

Soil condition assessment

Visual assessment of soil condition

(prepared on the basis of FAO methodology and supplemented according to soil evaluation parameters in the Czech Republic)

Field equipment

- Spade or off-the-shovel (to remove a block of soil to a spade width (17-20 cm) to a depth of 30-40 cm).
- Water bottle
- Knife (preferably 20 cm long), tweezers, lockable edaphon box
- Thick-walled plastic sheet (or bag, approx. 75 x 50 cm) on which the soil block can be placed
- Scale
- Land Assessment Manual
- Anything for photographic documentation
- Visual rating protocol, paper / notebook for notes and pencil

Selection of a representative soil sampling location:

- approx. 10 m from the edge of the ecosystem to avoid the edge effect (5 m in the field, work carefully to avoid excessive damage of vegetation)
- if the selected area is on a slope, then select the place approximately halfway down the slope,
- Avoid field depression
- To assess the representativeness of the selection, assess the vegetation cover - it should be similar to the prevailing vegetation type.

You can perform the assessment under any weather conditions, but it is recommended not to take it in the rain and under severe drought conditions (the soil structure cannot be objectively assessed in the over-wet and too dry soil).

Soil collection and evaluation

1. Using a spade, remove the least damaged block of soil (17-20 x 30-40 cm), put it on a plastic sheet, align the walls of the probe with a knife, document and describe the soil profile - measure the thickness of detectable surface horizons, describe the presence / absence of litter, in the case of its presence, describe the degree of decomposition and the type of fall layer (mul / moder / plague).

2. Remove the organic horizons from the soil block, set them aside and evaluate the biological presence/activity (do so as soon as your macrofauna escapes), then evaluate the other parameters in the rest (see below). ATTENTION: You rate the incidence of earthworms and edaphones throughout the whole soil block.
3. Mix the soil on the plastic sheet and determine the texture
4. Take a representative sample of mineral soil (approx. 100g), dry at home and determine the active pH and carbonate content (10% HCl) in the laboratory.
5. Check the protocol to determine if you have made all the necessary assessments.

Erosion Assessment

It is performed during terrain reconnaissance. Visible traces of the transfer of soil particles (fine ground) by wind or water are evaluated. If the selected area is on a slope, then it is judged whether the deposits of fine ground are visible at the foot of the slope, whether small or large traces of water drainage are visible on the field or meadow. A significant influence of erosion is also evidenced by the state of the vegetation. If there is significant erosion, then the slope is less grown to yellowed, sometimes mosaic (flats without vegetation).

Status	Description	Score
weak	intact biofunction, only slight traces of surface horizon loss	2
medium	Clear traces of surface horizon drainage, noticeable signs of influence on stand condition	1
strong	Surface horizon carried away (manifested by a lighter color of soil in places of drainage), under the slope visible deposits of fine soil, clear signs of poor development of the stand mostly in the upper part of the slope or where the upper layers of soil were removed (damaged soil biofunction)	0

Presence of compacted soil layer (Annex 1)

It is judged on terrain reconnaissance and on the exposed probe wall.

Soil compaction can be inferred from the occurrence of standing water on the soil surface, mainly in agricultural machinery tracks, in depression after rain. Usually, in these areas, the growth is less mature with signs of yellowing and drying. In places with hardened soil, the vegetation is also poorly growing, there are areas without vegetation (here and there the plant). Clay crusts are cracked on dry soil in the dry season.

In addition to visual assessment and comparison with images, you can test the penetration of the knife through the soil profile in less rocky soils. Insert the knife tip into the top of the soil and push it into the soil profile. Where a hardened layer is strongly developed, the throughput of the knife will deteriorate.

Appraisal by Annex 1 Images.

Assessment of biological presence and activity in soil profile

It is performed on the exposed probe profile and in the removed soil block.

In the forest, evaluate the presence of visible fungi and edaphones in organic horizons, the occurrence of ECM fungi at the roots of woody plants, the degree of rooting in the soil, the presence of earthworms and other edaphones.

Degree of rooting

Number of Roots	Root Status	Score
Small amount of roots, mainly horizontal, to depth <20 cm	Poor growth, large proportion of brown visibly decomposing roots	2
More roots growing vertically and horizontally, to a depth of 20-40 cm	Fine but mostly healthy roots	1
A lot of roots growing in depth, most roots go to depth > 40 cm	Strong roots, healthy (light color)	0

Number of earthworms in meadow and field soil; select individuals from the whole soil probe.

