Save Europe's oldest Reptile and Amphibians

Best Practice Guidelines

LIFE-NATURE Project LIFE/LT/000094 "Protection of the European pond turtle and amphibians in the North European lowlands"

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Introduction

NERIJUS ZABLECKIS, EXECUTIVE DIRECTOR
LITHUANIAN FUND FOR NATURE

The European pond turtle is a very threatened species mainly due to the loss of suitable habitats. Therefore the species is under strict protection in the European Union and is included in Annex II and Annex IV of the Habitats Directive 92/43/EEC (Conservation of Natural Habitats and of Wild Fauna and Flora). In the North European lowlands an ongoing decline of the Fire-bellied toad (*Bombina bombina*) is known for similar reasons like for the turtles and is also presumed for the Great crested newt (*Triturus cristatus*). In particular, the extreme climatic conditions in the North European lowlands make the life conditions for reptiles and amphibians more difficult there. As the European pond turtle is notably endangered in the northern border of species distribution in Lithuania, Poland and Germany, the herpetologists, ecologists and conservationists from these countries started cooperation and experience exchange on protection of pond turtles in 2004. The focus was also set on threatened amphibian species, e.g. Fire-bellied toad and Great crested newt, since they mostly occur together in the same habitats. Thus, the team was joined by herpetologists from Denmark, who have long-standing experience in habitat management.

Joint work resulted in the LIFE-NATURE Project LIFE/LT/000094 “Protection of the European pond turtle and amphibians in the North European lowlands” partly financed by the European Commission. The project started in 2005 and was run for 5 years. The total budget of the project - 2,346,185 Euro.

The aim of the project was to increase the long-term viability of the last turtle and threatened amphibian populations within their distribution range in lowlands of Lithuania, Poland and Germany through habitat restoration and management of populations.

Further objectives of the project have been:

- To save the small and isolated populations of Fire-bellied toad and Great crested newt from extinction in the project sites;
- To exchange experience among involved personnel;
- To educate local inhabitants and involve them in species protecti on activities;
- To write a concluding best management guide on the basis of the experience obtained.

The project team with guest during international workshop

During project duration different types of activities were accomplished:

- Preparatory actions e.g. developing monitoring methods and defining the favourable conservation status for turtles and amphibians, evaluation of ponds, turtle hibernation and nesting sites, creating action and local management plans as well as genetic investigations
- Purchase/lease of land and/or rights e.g. buffer zones and compensation
- Non-recurring management e.g. pond restoration and digging, creation of nesting and hibernation sites for turtles, installing a sustainable grazing regime, etc.
- Recurring management e.g. management agreements, rearing of turtles and managing foraging habitats
- Public awareness and dissemination of results e.g. education of experts and local communities as well as producing of educational material
- Overall project operation (project management) and monitoring effects of project actions

The best practice guidelines at hand are based on actions and results of conservation activities for the European pond turtle, the Fire-bellied toad and the Great crested newt during the LIFE-NATURE-Project LIFE05NAT/LT/000094. It presents the project species, their conservation status, as well as some selected important habitat requirements of the European pond turtle. Further, it provides examples of habitat management measures with technical recommendations and describes experiences in public awareness raising.

The project has been coordinated by Lithuanian Fund for Nature, actively acting in nature conservation in Lithuania. The project had even 11 partners from all three countries. From Lithuania: the administrations of protected areas: Zuvintas Biosphere Reserve, Veisiejai Regional Park and Meteliai Regional Park, and Nature Heritage Fund; from Poland: Polish Society for Protection of Birds, Naturalist Club, Bialoweza National Park and General Directorate of Forestry in Olsztyn; from Germany: Society for Nature and Species Protection - Agena, Landschaftsförderverein Oberes Rhinluch e.V. and Georg August University of Goettingen. Additionally, Consulting company “Amphi Consult” was contracted as overall project consultant. Available experiences from other LIFE and conservation projects concerning improvements and creation of habitats for threatened reptile and amphibian species were used as a basis for this project.

I sincerely appreciate the work and effort of the members of Project team without whom the project would not have been implemented, especially thanks to Lars Briggs, Lars Christian Adrados, dr. Martina Meeske, Norbert Schneeweiss, Heidrun Beckmann, Mariusz Rybacki, Iwona Mirowska Ibron, Renata Krzy ciak-Kosi ska, Stanislaw D browski, Ar nas Pranaitis, Irma Ma iulevi ien , Irma Kondratavi i t .

The European pond turtle Emys orbicularis (LINNAEUS, 1758)

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The European pond turtle is distributed from Northwest Africa over most of Europe and Asia Minor to the Aral Sea in Central Asia (Fritz 1995, 1996, 2001, 2003, Fritz & Günther 1996). In the three project countries Lithuania, Poland and Germany the species exists at the northern boundary of the distribution (Fritz 1995, 1996, Fritz & Günther 1996). At the moment about 14 subspecies can be distinguished (Fritz 2001, 2003). Big differences concerning biology and ecology can be recognized between the subspecies. In Lithuania, Poland and Germany, the subspecies *Emys orbicularis orbicularis* exists.

Description

Emys orbicularis can live more than 50 years and sometimes even up to 100 years in the northern range of the species distribution. The species is a medium-sized turtle with size variation across its distribution (12 - 20 cm length). The females of the northern species range have carapace length of 14 - 20 cm and weight of 600 - >1000 g. Usually, males are a bit smaller with carapace length of 13 - 18 cm and weight of 500 up to more than 700 g. In general, bigger individuals are the ones, which are older. Hatchlings have carapaces with a length of 2 - 3 cm and weight of 4 - 6 g.

European pond turtle

During the first 8 years of life turtles grow most quickly. *Emys orbicularis* interrupts its growth during winter time wherefore growth rings form on their carapace. Hence, the age of turtles can be estimated by counting growth rings up to an age of 20 or even 30 years.

The carapace is oval and rather flat, black with yellow spots. Plastron is predominantly black with smaller yellow parts. Extremities, neck and head are dark brown or even black coloured with yellow spots. Very old turtles can exhibit melanism. *Emys orbicularis* is a long-tailed freshwater turtle species. The tail of adults can reach half of their carapaces. Males and females show a distinct sexual dimorphism.

Basking is an important behaviour of pond turtles due to the poikilothermy of the species. Accordingly, the animals require water bodies with sun exposed places for basking e.g. shores, tree trunks, shrubs, deadwood, or foliage plants e.g. sedge tufts (*Carex* spp.) and cattail (*Typha* spp.) for obtaining solar energy, especially after hibernation, during reproduction period, and for growing of juveniles. Males require more energy for activities during mating period, and females for developing eggs. Turtles in the northern ranges, where summers are short, also have to use solar energy more intensively than turtles in South-Europe. With the help of a higher body temperature the metabolic rate is raised. The higher metabolic rate accelerates the process of accumulating reserve storage for the long winter time. Consequently, the availability of suitable basking sites can be even a limiting factor in the northern species range.

Because of its biology *Emys orbicularis* can feed only in water, therefore it is completely dependent on water bodies. The food of the turtles consists of invertebrates and their larvae, tadpoles and adult amphibians as well as carrion. Juveniles and adolescents consume a low proportion of plants too.

Habitat

Emys orbicularis requires aquatic and terrestrial habitats.

Emys orbicularis prefers mudy and highly structured water bodies

Aquatic habitats

European pond turtles prefer stagnant and slow running highly structured water bodies with muddy ground e.g. meadow and forest ponds, swamps, higher bogs, fens, coves of shallow inland lakes, back water of rivers and fens. They use ditches, channels and seasonally partly flooded wetlands for short-term stays and as migration routes. The animals also live in artificially created ponds, such as farm, village and fish ponds. Usually individuals occupy smaller and bigger permanent or temporary ponds (50 up to > 5000 m^2). These ponds can have different functions for turtles e.g. as summer-, breeding-, hibernation-, short-term-stay- or all-year-round pond. Highly structured ponds with abundant submerged and floating aquatic vegetation (e.g. *Potamogeton spp., Nymphea alba, Spirodela polyrrhiza, Typha latifolia* and/ or *Acorus calamus*) offer suitable hiding and feeding sites for the shy species. Other pond structures such as bushes and trees on the shore extending into the water as well as deadwood are useful as hiding sites in autumn, winter and early spring.

Smaller temporary ponds with a depth of 40-50 cm and with abundant vegetation are especially favoured by hatchlings and very young juveniles because of the higher water temperatures, abundance of suitable prey, less competition and more hiding sites to avoid predation. These factors allow good growing possibilities. They also help to develop swimming abilities, as hatchlings are bad swimmers and divers during the first weeks of their life. When small temporary ponds are situated close to the nesting sites they are very useful not only for the recently hatched juveniles, but also for resting and hiding of migrating females. The occurrence of suitable ponds can be a critical factor for survival of the hatchlings, because the northern populations of *Emys orbicularis* have a low reproduction rate and the survival of the northern juveniles is very important for the viability of the populations.

The availability of different types of water bodies with their resources e.g. food supplies, basking or hibernation sites have to fulfil all requirements for males, females and juveniles throughout the year. Hence the pond systems with various pond types have to be very appropriate for local populations of *Emys orbicularis*.

Terrestrial habitats

European pond turtles need also terrestrial habitats i.e. open sunny hilly areas for their nests. Especially in the northern species' range the ecological re-

quirements of nesting areas are eminently high. The most suitable are places with sandy or sandy loamy ground e.g. sandy dry grasslands with lower vegetation cover. Also, the slopes in the egg-laying places have to be exposed to the Southwest, South or Southeast; the slope inclination can be either slight or strong, it can be even flat. Nearby forest edges and hedges are very suitable as a wind break. The favourable microclimate in small places can determine a successful reproduction in areas with unfavourable climate.

Population biology

The population structure of *Emys orbicularis* is still insufficiently investigated, but in the view of the different habitat requirements it is assumable that the species can exist in a system of different local populations like meta-populations. Several places with different local populations can still be found in areas with smaller disturbances and less habitat destructions in Lithuania. Today, critical factors for the survival of the last northern turtle populations are the loss of habitats and the ecological connectivity as well as the small sizes and the increasing isolation of the local populations.

Population status:

(see chapter "Favourable conservation status for Emys orbicularis")

Individual Distribution:

Normally during the hibernation period turtles stay close together in small places e.g. in permanent hibernation ponds, while in late spring and summer the individuals spread upon different parts of bigger ponds as well as upon different ponds within a pond system (Meeske 2006). Particularly if ponds are not suitable for a local population all year round, animals change to different ponds in summertime.

Population size and density

Some of the Lithuanian populations have a small number of individuals (< 50); most of them have a very small number (< 20). Populations in the German, West- and Northeast-polish areas are very small (< 20). Population sizes are dependent on habitat size and quality. Consequently, systems of water bodies with their supply of nutrients, sites for thermoregulation, hiding and hibernation for juvenile and adult turtles are restricting factors (Meeske 2006, Meeske et al. 2006). On the other hand the lack of suitable nesting sites prevents successful reproduction and has a negative impact on population sizes, too.

The individual density of populations is low (less than 1 animal/ha), but such densities are typical for populations near the northern boundary of distribution (Meeske 2006).

Sex ratio, age structure and juvenile share

Normally populations in the North European lowlands have a surplus of females [sex ratio Lithuania: 1 : 3,1 (Meeske 2006); East-Poland 1 : 4 (Jablonski & Jablonska 1998)]. Besides, northern populations are often more or less over-aged. The longevity of the northern turtles is one reason for the "over-aged"- situation (Meeske 2006). Population in the northern species range have mostly a small number of juveniles (up to 20 %) (Meeske 2006).

Mortality and predation

In general the natural mortality and the natural predation rate of adults is low e.g. 3-5 % (comp. Meeske 2006). The predation rate on juveniles (especially younger than 3 years) and on nests (more than 70% of the clutches) is much higher (Meeske 2006) than on adults. Possible predators are foxes (*Vulpes vulpes*), racoon dogs (*Nyctereutes procyonoides*), racoons (*Procyon lotor*), wild boars (*Sus scrofa*), badgers (*Meles meles*), martens (*Martes martes, M. foina*), polecats (*Mustela putorius*), and minks (*Neovison vison*) (comp. Meeske 2009). However, invasive species e.g. racoons (*Procyon lotor*) in East-Germany can seriously raise the predation pressure on adult turtles too. A high predation rate can be very harmful or even crucial for small and isolated populations due to the lack of reproduction success (Meeske 2006).

Reproduction

Mating

After hibernation the mating period starts in March or April and lasts 2 or more weeks. Turtles favour shallow water for mating.

Nesting

4-8 weeks after mating the nesting season begins. Usually it begins in the end of May and lasts 2 or 3 weeks up to the middle of June. During this period females leave the water bodies and move on land several hundred meters up to several kilometres to find a suitable nesting site. Some animals show strong nesting site fidelity and use the same site for several years.

Normally females reproduce once a year and pro-

duce an average number of 12-14 eggs (maximum clutch sizes: > 20 eggs). Due to the strong requirements for suitable nesting sites in the northern boundary of distribution, the availability of nesting sites is a critical factor for the species survival here.

Incubation and reproduction success

Start and duration of incubation depend on weather conditions. Usually northern incubation takes about 3 months. The hatchlings begin to leave their eggshells in the end of August or in September. Some of them leave the nests too, but most of them remain in the nest cavity for the first winter and come out next spring or early summer. After leaving the nests the hatchlings move to the water habitats. In cold summers with low temperatures the development of the embryos is prolonged, sometimes the embryos can even die off. In cold winters without a sufficient cover of snow the young turtles freeze to death. An adequate temperature sum in summer and suitable conditions in the following winter are needed for a successful reproduction in the northern boundary of distribution. Therefore reproduction success is strongly dependent on temperature conditions and is not possible yearly.

The strategy of the northern populations is a long reproduction phase and a long life in order to compensate foe the low reproduction rate and the delayed sexual maturity (males > 10 year, females 12-20 years).

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Female laying eggs

The fire-bellied toad
(*Bombina bombina*, LINNAEUS, 1761)

DALIA BASTYTE

The fire-bellied toad is a small, furtive toad difficult to notice during a large part of the year. In spring, however, when mating season starts, the melodic chorus of these amphibians delights the ones who have a possibility to visit breeding habitats of fire-bellied toads. *Bombina bombina* belongs to one of the most ancient anuran genera; therefore this toad has particular demands for its habitat.

Description

Bombina bombina is a pear-shaped brownish or greenish warty toad. Its distinctive feature is its belly spotted with fiery red and black spots. The spotted pattern is unique for each individual and can help to distinguish one toad from another. The bright colours come in useful: when attacked the toad makes the so-called unkenreflex posture – bends so that the fiery colours of the limbs-underside would whisk away a predator.

Toad's eyes are situated rather high on the upper side of the head indicating that the toad is adjusted to the life in aquatic environment. It has shorter hind legs than evolutionary higher developed frogs of the genus *Rana*, which means that jumping movements are short in comparison with *Rana sp.* The toes on the hind feet are webbed.

Bombina bombina is the smallest toad in its genus – it rarely attains more than 5 cm in length. It lays eggs in batches of 15 – 40 eggs. In total during one season one female lays 200-500 eggs. The mean diameter of an egg without jelly capsule is 1.49 mm. The eggs can be recognised from the small batch size and a typical way of attaching a batch to vertical water vegetation 20 - 40 cm below the water surface. The egg laying dance looks as follows: the female catches a vertical plant stick with the front legs and the couple swirl-dances around the stick while attaching the egg clutch. Tadpoles of *B. bombina* can be distinguished by their high reticulated tail fin, two longitudinal dark stripes on the dorsal side, and a blue belly. Tadpoles grow up to 45 mm length. The toadlets after metamorphosis are 10 – 23 mm length. The dorsal side already has the same pattern as it will have during the whole life, but ventral side becomes spotted only after a few months. After the second hibernation the toadlets feed intensively and might reach adult size.

B. bombina tadpoles graze upon the surface of macrophyte stems, feed on algae, bacteria and protozoa.

The fire-bellied toad

When scared Bombina shows its belly

Fire-bellied toad

Adult toads are predatory. They feed on invertebrates and their larvae, i.e. various insects and their larvae, especially mosquito larvae, oligochaete worms and snails. All food has to be snapped, because the toad has only a short tongue.

Habitats

Bombina bombina can breed only in the water, therefore it is completely dependent on the presence of suitable water bodies. However, besides aquatic habitats the species also needs terrestrial habitats. *B. bombina* migrates between these habitat components and thus it is possible that from 5 to 6 migrations between habitat components happen from early spring to late fall. Sometimes one pond can contain all the necessary pond habitat components, which alleviates the migration.

Aquatic habitats:

Ponds near hibernation places

It is an advantage for the survival in early spring that the toads have as short distance as possible from a hibernation place to a pond where they find sunny shallow zones for warming up and some food before migrating to the breeding ponds. Especially the shallow warm water areas are important for the incubation of eggs and thus for the success of reproduction.

Breeding ponds

For breeding *Bombina bombina* prefers shallow temporary ponds (30-100 cm), which do not dry up until the end or at least the middle of the summer. These ponds have to be spacious enough for the males to select their territories. Preferably these ponds should have some vertical vegetation, on which the females can attach the eggs. The breeding ponds must be fully exposed to the sun and preferably sheltered from the wind because the tadpoles require warm water (>20°C) to complete their development. There must be densely vegetated areas where the toads and tadpoles can hide from predators as well as zones with open water.

In the northern part of its distribution range *Bombina bombina* breed both in smaller and in bigger ponds (50-10.000 m^2) with submerged and floating plant cover. For example, the toads reproduce in sub-

merged meadows where water has flooded terrestrial vegetation and formed small and shallow temporary ponds. Often *B. bombina* occurs in the village ponds. Also the species forms big populations in the fish-breeding-ponds, which are much bigger and deeper. It was noticed that *B. bombina* used ponds with different forms and structures. The existence of shallow and sun-exposed water-zones is of vital importance. Also important is an absence or low abundance of predators (especially fish). The species prefers ponds, which are extensively grazed, not shaded (the toads were not observed breeding in shaded ponds). But it is an advantage to have a forest in the close neighbourhood (up to 50 m) and other ponds in 100 – 200 m distance, as wet deciduous forest is known to be a late summer foraging site. Besides, burrows and cavities in a dry deciduous forest can be used as hibernation sites.

Foraging ponds

After the breeding season the toads often migrate to forage in other ponds. Foraging ponds are often partly overgrown; sometimes they are also partly shaded. Ponds with different vegetation zones, dead tree trunks and without fish are the most suitable for foraging.

Terrestrial habitat

The toads migrate to the terrestrial habitat in the second half of the summer, usually between July and September. They seek shelter and food in moist fen and meadow-like terrestrial habitats, which are sun-exposed due to natural conditions or due to management such as grazing or mowing. Another terrestrial habitat used later in the season especially when hibernation time approaches is forest with fallen trees or stone fences and hedgerows. Often the terrestrial habitat offers places where the toads can warm up in the sun or under wood and stones that are warmed up by the sun.

