# Ponderful

PONDS FOR CLIMATE

# Deliverable D2.4

## Data-sets targeted case studies

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

Ponderful Partners:


**University of Vic – Central University of Catalonia** (Spain) – Prof. Sandra Brucet (PI, Project Coordinator), Dr. Diana van Gent (Project Manager)

**IGB im Forschungsverbund Berlin (Germany)** – Dr. Thomas Mehner (PI, WP2 co-coordinator)

**Katholieke Universiteit Leuven (Belgium)** – Prof. Luc De Meester (PI, WP2 coordinator)

**Haute Ecole Spécialisée de Suisse occidentale (Switzerland)** – Prof. Beat Oertli (PI, WP4 coordinator)

**Universitat de Girona (Spain)** –Dr. Dani Boix (PI)

**Ecologic Institut gemeinnützige GmbH (Germany)** – Dr. Manuel Lago (PI)

**University College London (UK)** – Prof. Carl Sayer (PI)

**Middle East Technical University (Turkey)** – Prof. Meryem Beklioğlu (PI)

**CIIMAR - Interdisciplinary Centre of Marine and Environmental Research (Portugal)** –Dr. José Teixeira (PI, WP5 co-coordinator)

**Aarhus University (Denmark)** – Prof. Thomas A. Davidson (PI)

**Uppsala University (Sweden)** – Dr. Malgorzata Blicharska (PI, WP1 coordinator)

**Bangor University (UK)** – Dr. Sopan Patil (PI, WP3 coordinator)

**Technical University of Munich (Germany)** – Prof. Johannes Sauer (PI)

**I.S.A.R.A. – Institut Supérieur d'Agriculture Rhône-Alpes (France)** – Dr. Joël Robin (PI)

**Freshwater Habitats Trust (UK)** – Prof. Jeremy Biggs (PI, WP5 co-coordinator)

**Universidad de la República (Uruguay)** – Dr. Mariana Meerhoff (PI)

**Randbee Consultants SL (Spain)** – Juan Arevalo Torres (PI)

**Amphi International APS (Denmark)** – Lars Briggs (PI)

# Ponderful

**Authors:**
Carl Sayer (UCL), Helen Greaves (UCL)

**Contributors:**
Carl Sayer (UCL), Helen Greaves (UCL), Alice Walker (UCL), Ian Patmore (UCL), Pieter Lemmens (IGB/KUL), Beat Oertli (HES-SO), Julie Fahy (HES-SO), Joël Robin (ISARA), Léo Girard (ISARA), Thomas Davidson (Aarhus), Dani Boix (UdG), Maria Cuenca (UVic), Sandra Brucet (UVic), Caroline Trochine (UVic), Meryem Bekiloğlu (METU)

**Document title:** Datasets targeted case studies
**Document Type:** Deliverable

**WP No:** 2
**WP Title:** Effect of climate change on biodiversity, ecosystem functions and services and their interactions in ponds
**WP Lead:** KUL and IGB

**Date:** 22 January 2024
**Document Status:** Final version

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No ID869296

# Table of contents


1. DESCRIPTION OF DELIVERABLE 2.4 2

2. AIMS AND SUMMARY OF DATA COLLECTED FOR FIVE WP2 CASE STUDIES 2

2.1 Effects of hydroperiod and associated changes in pond habitat on pollinator communities 2

2.2 Consequences of pond terrestrialisation and restoration by major scrub and sediment removal for biodiversity and greenhouse gas emissions 3

2.3 Biodiversity and environmental conditions in Swiss urban ponds as affected by long-term urbanisation impacts 3

2.4 Temporal stability, biodiversity and ecosystem state in fish ponds 4

2.5 Re-sampling of WP2 stratified survey ponds 4

3. DATA STORAGE 6

# Executive Summary

The PONDERFUL project aims to better understand the key role of ponds for climate change mitigation and adaptation, as well as for biodiversity conservation and ecosystem service provision. Work Package 2 (WP2) involves extensive data collection and synthesis in European and CELAC (Uruguay) pondscapes focused on understanding how pond state and management affect ecosystem functions (including greenhouse gas emisisons and pollination) and biodiversity. In deliverable Deliverable 2.4 the datasets generated by five WP2 case studies, aimed at addressing these key questions, are summarised.

