The Lednické rybníky fishponds are among the most important bird localities in the Czech Republic with more than 140 recorded species of fishpond ecosystems and several forms of nature conservation areas being declared. The aim of the map presented in the paper is to introduce the locality and present data on observed numbers of selected important species and their changes during the last several decades. The main topographic map brings information about touristic infrastructure and general geography of the area. Several smaller thematic maps then show (i) forms of nature conservation, (ii) water levels during summer drainage of fishponds, (iii) migration of birds, (iv) extent of reed vegetation in the years 1933 and 2009, and (v) distribution of selected species within the Czech Republic. The maps are accompanied by short texts dealing with the presented issues, including the illustrations of selected important bird species (Northern Shoveler, Red-crested Pochard, Greylag Goose, Pied Avocet, Black-crowned Night Heron and Grey Heron) and graphs of observed individuals and nesting pairs in the years 1973–2014. The map is intended to serve as introductory material for birdwatchers and other visitors of the area as well as to supplement a brochure of the same title.

1. Introduction

The system of four fishponds (artificial water bodies designed for fish breeding) found near the South Moravian villages of Lednice, Hlohovec and Sedlec is considered to be one of the most important bird areas in the Czech Republic (Máliková & Laciná, 2001). Declared nature reserves in 1953 with some conservation restrictions applied even before this year, the Lednické rybníky fishponds have been drawing scientific attention for nearly a century. There is a long tradition of bird species monitoring (e.g. Chytíl, 2006; Glíž, 1937; Hájek, 1970, 1981; Hudec, 1975; Karásek, 1923; Schade, 1901) and also general biological monitoring (Heimlich & Sukop, 2014; Losos & Heteša, 1971). These sources bring information on a hundred nesting species and several dozens of other species stopping here during spring or autumn while migrating, including species that are considered extremely rare in the Czech Republic. In addition to natural values, the close neighbourhood of the fishponds – the Lednicko-valtický area – also has an important cultural and natural heritage (Orsillo, 2012). High environmental value is also related to the broader neighbourhood, the area of the lower reaches of the Morava and Dyje Rivers and their confluence (Miklín & Hradecký, 2015), as well as the Pálava Protected Landscape Area (Miklín, 2012).

The aim of the Main Map presented in this paper is to (i) introduce the geography and nature conservation of the Lednické rybníky fishponds and their surroundings, (ii) introduce the most important bird species of the locality and (iii) present data from the monitoring of selected species between the years 1973 and 2014.

1.1. Study area

The Lednické rybníky fishponds are situated in the southeastern part of the Czech Republic (Figure 1), in the low and flat landscape of Dolnomoravský úval (Dolní Morava Graben) (Demek & Mackovčín, 2006) characterised by a warm and dry climate with average temperature/precipitation 9.6°C/505 mm (Quitt, 2009). The system of Lednické rybníky (with a total area ~580 ha) consists of four fishponds lying on the Včelín Brook (Nesyt, Hlohovecký, Prostřední and Mýnský fishponds) and Zámecký rybník fishpond near Lednice Castle, supplemented with water from the Dyje River (AOPK, 2012). Established at the beginning of the fifteenth century, Nesyt (with an area ~300 ha and maximum depth 5.2 m) is the largest fishpond in Moravia. According to AOPK (2012), the flora of the fishponds and their surroundings contains (classified by national legislation – ČNR [1992]) 11 vulnerable species (V) and 3 heavily endangered species (HE), while fauna is represented with 16 V, 19 HE and 10 endangered species of birds.

Due to the importance of the fishponds, nearly all forms of the protection status used in the
Czech Republic (CENIA, 2008) can be found in this locality (Figure 2). Lednické rybníky fishponds were declared a National Nature Reserve in 1953 (AOPK, 2012). In 2004 and 2005 several reserves under the NATURA 2000 system (both Special Protection Areas (SPA) and Sites of Community Interest (SCI)) (CEC, 1979, 1992) were declared. Lednické rybníky are also (since 1990) recognised as Wetlands of International Interest under the Ramsar Convention (Matthews, 1993). The whole area has been a part of the Dolní Morava UNESCO Biosphere Reserve since 2003.

2. Methods

2.1. Bird monitoring

Birds on the water surface have repeatedly been counted since 1973 with more than 1000 complete checks (all fishponds except for Zámecký fishpond) and 10 s of checks of particular fishponds. The counting included all the birds on the water surface, males and females, pairs and young ones. Apart from surface counting, the inspection of reed, islands and shallow water was carried out mainly during the nesting seasons. It is not possible to count thousands of birds precisely, but since identical methods were used during all the checks (including the same daytime) possible inaccuracies are expected to be carried out.