Hibernation places

Normally *Bombina bombina* hibernate from October to April. They choose drier terrestrial habitats that never flood during spring and that are frost free during winter. These can be different burrows and cavities in a forest, or more anthropogenic places like gardens, hedgerows, stone fences, embankments, stone piles or house cellars.

Movements and population ecology

B. bombina needs several types of aquatic and terrestrial habitats, therefore 5 – 6 migrations can occur from early spring to late fall. The migrations usually are short, only of 100- 500 m length, only sometimes reaching up to 2 km. However, some individuals, especially young ones, tend to migrate in search for better habitats between the populations (it might be one of the reasons causing high mortality rate). The genetic estimates have shown that dispersal rates of *B. bombina* are more than double estimates obtained from mark–recapture data - rare long distance dispersers may move up to 11 km. Because of these many short and long migrations *B. bombina*, similarly to *Triturus cristatus*, appear to be particularly susceptible to habitat fragmentation.

Furthermore, *B. bombina* forms metapopulations, which means that separate patches of suitable habitats have to be not further away from each other than possible migration distance of *B. bombina*. If exchange of

The larvae of the toad

The juveniles of *B. Bombina*, 3 month old

Ideal conditions for *B. Bombina* breeding

migrants between subpopulations occupying different habitat patches is aggravated, metapopulation dynamics would be affected. This might result not only in extinction of individual sink populations but also would undermine the source populations.

Reproduction

The breeding period of *B. bombina* starts in May. The males, waiting for the females, form large chorus in the carefully selected ponds. They call when water temperatures rise to more than 12°C. Each male has a separate area in the pond, which is defended from the entrance of other males. Females usually produce eggs 1 to 3 times during the summer. Eggs are produced in batches, which are attached to vertical stems of water vegetation. In the cases when suitable vegetation is lacking the eggs are left on the bottom of the pond.

Fertilised eggs develop in a few days. The length of development depends on the temperature, but with suitable temperatures, i.e. 15 to 23°C during the day and 13 to 17°C during the night it takes 5 – 7 days. Quick development is an adaptation to unstable, often temporary breeding environment.

Larval development takes longer – 45 to 65 days. The newly metamorphosed toads usually appear in the second half of July and in August. After an aquatic foraging period, they migrate towards the hibernation sites. At the age of 2 - 3 years *B. bombina* starts breeding. *B. bombina* has a long life expectancy, presumably 15 years. So theoretically one individual can contribute to population strength over up to 12 seasons. In permanent grasslands, natural and seminatural habitats without intensive agriculture, the yearly adult survival rate is proven to be as high as 90-95 %. In an intensively used agricultural area, however, the fire bellied toads do not become that old and the adults seldom take part in reproduction more than 1 to 2 times in the reproduction season. The adult yearly survival rate in such area is about 50 % or less.

Hibernation place might be a pile of stones

Mortality and predation

Mortality rate of the fire-bellied toad between the time of metamorphosis and the age of 1 year is more than 98 %. Later the mortality rate dependends on the surrounding factors (e.g. abundance of predators, intensity of agriculture, fragmentation of landscape, traffic density, etc.). In the ideal landscape, which is close to natural, the mortality rate in the second year may be only about 40% and the yearly mortality of the older individuals can further decrease in optimal conditions to only 5-10 %.

Adult toad possesses glands which excrete unpalatable and slightly toxic secretion. The toad warns its predators by showing its brightly coloured limbs-underside in unkenreflex posture. Therefore the fire-bellied toad has few predators. Only the watershrew and some birds such as the stork, brown owl or bittern sometimes dare to predate the toad. Most mammals and the otherwise amphibian-loving grass snake (*Natrix natrix*) do not eat fire bellied toads. However, larval stage does not possess this defence mechanism and is heavily predated.

In the northern part of the range *Bombina bombina* can live up to 15 years. In comparison with other amphibians in the North European lowland its strategy is a relatively low reproduction rate and a high annual survival of adults. Thus an increase in adult mortality due to habitat degradation can cause local extinction. *Bombina bombina* indicates high amphibian diversity in the North European lowlands (proven in North East Poland, Germany and Denmark) and it is often the first species to go extinct when habitat degradation starts to take place.

General distribution of the species at European and national level and population trends

Bombina bombina is distributed in the European lowland from Eastern Ukraine and Bulgaria in the South East to Denmark and Lithuanian-Latvian border in the Northwest and North. Germany makes the western border. Nearly everywhere populations are declining, mainly due to anthropogenic habitat deterioration. Hence, conservation measures are in urgent need in its entire range.

Bombina bombina has a scattered distribution in Lithuania. It is very rare in the western part of the country but occurs in the southern and eastern parts of Lithuania. Because of observed decline the species is included in the Lithuanian Red Data Book from 1989. The decline is caused by draining, overgrowth of breeding and other habitats. The current estimation of bombina in Lithuania is defined as “restored” (red book, 2007), however landscape development may negatively affect populations of bombina since current distribution of bombina does not ensure stable long term survival.

In some parts of Poland such as the Northeastern part of Podlasie and the Mazurian lake district as well as along certain natural rivers such as Narew and Bug the species is common. In the western part of Poland the populations are clearly isolated and the species are more rare than in the eastern Poland.

In Germany the species is generally declining, but conservation project in Schleswig Holstein has helped to avoid further decline in recent years and several populations are now in increase there.

The great/northern crested newt (*Triturus cristatus*, LAURENTI, 1768)

DALIA BASTYT

These secretly living newts turn to small dragons in spring, when the males grow high-jagged crests and start their elaborate courtship displays fastidiously watched by the females. Besides their attractiveness these relatively small quiet living animals often are keystone species in their habitats – they have a disproportionate effect on their environment relative to their abundance. Moreover, because of their high requirements for the habitats crested newts are good habitat quality indicators.

Description and feeding ecology

The crested newt is an impressive, lizard-like amphibian. It is the largest European newt – adults can reach the length of even 16 – 17 cm. Its dorsal side is black or dark brown; just the lower flanks are finely stippled with white dots. Its belly is orange with asymmetrical black spots. The spotted pattern is unique for each individual and can help to distinguish one newt from another. The breeding males cannot be mistaken because of their imposing dorsal crest. It is high and jagged, deeply indented at the base of the tail. Its size and shape depends on the newt's age.

Great crested newt has yellow spotted belly

The crested newt is called "mouth size restricted predator", as it is an opportunistic predator predating anything from eggs of other species of amphibians to adult smooth newts. The crested newts often play a role of top predators in the small water bodies they occupy. Most often the crested newts feed on benthic or predominantly bottom-living organisms, for example, *Asellus aquaticus* and *Gastropoda*. When living terrestrially they eat all invertebrates such as insects, molluscs, woodlice and earthworms. The larvae of the crested newts are predatory too. They feed on small invertebrates or amphibian larvae swimming in the water column.

Great crested newt

Habitats

Triturus cristatus is a species, which needs aquatic habitat for its breeding as well as a few terrestrial habitat types after the breeding period. *Triturus cristatus* can only breed in the water, therefore it is completely dependent on water bodies. On average it spends 4-5 months per year in the water.

Breeding habitat

In early spring the adult newts migrate from a hibernation site to a breeding habitat, which is a small stagnant water body (the size ranges from 14 m^2 to 12.000 m^2). Usually that is a natural pond but sometimes the species might inhabit man-made environments, such as a village pond, a gravel pit, etc. Nevertheless the crested newt is not a flexible species.

The water bodies might be permanent or may be drying out in the second half of the summer. The maximum depth of a suitable breeding habitat is more than 0,5 m but there should also be shallow water zones of less than 0,5 m depth. The presence of shallow zones is especially important in the northern side of a breeding habitat, where the sun heats most intensively. Furthermore, the habitat must have inclined slopes, pref-

erably with the angle of approximately 20°. It has been noticed that breeding success is much lower when the slopes are steeper than 45°.

The crested newt uses ponds with different types of sediments: the variety of sediments ranges from clay and sand soils to mud and peat. Nevertheless it has been noticed that the newts prefer clear water to muddy or algae-green. Water bodies with different pH can be occupied by the crested newts (pH value can vary from 4.4 to 9.5) but the optimal pH is neutral or slightly alkaline.

Another important feature of the breeding habitat is aquatic plants. First of all, there has to be enough of submerged and floating vegetation but it should not overgrow all open spaces in the water body. Furthermore at least some of the water plant species must be soft leaved for the females to be able to wrap eggs into the leaves. The most suitable species are *Glyceria fluitans, Callitriche sp., Mentha sp., Potamogeton natans, Myosotis scorpiodes, Veronica beccabunga, Nasturtium officinale* and *Ranunculus* spp. However, when high vegetation reaching more than 1 m above the water surface (for example, *Typha* spp. or *Salix* spp.) shades the water body's area it has a negative influence on the crested newt population.

The optimal amount of shade falling on the surface of a breeding habitat differs in various parts of the species distribution range. In the southern part of the crested newt distribution, e.g. in France, moderately shadowed water bodies are preferred, whereas in the northern part, e.g. in Lithuania, more sun-exposed habitats are optimal with 25 – 50% of the surface of water body shaded.

The last but one of the most important features of the crested newt's breeding habitat is absence of fish. Fish predate pelagic larvae; hence the newts cannot breed in fish-inhabited water bodies. Even herbivorous fish are harmful for the newts as they alter the habitat by reducing plant diversity, releasing nutrients from the sediments, and in other ways that undermine the crested newt populations.

After the breeding period the adult crested newts stay in the same water body or migrate to another, deeper pond to forage. Also juvenile one or two year old crested newts may enter ponds for foraging during spring and summer.

Terrestrial habitat

At some point from July to September (timing is very much site-specific) most of the crested newt population leaves the water and seeks for shelter and food in terrestrial habitats. The terrestrial habitats have to be rich in hiding places, e.g. a forest with laying dead and alive tree trunks, or a cultural landscape with a mixture of stone fences and hedgerows. Typically the habitat is a mosaic of different patches; in optimal case it consists of a deciduous forest and meadows or extensively grazed pastures. If intensive agriculture is present in the vicinity of a breeding pond there must be a buffer zone of at least 10 m width around the pond. Most often the newts exploit a habitat that is located within 100 m range around a breeding pond. The terrestrial habitat does not have to be sun exposed.

Hibernation places

The hibernation places are located on dryer terrestrial habitats that never get flooded during spring and are frost-free during winter. These can be different burrows or cavities in a forest, especially deciduous, or hedgerows, gardens, embankments, stone fences and piles, and house cellars. Demands for the hibernation places are higher in the northern part of the crested newt's distribution range.

Movements and population ecology

Crested newts do not exhibit long distance migratory behaviour. After leaving the water 50% of the newts were found in refuges within 15 m distance from a breeding pond and 95% were found within 50 m distance (Jehle, 2000). Further migrations were observed in the open agricultural landscapes – even up to 1290 m.

The crested newt usually migrates between the 3 habitat components: a hibernation place, a breeding pond, and a terrestrial habitat. I.e. they carry out 3 migrations between habitat components from early spring to late fall.

Each population of crested newts must have as a minimum an aquatic breeding habitat, a terrestrial habitat for feeding, and a hibernation place. If one of these components disappears within the activity range of a population this population will go extinct.

Another vagility form is migrations between different subpopulations. Dispersal between the subpopulations is mainly undertaken by juveniles, one or two year old newts. The average distance they migrate is 250 m (investigated maximum was 1.200 m), which means that another subpopulation has to be located not much further away than this distance to keep a metapopulation structure functioning.

Reproduction

In early spring the males migrate to the ponds where

Water quality is an important factor for *Triturus cristatus*

they rapidly grow a dorsal crest and acquire a brighter colouration. The males choose patches in a pond for their elaborate courtship displays. For that they need shallow areas with flat bottom, free of vegetation or any other objects disturbing visibility. Unlike the smooth newts, the crested newts are territorial; hence the courtship areas are defended from other males.

Females follow males and when they reach the pond the males start courtship displays. The displays are stimulated by pheromones transmitted by both sexes. The male is jumping and moving his tail; 14 different movements can be distinguished during the display. The newts are able to assimilate oxygen dissolved in the water through their skin. Therefore the higher crest the male has the longer he can stay under the water without interrupting his display for gulping some air. If the female is impressed enough not to leave the male in the middle of the display then in the end of the display the male deposits a spermatophore on the bottom of the pond and situates it so that the female would take it.

After a few days the female lays 200 – 300 eggs, which are about 2,5 mm long, ovoid, yellow-green colour. The female folds the eggs one by one into the soft leaves of aquatic vegetation. The eggs develop in approximately 2 or 3 weeks. The newly hatched larvae are 12 mm length in total. Metamorphosis occurs in about three months, and by that time the larvae reach approximately 70 mm length. Larval development is usually more rapid in warm, ephemeral ponds than in deeper, permanent water bodies. Rainfall is another important factor to stimulate metamorphosis. The juveniles reach sexual maturity at 3 – 5 years old. Crested newts are long-lived amphibians: they might live up to 27 years in captivity but in the wild conditions they usually attain 10 – 15 years.

Predators

Adult crested newts have poisonous skin secretions and therefore have fewer predators than other members of the genus *Triturus*. Annual adult survival has been estimated to be more than three times higher than juvenile survival. Adult newts are eaten by species such as European pond turtles, grass snakes, herons, egrets, ducks, bitterns, and various mammals.

However, newt larvae not only do not possess protection in the form of skin secretion but also tend to swim in the open water not hiding from predators; therefore the proportion of predated larvae is very high. The highest threat for the larvae is created by fish. Crested newts cannot breed successfully in the water bodies inhabited by fish. To a lesser extent the larvae are also predated by a range of carnivorous invertebrates and waterfowl such as ducks.

Hibernation sites might be created by leaving piles of dead trees and branches

General distribution of the species at European and national level and population trends

The northern limits of *Triturus cristatus* distribution range extend from northern France, Great Britain and Southern Scandinavia to the north of Russia. The southern margin runs from central France to South-western Romania, then from central Moldavia through Southern Ukraine south-eastwards then northwards into central European Russia and the Southern Urals to the South of Kurgan Province in West Siberia. This species is included in Annex II and Annex IV of the Habitats Directive.

Triturus cristatus has a scattered distribution across the whole Lithuania and the thorough investigations have never been carried out, therefore it is not possible to tell neither exact species distribution nor its abundance. However, the decline was noticed and the species is included in the Red Data Book from 1991. Major threats to its survival are believed to be water pollution, the introduction of fish into ponds, water body evaporation, and qualitative changes such as deepening of water bodies.

In Germany *Triturus cristatus* is spread throughout nearly the whole country. Especially in the northwest and in the south the settled area already shows gaps. Over bigger parts of distribution area in Germany the crested newt shows stable populations of up to several thousand individuals per occurrence. But in intensively used agricultural and urban areas the supplies also decline. In the actual Red List (2009) *Triturus cristatus* is included in the advance warning list. The major threats are similar to the ones in Lithuania but in addition the fragmentation of the habitats, the intensification of agriculture, and the traffic are important.

In Poland the newt has appeared quite common in larger forested area inventoried during the recent years. However, in the parts of the country where larger areas of open land are used for farming the species is rare.

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The situation of *Emys orbicularis* and *Bombina bombina* in the North European lowlands

NORBERT SCHNEEWEIß

Lithuania, the northern part of Poland and North-East Germany are classified as the North European lowlands in the present project. This area is shaped climatically by continental influences. Geographically, it belongs to the most recent period of glaciation of the Pleistocene era, Vistula glacial period.

The European pond turtle and the fire-bellied toad are at their northern distribution border here, and at their most westerly distribution near the river Elbe. Both species are thermophilic and have their distribution centre in the continental Europe with gaps appearing more frequently along the Northern part of their distribution limit. At the beginning of the twentieth century various different authors (E.g. Kurck 1917, Hecht 1928) were discussing climate change as the cause of the decline of *Emys obicularis*. Kurck (1917) portrays this area as pushing in the climatic area of isotherms between 18 and 20 degrees Celsius in July.

With the subfossil findings it is proven, that after the last ice age *E. obicularis* – mainly in the boreal region – advanced up to southern Scandinavia and Western Europe (Kurck 1917, Isberg 1929, Degerbųl & Krog 1951, Fritz 1996, Sommer et al 2009). This propagation was marked by a relatively quick expansion of the area into the Central European region and an area regression starting already in the Atlanticum. On the North Western border of the area, the drop in summer temperatures and the widespread growth of shady forests in the course of 'altanticisation' are considered to be the determining causes for the decline of the species. According to historical sources (Fritz 1996), the easterly North German lowlands and Western Poland must have fostered an abundance of pond turtles up to the 18th century. The mini Ice Age, with cold periods from 1560 to 1630, and several further periods (mostly shorter), appearing until the 19th century (Kinzelbach 1988, Pfister 1999, Schwarzbach 1974), have certainly had a negative effect on the reproduction rate of the pond turtle population of Central and Northern Europe. On the top of that there has been a massive decimation of their populations caused by man (Schneeweiß 1997). The pond turtle was not rare at all in North-Eastern Poland, in Masuria, until the end of the 19th century (Düringen 1897). Bigger inventories existed in Lithuania until the 20th century (Meeske 2006).

The fire-bellied toad was also mainly distributed in Central and Northern Europe during the optimum climatic period after the Ice Age (Arntzen 1978). Climatic causes for the decline of the populations have been discussed, as well as anthropogenic ones (Böhme 1991). The growth in woodland might have affected the fire-bellied toad in the Atlanticum with comparable disadvantage to its effect on the pond turtle. With this 'overgrowth', came the overshadowing of the ponds used for reproduction. Nevertheless, for want of subfossil dates the postglacial area changes of the fire-bellied toad can barely be reconstructed.

The European pond turtle appears in the Red Lists of Threatened Species of Germany (Kühnel et. al. 2009a) and Poland (Glowacinski et al 2002) as being "critically endangered" and is considered to be 'endangered' in Lithuania. The fire-bellied toad appears on the German Red List (Kühnel et al. 2009b) as "endangered". In Poland (Glowacinski et al 2002) deficient data was followed by no classification, and in Lithuania it is classed as "rare" (Raçomavim ius 2007).

In total there are three current separate centres of population distribution south of the Baltic Sea, separated by large gaps: the region West and East of the Oder River, around Masuria in the North East of Poland, and the South West of Lithuania. On the basis of genetic data, northern appearance of *E. orbicularis* can be assigned to two different groups regarding genetic properties, glacial refuges and postglacial propagation directions (Lenk et al 1898). Under these circumstances, the populations in the Oder area (mitochondrial haplotype IIb) are to be distinguished from the populations of Eastern Europe (mitochondrial haplotype Ia), as the former are assigned to a glacial refuge in South Eastern Europe and a postglacial propagation direction to the south of the Carpathian Arch, and the latter is assigned to a glacial refuge on the northern coast of the Black Sea and the postglacial propagation direction north of the Carpathian Arch.

