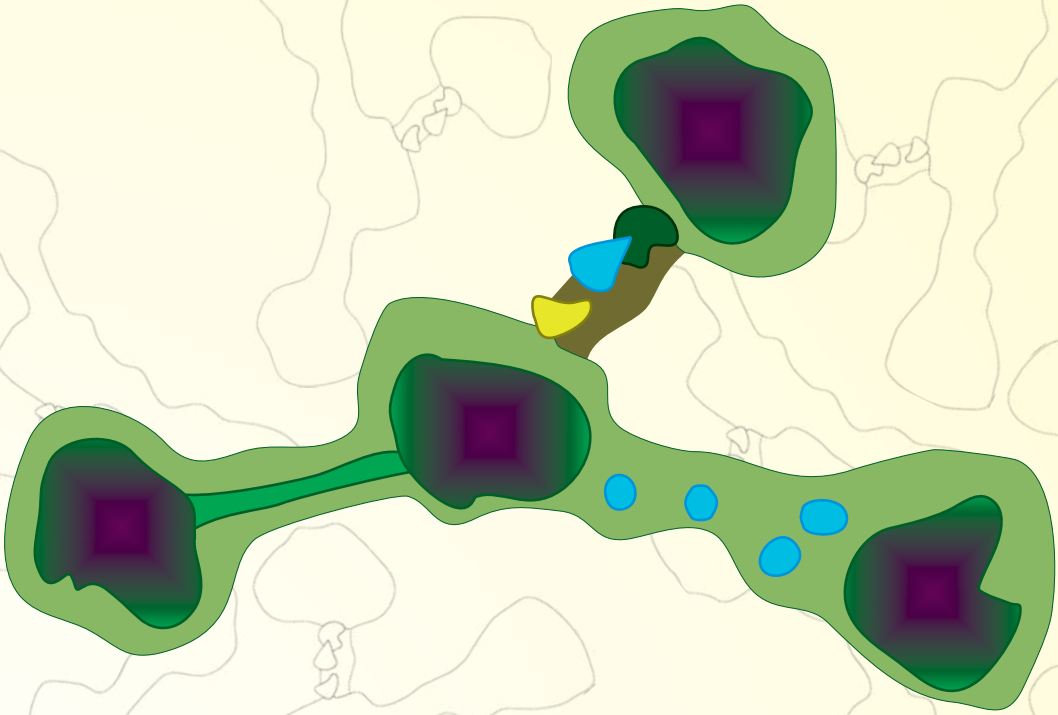

Development of a Pilot Ecological Network in South Lithuania

Development of
A PILOT ECOLOGICAL NETWORK
in the Southern Lithuania

BEST PRACTICE GUIDELINES

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Experience acquired during LIFE+ Nature project LIFE09 NAT/LT/000581

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Development of a Pilot Ecological Network in the Southern Lithuania. Best Practice Guidelines.

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TABLE OF CONTENTS

INTRODUCTION

Abundance of biodiversity is closely related to landscape and ability of each species in a given area to adapt to habitats, undergoing changes due to human activities. As the landscape changes, only most resilient species survive; whereas species facing extinction due to destruction / change of habitats, landscape fragmentation and similar reasons are listed in the Habitats Directive. The main task of LIFE+ Nature project "Development of a Pilot Ecological Network through Nature Frame areas in the Southern Lithuania" was to ensure favourable conservation status for 10 rare species by creating an ecological network, which consists of restored habitats.

For the purposes of this project, target species include autochthonic amphibian and reptilian species found in Lithuania, and listed in Annex II and IV of the Habitats Directive. These include 2 reptilian species: the European pond turtle *(Emys orbicularis)* and the sand lizard *(Lacerta agilis)*; as well as 8 amphibian species: the great crested newt *(Triturus cristatus)*, the fire-bellied toad *(Bombina bombina)*, the European tree frog *(Hyla arborea)*, the common spadefoot *(Pelobates fuscus)*, the natterjack toad *(Epidalea calamita)* and the European green toad *(Bufotes viridis)*, the moor frog *(Rana arvalis)* and the pool frog *(Pelophylax lessonae)*. The ecological needs and criteria serving to determine a favourable protection status of these species are described in Part 1.

The above LIFE+ Nature project had several tasks. These included, as suggested by the project title, set-up and testing of a methodology for distinguishing of ecological network (further – EN), as well as proposal to employ the said methodology for protection of specific species, found in other regions too. Distinguishing of potential areas for the ecological network and selection of specific localities for habitat restoration works is described in Part 2.

Theoretical work must be followed by practice, i.e. restoration of habitats for the target species. The habitats, while contributing to the existing landscape structures, enhance core areas and form an EN from stepping stone elements, which connect the protected areas. Rarest species in need of protection most, as observed in the project area, include the European pond turtle and the European tree-frog; Part 3, "Restoration of habitats" therefore focuses specifically on the said species. Both turtle and tree-frog represent rare and umbrella species, i.e. the habitats of these species are home to a number of other species, as well as other target species listed in the project. Hence the sections dedicated to restoration of habitats of the European tree-frog (3.2.) and the European pond turtle (3.3.) also encompass best practice on habitat restoration of other target species.

Once the habitats for extremely rare species are restored, the number of individuals of given species often appears inadequate, leading to distorted dynamics of the population, preventing it from spreading and taking up of new habitats. To enhance the populations, artificial breeding of such species is advisable, with a subsequent release of the hatch to the restored habitats. For some experience on enhancement of particularly rare herpetofauna species observed in Lithuania (the European tree frog and the European pond turtle), see Part 4.

One of the most effective tools available for environmental protection is education of public at large. The task before environmental professionals is to allow the man, in timely manner and adequate place, with no risk to animals, to "touch" these unique pond inhabitants: to listen to their magic calling, to have a look at the home of these rare animals, to observe wonderful mating rituals, as well as young animals that develop rapidly and take their first lessons in real-life. Part 5 is dedicated to public education and engagement of land owners.

Part 6 discusses monitoring of project outcomes and plans for the future. We trust that knowledge and know-how gained in course of the project will enhance populations of European pond turtle and other protected reptilians and amphibians, help them survive, and further encourage statement of functional and universal ecological networks on the local level, and allow the public and professionals alike to continue the activities initiated already and carry out new ones, as important for survival of the rare species.

Dalia Bastytė, project manager

Restoration of habitat of the European pond turtles

1. PROJECT AREA AND THE TARGET SPECIES

1.1. PROJECT AREA

Project activities were largely concentrated in the Southern Lithuania, i.e. Lazdijai and Varėna districts. The area was chosen for the abundance of rare amphibian and reptilian species: it is home to as many as 10 species of herpetofauna, listed in the Habitats Directive. The basis of the ecological network was formed to include every viable population of the European pond turtle in Lithuania. The Southern part (from the border of Belarus to Veisiejai town) of the EN connects the tree-frog population; there are no longer any European pond turtles in the said section of the EN. The project examined ca. 230 000 ha area of natural frame in the Southern Lithuania; it includes a pilot EN for reptiles and amphibians (ca. 40 000 ha area).

Project area

1.2. HABITAT NEEDS OF THE TARGET SPECIES

The European pond turtle *(Emys orbicularis)*

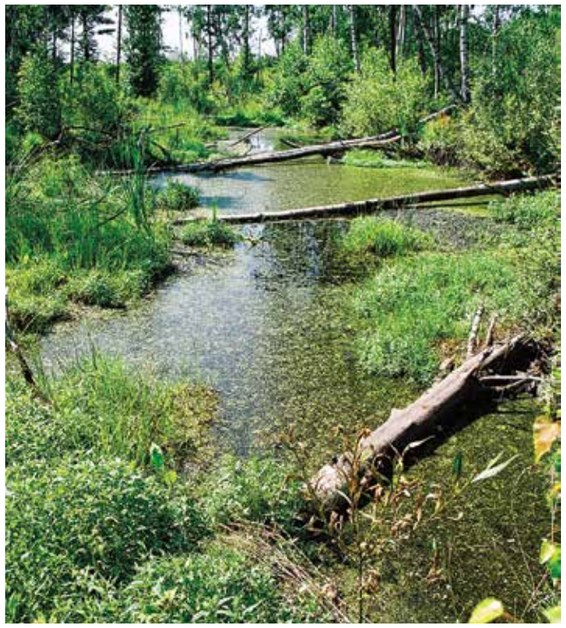
Distribution. The European pond turtle is an autochthonous Lithuanian species. It was once common in the country, but after land reclamation was carried out, its viable populations remained only in the Southern part of the country. To-date, these populations became the Northern edge of the species distribution (apart from single individuals observed in the other parts of Lithuania and Southern Latvia).

Habitat. The European pond turtle is a semi-aquatic species; it spends most of the time in the aquatic habitats. They come ashore to lay eggs, change a pond (if their sub-population occupies a pond cluster) and, in rare cases, migrate to the other sub-population.

Adult pond turtles might inhabit the same pond year round. Often, it is a sun exposed pond, with water surface of 500 to 2,000 m^2. Usually, it is situated in moraine hills, but its bottom is dark due to turf or mud. Despite the turf, the pH of the water is close to neutral. Sometimes it can be a larger pond or flooding (up to 10,000m^2), but then the body of water is shallow and contains a lot of structures, such as humps of vegetation, fallen tree trunks, large zones of shallow water (up to depth of 0.3 m) and some shrubs. Such shallow wetlands are home to some of the biggest populations of the pond turtles in Lithuania. The pond turtles can also inhabit different ponds in summer and winter time. The summer habitat is a sun exposed pond, while a winter habitat is a forest marsh or alder swamp. By contrast, young turtles appear in shallow densely vegetated ponds or shallow areas of deeper ponds rich in invertebrate prey.

The nesting sites of the European pond turtles in Lithuania include sandy grounds with warm microclimate. The inclination of a slope determines the microclimate, so that the site gets as much sun as possible, and surrounding trees, which stop wind, but do not overshadow the site. Soil in the site includes sand, gravel or sand clay mixture. Key limiting factors for the pond turtle population in Lithuania include lack of suitable egg-laying sites.

A cluster of several pond types and xerotermic terrestrial habitats are characteristic to all the areas inhabited by the biggest turtle populations in Southern Lithuania.



A pond suitable for the European pond turtles

The European tree-frog *(Hyla arborea)*

Systematics. The European tree-frogs are divided into several species. According to the latest works of the taxonomists, the Eastern tree-frog *(Hyla orientalis)* occurs in Lithuania. It was recently split off from the European tree-frog *(Hyla arborea)* on the basis of differences in nuclear and mitochondrial DNA (Stöck *et al.* 2012). The species has no morphologic differences from *H. arborea*; however, there may be certain biological differences. Old name of the species, i.e. European tree-frog *(Hyla arborea)* will be employed throughout the book.

Distribution. To-date, there are two distinct populations of the European tree-frogs in Lithuania. The first is in the Southern Lithuania, along the border with Belarus and the other in the Northern Lithuania, along the border with Latvia, where it appeared after the tree-frogs were reintroduced in Latvia. The first one was noticed in Lithuania in the end of 1980s and it is believed to be a part of Belarus population, currently is re-colonizing the areas in the Southern Lithuania. They are slowly spreading to the North. Habitat restoration during the project encompassed the biggest part of this population distribution.

Habitat. The temperature presents the key limiting factor for the breeding sites in Lithuania. Therefore all ponds, inhabited by the tree-frogs, are fully sun-exposed and shallow (30 - 100 cm deep), so the water can reach relatively high temperature. Another limiting factor is predators, especially the ones feeding on tadpoles. Due to temporary character of the ponds, they are free from or contain a limited number of major tadpole predators, such as fish or predatory insect larvae.

The terrestrial habitat must have an adequate sun exposure and can include a deciduous woodland, woodland edges, shrubs and tall herbaceous vegetation. It should not be further than 1 km from the breeding habitat. Such areas are sparse in the Southern Lithuania, thus often limiting the tree-frog populations to narrow corridors in river valleys and stripes of extensive agriculture where both shallow fish free ponds and deciduous trees and bushes are common. The tree frogs may disperse over long distances (up to several kilometres) and thus fairly widely separated breeding ponds may actually be genetically connected.

The great crested newt *(Triturus cristatus)*

Distribution. The species occurs throughout Lithuania, and is more frequent in the Eastern and Southern parts of the country, but even there it is not abundant.

Habitat. The species is found in ponds, marshes and natural depressions of different size. The most important factors for the species observed in the project area include:

- at least a part of the water surface heated by sun;
- abundance of shallow zones (up to 30 cm deep);
- abundance of aquatic vegetation with soft leaves;
- maximum depth of 1 to 1.5 m;
- clean water;
- absence of fish;
- close neighbourhood of mature deciduous forest as terrestrial habitat.

The great crested newts are often found in the same ponds as pond turtles, the main difference being their intolerance for fish, which predate the newt larvae. Therefore, it is very favourable for the great crested newts, if their pond dries out in the late summer once in several years. Another difference is their terrestrial habitat. Since unlike pond turtles, great crested newts hibernate on land, they need frost free environment for hibernation. During the winter months, they hide in deciduous forests because decaying wood of deciduous trees emits more heat than coniferous one. They also might be seeking shelter in the cellars and other man-made structures.

The red-bellied toad *(Bombina bombina)*

Distribution. The species occur throughout Southern, Eastern and north Eastern Lithuania. It is rather common in the suitable habitats in the project area.

Habitat. As Lithuania is part of the Northern border of the species distribution, the breeding ponds must be warm and have a full sun exposure. The red-bellied toads breed in both temporary and permanent water bodies with good water quality and natural eutrophic conditions. The breeding ponds should be rich in submerged vegetation and fish-free. The red-bellied toads can spend most of the spring and summer in breeding ponds, but they can also move to feed in a number of other pond types. Feeding ponds can be shallow (30 cm deep) warm pools and flooding early spring, and larger ponds later in summer. Often large populations of red-bellied toads in Lithuania occur in pond systems of carp farms; however, the breeding success is observed only in fish-free parts of the systems. The toads can move to alder swamps and other wetlands in forest in late summer and fall. The species hibernates in deciduous forest and in small terrestrial habitats, e. g. stone piles and hedgerows.

The green toad *(Bufotes viridis)*

Systematics. The green toads, commonly known as *Bufo viridis*, have recently been referred to as special genus, *Bufotes* (Dubois & Bour 2010), and the current official name is *Bufotes viridis*. What was formerly known as the species *viridis* should probably be considered as two species with similar external morphology, *B. viridis* and *B. variabilis* (Stöck *et al.*, 2006). The one that occurs in the Baltic region, presumably including Lithuania, is *B. variabilis* (Stöck, pers. comm.). It is defined only by mitochondrial DNA.

Distribution. The species occurs sporadically throughout Lithuania and also sporadically in the project areas. Sometimes it forms abundant populations close to humans, for example, in villages, where it feeds in the gardens and greenhouses.

Habitat. The green toads breed in two types of habitats in Lithuania: natural water bodies and man-made ponds. The species has one requirement, which distinguishes it from the other target species- very little emergent vegetation along the banks of its aquatic habitat should be present. The species even prefers water bodies with no vegetation at all- neither at the banks, nor in the water. The terrestrial habitat in the neighbouring areas of the breeding site has to be open, herbaceous vegetation should not be too dense. The species does not tolerate dense forest in the vicinity of the breeding site.

The natterjack toad *(Epidalea calamita)*

Distribution. The species is observed sporadically throughout Lithuania, often far away from each other and thus isolated. It is rather rare in the project area.

Habitat. The natterjack toad is associated with open landscapes. Its requirements are in many ways similar to those of the green toad. They differ concerning the emergent vegetation along the banks of the pond. Growing in with reeds or other higher vegetation is not favourable, but after all, the degree of tolerance is much higher than with the green toad. Another difference is that the optimal breeding pond should dry out in mid- or late summer. The tadpoles develop fast, and if the pond dries out after the end of June, they will have left the water already. When the pond dries out later in summer, this will kill or hamper potential predators, like dragonfly larvae or crested newts.

As to the terrestrial habitat, the natterjack toad may thrive in semi-natural areas with short grass, which is rarely the case for the green toad. Also, it is especially vulnerable for the presence of woods, especially broadleaved woods. Woods will favour common toads in the competition with the natterjack toads.

The spadefoot toad *(Pelobates fuscus)*

Distribution. The species is observed sporadically throughout Lithuania. However, it is difficult to estimate the population size, because the males are calling underwater; the calling is so weak that smaller males, or males in deep parts of the pond, cannot be heard at all by the human ear. Egg strings are often difficult to locate and therefore unsuitable for monitoring. Small to medium size tadpoles may be caught rather easily, but large tadpoles (from mid-June onwards) are fast and secretive and difficult to find. For these reasons, we do not set any criteria for population size. The species is common in all the corridors of the ecological network.

Habitats. For breeding purposes, the spadefoot toads prefer ponds situated close to dry grasslands, extensive agriculture areas, potato fields and vegetable gardens where the species feed. The most important criterion concerning the terrestrial habitat is that the soil structure should be so loose that the animals may easily dig into it.

Concerning connectivity, this is a species that moves much shorter distances than the others. To achieve maximum connectivity, the distance between ponds should be as little as 300 m, and if the distance is larger than 600 m, there will be only few individuals that shift from one pond to the other. This means that the spadefoot toads will thrive in undulating landscapes with many small ponds everywhere.

The moor frog *(Rana arvalis)*

Distribution. The moor frog was originally included in the Annex IV of the Habitats Directive because it is rare and faces extinction in larger part of Western Europe. In the Northern and Eastern Europe, however, it is generally common and widespread. Still, however, its inclusion in the Annex IV makes some sense, since the species requires relatively high presence of extensive wetlands and adequate connectivity.

Habitat. The species tolerates rather much vegetation in and around ponds, and does not require full sun exposition. The species breeds in all types of flooding in depressions dominated by sedge *(Carex spp.)* vegetation, and the zones vegetated by sedges is the main feeding area for the species in the Southern Lithuania. The species also breed in ponds provided there is a combination of wet and dry permanent grasslands nearby for feeding. As the agriculture gains in intensity, the species is losing feeding areas in the hilly moraine area of the Southern Lithuania.

As regards connectivity, the moor frogs largely move short distances away from the breeding site only. Various studies suggest that the range is usually only about 200 m. So, if breeding sites are more than 200 m apart, then the landscape will usually be more favourable to the common frog *(Rana temporaria)* than to the moor frog. In order to provide adequate conditions for the moor frogs, moist areas – pastures, meadows and swamps should be extended – so that the frogs can migrate through coherent moist areas and have to pass over dry land – fields, dry woods – for up to 200 m only. Therefore the moor frog serves as a very good indicator of connectivity of ponds and wetlands in the Southern Lithuanian corridors.

