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Activity cycle and reproductive characteristics of the European pond turtle (*Emys orbicularis*) in the Tajba National Nature Reserve, Slovakia

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Only one reproducing population of *Emys orbicularis* is known to occur in Slovakia. It lives in the Tajba reserve in the Southeast Slovak lowlands. Hibernation terminates in late March or early April. Turtles mate immidiately after overwintering. Females nest from mid-May to the end of June on meadows and abandoned vineyards south of the water body. Two clutches are produced per nesting season. The average egg number is 12.2 per clutch (range 6–16; $n = 21$). Young turtles hatch after 2.5–3 months, hibernate in the nest chambers and emerge in the next spring (mid-April to mid-May). Activity decreases quickly from late September onwards and turtles become dormant during the first December decade when the water surface gets ice-covered.

Key words: *Emys orbicularis*, natural history, activity, reproduction, Slovakia.

Introduction

The European pond turtle, *Emys orbicularis* (L., 1758) is the only native turtle species in Slovakia. Formerly, it occurred in all climatically suitable regions of the Slovak lowlands. Due to habitat degradation and landscape alterations, most wetlands have been destroyed until the mid of the 20th century. *E. orbicularis* has become the most endangered reptile in Slovakia and is now listed as only reptile species in the Slovak Red List under the category "Critically endangered" (IUCN Red List criteria; KAUTMAN et al., 2001).

Today, only one reproducing *E. orbicularis* population is known to occur in Slovakia. It lives in the Tajba National Nature Reserve near Streda nad Bodrogom. In order to save the species from extinction in Slovakia, various conservation measures have been implemented since 2000. They are part of a recovery programme, adopted by the Slovak Department of Environment. One of the most important prerequisites for any conservation measure is a detailed knowledge about natural history (IUCN, 1991; KLEMENS, 2000; TCF, 2002). As evident from the recent reviews in FRITZ (2001, 2003), there is only few information available for Slovakia. This is due to a general lack of investigations on the natural history of the pond turtle in our country. Recently, a diploma and a PhD thesis were written on the natural history of *E. orbicularis* in Slovakia (NOVOTNÝ, 2000; LEVKANIČOVÁ, 2003), and a preliminary report has

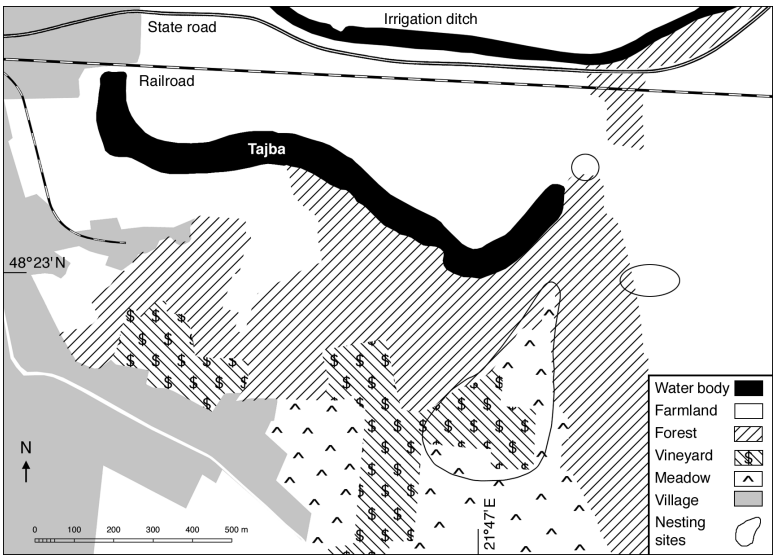

Fig. 1. The Tajba National Nature Reserve. Nesting sites are indicated.

been published (Novotný et al., 2001). In this study we present detailed information on the natural history of the European pond turtle in the southeastern Slovak lowlands and compare these data with observations from neighbouring countries.

Study area

The Tajba National Nature Reserve (48°23′ N, 21°47′ E) is situated below Roháč hill, approximately 1 km northeast of Streda nad Bodrogom village, at an altitude of about 100 m a.s.l. The protected zone covers 27.36 ha, and includes the Tajba pond and 100 m surrounding area. The reserve was established in 1966. Orographically, the area belongs to the Slánsko-Tokajské mountain range. Tajba reserve is located in a slight andesite ridge with sandy sediments. In this ridge lies a 2 km long and 100–150 m wide oxbow of the Bodrog river, the Tajba pond. The reserve is confined by a state road and a railway line in the north. Four landscape types occur (Fig. 1):

(i) The Tajba marsh. The plant communities are rather poor compared with other East Slovak lowland localities. They consist of a mosaic of Typhetum angustifoliae, Phragmitetum communis, and Salicetum cinerea (Špániková, 1985). Open water surface is confined to the western part of the water body; the rest is covered by *Stratoides aloides* and *Nuphar lutea. Typha latifolia* and *Carex* prevail during periods with low water level. Among trees dominate willows (*Salix cinerea*), forming in the water and along the banks loaf-shaped islands, and artificially planted abeles (*Populus alba*). However, abeles die from time to time during high water level periods. Deadwood is a preferred basking site of pond turtles.

