Distribution and biology of *Emys orbicularis* (L.) in Poland

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Abstract

The European pond turtle lives in small, scattered and isolated populations of lowland Poland. Females are bigger than males - the mean straight carapace length (SCL) measures 183 mm (170.3 - 200.1 mm) and 172 mm (159.0 - 186.6 mm) respectively for females and males. Emys orbicularis is active from the end of March to the beginning of September. The mating period lasts from the end of April to the first days of May. Oviposition occurs between the third decade of May to the middle of June. Females lay 7 - 23 eggs (mean 14.4) once a year. Eggs weigh 8 - 10 g and mean egg size measures 32.7 x 20.8 mm. Young turtles (SCL = 23.3 - 28.8 mm, body mass 3.7 - 6.1 g) hatch in the second half of August or September. Hatchlings emerge from nests from August until October or overwinter occasionally.

Key words

Testudines: Emydidae: *Emys orbicularis*; distribution, size, mating, egg laying, hatching, hatchling, Poland.

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Introduction

In Poland only one species of turtles occurs - the European pond turtle *Emys orbicularis*. It is very rare and carries on a hidden way of life (MŁYNARSKI 1971, JUSZCZYK 1987, JABLONSKI 1992b, ZEMANEK submitted); thus, only a few people in our country have seen this species in its natural habitat.

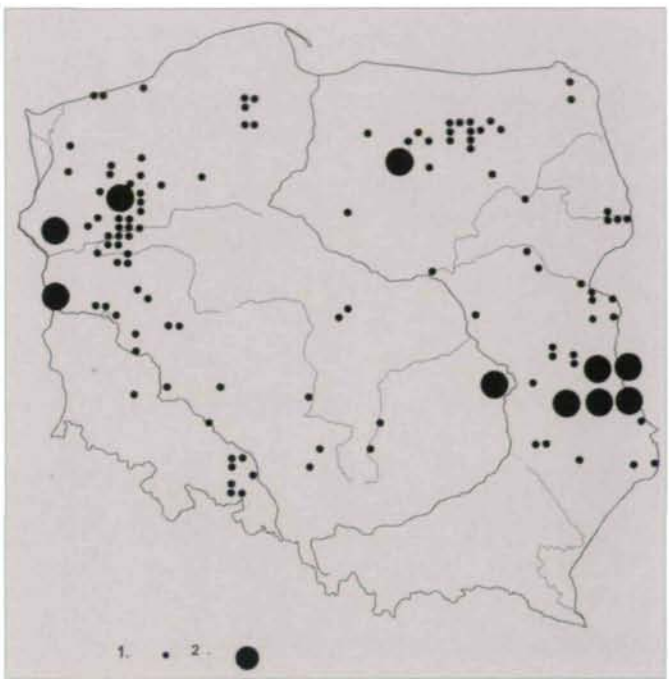

Fig. 1:
Present distribution of the European pond turtle in Poland which lives at lowlands. The largest population occupies the eastern part of the country (small circles - places, where singular specimens have been met: according to data from interviews after 1970, large circles - breeding populations, in which *E. orbicularis* reproduced successfully during the last years) (ZEMANEK submitted).

The first scientific studies on the European pond turtle in Poland started in the 1980s (ZEMANEK 1988, JABLONSKI 1992a). Until this time most of the information published in Polish literature was taken from observations in captivity or from foreign literature (MŁYNARSKI 1971, JUSZCYK 1987). In this chapter, most data on the biology of the European pond turtle in Poland is based on the research we have been carrying out in central Poland. In 1985, M. ZEMANEK has started research on the biology of the European pond turtle in the Zwolenka river valley of central Poland. Collaboration between the authors started in 1990.

Emys orbicularis Populations in Poland

Emys orbicularis occurs throughout the Polish lowlands in small, scattered and isolated populations (JABLONSKI 1992b, ZEMANEK submitted). Despite a lot of data from different places, most seem to refer to single individuals from dying populations (JABLONSKI 1998) or to animals which escaped from captivity. Sometimes even different *Emys* subspecies as well as other turtle species are reported (MITRUS & ZEMANEK unpubl. data). Large numbers

Fig. 2:
Natural habitat of the European pond turtle in Poland. The turtle lives in wetlands, old riverbeds and ponds. The animal became rare because a lot of such places had been drained in Poland (photo R. DROZDZ).

of turtles have been smuggled from the former Soviet Union countries in the 1990s and part of them could have been released to nature (MITRUS 2000).

