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RUNOFF CHANGES AFTER REWETTING OF A CUTOVER PEATLAND IN SWEDEN

Torbjörn Nilsson
Swedish University of Agricultural Sciences, Department of Soil and Environment, Box 7014
SE-750 07 Uppsala, Sweden
Tel.: 0046 18 67 3459; torbjorn.nilsson@slu.se

Lars Lundin[1)], Sabine Jordan[1)], Elve Lode[1,2)], Monika Strömgren[1)]

[1)]Swedish University of Agricultural Sciences, Department of Soil and Environment, Box 7014, SE-75007 Uppsala, Sweden
[2)]Tallinn University, Institute of Ecology, Estonia, Uus-Sadama 5, 10120, Tallinn, Estonia

SUMMARY

Continuous discharge measurements were made in outlets from a rewetted cutover peatland (14 ha) and a nearby self-restoring hand-cut mire (22 ha) during nine years. Mainly cotton grass was slowly but successively established over the peatland. Large areas of open water also existed in the rewetted area. The discharge measurements showed that annual runoff from the rewetted cutover peatland were lower compared to runoff from the self-restoring hand-cut mire. This difference could be explained with higher frequency of low flows and lower peak flows from the rewetted cutover peatland.

The low annual runoff from the rewetted cutover peatland was probably caused by water storage in the created wetlands and an increased evapotranspiration. The number of peak flows and their magnitudes were lower from the rewetted cutover peatland compared to the self-restoring hand-cut mire.

KEY WORDS: Discharge measurements, low water flow, peak flows

INTRODUCTION

In many parts of the world peatlands cover a substantial part of the land area. Peatlands are important for determining streamflow response to rainfall, snowmelt or drought events. The processes in peatlands, that generate and regulate runoff, are often more or less changed after drainage for agricultural or silvicultural use and extraction of peat for horticultural or energy purposes. Restoration of such disturbed wetlands also alters the hydrology and consequently also the water quality.

Wetland hydrology is crucial for the restoration of peatland functions. It is a challenge to maintain a stable water storage that is necessary for successful reclamation after terminated peat excavation. However, rewetting of peat cutover areas may also influence runoff amounts, which in turn can induce undesirable effects in downstream watercourses. Both low flow situations and high flow events may cause severe impacts in stream and rivers implying both droughts and inundation risks. To improve the knowledge how restoration of wetlands affects runoff patterns, a Swedish investigation were carried out in one rewetted cutover peatland and in one nearby self-restoring hand-cut mire.

MATERIALS AND METHODS

The study areas are located in south-central Sweden (E 14°40'; N 59°00') at an elevation of about 85 m.a.s.l. The mean annual temperature and precipitation for the period 1961-1990 was 5.0 °C and 680 mm, respectively (Alexandersson *et al*., 1991).

The self-restoring area at Läsarmossen mire, was originally a 50 ha large bog with a 3.7 m deep peat layer, on average, with maximum depths of up to 5 m. From 1940 to 1985 peat was hand-cut on 30 ha. The size of the peat pits was about 0.2 ha (100x20 m) and the pits were separated with 5-20 m wide peat beds. The abandoned drainage system was partly blocked in 1989 and spontaneous re-colonisation started in the open pits.

The rewetted cutover area at Porla peatland, is located 1.6 km WNW of Läsarmossen mire. The Porla peatland was originally a poor fen, where peat cutting for peat litter started in 1880. At the beginning of 1980s the harvested peat was used as fuel in municipal district heating plants. The peat cutting terminated 1998 and a man-made rewetted area (14 ha) was initiated in 1999.

Continuous discharge measurements were started 1996 at Läsarmossen mire in a main ditch, which drains 25 ha of the self-restoring area. Similar discharge measurements were started at Porla peatland in 1998. Due to different climatic and technical reasons daily runoff data are missing for shorter or longer periods. Reliable and comparable daily values on runoff were available at both sites during 1999 (calibration period), rewetting periods of 2000-2002 and 2007-2009. Data on air temperature and precipitation have been taken from nearby climate stations.

RESULTS

During the studied years (1999-2002 and 2007-2009) precipitation and especially temperature were higher in comparison with the long-term reference period 1961-1990. A very high annual precipitation (1023 mm) was recorded in the year 2000 (Fig. 1). This also resulted in high runoff values for this year (Fig. 2).