(ii) The second landscape type is formed by the steep northern and northeastern slopes of Roháč hill. The slopes are covered by secondary growth of robinias (*Robinia pseudoacacia*) and pines (*Pinus silvestris*). Primary forest, dominated by common oak (*Quercus robur*), hornbeam (*Carpinus betulus*), common maple (*Acer campestre*) and small-leaved elm (*Ulmus minor*) is very rare.

(iii) Southern sandy slopes with a xerophilous flora (Festucetea vaginatae) represent the third landscape type. Characteristic species are *Gypsophila paniculata, Festuca vaginata*, and *Acosta rhenana* (Ružičková et al., 1996). Part of this area is used as vineyards.

(iv) The fourth type of landscape is the northern bank of the water body, formed by loamy soil. This area is used as farmland.

Material and methods

Data were collected from 1999–2003. Daily and seasonal activity was recorded by direct observations, controlling nesting sites, and telemetry. Binoculars were used from 18 standardized positions on the banks for direct observations. Observations were made from March to October; the greatest intensity of fieldwork took place from April to June. The nesting sites were controlled during the egg-laying period (second half of May until end of June) daily from 18.00 to 22.00 CET. Females were photographed after nesting and later re-identified by comparing the individuals and the photos. Three females were radiotracked during 2002–2003. One turtle was monitored from April 2002 to August 2002, the other two females were observed from April 2002 to July 2003. These individuals were 227 times located by telemetry.

During the observation period, temperature data were recorded daily in that digital thermometers were

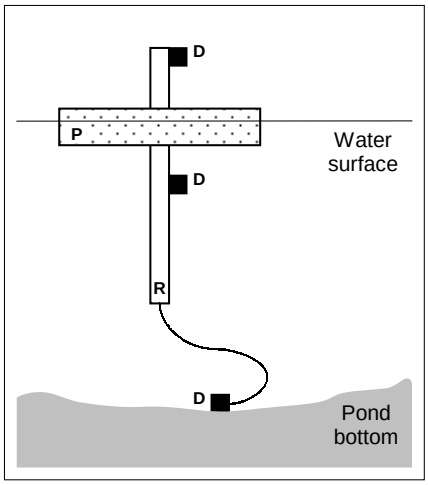

Fig. 2. Floating device with attached thermometers, used for temperature recording during the study. (D) digital thermometer; (P) polystyrene; (R) rod.

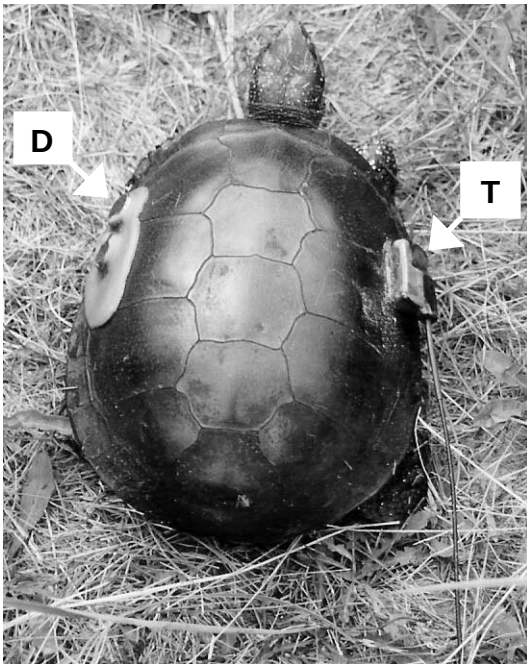

Fig. 3. *Emys orbicularis* with fixed digital thermometer (D) and transmitter (T).

fixed on the carapace of radiotracked turtles. The carapacial surface temperatures were compared with ambient temperatures. For measuring different ambient temperatures in exactly the same heights, a floating device was constructed (Fig. 2). It allowed measurements of the air temperature above the water surface in 10 cm height, and of the water temperature on the pond bottom and 10 cm below the water surface. Air temperature on the nesting sites was measured in 2 m height in one-hour intervals.

Clutch sizes were determined by direct observations of egg-laying and controlling nests. Nests were either opened after incubation (early October) or after winter, i. e. in early May of the next year.

For telemetry, equipment of the company ATS was used, consisting of a FM 100 receiver, a three-element folding Yagi antenna, and three transmitters R2030 (24 g, 14.5 cm antenna). For recording temperatures, 13 digital thermometers DS 1921 (Dallas Semiconductor) were used. Thermometers and transmitters were attached to the lateral carapace by acrylic glue (Dentacryl), allowing a minimal restriction of the turtle's movements and mating activities (Fig. 3).

