The role of groundwater in the degradation and restoration of raised bog ecosystems

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Introduction

• Aim:
  – To demonstrate that regional hydrology has a much greater role in the sustainability of a raised bog ecosystem than has previously been assumed

• Implication:
  – Restoration measures must take account of hydrogeological processes
  – Raised Bogs may be considered as GWTDEs under the WFD
Clara Bog

- Designated Special Area of conservation (SAC)
- Has been damaged in the past – it is now two bogs
- Irish-Dutch study 1989-1994 – ecohydrolgical advancements
- Still retains internationally important soak systems – rheotrophic drainage features
- Clara Bog West has undergone significant changes since the early 1990s – it is subsiding
NPWS Clara Bog Restoration Project

• Clara Bog West has subsided significantly -> 1.0 m in local areas and as far as 600 m from the bog margin towards its centre (< 20 years).

• Two main objectives of project:
  1. To investigate and establish the key hydrological controls relating to the sustainability of Clara Bog West
  2. To devise and design remediation measures to arrest the continuing deterioration in the morphology and hydroecology of the wetland
Geohydrological Framework

• Local geological framework and its material properties invariably control the movement of water in the subsurface

• Evaluate the hydraulic connectivity between wetland and underlying geological structure

• Essentially:
  1. The general geo-hydrological setting within which the wetland is situated
  2. Identifies the water supply mechanisms that sustain the wetland
GW-SW Connection

- Lacustrine clay a hydraulic barrier – downward seepage to groundwater is c. 10 mm/year
- Where absent, and peat sits directly on till mineral subsoil, a hydraulic connection between bog and RGWT exists - downward seepage from peat to groundwater > 50 mm/year
- Drains cut below RGWT
- Large tracts cut close, and into, till aquifer
- Upward hydraulic gradients
- Drains are now zones of groundwater discharge
Drain profile, electrical conductivity & local groundwater level

Graph showing variations in drain level, electrical conductivity, and groundwater level over distance.
Reduced GWL

- Regional groundwater has declined since the 1990s
- Coincident with peat and drain cutting
- Water level in peat profile has also reduced
- Two main drainage pathways:
  - Through till
  - Through sand lense/ palaeochannel
Ecological Impact from Reduced RGWL?

- Reduced RGWL in till aquifer has induced vertical drainage at the base of peat
- Peat consolidating at its base
- As peat shrinks the bog subsides
- Surface level gradients increase on the bog surface preventing *Sphagnum* growth
- Long flow paths maintaining soak systems impacted
- Value of raised bog as an ecosystem severely compromised
Drains cut below RGWT
Restoration?
Slow down subsidence - raise the RGWT
Conclusion

- Clara Bog is not an isolated hydrological system

- GW is indirectly sustaining the ecosystem by:
  1. Preventing drainage
  2. Providing an upward pressure gradient

- Role of GW becomes apparent if the regional GWL is reduced

- If subsidence is to stop/ slow down the GWT must be raised and the natural dynamics maintained

- This situation is not unique to Clara and may apply to other raised bogs and therefore has key implications for restoration and for the role of raised bogs as GWTDEs under the WFD