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Remarks on the intramontane continentality of the Western Carpathians defined by the absence of *Fagus sylvatica*

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Abstract: A number of authors (e.g. Tschermak, Svoboda, Zlatník) stated that a zone of continental climate without *Fagus sylvatica* was present between the Tatry Mts and the Nízke Tatry Mts, in the so-called central part of the Western Carpathians. However, recent research confirmed the autochthonous occurrence of *Fagus* within the Podtatranská kotlina and the occurrence of *Fagus* stands even on non-carbonate substrates. Hence, both the reason and the way of differentiation of the intramontane continentality supposed exclusively for this region of the Western Carpathians should be re-evaluated.

Keywords: absence of beech, *Fagus*, intramontane continentality, Western Carpathians.

Introduction

The variability of forest vegetation within mountain ranges has been the subject of many research papers. The larger the mountain range, the more pronounced the change of plant communities from the margins to the central parts of the mountain range. In Europe, the most striking example are the Alps, where three different vegetation zones were distinguished between the northern border of the Alps and the central zone: Randalpen, Zwischenalpen, Innenalpen (cf. TSCHERMAK 1944, BRAUN-BLANQUET et al. 1954, KUOCH 1954, ELLENBERG & KLÖTZLI 1972, MAYER 1974, NIKLFELD 1993, SAUBERER & WILLNER 2007). In connection with differences of climate and vegetation between the border- and central zones of a mountain range was used the term intramontane continentality.

Some authors studying the vegetation cover of the Alps visited also the Western Carpathians, where they noticed similar patterns of plant cover differentiation (BRAUN-BLANQUET 1930, TSCHERMAK 1944): "In den Zentralkarpaten der Slowakei findet sich, ähnlich wie in Gebieten größter Massenerhebung im Inneren der Alpen, eine "Innenlandschaft" mit kontinental getöntem "Zentralgebirgsklima", das sich auch hinsichtlich der vorkommenden Holzarten auswirkt." (TSCHERMAK, 1944, p. 12). Tschermak published more detailed accounts on the relationship between climate and distribution of some tree species within and outside of the Western Carpathian "Innenlandschaft", lying, according to him, "between the ridges of the Tatry Mts and the Nízke Tatry Mts, and in W–E direction between the towns Ružomberok and Poprad" (TSCHERMAK, 1944, p. 13; see Fig. 1). He repeatedly emphasized differences of tree species composition in forests of that intramontane Western Carpathian zone, particularly with stress on the absence of *Fagus sylvatica* L.

But Tschermak was not the first one who described differences in the forest cover of the abovementioned part of the Western Carpathians. Among the authors of former Czechoslovakia, especially SILLINGER (1933; Nízke Tatry Mts) and SVOBODA (1935, 1939; Západné Tatry Mts) published more detailed description of the distribution of forest communities with *Fagus* within that area. Regarding the differences in the distribution of *Fagus*, Sillinger pointed out the process of vegetation development during the Holocene and the continuing presence of the older *Picea*-forest phase at particular areas of the Nízke Tatry Mts. In accordance with older works of Tschermak from the Alps (cf. SVOBODA, 1939, p. 75), Svoboda held the view that a continental climate is the reason for the absence of *Fagus* in the central part of the southern slopes of the Tatry Mts.

TSCHERMAK's (1944) study influenced the whole-life work of Prof. ZLATNÍK (1955, 1957a, b, 1959, 1976, 1978; [ZLATNÍK?] in MELICHERČÍK & RANDUŠKA 1959: 245; RAUŠER & ZLATNÍK, 1966) who after World War II established in the former Czechoslovakia an independent forest typological school. Zlatník and his followers as well as other geobotanical and phytogeographical authors (see overview by KUČERA, 2009a) have exerted consistently the idea of the separate continental zone within the "Central" Western Carpathians, from which *Fagus* is absent for climatic reasons.

The current paper is based on the factual state of *Fagus sylvatica* occurrences in the proposed "beechless" zone as recorded during the author's field research of natural plant communities dominated by *Picea abies* (L.) H. Karst. in the Western Carpathians (cf. KUČERA, 2010, 2012a).

Methods

The studied area comprises in particular a zone of the Podtatranská kotlina bordering on the southern slopes of the Tatry Mts, eastwards up to the Tatranská Lomnica. Besides, relevant adjacent areas are included too. The geomorphological division of the area is used according to MAZÚR & LUKNIŠ (1980), geology after the map of NEMČOK et al. (1993). Geographical coordinates of particular localities (Tab. 1: L1, L2 etc.) are recorded in system WGS-84