The pool frog *(Pelophylax lessonae)*

Distribution. The pool frog is common in Central Europe, ranging from the Western France to the Central Russia.

It is rarely observed in pure populations, but usually together with the hybrid `species´ of edible frog *(Pelophylax esculentus)*, which contains chromosomes from *P. lessonae* and from the marsh frog *(Pelophylax ridibundus)*. In Lithuania, *P. esculentus* lives as a `klepton´, that is, a systematic unit that cannot exist alone; instead, it can only survive only by mating with one of its parent species, most often with *P. lessonae*. Typically in Lithuania, if a *P. lessonae* male or female mates with a *P. esculentus* of the opposite sex, the offspring will be *P. esculentus*; whereas if it mates with a *P. lessonae* individual, the offspring will be *P. lessonae*. If a male and a female *P. esculentus* mate, the offspring will not survive. This affects the selection pressure in *P. lessonae*, favouring those genes which function well in *P. esculentus* individuals.

Habitat. Populations of *P. lessonae* without any *P. esculenta* are very rare. Such pure populations mainly live in large shallow swamps and moors on peaty soil, often oligotrophic and surrounded by sandy forest. Here, selection pressure will favour those characteristics that benefit frogs in this particular landscape, and we may expect that the genetic constitution may be slightly different in pure populations as compared with mixed populations.

The pool frog is listed in the Annex IV of the Habitats Directive. For the above reasons, this may cause some problems. Special efforts to protect *P. lessonae* frogs in all situations are pointless, since mixed *esculenta-lessonae* populations are very common and live nearly everywhere, while the frogs there do not make out a pure species. On the other hand, pure *P. lessonae* populations appear to be living in some places in the studied area in the Southern Lithuania. They are unusual and worth protecting as such. So the remedies to protect them will include keeping *P. esculenta* frogs at a safe distance.

The sand lizard *(Lacerta agilis)*

Habitat. In Lithuania the sand lizard is common in sunny, dry places: open pine forests, sandy slopes and stone heaps. It differs from most other Lithuanian reptile species as regards its requirements for egg laying sites. Other species are either viviparous or use heaps of rotten vegetation, e.g. dung heaps, to lay eggs. Only pond turtle has requirements for egg laying similar to those of the sand lizard. Sand lizards are very vulnerable in the absence of contact with other nearby colonies; therefore, the distance between colonies should not exceed 700 m.

1.3. DEFINITION OF FAVOURABLE CONSERVATION STATUS

Several amphibian and reptile species are listed in Annex II and Annex IV of the EU Habitats Directive (92/43/EEC). Most of these species are rare and rapidly declining within Europe. Such status demands conservation efforts and explicit understanding of the species' habitat requirements in order to achieve favourable conservation status. The determination of the criteria for assessment of a favourable conservation status of these species for Lithuania has been one of the targets of the ECONAT project.

The criteria for species listed in Annex II of the EU Habitats Directive (*Triturus cristatus, Bombina bombina* and E*mys orbicularis*) were determined during LIFE project "Protection of Emys orbicularis and amphibians in the North European lowlands". They are available on NELEAP project website:

http://www.glis.lt/life/?pid=75&lang=en

Below, we define criteria for favourable conservation status for 7 species listed in the Annex IV, i.e. *Lacerta agilis, Hyla arborea, Pelobates fuscus, Epidalea calamita, Bufotes viridis, Rana arvalis, Pelophylax lessonae*. For each species, we have set up the criteria in a scheme. These criteria are partly based on published information, but mainly on personal experience from Lithuania and elsewhere.

The criteria set up in a scheme are applicable to a single population. An amphibian population may breed in just one pond, or in groups of several ponds. A reptile population may be just one colony, or several neighbouring colonies in contact with each other.

We will here present a scheme for an amphibian (*Bufotes viridis*) the principle of its composition. All the other schemes can be found on the project website:

http://www.glis.lt/ekotinklas/index.php/en/downloads

The green toad *(Bufotes viridis)*

In the row 1, we have a criterion for population size. If there are less than 20 males calling on an optimal night in an isolated population (which is at a distance of 5 km to the nearest populations), or if there are egg strings from less than 20 females, the situation is poor. This is because such a small population can easily be affected by inbreeding, and it is very much exposed to accidental deaths of the few surviving individuals. On the other hand, if we record more than 100 individuals of either sex, we can call the situation favourable. Here, we should remember that at no point in time will all individuals be at the ponds simultaneously; so the true population size will be larger, maybe much larger, than 100 males + 100 females. Studies have shown that the actual number of toads in a population exceeded the maximum number of males counted in the night 4 times.

Next, in the row 2, we see that the situation is unfavourable if there is one or a few small breeding ponds only. If there are only few ponds, there is a large risk that all ponds will change and become unsuitable.

The next rows (3-14) specify some habitat requirements that specifically apply to the green toad. Concerning the ponds, full sun exposition, and very little emergent vegetation – for instance very little reed (*Phragmites*) swamp is required. Concerning the terrestrial habitat, where the animals live most of the year, sun-exposed areas with very little vegetation, or no vegetation are required. It is also important that there are good hiding places, for instance at old farm houses.

Then there are connectivity criteria (row 10). Personal experience suggests that outside the breeding season, the green toads regularly disperse up to 3 km away from the breeding site, and that populations separated by 3 km + 3 km may exchange individuals and thus be in genetic contact. This will ensure that the population is part of a larger metapopulation, which will contribute positively to genetic variability.

There is a number of more detailed criteria in the last rows. These include a small risk for road kills. Of all the amphibian species in question, the green toad is most vulnerable to car traffic, since it prefers bare surfaces, such as asphalt, and often moves around on roads at night. Ideally, there should be no car roads at all within 50 m from the breeding sites.

BUFOTES VIRIDIS

	CRITERIA	"FAVOURABLE"	"GOOD"	"UNFAVOURABLE"
	Population	Excellent	Good	Average - bad
	Size	> 100 callers / egg strings	20-100 callers / egg strings	<20 callers / egg strings
	Structure	Reproductional success		no reproduction
Aquatic	Habitat	Excellent	Good	Average - bad
Aquatic	Number and size of bodies of water	>10 small bodies of water with total surface > 5.000 m² or 1 big body of water with total surface >10.000	>5 small bodies of water with total surface >2.500 m² or 1 big body of water with total surface >5.000m²	<5 small bodies of water with total surface <2.500 m² or 1 big body of water with total surface <5.000m²
Aquatic	% of shallow areas (<50cm depth)	>80%	40%-80%	<40%
Aquatic	Sun exposition in %	100 %	90-100 %	<90%
Aquatic	% cover emergent vegetation	0- 5 %	5%-20%	>20%
Aquatic	% cover submerse vegetation	0-10 %	10-90 %	> 90%
Aquatic	Drying out of pond	Semi-permanent, dries out in late summer in some years	1) permanent 2) Dries out before mid-July in some years	1) permanent 2) Dries out before mid-July in most years
Terrestrial	Presence of hiding places (crevices, holes, stone heaps etc.)	Many hiding places at buildings, between stones, in heaps of dung or rubbish, or by digging holes in south facing slopes	Few such hiding places	No obvious hiding places. Areas around buildings are tidy and clean.
Terrestrial	Presence of area with bare / scattered vegetation / ruderal areas / traditional village structures within 1 km radius around pond	>50% cover of area within 200 m radius	Several places within 1 km radius	Few or no places within 1 km radius
Aquatic	Threats	None	Average	Strong
Aquatic	Presence of fish	None	Few small fish (sticklebacks)	Yes
Aquatic	Growing in	No swamp / reed vegetation, due to grazing or newness	Scattered or low swamp / reed vegetation	Extensive reed vegetation
Terrestrial	Growing in	Many patches without vegetation	Few bare patches, most of the area grown in with grass or herbs	Much of the area grown in with grass or herbs, the rest shaded by bushes and trees
Terrestrial	Roads or car traffic within 50 m of terrestrial habitat	None	Roads with a little local traffic	< 30 cars per night
	Connectivity			
	Isolation due to land use in the assumed direction of migration	0% to 10% blocked	10% to 50% blocked	>50% blocked

2. ESTABLISHING ECOLOGICAL NETWORK

2.1. DISTINGUISHING POTENTIAL AREAS OF REPTILIAN AND AMPHIBIAN ECOLOGICAL NETWORK IN THE SOUTHERN LITHUANIA

The ecological network is a special system favourable to the animal migration, and including their habitats of highest bio-ecological importance, their environment, and migration corridors of animals and plants.

Legal framework

The pilot ecological network was distinguished in compliance with the Directive 92/43/EEC of the Council of the EU on the Conservation of Natural Habitats and of Wild Fauna and Flora (in short, the Habitats Directive), and in view of the Ramsar (1975), Berne (1982), Bonn (1983) and Flo-rence (2000) Conventions, and the national laws, such as the Law on Environmental Protection and the Law on Protected Areas, as well as related secondary legislation.

In accordance with the Law on Protected Areas of the Republic of Lithuania, the EN forms a part of a larger natural network of ecological compensation areas; the said network, i.e. Nature Frame, ensures the ecological ba-lance of the landscape. Since the Nature Frame combines protected areas subject to different protection regime on both the national and European Union level, the ecological protection zones, as well as forestry, natural recreation areas and agrarian areas of ecological importance in Lithuania, the Nature Frame must allow for preservation of biodiversity, combining habitats of highest ecological importance, their environment, as well as areas required for migration of animals and plants alike; protect the natural landscape and natural recreational resources; increase national wooded areas; and control urban development, spread of technologies, and agricultural development.

Limits of the Nature Frame, regulations governing protection and use of its areas are determined by the general documents of territorial planning on all levels. The Nature Frame is distinguished considering the need to ensure the ecological consistency of Natura 2000 network, by establishing or preserving landscape elements of importance to the wild fauna and flora.

The structure (limits) of the universal EN (systems of natural and sub-natural areas, habitat systems of considerable bio-ecological importance, allowing for preservation of near-extinct species) has been determined on the national level, regulations governing protection thereof were incorporated in the documents on the territorial planning since 2000; the same task was accomplished on the regional level in 2007 to 2010. As for the EN planning documents on the district level, they are fragmentary, and on the local level, they are non-existent.

Since no previous practice of development of a functional EN, in terms of spatial system, exists in Lithuania (one to ensure ecological needs of the target species, to improve ecological stability of landscape, and to contribute to the preservation of its structure), the project presented is of fundamental importance in both the species preservation, and methodological aspect.

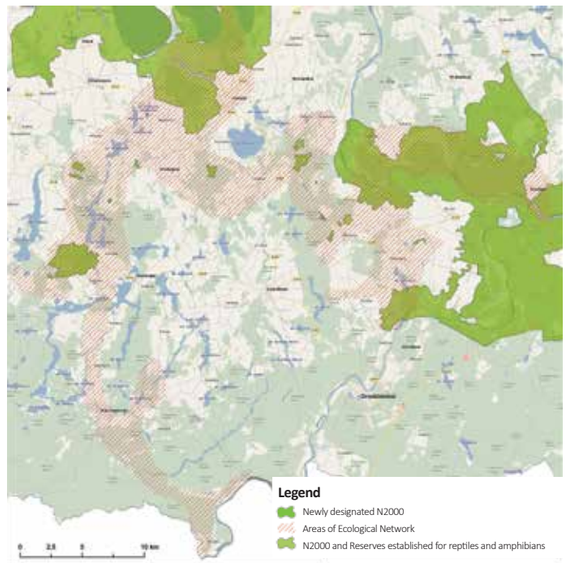
A part of Juodabalė Herpetological Reserve – a core area for the European pond turtle

Methodological principles

For the purposes of the project, the establishment of the EN was regarded as a set of research, planning (distinguishing), installation, protection and management, and public awareness raising. Setting up of the pilot EN in the Southern Lithuania complied with provisions governing formation of Natura 2000, key ecological network in Europe. In accordance with the effective Lithuanian laws, the EN is considered a separate protection layer in the areas of Nature Frame provided by the general plans, to be used primarily for ecological balance of the landscape. The EN in the Southern Lithuania includes core zones, ecological corridors, and buffer zones. The said network combines Natura 2000 and national protected areas. The EN seeks to preserve the reptilian and amphibian species, listed in Annex II and IV of the Habitat Directives.

In accordance with the guidelines on Preservation of Characteristics of Landscape Connections, important for the Wild Fauna and Flora (prepared in 2007) (concerning implementation of Article 3 of the Directive 79/409/EEC on the conservation of wild birds (the Birds Directive in short) and Article 10 of Habitats Directive of the Council of the EU), the pilot EN in the Southern Lithuania:

1. enhances the efficiency of existing environmental instruments, i.e. improves survival conditions of species in the protected areas on the EU and national level: in line with the areas of Nature Frame, as prioritised based on broad environmental and sustainable development objectives, set out in the planning documents, the landscape elements, important for migration of specific protected species, were formed and renewed in the EN area;
2. focuses on securing the ecological needs of target, fragmentation-sensitive species, existing in small populations, the survival whereof requires mitigation of the negative impact of human activity, as well as preservation of a favourable environmental state.



Territory of the ecological network

The project included area of Nature Frame of some 230,000 ha, located in the Southern Lithuania; it includes a pilot reptilian and amphibian EN of some 40,000 ha. By recognising the National Reserves, granted official protected status, and Natura 2000 areas (BAST_LKS94), offering protection for target species as EN core zone, and in view of formation criteria of specific functional elements of the European pond turtle and other target species, the stepping stone corridors were used to connect the known finding-places of the European pond turtle and areas potentially suitable for other target species, as determined during the selection of the latter using the GIS databases.

Criteria governing establishment of the ecological network

Core zones of the EN for the European pond turtle include stagnant bodies of water, whether natural or close to natural, suitable for feeding, hiding, resting, breeding, and hibernating, in the vicinity of open sandy slopes suitable for hatching. These include pools, ponds, or seasonally inundated wetlands (swamps in meadows or forests, water meadows and forests on riversides, and oxbow lakes), intensively used for watering animals. These bodies of water must be sufficiently warmed up, and include open water areas, not overshadowed by adjacent plants. The area of a core zone can include a single body of water used for the needs of turtles year round, or several bodies of water that can perform the said functions collectively, located at a distance of up to 500 m from each other, with a total surface area of at least 1 ha. The vicinity of the bodies of water must include turtles' nesting sites (up to 300 m.).

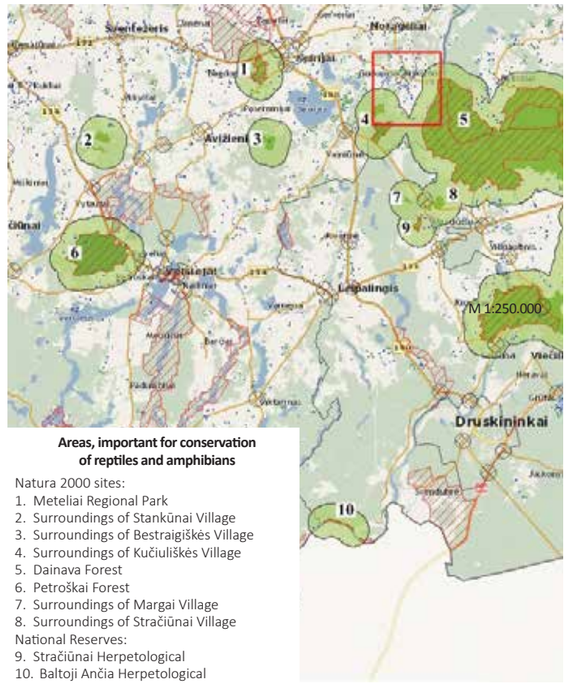
Ecological corridors for the European pond turtle. Turtles cover longer distances, via intermediate bodies of water, only in search for better habitats; therefore, the distance between the core zones should not exceed 10 km. The habitats should be interconnected by corridors with bodies of water and ponds suitable for a longer or shorter staying of turtles placed at a distance of up to 2 km, while the surrounding areas should be open, with small scrubs, hedges, and small groves, suitable for resting and hiding from the heat.

Criteria governing formation of corridors of other target species, employed when carrying out selection of potential EN areas

Criteria	European fire-bellied toad	Great crested newt	Marsh frog
Area of a water body (m^2)	500–2,000	50–500	500–2,000
Area of a peatbog (m^2)	Less than 5,000	500–1,000	5,000–10,000
Distance from a body of water to a peatbog (m)	0–200	50	0–50
Distance from a body of water to a deciduous forest (m)	100–300	0–50	100–300

The EN areas should be as natural as possible, with little exposure to intensive economic activities: unurbanised, undivided by highways, district, and local roads, crossroads (these elements are permitted at a distance of over 500 m), while nesting sites should be at a distance from roads, gravel roads, and arable land.

The potential areas of ecological network of protected reptilian and amphibian species were selected based on publicly available national databases, i.e. GDB_10, set of special data on soil of the territory of the Republic of Lithuania at a scale of M 1:10 000, and GIS databases of national registers of forests and protected areas of the Republic of Lithuania.



Selection of potential areas for the ecological network for amphibians

Situation plan of the ecological network for amphibians

The selection was carried out as follows:

I. By recognising the officially protected national reserves and Natura 2000 areas as **core zones of EN** (BAST_LKS94);

II. By forming the **EN buffer zones** as 1 km wide belts surrounding the national reserves and Natura 2000 areas (BAST_LKS94);

III. By forming the **EN stepping stone corridors** between the core zones as follows:

1. By selecting pools of suitable size for specific protected species;
2. By selecting areas suitable for restoration or establishment of new shallow bodies of water, fitting for specific protected species:
   1) By selecting habitats of suitable soil type of certain size;
   2) From the soil habitats selected, selecting those at a certain distance from the suitable bodies of water;
   3) By assessing the existence of forests meeting the ecological needs at a certain distance from the habitats selected.
3. By avoiding cities and towns, residential areas with compact build-up, as well as other areas (road crossings, pollution sources etc.) with potential intense negative impact on the target species; by distinguishing zones, at 500 m distance from road crossings and pollution sources, where no EN should be formed, and no important elements, important for protected species, should be installed.

