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Reintroduction of the European pond turtle using headstarted animals: is it possible?

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Abstract: The European pond turtle (*Emys orbicularis*) is endangered in many parts of its distribution area. Reintroduction programs are one of possibilities to protect of the species. However, survivorship of adult turtles is very high. Thus populations of such species are very sensitive on increase in mortality of adults (transferring adult individuals to other populations is tantamount to increase of mortality in parent population). Another chance is to use headstarted animals. I used life tables to model such possibility. Results of the studies indicate some essential problems with reintroductions using headstarted animals, e.g. results will be visible after long time, males will mature earlier, and large number of animals is needed. The real efficiency of such programs, however, also depends on behavior and fecundity of headstarted animals, factors that are currently not known. Reintroduction using headstarted turtles should still be considered experimental, and I am not in a position to recommend initiation of such programs.
Key words: *Emys orbicularis*, freshwater turtle, headstarting, protection.

Resumen: Reintroducción del galápago europeo a partir de individuos juveniles: ¿es posible? – El galápago europeo (*Emys orbicularis*) se encuentra amenazado en muchas zonas de su área de distribución. Los programas de reintroducción son una de las posibles alternativas de protección. Sin embargo la longevidad de las tortugas adultas es muy alta, por lo que las poblaciones son muy sensibles al aumento de mortalidad de los adultos (las translocaciones de unas poblaciones a otras equivalen a aumentar la mortalidad de la población parental). Otra opción es utilizar individuos juveniles criados en cautividad. Usando tablas de vida para la valoración, los resultados muestran algunos problemas esenciales de este tipo de reintroducciones como, por ejemplo, que los resultados sólo son apreciables después de largo tiempo, que los machos madurarán antes que las hembras y que se precisa un gran número de ejemplares. La eficacia real también depende de factores actualmente desconocidos como su comportamiento y fecundidad. La reintroducción usando juveniles criados en cautividad todavía debe ser considerada experimental sin que el autor esté en disposición de recomendar programas basados en ella.
Palabras clave: conservación, *Emys orbicularis*, galápago europeo, individuos juveniles.

Introduction

Populations of the European pond turtle, *Emys orbicularis*, are considered endangered in several parts of its range (Fritz & Andreas, 2000). Several countries have initiated active protection programs for this species (Mitrus, 2005). Currently, in some countries there are carried on reintroduction programs of the species (e.g. France, Cadi & Miquet, 2004) or such activities are planned.

The turtle is characterized by very high survival rate of adults (Girondot & Pieau, 1993; Mitrus & Zemanek, 2004). Thus

reintroduction of the turtle using adult individuals could be hazardous – exploitation of population of animals with very high survival rate of adults, even at low levels, would have long-term consequences for parent population (BROOKS *et al.*, 1991). And transferring adult individuals to another area is tantamount to increase of adults' mortality in parent population. Additionally, in Poland and other countries on northern part of the species distribution area, populations of the turtle are frequently small (e.g. MITRUS & ZEMANEK, 2004; PAUL, 2004), or we have no information about theirs size. Another possibility is using in reintroduction program headstarted animals. Headstarting is a technique which involves raising turtle hatchlings in captivity to an age of a few months up to several years, and then releasing them into a natural habitat. Such method probably would have smaller consequences for parent population than transferring adult turtles. Several actions of transferring headstarted turtles from eastern part of Poland to western and northern part of the country have been done. They have been unofficial activities mostly, and probably would turn out ineffective. During such programs each time from six to about 40 one or two year-old headstarted turtles have been transferred (cf. information described in MITRUS, 2002). Such activities could caused some problems, e.g. the turtles differ genetically in eastern and western part of Poland (LENK *et al.*, 1999). But the essential problem is how many young turtles we need to establish stable population in new area.

The objective of this study was to estimate of approximate number of needed headstarted turtles to using in reintroduction program in northern part of the turtle distribution area. Modeling such programs could also predict some risks of such programs.

MATERIALS AND METHODS

To analyze the efficiency of reintroduction program I used a life table prepared for the European pond turtle (cf. life table for turtle *Emydoidea blandingii* in CONGDON *et al.*, 1993) based on data from central Poland (Table 1). Survival rate of headstarted one-year-old turtles during the first year after releasing (the first year in natural condition), based on my experience and preliminary data (MITRUS, 2005), I assumed on 0.5. In central Poland no multiple nesting by one female during one season was observed (ZEMANEK & MITRUS, 1997; MITRUS, 2006), but clutch frequency is not known. However, it seems to

TABLE 1. Life history parameters of *Emys orbicularis* turtles in the Borowiec Nature Reserve (central Poland) used to construct life tables. The life tables were used in modeling reintroduction program.[1, 2]: MITRUS & ZEMANEK (1998, 2000),[3]: MITRUS & ZEMANEK (2004),[4]: MITRUS (2005),[5]: cf. preliminary data presented in MITRUS (2005),[6]: assumed the same value as for turtles in age 3-9 years (MITRUS & ZEMANEK, 2004).

