



Ponderful
PONDS FOR CLIMATE

DENMARK 

PONDSCAPE : FYN



Pond Ecosystems for Resilient Future Landscapes in a Changing Climate

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No ID 869296

WHAT IS A PONDSCAPE ?

DEFINITION

A pondscape is a network of ponds with spatial proximity (“connectedness”) and the surrounding landscape matrix.

The boundaries of a pondscape may be determined by physical or ecological settings (a valley, a catchment, a set of ponds in a nature reserve) or even determined by societal or political criteria (urban ponds, provincial or national boundaries).

PRESSURE/THREATS ON PONDS AND PONDSCAPES

50-90% of pond have been lost from European countries over the past century. Furthermore, ponds are largely neglected in water- and nature-related national and EU policies and strategies, including the EU-WFD.

WHY IS IT IMPORTANT TO PROMOTE THEM ?



BIODIVERSITY ENHANCEMENT

Largely neglected and generally undervalued, ponds are remarkably important for biodiversity conservation. Pondscapes represent biodiversity hotspots.



DISASTER RISK REDUCTION

Ponds and pondscapes play a fundamental role in mitigating flooding and also constitute a water reserve to fight fires.



HUMAN HEALTH

Ponds and pondscapes provide a wide range of co-benefits for human societies such as support for human health and quality of life, spaces for physical activities, or social interaction, but also aesthetic experiences and educational and recreational activities.



CLIMATE CHANGE MITIGATION AND ADAPTATION

Given their abundance and their high productivity, ponds influence markedly the carbon cycle by acting as both carbon sinks and sources.



WATER MANAGEMENT

Pondscapes provide a water reserve that is particularly important in the context of water scarcity. It is particularly useful for watering animals and for irrigation.

CONTEXT

The Fyn Islands pondscape covers Ærø, Avernakø and Birkholm, 3 out of about 55 islands of the South Fyn Archipelago. Ærø is the biggest island of 88 km² with over 6'000 inhabitants. Avernakø, populated by about 120 people, consists of two islands connected by an artificial dike with a total area of ca. 6 km². Birkholm is the smallest with a total area of nearly 1 km² and less than 10 people permanently living on it. A hilly moraine landscape covers both Avernakø and Ærø and clay dominates the subsoil. Although Birkholm has the same origin, is very flat, reaching only 2 m over the sea level. Most of the land on islands is agriculturally used.



Name of the pondscape : Fyn Island

Name of neighboring large town (in a 30 km radius):

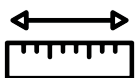
Faaborg/Marstal (6898/2119 habitants)

Bioclimatic zone : Continental

Dominant land use :

Pondscape - pasture

Surrounding environment - pasture and arable land



Pondscape area : 15 km²

Pond : number : 64 included in the Ponderful project
(Ærø:40, Avernakø:10, Birkholm: 14)