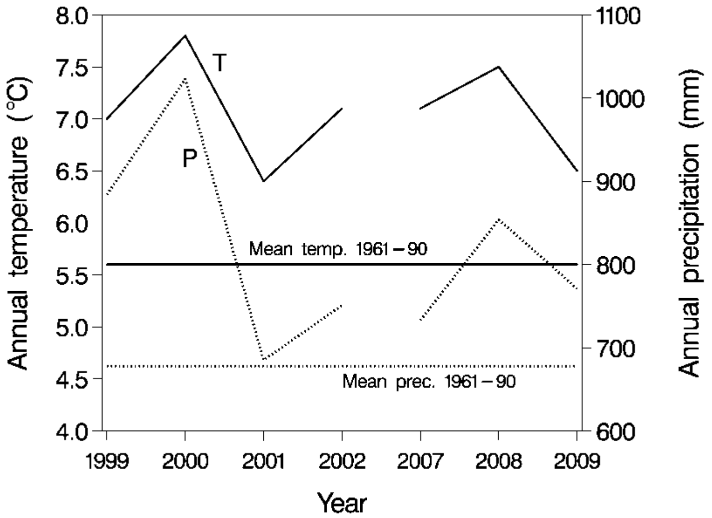

Figure 1. Annual temperature (solid line) and precipitation (dotted line) at nearby climatic stations during 1999-2002 and 2007-2009. During 2003-2006 runoff values are missing for two months or more for each year.

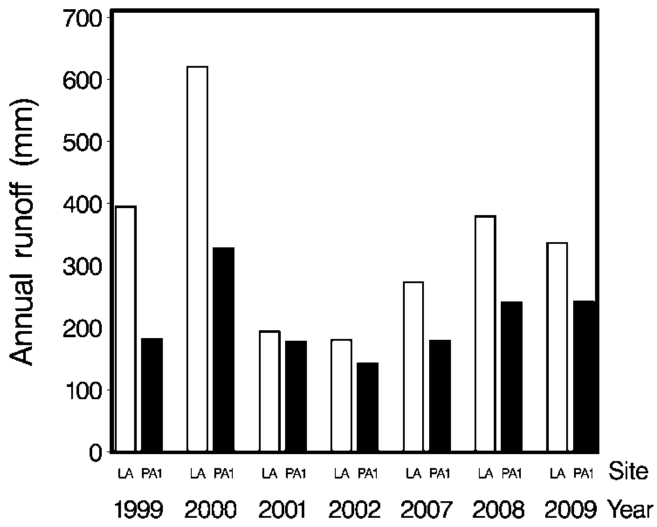

Figure 2. Annual runoff from the self-restoring area at Läsarmossen mire (white bars) and from the rewetted cutover area at Porla peatland (black bars) during 1999-2002 and 2007-2009).

During the calibration year (1999) the annual runoff at Porla peatland was 182 mm, which was 213 mm or 54 % lower than the runoff from the Läsarmossen mire. The first three years after the calibration period the runoff from Porla peatland was on average 115 mm (25 %) lower than the runoff from Läsarmossen mire. Five to seven years later (2007-2009), the average annual runoff values at Porla peatland and Läsarmossen mire were 220 mm and 330 mm, respectively. The difference (109 mm) was comparable to the average (115 mm) for the first three years after the calibration period, but due to lower runoff values during 2007-2009, the relative difference was larger (33 %) compared to the relative difference during 2000-2002.

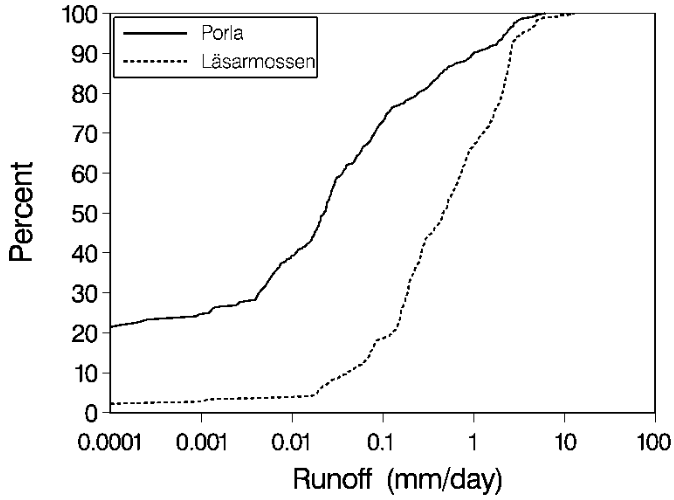

Figure 3. Accumulated frequency of runoff from the rewetted area at Porla peatland and from the self-restoring area at Läsarmossen mire during the calibration period in 1999.

Frequency of low flows (<0.01 mm/day) was much higher at Porla peatland compared to Läsarmossen mire during the calibration year. The large number of low flows at Porla peatland during this year was probably due to water storage in the created wetlands and an enhanced evaporation, due to an increased area of open water bodies. The number of high flows (> 1 mm/day) were thus fewer at Porla peatland compared to Läsarmossen mire, and the magnitude of the highest flows were also lower from Porla peatland (Fig. 3).