TABLA 1. Parámetros del ciclo vital de *Emys orbicularis* en la Reserva Natural de Borowiec (Polonia central) utilizados en la construcción de las tablas de vida usadas en la modelización del programa de reintroducción.[1, 2]: MITRUS & ZEMANEK (1998, 2000),[3]: MITRUS & ZEMANEK (2004),[4]: MITRUS (2005),[5]: de acuerdo a los datos preliminaries de MITRUS (2005),[6]: asumiendo el mismo valor que para ejemplares de 3-9 años (MITRUS & ZEMANEK, 2004).

known parameters	
average clutch size	14 eggs [1, 2]
average age of female' maturity	15 years [3]
average age of male' maturity	11 years [3]
survivorship to age one	0.075 [4]
mean annual survivorship of turtles	
– in age 3-9	0.80 [3]
– in age ≥10	0.98 [3]
assumed parameters	
sex ratio	1:1
clutch frequency	0.9 clutch per year
migrations	0.0
mean annual survivorship	
– during the first season in nature	0.5 [5]
– in age 2:	0.8 [6]

be very high, and many females are frequently watched nesting during some consecutive seasons (ZEMANEK & MITRUS, 1997; MITRUS, 2006), thus I assumed the parameter on 0.9 a year. I assumed also that behavior, age at maturity, fecundity, and survivorship of headstarted individuals older then one year are the same as for wild turtles. Based on the above assumptions projected net reproductive rate is rather high, 1.47.

I calculated some scenarios, with arbitrarily taken different number of headstarted turtles headstarted turtles in cohort (each season from 25 to 250 turtles), for reintroduction program of arbitrary length of five years (headstarted turtles are released during five consecutive seasons). Arbitrary, I accepted destination size of population at about 100 turtles older than one year.

I calculated also how many clutches are needed to have possibility to release yearly 150 headstarted turtles. I assumed that to not disturb natural sex ratio to artificial rearing hatchlings should be taken after natural incubation. If the summer would be not worm enough eggs in late stages of development could be taken and move to artificial incubation. Thus, I assumed that also in colder seasons would be reproduction success. Nest survival rate I assumed as 1.0 (predation rate of nests is 0.0 in the model), because to take hatchlings to artificial rearing we need precise data about nests' localizations, and in such situation we could protect the clutches (for example using a method proposed by GRAHAM, 1997).

RESULTS

During reintroduction program (in which 150 one-year-old headstarted turtles are released each year during five-year-program) after about 45 years population of about 100 turtles older than one year are suspected (Fig. 1A). Maturity age is different for males and females, and males will start to mature earlier. Thus since 11 to 18 year since start of reintroduction program in the population will be higher proportion of males (Fig. 1B).

To have possibility to release 150 one-year-old headstarted turtles we need hatchlings from about 20-21 clutches (Table 2).

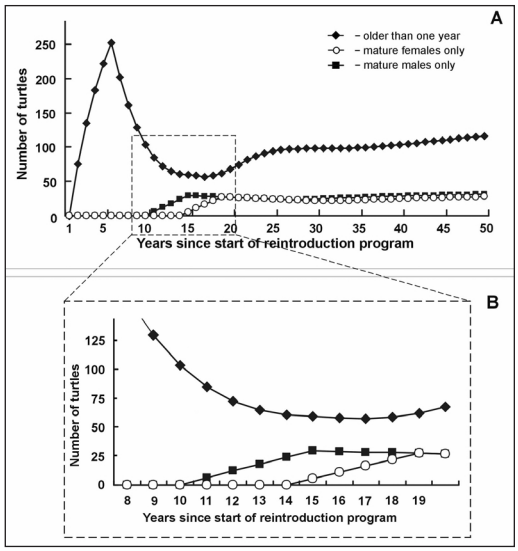

FIGURE 1. Turtles population projections for *Emys orbicularis* during reintroduction program using headstarted animals. Calculated using a model based on the life table based on data presented in Tables 1 and 2.

FIGURA 1. Proyección de las poblaciones de *Emys orbicularis* durante el programa de reintroducción usando individuos juveniles criados en cautividad. Los cálculos se basan en las datos incluidos en las Tablas 1 y 2.

