

HISTORY OF FOREST VEGETATION MAPPING IN BOSNIA AND HERZEGOVINA

ZGODOVINA KARTIRANJA GOZDNE VEGETACIJE V BOSNI IN HERCEGOVINI

Sead VOJNIKOVIC¹

ABSTRACT

History of forest vegetation mapping in Bosnia and Herzegovina.

The work presents the history of forest vegetation mapping in Bosnia and Herzegovina (B&H). Forest vegetation mapping in B&H is done from arrival of Austro-Hungarian monarchy from 1885 to present day. The most intensive forest vegetation mapping in B&H took place in 50's and 60's of the past century. Special significance in B&H forest vegetation mapping was given by: G. Beck, L. Adamović, I. Horvat, P. Fukarek, V. Stefanović, V. Beus... Since the end of XX century forest vegetation mapping was mainly done with the help of aerial photos and satellite images.

Key words: history, mapping, forest vegetation, Bosnia and Herzegovina.

IZVLEČEK

Zgodovina kartiranja gozdne vegetacije v Bosni in Hercegovini.

Članek opisuje zgodovino kartiranja gozdne vegetacije v Bosni in Hercegovini (BiH). Pričelo se je od prihoda Avstro-ogrske monarhije od leta 1885 do danes, najbolj intenzivno je bilo v obdobju 1950 in 1970. Poseben pečat kartiranju so dali G. Beck, L. Adamović, I. Horvat, P. Fukarek, V. Stefanović in V. Beus. Od konca 20. stoletja naprej si pri kartiranju vegetacije pomagamo z letalskimi in satelitskimi posnetki.

Ključne besede: zgodovina, kartiranje, gozdna vegetacija, Bosna in Hercegovina.

¹ Šumarski fakultet Univerzitet u Sarajevu, Zagrebačka 20, BA - 71000 Sarajevo, Bosna i Hercegovina, s.vojnikovic@sfsa.unsa.ba

1 INTRODUCTION

The first world vegetation maps prepared in the first half of XIX century are from: *Umrisse Der Pflanzengeographie*, (BERGHAUS 1838.), *übersicht der verbreitung der wichtigsten kultur,= baum = und strauchgewache in Europa* (BERGHAUS & SCHOW 1839.); *The distribution of the most important trees, shrubs and fruits according to zones of climate, & moisture* (KEITH 1852); *Geographical distribution of indigenous vegetation* (HANFREY, KEITH & SCHOW 1854). Considering the scarce knowledge on distribution and characteristics of vegetation these maps rather roughly presented world vegetation including Bosnia and Herzegovina, where vegetation is starting to being researched in 1836.

It is interesting that in our region the first vegetation maps appear somewhat earlier than in Europe and the world. Reason for this we can look for in undoubted florist wealth, preservation and diversity of vegetation that was unexplored, but also in geopolitical position of this part of Balkan Peninsula which represented a contact between two empires: Austro-Hungarian and Ottoman, i.e. two civilizations: west and east, and as such was important to know the area, primarily for military purposes. Therefore in Croatia, Serbia and Montenegro published maps (BERTOVIĆ 1966):

- 1764: *Mappa deren Kaiserlichen Königeichen an der See in Littoral Austriaco Liegenden Waldungen des Löblichen Liccaner Gränzregiment* (1:40.000).

- 1800: *Skizze der autochtonen Vegetationen von Serbien anfangs des XIX Jahrhunderts* (1:2.000.000).
- 1860: *Cultur-geographische Karte des Liburnischen (Croatischen) Küstenkarstes* (1:140.000).
- 1874: *Gospodarska karta šume "Josip Kozarac"* (1:400).
- 1876: *Wald: Bestandes Karte von Kroatien, Slavonien und der Militärgrenze K.k. General-Commando in Agram map supplement* (1:133.000)
- 1895: *Beiträge zur physischen Geographie von Montenegro*, Petermanns Geographische Mitteilungen, Ergänzungsheft, vol. 115, plate 3.

If we take out individual amateur depictions of certain authors, primarily, friars who dealt with medicinal herbs, systematic science researches of flora and vegetation in B&H start in 1836, by Ami Boué, and in period until 1878 is continued by known botanists according to FUKAREK (1954): Otto Sendtner, Emanuel Weiss, Otto Blau, Franz Mauer, Thomas Pichler, Robert Huter, Franz Maly, Josef Pantocsek, Josif Pančić and Roberto Visiani... However, although analytical depictions of flora were made, forest vegetation mapping was not done in mentioned period.

2 MAPPING OVERVIEW

Only, at arrival of Austro-Hungarian monarchy systematic researches and mapping of various resources of Bosni and Herzegovina, as well as forest vegetation are initiated. The first forest maps of Bosnia and Herzegovina are printed in 1885. These maps covered entire Bosnia and Herzegovina on sheets in scale of 1:200.000 in edition of *K. u K. Militärgeographische Institut Wien* (Austria). Each section of mentioned scale had many sheets in scale of 1:50.000, depending on the position of the section. Total number of sheets in scale of 1:50.000 was 223.

These initial maps showed only the border of forest vegetation, not the type of vegetation. In the widest sense (through symbols) they showed appearance of broadleaved and conifer vegetation, as well as mixed forests without borders between these forms of vegetation.

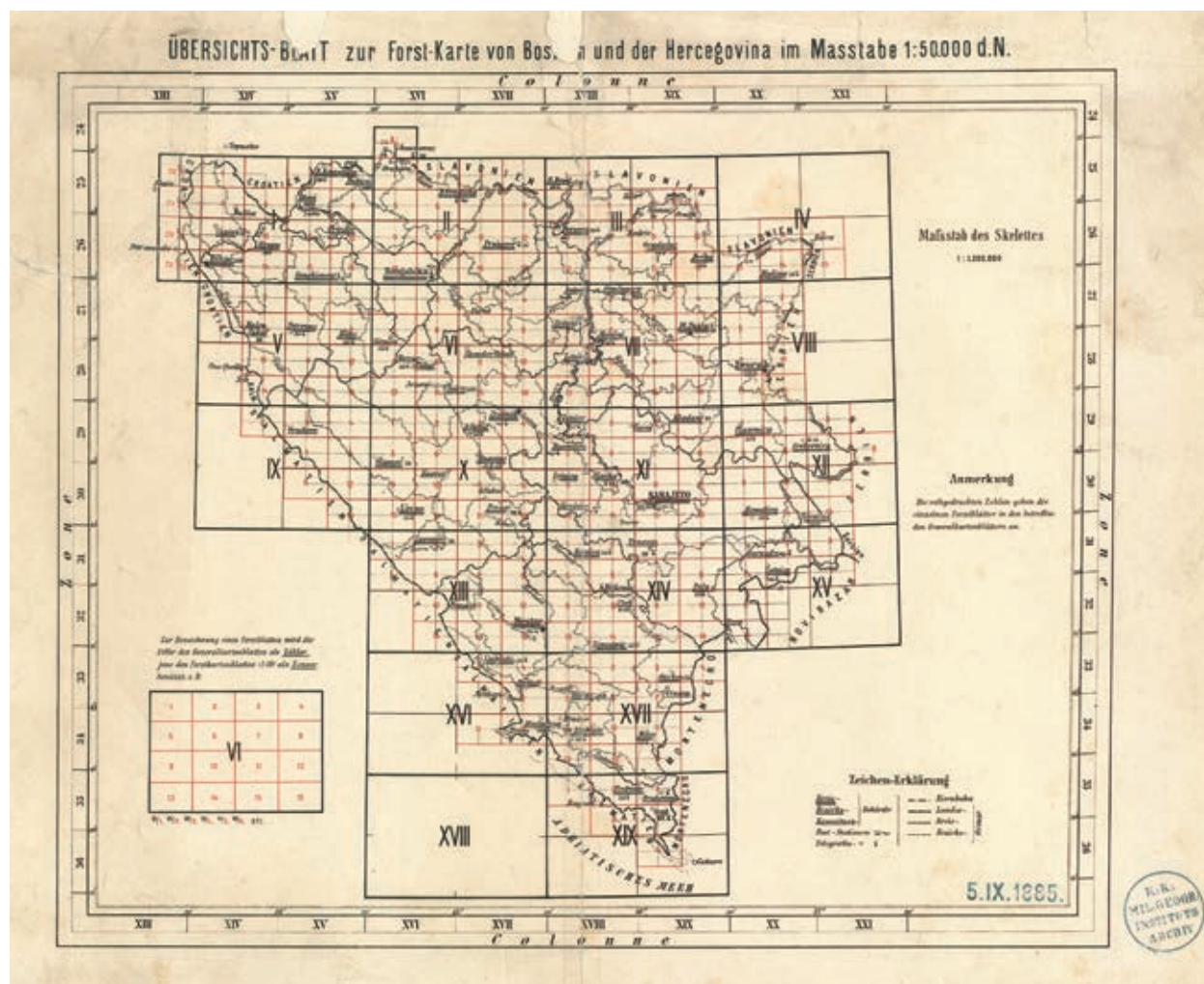
GÜNTHER BECK VON MANNAGETTA (1901) one of the most significant researchers of flora and vegetation of Bosnia and Herzegovina, dealt with mapping of veg-