It is difficult to say how many turtles live in Poland nowadays. In the Polish Red Data Book of Animals (JABLONSKI 1992b) the total number was estimated at 250-350 individuals. This high underestimation had been made before scientific research started. The largest turtle population lives in the Leczna-Wlodawa Lake District of eastern Poland (JABLONSKI 1998). The number of *E. orbicularis* in this area exceeds beyond 500 individuals. Currently, JABLONSKI (1998) places the population of this lake district at 500-600 individuals. Between 1992 to 1996, RÓŻYCKI & SOLTYS (1996) marked more than 70 individuals in the Polesie National Park and estimated their number at about 140. Due to the lack of extensive mapping we are of the opinion that the size of the population in eastern Poland could still be underestimated.

Other known populations of *E. orbicularis* live in the central (the Radom district), the northern (the Olsztyn district) and the western parts of Poland. In all these populations, the European pond turtles have reproduced successfully during recent years (GUZIKOWSKI, MACIANTOWICZ, MAJCHER, NAJBAR, RÓŻYCKI & RYBACKI unpubl. data, MITRUS & ZEMANEK 1998).

Habitat

The European pond turtle lives throughout the lowland part of Poland (Fig. 1). It prefers small bodies of water with muddy bottoms, old riverbeds, wetlands and little water holes and ponds (M£YNARSKI 1971, JUSZCZYK 1987) (Fig. 2). A lot of marshy areas have been destroyed because of human activity. *Eyms orbicularis* frequently lives in small ponds left after peat exploitation (STRAWINSKI 1953, ZEMANEK & MITRUS 1997). Quite often, it can be found living close to peoples' houses (STRAWINKSI 1953, KOSINSKI 1993, ZEMANEK 1992) contrary to the common opinion that it occurs in remote sites.

Taxonomic status and characteristics of the subspecies

The European pond turtle from Poland belongs to the *orbicularis* subspecies group (FRITZ 1998). Individuals from Poland are bigger than the ones from the southern part of the species distribution area (FRITZ 1998). In central Poland, the average straight carapace length (SCL) of females is 183 mm. Males are smaller and their mean SCL measures 172 mm (Tab. 1). Almost identical data on the mean straight carapace length is presented by FARKAS et al. (1998) for turtles from eastern Poland.

The age at which the European pond turtle reaches sexual maturity in Poland is not well defined. The youngest individuals with unambiguous male characters have straight

Fig. 3:
Plastrons of females. *E. orbicularis* in Poland is predominantly yellowish or brownish in colour (see photo). Plastrons of males can be completely black (photo M. RÊBIŚ).

Fig. 4:
Plastron of one-year-old *E. orbicularis*. At such individuals the colour patterns of their plastrons is still similar to the pattern characteristic for hatchlings - greyish with yellowish edges (photo S. MITRUS).

carapace lengths of about 130 mm. All females observed during oviposition had carapace lengths above 170 mm, but only a small number of them has been observed at all (MITRUS & ZEMANEK unpubl. data). Adult females have about 11-17 well visible growth annuli rings on their scutes. Further rings are narrower and difficult to count. Occurrences of about 15 easily visible rings can be correlated with reaching sexual maturity by the female, but more information on the subject is needed. Sometimes scutes are completely smooth with no visible annuli rings at all. The rings are better visible on plastron scutes than on those of the carapace (MITRUS & ZEMANEK unpubl. data).

Sex	SCL [mm] ±SD (range)	PL [mm] ±SD (range)	BM* [kg] ±SD (range)
Female	182.69 ±8.04 (170.3-200.1) n = 29	174.82 ±8.34 (162.2-191.6) n = 29	0.977 ±0.112 (0.79-1.18) n = 24
Male	171.80 ±8.68 (159.0-186.6) n = 9	154.06 ±8.25 (145.6-170.0) n = 9	0.733 ± 0.052 (0.67-0.82) n = 9

– body mass of females after eggs laying.

Table 1:
Straight carapace length (SCL), plastron length (PL) and body mass (BM) with standard deviation (SD) of adult European pond turtles from central Poland.

Fig. 5:
Portrait of female *E. orbicularis*. In Poland female *E. orbicularis* typically have yellow iris. They are larger than males and reach a carapace length of about 20 cm (photo R. DRÓŻDŻ).

