PRESENT LANDSCAPE STRUCTURE ELEMENTS IN ATTITUDE TO LANDSCAPE HYDRIC POTENTIAL IN BOŠÁCA VALLEY

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ABSTRACT

This article shows the present landscape structure influence on landscape hydric potential in the upper part of Bošáčka catchment in Protected Landscape Area Biele Karpaty. Present landscape structure was mapped in detail on a local scale. The quality, quantity and spatial distribution of elements reflect human activities that influence directly the ability of the land to retain and infiltrate atmospheric rainfall – hydric potential. Hydric landscape potential discussed in the article represents the synthesis of land use elements, CN numbers and hydrological soil groups (HSG) evaluated by CN - curves methodology. It resulted into the identification of six categories of the hydric potential (from very low to very high), where 58.13% of surveyed area falls within very high and high hydric potential areas.

Key words: land use elements, hydric potential, curve numbers

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INTRODUCTION

With the change of the landscape structure the landscape functions change accordingly. Functions such as infiltration, retention and accumulation of atmospheric rainfall combined are characterized as Hydric potential (Lepeška,2010).For the soils´ hydric function the most important is topsoil layer, where intense soil biological activities take place. Rich structured topsoil layer can take as much as 800 - 900 m^2 in 1g of forest soil (Perry, 1994). Úleha (1974)mentions that 1 kg of organic soil is able to retain 3kg of water.

Land use in Novobošácke kopanice on the Slovak – Moravian border, mapped and described in terms of present landscape structure, isdiscussedin their relation to the hydric potential of researched area quantitativelly evaluated in terms of CN curves methodology.Knowledge of this relation (land use – hydric potential) is the basis for landscape ecological optimization of hydric potential to prevent floods based on ecosystem restoration approach.

Research is carried out in the upper part of Bošáca valley in the subunit Lopenícka hornatina of the geomorfological unit White Carpathians in altitude ranging from 295 to 911 m.a.s.l.The area administratively belongs into the cadastral area of Nová Bočáca. It is the part of Protected Landscape Area Biele Karpaty as well asNATURA 2000 site SKUEV0367 Holubyho kopanice.

METHODOLOGY

Methodical platform for mapping present landscape structure elements (land use) was thebasic legend of landscape elements (Petrovič,Bugár,Hreško, 2009) that was adapted to the local conditions, land use elements occurrence and hydrological point of view. The basic data layer for field research were aerial photographstaken in 2007 and forest maps in the scale 1:10000 for LHC Nové Mesto nad Váhom. Data were processed in ArcView GIS 3.2 software.

Quantitative evaluation of land use elements hydric functions was processed by CN – curves methodology that was elaborated in Soil Conservation Service (SCS) in USA and successfully adapted for central European conditions (Janeček, 1992). The methodology is based on the relation of the catchments retentionto soil hydric attributes such as soil moisture, land use and hydric conditions. Curves numbers are tabled according to soil hydric attributes and divided into four groups: A, B, C and D based onland use and minimal water infiltration speed after long term saturation. It is understood that the higher CN value, the higheris the probability that the direct runoff will be that of surface runoff that was not infiltrated into the soil (Pechanec, 2006).

Based on bonita soil ecological elements (BPEJ) and forest database evaluation the hydrological soil groups (HSG) in terms of hydric attributes were identified in the surveyed area. These fall within the category B - soils with middle infiltration speed 0.06-0.12 $mm.min^{-1}$(typical fluvisols, eutric cambisols, typic planosols) and category C - soils with low infiltration speed 0.02-0.06 $mm.min^{-1}$(typical cambisols, mesotrofic cambisols, cambisols on flysch, typical regosols). CN values of every land use elements are mentioned in text for categories B and C (CN B,C).

RESULTS

We have were identified 35 land use elements in detail in surveyed area (3611.73 hectares) however these were grouped into 18 elementsaccording to the CN methodology. Dominant land use elements group is continual forest crop thatcovers 61.53 % of the area, 22.7% take meadows, 10% is covered by agricultural land, 3.13% take residence and traffic land use elements group, 1.81% is covered by line vegetation and 0.83% take land use elements group of water bodies and wetlands.

Land use elements	CN curve value HSG B	HSG C	Area (ha)	Area (%)	Hydric potential
Continual forest	30	52	1980.79	61.53	Very high
Alluvial forest	36	54	42.43	1.17	Very high
Linear vegetation	48	64	23.17	0.64	high
Overgrown fruitorchards	50	65	75.53	2.09	high
Fruit orchard	53	67	199.89	5.53	high
Areas overgrown by succession vegetation	56	70	90.77	2.51	high
Meadows	58	71	579.13	16.03	Medium
Pastures	61	73	187.67	5.19	Medium
Overgrown meadows	62	74	28.95	0.80	Medium
Small fields	75	82	85.41	2.36	Medium low
Forest clear-cuts	77	83	103.29	2.85	Medium low
Wetlands	84	84	8.79	0.24	low
Small erosive forest road	82	85	3.99	0.11	low
Medium erosive forest road	87	89	43.41	1.20	low
Strong erosive forest road	89	92	20.93	0.57	Very low
Water streams	98	98	15.44	0.42	Very low
Residential area	98	98	21.79	0.60	Very low
Indurated road	98	98	24.42	0.67	Very low