Basically, all occurrences of the European pond turtle in the area at the North West and Northern range limits are threatened by extinction, as the degree of danger decreases slightly from West to East. The western occurrences, on both sides of the Oder, are very small (< 20 adult/population), over-aged, and without supplementation it is not likely to survive even

in the short-term. All the populations are completely isolated at the moment, and can only be linked with the help of medium-term resettlement projects with neighbouring populations .

In the North East of Poland (Masuria) the situation of *E. orbicularis* is similarly drastic to that around the Oder. In the south of Lithuania the species is a little more widespread today. The size of the local populations here is estimated to be 30 (Meeske 2009). Most occurrences consist of a few, up to a maximum of 30 individuals. Only a small number of the populations have a short-term chance of survival, i.e. the populations which have more than 50 individuals in each case (Meeske 2009). A share of the Lithuanian populations shows well-balanced age structures. The clear outbalancing of the females is characteristic to the northern area fringe populations of *E. orbicularis.* The distribution samples of the fire-bellied toad and pond turtle are comparable in the area of their North Western area limits, although the former penetrates the West more, up to the river Elbe and in the North, to the East of Denmark and the South of Sweden. In contrast to European pond turtle, the fire-bellied toad even today has vital populations at its Northern limits. However, for some decades drastic decline of populations was marked here for (Schneeweiß 2009). In the meantime numerous occurrences are likewise isolated and are under immediate threat to become extinct. To the south of the Baltic Sea the spreading gaps in the area of the fire-bellied toads are increasing.

Today without exception all northern area fringe populations of the European pond turtle are extremely endangered. The three population areas (Oder, Masuria and Lithuania) within the scope of the present project also meet the outpost criterion (Steinicke et al. 2002), that is, the relevant states possess a particular responsibility for the preservation of the populations. On account of their fringe location and the exceptionally fragmented occurrences, the *E. orbicularis* and also *B. bombina* populations in Northern areas, have exceptionally sensitive reactions to negative influences. The significant endangering factors include further destruction of habitats (e.g. drainage), intensive agriculture (e.g. fertilizers, pesticides), further fragmenting of the landscape (e.g. by road construction) and considerable loss of individuals (e.g. through increasing traffic or invasive species/predators). In the region of their Northern limits changes in climate could also very quickly affect the population development of the mentioned species. Climatologists have recently referred to increasing continental influences on the concerned region. This development could concern the fire-bellied toad and pond turtle in two ways. On the one hand, it might provide the increase in hours of sunlight and higher temperatures in summer, i.e. the metamorphosis time of the fire-bellied toads would become shorter, and a higher number of pond turtle eggs would be successfully incubated. This may increase the reproduction rate of both species. On the other hand, a stronger overgrowth may overcome the aquatic habitat for European pond turtles and fire-bellied toads, e.g. ponds and shallow water zones, which again negatively affects the development of the populations. It is indisputable that the climatic influence on the distribution variations of both species at their Northern limit has significance for the future.

The uniqueness of the Northern area fringe populations of *E. orbicularis* and *B. bombina* has to be emphasized. The habitats of these species are also inhabited by many other threatened animal and plant species. In each case, they are worth protecting. With the designation of NATURA-2000 areas, as well as nature reserves in national law, but also with specific protection projects for the European pond turtle and the fire-bellied toad (e.g. the present EU LIFE project), Germany, Poland and Lithuania are getting to grips with the initial steps to protect the threatened relicts of their native amphibians and reptile fauna. Now it is a matter of expanding these projects, and of setting up the active protection of the area fringe populations and their habitats as a solid component of the nature conservation work of these countries.

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Main threats for *Emys orbicularis* and amphibians in the North European lowlands

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The project in general as well as the project actions are based on 11 defined main threats for the 3 project species *Emys orbicularis, Bombina bombina* and *Triturus cristatus* in all 3 project countries Lithuania, Poland and Germany:

Threat 1 Degeneration of the structure of (meta-) populations

Threat 2: Loss of water bodies

Threat 3: Overgrowth of water bodies

Threat 4: Loss of nesting areas

Threat 5: Lack of hibernation sites

Threat 6: Loss of terrestrial habitat

Threat 7: Agriculture

Threat 8: Predation on nests

Threat 9: Fish introduction

Threat 10: Lack of public environmental awareness

All these threats have similar negative impacts on the populations of *Emys orbicularis*, *Bombina bombina* and *Triturus cristatus* in the North European lowlands.

A meta-population is a group of associated local populations, where a regular individual exchange occurs. This makes population much less vulnerable to habitat changes than populations based on small single breeding groups. Smaller and more isolated populations in small habitats have a higher risk to become extinct. *Bombina bombina* and *Triturus cristatus*-populations are most robust if they inhabit a cluster of ponds, forming a meta-population. However, only a small number of *Bombina bombina* and *Titurus cristatus*-populations live under such conditions in the project countries. Emys orbicularis needs also a complex of varying ponds and nesting sites with regard to the habitat requirements throughout the year. Turtles could exist in similar population structure like meta-populations in former times. Nowadays, the small number of mostly isolated populations does not allow a meta-population structure.

Due to habitat destruction e.g. meliorations, drainage, building settlements and roads, afforestation, inappropriate land management, anthropogenic succession, intensive agriculture, etc. habitats and populations of *Emys orbicularis, Bombina bombina* and *Triturus cristatus* become fragmented, which changes and reduces the area and habitat conditions for populations as well as the sizes, viability and numbers of populations (threat 1). Today, most of the suitable habitats and populations are too small and far dispersed, e.g. only a small number of the Lithuanian and Polish and even no German *Emys orbicularis* localities have enough individuals for a short-term survival of these populations. Furthermore, migration corridors between fragmented habitats are destroyed, which increases the distances between the local populations. Thus the individual exchange and the genetic exchange between populations respectively are rendered more difficult (e.g. *Emys orbicularis* in South-Lithuania and East-Poland) or are even prevented (e.g. *Emys orbicularis* in North-Lithuania, West-Poland and Germany), affecting the genetic and demographic nature of these populations, especially the small ones.

Additionally, there is a new threat for the turtle populations. The appearance of allochthonous turtles within autochthonous populations destroys the gene pool of local populations in Germany, and these days in West-Poland too. Besides, the loss of the specific adaptations can clearly diminish the population viability.

A big loss of water bodies is known for all three project countries (threat 2). Due to their biology *Emys orbicularis*, *Bombina bombina* and *Triturus cristatus* are not only dependent on water and water bodies, but also they have specific requirements for the ponds and pond systems which they use (see Chapter 4). The size and the viability of these populations depend on quality and quantity of water bodies. Overland migrations belong to the activity range of turtles (movements between ponds and to nesting sites), but because of the loss of ponds overland migrations will be lengthened, which mean a higher risk of predation and stress through water loss. In the cases of complete loss of ponds in turtle habitats the animals are forced to spread upon artificial ponds near farms and villages, which are very often unsuitable because of size and structure of water bodies, disturbances by man, pollution and

Eutrophication represents one of the threats to water habitats

locations close to roads. Amphibians switch to unsuitable habitats, too. This fact also influences structure and viability of these populations.

In general, the aquatic (threat 3) and terrestrial habitats (threat 6) become overgrown by bushes and trees and become less suitable for species requiring open habitats e.g. *Emys orbicularis, Bombina bombina* and *Triturus cristatus*. Due to natural succession and decreasing land management (mowing and grazing) in Lithuania as well as a nutrient inflow of intensive agriculture in Germany open areas and many types of ponds overgrow with bushes and dense vegetation. Ponds are reduced in depth or completely disappear. The overgrowth by bushes and trees, in particular at the shore, destroys suitable basking sites for turtles which are essential for the poikilothermic species in the northern species distribution. In shaded and/or overgrown ponds turtles cannot get enough solar energy and with a lower body temperature they have a high risk of metabolic changes and disorders, problems to mature eggs and to build up weight before the winter. The situation is similar for *Bombina bombina.*

In Lithuania, most of the *Bombina bombina* and *Triturus cristatus* breeding ponds are situated in semi-natural communities and on farmlands. If water bodies become overgrown, they fall into shadow and the water temperature remains low. Lower water temperatures change not only the composition of vegetation and animal species as well as nutrients in a pond, but also prolong the growth of young turtles and amphibians. This means that higher water temperatures are very important in the development of *Emys orbicularis* juveniles and *Bombina bombina* and *Triturus cristatus* eggs and larvae. Consequently, overgrowth of water bodies impairs the reproduction success of *Emys orbicularis, Bombina bombina* and *Triturus cristatus* (threat 3).

Deciduous forests or grasslands are often replaced with pine forests, which do not provide enough foraging opportunities or hibernation spots for amphibians. Open areas e.g. grasslands provide favourable foraging and migrating conditions for Triturus cristatus. Moist terrestrial habitats as fens, meadows and mires are suitable foraging places for Bombina bombina. The loss of terrestrial habitat e.g. dense scrublands overgrowing in swamps, fens, meadows and hills and dense forests can reduce the availability of foraging areas and the opportunities for migration and hibernation for amphibians (threat 6). Furthermore, overland migrations of *Emys orbicularis* can be rendered more difficult for fulfilling all individual requirements throughout the year. Additionally, it can diminish movements

between local turtle and amphibian populations leading to further isolation and less viability.

Due to the loss of water bodies there is also a lack of suitable hibernation sites for *Emys orbicularis*. (threat 5). Turtles usually hibernate in specific sites in aquatic habitats e.g. in all-year-round-ponds, ditches and lakes. Indeed, winter mortality is not known for the species, but probably the lack of adequate hibernation sites can impact the survival during long and cold winter periods in the North European lowlands. In unsuitable hibernation conditions individuals can be enervated or even die. More detailed information concerning hibernation and the requirements of hibernation sites for *Emys orbicularis* are described in chapter 4 and 8.

Bombina bombina and *Triturus cristatus* hibernate on land in the crevices or burrows in the ground, in stone piles and under dead wood, but such hibernation structures are often removed in the modern landscape. Thus the availability of hibernation sites in the terrestrial habitat plays a crucial role in the survival of the amphibian species.

Many of the ponds used by *Emys orbicularis*, *Bombina bombina and Triturus cristatus* are located in agro-landscape in northern Europe. If the ponds are located in the central areas of a field, farmers tend to plough the land up to the very edge of a pond without keeping a margin/ buffer zone, e.g. this happens in Germany and Poland. Intensive use of pesticides, fertilisers and heavy machinery for soil-treatment is not only serious threats for migrating turtles and amphibians, but chemicals also contaminate water bodies deteriorating the water quality and the food resources for the project species inside the water (threat 7). Fertilisers decrease the number of different herbs and grasses and grassland becomes monotonous, being left with fewer species and a much poorer foraging choice for newts. Furthermore, amphibians can easily be killed by direct contact with pesticides and fertilisers. So for *Bombina bombina* and *Triturus cristatus* it is impossible to penetrate an intensively managed farmland. Consequently, agriculture has serious consequences for the survival of all three species.

The introduction of fish to ponds e.g. gibel carp (Carassius auratus gibelio) and perches (Perca fluviatilis) is one of the main threats for amphibians in Lithuania (threat 9). Fish can have negative effects on plant growth and water quality as well as influence the invertebrate abundance in a pond. Although fish do not eat adult amphibians, they feed on eggs and larvae of *Triturus cristatus* and tadpoles of *Bombina bombina*. In addition, *Emys orbicularis*-juveniles can be threatened by fish species as competitors in the view of feeding, and the juveniles can be threatened by bigger fishes as potential predators. A side-effect of fish introducing is fishing. Turtles can die in basking traps under water or become life-threatening injured by fishing-hooks. Consequently, fish stock in ponds has a negative influence on the reproduction success of turtles and amphibians and can even prevent successful reproduction of amphibians.

Emys orbicularis does not have successful reproduction every year in the northern species range due to the climatic conditions. The additional deficit of reproduction success for various reasons has a very negative impact particularly for the viability of very small and isolated populations. The lack of copulations and fertilisations, in e.g. far dispersed local turtle populations, forces females to lay unfertilised eggs (threat 1). All turtle populations in the three project countries live in habitats with decreasing numbers of suitable nesting areas. Due to the loss of nesting areas (threat 4) and open terrestrial habitats (threat 6) females nest in unsuitable nesting areas e.g. in more shaded places. There, lower ground and nest temperatures exist as the incubation period and the embryonic development are prolonged which can even lead to the dying off of the embryos and impact the hatching rate. The destruction of nests by agricultural activities with machines or cattle grazing (threat 7) or predation (threat 8) as well as the loss/lack of reproductive individuals e.g. through road death, angling

Overgrowing nesting sites

Wild boars destroy nesting sites

(threat 9) or catching away of turtles by people due to the lack of public environmental awareness (threat 10) are more important reasons for the reduced reproduction success. Particularly, the high rate of nest predation in small and isolated populations intensifies the high danger of extinction. More detailed information about nesting and the requirements of nesting sites are described in chapter 4 and 9.

Overgrown ponds (threat 3) impair successful breeding of *Bombina bombina and Triturus cristatus* because of the lack of submerged vegetation for egglaying as well as the loss of open water areas as mating places for *Triturus* and as feeding places for larvae. Furthermore, muddy overgrown ponds lack the oxygen which is essential for the development of amphibian eggs and larvae.

Public awareness is one of the keys towards a successful nature conservation strategy. If support from the locals for the efforts undertaken within this project is not guaranteed, the measures will fail over a long-term (threat 10). Local people without appropriate information concerning species behaviour and habitat demands can have a big negative impact on these species and the viability of their populations e.g. killing turtles in fish traps or with fishing hooks, introducing fish into breeding ponds of amphibians, using pesticides and fertilisers, etc.

Lack of international co-operation on the conservation and management of Emys orbicularis is responsible for a little progress in species conservation (threat 11). Lack of capacity, knowledge, and skills in some countries can be a barrier to the adoption of new conservation techniques or suitable management for *Emys orbicularis* and also for threatened amphibian populations. Without appropriate concern of international authorities to the decline of Emys orbicularis and threatened amphibians and without regular exchange among conservation managers, appropriate measures for conserving the species could be delayed and it could be crucial for these species.

All the 11 threats cause decreasing sizes and viabilities of populations as well as increasing isolation, which lead to the decline of the turtle and amphibian populations in the project countries. In addition, most of these threats can impair the reproduction success. Too little or even no breeding success can prevent the growth of small populations or even determine a negative population development. Consequently, this is very harmful or even crucial for small and isolated populations.

Evaluation of pond habitats in the project sites for *B. bombina* and *T. cristatus* in North European lowlands: recommendations for restoration of pond clusters for the *B. bombina*, *T.cristatus* and *E.obicularis*

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Introduction

An ongoing decline of the European Pond turtle, *Emys orbicularis* and the Fire-bellied toad, *Bombina bombina*, is now documented throughout the North European lowlands. Additionally, the decline of the Great crested newt Triturus cristatus is recognized in Estonia, Finland, Germany and Denmark and is suspected in Poland and Lithuania.

Based on population genetics theories, each population of these species has to have at least 500 adults to survive. However, today very few populations meet this criterion as most of them are below this value. One of the ways to reach the goal is to restore, improve or even create the habitats of the 3 target species, especially within intensively-used landscapes.

During successfully implemented *B.bombina* LIFE projects (Consolidation of *B.bombina* in Denmark, Management of *B.bombina* in the Baltic region) and T.cristatus LIFE project (Protection of *T.cristatus* in the eastern Baltic region), considerable knowledge has accumulated on the design and improvement of high quality pond landscapes for amphibians. With basic experience on turtle conservation already existing in Lithuania, Poland and Germany, there is a solid foundation for the implementation of protective measures in herpetological sites of European interest and for the development of a concept of active protection of sites of high herpetological diversity in the North European lowlands. The active protection of aquatic habitats of *E.orbicularis*, *B.bombina* and *T.cristatus* will often also support a number of annex IV amphibian species on the same sites, e.g. *Rana arvalis, Rana lessonae, Pelobates fuscus* and *Hyla arborea* depending on the region in North european lowland.

The main threats to the targeted habitats/species generally are habitat fragmentation and migration barriers, loss of water bodies, overgrowth of water bodies, loss of turtle nesting areas, lack of hibernation sites, loss of terrestrial habitats, intensive agriculture, predation on turtle nests, fish introduction, lack of public environmental awareness, and lack of international co-operation.

The main objective of the investigation is to find out optimal aquatic habitat characteristics for the species to ensure the possibility of creating and restoring enough cluster ponds of good quality for the populations in the North European lowland, where *T.cristatus* and *B.bombina* occur together and where they occur together with with *E.orbicularis*.

The habitat improvement is expected to increase population sizes, which is necessary for the structure of viable populations of *E.orbicularis*, *B.bombina* and *T.cristatus* and the successful preservation of all three species in the investigated region.

Methods

Data field forms were discussed and agreed during study tours in July 2005. All partners took part in collecting data from 274 ponds in the project areas. Field method used for adult and juvenile *E.orbicularis* was visual observation. For *T.cristatus* adult we used visual observations, traps, and dip-nets; *T.cristatus* larvae were checked only by dip-nets. For *B. bombina* adult, sound and visual observations were used, and for *B. bombina* larvae – dip-nets.

There were 104 ponds investigated in Poland, 47 in Lithuania, and 123 in Germany. The 3 species were searched for during the breeding period from May to July. Observing the pond turtles mainly in that period also allowed partly excluding smaller water bodies that could be used in early spring and late summer.

Ponds and surrounding habitats were checked for the following characteristics: physical parameters of ponds (type, size, maximum depth, slopes, shallow zones), geology and water quality (sediment, water clar-

ity and colour), surrounding habitats (buffer zone, grazing, terrestrial habitat within 50 m distance, terrestrial habitat within 50-500 m radius, distance to the forest, distance to other ponds), and biotic factors (shade provided by trees, fish, water birds). Parameters that could be quantified were quantified and noted down. For example, ponds were classified into the size categories of 0-100 m^2, 100-500 m^2, 500-1000 m^2, 1000-2000 m^2. Vegetation was evaluated by describing structure and quantifying percentage of shade from trees on the water surface.

The data analysis covering the North European lowlands is presented in the results section below. The results are presented in graphs where the percentage of occupancy of each species within each habitat category is shown for *Bombina bombina* and *Triturus cristatus*. The attention is then drawn to statistically significant results and most interesting trends to be used in decisions on practical implementation of habitat improvements. The data for *Emys orbicularis* was too poor to present; this species occupied only a couple of ponds from those investigated. Nevertheless there are a couple of interesting trends in the data on *Emys orbicularis* and they will be mentioned in the result and conclusion sections below. The telemetric studies in this project as well as several long-term studies in Bandenburg, Poland and Lithuania provide information on the exact habitat needs and structures within the water bodies, and we refer to those studies in the analysis.