Number of earthworms on arable land	Number of earthworms on a meadow / pasture	Score
>8	>20	2
4-8	10-20	1
<4	<10	0

For forest land - carried out in the organic horizons of the removed soil block, check on the probe wall if unclear. Spread the soil on the sack and count the animals trying to escape.

Biological presence/activity	Score
In the organic horizon there is a dense network of fungal mycelia, (coniferous forest) or the lower part is formed by a clearly recognizable layer of excrements of soil invertebrates (mixed and deciduous forest); on root tips of woody plants are clearly visible well developed ECM, abundance of meso- and macro edaphones is more than 100 of individuals	2
In the organic horizon it is possible to find the mycelium of fungi (coniferous forest) or excrements of soil invertebrates (mixed and deciduous forest); on some root tips of woody plants have ECM (less than 30%), abundant occurrence of meso- and macro edaphones ranges from 10-100 of individuals	1
In the organic horizon, the mycelium network (coniferous forest) is not visible, nor is the presence of excrements of soil invertebrates visible (mixed and deciduous forest); ECM is not visible on the root tips of the tree roots; less than 10 individuals of meso- and macro edaphones	0

Presence of colour spots (Annex 2)

The presence and frequency of colour spots is a good indicator of the aeration status of the soil. The presence of oxygen in the mineral soil is indicated by red-brown to orange. The presence of grey to grey-blue spots indicates the occurrence of anaerobic microenvironment. If the soil is permanently

flooded, then the soil has a uniform grey to grey-blue colour. Examine the presence of coloured spots on the side of the probe, immediately after digging and cleaning the walls, freshly cut.

Soil Porosity (Annex 3)

Porosity, mainly macropores, affects the movement of water and air in the soil. A good structure soil has a large amount of visible pores between and within the aggregates.

Cut a part from the side of the block of soil you made of about 10 * 15 * 20 cm. Break it into two parts, and compare the fresh fracture with the pictures in the Annex 3. This observation is complemented by the presence of pores in large lumps when testing soil structure (porosity test inside aggregates).

Soil Structure (Annex 4)

The soil structure is evaluated by size, shape, stability, porosity and relative representation of soil aggregates and lumps. The soil with good structure has disintegrating, small porous aggregates in the form of irregular lumps. Soils with poor structure have large, solid lumps with sharp break edges, with little or no pores, difficult to break.

Test: remove vegetation and surface litter layer from the soil block you made. If the soil did not break down and stay in the block, take the remaining block and repeatedly throw it 3 times on a plastic sheet from a height of about 1 meter (breast height). If the soil remains connected to large lumps after the first toss, repeat 1 - 2 times. If the lumps fall into small pieces just after the 1st or 2nd throw, there is no need to repeat the throwing. Do not repeat throwing more than 3 times.

Spread the soil on a plastic sheet so that you have fine particles on one side and coarser particles or large lumps on the other. Compare the distribution of soil aggregates from fine to coarse lumps with photo and evaluate the state of the structure. This assessment cannot be performed under too humid or too dry conditions.

Soil Texture (Annex 5)

After evaluating the structure, mix (homogenize) the soil on a plastic sack, take a pinch of soil, moisten it if necessary (mix with water on the palm of your hand) and estimate the texture based on the included key

texture	Score
Silty loam, clay	2
clay loam, silty clay loam, sandy-clay loam	1,5
sandy clay	1
loamy sand, silty clay, clay	0,5
sand	0

Soil colour (organic matter content)

Soil colour is an orientation indicator of soil quality. In general, the darker the soil, the higher the organic matter content. Compare the colour of the moist soil you tested the texture with.

Evaluation of soil colour by Němeček

Organic matter content	Percentage of organic matter	Wet soil colour	Score
very high	> 5	Black	2
High	3-5	Black-brown	1,5
medium	2-3	Dark brown, dark grey	1
weak	1-2	Grey	0,5
low	<1	Slightly brown, slightly grey	0

Presence of carbonates (laboratory determination)

Carbonate-free soil usually has less water-stable disintegrating aggregates. It usually has a low pH.

