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It is the endeavour of the University of Pristina to acquaint the scientific world with its achievements. We would like to affirm the intellectual potential of this region as well as natural resources of the Balkans. We would like to put forward our attitude of principle that science is universal and we invite all scientist to cooperate wherever heir scope of research may be. We are convinced that we shall contribute to the victory of science over barriers of all kinds erected throughout the Balkans.

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EDITOR'S NOTE

On 16 January 1998, there was an assassination attempt on Professor Radivoje Papovic, Rector of University of Pristina and Director of this periodical. The assassination attempt was carried out by a remote activation of the car bomb *planted* near his apartment in the moment of his leaving for work by his chauffeur driven car. Rector and his driver were seriously injured and miraculously survived. The responsibility for this criminal act was taken by an Albanian illegal terrorist organisation, "Liberation Army of Kosovo". The Chairman of the Chamber of Republics of the Federal Assembly and of the Assembly Chamber of Security declared to the National Press Agency "Tanjug" that the way how the assassination attempt was carried out was seriously disturbing and requested an energetic action of the authorities. He also noted that Rector Radivoje Papovic was an outstanding fighter against secessionist movement of Kosovo and Metohija and he was not selected for assassination by chance. Apart from a political aspect of this event, otherwise unprecedented in the world, we hereby invite all the international scholars to condemn this terrorist act as well as terrorism in general.

Editor
Predrag Jakšić, Pd, D.

Amount of Cellulose Decomposers in Some Soil Types of Kosovo and Metohija

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ABSTRACT

Microbiological investigation involved the three basic Kosovo and Metohia soil types: Vertisol, Pseudogley, and Dystric Cambisol. Cultivated soil profiles of the above mentioned soil types have been studied, as well as the uncultivated ones (virgin soil).

The investigated Kosovo and Metohia soils had a large amount of cellulose decomposers. Cultivated Vertisol and Dystric Cambisol had higher cellulose decomposers content regarding the same natural types, but this was not observed

in the case of Pseudogley. The bacteria vs. fungi relation, regarding cellulose transforming, was influenced by many factors, but the main factor was soil pH value. Number of fungi increased by acidification, and bacteria number decreased. In Vertisol, which had neutral pH value, bacteria were the main cellulose transformers; in Pseudogley, which was acid, percental part of fungi was larger than of bacteria; and in Dystric Cambisol, which was very acid, the main cellulose transformers were fungi.

Key words: Vertisol, Pseudogley, Dystric Cambisol, cellulolizators.

INTRADUCTION

Soil is a complex natural and historical product with dynamic character, in which the special microflora lives and works. In order to present results of microbiological investigation better, it is necessary to describe basic characteristic of the investigated soils.

One of the main traits of Kosovo and Metohia area is a proper soil spreading. It is, above all, due to the areas geographic position, and then due to its relief, and especially to its horizontal and vertical zonality.

A short review of Kosovo i Metohia soils enables to understand how various factors by their influences enabled forming of very numerous subtypes and varieties of a few basic soil types (F i l i p o v i ć, 1984).

Therefore we decided to study microbiological characteristics of Kosovo and Metohia basic soil types. The first chosen soil type, which was according to S t e b u t formed in Tertiary and early Quaternary, was the Vertisol soil type. We investigated it around Laplje Selo village, near Priština.

The second predominant soil type was Pseudogley, and it was much younger regarding genesis. We studied Pseudogley around Vitomirica village, near Peć.

Finally, we studied microbiological traits of the Dystric Cambisol type. We studied it around Tankosić village, near Uroševac.

The first investigations of Kosovo and Metohia soils were aimed to study their soil — scientific and agrochemical characteristics, and results of these studies gave the basic knowledge about this areas soils

fertility. The most of these studies were carried out from 1923-1950. Kosovo and Metohia soils are very different regarding their physical and chemical properties, they are mainly acid, and have different potential and effective fertility (S t e b u t, 1928; Č i r i ć, 1952). Investigations on Kosovo and Metohia soils productive properties were continued, and later reports confirmed these soils as very acid, and poor regarding nutritive elements (I v o v i ć, 1958; L a l i ć, 1976; P a j k o v i ć, 1977).

Organic remains with cellulose have been transforming faster or slower, which depends of soil type, ecological conditions, presence of necessary microorganisms, etc. According to cellulose spreading in profile and microorganisms presence, we can talk about "Cellulolizers profile", and about season dynamism of this specific microorganisms group. Higher or lower cellulose decomposers amount influences on growth of the other heterotrophic microorganisms, that are in metabolic and symbiotic relationship with cellulose decomposers. The humus-contained organic colloids are made by cellulose-transformation activity of this microflora.

MATERIAL AND METHODS

These microbiological investigations have been carried out in 1994 and 1995. Soil samples for analyses were taken during seasons: Autumn, Winter, Spring, and Summer. Soil samples were taken from different

depth of a profile: 0-25 cm, 25-50 cm, 50-75 cm, and 75-100 cm.

Amount of cellulose decomposers was observed on silica gel with standard solution for cellulolizers, and with filter-paper as the only carbon source. Growing bases were sowed by soil granules, and every Petrie-dish was sowed by 25 of granules, all in three repetitions. Incubation was done on 24°C. Number of fertile granules (in %) was determined 15 and 30 days after incubation.

RESULTS AND DISCUSSION

The investigated Vertisol had neutral pH value, a large content of humus, and the optimal content of available phosphorus and potassium.

Season dynamism of cellulose decomposers is closely related to organic matter input, which is made by natural vegetation or by field crops (T o d o r o v i ć et al. 1976, 1984, 1985, 1987).

Uncultivated Vertisol had a large amount of cellulose decomposers, and seasons were ranged as follow: Spring, Summer, Autumn, and Winter. We noticed, observing vertical arrangement of cellulose decomposers, that their number decreased by depth, which was obviously related to fresh organic matter content, that was lower in deeper layers, as well as to a lack of oxygen.

