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An attempt to assess of the influence of the bedrock on the habitat-forming properties of forest soils formed on Lower Triassic sediments (Buntsandstein) in the north-western part of the Świętokrzyskie (Holy Cross) Mountains

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Abstract

The subject of the research was forest soils developed on Lower Triassic (Bundsandstein) sediments in the north-western part of the Świętokrzyskie Mountains (Holy Cross Mountains) within the Suchedniowsko-Oblęgorski Landscape Park. The goal was to determine forest soil fertility formed from two types of sedimentary rocks – sandstones (SFS) and claystones/mudstones (SFCM), at similar geomorphological conditions. It was found that the tested soils have specific physicochemical properties depending on the type of rock substrate. As a result, the habitat-forming properties are variable. Calculated Trophic Soil Index (TSI) values point to mesotrophic character of the soils developed on the sandstones (SFS) and eutrophic one in the case of the soils formed over claystones/mudstones (SFCM).

1. Introduction

Forests are one of the most species-rich terrestrial ecosystems. They characterize in a high level of biological variability at different horizons, e.g., the genetic or species ones (Lindenmayer, 2009). They play an important role in development of ecosystem-related services of, i.a., delivery, regulative and cultural character (Miura et al., 2015; Maes et al., 2016). Their diversity is due to many factors of which soils are noteworthy to mention. They merge geological substrate with animated part of ecosystem. By representing the outermost zone of the lithosphere they form and change in time under the influence of numerous environmental factors, e.g., climatic conditions or vegetation cover. Soils also influence the remainder of ecosystem's components, e.g., composition of forest stands and local microclimate.

Issue of objective assessment of soils' quality and productive potential is an important matter forest site science and silviculture (Lasota et al., 2011). It also plays an important role in post-agricultural soils (Gawęda et al., 2018) and degraded areas (Pietrzykowski et al., 2010).

One of the most important problems in soil science is the determination of the mutual relationships between factors such as the genesis of the parent rock the soil formation process, the soil properties and the utilisation value of the soil. In the case of the forest soils, the latter parameter is understood as habitat-forming capacity.

According to many authors (Brożek, 2001; Gałka et al., 2013; Brożek and Zwydak, 2003; Kabała et al., 2011; Szopka et al., 2010) an important element considered in the evaluation of the habitat-related soil characteristics is geological structure and terrain morphology. Based on the geological data indicators related to the role of parent rocks in creation of a forest habitat are developed. Some of them, e.g., soil texture, comprise the so-called partial diagnoses that describe soil conditions and that are used to calculate the Trophic Soil Index (TSI). According to Lasota et al. (2011) the granulometric composition of the parent rocks or their weathering cover is of a particular importance for the assessment of quality of mountain forest habitats. This query is extremely important in the case of soils developed from formations of peculiar or diverse mineralogi-

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cal-petrographic properties. This is exemplified by soils formed from rocks known as *red beds* (Van Houten, 1973). These are sediments of rock formations that were formed in the geological past under terrigenous conditions (Walker, 1968). Currently they are present at surface in many sites worldwide, in different climatic zones and variable geomorphological conditions. In Poland this matter is mostly related to soils developed on Lower Triassic sediments in the Świętokrzyskie (Holy Cross) Mountains. Depending on the local geological structure the sediments occur over vast areas as compact complexes of red sandstones, mudstones and claystones (Barczuk, 1979). Soils ensued from these formations possess unique properties that are not observed in genetically and typologically similar soils. One of these is the characteristic red colour resulting from the presence of hematite in the parent rocks (Szafranek, 1989; Zagórski and Kaczorek, 2002; Zagórski and Kisiel, 2014). In the Świętokrzyskie (Holy Cross) Mountains most of the areas of the occurrence of the Lower Triassic sediments are occupied by compact forest complexes.

The paper presents a synthetic comparison of the main properties of forest soils formed on Lower Triassic (Bundsandstein) deposits in the north-western part of the Świętokrzyskie (Holy Cross) Mountains, in the Suchedniowsko-Oblęgorski Landscape Park. Based on the research results, the habitat-forming value of soils formed from two different types of sedimentary rocks was assessed: i) red sandstones, ii) red claystones located in similar geomorphological conditions. The work uses materials from many years of soil research conducted as part of projects financed from budget funds and own research, as well as current information about forest communities in Poland based on data from the Forest Data Bank (FDB). The soil trophic index (TSI) was used as an assessment indicator.

2. Materials and methods

The studies were conducted in north-western part of the Świętokrzyskie (Holy Cross) Mountains, within occurrences of the Lower Triassic (Buntsandstein) sediments. They comprise the northern Mesozoic edge of the Palaeozoic range of the Łysogóry (Fig. 1).

