

Reintroduction project of the turtle *Emys orbicularis* in Hesse (Germany): basic steps and first results

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Abstract: In 1998 a conservation project for the European pond turtle *Emys orbicularis* started in Hesse / Germany. The major aims of the project are: 1) clarify the situation and status of this species in the federal state Hesse, 2) protecting the natural habitat of *Emys orbicularis*, 3) establishing a breeding group of native haplotype IIa animals, and 4) finding suitable locations for reintroduction.

Management plans were elaborated in consideration of the requirements of this endangered pond turtle species and appropriate actions were arranged, for example improved nesting localities or enhanced basking possibilities. A captive breeding group of the native haplotype *Emys orbicularis orbicularis* was established in Zoo Frankfurt/Main. They were mainly feed with artificial gelatinous food in the first two years. At the age of 3-4 years the juvenile turtles were released with an average body mass of 200 g (108-435 g) and an average carapace length of 10.0 cm (8.0-12.9 cm). They were monitored by radio telemetry and direct field observation for collecting data on daily and seasonal activity and migrations to assess the success of the project. Capture-recapture documented an average gain of mass of 66 g (40-93 g) and an average growth of 0.99 cm (0.55-1.67 cm) after one year at the releasing site "NSG Hölle von Rockenberg". Since 2002, 89 juvenile turtles were released at five different localities, all of them behaved natural and grow well, so it seems to be no problem to use headstarted turtles for such projects. After five years of observation only one loss due to bites of a small mammal and the resulting infections was detected.

Key words: captive breeding, *Emys orbicularis*, headstarted animals, Hesse, reintroduction, telemetry.

Resumen: Reintroducción del galápago europeo (*Emys orbicularis*) en Hesse (Alemania): resultados preliminares. – En 1998 comenzó en Hesse (Alemania) un proyecto de conservación del galápago europeo (*Emys orbicularis*) cuyos objetivos principales fueron: 1) clarificar el status de esta especie en el estado federal de Hesse, 2) proteger su hábitat natural, 3) establecer un grupo de cría de haplotipo IIa nativo y 4) buscar las situaciones favorables para su reintroducción.

Considerando los requisitos de esta especie amenazada, se elaboraron planes de gestión adecuados, por ejemplo mejorando los lugares de anidamiento y asoleamiento. Se estableció un grupo de cría del haplotipo nativo (*Emys orbicularis orbicularis*) en el Parque zoológico Frankfurt / Main que se alimentó durante los dos primeros años de edad con comida artificial gelatinosa. A los 3-4 años se liberaron juveniles con pesos medios de 200 g (108-435 g) y longitudes medias de 10.0 centímetros (8.0-12.9 cm), a los que se realizó seguimientos por telemetría y observación directa valorando su actividad estacional y migraciones. Datos de captura-recaptura documentaron en "NSG Hölle von Rockenberg" ganancias medias de 66 g (40-93) y 0.99 cm (0.55-1.67) al año. Desde 2002, se han liberado 89 tortugas juveniles en cinco lugares diferentes constatándose su adecuado crecimiento que apoya el uso de juveniles en este tipo de proyectos. Tras cinco años de observación sólo se ha registrado una baja por mordeduras de un pequeño mamífero y la infección resultante.

Palabras clave: cría en cautividad, *Emys orbicularis*, Hesse, individuos juveniles, reintroduction, telemetry.

INTRODUCTION

The European pond turtle *Emys orbicularis* (Linnaeus, 1758) is the only native turtle species occurring in Germany. The German populations nearly became extinct, caused by numerous factors like exploitation as food resource, habitat destruction (especially the egg laying places), alteration and pollution of aquatic habitats. The introduction of foreign turtle species (e.g. *Trachemys* sp., *Graptemys* sp., *Chrysemys* sp., *Pseudemys* sp., and southern haplotypes of *Emys orbicularis*, mainly *Emys orbicularis hellenica*) causes further threat due to competition (GÜNTHER, 1996). As a result the European pond turtle is listed as endangered, critically endangered or extinct in nearly all federal states of Germany. In the federal state Hesse, situated in the middle of Germany (Fig. 1), *Emys orbicularis* was listed as status 1 (endangered, with serious consequences for the populations in Germany) (JÖGER, 1995). The only



FIGURE 1. Position of the state Hesse in the centre of Germany.

FIGURA 1. Situación del estado de Hesse en Alemania central.

well known small Hessian population in the "NSG Enkheimer Ried" near Frankfurt/Main turned out to be an hybrid population because it is mixed with mainly southern haplotypes (HANKA & JÖGER, 1998).