Table 1. The season dynamism of cellulose decomposers in Vertisol of Laplje Selo (percent of fertile soil granules)

UNCULTIVATED SOIL					CULTIVATED SOIL				
Depth	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	
0-25	88	28	84	94	100	20	90	84	
25-50	52	12	62	82	100	20	96	32	
50-75	24	12	24	2	58	6	36	24	
50-100	8	0	24	2	12	4	10	0	

Season dynamism of cellulose decomposers in cultivated Vertisol showed the following range: Autumn, Spring, Summer, and Winter, and it was different regarding uncultivated Vertisol, obviously due to applied agrotechnique measures. Cellulose decomposers more numerous in cultivated Vertisol, and that was expectable because of a large organic matter amount, filled under by ploughing in of harvest remains, and because of better aeration of cultivated soil. M i s h u s t i n (1974) reported that carrying in of mineral fertilizers influenced significantly on number and composition of cellulose decomposers. Representatives of many bacteria and fungi genera can be met among cellulose decomposers, but in this soil type the main cellulose transformers are bacteria.

Uncultivated Pseudogley had high amount of cellulose decomposers, and their season dynamism

showed the following range: Spring, Autumn, Winter, and Summer. However, bacteria were not predominant among cellulose decomposers, but fungi were, which was influenced by many factors, especially by soil pH value (T o d o r o v i ć, 1968).

Table 2. The season dynamism of cellulose decomposers in Pseudogley of Vitimirica (percent of fertile soil granules)

UNCULTIVATED SOIL					CULTIVATED SOIL				
Depth	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	
0-25	84	100	66	98	80	86	92	86	
25-50	52	50	62	58	44	78	40	28	
50-75	12	2	14	20	24	2	8	6	
50-100	2	0	8	14	4	12	2	6	

Cultivated Pseudogley had a little lower number of these microorganisms regarding the uncultivated one, and a reason for that might be growing of legume crops (alfalfa) during last five years. These results were in accordance with previous reports (T o d o r o v i ć et al., 1975; K a l i n o v i ć et al., 1975).

Investigated Dystric Cambisol had significantly lower amount of cellulose decomposers, regarding the two above mentioned soil types. That was mainly caused by this soil's acid pH value with a middle humus content in surface layer, and with very low humus content under 25 cm of depth. Available phosphorus content was low, and available potassium content was within middle values.

Table 3. The season dynamism of cellulose decomposers in Dystric Cambisol of Tankosić (percent of fertile soil granules)

UNCULTIVATED SOIL					CULTIVATED SOIL				
Depth	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	
0-25	64	6	66	72	88	74	72	46	
25-50	46	34	48	10	36	32	26	6	
50-75	2	0	2	0	8	6	0	14	
50-100	0	0	0	0	2	0	0	12	

Season dynamism was not same in uncultivated and cultivated Dystric Cambisol. In cultivated soil, the highest content of cellulose decomposers was in Autumn, and then in gradually decreased, so the lowest content of these microorganisms was observed in Summer. In uncultivated Dystric Cambisol, the seasons were ranged as follows: Spring, Summer, Autumn, and Winter.

Cultivated Dystric Cambisol had higher amount of cellulose decomposers regarding the uncultivated one, and that was expected, because of higher organic matter input and better aeration. The main cellulose decomposers in this soil type were fungi that made acid humus with unfavorable properties.

CONCLUSION

On the basis of obtained results concerning season dynamism and amount of cellulose decomposers in the investigated soil types, we can conclude the following:

— Cellulose decomposers were well-presented in the all investigated soil types.

— Cultivated Vertisol and Dystric Cambisol had higher cellulose decomposers content regarding the same natural types, but this was not observed in the case of Pseudogley.

— In Vertisol bacteria were the main cellulose transformers, but significant role played fungi too. In Pseudogley, percental part of fungi was larger than of bacteria, and in Dystric Cambisol bacteria took a very little percent of total cellulose transformation.

— The bacteria vs. fungi relation was influenced by many factors, but the main factor was soil pH value. Number of fungi increased by acidification, and bacteria number decreased.

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REZIME

ZASTUPLJENOST CELULOLIZATORA KOD NEKIH ZEMLJIŠNIH TIPOVA KOSOVA I METOHJE
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Od ukupne količine sveže organske materije koja dospeva u zemljište veliki procenat otpada na celulozu. Transformacijom celuloze stvaraju se humusne materije, veoma značajne za zemljište i dalje aktivnosti biljaka i mikroorganizama.

Mikrobiološkim proučavanjima su obuhvaćena tri osnovna tipa zemljišta Kosova i Metohije, smonica, pseudoglej i crvenica. Ispitivani su mikrobiološki profili navedenih zemljišnih tipova koji se obrađuju i onih koji nisu obrađivani (devičansko zemljište).

Celulozatori su dobro zastupljeni kod ispitivanih zemljišnih tipova Kosova i Metohije. Obradena smonica i crvenica su sa većom zastupljenošću celulozatorima od ispitivanih prirodnih tipova što nije slučaj sa pseudoglejem. Na odnos bakterija i gljiva u transformaciji celuloze utiče više faktora ali je najznačajnija pH vrednost zemljišta, sa povećanjem kiselosti učešće gljiva u transformaciji celuloze raste i bakterija opada. Glavni transformatori celuloze kod smonice koja je neutralne reakcije sredine su bakterije, kod pseudogleja koji je kisele reakcije sredine povećava su učešće gljiva u transformaciji celuloze, dok kod crvenice koja je jako kisele reakcije sredine glavni transformatori celuloze su gljive.

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Prikazi --- Book reviews

I

Zečević M., 1996. PREGLED FAUNE LEPTIRA SRBIJE (MAKROLEPIDOPTERA), Institut za istraživanja u poljoprivredi Srbije i IP Nauka, str. 1-157, Beograd

UDK 595.78 (497.11) (083.81)

Publikovanje ove monografije je značajan doprinos našoj entomologiji obzirom na sadašnje finansijske okolnosti koje izdavaštvo uopšte dovode na rub egzistencije. Pored toga, naša entomologija je na najnižim granama od vremena Pančića pa je zato objavljivanje ovog dela još značajnije. Činjenica da jedino amateri uspevaju da daju određeni doprinos najbolje odslikava suštinu zapostavljenosti naše entomologije. Iz navedenih razloga možemo zaključiti da je publikovanje ove monografije pravi podvig.