Place the soil on a petri dish and add a drop of 10% HCl:

Foaming after addition of acid	Carbonate content (%)
It will not appear	0
Weak and short foaming	0,3-3
Strong, prolonged foaming	>3

Active pH (laboratory determination)

Soil pH changes the availability of nutrients in the soil. The highest nutrient availability is in soil around neutral pH values.

pH Arable and Meadow Soil	Forest Soil	Score
6 - 7	5-7	2
4 – 6 or 7 - 8	3,5 – 5 or 7 - 8	1
< 4 or > 8	< 3,5 or > 8	0

Annex number 1. Soil compaction

1.



2.



3.



1. Good condition, There is no compacted layer, a fine, well formed structure with good porosity
2. Medium conditions, a firm layer in the bottom of the soil profile, but with small pores, cracks, poorly developed structure
3. Medium conditions, solid to hard compacted layer in the bottom of the soil profile, has no developed structure, only a small amount of cracks, no pores

Annex number 2. Presence of colour spots (soil aeration status assessment)

1.



2.



3.

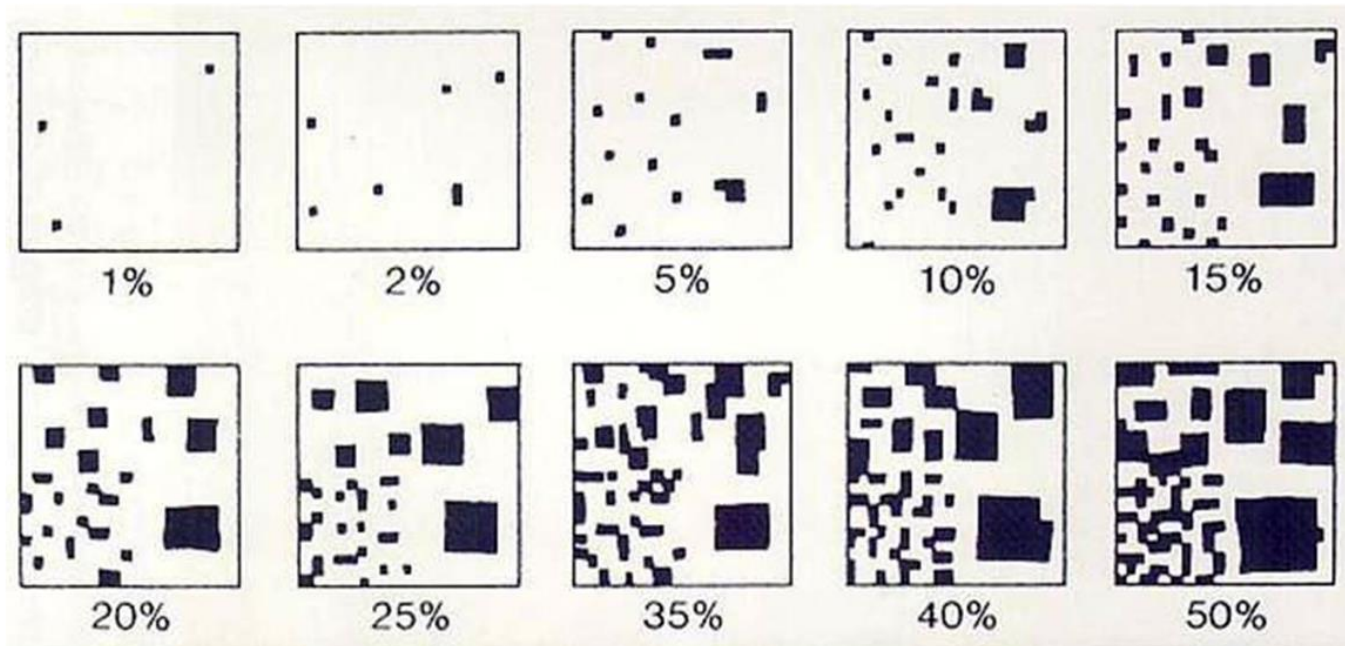


1. Good conditions, absence of stains that would indicate alternation of oxido-reduction conditions
2. Medium conditions, 10-25% of fine or medium-sized gray spots in the soil
3. Poor conditions, there are more than 50% of medium or large gray spots in the soil

Representation of oxidized / reduced spots in soil profile

Oxidized spots - red-brown, orange to yellow

Reduced spots - light grey, grey to blue-grey



It can also be used for the assessment of porosity - black areas represent pores

Annex number 3. Porosity

1.



2.



3.



