Hydrological field research factsheet – Gromovo Fluviogeneous Mire – Kaliningrad Region, Russia

Technical report of the DESIRE project – action 3.2

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Cover photo: Gromovo Fluviogenous Mire (Photo: Marta Stachowicz)

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1. Introduction

The following report was prepared in the framework of the action 3.2 of the DESIRE project 'Development of sustainable (adaptive) peatland management by restoration and paludiculture for nutrient retention and other ecosystem services in the Neman River catchment'. Main goal of this report is to document hydrological features of the Gromovo Fluviogeneous Mire (GFM) located in the Slavsk Region of the Kaliningrad Region of Russia (Fig. 1), which is situated in the zone of Neman Delta.

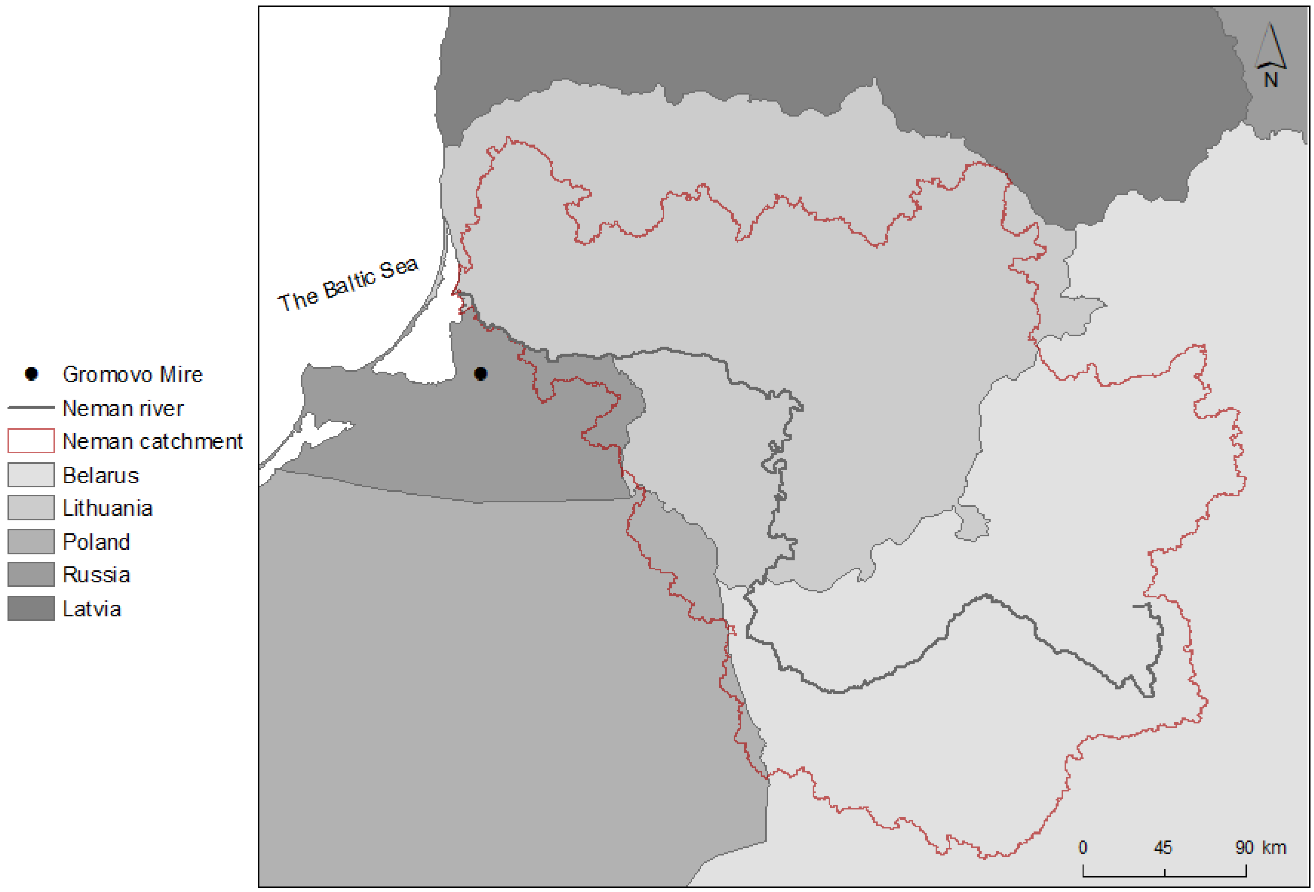

Figure 1. Location of the study site – Gromovo Fluviogeneous Mire, Kalinigrad Region, Russia.