Osnovna ideja dela je koncizna: da na jednom mestu budu objedinjeni i prezentirani podaci o vrstama naših leptira iz grupe makroleptira. To je, zapravo, izuzetno težak posao vezan za studiranje obimne literature razbacane po evropskoj i domaćoj periodici. Uz to je autor analizirao i postojeće muzejske i privatne zbirke kako bi uključio i one vrste koje još nisu obrađene i publikovane. Podrazumeva se da je za ovakav posao bilo neophodno autorovo solidno poznavanje sistematike obrađene grupe. Rezultat je spisak od 1.334 vrste makroleptira Srbije, prvi takav spisak za prostor naše republike uopšte. Uz svaku vrstu su navedeni i nazivi njenih podvrsta ako ih ima, potom njeni sinonimi i podaci o prvom autoru koji spominje nalaz na prostoru Srbije. Kod nepublikovanih podataka autor je korektno naveo iz čije je zbirke materijal, ostavljajući tako kolegama mogućnost naknadne publikacije. Monografija sadrži iscrpan in-

deks rodova, vrsta, podvrsta i sinonima čime je njeno korišćenje znatno olakšano.

Značaj ove monografije je veliki. Ona će, pre svega, podstaći brojne amatere lepidopterologe, a nadamo se i one kojima je to struka, da rade na dopuni postojeće liste. Možemo napraviti paralelu sa delom Lerauta (1980), kome je Zečevićeva monografija analoga, koje je sadržavalo listu od 4.677 vrsta Lepidoptera Francuske a sada je u pripremi drugo dopunjeno izdanje čija lista broji 5.062 vrste! Budući da je naša fauna Lepidoptera svakako bogatija od faune Francuske jasno je da Zečevićeva monografija evidentira tek nepunu trećinu naših vrsta. Ona je, prema tome, i svojevrsan poziv mladim entomolozima da se aktivno uključe u obradi Lepidoptera, prvenstveno onih grupa za koje još nemamo stručnjake. Najzad, ova monografija ima i veliku upotrebnu vrednost pa će, poput rečnika, morati stalno da bude korišćena i citirana.

Moramo se osvrnuti i na određene slabosti i propuste monografije. Najveći njen nedostatak je nedoslednost u pogledu taksonomije. Autor je morao da se opredeli između taksonomskog sistema Forster und Wohlfahrt (1973-1981) i sistema Lerauta (1980). Izabrao je sistem prve dvojice, koji uopšte nije taksonomski validan a primenjena je nomenklatura Lerauta, što je nedopustivo. Pojedine vrste i podvrste, poznate u literaturi za Srbiju, nisu unešene, što je i razumljivo jer autor i nije mogao doći do svih literaturnih podataka. Najzad, monografija sadrži dosta štamparskih greški u latinskim nazivima. Sve ove mane se mogu otkloniti u drugom izdanju i one nipošto ne umanjuju opšti utisak i osnovne vrednosti dela.

P. Jakšić

Amount of Nitrogen-fixing Microorganisms in Some Kosovo and Metohia Soils

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ABSTRAKT

Microbiological investigation involved the three basic Kosovo and Metohia soil types: Vertisol, Pseudogley, and Dystric Cambisol. Cultivated soil profiles of the above mentioned soil types have been studied, as well as the uncultivated ones (virgin soil).

Amount of free aerobe nitrogen fixing microorganisms in the investigated Kosovo and Metohia soils was low. Cultivated Vertisol had a higher amount of this microflora than the uncultivated one, which was expectable, but cultivated

Pseudogley and Dystric Cambisol did not follow this tendency, and they had a lower content of these microorganisms comparing with their natural types.

The applied agrotechnique measures influenced on increasing of this microflora number. However, using of mineral fertilizers high doses and chemical means for plant protection influenced unfavourably on free aerobe nitrogen-fixing microorganisms.

Key words: Vertisol, Pseudogley, Dystric Cambisol, cultivated uncultivated soil, free aerobe nitrogen fixing microorganisms.

INTRODUCTION

Many interesting changes of microbiological communities grouping can be observed by studying of various soil types microflora, especially according to their depth. That is in accordance with some soil-genetic processes, or with a gley layer, etc. Therefore Mishustin's school consider that character of microbiological communities represents character of soil-genetic processes.

Soil ecological factors influence on composition and changes of its microbiological communities, and at the same way they strongly influence on some microorganisms species changes in such communities. Many cases of appearing of new ecotypes, varieties, subspecies and even species in a group of microorganisms, if it was long-term under some conditions of survival in soil, were well-known. A classic example for that is *Azotobacter*: which nowadays involves several clear ecological species, that got characteristics of real biological species. Existing of such special species of these bacteria, which has normal or even the best growth in acid or alkal environment, is limited by soil pH value, organic matter content, phosphorus, microelements and water content (Alexander, 1977). *Azotobacter* is very important for soil, because it can be associated easily with different plant species roots, and on that way it can fix 20-55 kg/ha of atmosphere nitrogen (Govedarica et al., 1993).

There are both-sided influences between microorganisms and soils, and studying of these influences

is very important, with the final goal of increasing of effective fertility by its results, and increasing of crops yield.

We wanted, because Kosovo and Metohia soils were not enough microbiologically studied, to investigate amount of free nitrogen-fixing microorganisms in the three basic Kosovo and Metohia soils: Vertisol, Pseudogley, and Dystric Cambisol, when they were cultivated and uncultivated.

MATERIAL AND METHODS

This microbiological investigation have been carried out in 1994. and 1995. and the chosen Vertisol locality was near Laplje Selo village (Priština), Pseudogley locality was near Vitomirica village (Peć), and Dystric cambisol locality was near Tankosić village (Uroševac). Soil sampling for the investigation was done in season periods: Autumn, Winter, Spring, and Summer. Soil samples were taken from different depth of a profile: 0-25 cm, 25-50 cm, 50-75 cm, 75-100 cm.

Amount of free aerobe nitrogen-fixing microorganisms was determined on solica gel with standard solution without nitrogen, and with manit as the only carbon source. Growing bases were sowed by 25 soil granules, and amount of microorganisms was given as soil "fertile granules" percent.

RESULTS AND DISCUSSION

Number of free aerobe nitrogen-fixing bacteria in the investigated Kosovo and Metohia soils was low, although these microorganisms were very important for soils, because their fixing of atmosphere nitrogen, which was unreachable for plants.