1. Good conditions, in the soil there are macropores both between the aggregates and inside the aggregates (pore density or cracks is higher than 50 / cm^2)
2. Medium conditions, The proportion of macropores between the aggregates and inside the aggregates is considerably lower, but their presence can be clearly detected on closer inspection of the lumps (pore density or cracks 20-50 / cm^2)
3. Poor conditions, Macropore representation is not detectable, massive compact lumps are created with a smooth surface, only a small proportion of cracks and holes, can have sharp angles (pore density or cracks 20-50 / cm^2)

Annex number 4. Soil Structure

1.



2.



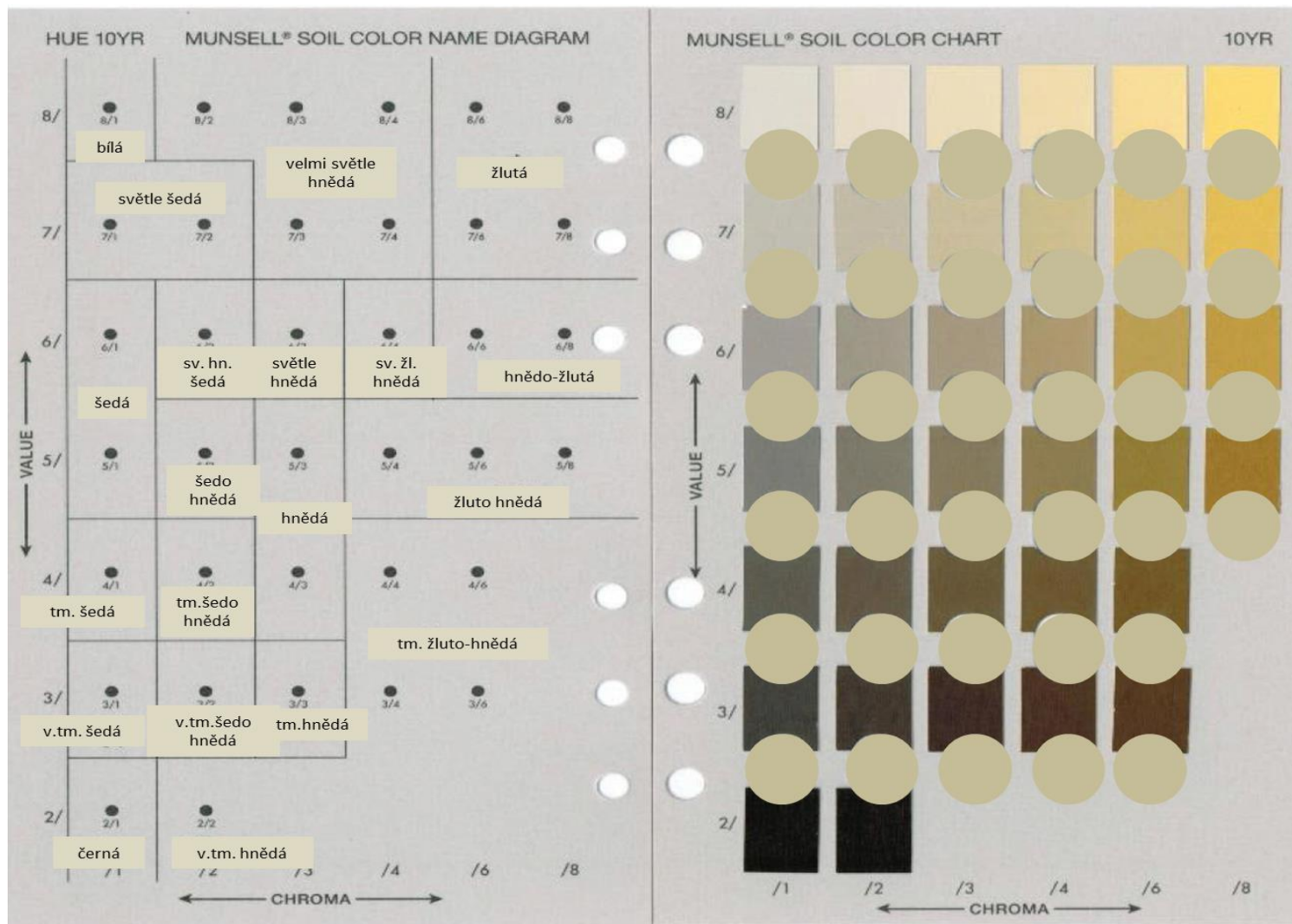
3.



