WETLAND RESTORATION OPTIONS WITH REGARD TO DIFFERENT OPERATIONAL REQUIREMENTS

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Abstract
One of the many possible landscape interventions for water retention in the landscape is the construction of natural small lakes - pools, a measure that is currently very common. At first sight, it is a relatively simple measure, in terms of legislation, design and implementation. However, there is often disillusionment, as there is a clash between the requirements of the individual public authorities with the nature conservation authorities and also with the water management options. Conflict can also arise over the actual function that the pools are ultimately intended to fulfil. Primarily preferred by experts, biodiversity, water retention, etc., can often clash with requirements for recreational use, especially if the feature is close to an urban area.

Key words: Water retention in the landscape, biodiversity, recreation

Introduction

Ponds occur in the landscape as natural depressions filled with water or artificially created by man. The pools are usually completely sunk below ground level, they do not have a dam or other technical equipment (drain, safety spillway), the maximum water level in the pool can be given by the level of the surrounding terrain. The outflow of water from the pond is solved in a way that is close to nature. The ponds (wetlands) are designed to meet the objectives of supporting nature protection, especially support and increasing biodiversity. They are not intended for fish farming or waterfowl. (NCA CR, 2014)

Wetlands provide important habitat for invertebrates, plants, and vertebrates (Gibbs, 2000, Hansson et al., 2005). Convention on Wetlands states the wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres (UNESCO, 1994). From the point of view of nature and landscape protection in the Czech Republic, priority is given to amphibians whose needs are adapted to the required technical parameters of the wetlands. Thus, irregularly shaped and shallow potholes fulfilled by water are usually understood as wetlands.

Materials and methods

In the following section, two completed pond projects are described. The ponds were designed to meet NCA CR (Nature Conservation Agency of the Czech Republic) standards as far as possible, yet they are two very different solutions.

Ponds Hastrman

The area concemed is located in cadastral area Janovice u Polné, at an altitude of 603–607. The dominant soil units are gley to pseudogley modal. According to Quitt, the area belongs to the mildly warm MT3 climate area with an average annual air temperature of 7.0 ° C and a long-term average annual rainfall of 630 mm (Jihlava).

This is the area of the former pond, the body of the dam is evident, along which the 2L Na Hastrmanu forest road runs. At the foot of the dam, there are currently large individuals of sycamore and linden, which will not be affected by the construction. The locality is situated on the stream: Poděšínský potok, IDVT 10239008 (ČHP 1-09-01-010), administration: Lesy ČR, s.p. (Forest of the Czech Republic). In the past, land reclamation was carried out in the area of the former floodplain by surface drainage ditches, opening into an upright and sunken watercourse. Subsequently, a commercial forest was planted in the floodplain. At present, in the central part of the area, there is an overgrown vegetation of Alnus glutinosa, aged 5–10 years, in a forest fence, which drains a significant amount of water through transpiration processes.

Ponds Sulíkov

The area of interest is located in cadastral area Sulíkov outside the built-up area of the village. The two pools are designed as flow-through. In the place of the proposed ponds, a historically waterworks probably existed, an earth dam is evident. The building is located south of the village at an altitude of

560 - 567. According to the regional division of the relief of the Czech Republic, the Hornosvratecká Highlands lie in the geomorphological unit. According to Quitt, the area belongs to the mildly warm MT3 climate area with an average annual air temperature of 6.5 ° C and a long-term average annual rainfall of 670 mm. The number of the hydrological order in the examined area is 4-15-02-0430. The main catchment area of the monitored locality is the Danube, the sub-catchment area is the Dyje, the basic catchment area is the Svitava, catchment area IV. of the order is Petrůvka.