There was a very small number of free aerobe nitrogen-fixing bacteria in both natural and antropogene Vertisol. We could observe, comparing amount of free aerobe nitrogen-fixing bacteria in uncultivated and cultivated Vertisol, that it was larger in cultivated Vertisol profile, which was expectable because *Azotobacter* indicated cultural status of a soil.

Season dynamics of free aerobe nitrogen-fixing bacteria in uncultivated and cultivated Vertisol were not the same, and in uncultivated soil seasons were ranged as follows: Spring, Summer, and Autumn. In cultivated vertisol they showed the following range: Autumn, Spring, Summer. These microorganisms were not found during Winter season.

This microflora vertical arrangement in a profile of uncultivated Vertisol was regular, the greatest number of them was in a surface layer, and that number decreased by depth. In cultivated Vertisol we met majority of these microorganisms in 25-50 cm of depth. This difference was obviously caused by applied agro-technique measures.

On soil *Azotobacter* number, as well as on the other nitrogen-fixing bacteria number, a great influence had mineral fertilizers too (Sarić, 1978).

Table 1. The season dynamism of nitrogen-fixing bacteria in Vertisol of Laplje Selo (percent of fertile soil granules)

UNCULTIVATED SOIL					CULTIVATED SOIL			
Depth	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer
0-25	12	0	0	6	2	0	8	18
25-50	0	0	0	4	0	0	14	4
50-75	0	0	0	0	0	0	4	2
50-100	0	0	0	0	0	0	0	0

The investigated Pseudogley had a low number of free aerobe nitrogen-fixing bacteria because of this soil's low pH value, with a row of unfavourable factors such as the following were: temperature, aeration, energetic value of organic remains, root systems secretions, and expression degree of destruction processes (Mickovskić, 1954; Vojnović, 1961).

Free nitrogen-fixing bacteria fix atmosphere nitrogen in the amount of about 20 kg/ha, but they can use a small amounts of mineral nitrogen. Therefore, they are called as oligonitrophiles by some investigators. Oligonitrophiles are sensitive on high doses of nitrogen fertilizers, that decrease their number in soil. Number of free nitrogen-fixing bacteria mainly depends of soil type and of its conditions. Many investigators reported different oligonitrophiles number for

different soil types (Paul and Newton, 1961; Ključevska et al., 1970; Linge and Lout, 1971).

Season dynamism of free aerobe nitrogen-fixing bacteria in uncultivated and cultivated Pseudogley was not the same. In cultivated Pseudogley, these microorganisms were registered in the all investigated seasons, but in very small percent, and the greatest their number we met in Winter and Spring. Season dynamism of free aerobe nitrogen-fixing bacteria in uncultivated Pseudogley had the following range: Winter, Spring, and Summer. During Autumn we did not observe these microorganisms.

Table 2. The season dynamism of nitrogen-fixing bacteria in Pseudogley of Vitomirica (percent of fertile soil granules)

UNCULTIVATED SOIL					CULTIVATED SOIL			
Depth	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer
0-25	0	2	6	2	2	6	4	2
25-50	0	14	4	0	0	0	6	0
50-75	0	0	0	0	0	0	0	0
50-100	0	0	0	0	0	0	0	0

We can observe, by comparing amount of free aerobe nitrogen-fixing bacteria in uncultivated and cultivated pseudogley, that number of these microorganisms was higher in uncultivated soil. We expected the opposite case because cultivated soil had more fresh organic matter and had better aeration. However, cultivated Pseudogley had a lower pH value than the uncultivated one. Chemical matters applied for crop protection also had the negative effect on this microflora amount.

Dystric Cambisol had a low amount of free aerobe nitrogen-fixing microorganisms, as we saw in the two previous soil types. We observed them in uncultivated Dystric Cambisol during only two of investigated seasons. In Winter, there was a very small percent of these microorganisms, and in Spring this percent significantly increased. The largest amount of these microorganisms was observed on 50-75 cm of depth.

Table 3. The season dynamism of nitrogen-fixing bacteria in Dystric cambisol of Tankosić (percent of fertile soil granules)

UNCULTIVATED SOIL					CULTIVATED SOIL			
Depth	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer
0-25	0	6	4	0	0	4	0	0
25-50	0	2	8	0	0	6	2	2
50-75	0	0	16	0	0	4	0	4
50-100	0	0	2	0	0	0	0	0

Season dynamism of free aerobe nitrogen-fixing bacteria in cultivated Dystric Cambisol profile was as follows: Winter, Summer, and Spring; in the Autumn we did not record this microflora. These microorgan-

isms vertical arrangement was not regular, and most of them we met in 25-50 cm deep layer.

We can observe, comparing amount of free aerobe nitrogen-fixing bacteria in uncultivated and cultivated Dystric Cambisol, that it was higher in uncultivated soil, which was unexpected because *Azotobacter* was an indicator of soil cultural status.

CONCLUSION

On the basis of the obtained results regarding season amount of free aerobe nitrogen-fixing microorganisms in the investigated soil types, we can conclude the following:

— Amount of free aerobe nitrogen-fixing bacteria in the investigated Kosovo and Metohia soils was low.

— Cultivated Vertisol had a higher amount of this microflora than the uncultivated one, which was expetable, but cultivated Pseudogley and Dystric cambisol did not follow this tendency, and they had a lower content of these microorganisms comparing with their natural types.

— The applied agrotechnique measures influenced on increasing of this microflora number. However, using of mineral fertilizers high doses influenced unfavourably on free aerobe nitrogen-fixing microorganisms.

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REZIME

ZASTUPLJENOST AZOTOFOKSATORA KOD NEKIH ZEMLJIŠNIH TIPOVA KOSOVA I METOHİJE

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Slobodni aerobni azotofiksatori su veoma značajna grupa mikroorganizama za zemljište, jer su sposobni da fiksiraju atmosferski azot koji je kao takav nedostupan biljkama i najvećem broju mikroorganizama.

Mikrobiološkim proučavanjima su obuhvaćena tri osnovna tipa zemljišta Kosova i Metohije, smonica, pseudoglej i crvenica. Ispitivani su zemljišni profili navedenih zemljišnih tipova koji se obrađuju i onih koji nisu obrađivani (devičansko zemljište).