During 2000-2002, i.e. the first three years after rewetting of cutover peatland at Porla, the difference in frequency distribution of runoff between Porla peatland and Läsarmossen mire was rather small. The frequency of low flows was even lower at Porla peatland compared to Läsarmossen mire. The high frequency of low flows at Läsarmossen mire during this period was mainly due to a dry two month period in August-October 2002, when there was no discharge at all from Läsarmossen mire. During this dry two month period, the discharge from Porla peatland never fell below 0.05 mm/day. The magnitude and frequency of peak flows at Porla peatland were thus still lower than at Läsarmossen mire (Fig. 4).

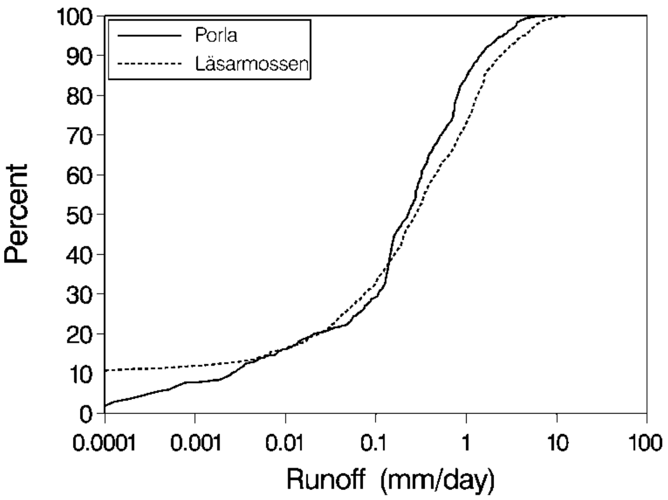

Figure 4. Accumulated frequency of runoff from the rewetted area at Porla peatland and from the self-restoring area at Läsarmossen mire during January 2000 – December 2002.

During 2007-2009, i.e. eight to ten years after rewetting, the frequency of low flows was again higher at Porla peatland compared to Läsarmossen mire. However, compared to the calibration year (1999) the frequency of such low discharges was lower. During 2007-2009 the maximum daily peak flow at Porla peatland were much lower compared to Läsarmossen mire; 2.84 mm/day and 6.72 mm/day, respectively.

A comparison of frequency distribution for runoff at Porla peatland during the calibration year (1999), one to three years after rewetting (2000-2002) and five to seven years later (2007-2009) also shows that rewetting lowered the frequency of low flows and possibly also the magnitude of peak flows (Fig. 5).

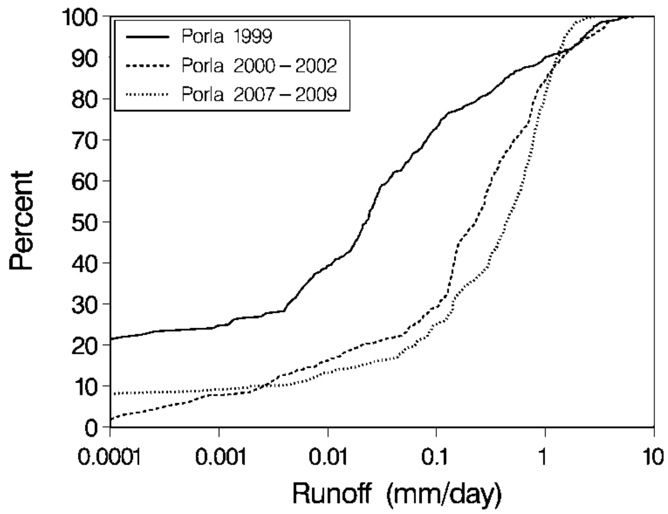

Figure 5. Accumulated frequency of runoff from the rewetted area at Porla peatland during the calibration year (1999) and during the first three years after rewetting (2000-2002) and during 8-10 years after rewetting (2007-2009).

CONCLUSION

Rewetting of a cutover peatland resulted in lower annual runoff values compared to one nearby self-restoring mire. The number of days with low water flow (<0.01 mm/day) were higher at the rewetted peatland than at the self-restoring mire. The lowered annual runoff and especially the high frequency of low flows may cause severe consequences for aquatic organisms in watercourses downstream rewetted peatlands.

REFERENCES

Alexandersson, H., Karlström, C., Larsson-McCann, S. 1991. Temperature and precipitation in Sweden 1961-90. Reference normals. (In Swedish, with English abstract). *SMHI Meteorologi* **81**. 88 pp. Swedish Meteorological and Hydrological Institute, Norrköping, Sweden.