



Trinity
College
Dublin

The University of Dublin

iCRAG

IRISH CENTRE FOR RESEARCH
IN APPLIED GEOSCIENCES

Ecohydrology and ecosystem services of groundwater-dependent wetlands in Irish karst

Fabio Delle Grazie¹, Laurence Gill¹, Owen Naughton^{1,2}

¹Department of Civil, Structural and Environmental Engineering, Trinity College Dublin, Dublin 2, Ireland, ²Geological Survey of Ireland



Ireland's European Structural and
Investment Funds Programmes
2014-2020

Co-funded by the Irish Government
and the European Union



European Union
European Regional
Development Fund

Science
Foundation
Ireland **sfi**
For what's next



Geological Survey
Suirbhéireacht Gheolaíochta
Ireland | Éireann

With support from



This publication has emanated from research with financial support in part from Science Foundation Ireland (SFI) under grant number 13/RC/2092 and 17/RC-PhD/3481 with support from the Geological Survey Ireland (GSI), and is co-funded under the European Regional Development Fund.

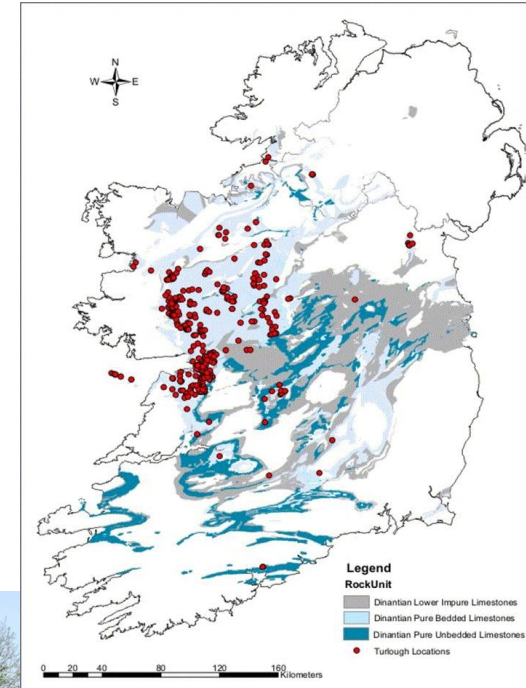




Background

- Turloughs are topographic depressions in karst, which are intermittently flooded on an annual cycle via groundwater sources and have substrate and/or ecological communities characteristic of wetlands. Most of them are located in the west of Ireland and developed on carboniferous limestone (figure 1).
- Ecosystem services can be defined as the contributions that ecosystems make to human well-being, CICES, Haines-Young and Potschin, 2013). It uses three main categories with some sub-categories: provisioning, regulating and cultural ecosystem services.
- As inland wetlands, they are valuable ecosystems though an evaluation of their ecosystem services has yet to be performed.

Figure 1. Irish turloughs



Blackrock turlough, south Galway

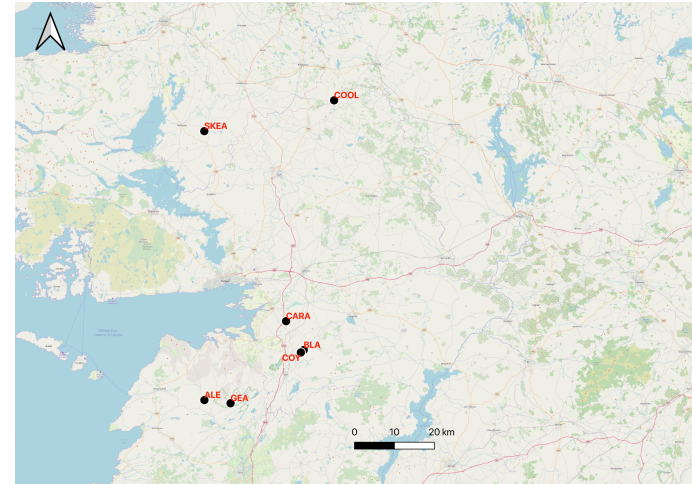




Methods

- Previous study of 22 turlough in the West of Ireland was funded by the National Parks & Wildlife Service of Ireland and it integrated hydrological, biological and chemical nutrient data (Waldren et al., 2015).
- Following up from this study, **7 turloughs** were selected which reflected different hydrological regimes and ecosystem characteristics (figure 3).
- Monthly **samples of water**, as well as **soil samples** and **greenhouse gas** measurements (CO_2 , CH_4 , N_2O).
- The relevant ecosystem provided by the turloughs were selected from the CICES classification.