Results

Ponds Hastrman

Five ponds with different surface areas, depths and bottom diversification were designed. In the riverbed, before the inlet to the culvert, under the body of the dam, a small approximately 0.3 m high wooden sill air sill with a stone backfill was built. By raising the level, it ensures the filling of ponds and also the creation of zones with very low water depth - wetlands. The ponds are built as separate, separated from the stream, except for the largest pond in the northern locality of the area, which connects to the stream, but its deepest part will be separated from the part adjacent to the riverbed by a quarry stone dam.

The terrain was modeled to protect part of the alder stump from permanent flooding.

In the middle of the locality, the existing sunken and upright Poděšín brook was loosened in its route, by inserting six opposite arches. Thus, even in the zone with flowing water, more favorable conditions will be created for animals and plants tied to this type of ecotope.

Part of the landscaping of pond excavation is also the creation of reptiles, leaving part of the branches from the existing stands on the site, as a possible hiding place for the fauna. Furthermore, tree trunks were also left in the places, both in the area of transition from aquatic and dry environment, as well as in the aquatic environment and in the field. There will be solitary stumps in the pool area.

Ponds 1 to 4 are separate non-flowing irregular shapes, max. depth 0.5 - 1.5 m. Pond 5 is in the area near the dam of the former pond. The surface of the pond follows the level in the riverbed. The pond is divided into two parts by a transverse aggregate dam - a quarry stone throw up to 80 kg. The first part, following the stream, has a maximum depth of 1.0 m, the rear part has a maximum depth of 1.5 m. An overview of pond parameters is in Tab. 1

The ponds will be irregular in shape, the slopes with a maximum slope of 1: 3 to 1: 8 will gradually follow the terrain, the depths in the ponds will be divided with emphasis on large shallow water zones (littoral). View of the realized ponds Fig. 1.

Tab. 1: Parameters of Hastrman ponds

	Pool T1	Pool T2	Pool T3	Pool T4	Pool T5
Level area (m^2)	105	105	1290	63	735
Volume (m^3)	27	45	798	12	347
Depth (m)	0,3-0,8	0,6-1,0	0,8-1,5	0,5	0,3-1,5

Fig. 1: Ponds in the locality Hastrman, photo just after the realization (Pelikán 2021)

Ponds Sulíkov

Two flow-through pools are proposed, which are connected to the existing drainage pipe. The depth of the pools varies from 0.7 m to 1.7 m. Slope gradients will range from 1:1.5 to 1:7. The drainage pipe is located at a depth of 1.3 m below ground surface. This pipe has been excavated in the area of the pools and left in the area between the pools. The length of the drainage pipe between the pools is approximately 17 m. The newly created slopes after the landscaping will be left to natural succession. Planting of wetland plant species is proposed on part of the area. The total volume of excavated soil will be 835 m^3. View of the realized ponds Fig. 2. This excavated material has been used to level the site. A right-angled 'elbow' pipe connected to the original drainage system is used to drain water from the pools. This measure will raise the water level in the ponds to the desired height. This extension pipe is lined with up to 200 kg of quarry stone and shaped to support the stability of the pipe and for aesthetic reasons. Part of the slope of the lower pool is covered with a macadam cover of up to 100 mm fraction for aesthetic and environmental reasons. See Table 2 for the parameters of the pools.

Tab. 2: Parameters of Sulíkov ponds

	Pool T1	Pool T2
Level area (m^2)	213	140
Volume (m^3)	192	113
Depth (m)	0,5-1,7	0,3-1,0

Fig. 2: Sulíkov locality, before implementation, just after and about a year after implementation (Marková 2018, 2020, 2021)

Discussion

It is important to realize that ponds are not a stable habitat, they evolve and change naturally. Clogging occurs due to possible erosion of the bank, and in the case of flow-through sediments, they become clogged internally, mainly due to the death of biomass and its deposition at the bottom. The ponds are also gradually overgrown with wetland vegetation, so the free surface area is gradually decreasing. If the natural processes or human intervention do not restore them, the pools will gradually disappear due to natural succession. It is these natural processes that some people may perceive as undesirable in ponds. Especially if the ponds are located close to the urban area and become a center of extensive recreation for locals. The transformation of such a place into an overgrown wetland is then considered unattractive, and the extinct water area as a wasted investment. Although in terms of biodiversity, this transformation is very valuable. In more remote localities, even the general public is willing to accept this natural process. Hastrman is located more than 1.5 km from the urban area and is not accessible by any hiking trails, only by forest haul road (Procházková and Hrůza, 2018).