They are sandstones with clay, mudstone and pseudo-oolite insets, and shales with phytofossil imprints. Claystones with conglomerate insets are also present here (Filonowicz, 1973, 1979). Geogenesis of these sediments, i.e., their development as a desert facies, led to their peculiar properties. Their basic distinguishing macroscopic feature is their red colour pointing to the presence of hematite. Typically, their mineralogical composition is of a low variability – in the sandstones quartz is the dominant species while in the claystones its role is taken over by kaolinite (Zagórski and Kaczorek, 2002). The properties mentioned are preserved in their weathering cover (Table 1).

The area under study characterizes in a variable geomorphology. A set of not too high (300-465 AMSL) hills is present. They are separated by indentations which are clearly seen in the terrain's morphology.

We have studied forest soils developed on weathering covers of sandstones and claystones/mudstones. The dominant factor determining selection of the materials was the soil texture of the parent rocks. Two groups of soils were studied. The first one

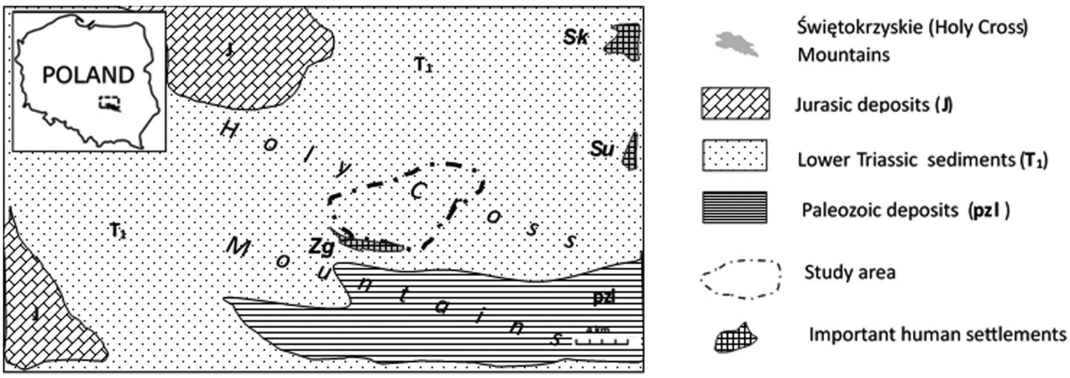

Fig. 1. Geological sketch of the NW Świętokrzyskie (Holy Cross) Mountains. Sk – Skarżysko-Kamienna, Su – Suchedniów, Zg – Zagnańsk

Table 1
Macroscopic features and mineralogical characteristics of sediments in the subsoil of forest soils

Geological background – the rock	Colour*	Lithological characteristics	Admixtures	Mineralogy	
				>0.002 mm fraction	<0.002 mm fraction
Sandstones	10R – red	loose weathering cover with rock fragments, or a compact rock	tree roots (rare)	Quartz +++	Kaolinite +++ Hematite +
Claystones, mudstones	10R – red	clay packets or claystone layers with interbedded mudstone	moderately abundant tree roots	Quartz + Hematite + (nodules)	Kaolinite +++ Hematite +

* according to Oyama and Takehara, 1970

were soils of a light texture, formed from sandstones (SFS). The second one were soils of a heavy texture, developed from claystones and mudstones (SFCM). Choosing the soil texture as the criterion was due to its role in determination of the TSI. The latter is used in the assessment of soil (Święcicki, 2012). Soils mainly classified as brown acidic (BA), according to the Classification of Forest Soils in Poland (Biały et al., 2000) of ones are these derived from the sandstones. Rusty brown soils (RB) are often encountered, especially in sites where a more intense weathering has led to higher sand add in the sandstones' weathering cover. The covers of claystones and mudstones gave rise to the BA soils, too. Where the clayey bedrock is located at a relatively shallow depth, proper pseudogley soils (PG) also occur. In the case of local terrain depressions stagno-gley soils (SG). According to World Reference Base for Soil Resources (WRB) the soils discussed may, in general, be qualified as Chromic Cambisols (IUSS Working Group WRB, 2015).