Although the site is not within the boundaries of the Neman River catchment, it represents peatland conditions found in the basin. The GFM is located in the catchment of the Rżewka River, which is a left tributary of the Nemonin River (Russian: Немонйн). The study site is located 2.6 km from the nearest river bank and is 9.48 hectares in size. It is an example of a fluviogenic peatland supplied mainly by river and groundwater. The site and its surroundings have a fairly extensive drainage network, but in fact the drainage ditches are overgrown and no longer functional. Figure 2 shows a map of the study site with the location of drainage ditches and installed piezometers.

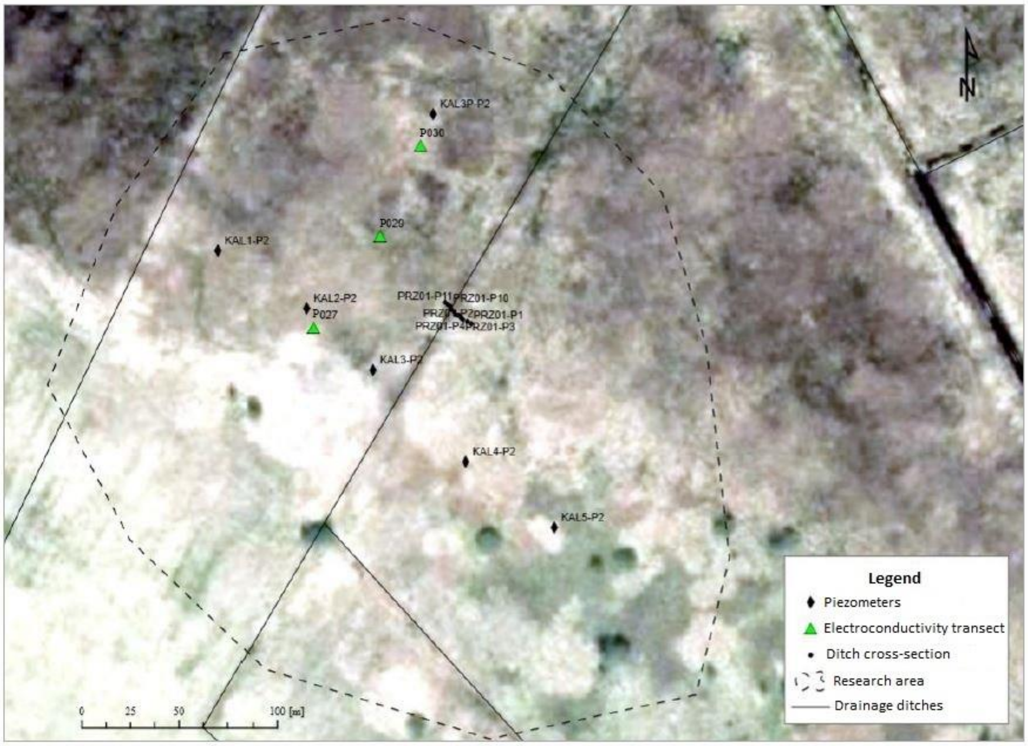

Figure 2. Location of the piezometers - Gromovo Fluviogeneous Mire

Table 1 summarizes the technical parameters and locations of the piezometers.

Table 1. Detailed information about measurement points

Piezometer 's name	Coordinate X [oN]	Coordinate Y [oE]	Elev. of the ground	Model of the diver	Outer diameter of the pipe	Pipe length	Diver's ID
			[m]	[-]	[mm]	[m]	[-]
KAL1	21.474435	54.954651	22.27	Solinst Levelogger Model 3001	60	2.00	102111187
KAL2	21.474839	54.954505	22.09				102111204
KAL3	21.475149	54.954342	22.13				102111200
KAL3P	21.475423	54.955015	22.12				102111213
KAL4	21.475568	54.954098	22.40				102111194
KAL5	21.475972	54.953926	22.44				102111192

The main objective of this report is to present and analyse the hydrological features of the Gromovo Fluviogeneous Mire. In this report we perform the meteorological analysis of the site, explain the methodology behind the research and present the results of field research and hydrological monitoring.