According to the literature, summarised by Hachler (1971) and Macháček (2009), 142 bird species of various wetlands habitats (e.g. open water, reed and other riparian and littoral vegetation, islands and exposed fishpond bottoms) were observed in the Lednické rybníky fishponds during the twentieth century and at the beginning of the twenty-first century. Six species were selected to be presented on the map.

Figure 1. Study area within the Czech Republic and Europe.

Figure 2. Types of nature conservation in the study area. 1 – Lednické rybníky SPA; 2 – Pálava SPA; 3 – Lednické rybníky SCI; 4 – Dyje Floodplain SCI; 5 – Bezručova Alej Alley SCI; 6 – Nesyt Saltmarsh SCI; 7 – SCI Lednický zámek castle; 8 – Lednické rybníky NNR; 9 – Lednice Pastureland; 10 – Kamence by Hlohovec NM; 11 – Nesyt Saltmarsh NNR; 12 – Lednické rybníky Ramsar Site; 13 – Lower Dyje Wetlands Ramsar Site.
The Northern Shoveler (*Anas clypeata*), Red-crested Pochard (*Netta rufina*), Greylag Goose (*Anser anser*) and Black-crowned Night Heron (*Nycticorax nycticorax*) are all target species of the NATURA 2000 SPA. The Grey Heron (*Ardea cinerea*) is a typical species of the area with a significant nesting colony, while the Pied Avocet (*Recurvirostra avosetta*) is an example of an extremely rare species whose presence is conditioned by the summer drainage of the fishponds.

### 2.2. Map design

We used freely available *OpenStreetMap* data as a base for the topographic map. Derived from various sources and map scales, these data have some qualitative limitations. On the one hand, for example, the layer of buildings is very precise as it originally comes from large-scale cadastral data. Having been adopted from the state water management map at 1:50,000 scale, the layers of water bodies and rivers of the Czech Republic are of relatively good quality whilst the quality of the transport infrastructure layer (roads and tracks) is quite good, thematic attributes (road categories) were often assigned incorrectly. On the other hand, the land use layer is derived from a small-scale map. Therefore, these data were adjusted and completed using an orthophoto and the layer of buildings generalised. The extent of reed vegetation was digitised from Zapletal (1933) and an orthophoto image from 2009. Thematic maps were created on a simplified base made up from the layers of fishponds and urbanised areas in different shade of grey, which makes it possible for thematic data to be visible.

The topographic map and a majority of thematic maps are in the S–JTSK national coordinate system and Krovák projection (1959). Maps of the location of the area use the Albers Equal Area Projection (with the central meridian 16.5°E; standard parallels 49°N and 50°N) for the map of the Czech Republic (the same coordinate system is used for the maps of bird distribution in the Czech Republic) and orthographic projection (longitude and latitude of centre 17°E, 49°N) for the map of the world. This same projection (with the latitude of the centre shifted to 40°N) is used for the map of bird migration.

### 3. Results and discussion

#### 3.1. Bird monitoring

Among more than four million recorded individuals of 127 species, 94.15 % were birds of 13 dominant species (with Wild Duck [*Anas platyrhynchos*], Eurasian Coot [*Fulica atra*], Black-headed Gull [*Larus ridibundus*], Greylag Goose [*A. anser*] and Common Pochard [*Aythya ferina*] being the most abundant species) (Table 1). Detailed information on selected species follow.

*Northern Shoveler* (*A. clypeata*) is one of the rarest species of *Anas* genus in the Czech Republic, with its number continuously decreasing (Musil, 1998). The nesting of the northern shoveler in the Lednické rybníky fishponds was reported by Schade (1901) and according to Zdobnitzky (1907) the northern shoveler was one of the most common ducks in the Lednické rybníky fishponds. The highest average numbers were observed in 1979 (1242 individuals) (Table 2). According to BirdLife International (2004), between 1970 and 1990 the European population of the northern shoveler was classified as stable, while in next decade (1990–2000) as decreasing. Despite the generally decreasing trend on the Lednické rybníky fishponds (which is probably caused by a shift to another migration stop), the northern shoveler can regularly be observed in the study area during spring and autumn migration with a few individuals nesting (e.g. on Nesyt rybník fishpond in the years 1981 and 2009). Being slightly higher on summer drainage fishponds, the bird numbers and frequency (during autumn migration) are highly influenced by the period of fishing out of the fishponds as the birds prefer the muddy bed of discharged fishponds.

