



**MINI ARRIBADA OF EUROPEAN POND TURTLE (*EMYS ORBCULARIS*)  
AT NORTHERN RANGE LIMIT IN THE SOUTHERN TAIGA ZONE.  
INVENTORY OF COMMUNAL NESTING AGGREGATIONS AND  
CONSERVATION OF THE BIGGEST EUROPEAN POPULATION  
(BELARUS)**

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**BACKGROUND**

Arribada is a large synchronous aggregation of the sea turtle females in preferred sites in a nesting season. The arribada is known only among sea turtles. Arribada, but in smaller quantity, recently has been found in European pond turtle (*Emys orbicularis*) in Belarus in the Pripyat River basin. On some open sandy hills from 5-15 to 50-70 (maximum - up to 300) females are coming. The area of local nesting sites equals 0.5-3 (up to 6) hectares, but clutch density quite often reaches 2-3/10 m<sup>2</sup>. Adult females come back to constant nesting sites annually. In preferred terrestrial nesting places, the females are accumulated from surrounding territory of 10-15 km<sup>2</sup>. They make long-distance water and land migrations (up to 3-4 km), when moving to habitual breeding ground. The reason of this phenomenon is not known. It is not known also about turtle orientation mechanism at migrations. The Pripyat River basin is explored very intensively as a result of human activities. Communal breeding sites of turtle are used as a sand source at construction of roads, dams, drainage channels. Many females perish during ground movements when crossing motor roads. Egg-eating predators (red fox, raccoon dog, and wolf) destroy up to 80% of clutches. The number of this population has reduced lately. Unique mini arribada of freshwater turtle in Belarus out of special measures will disappear in a near future.

**MATERIAL AND METHODS**

Data on breeding place distribution, number of nesting aggregations, and threat factors of the European pond turtle population in the Polesye region were collected from May to October 2006 and from April to May 2007 in basins of 8 largest rivers of this area: the Pina, the Gorin, the Stir, the Ubort, the Sluch, the Tremlya, the Bobrick, and the Yaselda (**Fig. 1**).



**Figure 1.** Distribution area and study area of European pond turtle in Belarus

**A** - current border of the range

**B** - study area

**C** - discovery point of largest nesting aggregation (more 250 female)

Searching for turtle nesting sites was conducted during an investigation on sandy hills which are located in radius not more than 3 km from water habitats of this species. For the finding of communal nesting place were used also turtle footprints and an eggshell of clutches destroyed by predators. A total 157 sites of open sandy hills around water habitats were surveyed where 37 nesting habitats of the pond turtle were found. The area of studied terrestrial landscapes composed approximately 45.5 km<sup>2</sup>.

The egg-laying period of the pond turtle in Belarus is very short, only 8-15 days, therefore the female number has been estimated accurately only in 3 big aggregations. The turtle abundance in other breeding places was calculated approximately on the data on nest number destroyed by predators. Route and length of female reproductive migrations between water habitats and nesting sites were estimated on results of visual observation and record points of marked individuals. Best time for counting of nesting females in breeding localities is an evening and nightfall from 5 till 11 p.m.

The individual marking of the turtle has been made using our method of a perforation of eight back marginal scutes of a carapace in different combinations (Drobenkov, 1992). Totally, 87 females have been met and marked. All caught turtles were measured, weighted, marked, and released at capture site in a short space of time. Routes and transposition length of egg-laying migrations of turtles were marked on large-scale maps.

In all breeding habitats we estimated microclimatic parameters, such as exposition, temperature of environment, soil moisture, as well as vegetation cover. The microclimate of egg incubation sites has been studied from May 15 till August, 30 in 3 nesting places with a regularity of 1 time per 7-10 days. Migratory course of turtle hatchlings was determined at visual observation from August 11 till August 30. Juveniles were marked by colour paints on the carapace. As predator-controlling agent we tested special equipment for a clutch protection, such as wooden grate (1.4x1.4 m) over egg-laying place. For turtle nest protection from predators in the 2007 a long cord with small red pennons (20 x 15 sm) has been also used.

## RESULTS

### Distribution and number of aggregations

Results of our research of 2006 and 2007 have shown that temporary aggregations of pond turtle females during nesting period are a character of life history of this species in the Pripyat River basin. Female breeding groups have been found in basins of all surveyed rivers, namely the Pina, the Gorin, the Stir, the Sluch, the Ubort, the Tremlya, the Bobrik, and the Yaselda. Surveys of reproductive sites indicate that the turtles choose usually collective habitats in all areas when single nests were comparatively rare. Generally, we found 44 nesting places which amount 19.4 % of all surveyed open sandy hills around turtle aquatic habitats.

Spatial localization of nesting habitats, habitat characteristics, and nest density in these areas was very similar. Biggest aggregations have been found in wetlands in the Ubort River basin, when most small nesting groups were registered in open secondary landscapes in the Pina water system. Female aggregations within the Polesye region include from 2-5 up to 73 specimens (**Tabl. 1**).