These alarming signals led into a project with the aim to rescue the European pond turtle in Hesse. In 1998, a conservation project was started to clarify the situation. At the beginning of this project, the actual distribution of *Emys orbicularis* in Hesse was unknown and no distribution maps existed at all. Historical records of the European pond turtle for this state are known (KINZELBACH, 1988). Consistently huge and very dark coloured European pond turtles were found there in climatic adequate regions, most of them could be classified by their morphological characteristics (FRITZ, 1996, 2003) as the native type *Emys orbicularis orbicularis*. Also the appearance of the turtles, e.g. carapaces with erosions, notches, etc did not affirm the assumption that they were escaped from captivity. Additional genetic analyses for all these turtles confirmed that they were native. The federal state Hesse and in particular the Rhein-Main region provides good climatic conditions for thermophile species, as the aesculapian snake (*Elaphe longissima*), the dice snake (*Natrix tessellata*), the green lizard (*Lacerta viridis*) and the wall lizard (*Podarcis muralis*) (GÜNTHER, 1996). North American turtle species like *Trachemys scripta* can survive in Hesse successful. Therefore no reasons seems to exist that a native turtle species could not tolerate the climate and survive there too. Relict populations of *Emys orbicularis* in Hesse can close the gap between the Danube and the Brenne populations.

A reintroduction project was conducted, based on the guidelines of the International Union for Nature Conservation (IUCN, 1995). The project was scientifically moni-

tored by radio telemetry. Radio telemetric monitoring is an internationally accepted and useful tool for conservation and reintroduction projects (KUCHLING, 2000; KENWARD, 2001). Monitoring with temperature-sensitive radio transmitters can provide a good survey of the preferred temperature range of the observed species, also other habitat preferences and special microclimate requirements (BROWN *et al.*, 1990; KING *et al.*, 1998; LITZGUS *et al.*, 1999; LITZGUS & BROOKS, 2000).

Here we present the concept of this project, the steps undertaken to start the reintroduction, the breeding programme and the scientific monitoring of the released European pond turtle.

MATERIALS AND METHODS

First actions

All governmental authorities, nature conservation groups and research institutes were involved in the project. All necessary permissions were obtained. A vast survey was conducted among all Hessian communities, numerous nature conservation groups and other groups with access to water, like fishing clubs, by sending them a special form. In this questionnaire we asked about any turtles in the surrounding water bodies, their number, the time and duration of observation, locality and if possible the species. All incoming reports were analysed and all relevant sites were checked to confirm the occurrence of *Emys orbicularis*. In case where observations of *Emys orbicularis* were confirmed, we tried to catch the concerning animals.

Haplotype analyses of every caught *Emys orbicularis* were carried out at the Institute of Pharmacy and Molecular Biotechnology at the University Heidelberg, Germany (method described in LENK *et al.*, 1997, 1999).

To inform the public about the mostly unknown only native turtle species and the

project to rescue them, talks were given and newspaper articles were published. As a main target of educational activity for turtle conservation, talks at school classes were given.

A special assessment (M. Gall, personal communication) was designed to value possible reintroduction sites in the whole federal state Hesse, taking into account the known requirements of the turtles, e.g. basking places, shallow water areas, egg laying sites etc. If necessary, management measures were taken, e.g. the vegetation of possible egg laying places were cut and additional basking possibilities were provided. Introduced exotic species like *Trachemys scripta* were caught to reduce competition at the reintroduction sites.

Breeding

A captive breeding program with turtles of the native haplotype IIa was established in cooperation with Zoo Frankfurt / Main, under permanent veterinary control. The hatched turtles were raised their first two years in an enclosure at Zoo Frankfurt/Main. They were feed with an artificial gelatinous food, especially made for turtles. When the juveniles were big enough (normally after two years), they were provided with an implanted microtransponder (AEG ID 162 FDX-B ISO Compliant) for further permanent and individual identification. Also all adult turtles became implanted microtransponders. For reading the transponder in the field, an Alvic Pocket Reader (Alvetra GmbH, Neumünster) was used.

A picture data set and a data collection of body mass, size and special characteristics, e.g. scute anomalies and injuries were compiled for all individuals.

For an additional acclimatisation period from one up to two years, the juvenile turtles were taken into an outside pond at Zoo Frankfurt/Main. The juveniles had to find here their own food, as they were not feed

there anymore and they had to hibernate in this pond.