Slobodni aerobni azotofiksatori su slabo zastupljeni u ispitivanim zemljištima Kosova i Metohije. Obrađena smonica je bogatija ovom mikroflorom od neobrađene smonice, što je i očekivano, ali to nije slučaj sa obrađenim pseudoglejem i obrađenom crvenicom koje su siromašnije ovom mikroflorom od njihovih prirodnih tipova.

Preduzete agrotehničke mere utiču na povećanje brojnosti ove mikroflora, međutim, korišćenje velikih doza mineralnih đubriva, kao i primena hemijskih sredstava u zaštiti gajenih biljaka nepovoljno utiču na zastupljenost slobodnih aerobnih azotofiksatora.

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Prikazi --- Book reviews

II

Stevanović, V., Vasić, V. eds. (1995): BIODIVERZITET JUGOSLAVIJE SA PREGLEDOM VRSTA OD MEĐUNARODNOG ZNAČAJA. Biološki fakultet i Ecolibri, str. 1-3+I-VIII+1-562, Beograd

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Ova monografska publikacija ima za osnovni cilj da prezentira bogatstvo biljaka, gljiva i životinja na prostoru SR Jugoslavije. Danas je moderno da živu prirodu označavamo pojmom biodiverzitet, podrazumevajući pod njim raznovrsnost formi ispoljavanja života: genetski biodiverzitet, specijski biodiverzitet i ekosistemski biodiverzitet, uz napomenu da se te forme realizuju u prostornom i vremenskom kontinuumu.

Monografija sadrži opšti i posebni deo. U opštem delu je u širem kontekstu razmatran pojam biodiverziteta uopšte. Istaknuti su savremeni principi i načela zaštite prirode uopšte. Prezentirani su brojni međunarodni sporazumi, standardi, kriterijumi i programi od značaja za zaštitu biodiverziteta. Ti dokumenti, zajedno sa domaćim ustavno-pravnim aktima su do sada bili rasuti po brojnim publikacijama, teško dostupnim. U ovom delu su obrađeni posebno i abiotički ekološki faktori (klimatski, geološki, pedološki) kao činioci biodiverziteta terestričnih ekosistema, potom su date osnovne hidrološke odlike kopnenih voda Jugoslavije i najzad je data biogeografska podela teritorije Jugoslavije. U posebnom delu je izvršena klasifikacija biodiverziteta i prezentiran je biodiverzitet biljaka, gljiva, dela beskičmenjaka i svih kičmenjaka Jugoslavije. Dat je i pregled vrsta od međunarodnog značaja.

Monografija ne pretenduje na sveobuhvatnost, što je i istaknuto u uvodnoj reči redaktora. Ovaj napor treba shvatiti kao još jedan izuzetno vredan i značajan korak ka krajnjem cilju — izradi nacionalne flore i faune i njihovoj zaštiti. Mi se moramo podsetiti da su takvi pokušaji već i ranije rađeni. Pomenimo *Catalogus faunae Jugoslaviae*, 1964. i dalje, potom 2. Kongres biosistematičara Jugoslavije, Gozd Martuljek, 1989; pa uspešno okončan projekat *Flora Srbije* (1970-1986) i dr.

Iako je u odnosu na prethodne pomenute pokušaje ostvaren značajan napredak u poznavanju živog sveta Jugoslavije još uvek su naša znanja o njemu skromna. To naročito važi za našu faunu beskičmenjaka, gde čitav niz predstavnika krupnih taksonomskih kategorija uopšte nije istražen, ili je istražen delimično i nedovoljno. Zato monografija BIODIVERZITET JUGOSLAVIJE pre svega opominje i ukazuje koji su primarni zadaci nacionalne biološke nauke. Prerano smo se odrekli usluga taksonoma florista i faunista. Nema rada sa mladima, nema stručne i naučno-popularne literature, premalo je prirodnjačkih muzeja. Evropske zemlje su još početkom veka imale svoje nacionalne flore i faune. Kako Bugarska može imati publikovane sveske svoje faune a mi ne? Može li klasična biologija kod nas postati ravnopravna sa molekularnom biologijom i drugim savremenim disciplinama? Sve ove dileme monografija na direktan ili indirektan način ističe i u tome je njena posebna vrednost. Da bilo koja evropska zemlja na svojoj teritoriji ima Staru planinu, Taru, Šar-planinu ... nijedna od takvih riznica prirode ne bi bila bez biološke istraživačke stanice. Bugari upravo zato imaju sveske svoje nacionalne faune jer su još u periodu između dva svetska rata imali takve stanice.

Pored otvorenog pitanja naše flore i faune ova monografija ukazuje na još jedan aktuelni problem, na pitanje vrsta od međunarodnog značaja. Pitanje je kako možemo govoriti o značajnim, retkim, ugroženim i zaštićenim vrstama kada još nemamo nacionalnu floru i faunu? Wilson (1992) tvrdi da dnevno 74 vrste živih bića biva uništeno sa naše planete. Očito je da će mnoge vrste naše flore i faune biti uništene zauvek a da mi nismo ni bili svesni njihovog postojanja na ovim prostorima.

Možemo, zato, zaključiti da je vrednost ove monografije dvostruka: ona pruža obilje stručnih informacija, širokom krugu korisnika, o živom svetu Jugoslavije, ali i podstiče na razmišljanje, budi uspavane savesti i daje nadu da će klasična biološka nauka u kojoj taksonomi čine jezgro biti reafirmisana.

P. Jakšić

Same Morphological-Anatomical Characteristics of Genus *Ptilostemon* (Cassini): *P. strictus* (Tenore) Greuter, 1967, and *P. afer* (Dumortier) 1967 (Fam: Asteraceae (Dumortier))

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ABSTRAKT

Ptilostemon strictus (Ten.) Greuter is distributed in central and southern part of Italy and southern part of Balkan Peninsula. Area of distribution of *P. afer* (Jacq.) Greuter is eastern and southern part of Balkan Peninsula and Romania. Anatomical parameters of these two species are analysed: root (length and width of vessel elements), leaf (bundles, vessel elements), stem (number of bundles and their size, length and width of vessel elements).

