Project **LIFE12NAT/LT/000965**
LIFEAUKSTUMALA Restoration of Aukstumala Raised Bog in Nemunas Delta Regional Park

Hydrological Monitoring Methodology and Report, 2014

Action D2:

HYDROLOGICAL MONITORING AT THE TARGETED SITES

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Hidrological monitoring. Material and methods

To assess the drainage effect on the hydrology of the Reserve, a hydrological monitoring system was installed (ten profiles with 6–10 water level measurement wells in each). For the installation of water level measurement wells, PVC tubes (diameter 50 mm, length 2 m, perforated along the full length) were inserted into 1.8 m peat deposit. To stop peat filling, the tube from the base was covered with nylon material. The top of the well was capped. The water level measurement was carried out with monthly interval during vegetation season in April–October, 2014. All hydrological monitoring profiles were grouped into 4 sites depending on hydrological conditions and the foreseen project actions (*Fig. 1*).

Fig. 1. Location of hydrological monitoring sites in Aukštumala Telmological Reserve

Hydrological monitoring profiles:

- **Site 1.** Two profiles (110 m length) with 6 water level measurement wells in each. Due to the old drainage system this site is characterised as degraded raised bog with intensive tree cover. In order to improve hydrological conditions, this site will be dammed. However, tree cuttings will not be carried out.
- **Site 2.** One profile (360 m length) with 10 water level measurement wells. The site is also qualified as degraded raised bog. Tree cuttings and dams will be carried out to improve hydrological conditions.
- **Site 3.** Six profiles (170 m length) with 9 water level measurement wells in each. Profiles are located in the contact zone of the Reserve and peat harvesting fields (southern, south-eastern part of the Reserve). None of the restoration measures will be taken.
- **Site 4.** Two profiles (170 m length) with 9 water level measurement wells in each. The site is located in the northern part of the Reserve, which was totally damaged by fire of 2011. The northern edge of the site is drained by 5–6 deep ditches. To improve hydrological conditions drainage ditches will be blocked.

Results of hydrological monitoring

Hydrological monitoring data obtained in 2014 has shown that water table depth reached the highest level in April and had a tendency to decrease gradually during the summer season in all hydrological monitoring profiles. However, seasonal fluctuations were much more prominent in the sites where natural water regime is damaged (Sites 1, 2, 4). Precipitation amount (538 mm) in 2014 was approx. 200 mm lower compared to perennial data obtained in Šilutė district, therefore mean water table during the vegetation season was 10–15 cm lower than usually.

According to previous hydrological studies water level in typical open raised bog communities during the vegetation season does not decrease less than 25–30 cm below the peat surface. Therefore in order to recreate favourable conditions for peat accumulation and natural functioning of the bog ecosystem, the water level should be raised at least up to -30 cm.

Site 1 is located near the southern edge of the Reserve, which is extensively drained by shallow ditches. Ground water level (GWL) in both profiles ranged between -24 to -133 cm. Therefore hydrological conditions (water level and its fluctuation amplitude) were not favourable for peat accumulation and formation of typical raised bog habitats. The site is also negatively influenced by the peat harvesting fields that is why water level during the dry season decreases to 96–133 cm below the peat surface in the edge of the Reserve (*Fig. 2*).

