Lithuanian Fund for Nature

Project LIFE05NAT/LT/000094 "Protection of European pond turtle and threatened amphibians in the North European lowlands"

ACTION A.5: EVALUATION OF THE CHARACTERISTICS AND STRUCTURE OF EUROPEAN POND TURTLE HIBERNATION SITES

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1 Content

2 Introduction

The northern edge of the species distribution of the European pond turtle (*Emys orbicularis*) is situated in the three project countries Lithuania, Poland and Germany (Fritz 1995, 1996, Fritz & Günther 1996). In the north european lowlands the subspecies *Emys orbicularis orbicularis* occurs. Due to the lack of knowledge on the requirements of favourable hibernation sites and the survival rate of turtles during hibernation in the northern areas, investigation on hibernation sites and their conditions and structures were led in all three project countries. In literature on the subject, some cases of turtles hibernating on land are described (Palm 1974, Fritz & Günther 1996), but usually turtles hibernate in water bodies. The concentration of turtles at specific sites shows that only a small number of areas fulfil the specific hibernation condition of *Emys orbicularis* (Schneeweiss & Steinhauer 1998, Schneeweiss 2003, Meeske 2000a, b, 2006). Initial observations indicate that oxygen supply and temperature determine the suitability of hibernation sites (Schneeweiss 2003).

Generally, the methods for identifying the hibernation places were telemetry, captures and also observations of pond turtles in late autumn (before hibernation) and in early spring (just after coming out of hibernation). Additionally, data about the characteristics and structure of hibernation sites were collected at some hibernation sites. As a result of the varied intensity of studies and the different situation of turtle populations including difficulties of animal observations and registrations in all project areas, the results of the partners are varying. Due to the fact that the turtles have similar climatic and ecological conditions as well as ecological requirements in all project areas, all different types of results from the partners are presented in this report for comparison with areas where such results are still lacking.

The evaluation of hibernation sites for *Emys orbicularis* based on our data leads to an improvement in knowledge on the habitat requirements of turtles throughout the year. This knowledge will be taken into consideration and defined for a suitable pond management regime; e.g. more hibernation places for local populations can be secured by giving some of the characteristics of hibernation sites to new or restored ponds.

Finally, a good basis of knowledge about the requirements for hibernation sites is useful for creating adequate local management and action plans for *Emys orbicularis*. With both plans a good habitat management can be guaranteed in

turtle areas which improves the chances of survival of such populations.

3 Methods and Results

3.1 Lithuania

3.1.1 Methods Lithuania

Turtles of different sex and age were captured by hand and with the help of traps baited with beef or pig heart (method by SERVAN 1986) (fig. 13+14). Lithuanian animals were located between early spring and autumn using visual searching, capturing and radio tracking. During late autumn and winter the animals were localised only by radiotracking. The radiotracking equipment consisted of a receiver (Yupiteru MVT-9000MK II) combined with a hand operated unidirectional antenna and transmitters (weight: 8-10 g, durability (batteries inside): 1 year).

Fig. 1: Adult male (up) and adult female (down) of *Emys orbicularis* fitted with transmitter before releasing

In 2008 and 2009 transmitters were glued on the carapace of a total of 22 adults (8 males, 13 females; Petroškai & Klepočiai: 3 males, 7 females; Juodabalė: 2 males, 2 females; Kučiuliškė: 1 male, 1 female; Stračiūnai: 1 female, Bestraigiškė: 2 males, 2 females) (fig. 1+2). Two radiotracking methods were applied during the study. In ponds triangulation was employed and for direct migration observation e.g. during migration on land walking in the direction indicated by the antenna (Homing-in-on the-Animal) (WHITE & GARROTT 1990) was conducted. Turtles with transmitters were checked daily until the end of September to find out preferred places for overwintering in the areas Juodabalė, Kučiuliškė and Bestraigiškė. In Klepočiai and Petroškai animals were regularly located every week. Between October and April all animals were located once per month (fig. 4).

Fig. 2: Release of adult female of *Emys orbicularis* with transmitter in restored project pond in Kučiuliškė Herpetological Reserve L05

3.1.2 Results Lithuania

3.1.2.1 Veisiejai Regional Park/ Petroškai L03

Klepočiai and Petroškai

In both areas 7 different hibernation places were found with the help of radiotracking. The telemetry pointed out, that six turtles spent the whole active period in the same ponds where they were caught in summer. However, four turtles showed more activities and moved between places and ponds. Three females moved 500 - 800 m to the south, towards their hibernation places. One female moved 800 m from pond 11 to the east and was located in the end of July in the lake of Sikinizeris (summer pond). In September this female was found again in pond 11, where she hibernated.

In late autumn all turtles were located near the pond shores under roots of trees. All places have a thick peat layer (tab. 1).