The carapace of Polish *E. orbicularis* has a dark, graphite grey coloration. The colour of the plastron in adult individuals of females is lighter than in males. Typically, the female plastron is partly yellowish or brownish and partly black (Fig. 3). Males may have completely black plastrons. The carapace of the neonate is grey or greyish brown in colour. Its plastron is grey with light, yellowish edges (FRITZ 1993) (Fig. 4). Such colouration of the plastron may be seen even in two-years-old turtles, but usually it progressively changes during the first year of life - more and more parts of the plastron turn brownish. Typically the surface scutes of neonate carapace is not smooth, but uneven. The surface layer of the first scutes may fall off and then the surface appears completely smooth (MITRUS & ZEMANEK unpubl. data).

Polish *E. orbicularis* lack the many yellow dots on legs, head or carapace found in individuals from the southern regions of the species' range (FRITZ 1998). Their patterns sometimes show only light speckling. Females have more dots on their heads than males (Fig. 5).

Neonates have smaller numbers of yellowish dots than adult turtles, but their spots are comparatively bigger than in adult individuals. The length of the neonate tail comprises 83% of the straight carapace length (82.9%, SD = 4.6, n = 43) whereas it reaches about 38% of SCL (38.1%, SD = 4.7, n = 36) in adult individuals. In addition to their legs, hatchlings also use their tail to surmount obstacles during the way from nesting places to the water (MITRUS & ZEMANEK unpubl. data, FINKLER & CLAUSSEN 1997).

The iris of adult females from Poland is usually yellow, in adult males it is reddish or brown (JABLONSKI 1998). Reddish irises of males are typical for the *orbicularis* subspecies group (FRITZ 1998). Females with yellow-brownish irises are known as well, so this feature cannot be used for sex identification. Nevertheless, it is a very useful cue for field observations, for example when only the head of the turtle is above the water's surface (Fig. 6). Neonates and young individuals have yellowish irises regardless of their sex (MITRUS & ZEMANEK unpubl. data).

Lifespan

There is no proven documentation about the lifespan of *E. orbicularis* in Poland. In central Poland, of 15 adults marked in 1986-1988, nine were observed in 1999, three others in 1998 (MITRUS & ZEMANEK unpubl. data).

Fig. 6:
Adult males usually have reddish iris. Although this feature alone cannot be used for sex identification, it may be useful for nature observations when only the turtles' heads reach above the water surface (photo R. Dróżdż).

Jablonski (1998) and Jablonski & Jablonska (1998) report on 120 years old individuals, but their data is highly anecdotal. It is obvious that the European pond turtle is a long lived animal, but more information is needed on the subject.

Activity period

In Poland, the European pond turtle usually hibernates from the beginning of September to the end of March or the first half of April (M£ynarsky 1971, Zemanek & Mitrus 1997). Generally, young individuals are active over a longer period than adults (Mitrus & Zemanek unpubl. data). Occasionally adult individuals may be seen active in October (Jablonski 1998) or even in the first days of November (Rózycki & Soltys 1996). The European pond turtle spends winter at the bottom of small ponds, burrowed into the mud (M£ynarski 1971). Based on the last and the first yearly observations in the "Borowiec" reserve (Zwolenka river valley, central Poland) there are sites where *E. orbicularis* probably hibernates in old riverbeds and a small pond. Both sites consist of areas with deep mud (Mitrus & Zemanek unpubl. data).

During the active months individuals can be seen basking on banks, plants, or on logs above the water's surface (M£ynarski 1971, Zemanek & Mitrus 1997) (Fig. 7). Very small individuals were noted basking on leaves of water plants as well. Places used for basking are often easily identified by trampled plants and soil. As water and air temperature is lower during earlier parts of the year, individuals spend more time on basking in spring than in summer. Spring is the best time for observation as the animals are generally less alert during this period.

Fig. 7:
A basking European pond turtle. The easiest way for observation is to watch them basking on banks. In spring, when the water is cold, they spend a lot of time basking (photo M. RÊBIš).