Results of comparative anatomical investigation showed that *Ptilostemon afer* possesses several characters which are similar to the *Cirsium* spp. analysed earlier. *P. strictus* is characterised by anatomical characters which distinguish this species very well from *P. afer* as well as from *Cirsium* spp. Taxonomical status of *Ptilostemon* Cass and *Cirsium* Adans. and significance of anatomical parameters in differentiation of these related genera are discussed.

Key words: *Ptilostemon*, morphology, anatomy, root, stem and leaf.

INTRODUCTION

P. strictus is characteristic species for the forest association *Q. montanum*, and it is widely spread in the bright oak forests. *P. afer* is mostly located on open domiciles in the zone of highly degraded forests. Species *P. afer* and *P. strictus* belonged to the *Cirsium* genus, but in Greuter's monograph they were classified into the *Ptilostemon* genus on the basis of vegetative characteristics.

Analyzing these two species we have noticed that next to the similarities and differences, that lead Greuter to separate *Cirsium afrium* species from *Cirsium* genus and classify it into *Ptilostemon* genus as *P. afer*, there are also strong reasons for *P. afer* to remain in *Cirsium* genus. *P. afer*'s external anatomy of vegetative organs is much closer to the one in species of *Cirsium* genus. Having this introductory remarks in mind we have decided to pay closer attention to parallel studying of anatomical form of *P. strictus* and *P. afer*.

MATERIAL AND METHODS

Studying material for morphological and anatomical structure of mentioned species was collected on the Grmija mountain near Priština, in order to study a morphological structure we have analyzed the height of plant, the length of the peak, the length studying the anatomical structure we have analyzed the root, the stem and the leaf. The number, height and width of trim stack, together with the diameter of tracheas in trim

stacks were analyzed. All of anatomical parameters were analyzed on permanent microscopic preparations.

RESULTS AND DISCUSSION

Results obtained from analyzing the morphological structure of *P. strictus* and *P. afer* species showed that *P. strictus* only has as the number of the peaks, the length of the peaks, the length of the peaks's stem and the number of the flowers in the peak, have higher values in *P. afer* (tab. 1).

Analyzing the anatomical structure of *P. strictus* and *P. afer* we found out the important differences in the leaf's structure and the structure of the stem and root. *P. strictus* have thin cuticular on epidermis of surface and epidermis on the back side. Epidermis of the back side is not mucous and covered with sparse multicellular hairs. But epidermis of the leaves in *P. afer* have much thick cuticular, and epidermis of the back side is mucous and sparse hairy.

The important differences exist in anatomy of leaf's main rib. In the main rib of *P. strictus* there are three trim stacks and around its mechanical boot leg there are no gland cells, while in the leaves of *P. afer* there are 6-8 trim stacks and gland cells are present and placed on the left and right side of the mechanical boot leg. Also, it is found that height and width of trim stacks in *P. strictus* are smaller than $26 \times 10 \mu$, more exactly

$16 \times 10 \mu$ (tab. 2), while in *P. afer* are bigger than $26 \times 10 \mu$, more exactly $16 \times 10 \mu$ (fig. 1, 2, 3, 4).

There are important differences in the stem anatomy. Epidermis of the stem in the *P. strictus* is covered with cuticular and colenchim cells are abset in subepidermal rib. Trim stacks have round shape and the gland cells are not present around its mechanical boot leg. There are lesser than thirty stacks with the height lesser than $50 \times 10 \mu$, and on the other side the stem epidermis in *P. afer* is covered with cuticular and in the rib below colenchim cells are present. Trim stem of *P. afer* have expensed from and their number in cross section is higher than 30, and their height surpass $50 \times 10 \mu$ (fig. 5 i 6).

Comparative analyzes of root structure showed that *P. strictus* have highly expressed structure in comparative with *P. afer*. *P. strictus* have visible rings, while in the root of *P. afer* there is no clear distinction between rings. Parenhim of the bark in *P. strictus* has ephemeral cells in thick walls, while *P. afer* does not have any (Fig. 7 i 8).

CONCLUSION

According to data gained by comparative analyzing of morphological and anatomical of *P. strictus* and *P. afer* species, the important differences in their structure were concluded. According to literary data the presence of gland cells is characteristic for *Cirsium* genus and for *Ptilostemon* genus. According to our data *P. afer* have gland cells in leave and stack, but they are absent in *P. strictus*, this point on great similarity with structure of leaves and stacks of species that belong to *Cirsium* genus. Beside this, there are many other characteristics wich prove that this two species have differences in morphology and anatomy. All this facts have brought us to a conclusion that separation of *Cirsium afrum* from *Cirsium* genus and its classification into *Ptilostemon* genus as *P. afer* species, which was based only on some morphological differences with species of *Cirsium* and *Ptilostemon* genus, cannot be excused.

In order to bring clear conclusions and suggestions about their status, we think that it would be necessary to do more detailed examinations of morphological and anatomical structure of the other species that belong to *Cirsium* and *Ptilostemon* genus, for, that is the only way to get clear picture of taxonomical belonging of these species.

Translated by
Nikoleta Bašić

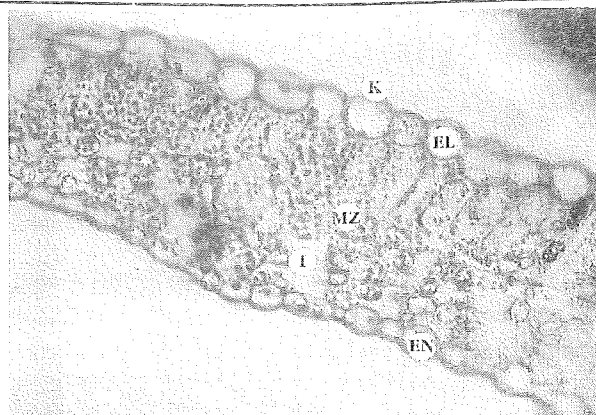


Fig. 1. Anatomical structure of *P. strictus* leave, k- cuticular, el- epidermis face, mz- mesophyll, en- epidermis surface, i- intercellular.