2. Analysis of meteorological situation of the mire

The meteorological analysis was performed based on the data from the nearest meteorological station in Sovetsk, from the All-Russian Scientific Institute of Hydrometeorological Information, which provides the average monthly air temperatures and monthly precipitation data from 1999 to 2018. The meteorological data for the Gromovo village was obtained from the web portal: http://russia.pogoda360.ru/.

January is the coldest month, with an average monthly air temperature of -2.7°C, and the warmest month is July with an average monthly air temperature of 18.7°C. The lowest monthly average temperature during the 20 years in question occurred in January 2010 and was -9°C, and the highest occurred in July of the same year and was 21.5°C. In terms of precipitation, on average the driest month is April (36.2 mm) and the wettest month is July (93.0 mm). Comparing the annual precipitation totals, the wettest years were 2007 with an annual rainfall of 1069.5 mm and 2017 with an annual rainfall of 1011.9 mm. The driest years were 2014 and 2018 with annual precipitation totals of 571.3 mm and 575.6 mm. The 20-year average annual precipitation is 760.9 mm, and the average annual air temperature is 7.9°C. The summary of monthly precipitation and average monthly air temperature in Sovetsk meteorological station is shown in Figure 3.

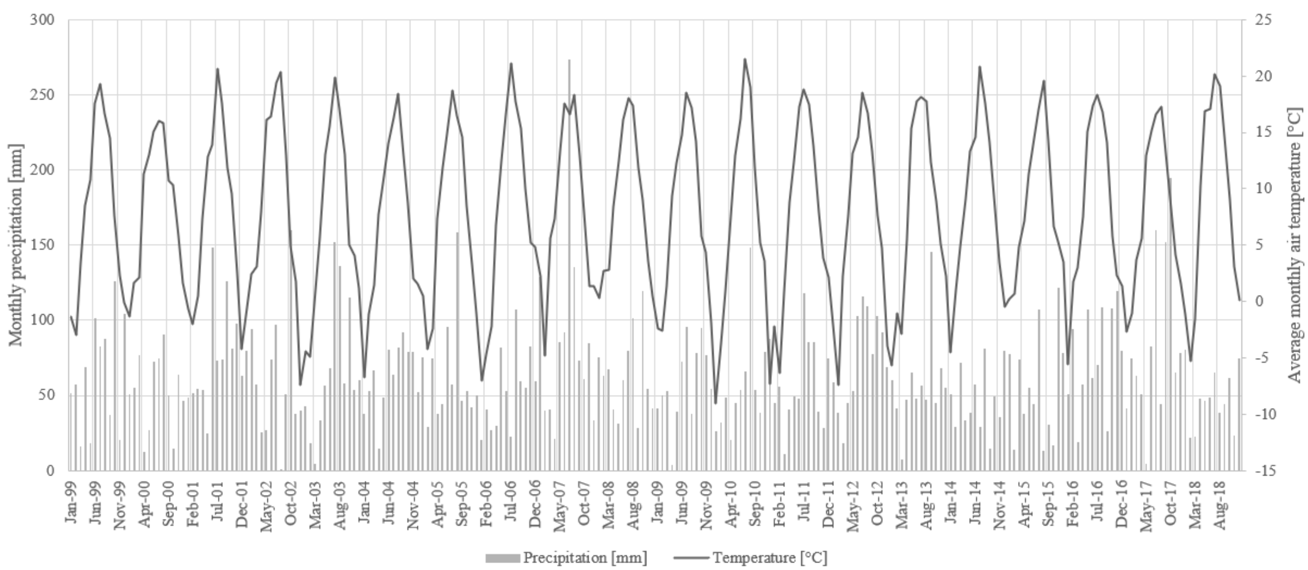

Figure 3. Summary of monthly precipitation in millimeters and average monthly air temperature in °C in Sovetsk, Kaliningrad Oblast from 1999 to 2018.