Feeding

BANNIKOV (1951) who studied *E. orbicularis* in the Russian Republic of Daghestan analysed a great number of stomach contents. European pond turtles feed mostly on aquatic and water-fallen terrestrial invertebrates. Fish are a rare diet. Animals living in small ponds in the steppe feed mostly on land invertebrates (grasshoppers) which had fallen into water. Turtles living in marshy areas mostly feed on aquatic invertebrates (BANNIKOV 1951), characterising *E. orbicularis* as non-specialised predator. LUKINA (1976) and KOTENKO (1999) describe the occurrence of mostly invertebrates in their diet as well. Plants play a large part of the adult diet as well (BANNIKOV 1951, LABBORONI & CHELAZZI 1991). In captivity, neonates fed on life invertebrates, sporadically take up water plants (MITRUS & ZEMANEK unpubl. data). *Emys orbicularis* eats invertebrates as well as fish and bird carrion (MITRUS & ZEMANEK unpubl. data). Based on faecal analysis SKIBINSKI (1954) reports aquatic invertebrates and tadpoles as main food source.

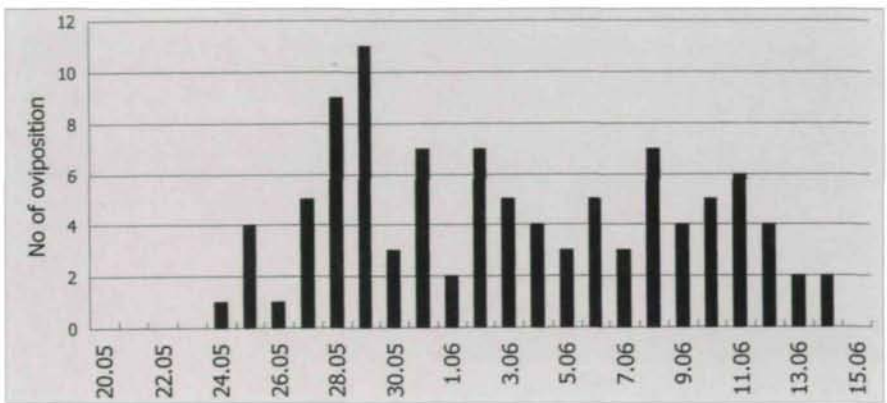

Fig. 8:
Temporal distribution of *E. orbicularis* oviposition at the Zwolenka river valley in central Poland from 1988 to 1999 (n = 100).

Fig. 9:
Typical nesting place of the European pond turtle in Poland. *Emys orbicularis* lays eggs at sunny sites, usually covered with xerothermic vegetation. The surface of the soil at such sites must be hard to prevent the breeding chamber from collapsing during digging (photo S. MITRUŠ).

Mating

Courtship takes place in shallow water (SNIESHKUS 1995). The mating period may last about two weeks (MITRUS & ZEMANEK 1998), but there is no precise information on the subject. Turtles mate at the end of April or during first days of May (DEHNEL 1929, ZEMANEK & MITRUS 1997, MITRUS & ZEMANEK 1998). In central Poland, mating has been observed on 29th April 1993, 1st May 1996, 3rd May 1997, 30th April 1998 (MITRUS & ZEMANEK 1998 and unpubl. data).

Breeding

The egg-laying period starts about one month after mating and its beginning as well as duration depends on the weather conditions. It may last from the third decade of May to mid-June (BAYGER 1937, ZEMANEK 1988, ZEMANEK & MITRUS 1997, JABLONSKI & JABLONSKA 1998) (Fig. 8). Egg laying in Poland occurs at the same time as in German populations (ANDREAS & PAUL 1998, SCHNEEWEISS et al. 1998). According to our observations in central Poland, egg-laying coincides with the blooming of *Iris pseudacorus* (L.) (ZEMANEK 1988, ZEMANEK & MITRUS 1997).

The places the turtles choose for egg laying are always sunny with a hard upper soil layer (Fig. 9). The gradient of the slope may vary considerably. The hard upper soil layer is preferred by females avoiding the collapse of the breeding chamber during excavation. Nesting sites are usually covered with xerothermic vegetation (BANNIKOV 1951, LUKINA 1971, 1976, ZEMANEK 1988, SNIESHKUS 1989, JABLONSKI 1998). The nesting area is usually close to water bodies but may be as far from the water as a few hundred meters or more (ZEMANEK 1988, LUKINA 1971, BANNIKOV 1951). Most females oviposit at the same sites for several years consecutively. Eggs are laid at exactly the same places with a tolerance of one up to several meters. Females may change their oviposition sites if these are damaged by man or shadowed by growing trees and bushes

(MITRUS & ZEMANEK unpubl. data). However, even without such changes of habitat some females may lay eggs in different sites than in previous years. We have observed one female laying eggs on opposite slopes of a valley for several years (MITRUS & ZEMANEK unpubl. data). Occasionally, turtles lay eggs on field roads, on road shoulders or in fields under cultivation (KOSINSKI 1993, ZEMANEK & MITRUS 1997 and unpubl. data).

