

¹ Department of Biological Bases of Animal Production,
² Department of Ecology of Wildlife Management
University of Life Sciences in Lublin, Akademicka 13, 20-950 Lublin
e-mail: ekosik87@wp.pl, mariusz.wojcik@up.lublin.pl

¹ELŻBIETA KOSIK, ²MARIUSZ WÓJCIK,
²SŁAWOMIR BEEGER, ¹IWONA ROZEMPOLSKA-RUCIŃSKA

**Carapace anomalies of pond turtles (*Emys orbicularis*) from the
Poleski National Park, from the hatch of 2008**

Anomalie karapaksu żółwi błotnych (*Emys orbicularis*)
z Poleskiego Parku Narodowego z lęgu 2008 roku

Summary. The territory of the Poleski National Park is one of the most populous stands of pond turtle *Emys orbicularis* (L., 1758) in Poland. In the turtles one can observe deviations from the typical structure of the shell, usually in the form of extra scutes or absence of typical scutes. The objective of the study was to estimate the kinds of anomalies and the frequency of their occurrence in European pond turtles from the hatch of 2008, kept at the European Pond Turtle Protection Centre at the Park facilities. In total, 441 individuals of the turtles were kept at the Centre, among which in 69 individuals (15.6%) carapace anomalies were found, and in the case of certain individuals several kinds of anomalies occurred simultaneously.

Key words: European pond turtle, *Emys orbicularis*, carapace anomalies, Polesie National Park

INTRODUCTION

European pond turtle *Emys orbicularis* (L., 1758) is a species native to North and Central America, Europe and Asia. Morphometric studies of European pond turtle conducted throughout Europe [Fritz 1992] revealed that the population living in Poland is the last such a large population of the species (*Emys orbicularis orbicularis*). It is the most abundant in the area of the Łęczna-Włodawa Lakeland. Small populations can also be encountered e.g. on the river Zwolenka in the Mazowieckie Province (ca. 80 individuals) and small groups are scattered all over Poland, e.g. in the neighbourhood of the cities of Szczecin, Zielona Góra, Słupsk and Gorzów Wielkopolski. Turtles are also encountered

individually or in groups of several, mostly old, individuals in the areas of the Pomeranian, Myśluborskie and Masurian Lake Districts [Jabłoński 1998].

The shells of many turtle species display various irregularities in the pattern of scutes [Najbar and Mitrus 2001, Schulze and Fritz 2003, Fernández and Rivera 2004, Özdemir and Türkozan 2006, Bujes and Verrastro 2007]. The frequency of occurrence of anomalies in european pond turtles varies with relation to the location of their appearance. The anomalies relate primarily to the shapes of the particular scutes, missing scutes, or the appearance of extra scutes in various places on the carapace or on the plastron. Instances of such anomalies recorded so far are slight changes, observed most frequently in the carapace. Changes in the plastron appear relatively rarely [Najbar and Maciantowicz 2000, Najbar and Mitrus 2001].

MATERIAL AND METHOD

The study of shell anomalies in european pond turtles was conducted at the European Pond Turtle Protection Centre in the Poleski National Park. Every year, young individuals of european pond turtle are collected from the hatching grounds, kept at the Centre through the winter season, and released in spring. The objective of that activity is the protection and incubation of eggs in the case of unfavourable weather conditions, protection against predation, and education of the society. The number of turtles collected from the hatching grounds in 2008 was 451, out of which 441 individuals were subjected to the study (Tab. 1).