Results and discussion

Post-hibernation emergence and activity

In the East Slovak lowlands, *Emys orbicularis* finishes hibernation in late March or early April. Then, the turtles leave their hibernation sites and start to move actively in the water. During the first activity days, they do not bask. The length of this phase depends on weather conditions. In 2003, the period between the first movements and the first observations of basking was exactly recorded for two individuals. For one turtle, this interval was four days (first movements: 26 March 2003; first basking: 30 March 2003), and 11 days for the other (first movements: 31 March 2003; first basking: 11 April 2003). The longer interval in the second case was caused by bad weather conditions combined with low air and water temperatures during early April. Generally, the first basking turtles were observed in early April (Tab. 1). The strikingly high number of observed turtles on 16 April 1999 is probably due to an observation gap. On 8 April 1999 no basking turtles were observed; the next observations were made on 16 April 1999.

Not all turtles finish their hibernation simultaneously. A turtle hibernating close to the north, sunny coastline in a depth of 70 cm was observed to finish its hibernation 5 days earlier than an individual which hibernated in a distance of only 80 m. However, the latter turtle overwintered near the southern, mainly shaded coastline in a depth of 1.05 m. These observations suggest that the date of the spring emergence depends not only on general weather conditions but also on micro-climatic factors and the chosen hibernation site.

In the Transcarpathian region of Ukraine, the first active turtles were observed from the

Table 1. First observations of basking turtles after hibernation in Tajba reserve.

Year	Date	Observed individuals
1999	16 April	12
2000	15 April	3
2001	3 April	2
2002	2 April	2
2003	12 April	2

Table 2. Observations of mating pond turtles in Tajba reserve.

Year	Dates
1998	1 May
1999	16 April, 30 April
2000	18 April, 4 May
2001	2 May, 4 May
2002	11 April, 16 April, 22 April, 2 June
2003	23 April, 3 May

end of March to mid-April (SHCHERBAK & SHCHERBAN', 1980). Hibernation terminates also from the end of March to the first half of April in Germany and Poland (FRITZ & GÜNTER, 1996; ZEMANEK & MITRUS, 1997). The first basking turtles in Hungary were recorded from mid-March (FARKAS, 2000) to mid-April (DELY, 1978). In the Donau-Auen national park in Austria the first basking turtles were observed during March (RÖSSLER, 2000b: Tab. 1).

Mating

When the first basking turtles were observed, also the first mating attempts were recorded. Similar observations are known from Central France where mating starts simultaneously with spring emergence (SERVAN, 1998). FRITZ & GÜNTER (1996) also describe for Germany the onset of mating activity shortly after hibernation.

We recorded a high activity of males during early April in the Tajba reserve. However, the first successful copulations were not observed before mid-April or early May. Later in May, mating activities decrease. The last copulation attempt was observed on 2 June 2002 (Tab. 2).

These data coincide with observations from adjacent countries. In Poland (ZEMANEK & MITRUS, 1997; MITRUS & ZEMANEK, 1998) and in the Transcarpathian region of Ukraine (SHCHERBAK & SHCHERBAN', 1980), mating is known to occur in late April or during the first days of May. In the Donau-Auen national park (Austria), copulations were observed from 28 April to 13 May (RÖSSLER, 1999). In Hungary, mating is said to occur in May (DELY, 1978; FARKAS, 2000).

Nesting

In the Tajba reserve, female turtles lay eggs from mid-May to the end of June (Fig. 4). Also in other Central European countries, nesting takes place at approximately the same time. In Poland, the egg-laying period usually lasts from the third decade of May to mid-June, depending on weather conditions (ZEMANEK & MITRUS, 1997; JABŁOŃSKI & JABŁOŃSKA, 1998; MITRUS & ZEMANEK, 1998, 2000; SCHNEEWEISS & JABLONSKY, 2000). Egg-laying starts somewhat later in Germany (end of May to early June: ANDREAS & PAUL, 1998; SCHNEEWEISS et al., 1998; SCHNEEWEISS & JABLONSKY, 2000) and in the Transcarpathian region of Ukraine (SHCHERBAK & SHCHERBAN', 1980). In Austria (Donau-Auen national park), turtles nest from the end of May to mid-July (RÖSSLER, 2000a, c), and in Hungary from June to the first days of July (DELY, 1978; FARKAS, 2000).

Most nests are located on meadows and uncultivated vineyeards in the south of Tajba marsh

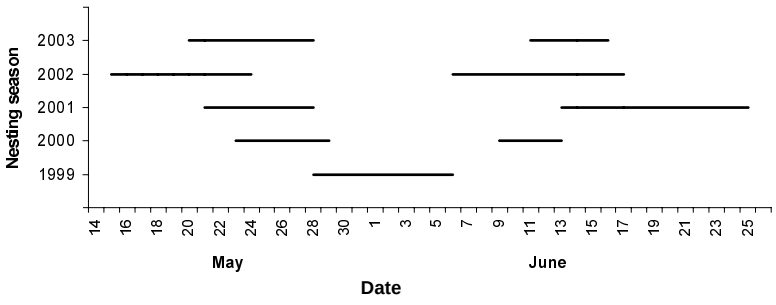

Fig. 4. Distribution of egg-laying periods of *Emys orbicularis* in Tajba reserve.

