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WATER CONSTRUCTIONS IN COUNTRYSIDE – CASE STUDY OF LAND USE ON THE RIVER SVRATKA IN THE VILLAGE UJČOV (MORAVIA)

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Abstract: Buildings and facilities on waterways have significant landscaping, water management and ecological importance. They affect the landscape and create conditions for the emergence of new habitats. Small dams, mills, saws, small hydropower plants, dams and other water objects and structures, which more or less affect the flow of the surrounding countryside, are built and are building in the countryside. Within design and construction of these objects environmental relationships must be respected and in line with the sustainable exploitation of the territory. Many objects built in the past adversely affected the flow and the landscape while make it impossible the migration of fish and amphibians. A series of objects is currently non-functional and have a negative impact on the flow and the surrounding countryside. In such cases the streams are revitalized or inoperative objects are removed, fish ladders are often built. This study evaluates the possibility of using land adjacent to the fixed weir on the Svratka river in the Ujčov village, from the viewpoint of maintaining the existing biodiversity, aesthetic and economic potential of the territory. A study with several options of land use is the result.

Key words: weir, small hydropower plants, Vír dam, fish ladder, the Czech Republic

Souhrn: Stavby a objekty na vodních tocích mají důležitý krajinotvorný, vodohospodářský a ekologický význam. Ovlivňují krajinný ráz a vytváří podmínky pro vznik nových biotopů. Ve venkovské krajině se v minulosti i současnosti budují malé vodní nádrže, mlýny, pily, malé vodní elektrárny, jezy a další vodohospodářské objekty a stavby, které více či méně ovlivňují daný tok i okolní krajinu. Při navrhování a výstavbě těchto objektů je nutné respektovat environmentální vztahy a postupovat v souladu s trvale udržitelným využíváním daného území. V minulosti bylo vybudováno mnoho objektů, které negativně ovlivnily daný tok i krajinu a zároveň ani neumožňovaly migraci ryb a obojživelníků, řada objektů je v současné době nefunkčních a mají negativní vliv na daný tok i okolní krajinu. V takových případech se přistupuje k revitalizaci toků, případně i odstranění nefunkčních objektů, často jsou budovány rybí přechody. Součástí práce je zhodnocení možností využití pozemků přilehlých k pevnému jezu na řece Svratce v obci Ujčov, a to z hlediska nenarušení

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biodiverzity, estetického a ekonomického potenciálu daného území. Byla vypracována studie s několika možnostmi využití daného území.

Klíčová slova: jez, malá vodní elektrárna, vodní nádrž Vír, rybí přechod, Česká republika

1. Introduction

Watercourses and water bodies belong to the most significant landscaping factor. Water is the basic natural resource, without which life would not exist. People have been for long settled in areas where there was the supply of quality drinking water and used it for their livelihood (fishery, agriculture, water energy, water transport) and later even for their hobbies (sport, recreation, sport fishing etc.). Using of watercourses and building objects and constructions significantly affect surrounding landscape.

The first manmade water tanks and ponds were established in our area probably in the 13th century by damming creeks and little rivers with short dikes. However, the largest development of fishponds started within the 16th century, when the widespread systems of ponds were constructed and countryside on a lot of places got new character. The biggest and the most important pond basins were in Czech countries established in Pardubice, Poděbrady and Třeboň region. The fish farming reached its peak in the 16th century, the summary of all ponds area was 180 000 ha (www. hiu.cas.cz).

Ponds are a solid compound of Czech landscape. Its amount and area greatly changed during the history. With the developing field management the ponds were in following years gradually phased and in 1850 the total acreage of ponds was only 35 000 ha. Nowadays, there are 24 thousand of ponds registered in the Czech Republic with the area of 52 000 ha. Although they are economically utilized as manmade water tanks, the ponds create harmonious elements in nature system of countryside. It is close to nature ecosystem rising the ecological value and stability of a landscape. It is impossible to imagine the Czech countryside without ponds and pond systems. Their extraordinary landscaping and aesthetic importance and ability to diversify countryside are closely combined with their multiple functionality and possibilities of use. Fish breeding and production, so valuable foodstuffs intended for human consumption, were and still are the main purpose of building the most of ponds. However, ponds are formed also because of other functions: flood protection, environmental or aesthetic, for sports or for final treatment of waste water from manufacturing companies (www.rybarstvi-litomysl.cz).

Ponds form a significant part of the continental freshwater resources also in Europe. The European Pond Conservation Network (EPCN) was launched in Geneva on October 30th, 2004, as an output of the 1st European Pond Workshop (Oertli et al., 2009).

There were established also other technical water powered constructions on lot of watercourses, e. g. mills, saws, iron mills, washboards and more, which are for years research subjects of many experts – architects, conservationists, historians and ethnologists. These builds are considerably enrolled into the cultural countryside, which were formed by its weirs, sluices, drives and various other supporting structures needed for the operation of the waterworks. Raceways, weirs and storage reservoirs had for its time, often exceptional parameters, even after many decades of inactivity are still legible leave traces in the landscape and highlight the fact that this was a significant building in the history of human (Štěpán, Křivanová, 2000).

Since the Middle Ages, there was also a great development in an inland waterway transport, causing not only floating wood, but also intervention in the actual watercourse. There has been smoothing stones and thus a change of channel (Šlezingr, 2010).