Tab. 1: Description of hibernation sites of *Emys orbicularis* in Klepočiai and Petroškai L03

Hibernation site	**Radiotracked turtles**	**Descriptions of hibernation sites**	**ph**	**Water temp.***
A	1 adult male 1 adult female	Site A belongs to a marsh in 37 forest quartal, 1,5 ha area with stumps and black alders; permanent water but water level decreases in dry autumn; aquatic vegetation: less kingcups, sedges, in summer covered by pondweeds	6.8	7.5 °C
B	2 adult females	To the north east of marsh A behind 400 m is a highmoor with *Shagnum magellanicum* and small water channels; overgrown by pines	6.5	8 °C
C	1 adult female	To the north site from marsh A there are a lot of small marshes with thick peat layer, where turtles hibernate.	6.5	8 °C
D	1 adult female	natural temporary pond (10 x 30 m, near pond no. 3) which dries up in the middle of summer; aquatic vegetation: sedges, kingcups, pondweeds; shore: overgrown with shrubs and trees	-	-
E	1 adult female	Pond No. 11 is a bog (1 ha) with a new small (10 x 30 m) dug pond in the south of bog during LIFE project; water remains until September; aquatic vegetation: not abundant, only sedges in the shore	6.4	7.5 °C
F	1 adult male 1 adult female	Pond No. 1. is a channel (20 x 300 m), which was dug in a bog 40 years ago; aquatic vegetation: sedges, kingcups and pondweeds; shore: trees and bushes	6.5	7 °C
H	1 adult male	Natural pond (0,2 ha), north part of the pond was deepened and scrubs were cut during LIFE project;	-	-

		southern shore: overgrown by willows; aquatic vegetation: lot of pondweeds; water depth in autumn: 10 cm		

* measured in February 2008

The deciduous forest in this area is dominated by a mix of spruces (*Picea abies*) and very dense undergrowth**.** 20 hectares of the forest were cut 16-21 years ago. Currently, a young dense deciduous forest grows there. A complex consisting of small water bodies (distances of about 50-100 m) within a raised bog and fragments of a marsh in lower parts lies in the forest. The marsh is flooded whole year round by rivulets from surroundings hills and melted snow in spring. A main hibernation site lies in this forest (fig. 3). This is the biggest marsh (1,5 ha) in this area. After hibernation up to 15 animals can be observed together in a small place In early spring. This indicates the concentration of many individulals for hibernation in the same place of the bigger pond. During spring and early summer turtles spread upon different summer ponds e.g. no. 3, 4, 5, 7, 8, 9 and 10 in the north. In the second part of the summer or in early autumn they move back to the forest/near to their hibernation site.

In the last year forest was cut again. Fewer trees lead to an increasing water level and pond sizes.

Fig. 3: Main hibernation site of *Emys orbicularis* in the forest in Petroškai L03

Fig. 4: Checking of turtles of *Emys orbicularis* with transmitters during hibernation period in Petroškai L03

3.1.2.2 Meteliai Regional Park L04

Juodabalė and Didyjis

Fig. 5: Summerly view of the hibernation site of *Emys orbicularis* in the restored pond complex in Juodabalė Herpetological Reserve L04

Concerning the first investigation results at least 3 hibernation places are known in the Meteliai Regional Park. More places are assumed. In 1999 the dried out turtle habitat in the **Juodabalė Herpetological Reserve** was restored and 7 interconnected water bodies were dug at the edge of the high moor. Meadows and pine forests are located next to the ponds. The mesotrophic ponds are sunny, muddy and highly structured with aquatic and shore vegetation. The shores are partly flat and partly steep. In 2008 radiotracking investigations showed, that turtles (1 female and 1 male) of this pond complex hibernate at the western shore of the high moor/ pond complex in a sunny, muddy and very shallow part between reed (*Phragmites australis*) and other abundant aquatic vegetation [seasonal flooded grassland, pondweed (*Potamogeton* spp.), cattail (*Typha latifolia*) and other aquatic plants] (fig. 5). Since July the radiotracked female and the male moved already more or less around their hibernation place. Consequently, the whole western shore part can be defined as pre-hibernation place. The transmitter of the second female in the pond complex was broken in the end of July and unfortunately, her hibernation place is unknown. During “her last radiotracking days” she was located several times close to the hibernation place of the other female and the male at the western shore of the high moor/ pond complex. Probably, this female hibernates at the same place like the other two animals. In autumn 2009 the female and the male could be localized in the same hibernation site like in 2008. This means, that both animals searched for the same hibernation site in at least two consecutive years and show hibernation site fidelity.

Fig. 6: Hibernation site of *Emys orbicularis* in the flooded southern part of a swamp in Meteliai Regional Park L04

The second radiotracked male of this pond complex stayed there only during summer and migrated to a swamp several hundred meters far away from the pond complex in the beginning of August. The swamp is situated between meadows. During the project new ponds were dug. The male hibernates in the flooded southern part of the swamp in a sunny, shallow part with abundant sedge tufts (*Carex* spp.) and overgrowth of young willows (*Salix* spp.) (fig. 6). A low water level is known in autumn, but in dry winters these flooded parts can dry up. In autumn 2009 this male could be located in the same place in this swamp. Consequently, it uses the same hibernation sites in at least two consecutive years and shows hibernation site fidelity.

At least one other hibernation place must be in **Didyjis**. Two juveniles were captured in the end of August 2006 and it is assumable that both hibernate in the same pond. The deep and less sunny pond (pond size. 100-200 m^2) with abundant shore vegetation (*Typha latifolia*) lies at the edge of a high moor/quaking bog consisting of Sphagnum (*Sphagnum magellanicum*) (fig. 7). Its shore is intensely overgrown by trees e.g. alder (*Alnus* spp.) and birch (*Betula* spp.), while the water surface is quite “clean”.