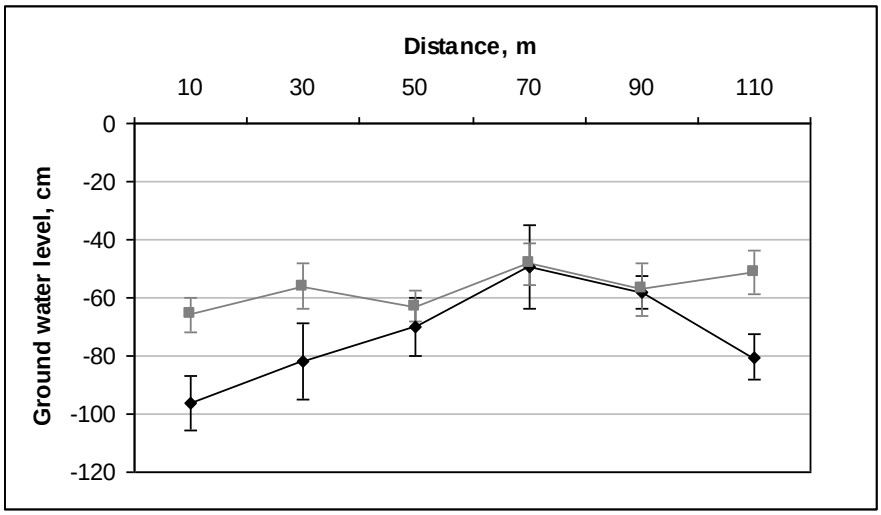

Fig. 2. Average ground water level (cm) in Site 1, Aukštumala Telmological Reserve April–October, 2014

Site 2 is also represented by degraded raised bog habitats, low ground water table and high water level fluctuation amplitudes. Bad hydrological conditions are determined by the dens net of deep drainage ditches (established every 20 m). Water level during 2014 vegetation season ranged from -29 cm to – 145 cm, the fluctuation amplitude in some wells reached even 104 cm. Moreover, ground water level in whole profile was lower than -30 cm, which is considered to be minimal level for the normal raised bog habitat existence (*Fig. 3*).

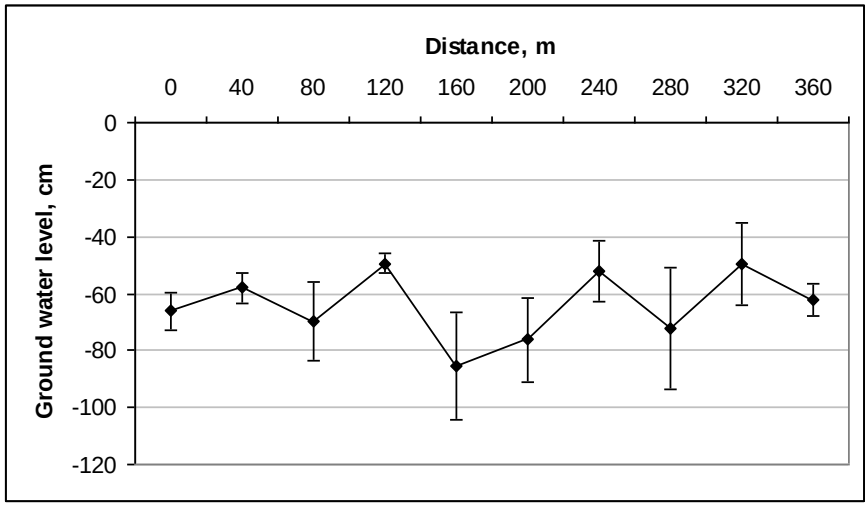

Fig. 3. Average ground water level in Site 2, Aukštumala Telmological Reserve, April–October, 2014

Site 3 is represented by relatively good hydrological conditions and open raised bog communities. However, the edge of the Reserve is under the impact of peat harvesting fields. As a result water level in the wells which are located in the contact zone (approx. 50 wide) is low and unfavourable for typical open raised bog habitats. In order to reduce negative impact posed by peat harvesting activity experimental polyethylene membrane (1 km length) in 2007 was installed. To assess the efficiency of polyethylene membrane ground water level was measured in 3 profiles with protective measure in 3

control profiles (without protective measure). Curves in *Fig. 4* illustrate mean ground water level in both treated and untreated sites in 2007–2014 period. Polyethylene membrane turned out to be an efficient measure to retain water in the bog and mitigate negative hydrological impact of peat harvesting from adjacent fields. Moreover, in further distant wells (70–170 m) water level remained relatively high and favourable for peat accumulation process in both (control and treated) profiles.