density : 10-15/km²

surface areas : 100 to 1'300 m²

depths : 0.4 to 2 m

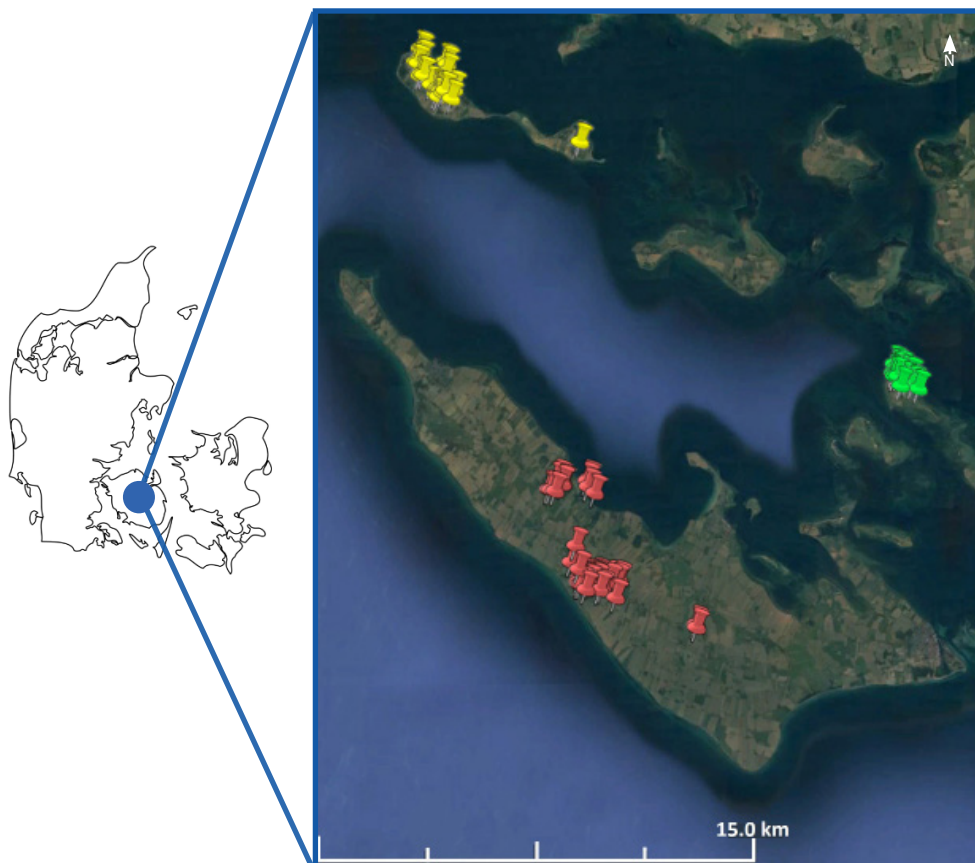
ages : 10 to >100 years

Land owner : Private owners, Danish Nature Agency, Municipalities

Land manager : Private owners, Danish Nature Agency

Public access : Majority of the area is not accessible since ponds are usually located on private pastures.

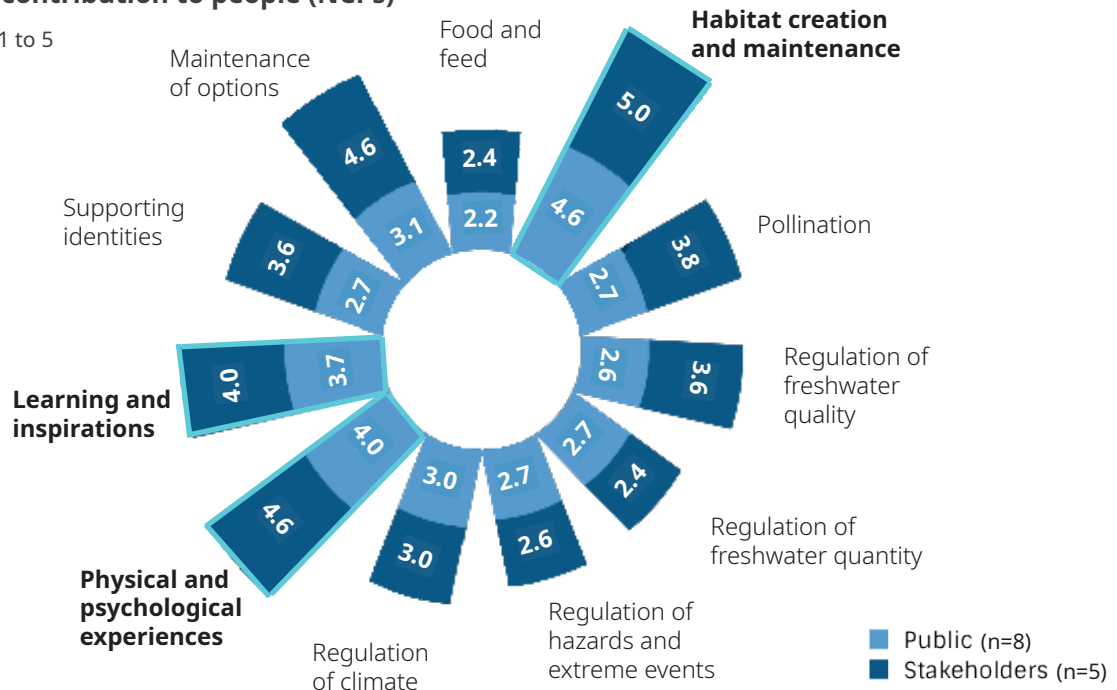
Public amenities : Several hiking and cycling trails as well as camping areas.



LOCAL COMMUNITY EXPECTATIONS

The 11 Nature-contribution to people (NCPs)

Scale : scores from 1 to 5



The expectations rely mainly on (i) the creation and maintenance of habitats for biodiversity and (ii) the direct use of these natural areas by people (physical and psychological experiences) as well as (iii) learning and inspiration.