The trend in the *Red-crested Pochard* (*N. rufina*) population is generally increasing, with the highest average number (210) observed in autumn 2012 (Table 2). At the beginning of the twentieth century, the Lednické rybníky fishponds were the only nesting locality in the Czech Republic for this species (Schade, 1901). Since 1974 the number of nesting pairs has varied reaching as many as 36 in the year 1981 with more pairs on average in the last decade. During the last century, the numbers of observed individuals, nesting pairs and areas of occurrence have increased (probably thanks to increasing fishpond trophy) and red-crested pochard has become a regular species of many fishpond areas of the Czech Republic (Musil, 1998). Also, the numbers of wintering individuals of the population in Central Europe have increased over the last few decades (Keller, 2006). Fluctuations within

### Table 1. Dominance of most dominant and selected (marked with *) species. Species are arranged according to year-round dominance.

| Species                  | Year-round | Spring migration (III–IV) | Nesting (V–VII) | Autumn migration (VIII–XI) | Winter migration (II, III) |
|--------------------------|------------|---------------------------|-----------------|----------------------------|----------------------------|
| Wild Duck                | 20.97      | 6.3                       | 10.57           | 22.23                      | 58.91                      |
| Eurasian Coot            | 19.62      | 31.81                     | 31.43           | 20.09                      | 1.69                       |
| Black-headed Gull        | 12.82      | 12.56                     | 13.58           | 8.98                       | 8.74                       |
| Greylag Goose*           | 12.20      | 3.18                      | 9.23            | 16.47                      | 2.87                       |
| Common Pochard           | 11.6       | 9.98                      | 17.43           | 10.45                      | 3.21                       |
| Northern Shoveler*       | 3.87       | 3.14                      | 0.23            | 5.48                       | 1.65                       |
| Red-crested Pochard*     | 1.8        | 2.29                      | 3.17            | 0.31                       | 0.09                       |
| Grey Heron*              | 0.81       | 0.62                      | 0.72            | 0.90                       | 0.69                       |
| Black-crowned Night Heron* | <0.05     | <0.05                     | 0.11            | <0.05                      | <0.05                      |
year numbers are probably caused by fishpond management; high carp numbers causing muddying of the water and thus a decrease of water plants and algae, which are the main source of food intake of the red-crested pochard. The Red-crested pochard prefers partly summer-drained fishponds, while significantly lower numbers were observed on totally summer-drained fishponds (e.g. Nesyt in 2007).

The numbers of observed individuals of Greylag Goose (A. anser) have a generally increasing trend, with the highest average numbers in 2008 (1336) and similar numbers in 1993, 2007 and 2012 (Table 2). This is similar with general trends of the population in Central Europe (Fox et al., 2010) and wild geese in general, probably thanks to restrictions on their hunting (Madsen, Cracknell, & Fox, 1999) and climatic changes. The oldest records from the beginning of the twentieth century note ca. 10–50 nesting pairs on all the fishponds. Observations since 1976 have been oscillating around the same numbers (1–37 nesting pairs), with the maximum observed number of individuals increasing from ca. 2000 to 6000 during the twentieth century. The period of this maximum shifted from July–August in the first half of the twentieth century to September–October–beginning of November in more recent decades due to climatic changes. The highest numbers are observed on summer-drained fishponds since birds prefer shallow water as places for rest. High summer numbers are also supplemented by individuals from the Neusiedler See Lake (Dick, Hudec, & Macháček, 1984). Some geese winter in the study area increasing numbers (Musil et al., 2008), South Moravian localities are the most important wintering places for the Greylag goose in the Czech Republic (Musil & Musilová, 2014).

