HISTORICAL DYNAMICS OF HUMAN IMPACT ON LANDSCAPES OF VITOSHA MOUNTAIN (SW BULGARIA)

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ABSTRACT

This article presents a study of the historical dynamics of human impact on the landscapes of Vitosha Mountain, Bulgaria. Information about the main historical and present-day anthropogenic impacts on landscapes was obtained from a various data sources and field research. These impacts include hunting, agriculture, grazing, logging, charcoal production, iron production, gold mining, stone quarry, reforestation, recreation. Five historical phases of anthropogenic impact on landscapes are recognized in our analysis: the Prehistoric phase, the Antiquity phase, the Mediaeval phase, the Ottoman phase and the Modern phase. The greatest anthropogenic impact was during the Ottoman phase, when the intensive agricultural and mining (iron and gold) activities contributed to a great landscape transformation and degradation. The functional purposes on the territory of Vitosha have undergone a radical change since 1934. The human impact on landscapes has gradually decreased and economic use gave way to conservation and recreation.

Keyworlds: human impact, anthropogenisation, long-term dynamics, landscape history, Vitosha Mountain

INTRODUCTION

Human activity is inseparable from its natural environment. Since George Perkins Marsh's groundbreaking "Man and Nature; or, Physical Geography as Modified by Human Action" published in 1864 (Marsh, 1965), which was strongly influenced by Humboldt's intellectual legacy (Wulf, 2015), the human impact on the environment has became one of the key research topics in geography and environmental science (Goudie, 2017). After the emergence of the concept of landscape (Antrop, 2019), it has been widely accepted that the present-day landscapes are the result both of natural development and changes, and the human (anthropogenic) impact on them over time. So, in order to understand the present-day state of a given area and its landscapes, it is crucial to have some knowledge of its past or its landscape history – that is to say, landscapes should be studied both in their spatial and temporal manifestations and based on a holistic view of the landscape, integrating natural and human activity (Marcucci, 2000).

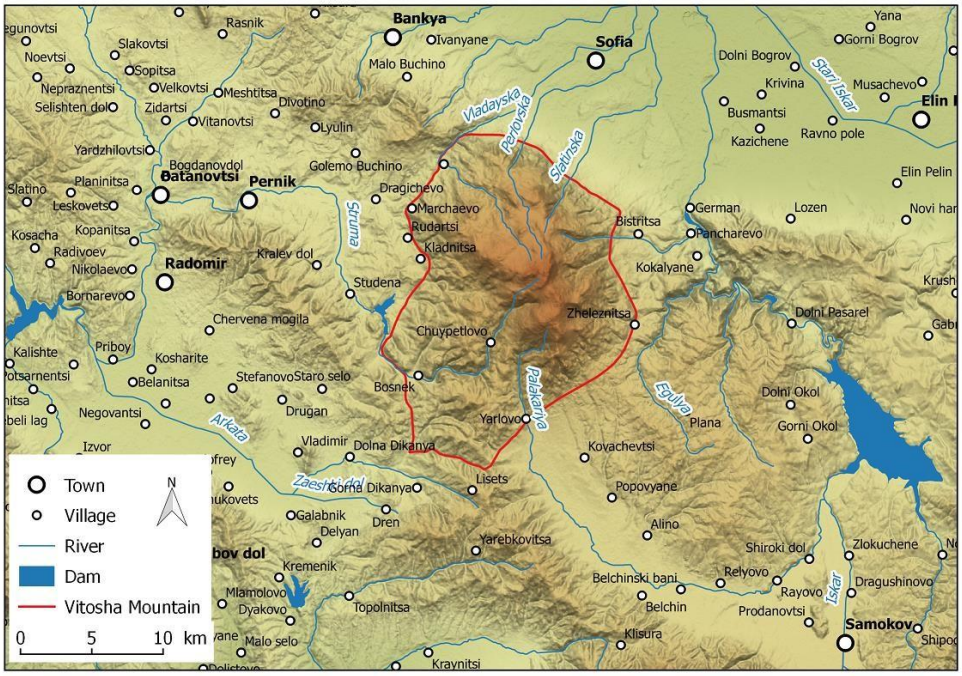
The area of Vitosha Mountain (most of it part of the Nature Park of the same name) selected for the present study and its landscapes are now objects of conservation and restoration. A better understanding of its landscape history with a focus in the past

anthropogenic impact may contribute to a better understanding of the past landscape changes and driving forces related with human activity. This information is important and may contribute to a better guidance of the landscape conservation and restoration activities in the future. Some recent studies about the origin, human impact, disturbance and management consider single vegetation communities (Dountchev *et al*., 2014; Panayotov & Georgiev, 2012; Panayotov *et al*., 2015; Todorova & Tzonev, 2010; Tsvetanov & Panayotov, 2013.). The spatial dimension of human impact on landscapes of the whole Vitosha was studied in previous research (Tzvetkov, 2017). The focus of this research is the temporal dimension of human impact. Thus the present article aims to: (1) identify the historical and present-day types of anthropogenic activities which modify landscapes; (2) reveal the historical dynamics of anthropogenic impact on landscapes; (3) create a periodization and define the main phases of the historical dynamics of the anthropogenic impact on the landscapes of the selected area.

STUDY AREA

Vitosha Mountain is located in SW Bulgaria near the capital Sofia (Fig. 1). Its total area is 27 485 ha with highest peak Cherni Vrah (Black Peak) at 2290 m a.s.l. The mean altitude of the mountain is nearly 1400 m a.s.l. The mountain is the first Bulgarian National Park and the first one in the Balkan Peninsula, established in 1934. Since 1998 Vitosha has been a Nature Park with a total area of 27 079 ha. It includes two reserves. "Bistrishko Branishte" (total area of 1061 ha) is a forest reserve with mainly spruce forests. "Torfeno Branishte" (total area of 785 ha) is a peat bog reserve located in the sub-alpine mountain belt. Vitosha Mountain preserves a valuable natural heritage of great biological diversity and serves important ecological and recreational functions to the adjacent capital of the country, Sofia.