2.2. SELECTING SITES FOR THE HABITAT RESTORATION

Choosing of the areas for the EN in the region should not be limited to the GIS modelling alone. The next stage of EN establishment is on-site investigation. Some of the core tasks when realizing such a project lie in analysing the landscape under the viewpoints of the target species distribution, ecological suitability and feasibility for the creation of corridors, synchronized with the availability of sites where the work can be carried out at all. Such availability is strongly dependant on the structure of ownership and the currently dominant type of land use.

In practical terms, this leads to identifying hot spot areas where the most threatened species (in case of the ECONAT project - European tree-frog and European pond turtle) exist, but are exposed to serious threat - e.g. by further loss of habitats, isolation, failure to successfully reproduce. When deciding on allocation of available resources to the project area, this information was a key element when reaching the final decisions.

In case of the ECONAT project, some of the planned resources were spent at or close to known turtle and the tree-frog sites

Inventory of the water bodies - search for the rare amphibian species

Supportive measures for the target species in the core areas

Before specific conservation actions can start, a screening of the abundance, distribution and situation of the target species within the project area must be carried out. Awareness of existence of species, their status and their threats allows fine tuning of the intended measures and generation of optimal results.

supporting the core populations and enabling them to carry out the first spreading into the corridors towards the next core population. These hotspots were favoured when distributing the resources because of their special importance and the highest threats endangering them.

Specific supportive measures at hotspots may encompass the creation of breeding / foraging / hibernation ponds and terrestrial habitats for amphibians and turtles as well as artificial supportive rearing of animals (these activities are described in the parts 3 and 4).

Landscape in which habitats of the pond turtles were restored

Habitat of the rare amphibian species

Connectivity of the core areas

Main features of the ecological corridors include enhancement of connectivity of the landscape (i.e. minimising spatial resistance) for the target species. By selecting mainly amphibians and reptiles with a low rate of spreading as target species, the corridors will also fulfil the same function for other species with a higher rate of dispersal (e.g., *Leucorrhinia pectoralis, Dytiscus lattissimus)*.

Connectivity between suitable habitats / habitat complexes can be improved by creating structures that allow the target species to safely migrate between the sites. The type of structure chosen depends on the target species. While for the dormouse e.g. the creation of hedgerows, or for forest birds the plantation of small tree groves in an otherwise open landscape would be appropriate, for amphibians and water-bound reptiles the creation of aquatic habitats within a coverable distance from each other is of the highest importance.

These habitats (mainly ponds or restored flooded wetlands) must fulfil at least two functions:

a) be suitable foraging habitats to allow migrating animals to rest and regain strength during migration; and

b) to serve as reproductional habitats in order to strengthen and allow the genetic exchange between major / sub-populations. In the second case one has to remember that the mere creation of breeding habitats might not by itself guarantee a successful growth and spreading of the local populations. In some cases, suitable hibernation quarters or additional foraging habitats for juveniles might be required. An evaluation of what habitats to create should be done by specialists who have visited the area and are familiar with the demands of target species.

The optimal distance of stepping stone habitats between each other should theoretically be determined by the dispersal rate of the targeted species and the spatial resistance of the surrounding landscape. These rates can be found in the literature as typical a yearly movement of a species between its breeding pond and its feeding and wintering areas. As a rough and ready rule, standard dispersal rates can be used. Blab (1986) states as annual dispersion rate e.g. for the European tree-frog in Rhineland-Palatinate (Germany) is 0.6 km. However, the juvenile dispersal to colonize new ponds has been observed to be up to 3,000 m in Denmark and Germany. In practical terms we therefore adapted the knowledge so we chose the distance 500 m to 1,000 m between the pond in the beginning of a corridor next to the main core population to be sure the closest ponds would be colonized and further away in the corridor 2,000-3,000 m between the ponds.

Availability of sites

The availability of potential sites where concrete conservation actions can be carried out constitutes an essential element of the planning of an ecological corridor. In highly industrialized countries (such as Germany or Denmark) only the economically least valuable plots of land can often be reserved for environmental purposes. In such cases, when the overall aim is to create a functioning network of ecological corridors other solutions have to be developed, e.g. compensation payments for loss of income due to nature friendly land use by means of agro-environmental schemes.

Challenges in the ECONAT project included finding a sufficient number of sites for restoration without compensation. Approximately 25% the landowners agreed to the restoration measures in their land (this activity is described in chapter 5.2).

3. HABITAT MANAGEMENT

3.1. HABITAT MANAGEMENT FOR TARGET SPECIES IN THE PROJECT AREA

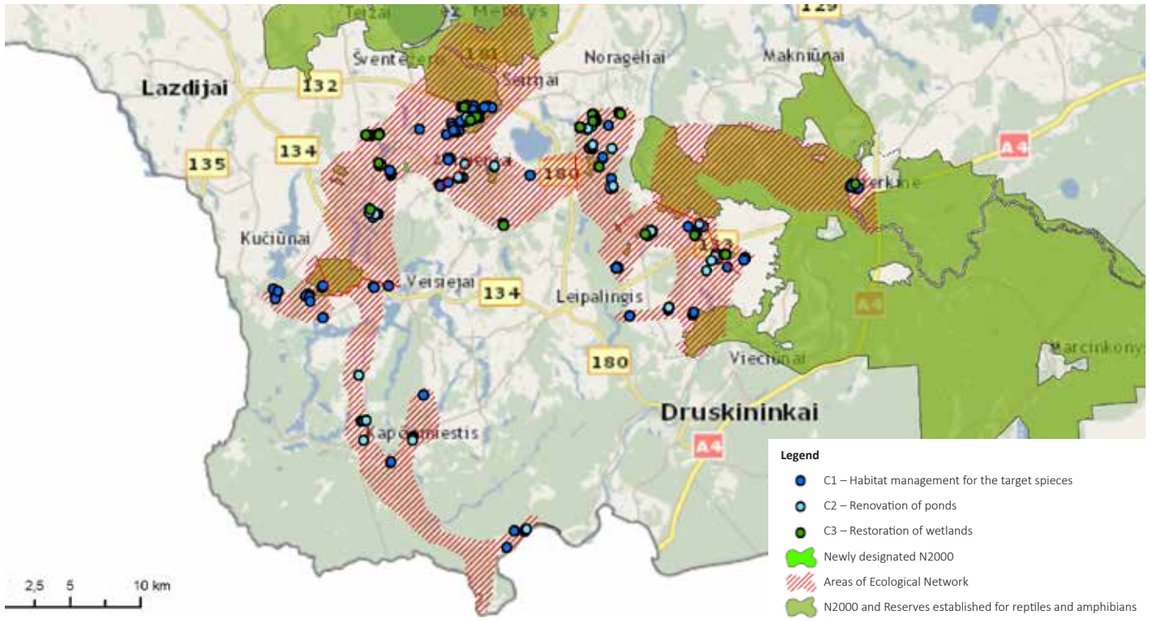
In 2005-2009, significant efforts in restoration of habitats for European pond turtle in Natura 2000 sites were made during project LIFE+ project NELEAP "Protection of *Emys orbicularis* and amphibians in the North European lowlands". In course of the NELEAP project, 54 ponds and 26 nesting sites in 7 areas were restored or established. Those areas now act as core areas with source populations within the ecological network.

The second step was implemented within ECONAT project. Activities of the project strengthened the core areas, and furthermore re-established interconnectivity between core areas by creating migration corridors, thus enhancing the chances of survival for the meta-population.

The European pond turtle and the European tree-frog were chosen as two umbrella species for the habitat restoration. Shallow, clean and sunny ponds, inhabited by the tree-frogs, often are also inhabited by the green, natterjack, red-bellied toads, and other amphibian and thermophile invertebrate species. Deeper, with brown water and plenty of structures but also sunny ponds, preferred by the pond turtles, are often populated by the great crested newts, red-bellied, spadefoot toads, pool and moor frogs and a number of other species, vertebrate and invertebrate alike. Sandy and sunny slopes, a place where the pond turtles lay their eggs, present perfect habitats for the sand lizards.

The habitats were largely restored where wetlands in the natural depressions have existed before. However, because of overgrowing with vegetation and lack of extensive management, a layer of peat overgrown with shrubs of genus *Salix spp*. has formed instead of water. While restoring such wetlands, the shrubs were cut, their roots removed and the wetland cleaned to its former bottom. The other ponds were dug in the bodies of water densely overgrown with the common reeds and cattails. Such ponds were cleaned from the vegetation and mud, creating surface of open water and less eutrophic environment. Some ponds were dug in the places, where no water body has existed before. Such ponds were designed for the tree-frogs, which require a very clean environment. This way, 164 ponds in 7 areas for turtles and amphibians were designed, their water surface ranging from 200 m² to 4,000 m², their maximum depth ranging from 0.5 m to 2 m. Their shape was designed according to the landscape and the layers of soil. The common features they have are: abundance of the shallow zones (5 – 30 cm depth) and sunny water surfaces.

Besides the main habitat restoration activity, there was a number of other activities in the areas of the ecological network. 52 ponds were improved to meet the needs of the target species, for example, shallow slopes created, mud cleaned or redundant vegetation removed. Amphibian hibernation places were built of roots and soil close to the aquatic habitats. The water level was raised in 24 drained wetlands by building dams. 40 egg laying sites were created for the pond turtles. All these activities improved the core zones of the ecological network and increased permeability for the reptiles and amphibians through the ecological corridors.



Habitat management activities in the project area

3.2. BEST PRACTICE ON RESTORATION OF EUROPEAN TREE-FROG *(HYLA ARBOREA)* HABITATS

The European tree-frogs are common in the Southern part of the ecological network. They are local from Bugieda village, which is on Belorussian boarder, to Veisiejai town. During the project, they have spread in created aquatic habitats to Petroškai Reserve and reached the areas of the turtle distribution. Currently, the conditions are created for the tree-frog further spreading to the North across the areas of the ecological network.

Tree-frog habitats should encompass:

- sun-exposed and shallow standing water bodies, free of fish with developed aquatic vegetation;
- shrubs and tall vegetation in the close surrounding of the aquatic habitat;
- meadows / pastures interspersed with woodlots, hedgerows or broad-leaf or mixed forest edges.

Analysis of habitats within ecological corridors proved lack of suitable aquatic habitats, especially shallow, sun-exposed ponds surrounded by open slopes. Therefore, management and creation of ponds was most important for protection of the tree-frog population. This chapter describes the best practice of restoring habitats or creating new bodies of water suitable for the European tree-frog and other amphibian species common in shallow, clean and sunny ponds.

European tree-frog

Planning the work

Choosing the place. First of all, a place for habitat restoration should be chosen taking into account the overall species distribution. In this case, the priority for habitat restoration shall be given to the core areas of European tree-frog in the ecological network.

Second, the place should be chosen according to the landscape. The type of soil the pond is dug in will determine the pond´s ability to retain water, its nutrition level and its future vegetation. Shallow ponds with clay bottom are especially important for this species and other thermophilic animals.

Throughout the year, the water level of a pond with clay bottom oscillates. When checking if a suitable site for the pond exists, make sure that there is enough supply of water for the pond. But be aware that optimal ponds for European tree-frog should dry out completely in summer, preferably by the end of July. Therefore, ponds fed by precipitation are more suitable than those connected to underground waters (established in depressions with springs). When a pond dries out, fish such as sticklebacks or of the carp family will die, yet the tree-frog can survive in the mud.

Creating new pond or restoring an existing one? An existing pond can be unsuitable for the tree-frog. Fish may have colonized the pond, surrounding trees may have overgrown and block out all sunlight, a thick layer of organic mud may have accumulated on the bottom or the pond may dry out regularly too early, before metamorphosis of the tree-frogs. When considering a renovation of a site, it is important to know the reason why the pond must be targeted and which features need improvements. Furthermore, it is important to evaluate the chances of eliminating the reasons why a pond has lost its suitability for the tree-frog in the past.

Ponds with clay bottom most suitable for a European tree-frog often have to be dug at completely new locations, where no ponds had existed before or a shallow pond has existed on clay soil in the past, but was drained away.

Other ecological features. There are other important questions to be considered when designing the pond: a) distance to the closest hibernation sites, b) whether the tree-frog will be able to migrate to the pond, c) will there be enough hiding places (e.g. stones, dead branches etc.) along the edge to provide shelter, d) how will the pond be managed in the future, e) does the surrounding of the pond provide sufficient forage. Potential threats have to be taken into account.

Choosing right time for activities. Driest months of the year are the most suitable for habitat restoration. Usually September and October are best months to dredge and restore an existing pond. Adults and young European tree-frog have already left the ponds and spread around, thus restoration will not harm them. The soil is then dry enough to carry the weight of excavating machines. The water level in the pond is also at its lowest level at this time of year. If the work is finished well in advance, before the first frost nights, many seeds will sprout before winter, and there may be lush stands of useful plants, e.g. water crow-foots, the following spring.

Digging can also take place in winter months and early spring, but it is important to make sure that no sensitive species is disturbed by the measures, such as amphibians (e.g. when digging in wet areas), or nesting birds. Often trees and bushes must be cut down before earth works; therefore, compliance with the national legislation is required. In Lithuania, tree cutting in protected areas is prohibited from 1st of March until 1st of August.

Creating new ponds

An effective way of creating new aquatic habitats is to start digging 1) test holes in order to gain information about the soil conditions and 2) digging a test cross section in order to define the dimensions as well as the depth of the new habitat. However, soil conditions can change within a few meters. If during the construction of the test cross section sandy areas are found (these threaten to drain the pond later on), these can be excavated and replaced with waterproof clay brought from another site.

Before reaching the clay layers, often nutrient rich layers of black topsoil will have to be removed from the digging site. To avoid a backflow of nutrients from the black soil caused by rainwater, this material has to be taken far enough away from the actual pond or be blocked off by a clay dam around the pond. Doing so must not block off rainwater from the original catchment area of the pond from flowing back into the excavated area.

Design of the pond. As general principles for the physical dimensions and attributes of ponds for European tree-frog, the following numbers can provide some guidance:

1. Size: minimum water surface of 500m²;
2. Depth: just deep enough so that the pond can dry out every couple of years completely but not before end of July;
3. Slopes 5° to 15°;
4. Sun exposition 80 to 100%;
5. Sediment: clean autochthone clay layers or natural bottom of old wet depression, preferably clay dominated.

In general, the pond should have plenty of shallow zones, with water depth of 5 to 25cm. Ideally, shallow areas should be situated in the North-eastern corner of the pond, as this site is most insulated in daytime.

The pond must have right shape, depth and sediment, if it is to function well as a tree frog habitat. The maximum depth of a pond often determines how long it will keep water or how frequently it will dry out. Shape and slopes of the pond determine to a high degree its suitability for the different target species. The tree-frogs need a pond offering plenty of shallow areas, a well-developed aquatic and amphibian vegetation, high sun exposition and relatively low abundance of predators. These key elements set the frame for most artificial *Hyla* ponds: shallow pond edges, high sun exposition and a depth just enough for a pond to occasionally dry out in order to reduce the predators in the pond.

Soil deposition. The strategy for depositing the excavated soil will differ on a site-by-site basis and considerably depends on the soil type, the relief and the surrounding management. In some cases, the soil should be transported away from the site, so as not to cover valuable biotopes or vegetation. The landowner can sometimes use the soil elsewhere e.g. for levelling a depression in a field, or for stabilizing a dirt road. In other cases, spreading the soil in a thin layer around the pond is an easy option; or the soil (clay) may be used to build a gently rounded dam protecting the pond from unwanted inflow of water. For instance, it may be useful to place the soil between the pond and a stream to prevent the colonisation of the pond by fish. When soil is placed around the pond, it is important to prevent blocking of inflow of rainwater from the surrounding environment. On the contrary, it should be designed and modulated to maximise the area of gentle slopes towards the pond in the surroundings.

Trophic stage of the pond. The nutrition level will have influence on the rate of the succession and lifetime of the pond. Amount of available nutrients and microelements (mainly nitrogen, phosphorus and potassium), and their ratio will determine amount of upcoming vegetation as well as the expected invertebrate fauna, which will form the food basis for tadpoles, juveniles and adults. However, high nutrient availability will enforce faster succession and reduce the pond life.

Means reducing nutrition level of a pond include:

- Cutting all trees on the shores of the pond (to avoid leaves, litter);
- Digging the pond in a nutrient-poor soil;
- Moving nutrient-rich soil layers further away from the pond;
- Prevention of inflow of nutrients from adjacent fields or soil by creating small dams or ditches.

Drainage and land reclamation systems. Subterranean drainage pipes or land reclamation ditches can drain a pond. Therefore local land reclamation schemes should be checked to prove that no such structures exist in the close vicinity of the pond. Such schemes are usually available at local municipality. Inflow of drainage water into a pond from adjacent fields can cause rapid eutrophication since such water is enriched with the discharges of fertilizers and pesticides from surrounding fields. Therefore the drainage pipes should be blocked before they enter the pond.

Restoration of old ponds

The general principles referred to in the previous paragraphs on creation of ponds suitable for a the European tree-frog of course also apply to renovated ponds. The difference is that there is often more freedom of choice when a completely new pond is dug. When restoring an old one, some factors cannot be changed (like position of the pond) and often landowners will have their own opinion on a restored pond. Therefore, detailed explanations and clarifications must be provided.

Preparation. Before the work on an existing pond can start, trees and bushes along the bank may have to be cut down to open a path to an excavator. If the pond still contains a lot of water, a pump may have to be installed in advance in order to get the working place dry. A smart solution is to contract a company owning a powerful pump (>10m³/min) connected to the excavator directly. Such a pump can be used to empty a pond fast.

Vegetation. Some of the aquatic vegetation already inside the pond can be saved. The machinery can cut some turfs of favourable vegetation – for instance stands of *Eleocharis, Glyceria fluitans* or *Sparganium* – and set these aside. When restoration is completed, the turf may be returned to the clean bottom layer of the pond. Usually there is no need for that since small amounts of bottom mud will inevitably be left behind, and this mud contains many aquatic plant seeds which will sprout soon.

Cleaning the pond. When cleaning the pond, willow bushes and alder trees, including their roots, are removed completely to prevent their re-growth. Reeds and cat's-tails are removed as much as possible although the roots of the common reeds *(Phragmites)* often grow too deep to be removed entirely. Finally, the bottom sludge is removed. As a rule, the bottom sludge should be removed entirely, until a blue clay bottom is exposed.