Release sites

The nature reserve "NSG Hölle von Rockenberg" is a closed sandpit, with arid grassland vegetation (Fig. 2). The size of this area is approx. 13 ha. There are three bigger ponds, five smaller ponds and a few temporary pools. It is situated 40 km north of Frankfurt / Main, and is protected under FFH-Guidelines. It is closely connected with a second nature reserve, 200 m westward, with approx. 50 ha.

The nature reserve "NSG Reinheimer Teich" is situated 30 km south of Frankfurt / Main. Since 1626 it was used for fishponds, and since 1975 it is protected. The size of this area is 77 ha, and it is an important part of the FFH- reserve "Untere Gesprenzaue" (3231 ha). There are two central ponds and many smaller ones, the area is supplied by subsurface springs and a few ditches. New nature reserve signs were installed, with direct reference to the project and to inform the public locally.

The third area the nature reserve "NSG Nachtweid von Dauernheim" is situated in

the Wetteraukreis, north of Frankfurt/Main. It is a floodplain area with approx. 75 ha. There is a large renaturation project ongoing, the biggest in the state Hesse. The connecting river Nidda is actually renatured at a length of 3 km. As a conservation measure, the nature reserve is extensively pastured by cattle, to keep the area open, and provide a suitable habitat for endangered avian and amphibian species in Hesse. The number of ponds is depending on the season, in autumn and in spring most of the area is flooded normally.

The fourth area is also situated in the Wetteraukreis, the "NSG Nidderauen von Stockheim". It is a floodplain area (approx. 52 ha) of the river Nidder, which is connected to the river Nidda.

The fifth area, the "NSG Breitecke-Fulda", is a 580 ha natural flood plain region with very high biodiversity, situated near the rivers Breitbach and Fulda.

We paid attention that all release sites were close to river and pond systems to provide the turtles a good possibility of migration and dispersion.

Radio telemetry

Since 2002 data was collected in the "NSG Hölle von Rockenberg" and the "NSG Reinheimer Teich". Daily and seasonal activity was monitored by direct field observation and radio telemetry. Binoculars and a telescope were used for behavioural observation. For radio telemetry studies a receiver (26 k scanning receiver, Titley Electronics, Australia) and a three- element folding Yagi antenna (Wildlife Materials Inc., USA) were used. Two types of radio transmitters were specially designed by Ökokart, Munich, one common type of radio transmitters (3-5 g, 18-20 mm diameter) informs about the turtle's location and another temperature- sensitive one (4-6 g, 20 mm diameter) informs about location and temperature of the turtle.



FIGURE 2. Release site "NSG Hölle von Rockenberg".

FIGURA 2. Lugar de liberación "NSG Hölle von Rockenberg".

The temperature-sensitive transmitters were calibrated using a water bath against a certified mercury bulb thermometer ($\pm 0.1^\circ\text{C}$); temperature was increased by 2°C increments from 0 to 42°C . The period between pulses was recorded by taking the time to hear 10 pulses using a stopwatch. Temperature was interpolated from calibration curves for each transmitter. In the field every 15 minutes temperature measurements of the outfitted turtles were taken. Environmental conditions, like cloudiness, rain and sun were recorded simultaneously. Ambient air and water temperatures were recorded approximately every hour with an electronic thermometer (Tronic) to compare transmitter data with the environmental conditions. If possible, the behaviour and the exact position of the turtle was recorded for each radiolocation. Since 2005 digital data loggers (ibutton, DS 1921; Dallas Semiconductor) were also used to store environmental temperature data continuously. The radio transmitters were attached at the distal carapace with 2-component adhesive (Fig. 3). To fill the gap between carapace and transmitter a polyurethane foam was used. This filling and the flexible antenna prevents the turtles from getting caught in water plants etc. The turtles could be distinguished by transmitter frequency. For better identification by direct field observation, all turtles were individually numbered with acrylic paint.

At the age of three or four years the juvenile turtles were released at the reintroduction



FIGURE 3. Juvenile *Emys orbicularis* with fixed radio transmitter.

FIGURA 3. Juvenil de *Emys orbicularis* con un transmisor fijado.

areas. Since 2002, 89 juveniles were released (Table 1) at five different reintroduction areas, 27 of them were radio tracked, some of them over two up to four years. Altogether, a total of 45 radio transmitters were used.

Observations and temperature data collections were made throughout the year, the greatest intensity of fieldwork took place from April to October. Radiotracking took place up to six times a week in spring and summer, and 2-3 times in winter.

After hibernation it was tried to recapture the turtles with a special sun basking trap (Fig. 4) or by hand, to change the radio transmitters and to update the data of size, mass, possible injuries and possible algae growth. This new data were compared with previous data, and a new picture set was made. After collecting the data and outfitting the turtles

TABLE 1. Released juvenile *Emys orbicularis* since 2002.

