Summary

Peatlands, unaffected by human impact produce peat, because the decomposition rate of organic matter is lower than the primary productivity. Thanks to this unique property, peatlands provide many vital ecosystem services to people, such as carbon sequestration and nutrient storage. Moreover, as permanently high watertable causes soil anoxia and nutrients are partly immobilised in peat or precipitated with calcium and iron complexes, peatlands are specific environments for plant life marked by strong environmental stresses. Such conditions favour weak competitors for light being at the same time stress-tolerant which nowadays are globally threatened due to the eutrophication problems. At the same time, peat-forming mires are among the habitat types with highest rate of human-induced degradation. Lowering of the watertable, which is a result of drainage, allows oxic mineralisation of peat, which releases carbon back to the atmosphere and nutrients to surface waters at a rate much faster than they were bound in the past. Simultaneous release of both environmental stresses leads to local extinction of weekly competitive plant species.

Degradation of the vast majority of peatlands in developed countries and its negative consequences, is the reason why ecological restoration of those ecosystems is implemented. The most commonly used method of ecological restoration of peatlands is rewetting by blocking or filling drainage ditches. However this method has been criticised from climate change perspective, due to the periodic significant increase in methane emissions. Moreover, its application on highly degraded peatlands causes mobilisation of nutrients, which pollute surface waters and leads to an increase of primary production hampering reestablishment perspectives of rare species. Second, rarely used, fen restoration method is degraded topsoil removal. Its effectiveness in restoring plant communities typical of well-preserved fens has been confirmed by several studies. However, until now, little is known about the influence of topsoil removal the on relative availability of individual nutrients, which may be important for the development of target vegetation. Moreover, our knowledge about the effectiveness of this method in restoring peatland ecosystem services, including greenhouse gas balance and nutrient cycling is very limited and based on indirect reasoning.

The main objective of the presented thesis was to evaluate the effectiveness topsoil removal, in comparison with rewetting, as a fen restoration method in terms of the perspectives to re-establish target vegetation and to recover natural nutrient cycling and greenhouse gas balance.

The study area was located within one of the largest fen peatlands of central Poland: the Całowanie Fen. The site is a typical example of peatland development, but also of its
degradation due to human influence within the European Lowland. Research was connected to a restoration project, which included a topsoil removal over 2 ha of severely degraded peatland. Within and around this area I established permanent plots including: topsoil removed plots, control plots on degraded peat, reference ones in fen remnants within old peat-cuts and experimentally rewetted plots, which allowed me to compare both restoration methods.

The results, obtained in the course of the study, proved that topsoil removal, in contrast to rewetting, can reduce nutrient concentration in the soil solution after restoration and does not increase methane emissions (in comparison with degraded situation). On the other hand, the removal of topsoil did not allow to fully recover site properties to the conditions of reference areas in terms of calcium and iron content in the groundwater. Moreover, it has not created phosphorous-limiting environment favourable for many endangered species because the availability of nitrogen was probably reduced stronger that the availability of phosphorous. Furthermore, when the impact of mineralisation of the removed topsoil is included in the assessment of global warming potential of both restoration methods it turns out that the restoration of fens with topsoil removal can be actually less favourable for climate that their rewetting.

Despite the abovementioned drawbacks, the general overview of pros and cons of both restoration methods in term of ecosystems services and recreation of habitat for endangered species led me to the conclusion that the topsoil removal has more advantages. Lack of nutrient mobilisation not only allows for the establishment of weekly competitive plant species, but also can reduce nitrogen loads to the catchment without the risk of phosphorus enrichment. What is more, the problem of climatic impact of the removed topsoil can be solved if it is utilised as substitute of fresh peat in forestry, agriculture of gardening. In this way, emissions of greenhouse gases caused by the restoration actions can be compensated by the reduction of emissions in another area.