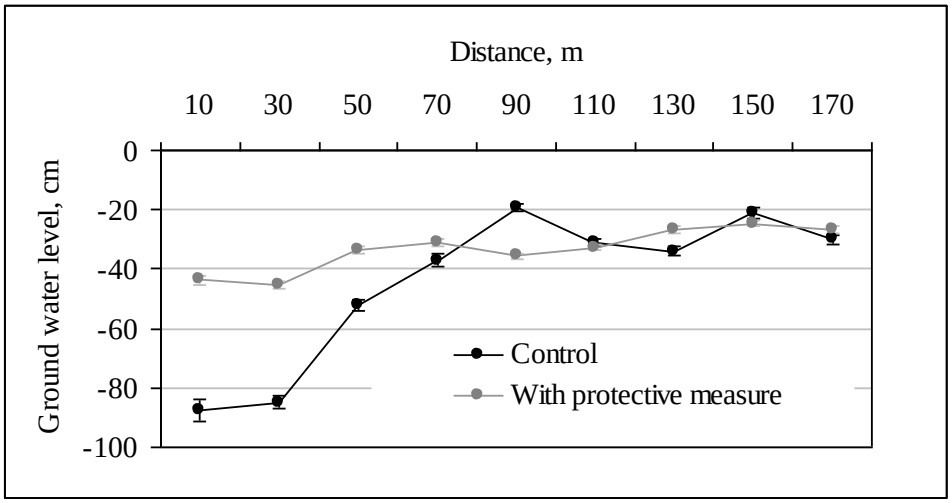

Fig. 4. Average ground water level in Site 3, Aukštumala Telmological Reserve, April–October, 2014

Site 4. Although northern edge of this site is drained by deep ditches, water level is not so drastically low in both installed profiles (*Fig. 5*). Relatively good hydrological situation of the site is caused by two reasons:

1. Fire in 2011 has killed off all trees and resulted reduce in evapotranspiration;
2. Experimental dams were constructed in 2011, 2012.

However, the hydrological conditions could be improved by constructing additional dams, because water level in some of the wells (-50 cm) is still to low for typical raised bog habitats.

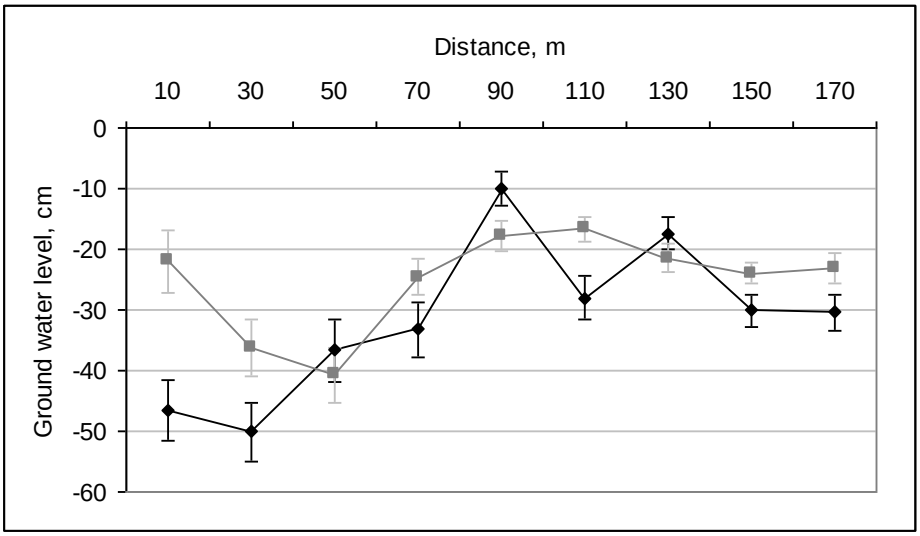

Fig. 5. Average ground water level in Site 4 Aukštumala Telmological Reserve, April–October, 2014

Monitoring of *Calluna vulgaris* cover

Calluna vulgaris is a good indicator for changes in hydrological regime in raised bogs, because dense cover of these dwarf-shrubs shows a negative hydrological changes in active raised bog communities, moreover they quite active reacts to rewetting of drained areas. Due to elevation of water table and rewetting or partly overflooding the bog surface, the heather is dying out.

To assess the efficiency of foreseen actions the initial measurements of *Calluna vulgaris* cover were carried out in selected sites in 2014, i.e. before rewetting/tree clearing activities began.

Material and methods

The percentage cover of *Calluna vulgaris* was estimated in August of 2014. Three liner transects (A, B, C) were established in the degraded parts of Aukštumala Telmological Reserve (*Fig. 6*).