Fig. 7: Presumed hibernation pond of *Emys orbicularis* in Didyjis L04

3.1.2.3 Kučiuliškė Herpetological Reserve L05

Since 1997 different types of investigations were led in this area. Pond turtles were located by telemetry, captures and observations throughout the year. First radiotracking studies and captures showed that the turtles of this local population concentrate together in small places during hibernation. In the reserve two main hibernation sites in the biggest ponds of the area are known. Captured animals were found in the muddy ground. In the end of September animals stayed in a depth of 20-30 cm in the mud, while in October individuals could be located in a depth of 30-70 cm. Turtles inhabiting pond complex A hibernate in pond A [noticed animals: 5 (1997), 10 (1998), 2 (1999), 5 (2000), 9 (2001), 1 (2004), 1 (2008)]. Pond A is the biggest pond in the area (pond size including flooded parts around: 5000 m^2, pond depth: up to 2 m), located at the edge of a high moor surrounded by a pine forest (afforestation 80 year ago) and extensively used meadows. The pond was originally formed at the edge of a high moor by cutting peat long time ago. It is a mesotrophic pond with abundant aquatic vegetation, sunny and shaded parts as well as deeper and shallow parts. After restoration (filling up of a drainage channel, cutting of

birches) the pond is distinctly enlarged due to lots of flooded parts in the high moor and the connection between pond A and the flooded parts. The hibernation site in pond A is located in the southern corner of the pond (fig. 8). It is a more shallow and shaded part around the roots of bushes and trees [alder (*Alnus* spp.), birch (*Betula* spp.)] as well as with a lot of deadwood and foliage on the mud. Turtles could be found hibernating there even when the part was nearly dried out. Usually a current flow could be noticed at the place. In August and the beginning of September several animals could be already localized nearby the hibernation site (20 m far away). Such places are defined as pre-hibernation site.

Fig. 8: Hibernation site (right side) of *Emys orbicularis* in the non-seasonal pond A in Kučiuliškė Herpetological Reserve L05

Animals living in pond complex G overwinter in pond G [noticed animals: 2 (1999), 5 (2000), 1 (2007), 1 (2008)]. Pond G is the second largest (pond size: 2000 m^2) and the deepest pond in the reserve (pond depth: up to 3 m) which is oligotrophic and situated within a quaking bog consisting of sphagnum (*Sphagnum magellanicum* and other *Sphagnum* spp.), common sundew (*Drosera rotundifolia*) and European cranberry (*Vaccinium oxycoccus*) inside the pine forest. Pond G is sunny and the aquatic vegetation is dominated by

water-lilys (*Nuphar lutea* and *Nymphaea alba*). The quagmire is overgrown by young downy birches (*Betula pubescens*) and pines (*Pinus sylvestris*).

The situation of the pre-hibernation and hibernation place in pond G is very similar to the situation in pond A. The hibernating individuals concentrate before hibernation in the south-eastern corner within the pond. However, the real hibernation site of this pond lies more than 20 m from the eastern pond shore inside/below the quaking bog (fig. 9). Turtles hibernating there, concentrate in a more open place/ under and in channels inside the quagmire. An underground well could be the reason for this “channel-building” within the quaking bog.

Fig. 9: Hibernation site (behind opposite shore) of *Emys orbicularis* in the non-seasonal pond G in Kučiuliškė Herpetological Reserve L05

A third hibernation site was recognized in the smaller permanent pond C (pond size: 800 m^2, pond depth: up to 2 m), where at least one adult female hibernates (fig. 10). The mesotrophic pond is situated between meadows and lies close to a road and a pine forest. Pond C is herbaceous and has smaller sunny and bigger shaded parts. The sunny parts are covered by duckweed (*Spirodela polyrhiza*), cattail (*Typha latifolia*) and other aquatic plants. Most of the parts of the shore of the sunny parts are overgrown by trees [willow (*Salix* spp.), alder (*Alnus* spp., birch (*Betula* spp.), etc.]. The shaded parts are

completely dominated by trees [willow (*Salix* spp.), alder (*Alnus* spp., birch (*Betula* spp.), etc.]. Between the permanent parts of the ponds, some temporarily flooded parts with sedge tufts (*Carex* spp.) exist. Most of the turtles use this pond only as summer pond, but this female was found at the south-western shore of the pond next to the roots of the trees at the shore in late autumn.

Fig. 10: Permanent pond C in Kučiuliškė Herpetological Reserve L05 which is used for hibernation (under trees of opposite shore) by a female of *Emys orbicularis*

3.1.2.3 Stračiūnai Herpetological Reserve L06

No turtles were noticed inside the reserve, but during the last years individuals were observed and captured about 500 m north of the reserve in a permanent pond (pond size: 5000 m^2) (fig. 11). First observation results showed the importance of this non-seasonal pond for the population in Stračiūnai. This pond is a mesotrophic high moor pond with muddy ground next to a quaking bog consisting of sphagnum (shagnum) and divided into several different water bodies. The pond is big enough and has a lot of different structures [(flat and

deeper) shores, depths (shallow and deeper parts), sunny and more shaded parts, variation in vegetation density and composition [big parts with cattail (*Typha latifolia*), horsetails (*Equisetum* spp., etc.) and overgrown shores with different trees [willow (*Salix* spp.), alder (*Alnus* spp.), birch (*Betula* spp.), etc.] which gives a good suitability for the changing requirements of *Emys orbicularis* throughout the year. At least one hibernation sites inside this pond could be determined, but exact localization was impossible because of the highmoor. Due to the insufficient protection for the population in Stračiūnai, the Lithuanian Fund for Nature applied for the enlargement of the herpetological reserve this year including this “turtle pond”.