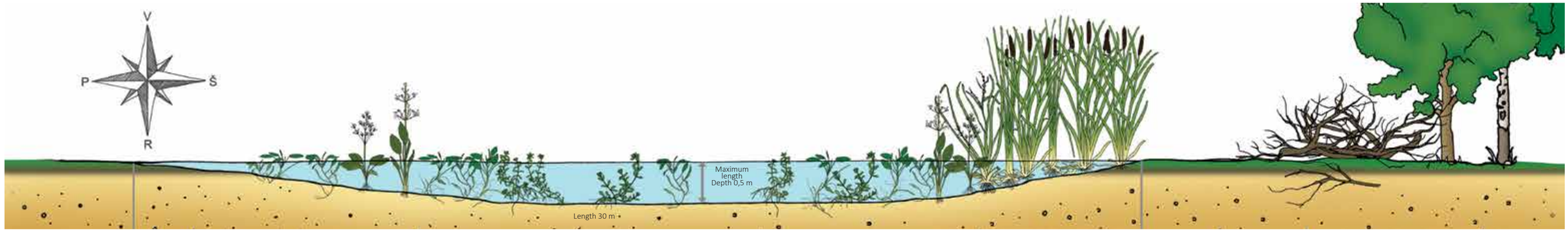
Monitoring the site

Regular visits at the site allow a quality control of the work carried out and, if necessary, the correction of mistakes made when designing the site. Later, it can for instance turn out that some trees were not removed carefully enough from the shoreline of the pond or that it dries out too early in the season, before the tree frog metamorphosis. Or the water quality may be low due to runoff water from adjacent fields reaching the pond or fish may have colonised the site.

Establishment of amphibian populations at the site should be recorded using standard herpetological field methods (counting of eggs, calling males, checking breeding success). When checking the site, notes should be taken at each visit to make sure changes of the habitat are documented and can be retraced. A detailed temporal report of the site development provides high value information for similar measures. In case a stagnation of the population development or even deterioration is observed, the reason for this development will have to be identified and counter-actions taken.

Check-up of adequate fulfilment of the agreements by the landowner is a must. If an evaluation reveals that the originally agreed management does not satisfy the needs of target species, adjustment must be negotiated. If the original agreements are not implemented, immediate implementation must be insisted upon.

Digging a pond for the European tree-frog – locality before, during and after the work



A pond, suitable for European tree-frog

3.3. BEST PRACTICE ON RESTORATION OF THE EUROPEAN POND TURTLE *(EMYS ORBICULARIS)* HABITATS

Majority of the work carried out in the area of the ecological network was devoted for the European pond turtle. Key actions included restoration of old aquatic habitats and digging of new ponds, raising water level in the wetlands, restoration of overgrown nesting sites and creating new ones; and accounted for the EN in practice. This chapter describes habitat restoration activities, devoted for the pond turtles and the other target species common in the same habitats as turtles.

European pond turtle

Planning the work

Creation and restoration of ponds or terrestrial habitats for the European pond turtle involves similar method of working and site selection as when creating ponds for European tree-frog; deficits and advantages of a site are to be identified and steps taken in order to both secure positive local conditions and to eliminate negative local factors.

Choosing the place. Considerable efforts were invested to strengthen populations in the core areas of the EN where habitats for the whole life cycle of turtle were created. Working on the ecological corridors more ponds, suitable for migration than other year-round needs of the turtles, were dug.

Choosing the place in the landscape, some unique requirements of the turtles should be taken into account. For instance, the turtles are more susceptible to human disturbance than amphibians; therefore the ponds should be further from the people. Furthermore, the water of the pond preferably should be brown; this can be determined choosing the place for digging. Finally, adult turtles do not require the pond to dry out once in a few years (which is quite essential for the amphibians).

Creating new pond or restoring an existing one? A lot of natural ponds inhabited by turtles a few decades ago are totally overgrown by woody vegetation nowadays. Cutting out the shrubs and cleaning natural depression from the roots and accumulated humus to the original bottom was most relied on when restoring aquatic habitats for the turtles in the project area. Even though this type of restoration is labour-intense, it creates the habitats where they are needed the most.

If a body of water in the site still exist, it will often be easier to renovate or improve existing ponds. Old ponds usually have mature vegetation and generally rich structures. In some cases it can be sufficient to create some deeper sites for hibernation, create basking places, and shallow slopes by digging out the roots of excessive vegetation.

Other ecological features are very similar to the ones described in the chapter 3.2. Additional feature for the pond turtles is nesting sites, which should be close to the ponds in the core areas of EN.

Choosing right time for activities is described in the chapter 3.2. In particular, existing turtle hibernation pond should not be disturbed during the winter months.

Characteristics	Requirements for the pond
Water depth	40–100 cm; hibernation pond should not dry up during winter
Water temperature (°C)	Sun exposed, in winter time without longer periods of temperatures below zero; 2 to 6 °C
Water quality	No special requirements, about neutral pH
Pond ground (substrate)	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; Hardly accessible locations

Table 1. Characteristics of a body of water for Emys orbicularis (from: Best practice guidelines NELEAP LIFE05 NAT/LT/000094)

Creating aquatic habitats

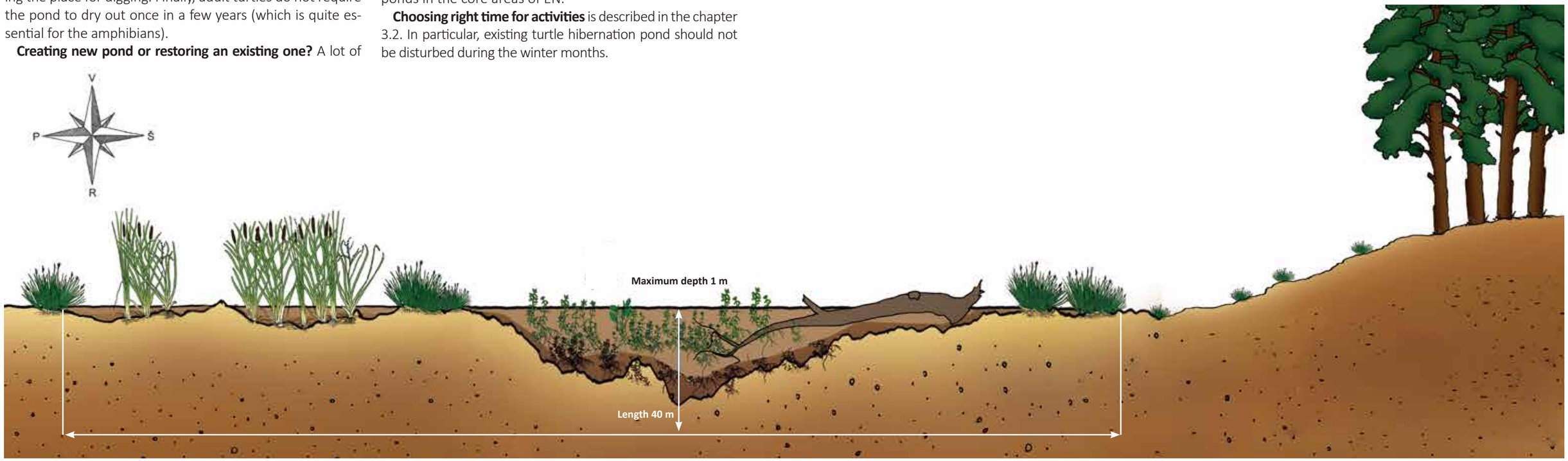
Designing the pond. An existing and functioning system is important, since it satisfies all the different needs of animals during a whole season. It can be one bigger pond with many structures or several smaller ponds, which are close together. There must be possibilities for hibernation, mating, foraging, hatchlings and migration.

A dam, which allows regulating water depth of a flooding

Creating of pond clusters. Pond clusters are especially important for the pond turtles. During habitat restoration in many cases it will be helpful to add different types of ponds to a known pond turtle site. Ideally, several new ponds (water surface 500 m²- 2,000 m²) should be created or old and small ones enlarged. Pond clusters for the turtles should contain at least three types of ponds:

- First "home" ponds for hatchlings: shallow and sun exposed, located close to nesting sites (within 300 m);
- Summer or whole year pond: rich in vegetation and structure, located in depressions;
- Hibernation pond: deep, located in marshes, swamps.

Improving the hydrological situation. Half of the Lithuanian territory was drained by land-reclamation systems during the era of the Soviet Union. Some of these systems were installed in the places unsuitable for agriculture; after the independence, these drained areas became wasteland. Restoration of the original hydrological situation in such places results in better habitat conditions for the European pond turtle as well as many other species. It can be reached by



A pond, suitable for the European pond turtle

Characteristics	Requirements of a nesting site
Minimum size per site	300 m²
Exposition	South, south-west, south-east
Inclination	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%-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 of sunshine per day should be guaranteed (daily average > 7:00 h)
Distance to next water habitat	< 300 m
Other	Protection from disturbances, as a rule hardly accessible locations

Table 2. Characteristics of nesting sites for Emys orbicularis (from: Best practice guidelines NELEAP LIFE05 NAT/LT/000094)

blocking the drainage and raising the water level.

The most efficient help for the pond turtles is by blocking the ditches directly draining wetlands. Despite the raised water level it is also recommended to clean parts of the wetland, so as to create ponds with open water. While building dams, we also paid attention to the needs of the local people – not only deciding how much the water level will be raised, but also leaving the possibility to adjust the water level and building the dams so that they could serve as a passing in some cases.

Consideration of other species when working for the pond turtles. When seeking to benefit the turtles it can quite often be possible to help other protected species such as the spadefoot and red-bellied toads or the tree-frogs at the same time. When keeping in mind the needs of other amphibians or reptiles in terms of aquatic habitats, and when implementing this, we can make a valuable addition to the overall effect of a digging campaign. Furthermore, the habitat needs of hatchlings and young turtles are more

Creating nesting site

Nesting site of the European pond turtle

similar to the needs of the endangered amphibian species above as the habitat of a pond turtle hatchling is preferably fish-free and rich in aquatic plants and invertebrate prey.

Creating of nesting sites

A nesting site is another habitat component vital for survival of the species. Quite often it is possible to create the nesting sites when digging machinery is working on aquatic habitats. Usually, the creation of terrestrial habitats is less labour-intense, compared to creation or renovation of ponds, hence it can easily be carried out simultaneously.

Designing nesting site. In Lithuania, which represents the Northern boundary of distribution of the European pond turtle, females lay eggs in inclined, sand-loamy areas exposed South, South East, or South West. Although vegetation cover varies (Table 2), but low vegetation cover is preferred. When no suitable nesting sites are available, the females choose open soils, such as roads, road sides and agricultural fields.

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 could lay eggs in the same place; furthermore, these places must not be threatened by fast overgrowth.

Removal of vegetation. A lot of sandy meadows in the project area used for extensive grazing are currently abandoned and in danger of overgrowth by pines. First of all, when restoring the nesting site, the shadowing woody vegetation must be removed. A few centimetres of upper soil layer can also be removed to create nutrient-poor ground, which would not overgrow by dense herbaceous vegetation. When the upper layer of soil is already nutrient-poor, loosening of soil and (or) pulling out tall herbaceous plants is enough to create xerotermic conditions. Preferred vegetation in a nesting site includes species, typical on sandy soils, such as the mouse-ear hawkweed *(Hieracium pilosella)*.

Monitoring

After the work on the habitat complex for *Emys orbicularis* is complete, its development should be closely followed (see chapter 3.2.) Furthermore, in case of pond turtles, it is important to check the nesting sites and record the annual behavioural pattern of the animals (e.g. using radio transmitters). This data can provide valuable information about suitability of the habitat complex and allow for future improvements.

3.4. EXTENSIVE BEEF CATTLE GRAZING IN HABITATS OF THE EUROPEAN POND TURTLE

Ecological corridors will fulfil their function only then when their elements, e.g. wetlands, natural and semi-natural meadows are properly maintained. Extensive farming such as grazing is yet another type of maintenance. A pilot robust cattle farm was established within Juodabalė Zoological Reserve, representing a core area of the ecological corridors.

Wetlands and hilly sites, which dominate within this area, are not particularly suitable for agriculture, however, quality beef can be grown here. Robust cattle breeds of extensive farming have been invented in the uplands of Scotland, therefore these cattle are adapted to unfavourable environments, and can graze in unfertile meadows, in wet places they feed on wetland and water vegetation (e.g. reeds, sedges, bulrushes, bushes), therefore, no mowing is required in these places.

The farm was established in collaboration with beef cattle experts Uppland Foundation (Sweden) and the Lithuanian Agriculture Advisory Service, co-funded by WWF Sweden (World Wide Fund).

Selection of farm

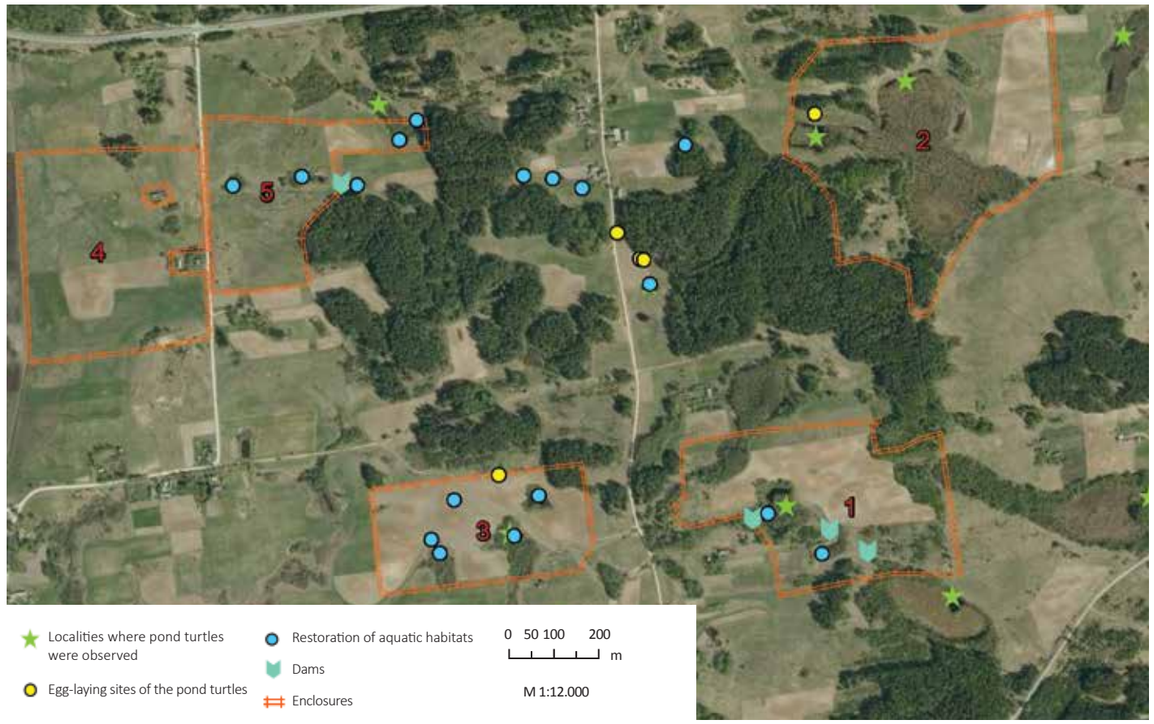
At the very first stage, a selection of the farms within the project sites of ECONAT was carried out. Project partners assisted in selection of potential farmers. The possibilities of farms' to participate in the project was evaluated in regard to the owned or rented area within project sites, possibility to acquire land, keep cattle, and further develop the farm. The best farmer who met all criteria was a young farmer Liudas Jurčiukonis. He took over the farm from his parents and farms within more than 1,000 ha area, partly located within Juodabalė Zoological Reserve, where the European pond turtles are protected.

Selection of cattle breed

Selection of appropriate breed of the cattle is a very important stage of farm establishment, which secures quality of habitat management and sustainability of the farm. Therefore, selection of breed must be very careful so as to respect the habitats, project goals, grazing type, and farmers' preferences. Pure breed of extensive breed *Angus* were chosen. Based on a written agreement with the farmer, 21 units of livestock were purchased.

Preparation of a fencing plan

Stationary fence for beef cattle is a must, especially in remote areas. Electric fence is not the best option since it can be broken by wildlife, and will not keep the herd when frightened. Thus, before a stationary fence is installed, it is necessary to make a fencing plan, calculate length of wire and poles required. 5 separate grazing plots were planned within the pastures of Liudas farm since private land intercepts areas owned and rented by Liudas. More information about beef cattle can be in the handbook for beef cattle farmers (Jamieson, 2013), which can be downloaded from http://www.glis.lt/?pid=48 .



Map of enclosures

Preparation of a grazing plan

Grazing plan ensures appropriate intensity of grazing and distribution of herd within the pastures. First, it is a helpful tool for the farmer itself, and allows for a better control. Plan can be corrected because of changed meteorological conditions, fertility of grass, therefor regular monitoring is necessary. Grazing plan is presented in Table 1. Cattle can be kept in the pastures throughout winter; however, grazing then is more complicated. Daily maintenance, fodder and water supply must be ensured; a mobile feeder can be installed to avoid loss of fodder and accumulation of manure.

In 2013, the young farmer shepherded 38 ha of pastures in the area for pond turtle protection, in 2014 the grazing area increased to 48 ha.

Monitoring

Monitoring of grazing is necessary to implement purposes of nature management. Although grazing is planned according to preliminary evaluation of situation, monitoring of the pastures is required in order to assess whether grazing is implemented appropriately. Cattle prefer young vegetation; therefore in spring they prefer sprouts of reeds in bodies of water. Monitoring did reveal that cattle on the shorelines of the ponds have damaged 90% of all reeds. Later in summer, as the water temperature rises, cattle go for flushing common bulrush. Bulls prefer sprouts of bushes, especially shoots, browse on the bark. However, cattle do not overcome old overgrown bushes, and only break them slightly; therefore, such bushes must be cut before grazing.