Table 1. Origin, populations of turtles and numbers of individuals with anomalies of the carapace in the Polesie National Park in 2008

Tabela 1. Pochodzenie, liczebność żółwi oraz ilość osobników z anomaliami pancerza w Poleskim Parku Narodowym

Locality Lokalizacja	Number of turtles Liczebność żółwi	Number of nest Liczba gniazd	Number of individuals with anomalies Liczebność osobników z anomaliami	Percent of individuals with anomalies Procentowy udział osobników z anomaliami
Zbójno	311	13	51	73,9
Załucze Stare – Babsk	18	1	1	1,4
Bubnów	20	1	5	7,2
Wola Wereszczyńska	46	1	8	11,6
Wólka Wytycka	56	2	4	5,8
Summary/W sumie	451	18	69	100

Individual young turtles were studied by counting the scutes and checking the arrangement of scutes in the carapace and the plastron. Photographic documentation was created for individuals with visible changes of the shell. The correct layout of scutes on the carapace includes: single scutes – 5 vertebral scutes, the nuchal scute. Symmetrically

on both sides there are 8 costal scutes, 2 marginal-cervical scute, 4 marginal-brachial scutes, 10 marginal-lateral scutes, 6 marginal-femoral scutes, one supracaudal scute (Fig. 1). The plastron is composed of numerous scutes located on both sides: gular, humeral, pectoral, abdominal, femoral, anal (Fig. 2)

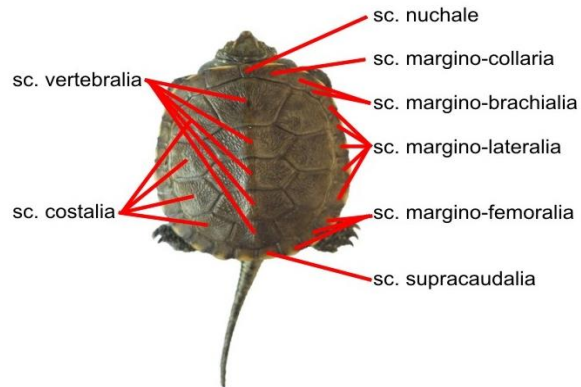


Fig. 1. Layout and names of scutes of the carapace of european pond turtle (Fig. by M. Wójcik)
Rys. 1. Układ i nazwy tarczek pancerza grzbietowego (karapaksu) żółwia błotnego (ryc. M. Wójcik)

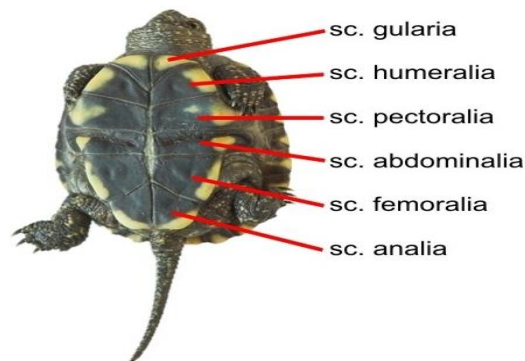


Fig. 2. Layout and names of the plastron of european pond turtle (Fig. by M. Wójcik)
Rys. 2. Układ i nazwy tarczek pancerza brzuszego żółwia błotnego (plastronu) (ryc. M. Wójcik)

With relation to the type of anomaly and its location, the following system of description has been adopted:

+V1-V2 – extra scute between vertebral scutes (No. 1 and No. 2)

+V5-sc.s – extra scute between vertebral scute (No. 5) and supracaudal scute

V2/2 – vertebral scute (No. 2) split into two parts

V4 asym. – asymmetrical vertebral scute (No. 4)
 +V1-sc.c1 – extra scute between vertebral scute (No. 1) and costal scute (No. 1)
 +sc.c2-sc.c3 – extra scute between costal scutes (No. 2 and No. 3)
 +sc.c4-V5 – extra scute between costal scute (No. 4) and vertebral scute (No. 5)
 V4b.s – very small vertebral scute (No. 4)
 Abs. sc.m-b – absence of marginal-brachial scute
 Abs. sc.m-f – absence of marginal-femoral scute
 Abs. sc.c1 – absence of costal scute (No. 1)
 +sc.m-l – extra marginal-lateral scute
 +sc.g-sc.h – extra scute between cervical scute and brachial scute

RESULTS

During the period of the examination, in 69 turtles out of 441 distinct anomalies in the layout of the carapace scutes were observed (Tab. 1). The largest number of individuals with anomalies – 51 – was found in Zbójno, i.e. in the area with the largest number of nests. The least number of individuals with anomalies – 1 – was among the turtles from the hatching area at the locality of Zahucze Stare-Babsk (Tab. 1). Individuals with anomalies constituted 15.6% of the population examined. Most of them had more than one type on anomaly of the carapace. The mean number of anomalies per individual was 2.01.