| Year | Maximal | Average | Maximal | Average | Maximal | Average | Maximal | Average |
|------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1973 | 2500    | 593     | 660     | 327     | 74      | 21      | 53      | 15      |
| 1974 | 1820    | 451     | 380     | 60      | 86      | 32      | 52      | 13      |
| 1975 | 1600    | 258     | 250     | 113     | 98      | 33      | 65      | 18      |
| 1976 | 2081    | 455     | 140     | 46      | 115     | 44      | 129     | 27      |
| 1977 | 2881    | 504     | 935     | 438     | 122     | 55      | 134     | 24      |
| 1978 | 3394    | 510     | 1820    | 832     | 182     | 93      | 101     | 20      |
| 1979 | 2190    | 423     | 1800    | 1242    | 228     | 141     | 102     | 23      |
| 1980 | 1845    | 305     | 1150    | 616     | 318     | 163     | 124     | 27      |
| 1981 | 3515    | 554     | 1200    | 589     | 288     | 122     | 215     | 51      |
| 1982 | 2300    | 399     | 720     | 534     | 269     | 152     | 218     | 50      |
| 1983 | 4636    | 664     | 280     | 167     | 172     | 93      | 101     | 35      |
| 1984 | 3500    | 531     | 440     | 216     | 81      | 19      | 136     | 29      |
| 1985 | 1650    | 200     | 2110    | 786     | 48      | 16      | 55      | 16      |
| 1986 | 2628    | 374     | 560     | 383     | 29      | 17      | 122     | 28      |
| 1987 | 2650    | 497     | 990     | 755     | 58      | 26      | 88      | 26      |
| 1988 | 4315    | 535     | 1110    | 485     | 49      | 27      | 177     | 57      |
| 1989 | 4208    | 724     | 1220    | 814     | 67      | 30      | 137     | 53      |
| 1990 | 4900    | 828     | 1043    | 447     | 50      | 24      | 257     | 64      |
| 1991 | 3400    | 500     | 1216    | 722     | 54      | 27      | 135     | 35      |
| 1992 | 2750    | 592     | 815     | 625     | 39      | 18      | 284     | 67      |
| 1993 | 4330    | 1307    | 980     | 646     | 77      | 44      | 160     | 48      |
| 1994 | 4410    | 765     | 1030    | 633     | 71      | 26      | 257     | 48      |
| 1995 | 3250    | 690     | 1100    | 791     | 74      | 33      | 273     | 49      |
| 1996 | 3420    | 666     | 1000    | 593     | 76      | 38      | 165     | 49      |
| 1997 | 1516    | 281     | 1050    | 759     | 116     | 57      | 324     | 55      |
| 1998 | 2935    | 571     | 1050    | 596     | 321     | 120     | 213     | 60      |
| 1999 | 2468    | 388     | 1430    | 640     | 367     | 142     | 189     | 50      |
| 2000 | 2554    | 511     | 1090    | 533     | 333     | 106     | 265     | 41      |
| 2001 | 6300    | 889     | 1083    | 634     | 286     | 137     | 181     | 36      |
| 2002 | 3752    | 473     | 720     | 352     | 294     | 177     | 286     | 49      |
| 2003 | 1820    | 536     | 720     | 456     | 228     | 84      | 254     | 52      |
| 2004 | 4700    | 542     | 1130    | 648     | 269     | 112     | 169     | 44      |
| 2005 | 3304    | 496     | 1260    | 723     | 250     | 149     | 229     | 41      |
| 2006 | 1620    | 290     | 1030    | 637     | 252     | 101     | 223     | 33      |
| 2007 | 6007    | 1162    | 906     | 487     | 188     | 79      | 82      | 21      |
| 2008 | 6475    | 1336    | 460     | 166     | 254     | 112     | 126     | 56      |
| 2009 | 5054    | 850     | 270     | 176     | 219     | 122     | 218     | 57      |
| 2010 | 3153    | 377     | 538     | 236     | 190     | 92      | 241     | 46      |
| 2011 | 2560    | 627     | 432     | 268     | 150     | 70      | 137     | 39      |
| 2012 | 7880    | 1286    | 94      | 47      | 447     | 210     | 202     | 59      |
| 2013 | 3646    | 742     | 206     | 84      | 222     | 85      | 165     | 33      |
| 2014 | 4200    | 801     | 509     | 135     | 208     | 82      | 103     | 34      |
The nesting colony of Zámecký rybník fishpond has continuously been observed since 1932. There was an interesting increase in the years 1986 and 1987, followed by a distinct decrease in 1988, which was probably caused by the establishment of a nesting colony in Pansee near Strašchin village (Macháček & Chytíl, 2001). The decrease in nests in 2005 can also be explained by establishing another nesting colony. Except for the nesting colony on Zámecký rybník fishpond, several tens of pairs regularly nest on the islands of Prostřední and Mlýnský fishponds.

Grey Heron (A. cinerea) nested on Lednické rybníky fishponds most likely throughout the whole twentieth century. However, according to Schade (1901), at the beginning of the twentieth century the nesting was individual or irregular. The nesting colony of Zámecký rybník fishpond has continuously been reported since 1932, with ca. 10 nesting pairs observed (Glíz, 1937). Since 1973 the numbers of observed individuals (Table 2) and nesting pairs (Table 4) have slowly been increasing in the area, although the highest average numbers were observed in the early 1990s. On the contrary, numbers of other egrets (i.e. Great egret, Ardea alba) have strongly increased in recent decades. In the course of a year, the highest numbers of grey herons are observed during autumn migration in September or October (with an average number of individuals during one check being over 100, as compared to ca. 30 individuals during spring). The number of wintering grey herons has significantly increased in the Czech Republic since the mid-twentieth century (Musil, Musilová, Fuchs, & Poláková, 2011).

First observations of Pied Avocet (R. avosetta) come from the year 1948, with several nesting pairs mainly on Nesyt rybník fishpond, but also on Mlýnský and Hlhořecký fishponds. Since the 1950s, the occurrence of this species has been very rare (monitoring years: 1961, 1975, 1981, 1993, 1994, 2001, 2002 and 2004). After the re-implementation of fishpond summer drainage, pied avocets returned and a high number of individuals and a few nesting pairs are generally observed.