TABLA 1. Liberaciones de juveniles de *Emys orbicularis* desde 2002.

	2002	2003	2004	2005	2006	2007	Total
"NSG Hölle von Rockenberg"	5	3	5	1	4	1	19
"NSG Reinheimer Teich"	4	1	8	5	13	1	33
"NSG Nachtweid von Dauernheim"			6		7		13
"NSG Nidderauen von Stockheim"					16		16
"NSG Breitecke"						8	8
All released turtles							89



FIGURE 4. Special designed sun basking trap.

FIGURA 4. Diseño de una trampa de asoleamiento.

with new transmitters, they were released at their capture place and a new observation period started. The highest observation intensity took place in "NSG Hölle von Rockenberg".

RESULTS

On the basis of the questionnaire a relict population of *Emys o. orbicularis* was found in southern Hesse. This population ("NSG Reinheimer Teich") was reported to NATURA 2000 (ELLWANGER, 2005). The intensive information of the public due to newspaper articles and short reports at local television programs, yielded into plenty notices and observations of turtles in the whole state Hesse and beyond its borderlines. In the last years nearly 80 found European pond turtles were brought to Zoo Frankfurt / Main.

The assessment of M. Gall (personal communication) to evaluate possible reintroduction sites, worked very well, only a few management measures (e.g. advanced basking possibilities with additional logs) were necessary.

The juvenile turtles showed good growth and health conditions after the acclimatisation period at the outside pond at Zoo Frank-

furt/Main, what became noticeable in width annual growth rings and gain of mass and size (Fig. 5)

The average release mass of the juvenile *Emys orbicularis* was 200 g (108-435 g) and the average carapace length was 10.0 cm (8.0-12.9 cm). Nearly all turtles (18 / 19) stayed at the releasing site "NSG Hölle von Rockenberg", at "NSG Reinheimer Teich" the turtles attempt a few migrations to unaccessible (for the observer) areas, but stayed in this nature reserve. The preferred basking places were logs and rocks in the water. At the "NSG Hölle von Rockenberg" 50% of all observed basking activities ($n = 735$) took place on logs. In spring they also basked on broken reeds but this basking possibility vanished within the growing period of the plants. The highest intensity of sun basking occurred in the mornings between 9 and 12 h, depending on the season. The turtles showed, as expected a high escape distance, but they get used to the observer. When they were disturbed by the observer, they escaped into the water, but returned on their basking places after a few minutes. In the "NSG Hölle von Rockenberg" in 2005 two mute swans (*Cygnus olor*) attacked the turtles, while there were basking at a log in the middle of the pond. The swans

FIGURE 5. Growth rings of released juvenile *Emys orbicularis*FIGURA 5. Anillos de crecimiento en un juvenil liberado de *Emys orbicularis*.

stayed in this area until October, and the turtles could not use this log anymore for sun basking.

Nearly all radio tracked juvenile turtles preferred shallow water areas for hibernation. In these shallow water areas the water depth was only between 20-50 cm. There, the turtles favoured places between reed (*Phragmites communis*) or cattail (*Typha angustifolia*). 55% of all recorded hibernation events ($n = 20$) took place in the same 6 m long reed region. During hibernation the turtles were quite stationary. If there had been any movement it must have been minimal and could therefore not be detected by radio telemetry.

The hibernation period (defined by the last observation and / or last change of place detected by radio telemetry) started in October and ended in mid March / early April.

Capture-recapture data showed a considerably gain of mass and size of the released turtles. One year after release the turtles in the releasing area "NSG Hölle von Rockenberg" gained an average of 66 g (40-93 g) and grew an average of 0.99 cm (0.55-1.67 cm).

Until now, only one injured turtle was found in "NSG Hölle von Rockenberg" in May 2007. This animal was bitten by a smaller mammal (we assume a rat or a marten), and the infections due to this bites resulted in the death of this turtle.

Since today, no reproduction of the released turtles occurred, only a few unsuccessfully mounting attempts were recorded as the females are not old and large enough yet.