etation of Illyrian area that includes large portion of Bosnia and Herzegovina. In 1901, he published a vegetation map of Illyrian area (*Die Vegetationsverhältnisse der illyrischen Länder*) with emphasis on forest vegetation. Besides the map, in text he described the specifics of the vegetation of the entire area.

The next author who presented B&H vegetation, i.e. vegetation of Balkan Peninsula, was Dubrovnik resident LUJO ADAMOVIĆ (1907), who, in his work: *„Die pflanzengeographische Stellung und Gliederung der Balkanhalbinsel“* – published two maps:

- *Die Vegetationsregion der Balkanhalbinsel* (1:2.000.000);
- *Die Vegetationszonen und Unterzonen der Balkanhalbinsel* (1:3.000.000).

This map depicted global vegetation relations and characteristics of Balkan Peninsula, but, for the first



Map 1. - Review sheets of forest map of Bosnia and Herzegovina from 1885 years
(K. u K. Militärgeographische Institut Wien).

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Karta 1. - Pregledna karta gozdov Bosne in Hercegovine iz leta 1885

(K. u K. Militärgeographische Institut Wien).

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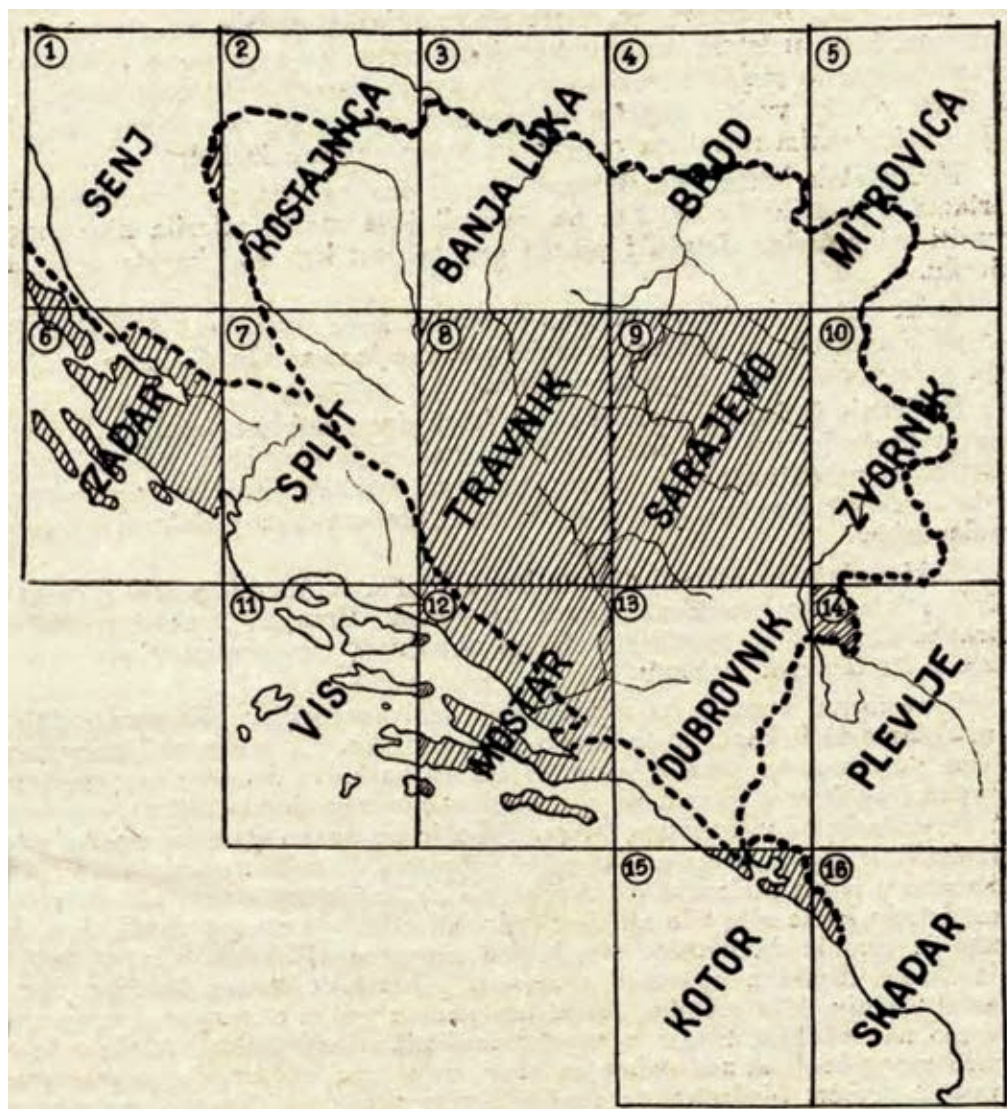
time, this work also presented vegetation zones. So, according to this author, Bosnia and Herzegovina in vegetation sense belongs to two zones:

Illyrian zone that covers whole of Bosnia and Herzegovina, and contains the following subzones: Croatian – North Bosniansubzone, Bosnian subzone, Herzegovinian subzone, Serbian subzone, Srijem-Serbian subzone.

Adriatic zone that covers further south of Herzegovina and contained Dalmatian subzone.