Based on the 2019 meteorological data from Gromovo village, the coldest month was January with the average monthly air temperature equaled -3.1 °C, and the warmest was July with the temperature of -18.6 °C. The driest month was March (42.9 mm) and the wettest month was July with 99.6 mm. The annual precipitation was 766.9 mm. The summary of monthly precipitation and average monthly air temperature in Gromovo in 2019 is shown in Figure 4.

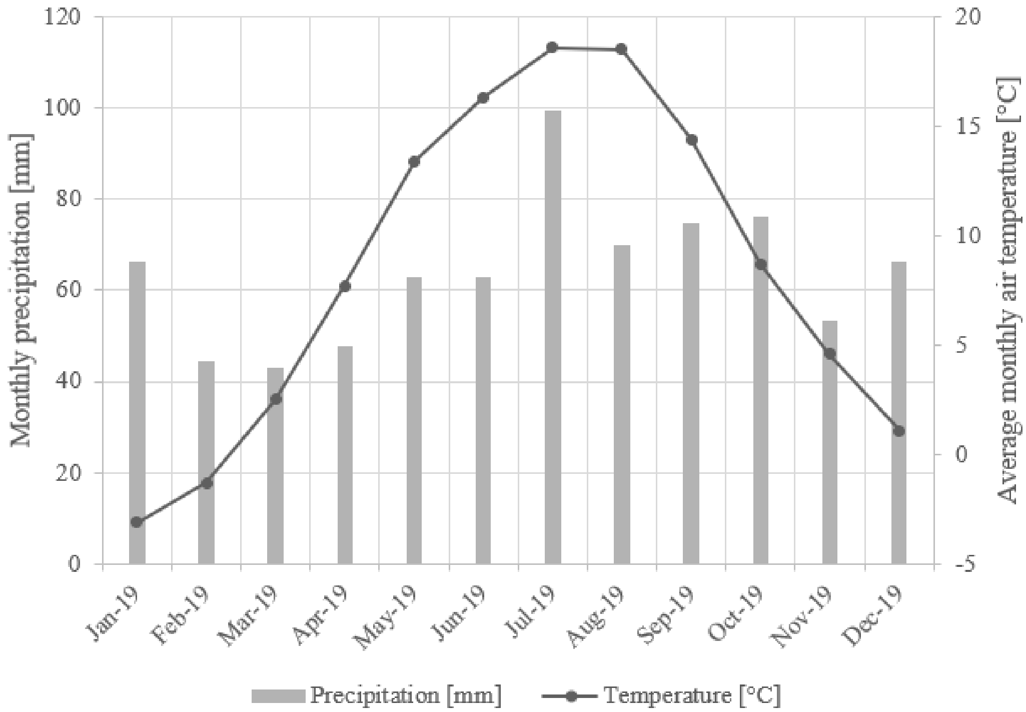

Figure 4. Summary of monthly precipitation in millimeters and monthly average air temperature in °C in Gromovo in 2019.

The 20-year meteorological data allows to observe traces of the climate change in the region of the study site. The area is characterized by warmer, slightly drier summers and warmer winters with unchanged average annual precipitation. This poses a threat of increased frequency of extreme weather events, such as droughts.

3. Methodology of field investigation

In order to analyze the water table system, 5 piezometers were installed at the depth of 2 m below ground level. Transect consisting of 5 points runs perpendicularly to drainage ditch (KAL01 - KAL05), last point for reference purposes was established in northern part of the investigated field (KAL03P). In each piezometer equipment was installed - Solinst Levelogger - a recorder of water level and water temperature changes, which is used for long-term monitoring. The measuring range of this equipment is 0 - 10 m (accuracy ± 0.05%) and -20°C to +80°C (accuracy ± 0.1°C). Besides, Solinst Barologger device was installed in the field, which is used to record changes in atmospheric pressure with a measuring range of 0 - 1.5 m (accuracy ± 0.05%). The measurements of the water level are performed in six piezometers from 05.10.2019 in 6-hour intervals.

During piezometric drilling, it was found that there was more than 2 m of peat in the study area, and it is sedge peat, highly hydrated and medium-decomposed. It was found that the peatland is submerged, while being supplied with surface water, which proves its uniqueness in a particular geographical latitude.