Although creation of wetlands may mitigate for the loss of wetland area, there is uncertainty about how effectively created wetlands replicate the functions of, or replace habitat provided by, natural wetlands (Brown et al., 2012, Zedler and Callaway, 2002). The boundary between a pond and a wetland cannot be fixed. Convention on Wetlands defines various features considered as wetlands whose other natural process is also possible drying. It should be noted that during long periods of no rainfall, wetlands with a predominantly surface water source may experience lowering of the water level and even temporary drying. Again, this phenomenon is often perceived negatively both by lay people and by professional grant bodies. Again, periodic drying provides the opportunity for considerable biodiversity for some organisms requiring alternation between aquatic and non-aquatic periods. This is not a reservoir where there is the possibility of maintaining a constant level due to handling facilities. In addition, the concept of very shallow wetlands with maximum allowable depth 1.5 m (instead of Ramsar Convention) may amplify the phenomenon.
Ponds are an important element for water retention in the landscape, reduce runoff from the catchment, improve the microclimate of the site (Huryna et al., 2014) and significantly support biodiversity.
Hastrman and Sulíkov ponds represents two different approach in the design with respect to the expected different requirements and increased interest in the vicinity of urban area. In both cases, however, an adequate habitat was created, which supports the biodiversity of the site.

Conclusion
The article describes two examples of pond sites built on completely different sites and of different extent. In the case of the "Hastrman" pond, it is a locality in a forest environment at the bottom of the former pond, where there was a young willow stand. Five ponds of different sizes with differentiated slopes were designed, with the stumps placed in the bottom for greater diversity and the possibility of shelters. It also included loosening the route of part of the stream that flows here and leaving part of the young stumps.
In the "Sulíkov" locality, two ponds on a piped stream were designed. The place was waterlogged, overgrown with riots, inaccessible. In the area of the ponds, the pipeline was removed and the terrain was deepened to create a free surface of the ponds in the area of the extended valley. The surroundings of the ponds were modified and modeled with an excess of soil, willow plantings took place. The location is close to the village and is the destination of frequent walks by locals, some ponds are used for refreshments (even in winter they have become a welcome addition to local hardy people).
The above examples show that ponds can perform really different functions in the landscape, sometimes quite unexpected.
Regardless of some associated functions, both sites primarily fulfill the function of retaining water in the landscape, creating a water element that was missing in the sites and new habitat options for animals and plants.

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Souhrn
Jedním z mnoha možných krajinných zásahů pro zadržování vody je výstavba tůní, opatření v současnosti velmi rozšířené. Na první pohled jde o poměrně jednoduché opatření, co se týče

legislativy, návrhu i implementace. Často však dochází ke střetu požadavků jednotlivých orgánů veřejné správy s orgány ochrany přírody a také s možnostmi hospodaření s vodou. Konflikt může také nastat ohledně skutečné funkce, kterou mají tůně v konečném důsledku plnit. Odborníci primárně preferovaná biodiverzita, zadržování vody atd. se může často střetávat s požadavky na rekreační využití, zejména pokud je objekt blízko osídlení. V článku jsou prezentovány dvě lokality realizace tůní. Lokalita Hastrman je v lesním komplexu, jde o několik neprůtočných tůní spolu s revitalizací části toku. Lokalita Sulíkov je v blízkosti zástavby, jedná se o dvě průtočné tůně vzniklé na lokalitě, kde bylo odstraněno zatrubnění.

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