Fig. 11: Hibernation site (left side) of *Emys orbicularis* in the permanent pond in Stračiūnai Herpetological Reserve L06

3.1.2.4 Bestraigiškė forest district

In this area one bigger permanent pond (pond size: 2000 m^2) is known which is inhabited by turtles all-season (fig. 12). The mesotrophic pond inside the hilly forest is sunny, has a lot of shore vegetation with cattail (*Typha latifolia*) and reed (*Phragmites australis*), a muddy ground and a steeper shore. Some parts

of the shore show a big overgrowth by willows (*Salix* spp.). The dominant aquatic vegetation is the water-lily (*Nymphea alba*). The pond provides suitable basking sites with its muddy shore with lush cattail, muddy islands and dead wood. Due to the fact that turtles live in the pond throughout the year, turtles hibernate there, too. While the turtles use the whole pond during active season, they stay close together in a shallow and highly structured part with sedge tufts (*Carex* spp.) of the north-eastern shore for hibernation. The hibernation place is sunny and has also an intense overgrowth by young willows. Several weeks before the animals appeared at the real hibernation place, they moved already along the whole north-eastern shore which has the function as pre-hibernation site.

Fig. 12: View to the hibernation site of *Emys orbicularis* at the north-eastern shore (opposite shore) of the non-seasonal pond in the forest of Bestraigiškė L07

3.1.2.6 Summary for Lithuanian areas

- 7 hibernation sites in 5 permanent and 2 temporary water bodies e.g. 3 sites belong to 1 big alder forest swamp in the areas of Klepočiai and Petroškai L03 in the Veisiejai Regional Park (fig. 3)
- 3 hibernation sites in 2 different permanent ponds near/at the edge of a highmoor/quaking bog (fig. 5+6) and 1 in a flooded swamp (fig. 7) in the Meteliai Regional Park L04
- 3 hibernation sites in 2 different permanent ponds (fig. 8+10) and 1 in a highmoor/quaking bog close to a highmoor pond (fig. 9) in the Kučiuliškė Herpetological Reserve L05
- 1 hibernation site in 1 permanent pond near a highmoor/quaking bog in the Stračiūnai Herpetological Reserve L06 (fig. 11)
- 1 hibernation site in 1 permanent forest pond in the Bestraigiškė Forest District L07 (fig. 12)

3.2 Poland

3.2.1 Methods Poland

Fig. 13-14: Methods of capture of *Emys orbicularis* in Western Poland [baited trap (fig. 13), capture by hand (fig. 14)]

Fig. 15: Catching of *Emys orbicularis* in Zachodnie Pojezierze Krzywińskie Pk05

Turtles were captured by hand and with the help of traps baited with beef or pig heart (method by SERVAN 1986) (fig. 13-15). The methods for identifying the hibernation places were telemetry and also spotting pond turtles before hibernation and/or just after coming out of hibernation.

In different project years single turtles were fitted with transmitters glued on their carapaces (fig. 16). The durability of turtle transmitters (batteries inside) was one year. Turtles were regularly located by radiotracking (equipment: receiver (Yupiteru MVT-9000MK II and hand operated unidirectional antenna).

3.2.2 Results Bialowieza

One female turtle was captured in June 2006 on the dry land and fitted with a transmitter. This animal spent all summer and September in a large beaver flooding created on the small stream, which was situated on the border of the open land and the forest (alder forest). In September 2006 there was no more a signal of the transmitter and thus we don’t know where this female hibernated. Furthermore, no turtle observations and captures were possible between 2007 and 2009 and hibernations sites in Bialowieza are still unkown.

3.2.3 Results Western Poland

3.2.3.1 Brzezno Pk01

In this area one female was caught in May 2009 19 km far away from Brzezno on the public road (not in LIFE project). She was released close to the new project pond Brzezno no. 3 (see map). In winter 2009/2010 she hibernates in a swamp 50 m far away from the pond no. 3. This area is a more or less overgrown part of the old Brzezno lake and not accessible. Thus, data were collected from the distance: water level: 1-3 m, mud level - more than 1,5 m, dominant vegetation on the edge of swamp: common reed (*Phragmites australis*), cattail (*Typha latifolia* and *T. angustifolia*), tule (*Schoenoplectus lacustris*) and in deeper water: European white water-lily (*Nymphaea alba*), yellow water-lily (*Nuphar lutea*) and large area with water soldier (*Stratiotes aloides*) and frogbit (*Hydrocharis morsus-rana*e), where the signal was stronger.

3.2.3.2 Ujscie Ilanki Pk03 - Rybocice

In winter 2007/2008, 14 hibernating turtles and in winter 2008/2009, 18 hibernating turtle were found in Ujscie Ilanki, using radiotelemetry (4 turtles with transmitters in 2007/2008 and 4 turtles with transmitters in 2008/2009). Additionally, 10 individuals were observed very close to hibernation sites. Hibernating animals were located in different places: in old river bed of Ilanka river (Rybocice 1a-1b) and in forest channel (Rybocice 2a-2c) (tab. 2, fig. 17). Turtles overwintered in muddy sites, mostly under tree branches and trunks, under leaves, among rootstocks of water plants e.g. yellow water-lily (*Nuphar lutea*). One hibernation place was noticed in an active beaver lodge. The water level in these places was between 10 cm and 50 cm.