### Table 3. Number of nesting pairs in Zámecký rybník fishpond colony.

| Year   | Black-crowned Night Heron (N. nycthemera) | Grey Heron (A. cinerea) |
|--------|------------------------------------------|-------------------------|
| 1974   | 50                                       | 30                      |
| 1975   | *                                        | *                       |
| 1976   | 45                                       | 42                      |
| 1977   | *                                        | 42                      |
| 1978   | 34                                       | 70                      |
| 1979   | *                                        | *                       |
| 1980   | *                                        | 76                      |
| 1981   | 28                                       | 113                     |
| 1982   | 27                                       | 98                      |
| 1983   | 38                                       | 105                     |
| 1984   | 92                                       | 145                     |
| 1985   | 86                                       | 164                     |
| 1986   | 87                                       | 197                     |
| 1987   | 165                                      | 190                     |
| 1988   | 268                                      | 210                     |
| 1989   | 140                                      | 264                     |
| 1990   | 273                                      | 267                     |
| 1991   | 214                                      | 245                     |
| 1992   | 222                                      | 255                     |
| 1993   | 244                                      | 254                     |
| 1994   | 258                                      | 267                     |
| 1995   | 239                                      | 268                     |
| 1996   | 271                                      | 211                     |
| 1997   | 261                                      | 219                     |
| 1998   | 231                                      | 259                     |
| 1999   | 239                                      | 244                     |
| 2000   | 229                                      | 238                     |
| 2001   | 253                                      | 217                     |
| 2002   | 243                                      | 200                     |
| 2003   | 247                                      | 198                     |
| 2004   | 261                                      | 217                     |
| 2005   | 185                                      | 202                     |
| 2006   | 215                                      | 187                     |
| 2007   | 218                                      | 181                     |
| 2008   | 179                                      | 198                     |
| 2009   | 212                                      | 243                     |
| 2010   | 233                                      | 183                     |
| 2011   | 169                                      | 167                     |
| 2012   | 194                                      | 174                     |
| 2013   | 190                                      | 192                     |
| 2014   | *                                        | *                       |

Note: During the years marked with *, natural conditions made it impossible to count the nests.

### Table 4. Number of observed species and individuals on Nesyt rybník fishpond between the years 2005 and 2014.

| Year | Number of species | Number of individuals | Number of species | Number of individuals |
|------|-------------------|-----------------------|-------------------|----------------------|
| 2005 | 32                | 20198                 | 5                 | 41                   |
| 2006 | 26                | 16219                 | 1                 | 17                   |
| 2007*| 49                | 52343                 | 19                | 3371                 |
| 2008 | 37                | 79509                 | 4                 | 10                   |
| 2009 | 41                | 53700                 | 8                 | 64                   |
| 2010 | 32                | 20863                 | 4                 | 15                   |
| 2011 | 33                | 14401                 | 5                 | 25                   |
| 2012*| 56                | 89653                 | 22                | 3459                 |
| 2013 | 38                | 28896                 | 7                 | 84                   |
| 2014*| 53                | 42729                 | 17                | 4083                 |

Note: In the years marked with *, the fishpond was summer-drained.

### 3.2. Summer drainage of fishponds

Throughout the centuries, an important part of fishpond management was summer drainage, that is, discharging the water for one season, usually every three to seven years (Dykyjová & Květ, 1978; Květ, Jeník, & Soukupová, 2002). Summer drainage has a negative effect on parasites, increases oxygen content in sediments on the fishpond bottom and – in some cases combined with seeding ‘green fertilisation’ plants – increases fishpond fertility in subsequent years (Herzog, 1970). Fishpond bed exposure is also crucial for several species of plants and birds. With the intensification of fishpond management during the twentieth century and an accent on maximum fish production, summer drainage was abandoned in nearly all the fishponds, which had a negative impact on some of the plant and bird species present and thus made them endangered (Šumberová, Lososová, Fabšičová, & Horáková, 2006; Sychra et al., 2008).
After nearly half a century without fishpond summer drainage, partial summer drainage was re-introduced by the state nature conservation administration in the 1990s. Nesyt fishpond was then totally drained in 2007. The water level of the fishpond was lowered from 174.74 to 173 m a.s.l. (partial summer drainage). Due to extreme drought in the spring of 2007, the water level further decreased to ca. 172.2, leaving only half of the fishpond flooded (Sychra et al., 2008) (Figure 3). Such summer drainage including further gradual decrease in the water level left optimal conditions for a large number of plant species. As was summarised by Sychra et al. (2008), during the summer of 2007 a number of very rare vascular plant species that had not been recorded for several years were observed on the exposed bottom of Nesyt fishpond (e.g. Swamp Pricklegrass [Heleochloa schoenoides] or Salt marsh Sand spurrey [Spergularia salina]).