Table 3. Nest numbers during the two annual nesting periods in Tajba reserve. It is not possible to assign destroyed nests discovered after the end of the second nesting period to the first or to the second nesting period.

Year	First period	Second period	First or Second period	Total
1999	13	?	18	31
2000	24	1	26	51
2001	9	5	16	30
2002	12	11	6	29
2003	12	5	7	24

Table 4. Egg-laying dates and internesting-intervals of the same female within one year in Tajba reserve.

Year	Registration number of female	First period	Second period	Internesting-interval [days]
2001	11	23 May	19 June	27
2002	5	19 May	11 June	23
	8	23 May	15 June	23
	40	17 May	8 June	22
2003	7	25 May	12 June	18

(Fig. 1). Some nesting sites are on horizontal ground, some are on south- or east-facing slopes. The south or east exposition improves the insolation rate and thus the incubation conditions for the clutches. Similar sites are used in Germany and Poland for nesting (Mitrus & Zemanek, 1998; Schneeweiss et al., 1998; Andreas, 2000).

The main nesting sites are characterized by sandy soil covered by sparse xerothermic vegetation, mainly *Gypsophila paniculata* or *Trifolium arvense* (see Study site). We located no nests on sandy soil without vegetation cover. This is mentioned also for Lithuania and Poland by Meeske (1997a) and Jabłoński & Jabłońska (1998). In the Tajba reserve, nests are usually not built where a dense grass vegetation cover exists. Only one destroyed nest was found in loamy soil near the northern coastline. It had an untypical shape and abnormal dimensions.

During the nesting seasons 2000–2003 we recorded two nesting periods per annum. The data for 1999 are ambiguous (Fig. 4, Tab. 3). In this year, our observations terminated after the first nesting period. However, according to the considerable number of new destroyed nests ($n = 18$) found in early July, a second nesting period is also likely for 1999.

The first nesting period lasts in Tajba reserve from mid-May to early June, the second from mid-June until the end of June (Fig. 4). From 1999–2003, the first nesting female was observed on 15 May (2002) and the last one on 25 June (2001). Some individuals produced evidently two clutches in the same season (Tab. 4). The average internesting-interval of these females was 22 days (range: 18–27 days, $n = 5$). The production of a second clutch is also known from Hungary and Austria. In the Hungarian Somogy district, the first clutch is laid during June or early July, the second in late July or early August (Marián & Szabó, 1961). In the Austrian Donau-Auen national park, a second clutch is deposited after 22–27 days (Rössler, 2000a, c). Only one clutch per year is reported for the Transcarpathian region of Ukraine (Shcherbak & Shcherban', 1980), while in the Danube delta two clutches are produced (Kotenko, 2000). In more northerly regions is generally only one clutch per season deposited (Poland: Zemanek & Mitrus, 1997; Jabłoński & Jabłońska, 1998; Mitrus & Zemanek, 1998, 2000, 2001; Germany: Fritz & Günther, 1996; Schneeweiss et al., 1998); however, an anecdotal report by Drobenkov (1999) mentions for Belarus two clutches per year.

There are obvious individual differences regarding the annual clutch numbers. Some females were never observed nesting since 1999, other individuals produced 1–5 clutches from 1999–2003. The record is held by a female which laid five clutches in three subsequent years (2001–2003). Similar variation is known from the Ukrainian Danube delta, where females produce zero, one, or two clutches during three to four subsequent years (Kotenko, 2000).

Females migrate over land to their nesting sites south of the Tajba pond. Initially, they move

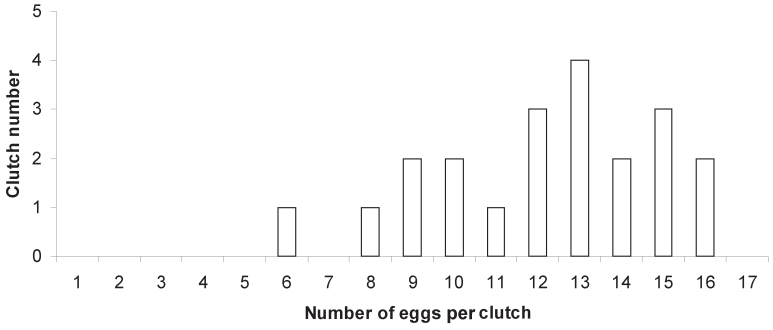

Fig. 5. Clutch sizes of *Emys orbicularis* in Tajba reserve.

in the water towards the nesting area, leaving their normal home ranges. Between 16,00 and 18,00 CET, the turtles usually leave the water. Some females stay during the night on the coastline and start on the next day to wander over land. Other individuals start to migrate to their nesting sites immediately after leaving the water. After nightfall, they stop and continue not before the next day.