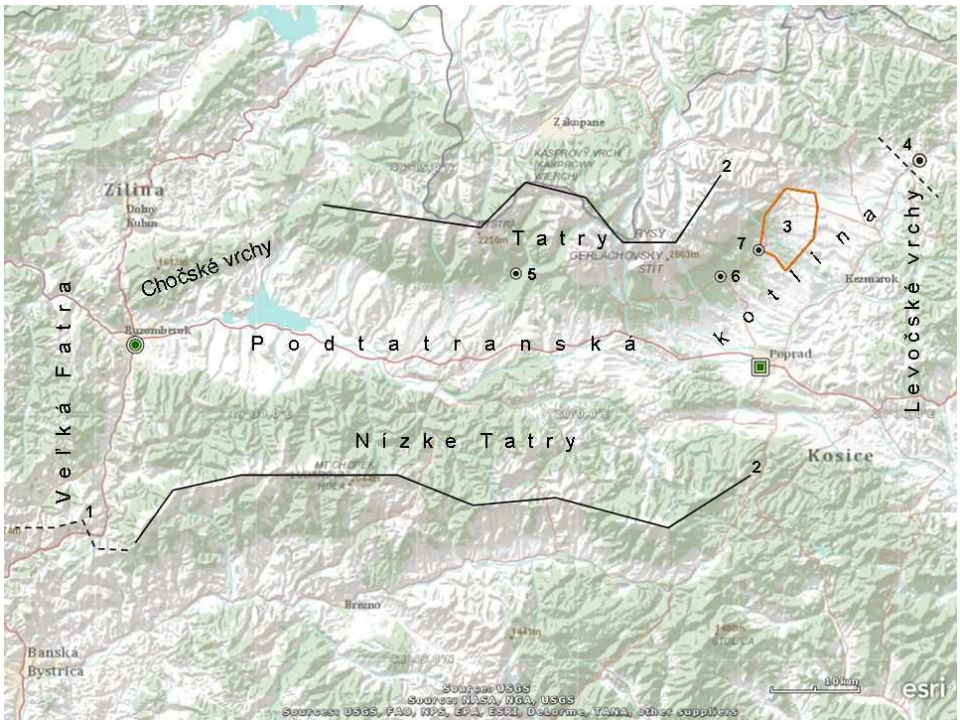

Fig. 1. Situation map of the beechless "Innenlandschaft" of Tschermak (1944). Base mape by ESRI ® ArcGIS Explorer.

1 – Watershed boundary of the Hron (southwards) and the Váh (northwards) northwards of the Banská Bystrica [Neusohl] (TSCHERMAK 1944, p. 12);
2 – Main ridges of the Tatry Mts. and Nízke Tatry Mts;
3 – Area of *Fagus* rich occurrence northeastwards of the Tatranská Lomnica;
4 – Probable east boundary of Innenlandschaft by Podolínec [Pudlein] as mentioned by TSCHERMAK (1944, p. 13);
5 – Podbanské;
6 – Starý Smokovec;
7 – Tatranská Lomnica

with Magellan Sportrak Pro (until 2006) and Garmin GPSMAP® 60CSx, those determined by Google® earth are marked "^{Ge}" (see Tab. 1). Geographical information is used according to maps Západné Tatry – Podbanské – Zverovka (2000), Vysoké Tatry (2002) and Nízke Tatry – Kráľova hoľa (2002).

Results

1. Comments to mountain ranges bordering the intramontane continental area in the sense of TSCHERMAK (1944).

The general distribution of *Fagus sylvatica* within the territory of Slovakia has previously been published (MAGIC, 2006). What follows here is a brief summary.

TSCHERMAK (1944) defined the boundary between extra- and intramontane region by the watershed of the Hron and the Váh drainage basins in the region of the Starohorské vrchy Mts. According to him, southwards to the watershed is the area of *Fagus sylvatica* and *Abies alba* Mill. forests, northwards the area of *Picea abies* and other conifer forests. However, *Picea* forests of the Starohorské vrchy Mts are monocultures only, and the species formed originally only small-scale phytocoenoses restricted to special habitats of this mountain range (KUČERA, 2012a). The area of natural fir-beech forests stretches northward up to the town of Ružomberok [after TSCHERMAK (1944) the western boundary of the beechless intramontane zone] situated at the foothills of the Nízke Tatry Mts, Veľká Fatra Mts and Chočské vrchy Mts. The two latter ones clearly are regions of natural climax forests of *Fagus* and *Abies*.

The vegetation cover of the Nízke Tatry Mts was characterized by SILLIGER (1933); newer vegetation maps show the different approach of later authors to reconstruction of forest stands (cf. MICHALKO et al., 1980, 1986; MAGLOCKÝ, 2002). Within the northern part of the Nízke Tatry Mts, i.e. part of the intramontane beechless zone of Tschermak, SILLINGER (1933) differentiated regions of three types of forest communities in the lower montane zone:

(1) ± typical beech forest (*Fagetum silvaticae carpaticum calcicolum*) in a small mostly western part of the Nízke Tatry Mts (Salatín group; south of the town of Ružomberok),

(2) mixed *Piceeto-Fagetum carpaticum* in the prevailing part of the northern slopes of the mountain range, and

(3) coniferous *Piceetum normale* (*Piceeto-Abietetum*) and *Piceetum excelsae myrtilletosum* p. p. occurring (3a) in the western part of the Nízke Tatry Mts only within the frame of the Demänovská dolina, and (3b) in the eastern part of the Nízke Tatry Mts in the surroundings of the Mt. Kráľova hoľa.

According to Sillinger, the last mentioned ± beechless area extends to the upper part of the Hornád drainage basin (western part of the Slovenský raj Mts, eastern part of the Kozie chrbty Mts), and is connected with the *Picea* region below the Vysoké Tatry Mts (cf. SILLINGER, 1933: map on p. 42). Also TSCHERMAK (1944) mentioned the absence of beech in the region of the Liptovská Teplička, even on carbonates.

According to current knowledge, the low abundance or even absence of *Fagus* in particular regions of the northern part of the Nízke Tatry Mts is due to long-term human influence. The secondary succession of *Fagus* in unnatural *Picea abies* or *Pinus sylvestris* L. stands indicates the area extent and the diversity of habitats originally taken by *Fagus* (KUČERA et al., 2009; KUČERA, 2012a).

The eastern border of the intramontane central Western Carpathian region (TSCHERMAK, 1944) is formed by the Levočské vrchy Mts. Here, *Fagus* is a natural element of forest stands. Indeed, forests with high abundance of beech extend as far as to the foothills of the Levočské vrchy Mts bordering to the Popradská kotlina (cf. FLACHBART, 2007; KUČERA, 2008a). The same holds true for the Spišská Magura Mts (cf. KUČERA, 2012b) and the valley of the Poprad down to the Podolínec (cf. TSCHERMAK, 1944, p. 13).