LOCAL POLICIES

The majority of land in the pondscape is owned and managed by farmers. The pondscape is partly protected by the Natura 2000 network and RAMSAR Convention on Wetlands. All ponds bigger than 100m² are protected by Danish law and change in their condition requires permission.

Since ponds are habitats for amphibian species protected by the Habitats Directive, Danish Law of Environmental Targets (Miljømålsloven) does not allow damage or destruction of their breeding and resting places, intentional disturbance of animals during breeding, migration or hibernating, as well as intentional capture or killing.

Many ponds in the pondscape were created or restored with funds of EU LIFE Programme, supporting conservation of species of EU interest.

The collaboration between landowners, government and private consultancy companies helps to maintain and increase the quality of the ponds, and promote pond biodiversity.

75% of the pondscape is protected under Natura 2000 network and Ramsar sites.

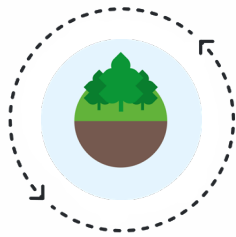
100% of ponds bigger than 100 m² are protected and changes in their condition require permission.

It is a national 'hot spot' for one of the rare amphibians, the Fire-bellied Toad. Many ponds in the pondscape were created or restored specifically for this species, saving it from extinction.

The pondscape is part of the South Fyn Archipelago of 55 islands.

75%
100%
HOT SPOT
55 ISLANDS

MAIN CHALLENGES AND OBJECTIVES



BIODIVERSITY ENHANCEMENT

Especially
amphibians, birds and
aquatic plants.



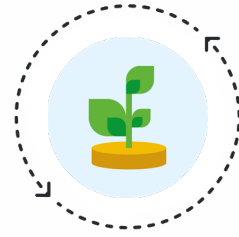
PARTICIPATORY PLANNING & GOVERNANCE

A nice place to
relax, and for social
activities, like cycle,
camp and hike.



WATER MANAGEMENT

Creating buffer zones
around the ponds to
reduce pollution from
nutrient run offs.



ECONOMIC OPPORTUNITIES

Environmentally
friendly farming
and subsidies for
landowners to
improve hydrology.



NATURE BASED SOLUTIONS (NBS)

The Nature-based Solutions put in practice to address the four identified societal challenges.

NEW POND CREATION

1990-2020's

creation of over 50 ponds for amphibian protection within the pondscape area.

PONDS AND PONDSCAPE MANAGEMENT

- Protecting threatened amphibian species.
- Implementing buffer zones surrounding ponds.
- Introduction of cattle grazing
- Conversion of arable fields to permanent grasslands.
- Scrub and sediment removal from some heavily shaded ponds. At least 18 ponds were restored during 1990-2020.
- Re-introduction and supportive breeding of rare amphibian species
- Monitoring of amphibians and flora in protected ponds



- Creation and maintenance of trails and nature. observation points.
- Protection of ground water through the creation of pesticide spray-free zones.
- Conversion of farming from conventional to environmentally friendly practices.



- Dredging of ponds.
- Regular monitoring of physical, chemical or biological indicators.



NATURE CONTRIBUTIONS TO PEOPLE AND MEASURED INDICATORS



AQUATIC BIODIVERSITY

SPECIES RICHNESS

Aquatic plants : **55**

(Ærø: 55; Avernakø: 40, Birkholm: 38)

Water birds : **61**

(Ærø: 61, Avernakø: 32, Birkholm: 40)

Dragonflies : **7**

Families of invertebrates : **21**

Amphibians : **5**

(Ærø: 5, Avernakø/Birkholm: 4)

AMOUNT OF

Conservation priority species (N) : **22**

Species on Habitat Directive Annexes (N): **5***

Bombina bombina, *Triturus cristatus*, *Rana dalmatina*, *Bufo viridis*, *Epidelea calamita* (Amphibians)

Introduced threatened species (N) : **1**

Invasive alien species (N) : **1**

FLAGSHIP SPECIES :



Bombina bombina



REGULATION OF CLIMATE

6.7t

Capacity of annual carbon storage in the ponds investigated on Ærø and Birkholm (by primary production, by organic matter accumulation) (tons CO₂ eq/pondscape/year)

NATURE CONTRIBUTIONS TO PEOPLE AND MEASURED INDICATORS



PHYSICAL AND PSYCHOLOGICAL EXPERIENCE

Number of people visiting the islands of the pondscape per year (leisure, tourism, fishing, nature watching etc.) (number/year)

175'000

100km

of bike trails on Ærø. Some sections are going along pastures with ponds.