Besides these maps, Lujo Adamović, according to FUKAREK (1948a, 1948b, 1961) forestry adviser of K. Petraschek, made very detailed map of distribution of

forests in B&H, in 16 sections according to composition of tree species, entitled: *Forstkarte von BOSNIEN, HERZEGOWINA UND DALMATIEN nach offiziellen Daten des Forstdepartements für Bosnien-Herzegowina und Privatangaben des Herrn Hofrats Karl Petraschek sowie nach eigenen Studien und Aufnahmen zusammengestellt von Prof. Dr. Lujo Adamović (Masstab 1 : 200.000)*, with legend for tree species and silviculture form of forests of high, low and shrubbery. Out of sixteen sections (FUKAREK 1948a and 1948b) in total were found eight sections, four in Mostar, three in Sarajevo and one in Travnik. Unfortunately today we do not know the faith of found sections of those maps.



Map 2.- View of found (hatched) and lost sections Adamović map the areal forest trees in Bosnia, Herzegovina and Dalmatia to Fukarek (1948a).

Karta 2.- Pregled najdenih in izgubljenih Adamovićevih kart površin gozdnega drevja Bosne in Hercegovine ter Dalmacije (Fukarek 1948a).

Maps of Beck von Mannagette and Adamović served as basis for further geobotanical-vegetation mapping of Bosnia and Herzegovina. So, FUKAREK (1961) writes: "Those maps are even today unsurpassed in a sense of depiction of wider physiognomical characteristics of vegetation of our areas...modern overview vegetation maps rely on some borders that are in them".

Although original manuscript sheets were not preserved, there is consolidated printed map from Adamović from 1913 that covers forest vegetation of Dinarides in scale 1:750.000.

After Adamović, we can extract the work of Slovenian G. Tomažič from 1932 who made Balkans vegetation map, but in handwriting, which unfortunately was not published (B. JOVANOVIĆ, R. JOVANOVIĆ & ZUPANČIĆ 1986). That was the first attempt of vegetation mapping via modern concept.

One of rare forest management maps made prior to Second World War from year 1933, remained preserved is: "Osnovna karta – Šume Trapiskog samostana kod Banjaluke" (Main map-Forest of Trapiski monastery near Banjaluka) in scale 1:10.000 made by Aleksandar Panov, graduated forestry engineer. Map shows



Figure 1. - The legend for the map of forest vegetation BiH L. Adamovića (Fukarek 1948a)

Slika 1. - Legenda za karto gozdne vegetacije BiH L. Adamovića (Fukarek 1948a)

sections and tree species that sections comprises of (JURIŠIĆ 1989).

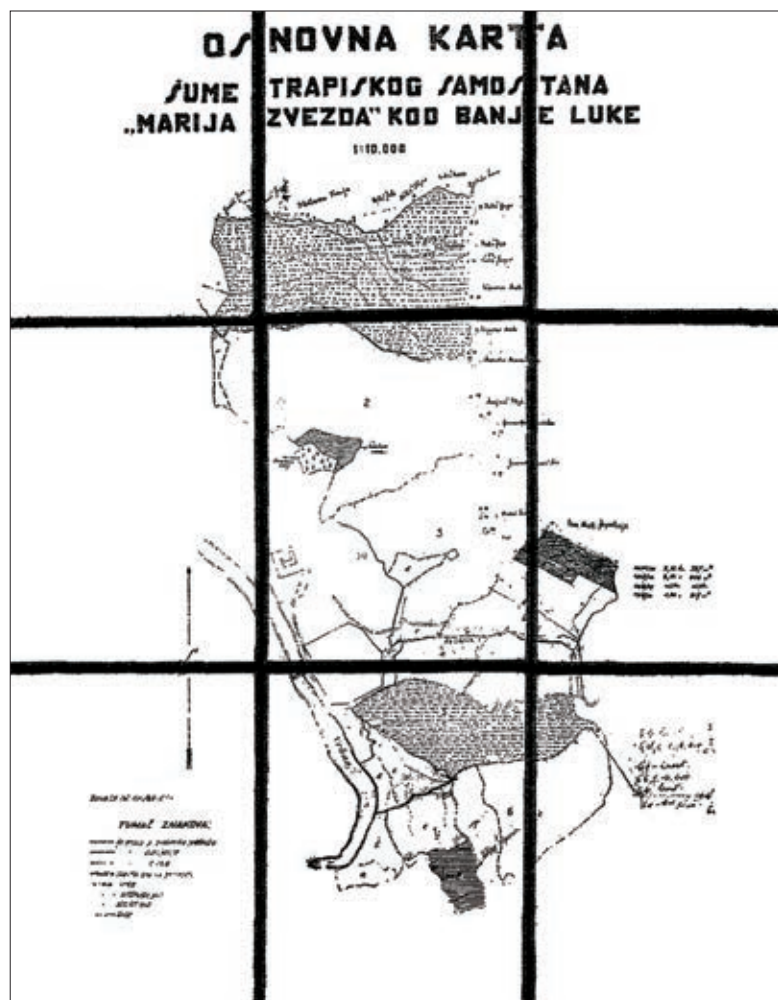
In time of Kingdom of Yugoslavia between two World Wars, vegetation mapping in Bosnia and Herzegovina was reduced, one can say even stopped. As rare examples of mapping we can separate areal maps of Serbian spruce (*Picea omorika*) by MALY (1934) and PLAVŠIĆ (1936, 1937), as well as areal map of Oriental Hornbeam (*Carpinus orientalis*) in vicinity of Sarajevo, by MALY (1940).

It is little known that in document Zemljopis Hrvatske ("Geography of Croatia") whose editor was Zvonimir Dugački, I. HORVAT (1942) prepared the map: "*Biljnogeografska područja Hrvatske i područnih krajeva*" (Phytogeographical areas of Croatia and local areas) with use of vegetation maps of G. Becka-Mannagete and L. Adamović in scale 1:2.500.000 that also covers B&H. Map represents synthesis of works and findings of Beck and Adamović and represents one of the first vegetation maps printed in color in B&H.

Immediately after WWII in 1948 comes the formation of Agriculture-Forestry Faculty University of Sarajevo. On this institution Institute for dendrology and phytocoenology (which is later renamed into Institute for forest botany) is formed, which represents backbone of research of forest flora and vegetation in

B&H at the time. Through work and research of this Institute comes the intensive research of forest flora and vegetation in B&H in systematic approach of research of forest vegetation, and particularly in sense of forest vegetation map development. Later, as product of these researches and phytocoenological mapping, areal maps, as well as overview geo-botanical maps of B&H, i.e. maps of herbal-geographical areas of B&H, were made. The biggest contribution to these researches was given by known professors of Forestry Faculty in Sarajevo: academician Pavle Fukarek and professor Vitomir Stefanović PhD. Further on chronological overview of research of flora and forest vegetation in B&H shall be provided by Forestry department of Agriculture-Forestry Faculty (from 1959 Forestry Faculty) in Sarajevo (FUKAREK, 1955, 1957, 1958 a,b, 1959).

- 1950 – Conducted research and mapping of Faculty's pilot plot „Igman“, i.e. north slope of Bjelašnica. The same year the map of Serbian spruce stand in Eastern Bosnia was made.
- 1951 – Started researches of National Park "Sutjeska", and particularly virgin forest "Perućica" (these researches and mapping continues in 1953 and 1955).
- 1952 – Conducted research and mapping of mountain Treskavica near Sarajevo.