Constructing of dams is essential for countryside. They affect not only the landscape of large territory under the dam, but even the watercourse. The manmade dam causes extraordinary intervention in the original environment. Broža and Satrapa (2007) divide the consequences of the construction of water reservoirs into the physical, chemical, biological, landscape and social and political one. The importance of water reservoirs for water sources in the Czech Republic is evident - virtually all the water flows out of our territory and available water sources are depended only on precipitations. There are hydrological extremes occurring – floods and drought – because of the variability of precipitations. This led historically to building of water reservoirs, which allowed coping with these deflections and thus dampening their negative impact. Addition accumulated water strengthen the limited available water resources, because in the European context, the Czech Republic belongs to the group of countries with limited water resources. Demand for stabile water resources necessary for industry development in 18th century occurred when sweatshops arose. It initiated the construction of dams. There were 19 dams on the area of the Czech Republic till 19th century (corresponding substantially to the criteria presently used in accordance with the conditions ICOLD – International Commission on Large Dams). Construction were limited for certain period after a catastrophe of burst of Bílá Desná dam, however, it was necessary to ensure a sufficient water leads to the further development of the construction during the thirties, which culminated in 1945–1990. Then ca. 80 dams were established. As follows from the results of various scenarios of climate change, it is possible to expect a shortage of water resources in the future due to the fluctuations of rainfall. Therefore it is appropriate to apply not only efficient use of water resources, strengthen water retention in the landscape, to optimize the handling of existing waterworks and correct modes multipurpose utilization of existing dams but also to prepare other options for water accumulation in river basins as well as considering possibilities for strengthening abstractions for agriculture and energy in the case of regular and prolonged droughts. Availability of water per capita in the Czech Republic presented by EEA (World Water Forum, Turkey, 2009) is one of the lowest within developed countries – within the EU just Cyprus and Malta have lower availability (Punčochář, 2012).

The biggest technical interventions into waterbeds occurred in our area in the late 19th century with new technical possibilities – machines. Small rivers and creeks began to disappear from the landscape and instead replaced by the crash barrier, canals and landscaped waterways. There was the culmination of activation due to a massive chemical use in agriculture in 70´s and 80´s of the 20th century, which caused visible decrease of water quality. There were straightening and tubing streams and drainage of adjacent floodplains. Because of the profound and all-surface changes in the aquatic environment there was a need for revitalization (Just, 2005). From a historical point of view revitalization of watercourses and water areas does not extend so far as a technical modifications and interventions into riverbeds (Šlezingr, 2010). Water management revitalization started in the world already in 1970, when there was attempt to reconstruct the damaged countryside and restore its original state close to nature. These activities were mainly in the United States of America and Great Britain, where the emphasis was on the biological aspects of the landscape. Revitalizations in Switzerland, Austria or Germany are the closest to our conditions. Here the revitalizations of river basins, banks of watercourses, creeks and streams, including support of wetlands, are standard work of the Ministry for Environmental Issues and territory development and subordinate offices. At the same time they implement flood activity and overflowing flood outside built-up areas of municipalities or towns (Just et al., 2003).

Revitalizations are focused on elimination or mitigation of consequences of negative regulation of watercourses on ecosystem, improving or fully restoring ecological function of countryside taking into account the purpose of the function of the treated stream. Restoring the flow should be implemented as necessary integration into the flow of the landscape with respect to the character of the area (Ehrlich et al. 1996). Restoring natural processes should be priority, it creates variability of both watercourses and health and quality of banks. However, if necessary, it is possible to place artificial barriers, which provides immediate protection to given individuals (Gordon, 2004). Revitalization of these areas could be difficult and requests sufficient knowledge of the basin, individual watercourses and its previous characteristic. Each region has its own specifics and there is no handbook that would allow restoring of all watercourses uniformly. (Brooks et al, 2003).

Restoration ecology often grapples with the precise meaning of the terms restoration and rehabilitation of a degraded ecosystem. A *degraded* stream is defined as any stream that is not functioning at its hydrologic or biologic potential. *Restoration* of such a stream involves its return to previously undisturbed condition by reconstructing the structure and function of the pre-disturbance ecosystem. *Reclamation* is another approach that aims to achieve a similar, but not identical, end point by re-establishing an ecosystem that develops along the original successional pathway so that it assumes a similar function and composition of the original ecosystem. On the other hand *Rehabilitation* of the stream involves the enhancement of ecological functioning of the system on a recovery pathway toward an improved target conditions. The recovery pathway in rehabilitation will be on a similar trend to that of restoration but with a different end point that is likely to feature an altered species composition (Stockwell, 2000).

In recent years it gets more and more into the forefront of professional and public issues of small hydropower plants. Using of water energy has always been one of the fundamental sources of getting energy. In the Czech Republic small hydropower plant means facilities with the output up to 10 MW. Thanks to disperse across the country it is advantageous in terms of energy, that energy supply is not necessary to transmit at the cost of distribution losses. Likewise, failure of some of the small hydropower plant is not significant in terms of the network, unlike a large central source (Vítková, 2014).

Energy from hydropower plant belongs to clean energy sources. Construction of small hydropower plant is not structurally challenging in most cases and used technologies do not represent a significant threat to the environment. Service of hydropower plant consumes a minimum of energy and do not pollute the environment (Gabriel, 1998). The most common arguments of small hydropower plant impact on the environment are represented by changes in flow rates, increased erosion efficiency of the flow regime change, groundwater effecting migration of fish and other aquatic fauna through the grades to flow, potential oil spills, endangering aquatic animals by running turbines, changes in species composition of aquatic organisms, noise, traffic, affecting riparian vegetation; annexation of land and encroachment into the area during construction and urban encroachment into the surrounding landscape environment.