Plot No.	2013 m.			2014 m.		
	Grazing area, ha	Amount of cattle	Duration	Grazing area, ha	Amount of cattle	Duration
1	15 ha	20 adult cows +8 calves	26.06–20.07; 5.08–31.08; 01.10–31.10	15 ha	28 adult cows +17 calves	05.06–10.07; 23.08–10.09
2	23 ha	20 adult cows +8 calves	01.11–30.11	23 ha	28 adult cows +18 calves	10.09–30.09
3				10 ha	28 adult cows +18 calves	01.08–20.08; 01.10–15.10
4	15 ha	20 adult cows +8 calves	01.06–25.06; 21.07–14.08; 01.09–30.09	15 ha	28 adult cows +17 calves	10.07–31.07
5*		20 adult cows +8 calves	Early May–01.06		28 adult cows +18 calves	Early May–06.06; 15.10–01.11
Total	**38 (53) ha**			**48 (63) ha**		

Table 1. Grazing plan. ** Enclosure by the stable is not included in the total area.*

Economic evaluation

Long-term management and success of habitat management depends upon the farmer's possibilities to sell the products profitably. We provide a table of Liudas Jurčiukonis farm costs and income, which we recommend to use for establishment of similar farms. This table serves as a guideline only, since prices, particularly in the beef market, are unpredictable. Planned income might be significantly lower than indicated in the table.

Costs, LTL		Income, LTL	
Farm produced silage and straw, includes labour for harvest etc.	12 600 Lt	Direct payments (47 ha)	24 581 Lt
Feed acquired (including salt, minerals etc.)	192 Lt	Subsidies for beef	10 500 Lt
Other variable costs (including grazing, veterinary, bull etc.)	300 Lt	Value of calves (7 bulls in 2014)	10 500* Lt
Materials for stable renovation	1 200 Lt		
Labour cost for animal care in winter time (25 LTL/day)	4 500 Lt		
Labour cost for animal care in summer time (15 LTL/day)	2 700 Lt		
Total	**21492 Lt**	**Total**	**45581 Lt**
		Profit	**24089 Lt**

Table 2. Calculation of farm's expenditures and income.

Acknowledgment

We are greatly thankful to experts Sven-Olov Borgegård, Anna Jamieson and Vilma Živatkauskienė for their consulting and contributions to the establishment of the farm.

4. CONSERVATION OF POPULATIONS

4.1. PROTECTION OF EGG CLUTCHES OF THE EUROPEAN POND TURTLE

Even though the pond turtles lay comparatively few eggs (a clutch includes 6 to 19 eggs), but the turtles reach very advanced age (some specimens in the Northern populations may reach over a 100 years of age) and the female turtles lay 1 egg clutch per year (or 1 clutch in 2 years) almost throughout their entire life. Therefore the above number of eggs ensures survival of the species. However, if most juveniles don't reach puberty, the number of population starts dropping.

There were very few juvenile turtles observed in the Southern Lithuania prior to the launching of the ECONAT project. Naturally, there are numerous natural predators threatening the turtles, with shelter to be constantly taken in bodies of water, amid vegetation. Sadly, most juvenile turtles in the Southern Lithuania do not even reach bodies of water. There are a few reasons at play:

1. Lithuania contains the Northern margin of prevalence of the pond turtles, and numerous juvenile turtles don't make it through the first winter. Periods of heavy freezing and no snow to protect the juvenile turtles during hibernation in a nesting place are particularly hard to survive. As the climate changes, the said periods in Lithuania come with increasing frequency;
2. As the places suitable for laying of turtle eggs develop spontaneous pinewood, the female turtles start laying of eggs either at considerable distance from the bodies of water, or using other open soil, such as gravel roads, roadsides, or arable land. The chances of development and safe hatching of the juvenile turtles at these locations are considerable lower. A 3 cm-long awkward juvenile turtle hatched in a nesting place at a distance of over 300 m away from a body of water has very little chance to make it to a waterbody safely;
3. As the number of population of predators digging out and consuming the turtle eggs increases (for instance, foxes and raccoon dogs) in the Southern Lithuania, most of egg clutches are destroyed right after the moment they are laid.

In order to preserve as many juvenile turtles as possible, the ECONAT project included intensive protection of the turtle egg clutches. In the period where eggs would be laid, the staff of the project would be on duty in the event and at night by the identified turtle nesting sites, observe the female turtles laying eggs and would cover the egg clutches with a metal mesh to protect them from predators. Over a 4-year period, 86 egg clutches of the pond turtle were so covered. Also the project staff would ensure that in spring, when the juvenile turtles start digging their way out of the nesting places and making their way to the bodies of water, the first-ever trip of the juvenile turtles would be a success, with the juvenile turtles reaching the water safely.

If observation of female turtles laying eggs revealed females laying eggs in an unsafe location, an egg clutch in question would be delivered to the Lithuanian Zoo the very next morning. Here, the eggs would be hatched, and the juveniles would be raised for a certain period of time

Egg clutch laid on a path

to raise their resistance to predators. In July 2014, they were released to the restored bodies of water, situated in the vicinity of places the egg clutches were collected. Chapter 4.3 provides a detailed description of the incubation of the turtle eggs and raising of juvenile turtles at the Lithuanian Zoo.

Lastly, places for laying of eggs were restored close to the bodies of water populated by the pond turtles. A female turtle usually returns to lay eggs to a familiar place, sometimes to even the very same piece of land; therefore, new shallow bodies of water, suitable for juvenile turtles, were dug out in the vicinity of places for laying eggs habitual to the turtles, when these lie at a distance exceeding 300 m from the bodies of water. Chapter 3.3 provides a detailed description of the development of such sets of habitats.

Hatchling attacked by the ants during the first journey to a waterbody

4.2. HEADSTARTING OF THE EUROPEAN POND TURTLE AT LITHUANIAN ZOOLOGIAL GARDEN

Tasks and objectives

The task of the Lithuanian Zoo in the project included incubation of eggs collected in unsuitable nesting places of the European pond turtle *(Emys orbicularis),* raising of young turtles until they reach 3 years, subsequently releasing them into the wild. The activity represented a method for increasing population of the European pond turtle in Lithuania. Objectives of the Lithuanian Zoo (LZ) included development of methodology for breeding the European pond turtle in captivity and raising of young turtles.

Incubation of eggs

In the period from 2011 to 2013, 167 eggs of the European pond turtle were delivered to the LZ (15 sets). Another 6 eggs were laid by a female turtle transported for treatment from Kučiuliškė Herpetological Reserve. A total of 173 eggs were incubated.

The best room temperature allowing for a regular operation of incubators is 23°C. In case the temperature in the room rises, so does the temperature in the incubators. This can lead to overheating of eggs and destruction of embryo simultaneously.

We have incubated eggs in R COM JURAGON PRO PX-20RD (Professional) and R COM JURAGON PRO PX-20R (Standard) incubators. They were filled with vermiculite. 2/3 of an egg was emerged in the humid filling and covered with sphagnum *(Sphagnum sp.)* on the top. Moss exhibits antibacterial and absorption characteristics.

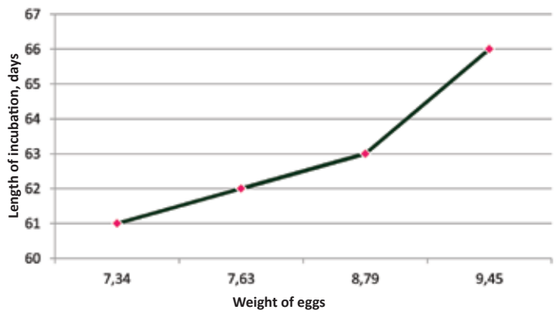


Fig. 1. Dependence of the duration of incubation from the weight

The analysis of data suggests that the optimum incubation treatment was as follows: daytime temperature of 28–29 °C, while nigh time temperature of 22–24 °C. The humidity ranges from 92 to 96%. Night time duration was 10 hours. The duration of incubation depended on the weight of the eggs (Fig. 1). Some turtle eggs in each set usually remain unfertilized; this we have observed too. Some embryos were lost, especially in 2013, when a set of eggs was delivered after over a day since the time it was laid (Fig. 2).

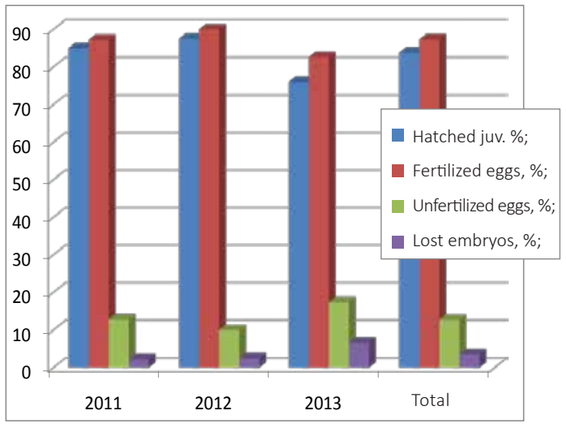


Fig. 2. Incubation outcome of the European pond turtle

Hatching

A turtle egg undergoes certain changes before splitting. There is a visual display of a thinner shell, which breaks at a times. When the shell splits, there appears a "window" and a turtle egg or a moving leg is visible inside an egg, with an egg then removed from the incubator and placed in a plastic box with the very wet foam, then covered with humid sphagnum and placed in a terrarium for hatching. Some 24 to 36 hours pass from the time a "window" opens until a young turtle leaves its egg.

Over 3 years we have raised a total of 128 European pond turtles. These include, based on morphological and biometrical characteristics, 83 female, 38 male turtles, with the sex of 7 animals completely unclear. The said method for determination of sex is not quite precise for the turtles of such an early age, however the trend is clear.

Hatching of a turtle juvenile

Raising of turtle juveniles

Once the eggs hatch, the turtle juveniles are placed in groups 3 to 4 turtles and for several days in 6-litre terrariums on wet foam and sphagnum. Young turtle are then transported to glass terrariums. The water level in the terrariums ensures that a young turtle can swim and raise its head above the water standing on its legs. To make sure a young turtle can rest, bits of deciduous tree, foam, oak leaves are added to the water so that the young turtles could climb on it or hide under it.

Young turtles of each set are raised in separate aquariums. Heat lamps are suspended above each aquarium to keep the warmth in. The lamps are turned off at night, accounting for a temperature difference of 2 to 4 °C between day and night. To make sure the young turtles can be raised successfully, UVB lamps are turned on for 2 to 4 hours daily.

When the outside temperature would reach 24 to 26 °C, the young turtles were taken outside for 1 to 4 hours to receive their sunbathing.

In the second half of October, we would start lowering the water temperature in the aquariums of all young turtles.

Sunbathing

Change in the photo period and lowering of temperature in the aquarium is a necessary precondition for the resting period of turtles. The daytime would be reduced by 1 to 2 hours per week. When the water temperature reached 16–18 °C, we would no longer feed the young turtles.

In the late December, 3 to 4 young turtles of each clutch were accommodated in boxes with some 15 to 25 mm water depth. The boxes included foam, sphagnum moss *(Sphagnum sp.)* and dried leaves of oak *(Quercus sp.)*. In the first year of raising, hibernation involved a household refrigerator. The temperature in the refrigerator would range from 5 to 10 °C. The hibernation of the first year turtles in 2011 lasted 11 weeks, and in 2013 and 2014 it lasted 14 weeks.

After hibernation, we removed the young turtles and placed them in plastic boxes with little water and some foam flakes. The water temperature remains the same as during the hibernation; furthermore we kept the young turtles in half-light. Gradually the air temperature was raised to 20–25 °C. We started feeding the animals when the water temperature reached 18 °C.

We would raise the water level in the aquariums by some 10 to 20 mm per week until we arrived at the level of 250 to 300 mm. This helped the young turtles to acquire their diving skills gradually. After the hibernation of the year 2 and 3, the turtles were accustomed to regular treatment in the same manner, only faster, with adaptation lasting 2 weeks.

As the air got warmer, the young turtles would be released in outside enclosures in summertime. There are 3 enclosures dedicated to young turtles. The area of two enclosures is

A young turtle in an outside enclosure

10 m^2, while the area of the third one, dedicated for oldest animals, is 30 m^2. The constructions are wooden, surrounded by welded mesh. Eyes of the mesh measure 10x25 mm. The bottom of the enclosure is covered in mesh. The place of an enclosure is important too, since the young turtles need a lot of sunshine.

In the first year of raising the turtle juveniles, we have installed pools of 100 to 300 mm deep and the bottom covered with pool film. However, this did not work out. The pool film cannot be placed without forming creases. Small young turtles of 4 to 6 cm long get there and sometimes fail to get out. In order to protect the young turtles from danger, we have replaced the pools with new ones made of concrete, with sloping banks of some 5 m^2 area and 100 to 550 mm deep. The enclosure of oldest turtles had a pool with area of 10 m^2. Slopes of the waterbody differ from 5 to 45 degrees steep. We have added tree bark, pebbles, etc. in the water to make sure the turtles can use them to climb out of the water and to sunbath or hide. We have also fixed heating lamps for sunbathing. The young turtles could sunbath there during cloudy days or the cold nights.

When the air temperature dropped, i.e. when the outside air temperature during day time fell to +15 °C, the animals were taken inside. In 2012, we reared as many as 107 young European pond turtles; as the compartment of the domestic refrigerator was too small for hibernation, a special hibernation room was installed.

In the second winter, the young turtles spent 14 weeks in hibernation. The water temperature in hibernation was 6 to 8 °C.

At the end of the hibernation period, the young turtles were placed in aquariums just as after the first hibernation. As the air temperature reached 20 to 23 °C, the animals were removed to outside enclosures and spent the summer there.

In October, when the young turtles reached 2 years old, preparations for the third hibernation started. This hibernation lasted longer, i.e. 16 weeks. When preparing the young turtles for any hibernation, it is very important to make sure there is no feed left in the digestion system of the animals. As the surrounding temperature drops, the young turtles no longer digest the feed. Analysis of the outcome of 3 hibernations suggests that in the current environment, optimum hibernation temperature ranges from 5 to 8 °C.

At the end of the third hibernation period, the young turtles prepared for active life just as after the first and second hibernation. As soon as the outside air temperature reached 19 to 23 °C, in daytime, the animals were removed to an outside enclosure. As this period represents an adjustment for living in the wild, the ration was also exceptional and consisted almost exclusively of live insects and their larvae.

Identification and collection of biometrical data of the European pond turtle juveniles

Data gathering concerning the turtles started with a weighing of each egg. Data received provide information concerning development of a young turtle, its optimum menu and health. Turtles were weighed on a monthly basis and plastron patterns were photographed for the identification of the turtles. We decided to manage without computer identification software since each young turtle would be thoroughly inspected with each weighing, including checking of the state of the shell.

Feeding

The feeding regime of young European pond turtles in the wild is rather straightforward and includes various small invertebrates; however, there is very scarce information on the feeding of the said turtles in captivity. It was our purpose to develop a methodology for feeding young turtles, hence feeding rations of animals raised in captivity forms an important part of the work. For establishing rations for young European pond turtles of different age we have used the experience gained by foreign institutions, including Linum Breeding Centre for the European Pond Turtle, the Zoo of Frankfurt am Main (Germany) and Daugavpils University (Latvia), as well as nutrition of the European pond turtles and their juveniles described in the literature, and took into account possibilities of the LZ. Prior to the first hibernation, the young turtles gain mass very rapidly: just in a few months, the young turtles reach 5 times larger weight than compared to the body mass in the time of hatching. Subsequently, the growth of the weight is not so significant (Table 1), hence the energy quantity required with the feeds should also be lower. As the young

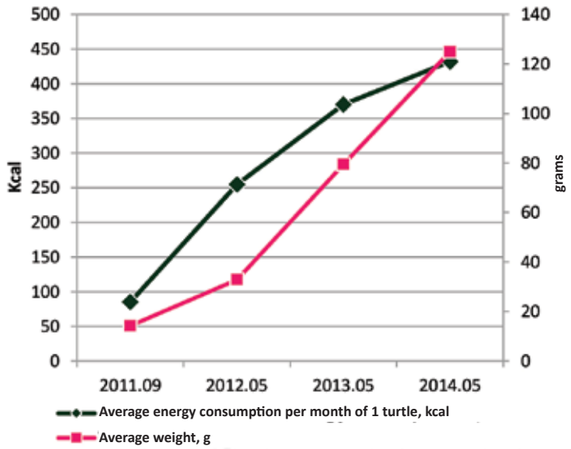


Fig. 3. Dynamics of energy used and average weight of young turtles of various age

turtles grow older, the quantity of energy used gradually drops (Fig. 3), while the average weight gain per month in the first and second and third year was similar and ranged from 4.7 to 7.7 g per month of active growth (Fig.4). This suggests as the young turtles grow older, the rate of metabolism drops and consequently the energy required falls.

Analysis of other breeders of young turtles suggest that the rations for turtles are compiled without taking into account the energy need of the animals. What counts is the actual consumption of feeds. Based on the formula for calculating energy need of animals developed by foreign scientists and available in references, we have calculated the energy need of young turtles depending on the level of body mass and activity. As we were compiling the rations, we also took into account the need of other nutrients required to make sure the young turtles grow healthy and fully develop.

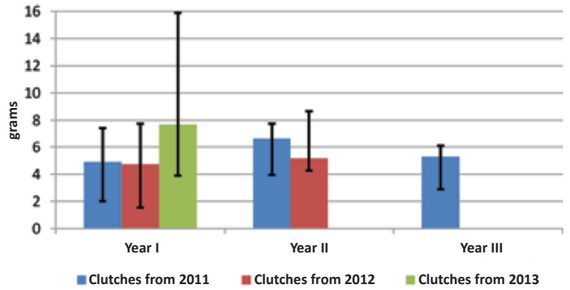


Fig. 4. Increase of weight of turtle juveniles of various age per month during the active growing period

The young turtles just hatched do not feed. They start feeding in day three (sometimes even day four) after hatching. The feed is served daily, usually in the afternoon, when both the water and the animals are warmer. We made a conscious effort not to feed the young turtles always on the same time to avoid conditional reflexes that would make their adaptation in the wild more difficult.

In the first week of existence, the food ration of young turtles include daphnia *(Daphnia sp.)*, live larvae of midges *(Chironomus)*, amphipods of *Gammarus sp*. genus and other products. Only one type of feed is served any given day. A young turtle consumes some 0.4 to 0.5 g food during the first feedings.

At the end of the second week, some jelly and other products are served apart from the existing feed (one day per week). Jelly is a custom made feed based on fish, beef parts, carrots, apples and vitamin supplements.

In the third week, the ration is expanded by preserved cat feed, as well as specialised dry food for pond turtles or carps, and earthworms *(Lumbricidae sp.)*. This ration with small changes stays until the month three.

In the third month, the young turtles feed on Turkestan cockroach *(Shelfordella tartara)*, field cricket *(Gryllus sp.)* and other insects or their larvae, fed in the water once per week. This awakens their hunting instinct.

The quantity of feed is increased in view of the weight of animals, to keep the young turtles from overfeeding.