The conclusions part below presents suggestions how to use the results in practice.

Our data on habitat needs is not detailed or strong but they provide some trends in some habitat features over the North Europen lowland based on 274 ponds in the remaining best-preserved *Emys orbiculars* areas. For analyzing the significance of obtained results we used just a simple Chi-square test based on the null hypothesis theory. In some cases we applied Yate's correction factor (20,5). With this simple statistics we could look individually at each parameter, e.g. pond size, amount of shade on the water surface, fish present or not, etc. Each of these parameters was manipulated in the habitats during the project period to benefit the 3 target species. For example we had to decide how big ponds should be dug for each species in every area, how many trees to cut to get the optimal balance of sun and shade on the water, and whether to remove fish or not from selected ponds. We hope this final analysis together with the *Emys orbicularis* specific studies will make it possible to make even better decisions for habitat management than the decisions for management presented in these best practice guidelines.

Results

The results provide an overview of aquatic habitat characteristics in the North European lowlands. More detailed studies of single species were carried out as part of LIFE *T.cristatus* (2004-08) and LIFE *B.bombina* (1999-2003, 2004-09) projects in smaller regions of North Europe and presented in the Best practice guidelines developed under those projects. The strength of this study is that it covers data collected in a broad area covering 3 countries, from Lithuania, Northeast Poland, Northwest Poland, and Brandenburg. Statistical analysis and the percentage of the occupancy of the species in each habitat category are presented below.

Pond size

Some tendency to prefer smaller ponds (less than 500 m^2) can be noticed in *T.cristatus* larvae occupancy (36-42%). Big ponds (more than 2000 m^2) were found out to be preferable for adult *B.bombina* (57-59% occurrence), with considerable significance (?2 = 17.489, p = 0.0016) (Figs. 1, 3).

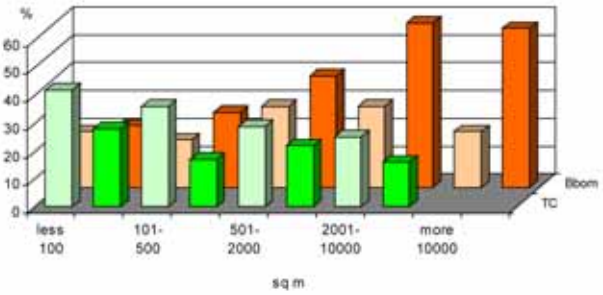

Fig.1. Size of the pond (light colours – larvae; bright colours – adults).

Pond depth

The analysis shows significant preference for 0.5-1 m depth for *T.cristatus* larvae (46% occurrence) and more than 1 m depth for adults (24%). Adult *B.bombina* is only found where the water depth is at least 0.5 m (45-49% occurrence) (Figs. 2).

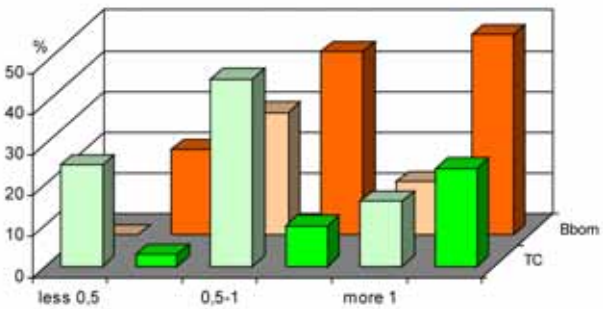

Fig. 2. Maximum depth of the pond (light colours – larvae; bright colours – adults).

Pond of *Bombina bombina* adult and *Emys orbicularis* (large size (>2000 m²) and over 1 m deep) in the Northeastern Poland (Bagienko locality). The pond has fish and is unsuitable for larvae of *B.bombina* and *T.cristatus*.

Pond slope

Analysis of the pond slope inclination does not show any significant dispersal for *T.cristatus*. The frequency trend of pond slope inclination shows higher adult *B.bombina* occurrence on flatter slopes (Fig. 3).

Shallow zone

No significant differences between *T.cristatus* preferences for shallow water areas were noticed. For *B.bombina* adults (73% occurrence) and larvae (40%) conditions seem to be more optimal when the shallow water zone exceeds 25% (Figs. 4).

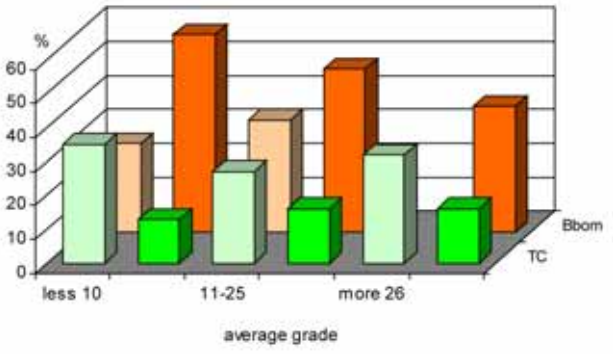

Fig. 3. Pond slope inclination (light colours – larvae; bright colours – adults).

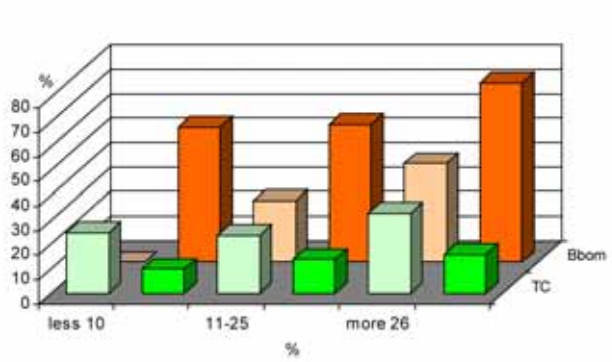

Fig. 4. Shallow water zone (0–30 cm) (light colours – larvae; bright colours – adults).

Restoration of a shallow water pond for all 3 target species below the nesting slope for E.orbicularis in Southern Lithuania

Water clarity of ponds

The highest frequency of larvae of *T.cristatus* was found in clear water ponds (38%) while the highest occupancy of adults was recorded in brown waters (24%). The preferred water conditions for *B.bombina* larvae (32%) and adults (55%) is clear water (Fig. 5).

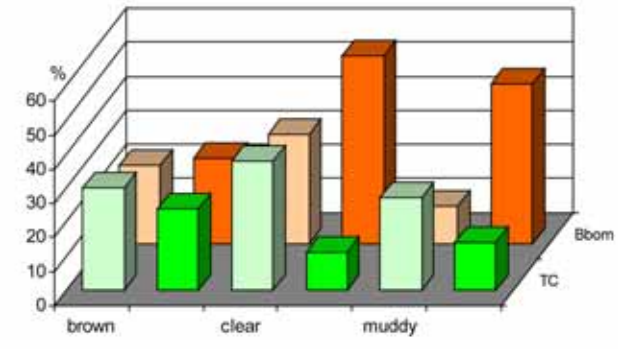

Fig. 5. Water clarity of the pond (light colours – larvae; bright colours – adults)

Buffer zone of uncultivated land around the pond

T.cristatus occupancy was rather low in case of narrow buffer zone (0-9 m) (up to 7% occurrence) compared to the wider zones, especially in larvae stage (31-37%). Only larvae of *B.bombina* show extremely significant positive relation between the width of a buffer zone and occurrence of the larvae (34% in case of more than 50 m wide buffer zone) (Figs. 6).

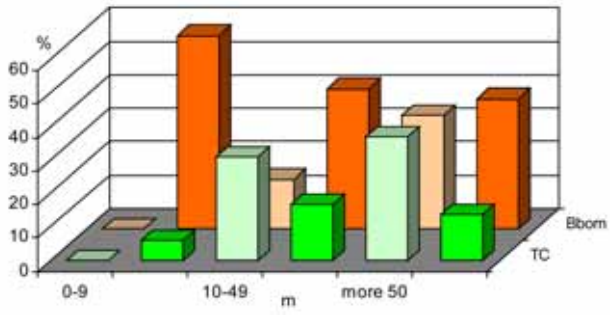

Fig. 6 Buffer zone around the pond (area of any type of habitat except cultivated land) (light colours – larvae; bright colours – adults)

Purchased *E.orbicularis* nesting site and buffer zone towards ponds with *E.orbicularis*, *B.bombina* and *T.cristatus* to extensify the existing land-use in Northern Germany

Distance from pond to forest

The data show that *T.cristatus* is only found in ponds with a maximum distance to forest of 200 m. B. bombina has the highest occurrence when forest is within 50 to 200 m distance: larvae in 35% and adults in 92% of the ponds (Fig. 7).

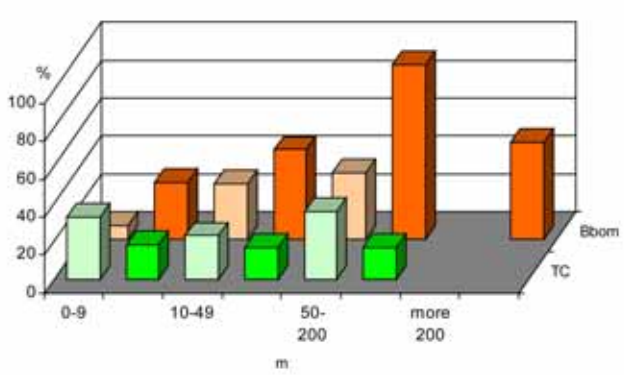

Fig. 7. Purchased E.orbicularis nesting site and buffer zone towards ponds with *E.orbicularis*, *B.bombina* and *T.cristatus* to extensify the existing land-use in Northern Germany

Distance to the closest other pond

Both *T.cristatus* larvae (47%) and adults (17%) have the highest occupancy in those ponds where the distance to the closest other pond is less than 100 m (÷2= 11.414, p=0.0097 for larvae). The highest occupancy of B.bombina adults (73%) was recorded in the ponds with neighbouring ponds within 100-200 m distance (÷2 = 9.889, p= 0.0195) in Poland only (Fig. 8).

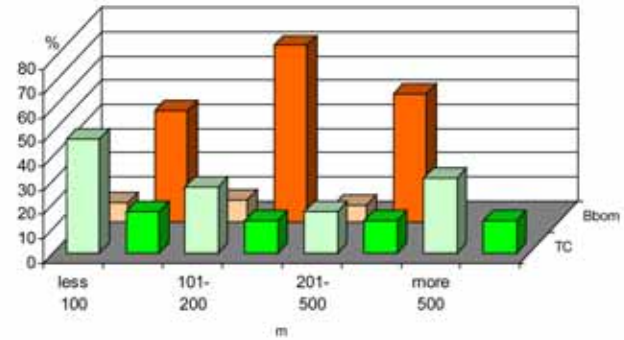

Fig. 8. Distance between the investigated pond and other ponds (light colours – larvae; bright colours – adults)

Grazing of pond

Pond grazing seems to have a slightly negative influence on the occurrence of *T.cristatus* larvae, however it is not proven to be statistically significant. Clear assumption can be made in case of *B.bombina*: both larvae and adults are much more frequent in grazed ponds but the results are considered to be not statistically significant (Figs. 9).

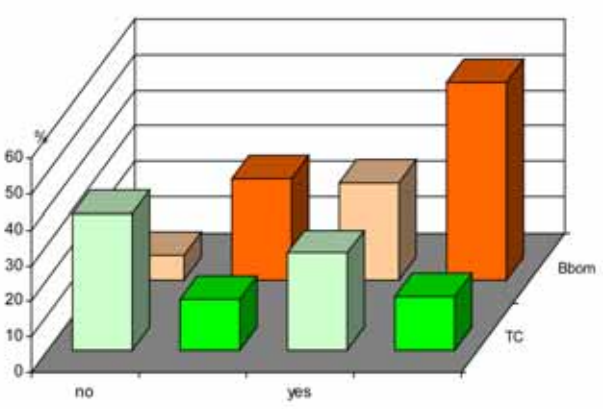

Fig. 9. Grazing of pond (light colours – larvae; bright colours – adults)

Characteristics of habitats around the pond

Analysis of surrounding terrestrial habitats showed that *T.cristatus* larvae and adults have the highest presence when in the vicinity of the pond there is dead wood (39% for larvae, 18% for adults), meadow/fen (41% for larvae, 20% for adults), or common dry grassland (46% for larvae, 25% for adults). High occurrence of *B.bombina* larvae was recorded in cases where the surrounding habitat was meadow/fen, shrub, deciduous forest, or common dry grass presence (24-29%). *B.bombina* adults were found mostly in the ponds where field and shrub occur around the pond (56-57%). This is not necessary because adults prefer fields. It may be that adults are found in many pond types with different surroundings, whilst larvae is found mainly when surroundings consist of more natural habitats. In landscapes of intense agriculture, where populations of *B.bombina* are declining, adults may still occur in many places but breeding is reduced or limited by agricultural pollution of the ponds.

Pond of *B.bombina* and *T.cristatus* in North-Eastern Poland (Kolonia Rzeck locality)

Amount of shade on the surface of the pond:

Optimal shade over the pond for *T.cristatus* is 25-75%. The conclusion is considered to be statistically significant for larvae of *T.cristatus* (33-50% occupancy). The less shade (0%) the better conditions for B.bombina larvae and adults (29% and 50% correspondingly), which is also statistically significant ($\div 2_{0,5}$= 5.786, p = 0.0173 and ÷2 = 33.830, p = 0.0001) (Fig. 10).

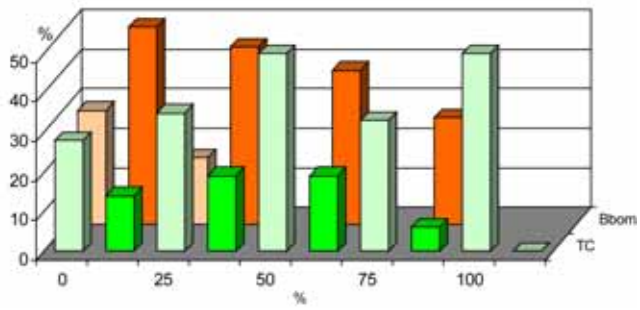

Fig. 10. Shade provided by trees over the pond (light colours – larvae; bright colours – adults)

Influence of fish

Analysis of the influence of fish presence showed that *T.cristatus* larvae has much higher occurrence in fishless ponds (39%) compared to those with fish (13%). *B.bombina* larvae was found only in the ponds without fish (9%), whereas adults inhabit both pond types (36% and 49%) (Fig. 11).

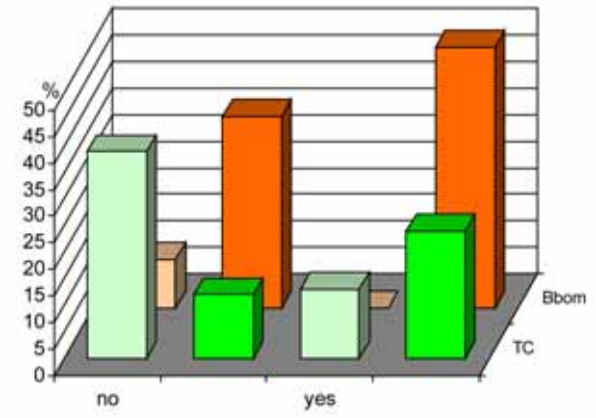

Fig. 11. Fish presence in the pond (light colours – larvae; bright colours – adults)

Pond of *T.cristatus* and *E.orbicularis* in North-Eastern Poland (Lutynowo locality). *B.bombina* can not breed in this pond due to much shade

Influence of waterbirds

With waterbird presence in the pond, there is statistically significant lower occurrence for T.cristatus larvae ($\div 2_{0,5}$ = 11.253, p = 0.0008) but not for adults ($\div 2_{0,5}$ = 2.250, p = 0.1673). Results of analysis of the given parameter (mostly foraging of water birds) for larvae and adult of B.bombina are considered to be not statistically significant ($\div 2_{0,5}$ = 2.564, p = 0.1233) (Fig. 12).

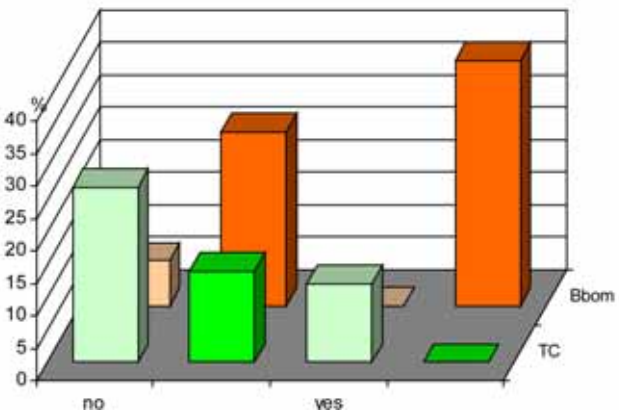

Fig. 12. Water bird presence in the pond (light colours – larvae; bright colours – adults)

Conclusions

Based on our inventories of 274 ponds in the project areas of the 3 countries and 31 ponds created or restored in Denmark and Schleswig-Holstein targeting *B.bombina* and *T.cristatus* in previous LIFE projects, we could make recommendations for our own work on pond creation and restoration. The recommendations were used in practice in this ongoing LIFE project. We recommend paying attention to the following criteria and parameters when restoring aquatic habitats for the 3 target species *E. orbicularis*, *B.bombina* and *T.cristatus* in North European lowlands.

Generally it is very important for all 3 species to have pond clusters with different pond size and rich in biological structures needed for each species (see chapters on *Emys orbicularis* in these guidelines and best practice guidelines from previous LIFE Bombina and LIFE Cristatus projects).

These biological structures of plant communities and dead wood develop with time. However, during the restoration and creation process it is possible to directly influence physical parameters of the ponds, such as water colour and quality, shade over the pond, distance to other habitats, fish presence, and grazing.

POND CLUSTERS

It was found to be significant that the distances between ponds in a pond cluster should preferably be 100 m for *Triturus cristatus* and 200 m for *Bombina bombina*. Pond clusters are probably also important for *Emys orbicularis*, although in other areas the whole population live in one larger wetland or pond. We suggest that increasing pond density will benefit all three species.

POND SIZE

In each pond cluster it appears to be better to make some ponds of less than 500 m^2 for *Triturus cristatus* and some ponds larger than 2000 m^2 for *Bombina bombina*. *Emys orbicularis* was found most often in ponds of 500 -2000 m^2 size and thus if possible some of the created ponds should be of this size.

POND DEPTH

It is most optimal to create 0.5-1.0 m deep ponds for *Triturus cristatus* and deeper than 0,5 m for *Bombina bombina*. *Emys orbicularis* shows similar tendency as *Bombina bombina*. Therefore there should be some ponds in the pond cluster with more than 0.5 m.

