraded habitats coming from wetlands, meadows (in case of higher mountains – also from sub-alpine meadows), and from marshy lands of the woodless farmlands for long-lasting plant cover. Sometimes they derive from semi-natural herb vegetation, even if the vegetation had started its evolvement in woodland. There are, for example, eutrophicated bog-springs, various depressions in agricultural space, bank slopes of drainage ditches. Invasive as well as ruderal species and their communities typically develop in such places.

6. Pioneer coppices on not-reclaimed anthropogenic substratum (XK4)

Biotopes of abandoned, soil-less areas e.g. worked-out carries, various surface excavations like sandpits, opencast workings etc., post-mining or post-industrial waste

heaps with self-established plant cover. There are relatively stable series of plant stages, however with participation of pioneer species. Edaphic and microclimatic conditions are not similar to those of natural habitats. The structure of these communities is determined by physicochemical features of mineral substrate. Associations of trees and shrubs may appear in the way of primary succession or, alternatively, in result of afforestation activities carried out with implementation of soil-less methods.

A common result of the Bobrek River regulation will be drainage of the area and, as a consequence, change of biotope structure (i.e. replacement of wetlands by terrestrial biotopes, like ruderal biotopes). Next steps of plant succession will be self-oriented on shrubs and some species of trees. As a result of the Bobrek River regulation, two other biotopes will appear:

- Biotopes of abandoned places with trees and shrubs associations (XK.2)

Plant communities established in the way of secondary succession on formerly abandoned meadows or pastures, on moderately humid or even water-logged grounds. There are later succession stages which originate from seriously impacted biotopes like XT3 and XM1. Common feature of these communities is great amount of ruderal and of invasive plant species.

- Fully channelized streams (X1.3).

Biotopes of running waters with highly impacted hydrological and geomorphological regime – in completely regulated river channels (e.g. channelized river beds in urban areas, replaced channels in areas highly impacted by mining activities, waterways, graded channels, and sluices). Riverbanks and riverbed are revetted with stone, brick, and concrete blocks. Typically, implemented technical solutions include sluices or similar constructions – resulting in high variability of water level. Such biota are very poor; the structure of plant community is similar to degraded plant communities derived from biotope types V4.1-V4.5. The regulation seriously impacts dynamics of all the hydrological and biological processes/phenomena in the river. As a result of technical regulation of banks and riverbed, straightening of the channel, and building of weirs/steps (cascades), the natural flow (especially in trout and grayling rivers) can be seriously reduced and sometimes can disappear at all. Another result is disappearance of structural heterogenity of water biotope. Channel straightening, regulation of riverbed and banks as well as building of on-line ponds on barbel and bream rivers result in a serious reduction of the self-cleaning capability and in instability of oxygen amount in water. Disappearing of old channels, which is a typical result of regulation, is the reason of reduction of biodiversity; lack of diversity of river substrates (i.e. debris) leads to reduction of many macrozoobenthos species and communities.

Predictable changes resulting, with time, from the Bobrek River regulation can be summarized as follows:

- complete replacement of biotope M1.1 (reed and tall-sedge beds) by biotope X1.3 (fully channelized streams),

- complete replacement of biotope XV.4 (regulated local stretches of streams) by biotope XI.3,
- gradual self-establishment of XK.2 biotope (abandoned places with trees and shrubs associations) in surroundings of X1.3 biotope,
- serious changes in distribution of other currently existing biotopes, including increase of XK4 biotope area as well as decrease of XV1 biotope area.

Predictable distribution of biotopes after the Bobrek River regulation is illustrated in Fig. 3.

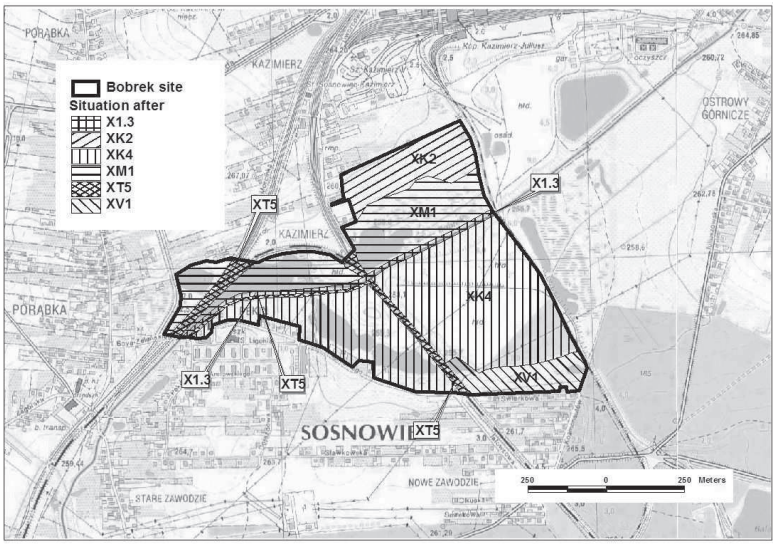


**Fig. 3.** Predictable distribution of biotopes after changes resulting from planned regulation of the Bobrek River
**Rys. 3.** Przewidywane rozmieszczenie siedlisk po zmianach wynikających z planowanej regulacji koryta Bobrka

Areas of particular biotopes before and after regulation are illustrated in Table 1 and in Figure 4.