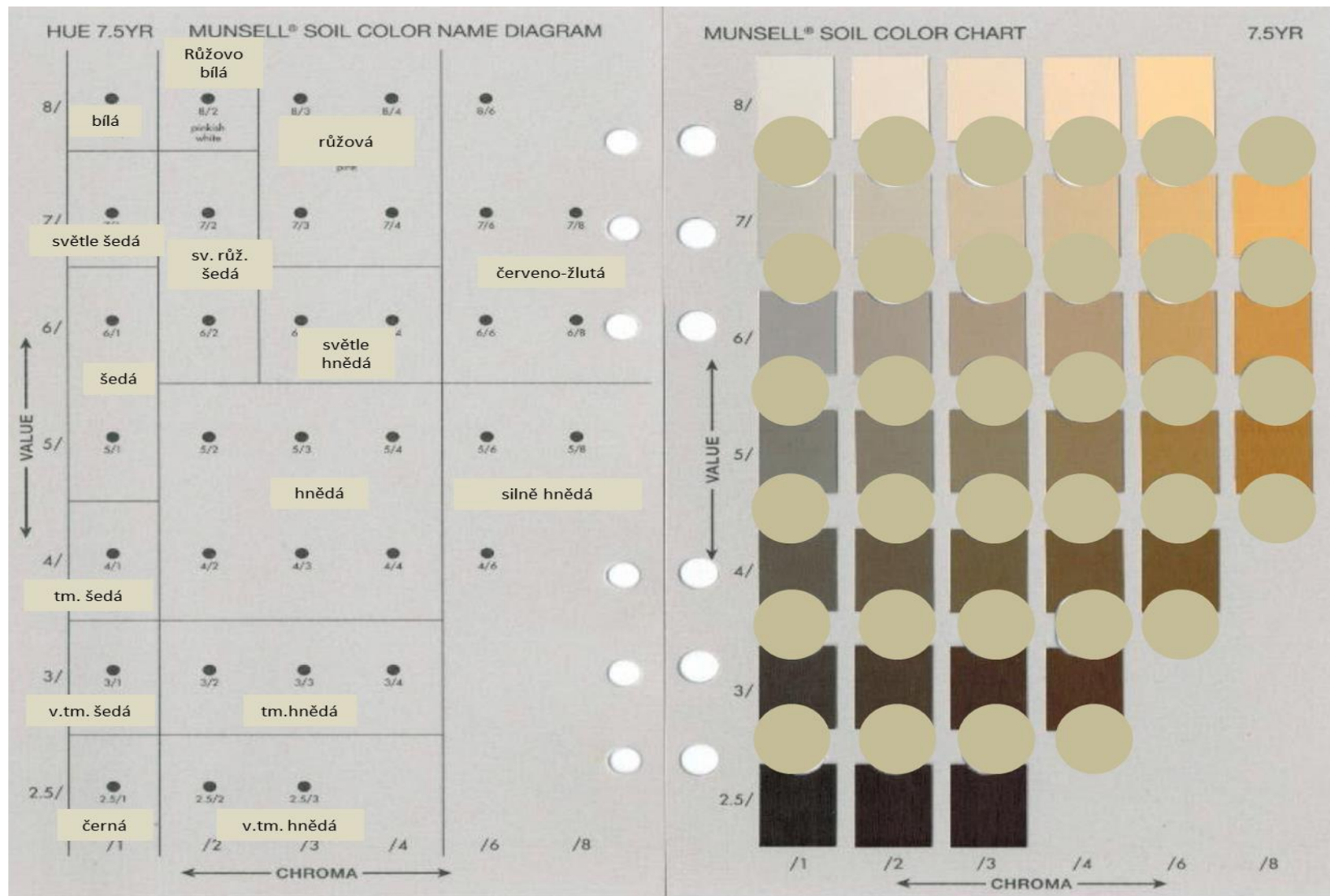
1. Good conditions, Crumbled structure, soil disintegrates into finer aggregates, without significant features of clod formation
2. Medium conditions, The soil contains a significant amount of coarse solid lumps and finer friable aggregates
3. Poor conditions, Coarse, very strong lumps prevail in the soil; low content of friable aggregates