Preferred reproductive habitats of the pond turtle in study area are slopes of sandy hills with open soil or covered by lichens or grassy vegetation no more than 15-20% (**Fig. 2**).

**Table 1.** Results of nesting habitat and aggregation number estimation of pond turtle in basins of largest rivers of the Polesye region

River basin	Observed terrestrial sites	Nesting habitats	Area of nesting habitats, m <sup>2</sup>	Destroyed nests	Mean nest density, on 100 m <sup>2</sup>	Females
Pina	14	3 (6.8%)	45-380	2-4	1.6	2-11
Gorin	16	5 (11.4%)	120-1030	4-11	0.9	3-14
Stir	15	4 (9.1%)	250-1320	2-10	3.6	3-19
Ubort	25	12 (27.3%)	65-2200	3-26	6.8	5-73
Sluch	16	4 (9.1%)	150-1850	2-16	2.3	8-45
Tremlya	27	9 (20.5%)	90-3400	3-19	4.1	6-51
Bobrick	19	2 (4.6%)	180-2100	4-16	2.7	8-37

Yaselda	25	5 (16.7%)	150-490	2-7	1.9	4-25
Total	157	44				



**Figure 2.** Typical nesting habitat of *Emys orbicularis* in floodplain of small river in Poleskiy National Park

Rare trees or bushes often are present on hills. Sandy hills, moraine ridges and beach terraces are dominant group of habitats in swampy landscapes of the Polesye region (approximately 78%), when in an agricultural landscapes or other man-altered landscapes the turtle make nests on roadsides, dams of drainage channels, slopes of sandpits, edges and hills of fields.

By reason of short nesting period we had an opportunity to numerate female abundance only in 3 biggest nesting aggregations. We have estimated turtle number in the Bobrick, the Ubort and the Tremlya river basins, and they had accordingly 37, 73 and 51 specimens (**Fig. 3**).



**Figure 3.** Nesting group of the pond turtle females caught for one evening in the large aggregation in Tremlya River basin

The largest reproductive assembly of *Emys orbicularis* in Belarus and probably generally within all Europe, which include more 250 females, we found in 1993-1994 between the Borschevka and Mosani village in Hoiniki district, east part of the Polesye Region. This unique aggregation formed during last 15-20 years in protected territory of Poleskiy Reserve which has been organized in 1986 in Chernobyl reactor accident zone.

After finishing the breeding season from the middle of June up to the beginning of September for nesting place searching and a rough estimating of aggregation, we used egg pieces from turtle nests destroyed by predators. As show our research in many areas terrestrial predators destroy approximately 40% of all nests, therefore at calculation of female number we used average correction coefficient 2.5.

This method is inaccurate because influence of predators is different in different areas, however it enables to increase a research term and true number can be estimated later. During the summer 2006 we have found more than 620 destroyed nests. Some nests with undeveloped eggs and young hatchlings have been killed by foxes and other mammal species in April of a next year.

The majority of breeding places of pond turtle was situated between 230 and 1.2 km from the water bodies, but some aggregations were found on distance of 1.7-2.3 km and one locality was disposed far away, more 3 km. As a rule, females of largest aggregations had more long migrations because such collective nesting habitats include of turtles from more distant ponds.

### **Most important threat factors**

Around 78% (29 among 37) of all found collective nesting places of the pond turtle are located in a semi-natural landscapes and turtle population here declines because of various factors. The main human-related dangers can be combined in 3 groups: (a) exploitation of hills at sand extraction under construction of roads, dams, and drainage channels; (b) traffic on the roads crossing the ways of female migrations and hatchling dispersal; (c) an increase of predator number as a result of economic activities.

The predators such as a red fox, a raccoon dog, and a wolf are big threat for reproductive aggregations and population number and annually destroy approximately from 10-15 to 80% (on the average around 40%) of nests. This influence is not exclusively a natural factor because number of some species of terrestrial predators in the Polesye Region has much increased as a result of agricultural activity after drainage amelioration. At present a population of red fox has increased in 5-7 times in comparison with middle of the last century on account of increase of agrocenosis area and rodent number.

Results of man-made changes of environment in turtle reproductive habitats are:

(a) a steady decrease of survival of juveniles or total disturbance of self-reproduction of a micropopulation by reason of radical transformation of environmental conditions or nesting habitat destruction.

(b) an increase in female number perishing annually on breeding migration routes.

(c) an increase in death rate of the hatchings at big distance movement (on the roads, from predators, and other reasons).

(d) an increase in death rate of females at its searching of new nesting places.

The long-distance migrations of the pond turtle in the Polesye Region are a critical period of a life of the adult females and young specimens.