# 1. Description of deliverable 2.4

This document provides a brief overview of the structure and composition of the datasets and resulting databases generated for PONDERFUL WP2 Deliverable 2.4. Deliverable 2.4 includes five case studies, as follows, with the project partners responsible for case study delivery given in parentheses:

(i) Effects of hydroperiod and associated changes in pond habitat on pollinator communities (UCL)

(ii) Consequences of pond terrestrialisation and restoration by major scrub and sediment removal for biodiversity and greenhouse gas emissions (UCL and AU)

(iii) Biodiversity and environmental conditions in Swiss and Belgium urban ponds as affected by long-term urbanisation impacts (HES-SO and KUL)

(iv) Temporal stability, biodiversity and ecosystem state in fish ponds (KUL, ISARA)

(v) Re-sampling of WP2 stratified survey ponds (all WP2 partners)

# 2. Aims and summary of data collected for five WP2 case studies

## 2.1 Effects of hydroperiod and associated changes in pond habitat on pollinator communities

This case study sought to determine the influence of hydroperiod and associated habitat changes on pond-associated pollinator communities and species diversity. It was hypothesised that permanent open-canopy ponds, with substantive drawdown zones, would support more abundant and structurally complex pollinator communities than ponds with very short hydroperiods and hence a predominance of dry-loving plants. Studies were undertaken of fifteen farmland ponds located in Norfolk, eastern England, with the ponds selected to fit into three categories with five replicate ponds in each category (i) permanent ponds, (ii) semi-permanent ponds that dry in some years and not in wetter years, and (iii) ephemeral ponds that dry up in the summer in all years. At all 15 ponds pollinator data was collected for three time intervals in 2022: spring (May), mid-summer (July) and late summer (August) by fixed periods of visual observation and pan trapping. The data have been used to determine pollinator diversity and to constuct plant-pollinator networks for each pond category.

The following associated files can be found on the PONDERFUL Information System:

1. Ponderful Pollinator Case Study Environmental Data
2. Ponderful Pollinator Case Study Flower Visit Data
3. Ponderful Pollinator Case Study Pan Trap Data

## 2.2 Consequences of pond terrestrialisation and restoration by major scrub and sediment removal for biodiversity and greenhouse gas emissions

In northern Europe, over the past 50-100 years, many ponds in farmland areas, have become dominated by trees and dead wood and it is possible that this may be an important driver of enhanced greenhouse gas (GHG) emissions across pond landscapes. However, the consequences of pond terrestrialisation and, in turn, pond restoration by major scrub and sediment removal for GHG ($CO_2$, $N_2O$ and $CH_4$ diffusion and ebullition) are currently poorly understood. To address these key questions, ten overgrown ponds dominated by woody vegetation and ten open-canopy, macrophyte-dominated ponds, all located in the United Kingdon PONDERFUL Cheshire-Lancashire pondscape (as used for the WP2 stratified survey as reported in D2.2 and D2.3), were selected for study. Each of the twenty study ponds were monitored for one year (2022) with GHG sampled during three seasonal windows (spring, summer, autumn) to understand the implications of pond terrestrialisation for GHG dynamics. After this, five of the overgrown ponds were restored (autumn 2022) and these ponds, in addition to five of the open-canopy ponds, were monitored during 2023 (with sampling in spring and summer) to determine the early effects of restoration on greenhouse gas emissions.

