Collaboration for Environmental Evidence

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Plain Language Summary
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Systematic Review
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Restoring drained peatlands in boreal and temperate climates raises the groundwater level to pre-drainage levels near ditches

Arvid Bring, Josefin Thorslund, Lars Rosén, Karin Tonderski, Charlotte Åberg, Ida Envall and Hjalmar Laudon

Peatland restoration. Photo: Soil Paparazzi

The effectiveness of filling in peatland ditches to increase groundwater level reduces significantly with distance away from the ditch. After nine meters from the restored ditch, there was only a 50 % groundwater rise compared to the effect near the ditch. The effectiveness of drainage reached somewhat farther. With ditches present, there was a 50% reduction in lowering of the groundwater level remaining at 21 meters from the ditch. On average, restoring drained peatlands raises groundwater levels with 22 cm near the ditches. This is similar to the reduction in groundwater level caused by the presence of the ditch (19 cm).

Why is this Evidence Synthesis Needed?

Wetland drainage through the creation of ditches has caused widespread wetland loss by lowering the groundwater level and thereby impairing the ecosystem services provided by wetlands.

Wetland restoration programs aim to reintroduce ecosystem services such as habitats and nutrient retention. Recently, dry summers in boreal and temperate regions have raised interest in the potential for wetlands to enhance groundwater storage, both in and around the wetland.

Wetland restoration often entails blocking or filling in drainage ditches. However, there are several knowledge gaps regarding the effect of blocking/filling in ditches on groundwater storage, including if effects extend beyond the wetland and how they vary with local conditions. This review evaluated the effects of restoring, constructing or draining wetlands on groundwater storage in boreal and temperate climates. The purpose of including drainage is primarily to assess how far restoration can go in reversing the impact of drainage on groundwater storage.

This Collaboration for Environmental Evidence Systematic Review examines the effect of restoring, creating, or draining wetlands on groundwater storage in boreal and temperate climates. The review summarizes evidence from 226 studies, 146 of which were included in meta-analysis.

Main Findings

What studies are included?

This review includes 111 studies on restoration, 110 studies on drainage and 5 studies on creation of wetlands. Within a wetland, the available evidence shows that restoration (multiple interventions, typically blocking or filling in ditches) restores the groundwater level near the ditches. However, the effectiveness of the restoration to raise groundwater declines exponentially with increasing distance from the ditch. The drainage effect (caused by the creation of ditches) declines in a similar way, but may extend farther than the effectiveness of the restoration.

The evidence base is dominated by studies on peatlands (bogs: 91 studies, fens: 54 studies; unspecified peatlands: 43 studies; mires: 23 studies), comprising 89% of all studies[2]. In total, 18 countries are represented, six of them with at least 10 studies (Finland, UK, Canada, USA, Sweden and Germany). Most studies have some methodological weakness, but about half of studies still have high reliability.

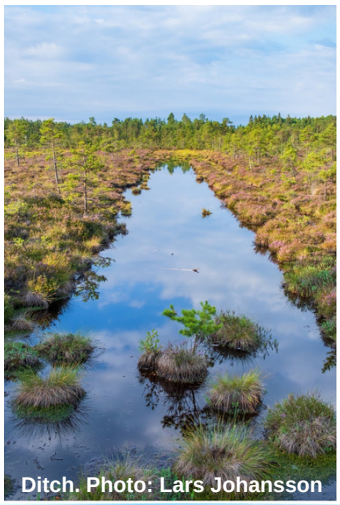
There was not enough evidence to synthesize effects on groundwater storage outside of or adjacent to studied wetland areas.

What are the Implications of the Review Findings?

In practice, the effectiveness of restoring peatlands to increase groundwater level is dependant on local factors. This means that two proposed wetland restoration projects, even if they are similar in approach and magnitude, may have different results on groundwater level changes. The decreasing effect of peatland restoration with increasing distance from the ditch is the only consistent factor we identified that may predict groundwater storage in wetlands under restoration.

Therefore, wetland interventions must consider the uncertainty in the effectiveness of restoration if specific amounts of groundwater level change are desired. The distance that the effects reach before halving in size to half of the effect, however, is a useful rule to estimate the extent of changes that can be expected. In practice, it puts a typical limit of a few tens of meters around a ditch in typical cases.

If effects outside the wetland are desired, it helps if soils adjacent to the wetland allow easy flow of groundwater. To better understand the effects of groundwater storage outside of or adjacent to studied wetland areas, wetland project managers should expand the areas they monitor as



Ditch. Photo: Lars Johansson

Restored wetland. Photo: Maksim Safaniuk

Synthesis Time Frame

The review authors searched for studies published before December 10, 2021. This CEE Systematic Review was published in December 2022.

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