Migrating turtles avoid open areas and direct sunshine. They are very attentive and shy. If disturbed, they hide by burying into the soil. The most frequently used nesting sites (95% of nests) are 200–800 m distant from the water body. Similar distances between the water bodies and nesting sites (up to 800 m) are known from Austria (RÖSSLER, 2000c). In Germany (Brandenburg), females migrate over distances of several hundred metres to 1.5 km to the nesting sites (SCHNEEWEISS et al., 1998). In Central Poland, the nesting sites are usually close to the water bodies, but somethimes they are a few hundred metres or farer away (MITRUS & ZEMANEK, 1998, 2000). The known maximum distance in Central Poland is 2 km (ZEMANEK, 1988). For East Poland, a distance of more than 4 km distance is known as record (JABŁOŃSKI & JABŁOŃSKA, 1998). For the Transcarpathian region of Ukraine, SHCHERBAK & SHCHERBAN' (1980) describe egg-laying near the coastline.

There are individual differences in the choice of nesting sites in our study area. One female deposited from 1999–2002 four clutches within a diameter of 2 m. The nesting sites of other females varied for several hundred metres even within the same year. Such distant nests were in part separated by forest (Fig. 1). Turtles appear in the nesting areas during the late afternoon or early evening. Females usually start excavating nest chambers after 18,00 CET or earlier if the weather is cold or wet. Egg deposition is normally finished until midnight. Similar observations were made in Poland. In Central Poland, turtles start to excavate nest chambers in the afternoon or evening (up to 21.00 CET; MITRUS & ZEMANEK, 2000). Egg-laying starts in East Poland after 18.00 CET and finishes around 22.00–23.00 CET; the majority of females is recorded at 20,00 CET (JABŁOŃSKI & JABŁOŃSKA, 1998). MITRUS & ZEMANEK (1998) report that nesting starts earlier during cooler weather episodes (at 16.00–17.00 CET).

We observed in our study area that females start to excavate the nesting cavity as soon as they found a suitable site. Females are very attentive and shy during the whole nesting process. The left and the right hind foot alternate during digging. Nests are roughly jug-shaped and have an overall depth of 10–12 cm. The opening of a nest is elliptically shaped. In a depth of approximately 6 cm, the nest widens into a chamber. The behaviour of nesting females was previously described by MEESKE (1997b), ZEMANEK & MITRUS (1997), JABŁOŃSKI & JABŁOŃSKA (1998), and MITRUS & ZEMANEK (2001). Their descriptions correspond to our observations in the Tajba reserve.

Directly after oviposition, females leave the nest and hide in vegetation. Normally, they start after sunrise on the next morning to migrate back to the water body. However, if nesting is still finished during daylight, they may return to the pond on the same day after a short break.

Clutches contain 6–16 eggs in the Tajba reserve, with an average of 12.2 eggs ($n = 21$; Fig. 5). The clutch sizes do not differ between the first and the second clutch (Tab. 5). Similar clutch sizes were reported from Austria (8–17, average 12.4; RÖSSLER, 2000a), while clutches contain only 4–11 eggs in Hungary (MARIÁN & SZABÓ, 1961; DELY, 1978). The average egg number of 46 clutches in the Hungarian Somogy district was only 5.7 (MARIÁN & SZABÓ, 1961). SHCHERBAK & SHCHERBAN' (1980) mention for the Transcarpathian region of Ukraine that most clutches contain 6–9, and rarely 12 eggs. Clutches contain

Table 5. Clutch sizes in Tajba reserve.

Year	First clutch			Second clutch			Total		
	Range	Average	n	Range	Average	n	Range	Average	n
1999	9–13	11.4	5	–	–	–	9–13	11.4	5
2000	15	15	1	–	–	–	15	15	1
2001	8–15	10.7	3	6–12	9.3	3	6–15	10	6
2002	14–16	15	2	11–16	13.4	7	11–16	13.8	9
Total	8–16	12.2	11	6–16	12.2	10	6–16	12.2	21

Table 6. Incubation periods in Tajba reserve.

Oviposition date	Hatching date	Incubation time [days]
12 June 2003	25 August 2003	74
13 June 2003	10 September 2003	89
14 June 2003	3 September 2003	81
14 June 2003	10 September 2003	88

more eggs in Poland (9–19, average 15 in East Poland; JABŁOŃSKI & JABŁOŃSKA, 1998). The largest known Polish clutch had 23 eggs (MITRUS & ZEMANEK, 2000).