For the construction of small hydropower plants it is necessary to take into account all possible negative effects on the environment and incorporate them into the project documentation. It is also necessary to get permission for water use before starting the hydraulic structure (Dušička et al., 2003).

2. Characteristics of the location of interest in a broader context

The area of interest (Fig. 1) is located in the Czech Republic in Vysočina region close to border with South Moravia region on the Ujčov cadastral municipality. The locality belongs to Sýkoř bioregion, which consist of mountainous region with a network of deep rocky valley of Svratka river and its tributaries (Fig. 1).

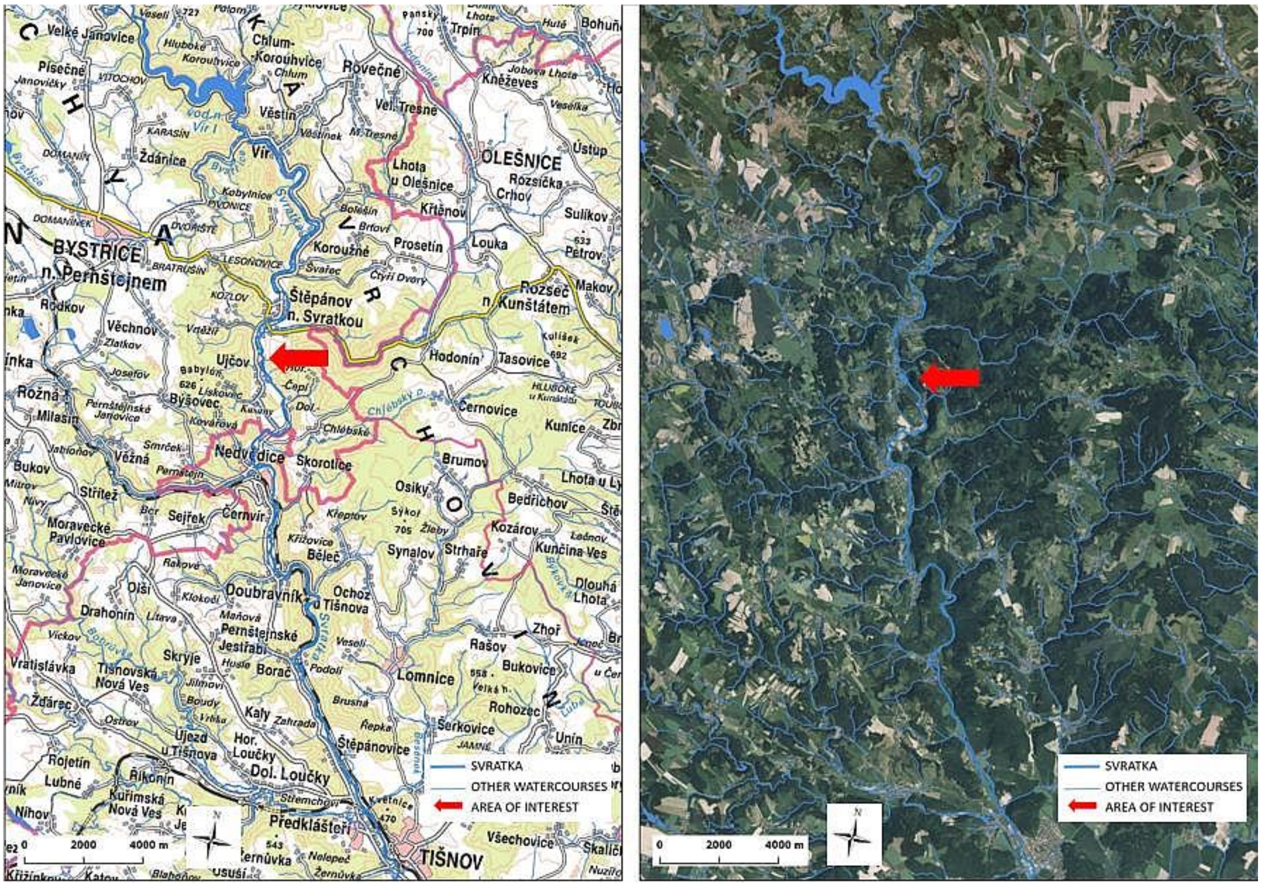

Fig 1. Situation of wider relations with highlighted watercourses. Location of Vír dam and the area of interest (underlay COSMC, DIBAVOD, modified by author).

Historical development of the landscape in the area of interest

Description of this landscape comes from two information sources. The first is an oral filing supplemented by historical sources. The second area of information comes out from graphic underlay that means maps (Fig. 2) and historical photos (Fig. 3 and 4).

Fig 2. Historical photo of the locality before 1950. Author's family photo archive

Fig 3. Comparison of aerial shots and map from the second military mapping in area of interest. Source: www.mapy.cz, www.cuzk.cz

Fig 4. The area of interest in 2010. Author's family photo archive

Different water constructions are described since middle ages in the Svratka valley. It is mainly iron mils in Borovec (Fig. 5) close to today's Štěpánov nad Svratkou and then nearly in every establishment mills, often with sawmill. These hydrological constructions were used for their service energy of river Svratka and the population settled in its neighbourhood. Thereby it has significantly affected the countryside near the stream and the wider area.