DISCUSSION

Many parameters of life history for headstarted and wild the European pond turtles are not known, or known data are based on small probes (MITRUS, 2005). Thus to make analysis it is necessary to assume some parameters (Table 1). To analyze the efficiency of reintroduction program I used life table. This method does not take into consideration random incidents. However,

TABLE 2. Estimation of needed clutches to have possibility of releasing 150 one-year-old headstarted *Emys orbicularis* turtles a year.[1]: Assumed nest program protection. Actual data: 0.8 (MITRUS, 2005),[2]: MITRUS (2005),[3, 4]: MITRUS & ZEMANEK (1998, 2000).

TABLA 2. Estima de los nidos necesarios para la liberación anual de 150 juveniles de *Emys orbicularis* de un año de edad.[1]: Nidos del programa de protección. Datos actuales: 0.8 (MITRUS, 2005),[2]: MITRUS (2005),[3, 4]: MITRUS & ZEMANEK (1998, 2000).

Nest survival rate	1.0 [1]
Hatching success	0.61 [2]
Survival rate in artificial rearing	0.85 [2]
Survival rate to release (1.0 x 0.61 x 0.85)	0.52
Number of needful eggs (150 hatchlings per year/0.52)	~290 eggs
Mean clutch size	14 eggs [3, 4]
Number of needful clutches (290 eggs) / (14 eggs per clutch)	~20-21 clutches

using life history table it is possible to e.g. estimate of approximate number of turtles, as well as predict some risks of such activities.

Long-term perspective needed

The turtle mature in age about dozen years (GIRONDOT & PIEAU, 1993; MITRUS & ZEMANEK, 2004). So mature turtles which start to reproduce after dozen or more years since start of reintroduction program (Fig. 1A), and the first real effects of such reintroduction program could become visible after 20 or more years. Thus if in the future we will find that any of my assumptions is wrong, it could be to late to correct the reintroduction program.

Disturbed sex ratio

Age of maturity of males and females is different. Between about 11-18 years since start of reintroduction program in the new population probably will be disturbed sex ratio of mature animals (Fig. 1B). The analysis are based on mean maturity age only. In fact age of maturity is variable (MITRUS & ZEMANEK, 2004), so the effect could be no so strong. However, it is not possible to predict what will be in population with disturbed sex ratio (VOGT, 1994). I think that it is possible that young mature males will emigrate as they will not find mature females. Such emigrations could have strong influence on reintroduction program.

High density of headstarted turtles

I based my scenario on program carried on during some years only (releasing one-year-old turtles during five consecutive seasons). I not assumed that all the headstarted turtles will be release during one year, because of natural conditions during embryonic development, sex ratio could differ during some consecutive years (JANZEN, 1994). So releasing turtles from eggs from one seasons only could effect in disturbed sex ratio in new population (in extreme case in one season would be produced males only, or females only). What more, releasing 750 (5 x 150) one-year-old turtles in single season could effects on high density of young turtles. Such density could effects of increased mortality of the animals (JANZEN *et al.*, 2000) or their higher migrations from the area (GIBBONS *et al.*, 1990). Thus I think that better is to carry on such program during some consecutive years.

To limit the negative effects described above we can plan program on 10, 20 or even more years. But is such situation we could have different problems, e.g. it is more difficult to provide such long program with enough financial support, and effects will be visible after longer time since start of reintroduction program. I think that program of length of several years will be optimal (but –of course– after releasing phase it is important to ensure long-term monitoring program).

Number of needed clutches

For reintroduction program we need turtles from about 20-21 clutches each year during five seasons (Table 2). It is rather small number for large population. However, in northern part of the turtle distribution area most population are small. For example in Borowiec Nature Reserve live about 40 adult turtles (MITRUS & ZEMANEK, 2004). For such population it would be difficult to take hatchlings from 20 clutches a year with no negative effects for the parent population.

Other factors

We still have no information, for example, if fecundity and behavior of headstarted turtle is the same as wild turtles, as well no information about survival rate of headstarted turtles after longer time in nature (MITRUS, 2005). Thus real results are impossible to predict.

DISCUSSION

In conclusion, the reintroduction of the European pond turtle using headstarted animals should be considered experimental. I feel in a position to not recommend the initiation of reintroduction program using headstarted turtles. I think that for protection of the turtle (at least in Poland) more important is protection of known populations, and especially protection of habitat in which live turtles.

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REFERENCES

BROOKS, R.J., BROWN, G.P. & GALBRAITH, D.A. (1991): Effects of a sudden increase in natural mortality of adults on a population of the common snapping turtle (*Chelydra serpentina*). *Canadian Journal of Zoology*, 69: 1314-1320.