The behaviour of females on their way to the nesting sites and on their nesting grounds were described by ZEMANEK (1988), SNIESHKUS (1989), ZEMANEK & MITRUS (1997) and JABLONSKI & JABLONSKA (1998). Females are very alert during the oviposition period. They set off in the morning and afternoon, resting during the warmest part of the day under trees, bushes or litter. We have watched individuals that did not deliver eggs at the first attempt and returned to water, then tried a second time - on the next day or a few days later.

In the general nesting area, turtles hardly ever go directly to the actual site of the egg chamber. They walk up and down, looking for a place for the egg chamber, and seem to try to mislead predators by making a lot of tracks. Females dig preliminary small "test" holes using their front limbs and touching the surface of the soil with the chin. We believe that by this behaviour they are able to control the temperature, moisture or maybe other parameters of the soil.

In the afternoon or evening up to 21.00 h, females start digging their egg chambers. If the soil surface is covered by thick vegetation the female tramples the plants with her forelimbs prior to the digging behaviour. With movements of the shell the surface of the ground is cleared from the plants. The onset of the trip to the nesting area and the time for starting to dig the chamber are weather dependent. If the day is cold, females start about 16-17h. On warm days they start later than on sunny, but cold days (BANNIKOV 1951, LUKINA 1971, 1976, ZEMANEK 1988). Digging is usually carried out in the evening or in the early night hours and lasts about one hour. Females dig the chamber using their right and left hind legs alternately.

The breeding chamber is pear-shaped and has a small, round entrance (ZEMANEK 1988, ANDREAS & PAUL 1998) of about 5 cm in diameter; its depth is about 15 cm - as deep as the female legs can reach. During oviposition (Fig. 10, 11), eggs are taken by the hind leg and deposited delicately in the lowest part of the chamber (BANNIKOV 1951, LUKINA 1976, 1998). Sometimes the eggs drop straight to the bottom. Oviposition lasts about half an hour. After eggs are laid the female covers the chamber and smoothes the soil surface using her hind legs. The whole process during which the forelegs are maintained in a constant position all the time may last up to 24.00 h or even until the morning (JABLONSKI 1998).

Length [mm] _ SD (range)	Width [mm] _ SD (range)	Mass [g] _ SD (range)
32.70 _ 2.28 (28.2 - 37.1) n = 117	20.82 _ 0.76, (19.2 - 23.1) n = 117	9.33g _ 0.31 (8.0 - 10.0) n = 14*

* – from 1 clutch.

Table 2:
Egg size of the European pond turtle from central Poland.

Contrary to individuals from populations from the southern distribution area (BANNIKOV 1951, KOTENKO & FEDORCHENKO 1993, ZUFFI & ODETTI 1998) the Polish individuals lay only one clutch per year (ZEMANEK 1992, ZEMANEK & MITRUS 1997, JABLONSKI & JABLONSKA 1998). The European pond turtle lays as many clutches as the environmental conditions allow (KELLER 1999). Eggs from a second clutch in Poland would have a low probability of hatching because of a shortened incubation period. In central Poland clutches contain between 7 and 23 eggs (mean 14.4 eggs, SD = 2.7, n = 80). The eggs are about 32 mm in length and 21 mm in width and weigh between 8-10 g (Tab. 2).

Single annual nesting and the mean clutch size is typical for the individuals in the northern part of the *E. orbicularis* distribution area (ANDREAS & PAUL 1998, ZEMANEK & MITRUS 1997, JABLONSKI 1998, SCHNEEWEISS et al. 1998), although a clutch size of 23 eggs had not been reported earlier. The eggs have a hard calcareous shell. During the last period of incubation, the calcareous eggshell becomes often soft and pliable (ZEMANEK & MITRUS 1997). Softening occurs due to the uptake of the eggshell's calcium by the embryo which may lead to changes in the structure of the shell (PACKARD et al. 1977, MITRUS 1997). After laying we usually take the females to our