Map 3 - The main map - Forests Trapist monastery near Banja Luka at scale 1:10.000 (author: Aleksander Panov, 1933) (Jurišić 1989)

Karta 3. - Osnovna karta gozdov trapistovskega samostana pri Banjaluki v razmerju 1:10.000 (avtor: Aleksander Panov, 1933), (Jurišić 1989)

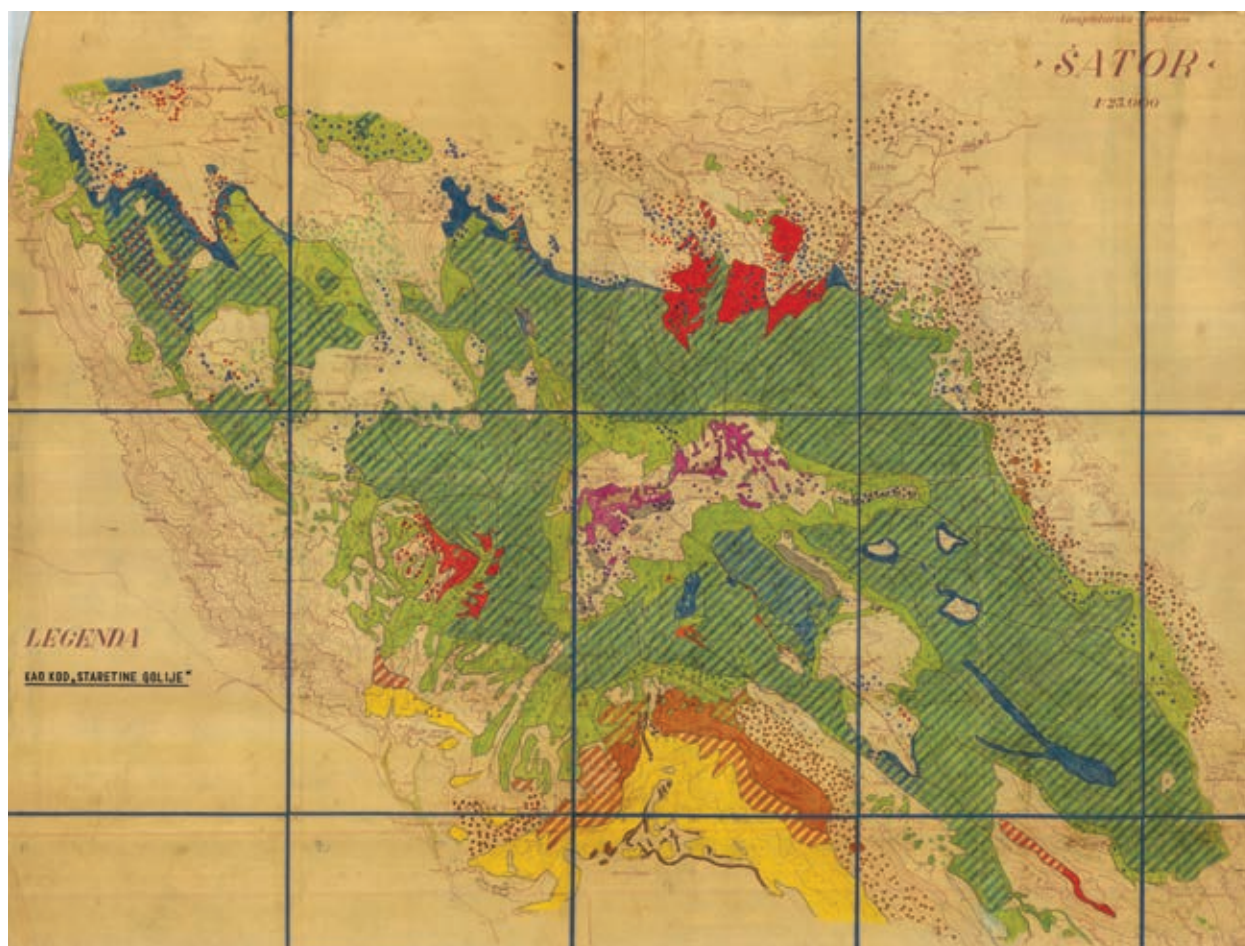
- 1953 – Started research and mapping of peridotite-serpentine areas in watershed of river Krivaja (Maoča, Župeljeva) and hill Svatovac-Rudenik near Tuzla.
- 1954 – Conducted research and mapping of Vranica mountain area and its ness in central Bosnia.
- 1955 – Started research of central part of Prenj (continued in later period). That year extensive research and mapping of West Bosnian mountains Šator, Golija, Staretina, Cincar and Slovinia were conducted. Also the same year the vegetation map of closer vicinity of Zenica was made.
- 1956 – Conducted research and mapping of area of southern slopes of Bjelašnica, Visočica, near Konjic. At the same time conducted mapping of forest communities of Kruščica near Travnik.
- 1957 – Conducted research and mapping of mountain Velež that were continued in a direction of Crvanj Mountain. At the same time conducted detailed studies and mapping of forest communities on dolomite slopes of mountains Plazenica and Stožer near Bugojno. The same year finalized research and mapping of Romanija and Eastern Bosnia.
- 1958 – Researched and mapped area of mountain Ljubišnja near Foča, and conducted minor research on Motajica in northern Bosnia.
- 1959 – Researched area of virgin forest Janj near Donji Vakuf. At the same time conducted research and mapping of area of watersheds of Trstionica, Stavnja and Misoča on slopes of mountain Zvijezda near Vareš. Minor research and mapping conducted in area of Mediterranean and Sub Mediterranean vegetation in area of Neum-Klek.
- 1960 – Conducted research and mapping of central section of mountain Prenj (that were continued in 1965 and 1968). In 1968 researched and mapped area of forests in watershed of river Lepenica between Sarajevo and Kiseljak.

These detailed researches were done in scale 1:25.000 with Braun-Blanquet method and were „scattered“ because they were to serve as „models“ from the field that will help to get, as soon as possible, to basic scientifically verified data which will help to prepare maps of climate realistic and potential vegetation, and herbal-geographical analysis of B&H.

After reorganization of scientific-research work of the Faculty from the beginning of 60's of the past century and closing of Institute, scientific activity of research and mapping of forest vegetation moves than to Republic Institute for forestry and wood industry. For mentioned research FUKAREK (1976) states: „*Research in such way became incomplete, but gave very rich documentation material, that consists of multiple florist analysis and original manuscripts and vegetation maps in scale 1:25.000*“. Unfortunately, during the last war 1992-1995 we are missing a lot of these maps. Forestry Faculty in Sarajevo has only certain sections: Šator

(Livno area) I and II part; Staretina, Golija, Hrbilje, Kujača; Gornji Ugar all in scale of 1:25.000.