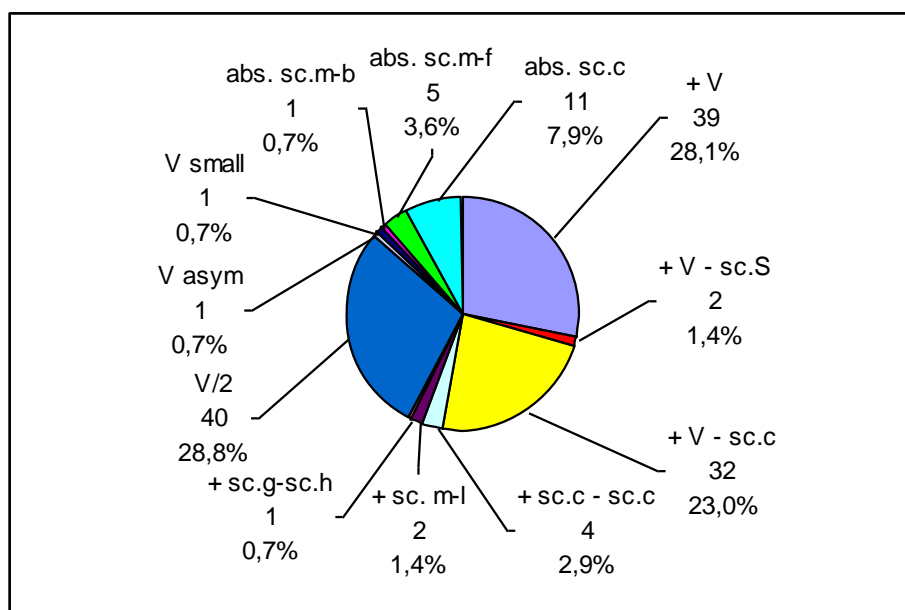


Fig. 3. Percentage share of anomalies in young european pond turtles from the hatch of 2008

Ryc. 3. Udział typów anomalii (n i %) u młodych żółwi błotnych z lęgu w 2008 r.

Table 2. Shares of the types of anomalies (n) in young european pond turtles from the hatch of 2008 as related to the location of origin and nest.

Tabela 2. Udział typów anomalii (n) u młodych żółwi błotnych z lęgu w 2008 r. w zależności od miejsca pochodzenia i gniazda.

Types of anomalies Rodzaj anomalii	Locality and nest number – Lokalizacja i numer gniazda																		Total – Ogółem
	Zbójno													Zalucze	Bubnów	Wola W.	Wólka W.		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
+ V1-V2	1	1			1	2		1		1		1				4		1	13
+ V2-V3	1																		1
+ V3-V4	1							1					1				1		4
+ V4-V5	2			1	1	3		1	3		1	3			1	3		2	21
+ V5-sc.S							1								1				2
V2/2	2		1	1	2			1			1	2			2	2		1	15
V3/2			1	2				1			2		1			1			8
V4/2	1		1	2			1	2			1		2			2			12
V5/2				1				1	1						2				5
V4asym.							1												1
+V1-sc.c1 l		1		1	2			1		1									6
+V1-sc.c1 p			1											1					2
+sc.c1-sc.c2 l				2															2
+sc.c2-sc.c3 l						1													1
+sc.c3-sc.c4 l																1			1
+sc.c4-V5 l	2			1				1			1	2			3	4		1	15
+sc.c4-V5 p	1			1		1	1		1	1					2			1	9
V4 b.s	1																		1
Abs. sc.m-b p												1							1
Abs. sc.m-f l	1												1						2
Abs. sc.m-f p	1				1									1					3
Abs. sc.c1 l											1							1	2
Abs. sc.c2 l								1											1
Abs. sc.c2 p								1											1
Abs. sc.c3 p											1								1
Abs. sc.c4 l				1				1					2	1					5
Abs. sc.c4 p														1					1
+sc.m-l l																	1		1
+sc.m-l p																	1		1
+sc.g-sc.h											1								1
Total Ogółem	14	2	4	13	7	7	4	13	5	3	9	9	8	3	11	17	3	7	139