Figure 3. Studied sites





Results: water biogeochemistry

- Previous study of 22 turlough in the West of Ireland was funded by the National Parks & Wildlife Service of Ireland and it integrated hydrological, biological and chemical nutrient data (Waldren et al., 2015).
- Following up from this study, **7 turloughs** were selected which reflected different hydrological regimes and ecosystem characteristics (figure 3).
- Monthly **samples of water**, as well as **soil samples** and **greenhouse gas** measurements (CO_2 , CH_4 , N_2O).
- The relevant ecosystem provided by the turloughs were selected from the CICES classification.



Results: soil chemistry

- Previous study of 22 turlough in the West of Ireland was funded by the National Parks & Wildlife Service of Ireland and it integrated hydrological, biological and chemical nutrient data (Waldren et al., 2015).
- Following up from this study, **7 turloughs** were selected which reflected different hydrological regimes and ecosystem characteristics (figure 3).
- Monthly **samples of water**, as well as **soil samples** and **greenhouse gas** measurements (CO_2 , CH_4 , N_2O).
- The relevant ecosystem provided by the turloughs were selected from the CICES classification.



Results: ecosystem services

- Previous study of 22 turlough in the West of Ireland was funded by the National Parks & Wildlife Service of Ireland and it integrated hydrological, biological and chemical nutrient data (Waldren et al., 2015).
- Following up from this study, **7 turloughs** were selected which reflected different hydrological regimes and ecosystem characteristics (figure 3).
- Monthly **samples of water**, as well as **soil samples** and **greenhouse gas** measurements (CO_2 , CH_4 , N_2O).
- The relevant ecosystem provided by the turloughs were selected from the CICES classification.



Results: ecosystem services

- A qualitative assessment of the ecosystems services provided by the turloughs can be found in Table 3.
- Blackrock has the highest floodwater extension as well as water depths, therefore providing the highest amounts of water. Lough Gealain is important for tourism. Caranavoodaun and Lough Gealain have the best for ecosystem conditions. For carbon sequestration, turloughs with peaty soils and woody vegetation will have a higher value.
- Turloughs can both alleviate **flooding** in their basins and soils but also cause it, following exceptional rainfall events. Drainage is one of the main threats to turloughs as it alters their flooded regime, so that plants and soils are affected. It is sometimes proposed to alleviate flooding to nearby houses.
- Turloughs are very important **culturally** and some of them for **tourism**. For example, Lough Gealain (photo in the first slide) is located in the Burren National Park and received thousands of visitors annually.



Discussion

Figure 3. Studied sites

- Wetlands have been recognised as some of the most important and most valuable ecosystems on Earth. Turloughs are intermittent inland wetlands, therefore showing both the characteristics of wetlands and of terrestrial habitats (ecotones).
- The ecosystems services of wetlands are subject to increasing interest because of the range and value of ecosystem services they can provide. One popular evaluation has been performed by De Groot et al. (2012) and for inland wetlands recognises regulating services (flood risk reduction, nutrient retention, carbon sequestration) as the most valuable (Table 5). Similar results are expected for turloughs, especially for the flood risk reduction service.
- There seems to be enrichment in nutrients in Caranavoodaun, Lough Gealain and Skealoghan. Blackrock has the highest floodwater extension as well as water depths, therefore providing the highest amounts of water. Lough Gealain is important for tourism. Caranavoodaun and Lough Gealain have the best ecosystem condition. For carbon sequestration, turloughs with peaty soils and woody vegetation will have a higher value.



Preliminary conclusions

- Small inland wetlands have been recognised as providing important ecosystem services and are not as well studied as the bigger ones.
- More than 400 turloughs are present in Ireland and they are protected under the Water Framework Directive (WFD, Directive 2000/60/EC). As they host protected fauna and flora, they are also designated as a Priority Habitat in Annex 1 of the EU Habitats Directive (92/43/EEC).
- Quantification of the ecosystem services of turloughs can help better inform the appropriate stakeholders when deciding on conflicting developments and can also help in specific accounting projects like carbon accounting schemes and ecosystem service quantification and mapping like the Mapping and Assessment of Ecosystems and their Services (Maes, 2013).
- Since turloughs dry up in summer they are considered ecotones between wetlands and terrestrial habitats, therefore their ecosystem services will reflect this.