REPORT

Ground subsidence on peat

Two of the world's classic sites of peat subsidence are the English Fenlands and the Florida Everglades. Peat reduces in volume by slow consolidation under its own weight, but the great proportion of ground surface lowering over peat is due to oxidation above the water table, which converts peat to carbon dioxide that is then lost into the atmosphere. This process is known as wastage. Peat is stable beneath wetland, but is rapidly lost when drained in order to create land of agricultural value. Ground subsidence has been induced in both the Fenlands and the Everglades by artificial drainage. Each site has its marker post, founded on underlying bedrock and now projecting far above the ground surface that continues to subside at both sites.

Holme Post, in the Fenlands

Nearly 10 km south of Peterborough, Holme Fen was the last of the fens to be drained, in 1851 (Hutchinson 1980; Waltham 2000). Past experience meant that the inevitable ground subsidence was expected, and a timber post was placed in the ground, founded in stable mudrock at depth and with its top cut level to the ground surface. Soon afterwards, it was replaced by a cast iron post supported on massive oak piles; this is now known as the Holme Post (Fig. 1). A second post was installed in 1957 on a concrete pile also founded in stable ground beneath the peat (Fillenham 1963).

Multiple measurements of the Holme Post over the years have provided an unsurpassed record of long-term ground subsidence on peat that has been repeatedly drained to create good agricultural land from uneconomic wetland (Fig. 2). Between the author's visits in 1979 and 2022, subsidence has been seen to continue at a very low rate, with ground level declining by a little over 250 mm in the 43 years. The last stage of pumping to further reduce water levels in the area was in 1962. The tops of the oak piles are now becoming exposed, and will therefore soon start to decay,

Since 2001, Holme Fen has been included in the Great Fen Project. This continues, with its aim to replace the artificial drainage of the land by wetland management that will sustain the natural ecology and habitats of the two nature reserves, at Holme Fen and the nearby Woodwalton Fen. The project could involve a small recovery of groundwater level at Holme Fen, which should reduce peat wastage and ground subsidence to minimal rates, but this is for the future, when wider problems with the drainage have been resolved.

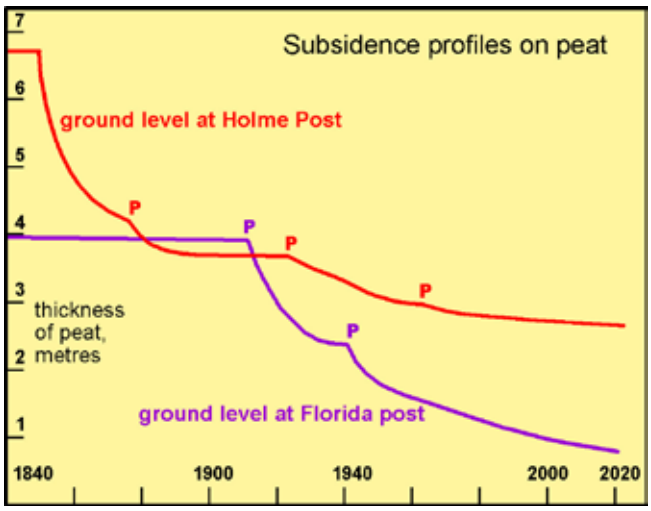

***Figure 2**. Profiles of peat subsidence against time at both the Holme Post in England and the Subsidence Post in Florida. The letters P denote renewed phases of drainage to lower levels.*

***Figure 1**. Comparative images of the Holme Post in the English Fenlands, in 1979 and 2022. The wooden fence is founded within the peat, so is subsiding along with the ground surface. The pyramidal cap was missing in 1979.*

***Figure 3**. Comparative images of the Subsidence Post at Belle Glade in the Florida Everglades in 1987 and 2021. Posts for the chain fence also reach down to bedrock beneath the peat. The post now has an explanatory signboard, which was temporarily removed to take the later photograph.*

Subsidence Post in the Everglades

Just 4 km southeast of Belle Glade, the Subsidence Post stands in the grounds of the University of Florida's Everglades Research Centre (Jehangir *et al.* 2020). The concrete post, which is 9 feet (2.75 m) long, was placed in 1924 with its base on the limestone bedrock and its top level with the ground surface on the peat soil. Its purpose was to record the subsidence of the extensive peatlands that were being drained for agricultural use, and its exposed section is kept painted with graduations in feet indicated in Roman numerals (Fig. 3).

The site has recorded peat subsidence with the classic profile of surface decline in response to multiple stages of drainage (Fig. 2). The post has indicated recent ground subsidence at a rate of about 10 mm/year, which is around half the rate that was recorded initially. This decrease in subsidence rate is partially attributed to improved management practices by the local sugar farmers. However, the subsidence profile matches that recorded in numerous peat terrains, with the rate steadily decreasing due to the relative increase of stable soil components that are residual during wastage loss of the peat. Between visits in 1987 and 2021, the ground at Belle Glade has subsided by nearly 350 mm, at a rate rather higher than that recorded at Holme Fen. Besides any external factors, one would expect faster subsidence in Florida, as wastage by oxidation is well known to be greater in warmer regions.

***Figure 4**. A house at Belle Glade university site, which was close to ground level when built in the early 1950s.*

Almost more spectacular than the post are the houses at the university site, which were built in the 1950s at ground level (Fig. 4). In compliance with local building codes, these timber structures were founded on concrete piles (150 mm square, the same as the Subsidence Post) that were driven to bedrock beneath the peat. The houses now stand far above ground level, having gained new storage space beneath. Flights of timber steps now lead up to the front doors, each with a lowest concrete step slowly falling away as the ground continues to subside.

References

Fillenham, L. F. 1963. Holme Fen Post. *Geographical J.*, **129**, 502–503.

Hutchinson, J. N. 1980.The record of peat wastage in the East Anglian Fenlands at Holme Post, 1848–1978 AD. *J. Ecology*, **68**, 229–249.

Jehangir H. B., Wright, A. L. & Snyder, G. H. 2020. Everglades Agricultural Area soil subsidence and sustainability. University of Florida: https://edis.ifas.ufl.edu/pdf/SS/SS52300.pdf

Waltham, T. 2000. Peat subsidence at the Holme Post. *Mercian Geologist*, **15**, 49–51.

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