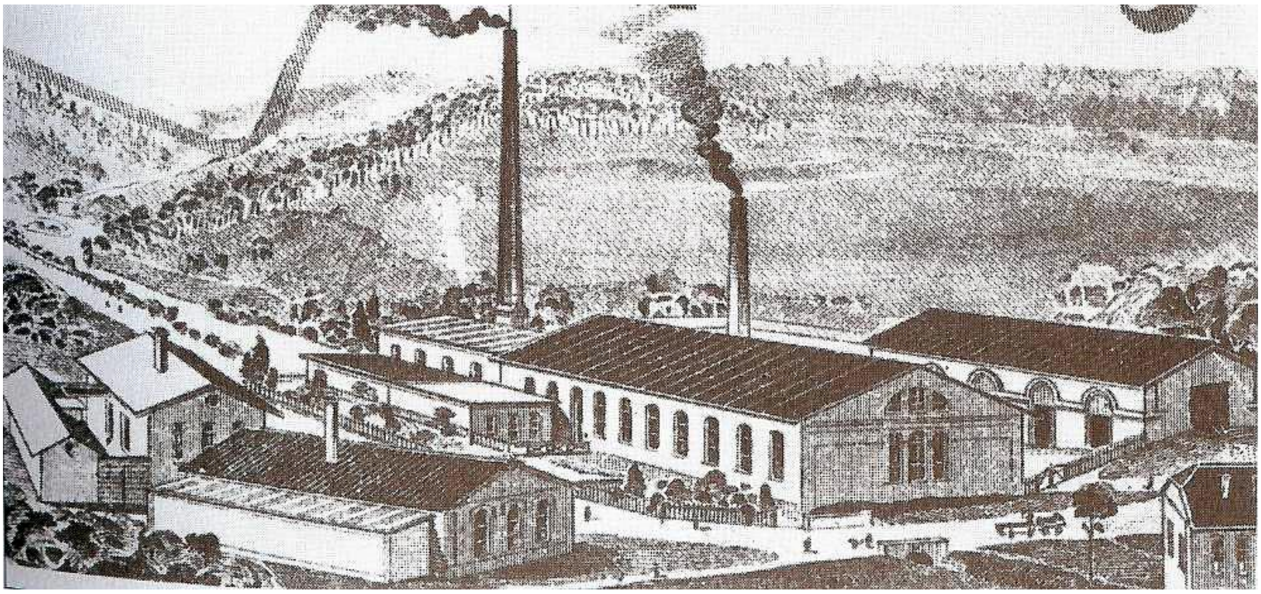
Fig 5. Historical draw of iron mill in Borovec, 19th century. Source: Jurman, 2014

Written note of a mill in Ujčov is dated back to the 16th century (Fig. 6). It is located ca. 40 m far from nowadays Svratka river basin. Wooden-stone weir with drop about 2 m secured inflow to drive the mill. Around 1880 the owner of the mill erected a saw. At that time water wheel was used to drive. In 1921 the mill was equipped with a Francis turbine (gradient of 2.3 meters, installed power of 50 HP) (Jirák, 1932).

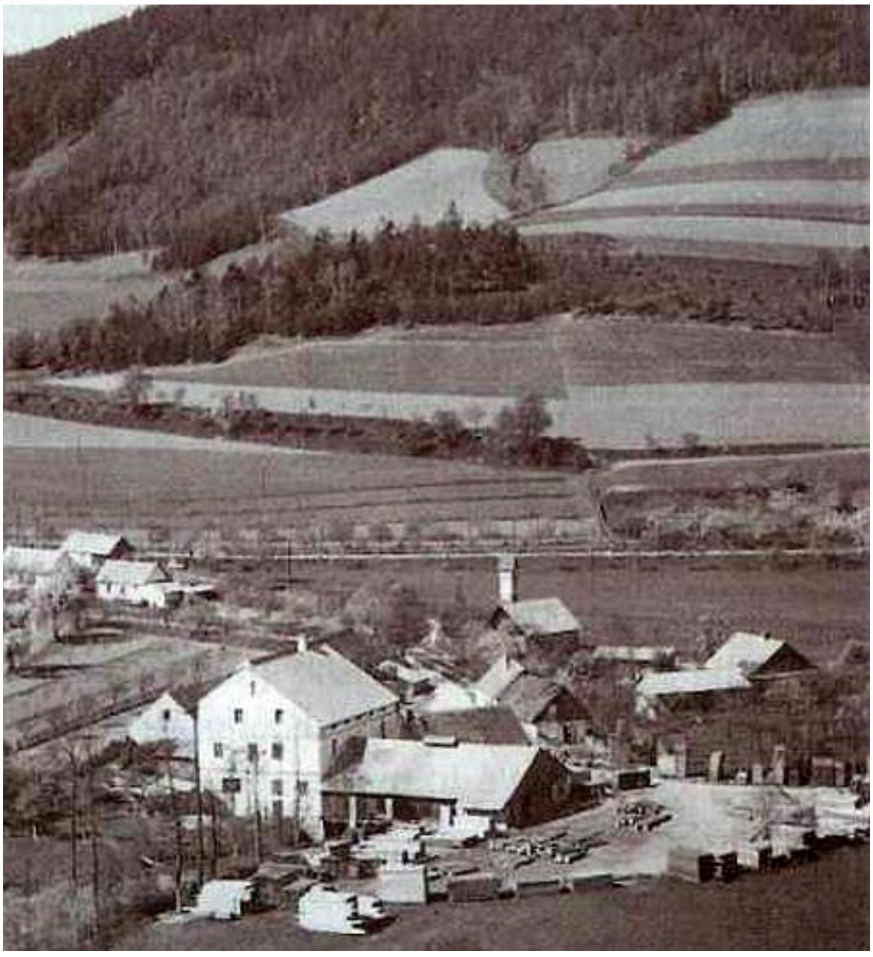
Fig 6. The mill in Ujčov (1920). Source: Štarha, 2010