At the end of the turtle hibernation cycle, the ration is no different from one offered to the young turtles prior to hibernation, with the quantity of products served considerably larger. As the animals stay in the outside enclosure, the quantity of feed is decreased since the pool now includes larvae of different insects on which the young turtles feed, thus contributing to the diversity of their nutrition.

Identification pictures of plastron of young European pond turtles

Hatch		After hatching (g)	5 month	9 month	11 month	14 month	17 month	21 month	23 month	27 month	29 month	33 month	35 month
2011	Mean	4.9	24.4	27.0	51.6	62.1	82.0	78.2	93.1	103.6	119.0	121.4	134.4
	Min.	3.3	14.7	14.2	27	32.9	57.5	52.2	62.1	74.8	80.1	86.2	98
	Max.	5.6	45.2	49.14	76.9	90.7	114.8	114.7	140	160	175.2	175.2	196.6
2012	Mean	4.8	17.8	19.7	42.8	54.4	65.0	63.0	84.1				
	Min.	3.9	10.5	10.0	15.7	20.3	32.1	30.0	50.3				
	Max.	5.6	28.6	41.5	67.5	84.3	107.8	105.0	136.8				
2013	Mean	4.6	31.1	35.5	58.4								
	Min.	3.7	18.2	23.1	30.9								
	Max.	5.5	47.8	55.3	116.6								

Table 1. Dynamics of weight of the young European pond turtles

Results

Year of egg picking	Number of eggs picked	Number of young turtles split/% of total number of eggs	Number of young turtles raised before releasing to the wild/ % of young turtles split	Number of young turtles released to the wild/ % of turtles raised before releasing to the wild	Number of turtles left at the LZ until summer of 2015
2011	47	40 / 85	29 / 72.5	29 / 100	-
2012	80	70 / 87.5	64 / 91.4	47 / 73.4	17
2013	46	35 / 76	35 / 100	25 / 71.4	10
Total:	173	145 / 83.8	128 / 88.3	101 / 78.9	27

Table 2. Number of eggs of European pond turtle and number of young turtles hatched, raised and released to the wild

Release to the wild

Successful adaptation of young turtles in the wild greatly depends on the outside temperature: when it is higher, the young turtles are more active, able to hunt down prey and to find a place to hide. For this reason, we have released the young turtles to the wild in mid-summer, with air temperature around 30°C degrees for a few days.

In 2014, we have released 101 young turtles to the wild. Young turtle of each clutch were released in places, were the eggs were collected. 27 weaker turtle juveniles stayed in the LZ and will be released to the wild in the summer of 2015.

Originally, the plan was to raise the young turtles until they reach three years; however, we decided that even 1 year old turtles are strong enough and can be returned to the nature. No European pond turtles hatched in the incubators have been released to the wild in Lithuania before, hence we cannot predict the age young turtles acclimatise best, find hibernation place and survive in the wild. Perhaps in a few years we can review the said information and tell the age of young turtles when they should be released to the wild in Lithuania.

4.3. REARING OF THE EUROPEAN TREE-FROGS

In order to strengthen the rarest amphibian and reptilian species in Lithuania, rearing actions were carried out. Target species for rearing included the European tree-frog – the rarest Lithuanian amphibian species. Rearing of the tree-frogs was carried out for three years: 2011, 2012 and 2013. During the tree years, 2,799 young froglets were released. Young froglets were released in the restored habitats in the core areas and ecological corridors of the ecological network to strengthen not only the core populations, but also connectivity between the populations. Thus rearing of the tree-frogs contributed to the establishment of the ecological network.

Methodology

The tree-frogs were reared by creating more favourable conditions for the most vulnerable life stage – tadpole. Therefore, eggs were collected from the most viable population in the Southern Lithuania and placed into containers. After hatching, the tadpoles were raised in the containers until they reached 2 cm length. Afterwards, they were released into cages, which were placed in the natural pond environment. This protected them from predators. After metamorphosis, 10% of the froglets were released to the parent pond, while the others were distributed among the other parts of the meta-population strengthening its Northern border and overall population connectivity.

Preparation work

At least 7 days before eggs are collected, preparations in the breeding station have to be made. Containers for the eggs have to be cleaned and filled with a mixture of tap water and pond water (from a pond, inhabited by a strong tree-frog population) with a ratio of 9:1. All containers have been equipped with air pumps and heating elements. Air pumps have to be switched on, allowing the microorganisms from the pond water to further develop in the breeding containers.

Collecting eggs

The place for collecting the eggs was chosen according to the viability of the populations. The eggs were collected from the most viable population in the Southern Lithuania. Less than 5% of the estimated laid eggs per year were taken from the population. 10% of the originally removed eggs where returned to the source population as metamorphosed animals (as only ~5% of the complete spawn of one season is expected to reach the metamorphosis, the return ratio of 10% seems to be sufficient to guarantee that the population is not harmed by the egg extraction, including a sufficient safety margin).

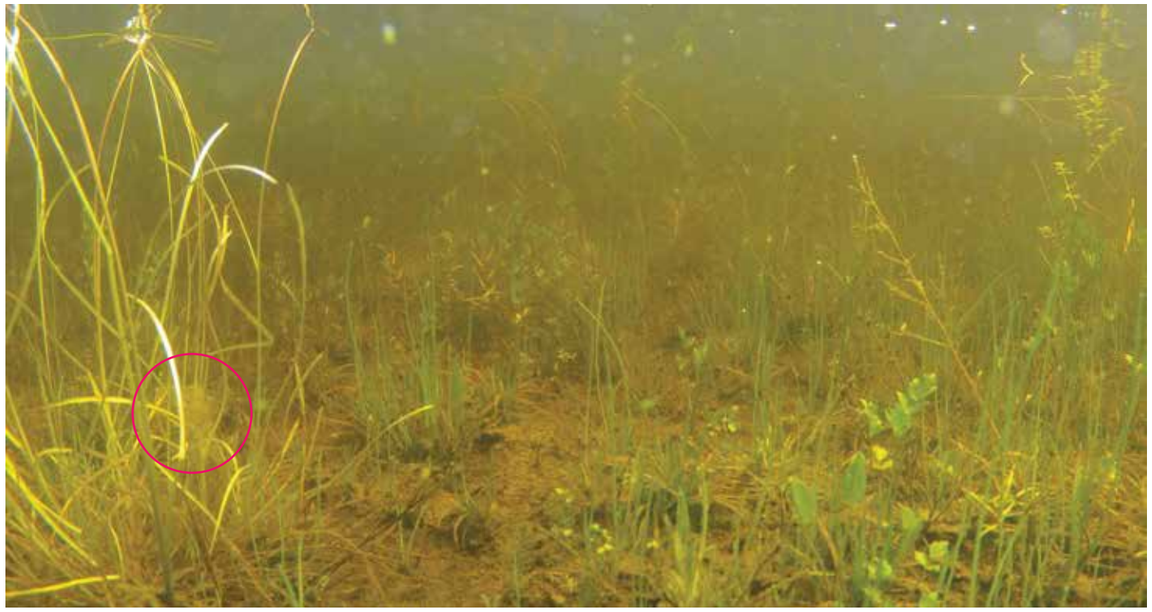
It is important to know where the tree-frogs usually deposit their eggs. The following parameters were important in the main pond in the core populations, where eggs were collected:

- Water depth 20 to 60 cm.
- Presence of rather dense and tangled submerged vegetation
- Oxygen-rich water.
- Sun exposure.

Eggs of a tree-frog look similar like eggs of green frogs or even red-bellied toad. In general, the nucleus measures 1.5-2 mm (jelly 3-4 mm). Spawn is deposited as small clutches (around 50 eggs per clutch) and fixed to submersed vegetation. One egg clutch reaches the approximate size of a walnut, usually with a golden, golden-brown colour of egg. After 2 to 3 days, the embryonic development is usually completed.

For transportation of the eggs, the two most important factors are the supply of oxygen and protection against shocks and jolts. As a rough guide, 50 eggs per litre can be maintained for 3h at 20°C without additional oxygen, provided water is clear. To protect the eggs against shocks, each cluster has to be put into a separate small plastic bag, which is knotted tight and then put into a bucket with water and sealed by a lid. Alternatively, vegetation, such as aquatic moss or from genus *Batrachium*, should be added to the bucket in which clutches are stored in order to provide some buffering.

Collection of eggs



Underwater world of a tree-frog pond. Egg clutch marked on the left.

From egg to metamorphosis

The eggs collected were counted and 100 eggs put into each container. Temperature in the containers should now be set at 22 to 26°C during the day and 20°C during the night. A gentle and slow flow of air bubbles was added to each container. The eggs were neither resting on the bottom nor floating at the surface. Eggs floating in an outdoor tank may be damaged by UV radiation. Eggs that have sunk to the bottom develop fungus easier.

After the larvae have hatched, they should remain in the smaller tanks for some days, until they start to swim around in the search for food independently. As a tolerable density the rough guide of 10 larvae / eggs per litre should be used in this stage. To rear this life stage, we used 15-litre white plastic buckets.

First feeding is necessary, once the newly hatched larvae start to swim around with jerky movements. Then commercially available food for aquarium fish which is relatively rich in protein should be used. During the first days, the food should be crushed or ground to a fine powder which sinks to the bottom of the container. If food is concentrated in one place, the larvae may fail to find it; therefore, an even distribution of the food should be aimed for. Growth of algae on the sides of the tank and/or on water plants in the tank often guarantees a steady food supply. Alternatively, finely cut bits of fruit or vegetable can be used for feeding (e.g. bananas, tomatoes, boiled cabbage etc.).

Only as much food should be put in the container as can be consumed within half a day. Remove faeces, unconsumed food, dead animals and thick green algae from the containers daily. ⅔ of the water has to be changed every second day - or more frequently, if the water develops a milky, turbid quality - in each container. Filamentous algae growing in the container were removed since they are indigestible to the tadpoles. It is useful to keep daphnia in the containers because they keep the water clean.

When larvae reach 2 cm length, they are resettled to the cages. We used 1.25 m x 1.25m x 0.60 m cages with a net of 1 x 1 mm holes. The cages were placed into ponds with a good water quality and algae community for tadpole feeding. It turned out that the presence of aquatic plants (especially with a high surface, such as the common water-crowfoot *(Ranunculus aquatilis)*) in the cages helped the development of larvae. Tadpoles feed directly of the water plants but also on the walls of the cages. When the plants from ponds are put into the breeding cages, they have to be checked very carefully for the presence of predators that might be moved into the cages together with the plants. The cages are covered with a net to protect the tadpoles from the birds.

Predators and diseases

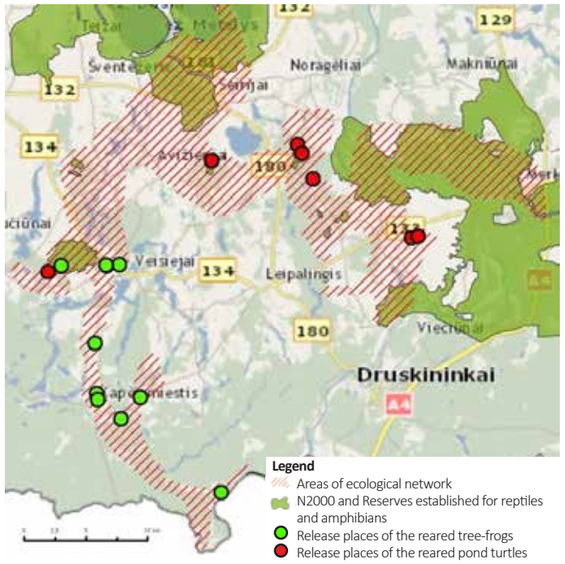
Predators in the breeding containers must be avoided. Presence of the water beetle *(Dytiscus)*, the backswimmer *(Notonecta)*, the dragon fly larvae or leeches was checked daily. Cages in the ponds were checked for predators once a week.

Breeding containers can become infected with parasites or diseases. This is usually recognized when dead tadpoles

Cages in which tadpoles are growing.

Release of the juveniles

are seen on the bottom or if the larvae show atypical behaviour (swimming in circles, lying on their side or floating on the surface). If this is the case, it is important to act very fast because diseases spread in no time and may kill all tadpoles in one or two days. First, a new tank with fresh water must be prepared and healthily looking tadpoles must be transferred to this tank. Slightly weakened, but not seriously ill, tadpoles should be placed in separate tanks and receive extra heating. For future, all affected tadpoles must be kept isolated from others in order to prevent infection of others.



Release places of tree-frog and pond turtle juveniles

Post-metamorphosis

When reaching metamorphosis (development of front legs), the tadpoles were given the possibility to reach dry land or climb out of the water. If they do not have this option, they will drown. Therefore, the cages were placed in shallow water, so that one side would be deeper than the other. Humps of grass were placed in the shallow side of the cages that the froglets could climb on them.

When the animals have metamorphosed and entered land, they were released at once, or kept for some time in order to strengthen them. They are able to feed on insects when approximately half the tail has been resorbed. For the tree-frogs, small insects caught in meadows with a butterfly net provide a good food source. Alternatively, *Drosophila* can be used. For a tree-frog it is quite important to prevent the metamorphosed animals from climbing out of the containers and escaping into the wild. To do so, lids or fine-meshed net coverings were used.

Release of young tree-frogs

The froglets metamorphosed in July – September. They were released in several batches in the water bodies selected. 10% of the froglets were released to the parental population to avoid reduction of population because of egg extraction. The other froglets were released in the other parts of the ecological network, 10 water bodies in total. The sites for release were chosen so that released animals would strengthen different parts of the tree-frog population, especially its Northern part. The froglets were released to the restored or newly created habitats. 3 years after the release, tree-frogs were observed in the newly created ponds, where they had not been observed previously. This suggests that rearing activities were successful – the tree-frogs found their place in the newly created habitats, expanded the range of the population and contributed to the greater connectivity between sub-populations.

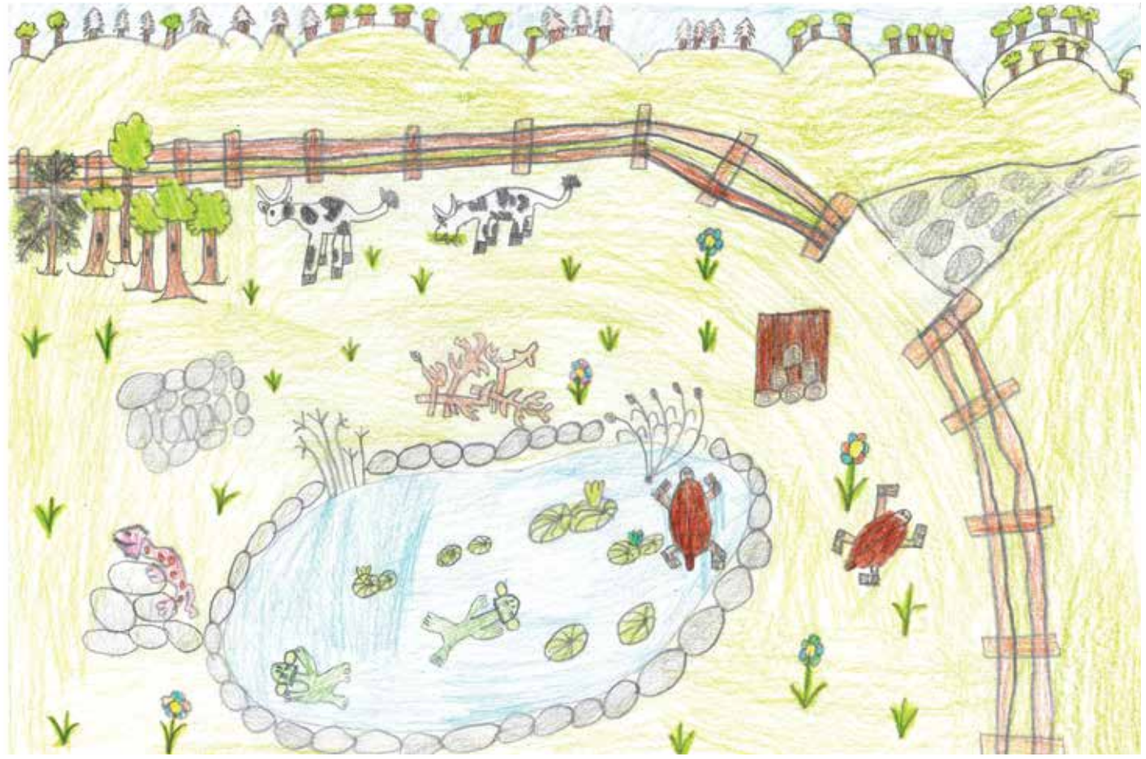
5. RAISING AWARENESS

5.1. PUBLIC INVOLVEMENT GUARANTEES A LONG-TERM EFFECT

Preservation of endangered species absolutely requires better public education, particularly so in the environmental field, and better public awareness. The project seeks to address the threats to the survival of the rare species by letting the animals “speak” for themselves, rather than taking a didactical tone. Not surprisingly, as the rare reptiles and amphibians found in Lithuania explain, more forcefully than anything else, what miraculous creatures they are, and why they must be preserved. It is the duty of environmental professionals to allow each of us, in timely manner and adequate place, with no risk to animals, to “touch” these unique pond inhabitants: to listen to their magic calling, to have a look at the home of these rare animals, to observe wonderful mating rituals, as well as young animals that develop rapidly and take their first lessons in real-life. The opportunities lie in the wild, the Zoo, photographs, and on a cinema screen. And you find your way to the magic world of pond-dwellers, only some key facts should be stressed lightly, with stories on diversity and co-existence of various species, their efforts to adapt to the disastrous man-made impact, and the contribution that each of us can make to preserve these rare animals.

Education at the Lithuanian Zoo

Very few of us know that Lithuania is home to the European pond turtles; their mysterious lifestyle is still beyond reach for most of us. It was the LZ that has introduced us to these long-living animals. Based on an initiative of devoted guardians of the European pond turtles, the LZ has celebrated, yearly, the “Day of the European pond turtle”, while the staff of the LZ have spoken of the European pond turtles in a few hundred schools. The visitors personally saw young turtles hatched in LZ from eggs laid in unsafe places in the human affected landscape, and were informed these turtles turned very lucky, since their “cousins” face numerous dangers their first year in the wild. Those most interested even studied the menu offered for turtles, had an opportunity to watch them feed, bid the young turtles goodnight before the hibernation. As the children inspected reptilian cast-off skin and skeletons, they learned to tell a pond turtle from other reptiles. The participants had an opportunity to touch a delicate egg of a turtle, and studied the life cycle of a turtle by examining an embryo preparation. The knowledge gained was further cemented by drawing a portrait of a turtle, and by playing games on habitats of the European pond turtle. The children, with a help of their parents, tried to solve a dilemma: what can you do to help a turtle found in the wild? It appears best to leave it alone, since a turtle knows best where it is going.