The research area includes forest areas belonging to the Suchedniowsko-Oblęgorski Landscape Park, which are the remains of the former Świętokrzyska Forest. Based on publicly available publications and data, it can be determined that in the mentioned area there are fresh mixed upland forests, with dominant Holy Cross fir forest – habitat code 91P0 *Abietetum polonicum* phytocenosis. The multi-layered forest stand is dominated by silver fir (*Abies alba*) with an admixture of common beech (*Fagus sylvatica*) and Norway spruce (*Picea abies*). The shrub layer consists of fir and beech trees. The thickets also include shiny sea buckthorn (*Frangula alnus*), mountain ash (*Sorbus aucuparia*) and silver birch (*Betula pendula*). In the vicinity of fresh mixed upland forests there are fresh mountain forests with rich beech forest habitat code 9130 (*Dentario glandulosae-Fagetum*). The forest stand is made up of dominant common beech (*Fagus sylvatica*) and common silver fir (*Abies alba*) and other species occurring locally. The shrub layer, collectively, comprises of common silver fir and common beech sapling. Common silver fir, European hornbeam and common birch are found, beside common beech, within the undergrowth. The sites studied also comprise oak-hornbeam forests *Tilio-Carpinetum* vegetation assemblages of a multi-layer vegetative structure. Here, the forest stand mainly bears common beech and common silver fir. The shrub layer is formed by a set of forest-forming species while European hornbeam and common birch are found, in addition to common silver fir and common beech, in the underbrush (FDB; Piwowarski and Przemyski, 2020).

The comparison of the soil environment and forest vegetation was carried out on 6 selected forest plots in the Zagnańsk and Suchedniów forest inspectorate (Fig. 2, Fig. 3, Table 2).

The selection criteria included i) geological background – natural outcrops of Lower Triassic sandstones or claystones; ii) similar geomorphological features of the area – usually flat plateaus or denudation terraces; iii) described forest vegetation.

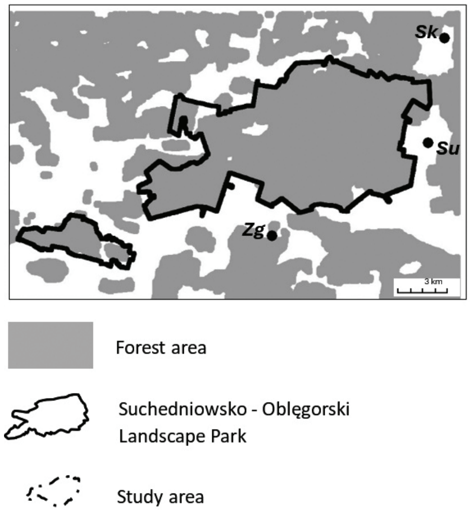

Fig. 2. Forest areas in the NW Świętokrzyskie (Holy Cross) Mountains. Sk – Skarżysko-Kamienna, Su – Suchedniów, Zg – Zagnańsk

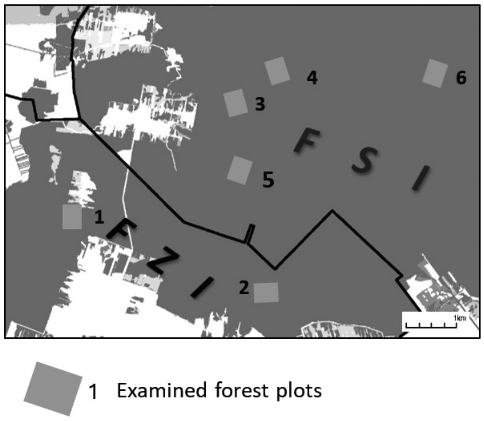

Fig. 3. Location of the forest plots where the soil and sediment tests were performed. FZI – Zagnańsk Forest Inspectorate; FSI – Suchedniów Forest Inspectorate

Table 2
Selected soil-forest areas

Numbers of the studied forest plots (Fig. 3)	Forest inspectorate	Forest district	Forest division
1	Zagnańsk	Długojów	82a
2	Zagnańsk	Występa	34b
3	Suchedniów	Osieczno	97h
4	Suchedniów	Osieczno	98f
5	Suchedniów	Szałas	168a
6	Suchedniów	Jastrzębia	203c

During field soil research, observations were made of natural outcrops of Lower Triassic rocks and forest soils. In order to identify the geological substrate and collect samples, several dozen manual drillings and some soil profiles were made. Soil samples were collected from representative locations – drillings or soil horizons – 14 from soils formed from sandstones and 10 from soils formed from claystones (Fig. 4).

The determination of the main soil properties was made according to the standards used in soil science (Kabała and Karczewska, 2019). The following parameters were determined: particle-size distribution (PSD) of soils using Bouyuocos-Casagrande's areometric method modified by Prószyński, grouping the particles into classes according to the Polish Soil Classification (2019) using the Casagrande method in the modification of Prószyński. The reaction (pH) as potentiometrically measured in suspension with deionized water and 1 mol dm^3 KCl in the soil-water/ KCl ratio of 1:2.5 (pH-meter Elmetron CPC-401); exchangeable hydrogen (H_{ex}), exchangeable aluminium (Al_{ex}) using the Sokolov method (1M KCl); potential acidity (H_h) (extracting agent Na acetate) and the sum of exchangeable base cations (S) using the Kappen method and degree of saturation of the sorption complex with base cations (V); total organic carbon (C_{org}) and total nitrogen (N_t) determined by the dry-combustion method through 9 varioMacroCubeElementar, Germany.