2. Intramontane continental area in the sense of SVOBODA (1939), ZLATNÍK (1957)

SVOBODA (1939, p. 74–75) gave the following description of the occurrence of *Fagus sylvatica* on southern slopes of the Západné Tatry Mts [translated from Czech]:

"On the S side frequent (but mostly sporadic) at carbonates around Mních [1 459.8 m] and Sokol [1 316.1 m], especially on S and E slopes towards the Jalovecká dolina. However, *Fagus* ceases onward [eastwards] with the disappearing of carbonates and the increasing of massiveness of the mountain range. Only sporadic dwarfed specimens can be found in *Corylus avellana* stands and similar secondary plant communities in front of the Jamnícka dolina (above „Medokýš"), and on limestone islands of Surový Hrádok in front of the Kamenistá dolina and Hrádok in front of the Tri studničky. The species is missing on gneiss and granite…"

According to the map of MYCZKOWSKI (1969, Fig. 8), *Fagus* occurs on the southern foothills of the Západné Tatry Mts at two different sites eastwards of the Jalovecká dolina: up to the Žiarska dolina. SCHÖNSGIBL (1979) published altogether three localities of *Fagus* eastwards of the Jalovecký potok, however, according to him, the native occurrence of the species faded away already on eastern slopes of the Jalovecká dolina.

In contrast to Svoboda, we can affirm that *Fagus* is in the condition to form separate stands also on southern slopes of the Západné Tatry: in the carbonate region of the wider region of Sivý vrch (1 804.5 m) (KUČERA, 2012a) as well as on non-carbonate substrates, e. g. nearly at bottom of the Jalovecká dolina (L1, and higher in the valley; L2). I recorded *Fagus* even deeper in the mountain massive – below the confluence of streams of the Poliansky potok and the Jalovecký potok (L3). Besides, *Fagus* thrives in the foreland of the Jalovecká dolina (L4), already outside of the Západné Tatry Mts – in the basin of Liptovská kotlina.

Non-carbonate substrate is not a limitation to the occurrence of *Fagus* in the Západné Tatry Mts as indicated by the locality in the Žiarska dolina (L5): the valley is most influenced by human impact in the entire mountain range (cf. SVOBODA, 1939). At the bottom of slopes of Baranec (2 184.0 m) recently increasing numbers of *Fagus* individuals are growing: in the vicinity of L6 up to the altitude 1 032 m (L7), between localities L8 and L9 even small *Fagus* stands (L8) can be found. The location of Svoboda's (1939, p. 74) *Fagus* site "above Medokýš" [see above] is uncertain, but the present findings confirm the presence of *Fagus* close to the Jamnícka dolina (L10, up to 1 044 m).

In the eastern part of the Západné Tatry Mts, SVOBODA (1939) recorded *Fagus* on limestones of Surový Hrádok (1 015.6 m). His data were confirmed by me, although, normal tree growth of *Fagus* was observed (L11, L12 – also *Ulmus glabra* Huds.), young individuals are not dwarfed (L13). In addition, occurrence of *Fagus* was noticed here also on non-carbonate substrate (L14).

Near the Podbanské, a record of *Fagus* was published already by BLATTNÝ & ŠŤASTNÝ (1959). KRAJČOVIČ (1966) wrote that *Fagus* is here [within the *Pineto-*

Piceetum] not a native species, although planted *Fagus* by a road before the Tichá dolina had a good growth. MYCZKOWSKI (1969, Fig. 8) indicated a locality of *Fagus* in the valley mouth of the Tichá dolina. Also data of KOBZÁKOVÁ (1987; locality at 1 230 m!) and NAĎOVÁ (1987) from the Tichá dolina are available – this region could be regarded as a central section of the southern zone of the Západné Tatry Mts and Vysoké Tatry Mts together. Remarkable are findings of MORAVČÍKOVÁ (1987) and NAĎOVÁ (1987) who recorded here phytocoenoses with dominance of *Abies alba*: thus, the species has full vitality also in this "continental" region, unlike noted by TSCHERMAK (1944). Locally, thickets of young *Abies* individuals can be found (N 49°8,967´, E 19°57,482´, 1 143 m, 30. 9. 2006, P. Kučera). Other *Fagus* localities near the Podbanské were recorded by Flachbart (in e-mail; cf. FLACHBART, 2007).

Eastwards of the Podbanské, *Fagus* grows well on non-carbonate moraine sediments (between L15 [KUČERA, 2008a], L16 and L17) and deluvial sediments (L18; with *Alnus*, *Typha*!). In the frame of the ecological influence of small carbonate islands westwards of the Tri Studničky (foothill of Kriváň (2 494.7 m)), more *Fagus* localities exist (L19, L20, L21: KUČERA, 2008a). KRAJČOVIČ (1966) mentioned from the vicinity of the Tri Studničky the occurrence of the group of forest types *Fageto-Piceetum*, but without data on *Fagus*. However, on the area of wind-blown *Picea* stands (2004–2010) in the drainage area of the Beliansky potok, larger amounts (hundreds) of young *Fagus* specimen were observed: in the wider area approximately between coordinates L22 and ca L23, without respect to geological background.

I am not aware of published data on the occurrence of *Fagus* from the area of Surovec (1 153.3 m). Its surroundings fall within the area of the presupposed natural dominance of *Picea abies*, which forms on this western part of the Tatranské podhorie forest stands classified as the group of forest types *Piceetum abietinum*, without *Fagus* and with *Abies alba* (supposedly up to 20 %) and other woody species (cf. HANČINSKÝ, 1972, 1977). In the vicinity of the Surovec (L24–L25–L26–L27) larger amounts of *Fagus* individuals and groups can be found up to its top-hill plain (L28). *Fagus* is here an original element of forest stands growing up to standard tree form (L29). Together with *Abies alba* (recorded trees over 150 years old) it resists to wind much better than *Picea* stands (monocultures). Mixed *Fagus-Abies* communities with *Picea* formed primary forest stands (cf. L30). Also in the vicinity is *Fagus* not bound to carbonate substrates: its natural regeneration can be seen on non-carbonate deluvial sediments (L31, L32). *Fagus* was near Surovec also probably (?) planted (L33).