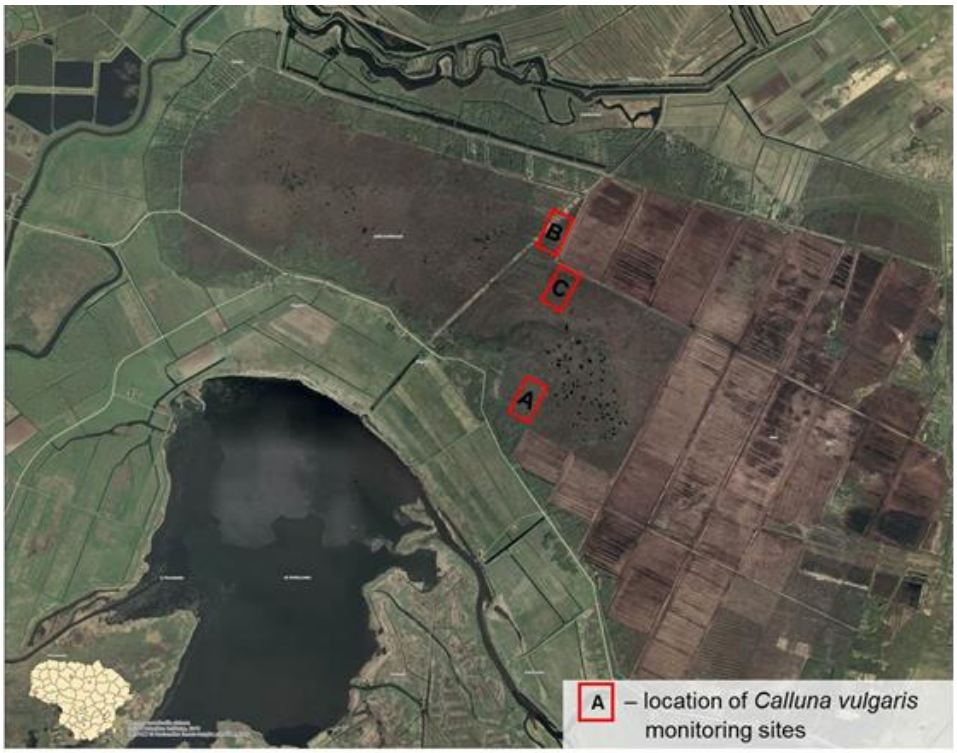

Fig. 6. Location of *Calluna vulgaris* monitoring transects (A–C) in Aukštumala Telmological Reserve

Calluna vulgaris monitoring transects:

- **Transect A** (380 m length) was established in degraded raised bog area with dense net of drainage ditches and low water level. 20 permanent study plots (1.0×1.0 m in size) were distributed every 20 m in the transect. The site is characterised by dominant tree cover (*Betula pendula*, *B. pubescens*, *Pinus sylvestris*), well developed *Ledum palustre* and sparse coverage of grasses and *Sphagnum* mosses (up to 5 %).
- **Transect B** (180 m length) was established in damaged by fire area with dense net of drainage ditches and low water level. 10 permanent study plots (1.0×1.0 m in size) were distributed every 20 m. Before the fire 2011, the site was overgrown by 30-40 years old *Betula pendula*, *B. pubescens*, *Pinus sylvestris* trees stand with well-developed *Calluna*

vulgaris dwarf-shrubs, while *Sphagnum* cover was absent. During the above mentioned fire almost all woody vegetation was burned. Heather quickly recovered after the fire and currently *Calluna vulgaris* dominate in the vegetation cover.

- **Transect C** (180 m length) was established in damaged by fire area, perpendicularly to the contact line of the Reserve and peat harvesting fields. 10 permanent study plots (1.0×1.0 m in size) were distributed every 20 m. The northern edge of the transect (degraded raised bog area) was influenced by 5-6 actively working ditches, which were dammed right after the fire. In the southern edge of the transect is located in the active raised bog area.

In the every permanent study plots percentage cover of *Calluna vulgaris* was estimated, as well as other vascular plant and mosses were inventoried. Geographical coordinates of each permanent study plot were set by *Garmin e-Trex* (coordinates system LKS 94).