**Table 1.** Identified and predictable areas of biotopes

| Biotope type | Area ($m^2$) before regulation | Area ($m^2$) after regulation |
|---|---|---|
| XT5 | 29 623 | 29 624 |
| M1.1 | 106 511 | 0 |
| XV1 | 91 227 | 38 606 |
| XK4 | 215 848 | 298 297 |
| XM1 | 120 435 | 137 463 |
| XV4 | 16 589 | 0 |
| X1.3 | 0 | 16 589 |
| XK2 | 0 | 59 654 |
| Total area | **580 233** | **580 233** |

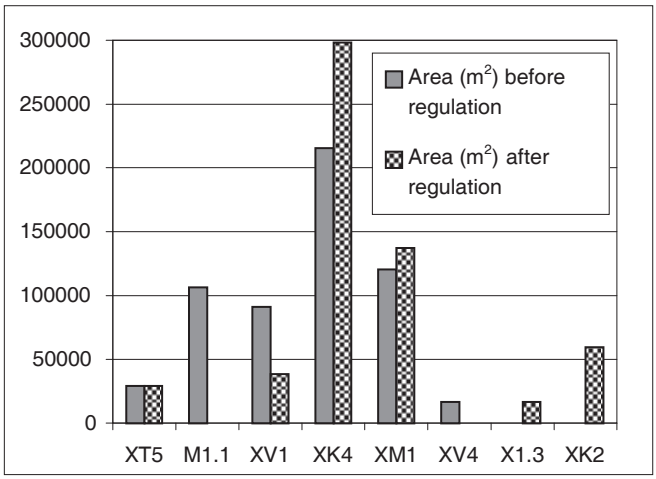


**Fig. 4.** Predictable area change of particular biotopes resulting from the Bobrek River regulation

**Rys. 4.** Przewidywane zmiany wielkości powierzchni poszczególnych siedlisk wynikające z planowanej regulacji koryta Bobrka

## 5. VALIDATION OF BIOTOPES

According to the Czech procedure of validation, current total score of biotopes is 10 486 526 points. As a result of river regulation the score will decrease by 12,8% (1 348 387 points). The reason of the decrease will be replacement of the most valuable biotopes M1.1 and XV4 by the X.3 biotope.

The results of scoring are illustrated in Table. 2

**Table 2.** Comparison of biotope scoring before and after regulation

| Biotope type | Points/m² | Score – before regulation (points) | Score – after regulation (points) |
|---|---|---|---|
| XT5 | 15 | 444 345 | 444 360 |
| M1.1 | 28 | 2 982 308 | 0 |
| XV1 | 17 | 1 550 859 | 656 302 |
| XK4 | 13 | 2 806 024 | 3 877 861 |
| XM1 | 19 | 2 288 265 | 2 611 797 |
| XV4 | 25 | 414 725 | 0 |
| X1.3 | 7 | 0 | 116 123 |
| XK2 | 24 | 0 | 1 431 696 |
| Total score | | **10 486 526** | **9 138 139** |

According to the Czech procedure of financial conversion, current value is 4 194 610 €. The loss of biotope value resulting from the Bobrek regulation can be assessed as 539 254 €. Conversion of scoring into financial value is illustrated in Table 3.

**Table 3.** Results of conversion

| Biotope type | Financial value – before regulation (€) | Financial value – after regulation (€) |
|---|---|---|
| XT5 | 177 738 | 177 744 |
| M1.1 | 1 192 923 | 0 |
| XV1 | 620 344 | 262 521 |
| XK4 | 1 122 410 | 1 551 144 |
| XM1 | 915 306 | 1 044 719 |
| XV4 | 165 890 | 0 |
| X1.3 | 0 | 46 449 |
| XK2 | 0 | 572 678 |
| Total score | **4 194 610** | **3 655 256** |

## 6. DISCUSSION

Local authorities, mining enterprises and naturalists should cooperate in aid of target management direction for the Bobrek valley, e.g. for human recreation. Unfortunately, in Upper Silesia there does not exist a good decision making practice/procedure for such objects. Such procedure should include a comparison between financial loss of ecosystem value resulting from a river regulation and repurchase cost of properties.