Fig. 1: Map of the study area and its vicinity



DATA AND METHODS

The historical dynamics of human impact on landscapes and the formation and development of cultural landscapes is studied by various disciplines like landscape science (and landscape ecology), historical geography, environmental history, historical ecology and geohistory which deal with broad diversity of conceptual frames, methodological approaches and data sources (Baker, 2003; Balée, 2006; Darby, 1953, 1960, 1977; Hughes, 2006; Marcucci, 2000; Meyer & Crumley, 2012; Naylor, 2006; Newcomb, 1969; Nizovtsev, 2010; Piovan, 2020; Santana-Cordero & Szabo, 2019; Sauer, 1925, 1941; Thomas, 1956; Vampilova, 2008; Worster, 1988).

The basic method we have used is the traditional cross-section (vertical theme) method. For this study we collected data from various sources: already published data and studies, archive data (old maps, old photographs) as well as own field research. We organize these data in two datasets. The first dataset is palaeoenvironmental and includes mainly palaeobotanical publications and field research. From the published pollen diagrams we obtained information about the vegetation changes during the last six millennia and information about which changes may be linked to the anthropogenic impact. Traces of the human impact left on the landscape and preserved today were studied in the field. The second dataset is socio-historical. It includes narrative sources (mainly historical and ethnographic ones, and the local toponymy) as well as archaeological publications about the studied area and its vicinity. From these we analyze the main historical processes of settlement, ethnic changes, state-administrative changes, as well as (as far as available) changes in population, number of settlements and size of settlements. At this stage of the research we try to find the socio-historical context of the human activity and its environmental impact. At the next stage we analyze the economy of the studied area and its vicinity and the process of historical economic development of the area, with a primary focus on the land use and main environmental management types. When performing a spatial analysis of economic activities on the basis of available archaeological and historical data, we created maps with the use of GIS tools. At the final stage of this research we produced a historical periodization of the anthropogenic impact on landscapes based on the main types of anthropogenic activities and its chronology.

RESULTS AND DISCUSSION

Palaeoenvironmental analysis – Holocene environmental changes

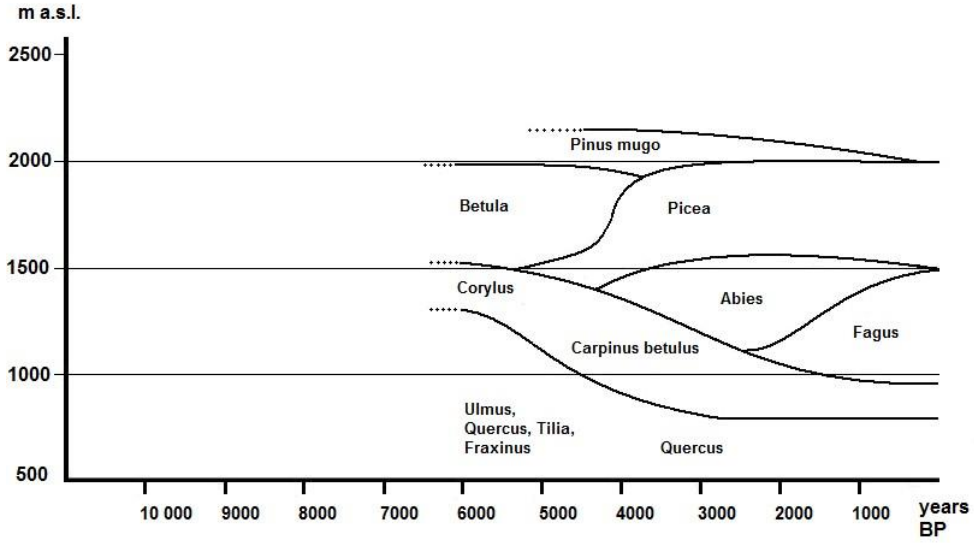
Palynological studies (Filipovitch, 1988a) of the peat bogs found that the earliest peat accumulation started around 5600 – 6000 ^{14}C years BP, based on radiocarbon dating. According to L. Filipovitch the vegetation development during the last six millennia had four stages:

(1) The stage with dominant deciduous trees where at the lower parts of the mountain were spread *Ulmus*, *Quercus*, *Tilia* and *Fraxinus*. Above them were spread *Betula*, *Corylus*, and *Carpinus betulus*. The highest parts were covered with grass vegetation: *Poaceae*, *Cyperaceae*, *Apiaceae*, *Caryophylaceae*, *Asteraceae* etc.

(2) The stage with a predominance of *Carpinus betulus* and *Quercus* at low altitudes and a decline of *Ulmus*, *Tilia*, *Fraxinus* and *Acer* distribution. Above them in the upper forest belt *Abies alba* and *Picea abies* were predominant. At the highest parts of the mountain *Pinus mugo* was also spread along with the grass vegetation. This stage generally coincides with Subboreal.

(3) The stage with predominance of *Fagus sylvestris* and *Carpinus betulus* at low altitudes, and decline of *Abies alba*. Above them in the upper forest belt *Picea abies* was predominant. This stage generally coincides with Subatlantic.
(4) The stage with significant decline of the forest trees abundance due to the great acceleration of the human impact started around 700 ^{14}C years BP. At this stage *Pinus mugo* almost entirely disappeared and was replaced by *Juniperus* (Fig. 2).

Fig. 2: Graphical representation (own elaboration) of the Holocene vegetation development of Vitosha Mountain based on palaeobotanical data collected by L. Filipovitch (1988a)



One general conclusion of the palynological studies is that the environmental changes during the Holocene connected with expansion or decline of the dominant species are mostly natural with the exception of *Pinus mugo* which decline is entirely attributed to the human activity (Filipovitch, 1988a, 1988b).