Tab. 2: Characteristics of hibernation sites of *Emys orbicularis* in Ujscie Ilanki Pk03

Name of water reservoir	Characteristics of hibernation site	No. of turtles observed near hibernation site	No. of turtles caught in hibernation site	First observation after winter
Rybocice 1a	old river bed: shallow bottom deposit with many	10 (IX 2007) 15 (X 2008)	10	IV 2008 IV 2009

	branches			
Rybocice 1b	old river bed: among rootstocks of *Nuphar lutea*	2-4 (IX 2007) 5 (X 2008)	2	IV 2008 IV 2009
Rybocice 2a	forest channel: border between water and bottom deposit, under tree trunk, thick layer of leaves	1 (X 2007) 4 (X 2008)	2	IV 2008 IV 2009
Rybocice 2b	forest channel: shallow bottom deposit with many branches, thick layer of leaves	2-3 (X 2007) 6 (X 2008)	4	IV 2008 IV 2009
Rybocice 2c	forest channel: beaver lodge	2-3 (X 2007)	1	IV 2008

In November 2008 selected physical and chemical water parameters in hibernation sites were measured, results are given in table 3.

Tab. 3: Physical and chemical parameters of water in hibernation sites of *Emys orbicularis* in Ujscie Ilanki Pk03

Parameter	**Unit**	**Hibernation site**	
		Rybocice 1	**Rybocice 2**
Temperature	^{o}C	3,9	3,7
pH	-	6,2	7,5
Cl	mg/dm^3	3	17
SO4	mg/dm^3	55	134
N	mgN/dm^3	4,3	5,8
P	mgP/dm^3	0,16	0,3
O_2	mg/l	5,1	5,56
C organic	mgC/dm^3	12	15
K	mg/dm^3	1	1,1
Na	mg/dm^3	9	5
Ca	mg/dm^3	104	122
Mg	mg/dm^3	7,9	6
Fe	mg/dm^3	0,5	1

Fig. 16-17: A female of *Emys orbicularis* with transmitter (fig. 16) and hibernation site of *Emys orbicularis* Rybocice 2c Pk03 (fig. 17)

3.2.3.3 Uroczysko Puszczy Drawskiej Pk04 – Drawiny

Fig. 18-19: Hibernation site of *Emys orbicularis* in Drawiny Pk04 (fig. 18) situated in the corner of a large, extensively cultivated fish pond (fig. 19)

In the winterperiods 2006/2007-2008/2009 one hibernation site was found in Drawiny. At least one turtle female overwintered in the pond Drawiny 1 (confirmed by radiotelemetry). This hibernation place was situated in a corner of a large fish pond (5,5 ha) (fig. 18 +19). Turtles have been observed there for many years, also in early spring, because in this area (1600m^2) there is an abundance of water plants (e.g. *Typha* spp., *Nuphar lutea*), in addition there

are old tree stumps and holes in the bottom. Due to high mud level in this place, it was impossible to find the hibernating female. The water level in this place was ca. 20-50 cm at that time.

3.2.3.4 Zachodnie Pojezierze Krzywińskie Pk05 - Drzeczkowo

In the winterperiods 2006/2007-2008/2009 one hibernation site was found in Drzeczkowo. At least one turtle female overwintered in the pond Drzeczkowo 3 (confirmed by radiotelemetry) (fig. 20+21). This female hibernated in a forest swamp (area ca. 1200 m^2 in spring), with a ditch in the middle, almost completely overgrown by *Salix, Alnus, Typha, Phragmites and Carex*. In autumn vast area is often dried up. The exact localization of the female was difficult due to the weak signal of the transmitter.


20


21

Fig. 20-21: Hibernation site of *Emys orbicularis* in a forest swamp Drzeczkowo Pk05 (3) – almost dried up in September 2008 (fig. 20), – deepened in November 2008 (fig. 21)

3.2.3.5 Summary for west-polish project areas

- 1 hibernation site in a swamp in Brzezno Pk01 (but observed female was relocated close to this place!)
- 5 hibernation sites (2 in old river bed of Ilanka river and 3 in forest channel) in Rybocice/Ujscie Ilanki Pk03 (fig. 17)
- 1 hibernation site in a corner of a large fish pond in Drawiny/Uroczysko Puszczy Drawskiej Pk04 (fig. 18+19)

- 1 hibernation site in a forest swamp in Drzeczkowo/Zachodnie Pojezierze Krzywińskie Pk05 (fig. 20+21)

3.3 Germany

3.3.1 Methods Germany

Within the scope of the EU-Life project the hibernation behavior of 12 European pond turtles, equipped with a telemetry transmitter was being examined in 3 project areas (Da02, Da03 and Da04). In the project areas Da01 and Da05 no more pond turtles could be detected in the project period. From project area Da05 older data on hibernation behavior of *Emys orbicularis* are present. As a rule the radio bearings were carried out from at least 3 bearing positions along the bank line. In particular cases it was possible to penetrate on tufts or willow shrubs up to the immediate locality of the hibernation place, so that its structure, vegetation, water deepness etc. could be registered in detail. When the ponds had strongly frozen up, the ice surfaces were used to determine the exact hibernation locations.