The volume density of the soils (D) was calculated for the surface layers based on the total organic matter content (TOC) using the formula of $D = 1,3773 \cdot e^{-0,0547 \cdot TOC}$ (Brożek and Zwydak 2003). The determination of density (D) for deeper layers was based on the granulometric composition according to Brogowski's formula (1990). The grain size was determined at each research point.

Due to high variability of the parameters being determined, for both the soil profiles and between them, we used medians values for each of the two types of the geological beds (see Fig. 5–10). The median values of the parameters were used to determine the TSI (Święcicki, 2012).

For the soils under scope the TSI was calculated according to the following formula:

$$TSI = W_{0.02} + W_S + W_Y + W_N$$

where:

$W_{0.02}$– index of the soil content of particles under 0.02 mm,
W_S – index of the basic cations' content,
W_Y – index of the recalculated acidity,
W_N – index of the recalculated nitrogen.

Results were compared using the t-test, the Mann-Whitney U test, or the Kruskal-Wallis test. Correlation of soil characteristics was analyzed using Pearson correlation or Spearman's rank correlation. Normality of results was checked by means of the Shapiro-Wilk test and homogeneity of variance by the Levene's test. Significance level (α) in this study was 0.05.

3. Results and discussion

It is due to the character of the forest vegetation which rootage going much deeper than in the case of the cultivable plants. This is expressed in setting the impact depth of 150 cm in considerations of the mentioned bedrock significance. This depth is often higher than soil profiles' thickness (i.e., extent of the pedogenic processes), but it also often introduces some features of the parent rocks into the habitat assessment. One of the important factors considered is soil texture. During the calculation of the TSI parameter a pivotal role is played by an index of the soil content of particles under 0.02 mm. Thus, we separately analyzed soils and forest communities formed on the two lithologically discrete rocks. The common feature of these rocks is their red colouration, mainly in the 10R Munsell range.

The SFS show the loamy-sand texture grading to sandy loam. The sand fractions are dominant (77 % on average), with small add of the silt (14%) and clay (10%) fraction. Grains of the sand and silt comprise quartz derived from physical weathering of the sandstones while the glue-derived clay fraction bears kaolinite and hematite (Zagórski et al., 2015). Soil texture of the SFCM points to light loam in the upper portions of the profiles or normal clay in the lower ones. The soil granulometry described

Fig. 4. Examples of vegetation and soils formed on the Lower Triassic deposits in the north-western Świętokrzyskie (Holy Cross) Mountains
A) An example of a forest community occurring on soils developed from Lower Triassic sediments – Długojów district, section 82a (16-18-1-04-82-a-99).
B) An example of soil developed from weathered red sandstones (SFS) – rusty RB soil (Chromic Leptic Cambisol WRB)
C) An example of soil developed from weathered red claystones and siltstones (SFCM) – acidic brown soil BA (Chromic Cambisol (Clayic) (WRB)

is due to characteristic distribution of the fractions in the rocks and their weathering cover. In general, the sand content is not high (22%; Fig. 5).

Broad-range fluctuations observed are mainly due to variation within the soil profiles – in the surface horizons the sand content is usually higher (up to 56%), due to a local enrichment related to geomorphological processes. The silt and clay fractions content corresponds to the rock lithology. Thin insets of the mudstones within the claystones are responsible for the silt fraction content in the materials studied. In terms of mineralogy, the soil substrate derived from the clay/mudstone rocks is analogous as in the sandstone case. Diversification of the texture of the soils under scope results in variable granulometric index – the content of particles under 0.02 mm. Indeed, this parameter is clearly different for the two soil groups studied. In the SFS it is 18% on average, being much higher in the SFCM-type ones (70%; Fig. 6).

Geogenesis of the soil substrate influences the soil physical properties. This is due to physical features of the rocks parent to the weathering coverage. Values of the bulk density (D) are important here. The sandstone weathering covers are usually looser than the post-claystone ones. In the SFS soils case the average D is 1.84 g cm^{-3} while that of the SFCM ones is higher, being averagely 2.14 g cm^{-3}. Elevated D values within the soil profiles result from higher compactness of material in the lower soil horizons. This is due to the compaction process. Lower D values in the upper portions are due to higher part of the organic matter.

The tested soils show characteristic and specific physicochemical properties resulting from the type of rock substrate. Regardless of the source rock type, these soils are highly acidic, with average pH_{H2O} of 4.1 and 3.9 for SFS and SFCM, respectively. In the case of pH_{KCl}, a clear influence of clay substrate is observed for SFCM – pH_{KCl} on average up to 3, and there is a greater range of variability (Fig. 7).