Annex number 5. Soil colour

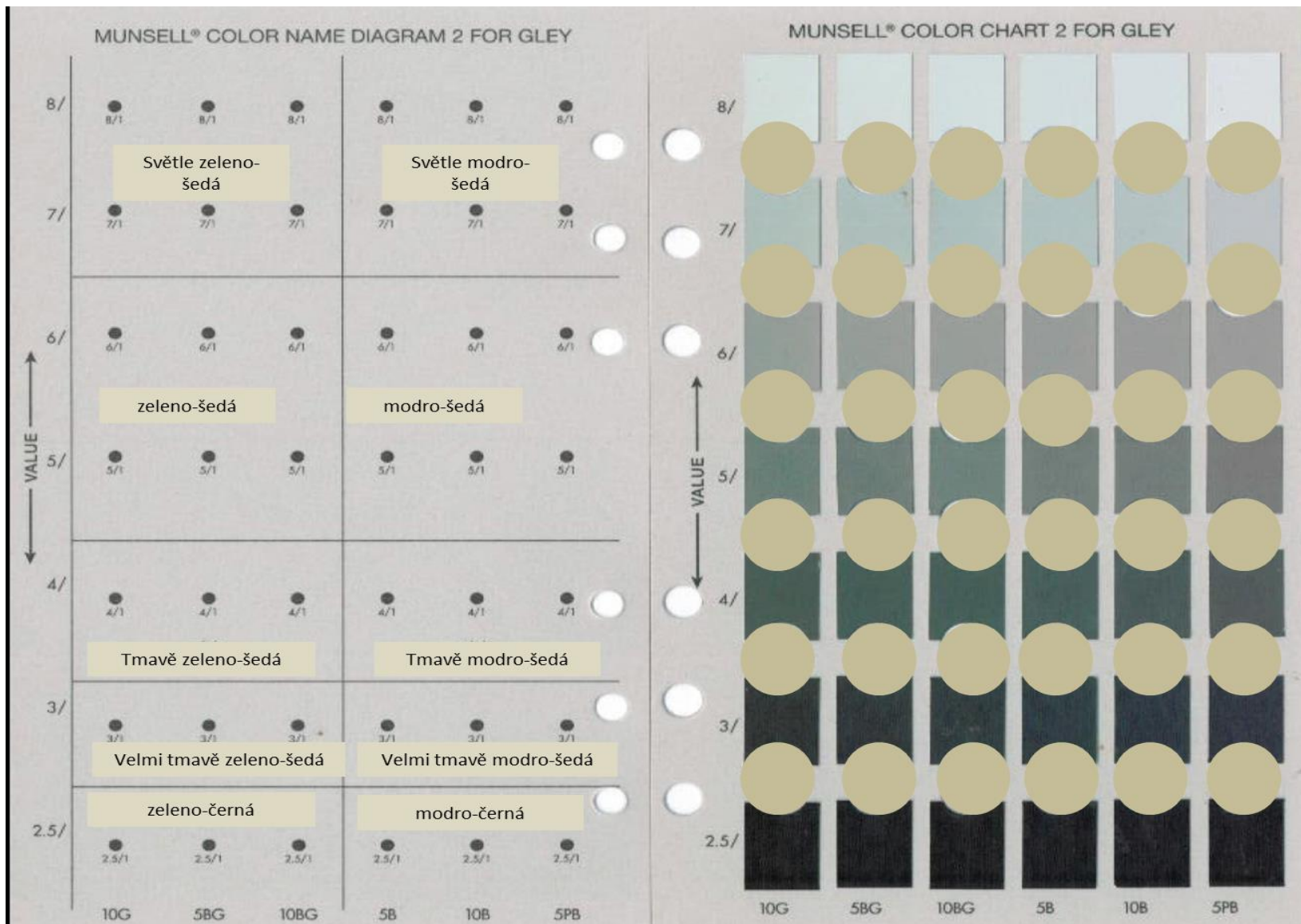
Upraveno podle Munsell Soil Color Chart, 2000