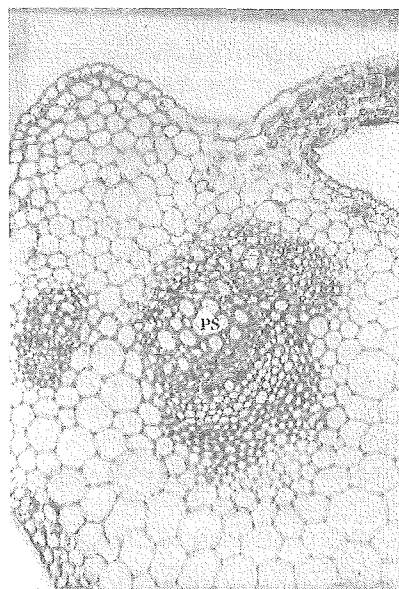


Fig. 2. Anatomical structure of main nerve of *P. strictus* ps-vascular bundle.

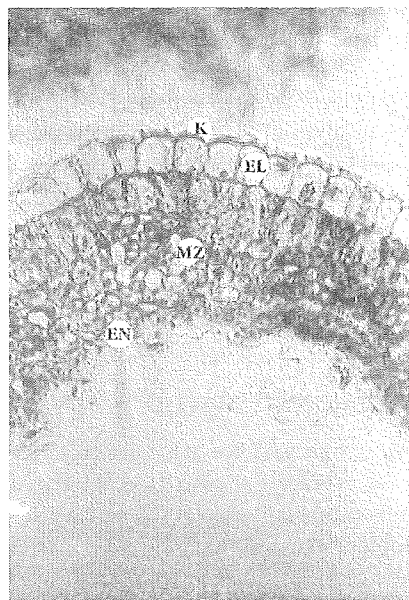


Fig. 3. Anatomical structure of main nerve *P. afer*, k- cuticular, el- epidermis face, mz- mezophyll, en- epidermis surface.



Fig. 4. Anatomical structure of the main nerve *P. afer* ps-vascular bundle.

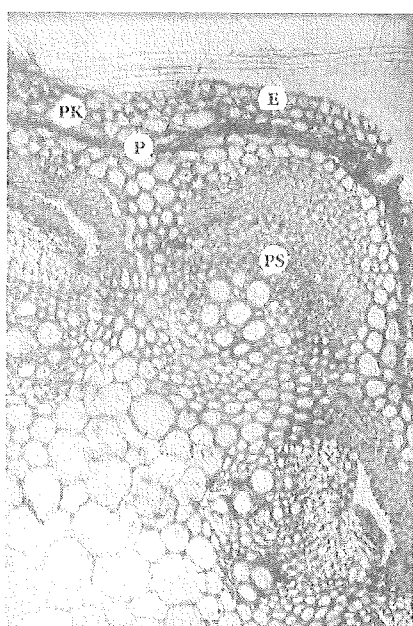


Fig. 5. Anatomical structure of *P. strictus* stem e- epidermis, pk- primary cortex, p- periderm, ps- vascular bundle.

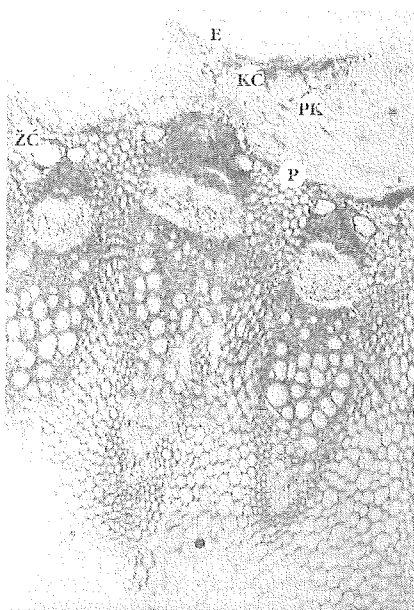


Fig. 6. Anatomical structure of *P. afer* stem, e- epidermis, pk- primary cortex, kc- collenchyma cells, žč- glean duller cells.

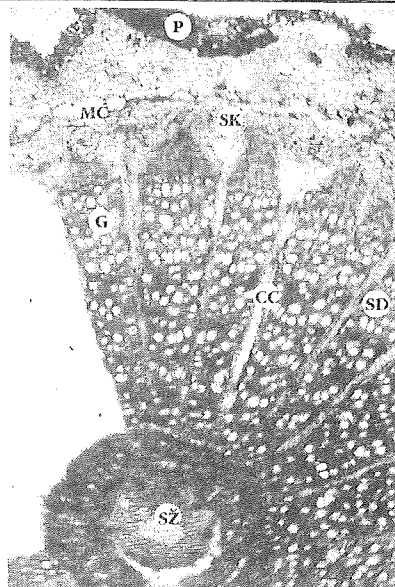


Fig. 7. Anatomical structure of the *P. strictus* stem p- periderm, sk- secondary cortex, mč- bladder cells, cc- stele, g- ring, sk- secyndar wood, sž- medulla.

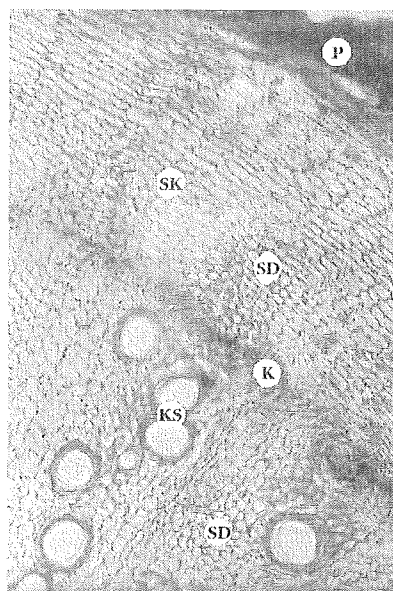


Fig. 8. Anatomical structure of *P. afer* root, p- periderm, sk- secondary cortex, sd- sieve part, k- cambium, ks- xylem, sd- secyndar cortex