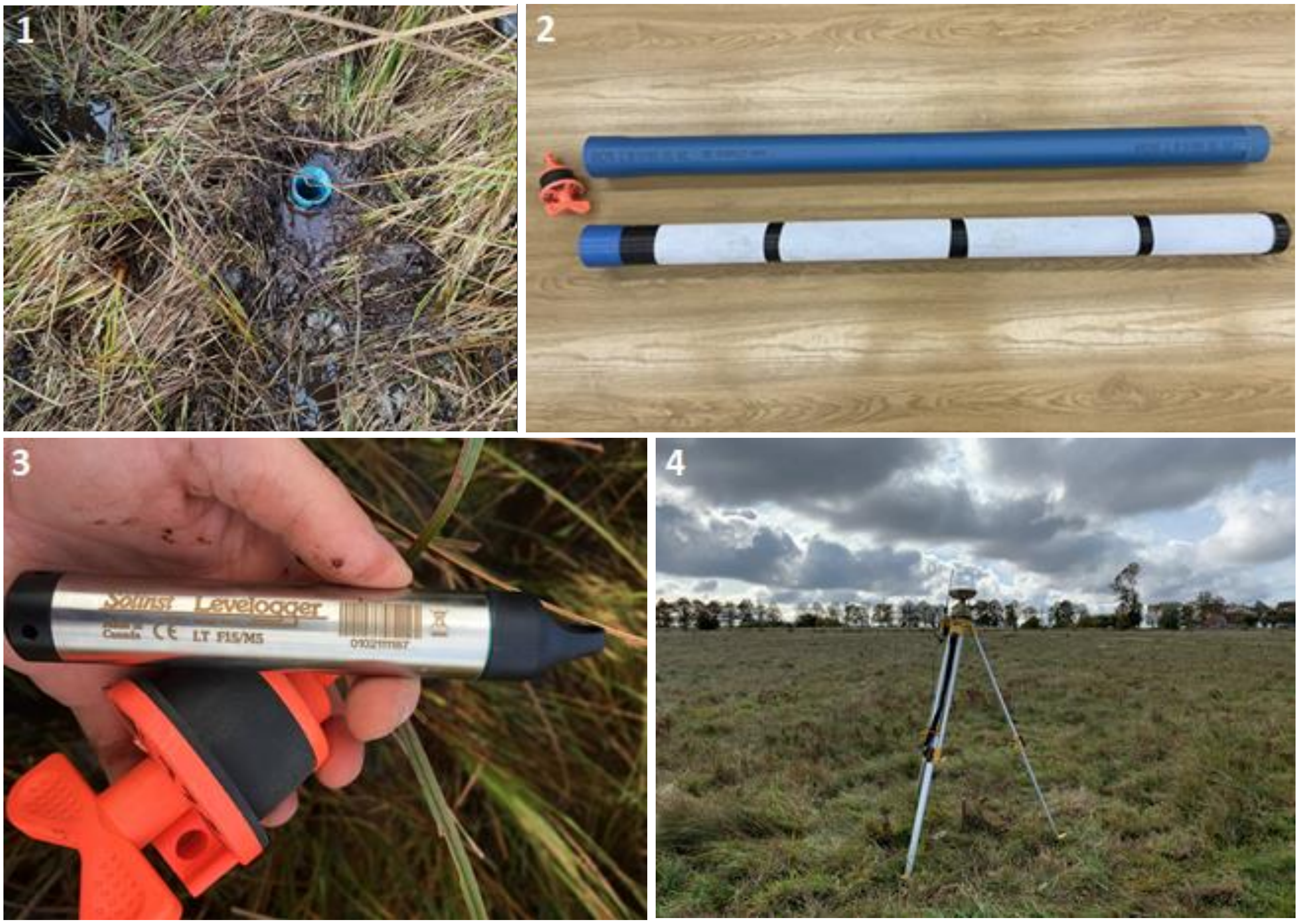

Figure 5. Installed piezometer (1), piezometer construction (2), Solinst Levelogger (3), GPS base station (4).

