SHORT NOTES

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EUROPEAN POND TORTOISE, *EMYS ORBICULARIS*, NEONATES OVERWINTERING IN THE NEST

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In Central Europe the European pond tortoise, *Emys orbicularis,* is near the northern limit of its range (Fritz, 1998). In this region the tortoise lays eggs from the end of May through to the first half of June (Andreas & Paul, 1998; Jablonski, 1992; Mitrus & Zemanek, 1998; Schneeweiss *et al.*, 1998; Zemanek, 1988). The young tortoises hatch between mid-August and mid-September (Lukina, 1971; Mitrus & Zemanek, 1998, 2000; Schneeweiss *et al.*, 1998). Hatchlings may emerge from the nest by the end of the summer (Schneeweiss *et al.*, 1998; Zemanek & Mitrus, 1997) or even in late October (Mitrus & Zemanek, 2000). Some neonates may overwinter in nests (Kotenko & Fedorchenko, 1993; Servan, 1983 - in Servan, 1998; Schneeweiss & Jablonsky, 2000). However, Bannikov (1951), who studied the tortoise in Dagestan (the north-east of the Caucasus mountain range, south of the Russian Federation) suggested that the neonates overwintering on land did not stay in the nest itself, but buried deeper into the soil.

In 1998 we followed females on their way to the nesting areas and observed them using binoculars. We marked seventeen clutches in the Zwolenka River valley (central Poland). Two of the clutches were destroyed during incubation, nine were dug out on 11 September 1998 as a part of the active protection program (cf. Mitrus & Zemanek, 1998), and the remaining six nests were left for the winter (Table 1).

On 28 March 1999, neonates from the clutch deposited on 29 May 1998 were observed emerging from the soil (Table 1, nest number 7); one neonate was on the surface of the ground about 30 cm from the nest, and a second was in a tunnel from the nest to the surface of ground (Fig. 1). We opened the nest from one side and at the lowest part of the nest (Fig. 2, "C") we found one live hatchling, pieces of eggshell, empty eggshell, and two eggs (probably unfertilized). Above this there was

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FIG. 1. Hatchling of the European pond tortoise (*Emys orbicularis*) during emergence on 28 March 1999, after overwintering in the nest, Zwolenka River valley, central Poland (diameter of the coin = 23.1 mm); photo S. Mitrus.

a layer about 2 cm thick of dense soil (Fig. 2, "B"). Higher still, we observed a second section of the nest (Fig. 2, "A") with one live and eight dead hatchlings. The roof of this chamber was about 5 cm below ground level.

Nine more live neonates were collected later in the Zwolenka River valley. On 3 April 1999, six live and one dead neonates were found in a shallow pit by volun-

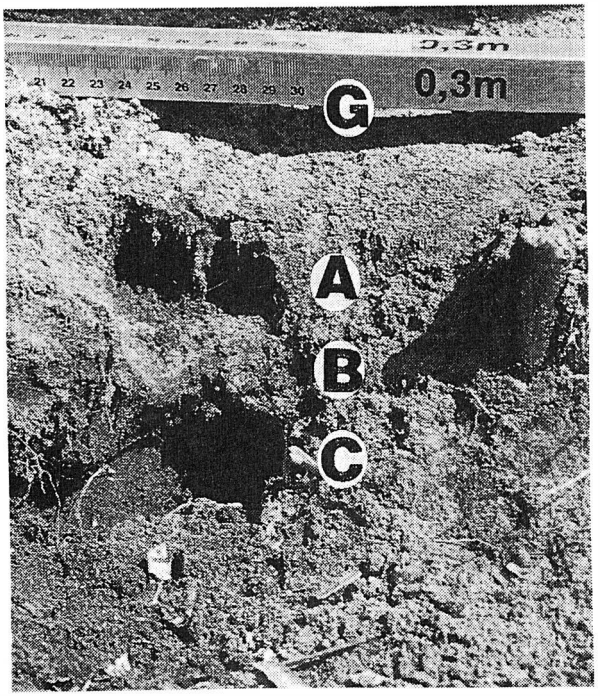

FIG. 2. Section of a nest of *Emys orbicularis* after neonates had overwintered in it. During emergence neonates scrape soil from the roof of the nest and push it down. The chamber is divided into two parts. (G, ground level; A, higher part of the chamber where there were eight dead and one live neonates; B, layer of dense soil; C, the second part of the chamber where were there was one live neonate with pieces of eggshell); photo S. Mitrus.