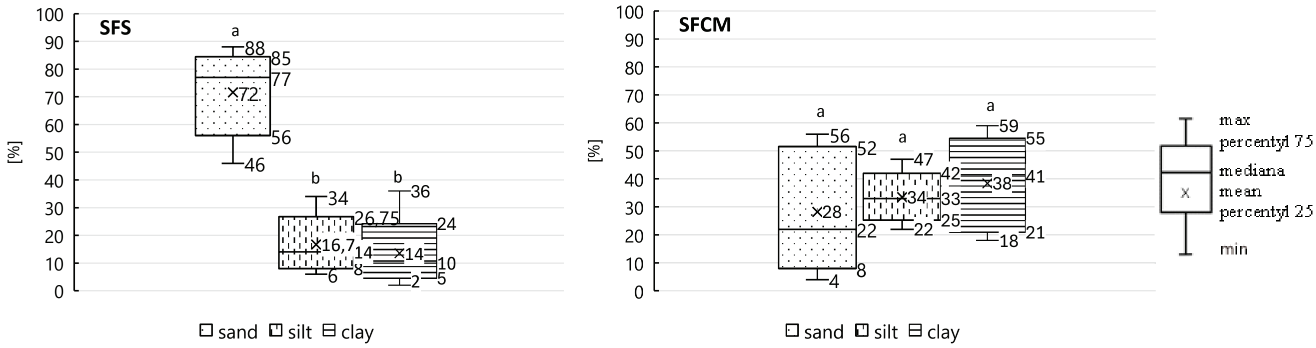

Fig. 5. Texture of the forest soils developed from Lower Triassic sediments
Content of the main fractions: sand, dust, clay
SFS – soils developed from sandstones, SFCM – soils developed from claystones and mudstones

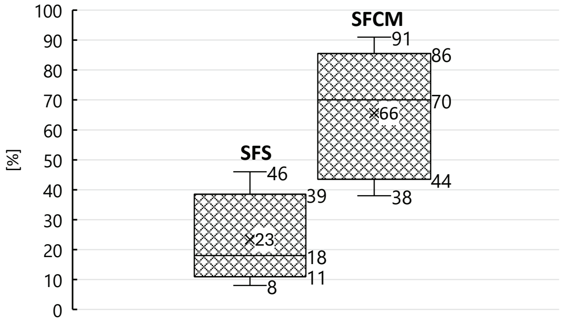

Fig. 6. Content of the below 0.02 mm fraction in the forest soils developed from the Lower Triassic sediments (Z = –4.22; p<0.05; N = 30)

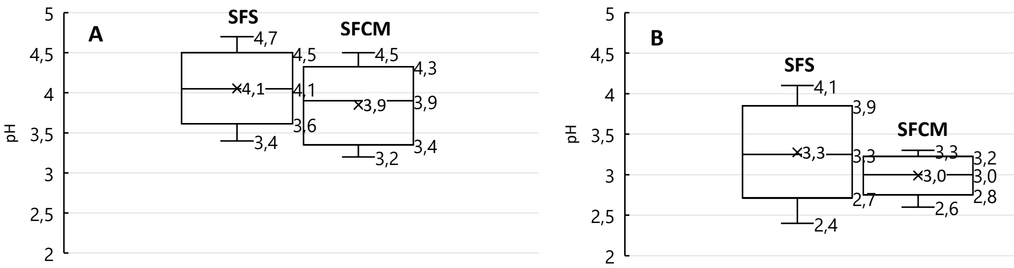

Fig. 7. Variability of pH of the forest soils developed from the Lower Triassic sediments
A) pH $_{H2O}$ (t=1.23; df=28; p>0.05; N=30)
B) pH $_{KCl}$ (Z=2.31; p<0.05; N=30)

A more specific connection between the pH and the exchangeable acidity (H_{ex}+ Al_{ex}) is known. In the soils from the substrates discussed the exchangeable acidity (H_{ex}) values are mainly determined by the exchangeable aluminium (Al_{ex}) parameter, and the exchangeable hydrogen (H_{ex}) is minimal. This is especially clear in the case of the SFCM-soils, where the Al_{ex} values are as high as 30.2 $cmol_{(+)}$ kg^{-1} on average (Fig. 8). The correlation coefficient of Al_{ex} with fraction content <0.02 mm is 0.83 (Table 3). This is related to the mineral composition of the parent rocks. The clayey substrate is dominated by kaolinite while carbonates are absent, as already noticed by Zagórski et al. (2015).