Considering that in period 1964-1968 the project was realized entitled: „*Inventure šuma na velikim površinama u BiH*“ (Forest inventory on large areas in B&H) forestry experts according to newly adopted typology method (that was better adjusted to forestry profession) conducted mapping which represented different approach from „usual mapping“ by Braun-Blanquet method that was used in initial researches from 50's of the past century. Detailed mapping of forest vegetation and forest land in Bosnia and Herzegovina and preparation of maps of real forest vegetation and maps of forest lands, on new topographic basis (scale 1:25.000, partially scale 1:10.000), started in 1969. Earlier maps in scale 1:25.000 and 1:10.000 were pantographed from maps of the smaller scale (1:50.000 and 1:100.000), due to which depiction of the terrain was less accurate, i.e. their scale was only formal, and



Map 4 - Map of real forest vegetation Šator Mountain at the scale 1: 25.000, authors Fukarek and Stefanović (1955) (mnsc.)
Karta 4. - Karta realne gozdne vegetacije Šator planine v merilu 1: 25.000, avtorja Fukarek in Stefanović (1955) (mnsc.)

therefore their content, most often, was only referent. Cartographic units of forest vegetation were separated based on edificatory tree species and in average on 50ha areas phytocoenological surveys were done for floral characterization of separated cartographic units. Forest vegetation maps and forest land maps on new topographic basis, have, among other, served to prepare typological maps as basis for modern forest and forest land management. Mapping were done as per management units, and first works of mapping and development of map of real forest vegetation and map of forest land were done for MU „Gostović“ and then, by the end of 1971, for the whole forest management area „Krivajsko“ Zavidovići. Cartographers were assistants from the Institute for forestry in Sarajevo: Vladimir Beus, Svetozar Golić, Ljubiša Marković and Jovan Travar. Then followed mapping of other forest management areas and by the end of 1990, mapping and maps was done for nearly 70% of forest and forest land area in Bosnia and Herzegovina¹. In later works some of the first cartographers did not participate, and new ones, forestry engineers from company „Šumaplan“ in Sarajevo, got involved: Borivoj Krstović, Boško Miloš, Milenko Pinjuh, Nusret Talović and Josip Vrljićak.

However, even besides mentioned reorganizations of forestry institutions, ways, methods and mapping scales academician Fukarek independently or with help of professor. Nikola Janjić PhD (then assistant) until 1970 mapped the following areas: Orijen – Bijela Gora; Zelenogora, Maglić and Volujak, (NP Sutjeska) and virgin forest reservation Perućica, virgin forest Lom near Drvar, parts of mountains Prenj, Čvrtnica, Vran in Herzegovina, and some areas in close vicinity to Sarajevo: watershed of Ljubina, Bukovik and Ozren of Sarajevo.

At the beginning of 1960's of the past century I. Horvat proposed development of overview map of potential natural vegetation of Yugoslavia. In 1962 he started the project Vegetation Map of Yugoslavia, chaired by I. Horvat until his death. After his death, the chairman of the project was P. Fukarek until his death. In this period were started project „Vegetacijska karta Jugoslavije“ (Vegetation map of Yugoslavia) represented by development of „Vegetacijska karta BiH“ (Vegetation map of B&H). In this project besides forestry experts from Department for forest ecology of Forestry Faculty University of Sarajevo, were involved biologists from Department of botany Faculty of Mathematics and Natural sciences in Sarajevo. These mappings were done in scale 1:100.000 and 1:200.000,

¹ Seminar: „Utilization of typological and pedological maps in forestry“; Forestry Faculty University of Sarajevo

which also represented a change considering the scale of map development and the way of work in the field. Mentioned, above all, those method differences brought us to slowing down of initiated classic vegetation researches.

Project „Vegetacijska karta Jugoslavije“ was completed in 1989. Indevlopment of this map participated large number of experts from former Yugoslavia, and from Bosnia and Herzegovina, as authors, cartographers or associates the following worked: Pavle Fukarek (project manager for B&H), Vitomir Stefanović, Radomir Lakušić, Vladimir Beus, Željka Bjeličić, Ljerk Kutleša, Čedomil Šilić, Petar Grgić, Ljubomir Mišić. As known, for B&H was published a sheet Tuzla – Bijeljina in scale 1:100.000 and was prepared for printing the sheet Sarajevo in scale 1:200.000. Unfortunately, due to war events (1992-1995.) sheets, as well as work sheets of the sections with field researches went missing.

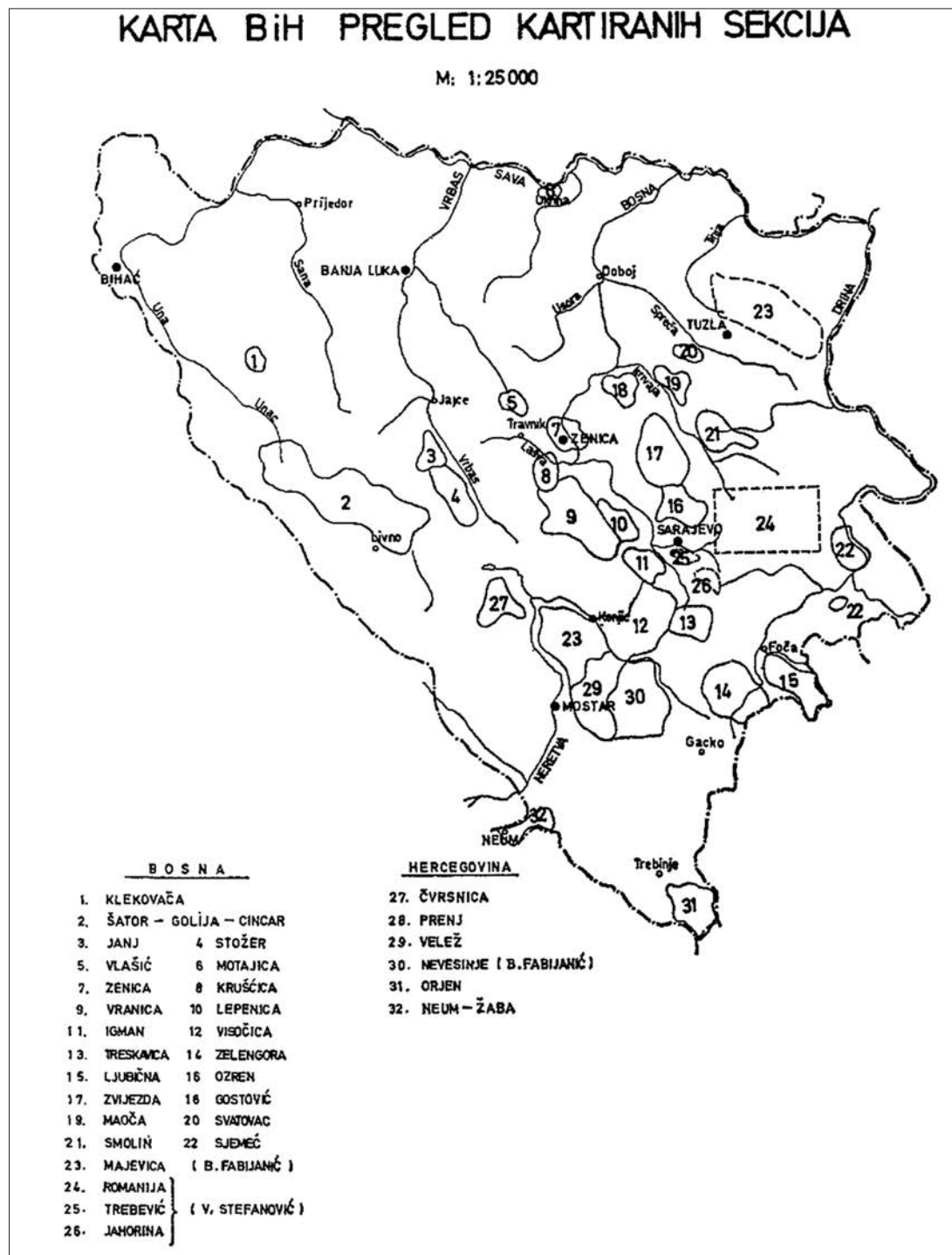
Within project „Ekološko-vegetacijska rejonizacija Bosne i Hercegovine“ (Ecological-vegetation regionalization of Bosnia and Herzegovina) realized on Department for forest ecology of Forestry Faculty University of Sarajevo, besides other, maps were printed (1983): Map of potential vegetation of B&H, Map of real vegetation of B&H, Map of ecological-vegetation regions of B&H, all in scale 1:500.000. Authors of these maps are: Vladimir Beus and Vitomir Stefanović.

