

## CREATION OF TEMPORARY PONDS FOR AMPHIBIANS IN NORTHERN AND CENTRAL EUROPE

LARS BRIGGS

(Lars Briggs, *Amphi Consult, Science Park Odense, Forskerparken 10, 5230 Odense M., Denmark*) [*Email: [Briggs@amphi.spo.dk](mailto:Briggs@amphi.spo.dk)*]

### Introduction

More than 4000 ponds have been created or restored in Denmark since 1985 as part of a large-scale pond-digging programme to protect endangered amphibians in particular and pond flora and fauna in general. Most ponds are created on private land with public financing. The programme was triggered by, among other factors, a drastic decline in amphibian populations in Denmark between 1940 and 1980. However, in recent years there has been an increased awareness in Denmark that temporary ponds are important for the conservation of some of the most rare amphibian species, such as fire-bellied toad *Bombina bombina*, natterjack toad *Bufo calamita* and green toad *Bufo viridis*. Other rare species such as moor frog *Rana arvalis* and European tree frog *Hyla arborea* also benefit from temporary ponds. The last 15 years of work on the conservation of endangered species and their habitats has resulted in a last-minute rescue and a subsequent growth in the size of most Danish populations of fire-bellied toad and green toad; some populations of the relatively more common natterjack toad have also increased. The creation of temporary ponds plays an important role in the success of these three species.

The creation of ponds to help restore viable populations of the most rare amphibians has not been easy. To study the conditions that may need to be created, Danish herpetologists searched for areas with temporary ponds that had good water quality, natural hydrological conditions and a management regime influenced by traditional agricultural methods. An ideal location was found around the Bialowieza Forest in north-east Poland where temporary ponds are still very common, although even here these ponds are now disappearing in some areas due to natural succession of vegetation and in other areas due to more intensive agriculture. Most of the 12 amphibian species in the area of Bialowieza Forest (Table 1) breed to a large extent in temporary ponds.

### Amphibian species dependent on temporary ponds

A number of amphibian species in the north European lowlands are dependent on temporary ponds for successful reproduction.

In Denmark and in Estonia near the Baltic Sea area, the natterjack toad

Table 1. Amphibian species in the Bialowieza Forest area, north-east Poland

Species	Common name	Notes
<i>Bufo bufo</i>	Common toad	–
<i>Bufo calamita</i>	Natterjack toad	In 2000, found to be extinct in agricultural area around Bialowieza village
<i>Bufo viridis</i>	Green toad	–
<i>Bombina bombina</i>	Fire bellied toad	In 2000, found to be extinct in agricultural area around Bialowieza village
<i>Hyla arborea</i>	European treefrog	–
<i>Pelobates fuscus</i>	Common spadefoot	–
<i>Rana arvalis</i>	Moor frog	–
<i>Rana esculenta</i>	Edible frog	–
<i>Rana lessonae</i>	Pool frog	–
<i>Rana temporaria</i>	Grass frog	–
<i>Triturus cristatus</i>	Great crested newt	–
<i>Triturus vulgaris</i>	Smooth newt	–

successfully breeds in temporary, poorly-vegetated ponds in gravel pits, sand dunes and on well-grazed coastal meadows. For their long-term survival, all populations depend on temporary ponds that dry out every year. Inland populations in semi-natural habitats are extinct in Denmark.

The green toad successfully breeds in Denmark in temporary, fresh or brackish ponds with poor vegetation. As with the natterjack toad, most populations in Denmark depend on temporary ponds for long-term survival.

In Denmark, the fire-bellied toad successfully breeds in temporary, richly-vegetated ponds. It uses more permanent ponds for foraging. All populations are dependent on a combination of temporary and permanent ponds for long-term survival, but the temporary ponds must remain wet until August in most years for breeding to be successful. Temporary ponds supporting fire-bellied toads are often inhabited by at least four other amphibian species.

In France and Poland, the yellow-bellied toad *Bombina variegata* is dependent on temporary ponds, often very small, for reproduction.

In the Bialowieza Forest area in eastern Poland, the diversity of amphibian species is relatively high. Up to 10 of the 12 species here can be found in temporary ponds that dry up every year. Natural hydrological conditions and traditional agriculture with scarcely any use of chemicals, favour the existence of these amphibian communities in temporary ponds.

### Creating and restoring ponds on private land

As most of the populations of rare amphibians in Denmark occur on private

land, the creation and restoration of temporary ponds often involves negotiation with landowners. In these cases, it is particularly important to develop good communication with the landowner(s). Television and newspapers can be used as a tool to raise general awareness, but for a successful pond creation/restoration project it is necessary to provide specific information directly to those involved, for example in the form of "information packs", and to explain the habitat requirements of the amphibian species concerned.

For aesthetic reasons, private owners often prefer to have a permanent pond on their property, and it can be difficult to convince them of the benefits of temporary ponds. Consequently, it is often necessary to sponsor both a permanent and a temporary pond in order to achieve agreement on a temporary pond. However, even this solution can be difficult to promote as temporary ponds need a higher level of care and intensity of management to be successful as breeding sites for rare amphibians.