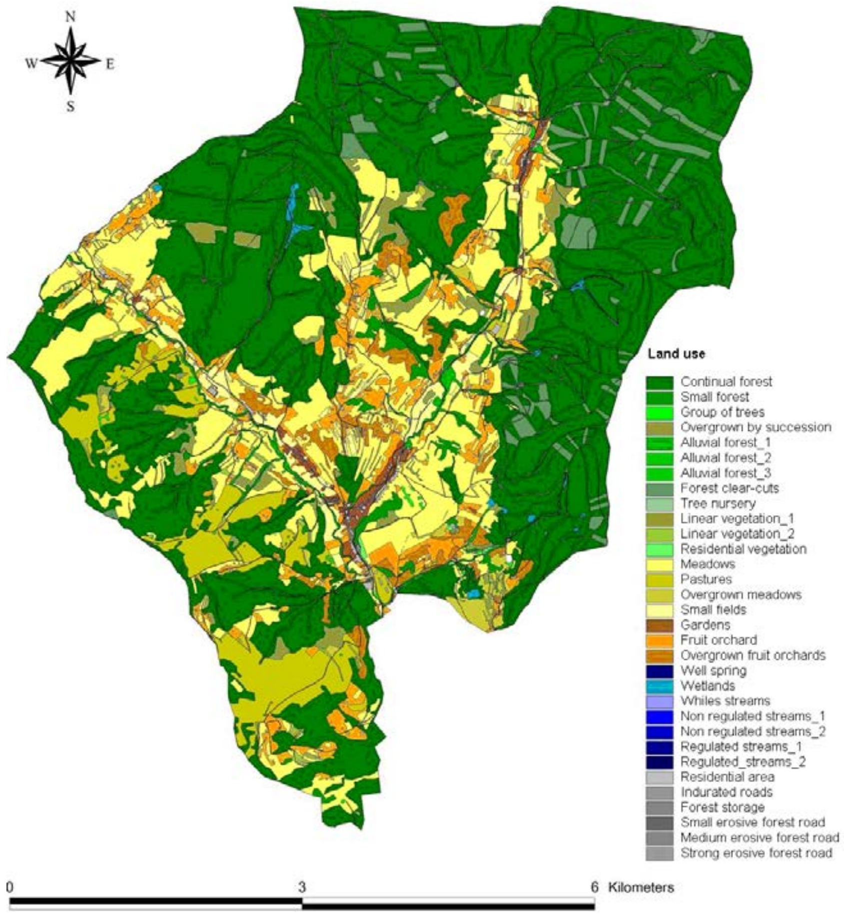

Fig.1. Map of present landscape structure in cadastral area Nová Bošáca, mapped in the years 2011 and 2012.Within the area of 3611, 73 ha we have identified 35 land use elementsthat were grouped into 18 land use elements according to the CN methodology (Tab.1).

Of all land use elements continual forestnaturally represent the highest value of hydric potential thus creating an optimal soil conservation and protection system. According to Kantor (2002) the surface runoff and continual soil erosion in forest iscompletely negligible. Mountain forests absorb easily storm rainfall(up to 50 mm), critical border of effective rainfall absorption in forests is continual rainfall up to 150 – 200 mm.

In surveyed area the natural species forests of *Fagus sylvatica* with *Quercus petreae*,*Carpinus betullus*, *Acer pseudoplatanus*, *Fraxinus excelsior*, *Cerasus avium*are dominant.Alluvial forests with their root system stabilize river banks from erosion, shape water streamand influence surface runoff speed (*Alnus glutinosa* roots create meanders, fallen trees slow down the surface runoff speed).

Agricultural landscape covered by fruit orchards in different phases of succession is characterized by high hydric potential as well as high ecological and high economical potential, protects soil, biodiversity and landscape character. Line vegetation along contour lines is very important stabilization elementthat divides large blocks of agriculture fields and mechanically processed meadows. Soil in orchards under trees and grass linearvegetation shows crucial infiltration capacity (Vašků ,1998).

Medium hydric potential is associated to agricultural land use elements of pastures and meadows that are the second largest element in our area of interest. Connected grassland divet is in average 10% more porous and spongy than arable soil (Rychnovská, 1985).

Medium to low hydric potential is attributed to land use elements with disturbed soil surface, without vegetation or only with sparse vegetation. Erosive processes on logging slopes are the consequence of clear-cutting of forests as well as poorly organized heavy machinery work. Especially on flysh sub-soil it has extremely negative impact on the soil quality as well as on hydric potential (Kantor,2002).