Results

Transect A. The site was drained by dense net of ditches, vegetation cover was removed and prepared for industrial peat harvesting in the late 80's of 20th century. Currently the site is characterised by degraded raised bog communities with dominant woody vegetation. *Calluna vulgaris* coverage ranged from 25% (in the contact zone with active raised bog) to 91% (mean 55%) in permanent study plots (*Fig. 7–8*). Because of low water level (mean water level during vegetation season -64 cm) *Sphagnum* cover is sparse (up to 5%) and replaced by brown mosses (*Pleurozium shreberi, Dicranum polysetum, Polytrichum strictum*). However, it should be noted that in the northern edge of the transect (which adjacent to active raised bog area) *Sphagnum* mosses covers up to 80–90% of study plots.

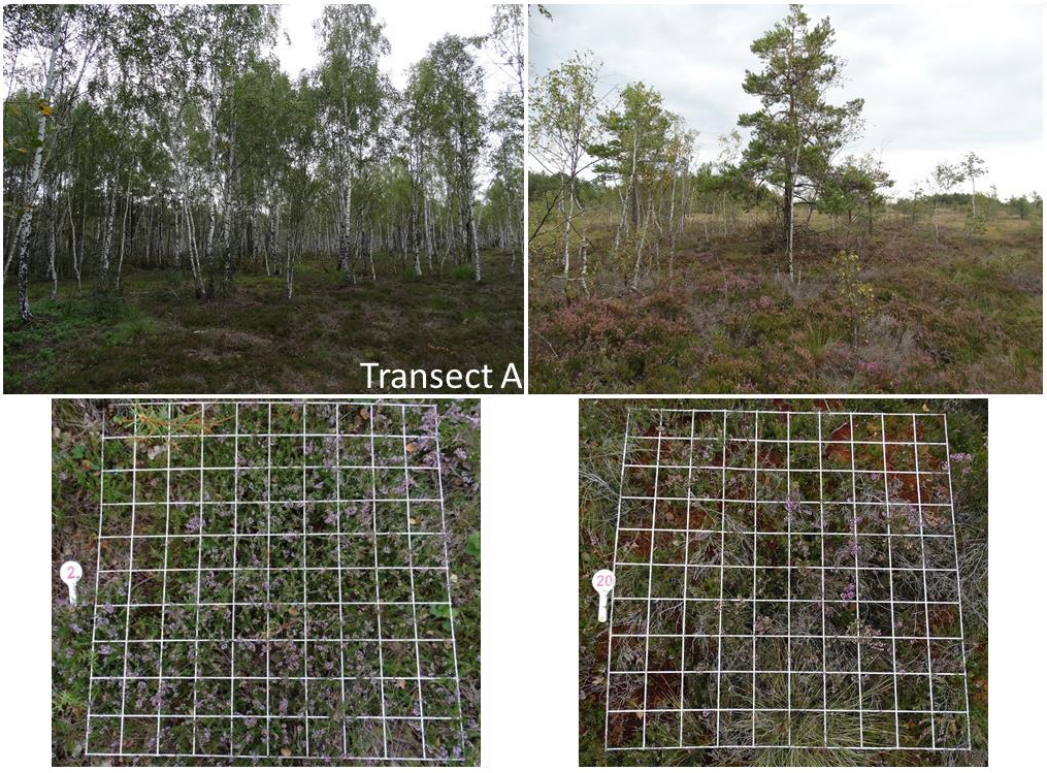

Fig. 7. Estimation of *Calluna vulgaris* covers in Transect A (2nd and 20th permanent study plots; 1.0×1.0 m in size), Aukštumala Telmological Reserve