Incubation, hatching and hatchling emergence
In 2003 the incubation periods of four clutches were exactly recorded (Tab. 6). All studied clutches originated from the second nesting period. Our data (74–89 days) correspond to observations from the Transcarpathian region of Ukraine (2.5–3 months; SHCHERBAK & SHCHERBAN', 1980). However, these incubation periods are shorter than in Austria (90–117 days; RÖSSLER, 2000a, c) and Poland (85–113 days; MITRUS & ZEMANEK, 2000). We did not record incubation temperatures but LEVKANIČOVÁ (2003) reports for the Tajba reserve an average incubation temperature of 20.8 °C (2001: 19.8–22.3 °C; $n = 1$) and 23.4 °C (2003: 21.5–26 °C; $n = 5$), without mentioning the recording and incubation times.

The hatchlings overwinter in our study area in the nest chambers and leave the nests in the next spring. An autumn emergence of hatchlings has never been recorded. SHCHERBAK (1998) reports similar observations for Ukraine; however, KOTENKO (2000) observed surfacing hatchlings from August to November. In Poland, hatchlings may leave the nests in late summer or autumn during warm years, while they overwinter in the nesting chambers in years with cooler summers (ZEMANEK & MITRUS, 1997; MITRUS & ZEMANEK, 1998, 2000, 2001). In Austria, most hatchlings emerge in September (RÖSSLER, 1999).

Spring emergence of hatchlings depends on temperature. In Tajba reserve, hatchlings are normally found from mid-April to mid-May. In spring 2003, hatchlings from seven monitored nests emerged within two days (16–17 April). After surfacing, the hatchlings migrate in different directions, searching for water. Often, they wander in wrong directions, and many hatchlings die in the sandy meadows, vineyards, or on the state road. This hatchling dispersal represents perhaps a colonization strategy for new water bodies. We recorded migrating hatchlings between 28 April and 25 May. The highest number of migrating hatchlings was recorded during early May.

Hibernation
During September, the activity of turtles decreases quickly. They leave the water then only rarely for basking. The last basking individuals were observed on 26 and 29 September 2002. As long as the water surface is not frozen, turtles are still surfacing for air and move in different water depths with temperatures over 5 °C. Our radiotracked females started in 2002 to hibernate on 8 December when entering a 1 °C cold water layer. During hibernation the females stayed at the same site. Turtles became dormant when the water surface got ice-covered. Perhaps this was not directly related to the dropped temperatures but to the blocked access to atmospheric air.

In Poland, overwintering starts normally in late August or early September. Sporadically, turtles are observed until early November (MITRUS & ZEMANEK, 2001). In the Transcarpathian region of Ukraine, turtles start hibernation in late September or during October (SHCHERBAK & SHCHERBAN', 1980) and somewhat later in Hungary (end of October to first half of November; DELY, 1978). Other data reporting a much earlier hibernation start were likely obtained by visual observations of the last basking or active individuals and do probably not represent the true onset of overwintering.

Adult turtles hibernate on the bottom of the Tajba pond. Terrestrial hibernation, as mentioned by DELY (1978), FRITZ & GÜNTHER (1996) and PUPIŃA & PUPIŃŚ (1996), was never observed. Our radiotracked turtles overwintered not in open water but in *Salix cinerea* thickets. A female was found in a water depth of 0.5 m on the bottom among willow roots when the water was ice-covered. This observation contradicts many reports from different countries that turtles bury into the mud during hibernation (e. g. LÁC, 1968; DELY, 1978; MEESKE, 2000; MITRUS & ZEMANEK, 2001; KUZMIN, 2002).

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References

ANDREAS, B. 2000. Reproductive ecology and conservation of *Emys orbicularis* in Brandenburg (NE-Germany). In: Proceedings of the 2nd International Symposium on *Emys orbicularis,* Chelonii **2**.

ANDREAS, B. & PAUL, R. 1998. Clutch size and structure of breeding chambers of *Emys o. orbicularis* in Brandenburg, pp. 29–32. In: FRITZ, U., JOGER, U., PODLOUCKY, R. & SERVAN, J. (eds) Proceedings of the EMYS Symposium Dresden 96, Mertensiella **10**.

DELY, O. G. 1978. Hüllők – Reptilia, pp. 1–120. In: Magyarország Állatvilága (Fauna Hungariae), No. 130, Akadémiai Kiadó, Budapest.

DROBENKOV, S. M. 1999. Characteristic features of the pond turtle (*Emys orbicularis*) ecology and morphology in the north of the range area, p. 10. In: Abstracts, 2nd International Symposium on *Emys orbicularis*, 25–26–27 June 1999, Le Blanc.

FARKAS, B. 2000. The European pond turtle *Emys orbicularis* (L.) in Hungary, pp. 127–132. In: HÖDL, W. & RÖSSLER, M. (eds) Die Europäische Sumpfschildkröte, Stapfia **69**.

