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Consequences of marginal drainage from a raised bog and understanding the hydrogeological dynamics as a basis for restoration

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Raised bogs in Ireland have long been exploited for local fuel utilisation. The drainage associated with such activities alters the hydrological regime of the bog as consolidation of the peat substrate results in significant water loss and subsidence of the bog. Undisturbed raised bog environments are typically characterised by distinct ecological systems, or ecotopes, which are controlled by the relationship between surface slopes, flow path lengths and drainage conditions. Shrinkage of the main peat profile, or catotelm, invariably alters these conditions, changes of which significantly damage ecotopes of conservational value.

Clara Bog, Ireland, is one of western Europe's largest remaining raised bogs and on which much hydroecological research has been conducted since the early 1990's. Though a relatively intact raised bog, it has been extensively damaged in the past with the construction of a road through the centre of the bog known to have resulted in subsidence of 9-10m. However, the western tract of Clara Bog, Clara Bog West, has also subsided significantly since the early 1990's due to on-going peat cutting activities on the bogs margins.

Current research now indicates that the bog is not an isolated hydrological entity, as generally perceived of bogs, but rather that Clara Bog West is intrinsically linked to the regional groundwater table, which appears to provide a significant 'support' function to the bog. Hydrogeological monitoring and analysis has shown that water losses are not simply a result of lateral seepage of water through the peat profile at the bogs margins. Measurements of flow rates and electrical conductivity in drains bordering the bog indicate that little water is discharging laterally through the peat profile. However, piezometric head levels in mineral subsoil underlying the bog and close to the margins of the bog have decreased by 0.3 to 0.5m and 0.4 to 1.0m respectively since the early 1990s and it is believed that this is a result of vertical water losses in the peat profile not confined to the bog margins. Distinct zones of groundwater seepage in the marginal drains have been mapped based on hydrochemical and stable isotopic composition of the water and occur where drains have cut into permeable subsoil beneath the peat substrate and where the potentiometric surface of the regional groundwater table is below, or coincident with, the elevation at the base of the drain.

Groundwater as a 'supporting' ecological condition is usually confined to the perimeter of a raised bog, where peat and underlying clay thin towards the margin, allowing regional groundwater and peat water to converge and mix, thereby giving rise to characteristic nutrient rich 'lagg' zone vegetation. However, in Clara Bog West it appears there is also a connection between the regional groundwater table and the high bog. Such a connection appears to be unique to Clara Bog West as a result of the prevailing geological conditions. A succession of Carboniferous Limestone to relatively permeable glacial till deposits to low permeability lacustrine clay sediment is the predominant underlying geology of the bog. However, there are areas where the glacial till protrudes through the lacustrine clay, which ordinarily isolates the high bog from underlying groundwater, thereby engendering a dependency on regional groundwater conditions. The hydrogeological data now suggest that drainage at the bog margin has created a hydraulic connection between these 'subsoil subcrops' and the marginal drains, developed within the same subsoil, thereby lowering the regional groundwater table, steepening the hydraulic gradient and resulting in significant water loss from the main bog body. As such, understanding this hydrogeological connection is central to restoration activities that will aim to arrest subsidence and restore water levels that are indicative for ecotope development, on the high bog.

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