Summer drainage also had a highly positive influence on birds (Macháček, 2007), the effect of which lasted for several years (Macháček, 2012). Extreme abundance was recorded for some species of the suborder of waders (Charadrii) (e.g. Pied Avocet [R. avosetta], Common Greenshank [Tringa nebularia], Wood Sandpiper [Tringa glareola] or Ringed Plover [Charadrius hiaticula]). Within only a year, the number of these species exceeded all records from the period of 1973–2006. The nesting of Pied Avocet was observed again after 51 years. If until the 1990s flocks of hundreds of Ruff (Philomachus pugnax) individuals were common, however in recent decades only tens of birds were recorded. However, after this strong decrease, 410 individuals were observed again. Repeated partial summer drainage of Nesyt fishpond in the year 2012 together with monitoring in subsequent years after the summer drainage (Table 3) showed a significant influence on birds, both in the abundance, nesting and numbers of individuals. On the basis of the monitoring results, partial summer drainage of the fishponds has been included into the nature reserve management plans for the following ten years (AOPK, 2012).

### 3.3. Reed vegetation

The intensity of fishpond management and agricultural production is also connected with the extent of reed vegetation comprising Common Reed [Phragmites australis] and Narrow-leaved Cattail [Typha angustifolia]). Zapletálek (1933) mapped reed vegetation on ca. 105.9 ha in the year 1933, according to aerial photographs from 2009, reed cover was 69.8 ha (65.9% of the area in the year 1933), with 32.1 ha of the area covered by reeds in both monitoring periods (Figure 5). However, Zapletálek (1933) results are indicative of the methods of mapping. Reed vegetation was traditionally cut mainly during winter and preferably in areas close to villages, which probably had a positive effect on reed stands and its potential to spread (Englouncer, 2009). The declaration order of the state reserve from 1953 included paragraphs on the protection of reed vegetation and regulation of its cutting. Agricultural use of reed vegetation was abandoned during the second half of the twentieth century leaving carps (and their increasing numbers mainly in 1980s) the main limiting factor of reed vegetation. The decrease of reed area is also connected to higher water level, as reeds successively die in deeper water.

On Nesyt fishpond, the oldest records (Čapek, 1940; Čapek & Hachler, 1948) mention dense reed cover at south-western and partly northern shores of the fishpond; the western part of the fishpond was totally overgrown. Zapletálek’s mapping (1933) captured far fewer vegetated conditions – reeds were absent mainly in the north-western and southernmost parts of the fishpond, but still covered ca. 65 ha. In total ca. 20–50 ha of reed vegetation was reported during the twentieth century. Aerial photographs from the year 2009 show reed extent to be ca. 52 ha. At the end of 2004, reed vegetation in the westernmost part of the fishpond was subdivided by a network of 10 m-wide main canals of a total length of 600 and 5 m-wide connecting canals of a total length of 750 m. The purpose of this nature management measure was to make the reeds more accessible and thus attractive for birds (AOPK, 2012).
Except for the eastern shore, the whole shoreline of Hlohovecký rybník fishpond is fringed with stable reed vegetation. According to maps, its cover decreased from ca. 19 ha in 1933 to 7 ha in 2009. The reed of Prosťední rybník fishpond undertook dynamic changes in the twentieth century as out of ca. 2 ha of reed in 1933, in the 1960s reed vegetation had expanded along the whole southern shore creating up to a 30 m-wide belt. Since the 1980s, the area of vegetation has been decreasing and in 2009 it was slightly over 2 ha. In Mlýnský rybník fishpond, the northern and western shores are fringed with a broad belt of reed vegetation, while the southern shore has only thin and discontinuous reed vegetation. Compared to 1933 (ca. 19 ha), the area of reed vegetation decreased to 8 ha in 2009.

3.4. Maps

The Main Map sheet is prepared on A1 landscape format (841 × 594 mm) and contains (i) the main topographic map of the fishponds and their neighbourhood (1:20,000 scale; geography of the area with an accent on tourist features such as marked trails, educational trail (with a list of panels), parking lot and bus and train stops), (ii) a map of the location of Lednické rybníky fishponds within the Czech Republic and in the world (1:6,500,000 and 1:340,000,000 scales) (Figure 1), (iii) a thematic map of nature conservation (1:75,000 scale; because of extensive overlap of reserve types, the map uses hatchings of a different angle and a colour for area symbols) (Figure 2), (iv) a thematic map of bird migration (1:60,000,000 scale; with migration ways of bird species, their wintering places and common time/month of departure and arrival to/from the wintering place), (v) a map of reed vegetation in the years 1933 and 2009 (1:75,000 scale) (Figure 5), (vi) a map of water levels during the summer drainage of fishponds (1:75,000 scale) (Figure 4) and (vii) six small schematic maps of the distribution of selected species within the Czech Republic. The maps are accompanied by (i) six bar graphs of the numbers of observed individuals/nesting pairs of selected species in the years 1973–2014 (average numbers coming from all the check days within a year), (ii) short text on nature conservation and selected species and (iii) illustrations of selected bird species with diagrams of the nesting time for each species. A specific colour (used for headlines, scheme of nesting, diagrams or silhouette map marker) was selected for each bird species, according to its recognition colour (Figure 5).