As the easternmost isolated locality of dwarfed *Fagus*, SVOBODA (1939) mentioned Hrádok (1 140.7 m), formed by dolomite rocks (NEMČOK et al., 1993). The same isolated locality was mentioned by BLATTNÝ & ŠŤASTNÝ (1959, p. 152) and probably SOMORA (1958, p. 111). The locality of MYCZKOWSKI (1969, Fig. 8) probably lies northly of Hrádok. Unlike Svoboda ŠMARDA (1961) evaluated the occurrence of *Fagus* on slopes of the Hrádok: according to him, *Fagus* forests originally grew on Hrádok, although he observed only sporadic *Fagus* individuals

[however, numerous dwarfed ones on close pastures]. A similar idea is expressed in an older version of the map of potential natural vegetation (MICHALKO et al., 1980), where islet of beech-fir forests is indicated. On the contrary, ZLATNÍK (1957) did not know any *Fagus* occurrence on carbonates across the entire range between the Tatry Mts and the Nízke Tatry Mts. According to him (ZLATNÍK, 1975), *Fagus* is missing on the southern slopes above that table-land and on eastern slopes of the Vysoké Tatry Mts above Popradská kotlina (cf. also MICHALKO et al., 1986).

During a preliminary field investigation of Hrádok hundreds *Fagus* individuals and groups were seen on the slopes between the localities L34 and L35, some of them more than 60–80 years old (older trees also between L34 and L36). Western and northwestern slopes of Hrádok belong to the steepest ones thus forming here the most extreme forest habitats on carbonates: this very characteristic situation has enabled the conservation of occurrence of *Fagus* as these slopes are not prone to stronger human influence such as e.g. large-scale deforestation and plantation of *Picea* monocultures (however, planted *Pinus nigra* Arn. was recorder together with *Pinus sylvestris* and *Fagus sylvatica* – L37). Occurrence of individuals of *Juniperus communis* L. subsp. *communis* was recorded locally, living or already withered away. They reflect historical anthropogenic influence, especially partial deforestation and pasture.

In some places, a richer *Fagus* natural regeneration was noted (L38), similar to one observed in the Western Carpathian mountain ranges with climax *Fagus* forests (e.g. Veľká Fatra Mts, Malá Fatra Mts). Altogether, a larger number of individual *Fagus* localities (except those between L34 and L35) was noted on dolomite rocks of Hrádok (L39–L45; between 986 and 1 132 m a.s.l.) as well as those of elevation point 1 133.0 m (L46–L49), and on various carbonate sediments more northwards (L50–L56). In general, on the foothills of Kriváň (2 494.7 m) a larger area of various types of Mesozoic and Tertiary carbonate rocks extends, including the above-mentioned hill of Surovec (cf. NEMČOK et al., 1993). Based on the gathered knowledge on *Fagus* distribution, I assume that this area (westwards approximately to the gorge Hybická tiesňava; cf. ŠMARDA, 1961, p. 763; ŠKOLEK, 2002) was originally a region of natural *Abies* and *Fagus* forests (with *Picea abies*, etc.) (cf. MICHALKO et al., 1980). However, more remarkable is the finding of *Fagus* below the road Cesta slobody (L57, 1 179 m), on [non-carbonate] glaciofluvial gravels: Originally, *Fagus* was not exclusively bound to carbonates. The second easternmost *Fagus* locality indicated by MYCZKOWSKI (1969, Fig. 8) lies even somewhat to the east.

Some authors mentioned the occurrence of *Fagus sylvatica* on the meadows Važecké lúky referring to dwarfed individuals (ZLATNÍK, 1957) [ŠMARDA (1961) numerous dwarfed ones] or cut down of one of the last *Fagus* trees (cf. VOŠKO et al., 1990). Recently, normal tree growth of *Fagus* was recorded on forest edges and windthrows on several places between Hrádok and Važec, all of the localities within non-carbonate sediments (L58–L65). Slightly to the east, SOMORA (1962) recorded the occurrence of dwarfed *Fagus*: on the left bank of the Solisková voda. Surprisingly, these data are not the easternmost limit of the

natural distribution of *Fagus* on non-carbonate substrates below the slopes of the Vysoké Tatry Mts. In 2010 (7. 10. 2010, not.), I observed a locality within the upper drainage area of the Biely Váh. In a wider area around localities L66 and L67, larger amounts of *Fagus* individuals are growing as well as forest phytocoenoses dominated by *Fagus* (e.g. L68). Such pattern of occurrence of the species was never published or even expected as this region is generally considered as a zone with continental climate causing the absence of *Fagus*. *Fagus* is here actually not limited by any type of habitat (except wetland habitats) as natural regeneration was recorded down to the river banks and floodplain terrace (e.g. L69). There exists also published indications of *Fagus* occurrence somewhat north of the presented area (cf. MYCZKOWSKI, 1969, Fig. 8), but it is difficult to localize this locality more precisely.