Historical and present-day anthropogenic activity and its impact on landscapes

Hunting

Hunting is the oldest human activity affecting the natural environment and its fauna. Since we do not have any direct evidence of hunting activity in Vitosha Mountain during historical times, we might only suggest that it has not affected the landscapes significantly. Despite the conservation status of the Vitosha Mountain, hunting activity is still active today legally and illegally. Legal hunting is managed by the Vitoshko-Studena state game enterprise which covers a total territory of 16 174 ha in the southern parts of Vitosha. Main game species here are red deer (*Cervus elaphus*) with annually hunting up to 4 specimens (0-4), fallow deer (*Dama dama*) with annually hunting up to 7 specimens (2-7), roe deer (*Carpeolus carpeolus*) with annually hunting up to 34 specimens (18-34), wild boar (*Sus scrofa*) with annually

hunting up to 160 specimens (40-160), gray wolf (*Canis lupus*), acclimatized mouflon (*Ovis musimon*) with annually hunting up to 13 specimens (Damianov *et al*., 2008).

Agriculture and grazing

Agriculture and livestock breeding are human activities which affected the landscapes of Vitosha longer than any other activity except hunting. The earliest known Neolithic settlement near Vitosha was Slatina, now in the eastern part of Sofia town (Nikolov & Takorova, 2018). The beginning of this settlement was dated around 6000 years BC. Several Neolithic settlements also exist in the vicinity: Kremikovtsi, Lozen, Botunets, Kurilo etc. At this time the cultivated plants and animals correspond to the so called Near Eastern assemblage and the human population was small, so for farming they used the land near the settlements located at the most suitable places (Marinova, 2007; Todorova, 1986; Todorova & Vajsov, 1993). This is in concordance with some recent studes of the nitrogen and carbon isotopes (δ^{15}N и δ^{13}C) contained in crop remains from several Neolithic sites (including Slatina) which found that early farmers used long-established intensive cultivated land plots with livestock manure (Bogaard *et al*., 2013). After the Neolithic human occupation in the area of present-day Sofia continued uninterrupted throughout the ages. Most of the present-day settlements around Vitosha already existed at the end of the Second Bulgarian Empire (around the 14th century AD).

Direct evidence about past human impact can be extracted from pollen records (Filipovitch, 1988a, 1988b). For Vitosha, the earliest dated pollen records are around 6000 ^{14}C years BP or 6800 calibrated years BP (for conversion see: Roberts, 2014). This coincides with the beginning of the Chalcolithic. During the first stage of the mixed deciduous forest there is no evidence for human presence and its impact over the mountain landscapes. During the second stage of the hornbeam and coniferous forest (generally coincides with the Bronze Age) also there are no certain signs for human impact either, but there are more evidence for human impact over the mountain vicinity. Single grains of anthropic pollen indicators like *Chenopodiaceae*, *Artemisia*, *Rumex*, *Urtica*, *Plantago lanceolata*, *Polygonum aviculare* exist in almost every pollen site. In one site presented single grains of crops (*Avena/Triticum*), and other one of weeds (*Centaurea cyanus*) are presented. At the end of this stage, in some sites single pollen grains of *Rumex alpinus* and also of *Juglans* appeared. This is evidence that the walnut tree was already cultivated in the mountain vicinity during the Late Bronze Age. From this data it can be assumed that during the Late Bronze Age some livestock herds had already incidentally reached the highest parts of Vitosha. It has been already suggested that during the Bronze Age (its second half around 4000 cal. years BP) in the Balkans and specifically in the Bulgarian lands the livestock breeding type changed to a more mobile (transhumant pastoralism) and more extensive one in the most of the territories, which was accompanied by forest clearing for pastures (Arnold & Greenfield, 2006; Chapman *et al*., 2009; Connor *et al*., 2013). At this time, along with more mobile animal husbandry also started the populating of lower mountains and building of specific mountain sanctuaries (Leshtakov, 2006). The beginning of the next pollen stage of the beech and coniferous forests coincides with the beginning of the Iron Age (around first millennium BC). During this stage the presence of anthropic pollen indicators increases with an abundance of crops (wheat, oats, and rye) and weeds. Greater, however, was the anthropogenic impact of grazing which took place in the whole mountain. It is accompanied by a significant increase in *Polygonum aviculare*, *Plantago lanceolata*, *P. media*, *P. major*, *Artemisia*, *Rumex*, *Urtica*, *Chenopodiaceae*, and *Pteridium aquilimum*. The decrease of the arboreal pollen abundance indicates the beginning of mountain forest clearing. These data are similar to some general processes representative of SW Bulgaria where significant

evidence about an anthropogenic impact on landscapes visible in the pollen records is dated around the end of the Bronze Age (Marinova *et al*., 2012). Very similar are the results from Carpathians where the anthropogenic impact is registered in the pollen records during the late Bronze Age, increased during the Roman period and reached its highest levels during the last 500 years (Feurdean *et al*., 2013; 2015). More generally, evidence about significant human transformation of the landscape on a larger scale appeared during the second half of the first millennium BC in Thrace (Georgieva, 2015) and in the lower Danube Plain (Feurdean *et al*., 2021). This process was synchronous with the permanent populating and reclamation of mountain areas in Ancient Thrace which is dated (by numerous archaeological artifacts) after ca. 6th century BC (Hristov, 1999; 2002). The last pollen stage of Vitosha is connected with great forest degradation. The beginning of this stage is dated to 705 ± 65 ^{14}C years BP. It is during this stage that the highest abundance of anthropic pollen indicators is recorded. Also the lowering of the upper forest line had also started. This was done with using burning, and was registered through charcoal finds in the peat samples (Filipovitch, 1988b).

Agriculture spread over the Vitosha Mountain during the last pollen stage. We can assume that this happened specifically during the Ottoman rule when some of the population migrated from plains to mountains. Suitable for arable lands are only small flat and denudated areas with highest elevation between 1300 – 1400 m a.s.l. in the southern parts of the mountain around Petrus peak (1454 m). These lands are used for agriculture even nowadays (for wheat, oats, and rye) and occupy around 100 ha.