4. Conclusion

The paper summarises more than 40 years of bird observation in the area of Lednické rybníky ponds. These results confirm the prominent position of the study.
area within bird areas of the Czech Republic, for example, when compared to similar localities in Southern Bohemia (Macháček, Pykal, Ševčík, & Chobotská, 2008). The system of ca. 600 ha of Lednické rybníky fishponds is characterised by a higher number of observed individuals of many species (e.g. Red-crested Pochard, Northern Shoveler and Greylag Goose) when compared with the system of Třeboňské rybníky fishponds (4302 ha) or Českobudějovické rybníky fishponds (1600 ha). In agreement with general trends in the Czech Republic, the number of observed individuals of many species increased continuously until the year 1982/1983, when it rapidly and strongly decreased. This decrease is usually explained by a high intensity of fishpond management (especially carp abundance) and its changes, decrease in littoral vegetation, eutrophication or general changes in the landscape such as draining and irrigation, transformation of grassland into arable land, and changes in the landscape structure (Pykal & Janda, 1994). After this decrease, the number of birds remained steadily low and only later started to grow until now when the highest numbers are recorded in many localities. In general, during the twentieth century a few species disappeared from the Lednické rybníky fishponds, but more new species appeared in the locality with more regular and stronger occurrence. A very important influence on the number and occurrence of waterfowl has been the re-implementation of the summer drainage of the fishponds in the last decade.

However, conservation management (such as the above mentioned summer drainage of fishponds or the regulation of the number and species of stocked fishes), performed in the name of endangered species of the area, is often understood as strange, limiting and restrictive by local people (e.g. Fryšavský, 2007; Vojtek, 2007). Especially as the fishponds are more predisposed to conflicts between conservation restrictions and production management (IUCN, 1997; Macháček, 2005; Pavelka & Košfál, 2000; Přibil, Janda, & Jeník, 1990). Therefore, public education, informing about the value of the reserves are important for nature conservation management authorities of the reserves. Together with books (e.g. Macháček, 2009), brochures (e.g. Heralt & Kmet, 2015) or the educational trail along the fishponds (with 14 information panels describing the history, presence, biology and conservation needs of the area), our map is one of the contributions to this task. Intended distribution of the map includes a freely available electronic copy (PDF file format) on the website or printed wall maps placed in regional museums, tourist information points or schools and institutes of ecological education. Our map can also contribute to further development of bird watching, which is an important part of ecotourism with a potentially positive value for both the local economy and conservation needs (Sekercioglu, 2002) of the area.

Software

All maps were created and exported to PDF format using Esri ArcGIS (version 10.2), and completed (labeling and thematic content) in Adobe InDesign (version CS6). Adobe InDesign was also used for designing the final map sheet. Some adjustments of raster images were processed in Adobe Photoshop (version CS6).

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ORCID

Jan Miklín © http://orcid.org/0000-0002-0125-2539

References

AOPK. (2012). Plán péče o národní přírodní rezervaci Lednické rybníky na období 2012-2021 [Conservation management plan for National Nature Reserve Lednické rybníky fishponds for years 2012–2021]. Mikulov: Author. Retrieved August 26, 2015, from http://palava.ochranaprirody.cz/res/archive/081/012027.pdf?seek=1371224322

BirdLife International. (2004). Birds in Europe: Population estimates, trends and conservation status. Cambridge: Author.

Čapek, V. (1940). Ornitologické pozorování zjižní Moravy [Ornithological observation from South Moravia]. Ornitholog, 7, 33–36.

Čapek, V., & Hachler, E. (1948). Ornitologické pozorování zjižní Moravy [Ornithological observations from South Moravia]. Čs. ornitholog, 15, 46–48.