The described identification and validation methodology of biotopes is fully applicable in the South part of Poland because the natural conditions in this region are in fact very similar to those of the Czech Republic. However, economic reality is different in Poland than in the Czech Republic. The financial value of particular biotopes in the Czech Republic is based on material prices and labour cost of the last decade (starting from 1997) in this country. Obviously, the financial value of any biotope in Poland (measured in €) can significantly differ from that in the Czech Republic. It means, the results of financial estimation calculated in this work for the Bobrek biotopes are just approximate. However, predictable loss of biotope value (c.a. 12.8%) is a fact and it weighs against implementation of a currently existing technical project aimed at draining the valley.

The taxonomy of plant communities is more complex than biotope classification system accepted for identification. In Poland they distinguish about 500 plant communities (Matuszkiewicz 2007); thus, the main task for scientists is to translate the language of plant communities taxonomy into a description of biotopes. Each natural or semi-natural biotope needs to have the names of specific plant communities assigned. For seriously impacted biotopes, as well as for anthropogenic ones (including those of very limited plant cover) there is a need to combine morphological descriptions with lists of indicator species. Such combined descriptions were elaborated in all states, in which expert methods of biotope identification and the validation were worked out (Seják, Dejmal 2003).

In Poland there seem not to exist serious informational or scientific barriers for financial evaluation of biotopes. The the first time, the need for methodology elaboration of financial estimation of biotopes was claimed by Polish scientists more than a dozen years ago. However, no serious project for this has been carried out since then (Łaguna, Witkowska-Dąbrowska 2005). Probably the core problem is political in fact.

For example, one can imagine that high financial value of local biotopes can function as a kind of barrier for public projects, especially if the land is in private ownership. On the other hand, investors and, probably, also legislative boards are not interested in internalization of external (i.e. environmental) costs of projects.

An objective financial estimation of biotopes should be a very useful base of social dialogue, especially if needs of spatial development and that of nature protection seem to be in conflict. The estimation method should also become a good tool of decision support for decision makers responsible for nature protection – from central (ministry) to local (commune) level.

Lack of financial evaluation method is recognized as one of several dozen barriers for revitalization projects of local rivers in Poland, and especially in suburban areas impacted by mining activities (Winpenny 1995). Probably, removal of this barrier should lead to removal of other barriers, especially social and economic ones.

Elaboration of biotopes financial evaluation methodology should become in Poland just a starting point for its implementation into the Polish law. Especially, the conversion step from scoring to financial value should become, in few years, an important element of environmental assessment procedures for investment activities. Such practices are not very common yet in Europe, however there are some regions of Gemany (Richtlinien… 1992) where they are applied.

An interdisciplinary research project ought to be carried out to elaborate Polish version of financial evaluation methodology. The two first steps – identification of biotopes and validation – should give back both the morphology of the biotope and possible transformation directions of the ecosystem. Such a study, transferring the taxonomy of plant communities into the matrix arrangement modeled on the Czech method seems to be feasible for Polish phytosociologists. The third step – conversion to the financial value – will probably be more complicated. The aim of study work should be individual coefficient elaboration for the monetary value of biotopes in Poland.

## CONCLUSIONS

1. There is a need to prepare in Poland research work consisting of, at least:
   - Translation of the Polish taxonomy of plant communities (nearly 500 syntaxons) to description of biotopes (probably about 200 types) – for identification of biotopes.
   - Value coefficient elaboration for each biotope type – for valuation of biotopes.
   - Analyses of at least several dozen case studies for cost estimation of biotope revitalization practices – for conversion of validation results to financial value.
2. The Czech method for financial assessment of biotopes can be adapted to the Polish conditions. However, firstly the classification of natural, semi-natural and anthropogenic biotopes existing in Poland should be adjusted according to plant communities taxonomy, indicative plant species and morphological features of habitats. Due to general similarity in climate, geomorphology as well as in historical and

current land-use trends, the Polish classification of biotopes and their value coefficients will be, in all probability, very similar to that of the Czech Republic.
3. Described validation method seems to be fully implementable in South part of Poland, including biotopes impacted by mining activities.
4. Principles of conversion to the financial value will probably be similar to those elaborated in the Czech Republic. What is of utmost importance, though, is striving for having them implemented/adapted for the use of Polish decision-making conditions connected with managing temporarily inactive areas, with the choice of scope, pattern and technology of soil reclamation.
5. In case of the Bobrek River, the ultimate decision about the riverbed regulation should take into consideration the estimated change (loss) of ecosystem value resulting from the activities connected with the regulation. This change ought to constitute a part of costs of the regulation.

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**Recenzent:** mgr inż. Paweł Olszewski