Weir itself has undergone extensive renovations in 1940 and took its present image of a concrete object. The mill was used till 1950 with different intensity when its service was stopped. From that time, water in the millrace flew just slowly and the main flow volume flew over the weir uselessly. Grounds on the right bank including the millrace were redeemed before 1978 and large complex of trout breeding has been established there. It used backwater of the weir for inflow. State fishery searched for suitable place for erection the trout breeding and they were able to agree on redeeming of appropriate grounds just in Ujčov. The complex consists of several bigger water tanks (Fig. 7). Water flew between those water tanks throw nurseries, in which there were trout in fattening. Water flew from the lower tank back into the Svratka river. During last several years the trout breeding was out of service but these years the service was partly renewed by water inflow from river right into the nurseries (bigger water tanks are not used). Village has changed considerably due to the construction of fishing grounds; also the level of underground water has increased. Flanking vegetation of millrace was removed and possibility to produce electricity from renewable source has decreased due to thedevelopment. The complex capacity is oversized and there has been unnecessarily large land grab. On the other side delay a relatively large amount of water in aquaculture is certainly positive.

Fig 7. Aerial view of Ujčov with area of fisheries in 2010. Source: Štarha, 2010

3. Detailed characterization of the area

Designed lands are located on the left bank of the Svratka river opposite the economic building among rows: 93.850 and 94.050 km (DIBAVOD). The central part of the Svratka oxbow at the weir contains existing pool and immediate adjacent of wetland areas with hydrophilic vegetation. Ameliorations of field track Zemanka flows into the wetland in the northwest part of the territory. The pool itself is 400 m^2 large, oval to rectangular shape with the length 40 m and width 8–12 m. Depth varies between 1 to 2 m. There are farmed lands surrounding (Fig. 8), it is regularly mowed grasslands, field and outgoing apple orchard, where the fruit trees are variously scattered throughout the territory. The area is partially fenced and the fence is largely accompanied by alley.

Solid concrete weir with wooden supers, which ensures the inflow of water into the fish hatcheries located on the right bank of Svratka river is a prominent feature on the flow in the area of interest. Backwater of the weir is evident to row. 94.300 km. The longitudinal slope of the weir trough increases and hence the rate of water which slows down until the first sharp meander.

Fig 8. View on the locality form Burša hill (2000). Source: http://info.bystricenp.cz/ujcov

4. The effect of Vír dam at the site of interest

The storage plant Vír (Fig. 9) built on Svratka river ca. 10 km far from site of interest strongly influenced conditions in the stream below the dam, and even the landscape and land use. The issue of Vír dam is not part of this work, but it is necessary to mention its impact on the landscape in the basin underneath the tank, which was crucial.

Fig 9. Vír dam (the place of the dam before construction (1953 and nowadays). Source:http://www.virvudolisvratky.cz

Previously, the land lying in flooded areas in the Svratka floodplain did not plow usually up to the centennial water overflows (Fig. 10). The facets of arable land were located at higher elevations and on steep slopes. The original meadows were affected by the high water table. That's why ameliorative teams were created already hundred years ago (Štarha, 2010).

Flood flows and ice were reduced after the construction of Vír dam and there was a gradual plowing of floodplain. Meadows and fields were drained off and intensive farming started. Also, shrubs and other solitary trees have been removed in favour to intensification of agriculture. Wetlands were drained off too and economically exploit, if possible. Hunger for an agricultural land was always a great during history.