Among other physic-chemical properties of soils a very important habitat-forming role is attributed to the hydrolytic acidity (H_h) and total content of basic cations (S). They are considered as contributing factors in the TSI calculation. For the soils studied a diversity of both the H_h and S depending on the substrate is seen. Where SFS occurs, the Hh varies within wide limits of 2.3–23.9 $cmol_{(+)}$ kg^{-1}, but the average H_h value is low – 4.6 $cmol_{(+)}$ kg^{-1}, while SFCM is more even and on average higher – 11.1 $cmol_{(+)}$ kg^{-1} (Fig. 9). The value of hydrolytic acidity (H_h) is certainly influenced by organic acids that migrate from surface organic horizons O (e.g. forest litters) to deeper soil zones. It is very likely that external factors also influence acidification – e.g. acidic precipitation reaching directly to the soil as a result of runoff over tree trunks and penetrating through tree crowns (Kozłowski, Adwent 2011).

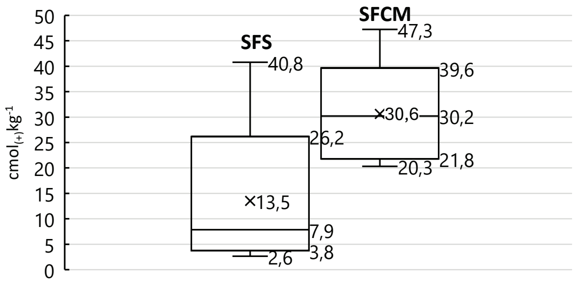

Fig. 8. Content of exchangeable aluminium Al_{ex} in soils developed from Lower Triassic sediments (Z = –2.39; p<0.05; N = 29)

The S parameter of the SFCM soils is low – from 0.6 to 4.2 $cmol_{(+)}$ kg^{-1} (just 1.6 $cmol_{(+)}$ kg^{-1} on average), being even lower in the SFS ones: from 0.2 to 3,1 $cmol_{(+)}$ kg^{-1} (0.7 $cmol_{(+)}$ kg^{-1} on average). Such low S values are not just due to the parent rock lithology but, above all, their geochemistry. These rocks are severely devoid of basic elements in ionic form (Ca^{2+}, Mg^{2+}, K^{+} and Na^{+}). The potential amount of these elements that can be mobilized by weathering is also small (Zagórski and Kisiel, 2018).

The size of the cationic sorption capacity (CEC) and the base saturation Vs closely correspond to Hh and S (Fig. 10). The large differences in sorption properties demonstrated indicate the huge role played by the specificity of the soil substrate, determined by the type of parent rocks. They prove that the sandy soil substratum is strongly depleted in aluminosilicates, and the clay fraction of claystones contains kaolinite – a type of mineral with a low CEC. This is confirmed by mineralogical studies (Brzychcy et al., 2012). The substrate is therefore definitely different from that formed by glacial clays, loess and weathered covers of igneous or sedimentary rocks (e.g., limestone). This is typical for soils formed from ancient terrigenous deposits of desert facies.

The components most important for assessment of the trophism of forest habitats is organic carbon (C_{org}) and total nitrogen (N_t). In the forest soils these parameters are usually determined

Table 3
Correlation coefficients determined for various parameters describing properties of the forest soils studied

SFS	ř <0.02 mm fraction	pH_{H2O}	pH_{KCl}	C_{org}	N_t	H_{ex}+Al_{ex}	S	H_h
ř <0.02 mm fraction	1.00							
pH_{H2O}	0.26	1.00						
pH_{KCl}	–0.08	0.61*	1.00					
C_{org}	–0.17	–0.68*	–0.69*	1.00				
N_t	0.09	–0.44	–0.76*	0.81*	1.00			
H_{ex}+Al_{ex}	0.53*	–0.41	–0.57*	0.41	0.48*	1.00		
S	0.11	–0.42	–0.39	0.31	0.41	0.26	1.00	
H_h	0.39	–0.44	–0.78*	0.65*	0.85*	0.72*	0.64*	1.00
SFCM	ř <0.02 mm fraction	pH_{H2O}	pH_{KCl}	C_{org}	N_t	H_{ex}+Al_{ex}	S	H_h
ř <0.02 mm fraction	1.00							
pH_{H2O}	0.69*	1.00						
pH_{KCl}	0.53	0.78*	1.00					
C_{org}	–0.43	–0.77*	–0.73*	1.00				
N_t	–0.46	–0.71*	–0.60	0.97*	1.00			
H_{ex}+Al_{ex}	0.83*	0.50	0.22	–0.33	–0.41	1.00		
S	0.08	–0.05	–0.29	–0.10	–0.21	–0.11	1.00	
H_h	–0.85*	–0.68*	–0.61*	0.49	0.53	–0.75*	0.15	1.00

* correlation coefficients – statistically important differences (p<0.05)