The following associated files can be found on the PONDERFUL Information System:

1. UK CASE STUDY RESTORATION Carbon Sequestration
2. UK CASE STUDY RESTORATION CH4 Bubble Fluxes
3. UK CASE STUDY RESTORATION GHG Surface Fluxes
4. UK CASE STUDY RESTORATION Metabolism
5. UK CASE STUDY RESTORATION Pond Metadata
6. UK CASE STUDY RESTORATION Physico-chemistry

## 2.3 Biodiversity and environmental conditions in Swiss and Belgian urban ponds as affected by long-term urbanisation impacts

A resampling of formerly investigated urban ponds in Belgium (n=11) and Switzerland (n=13) for key pond environmental conditions and biodiversity has been conducted to assess temporal stability in pond chemistry and biology in relation to urbanisation. In Switzerland, biodiversity surveys were carried out for macrophytes and some aquatic macroinvertebrate groups (Odonata, Ephemeroptera, Trichoptera, Coleoptera and Gastropoda). In Belgium, biodiversity data included macrophytes and zooplankton. In both countries, physico-chemical parameters were measured, including pH, conductivity, oxygen concentration, total nitrogen, total phosphorus, DOC, chlorophyll-a and phycocyanine concentrations. Some 11 of the 13 Swiss urban ponds and all Belgian ponds were studied 10 years ago as part of other projects, and the resampling data will be used to investigate temporal changes in urban pond biological communities (e.g. in terms of taxonomic richness and species composition).

In addition, 19 Swiss rural ponds near Geneva were resampled in 2021 for biodiversity (macrophytes and/or targeted groups of aquatic macroinvertebrates) and water quality. These ponds were resampled as part of the WP2 stratified sampling as included in Deliverable 2.2 (Ponds RHO014b, RHO014c, RH011c, CHA15_1, CHA0028, SEY0029, SEY0044, VER0040, VER0050, VER0042, JUS0043, JUS0046, JUS026b, JUS027a, JUS027b, JUS027c, JUS0047, MEY9931 and MEY9932). These ponds have been previously studied between 8 to 37 years ago. Half of them have been more intensively monitored over the years and were sampled 3 to 5 times. Furthermore, one “pilot” pond was sampled 7 times. Sample processing and species identification are now complete, and an analysis is under way to investigate temporal trends in biodiversity at the pond and pondscape scales.

The following associated files can be found on the PONDERFUL Information System:

1. CASE STUDY URBAN Carbon Sequestration
2. CASE STUDY URBAN CH4 Bubble Fluxes
3. CASE STUDY URBAN Surface Fluxes
4. CASE STUDY URBAN BELGIUM Human Activity
5. CASE STUDY URBAN BELGIUM Land Use
6. CASE STUDY URBAN BELGIUM Macrophytes
7. CASE STUDY URBAN BELGIUM Physicochemistry
8. CASE STUDY URBAN BELGIUM Pond Characteristics
9. CASE STUDY URBAN BELGIUM Pond Identifier
10. CASE STUDY URBAN BELGIUM Zooplankton
11. CASE STUDY URBAN BELGIUM Zooplankton Size

12. CASE STUDY URBAN SWITZERLAND Amphibians
13. CASE STUDY URBAN SWITZERLAND Decomposition
14. CASE STUDY URBAN SWITZERLAND Fish
15. CASE STUDY URBAN SWITZERLAND Human Activity
16. CASE STUDY URBAN SWITZERLAND Land Use 5m
17. CASE STUDY URBAN SWITZERLAND Land Use 100m
18. CASE STUDY URBAN SWITZERLAND Macroinvertebrates
19. CASE STUDY URBAN SWITZERLAND Macrophytes
20. CASE STUDY URBAN SWITZERLAND Macroinvertebrate Size
21. CASE STUDY URBAN SWITZERLAND Physicochemistry

## 2.4 Temporal stability, biodiversity and ecosystem state in fish ponds

In order to assess temporal stability across years in relation to different pond management types, using a combination of existing and newly collected data, fish ponds in France (n=20) and Belgium (n=21) have been resampled in 2021 and 2022. The selected ponds represent different types of management (management directed towards nature conservation, low intensity fish farming and high intensity farming in Belgium; and moderate intensity farming in France). In both years, ponds have been assessed for biodiversity spanning multiple groups (including macrophytes, zooplankton and macroinvertebrates), key pond environmental conditions (including concentrations of total nitrogen and total phosphorus, phytoplankton biomass, coverage with aquatic vegetation, dissolved oxygen, pH, conductivity, and water temperature) and GHG emissions ($CO_2$, $N_2O$ and $CH_4$ diffusion and ebullition). The newly collected data complement existing data on fish ponds sampled by KUL and ISARA during several years over the past decade. The new data have been collected based on protocols (different to PONDERFUL) developed in the past by both teams, while GHG emissions were assessed following the methods outlined in the PONDERFUL protocol.