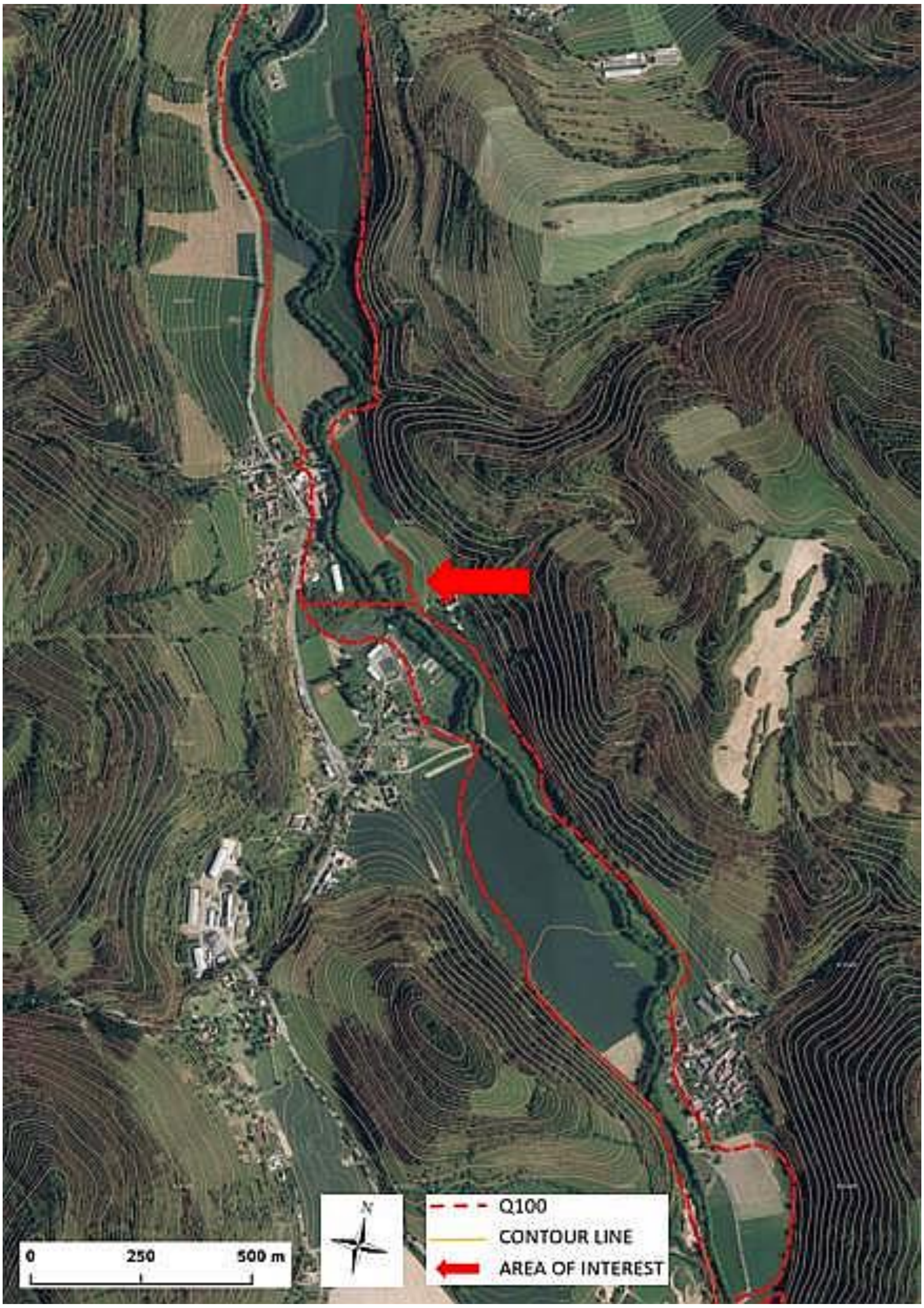

Fig 10. Borders of 100-year flood of Svratka River (COSMC, WMRI basis, adjusted by author).

5. Establishment of oxbow at the weir in Ujčov

Floods occured during spring seasons by snowmelting and ice running with following ice barriers in the river bad were more frequent before constructing of the dam. Next floods were coused in summer time by torrential rainfall with a longer duration of critical rain (Fig. 11).

Fig 11. Svratka River during the flood in neighbouring Štěpánov n. S. created new river bad around 1922. Source: Jurman, 2014

Water overflew from the river bad above the weir even at low flow rates thanks to ice running and ice barriers. The water that poured out on the left bank near the bend in the weir gradually formed centred drain in the lowest areas. As a result of increasing speed of the water flow water erosion has started and creates a new channel, which flowed back into the Svratka weir (Fig. 12). This development had again a significant impact on changing the landscape in the area of interest, while part of the oxbow is still preserved. The greater part of Svratka oxbow was gradually filled up and cultivated into farmland again.

Fig 12. Schema the oxbow creation (underlay aerial map Mapy.cz 2006, modified by author).

6. Recreation

Water temperature under the dam after its construction considerable decreased and this underlying affected not only the fish stock but even use of the river for recreation. Previously, local places were used for recreation because of travel restrictions. Locals used the area of the weir frequently for bathing (Fig. 13), nowadays it is used mainly for walks (Fig. 14).