Modern forest vegetation mapping in B&H through satellite images started in 1998 when B&H joined PHARE – Regional Environmental Program within which was developed project „CORINE Land Cover project B&H 2000“ (CLC project). Implementing agency of the project was (now closed) PE Geodesy Institute of B&H, and experts from other institution participated: Forestry Faculty in Sarajevo, Institute for development planning of Sarajevo Canton and Institute for development planning of Tuzla Canton. For data gathering Landast 5 TM satellite images from 1998 in scale 1:100.000 (64 sheets) in TM (Thematic Mapper) technique (VOJNIKović & TALETOVIĆ 2002) were used. Besides receiving realistic status of forest areas and their spatial distribution of forest vegetation, mentioned mapping completely was comparable with European data from CORINE project because in whole of Europe identical mapping method was used. CORINE project continued in two turns in B&H in 2006 and 2012.

At CLC mapping in 2006 and 2012, SPOT – 4 and SPOT – 5, as well as IRS P6 were used. These projects were realized on Agriculture-food Faculty University of Sarajevo under management of professor Hamid Čustović PhD. It is worth mentioning that level of de-

tails in these satellite images was low in a sense of determining type of forest vegetation, because only visible were: conifer, broadleaved and mixed forests, successions of forest vegetation, thermophile vegetation

and curve stands, which was done according to common EU methodology (ČUSTOVIĆ et al. 2007-2008 and ČUSTOVIĆ et al. 2014.). The smallest mapping area was 5 ha. During CLC mapping (2000, 2006 and 2012) the

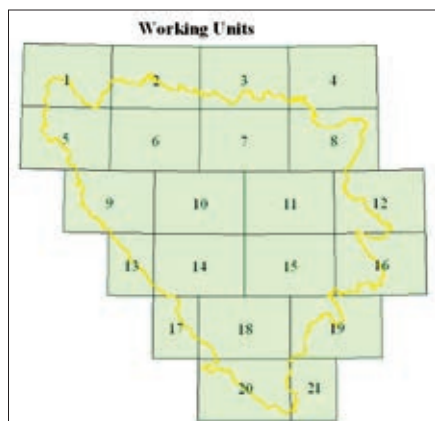


Map 5. – View of mapped forest vegetation areas in Bosnia and Herzegovina between 1950 and 1960 (Fukarek 1976).

Karta 5. – Pregledna karta kartiranih območij gozdne vegetacije Bosne in Hercegovine med letoma 1950 in 1960 (Fukarek 1976).

following photo interpreters were: Sead Vojniković, Jasmin Taletović, Melisa Ljuša, Besim Balić, Fahrudin

Đuzo, Valnetino Vlašić, Hasumana Abaza, Šukrija Sarić and Enver Buza.



Map 6. - The sheets of satellite imagery for CLC BiH 2006
Karta 6. - Listi satelitskih posnetkov za CLC BiH 2006



Map 7. - The sheets of satellite imagery for CLC BiH 2012
Karta 7. - Listi satelitskih posnetkov za CLC BiH 2012

Besides mentioned CLC map of B&H, CLC map of Sarajevo Canton was made in project “*Inventarizacija stanja i izrada baze podataka pokrivenosti i načina korištenja zemljišta Kantona Sarajevo u GIS tehnologiji*” (Inventory of status and development of coverage database and ways to utilize land in Sarajevo Canton in GIS technology) that was implemented by Zavod za vodoprivredu stock holding company Sarajevo in scale 1:5.000. Project was coordinated by professor Hamid Čustović PhD. Digital orthophoto images were used (DOF) of Sarajevo Canton on 252 sheets (resolution 0,4 x 0,4 m), and separated polygons were larger or equal to 1ha. For this occasion the forth CLC level of details

for B&H (ČUSTOVIĆ et al. 2011; VOJNIKović et al. 2013) was made. This mapping was participated by: Sead Vojniković, Jasmin Taletović, Melisa Ljuša, Besim Balić, Fahrudin Đuzo, Ognjen Žurovec.

Also it is important to point out the work ČABARAVDIĆ (2007) and ČABARAVDIĆ et al. (2014) that with satellite images with kNN method conducted vegetation mapping and assessment of specific taxation parameters of MU Konjih and MU Igman. Particularly valuable work is mapping of forest vegetation of mountain Čemernica by author Jugoslav Brujić in his PhD thesis (BRUJIĆ 2013).

3 CONCLUSIONS

From mentioned we can conclude that there were three mapping periods covering the following intervals:

- End of XIX and beginning of XX century. First generation is represented by pioneers that gave the largest contributions to knowledge of vegetation of B&H and Balkans and development of bio-geography of these areas: Günther Beck von Mannagetta and Lujo Adamović, Ivo Horvat and Karlo Maly.
- After Second World War. Second generation, when vegetation mapping reached its peak in B&H is represented, among other, by professors of Forestry Faculty in Sarajevo: Pavle Fukarek and Vitomir Stefanović, and their successors: Vladimir Beus,

Nikola Janjić as well as biologists: Radomir Lakušić, Željka Bjelčić, Ljerka Kutleša, Čedomil Šilić, Petar Grgić, Ljubomir Mišić. In period 1969-1990 particularly significant were the mappings of forest vegetation and forest land, for the first time in Bosnia and Herzegovina on new topographic basis M 1:25.000, partially in M 1:10.000 and development of maps of real forest vegetation and maps of forest lands as basis to develop typological maps for particular forest management areas. As cartographers there were: Vledimir Beus, Svetozar Golić, Borivoje Krstović, Ljubiša Marković, Milenko Pinjuh, Nusret Talović, Jovan Travar and Josip Vrljićak.

- End of XX and beginning of XXI century. Third generation is represented also by forestry experts that are working on aerial-photo and satellite mapping of forest vegetation: Sead Vojniković, Besim Balić, Azra Čabaravdić, Jugoslav Brujić, as well as geodesy and agriculture experts, above all: Jasmin Taletović, Fahrudin Đuzo, Melisa Ljuša, Ognjen Žurovec.

During these periods the methods, as well as techniques, of forest vegetation mapping changed. From initial manual methods (even without clear coordinate grid, considering that Gauss Krueger was adopted for Kingdom of Yugoslavia in 1924) to various satellite images done in GIS environment. Also it can be concluded that most commonly used scales for forest vegetation mapping were 1:25.000 and 1:50.000, although others were used as well, such as: 1:10.000 or 1:100.000, but more rarely.