Recent important records of *Fagus* within the beechless area of the foothills of the Vysoké Tatry Mts [Tatranské podhorie, part of the Podtatranská kotlina] were published by FLACHBART (2007) who recorded its saplings at an altitude ca 1 300 m, below the Štrbské pleso. His findings were a strong impulse for all of my field investigations. Young *Fagus* individuals recorded between L70 and L71 are perhaps the same individuals as photographically documented by FLACHBART (2007). Their unnatural origin cannot be confirmed for sure for the time being. Below the locality, other *Fagus* saplings grow (L72– L73). Older trees can be found close to the road Cesta slobody (below L74). At locality L75, a small plantation of *Fagus sylvatica*, *Abies alba*, *Acer pseudoplatanus* L. etc. (also *Tilia cordata* Mill.) is found. However, the most surprising finding from the slopes in the surroundings of the Štrbské pleso are two old *Fagus* trees (L76, 1 321 m). Based on the relatively small distance from the preserved *Fagus* area near the Biely Váh and on the Hrádok it can be supposed that locality L76 falls within the range of original natural distribution of *Fagus* in the Tatranské podhorie. Here, the species is able to regenerate naturally (L77, L78). Somewhat dwarfed, isolated *Fagus* specimen (L79) might also originate from natural regeneration. Besides all of the previous localities, four plantations of *Fagus sylvatica* (with *Abies alba*) were seen southwest of the Štrbské pleso (L80, L81, L82, L83). The last three ones are in a flat landscape with somewhat damp soils. *Fagus* and especially *Abies* is there damaged by game (deer).

Eastwards of the Štrbské pleso, a zone of prevailing *Picea abies* forests with *Pinus sylvestris* (group of forest types *Pineto-Piceetum*) was differentiated in the forest literature with supposed climate conditions unfavourable to the natural occurrence of *Fagus sylvatica* as well as *Abies alba* (or *Abies* occurring in insignificant numbers) (HANČINSKÝ, 1972, 1977). However, regional climate does allow growing of *Fagus* populations as can be seen from a plantation westwards from the Vyšné Hágy (L84–L85) and also provides suitable conditions for *Abies* (N 49°7,128´, E 20°7,064´, ± 5 m, 1 101 m). Planted individuals from the Vyšné Hágy were already mentioned by TSCHERMAK (1944). Another plantation of *Fagus* (and *Carpinus betulus* L.!) was noted in the Nová Polianka (L86). More remarkable localities of *Fagus* were observed eastwards of the Vyšné Hágy (L87–L93) up to the Nový Smokovec; the most remarkable one (L90) in the fire

area (from 30. 7. 2005) on a large-scale windthrow zone (from 19. 11. 2004): as the intensity of fire was not high, roots of *Fagus* tree (older than 40 years) that was destroyed by the fire survived, and the individual rejuvenated.

SOMORA (1958) mentioned a plantation of *Fagus* in the Nový Smokovec. Recently, planted *Fagus* trees as well as a natural regenerations could be seen there and also in the Starý Smokovec and the Horný Smokovec (3. 10. 2006, not.). In the surroundings of the Dolný Smokovec *Fagus* grows (27. 9. 2007, D. Bernátová, not.) already in a small forest formed belt near a road from Poprad: between L94 and L95, individuals up to ca 898 m (L96). Younger saplings of *Fagus* grow here also on the other side of the road: the population spreads also by natural regeneration. In the northeastern direction from the Dolný Smokovec, the occurrence of *Fagus* (for example ± L97, L98) was already documented especially in the vicinity of the Tatranská Lomnica (SOMORA, 1958; NEUHÄUSLOVÁ-NOVOTNÁ & NEUHÄUSL, 1969; BOHUŠ, 1977; FLACHBART, 2007; KUČERA, 3. 10. 2006, not.). *Fagus* occurrence extends also deeper in the Podtatranská kotlina below the Tatranská Lomnica (L99, L100).

Northeastwards of the Tatranská Lomnica the occurrence of *Fagus* is quite common (even *Carpinus betulus*, *Quercus robur*, *Q. petraea*, and *Q. cerris* were recorded: KUČERA, 2008a, 2011). If future forest management will be favourable to *Fagus*, more wind-resistant mixed forests will be growing there. It can be said that in the zone between the roads Tatranská Lomnica – Eurocamp FICC and Tatranská Kotlina – Šarpanec thousands of *Fagus* individuals have recently been growing (Fig. 1: 3). Actually, *Fagus* forest islets could be seen (cf. KUČERA, 2008a).

In addition to all mentioned localities situated on the foothills of the Vysoké Tatry Mts (within the Tatranské podhorie and the Popradská kotlina), *Fagus* was found on several localities within the northwestern part of the geomorphological subunit Dúbrava (cf. MAZÚR & LUKNIŠ, 1980) bordering on the Podtatranská kotlina. Noted was a natural regeneration of *Fagus* in secondary *Picea abies* or *Pinus sylvestris* stands (L101: 9. 10. 2009, D. Bernátová; L102–L108). These localities could be counted as belonging to "beechless carbonates of the region between the Nízke Tatry and the Vysoké Tatry" (cf. ZLATNÍK, 1957) as well as to the eastern coniferous *Piceetum* zone of SILLINGER (1933, p. 42). The orientation map of selected localities of *Fagus sylvatica* is provided in Fig. 2, which represents the spatial pattern of beech occurrence in the area studied.

Discussion

The previously recorded irregularity in the distribution of *Fagus sylvatica* in the region southwards of the Tatry Mts caused several researchers (e.g. SVOBODA, 1939; TSCHERMAK, 1944; ZLATNÍK 1957) to conclude that a continental climate is responsible for the regional absence of *Fagus*. Hence, the climate was considered as the natural limit of beech distribution within the Western Carpathians.