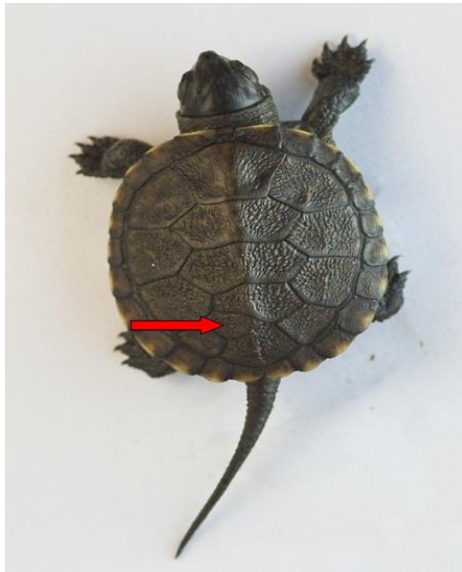


Fig. 4. Type of anomaly +V4-V5
(Photo M. Wójcik)

Rys. 4. Rodzaj anomalii +V4-V5
(fot. M. Wójcik)



Fig. 5. Type of anomaly V2/2
(Photo M. Wójcik)

Rys. 5. Rodzaj anomalii V2/2
(fot. M. Wójcik)

The most frequent anomaly was an extra scute between vertebral scutes Nos. 4 and 5 (+V4-V5), observed in 21 individuals (Tab. 2, Fig. 4).

Another frequent type of anomaly of the carapace was split vertebral scute No. 2 (V2/2), found in 15 individuals (Fig. 5) and an extra scute between vertebral scute No. 4 and left-hand costal scute No. 5 (+sc.c4-V5l), also observed in 15 individuals. An anomaly in the plastron scute layout, consisting in the presence of an extra scute between the gular and humeral scutes (+sc.g-sc.h), was noted in only one individual.

DISCUSSION

Zangerl [1969], in his paper on the turtle shell, revealed that extra or asymmetrical scutes in the shell appear in ca. 15% of turtles. In the population of european pond turtles anomalies of the shell scutes are rare [Cherepanov 1994, Najbar and Maciantowicz 2000, Mosimann 2002, Fritz 1993]. Fernández and Rivera [2004], studying european pond turtles captures from two different locations (131 individuals from the catchment basin of Louro in 1996-2003 and 55 individuals from the catchment of Arnoia in 2001–2003, in Spain) observed distinct anomalies of the carapace scutes. According to their study, 75% individuals from the population from Louro and extra and asymmetrical scutes in the carapace layout. In 5 individuals the presence of an extra scute in the plastron was discovered. The most

frequent anomaly was the appearance of an extra scute between vertebral scutes Nos. 4 and 5 of the carapace. In the population from Arnoia, 40% of the individuals had at least one extra scute.

In the years 1998–2000 in the western part of Poland, among 17 captured turtles Najbar and Mitrus [2001] found the occurrence of anomalies in the scute layout of the shell in as much as 64.7%. Among 165 young individuals bred in the Poleski National Park in 1999 anomalies became apparent in 9.1% of the turtles. The anomalies related to various numbers and shapes of vertebral, costal and marginal scutes [Różycki unpublished material, after Najbar and Mitrus 2001]. Najbar and Maciantowicz [2000] report that the cause for the appearance of anomalies are genetic factors or factors induced by the environment. Hereditary developmental anomalies may appear spontaneously in so-called critical development phases, related with the differentiation of the particular organs in the embryo. That period is characterised by the greatest sensitivity to the effect of teratogenic factors.