SLOPE OF POND

Pond slope inclination had no real negative influence on *Triturus cristatus* in this study, while *Bombina bombina* preferred ponds with flat slopes. *Emys orbicularis* adults seem to have preference for ponds with some steep unexposed slopes, whilst juvenile and subadults occur more in ponds with flat slopes. So it is recommended to have ponds with a variety of slopes in order to benefit all 3 species.

SHALLOW WATER ZONE AREA

Shallow water zone area does not seem to influence *Triturus cristatus*. *Emys orbicularis* does not seem to show tight attachment to shallow zones in the ponds either. However ponds with shallow zones covering more than 25% of the pond area are preferred by *Bombina bombina*. It is therefore recommended to always create some ponds with shallow zones in order to have *B.bombina* in the ponds.

WATER CLAERNESS

It is better to have clear water in the ponds for *Triturus cristatus* and *Bombina bombina*, especially in case of larvae, but adults can also live in brown or muddy water. Water quality has no significant influence on *Emys orbicularis* presence. It is recommended

Created pond cluster for turtles: before

After

to have several ponds with clear water in each cluster to secure breeding of *Triturus cristatus* and *Bombina bombina*.

BUFFER ZONE

Triturus cristatus and *Bombina bombina* larvae show clear preference for the aquatic habitats with wide uncultivated buffer zones (over 50 m around the pond). The same is valid in the case of *Emys orbicularis* adults, and even more for the juveniles and subadults.

DISTANCE FROM POND TO FOREST

The results of this study show that preferable distance from the pond to the nearest forest for *Triturus cristatus* and *Bombina bombina* larvae is no more than 200 m, and even smaller distance is preferable for *T. cristatus*. Presence of forest is not so important for *Emys orbicularis*, despite the fact that last remaining populations of *Emys orbicularis* often occur in small open areas inside or on the edge of larger forested areas. The recommendation is that several of the ponds in a pond cluster should be within 200 m distance from the forest in order to have all 3 target species in the cluster.

GRAZING

Grazing was found to have a slightly negative influence on *Triturus cristatus* larvae but *Bombina bombina* on the contrary prefers grazing. Grazing should be carefully planned not to harm the rest of the species including *Emys orbicularis*, for which wrongly planned grazing on the nesting sites and some pond slopes can have a negative impact.

SOURROUNDING HABITATS

It is important to have permanent grasslands close to *Triturus cristatus* and *Bombina bombina* aquatic habitats (within 50 m around the ponds), and addi-

An example of a newly created and restored pond cluster for *B. bombina* and *T. cristatus* in Schleswig–Holstein, Germany well protected from the intensive agriculture by buffer zones, and with different sizes ponds, containing different water quality and different distance to forest habitats

tionally dead wood nearby in case of *Triturus cristatus*. It looks to be important to add dead wood to the banks of newly created ponds for *Emys orbicularis*, and most important is to maintain and create nesting sites as close as possible to the ponds.

SHADE ON PONDS

It is better to make moderately shaded ponds for *Triturus cristatus*, whilst the less shade the better conditions are for *Bombina bombina*. No significant preference for pond shade was noticed for *Emys orbicularis*, however there must be a minimum of 25-50 % sun in summer ponds (not hibernation ponds, which can have much shade), and each pond must be evaluated by experts before making any changes in shading and sun influx.

FISH PRESENCE

Triturus cristatus and *Bombina bombina* larvae can normally survive only in fishless ponds, with exemptions sometimes being ponds with a large fluctuating shallow zone, whilst adults can also live in ponds with fish. It seems not important for *Emys orbicularis* whether there is fish in the pond or not. It is known that turtle can feed on dead fish, and thus it is recommended to have some ponds with fish and some without fish in a pond cluster.

WATER BIRD PRESENCE

It is recommended to avoid water birds, especially ducks, for larvae of *Triturus cristatus* and *Bombina bombina*, while the birds do not harm adults according to this pond study. However it is known that heron can reduce number of adults of *Triturus cristatus* and *Bombina bombina* significantly. Water birds seemed to pose no problems for *Emys orbicularis* in this study but again there can be cases where some birds are predating, especially on small turtles. Generally it is not needed to avoid birds in a pond cluster but it is important not to do actions that attract birds, such as feeding birds or setting up nest boxes or platforms for ducks.

Hibernation site evaluation

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1. Introduction

The European pond turtle spends up to 6 months in hibernation in the three project countries Lithuania, Poland and Germany, where extreme climatic conditions with long and cold winters occur. Due to the lack of knowledge on the requirements of favourable hibernation sites and the survival rate of turtles during hibernation in the three above-mentioned project countries, investigation of hibernation sites and their conditions and structures was carried out. In literature on the subject, some cases of turtles hibernating on land are described (PALM 1974, FRITZ & GÜNTHER 1996) but usually turtles hibernate in water bodies. The concentration of turtles at specific sites shows, that only a small number of areas fulfil the specific hibernation conditions of *Emys orbicularis* (SCHNEEWEISS & STEINHAUER 1998, SCHNEEWEIß 2003, MEESKE 2000a, b, 2006). Initial observations indicate that oxygen supply and temperature determine the suitability of hibernation sites (SCHNEEWEIß 2003). Therefore hibernation sites are often situated near subterranean springs or current flows, where more oxygen and less frost occur, because long-term freezing can have mortal consequences for turtles.

Generally, the methods for identifying the hibernation places were telemetry, captures, and observations of pond turtles in late autumn (before hibernation) and in early spring (just after coming out of hibernation). Additionally, data about the characteristics and structure of hibernation sites were collected at some hibernation sites.

The evaluation of hibernation sites for Emys orbicularis based on our data leads to an improvement in knowledge on the habitat requirements of turtles throughout the year. This knowledge will be taken into consideration when defining suitable pond management regime. E.g. more hibernation places for local populations can be secured by giving some of the characteristics of hibernation sites to new or restored ponds.

In addition, detailed information on the requirements for hibernation sites is useful for developing adequate local management and action plans for *Emys orbicularis*. These plans are the basis for a good habitat management in turtle areas.

2. Methods

The methods for identifying the hibernation places were observations of turtles before hibernation and/or just after coming out of hibernation, as well as telemetry. During spring and summer individuals of different sex and age were captured by hand, fishery traps (1/3 above the water surface), and traps baited with beef or pig heart (method by SERVAN 1986) (fig. 1 and 2). Selected animals in all project countries were fitted with transmitters (weight: 8-10 g, durability of batteries inside: 1 year) for locating by radiotracking (fig. 3). The radiotracking equipment consisted of a receiver (Yupiteru MVT-9000MK II) combined with a hand operated unidirectional antenna and transmitters. Turtles with transmitters were checked every week, and in some areas even daily, from the beginning of summer until the end of September, in order to find out preferred places for overwintering. Between October and April all animals were located once or twice per month. Two radiotracking methods were applied during the study. In ponds triangulation was employed, and for direct migration observation (e.g. during migration on land), walking in the direction indicated by the antenna was used (Homing-in-on the Animal) (WHITE & GARROTT 1990).

Methods of turtle captures in Western Poland: baited trap, capture by hand

Release of adult female of *Emys orbicularis* with transmitter in a restored project pond in Kuciuliske Herpetological Reserve L05

3. Results and Discussion

3.1 Existing hibernation sites of *Emys orbicularis* in the project areas

3.1.1 Lithuania

- 7 hibernation sites in 5 permanent and 2 temporary water bodies. E.g. 3 sites belonging to a big alder forest swamp are known in the area of Klepociai and Petroskai L03 in Veisiejai Regional Park
- 3 hibernation sites in 2 different permanent ponds near/at the edge of a highmoor/ quaking bog and 1 in a flooded swamp are known in the Meteliai Regional Park L04
- 3 hibernation sites in 2 different permanent ponds and 1 site in a highmoor/quaking bog close to a highmoor pond are known for the Kuciuliske Herpetological Reserve L05
- 1 hibernation site in a permanent pond near a highmoor/quaking bog is presumed for the Straciunai Herpetological Reserve L06
- 1 hibernation site in a permanent forest pond is known in the Bestraigiske Forest District L07

3.1.2 West-Poland

- 1 hibernation site in a pond of Uroczysko Puszczy Drawskiej (Jeziora Pszczewskie i Dolina Obry Pk01)
- 5 hibernation sites (2 in an old river bed of Ilanka river and 3 in a forest channel) in Rybocice/Ujscie Ilanki Pk03
- 1 hibernation site in a corner of a large fish pond in Drawiny (Uroczysko Puszczy Drawskiej Pk04)
- 1 hibernation site in a forest swamp in Drzeczkowo (Zachodnie Pojezierze Krzywinskie Pk05)

3.1.3 Northeast-Germany

- 1 hibernation site in a small, very structured field-pond (Typha- and Phragmites reed, willow shrubs) in Stobbertal Da02
- 2 hibernation sites in a shaded forest-pond with high dead wood share directly in neighborhood of Stobbertal Da02
- 3 hibernation sites in a shallow cove and 1 hibernation site at a willow shrub of a big semi-open pond with structured reed in Poratz Da03
- 3 hibernation sites in a structured alder- and willow pond with high dead wood share in Poratz Da03
- 2 hibernation sites in structured willow shrubs and 2 hibernations sites in structured reed areas of a big pond at the edge of the forest in Poratz Da03
- 2 hibernation sites in a structured alder-/reed-field pond in a thick alder fens with high dead wood share in Poratz Da03
- 4 hibernation sites in structured willow-/alder shrubs, and 1 hibernation site in a structured reed belt of a pond at the edge of the forest in Kölpinsee Da04

3.2 Types and requirements of winter habitats of *Emys orbicularis*

In the project areas *Emys orbicularis* lives on the northern border of the species range. During project

Checking the turtles of *Emys orbicularis* with transmitters during hibernation period in Petroskai L03

investigations and in earlier studies in East-Germany (SCHNEEWEIß 2003) it could be ascertained that pond turtles hibernate in ponds or pond parts where they are more protected from frost and extreme temperature fluctuations. Hibernating individuals could be found in very natural forest swamps e.g. alder swamps, in different types of natural or near-natural, eutrophic or mesotrophic permanent ponds, as well as in smaller lakes, quagmires, channels and natural temporary ponds. In some areas animals also hibernate in artificial ponds such as fish ponds, e.g. in West-Poland. In principle, *Emys orbicularis* spends the wintertime near shores, e.g. under roots of trees and shrubs or in structured silted-up areas of the hibernation ponds with relatively deep mud layers. Typical vegetation next to or at the hibernation sites are shrubs and trees such as willows (*Salix* spp.) and alders (*Alnus* spp.), as well as foliage plants like cattail (*Typha* spp.), reed (*Phragmites* spp.) and sedge tufts (*Carex* spp.), and furthermore Sphagnum (*Sphagnum* spp.) in highmoors.

Types of hibernation sites with the typical vegetation:

- permanent pond with shallow pond parts with bright reeds, cattail and sedge tufts; permanent pond with shallow pond parts or swamps with sedge tufts and shrubs, e.g. willows and/or alders
- permanent pond with shrubs and trees near shores with coves and/or in shallow pond parts e.g. willows and/or alders with high dead-wood share e.g. stumps
- aquatic, structured forest swamps e.g. alder forest with high dead-wood share, e.g. stumps as a result of water level fluctuations
- under or in a channel inside quagmires consisting of Sphagnum (close to a high moor pond)
- channel in bogs with sedge tufts and trees and bushes on the shore, e.g. willow and/or alders
- forest channel with woody structures e.g. dead wood, tree trunks, branches and/ or beaver lodges
- old river bed with woody structures e.g. dead wood, branches and/or rootstocks of plants, e.g. yellow water-lily (Nuphar lutea) or white water lily (Nymphaea alba)
- temporary pond with sedge tufts and with or without shrubs and trees at the shore, e.g. willows and/or alders; hibernation site can dry up in winter

The aquatic hibernation sites are situated in water depths of 20 to 100 cm, but the turtles favour depths of 20-50 cm for hibernation. However, during real frost periods animals move from near-surface layers to deeper layers. If hibernation sites even dry up individuals shift deeper to the mud layers of the bottom. In wintertime water temperatures at the hibernation sites are between 2 and 7.5°C and during the real hibernation period a bit lower (2 to 6°C). Investigations in East-Germany showed that hibernation sites can be low in oxygen or even anaerobic (SCHNEEWEIß 2003).

Summerly view of the hibernation site in a restored pond complex at the edge of a bog in Juodabale Herpetological Reserve,Lithuania

Hibernation site in the flooded southern part of a swamp in Meteliai Regional Park, Lithuania

Hibernation site (right side) in a permanent pond at the edge of a bog in Kuciuliske Herpetological Reserve, Lithuania

Hibernation site in a forest swamp in Zachodnie Pojezierze Krzywinskie, Poland

Hibernation site in structured reed areas of a big pond at the edge of a forest in Poratz, Germany

Hibernation site in a structured alder- and willow pond with high dead wood share in Poratz, Germany

Tab. 1: List of requirements at hibernation places of Emys orbicularis in the North European lowlands

Characteristics	Requirements
Water depth	40-100 cm; hibernation sites should not dry up during winter
Water temperature (°C)	without longer periods of temperatures below zero; 2 to 6 °C
Water quality	no special requirements, about neutral pH
Pond ground (substrate)	as a rule, deep mud layer
Microclimate	protected position with no strong temperature fluctuations, with good windbreak (e.g. coves, reeds, channels, forest ponds, fens with trees e.g. alder fens)
Structure/vegetation	rich in structure by dead-wood and/or roots, rhizomes and tufts
Cover	rich in cover, dead vegetation, foliage, dead-wood
Lighting conditions	unshaded up to shaded
Position (aspect: disturbances)	protection from disturbances; as a rule, hardly accessible locations

3.3 Hibernation behaviour of *Emys orbicularis*

Between July and October turtles move to their hibernation habitats, which lie typically outside of their summer activity ranges. The distance between summer and winter habitats can be up to 1000 m. Usually, Lithuanian turtles migrate a bit earlier to their hibernation ponds (between End of July and end of September) (MEESKE & RYBCZYNSKI 2001, MEESKE 2006) than East-German animals (between end of August and middle of October) (SCHNEEWEIß 2003). The hibernation period is dependent on climatic conditions and lasts normally until the middle of March or end of April. In general, the hibernation period starts a little later in East-Germany and ends a little sooner than in Lithuania.

During hibernation turtles perform smaller movements at water temperatures between 5 and 8°C, but at temperatures lower than 4.5°C they remain totally motionless.

Due to the fact that European pond turtles often hibernate together with other individuals, a substantial concentration of animals can be found in the hibernation sites. Such observations were already described for East-German turtles by SCHNEEWEISS & STEINHAUER (1998) and SCHNEEWEIß (2003) as well as for Lithuanian turtles by MEESKE (2000a, b, 2006), and could be noticed in some project areas during this project. Furthermore, individuals show a fidelity to their hibernation sites in East-Germany (SCHNEEWEISS 2003) and in Lithuania (MEESKE 2000a, b, 2006). Directly after the hibernation period animals start the mating period, as the concentrations of individuals at hibernation sites makes it easier to find sex partner.

3.4 Threats for hibernating *Emys orbicularis*

Threats for hibernating turtles are fen and peat digging and cleaning of channels, if these activities are done close to or in the hibernation sites during winter. In particular, as turtles hibernate together, the destruction of one hibernation site is already a risk for several individuals. Hibernating animals cannot flee from disturbances and can be killed by machines. Furthermore, if hibernation sites are destroyed in winter the turtles have no chance to find another suitable hibernation site.

Additionally, predators of turtles are a big danger for hibernating animals, e.g. wild boars (SCHNEEWEISS 2003), foxes, racoon dogs (LUKINA 1966, cited in FRITZ 2001), racoons (SCHNEEWEIß & WOLF 2009), and otters (KOTENKO 2000). E.g. in shallow waters it is very easy for wild boars to dig out hibernating turtles from the muddy ground. A good water level can secure turtles from predation by wild boars, raccoon dogs and foxes, but not by otters.

3.5 Conservation conclusions for hibernation sites of *Emys orbicularis*

Habitat management activities should always take into account the requirements for turtle hibernation sites. Hibernation is an important period in the course of the year, because turtles hibernate up to 6 months at the northern border of the species range. Furthermore, turtles need specific characteristics for suitable hibernation sites. E.g. due to the fact that turtles begin to mate after hibernation, hibernation sites should be situated close to mating sites. In the ideal case, studies on habitat use should be carried out to find out the annual distribution of turtle populations in their habitats before habitat actions are started.

Actually, bushes and trees at pond shores can destroy basking sites of turtles, but on the other hand woody plants with their branches and root systems submerged in water have important functions as hiding sites in late autumn and as hibernation sites in winter. Dead wood, branches, stumps, roots, and foliage provide a cover and protect hibernating turtles from frost and extreme temperature fluctuations. Therefore bush and tree cutting in and near ponds used by turtles throughout the year should be done partly and not during the real hibernation period. Restoration of turtle ponds e.g. deepening or the removal of trees with their root systems where turtle hibernate should never be carried out during the main hibernation period (October-March/April). The right time and the exact places for habitat management meanures in winter habitats of *Emys orbicularis* should be accurately defined in suitable local management plans and in action plans for the species.

In areas with a higher predator density, an irrigation management can inhibit the drying-up of turtle hibernating ponds during dry years.

Fen and peat digging and cleaning of channels should be prevented in turtle hibernation habitats in wintertime, as hibernating individuals can get hurt or even killed by machines.

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Evaluation of nesting sites of the European pond turtle (*Emys orbicularis L.*) in the North European Lowlands

M.A.-C. MEESKE & N. SCHNEEWEIß

Introduction

In the three project countries Lithuania, Poland and Germany, Emys orbicularis exists at the northern boundary of distribution (FRITZ 1995, 1996, FRITZ & GÜNTHER 1996), where turtles live under extreme climatic conditions, including short summers and cold winters. This fact leads to a stressful reproduction (SCHNEEWEISS & JABLONSKY 2000). Up to the beginning of the 90s it was assumed that the extreme small and superannuated northern populations cannot reproduce any more. However, investigations from East-Germany (ANDREAS et al. 1996, SCHNEEWEISS et al. 1998, ANDREAS 2000, SCHNEEWEISS & JABLONSKY 2000, SCHNEEWEISS 2003, 2004), Central Poland (MITRUS & ZEMANEK 1998, 2000, 2004), East-Poland (SCHNEEWEISS & JABLONSKY 2000) and Lithuania (MEESKE 1997a, b, MEESKE 1998, MEESKE & RYBCZYNSKI 2002, MEESKE et al. 2002, MEESKE & MÜHLENBERG 2004) show the contrary. Nevertheless, the locations and the conditions of the egg-laying places of Emys orbicularis in the project countries were still not known up to the beginning of the protection efforts.