Mapping forest vegetation used to be different cartographic units: from the original simple units forests

- non forests, forest trees (edificators and subedificators), over synsystematical units of Braun-Blanquet system, types of forest – (forest typological system), the forest vegetation formations: deciduous, coniferous and mixed forest, succession of forest, thermophilic vegetation ..

Although summary maps of smaller scale that were printed within certain editions were preserved, such as: BECK 1901 (1:750.000); ADAMOVIĆ 1913 (1:750.000), HORVAT 1942 (1:2.500.000); BEUS AND STEFANOVIĆ 1983 (1:500.000); B. JOVANOVIĆ, R. JOVANOVIĆ & ZUPANČIĆ, 1986 (1:1.000.000), that consolidate various periods of research, unfortunately, large number of original maps of larger scale (1:25.000 and 1:10.000) for specific areas, from which mentioned synthesized maps were made, most often due to war circumstances were irretrievably lost. Mentioned facts point to large and permanent cultural-historical, as well as scientific and economical loss for Bosnia and Herzegovina.

4 POVZETEK

Zgodovinski podatki o kartiranju gozdne vegetacije Bosne in Hercegovine izkazujejo tri posebej intenzivna obdobja prikazovanja vegetacije.

Prvo obdobje je trajalo od konca devetnajstega do začetka dvajsetega stoletja. To obdobje je zaznamovala generacija pionirjev: naravoslovcev-botanikov in biogeografov-fitogeografov. To so bili Güthar von Beck Mannegetta, Lujo Adamović, Karlo Maly in Ivo Horvat., ki so pozneje preučevali fitocenoze po srednjeevropski metodi.

Drugo obdobje preučevanja in kartiranje vegetacije je začelo po drugi svetovni vojni in je znanstveni vrh doseglo z evropsko priznanima fitocenologoma-gozdarjema Pavlom Fukarekom in Vitomirjem Stefanovićem ter njunimi nasledniki, gozdarji Vladimirjem Beusom, Nikolom Janjićem in Čedomirjem Šilićem. Iz vrst biologov pa so se uveljavili: Željka Bjelić, Radomir Lakušić, Ljerka Kutleša, ter mlajša: Petar Grgić in Ljubomir Mišić. V tem obdobju je zlasti pomemben čas v letih 1969-1990, ko je potekalo kartiranje gozdne vegetacije oziroma gozdnih zemljišč na novih topografskih kartah (listih) v merilu 1:25.000 ali celo 1:10.000. Te karte so bile podlaga za tipološko vrednotenje nekaterih gospodarsko zanimivih gozdnih območij, kar je operativnim gozdarjem omogočilo boljše razumevanje gojenja in urejanja gozdov na ekološko-naravoslovni osnovi. Kartografi za ta območja so bili: Vladimir Beus, Svetozar Golić, Borivoja Krstović, Lju-

biša Marković, Milenko Pinjuh, Nusret Talović, Jovan Travar in Josip Vrljićak.

Ob prelomu dvajsetega v enaindvajseto stoletje se je začelo tretje obdobje novejšega kartiranja na osnovi aerofotografije in satelitskih metod. Kartiranja izvaja gozdarski strokovnjaki: Sead Vojniković, Besim Balić, Azra Čabaravdić in Jugoslav Brujić ob pomoči geodetskih in kmetijskih strokovnjakov: Jasmina Taletovića, Fahrudina Đuze, Melise Ljuše, Ognjena Žrovca in drugih.

Za našeta obdobja je značilno, da so se spreminjale metode in tehnike kartiranja gozdne vegetacije. Od začetnih ročnih metod v prvem obdobju, ki so deloma segale tudi v drugo obdobje, vendar že ob uvajanju sodobnejših kartografskih načinov kot foto postopki, do različnih satelitskih in drugih metod GIS, ki so v uporabi danes in jih še naprej izpopolnjujejo. Najpogostejša kartiranja so bila narejena v merilih 1:25.000 in 1:50.000. Redkeje se je uporabljalo kartiranje v večjem merilu 1:10.000 ali manjšem merilu 1:100.000. Merila so bila predvsem odvisna od načina prikaza kartografske enote: od najbolj preproste razmejitve gozd-negozd, po drevesnih vrstah kot edifikatorjih ali subedifikatorjih gozdnih sestojev, po vegetacijskih formacijah npr.: listavci, iglavci, mešani gozd, ali pa po zahtevnejši srednjeevropski fitocenološki metodi Braun-Blanqueta.

V vojnem času so se v Bosni in Hercegovini začela ohranile vegetacijske karte manjših meril, npr.: BECK-

OVA (1901 v M = 1:750.000), ADAMOVIĆEVA (1913 v M=1:750.000), HORVATOVA (1942 v M=1:2.500.000), BEVSOVO-STEFANOVIĆEVA (v M=1:500.000), Karta naravne potencialne vegetacije SFRJ (v M=1:1.000.000 B. JOVANOVIĆ, R. JOVANOVIĆ & ZUPANČIĆ 1986), ki predstavljajo različna obdobja raziskovanja in kartiranj ve-

getacije. Žal so se v vojnem času izgubile vegetacijske karte manjših meril (M = 1:25.000, 1:10.000) ki so podrobneje prikazovale vegetacijo različnih območij Bosne in Hercegovine. To je velika kulturno-zgodovinska, znanstvena in gospodarska izguba za Bosno in Hercegovino.