Livestock breeding and grazing had a more significant impact over the landscapes of Vitosha. During the Ottoman rule subalpine meadows were used for grazing sheep herds owned by Sarakatsans (Karakachans), Yörüks, and also Bulgarians. Their presence in the mountain and their practice of burning subalpine meadows and shrubs as well as high mountain forests for pastures are well documented (Deliradev, 1926; Jireček, 1899). It was because of this practice that a large part of the southern slopes of the mountain was deforested. The practice of burning was discontinued soon after the National Park was created. Nowadays due to the significant reduction in the number of livestock in the surrounding villages grazing impact over the landscapes is small and insignificant.

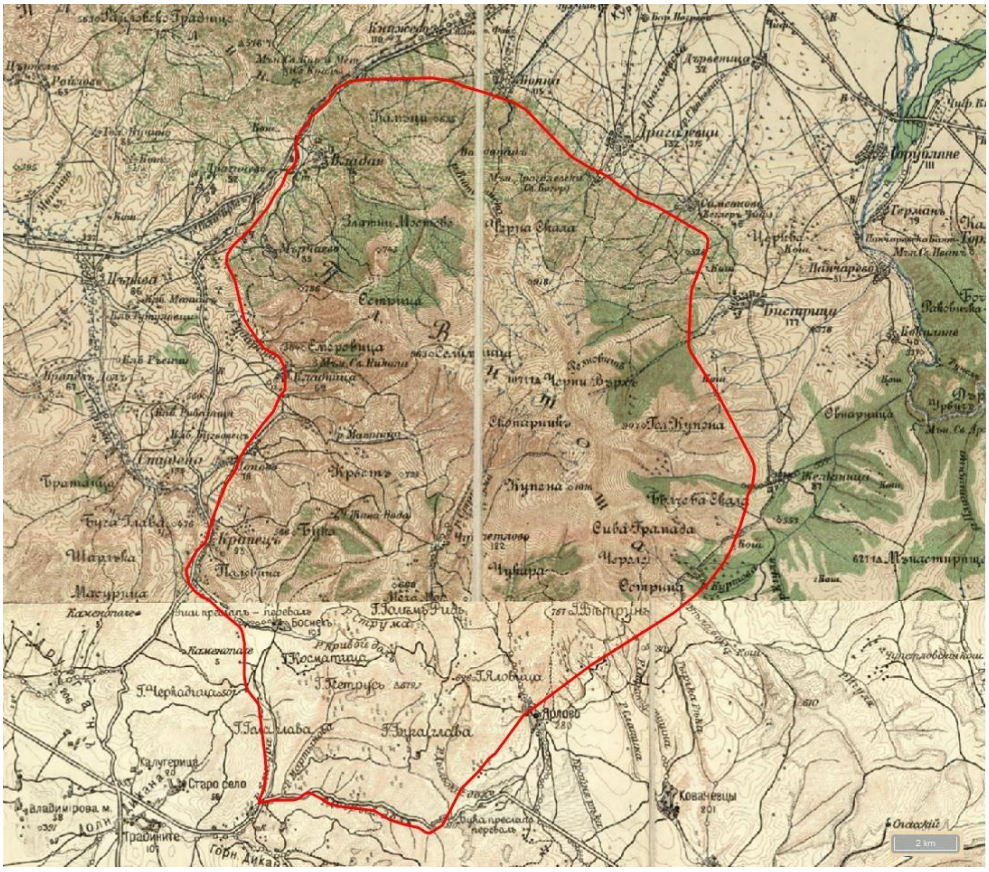
Logging and charcoal production

It is difficult to pinpoint the beginning of active logging in Vitosha. For firewood, people first used oak forests and riparian woodland near the settlements (Marinova *et al*., 2012; Marinova & Ntinou, 2018) and later the mountain forests. It is assumed that great acceleration of logging in Vitosha started after the establishment of ancient iron production because charcoal was used as fuel for the smelting processes.

At the end of the 14th century AD Ottoman military commander Lala Sahin Pasha described the vicinity of Sofia as covered with forest with large trees suitable for building (Ihchiev, 1906). A few centuries later, according to the description of Vitosha given by Ami Boue (in 1836 – 1837), the mountain was deforested, especially its southern slopes (Filipovitch, 1988b). Later F. von Hochstetter described the southern slopes as completely deforested, and the northern, eastern and western slopes as only partly wooded (Hochstetter, 1872). In his travels around Bulgaria the Czech historian Konstantin Jireček described Vitosha as deforested with small forests on the northern slope around the village of Vladaya. It was to this deforestation that he attributed the accelerated erosion and debris accumulation of large stones slid from the slopes by torrents on the mountain foothills (Jireček, 1899). The Belgian economist E. de Laveleye also described Vitosha as completely deforested and covered with shrubs grazed by goats (Laveleye, 1890). This is clear visible on a Russian topographic map of Bulgaria created during the Russo-Turkish War (1877 – 1878) with

a scale of 1:126 000 (the so called "Triverstova map") (Fig. 3). The current significantly deforested appearance of the mountain has probably existed since the beginning of the 19th century. Some forests were preserved during the Ottoman period due to a logging ban by individual Ottoman authorities, and later by Bulgarian authorities and private owners (e.g. the forests in the valleys of the Vladayska River and the Bistritsa River) (Deliradev, 1926; Jireček, 1899; Yordanov, 1977).