Self-reported satisfaction well-being (scale 1 to 5)

3.8

Most popular activities :

wildlife observation (21%), relaxing (16%) and biking (11%)



WATER QUANTITY

~ **49'680m³**

Total water volume (m³) stored in the ponds investigated by Ponderful project.



WATER QUALITY

Nutrients : **MODERATE**

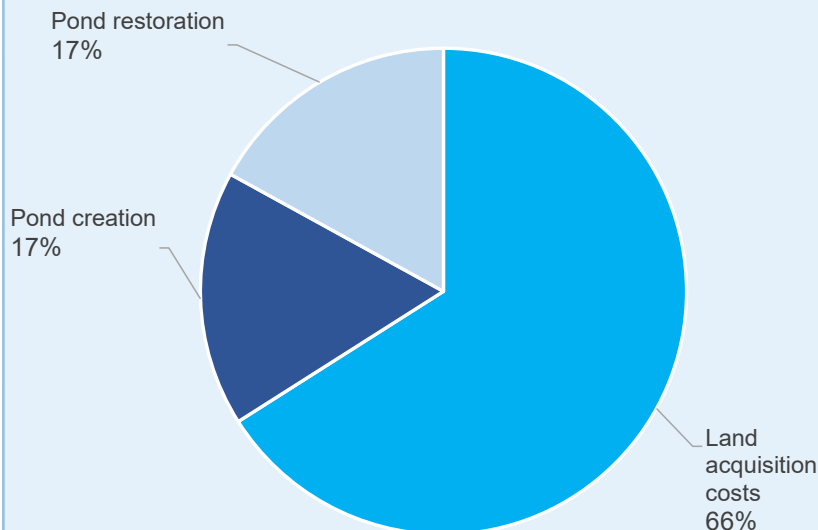
Pond quality range is "bad to good"; with mean concentrations of Total Phosphorus =0.35 & Total Nitrogen =2.4 mg/L, Chlorophyll-a=23 ug/L.

COSTS AND BENEFITS ANALYSIS

OVERALL COSTS ASSESSMENT

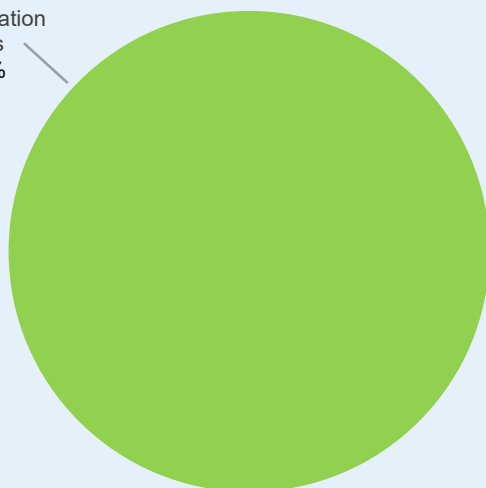


SHARE OF COSTS FOR NBS ACTION



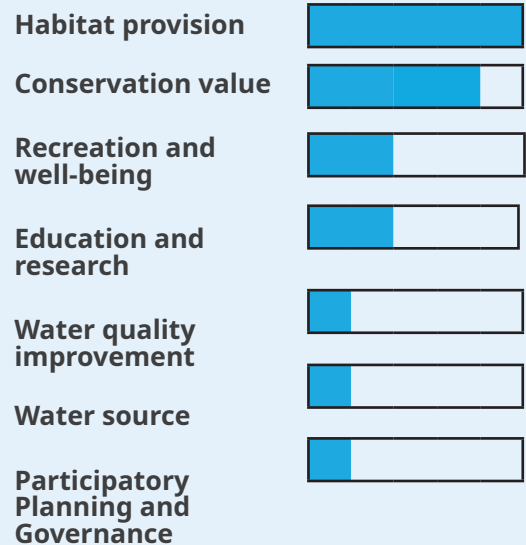
Relative cost of NbS creation measures

Maintenance and operation costs 100%



Relative cost of ongoing NbS management measures

BENEFITS ASSESSMENT



SUITABLE FINANCE INSTRUMENTS TO REDUCE THE GAP

- ✓ 1. Income instruments
-sale of market goods and services
- ✓ 2. Voluntary contributions /donations
- ✓ 3. Grants