### **Conservation**

As a result of surveys on a vast territory in 2006 we discovered several large reproductive aggregations of the pond turtle which included from 30 up to 73 females. These communal habitats are located in the central part of the Polesye Region in the Bobric, the Ubort and the Tremlya River basin. For their protection and reservation, we have sent the proposal and package of recommendations about their management to the Ministry of Resources and Conservation of Republic of Belarus. Now we have some difficulties with reservation of one breeding place because this area is located in territory of fish-breeding producers' cooperative, but we hope that we will solve this difficulty.

Effect of egg-eating predators is one of the strongest factors of recruitment decrease of the pond turtle population within the Polesye Region, both in natural habitats and reserved areas. For the purpose of nest protection in collective breeding habitats and survival rate increase of juvenile turtles we used 2 methods: (a) clutch sites were covered by wooden grates; (b) a collective nesting area was enclosed by a cord with red tags. Field observation proved the high effectiveness of such means, but only during first 1-2 weeks after egg deposition.

Predators escape wooden grates and cords with tags, possibly, because of their smell and an unusual appearance (**Fig. 4**). Around such protected place we did not find the destroyed nests or predator tracks. These protective measures allow to an increase survival rate of young turtles approximately by 40%. Unfortunately, in some places few grates have been stolen by people after 2-20 days. In this connection these methods of nest protection are possible only in nature reserves or under special reliable protection of grates. However, as a whole, our research has shown high efficiency of special device use for clutch protection and increase of juvenile survival rate.

### **Conservation program**

Our study enabled to develop the principal ways of the pond turtle conservation in Belarus which is based on ecological features of its population. Environmental protection in mass nesting sites is the main current measure of population restoration in south part of Belarus, and this action is an alternative to traditional conservation of water habitats. The region still includes great number of ponds favourable for turtle life which are transformed at a lesser degree, than terrestrial areas. The largest reproductive aggregations of the pond turtle have survived only in wilderness areas, such as wetlands. In semi-natural landscapes a destruction of collective nesting habitats and spatial segregation of water and terrestrial habitats were the main reasons of turtle disappearance.



**Figure 4.** Wooden grates are an effective anti-predator device

The most important conservation actions are:

(a) Development of a network of micro reserves in the areas with large reproductive aggregations including 20-30 females and more.

(b) Prohibition of any economic activities and an implementation of regular control of environmental conditions in the large collective nesting habitats and their immediate surroundings.

(c) Special protection of the turtle nests in collective nesting sites for increase of young survival.

(d) Development and use of protective measures on seasonal migration routes in semi-natural landscapes, such as the bypass routs, special tunnels under roads, warning signs for drivers.

(e) Continuation of an inventory and reservation of collective breeding sites of turtle in other areas.

### **The origin reasons of turtle aggregations**

For studying of the reasons of an origin of *Emys orbicularis* reproductive aggregations in northernmost part of range we tested 3 probable hypotheses: (a) deficiency of preferred habitats for egg incubation in boggy and forest landscapes of the region; (b) higher temperature in collective nesting habitats which is necessary for successful development of embryos in area with a cold climate; (c) homing, i.e. return of mature females to birth places.

The preliminary results testify that principal reason of origin of the pond turtle nesting aggregations was the landscape features in the Polesye Region. This area is the big woodland in boggy lowland of the Pripyat River basin, which includes dense hydrological system, many bogs, rivers, lakes, and channels. The forests cover about 70% of the region and optimal habitats for turtle breeding are very rare. In our study areas only 2-3% of a territory was open landscapes, and nesting places present less 0.1% of total area. Forests or bushes always surround the water bodies; therefore, the females are compelled to migrate to the nearest open hills for the egg laying.

Belarus is located in northern part of *Emys orbicularis* range on the natural bioclimatic range border of all world-wide turtles. An embryonic development is one of the more critical periods of the turtle life history in the region; therefore, females specially choose the warmest sites of landscapes for reproduction. Such reproductive strategy, including a searching of preferred habitat, mass breeding migration of females, nesting site fidelity, and collective clutches in optimal habitats, probably, are behavioural and ecological adaptations of the pond turtle in extreme environments.

Our field observations show that the females make usually purposive movements to egg-laying places. The main direction of their migrations coincides with a hydrothermal gradient of environment which is directed from the lowest and humid sites to the highest and dry place of a landscape. During terrestrial movement the females regularly touch the soil by a neck. Such touches probably are the testing actions at spatial orientation.

We could not estimate homing effect because the pond turtle has the long-term period of sexual maturation. In Belarus the females mature only in 9-12 years age. According to our long-term research started in 1991 many breeding sites for 10-15 years had small changes therefore at migrations and spatial orientations the turtles can use visual marks (**Fig. 5**). However now we cannot confirm returning the young to birthplaces because of the lack of sure methods of hatching marking and high duration of such research. The data on migrations of various age females have shown that old specimens move to nesting places more

purposefully, when the young females frequently search for suitable places. It is possible also that old females remember last year's egg-laying place.



**Figure 5.** Female at seasonal migration to nesting site

## References

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