4. Groundwater levels – monitoring

Water table in the whole mire is constantly above ground level, even in the higher parts of the area. In the measurement period for 3 piezometers (KAL2, KAL3, KAL3P) the water table was above the ground level almost all the time. It is unique for this type of peatlands in this part of the world, additionally taking into account the attempt of its reclamation. It can be concluded that the height of the water table was dependent on atmospheric conditions during the study period, however, these changes did not affect the overall condition of the studied peatland (continuous water saturation). Figure 6 shows the variation of water table in time for individual piezometers and the statistics are contained in the Table 2.

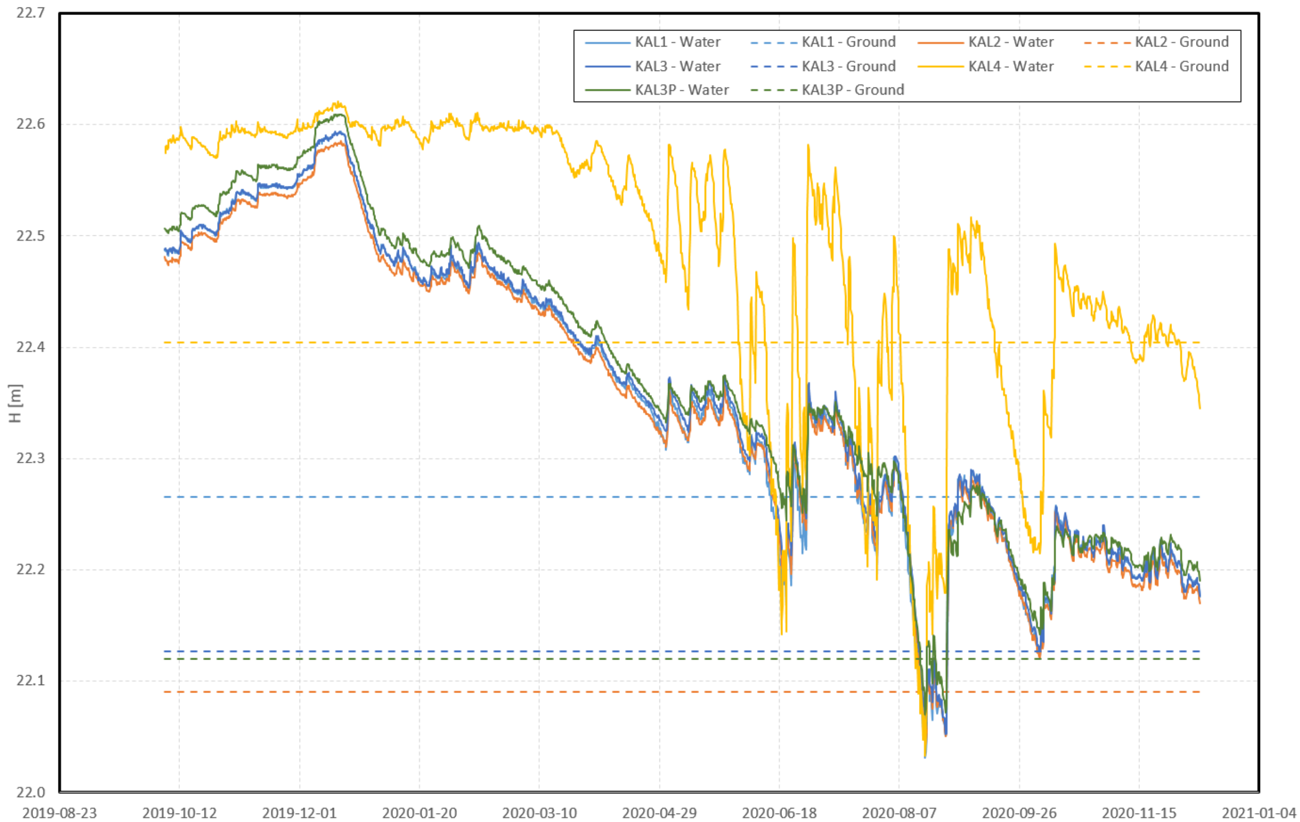

Figure 6. Variability of the groundwater table in the piezometers on the Gromovo Fluviogeneous Mire.