Winner of the drawing competition - a picture drawn by Džiugas Klimašauskas, a third-grade student at Leipalingis secondary school

A dance of little frogs commemorating the 20th anniversary of LIFE programme

Orientational bicycle trips

Trips in Veisiejai Regional Park provided an opportunity to get to know the reptilian and amphibian habitats really well. A competition "Don't be as slow as a turtle" *(Nebūk vėžlys)* of 2011 gathered 32 cyclists. A trip of 2012, "Where tree-frogs jump" *(Ten, kur medvarlės šokuoja)* combined 43 participants, who travelled around Veisiejai and Kapčiamiestis by bicycle and learned of prevalence of tree-frogs and protection of their habitats. Those taking part in the orientation competition had to tackle various tasks, hidden close to areas important to the European pond turtle and tree-frog.

This is what a red-bellied toad looks like

Educational path of Ilgabalė

Following the 1 km long path built in Dzūkija National Park is an opportunity to access the species, greatly depending on ecological corridors, as well as their habitats. Informational boards display detailed information on the protected species and the role of the ecological network. A section in a wetland can be tackled using a wooden path; there are arrows to help you stay on the track. We believe that numerous tourists coming to Dzūkija National Park will contribute towards a wide dissemination of the message on the rare reptiles and amphibians found here.

"Eurovision" of fire-bellied toads

An international competition for the title of best "singing" European fire-bellied toad summoned the animals from Lithuania, Latvia, Denmark, Sweden, and Germany for competition. In spring 2012, a numerous supporting team gathered by Trakų Vokė ponds, close to the capital city; from there, voice recording of these amphibians was broadcasted internationally. Fierce voting by the fans on the Internet lead to a victory of the Lithuanian fire-bellied toads. The curious audience gathered at the event had an opportunity to get to know these unique amphibians, hear their voices, watch the spring male fights and mating rituals, and visit their habitats.

Recording of a red-bellied toad choir

After a year, the organisers of the event, inspired by the success of the unusual "Eurovision" invited the public to listen to the voices of all the amphibians found in Lithuania and to choose those that sound best. The organisers, in cooperation with the Directorate of Verkiai and Pavilnių Regional Park, have called the nature enthusiasts to an event "TOP 10 of frog voices" *(Varlių balsų TOP 10)*, where the related species competed with the fire-bellied toad for the title of "Golden Voice". The contest found that no other members of the choir managed to beat the said soloist. The title of "Silver voice" was awarded to green toad, while that of the "Bronze voice" was awarded to marsh frog.

Picture exhibition "Whence such a beauty?"

Out of over 250 pictures of reptiles and amphibians, sent over by enthusiasts of nature photography, 24 best ones were selected, and placed in a picture exhibition "Whence such a beauty?" *(Ar iš balos tas gražumas?)*. In the first year, the said mobile exhibition travelled across Dzūkija, attracting both civil servants and rural communities alike. Later on, the pictures revealing a rich Lithuanian natural diversity were displayed in Vilnius, Kėdainiai, and the Curonian Spit.

Opening of the picture exhibition in Alytus Region Environmental Department

A film on protection of rare reptiles and amphibians

A film takes a viewer to a pond, where the viewer is introduced to the diversity of rare reptiles and amphibians. The viewer experiences a full year cycle together with the pond inhabitants: early awakening from hibernation, urgent mating and producing young offspring, their first fights for survival, constant hiding from predators and hunting for food, followed by hibernation again. Each of the said stages underlines utmost importance of the habitats, and the danger of extinction of the rare reptiles and amphibians, as these habitats dwindle and turn isolated. The story is intertwined with memories and impressions of the local residents, witnessing that the man and the reptiles have learned coexistence ages ago. If you want to watch this film, contact the Lithuanian Fund for Nature.

LIFE fosters the animals we protect

The event was organised in 2012, to commemorate the 20th anniversary of LIFE programme, which is supporting environmental projects. On the occasion, the environmental organisations reported their efforts to preserve the Lithuanian nature, while the guests of the event had an opportunity to talk to an impersonation of the European pond turtle, and to learn of the threats faced by the turtles and other rare species.

Public initiatives and joint efforts

The general public has also made its contribution towards preservation of the rare species. In spring 2012, students of natural sciences have observed female turtles in egg-laying places and informed of eggs laid in unsuitable places; they have also cleaned out a few valuable habitats about to overgrow with vegetation. In 2013, members of the Lithuanian Herpetological Society have assisted in releasing young tree-frogs raised in captivity, having removed the the cattails that have overshadowed the pond. During the spring migration of frogs in 2014, students of a Vilnius school have helped the amphibians to cross a road in Vingis Park safely.

Students from Vilnius University carrying out management of a European pond turtle habitat

Publications

Some articles on the rare reptiles and amphibians have appeared on the website of the Lithuanian Fund for Nature, in the periodic press, radio and television programmes, Facebook social network; they have also contributed to the environmental education of the general public.

Even if not all participants of the educational activities learn how to identify different reptilian and amphibian species flawlessly, or pick up Latin names for the species, what matters most is the newly acquired ability to monitor changes in the habitats of rare species sensitively and carefully, understand the signs of their life, recognise the threats to these reptiles and amphibians and find a way to contribute towards elimination of the said threats and preservation of animals.

5.2. ENGAGING LANDOWNERS

An important role in the traditional landscape of the Eastern Lithuanian region is played by small bodies of waters, i.e. ponds of particular importance for preservation of biodiversity. Ever increasing agricultural activities continuously destroy ponds, drain and bury them, turn ponds into arable land or cultured meadows. Only in the last decades did one realise the damage caused to the small organisms, amphibians and other creatures found in the ponds. Although the ponds have survived among agricultural land subject to intensive use, they become overshadowed by shrubs, reed, and cattail; hence they no longer retain their natural value. It is still not too late to see human interference and restoration of natural processes, through management of ponds or wetlands damaged. Support of a functioning landscape cannot be prerogative of environmentalists alone, therefore users and owners of land play an important part and carry on an important work in order to preserve and foster the species in ponds and wetlands exposed to the threat of extinction.

Preparatory works

Before restoration of ponds in the target area can start, it is important to enquire into development and history of its landscape. It is necessary to find out what rare species of amphibians were common in the environs and the reasons the same species went extinct or travelled elsewhere. It is important to talk to local residents to have them tell in detail of the extinct or withered ponds, once habitat to the rare creatures. Afterwards the data available has to be summarised and potential places for ponds selected.

Before engaging in negotiations with a landowner as regards restoration of a pond, it is imperative to verify effective documents governing management of the same areas, including general municipal plans, management plans of protected areas and planning documents of other areas. We should also find out whether the ponds expected for excavation will not be destroyed by the planned infrastructure works and whether or not our intentions run conflict to the landscape management plans. One must also consult maps of land reclamation, to ensure that a pond under excavation does not damage current systems of land reclamation. Once the same works are complete, one must determine and clarify owners of the future place for pond: to gain this information, it is best to enquire municipal land use division. Having received details of an owner, let us plan a business meeting and discuss possible installation and maintenance of a pond.

Meeting with a landowner

At a meeting with a landowner, it is advisable to discuss perspectives of a farm and introduce a landowner to the biodiversity in his area. Environmental activities can continue, provided further development of a farm as planned does not prejudice the needs of the rare species. An owner must be informed that the purpose of pond under restoration is to serve as a habitat of a certain species. As a result, the pond in question will be shallow and will turn dry in certain summers. It is important to inform a landowner that this will be caused not by any mistake but is very important for the target species. Furthermore the banks of a pond will be slanting and the pond will take an irregular shape. Should an owner agree an agreement will be signed providing that a pond will not be filled with ground for 10 years, providing for a 2 meter wide protective zone around a pond, not to be used for arable works and not to be enriched with mineral fertilizers. It is advisable to keep a pond free from fish, cultivate no ducks, ensure extensive grazing, water livestock, and mow the edges.

Process of works

Before the excavation machinery arrives, it is advisable to invite a landowner to the prospective place of a pond to observe the above works and to have a joint discussion on the progress. The best time to excavate a pond is under slight frost and with little or no snow. Works in this setting allows for least damage to the pond environment or a meadow. In case a body of water under restoration or a place of a new pond is overshadowed by trees and shrubs, they must be cut down, tree stumps removed and hibernation place formed for the amphibians.

Any questions while the pond installation works are still in progres, must be discussed with landowners, as the same landowners will be required to maintain a pond and ensure its condition. Once a pond is excavated and its environment managed, the works carried out must be inspected with a landowner and to see if his/her expectations are met.

Process of works

Follow-up role of a landowner when preserving reptiles and amphibians

In line with the guidelines, a pond owner can contribute voluntarily towards preservation of the rare species by excavating and maintaining ponds. Preservation of endangered species requires both knowledge and experience, therefore it is recommended to entrust observations of monitoring of reptilians and amphibians to environmental professionals; however, any information on animals observed provided by the landowners is also very valuable. Any owner can contribute to the preservation of protected amphibians by maintaining the condition of habitats restored, e.g. by preventing growing over of an excavated pond with plants that cast shadow, or by mowing egg laying places of turtles. Occasionally, an owner informed of the special characteristics of the situation and trained to behave while not scaring away egg-laying turtles, can contribute to cover-up of turtle egg clutches. It is best where an owner carries out observation or protection measures of the same protected species for several years, in cooperation with a professional; subsequently, a landowner, having acquired some experience, may be able to carry out the same works independently.

5.3. KNOWLEDGE EXCHANGE AMONG PROFESSIONALS

Numerous activities included in the framework of ECONAT project were previously not implemented in Lithuania. In order to see a successful implementation of the activities in question, new knowledge was necessary even to the environmental professionals. This was covered by international seminars and educational trips abroad. There were a total of 5 seminars organised as follows:

1. **Ecological networks: experience and perspectives**, taking place in the outset of the project, February 2011. There, experts from 10 countries across Europe presented their experience learned when designing ecological networks in respective countries; the participants also discussed the perspectives of designing of the ecological network in the Southern Lithuania.
2. Seminar dedicated to the **methods of inventories, restoration of habitats and monitoring of protected amphibians and reptiles** took place in May 2011. On the occasion, the staff of the protected areas in Lithuania was introduced to the needs of the protected reptiles and amphibians as regards their habitats, methods of restoration and monitoring of the said habitats, as employed in both Lithuania and Denmark.
3. **Aspects of biodiversity in the process of environmental impact assessment, based on the example of protected reptilians and amphibians**. The seminar took place in April 2013 and provided an opportunity for an in-depth discussion of the prevailing methodology of assessment of biodiversity in the process of the environmental impact assessment. Particular focus was placed on the assessment of impact on the habitats of amphibians and reptiles.
4. A seminar on the **examples of ecological networks and legal preconditions for their set-up in Lithuania** was conducted in May 2014 and was dedicated to the staff of Lithuanian authorities in charge of the set-up of the ecological network.
5. **Final seminar of the project** took place in August 2014; it involved presentation and sharing of experience of foreign countries learned in the project in the following areas: restoration of habitats, development of the ecological network, breeding of the pond turtles and the tree-frogs, and raising of public awareness.

Mr Grzegorz Gorecky telling of the maintenance of the habitats of the pond turtles in Napiwodska-Ramucka location

Participants of a workshop

Furthermore, there were 4 educational trips organised, used by the staff involved in the project to examine the experience of foreign countries in the fields most relevant to them:

- **Turtle breeding methods in Germany in 2011.** Before the ECONAT project was launched, there was no breeding of the pond turtles in Lithuania; while preservation of turtle egg-clutches laid in unsafe places and raising of juvenile turtles presented a new activity to the project staff. Therefore, before embarking on the said activity, we visited 4 institutions of breeding the pond turtles based in Germany. It was there that the fundamentals of the methodology governing incubation of the pond turtle eggs and raising of juvenile turtles in the Lithuanian Zoo were first built.
- **Development of environmentally friendly farms in Latvia in 2011.** Before setting up of the pastures for extensive beef cattle in Juodabalė Herpetological Reserve, both the project staff and the specialists of the Lithuanian Agricultural Advisory Service visited the farms protecting biodiversity in Latvia.
- **Introduction to the best practices of amphibian protection in Denmark in 2012.** The staff of the Ministry of Environment, Alytus Region Environmental Protection Department, the Lithuanian Road Administration as well as the staff of protected territories situated in the project areas were introduced to the best practices of amphibian protection in Denmark (on the roads, close to buildings and depleted gravel quarries).
- **Long-term maintenance of the habitats restored for reptiles and amphibians and the experience of breeding and releasing of the pond turtles in Poland in 2014.** Following restoration of habitats in the territory of ECONAT project, a decision was made to see how the said habitats were maintained after 10 years and more following the restoration in the Natura 2000 areas of Napiwodcka–Ramucka, and in Biebrza and Podlaska National Parks. Furthermore, preparation for the headstarting of the juvenile turtles for the first time in Lithuania included a visit to Podlaska National Parks, where the pond turtles are raised and released for a number of years now.

6. MONITORING AND FUTURE PLANS

6.1. INVESTIGATIONS OF NEWLY DUG PONDS

In May 2014, restored and newly dug ponds were investigated for presence of amphibian and invertebrate colonization. Particular attention was paid to the species listed in the Annexes II and IV of the Habitats Directive. The methodology used for investigation was minimum 30-minutes dip netting one pond through vegetation zones and all depth more shallow than 1.5 m. Even though majority of the ponds were newly dug (dug 2013 autumn – 2014 spring) and had not yet developed the vegetation needed for the target species, this investigation already suggested positive results of the first colonisations.

Searching for tadpoles

The **pool frog** *(Pelophylax lessonae)* was the fastest colonizer of the new ponds. Adults of this species were found in 49 ponds, including 9 where eggs were found. Only in 2 out of the 49 ponds, adults of the **edible frog** *(P. esculentus)* were found, indicating that the dominating green frog in the ponds dug and in the area to be the pool frog. The **moor frog** *(Rana arvalis)* was the second most successful and fast colonizer of the new ponds. Its larvae were found in 24 ponds. Both juveniles and adult frogs were found feeding on the edges of several other ponds.

Eggs of the **great crested newt** *(Triturus cristatus)* confirmed the presence of this species in as many as 20 ponds. It is considered a successful fast colonization of the newly created habitats by this species. The presence of eggs and sometimes small larvae indicates the growth of new sub-populations in the area. The **red-bellied toad** (*Bombina bombina*) was a rather successful colonizer and was heard in 12 ponds and in some ponds with up to 10 males. No tadpoles were found as month since May is too early for tadpoles of the red-bellied toad.

Tadpoles of the **spadefoot toad** *(Pelobates fuscus)* were found in 5 ponds. The above investigation found no **green toads** *(Bufotes viridis)* or **spadefoot toads** *(Epidalea calamita)* in the newly dug ponds. These toads were heard during the mating season and later on their tadpoles were found in several newly dug ponds during the other investigations of the project area.

Ponds for the European **tree-frog** *(Hyla arborea)* were dug earlier (autumn 2011 – spring 2012) than majority of the other ponds. During investigations in 2013 and 2014 (including night visits), males of the tree-frogs were heard in 10 ponds.

Majority of amphibian species (except *Hyla arborea*) were inventoried during the day time; this method reduces the number of results, since night calling males are unaccounted for. However, the first results of amphibian inventories indicated the growth of new sub-populations in the EN area.

Even though dip netting is obviously not the best method for investigation of the **pond turtle** *(Emys orbicularis)* distribution, 2 young turtles of this species were caught in one pond by the standardized method of dip netting in 30 minutes. Observation of the restored and newly created habitats found the pond turtles sun basking in 16 ponds. The turtles were observed in various areas of the EN, mainly in the restored or newly created habitats, which are less than 1km away from the bigger turtle populations. One can therefore assume that these ponds are already inhabited by turtles on a more constant basis than migration. In order to observe migration of turtles, different methods of investigation should be used, for instance, mark-recapture in different sub-populations for several years.

A male European tree-frog is calling females

6.2. OBSERVATION OF EUROPEAN POND TURTLES RELEASED IN THE SOUTHERN LITHUANIA

With the changing landscape of the Southern Lithuania, female turtles, when no longer able to find suitable egg laying places, often lay eggs on small dirt and gravel roads. These locations are not considered safe for egg development; therefore, in the period of 2011 to 2013, 16 clutches of European pond turtle eggs were collected in Lazdijai and Varėna areas. The eggs were taken to the Lithuanian Zoo, put to incubation, and raised in an artificial environment. Young turtles were accustomed to live prey, while circadian and biologic rhythms were imitated. In July 2014, 101 young turtles raised were released in ponds of Dzūkija, using bodies of water in the proximity of the finding-places. This represents the first effort to raise the European pond turtle in captivity and then release them back to the restored habitats in Lithuania. Out of 8 locations used for release of juvenile turtles, in 2 locations juvenile adjustment to the natural environment was investigated.

Description of localities

The study was conducted in 2 locations with existing population of the European pond turtle. The first is in Lazdijai district, Paserninkai village. Total water surface area of a pond 900 m^2. The pond is visited by the turtles, spending most time in a larger pond away from the hatching place. The pond was restored specifically for the turtles in 2013: shallow banks were formed, surface area increased, and another shallow pond was excavated. 8 two-year old turtles were released to the pond. The second location lies in Varėna area, in vicinity of Vilkiautinis. The latter includes two ponds at a distance of 100 meters, with area of 10,000 m^2 and 20,000 m^2 respectively, and home to some 55 European pond turtles of various age. 13 young turtles (hatched in 2011), 7 turtles (hatched in 2012), and 6 turtles (hatched in 2013) were released here.

Methodology

The study lasted a month after the release of the turtles. Baby turtles were caught using box-traps with bait (Servan, 1986). A total of 7 traps were used, checked twice per day. Each turtle caught was weighed on the spot, with precision rate of 1 g. Baby turtles were also measured using a Vernier an angle meter (maximum carapace length). Plastron of all turtles was photographed, allowing for future identification. Having done that, the turtles were released in the water. The behaviour of the turtles was observed for 3–5 hours daily, in natural environment, using binoculars and a monocle (magnification rate up to 60 times), allowing perfect observation of a 10 cm long young turtle from a distance of 30–50 meters.