Foreign researchers report that anomalies could have been caused by at least three different causes (mutually non-exclusive). The first is the negative effect of chemical substances from a highly industrialised area, e.g. high concentration of heavy metals (Pb, As) and pesticides (DDT) [Alvarez-Campana Gallo 1996, González Rodríguez 1999]. The second – crisis caused by endogamic inbreeding, due to small size of the population, or insertion of new individuals into the breeding population (contact of genomes globally diverse) [Fritz *et al.* 1996]. The third cause of the appearance of anomalies in the turtle shell scute layout is sub-optimal temperature or humidity during the hatching [Gardner and Ullrich 1950, MacCulloch 1981].

Shneider [1783] experimented with embryos of the painted turtle *Chrysemys picta*, and Gardner and Ullrich [1950] with embryos of the common snapping turtle *Chelydra serpentina* (L., 1758) that were subjected to sub-optimal humidity at various stages of their development. Their studies confirmed the effect of sub-optimal humidity on the appearance of shell anomalies. Palmer and Strobeck [1986], in turn, adopted one particular type of asymmetry – variation of asymmetry – as an indicator of environmental stress in many kinds of organisms. Anomalies occurring in the turtles included in our study constituted 15.6% of the population. Their causes in the territory of the Poleski National Park have not been elucidated yet. The territory of the Park is not exposed to strong chemical pollution (heavy metals, pesticides), endogamic inbreeding also should not be a cause for the appearance of anomalies due to the relatively large population of turtles inhabiting the area. In this case, the appearance of the anomalies should be best attributed to sub-optimal temperature or humidity during the hatching period and hereditary (genetic) factors.

CONCLUSIONS

1. In February 2009, 441 young individuals of european pond turtle were examined at the European Pond Turtle Protection Centre in the Poleski National Park.
2. The appearance of anomalies was found in 69 individuals, which constitutes 15.6% of the population examined.
3. The total number of observed anomalies of scute layout was 139, which averages at more than two non-typical scutes per individual. The largest number of individuals with anomalies – 51 – was found in Zbójno. Only a single individual with anomalies was noted in the area of Załucze Stare-Babsk.

4. The total number of 139 anomalies comprised 30 types of different anomalies.
5. Anomalies in the scute layout of the plastron were found in only a single individual.
6. The probable causes of the anomalies in the scute layout of the turtle shell include sub-optimal temperature or moisture during the hatching period and hereditary factors.