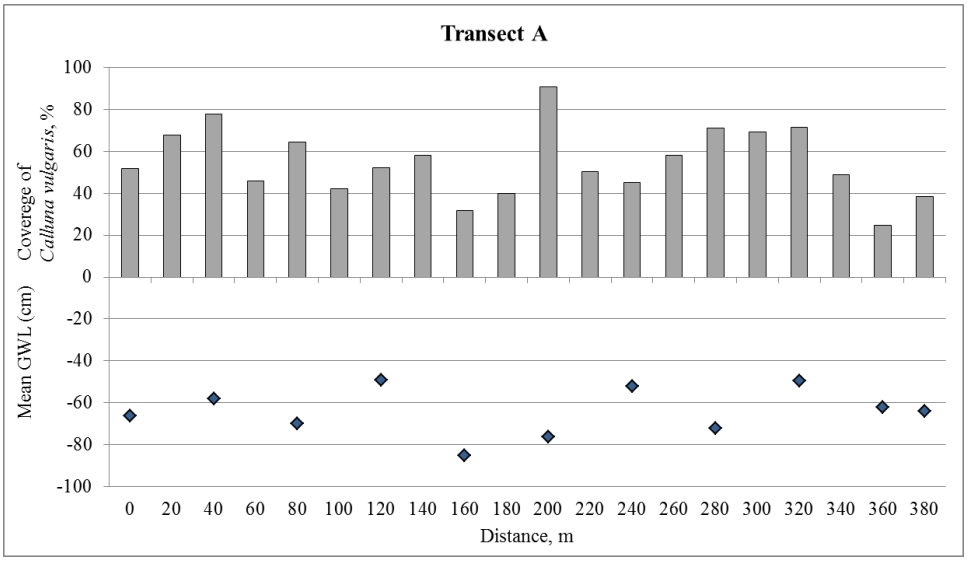

Fig. 8. Coverage of *Calluna vulgaris* (%) and mean ground water level (cm) in the Transect A, Aukštumala Telmological Reserve, 2014

Transect B. The site was drained by dense net of ditches, vegetation cover was removed and prepared for industrial peat harvesting in the late 80's of 20th century. Almost 40 years of intensive drainage turned this site in to forest dominated habitat (*Betula pendula, B. pubescens, Pinus sylvestris*). After fire in 2011 all vegetation cover was completely burned. Currently the area is completely covered by *Calluna vulgaris* (64–96% of permanent study plot; *Fig. 9*). *Sphagnum* can only be found in the drainage ditches. The coverage of typical raised bog species (*Rubus chamaemorus, Vaccinium vitis-idea, Rhynchospora alba*) was very sparse.

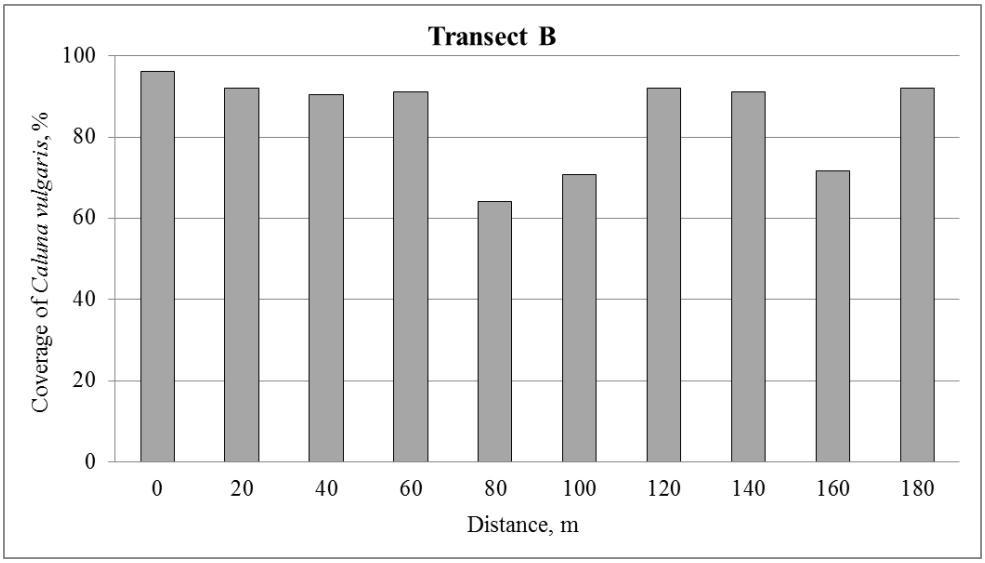

Fig. 9. Coverage of *Calluna vulgaris* (%) and mean ground water level (cm) in the Transect B, Aukštumala Telmological Reserve, 2014