Hence, the aim of the present studies was to analyse the aspects of reproduction biology as well as the ecological requirements, and the availability and suitability of nesting areas of *Emys orbicularis* in the North European lowlands. During the project studies different data on nesting conditions were collected to evaluate the characteristics of nesting sites and the reproduction status of populations in all project countries. These results give a better understanding of the improvement of existing areas, the restoration of old sites, and the creation of new potential nesting areas with regard to the habitat requirements of *Emys orbicularis* for successful reproduction.

Furthermore, a good knowledge about the localities of old and existing nesting sites, their current status, conditions and threats is necessary for creating adequate local management and action plans for *Emys orbicularis*. With both plans a successful reproduction can be achieved as a basis of a good population management and increase in population sizes, which are vital for viable turtle populations.

Methods

In the course of the project regular visual controls were carried out in the known and possible suitable areas/nesting sites (open south-exposed areas) between the end of May and middle of June (between the 20th of May and 15th of June) every evening. Before the nesting period, adult females were captured by hand, with fishery traps, or with the help of traps baited with beef or pig heart (method by SERVAN 1986). Selected animals in all project countries were fitted with transmitters (weight: 8-10 g, durability of batteries inside: 1 year) for locating by radiotracking. The radiotracking equipment consisted of a receiver (Yupiteru MVT-9000MK II or Wildlife Materials TRX-1000S) combined with a hand-operated unidirectional antenna. During the nesting period females with transmitters were located at least 1 or 2 times during daytime in their home ponds. Additionally, migrating females were followed directly in the direction indicated by the antenna (Homing-in-on the-Animal) (WHITE & GARROTT 1990) in the afternoon and evening to find out their nesting sites in the project areas. The aim of this study part was to get data about time and duration of nesting period, used nesting sites and location of nests, nesting habitats, number of nesting females and nests per season.

Further controls of the known nesting sites were conducted all year round to notice predated nests and indications for reproduction success. Additionally, nesting sites and all located nests were investigated, e.g. photos and GPS-coordinates as well as registration on GIS base (ESRI ARC-VIEW).

Due to the lack of turtle observations in Bialowieza, where only one female turtle was captured in June 2006, no data on reproduction and nesting could be gathered there.

Results and Discussion

Existing and potential nesting sites of *Emys orbicularis* in the project areas

Nesting sites were recorded and reproduction success was recognized in the project sites in Lithuania (Petroskai, Juodabale, Kuciuliske, Bestraigiske), West-Poland (Ujscie Ilanki), and Germany (Poratz, Kölpinsee).

Lithuania

- 5 nesting sites (1 xerothermic place near a field path) in Petroskai L03 in the Veisiejai Regional Park,
- 3 nesting sites [1 in Juodobale Herpetological Reserve (sandy dry grassland), 1 in the village Rockiai (xerothermic place near field path and meadows), and 1 in Didyjis (xerothermic place near meadows)] in the Meteliai Regional Park L04 (more places are assumed),
- 3 nesting areas separated into 7 different sites (sandy dry grasslands near meadows, 1 xerothermic place near/on a field/forest path, 1 xerothermic place in a clearing) in the Kuciuliske Herpetological Reserve L05 (more places are assumed),
- 3 nesting sites (1 xerothermic place near forest road, 1 xerothermic place outside the forest near meadows, 1 old nesting site in the forest destroyed by overgrowth) in the Bestraigiske Forest District L07 (more places are assumed).

West-Poland

- 1 existing nesting site on a small forest clearing in Ujscie Ilanki Pk03,
- 1 potential nesting site in Torfowisko Mlodno Pk02 (1 female observed in 2002),
- 3 potential nesting sites in Ujscie Ilanki Pk03 (a few females observed in 2006 and 2007),
- 2 potential nesting sites in Uroczysko Puszczy Drawskiej Pk04 (2 females observed between 2002 and 2006),
- 1 potential nesting site in Zachodnie Pojezierze Krzywinskie Pk05 (1 destroyed nest found in the 80s and parts of a turtle carapace found in 2007).

Main nesting area in the Juodabale Herpetological Reserve, Lithuania

Predated nests in the Bestraigiskiu Forest District, Lithuania

Nesting area with bottles for predator defence in Ujscie Ilanki, Poland

Traditional nesting site in Kolpinsee, Germany

Northeast-Germany

Currently used nest-sites exist only in Da03 and Da04 (in the following text, "extensively used" means mowed 1-2 times per year).

- 5 nesting sites [2 on extensively used meadows (semi-natural dry grassland), 2 on fallow-land, earlier (12 years ago) arable land, today extensively used meadows (semi-natural dry grassland), 1 on actually fallow-land, earlier arable land and freshly sowed meadow (extensively used), ecological type fallow arable land (development objective: semi-natural dry grassland)] in Poratz Da03,
- 3 nesting sites [1 on extensively used meadows (sandy dry grassland), 2 on fallow-land, earlier (10 years ago) arable land, today extensively used meadows, semi-natural dry grassland] in Kölpinsee Da04,
- 1 historical nesting site (last female observed in 1994) in Frauenhagen Da01,
- Several potential suitable nesting sites in Märkische Schweiz Da02,
- 1 potential very suitable nesting site in Brodowin – Parstein Da05.

Nesting behaviour of Emys orbicularis

During the nesting period females leave the ponds in the daytime and move to the nesting sites. In some cases they start their migrations one or a couple of days before nesting. Usually, searching of a suitable nesting site and nesting itself occurs in the late afternoon and evening and lasts several hours (MEESKE 1997b). With finishing the search of a suitable site, females start to dig the nest chamber with their hind legs. They lay up to more than 20 eggs. After egg deposition, turtles close the nests and move to their home or summer ponds. They often spend the night after egg deposition on land in a hidden place near the nest.

Weather conditions influence not only the start and duration of the nesting period but also the starting time of the real nesting (searching, digging, egg-laying). Mostly, on colder days females begin earlier with their nesting activities. On too cold or rainy days, they do not lay eggs at all, e.g. at < 15°C vespertine air temperature (MEESKE 2006).

Usually nesting site fidelity is described for Emys orbicularis in the project countries Germany (SCHNEEWEISS & STEINHAUER 1998) and Poland (MITRUS & ZEMANEK 2000), as well as in other countries like Italy (ROVERO & CHELAZZI 1996). Interestingly, females of the Lithuanian local population Kuciuliske show different strategies for finding suitable nest sites (fidelity-and shifting-strategy). The number of "shifting"-females during a previous study was about 38 %, but now it was determined that the real number of "shifting"-females should be higher. This assumption is based on the increase of observations of shifting females with the increase of observation years. Consequently, a high percentage of „shifting"-females is registered at the northern border of the species range. The Lithuanian findings could elucidate those extreme conditions at the northern border of the species range affect good adaptations to prevent extinction of local populations (MEESKE 2006). Thus, the Lithuanian turtles are well adapted to changing habitat conditions by e.g. using the shifting strategy.

Requirements for nesting sites of Emys orbicularis in the North European lowlands

The quality and the suitability of the microclimate at a nest site are decisive for the reproduction success of a female (MORREALE et al. 1984, SCHNEEWEISS 2003). At the same time SCHNEEWEISS (2003) points out that in regions with an unfavourable climate a successful incubation is possible at sites with a suitable microclimate. Different characteristics influence the microclimate, including exposition, inclination, windbreak, substrate, vegetation, etc.. Furthermore, the availability of suitable nest sites is a critical factor for the population dynamics (ROVERO & CHELAZZI 1996).

The following text describes important criteria of suitable nesting sites determined on the basis of collected data in different studies before and during the project period in the project areas. In the North-European lowlands, nests of *Emys orbicularis* can be found in places with eastern (lots of morning sun) up to western expositions (lots of setting sun) (80-280°) but most of the nests are located in places with southern, south-eastern and south-western expositions. Generally, southern and south-western/-eastern slopes heat up better than western, eastern and northern slopes or plateaus.

Emys-females of the northern boundary of distribution range search for nest sites in flat, slightly and strongly inclined areas (0-20°). In exceptional cases, single nests are dug in steeper ground as well (up to 40-50°) [Germany: 3,5-19,5° (ANDREAS 2000), 3-39° (SCHNEEWEISS 2003); Lithuania: 0-20° (MEESKE et al. 2002, MEESKE 2006)]. In slightly and strongly inclined places stagnant moisture is prevented (ANDREAS 2000, RÖSSLER 2000) and a better warming up of the soil occurs than in flat places

with the same exposition. Thus, at southern slopes the soil temperature is significantly higher than in flat areas (BREITENBACH et al. 1984, MÜCKENHAUSEN 1985).

In the North-European lowlands nests can be found in places with a vegetation cover of 5 up to 95 % [Germany: 5-80 % (SCHNEEWEISS et al. 1998, SCHNEEWEISS 2003); Lithuania: 5-95 % (MEESKE 2006)]. The vegetation cover reduces variation of soil temperature (MÜCKENHAUSEN 1985) and could have advantages for the incubation period. The incubation should last as short as possible to guarantee a hatching success in the northern regions. The incubation period extends under artificial conditions with day- and night-variation of temperatures in comparison with constant temperatures (SCHNEEWEISS 2003). Furthermore, most of the plant species occurring at these nesting sites are single grass or have a short growth, which prevents the nests from shading or shades them only slightly (comp. MEESKE et al. 2002, comp. MEESKE 2006).

In the German project areas it was investigated how the sunshine duration between June and August influences incubation results: insufficient sunshine when total sunshine duration is < 580 h and daily average < 6:15 h; moderate to medium conditions when total sunshine duration is 580-675 h and daily average 6:20-7:20 h; and favourable conditions when total sunshine duration > 675 h and daily average > 7:20 h (SCHNEEWEISS 2003, 2004). It is assumed that at the northern boundary of species distribution the necessary sum of temperatures for the incubation can be guaranteed by a longer duration of sunshine. In summers with less sunshine duration, clutches at less shaded nesting areas should be favoured. More shaded nesting areas could mean incubation failure of a clutch. On the other hand a good ability of heat storage of the substrate can compensate certain differences of insulation at nesting sites.

In most of the North European areas with *Emys orbicularis* populations a high predation rate on nests is known (up to 70-90 %). Protection of eggs and hatchlings inside the nests against predators can prevent big losses of offspring.

Aquatic habitats within small distances from the nesting sites (< 300 m) are very important, as they provide resting and hiding sites for nesting females, and have an important function as first "home" ponds for hatchlings after leaving the nests. Furthermore, the predation risk especially for hatchlings is much lower in water than on land. This means that ponds nearby nesting sites prevent longer migrations on land and reduce the predation risk. In particular, small, shallow and highly structured ponds (without fish), ponds with shallow highly structured zones, or flooded areas e.g. swamps and high moors near the nesting sites are very suitable for hatchlings during their first weeks and months of life, offering suitable conditions for growing juveniles. Such water habitats offer higher water temperatures, suitable prey, less competition, and more hiding sites.

Sizes of nesting sites can be very different (from < 10 m^2 to several hundred m^2). The size of a suitable nesting site should not be too small so that several females can lay eggs in the same place, and that these places are not so threatened by fast overgrowth (tab.1).

Tab. 1: List of requirements for nesting sites of Emys orbicularis in the North European lowlands

Characteristics	Requirements
Minimum size per site	300 m^2
Exposition	south, south-western, south-eastern
Inclination	flat, slightly or strongly inclined areas (0-20°)
Substrate	sandy, sandy-loamy
Structure	dry nutrient-poor locations e.g. sandy dry grasslands
Vegetation and vegetation cover	graminaceous and herbaceous plants, half-shrubs, etc.; lower cover (5 to 50 %), or in case of higher vegetation cover (up to 95 %) it should be vegetation with short growth/height to prevent shading of the ground
Microclimate	xerothermic, protected position with heat storing function and windbreak, as well as without strong temperature fluctuations (e.g. in near/front of forest edges, in bigger clearings)
Lighting conditions	unshaded up to partly shaded; several hours sunshine per day should be guaranteed (daily average > 7:00 h)
Distance to the next water habitat	< 300 m
Position (aspect: disturbances)	protection from disturbances; as a rule, hardly accessible locations

Threats for nesting Emys orbicularis

Threats for nesting females are human activities e.g. hay cutting. If these activities are done close to or in the nesting areas and on the migration routes during the nesting time, female turtles can get hurt or even killed by agricultural machines. On the other hand animals "only" disturbed by humans during searching or digging are already stressed and interrupt their activities for hours or days. If the worst comes to the worst disturbed individuals completely capitulate nesting and release their eggs in water. In areas with a lack of suitable places for nesting, females are forced to move longer distances on land to remote places where they can get stressed, hurt or killed by longer overland migrations due to the risk of traffic and a higher risk of predation.

Conservation conclusions for nesting sites of Emys orbicularis

In the North-European lowlands, populations of *Emys orbicularis* are mostly small, and that is why successful reproduction is essential and suitable nesting sites are very important for saving the last northern turtle populations. On the other hand the species lives here under extreme climatic conditions including short summers and cold winters, which cause an arduous reproduction (SCHNEEWEISS & JABLONSKY 2000). In areas along the northern border of distribution range, the unfavourable climatic conditions can be compensated by availability of places with a favourable microclimate. This means that nesting areas are a decisive or even a limiting factor for the survival of populations. In particular, very small local populations are not able to survive with a regular deficit of reproduction. Therefore the prevention of the loss of open areas and the maintenance of suitable nesting sites are important conditions for saving the last turtle populations in the extreme climatic conditions in the North-European lowlands.

In order to create, restore or maintain places for nesting of *Emys orbicularis*, the requirements for suitable sites should be taken into account. Management plans have to be developed and adapted to the conditions of the specific sites and the status of the local populations, describing exact places and right time for habitat management of nesting habitats of *Emys orbicularis*. In the ideal case, preparatory and accompanying studies should be undertaken to obtain information on nesting ecology (utilisation of nesting sites and reproduction frequency) before habitat actions are started. The studies will also help to evaluate the effects of management.

General recommendations for turtle habitat management and practical instructions for nesting site management are described in chapters 12 and 15.

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Favourable conservation status of *Emys orbicularis* (LINNAEUS, 1758)

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Introduction

The EU Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora (the Habitat Directive) was developed for ensuring the biological diversity by conserving of natural habitats and wild flora and fauna in all EU Member States. This directive is the basis of the creation of the Natura 2000 network which is an ecological network of species areas including natural habitat types and habitats of species. For that purpose measures have to be designed in order to maintain or restore the favourable conservation status as well as in order to undertake surveillance of the conservation status. Furthermore suitable indicators have to be described and defined for assessing and maintaining the conservation status. Species registered in Annexes II and IV of the Habitats Directive like *Emys orbicularis* encourages member states and accession countries to restore the species to a favourable conservation status across the EU.

In order to evaluate and to determine the favourable conservation status for threatened species in different areas, regions and countries with similar habitat types and climatic conditions it is necessary to develop comparable criteria for the whole area. This was done for the European pond turtle (*Emys orbicularis*) during the LIFE-Nature-Project "Protection of Emys orbicularis and amphibians in the North European Lowlands". These criteria will help biologists and ecologists doing monitoring of species to determine the current favourable conservation status and finally to evaluate regularly the effects of management measures or existing threats for the monitored populations in the northern range of the species distribution.

Furthermore, populations living under extreme living conditions at the border of species distribution can increase the genetic variation of a species e.g. *Emys orbicularis* in the North European lowlands (comp. MOCKFORD et al. 1999). However, these specific adaptations can be the fatality for the populations because of already smaller changes of the living conditions. Hence, populations at the edge of the species distribution should have a specific attention and a high protection priority (SCHLÜPMANN 1992, FRITZ 2000).

Criteria for defining the favourable conservation status of populations of *Emys orbicularis*

Individual numbers for the different conservation status of *Emys orbicularis*

- **A** > 50/40 individuals ⇒ excellent (favourable on long term)
- **B** 30-50/20-40 individuals ⇒ well (favourable on short term)
- **C** 10-30/< 20 individuals ⇒ medium (unfavourable) (too small populations or declining)
- **D** < 10 individuals ⇒ bad (highly unfavourable up to nearly extinct) (too small populations, declining, no or too small reproduction success)
- **E** 0 individuals ⇒ extinct

Table 1 is based on the criteria by SCHNITTER et. al (2006) for the monitoring of *Emys orbicularis* in Germany. These criteria were revised, complemented and adapted to the conditions of the turtle populations and their habitats in the North European lowlands.