LITERATURA

- ADAMOVIĆ, L., 1907: „Die pflanzengeographische Stellung und Gliederung der Balkanhalbinsel“ - Resultate einer im Sommer 1905 in den Balkanländern unternommenen Reise, Kaiserlichen Akademie der Wissenschaften. Wien + Karten.
- ADAMOVIĆ, L., 1913: *Die Verbreitung der Holzgewächse in den Dinarischen Ländern*. Von L. Adamovic. Geographischen Gesellschaft (Wien), 10: (3) + Pflanzengeographische Karte der Dinarischen Länder (M 1:750.000)
- BECK VON MANNAGETTA, G., 1901: *Die Vegetationsverhältnisse der illyrischen Länder, begreifend Sudkroatien, die Quarnero-Inseln, Dalmatien, Bosnien und die Hercegovina, Montenegro, Nordalbanien, den Sandzak/ Novipazar und Serbien*. Die Vegetation der Erde, vol. 4. Leipzig.
- BERGHAUS, H., 1838: *Umriss der Pflanzengeographie* - Berghaus Physiscal Atlas; Justus Perthes, Gotha; 1:130.000.000.
- BERGHAUS H. & J. F. SCHOW 1839: *übersicht der verbreitung der wichtigsten kultur,= baum = und strauchgewache in Europa, mit angabe der isotheren und isochmenen*, Berghaus Physiscal Atlas, 5^{te} Abtheilung: Phytogeographie, 5. Justus Perthes, Gotha; 1:15.000.000.
- BERTOVIĆ, S., 1966: *Yugoslavia in: International Bibliography of Vegetation Maps* (ed. Kuchler A.W.), Volume 2 - Europe; University of Kansas, Libraries.
- BEUS, V. & V. STEFANOVIĆ, 1983: *Karta potencijalne vegetacije BiH, Karta realne vegetacije BiH, Karta ekološko-vegetacijskih reona BiH*, in: Stefanović V., Beus V., Burlica C, Dizdarević H., Vukorep I. (1983): *Ekološko-vegetacijska rejonizacija Bosne i Hercegovine*, Šumarski fakultet Univerziteta u Sarajevu, Posebna izdanja Fakulteta (Sarajevo). 17.
- BRUJIĆ, J., 2013: *Šumska vegetacija Čemernice*; doktorska disertacija Šumarski fakultet Univerziteta u Banjoj Luci. (manuskript).
- ČABARAVDIĆ, A., 2007: *Efficient Estimation of Forest Attributes with k NN*. Ph.D. thesis, Faculty of Forest and Environmental Sciences, Albert-Ludwigs-Universität Freiburg im Breisgau, Germany
- ČABARAVDIĆ, A., B. BALIĆ, M. OSMANOVIĆ, A. AVDAGIĆ, 2014: *Estimation of wood production spatial distribution in the high forest on Igman mountain*, Works of the Faculty of Forestry University of Sarajevo (Sarajevo) 1:25-35.
- ČUSTOVIĆ, H., M. LUŠA, & J. TALETOVIĆ, 2007-2008: *CORINE Land Cover 2006 project in Bosnia and Herzegovina (FINAL REPORT)*; Faculty of Agriculture and Food Science, University of Sarajevo. (Sarajevo).
- ČUSTOVIĆ, H., M. LUŠA & J. TALETOVIĆ, 2014: *Project implementation of CLC2014 in the west Balkan countries (FINAL REPORT Bosnia-Herzegovina)*; Faculty of Agriculture and Food Science, University of Sarajevo. (Sarajevo).
- ČUSTOVIĆ, H., S. VOJNIKOVIĆ, M. LJUŠA, J. TALETOVIĆ, O. ŽUROVEC & ĐUZO, M., 2011: *Studija - Inventarizacija stanja i izrada baze podataka pokrivenosti i načina korištenja zemljišta Kantona Sarajevo u GIS tehnologiji*; Zavod za vodoprivredu. Sarajevo.
- FUKAREK, P., 1948a: *Biljno-geografska karta šumskog drveća u Bosni, Hercegovini i Dalmaciji od Dr-a L. Adamovića*. Šumarski list. (Zagreb) 5-6: 171
- FUKAREK, P., 1948b: *Pronalazak još dviju od zagubljenih sekcija Adamovićeve karte*. Šumarski list. (Zagreb) 11: 380
- FUKAREK, P., 1954: *Istraživanje flore i vegetacije Bosne i Hercegovine*. Godišnjak Biološkog instituta. Sarajevo 7, (1-2): 111-168.
- FUKAREK, P., 1955: *Kartiranje šumske vegetacije i zadaci Zavoda za šumarsku botaniku u Sarajevu*, Narodni šumar (Sarajevo) 9-10: 341-360.
- FUKAREK, P., 1957: *Radovi na istraživanju i kartiranju šumske vegetacije Bosne i Hercegovine*, Narodni šumar (Sarajevo) 10 (11-12): 359-378 (Sa preglednom kartom istraženih područja na str. 358)

- FUKAREK, P. 1958: *Radovi na istraživanju i kartiranju šumske vegetacije u Bosni i Hercegovini*, Narodni šumar (Sarajevo) 10 (10-12): 359-378.
- FUKAREK, P., 1958: *Istraživanje i kartiranje šumske vegetacije pklanina Jahorine, Igmana, Ljubične, Veleža i područja oko rijeke Drine*. Narodni šumar (Sarajevo) 12:11-12.
- FUKAREK, P. 1959: *Istraživanje i kartiranja šumskih fitocenoza na području Bosne i Hercegovine u 1959 godini*. Narodni šumar (Sarajevo) 13 (11-12): 669-678 (Sa preglednom kartom istraženih područja na str. 678).
- FUKAREK, P. 1961: *Istraživanje i kartiranje šumske vegetacije i šumskih fitocenoza u Bosni i Hercegovini*, Narodni šumar (Sarajevo), (Sveska: Uloga i mjesto fitocenologije u savremenoj šumskoj privredi): 182—192.
- FUKAREK, P., 1976: *Fitogeografska istraživanja i kartiranje šuma u Bosni i Hercegovini u razdoblju od 1950. do 1970. godine*. Zbornik X. Kongresa geografa Jugoslavije (15-20. IX 1976): 81-88, Beograd.
- HANFREY A., J. A. KEITH & J. F., SCHOW 1854: *Geographical distribution of indigenous vegetation – The Distribution of Plants in a perpendicular directions* – Physical Atlas – Phytology and Zoology, (1:91.000.000), Edinburgh, 2.
- HORVAT, I., 1942: *Biljni svijet Hrvatske*,; *Zemljopis Hrvatske I-II + 3 karte*, (ur. Dugački Zvonimir); Matica Hrvatske, Zagreb. (Karta - Biljnogeografska područja Hrvatske i pograničnih krajeva uz upotrebu vegetacijskih karata G. Becka Mannagetta i L. Adamovica; M 1:2.500.000)
- JOVANOVIĆ, B., R. JOVANOVIĆ, M. ZUPANČIĆ, 1986: Karta prirodne potencijalne vegetacije SFR Jugoslavije M 1:1.000.000; Naučno veće Vegetacijske karte Jugoslavije, Ljubljana.
- JURIŠIĆ, M., 1989: *Historijski prikaz formiranja park šume Trapisti kod Banjaluke*; Naše starine; Zavod za zaštitu kulturno-istorijskog i prirodnog naslijeđa Bosne i Hercegovine, (Sarajevo) 18: 253-359.
- KEITH J. A., 1852: *The distribution of the most important trees, shrubs and fruits according to zones of climate, & moisture* – Natural history -Plate 15, (1:130.000.000), Edinburgh.
- MALY, K., 1934: *Beiträge zur Kenntnis der Picea omorika*; Glasnik Zemlajskog muzeja u Sarajevu , Sveska za prirodne nauke (Sarajevo) 46:37-64.
- MALY, K., 1940: *Notizzen zur Flora von Bosnien - Hercegovina*; Glasnik zemaljskog muzeja u Sarajevu , Prirodne nauke (Sarajevo) 52:21-46.
- PLAVŠIĆ, S., 1936: *Picea omorika on the left bank of the river Drina*; Glasnik Zemaljskog muzeja u Sarajevu , Sveska za prirodne nauke (Sarajevo) 48:17-26.
- PLAVŠIĆ, S. 1937: *Picea omorika stations in the vicinity of Foča*; Glasnik Zemaljskog muzeja u Sarajevu , Sveska za prirodne nauke (Sarajevo) 49:29-34.
- VOJNIKOVIĆ, S., J., TALETOVIĆ, 2002: *Šumska vegetacija i šumska zemljišta u Bosni i Hercegovini prema CORINE projektu*; Radovi Šumarskog fakulteta (Sarajevo) 32(1): 99 – 109.
- VOJNIKOVIĆ, S., J. TALETOVIĆ, B. BALIĆ, M. LJUŠA, O. ŽUROVEC & H. ČUSTOVIĆ, 2013: *Procijena površina šuma u Kantonu Sarajevo prema 4-tom nivou nomenclature zemljišnog pokrivača*; Naše šume (Sarajevo) 12(32-33):12-22.