research station for measurements the next morning. In 5 of 65 cases females laid one or two "extra" eggs during the night or on the following morning in our station (ZEMANEK & MITRUS 1997). It is not clear whether without our intervention the eggs would have been reabsorbed or dropped. The chance of turtles nests' destruction by mammalian predators is high. Incubating clutches may be destroyed during the first few days after laying and during hatching or emergence of the neonates to the surface. In eastern Poland 70-80% of the nests are destroyed within a few days after laying (JABLONSKI & JABLONSKA 1998). The same situation has been observed in other areas (LUKINA 1971, SERVAN 1988, KOTENKO 1999). In central Poland, however, we have not observed any destruction of clutches immediately after oviposition. Some nests in central Poland may be destroyed during the hatching period (ZEMANEK 1992), in the second half of August or in September. In 1995, 6 out of 14 known clutches had been destroyed during the hatching period by predators, an additional one was accidentally smashed by a vehicle.

Lack of nest destruction during the time of laying can be associated with the close proximity of human habitation in central Poland. Consequently, predators cannot easily penetrate the areas. In contrast, SCHNEEWEISS et al. (1998) mention high predator pressure on a small population in Brandenburg.

Hatching

The period from laying eggs to hatching (= emergence from eggshell) depends on the temperature of incubation (EWERT 1989). If the summer months are cold (average temperature below 18° C in June to August) embryos are not able to complete their development by September and die during autumn or winter (ZEMANEK 1991). However, if the summer is warm, the hatchlings are able to leave the clutches as early as in the second half of August (ZEMANEK & MITRUS 1997, SCHNEEWEISS 1998, MITRUS & ZEMANEK unpubl. data). Neonates typically begin to leave the nests at the end of August or during the first half of September. The summer of 1999 was exceptionally hot in Poland and hatchlings started to emerge from nests around 20th August (between 17-20th and on 23rd or 24th August - data for two different clutches, both laid on 28th May 1999). From the subsequent 8 out of 21 known clutches, neonates emerged between the second half of August and the

Fig. 10-11:
Oviposition. In Poland the ovipositon period lasts from the third decade of May to middle of June. In Poland European pond turtles lay 14-15 eggs during the evening or night once a year (photo R. DROZDZ).

first half of September. Hatchlings are able to exit nests as late as the end of October. From one clutch laid on 31st May 1999 neonates left on the last day of October or during the first days of November. In 1997 the period of incubation (= period from the moment of laying to that of hatching) lasted 97.4 days (85-113 days; SD = 6.6; data for 188 hatchlings from 17 clutches). All known clutches in 1997 were dug out on 5-6th September as an act of the active protection program (MITRUS 2000) and this was also the time when the hatching started. Hatching took place under artificial conditions between 5th September and 2nd October.

During warm years, hatchlings may go to water at the end of summer, but in the northern part of the distribution area they are able to spend their first winter on land (BANNIKOV 1951, ZEMANEK 1992, ANDREAS et al. 1996, ZEMANEK & MITRUS 1997, MITRUS & ZEMANEK 1998, JABLONSKI 1998). After terrestrial hibernation in the breeding chamber they climb onto the surface of the soil in the following spring. On 28th March 1999 we observed neonates departing a breeding chamber, in which the clutch was deposited on 31st May 1998. One neonate was on the surface of the ground about 30 cm from the clutch, the second one was just in the neck of the chamber while the rest was still remaining in the breeding chamber. All hatchlings found inside the chamber - four alive and eight dead - were in an upright position. The upright position of neonates in breeding chambers in spring was described by ANDREAS & PAUL (1998). We also observed opened nests on 3rd and 5th April 1999 and found wandering neonates on 3rd June 1992, 23rd April 1995 and 16th April 1999. Dead ones (killed by cars) were found on unpaved roads on 25th April and 1st May 1995. During hatching, *E. orbicularis* use their forelimbs and an egg caruncle. They pierce the egg shell mainly with their forelimbs (OBST 1986). In individuals kept in captivity (at a water temperature of about 20° C) the egg caruncle typically falls off one month after hatching, but can remain for as long as three months. Under natural conditions, neonates, after spending the winter on land still have their caruncles in the following spring (MITRUS & ZEMANEK unpubl. data). Newborn hatchlings have an average body mass of 5.04 g (3.7-6,1 g, SD = 0.50) and SCL = 26.59 mm (23.2.-28.8 mm, SD = 0.97 - data for 105 hatchlings from 12 clutches deposited in 1999) (Fig. 12).