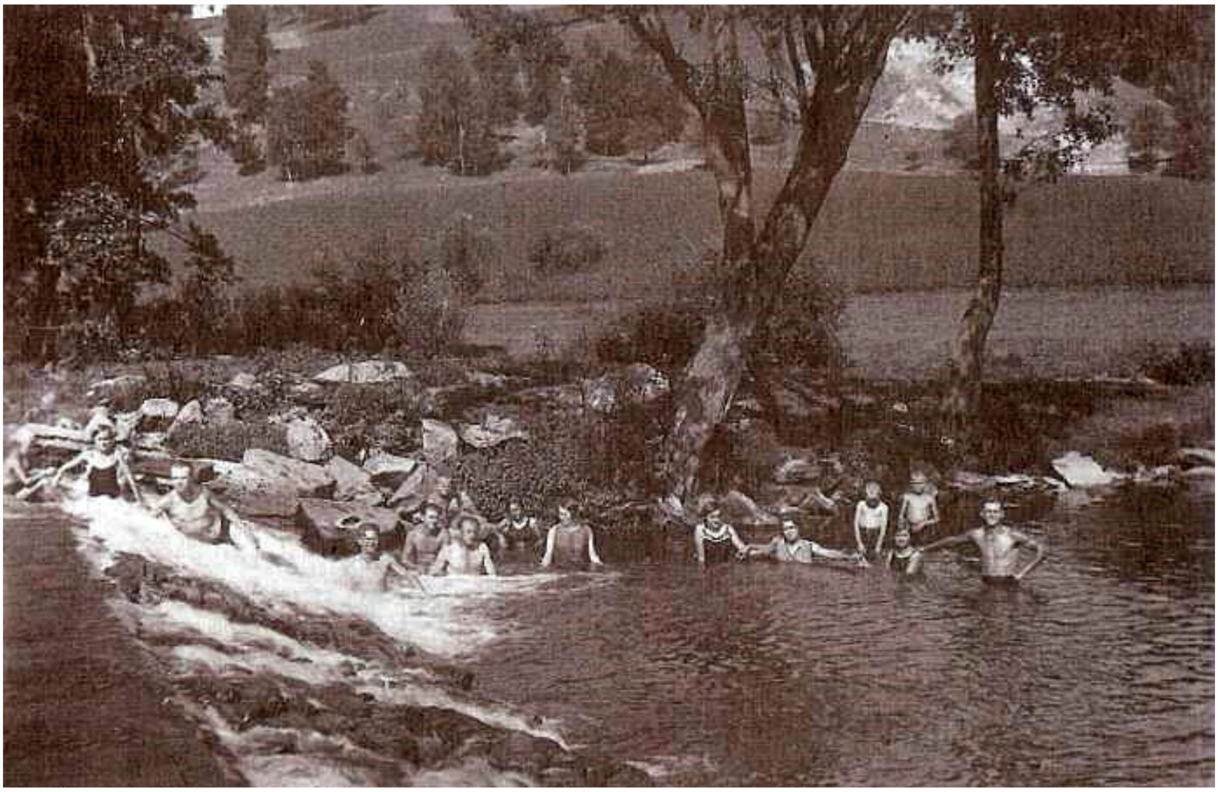

Fig 13. Bathing under the weir (1930). Source: Štarha, 2010

Fig 14. The area of the weir is still popular place for leisure time but just few besides boaters and hardies dares to cold water (2005). Source: http://info.bystricenp.cz/ujcov

7. Results and discussion

Crating of several proposals how to use a site is a part of a study; individual variants have different influence on surrounding countryside.

a) Spontaneous renaturation with sensitive human intervention

In case spontaneous renaturation apply the area would be left largely in its current state. When intervention occurs in woody structure it is necessary to consider removing fruit trees. Empty places after these woods would be gradually overgrown, particularly by hydrophilic and self-seeding trees.

It would be appropriate to remove fallen branches from the pool and to extract the sediments and build gradual entries into the water levels, which are suitable for most of animals. Extending the pool area would be suitable for the representation of a large number of species and individuals of animals, which would increase regional biodiversity. The pool without a flow rate and its large shading cause considerable water stratification mainly in summer and autumn months, which is supported by waste from adjacent deciduous trees.

b) Building a pond

The second option is to build a pond with intensive farming of fish and water fowl. The present ecosystem would be seriously affected in this case. Production function of ponds is done by intensive management, which includes activities to ensure maximum production of economically important fish species. These are the activities, which can have negative impact on the water quality and vegetation in the water tank: fertilizing, liming, excessive fish stock, the use of herbicides, water fowl.

High quality land should be taken if the area of water tank would be higher. There is a shortage of quality land on the left bank of the Svratka river. There could be a risk of increase of groundwater level on adjacent cropland in the context of disabling of drainage the field line Zemanka. Previouse land use as an orchard was an inappropriate intervention into the territory. Firstly, production and quality of fruit trees in that area is not ideal, the actual species composition of fruit trees is not particularly original and unused shattering and fruits negatively affect water quality in the area. Due to the small area of suitable land, relatively high construction costs, the impact on the surrounding landscape, biodiversity and the return on investment, this seems inappropriate.

c) Complete revitalization area with the construction of fish ladder and small hydropower plant

Assessing the possibility of building a small hydroelectric power plant in the Ujčov village on the left bank of the Svratka river on 100.420 km was part of the study. Hydroelectricity is designed as a weir, with the weir site, which is located on the Svratka river in a row. 100,420 km in terms of a simple gradient (difference in water level above and under the weir) and annual average flow rate is appropriate to consider the construction of small hydropower plants (Bureš, 2015). The weir is located on a plat no. 442/2 owned by Povodí Moravy s. p. Currently used by Kolář Fisheries and serves for heaving of water and its subsequent removal to the right bank fish nursery.

Assuming the construction of small hydropower plant is needed to build a fish pass at the same time ensuring fish migration. In this case, left bank land can be used, which is also privately owned by investor, and pools to establish a fish ladder and the creation a nature friendly measure for fish migration. The surrounding area consists mainly of permanent grassland and suitable natural vegetation. Fallow land will be positively utilized due to binding of a fish ladder at the pools (Fig. 15).

The first flow pool follows the position of the current pool. It is appropriate to provide a gentle slope inclination when building ponds, mainly due to the stability of banks, development and vertical zonation of coast zone. Such shores are not necessary to fortify separately. The problem of land-filling can appears mainly in pools of small dimensions follow a few feet a year. Therefore, it is advisable to dig a rather large pond with a depth of around 1 meter and a width of at least 5 meters due to their viability.

Fig 15. A schema of possible visualization of modification of left bank land (created by authors).

The second smaller flow pool constructed between the original one and Svratka river bed will be partly used as a sedimentation tank. Due to its oval shape and dimensions of about 5 x 15 m there will be no problem with periodic extraction of sediments.

The northern part of the existing wetland will be left to avoid disruption of existing communities, and also a small non-draining pool of approximately 15 to 20 m^2 will be excavated at this site. This non-flow pool will be suitable as a habitat of amphibians, etc., who will be protected here from predatory fish. Water surface should be at least partially sunlit for amphibians live and decreasing of eutrophication level of the pool. This is the reason why the south edges are planted only in exceptional cases.