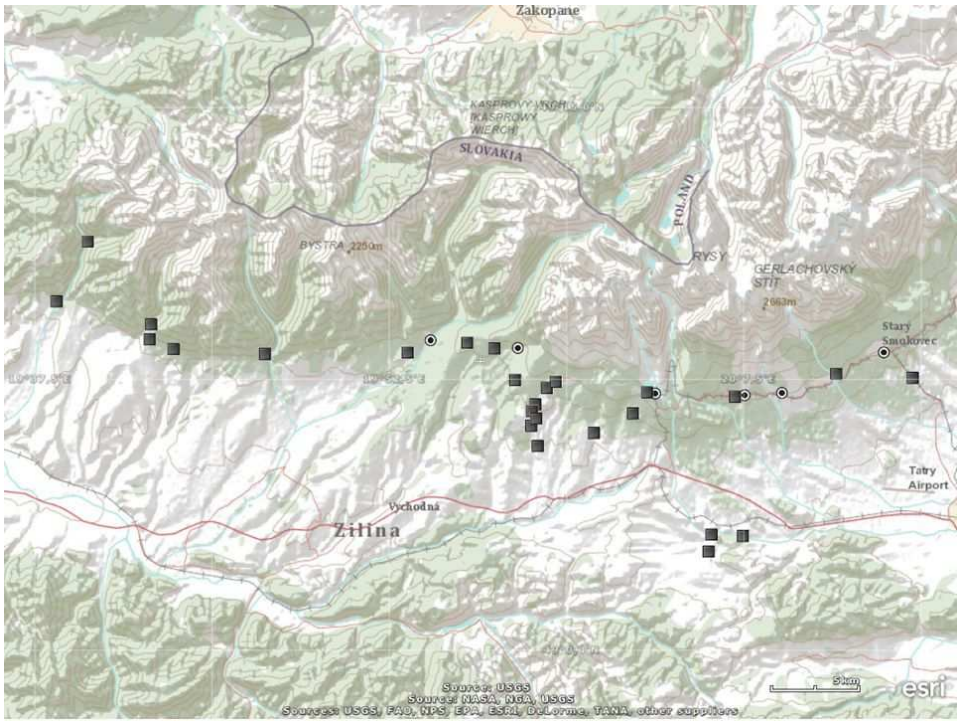

Fig. 2. Main localities of *Fagus* mentioned in text. Base map by ESRI ® ArcGIS Explorer.

However, in the Podtatranská kotlina *Fagus* grows well, forming small stands even on non-carbonate substrates. The list of the localities given in Tab. 1 indicates that the abovementioned way of "creation" of intramontane continental zone and setting its boundaries was incorrect. If the recorded number of *Fagus* individuals will be preserved by adequate forest management in the future, a noticeable increase of its abundance in forest stands is to be expected. Future research should anew assess in which forest communities *Fagus* forms a natural element.

With regard to evaluation of climate conditions, the origin of the *Fagus* individuals (planted, natural regeneration from planted trees, natural regeneration from original population) does not matter: if the climate was unfavourable to the growth of the species, then any kind of human measure to promote spreading of *Fagus* would be fruitless. On the contrary, large-scale windthrows southwards below the Tatry Mts throughout decades (OTRUBA & WISZNIEWSKI, 1974) repeatedly reduce *Picea abies* populations, hence allowing natural expansion of other more wind-resistant conifer and deciduous woody species native in this region.

I am not aware of a climatological assessment of the Podtatranská kotlina nor of a such one including a detailed comparison with adjacent or other similar

regions. However, relatively sufficient information is given by KONČEK et al. (1974) in the detailed monograph on the climate of the Tatry Mts. In relation to use of this or other regional climatological studies I pointed out that some evaluations should be interpreted rather relatively as they mostly do not refer to the whole territory of Slovakia or the Western Carpathians (KUČERA, 2009a). With respect to a climatological zonation of the whole zone studied, some differences are significant (KONČEK, 1974, 1980); within the regionalisation of climatogeographical types of Slovakia they are expressed as a separate kind of a so-called "basin climate" (TARÁBEK, 1980). However, such a type cannot be identified with true European continental climate with the absence of beech eastwards of Poland and Ukrajine (cf. KUČERA, 2009a). If a real natural beechless area would be confirmed within the Podtatranská kotlina, then the referred basin climate should be indicated as a ground for the absence of *Fagus* (by contrast to the "invented" intramontane beechless zone of the Western Carpathians).

To begin with the results of TSCHERMAK (1944) it can be stated that his conclusions are insufficient especially with respect to the overall natural distribution of *Fagus* stands in the Western Carpathians (KUČERA, 2008b). With regard to recorded old *Fagus* trees (populations) on carbonate as well as non-carbonate substrate also the notion of a beechless zone of later authors (e.g. SVOBODA, 1939; ZLATNÍK, 1957, 1975; HADAČ, 1965; NEUHÄUSL & NEUHÄUSLOVÁ-NOVOTNÁ, 1968; HANČINSKÝ, 1972, 1977; RYBNÍČEK & RYBNÍČKOVÁ, 1986; PLESNÍK, 1995) must be re-evaluated and corrected.

In compliance with the gathered findings of *Fagus*, more attention should be given to palynological records of *Fagus* below the slopes of the Vysoké Tatry Mts as provided by KRIPPEL (1963, 1986) already for the period of the younger Atlantic and especially Subboreal. On the contrary, RYBNÍČKOVÁ & RYBNÍČEK (2006) suppose that *Fagus* pollen recorded in the site of the Štrbské pleso comes from distant transport and *Fagus* formed mixed forests only "in the neighbouring highlands". They state that the soil and also climatic conditions seem to be very inimical for beech in Tatra forests (RYBNÍČKOVÁ & RYBNÍČEK 2006, p. 355). Similarly, JANKOVSKÁ (1988, 1991) supposed (sporadic) occurrence of *Fagus* for the older Subatlantic but in adjacent mountain ranges (except Tatry Mts) only, especially on carbonates. However, *Fagus* has already been growing here recently (e.g. L76). The role of historical and recent human influence on the distribution of *Fagus* is to be cleared in more detail (cf. KRIPPEL, 1963, 1986; PLESNÍK, 1971; HAJNALOVÁ, 1996; Flachbart, 2007; Kučera, 2008a, 2009b). In this context, LOŽEK (1979) refers to prehistoric deforestation of the Popradská kotlina.