Where individual turtles stood (+/-30 cm) hydrochemical and physical dates were raised during hibernation. Water temperature, conductivity, pH-value as well as oxygen concentration and oxygen saturation were measured with mobile devices on site. The determination of the chemical oxygen demand (COD) and the quantitative analysis of the nutrients occurred in photo-metrical way in the laboratory according to standardized tests by the company MACHERY & NAGEL.

3.3.2 Results Germany

During the study hibernation sites could be determined in the project areas Da03 and Kölpinsee Poratz Da04. In the 1990'ies only a very small population could be noticed in the project area Märkische Schweiz Da02, but unfortunately, since several years no individuals could be observed again and this population must be extinct. Nevertheless, data of this area are presented in the following text.

3.3.2.1 Water depth

In the Brandenburg investigation fields *Emys orbicularis* spends the winter basically in aquatic habitats. Only if the actual pond dries up as a result of long dry spells, the animals withdraw into the mud shift. Here they are endangered by predators (in particular wild boars). With a successful irrigation management the drying-out of ponds inhabited by pond turtles could be prevented in all project areas also during dry years.

According to present experiences hibernation places of *Emys orbicularis* lie in depths between 0.2 to 1.0 m. If the pond freezes over, turtles move from near-surface layers to deeper layers.

3.3.2.2 Habitats and habitat structures

Fig. 22: Hibernation site of *Emys orbicularis* in structured reed areas in Kölpinsee Da04

Fig. 23: Hibernation site of *Emys orbicularis* in structured willow-/alder shrubs in Kölpinsee Da04

Fig. 24: Hibernation site of *Emys orbicularis* in structured reed areas of a big pond at the edge of the forest in Poratz Da03

In all 3 investigation fields pond turtles used near-natural, perennial small ponds or small lakes for hibernation. The animals migrate in the period between the end of August and the middle of October from their summery habitat to the specific hibernation places. Basically the turtles spent the winter in the structured aggradation areas of the pond. Characteristic to all hibernation ponds were relatively deep mud layers. The habitat structures of the hibernation places in detail can be classified as follows:

- **Bright reeds and sedge tufts:** Loose reeds which offer open channel-like crossings to the free water-surface from the water-sided deeper aggradation area. The reed rhizomes still form no concluded stock here. For hibernation this structure was used above all in area Da04 and in one case also in Da02 (fig. 22+24).
- **Willow shrubs with high dead-wood share:** Here it concerns willow shrubs which feature living as well as already dead sections as a result of water level fluctuations. The turtles preferred locations with a higher dead-wood share in form of dead willows branches in water depths between 40 and 80 cm. Such hibernation sites were registered in the project areas Da02 and Da03 (fig. 25).
- **Aquatic, structured alder fens with high dead-wood share:** Bright mostly younger fen wood associations, structured in itself and as a result of water level fluctuations characterized by a variation of dying and regenerating alders. Besides alder sedge tufts and willow shrubs form these habitats. Under the water surface dead alders and willows offer favorable dead-wood structures. Hibernation sites of this kind exist above all in the project areas Da03 and Da04 (fig. 23).

Fig. 25: Hibernation site of *Emys orbicularis* in a structured alder- and willow pond with high dead wood share in Poratz Da03

3.3.2.3 Temperature and results of climate monitoring

Already in earlier investigations (Schneeweiss 2003) it appeared that European pond turtles at the northwest edge of its distribution use ponds or pond-parts for hibernation which offer, protection from frost and protection from extreme temperature fluctuations. The hibernation behavior documented within the scope of this project confirms these experiences. Thus water temperatures were measured at the hibernation place between 2 and 7.5 °C. During the true hibernation the water temperature is 2 to 6 °C. The seasonal stages of the true hibernation lay between beginning of December and the middle of March during which, correlating with higher temperatures the animals expressed locomotive activities. Thus vertical movements were proved several times depending on a change in water temperature or icing stage. In warmer periods (Tmaxw: 7°C, TmaxL: 14°C) the animals were being seen at the water surface to take a breath in an interval of several hours to several days. Single individuals changed their whereabouts at shorter distances (3-5 m). Triggers of

this behavior were beside the temperature rise possibly disturbances by activities of other wild animals (?), e.g., wild boars or an obvious increase of the water level or influx of surface water.

Of determining importance for the successful hibernation of *Emys orbicularis* are concerning water temperatures microclimatic preferred ponds or pond-parts which distinguish themselves in comparison to free water by a more temperate temperature behavior that has above all substantially lower temperature fluctuations. A characteristic of these climatic relatively protected locations are their seasonally relatively late beginning and late ending icing or cold stage.

3.3.2.4 Hydrochemical and physical parameters

Results: The pond turtles spent the winter in near-nature eutrophic small ponds or small lakes. The pH-values of the ponds were in the neutral range (6.6 to 7.3). The zones where the pond turtles spent the winter turned out to be low in oxygen or even anaerobic. Further hydrochemical and physical parameters are to be taken from the table 4.