Transect C. The site is negatively influenced by peat harvesting. Moreover, the northern part of the transect (up to 60 m length) is affected by 5 drainage ditches. The area is also damaged by fire in 2011. Vegetation cover in drained area (degraded raised bog) was burned out completely, whereas in the rest part of transect C (active raised bog) was strongly damaged. Currently *Calluna vulgaris* dominate in one third of the transect (up to 60 m length) – 64–97%, whereas in the rest part of the

transect *Calluna vulgaris* coverage is more related with microtopography (from 0% in depressions to 86% in hummocks; *Fig. 10*). Although water level compared with above mentioned sites is relatively high (average -31 cm), the coverage of *Calluna vulgaris* is still dense and not typical to open raised bog communities. This site has a biggest potential for the changes towards active raised bog vegetation, because of presence of typical raised bog species (*Rubus chamaemorus, Rhynchospora alba, Oxycoccus palustris, Andromeda polifolia, Eriophorum vaginatum, Drosera anglica, D. rotundifolia, Sphagnum magellanicum, S. fuscum., S. rubellum* etc.).

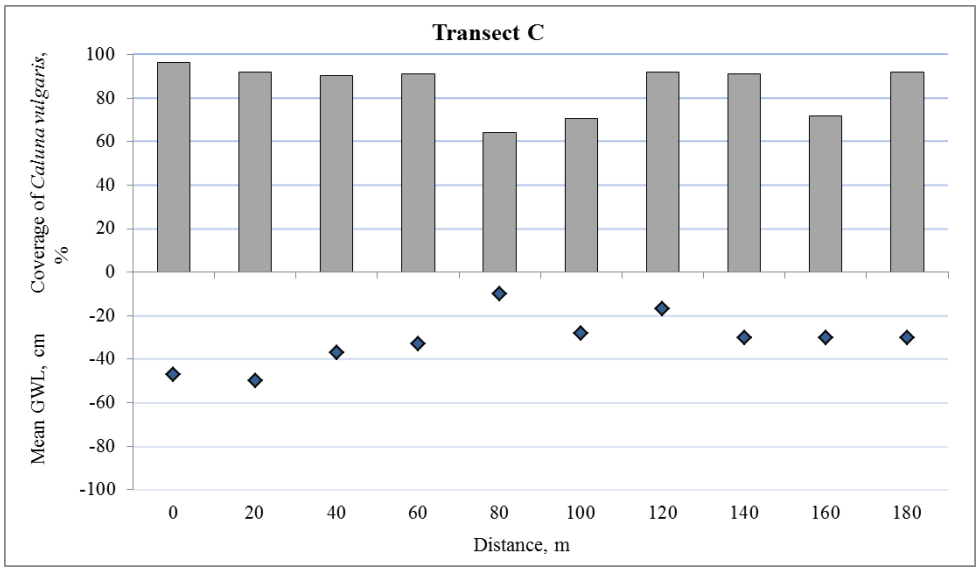

Fig. 10. Coverage of *Calluna vulgaris* (%) and mean ground water level (cm) in the Transect C, Aukštumala Telmological Reserve, 2014

CONCLUSIONS

1. Hydrological monitoring data (April–October, 2014) was collected in three different habitat types: active raised bog, degraded raised bog and areas totally destroyed by dense and active drainage system and/or fire (2011).
2. According to hydrological monitoring data the main threats to habitats of Aukštumala Telmological Reserve are posed by dense and active drainage system, peat harvesting in the adjacent territories and evapotranspiration by trees. The worst hydrological condition in project area was ascertained in Sites 1, 2 and 4 were ground water level usually dropped deeper than 50 cm.
3. *Calluna vulgaris* is a good indicator for changes in hydrological regime in raised bogs. This dwarf-shrub dominates in all the investigated transects. According to monitoring results Transect B is in the worst condition, i.e. *Calluna vulgaris* covers from 64% to 96% of permanent study plots. In this area it might take a longest time and biggest efforts to restore habitat towards typical raised bog. *Sphagnum* mosses was only inventoried in Transects A and C in the areas close to the habitats of active raised bog.
4. In order to improve hydrological condition and restore typical raised bog vegetation cover drainage blocking and tree clearing actions must be taken.