Fig. 3: Vitosha Mountain (red line) shown on a Russian topographic map (1877 - 1878) with a scale of 1:126 000. Dotted green areas indicate scrub lands; dense green areas indicate forest lands. (Source: BGM, 2020)



An important part of logging was related to the production of charcoal intended for the needs of metallurgy, without which the necessary temperatures for melting the metal could not be reached and maintained. It is calculated (for Sussex between 120 – 240 AD) that 1 ton of iron required 12 tons of charcoal, the latter requiring about 84 tons of woods (7 tons of wood per 1 ton charcoal), obtained from 2 acre (0,8 ha) woodland and wood:iron ratio of 50:1 to 40:1 (Rackham, 2006). In total for medieval production in Europe it is stated that 1 ton of iron was extracted from about 10 tons of ore and 8 tons of charcoal, the latter requiring about 30 tons of wood, equivalent to the annual production of 5 ha of beech coppice forest (Hoffmann, 2014). Some authors, however, are skeptical about such calculations (Williams, 2006, p. 169-170) and the above mentioned calculations should be treated with some caution

as approximately average because several factors (like iron furnace productivity, charcoal making productivity, woodland yield etc.) may vary in space and over time. The production of charcoal by carbonization of wood has been known since ancient times. The earliest preserved description of this production process was given by Theophrastus in his book "Enquiry into Plants". He described a method in which wood accumulated in piles (earth mound kiln) is charred by internal heating. Another method was applied by digging an earth pit (Theophrastus, 1916, p. 467-471). Both methods have been practiced in Europe, but the former was widespread and applied almost unchanged until the 19th century AD (for visual representation from the 18th century AD see: Diderot, d'Alembert, 1762). Although with different variations in different parts of Europe, the technology was basically similar (Svedelius, 1875). Mostly mature trees (neither too old nor too young) were used for production, and they were preferably species with harder wood (beech, oak, hornbeam), but in the north countries (with mostly coniferous forests) pine, spruce and other trees were used. The production varied between approximately 15 % and 20 – 25 % by weight of the wood used (Emrich, 1985; Pleiner, 2000). In Bulgaria the flat sites for charcoal production was called "*shtetini*", and the wood piles for burning was called "*zhizni*" (Georgiev, 1978; Konyarov, 1953). Some studies of the Samokov region and of the Vitosha Mountain have found that not only deciduous trees (beech), but also coniferous trees (spruce) were used for charcoal production (Filipovitch, 1988b; Markov, 1898; Yordanov, 1977).

Relatively little is known about the forest management practiced of Vitosha. The first forest law regulations in the Ottoman Empire were introduced in 1870, but they were not observed strictly, so forest management was entirely local. Widespread during the last centuries in Europe was the practice of coppicing (Feher, 2018; Hoffmann, 2014; Rackham, 2006; Stajic, 2009; Williams, 2006). There are no preserved written documents about Vitosha to prove that this practice was adopted. According to G. Georgiev, logging for charcoal production was not organized but was done spontaneously, as a result of which there were substantial differences in the composition and distribution of forests (Georgiev, 1978). According to P. Deliradev, despite the fact that the iron industry and charcoal production played a significant role in the deforestation of Vitosha, charcoal production proved efficient, as the large needs of iron production were met for several centuries. According to him, the greatest forest exploitation began shortly before the Liberation (1878) and continued even more intensely after the Liberation and in the early 20th century AD (including illegal logging) (Deliradev, 1926). However Ami Boue's observations of logging and charcoal production in the area of the Balkan metallurgical centers indicate that it did not follow any rules or kept to any plans (Boue, 1840).

Contemporary logging within the boundaries of the Vitosha Nature Park is carried out under the control of the state forestries. It is carried out through selective felling, mostly in planted coniferous forests, thus minimizing the negative impacts on landscapes.

Iron production

The vicinity of Vitosha Mountain, Plana Mountain and NE Rila Mountain (around the town of Samokov) where igneous rocks with high content of magnetite are spread was an old iron metallurgy center during the late mediaeval times, that was well known in the Ottoman Empire and one of the biggest in the Balkan Peninsula (Georgiev, 1978). This is reflected very clearly in the names of the local settlements. Most of them are connected with the iron metallurgy, e.g. Samokov, Zheleznitsa, Rudartsi and Kovachevtsi (see Fig. 1). Several local toponyms (place names) of Vitosha also indicate this (Yordanov, 1999).

Probably the mining activity in the area started during Pre-Roman times with the Thracians. Some archaeological sites dated back to the Iron Age in the upper Struma River

basin are closely related with ores and ancient mining, and this is known about the archaeological sites near the village of Bosnek (Mihaylov, 2016; Mitova-Djonova, 1983). Although the exact chronology of iron metallurgy in the study area is not clear it is known that it was most intensive during the Ottoman Empire and declined around the Crimean war (1853 – 1856) (Georgiev, 1978). Mediaeval metallurgy technology in Europe was described by Geogrius Agricola in his book "De Re Metallica" (Agricola, 1950). In Bulgaria the best documented is the period between the late 19th century and early 20th century AD when some of the old iron metallurgy centers still operated. F. von Hochstetter (1872) gave one of the first more detailed descriptions of the iron industry around Vitosha and Samokov. The most detailed publications on the topic have been published by G. Konyarov (1953) and especially by G. Georgiev (1978). We will briefly describe the technology here, with particular emphasis on its environmental impact. After forest clearing the ore fields were prepared when the soils and superficial materials have been ploughed up and broken. Then for the sediment transportation water channels (Fig. 4 and Fig. 5) connected with pounds were used (the pounds varied in length from 20 to 60-70 m and in width from 10 to 20-30 m).

Fig. 4: Map of known localities of the old iron and gold production. The map is based on previous map sketches and data collected by G. Georgiev (1978) and S. Avdev (1996)