FRITZ, U. 2001. *Emys orbicularis* (Linnaeus, 1758) – Europäische Sumpfschildkröte, pp. 343–515. In: FRITZ, U. (ed.) Handbuch der Reptilien und Amphibien Europas, Band 3/IIIA: Schildkröten I, Aula, Wiebelsheim.

FRITZ, U. 2003. Die Europäische Sumpfschildkröte. Laurenti, Bielefeld, 224 pp.

FRITZ, U. & GÜNTHER, R. 1996. Europäische Sumpfschildkröte – *Emys orbicularis* (Linnaeus, 1758), pp. 518–534. In: GÜNTHER, R. (ed.) Die Amphibien und Reptilien Deutschlands, G. Fischer, Jena.

IUCN [International Union for Conservation of Nature and Natural Sources]. 1991. Tortoises and Freshwater Turtles – an Action Plan for their Conservation. IUCN Species Survival Commision, Tortoise and Freshwater Turtles Specialist Group, Gland, 2nd edition, 48 pp.

JABŁOŃSKI, A. & JABŁOŃSKA, S. 1998. Egg-laying in the European pond turtle, *Emys orbicularis* (L.), in Łęczyńsko-Włodawskie Lake District (East Poland), pp. 141–146. In: FRITZ, U., JOGER, U., PODLOUCKY, R. & SERVAN, J. (eds) Proceedings of the EMYS Symposium Dresden 96, Mertensiella **10**.

KAUTMAN, J., BARTÍK, I. & URBAN, P. 2001. Červený (Ekosozologický) zoznam plazov (Reptilia) Slovenska [Red (Ecosozological) list of reptiles (Reptilia) of Slovakia], pp. 148–149. In: BALÁŽ, D., MARHOLD, K. & URBAN, P. (eds) Červený zoznam rastlín a živočíchov Slovenska [Red List of Plants and Animals of Slovakia], Ochrana prírody **20** (Suppl.).

KLEMENS, M. W. (ed.) 2000. Turtle Conservation. Smithsonian Institution Press, Washington, D. C., 344 pp.

KOTENKO, T. 2000. The European pond turtle (*Emys orbicularis*) in the steppe zone of the Ukraine, pp. 87–106. In: HÖDL, W. & RÖSSLER, M. (eds) Die Europäische Sumpfschildkröte, Stapfia **69**.

KUZMIN, S. L. 2002. The Turtles of Russia and Other Ex-Soviet Republics. Chimaira, Frankfurt am Main, 159 pp.

LÁC, J. 1968. Plazy – Reptilia, pp. 313–366. In: OLIVA, O., HRABĚ, S. & LÁC, J. (eds) Stavovce Slovenska I – Ryby, obojživelníky a plazy [Vertebrates of Slovakia I – Fishes, Amphibians and Reptiles], Slovak Academy of Sciences, Bratislava.

LEVKANIČOVÁ, Z. 2003. Problematika rozmnožovania korytnačky močiarnej (*Emys orbicularis* L., 1758) v klimatických podmienkach Východoslovenskej nížiny [Aspects of reproduction of the European pond turtle (*Emys orbicularis* L., 1758) under the

climatic conditions of the East Slovak lowlands]. Diploma Thesis. PF UPJŠ, Košice, 64 pp.

Marián, M. & Szabó, I. 1961. Adatok a mocsári teknős (*Emys orbicularis* L.) szaporodásbiológiájához [Data on the reproductive biology of the European pond turtle (*Emys orbicularis* L.)]. Állatt. Közl. **48**: 85–90.

Meeske, M. 1997a. Nesting ecology of European pond turtle (*Emys orbicularis*) in South Lithuania. Acta. Zool. Lithuanica, Biodiversity **7**: 138–142.

Meeske, M. 1997b. Nesting behaviour of European pond turtle (*Emys orbicularis*) in South Lithuania. Acta. Zool. Lithuanica, Biodiversity **7**: 143–150.

Meeske, M. 2000. Habitat requirements of the European pond turtle (*Emys orbicularis*) in Lithuania, pp. 27–32. In: Proceedings of the 2nd International Symposium on *Emys orbicularis*, Chelonii **2**.

Mitrus, S. & Zemanek, M. 1998. Reproduction of *Emys orbicularis* (L.) in Central Poland, pp. 187–191. In: Fritz, U., Joger, U., Podloucky, R. & Servan, J. (eds) Proceedings of the EMYS Symposium Dresden 96, Mertensiella **10**.

Mitrus, S. & Zemanek, M. 2000. Distribution and biology of *Emys orbicularis* (L.) in Poland, pp. 107–118. In: Hödl, W. & Rössler, M. (eds) Die Europäische Sumpfschildkröte, Stapfia **69**.

Mitrus, S. & Zemanek, M. 2001. Biologia rozrodu [Reproductive biology], pp. 50–56. In: Najbar, B. (ed.) Żółw błotny [European pond turtle], Lubuski Klub Przyrodników, Świebodzin.