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Tab. 1. Localities of *Fagus sylvatica* in the studied area.

1 Locality	2 Geographic coordinates			3 Origin	4 Number of individuals	5 Age class	6 Date of (first) record
	N 49°...	E 19°...					
L1	Ge 9´46˝	38´46˝	–	n	N_{10}	II–III (IV)	24. 6. 2006
L2	Ge 10´40˝	39´26˝	–	n	N_{10}	II	24. 6. 2006
L3	Ge 11´18˝	39´44˝	–	n	1	I	24. 6. 2006
L4	Ge 9´39˝	38´25˝	–	n	N_{100}	I–II	24. 6. 2006
L5	9,012´	42,378´	± 4 m	n	N_{10}	I (II)	21. 6. 2008
L6	8,596´	42,285´	± 17 m	n	N_{10}	I–II	19. 6. 2004
L7	8,603´	42,388´	± 21 m	n	N_{10}	I (II)	19. 6. 2004
L8	Ge 8,59´	42,04´	–	n	N_{500}	I–II	16. 6. 2007
L9	8,338´	43,378´	± 12 m				16. 6. 2007
L10	8,193´	47,238´	± 22 m	pp	N_{10}	I	16. 6. 2007
L11 #1	8,015´	52,912´	± 3 m	n	1+	IV+	29. 7. 2008
L12	8,120´	53,133´	± 3 m	n	1	IV+	29. 7. 2008
L13	8,103´	52,897´	± 4 m	n	N_{10}	I	29. 7. 2008
L14	8,239´	53,279´	± 3 m	n; ?p #2	N_{100}	I–II	29. 7. 2008
L15	8,453´	55,817´	± 10 m				2. 10. 2007
L16	8,513	55,743	± 5 m	?p, n	N_{50}	I–III	9. 10. 2009
L17	8,517	55,802´	± 5 m				9. 10. 2009
L18	8,359´	56,954´	± 5 m	?n	4	III+	3. 10. 2006
L19	8,353´	57,666´	± 9 m	p	3	III	(9. 9. 2009)
L20	8,323´	57,678´	± 7 m	n	1+	I	9. 9. 2009
L21	Ge 8´23˝	57´53˝	–	n	1+	I	30. 9. 2006
L22	8,331´	57,368´	± 6 m	n, p	N_{500}	I–II (III)	–
L23	7´42˝	57´48˝	–				
L24	7,501´	57,696´	± 5 m	n	N_{500}	I-II	28. 10. 2010
L25	7,493´	57,837´	± 5 m				28. 10. 2010
L26	7,541´	57,958´	± 4 m				28. 10. 2010
L27	7,546´	57,756´	± 7 m				7. 10. 2010
L28	7,524´	57,944´	± 3 m	n	1+	I	28. 10. 2010
L29	7,470´	57,818´	± 4 m	n	1	V+	28. 10. 2010
L30	7,464´	57,741´	± 6 m	n	N_{50}	I (II)	28. 10. 2010
L31	7,577´	58,112´	± 3 m	n; (?p)	N_{10}	I–II	28. 10. 2010
L32	7,673´	58,153´	± 3 m	n	2	I	28. 10. 2010
L33	Ge 7´36˝	57´56˝	–	p?	N_{50}	I	7. 10. 2010
L34	6,624´	58,524´	± 6 m	n	N_{500}	I–V+	28. 10. 2010
L35	6,807´	58,670´	± 5 m				16. 11. 2010
L36	6,621´	58,623´	± 7 m	n	1+	I–IV	28. 10. 2010
L37	6,791´	58,577´	± 6 m	n	N_{50}	I–V	16. 11. 2010
L38	6,589´	58,508´	± 8 m	n	N_{10}	I	28. 10. 2010
L39	6,528´	58,587´	± 5 m	n	1+	I–II	28. 10. 2010
L40	6,764´	58,566´	± 7 m	n	1	II+	16. 11. 2010
L41	6,744´	58,579´	± 8 m	n	2	I	–„–
L42	6,722´	58,627´	± 3 m	n	2	I	–„–
L43	6,741´	58,645´	± 4 m	n	1	I	–„–
L44	6,745´	58,737´	± 5 m	n	1+	I	–„–
L45	6,789´	58,790´	± 4 m	n	1	I	–„–
L46	6,903´	58,868´	± 7 m	n	1	I	–„–

Tab. 1. – cont.