The following associated files can be found on the PONDERFUL Information System:

1. CASE STUDY FISH Carbon Sequestration
2. CASE STUDY FISH CH4 Bubble Fluxes
3. CASE STUDY FISH GHG Surface Fluxes
4. CASE STUDY FISH France Carbon Sequestration
5. CASE STUDY FISH France MacroInvertebrates
6. CASE STUDY FISH France Macrophytes 2021
7. CASE STUDY FISH France Macrophytes 2022

8. CASE STUDY FISH France Physicochemistry 2021-2022
9. CASE STUDY FISH France Pond ID
10. CASE STUDY FISH France Metabolism
11. CASE STUDY FISH France Dryflux 2022
12. CASE STUDY FISH France GHG Concentrations 2022
13. CASE STUDY FISH France Diffusion_2022
14. CASE STUDY FISH France CH4 Bubble Fluxes
15. CASE STUDY FISH Belgium COMPILED DATA

## 2.5 Re-sampling of WP2 stratified survey ponds

This dataset covers the re-sampling of the WP2 stratified survey ponds in 2022 (all partners except Turkey) and 2023 (Turkey), covering 12 ponds in each of 8 countries. Building on the main stratified survey, as undertaken at 240 ponds located in 8 different countries (namely Belgium, Denmark, Germany, Spain, Switzerland, Turkey, United Kingdom and Uruguay - 30 ponds x 8 countries), re-sampling was undertaken to help understand the consequences of inter-annual variation in weather conditions and pond hydroperiod for pond biodiversity (as for Deliverable 2.2) and ecosystem functions (as for Deliverable 2.3). The database combines data from the stratified survey (sampled in 2021) with newly collected data from the resampling (sampled in 2022 and 2023 as above) for pond physico-chemistry (22 parameters), hydroperiod, biodiversity (quantitative taxonomic data on zooplankton, macro-invertebrates, aquatic plants) and ecosystem functions (GHG emissions, C-burial, decomposition and pond metabolism) for subsets of ponds from the stratified survey (6 ponds in 2 pondscapes in 8 countries = 96 ponds in total). Due to COVID, which resulted in a delayed start of the sampling in Turkey (as reported earlier in the annual report), Turkish data generated from the resampling are delayed, but will be added to the central database in May 2024.

The following associated files can be found on the PONDERFUL Information System:

1. Sampling protocol
2. Metadata file
3. Central Pond Identifier
4. Physico-chemistry
5. Pond characteristics
6. Human activity
7. Hydroperiod
8. Macrophyte community
9. Zooplankton community
10. Macro-invertebrate community
11. Fish community – Uruguay only

12. Zooplankton body size measurements
13. Macro-invertebrate body size measurements
14. Land-use at 5 m perimeter
15. Land-use at 100 m perimeter
16. Land use by animals
17. Carbon sequestration
18. CH4 bubble fluxes
19. GHG surface fluxes
20. Pond metabolism
21. Decomposition

# 3. Data storage

All data have been uploaded on the PONDERFUL Information System and are currently available to the project consortium. They will be made publicly available at the end of the project after an embargo period.

# Ponderful

**Coordinator**: Prof. Sandra Brucet, University of Vic – Central University of Catalonia & ICREA

**Project Manager**: Dr. Diana van Gent, University of Vic – Central University of Catalonia

**Contact**: diana.vangent@uvic.cat

**Duration:** 1 December 2020 to 30 November 2024

**Website:** www.ponderful.eu

**Facebook:** /Ponderful-331847228188664

**Twitter**: @ponds4climate

**Instagram**: @ponds4climate

European Commission

**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