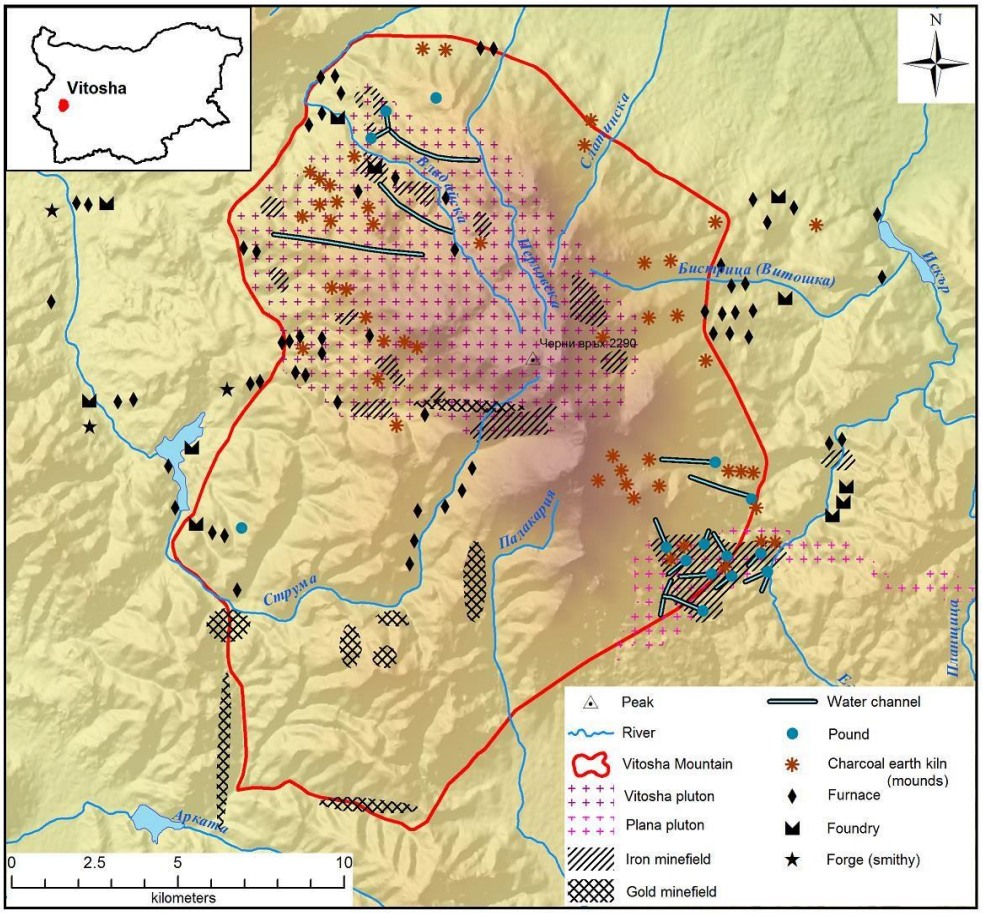


Fig. 5: The remains of an artificial channel bend created to slow-down the stream speed. The arrow indicates the stream flow direction

It is obvious that this process has a dramatic environmental impact on the landscapes. It is not only connected with the destruction of the natural vegetation, but also with the destruction of the soil cover and to the complete transformation of the landscape. The documented places of such ore fields on Vitosha are near Vladaya, Marchaevo, Rudartsi, the catchment area of the Matnitsa River, in the source parts of the Struma River and the Bistritsa River (immediately below Skoparnik Peak), in the locality of Zlatnite Mostove and probably in other places. The smelting of iron ore took place in furnaces called "*vidni*", producing bloomery iron. Later iron processing took place in foundry called "*samokov*" (in Turkich "*madan*"), producing bar iron. The exact number of furnaces in the area of Vitosha is difficult to establish, but it was significant. Over 40 furnaces and 10 foundries probably existed in the study area (Fig. 4) (Georgiev, 1978). Their work also required water power, as well as a large amount of charcoal and firewood. During the second half of the 20th century AD, a significant part of the slag from this iron mining in the western and southern parts of the mountain was obtain for processing in the metallurgical enterprise in Pernik (the former metallurgical plant DMZ Lenin) – only from the area of the village of Chuypetlyovo, for example, 700 t of slag were obtained – which largely removed the traces of this activity we have today (Georgiev, 1978).

Currently, some of the areas that were heavily deforested in the past as a result of iron mining are reforested with coniferous forests. Such places are the entire foothills in the range of the Vitosha pluton (mainly of sienite) from Vladaya, Marchaevo and Rudartsi to Kladnitsa, as well as the surroundings of the village of Yarema in the range of the Plana pluton.

Gold mining

Gold extraction and metallurgy in Bulgaria has a long history (Krauss *et al*., 2020; Radivojevic & Roberts, 2021), but the first written records of gold mining in the study area date back to the 15th century AD. They indicate the existence of a large gold and silver mine on the southern slopes of Vitosha (the exact location has not been established) – one of the largest in the Balkan Peninsula. The opencast gold mining was carried out both from secondary alluvial deposits, from the rivers Palakaria, Struma, Vladayska, Boyanska (Perlovska), Bistritsa, and from primary deposits – opencast hard-rock mines (Fig. 4) (Avdev, 1996; 2005). It has been suggested that it was quite intensive during the Romans along with the extraction of other metals (Deliradev, 1926), but there are no reliable written or archaeological data about that. Based on indirect evidence (gold coins minted in the Roman town of Serdica) some scholars accept this view (Avdev & Tsankov, 2008). Although the exact chronology and dating of gold mining in many sites is difficult, there are several sites in Bulgaria where gold mining is associated with the Thracians and is dated during the Pre-Roman times (Tonkova, 2008). The significant amount of gold artifacts found in the alluvial deposits in a number of rivers in Western Bulgaria (including Palakaria) and their similarity with gold artifacts from archaeological sites dated to the Early Bronze Age (Bachmann & Tsintsov, 2003; Christov, 2008; Tsintsov, 2008; Tsintsov *et al*., 2009), indicate that it is possible that the gold mining from alluvial deposits in the area may have begun in very ancient times. Another indirect evidence to support this hypothesis is the existence of very advanced mining technologies for processing even primary gold (and copper) deposits during the Bronze Age (Stöllner, 2018). Nevertheless the most intensive gold extraction was during the 16 – 17th century AD, containing on a much smaller scale until the end of the 19th and the beginning of the 20th century AD. It is assumed that some place names in Vitosha Mountain remained from this activity, such as Zlatnite Mostove ("The Golden Bridges") (Deliradev, 1926).