CADI A. & MIQUET A. (2004): A reintroduction program for the European pond turtle (*Emys orbicularis*) in Lake Bourget (Savoie, France): first results after two years. Pp. 155-159, *in*: Fritz, U. & Havas, P. (eds.), *Proceedings of the 3rd International Symposium on Emys orbicularis, Kosice 2002. Biología, Bratislava*, 59 (Suppl. 14).

CONGDON, J.D., DUNHAM, A.E. & VAN LOBEN SELS, R.C. (1993): Delayed sexual maturity and demographics of Blanding's turtles (*Emydoidea blandingii*): implications for conservation and management of long-lived organisms. *Conservation Biology*, 7: 826-833.

FRITZ, U. & ANDREAS, B. (2000): Distribution, variety of forms and conservation of the European pond turtle. *Proceedings of the 2nd International Symposium on Emys orbicularis, Le Blanc, 1999. Chelonii* 2: 23-26.

GIBBONS, J.W., GREENE, J.L. & CONGDON, J.D. (1990): Temporal and spatial movement patterns of sliders and other turtles. Pp. 201-215, *in*: Gibbons, J.W. (ed.), *Life History and Ecology of the Slider Turtle*. Smithsonian Institution Press, Washington, D.C.

GIRONDOT, M. & PIEAU, C. (1993): Effects of

sexual differences of age at maturity and survival on population sex ratio. *Evolutionary Ecology*, 7: 645-650.

GRAHAM, T. (1997): Effective predator excluders for turtle nests. *Herpetological Review*, 28: 76-76.

JANZEN, F.J. (1994): Climate change and temperature-dependent sex determination in reptiles. *Proceedings of the National Academy of Science of the USA*, 91: 7487-7490.

JANZEN, F.J., TUCKER, J.K. & PAUKSTIS, G.L. (2000): Experimental analysis of an early life-history stage: Selection on size of hatchling turtles. *Journal of Evolutionary Biology*, 13: 947-954

LENK, P., FRITZ, U., JOGER, U. & WINK, M. (1999): Mitochondrial phylogeography of the European pond turtle, *Emys orbicularis* (Linnaeus 1758). *Molecular Ecology*, 8: 1911-1922.

MITRUS, S. (2002): *Historia życiowa żółwia błotnego, Emys orbicularis - implikacje dla ochrony gatunków długżyjących*. PhD. Thesis, Jagiellonian University, Kraków.

MITRUS, S. (2005): Headstarting in European pond turtles (*Emys orbicularis*): Does it work? *Amphibia-Reptilia*, 26: 333-341.

MITRUS, S. (2006): Fidelity to nesting area of the European pond turtle, *Emys orbicularis* (Linnaeus, 1758). *Belgian Journal of Zoology*, 136: 25-30.

MITRUS, S. & ZEMANEK, M. (1998). Reproduction of *Emys orbicularis* (L.) in Poland. Pp. 187-191, *in*: Fritz, U., Joger, U., Podloucky, R., Servan, J. & Buskirk, J.R. (eds.), *Proceedings of the EMYS Symposium Dresden 96. Mertensiella, Rheinbach*, 10.

MITRUS, S. & ZEMANEK, M. (2000): Distribution and biology of *Emys orbicularis* (L.) in Poland. Pp. 107-118, *in*: Hödl, W. & Rössler, M. (eds.), *Die Europäische Sumpfschildkröte*. Linz: Land Oberösterreich, OÖ. Landesmuseum.

MITRUS, S. & ZEMANEK, M. (2004): Body size and survivorship of the European pond turtle *Emys orbicularis* in Central Poland. Pp. 103-107, *in*: Fritz, U. & Havas, P. (eds.), *Proceedings of the 3rd International Symposium on Emys orbicularis, Kosice 2002. Biología, Bratislava*, 59 (Suppl. 14).

PAUL, R. (2004): Population viability analysis and effect of conservation measures in *Emys orbicularis* in Northeast Germany using computer simulation. Pp. 191-200, *in*: Fritz, U. & Havas, P. (eds.), *Proceedings of the 3rd International Symposium on Emys orbicularis, Kosice 2002. Biología, Bratislava*, 59 (Suppl. 14).

VOGT, R.C. (1994): Temperature controlled sex determination as a tool for turtle conservation. *Chelonian Conservation and Biology*, 1: 159-162.

ZEMANEK, M. & MITRUS, S. (1997): Biologia i ochrona żołwia błotnego *Emys orbicularis* w województwie radomskim. *Chrońmy Przyrodę Ojczystą*, 53: 67-83.

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