Pattern of turtle plastron is unique; it changes overtime, however, when little time passes between catching, identification of a turtle is easy. As the turtles grow older, the patterns become more alike.

Results

Catching of turtles. Overall, 31 European pond turtles were caught (63 instances of catching). One turtle was caught most often, 7 times. 8 young turtles were released to Paserninkai ponds, 6 were caught and weighed. 24 young turtles were released to Vilkiautinis ponds, 6 that were caught and weighed. Migration of 2 young turtles was recorded between two ponds in Vilkiautinis area. Both were released in one pond, and caught in another, at 100 m distance, after a month.

Juvenile turtle, when seen through a monocle

Observation post

Number of a turtle	Year of hatching	Weight on release (g) (8 July)	Caught (month - day)	Weight on the catching day (g)	Change in weight between release and catching day (g)
3F	**2012**	55,1	07-17	50	-5,1
2M	**2012**	96,2	07-18	105	8,8
		96,2	08-07	109	12,8
8F	**2012**	136,8	07-19	150	13,2
7M	**2012**	91,8	07-28	95	3,2
		91,8	08-05	110	18,2
		91,8	08-07	106	14,2
4F	**2012**	104,5	08-05	122	17,5
			08-11	119	14,5
10M	**2012**	96,3	08-07	104	7,7

Data on weighting young turtles caught in Paserninkai pond

Number of a turtle	Year of hatching	Weight on release (g) (8 July)	Caught (month - day)	Weight on the catching day (g)	Change in weight between release and catching day (g)
(2)4 F	**2011**	196,6	07-19	200	3,4
(2)1 M	**2011**	142,2	07-20	140	-2,2
			07-30	158	15,8
			08-12	162	19,8
(2)5 M	**2011**	134,8	07-27	147	12,2
(2)3 F	**2011**	128,7	07-28	141	12,3
			08-06	156	27,3
			08-12	153	24,3
4 F	**2013**	71,2	08-06	102	30,8
(4)3 F	**2011**	139,3	08-06	151	11,7

Data on weighting young turtles caught in Vilkiautinis pond

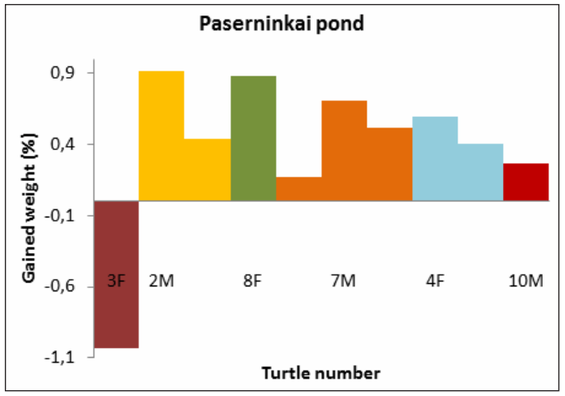


Fig. 1. Percentage of body mass gain in young turtles, raised in the Lithuanian Zoo, and released to Paserninkai village pond, on average per day, compared to the original turtle weight. The diagram provides data on 2-year old young turtles only: readings of each appear in a different colour.

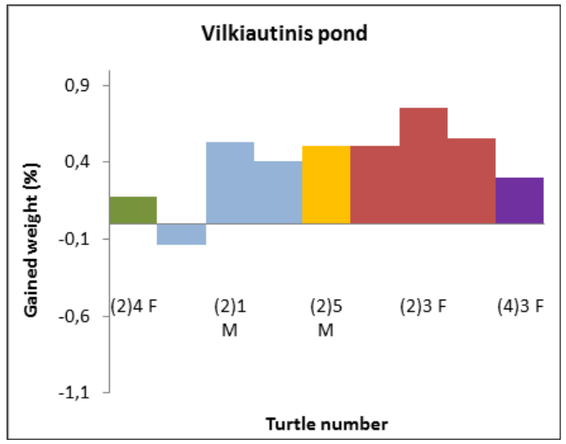


Fig. 2. Percentage of body mass gain in young turtles, raised in the Lithuanian Zoo, and released to Vilkiautinis pond, on average per day, compared to the original turtle weight. The diagram provides data on 3-year old young turtles only: readings of each appear in a different colour.

Most of turtle juveniles gained weight during the study period. In Paserninkai village, 2 year old turtles were released, with average weight when released of 96.78 g. They were caught again in different intervals after the release. Ave-rage weight gained per day after release was 0.37 g or 0.25% body mass when released. Figure 1 demonstrates that one young turtle lost weight; however, since this young turtle was only caught once, we cannot bring sound conclusions as to the change in weight. 5 young turtles gained weight, including some caught a few times. It is therefore likely that most young turtles gained weight in Paserninkai pond in the summer.

Turtles 1 to 3 years old were released in Vilkiautinis ponds. Since these bodies of water are considerable bigger, not all released turtle juveniles were caught. Five 3 year old turtles and one 1 year old turtle were caught. Average weight of a 3 year old turtles when released was 142.32 g. They were caught again in different intervals after the release. Average weight gained per day after release was 0.54 g or 0.39% body mass when released. Figure 2 demonstrates that one young turtle lost weight; however, since this young turtle was only caught once, we cannot bring sound conclusions as to the change in weight. 4 young turtles gained weight, including some caught a few times. It is therefore likely that most young turtles gained weight in Vilkiautinis pond in the summer. One year old turtle weighed 71.2 g when released, and in 28 days after release, its weight reached 102 g, i.e. the turtle gained almost 30% of its body weight.

Observations of behaviour. The behaviour of turtles was observed from 9:30 am. to 08:00 pm. Highest number of turtles, as confirmed by other observers (*Capula et al*., 1994), was recorded during the midday.

Observations suggest that baby turtles take different places in their habitats, as compared to the adult turtles. Young turtles preferred a more shallow section, with easy reach from the shore. This type of behaviour is also listed by other scientists (Meeske and Muhlenberg, 2004; Meeske and Schneeweiss, 2009). Observations mostly found adult turtles; these prefer sunbathing in hardly accessible parts of the pond, as far from the man-made trail as possible (*Capula et al*., 1994).

Turtles, when sensing danger (e.g. presence of an observer), usually avoid climbing on a hump; instead, they swim in the bulrush, sometime sticking their head and top of the shell above the water. They seem to hesitate or failing to find a good spot for sunbath, and can float in thick mud, close to shallow end, and on the shore side, in places not overshadowed by vegetation for as long as a few hours. When immersed, turtles demonstrate a weaker response to the surrounding environment, unlike when above the water.

The behaviour of young turtles and adult ones is the same, when sunbathing. A turtle wags its head, moves its limbs, as though trying to chase away the insects buzzing around its head, then turns each side to face the sun, alternating them, or moves to a different side on the hump. Occasionally, a turtle immerses its head in the water, and wags it: it so looks for prey, making sudden lateral moves with its head, ripping away part of its prey, seemingly chewing it. A turtle can take a dive suddenly, as if having had enough sunbathing. This type of behaviour is inherent to young and adult turtles alike.

Conclusions and plans for the future

When a month passed since the release of the young turtles, most have gained weight. The study included 2 rather different habitats; both demonstrated an increase in the turtle body mass; this suggests a successful adaptation of the released animals in the natural environment.

The study will be continued until summer 2015. We assume that young introduced turtles will find the first hibernation out in the wild most challenging. More solid conclusions as regards efficiency of raising in captivity and release from it, in order to increase the population of the European pond turtles in Lithuania can be drawn next spring. The guidelines suggest tracking the same young turtles for at least several years, until they reach size that makes their hunting for the predators rather difficult.

Turtle juvenile reared in the Lithuanian Zoo

6.3. SECURING A LONG-TERM IMPACT

The ECONAT project involved numerous activities: starting with digging of ponds to establishment of an ecological network, starting with classes concerning reptiles and amphibians to children in Lazdijai area to international conferences for environmental experts. The project was completed in 4 years. Compared to the life span of the European pond turtle which can reach 100 years, the duration of the project is like the first "introductory" steps, with continuity to be ensured in the future in order to preserve the target species and to ensure that the ecological network will carry out its functions successfully.

Maintaining sound habitats

Key reason for extinction of amphibians and reptiles in Lithuania includes destruction and alteration of habitats required for the said animals. For this reason, the project largely focused on restoration of habitats of the target species. Upon completion of the project, it is foreseen to carry out maintenance of sound habitats.

1. In the core zones of ecological network

The core zones of EN have national and international protection status. The Law on Protected areas ensures that any activities potentially harmful to the protected habitats and species are either prohibited or restricted in the core zones of the EN, part of Natura2000 European ecological network. As far as Natura2000 areas dedicated for the European pond turtle, destruction of turtle habitats, injuring of animals when fishing, intimidation of animals by holding massive events or when navigating using navigational measures shall be prohibited. It is recommended to remove some vegetation, protect turtle's eggs from the predators and to restore places, where the turtles lay eggs.

Similar measures are also recommended for the other two target species listed in Annex II to the Habitats Directive: the European fire-bellied toad and the great crested newt. The shallow bodies of water situated in the habitats of the said species may not be destroyed or polluted, amphibian hibernation places must be preserved, and the animals must be protected from casualties on the motorways. These general restrictions ensure the preservation of habitats in the EN core zones.

As regards the five Natura 2000 areas were established in the project, management plans for them were prepared, including specific measures to maintain the habitats for a period of a decade. Action plans for the European pond turtle and the European tree-frog were prepared, ensuring the species protection on the national level. Furthermore, there are EN core zones in the area of Dzūkija National Park and Meteliai and Veisiejai Regional Parks. The Directorates of these parks are responsible to ensure the protection of said species and their habitats.

2. Corridors of the ecological network

Not only the EN core zones, but also corridors and buffer zones must be preserved so, that the ecological needs of the protected species would not be affected. It is important to keep shallow bodies of water, new or restored ones, from overgrowing with vegetation. Mowing and grazing helps to keep an open landscape, hence an extensive, ecological farming is recommended in the EN corridors, as well as application of the agricultural environmental measures.

Landowners of the land plots, in which ecological network corridors were formed and new ponds have been dug, also agreed, on contractual basis, to maintain ecologically suitable environment for the rare and threatened species found in the area: refrain back-filling the ponds, or deepening them, sustainably maintain buffer zones of the ponds- ensure grazing or mowing of the shoreline. It is recommended to keep the bodies of water fish-free, out of reach of poultry. We believe the environmental farm established in Juodabalė Herpetological Reserve will serve as an inspiration and educational case to numerous farmers in the region to take on the sustainable agriculture, thus contributing to the preservation of the habitats of rare species.

Farmer Liudas Jurčiukonis with his cattle grazing Juodabalė Herpetological Reserve

Officials responsible for environmental control will undertake checking of the state of particular water bodies at least once per year. The survey and observations will be combined with the active dialog and consultations with the landowners, local residents, other parties of agreements in order to stimulate good practices, give advice, provide active professional support, and comply with the obligations of legal acts and personal contracts related to the protection of rare species and the environmental state of EN.

Maintaining good state of the populations

The project sought to directly enhance the numbers of the populations of the two rarest target species, i.e. the European tree frog and the European pond turtle (the said activities are described in Part 4). The project found that the tree frogs were successfully spreading, taking hold of the restored habitats; consequently, the said species will no longer be bred and released to the habitats restored. The number of individuals of the European pond turtle increase slowly; this is natural, however, for such long-living, sedentary animals, having few offsprings. The population of the European pond turtle will therefore be enhanced on a continuous basis. The staff of Meteliai and Veisiejai Regional Parks will protect the eggs of turtles from predators, while the eggs laid in unsuitable places will still be put to incubation in the Lithuanian Zoo.

The possibility now considered is to initiate the project which would assist protection of rare species preventing appearance of turtles of invasive species (*Trachemys scripta*), which could supersede the native turtles, and would mitigate the risk of releasing invasive animals in the habitats of the European pond turtle by taking away these home kept animals from the owners unwilling to raise them anymore.

Legal status of the protection and management of the ecological network

The greatest responsibility to preserve the established structure, integrity and state of the EN falls on the public authorities. In accordance with the law on Protected areas the Ministry of Environment (MoE) prepares the material and initiates establishment of Natura 2000 areas. MoE is responsible for establishment of the EN core zones, planning establishment and the management of protected areas designated for preservation and protection of the biodiversity and specific species. This authority must ensure that the EN core and buffer zones coincide with the national and biosphere reserves, national parks and reserves or their buffer zones. National institutions, the MoE particularly, will assess the outcomes of the project, take them into account forming the tasks of National environmental monitoring, and consider them in the process of decision making concerning the new environmental measures implementation or introduction of the new environmental policy of the said areas.

The protection and adequate ecological state of the pilot EN in the Southern Lithuania will be guaranteed by the legal protection measures of the habitats approved on the

Turtle juvenile headstarted in the Lithuanian Zoo

National level. During the project, the methodology governing establishment of the EN for the target species in the national Nature Frame was established and published in the website of the MoE and shall contribute to the establishment of other ENs in the future. The methodology is available at: http://www.am.lt/VI/index.php#a/13910.

Local authorities of municipalities which territories possess habitats of rare and endangered species will be encouraged to take strategic legal decisions concerning establishment and protection of the EN corridors locally. National targets of Landscape and biodiversity protection and preservation of will be embodied providing the financial support – it is planned to include these specific targets and fields into the Plans for EU Structural funds financial assistance by the State and the EU for the period of 2014 to 2020.

The MoE will ensure that the data and information gathered by the project will be used to develop new or adjusting of existing integrated documents of Territorial (spatial) planning on local or regional level. These documents should officially set borders of the EN connective structures and other areas important for preservation of species and determine concrete regulations on protection and management of the said areas.

The Ministry of Environment is considering opportunities to develop the said activities on international level, including possibility to establish a Joint frontier Polygon of Biosphere jointly with the Belarus side in the EN area situated close to the State border of Poland and Belarus.

Solutions of the Documents of territorial planning and Environmental impact assessment of planned activities on the protected species and the EN

The most important solutions about the management and protection of particular territories are taken in the process of territorial planning. The success of this process depends on the consciousness and the knowledge of all parties (national and local authorities, planners, local communities, etc.) taking part in decision making. The lack of experience how to support the protection of rare species through the rational and sustainable land use, how to safeguard the favourable conservation status of populations, avoid and mitigate the potential risks is still being estimated.

The findings of the project will support development of the territorial planning methodologies both general and specific, related to EN and protection of rare species at all levels as well. Using the experience acquired during the project national and local authorities can identify and take into account the impact of any economic activities on the EN and the target species protected in the examined area.

Assessing the Impact of Plans and projects as obligatory by the EU Directive on Strategic Environmental Impact Assessment, all transformation of an area (expansion of settlements, development of industry, road system and recreation, land improvement and land reclamation works, etc.) need to be assessed on the aspect of Landscape and biodiversity and safeguarded that no effect neither on the Natura 2000 areas (the EN core zones) nor on the EN corridors will be estimated.

Implementing the EU directive on Environmental Impact Assessment of planned economic activities involves mandatory assessment procedures of an impact on natural landscape and biodiversity, analysis whether the planned activity may affect an infringement of ecological needs of the species, foreseen measures to mitigate and compensate the anthropogenic impact, preservation or restoration of natural landscape and biodiversity. No roads may be built by crossing the areas of EN core zones, and where this is not an option, compensation measures must be planned (establishment of new bodies of water and guarantee of development of a landscape beneficial to a species in respective area; when the migration corridors are breached, places for animal road crossing must be provided for).

European pond turtle was noticed in a habitat restored two years ago

Dissemination of information ensuring the long-term project outcome

The long-term nature of the project is guaranteed by adequately streamlined, protected and submitted information. The project partners shared the valuable scientific and practical experience gained in the project at various seminars, conferences, and meetings. To make sure that the representatives of the institutions subordinate to the MoE and representatives of the municipalities, professionals of environmental impact assessment and education, planners and landowners are aware of the needs of protected species, management methods of the terrestrial and aquatic habitats of rare animals, the type and nature of restrictions applicable to activities in the EN areas, important information is published on the website of the project, to be accessible also after the completion of the project (www.glis.lt/ekotinklas).

When the project was close to completion, the stakeholders agreed that the cooperation network will be continuously coordinated by the Ministry of Environment. Every partner of the project agreed to share the methodological experience they have acquired, thus contributing to better knowledge of various professionals as regards the ecological needs of the target species, the importance of the EN development, disseminate information on the outcomes of the project, encourage the territorial planning and road development sectors to take responsibility for the preservation of the biodiversity and landscape.

Third grade school children learn about diversity of reptiles and amphibians

The scientific data gathered in course of the project concerning the finding places of the rare target species will be published in a special designated website and shall be included in the Information System of Wild Animals, Plants and Mushrooms, Existing or Temporarily Present in the Natural Environment in Lithuanian Territory, administered by the MoE (SRIS; https://sris.am.lt). This information will have to be considered when planning economic activities and assessing its potential impact on both the EN and endangered species. The Lithuanian Fund for Nature has prepared a database of the water bodies located in the EN, as well as information about landowners, their contractual obligations and provided it to the Ministry of Environment who will be responsible for this information storage and dissemination.

Raising of public awareness

During the project the general public was introduced to rare reptiles and amphibians, the need to protect them, as well as the measures available to each landowner (for description of these activities see Part 5) by big range of different activities.

The dissemination of information concerning preservation of the rare reptiles and amphibians will continue even after the completion of the project. Just as before, this will fall on the Lithuanian Fund for Nature, the Lithuanian Zoo, and the Directorates of the protected areas. Specialists from these organisations will be joined by the staff of local environmental authorities and specialists from the municipal administration, once trained and provided with the educational literature. Based on the educational material prepared in course of the project, the teachers, especially teachers from the local schools, shall use the EN and surrounding areas as educational spaces to explain the school children about the species, which are rare in the whole Europe, but live in the areas of the EN.

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LIETUVOS GAMTOS FONDAS

"It is a project characterised by beautiful harmony of theoretical-methodical knowledge and implementation of practical work. The project has great demonstrational power; the experience it has accumulated will be taken over not only by other naturalists, but also by specialists of territorial planning and decision makers of landscape management and environmental engineering solutions."

Algirdas Klimavičius, Head of Protected Areas Strategy Division, Ministry of Environment.