Fig. 6: Spoil heaps of boulders and pebbles are remains of old gold and iron (?) production, top photo with human for scale

According to S. Avdev (1996), the remains of the mining activity in the area of Vitosha are considered to be one of the mot substantial in Bulgaria. By observing the remains of quarries and dumps, he made a preliminary estimation that there are several million tonnes of extracted and processed ore and several dozens of millions of washed sands and gravels (Avdev, 1996). Significant remains of gold mining can be seen north of the village of Chuypetlyovo piled up as large heaps in long rows along the Struma River (Fig. 6). According to P. Deliradev remains of such gold mining exists near the village of Chuypetlyovo, on the watershed from Kupena peak between Vitosha and Verila Mountains, and also near the villages of Kladnitsa, Bosnek and Bistritsa (Deliradev, 1926). There are old remains of hard-rock mining – quarries for gold and silver – near the following sites: Smilyo, Yanchevsko Usoe, Sichkova Bara, Hrebeta, Balabanitsa (between the villages of Yarlovo and Chuypetlyovo). The quarries at Smilyo are impressive in size: 555 m in length, 40 - 50 m in width and 10 m in depth. There are several large (up to 400 m long) opencast pits NE of Krasta Peak (1561 m a.s.l.). Such are the pits in the springs of Matnitsa River in Nakev

Kamak locality. The opencast pits near Petrus Peak are known as Petrunovi Gramadi (Avdev, 1996, 2005; Avdev & Tsankov, 2008).

Stone quarries

They were worked mainly for the needs of road construction and started after the Liberation (1878), with the most intensive exploitation around the 1940s – 1950s. The main sites of the quarries are at about 1000 – 1200 m a.s.l. in the syenite part of the western slope of Vitosha (between Vladaya, Marchaevo and Rudartsi, as well as near Selimitsa hut). Their extraction has been suspended since 1981, and the Protected Areas Act from 1998 (Art. 31, item 7) prohibited the extraction of minerals from open quarries within the boundaries of nature parks. The consequences of this activity are local, as the negative impact on the landscapes at this stage is mainly aesthetic. Significant restoration and reforestation activities are not being undertaken at the moment.

Reforestation

According to L. Yordanov, the reforestation of Vitosha began in 1891 with the first planted *Pinus sylvestris* trees near Knyazhevo, but this early attempt was carried out only in a small area. After the wars, the reforestation activities resumed and in 1924 reforestation took place in the area of the Dragalevtsi Monastery, and in 1925 a much larger reforestation began in the area of Aleko hut. A few years later, reforestation with coniferous species was carried out in many different parts of Vitosha (the localities of Mandrata, Balabana, Kamennoto Zdanie, Momina Skala, and around the huts Septemvri and Sredets). In the 1930s, about 600 ha were reforested, and new forests already cover the southern slopes (Rudartsi, Kladnitsa). After 1952, reforestation activities were given new impetus, and by the end of the 1970s the planted forests of Vitosha amounted to about 4500 ha (Yordanov, 1977).

The major species in the coniferous forest belt of Vitosha is spruce (*Picea abies*). The natural or seminatural forests of spruce amount around 5 % (1473 ha). The major species used for reforestation along with *Picea abies* have been *Pinus sylvestris*, *Pinus nigra* and *Pinus peuce* (one disadvantage is that reforestation include coniferous species planted in the deciduous belt, as well as coniferous species planted in the coniferous belt, which are not typical or natural for it). The total area of planted coniferous forests is around 15 %. However, the secondary meadows in the forest belt amount around 24 % or 6688 ha (Tzvetkov, 2017).

During the second half of 20th century, the so-called “forest transition” (Mather, 1992; Mather & Needle, 1998) took place on Vitosha. In contrast with other mountain areas where

the main driving force of forest transition was agricultural adjustment and land abandonment (MacDonald *et al*., 2000; Kozak, 2010), the main driving force here was environmental policy and establishment of Vitosha Nature Park in 1934.

Recreation activities

The date of August 27, 1895, when the Bulgarian writer Aleko Konstantinov organized a group ascent of Cherni Vrah for nearly 300 people, has been conventionally accepted as the beginning of the organized tourist activity in Vitosha (and generally in Bulgaria). The construction of the tourist infrastructure, however, began much later, when in 1924 the first tourist hut (Aleko) in Vitosha was built. The next 20 years saw the building of the huts Edelweiss, Selimitsa, Kamen Del, Tintyava, Fonfon, Planinets, Bor, Sredets, Momina Skala and others. However, the most intensive construction was in the period after the World War II, when huts, hotels, rest stations, restaurants, lifts, ski slopes, shelters, power supply facilities, water supply facilities (the largest one – Studena dam, was built in 1953) and others were built.

In 1934 the creation of Vitosha National Park with an area of 6400 ha was announced, which was expanded several times in 1952 to 22 725 ha, in 1981 to 26 547 ha, in 1991 to 26 606 ha, and in 2004 to 27 079 ha. Now Vitosha is the most visited Bulgarian mountain, as the number of tourists visiting it annually is determined between 1.5 million and 3.5 million according to various sources, but there has been no exact estimation yet. The road network constructed in the northern part has a total length of 111.7 km (of which 70 km with permanent pavement) and the alley network is 290.6 km. The northern part of the mountain attracts about 80 % of the flow of tourist.

The anthropogenisation on landscapes related with recreation and tourist activity is a complex of impacts of different types, with different spatial distribution and different intensity during the year. It includes noise and disturbance of the animal species (also poaching), pollution from waste (mostly packaging), mushroom picking, picking of wild fruits (blueberries, raspberries, etc.), medical plants and wild flowers, and soil erosion on mountain trails.

Historical periodization of anthropogenic impact on landscapes

As a result of the analysis of the palaeoenvironmental and socio-historical data sets, a historical periodization of the landscape anthropogenisation can be produced. We distinguish five phases of anthropogenisation, which reflect the degree of impact on the landscapes in combination with the chronological manifestation of the types of anthropogenisation (the result of the economic activities undertaken in the mountains). They are shown in tabular form in Table 1.