Novotný, M. 2000. Sledovanie sezónnej aktivity korytnačky močiarnej [Observation of seasonal activity of the European pond turtle]. PhD Thesis. PF UPJŠ, Košice, 29 pp.

Novotný, M., Danko, S. & Havaš, P. 2001. Rozmnožovanie a ochrana korytnačky močiarnej (*Emys orbicularis*) v Národnej prírodnej rezervácii Tajba [Reproduction and protection of the European pond turtle (*Emys orbicularis*) in the Tajba Nature Reserve]. Terarista **5**: 25–31.

Pupiña, A. & Pupiňš, M. 1996. Żółw błotny (*Emys orbicularis* L.) na Łotwie [The European pond turtle (*Emys orbicularis* L.) in Latvia]. Proc., IV Ogólnopolska Konferencia Herpetologiczna, Kraków, 3 pp.

Rössler, M. 1999. Populationsökologische Untersuchung von *Emys orbicularis* (Linnaeus, 1758) in den österreichischen Donau-Auen. Faunist. Abh. Mus. Tierkd. Dresden **21**: 283–304.

Rössler, M. 2000a. Die Fortpflanzung der Europäischen Sumpfschildkröte *Emys orbicularis* (L.) im Nationalpark Donau-Auen (Niederösterreich), pp. 145–156. In: Hödl, W. & Rössler, M. (eds) Die Europäische Sumpfschildkröte, Stapfia **69**.

Rössler, M. 2000b. Der Lebensraum der Europäischen Sumpfschildkröte *Emys orbicularis* (L.) in den niederösterreichischen Donau-Auen, pp. 157–167. In: Hödl, W. & Rössler, M. (eds) Die Europäische Sumpfschildkröte, Stapfia **69**.

Rössler, M. 2000c. The ecology and reproduction of an *Emys orbicularis* population in Austria, pp. 69–72. In: Proceedings of the 2nd International Symposium on *Emys orbicularis,* Chelonii **2**.

Ružičková, H., Halada, Ľ., Jedlička, L. & Kalivodová, E. (eds) 1996. Biotopy Slovenska [Biotopes of Slovakia]. Ústav krajinnej ekológie SAV, Bratislava, 192 pp.

Schneeweiss, N., Andreas, B. & Jendretzke, N. 1998. Reproductive ecology data of the European pond turtle (*Emys o. orbicularis*) in Brandenburg, Northeast Germany, pp. 227–234. In: Fritz, U., Joger, U., Podloucky, R. & Servan, J. (eds) Proceedings of the EMYS Symposium Dresden 96, Mertensiella **10**.

Schneeweiss, N. & Jablonsky, A. 2000. The reproduction of *Emys orbicularis* in relation to climatic factors in northeast Germany and eastern Poland, pp. 83–85. In: Proceedings of the 2nd International Symposium on *Emys orbicularis,* Chelonii **2**.

Servan, J. 1998. Ecological study of *Emys orbicularis* in Brenne (Central France), pp. 245–252. In: Fritz, U., Joger, U., Podloucky, R. & Servan, J. (eds) Proceedings of the EMYS Symposium Dresden 96, Mertensiella **10**.

Shcherbak [Szczerbak], N. N. 1998. The European pond turtle (*Emys orbicularis*) in Ukraine, pp. 259–266. In: Fritz, U., Joger, U., Podloucky, R. & Servan, J. (eds) Proceedings of the EMYS Symposium Dresden 96, Mertensiella **10**.

Shcherbak, N. N. & Shcherban', M. I. 1980. Zemnovodnye i presmykayushchiesya Ukrainskykh Karpat [Amphibians and Reptiles of the Ukrainian Carpathians]. Naukova dumka, Kiev, 268 pp.

Špániková, A. (ed.). 1985. Vegetačné pomery južnej časti Východoslovenskej nížiny [Vegetational conditions of the south part of the East Slovak lowlands]. Acta Botanica Slovaca Series A **8**, 189 pp.

TCF [Turtle Conservation Fund]. 2002. A Global Action Plan for Conservation of Tortoises and Freshwater Turtles – Strategy and Funding Prospects 2002–2007. Conservation International and Chelonian Research Foundation, Washington, 30 pp.

Zemanek, M. 1988. Składanie jaj przez żółwie błotne, *Emys orbicularis* (L.), w Polsce Środkowej w warunkach naturalnych [Egg deposition of the European pond turtle, *Emys orbicularis* (L.), under natural conditions in Central Poland]. Przegl. Zool. **32**: 405–417.

Zemanek, M. & Mitrus, S. 1997. Biologia i ochrona żółwia błotnego *Emys orbicularis* w województwie radomskim [Biology and conservation of the European pond turtle *Emys orbicularis* in Radom district]. Chrońmy Przyr. Ojcz. **53**: 67–83.