Tab. 1. Criteria for defining the favourable conservation status of populations of Emys orbicularis

	A	B	C	D
Status of populations	excellent	well	medium	bad
Population evidence LT Age structure	> 50 adults of different age classes	30-50 adults of different age classes	10-30 adults	< 10 adults
Population structure LT	> 12 subadults, in addition juveniles existing	at least 7-12 subadults, in addition juveniles existing	at least 7 subadults and/or juveniles	< 3 subadults and/or juveniles
Population evidence PL Age structure	> 40 adults of different age classes	20-40 adults of different age classes	10-20 adults	< 10 adults
Population structure PL	> 10 subadults, in addition juveniles existing	at least 5-10 subadults, in addition juveniles existing	at least 5 subadults and/or juveniles	< 3 subadults and/or juveniles
Population evidence DE Age structure	> 40 adults of different age classes	20-40 adults of different age classes	10-20 adults	< 10 adults
Population structure DE	> 10 subadults, in addition juveniles existing	at least 5-10 subadults, in addition juveniles existing	at least 5 subadults and/or juveniles	< 3 subadults and/or juveniles
Habitat quality	excellent	well	medium	bad
Water habitat				
Structure of the water bodies/ of the system of water bodies e.g. summer habitats, winter habitats with less danger of frost, structured shallows zones with submerse vegetation, woody and foliage plants in water and at shores as hiding and feeding sites, muddy ground	all components of the annual habitat optimal, lots of suitable pond structures e.g. lots of sunny summer habitats, several protected deeper and more shaded parts for hibernation, lots of structured shallow zones, lots of vegetation in water and at shores, thick mud layer	similar **A**, but few components of the annual habitat not optimal or not so abundant	several components of the annual habitat not optimal, insufficient variation in pond structure e.g. less sunny summer habitats, few protected deeper and more shaded parts for hibernation, less shallow zones, less vegetation in water and at shores, thin mud layer	most components of the annual habitat not optimal, pond is uniform, no variation in pond structure e.g. no sunny summer habitats, no protected deeper and more shaded parts for hibernation, no shallow zones, no vegetation in water and at shores, no mud layer
Total size of the water bodies/ of the system of water bodies if all or most of the water bodies are suitable	> 1 ha under normal conditions; exceptional minimum in very dry periods: > 0,3 ha	> 0,6 ha under normal conditions; exceptional minimum in very dry periods: > 0,2 ha	> 0,2 ha under normal conditions; exceptional minimum in very dry periods: > 0,1 ha	< 0,2 ha under normal conditions; exceptional minimum in very dry periods: < 0,1 ha
Number and structure of suitable basking sites e.g. shore, living and dead vegetation, stones	abundantly available, structure of shore and water structure suitable for basking e.g. protected sunny shores, tree trunks, shrubs, deadwood, foliage plants e.g. sedge tufts, cattail	similar **A** but suitable sites partly shaded or not so abundant	more unprotected open shores, water surface appears „tidy" and lack of suitable basking sites respectively	only unprotected open shores, water surface appears „tidy" and big lack of or no suitable basking sites respectively

Land habitat				
Characteristics of the bank vegetation/ structure as basking sites	sunny shores not too open, not too overgrown, shores with different inclinations e.g. steeper and more slightly inclined	only partly too open or too dense vegetation	larger area either too dense or too open, only 1 type of shore inclination e.g. steep or flat	almost all bank either too dense or too open, only 1 type of shore inclination e.g. steep or flat
Nesting sites				
Number of potential nesting sites	numerously existent (> 7)	sufficiently existent (5-7)	barely existent (3-4)	barely existent up to nonexistent (0-2)
Size per nesting site	> 300 m^2	200-300 m^2	100-200 m^2	< 100 m^2
Distance to next water habitat	< 300 m	300-600 m	> 600 m	> 1000 m
Microclimate e.g. sun exposition, southern location on a slope, substrate, windbreak	very favourable e.g. sunshine (daily average > 10:00 h), southern exposition, slight and/or strong inclination (5-20°), sandy soil, xerothermic, windbreak	favourable e.g. sunshine (daily average > 07:00 h), flat (< 5°) and/or steep inclination (20-30°), sandy-loamy soil, partly less windbreak	unfavourable e.g. less sunshine (daily average < 07:00 h), more eastern and/or western exposition, loamy-sandy soil, less windbreak, less heat storing, risk of stagnant moisture	very unfavourable, e.g. too less sunshine (daily average < 05:00 h), northern exposition, loamy soil, no windbreak, no heat storing, bigger risk of stagnant moisture
Predation risk (e.g. wild boars, racoon dogs)	no or marginal e.g. adequate protection measures, low predator density	medium e.g. adequate protection measures, lower predator density	high and no or not sufficient protection measures	very high and no protection measures
Integration				
Distance to the next population	< 500-1000 m	1000-2000 m	2000-3000 m	> 3000 m
	A	**B**	**C**	**D**
Impairments	none up to marginal	medium	intense	very intense
General				
Pressure of leisure	none	infrequent at shores and in the range of nesting sites respectively	regular at shores and water-based and in the range of nesting sites respectively	regular and intense at shores and water-based and in the range of nesting sites respectively
Application of fertilisers and pesticides around water habitats	not ascertainable, buffer zone > 50 m	not ascertainable, buffer zone 20-50 m	ascertainable, no buffer zone	ascertainable, no buffer zone
Water habitat				
Utilisation of fishery	no utilisation	marginal and not dangerous for the species respectively	often and dangerous for the species respectively	numerous and very dangerous for the species respectively
Utilisation of water habitats e.g. cattle drinking, washing	no utilisation	marginal and not dangerous for the species respectively	often and dangerous for the species respectively	numerous and very dangerous for the species respectively
Water regime	undisturbed	marginally disturbed	intensely disturbed e.g. meliorations, afforestations	very intensely disturbed e.g. lots of meliorations, afforestations

Water habitat destruction e.g. overgrowth, gravel pit construction	no water habitat destruction	no water habitat destruction	threatened by water habitat destruction	heavily threatened by water habitat destruction
Land habitat				
Habitat destruction e.g. succession, agriculture, afforestation, building, road construction	no land habitat destruction	no land habitat destruction	threatened by land habitat destruction	heavily threatened by land habitat destruction
Nesting sites				
Succession at nesting sites	none or adequate management measures	marginal, succession nonserious	progressing, succession serious and no adequate management measures	quickly progressing, succession very serious and no adequate management measures
Human disturbances by agricultural activities, grazing and trampling of cattle and horses particularly during nesting season	none	infrequent	less, but regular	intensive, regular
Isolation				
Road ways in the land habitat/ adjacent	not existent	less existent and scarcely frequented	existent and moderately frequented	more existent and numerously frequented
Inter- and intraspecific competition				
Allochthonous individuals	not existent	not existent	existent	existent
Exotic turtle species	not existent	not existent	existent	existent
Predation on adults				
Predation risk by alien species e.g. racoons	not existent	not existent	existent	existent

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Favourable Conservation Status for Fire Bellied Toad and Great Crested Newt in North European lowland

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Introduction

Our definition of the North Europen lowland is areas below 400 m above sealevel and south of the boreal forested zone in Lithuania, Northern Poland, Northern Germany, Denmark, Skåne in South Sweden.

Definition of two population structures of Fire Bellied Toad and Great Crested Newt.

There are mainly two types of fire bellied toads and great crested newt's population structures present in Lithuania, Poland, Germany and Denmark.

1. Isolated populations, which does not have possibilities for immigration. Each isolated population is dependent on a single breeding pond or very few ones.
2. Meta-populations, formed by several sub-populations of fire bellied toad or crested newt, which are connected to each other with migration corridors and ponds functioning as stepping stones for the two species. Thus the individuals can migrate freely between sub-populations. Even each sub-population has only a single breeding pond; the whole meta-population system offers several breeding possibilities for fire bellied toad or great crested newt to the connectivity.

The criteria for assessing the favourable conservation status of fire bellied toad or great crested newt are different depending on the type of population structure.

Favourable conservation status of Fire Bellied Toad

Isolated population

– In case of isolated population there have to be an annual stable breeding success, at least in 3 ponds, with distances between ponds no more than 300 m. However, in some natural floodplain landscapes, natural forest meadows habitats or city landscapes, the number of ponds with annual breeding success might be lower due to natural topography or urbanisation and with little chance to chance the situation.

– The ponds must be fish free, with the slopes of 5- 20 and with clear water. The shallow water (up to 50 cm) should form at least 50% of the total area of the pond. There have to be swamp vegetation (less than 1 m high) present in the edges of the pond (more than 25%). 25%-50% of the total surface of the pond should be vegetated with floating vegetation (for example potamogeton natans or Glyceria fluitans), which covers maximum 50 % of the water surface inside its own vegetation zone.

– The effective population size should be at least 500 adults, which means that the population must count at least 1000 adults. Depending on the quality of foraging ponds and swamps and the terrestrial habitat, the average pond (natural eutrofic, fish free, spring depth of 0,5-1.5 m) can support different amount of adult fire bellied toads. The fire bellied toad can be flexible in its feeding behaviour and extend its terrestrial feeding period if ponds dry up early in the seasons as they do on relative more sandy flat terrain compared to moraine hills formed of clay. The fire bellied toad can use wet forest, dried out swamps, piles of logs and stone fences as hiding and terrestrial foraging habitat. So in areas with relative few ponds and ponds of drying out character the other terrestrial habitats become more important. In those situations the area of good terrestrial habitat can compensate for relative few and poor quality of foraging ponds in order to sustain a favourable conservation status.

– The habitat components (breeding and foraging ponds, terrestrial foraging area and hibernation sites) should be safeguarded in the area where the population occurs.

– In case of poor terrestrial habitats, each site with a population of fire bellied toads should contain minimum 10 potential breeding ponds with a yearly breeding success in 3 ponds or alternatively, water surface of breeding waters of mini-

mum of 5000 m^2. When terrestrial feeding habitats are poor (as fields or pine plantations) the amount of foraging waters should be 50 m^2 per adult frog meaning an total area of foraging waters of 50.000 m^2 (including the 5000 m^2 of breeding ponds) are desirable. If the terrestrial habitat is richer (wet forest, wet grassland, pasture), the water surface could be 25 m^2 per adult frog thus with a need of 25000 m^2 (including the 5000 m^2 of breeding ponds) for one fire bellied toad population.

– In agricultural land there should be a buffer zone (uncultivated land) at least 20-50 m wide, around of each pond and preferably also such zone around good foraging habitats as wet forest.

Meta–population

If several fire bellied toad populations of less than 1000 adults are connected to each other (distance between two such sub-populations is 1.0 to 2.0 km), they form a meta-population network. In case of meta-population the individual sub-population can have less than 1000 adults, because the network of 20 sub-populations of approximately 100 adults could form a meta-populations of 2000 adults.

- Each sub-population must have an annual stable breeding success, in at least one ponds.

– The ponds must be fish free, with the slopes of 5-20 and with clear water. The shallow water (up to 50 cm) should form at least 50% of the total area of the pond. There have to be swamp vegetation (less than 1 m high) present in the edges of the pond (more than 25%). 25-50% of the total surface of the pond should be vegetated with floating vegetation (for example potamogeton natans or Glyceria fluitans), which covers maximum 50 % of the water surface inside its own vegetation zone.

– The habitat components (breeding and foraging ponds, terrestrial foraging area and hibernation sites) should be safeguarded in the area where the sub-population occurs.

- The distance between two sub-populations should be 1.0 km and definitely not more than 2 km.

- The migration possibilities between sub-populations have to be assured for fire bellied toads by creating and restoring fish free water bodies and maintaining open semi-natural terrestrial habitats, and securing wet and dry forest with logs as good foraging, hibernation and migration.

– In agricultural land there should be a buffer zone (uncultivated land) at least 20-50 m wide, around of each pond.

Favourable conservation status of Great crested Newt

Isolated population

– In case of isolated population there have to be an annual stable breeding success, at least in 5 ponds, with distances between ponds no more than 500 m. However, in some natural forest landscapes, mountainous or city landscapes, the number of ponds with annual breeding success might be lower.

– The ponds must be fish free, with the slopes of 20- 40 and with clear water. The shallow water (up to 50 cm) should form at least 25% of the total area of the pond. There have to be swamp vegetation (less than 1 m high) present in the edges of the pond (more than 25%). 25%-50% of the total surface of the pond should be covered with floating vegetation.

– The effective population size should be at least 500 adults, which means that the population must count at least 1000 adults. Depending on the quality of terrestrial habitat, the average pond (fish free, spring depth of 1-1.5 m) can support different amount of adult newts. As the crested newt is known to be flexible in its feeding behaviour, in cases of poor terrestrial habitats (fields with intensive agriculture, scrub) water bodies are important not only as a breeding place, but also as a feeding ground. Thus in those situations the area of aquatic habitat should be relatively larger to sustain a favourable conservation status.

For example, in Denmark and Germany, where the terrestrial habitat is relatively poor, consisting often large intensively managed fields, the average pond with water table of 500 m^2 can support a population of approximately 100 adult newts.

In some cases much more than 100 adult newts can live in a 500 m^2 pond, but in an average Danish/German pond one should not expect more than 100 adult newts.

The habitat components (breeding and foraging ponds, terrestrial foraging area and hibernation sites) should be safeguarded in the area where the population occurs.

– In case of poor terrestrial habitats, each site with a population of newts should contain either 10 ponds or alternatively, water surface of 5000 m^2. If the terrestrial habitat is richer (forest, grassland, pasture), the water surface could be 2500 m^2 for one newt's population.

– In agricultural land there should be a buffer zone (uncultivated land) at least 5 m wide, around of each pond.

Meta-population

If several newt populations of less than 1000 adults are connected to each other (distance between two such sub-populations is 0.5 to 1 km), they form a meta-population network. In case of meta-population the individual sub-population can have less than 1000 adults, because the network of 20 sub-populations of approximately 100 adults could form a meta-populations of 2000 adults.

- Each sub-population must have an annual stable breeding success, in at least three ponds.

–The ponds must be fish free, with clear water and slopes of 20-40. The shallow water (up to 50 cm) should form at least 25% of the total area of the pond. There have to be swamp vegetation (less than 1 m high) present in the edges of the pond (more than 25%). 25-50% of the total surface of the pond should be covered with floating vegetation.

– The habitat components (breeding and foraging ponds, terrestrial foraging area and hibernation sites) should be safeguarded in the area where the sub-population occurs.

- The distance between two sub-populations should be 0.5 km and definitely not more than 1 km.
- The migration possibilities between sub-populations have to be assured for newts by creating and restoring fish free water bodies and maintaining open semi-natural terrestrial habitats.

– In agricultural land there should be a buffer zone (uncultivated land) at least 5 m wide, around of each pond.

General Recommendations for Habitat Management

NORBERT SCHNEEWEISS

The following recommendations valid for the European pond turtle as well as amphibians (specifically the Fire-bellied toad and Crested newt) have been outlined based on practical experience with habitat management .

- The habitat management must seek to increase the constancy of ponds. Above all this is to be achieved by improving water retention in the drainage basin. Even today a far-reaching network of drainage ditches has an adverse effect on the landscape's water levels. Therefore targeted interventions in the melioration system in the form of dams or low weirs are required. Drainage ditches should be filled as far as possible or completely dammed. In addition, small overgrown and/or silted-up ponds should be revitalised and new ponds should be created at appropriate locations. In case a pond is part of a complex (group) of ponds the minimum size of a pond should be 200 m², and in case of a single pond the surface area should be at least 500 m²).
- Conservation and restoration of complexes (groups) of various types of ponds is especially important. Such groups should include preferably more than 3 multifaceted ponds, shallow structured bays, water-alder swamps, etc.. At least 50% of the shallow lots and riparian zones should be well exposed to the sun. Dead wood, bunches of sedges and willow thickets provide terrapins places for sun-basking. Such structures should be preserved or created.
- Before undertaking any water infrastructure works (including renovation)an investigation of the habitat and site conditions should be first carried out. Interventions in vulnerable biotops (e.g. a wet meadow) should be avoided.
- Anthropogenic influence on the aquatic species communities should be limited. Fish stocking in smaller water bodies should be prohibited. The stock of fish in larger water bodies should be reduced where appropriate, or the fish should be taken away entirely by harvesting or pumping. Fishing and the use of fish traps should not be permitted in terrapin-occupied waters. Temporary drying out of ponds in late summer or autumn promotes amphibian populations.
- In the vicinity of the aquatic habitats of European pond turtles (within 300 m around the water bodies) there should be some open plains , especially on south-facing slopes (if possible sheltered from wind), for the turtles to have a location to recreate. These open plains, preferably located on poor (sandy) soils, should be extensively used as a meadow and/or pasture. Combination with plant and/or insect species protection is possible. Mowing and grazing should take place in the periods outside the nesting season (May 15 - June 15) and outside the migration period of the hatchlings (March 1 - April 30 and during hot summers from September 1 to October 10). Only light animals such as sheep or goats should be grazing these meadows (herded, not corralled).
- The areas within 500 m around the aquatic habitat should form suitable habitats for the amphibian populations. These include forests, meadows, marshes, gardens, and wasteland. The quality of such terrestrial habitats is primarily determined by what their structure offers in the form of woody debris, rock piles, shrubs and the like. Such structures should be preserved or created.
- When the aquatic habitat is situated in a large scale intensively managed agricultural landscape, appropriate areas of farmland such as wet or sandy plains or hill tops should be transformed into extensively-used grassland. The areas surrounding the water (within 20-50 m distance) should be extensively cultivated as buffer zones, with no application of fertilizers and / or pesticides.
- The habitats have to be preserved by means of appropriate measures in the context of extensive agricultural or forest use and landscape management in a favourable condition for the target species. These are the priority measures against siltation or shading of aquatic habitats, or the growth of wooded areas at nesting sites. The measures of care are to be realised primarily during winter months (see also Section 4).
- The interconnection of habitats is a crucial prerequisite for the long-term survival of the Euro-

Digging of new pond for amphibians

pean pond turtle, and endangered amphibians and reptiles in general. Fragmentation of the habitats through road construction, the expansion of forest tracks and country roads, or the construction of bicycle lanes should be avoided.There is an extremely large set of predators for the amphibian and reptile species, and particularly for the European pond turtle. In addition to the fox and wild boar, non-native species such as mink, raccoon, and raccoon dog are becoming increasingly important predators. The following measures are a prerequisite for the survival and the resettling of E. orbicularis: (i) reduction of the predation losses on the nesting sites by covering the nest with guards or fencing, or weathering of clutch squares, (ii) targeted reduction of local predator population, e.g. by installing box traps for raccoons, and (iii) prohibiting wild boar feedings or baits in the vicinity of pond-turtle water habitats and nesting sites (within 100 m radius).

Specifically, habitat management is to be described and defined in the context of management plans. Here, a comparison is made with other species and habitat protection requirements as well as development-oriented objectives.

More than 5000 m of dams were installed in Poland

The place must be carefully tested before digging

Removal of upper vegeta-tion layer in nesting site

Fencing of nesting sites helps to prevent predation of nests

Site management in Juodabale herpetological Reserve

NERIJUS ZABLECKIS

Situation of the area

The Juodabale zoological reserve was established in 1976 for the protection of populations of European pond turtle within the lake of Menkutis and its surrounding wetlands. The reserve occupies 97 ha area in the Southern part of Lithuania, district of Lazdijai bordering with Poland. The reserve was included into the Natura 2000 network in 2005 as part of Meteliai Regional Park (code of the area LTLAZ0010).

Habitat

The Juodabale herpetological reserve has 7 interconnected water bodies on the edge of a high moor that were restored in 1999. Pond size varies from 300 to 700 m2. The total water surface of the ponds and connecting channels is more than 4000 m^2. The mesotrophic ponds are sunny, muddy and highly structured with the following aquatic vegetation: reed (Phragmites australis), seasonal flooded grassland, pondweed (Potamogeton sp.), bulrush (Typha latifolia), and other aquatic plants. The ponds also have the following shore vegetation/overgrowth: willow (Salix sp.), birch (Betula sp.), alder (Alnus sp.), and poplar (Populus sp., etc.). The shores are partly flat and partly steep. Meadows and pine forests are located next to the ponds. One southern sunny sandy hill lies close to the pond complex.

Individual number, density and distribution

More than 30 individuals are estimated to be inhabiting the restored pond complex in the Juodabale herpetological reserve. Individual density is 53 animals per hectare of water surface). The area is used by the turtles throughout the whole year. Presumably the Juodabale population is much larger when turtles living in a neighboring pond complex are considered.

The individuals inhabited all ponds of this pond complex during active season and changed between the ponds using the channels. Some animals live not only in the pond complex but also in a swampy area several hundred meters away for summer and/or hibernation. During the project new ponds were dug in this swamp situated between meadows.

Age structure, sex ratio and juvenile share

In 2008, 18 individuals could be captured and registered [12 adults (9 females, 3 males), 4 subadults (1999), 2 juveniles (2003)]. More turtles could be observed and also juveniles from different years (1 of 2007, 1 of 2008). During the individual registration of the Juodobale population the sex ratio of 1:3 and juvenile share of 30 % was found out.The age structure of the local population also shows a good situation. Only 4 adults can be classified as old or very old, 1 turtle as older and even 7 animals have a younger age (< 30 years old). The Juodabale population is smaller but seems to be in viable conditions because of its age structure and juvenile share. The high juvenile share indicates good habitat conditions in spite of a high nest predation rate. Sunny interconnected ponds with shallow parts and highly vegetation structure are situated close to the nesting site providing suitable conditions of life for hatchlings (short migration on land, pond changes in water and lots of hiding and feeding sites for guaranteeing a secure and fast growth).