FUNDING GAP ASSESSMENT



REMAINING THREATS

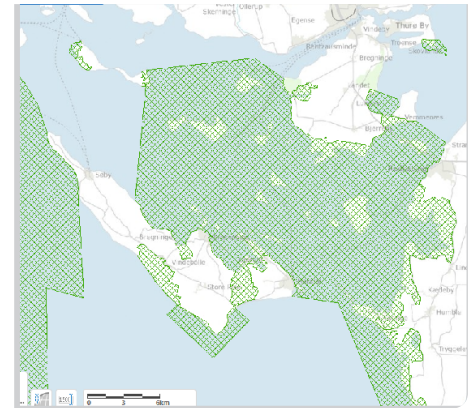
1. Changes in hydrology linked to climate change, including the timing and quantity of rainfall. Smaller ponds are likely to disappear. This will impact biodiversity.
2. Increased frequency of storm events as well as sea level rise due to the impact of climate change. It causes frequent flooding of ponds with salt water severely impacting biodiversity.

SUCCESS STORY AND TRANSFERABILITY

ACTIVE MANAGEMENT OF DECLINING SPECIES IN DENMARK



The South Fyn Archipelago with its mild climate is a 'hot spot' for the Fire-bellied Toad (*Bombina bombina*), the rarest amphibian in Denmark and one of the species included in the Annex II/IV of the Habitats Directive. Today *Bombina bombina* can be found on 7 islands including Avernakø, Ærø and Birkholm thanks to over 35 years of management of the pondscape for the species. Only 2 populations on Avernakø and Hjørtø are original. All the others on the remaining islands have been restored through re-introduction. The habitats of toads are partially protected by two Natura 2000 sites, which were established especially for the species.

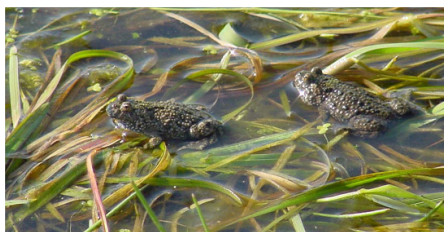


Management of the pondscape for *Bombina bombina* aimed at improving and enlarging both aquatic and terrestrial habitats as well as preserving genetic variability of the remaining populations. Thanks to the several projects financed by local as well EU LIFE Programme funds, over 80 ponds were created or restored after 1990s, and on Avernakø alone nearly 35 ha of arable land were transformed permanently to meadows without fertilizer, pesticides, or soil treatment. Creation and restoration of ponds in clusters supported habitat connectivity and provided the variability of aquatic habitats required by *Bombina bombina*. Also, municipalities and Nature Agency have helped farmers to start cattle grazing by financing fencing of the meadows. Grazing with the right species and optimal grazing pressure is a very important tool to keep habitats of the Fire-bellied Toad in favorable condition. If the grazing pressure is too low, trees and rushes will develop, shading the ponds and making water cold and unsuitable for *Bombina bombina*. If the grazing pressure is too high, all aquatic plants are eaten, the banks are trampled and cattle excrements lead to eutrophication of the ponds.



In 1987, before a supportive breeding program was initiated, Avernakø had one of the 2 largest surviving populations of Fire-bellied Toad, with only 15-20 adults remaining in the west Danish populations. Avernakø was also proven (in EU LIFE Bombina S-H project) to contain the largest diversity of genetic material, with the population on the island surviving the genetic bottleneck period of 1970-1987. Today the population remains largest in the Archipelago islands with about 180 animals. The population on Ærø was restored with toads coming from Hjørtø and Avernakø. The rearing program for the island was carried out during 1987 to 2002. At first, the program was a success and the population increased to 100 animals after 10 years, but a combination of deteriorating terrestrial habitats as well as periods of droughts resulted in decline. The population on Birkholm restored during 1998-2000 from animals coming from Ærø and Hjørtø and today it is the second biggest in Archipelago with over 100 animals.

This success story also contributed to an increase in public environmental awareness and knowledge, because of the involvement of the local community in the re-introduction and habitat improvement program. This good-looking toad was also used for marketing the islands as a local tourist attraction. Every year there are some guided tours for tourists to see them and listen calling to toads during breeding season. The management of the habitats and the restoration of the Fire-bellied Toad (*Bombina bombina*) populations on the South Fyn Archipelago Islands was a success. The species was saved from extinction and it now ranges over a larger area, securing their population for the future.





HANDBOOK :



APPENDIX :



PHOTOS CREDITS

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Shelter, p.6 © <https://www.alltrails.com/?ref=header>
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AUTHORS

Rasmussen M., Briggs L.
Levi E. E., Davidson T. A.

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