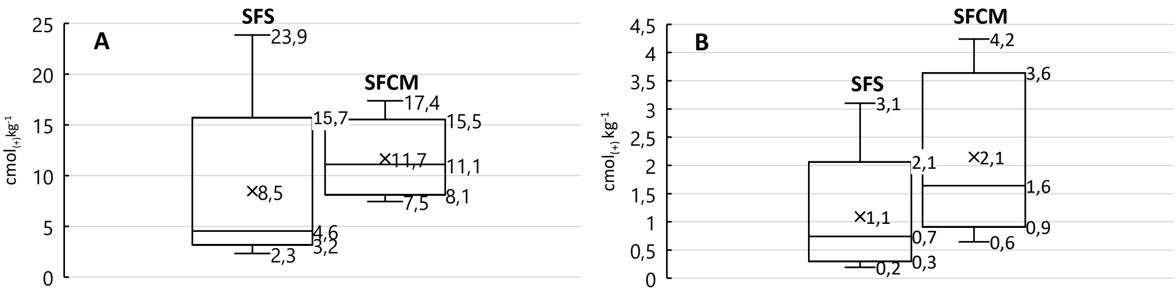

Fig. 9. Selected sorption properties of the forest soils developed from the Lower Triassic sediments. A) the amount of hydrolytic acidity Hh; B) sum of basic cations S
Hh (Z = – 2.88; p<0.05; N = 30); S (Z = –3.14; p<0.05; N = 30)

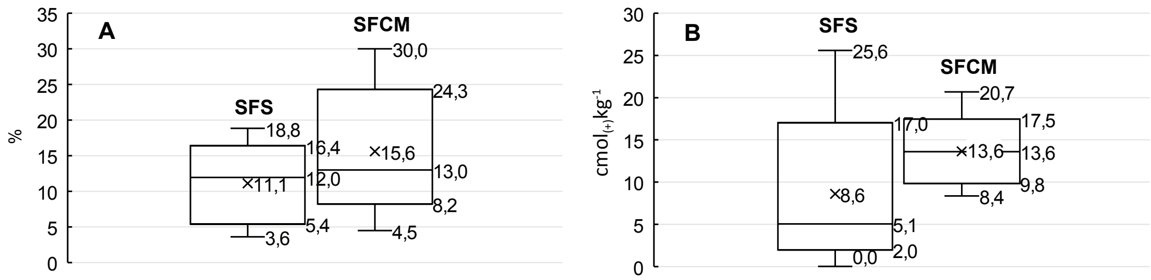

Fig. 10. Sorption properties of the forest soils studied. A) the size of the cationic sorption capacity (CEC), B) the size of the the base saturation Vs
Vs (t = –2.30; df = 28; p<0.05; N = 30); CEC (Z = –2.93; p<0.05; N = 30)

in the surface (O and A) horizons due to presence and transformation of organic substance within. In the lower levels the content of the organic matter drops dramatically, as guessed from low values of the above parameters. It shows that an important factor determining these parameters' values is of a biotic and not a mineral-substrate character. Lithology of the parent rock only partially influences these components. Thus, their values and mutual relations as parameters constituting the base for calculation of the TSI are only derived for the surface horizons.

In the discussed areas, the soils formed on sandstones or claystones differs in their C_{org} and N_t values. The C_{org} range is very large: 0.1–5.27% for the SFS and even higher: 0.11–7.98% for the SFMS. The average values are 0.34% for the SFS and 0.64% for the SFCM soils. The N_t value is also very variable and ranges from 0.01% to 0.30% for SFS soils and from 0.02% to 0.33% for SFCM (Fig. 11). Generally, the nitrogen content is strongly correlated with the amount of organic carbon (Table 3).

The area of the occurrence of the soils studied, in the NW part of the Świętokrzyskie (Holy Cross) Mountains, is fully covered by forest vegetation of a quite univocal habitat features. Thus, it is interesting to state how the established variation of the soils' properties related to the geological bedrock may influence their habitat-forming role. Mutual relations in the soil-(forest) habitat system are described by the TSI (Brożek and Zwydak, 2003; Brożek et al., 2011).

The diagnostics of trophism of the forest habitats is based on numerical indicators that include various, selected soil properties. The approach to the soil trophism in such form enables diagnosis and objective comparison of habitats (Schoenholtz et al., 2000).