Tab. 4: Hydrochemical and physical parameters in hibernation ponds of *Emys orbicularis* in winter in 2006-2007 in East-Germany

Parameter at 20-30-cm depth	**minimum**	**maximum**	**average value**	**n**
Water temperature (°C)	1	6	4.2	6
Air temperature (°C)	-3	14	6	6
Oxygen (mg / l)	0	7	2	4
Oxygen saturation (%)	0	48	20	4
pH-value	6,6	7,3	6.9	4
Conductivity (µ S/cm)	700	820	770	4
COD (mg / l)	10	110	58.3	4
Ammonium (mg / l)	0,5	4,8	2.6	4
Nitrite (mg / l)	0,03	0.09	0.05	4
Nitrate (mg / l)	1	24	6.5	4
Ortho-phosphate (mg / l)	0,2	2,6	1.1	4
Total phosphate (mg / l)	0,2	4	2.2	4
Chloride (mg / l)	30	110	270	4
Sulfate (mg / l)	5	240	64.5	4
German hardness (°dH)	5	30	17.5	4
Carbonat hardness (mg / l)	2	22	7.4	4

3.3.2.5 Behavior of hibernating pond turtles

The behavior of the hibernating pond turtles can be summarized as follows. In the period from end of August till the middle of October the animals go to their hibernation places, which are normally beyond the summerly activity ranges. During the quiescence in winter the turtles pause more or less without moving in the water, they prefer positions in water depths between 20 and 50 cm. In often floating position the animals anchor themselves with their limbs in dead branches, in roots or reed rhizomes. While the turtles carry out smaller changes of location at water temperatures between 5 and 8 °C, e.g., in the verticals to take a breath, at temperatures below 4.5 °C they stay in a motionless stiffness. The periods between the appearance at the water surface depend on the water temperature and icing and vary from several hours to more than two months. In Brandenburg, European pond turtles finish their hibernation between middle of March till the middle of April depending from the climatic conditions. The hibernating turtles used foliage as a cover in the water.

3.3.2.6 Summary for northeast German project areas

- 1 hibernation site in a small, very structured field-pond (Typha- and Phragmites reed, willow shrubs) in Stobbertal Da02
- 2 hibernation sites in a shaded forest-pond with high dead wood share directly in neighborhood of Stobbertal Da02
- 3 hibernation sites in a shallow cove and 1 hibernation site at a willow shrub of a big semi-open pond with structured reed in Poratz Da03
- 3 hibernation sites in a structured alder- and willow pond with high dead wood share in Poratz Da03 (fig. 25)
- 2 hibernation sites in structured willow shrubs and 2 hibernations sites in structured reed areas of a big pond at the edge of the forest in Poratz Da03 (fig. 23)

- 2 hibernation sites in a structured alder-/reed-field pond in a thick alder fens with high dead wood share in Poratz Da03
- 4 hibernation sites in structured willow-/alder shrubs, an 1 hibernation site in a structured reed belt of a pond at the edge of the forest in Kölpin-see Da04 (fig. 22)

4 Conclusions

4.1 Requirements for winter habitats of *Emys orbicularis*

In the project areas *Emys orbicularis* lives on the northern border of the species range. During project investigations and in earlier studies in East-Germany (Schneeweiss 2003) it could be ascertained that pond turtles hibernate in ponds or pond parts where they are more protected from frost and extreme temperature fluctuations. Hibernating individuals could be found in very natural forest swamps e.g. alder swamps, in swamps, in different types of natural or near-natural, eutrophic or mesotrophic, permanent ponds as well as in smaller lakes, quagmires, channels and in exceptional cases in natural temporary ponds, too. In some areas e.g. in West-Poland animals hibernate in artificial ponds like fish ponds, too. However, a small number of observations of turtles hibernating in dry places are known from literature (Palm 1974, Fritz & Günther 1996), but could not be noticed during the project.

In principle, *Emys orbicularis* spends the wintertime near shores e.g. under roots of trees and shrubs or in structured silted-up areas of the hibernation ponds with relative deep mud layers. Typical vegetation next to or at the hibernation sites are shrubs and trees like willows (*Salix* spp.) and alders (*Alnus* spp.) as well as foliage plants like cattail (*Typha* spp.), reed (*Phragmites* spp.) and sedge tufts (*Carex* spp.) and furthermore Sphagnum (*Sphagnum* spp.) in highmoors.

Types of hibernation sites of *Emys orbicularis* with the typical vegetation in the North European lowlands:

- permanent pond with shallow pond parts with bright reeds (*Phragmites* spp.), cattail (*Typha* spp.) and/or sedge tufts (*Carex* spp.) (fig. 5, 22+24)

- permanent pond with shallow pond parts or swamps with sedge tufts (*Carex* spp.) and young willows (*Salix* spp.) and/or alder (*Alnus* spp.) (fig. 6+12)
- permanent pond with shrubs and trees near shores with coves and/or in shallow pond parts e.g. willow (*Salix* spp.) and/or alders (*Alnus* spp.) with high dead-wood share e.g stumps (fig. 8, 10, 23+25)
- aquatic, structured forest swamps e.g. alder forest (*Alnus* spp.) with high dead-wood share e.g stumps as a result of water level fluctuations (fig. 3, 20+21)
- under or in a channel inside quagmires consisting of Sphagnum (*Sphagnum* spp.) (fig. 9)
- channel in bogs with sedge tufts (*Carex* spp.) and trees and bushes at the shore e.g. willow (*Salix* spp.) and/or alders (*Alnus* spp.)
- forest channel with woody structures e.g. dead wood, tree trunks, branches and/ or beaver lodges (fig. 17)
- old river bed with woody structures e.g. dead wood, branches and/ or rootstocks of plants e.g. yellow water-lily (*Nuphar lutea*)
- temporary pond with sedges tufts (*Carex* spp.) and with or without shrubs and trees at the shore e.g. willow (*Salix* spp.) and/or alders (*Alnus* spp.), hibernation site can dry up in winter