CEC. (1979). Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds. Retrieved August 6, 2015, from http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31979L0409:EN:HTML

CEC. (1992). Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and wild fauna and flora. Retrieved August 6, 2015, from http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31992L0043:EN:HTML

CENIA. (2008). Nature conservation: The Environment of the Czech Republic. Retrieved November 24, 2012, from...
Convention Bureau. Retrieved August 6, 2015, from http://archive.ramsar.org/pdf/lib/Matthews-history.pdf
Miklín, J. (2012). Atlas of Pálava protected landscape area. Journal of Maps, 8, 492–498. doi:10.1080/17445647.2012.749002
Miklín, J., & Hradecký, J. (2015). Confluence of the Morava and Dyje Rivers: A century of landscape changes in maps. Journal of Maps. doi:10.1080/17445647.2015.1068714
Musil, P. (1998). Změny početnosti hnízdících populací vodních ptáků na rybnících Třeboňské pánve v letech 1981–1997 [Changes in numbers of breeding populations of water birds on fishponds in the Třeboň Basin in the years 1981–1997]. Sylvia, 34, 13–26. Retrieved August 15, 2015, from www.cso.cz/wpimages/other/sylviad34_1_2Musil.pdf
Musil, P., Darolová, A., Jureček, R., Musilová, Z., Podhradský, M., & Slabeyová, K. (2008). Dlouhodobé změny početnosti zimujících hus v České republice a na Slovensku v letech 1991–2007 [The long-term trends in numbers of wintering geese in the Czech Republic and Slovakia in 1991–2007]. Tichodroma, 20, 61–67. Retrieved August 26, 2015, from http://www.tichodroma.sk/pdfs/Tichodroma_20.split/Tichodroma_20.61-67.pdf
Musil, P., & Musilová, Z. (2014). Rozšíření a početnost hoinějších druhů vodních ptáků v lednu 2004 až 2013 [Numbers and distribution of common waterbird species in January between 2004 and 2013]. Aythya, 5, 27–47. Retrieved August 26, 2015, from http://www.waterbirdmonitoring.cz/media/Aythya-5/3_commonspecies_04_13b.pdf
Musil, P., Musilová, Z., Fuchs, R. & Poláková, S. (2011). Long-term changes in numbers and distribution of wintering waterbirds in the Czech Republic, 1966–2008. Bird Study, 58, 450–460. doi:10.1080/00063657.2011.603289
Orsillo, N. P. (2012). Nature and cultural landscape protection from a historical perspective – The case of the Lednice-Valtice Cultural Landscape. XV. International Conference of Historical Geographers, Brno.
Pavelka, K., & Košťál, J. (2000). Water and wetland birds on fishponds with different carp fishstock in the Poodří floodplain, 1993–98. Sylvia, 36, 17.
Přibil, S., Janda, J., & Jeník, J. (Eds.). (1990). Ekologie a ekonomika Třeboňská po deseti letech [Ecology and economics of Třeboňsko after ten years]. Třeboň: Botanical institute of CSAV.
Pykal, J., & Janda, J. (1994). Početnost vodních ptáků na jihočeštích rybnících ve vztahu k rybničnímu hospodáření [Relation between waterfowl numbers on South Bohemia Fishponds and Fishpond Management]. Sylvia, 30, 3–11.
Quitt, E. (2009). Climatic regions. In Hrnčiarová, T., Mackovčin, P., & Zvara, I. (Eds.), Atlas krajiny České republiky [Landscape atlas of the Czech Republic] (pp. 104–105). Praha: Ministerstvo životního prostředí.
Schade, F. (1901). Ornithologische Notizen aus Mähren mit besonderen Berücksichtigung der nächsten Umbgebung Brünnns [Ornithological observations from Moravia with focus on Brno neighborhood]. Ornithologisches Jahrbuch, 12, 181–200.
Sekercioğlu, Ç. H. (2002). Impacts of birdwatching on human and avian communities. Environmental Conservation, 29, 282–289. doi:10.1017/S0376892902000206
Šumberová, K., Lososová, Z., Fabišová, M., & Horáková, V. (2006). Variability of vegetation of exposed pond bottoms in relation to management and environmental factors. Přešla, 78, 235–252.
Sychra, J., Danihelka, J., Heralt, P., Horal, D., Horsák, M., Chytíl, J.,… Roleček, J. (2008). Letníný rybníka Nesyt v roce 2007 [Summer drainage of Nesyt fishpond in 2007]. Živa, 4, 189–192. Retrieved August 2, 2015, from http://ziva.avcr.cz/files/ziva/pdf/letneni-rybnika-nesyt-v-roc2007.pdf
Vojtek, M. (2007). Největší moravský rybník přestal existo-vat [The largest Moravian fishpond pass existence]. Retrieved August 7, 2015, from http://www.novinky.cz/doma/115804-nejvetsi-moravsky-rybni-prestal-existovat.html
Zapletal, J. (1933). Květena Lednica [Flora of Lednice]. Brno: Masaryk University.
Zdobnitzky, F. (1907). Ergenbisse von Frühjahrsbeobachtungen aus dem Ungebung von Muschau [Results of the spring observations from the Muschau area]. Mitteilungen der Komission zur naturwissenschaftlichen Durchforschung Mährens, 10, 1–38.