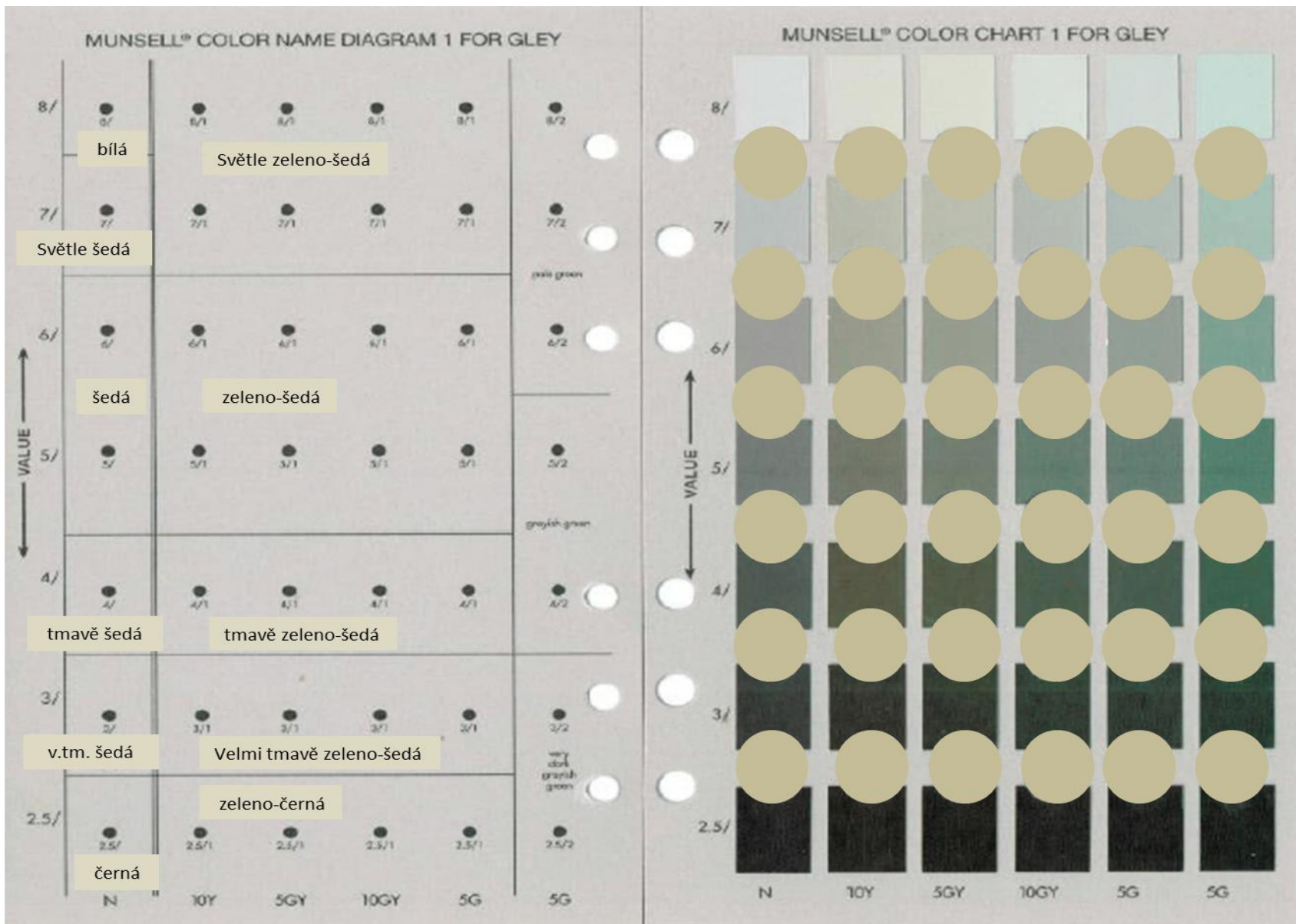
Upraveno podle Munsell Soil Color Chart, 2000



Upraveno podle Munsell Soil Color Chart, 2000



Upraveno podle Munsell Soil Color Chart, 2000



Soil Condition Assessment Protocol

Soil Condition Assessment Protocol		
Name		
Date		
Locality		
Weather at the sampling time		
Soil type		
Other characteristics:	climatic region	
	soil depth	
	slope	
	exposition	
Geological subsoil		
Texture		
Content of carbonate		
Soil pH		
Vegetation		
parameter	score	evaluation
Soil texture		
Soil structure		
Porosity		
Soil colour		
Colour spots		
Soil erosion		
Compacted layer		
pH		
Earthworm presence		
Edaphones presence		
Root presence		
Total score		
Soil quality assessment		Total score
poor		<15
medium		15 - 28
good		>28