The result of pond-digging projects is often a mixture of temporary and permanent ponds in relatively small areas. In many cases this is enough to secure the survival of the amphibian species which the pond project is designed to protect. In some cases, however, buying land and establishing numerous temporary ponds, with appropriate management regimes, is necessary to build up and maintain viable amphibian populations.

### **Pond project for *Bombina bombina* in Denmark**

Populations of fire-bellied toad steadily declined in Denmark throughout the twentieth century, with numbers decreasing by 50 to 60% every 10 years (Fog 1988, 1997). Six populations still existed in Funen County by 1980, but by 1988 only three populations were left. Between 1980 and 1988, several efforts were made to rear amphibians and to create and restore ponds, but without success (Briggs et al. 1988). From 1988, a countywide pond project was initiated in Funen County and a rearing programme was carried out in all localities (Briggs 1997). By 1997, a total of 69 ponds had been created or restored in Funen County, specifically targeted at the conservation of fire-bellied toad; populations had increased to 100 adult individuals in most cases, and the species was breeding naturally and successfully (artificial rearing stopped between 1992 and 1997). Some of the newly created ponds were temporary and these were essential to the breeding success.

In the first 10 years of this successful pond project, we were able to demonstrate the importance of temporary ponds for the conservation of fire-bellied toad. To build on this experience by creating more natural hydrological conditions for the toad in temporary ponds in Denmark, an EU-

funded LIFE project, "Consolidation of *Bombina bombina* in Denmark", was started in 1999. The financial support from this LIFE project has allowed us to purchase land to create and restore more temporary ponds, from which we hope to create local breeding populations totalling 500 to 1000 individuals. An effective population size of 500 individuals in a particular locality is necessary to avoid loss of genetic variation and to maintain a series of small populations in the long term (Lehmkuhl 1984). Fig. 1 illustrates the population decline of fire-bellied toad on the island of Avernak in Funen County from 1983 to 1989, and a subsequent increase from 1990 to 2000. This is an example of a population that has benefited from the restoration of temporary ponds. In the LIFE project we will be able to buy land and create temporary ponds to help increase the population on Avernak further, closer to an effective population size of 500 individuals.

### Pond project for *Bufo viridis* in Denmark

The green toad was one of the fastest declining amphibian species in Denmark in the 20th century. Decline rates varied from 50% per 10 years in Funen County (Briggs 1997; Fog 1997), to 70% in Storstroms and Aarhus County (Amkjær 1995), and 90% in Northern Zealand (Fog 1997). The species is found naturally in temporary ponds influenced by sea water on coastal

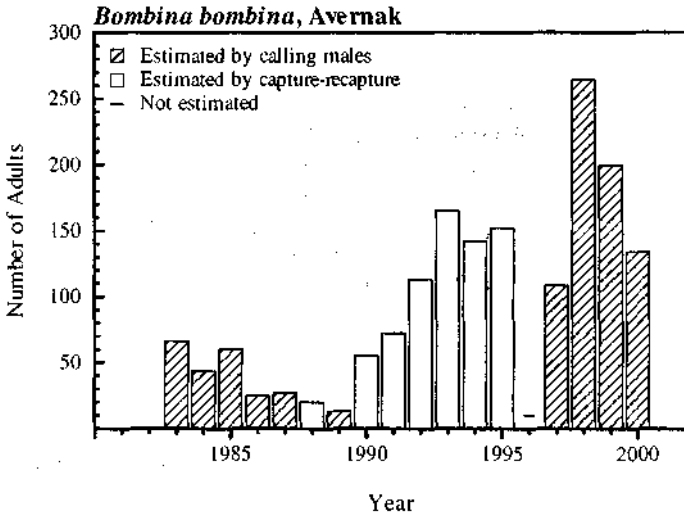


FIG. 1. Population change of *Bombina bombina* on the island of Avernak from 1983 to 2000.

meadows. The decline is mainly caused by changes in hydrological conditions following draining of the coastal meadows, and coastal meadows becoming "over-grown" when grazing by livestock is stopped.

A species recovery project started in 1989 in Funen County. By 1997, 23 new ponds and 25 restored ponds had been established, of which many were temporary. Grazing was also reintroduced to 73 ha of coastal meadows and coastal fields (Briggs 2001). The total population of green toads in Funen County increased from 1644 individuals to 4950 in seven years, the number of occupied ponds increased from 29 to 61, and the number of ponds with breeding success increased from 11 to 22 (Briggs 2001).

Fig. 2 illustrates the results of this work in one locality, Avernak0. After digging five temporary ponds, grazing by livestock was reintroduced on the surrounding 30 ha of coastal meadow. The effect on numbers of green toads was a population increase from five calling males (representing 20 individuals - males and females) in 1987 to 720 males (representing 3080 individuals) in 1995. The population in the year 2000 is stable at around 1200 to 1500 individuals.