DISCUSSION

The federal state Hesse in the middle of Germany provides good climatic conditions for thermophile organisms. There are some relict populations of the aesculapian snake (*Elaphe longissima*), the dice snake (*Natrix*

tessellata), the Green lizard (*Lacerta viridis*) and the wall lizard (*Podarcis muralis*) (GÜNTHER, 1996). Also illegally released exotic turtle species, like *Trachemys scripta*, *Graptemys ssp.* or *Chrysemys picta*, do survive here. There are no doubts of the climatic requirements for a survival of *Emys orbicularis* in Hesse. Repeatedly adult, dark and big European pond turtles were found in climatic adequate regions in Hesse, who can be classed by their morphological characteristics as *Emys orbicularis orbicularis* (FRITZ, 2003). The finding of the small relict European pond turtle population in southern Hesse, underlined the assumption that *Emys orbicularis* can survive in Hesse. Even though Hesse is a densely populated region, it could not be excluded that there are still scattered surviving relict populations. It was mentioned by FRITZ *et al.* (2004) that it is unlikely that *Emys orbicularis* populations exist without having been detected, but e.g. observations of turtles in the region of the Reinheimer Teich exist since at least the early 60's (Klein, personal communicatio). Most of the people not even know that Germany has a native turtle species and often they were taken for North American turtle species, because they are common as a pet. The European pond turtles are very shy and they have a very high escape distance, therefore they are not easy to detect in the field. More work must be done to improve the knowledge of the public, e.g. talks at schools or kindergarten, and by newspaper articles. Only a well informed public will support such a long-term nature protection project. The unbroken delivery of newly found European pond turtles at Zoo Frankfurt / Main showed impressively the benefit of a well informed public.

All released turtles used the basking places in the chosen reintroduction sites as expected and the provided additional basking possibilities (here logs) were used permanent-

ly. Only at the "NSG Hölle von Rockenberg" two mute swans (*Cygnus olor*) caused a problem in 2005, because the turtles could not use a preferred basking log in the middle of the pond not anymore. But they had a lot of other possibilities, e.g. small logs in-between the reed were they could bask. The observation shows that the turtles used the provided basking places with individual and seasonal frequency. It seems that many different basking and hiding possibilities enhance the familiarisation of the juvenile turtles at the new habitat. The number of turtles (18/19) who stayed in the release site "NSG Hölle von Rockenberg" underline this.

The acclimatisation and hibernation period from one up to two years at the outside pond at the Zoo Frankfurt / Main seems to be a very good preparation before release. The good growth and health conditions of the juvenile turtles at this outside pond showed that there is no need to teach them how to find food and what to eat. The considerable increase of mass and size of the released turtles at the chosen release sites emphasised this impressively. Therefore the artificial gelatine food, which was used to raise them, seems to be no problem at all. It is not necessary to feed them with only natural (living) food items. These natural food items often have very low nutrients and result in slower growth rates of the turtles (MITRUS & ZEMANEK, 1998). As an technical disadvantage you have to catch or rear this food items too. The optimal design of artificial gelatine food especially for turtles with all necessary vitamins, minerals and nutrients prevent the juveniles from diseases which occurred in a comparable study (MEESKE *et al.*, 2000) where the juveniles were mainly feed with slices of brown trout (*Salmo trutta fario*) and larvae of insects. Further advantages of this artificial gelatine food is the easy production (of big amounts), the specific composition, the good storage

(freezable) and the good and easy dosage (sliceable). The high survival rate (only one loss after 5 years) of the released turtles demonstrates that good starting conditions ensure the success of the reintroduction. It seems to be no problem to use headstarted animals for a release project, if there is a good preparation and the released turtles are big (or old) enough. The results of your study showed that it is definitely useful to use headstarted turtles for such releasing projects. There are no detectable negative effects as a result of the breeding program, all released turtles behaved naturally and a high survivorship with good growth was recorded. Releasing programs with headstarted turtles should not longer be considered as experimental (MITRUS, 2008) but rather as an important and superior tool to prevent species from extinction.

We know that a breeding program like this one is very time and cost intensive, and only a good equipped breeding facility (like in our case the Zoo Frankfurt / Main) can afford this. Feeding with artificial gelatine food and breeding in additional outside ponds can minimize the costs and work.

The most important disturbance factor in field were people with loose dogs or people who disobeyed the protected area signs. In the "NSG Reinheimer Teich" new nature reserve signs were tested, with a lot of information for the visitor. It seems that this new signs worked better, because less people left the lanes and less loose dogs were seen. It is planned to use this kind of signs in all other release areas.

All results of the scientific monitoring of this reintroduction project will flow into management concepts for an improvement and a better protection of the established areas and the released turtles. The search for new habitats that could be used for a reintroduction of the European pond turtle in Hesse will be continued. First clutches in the wild are

expected in 2009. It is planned to release nearly 500 turtles in the next seven years, if possible at ten different localities, in Hesse. So we ensure that viable European pond turtle populations can be re-established in the federal state Hesse.

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