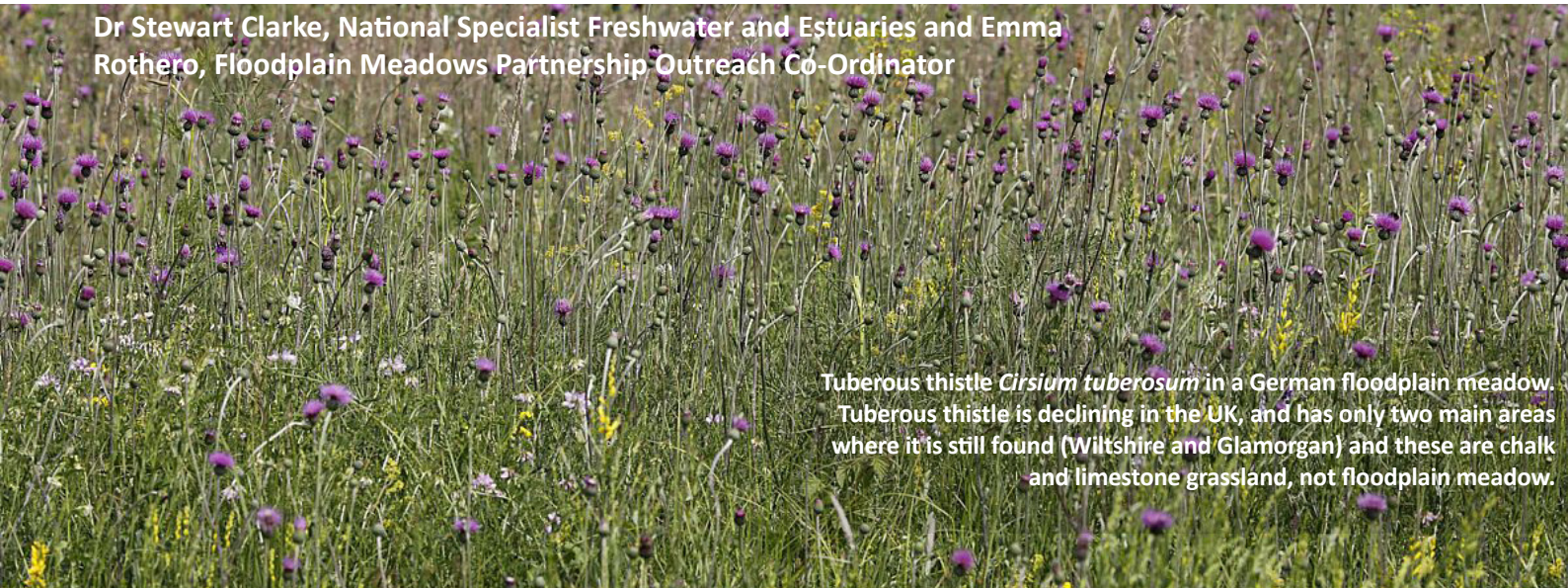


Dr Stewart Clarke, National Specialist Freshwater and Estuaries and Emma Rothero, Floodplain Meadows Partnership Outreach Co-Ordinator



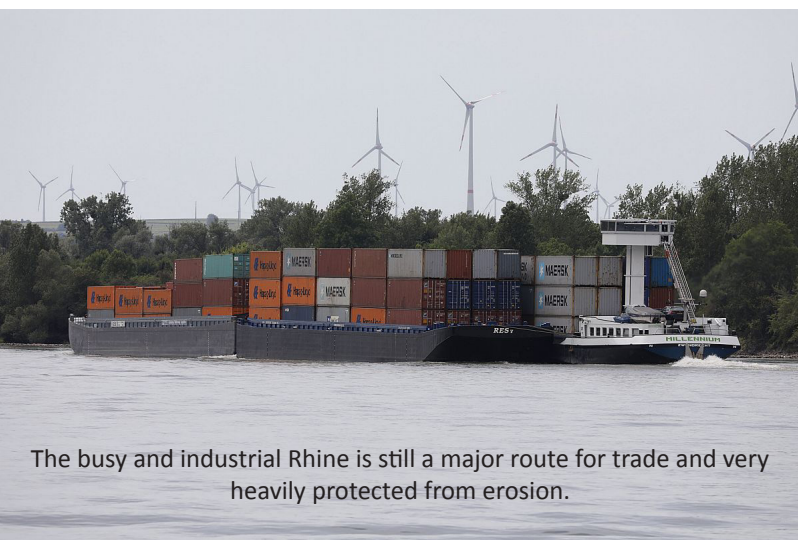
Tuberosus thistle *Cirsium tuberosum* in a German floodplain meadow. Tuberosus thistle is declining in the UK, and has only two main areas where it is still found (Wiltshire and Glamorgan) and these are chalk and limestone grassland, not floodplain meadow.