According to Government Regulation no. 71/2003 and its amendment no. 169/2006 Coll. The flow of Svratka in the area of interest is defined as a segment of salmonid waters no. 275. For natural fish passage trapezoidal trough bottoms with natural fortifications and the shores of width in the bottom of 2 meters is expected. The bottom of fish ladder is supposed inclination 1: 20. Transverse bulkheads in the bottom of fish passage are formed by boulders of suitable shape and size. The width of the gap between the stones is between 10 and 25 cm. Among the rocks there is also the gap left with a variable width of 30–60 cm.

The flanking vegetation of watercourses and tanks is an essential part of territorial system of ecological stability and has significantly contributed to the landscape character. Suitable execution of flanking vegetation leads to a stable, species-rich and near-natural habitat. It is possible to reach a high revitalizing affect by suitable composition. Existing vegetation may be damaged during construction work, it is also appropriate to rectify the previous improper human intervention in species composition in the area. Woody species suitable to be added to the location of interest are particularly: an oak (*Quercus robur*) – an important floodplain tree species tolerant to occasional flooding; an ash (*Fraxinus excelsior*) – quality tree of swamp forests, which as a young man tolerates shade; Norway maple (*Acer platanoides*) – relatively well tolerates stagnant water, frequent fluctuations in the water table are unsuitable; alder (Alnus glutinosa) – light-requiring woody of shores, wetlands and wet habitats, also does not tolerate large fluctuations in groundwater level; Prunus Padus (*Padus avium)* – flexible and durable tree to shrub, which can properly create the bottom floor of supporting vegetation; willow (*Salix sp.)* – Good to non-shadowed banks and damp places directly in the bank line, it is suitable for vegetation coverage of areas where tree growth is not appropriate due to shading; birch (*Betula sp.)* – well grows on both wet and rocky places, do not tolerate fluctuation in water level. A specific example of technically modified watercourses renaturation in the Czech Republic presents Just (2009).

The watercourses revitalization and the fish ladder construction are resolved in the most of Europe countries. Freshwater fish conservation and river restoration is supported by traditional LIFE projects for the 2014–2020 funding period.

A good example of river management to boost salmon numbers was carried out on the River Mulkear, located in the Lower Shannon SAC in Ireland. The main focus of the Mulkear LIFE project was the conservation of Sea lamprey (Petromyzon marinus), European otter (Lutra lutra) and Atlantic salmon, which after many years of site mismanagement had become seriously threatened. Modifications to the river, such as straightening its course and installing weirs, represented particular obstacles to the conservation of these species. The specific measures carried out by the project are designed to mimic the conditions typically found in a natural river or an undrained river. These works alter the river flow, gradient, bed, channel or banks (LIFE and freshwater fish, 2015).

Other LIFE project was set up to ensure the restoration of the Segura river basin (Spain), by removing one weir and constructing fish passes across eight others. By improving the continuity of the river, the project expects to bolster the biodiversity of the area and expand the range of fish species, such as the Andalusian Barbel for which dams and weirs represent insurmountable barriers during their annual breeding migration (LIFE and freshwater fish, 2015).

The impact of Small Hydro-Power Plants on Salmonid Fishes Spawning Migrations in Lithuania presents Stakenas and Skrupskelis (2009). In 2000 and 2005, fish ladders were built in Vilni and Siesartis rivers providing fish access to another 10 and 25 km of the rivers respectively. The analysis of redd distribution and abundance in both rivers revealed that the construction of fish ladders significantly increased the number and share of redds above dams, however, a significant increase in redds above the dam occurred 2–4 years after fish ladders construction supporting homing behaviour as one of the most important factors for the recolonization of the newly accessible habitats. Assessed fish ladders efficiency for migrating salmonids made 66%. Minor construction defects and lack of protection were the main factors reducing fishway efficiency (Stakenas, Skrupskelis, 2009).

In northern Sweden, two LIFE projects are removing obstacles to fish migration, which were erected as part of timber-floating operations and during road construction. River Vindel LIFE project has removed 18 wooden floatway dams on tributaries of the Vindel River, which were used to hold back water in the spring in order to release it to float timber downstream during the drier summer months. Other LIFE project has removed around 300 dams and migratory barriers caused by road infrastructure, after inventories showed that approximately 30%–50% of all culverts built to carry water under roads in the project area were acting as migratory barriers because of poor positioning (LIFE and freshwater fish, 2015).

8. Conclusion

Positive aspects of spontaneous renaturation are represented mainly by low cost and the friendly intervention in the current flora and fauna. Potential of the area would not be filled.

In the case of total construction sites converting interest on intensive breeding pond with fish and water fowl, the current ecosystem would be seriously affected. This solution is not appropriate because of small area, relatively high construction costs and negative impact on biodiversity and long-term return on investment.

Small hydropower plant would be constructed with realization of fish ladder, which would allow fish migration. Connecting the fish ladder with flow pools with an area of several hundred square metres and accompanying non-flow pool is a suitable solution both for fish migration and for live of lot of amphibian species and another flora and fauna. Small hydropower plant would be weir, reduced flow (the necessity of maintaining the minimum residual flow) would manifest only on the weir, and the construction would be realized with maximum respect to life of organisms in Svratka.

The future of Ujčov fishery is probably the main limiting factor. If the fishery would be put into operation again and way of supplying water reservoirs remains unchanged, large amount of flow from above the weir will flow into area of fishery. Thus achievable flow rates in the proposed power plant change significantly and the profitability of its construction will be greatly devalued. If power plant will not be realized, the investor will not be forced to build fish passage and is on his discretion and financial possibilities, if he decides only for renaturation area with gentle human intervention, or with the support of grant funds to build fish pass and other water treatment in the area.

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