### **Pond project for amphibian diversity in Poland**

An ongoing study of a large number of ponds is now being carried out in north-east Poland in order to gain more experience of the importance of temporary ponds for amphibians (Briggs et al. 1999). Twelve species of amphibians occur in the agricultural landscape of north-east Poland (Table 1). The only historical field data available on these amphibians relates to the agricultural area (14 km<sup>2</sup>) around the Bialowieza village, in the centre of the Bialowieza Forest, where in 1990, all 12 species still occurred. In the year 2000, however, two species had become extinct: the natterjack and fire-bellied toads. Both species depend mostly on the temporary ponds that exist in this region for their long-term survival. Furthermore, the green toad is now only reproducing in one, temporary, pond near Bialowieza village and is in danger of being the next species to become extinct in this area.

A pilot pond-digging project was carried out around Bialowieza village in 1997, creating three permanent and four temporary ponds. Vulnerable species such as the European tree-frog, common spadefoot *Pelobates fuscus* and great crested newt *Triturus cristatus* successfully colonized the ponds. However, the temporary ponds were more successful for amphibian reproduction.

In addition, a pilot pond project was carried out in Wigry National Park, with 10 ponds created especially to restore populations of fire-bellied toads and European tree-frogs. These two species colonised and bred in the temporary ponds but not in the permanent ponds.

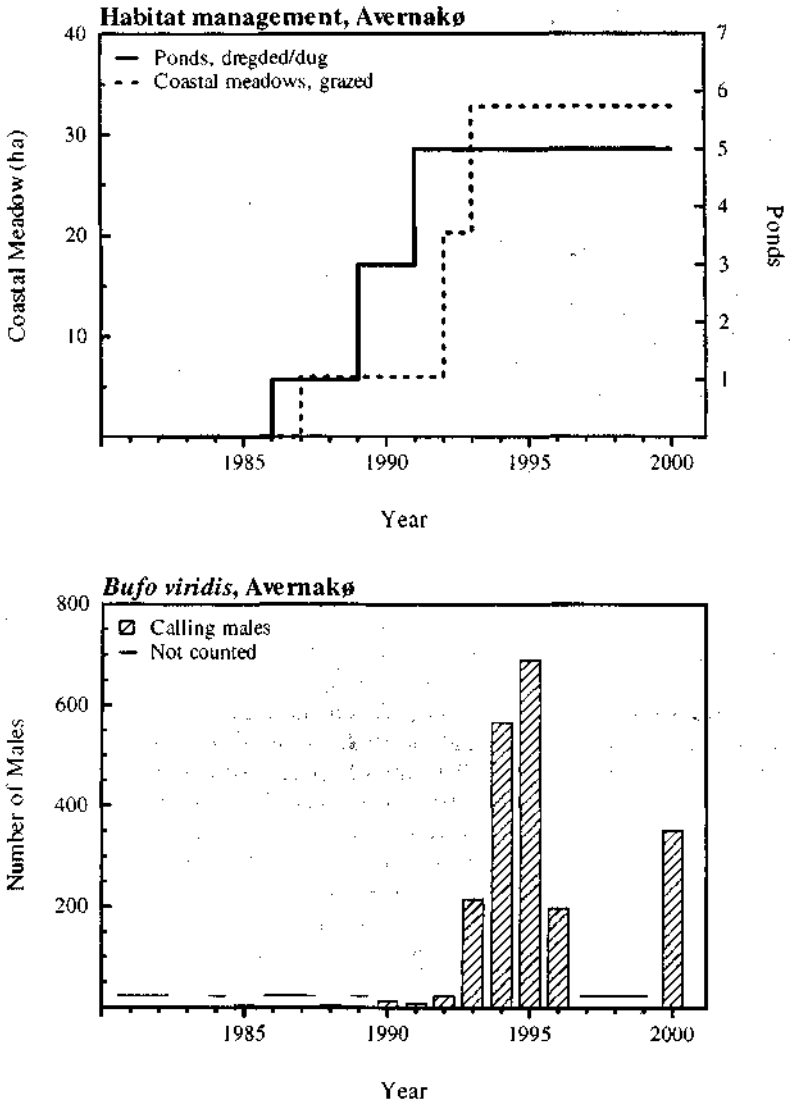


FIG 2. Above: Management of ponds and coastal meadows on the island of Avernakø, 1987 to 2000. Below: Population change of *Bufo viridis* on Avernakø from 1983 to 2000.



*Above:* A temporary pond under construction on coastal meadow on the island of Avernak, Denmark, in 1990. The pond was designed to support green and natterjack toads, and both species were still successfully breeding here in 2001. *Below:* The reality in eastern Poland in 1999. A set of temporary ponds on meadows with high mineral soils, inhabited by natterjack toad, European treefrog and moor frog (foreground), is being drained with the laying of drainage pipes across the meadow (background).

### Management of temporary ponds

The management of temporary ponds needs close co-operation between pond managers and landowners. Removal of unwanted plants such as bulrush (or cattail) *Typha latifolia* and willow (*Salix* sp.) is required. Of the several management techniques mentioned in this article, the introduction of grazing, especially by cattle, has had the most positive effect on amphibian populations. EU agri-environmental schemes, combined with direct support from landowners by fencing cattle, have given the best and most sustainable grazing results.

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