In June this year, the Floodplain Meadows Partnership went to Germany. This was something we had talked about doing ever since our first conference in 2010 when we were unable to hear a key speaker (Matthias Harnisch) due to the ash cloud from the Eyjafjallajökull volcano in Iceland stopping travel. We were deeply disappointed because Matthias has been responsible for a significant floodplain-meadow restoration project along the Rhine (south of Frankfurt) over many years, and we were very keen to hear him speak.

For our 2014 conference, again Matthias was unable to attend, so in 2017, we specifically funded him to come with a special invitation from the Partnership, and his boss, the Mayor of Riedstadt released him from other duties. At the same time, we secured funding to take some of our Steering Group to see the Rhine Floodplain-Meadow Project, which Matthias and Professor Norbert Hölzel (Munster University) have been managing. The funding for both these opportunities has come from Santander Bank, who offer a networking fund to a select group of universities across the globe.

The Rhine is one of Europe's largest rivers with a long history of modification and management for navigation, flood management and land drainage. As the river flows through the federal state of Hesse (south of Frankfurt) the landscape is dominated by modern agriculture with some big industrial areas; not the most promising place for traditionally managed flower-rich meadows, and no semi-natural grassland

to be found outside of the floodplain areas in this part of the country. All flat, useable land is used for arable and horticulture, particularly on the old Rhine floodplain - not even any grazing animals. Nearly all of the remaining species-rich and restoration meadows are in public ownership with no privately owned conservation focused enterprises.



The busy and industrial Rhine is still a major route for trade and very heavily protected from erosion.

Despite being heavily modified and controlled, there are still areas where the river is able to interact with its floodplain and in these areas some remnants of floodplain meadow and forest have been able to persist. Mostly, these areas are within the floodbanks (now built up to withstand a 1:200

year flood event) and in nature reserves. Visiting some big reserves based around former meanders cut-off by engineering or major floods, emphasised that despite efforts, taming a river like the Rhine is never entirely possible.

Our three day visit was intended to introduce us to some of the Rhine's best remaining examples of floodplain meadow, but most importantly to show us some successful restoration carried out by the City of Riedstadt since 2000. We visited a series of floodplain habitats in the area, including remnant and restored meadows and alluvial forest.

A Rhine floodbank, built to withstand a 1-200 year flood event, protects very significant areas of land from flooding for agricultural purposes, as well as downstream flood protection. The ecologists have persuaded the engineers that a species rich sward could be grown on this bank, and cut twice a year (subject to H&S or other issues that may result in amendments). This provided a fantastic resource for pollinators and biodiversity in general. It would be great to see if we can do more of this in the UK.



Siberian flag iris *Iris sibirica*, successfully growing in restoration meadows



Old meadows on the Rhine

We visited a few old meadows (thought to be at least 200 years old). The original banks built to try and gain arable land from the floodplain were started in the 12th century, but more serious land drainage and river management started in the early 1800's, with a ramping up in the early 1900's and then again in the 1970's.

These meadows are influenced by the continental climate and therefore have species we never see in our meadows. Great burnet (*Sanguisorba officinalis*) was much less prominent than in UK meadows, but the Rhine meadows supported flowers we lack such as Siberian and blue irises (*Iris sibirica*, *I. spuria*) tall violet (*Viola elatior*) and mouse garlic (*Allium angulosum*). Hydrology and the duration of flooding seem to be the main driver of meadow composition and structure just as it is in the UK.