REFERENCES

- Alvarez-Campana Gallo M., 1996. La contaminación de las aguas subterráneas en Galicia. Caso del entorno hidrogeológico del río Louro. *Tierra Tecnol.* 12, 57–66.
- Bujes C.S., Verrastro L., 2007. Supernumerary epidermal shields and carapace variation in Orbigny's slider turtles, *Trachemys dorbigni* (*Testudines Emydidae*). *Rev. Brasil. Zool.* 24 (3), 666–672.
- Cherepanov G.O., 1994. Anomalii kostnogo pantsirya cherepakh [Anomalies of bony carapace in turtles]. *Zool. Zhurnal* 73, 68–78.
- Fernández A. C., Rivera C. A., 2004. Asymmetries and accessory scutes in *Emys orbicularis* from Northwest Spain. *Biologia*, Bratislava, 59/Suppl. 14, 85–88.
- Fritz U., 1992. Zur innerartlichen Variabilität von *Emys orbicularis* (Linnaeus, 1758), 2. Variabilität in Osteuropa und Redefinition von *Emys orbicularis orbicularis* (Linnaeus, 1758) und *E.o.hellenica* (Valenciennes, 1832), (*Reptilia, Testudines: Emydidae*), *Zool. Abh.* 47, 37–77.
- Fritz U., 1993. Zur innerartlichen Variabilität von *Emys orbicularis* (Linnaeus, 1758) 3. Zwei neue Unterarten von der Iberischen Halbinsel und aus Nordafrika, *Emys orbicularis fritzjuergenobsti* subsp. nov. und *E. o. occidentalis* subsp. nov. *Zool. Abh. Mus. Tierkd. Dresden* 47, 131–153.
- Fritz U., Keller C., Budde M., 1996. Eine neue Unterart der Europäischen Sumpfschildkröte aus Südwestspanien, *Emys orbicularis hispanica* subsp. nov. *Salamandra* 32, 129–152.
- Gardner L.W., Ullrich M., 1950. Experimental production of shell abnormalities in turtles. *Copeia* 1950, 253–262.
- González Rodríguez M.O., 1999. Informe-resumen de los trabajos realizados con relación a la investigación de detalle de la contaminación por HCH en el entorno del polígono de Torneiros –O Porriño– (Pontevedra).
- Jabłoński A.J., 1998. Żółw błotny. Monografie przyrodnicze. Wyd. Lubuskiego Klubu Przyrodników, Świebodzin.
- MacCulloch R.D., 1981. Variation in the shell of *Chrysemys picta bellii* from southern Saskatchewan. *J. Herpetol.* 15, 181–185.
- Mosimann D., 2002. Situation einer Population von Europäischen Sumpfschildkröten, *Emys orbicularis* (Linnaeus 1758), 50 Jahre nach der ersten Ansiedlung in Moulin-de-Vert (Genf, Schweiz). *Testudo* 11 (4), 25–39.
- Najbar B., Maciantowicz M., 2000. Deformations and damage to carapaces of the European Pond Turtle – *Emys orbicularis* (L.) in Western Poland. In: Proceedings of the 2nd International Symposium on *Emys orbicularis, Chelonii*, 88–94.
- Najbar B., Mitrus S., 2001. Żółw błotny. Monografie przyrodnicze. Wyd. Lubuskiego Klubu Przyrodników, Świebodzin, ss. 135.
- Özdemir B., Türkozan O., 2006. Carapacial Scute Variation in Green Turtle, *Chelonia mydas* Hatchlings in Northern Cyprus. *Turk. J. Zool.* 30 (2006) 141–146.
- Palmer A.R., Strobeck C., 1986. Fluctuating asymmetry: measurement, analysis, patterns. *Annu. Rev. Ecol. Syst.* 17, 391–421.
- Schneider J.G., 1783. Allgemeine Naturgeschichte der Schildkröten, nebst einem Systematischen Verzeichnisse der einzelnen Arten. Müller, Leipzig.

Schulze A., Fritz U., 2003. Morphological variation in Tyrrhenian *Emys orbicularis* revisited. *Amphibia-Reptilia* 24, 230–234.

Zangerl R., 1969. The turtle shell. In: Gans C., Bellairs A.D., Parsons T.S. (eds.) *Biology of the Reptilia*. Vol. 1, Morphology A, Academic Press, London, 311–339.

Streszczenie. Tereny Poleskiego Parku Narodowego to jedno z najliczniejszych stanowisk występowania żółwia błotnego *Emys orbicularis* (L., 1758) w Polsce. U żółwi stwierdzone są odstępstwa od typowej budowy pancerza, zwykle w postaci dodatkowych tarczek lub braku typowych tarczek. Przedmiotem pracy była ocena rodzajów anomalii i częstości ich występowania u żółwi błotnych, pochodzących z lęgu w 2008 r., przetrzymywanych w Ośrodku Ochrony Żółwia Błotnego w siedzibie Parku. Łącznie w Ośrodku przetrzymywano 441 osobników żółwi, z czego u 69 (15,6%) stwierdzono występowanie anomalii karapaksu, w tym u niektórych osobników po kilka ich rodzajów.

Słowa kluczowe: żółw błotny, *Emys orbicularis*, anomalie karapaksu, Poleski Park Narodowy