1 Locality	2 Geographic coordinates			3 Origin	4 Number of individuals	5 Age class	6 Date of (first) record
	N 49°…	E 19°…					
L47	6,778´	59,005´	± 5 m	n; ?p	1+	I	–„–
L48	6,836´	59,100´	± 7 m	?p; ?n	N_{10}	I	–„–
L49	6,921´	59,008´	± 5 m	n; ?p	1+	I+	–„–
L50	6,997´	59,084´	± 5 m	n	1+	I+	–„–
L51	7,001´	59,050´	± 7 m	n	2	I	–„–
L52	7,044´	59,128´	± 5 m	n	1	I+	–„–
L53	7,089´	59,012´	± 6 m	n	2	I	–„–
L54	7,099´	59,109´	± 7 m	?	1+	I+	–„–
L55	7,144´	59,134´	± 5 m	n	1+	I	–„–
L56	7,263´	59,175´	± 6 m	n	3	I	–„–
L57	7,431´	59,532´	± 6 m	n; ?	N_{10}	I–II	16. 11. 2010
L58	6,522´	58,508´	± 5 m	n	2	I	28. 10. 2010
L59	6,454´	58,600´	± 5 m	n	4	I, II	28. 10. 2010
L60	6,489´	58,632´	± 4 m	n	1+	I, II	28. 10. 2010
L61	6,414´	58,719´	± 5 m	n	1+	III+	28. 10. 2010
L62	Ge 6´8˝	58´56˝	–	n	2	II	16. 11. 2010
L63	6,211´	58,501´	± 9 m	n	N_{10}	I–III	28. 10. 2010
L64	Ge 5´49˝	58´35˝	–	n	1+	I	28. 10. 2010
L65	5,652´	58,774´	± 5 m	n	1+	I–II	28. 10. 2010
	N 49°…	E 20°…					
L66	5,888´	1,095´	± 6 m	n	N_{100}	I–V+	28. 10. 2010
L67	6,095´	0,973´	± 6 m				28. 10. 2010
L68	6,020´	0,974´	± 6 m	n	N_{10}	I–V+	28. 10. 2010
L69	6,021´	1,140´	± 5 m	n	1+	I	28. 10. 2010
L70	7,062´	3,379´	± 6 m	?	N_{50}	I–II	28. 10. 2010
L71	7,090´	3,448´	± 9 m				7. 10. 2010
L72	7,015´	3,350´	± 7 m	?n	N_{10}	I (II?)	7. 10. 2010
L73	7,022´	3,404´	± 5 m				28. 10. 2010
L74	7,002´	3,396´	± 6 m	?n	1+	II	28. 10. 2010
L75	7,032´	3,595´	± 8 m	p	1+	II	7. 10. 2010
L76	7,132´	3,408´	± 7 m	n?	2	IV	7. 10. 2010
L77	7,121´	3,381´	± 9 m	n	2	I+	7. 10. 2010
L78	7,133´	3,291´	± 11 m	n	1	I	7. 10. 2010
L79	7,143´	3,151´	± 7 m	n?	1	II	7. 10. 2010
L80	7,011´	3,126´	± 5 m	p	N_{10}	III	28. 10. 2010
L81	6,487´	2,734´	± 4 m	p	N_{10}	II	7. 10. 2010
L82	6,551´	2,815´	± 4 m	p	N_{10}	II	7. 10. 2010
L83	6,546´	2,863´	± 5 m	p	N_{10}	II	7. 10. 2010
L84	7,020´	7,126´	± 6 m	p	N_{50}	I	16. 11. 2010
L85	7,054´	7,153´	± 5 m				
L86	7,130´	9,155´	± 9 m	p	1+	I	16. 11. 2010
L87	7,125´	10,040´	± 3 m	?	1+	I	16. 11. 2010
L88	7,562´	11,364´	± 4 m	?; n	1+	I, III+	16. 11. 2010
L89	7,621´	11,383´	± 5 m	n	1	I	16. 11. 2010
L90	7,648´	11,408´	± 4 m	n	1+	I	16. 11. 2010
L91	7,543´	11,566´	± 5 m	?n	1+	III+	3. 10. 2006

Tab. 1. – cont.

1 Locality	2 Geographic coordinates			3 Origin	4 Number of individuals	5 Age class	6 Date of (first) record
	N 49°…	E 20°…					
L92	7,915´	12,281´	± 4 m	?n	1+	III	3. 10. 2006
L93	7,972´	12,404´	± 6 m	?n; n	1+	I, III	3. 10. 2006
L94	7,535´	14,635´	± 4 m				
L95	7,675´	14,452´	± 5 m	?p, n	N_{100}	I–III	16. 11. 2010
L96	7,790´	14,300´	± 5 m				
L97	Ge 9´17˝	16´2˝	–	?p	1+	I	3. 10. 2006
L98	Ge 9´24˝	16´17˝	–	p	N_{10}	I+	3. 10. 2006
L99	9,731´	17,768´	± 4 m	?; n	N_{10}	I–III+	16. 11. 2010
L100	9,644´	18,191´	± 5 m	?; n	N_{50}	I–III+	2008
L101	3,162´	7,458´	± 6 m	n	N_{50}	I–II	9. 10. 2009
L102	3,069´	7,488´	± 6 m	n	1	II	9. 10. 2009
L103	3,177´	6,175´	± 8 m	n	3	I	9. 10. 2009
L104	3,189´	6,151´	± 9 m	?n	1+	I	9. 10. 2009
L105	3,202´	6,123´	± 7 m	p; ?n	N_{10}	I+	9. 10. 2009
L106	2,737´	6,053´	± 8 m	n	N_{50}	I+	9. 10. 2009
L107	2,746´	6,015´	± 7 m	n	N_{10}	I–II	9. 10. 2009
L108	Ge 2´24˝	6´21˝	–	n	1+	I+	9. 10. 2009

Explanations:

Col. 2: Ge – coordinates after Google® earth;

Col. 3: origin of the *Fagus* individuals seen: n – natural regeneration, p – planting, pp – probably planted, ? – uncertain;

Col. 4: absolute or estimated number of *Fagus* individuals seen: 1+ – more than 1 (up to 10), N_{10} – tens of individuals; N_{50} – detto but with higher number (up to 100); N_{100} – hundreds of individuals; etc.;

Col. 5: approx. age (age class) of *Fagus* individuals seen: I (1–20 years), II (21–40), III (41–60), IV (61–80), V (81–100); III+ – 41–60 years or older (estimate uncertain),

#1 noted tree lower on the slope

#2 those on windthrow

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