To determine the value of the TSI parameter for the soils in the forest habitats of the NW part of the Świętokrzyskie (Holy Cross) Mountains, median values of selected soil properties were adopted. As shown in Table 4 and 5 individual parameters calcu-

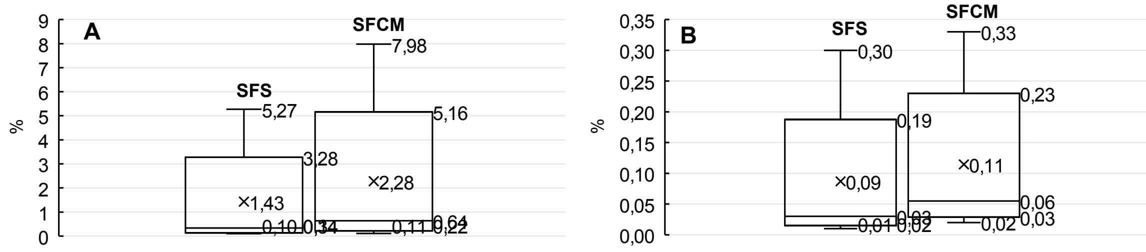

Fig. 11. Contents of organic carbon (C_{org}) – A, and total nitrogen (N_t) – B in the forest soils under study
C (Z = –0.69; p>0.05; N = 26), N (Z = –1.40; p>0.05; N = 26)

Table 4
Median values of some soil properties

	Content of soil fraction, %				D	C_{org}	N_t	H_h	S
	sand	silt	clay	<0,02 mm					
SFS	77	14	10	18	1.84	4.8	0.21	4.6	0.74
SFCM	22	31	41	70	2.14	6.17	0.33	11.1	1.64

Table 5
Partial indicators and values of the TSI of the soils developed on the Lower Triassic sandstones and claystones/mudstones of the Świętokrzyskie (Holy Cross) Mountains

	$W_{0.02}$	W_N	W_Y	W_S	TSI*
SFS	8.00	7.00	8.00	7.00	30.00
SFCM	10.00	9.00	9.00	9.00	37.00

* Trophic Soil Index

Table 6
Comparison of habitat fertility using the TSI index with data obtained from the FDB (Forest Data Bank)

Bed Rock	Trophic variety of soil subtype according to TSI	Habitat diagnosis based on soil TSI	Habitat type of the forest according to FDB	Dominant tree species according to FDB (%)
Sandstones	Mesotrohpic	Mixed forest	Fresh upland Fresh upland mixed forest	Fir (80–100) Beech (10–30)
Claystones and mudstones	Eutrophic	Forest	Fresh mountain forest	Beech (50–80) Fir (20–50)

lated for the SFS and SFCM differ from each other. The obtained TSI value for soils on a sandstone substrate is 30, and for soils on a claystone-mudstone substrate – 37. These values are indicative, but they allow determining the trophism of the habitat and synthetically diagnosing its fertility. The related comparison is presented in Table 6.

Currently, according to the FDB data, in the studied area of the NW part of the Świętokrzyskie (Holy Cross) Mountains, where the soil is developed on the Lower Triassic sandstones, there are mesotrophic habitats of fresh upland forests. In turn, in the case of soils with Lower Triassic clays or mudstones, eutrophic habitats occur. The authors propose to classify them as fresh upland forests and not as mountain forests, as proposed in the FDB source. The deviation of the current habitats from the model calculated on the basis of the TSI indicates a low degree of degradation – a condition close to natural.

4. Conclusions

1. The character of bedrocks of the NW part of the Świętokrzyskie (Holy Cross) Mountains influences properties of forest soils developed from Lower Triassic sandstones and claystones/mudstones.
2. The bedrock of the NW part of the Świętokrzyskie (Holy Cross) Mountains influences trophism of the forest soils. The value of the Trophic Soil Index suggests the mesotrophic character of the post-sandstone soils and the eutrophic character of the post-claystone/mudstone ones.

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Próba oceny wpływu podłoża skalnego na właściwości siedliskotwórcze gleb leśnych powstałych na osadach dolnego triasu (Buntsandstein) w północno-zachodniej części Gór Świętokrzyskich

Słowa kluczowe

Właściwości siedliskotwórcze
Siedliskowy Indeks Glebowy (SIG)
Podłoże skalne

Streszczenie

Przedmiotem podjętych badań były gleby leśne wykształcone na osadach dolnego triasu (Buntsandstein) w północno-zachodniej części Gór Świętokrzyskich w obrębie Suchedniowsko-Oblęgorskiego Parku Krajobrazowego. Celem badań było ocena wartości siedliskotwórczej gleb wytworzonych z dwóch typów skał osadowych – piaskowców (SFS) oraz iłowców i mułowców (SFCM) w zbliżonych warunkach geomorfologicznych. Stwierdzono, że badane gleby cechują się charakterystyczną znaczną specyfiką właściwości fizykochemicznych uwarunkowaną rodzajem skał podłoża. Przekłada się to na ich zróżnicowane właściwości siedliskotwórcze. Wyznaczone wartości indeksu SIG wskazują na mezotroficzny charakter gleb rozwiniętych na piaskowcach (SFS) oraz eutroficzny w przypadku gleb rozwiniętych na iłowcach i mułowcach (SFCM).