The aquatic hibernation sites are situated in water depths of 20 to 100 cm, but the turtles favour depths of 20-50 cm for hibernation. However, during real frost periods animals move from near-surface layers to deeper layers. If hibernation sites even dry up individuals shift to deeper mud layers of the bottom. In winter the water temperature at the hibernation sites is between 2 and 7.5 °C and during the real hibernation period a bit lower (2 to 6 °C). Aside from first investigations in East-Germany showed that hibernation sites can be low in oxygen or even anaerobic (SCHNEEWEISS 2003).

Tab. 5: List of requirements at hibernation places of *Emys orbicularis* in the North European lowlands

Characteristics	**Requirements**
Water depths	40-100 cm, hibernation sites should not dry up during winter
Water temperature (°C)	without longer periods of frozen temperatures, 2 to

	6 °C
Water quality	no special requirements, about neutral pH
Pond ground (substrate)	as a rule, deep mud layer
Microclimate	protected position with no strong temperature fluctuations with good windbreak (e.g. coves, reeds, channels, forest ponds, fens with trees e.g. alder fens, alder forests)
Structure/vegetation	rich in structure by dead-wood and/or roots, rhizomes, tufts
Cover	rich in cover, dead vegetation, foliage, dead-wood
Lighting conditions	unshaded up to shaded
Position (aspect: disturbances)	protection from disturbances, as a rule, hardly accessible locations

4.2 Hibernation behaviour of *Emys orbicularis*

Between July and October turtles move to their hibernation ponds, which lie typically outside of their summerly activity ranges. The distance between summer and winter habitats can be up to 800 m. Usually, Lithuanian turtles migrate a bit earlier to their hibernation ponds (between End of July and end of September) (Meeske & Rybczynski 2001, Meeske 2006) than East-German animals (between end of August and middle of October) (Schneeweiss 2003). The hibernation period is dependent on climatic conditions and lasts normally until middle of March or end of April. In general, the hibernation period starts a little later in East-Germany and ends a little sooner than in Lithuania.

During hibernation turtles perform smaller movements at water temperatures between 5 and 8 °C, but at temperatures lower than 4.5 °C they remain total motionless.

Due to the fact that European pond turtles often hibernate together with other individuals, a concentration of animals can be found in the hibernation sites. Such observations were already described for East-German turtles by Schneeweiss & Steinhauer (1998) and Schneeweiss (2003) as well as for Lithuanian turtles by Meeske (2000a, b, 2006) and could be confirmed in some project areas during the project. Furthermore, individuals show a fidelity to their hibernation sites in East-Germany (Schneeweiss 2003)) and in Lithuania (Meeske 2000a, b, 2006).

4.3 Threats for hibernating *Emys orbicularis*

Threats for hibernating turtles are fen and peat digging and cleaning of channels, if these activities are done close or in the hibernation sites during winter. Hibernating animals cannot flee from disturbances and can be killed by machines. Furthermore, if hibernation sites are destroyed in winter the turtles have no chance to find other suitable hibernation sites.

Additionally, predators of turtles are big danger for hibernating animals e.g. wild boars in East-Germany (SCHNEEWEISS 2003), foxes and racoon dogs in the western Ciscaucasia (LUKINA 1966, cited in FRITZ 2001) as well as otters in Kiev (KOTENKO 2000). In shallow waters e.g. it is very easy for wild boars to dig out hibernating turtles in the muddy ground. However, a good water level can secure turtles from predation by wild boars, raccoon dogs and foxes.

4.4 Conservation conclusions for hibernation sites of *Emys orbicularis*

Habitat management activities should always taken into account the requirements for turtle hibernation sites. In ideal case, studies on habitat use allow the knowledge on the annual distribution of turtle populations in their habitats before habitat actions will be started.

In fact, bushes and trees at pond shores can destroy basking sites of turtles, but on the other hand woody plants with their branches and root systems in water have important functions as hiding sites in late autumn and as hibernation sites in winter. Dead wood, branches, stumps, roots and foliage provide a cover and protect hibernating turtles from frost and extreme temperature fluctuations. Therefore bush and tree cutting in and near ponds used by turtles throughout the year should be done partly and not directly at the hibernation sites during the hibernation period. Restoration of turtle ponds e.g. deepening or the removal of trees with their root systems where turtle hibernate should be never carried out during the main hibernation period (October-March/April). The right time and the exact places for habitat management in winter habitats of *Emys orbicularis* should be accurately defined in suitable local management plans and in action plans for the species.

In areas with a higher predator density an irrigation management can inhibit the drying-out of ponds inhabited by pond turtles during dry years.

Fen and peat digging and cleaning of channels should not be conducted in turtle hibernation habitats in wintertime, because hibernating individuals can get hurt or even killed by machines.

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