TABLE 1.History of nests followed over the winter 1998-1999 and ones opened on 11th September 1998.[a] – eggs were counted during oviposition or/and during opening the nest chambers, [b] – number of hatchlings counted from eggshells,[c] – embryos not found, [d] – nests destroyed on summer 1998: one by any predator, and one by agriculture vehicle, [e] – two of them found on the surface of ground (for details see text), [f] – hatched in artificial condition (since 11th to 23rd September 1998), [g] – eggs opened on 18th October 1998, [h] – dead embryos in the last development stages (stages 22-24 – Yntema, 1968);

Oviposition				Live hatchlings			Dead in nest		Eggs		
Date	No. of laid eggs[a]	Fate of nest	Date of first emergence	Found in nest	Emerged between controls[b]	Hatched from collected eggs	Hatched	Still in eggshells	Dead embryos	Unfert-ilized[c]	Destroyed in nest
20.05.98	15	opened 11.09.98		15							
26.05.98	12/13	left for overwintering	before 28.03.99	0	3 or 4		3		1	3	2
27.05.98	15	left for overwintering	28.03-03.04.99	6	8		1				
27.05.98	12	opened 11.09.98		10		0	0		1[g]	1[g]	
27.05.98	14	opened 11.09.98		10		0	0		0	14[g]	
28.05.98	11	opened 11.09.98		3		0	0		4[g]	4	
29.05.98	14	left for overwintering	28.03.99	4[e]	0		8		0	2	
29.05.98	15	left for overwintering	28.03-05.04.99	1	10		1	1	0	2	
29.05.98	23	left for overwintering			nest not found in spring 1999						
29.05.98	?	destroyed[d]									?
29.05.98	17	opened 11.09.98		0		0	0		12[g,h]	5[g]	
29.05.98	17	opened 11.09.98		0		3[f]	0		7[g]	7[g]	
30.05.98	18	opened 11.09.98		8		10[f]	0				
01.06.98	18	opened 11.09.98		0		1[f]	4		13[g,h]	0	
01.06.98	15	left for overwintering	[opened 16.04.99]	1			1	10	0	3	
02.06.98	?	destroyed[d]									?
04.06.98	16	opened 11.09.98		11		0	0		(2[h]+2)[g]	1[g]	

FIG 3. The roof of the nest of *Emys orbicularis* may collapse during the hatchlings' attempts to emerge, revealing neonates in a shallow pit; photo M. Rebis.

teer collaborators (Fig. 3); this pit was formed when the roof of the nest collapsed. Likewise, on 5 April we found one neonate from another clutch. Both nests showed signs that other hatchlings had emerged previously. On 16 April, one live neonate was dug out from a nest chamber and another one was found on a road.

The nest of the European pond tortoise has been described as "pear-shaped" (Zemanek, 1988; Andreas & Paul, 1998). We observed such a shape during the digging behaviour by females and when digging out of chambers in September, as well as during the spring in chambers without hatched eggs. The structure of the breeding chamber after overwintering was different, as described above. We suggest that when neonates try to emerge, they scrape off the soil from the roof of the nest and push it below them - a behaviour described also by Bannikov (1951). This behaviour results in a layer of eggshell fragments and unfertilized eggs that is covered by a layer of soil, and may cause the roof of the nest to collapse (Fig. 3).

Andreas *et al.* (1996) and Schneeweiss *et al.* (1998) wrote about early-season emergence from clutches (in March and April) after overwintering on land. In the Zwoleñka River valley, we found newly emerged hatchlings moving to water on 3 June 1992 and 23 April 1995, and two dead hatchlings on 25 April and 1 May 1995 (Mitrus & Zemanek, 1998; Zemanek, 1992).

Hatchlings of numerous turtle species occurring at lower latitudes in North America overwinter inside the nest chambers (Ultsch, 1989). Such behaviour is probably adaptive because it minimizes the exposure of hatchlings to predators in late summer and autumn, when little growth can be achieved (Gibbons & Nelson, 1975). However, hatchlings of Blanding's turtle *Emydoidea blandingii*, the species most closely related to the European pond tortoise (Burke *et al.*, 1996), seldom overwinter in the nest chambers because freezing is not tolerated by most Blanding's turtle neonates (Packard *et al.*, 2000). The data presented in Table 1 show that most of the hatched European pond turtles that remained in nest chambers for the winter 1998-1999 survived. However, in a nest laid on 1 June 1998 (Table 1, nest No 15), only two turtles hatched before the winter and all those remaining in their eggshells were found dead the following spring.

It is possible that in areas with a continental climate (for example, Dagestan) neonates do not stay in the nest but bury deeper into the soil (Bannikov, 1951), where temperatures during winter are higher, whereas in less severe climates they are able to overwinter in the nest (Kotenko & Fedorchenko, 1993; Servan, 1983 - in Servan, 1998). Our observations demonstrate that at the northern limit of the species' distribution, neonates are able to successfully overwinter in nests, at least in some years.

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