Table 1: Anthropogenic impact types and historical phases of anthropogenisation on landscapes

Impact type / Phases	Prehistoric			Antiquity	Mediaeval	Ottoman	Modern	
	1	2	3				1	2
Hunting	?	+	+	+	+	+	+	+
Agriculture					?	+	+	+
Grazing			?	+	+	++	++	+\-
Logging				+	+	++	++	+
Charcoal production				+	?	++		
Iron production				+	?	++		
Gold mining			?	+	?	++		
Stone quarry							+	+\-
Reforestation							+	+
Recreation							+	++

Symbols: probably presence (?); presence (+); intensive presence (++); discontinued (-)

1. Prehistoric phase with three sub-phases:

1.1. Paleolithic-Mesolithic sub-phase: up to ca. 7000 – 6500 BC. For this sub-phase there are no direct data for Vitosha, therefore its differentiation is done on the basis of analogy. The anthropogenisation was mainly connected with hunting and gathering.

1.2. Neolithic-Chalcolithic sub-phase: ca. 7000 – 6500 BC to ca. 3000 BC. For this sub-phase the direct data for Vitosha cover its second part (Chalcolithic). The pollen diagrams do not register a large-scale impact of anthropogenic activity, which is why it is assumed that it is insignificant and only has a local character. At that time, the transition from forage to farming and the emergence of agriculture and animal husbandry (the Neolithic revolution) was initially mostly connected with areas of the country away from the mountains. However, hunting continued to be important and practiced, especially in forested mountain areas. Some occasional effects of livestock grazing were also possible.

1.3. Bronze sub-phase: ca. 3000 BC to ca. 1200 BC. Palynological data about the Bronze Age do not show an increasing trend of change in the intensity of anthropogenic activity, as such is mostly observed at the end of the Bronze Age. It is believed that at that time animal husbandry was more actively developed than agriculture and therefore its role was more significant. Probably at that time began the exploitation of the high mountain pastures of Vitosha. It is possible that gold mining from alluvial sediments began during this sub-stage.

2. Antiquity phase: ca. 1200 BC to ca. 6th century AD. In general, this phase is characterized by a gradual increase in anthropogenisation. With the beginning of iron metallurgy, new preconditions emerged for the settlement of mountainous and semi-mountainous areas. At that time began the iron mining in the region of Vitosha, which most likely intensified during the Roman era. Remains of ancient archeological sites can be found in many places around the foot of the mountain, as well as in the southern parts of Vitosha.

3. Medieval phase: ca. 7th century AD to ca. 14th century AD. At the end of this phase the modern settlement network at the foot of Vitosha had been formed marking a significant increase in the degree of anthropogenisation. Most active human impacts were, agriculture, logging and probably iron mining.

4. Ottoman phase: ca. 14th century AD to the Liberation (1878). During this phase the settlement and the formation of the settlement network reached its peak. Livestock grazing and agricultural was at its peak, as well as gold mining, the exploitation of iron ore deposits and the related active forestry use. The economy was developing extensively and during this phase human impact was spread over the landscapes in all altitude belts.

5. Modern phase with two sub-phases:

5.1. Post-liberation transitional sub-phase: from 1878 to 1934. During this sub-phase the iron and gold mining activity was practically ceased, the extraction of quarry materials began, the agricultural and forestry anthropogenisation continued. Some reforestation measures were being taken with varying degrees of success.

5.2. Conservation sub-phase: after the creation of Vitosha National Park (1934). The extraction of quarry materials continued until 1981. The agricultural and forestry anthropogenisation significantly decreased. Tourist anthropogenisation and building activities related to the recreational infrastructure are intensifying. Large-scale reforestation measures are being implemented.

CONCLUSIONS

The anthropogenic impact on landscapes exerted for centuries on the Vitosha Mountain was significant. We identified the following historical and present-day anthropogenic activity types: hunting, agriculture, grazing, logging, charcoal production, iron production, gold mining, stone quarry, reforestation, recreation. In our analysis we also recognize five historical phases of anthropogenic impact on landscapes:

1. Prehistoric phase with three sub-phases: 1.1. Paleolithic-Mesolithic sub-phase: up to about 7000 - 6500 BC. 1.2. Neolithic-Chalcolithic sub-phase: ca. 7000 - 6500 BC until ca. 3000. 1.3. Bronze sub-phase – ca. 3000 BC until ca. 1200 BC.

2. Antiquity phase: ca. 1200 BC to ca. 6th century AD.

3. Medieval phase: ca. 7th to ca. 14th century AD.

4. Ottoman phase: ca. 14th century AD to the Liberation (1878).

5. Modern phase with two sub-phases: 5.1. Post-liberation transitional sub-stage: from 1878 to 1934. 5.2. Conservation sub-stage: after the creation of Vitosha National Park (1934).

The greatest anthropogenic impact was during the Ottoman phase, when the most intensive agricultural and mining (iron and gold) activities were undertaken in the studied area. Several factors probably contributed to the significant deforestation: logging, charcoal production (for iron metallurgy), and expansion of pastures for grazing. The greater part of the mountain was transformed into cultural landscapes and was devastated. After 1934 a radical change in the functional purposes on the territory of Vitosha was done. The human impact on landscapes gradually decreased and economic use shifted to conservation and recreation. Some of the devastated landscapes were reforested and a lot of past anthropogenic impact traces were removed. It is possible for the park administration to exhibit some of the remains

of the mining landscapes (e.g. Fig. 6), accompanied with relevant historical information, as they are part of the cultural heritage of the park.

Future research is necessary in several directions to obtain more detailed information about the anthropogenic impact on the environment and to address more clearly such questions as which human activities contributed more to deforestation in the past: mining and charcoal production or forest clearing for pastures and grazing. New research on the mountain peat-bogs (palynological, anthracological, geochemical) may reveal the timing of the wildfires and the human contribution to them, as well as the timing of the mining activities and related local atmospheric pollution. The exact location of the charcoal kiln sites (employing airborne laser scanning, field research) and its research (soil research, anthracological research, and absolute dating) may reveal which tree species were used for charcoal. Its age may shed light on the forest management (if coppice practice was used) and the chronology of charcoal making. Finding the remains of old slags, and archaeometallurgical research also may reveal new information about the past metallurgical practices.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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