Land use elements with low and very low hydric potential are forest roads that were mapped in three categories (small, medium and high erosive forest roads). Surface runoff occurs already duringlow rainfallsin the places where heavy mechanisms move and drag trees stocks to the soil compression and elimination of soil pores.Surface runoff on forest roads is possible to take 1300 timeshigher than surface runoff in adult forest (Midriak,1995), which means that almost all water which falls down on forest roads flow flow into the water stream (Midriak,2002).

Wetlands represented by forests and meadow springs as well as wet alluvial forests are ecologically important habitats that work like a sponge,they accumulate large capacity of waterin rainy season and then release it slowlyin dry season. Relatively high CN Number _84 is explainedin the methodology by high water saturation in such habitats.

Water streams are in CN methodology considered as impermeable surfaces. However the level of changes in naturalwater course is important aspect of surface runoff speed, but it is not reflected in this level of methodology.

Residential areas and stabilised roads are land use elements with the highest CN number, because of impermeable surface. The density of these elements in researched area isvery low, so their hydric impact is not taken into the consideration.

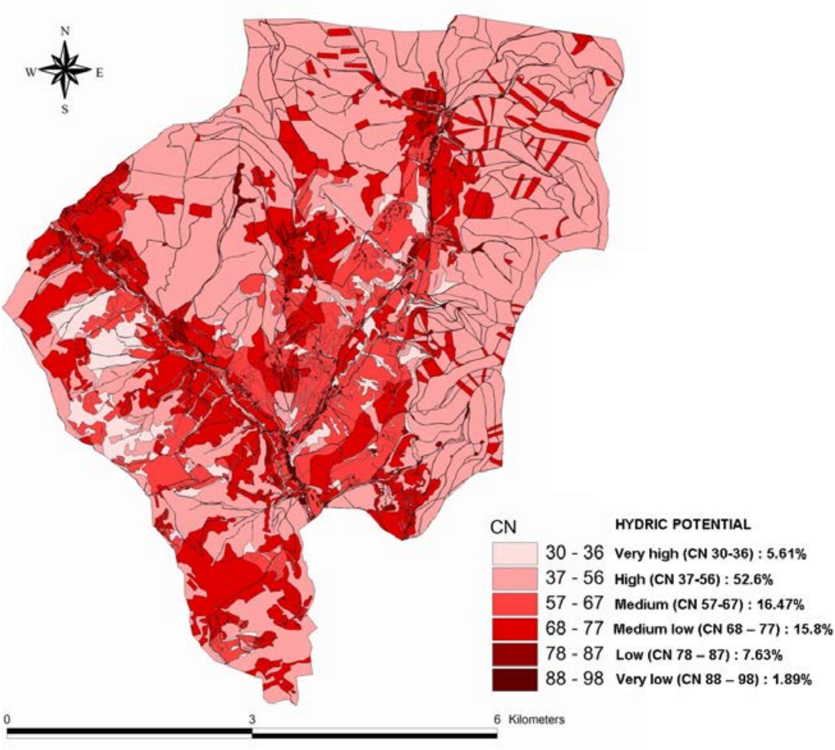

Fig.2 Hydric potential map of Nová Bošáca cadastralarea is synthesis of land use elements, hydrological soil group(HSG) and CN numbers.Map shows high hydric potential of Nová Bošáca cadastral area (with 58.13% of the area covered by very high and high hydric potential areas).

DISCUSION

Selection and detailed assessment of land use elements was chosen accordingly tomap accurately on local scale andin regard to hydric potential. Evaluation was based on empiric methodsduringfield mapping, study of scientific publications and on the CN curves methodology, which represents one of the inputs into the hydrological software model LOREP.

LOREP is implemented to identify and localize areas with low hydric potential with possibility to assess proposed scenarios. Part of this model is structured catalogue proceedings of non-technic type to increase and support water retention in landscape (Pechanec, 2006). This software model cannot work with very detailed data that were obtained by field research, so the data have to be adapted to LOREP data structure. Software modelling in LOREP is the next step of research (proposal of hydric potential optimization) that can help us to prevent floods with ecosystem approach.

CONCLUSION

Mapping of present landscape structure confirmed high landscape - ecological diversity of upper part of Bošácka valley. Covering the area of 3611.73 hectares as much as35 land use elementswere identified. Thesewere together with CN numbers and hydric soil groups basic inputs into the landscape ecological synthesis.The result of this synthesis is the identification of six categories according to hydric potential.

Area with very high hydric potential represents 5. 61% of surveyed area, high hydric potential area represents 52.6 % of researched area.

Medium hydric potential area covers 16.47% and medium low hydric potential 15.8% of researched area. Low hydric potential area is attributed to 7.63% and very low hydric potential area to 1.89% of researched area.

Results of the research confirm high hydric potential of Nová Bošáca cadastral area (with 58.13% very high and high hydric potential areas). Key land use elements that increases landscape hydric potential are continual forests and in agricultural landscape it is mostly linear vegetation, alluvial forests and fruitorchards in different succession phases.

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