In "cooler" summers, reproductive success of *E. orbicularis* in Poland can be zero (ZEMANEK 1991). Based on collected eggs during the active protection program and artificial final period of incubation (MITRUS 2000) the mean

Fig. 12:
Hatchling of the European pond turtle. If summers are warm enough individuals are able to hatch in the second half of August or in September. They migrate to water reservoirs at the end of summer or they hibernate on land and migrate to aquatic habitats during the following spring (photo S. MITRUŠ).

of hatched eggs is 62.3% (0%-100%, data for 815 eggs and hatchlings collected from 63 clutches since 1989 to 1999). Within a single nest, one or more eggs remain usually unfertilised (= no embryos visible). In 1997, when all known clutches (21 with 308 eggs) were dug out before hatchlings started to emerge, 202 eggs (65.6%) hatched under artificial conditions (Tab. 3).

	Number	Percentage
alive hatchlings [1]	202	65.6
hatchlings dead [2]	20	6.5
unfertilised [3]	53	17.2
with dead embryos	9	2.9
smashed during incubation	15	4.9
empty eggshells [4]	7	2.3
damaged [5]	2	0.6

Table 3:
Fate of 308 eggs from clutches of *Emys orbicularis* collected in 1997

1 all eggs hatched after taken from the clutch
2 hatchlings dead during emergence from eggshells or found dead in eggshells
3 without embryos
4 empty eggshells found in the clutches - eggs probably eaten by invertebrates
5 one egg damaged during opening the nest and one in incubation - both embryos died

Migrations

Adult females are often encountered at the same area over several years (MITRUS & ZEMANEK unpubl. data). Migrations routes of few hundered meters between nesting sites and summer habitats are frequent (M£YNARSKI 1971, ZEMANEK & MITRUS 1997, JABLONSKI 1998). Females probably use rivers and water reservoirs as migration routes. JABLONSKI (1998) writes about a 4 km long migration route to the nesting area.

KOSINSKI (1993) found individuals about 1.5 km away from the places where they had been a year earlier. In central Poland one female marked in the "Borowiec" natural reserve in 1987 now lives about 10 km away. It is not known whether it migrated or it was transferred by man. Young turtles are able to swim across the Zwolenk river: some one-year-old turtles had been released in the old riverbed and were found some weeks later in the marshes on the opposite bank of the 4 meter wide river (MITRUS & ZEMANEK unpubl. data).

Enemies and injuries

Adult individuals do not have many enemies. The most dangerous one can be man, but in Poland people are rather well disposed towards turtles (M£YNARSKI 1971). *Emys orbicularis* is very resistant to injuries (M£YNARSKI 1971, JUSZCZYK 1987). From central Poland a female without a tail and another one without a hind leg are known. They have been observed with these injuries since 1987 and 1988. Both of them lay eggs almost every year (the tailless female lays exclusively unfertilised eggs. The female missing a hind leg has problems digging its chambers, but it is able to dig and lay fertile eggs. From central Poland 4 out of 27 young turtles (aged >3 years) and 3 of 53 adult ones had damaged scutes of the shell (two of them were wounded by man, the causes of the other injuries are unknown). Two other turtles had parts of the horny jaw torn out (MITRUS & ZEMANEK unpubl. data).

Individuals are often found with leeches *Placobdella costata* (*Haementeria costata*) (M£YNARSKI 1971, JABLONSKI 1998). The leeches are attached to the skin as well as to the shell. In 1999, a young turtle was found with a large number of very young leeches hanging from the skin of the neck. Probably they have hatched from an egg clutch positioned on to the skin of the turtle.

Anomalies in the shell pattern

As only little information about shell anomalies of the turtle in nature is available, it is hard to estimate the percentage of such individuals in the populations. In central Poland 3 out of 53 adult individuals had major anomalies of carapace scutes, and an additional one has anomalies of the plastron scutes.

From 202 alive neonates hatched in 1998, 17 had duplicate or divided central or coastal scutes. Sometimes in one clutch most of the neonates have anomalies (for example 6 out of 8 life hatchlings from one clutch in 1999). "Typical" anomalies of the turtle in Poland are: division of the last central scute and/or last coastal scutes. Turtles with dovetail syndrome in the carapace scutes have also been found. Such a percentage of anomalies can be typical for the natural *E. orbicularis* populations (ZANGERL 1969, EWERT 1989).

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