Restoration meadows on the Rhine

The Riedstadt project now has 85 ha of meadow (soon to be 90 ha) in various stages of restoration. Funding has come from various sources including the German Federal Agency for Nature Conservation, the City of Riedstadt, the Federal State of Hesse and the Frankfurt Airport Company amongst others. More information on funding can be seen here (<https://www.riedstadt.de/stromtalwiesen/english-version/in-short.html>).

We visited meadows started in 2000 that looked very similar to those which have been spared drainage or agricultural improvement. More recently restored sites seemed to display a clear trajectory of vegetation change, from weedy, ruderal species at the start to more characteristic floodplain species after a few years. The Germans have been employing meadow restoration techniques that will be familiar in the UK, namely the use of green hay from sites with a good seed supply of desirable species. There were some interesting differences and potentially some lessons for us in the UK in how to convert arable fields to flower rich meadows:

- Green hay was applied in strips, from which plants slowly colonise, and was applied in large volumes; a site we visited had received hay in late 2016 and still had a 15-20cm deep layer of material on the surface (the dry continental climate helps ensure this doesn't become a nasty rotting mass).
- Hay was applied in late summer up to the beginning of November and they felt this favours development of herbs rather than grasses and helps prevent the grass dominance that blights some meadow restoration. Dry hay can also be used if there is no green hay in the vicinity or it cannot be spread directly after cutting.
- Top soil removal and re-profiling the surface to create varied topography tends to lead to better results and a typical meadow structure more quickly (but is very costly).

And some take home messages:

- Never give up trying, even if the land doesn't flood anymore (or isn't likely to) because of large flood banks and insurmountable navigation interests and grazing seems impossible.
- Bigger is always better, be ambitious, get the local community & the mayor on board. Much is achievable.



Mouse garlic *Allium angulosum*

Over the three days we saw some spectacular meadows and whilst some of the species were different, there were many similarities with our own floodplain meadows. One notable difference was in management; the Rhine meadows are rarely grazed but instead many may receive two hay cuts per year. Perhaps this could help us with sites in the UK where we struggle to secure the right aftermath grazing?

Of course, floodplains are not just about meadows and we saw a range of habitats in the reserves we visited. Some areas of floodplain had seen major floods create opportunities for some impressive naturally regenerating floodplain woodland in which pioneer willow and black poplar was gradually giving way to oak and ash in the driest areas. This proved to be great habitat for us to see some nice birds (black and middle-spotted woodpecker, golden oriole). This is a habitat we have largely lost in the UK as our floodplains have been developed, drained and converted to arable lands. Given recent interest in creating more space for water in our landscapes, perhaps this is something we might begin to think about making space for in the UK?



Orchard meadows and wedding meadows have been created. Couples getting married are invited to plant a tree in an orchard floodplain meadow. These meadows are towards the drier end of floodplain-meadow systems. We were assured the apple trees were fully tolerant of short duration flooding and therefore well suited to this floodplain system. The scheme was so popular, all available land has now been used!

Further information and reading:

There is plenty of published literature about the various projects in this area. Some can be found here:

https://www.researchgate.net/publication/316665024_Flooding_tolerance_of_four_floodplain_meadow_species_depends_on_age

https://www.researchgate.net/publication/275968355_Effects_of_Reduced_Summer_Precipitation_on_Productivity_and_Forage_Quality_of_Floodplain_Meadows_at_the_Elbe_and_the_Rhine_River

https://www.researchgate.net/publication/268750380_Alluvial_grasslands_along_the_northern_upper_Rhine_-_nature_conservation_value_vs_agricultural_value_under_non-intensive_management

https://www.researchgate.net/publication/234842447_Establishment_of_rare_flood_meadow_species_by_plant_material_transfer_Experimental_tests_of_threshold_amounts_and_the_effect_of_sowing_position

https://www.researchgate.net/publication/230531925_Enhancing_plant_biodiversity_in_species-poor_grassland_through_plant_material_transfer_-_the_impact_of_sward_disturbance

https://www.researchgate.net/publication/235685470_Spatially-restricted_plant_material_application_creates_colonization_initials_for_flood-meadow_restoration

https://www.researchgate.net/publication/223441202_Perspectives_for_incorporating_biomass_from_non-intensively_managed_temperate_flood-meadows_into_farming_systems

A list of older publications can be found here: <http://www1.uni-giessen.de/stromtalwiesen/ee/index.htm>