Table 2. Depth to Water Table [m] – minimum/average/maximum and % of all measurement days with the water table above the ground. Measurement period: 2019-10-05 - 2020-12-10.
(“+“ – above the ground / “-” – below the ground level).

Piezometer	Depth to Water Table [m]			% of all measurement days with the water table above the ground
	MAX	AVERAGE	MIN	
KAL1	0.33	0.09	-0.23	68
KAL2	0.49	0.26	-0.05	98
KAL3	0.47	0.23	-0.07	97
KAL3P	0.49	0.25	-0.05	98
KAL4	0.22	0.08	-0.37	78

Figure 7 shows water-level-duration curves for 5 piezometers located in the Gromovo Fluviogeneous Mire. Axis X represents measured frequency of exceedance where depth to the water table is higher or equal to value from axis Y.

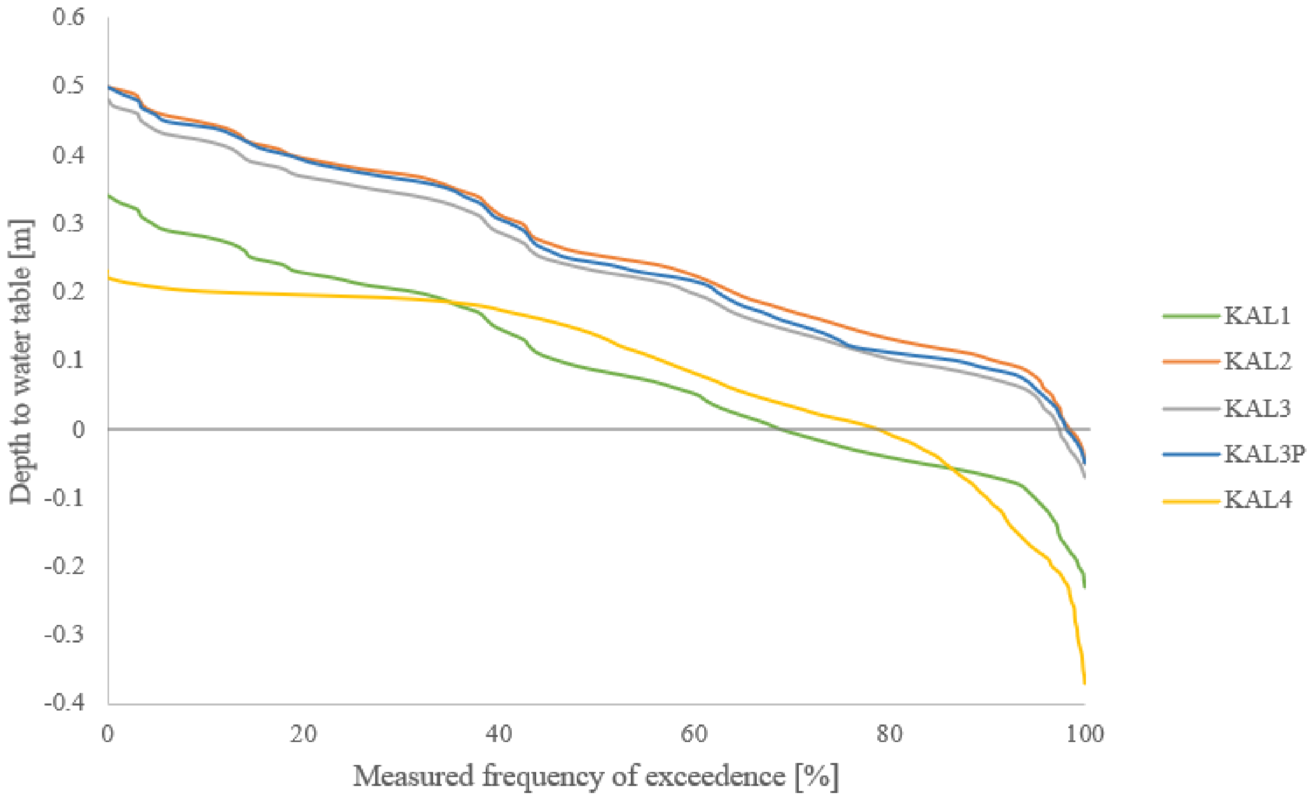

Figure 7. Water-level-duration curves for 5 piezometers located in the Gromovo Fluviogeneous Mire.