Threats:

The main threats were lack of summer ponds mainly because of overgrowth and accumulation of mud, lack of nesting sites, and nest predation.

Management measures

Management had the following main aims:

- to restore summer ponds for turtles;
- to create hibernation sites for turtles;
- to restore nesting sites and prevent predation;
- to restore ponds for amphibians: Bombina bombina and Triturus cristatus;
- to create hibernation sites for amphibians.

Restoration of summer ponds

10 ponds have been restored in swampy areas 300-400 m away from the main pond complex. Before the soviet melioration the swamps were used for mowing hay, however later they became dier and traditional farming was stopped resulting in overgrowth by bushes and trees. As part of restoration effort, the area of 5 ha was opened by partly removing bushes and trees, and ponds were dug. The ponds are mostly shallow due to high clay layer, which was not dug through to keep the water table in the pond. However one pond in each swampy area has a deeper place for hibernation of turtles.

In first year after digging a turtle has been observed in three ponds close to the main pond complex. Other ponds have so far remained unused by turtles, however one of the shallow ponds was inhabited by Fire bellied toads (in 2009, 16 juveniles were found). The calling bombina have been observed in 2 ponds.

Two more ponds were cleaned from vegetation close to the places where Great crested newt has been found.

The area of 5 ha has been flooded on the western part of the pond complex outside the zoological reserve, and a drainage ditch that had been dewatering huge wetland area was blocked by pulling soil into the ditch. The flooded area can now be used by turtles and connect neighbouring populations.

Creation of hibernation sites

Animals of the restored pond complex hibernate in the channel at the western shore of the high moor/pond complex in a sunny, muddy and very shallow part between reed (Phragmites australis) and other abundant aquatic vegetation [seasonal flooded grassland, pondweed (Potamogeton sp.), bulrush (Typha latifolia) and other aquatic plants].

Another hibernation site is known in the shallow flooded southern part of the swamp with abundant vegetation (seasonal flooded grassland) and overgrowth of young willows (Salix sp.) next to one of the restored ponds. The shores close to the hibernating places have been cleaned from overgrowing vegetation in order to open sun basking places, especially after wintertime.

Hibernation sites for amphibians were created in the vicinity of the new dredged ponds where natural structures suitable for hibernation of amphibians are missing. The sites are clusters of lop covered with grass sods to imitate the roots of shrubs or an old tree.

Restoration and conservation of nesting sites

10 nesting sites have been restored and managed. The main nesting sites are found on the south-exposed nesting site close to the restored area. This place on sandy dry grassland lies in front of a small pine forest and is adjacent to a meadow. Two of the restored ponds are within a small distance from the nesting site (30 m), and there is a herbaceous shallow channel between both ponds. This situation prevents long and stressful migrations on land and reduces the risk of predation for nesting females and hatchlings. For that reason the sites have been mown every year in late summer to keep the vegetation away for next spring. In order to avoid predation the area has been fenced by wildlife fence leaving 10x10 cm holes in the lower row of the fence for turtle females while blocking entrance of racoon dogs and foxes.

Other nesting sites have been cleaned from growing young pines and bushes, and were also mown from vegetation.

Conclusions for the management

The Juodobale turtle population has good chances for survival in spite of small population size. The pond system and the number of suitable nesting sites have been optimised as part of the management effort: some overgrowth at the pond shore was eliminated, mud was removed, and nesting sites were created close to the ponds.

Further management measures should be undertaken to improve the connection and exchange between the Juodobale population and its neighbouring populations by creating corridors between them and restoring habitats of the small neighbouring populations.

Amphibian management in the Upper Rhinluch

THORSTEN SEEGER

Location of the area

The Upper Rhinluch lies about 50 km northwest of Berlin. It is an agricultural used fen area covering about 15.000 ha.

Characteristic of the area

The soil surface in the Upper Rhinluch is apart some spots - fen peat, but due to drainage and former land use the peat layer is predominantly thin (<40 cm) and devastated. Therefore, the content of water soluble nutrients, especially nitrogen compounds, in the soil is high. As a result the waters in the Upper Rhinluch are eutrophic and the cover of grasses and forbs is dense and dominated by nitrophile plant species.

In large parts of the Upper Rhinluch a chalk-bed lies between the peat and the sandy underground. Therefor the soil and the waters in the region are neutral to basic and calcareous.

The Upper Rhinluch is an open land, today characterized by meadows and pastures. A system of ditches, usually with windbreak strips along them, subdivides grassland into single units of up to 100 ha. The system of ditches is connected with canals or canalised courses of the Rhin river system. Additionally, Upper Rhinluch includes 3 extensive shallow lakes that belong to the river system of the Rhin, 2 large open (i.e. = not covered by vegetation) water bodies in a natural fen site and a number of ponds. All these bodies of standing water are surrounded by rests of the original water and fen vegetation, close-to-natural biotopes (abandoned grassland, bush land, birch as well as willow forests) and extensively used grasslands. Those types of biotopes can also be found in the centre of the Upper Rhinluch at both sides of "Bützrhin", "Ruppiner Kanal" and "Alter Rhin" (all these are parts of the Rhin system). Namely there the sites chosen for amphibian management are situated. The sites "Potsdamer Platz" and "Rhinbogen" have an area of about 150 ha in total. They were covered by research project on fen restoration that run in the 1990ies. In this period large parts of the sites were temporarily flooded and "Potsdamer Platz" as well as "Rhinbogen" showed a pattern of unused wetland and meadows where extensive agriculture was practised.

Facts on the target species before start of the management

At the project sites in the centre of the Rhinluch single individuals of Bombina bombina were observed and heard in some years during examinations in the 1990ies. But there was probably no successful reproduction of amphibians because the natural depressions the calls came from usually dried up in the summer. The individuals that emerged in the central Rhinluch presumably descended from a population that had survived in the Linum fish ponds. But there was no information about the size and the survivability of that population.

Less information existed on Triturus cristatus in the Upper Rhinluch. Some breeding sites in the surrounding of the fen area were known (many of them threatened with drying-up), but only one observation from the Upper Rhinluch.

In contrast to Fire-bellied toad and Great crested newt, European pond turtle became extinct in the Upper Rhinluch for a long time ago. Therefore, it was not chosen to a species targeted in that area.

So, the aim was to stabilize the autochthonous populations of the target amphibian species in the Upper Rhinluch and to extend its area by

- optimising breeding habitats,
- creating new breeding and hibernation sites and
- managing land habitats in a way optimal for amphibians.

Management measures

Ponds

Already in the 1990ies a former pond in the Linum fish pond area has been restored and conservation management was introduced there. The management aimed at developing a species rich biotope rather than targeting solely amphibians. Every winter the water in the pond is drained away in order to enable cutting of vegetation at parts of the site. In late winter the pond is re-filled with water. So, during vegetation period it is a pattern of open water areas and areas with dense reed and Typha vegetation at a water level of about half a meter.

Some natural depressions were dredged in the project sites to turn these depressions into permanent small waters bodies. The ponds created are characterized by a kind of ditch in the centre surrounded by large shallow water areas with a water depth of about 30 cm in spring. The shallow water zones provide relatively high water temperatures for amphibians whereas the "ditches" have been constructed to be a rescue site for tadpoles and juveniles when the shallow water zones dry up in summer.

Hibernation sites

Hibernation sites were created in the vicinity of the new dredged ponds where natural structures suitable for hibernation of amphibians were missing. The sites are clusters of lop covered with grass sods to imitate the roots of shrubs or an old tree. To sustain good conditions for hibernation of amphibians for a long time trees and shrubs were planted. Only autochthonous material (trees and willow branches) adapted to the soil and climatic conditions of the Rhinluch area was used for planting. Stones are very rare in the region, so only some of the lop clusters got a stone ground.

Other terrestrial habitats

About 25 ha of meadowland around the ponds were purchased and contracts with land users were signed that ensure the maintenance of land habitats suitable for amphibians (cut, but not fertilized grassland and a 5-10 m width, uncut buffer zone around the ponds).

Results and conclusions

Just after introduction in conservation management in one of the Linum fish ponds it turned into a breeding site for different rare and endangered species, including *Bombina bombina*. Already a couple of years after the management had started some hundred Fire-bellied toads were observed in and around the pond which has a size of just 4 ha. So, these management measures (draining off, cutting vegetation at parts of the pond and re-filling with water when all actions are carried out in the winter), that made the pond at the

centre of the Bombina bombina meta-population in the Upper Rhinluch, can be considered to be optimal.

Development of the ponds and their colonization by amphibians were investigated in detail at the new created ponds in the amphibian project sites. Already in the first spring after the ponds had been created individuals of different amphibian species were found on the way to the ponds. Among them were many mature Fire-bellied toads and some Great crested newts , indicating that both species had existed in the project sites. Although there were even calling amphibians, only some eggs of Rana arvalis and tadpoles of Rana arvalis, Bufo bufo and Rana esculenta were found in the new ponds during the first two years of the pond existence. The reason for that is probably, that no plant communities of typical hydrophytes developed during this period. Therefore there was a lack of sites for egg deposition and lack of safe sites for amphibian larvae. Instead of mono- and dicotyledones algae appeared and showed a rapid growth in some ponds, but – probably due to wind and waves – the algae content could change in short terms. Additionally, the chances of successful reproduction among amphibians diminished due to appearance of predatory water insects, insect larvae and fishes. Even fishes reached the new ponds in the first year after dredging, but the fishes disappear after dry summers when the ponds dry up. Taking into account, that the ecological equilibrium in the ponds stabilizes after some years the survival rates of amphibian eggs and juveniles are expected to reach a level sufficient for maintenance of the population.

Biological factors also made some problems at the hibernation sites, too. Different herbivores (roe deer, but also rodents) caused damages to planted trees and shrubs.

The following are some general experiences/tips from amphibian management and research in the Upper Rhinluch are:

- A mosaic of open water areas and reeds in ponds seem to be favourable to Bombina bombina. Drying up in late autumn and winter is another factor that influences a Bombina bombina population positively.
- In an area where individuals of Bombina bombina and Triturus cristatus are present new ponds get colonized by these species very quickly. But as long as there is no cluster of mono- or dicotyledonous hydrophytes and no stable biological equilibrium in the ponds successful breeding is hardly possible.
- Waters suitabel as breeding habitats for amphibians should meet the following criteria:

– extensive, sun exposed shallow water areas in srping (water depth about 30 cm), as well as deeper areas that are flooded even in dry periods in summer

– larger open water areas exposed to the wind – if plaque of algae could bee a problem (as it is the case in nutrient rich environment)

- If algae fill almost the whole body of water they have to be removed manually, at least in parts of water body (pay attention to eggs and tadpoles).
- New water bodies in the field can get colonized by fishes quickly - even if they have no direct connection with any other waters.
- For establishment of single trees and shrubs in Central European grasslands measures against damages caused by herbivores are required (e.g. fencing).
- To maintain or develop terrestrial habitats suitable for amphibians purchase or leasing of land and agreements on appropriate land use are recommended.

Planting of hedgerows in Upper Rhinluch

Awareness raising and education

RENATA KRZYSCIAK-KOSINSKA, NORBERT SCHENEWEISS, TORSTEN SEEGER

International workshops

In the course of the project, two study tours were held, the first in North East Germany, the later in West Poland, North East Germany and Denmark. The participants were the project's experts and nature conservation specialists from the participating organizations. The aim was to introduce project actions, gather experience and generally broaden the mind.

Further three international workshops including the final seminar were organized. The first workshop took place in Lithuania and North East Poland, the second workshop took place in North East Germany and the final seminar took place in Meteliai, Lithuania and Olsztynek, Poland. Participants were besides the project's experts and conservation specialists, herpetological experts from all over Europe including representatives from other LIFE projects.

Education of local community

A broad range of local communication activities have been carried through:

- 8 turtle days, mainly in Lithuania,
- 8 amphibian days in Poland and Germany,
- 15 local educational seminars, mainly in Germany but also in Poland and Lithuania,
- 4 grazer exhibitions days, all in Lithuania

On site education

In the project sites, the onsite educations have included Installment of 1 information board on each project site, in total 21 information boards.

In Lithuania nature trail was installed in Zuvintas Biosphere Reserve, where 700 m long paths along the shoreline includes a path through newly dug ponds for amphibians. Visitors may observe the amphibians, hardy grazers nearby and rare birds, gathering around the water bodies. 3 more nature trails and 8 information boards were prepared and built in West Poland.

Turtle day in Lithuania

The longest trail is 1100 m long (Cybinka forest department), the rest are about 800 m. The main point of each path is educational board with short description of biology and ecology of turtle and amphibians in a year cycle. Besides of the main board nature paths include 10 stops with smaller boards each. For each nature path a separate leaflet was printed with short description of presented species and habitat restoration.

General public awareness

Public awareness and positive attitude of people towards all conservation efforts is a tremendous asset. People generally are aware of the value of mammals, birds or plants, in particular those that have an appealing appearance, but rarely acknowledge the importance of smaller animals, such as reptiles and amphibians. Especially in this part of the world amphibians and reptiles are not regarded as animals of much use or threat to people. They are quite often overlooked by the scientists, environmentalists, amateur observers of nature and general public. They do not serve as an important source of food, nor they have any other domestic or industrial use. They do not attract attention by colourful plumage, singing, spectacular mating rituals like some mammals or birds. And, what is very important, they do not pose any significant threat to life or health of people or domestic animals. And they were always very common, while people are much more interested in the rare or endangered.

Education and spread of knowledge on biology, ecology and threats to amphibians and reptiles is a very important factor in supporting the best conservation status of those animals and establishing a proper conservation regime.

Generally, an attitude of local farmers, local authorities, landowners, land managers and NGOs towards *Emys orbicularis, Triturus cristatus and Bombina bombina* is positive. But knowledge concerning these species ecology, habitat demands and factors endangering the species is very scarce even among nature conservation specialists.

It is a generally believed that education should be directed at the young people in the first place. They are willing to learn new things, they are open to new ideas and new ways of living. And they care as they are aware that they do something for their own better future. Within the framework of this project we concentrated on the young students. Lectures were held for the primary school children and secondary school pupils as well as students. Apart from the standard lectures, there were field trainings and excursions. They were actively involved into the amphibian rescue ac-

Amphibian rescue in Bialowezha National Park

tions each spring. During those actions they helped with setting the fence along the road and then they were scheduled to come and help with collecting, counting and carrying the animals across the road. That gave them opportunity to learn a lot about amphibian species, their biology, ecology and habitat requirements. They learned how to recognise the species and sex of individuals. That was also an important lesson of responsibility for the creatures living around us. They could judge by themselves the extent of threat people pose at amphibians.

Amphibians raise interest by children

Another target group was the teachers. The level of ignorance of teachers is surprisingly high. Biology teachers focus mainly on passing the general biology knowledge on the pupils. Ecology is not in the centre of attention, although that is starting to change lately. Biology lessons are rarely carried out outside of the classroom. Our experience with biology teachers taught us that it was essential to convince them to go out into nature with the pupils as that changed their perspective and could transform them from theoretical observers to actiove watchers or even conservation assistants.

Education activities in Poland

Separate lectures and field trainings were directed at employees of the national park, tourist guides as well as local people. Tourist guides are also a very im-

Amphibian day in Germany

portant group as they, just like teachers, pass the information on.

Even though we believe that conservationists, NGOs' representative or scientists have the knowledge of ecology as well as threats to nature, these target groups should be also taken into account. Therefore, the amphibian rescue action is, apart from the fact that it actually saves hundreds or thousands of animals, a perfect opportunity of teaching by personal experience. People of different ages and professions, but children in particular, react very spontaneously to animals they can touch. Especially if we consider animals towards which people express ambiguous feelings, and we may undoubtedly include amphibians and reptiles into that group. They overcome their fears and turn into allies of those animals.

Farmers and land owners which were visited did not show much enthusiasm to our project but they were not in opposition to it. They mainly did not care for those organisms as they did not see uses nor threats coming from them. As in Poland and Lithuania Natura 2000 is a relatively new concept, people tend to be a little afraid, that if the target species inhabit their land that would mean severe restrictions on the land use. Therefore the main objective was to disseminate the knowledge and address their fears not to the animals but to the Natura 2000 concept. They were generally positive as far as creating new ponds or nesting sites for turtles was concerned.

Education activities in Germany

Even in regions without rangers or educated tourist guides, such as the Upper Rhinluch, Germany, there are possibilities to educate people and use them as carrier and "multiplier" of all kind of information on amphibians. So, LFV Oberes Rhinluch, which is a regional NGO, carried out yearly an "amphibian day". This event was open to all, but in the first line invitation aimed at LFV's members. This group consists mainly of inhabitants of the region who are laymen but very interested in conservation. So, the attendance in the excursions and practical demonstrations of the amphibian days was good. Participants got a lot of information from amphibian specialist not only on the species and habitat requirements, but also on the aims of the LIFE project and the biocoenoses in the amphibian ponds in general. Furthermore some of the members were directly involved in monitoring actions of the LIFE project.

The result of these efforts is that people who took part in these actions make "private" excursions now to the project sites to proudly present them to their guests or, if they are teachers of schools and universities, they even organize excursions to the sites where they pass the knowledge on to their pupils and students.

Lectures, information boards and leaflets are important, but they just inform people. To ensure the effectiveness of our efforts, we shall support our good intentions with actions.

Public relations of Agena e. V. within the scope of the EU-Life project

Between 2005 and 2009 open days were organized annually in the nature conservation station Rhinluch. The association Agena e. V. used these opportunities to inform about current results in the EU-Life project for the protection of the pond turtle and the amphibians in the North European lowland in presentations, guidances and with exhibitions.

Annually the land conferences of herpetologists from Berlin and Brandenburg were organized together with the NABU Brandenburg e. V. On this occasion, different actors reported in professional presentations about the project.

In addition, the project was introduced on several arrangements and public excursions in the biosphere reserve Schorfheide-Chorin and in the nature reserve Märkische Schweiz.

A special workshop for the hunters and the department of forestry was carried out on the 15th July 2008 at the forest office Templin on the subject predator-management in pond turtle habitats.

On an international workshop in the NABU nature conservation center Blumberger Mühle (biosphere reserve Schorfheide-Chorin) the project partners and salesmen of the nature reserve management and regional administrations traded their experiences in the context of the EU-Life project. Also in press contributions and professional conservation-journals was informed regularly about the project.

The folder „LIFE project for relicts of original amphibians and reptiles fauna in north-east Europe" and a poster likewise produced within the scope of the project advertise the protection of the European pond turtle and threatened amphibians. The folder „Pools, Ponds, Kettle Holes - Oases of the Landscape" gives in text and image recommendations for the protection and the care of small ponds.

Lecture in Linum, Germany

Information board