The Gromowo site can be compared to peatlands occurring in Poland in the Narew valley. The Narew, similarly to the Rżewka River, is a lowland river whose catchment area is dominated by peat soils, and the climate in both areas is similar. In the area of the Narew National Park there are mainly fluviogenic bogs. However, both areas are characterized by different parameters. While the Gromowo peatland is permanently waterlogged, the Narew valley peatlands dry out during summer, the groundwater level is usually below the ground surface, at a depth of about several tens of centimeters, and surface flooding that persists throughout the year is sporadic (Banaszuk and Wolkowycki, 2016). Thus, the states of the two areas must be due to different factors. The source of water shortage in Poland may be extensive transformation of the river network or inadequate management of water resources. Gromowo bog, due to the natural character of its feeder river - Rżewka, is not affected by the problems of the Narew valley bogs. It is in a very well preserved condition. The Gromowo mire is an example of a reference site for the management of good environmental status of fluviogenic peatlands. A comparison of two fluviogenous mires - Narew and Gromovo Fluviogeneous Mire is shown in Fig. 8 (Scenario 1 – Renewal of drainage ditches (1 m deep, clean), no modification of river regime.

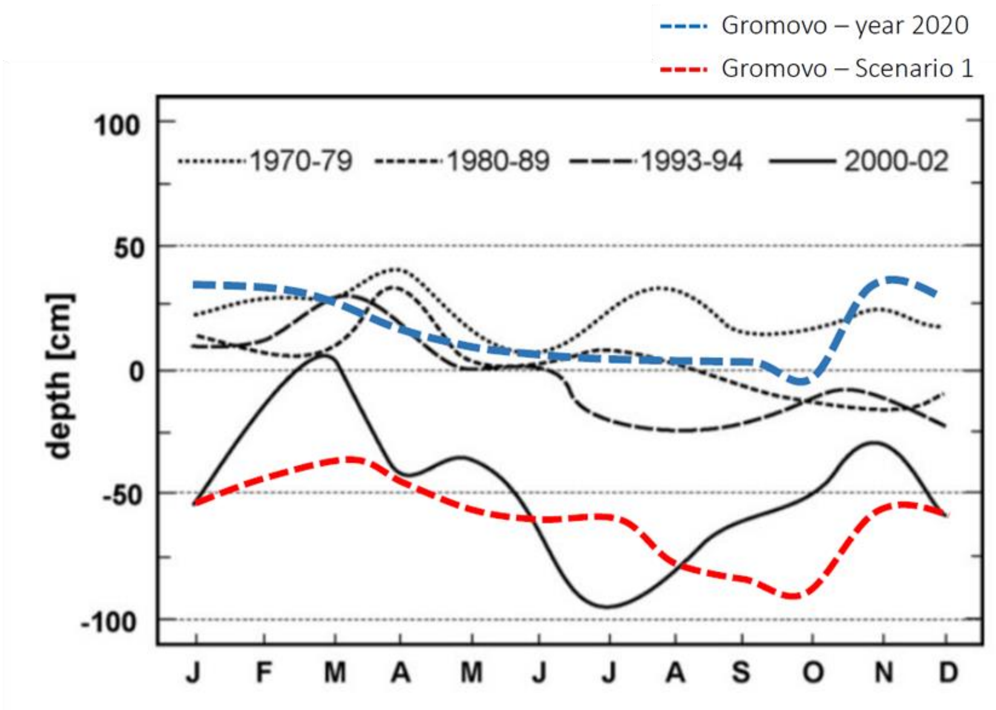

Figure 8. Comparison with other fluviogenous mire (Narew Valley) – 2020 – the warmest year recorded.

5. Conclusions

- Water table in the Gromovo Fluviogenous Mire was above the ground level for the significant majority of the measurement period, therefore hydrological conditions in the GFM are favorable for peat accumulation.
- The GFM shows low eutrophication potential.
- The GFM was drained in the past, but as a result of the overgrowth of the drainage ditches it has self-restored, thus it is a good example of spontaneous peatland restoration.

6. References

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7. Annexes

Annex 1. Cross section of a drainage ditch located in the Gromovo Fluviogeneous Mire.