Tab. 1. Comparative Morphological survey of species *P. strictus* and *P. afer*

Tab. 1. Uporedni morfološki pregled vrsta *P. strictus* i *P. afer*

	<i>P. strictus</i>			<i>P. afer</i>		
	Xsr	Xmin	Xmax	Xsr	Xmin	Xmax
Heigh of plant Visina biljke	79.8	69.3	92	64.7	59.2	73.8
Number of peaks Broj glavice	3.9	2	6	9.8	5	13
Lenght of peaks Dužina glavice	2.9	2.7	4	3	3	5.5
Lenght of peak stem Dužine drške glavice	1.1	0.5	1.6	10.4	6	12
Number of flowers in peak Broj cvetova u glavici	1.9	13	25	66.8	35	86

Tab. 2. Comparative Morphological — Anatomical survey of *P. strictus* and *P. afer* species

Tab. 2. Uporedni morfološko-anatomski pregled vrsta *P. strictus* i *P. afer*

		<i>P. strictus</i>	<i>P. afer</i>
L. I.	Cuticular epidermis surface Kutikula epidermisa lica	Thin Tanko	Thick Debela
E. I.	Hairiness of epidermis surface Dlakavost epidermisa naličja	+-	+++
A. S.	Sliminess of epidermis surface Sluzavost epidermisa naličja	-	+
V. T.	Vascular bundle in main rib of nerve Prov. snopići u rebru nerva	3	6-8
E.	Clean duller cells around vascular bundles Žlezdane ćelije oko provodnih snopića	-	+
	Height and width of vascular bundles Visina i širina provodnih snopića ($10^3 \mu$)	<od 260-160>	>od 260-160
S. S.	Cuticula of epidermis Kutikula epidermisa	Thin Tanko	Thick Debela
T.	Collenchyma in rib under epidermis Kolen u rebru ispod epidermisa	-	+
T. A.	Presence of glandular cells around mechanical supporting tissue (Sara) Prisut. žlezd. ćelija oko mehaničke sare	-	+
E. B.	Shape of vascular bundle Oblik provodnih snopića	Spherical Loptast	Elongated Izdužen
I.	Number of vascular bundle Broj provodnih snopića	< od 30	> od 30
M. O.	Height of vascular bundle Visina provodnih snopića ($10^3 \mu$)	< od 50	> od 500
	Diameter of fruthea Dijametar trnčica ($10^3 \mu$)	<od 150-140>	>od 10-140
R. K.	Bladder cells Mehuraste ćelije	+	-
O. R.	Secondary anatomy Sekundarna građa	More expressive Jače izraženo	Less expressive Slabije
O. E.	Presence of rings Prisustvo prstenova	+	-

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REZIME

NEKE MORFOLOŠKO-ANATOMSKE ODLIKE VRSTA RODA *PTILOSTEMON* (CASSINI) *P. STRICTUS* (TENORE) GREUTER 1967. I *P. AFER* (DURMOTIER) 1967.

VASIĆ P., GLIGORIJEVIĆ S. i KRIVOŠEJ Z.

P. strictus (Ten) Greuter je endemična vrsta tipična za centralnu i južnu Italiju i južne delove Balkanskog poluostrva, dok je *P. afer* raste na stenovitim i travnatim mestima, a rasprostranjen je u Albaniji, Grčkoj, Jugoslaviji. Anatomske i morfološke materijal za proučavanje ovih dveju vrsta sakupljan je na planini Grmija kod Prištine. Za proučavanje morfološke građe analizirani su visina biljke, broj glavica, dužina glavice, dužina drške glavice i broj cvetova i glavice. (Tab. 1) Analiziran je broj provodnih snopića, visina i širina provodnih snopića. Svi anatomske parametri proučavani su na trajnim mikroskopskim preparatima koji su pravljani na ručnom mikrotomu. (Tab. 2)

Na osnovu dobijenih podataka zapazili smo da pored sličnosti i razlika zbog kojih je Greuter izdvojio *Cirsium afrum* iz roda *Cirsium* i uvrstio u rod *Ptilostemon* kao *P. afer*, postoje značajni razlozi da *P. afer* ostane u rodu *Cirsium*. Ovo pre svega zbog toga što je *P. afer* po unutrašnjoj građi vegetativnih organa znatno bliži vrstama iz roda *Cirsium*.

Proučavanjem anatomske građe *P. strictus* i *P. afer* konstatovali smo značajne razlike kako u građi listova, tako i u građi stabla i korena. Tako, *P. strictus* ima tanku kutikulu na licu i na naličju epidermisa. Epidermis naličja nije sluzav i pokriven je retkim više ćelijskim dlakama, dok *P. afer* ima znatno deblju kutikulu, a epidermis naličja je sluzav i prstenasto dlakav. (slika 1 i 3)

U glavnom rebru nerva *P. strictus* ima tri provodna snopića oko čije mehaničke sare nema žlezdanih ćelija, dok u listovima *P. afer* ima šest do osam provodnih snopića, žlezdane ćelije su prisutne i raspoređene sa leve i desne strane mehaničke sare. (slika 2 i 4) Utvrđeno je da je visina i širina provodnih snopića manja kod *P. strictus* nego kod *P. afer*.

Epidermis stabla *P. strictus* je pokriven tankom kutikulom, a subepidermalno u rebru nema kolenhimske ćelije. Provodni snopići su okruglog oblika, a oko mehaničke sare nema žlezdanih ćelija. Broj provodnih snopića je manji od 30. S druge strane epidermis stabla *P. afer* pokriven je debelom kutikulom i ispod njega u rebru su smeštene kolenhimske ćelije. Provodni snopići su izduženog oblika, a njihov broj je veći od 30 (slika 5 i 6).

Na poprečnom preseku korena *P. strictus* uočena je jače izražena sekundarna građa u odnosu na *P. afer*. Kod *P. strictus* se jasno uočavaju godovi, dok u korenu *P. afer* skoro da i ne postoje. U korenu *P. strictus* zapažaju se mehuraste ćelije zadebljelih zidova kojih kod *P. afer* nema (slika 7 i 8).

Na osnovu podataka morfo-anatomskih dobijeni proučavanjem vrsta *P. strictus* i *P. afer* konstatovane su značajne razlike u njihovoj građi. Na osnovu literaturnih podataka prisustvo žlezdanih ćelija je karakteristika roda *Cirsium*, a ne roda *Ptilostemon*. Po našim podacima *P. afer* poseduju žlezdane ćelije i u stablu i listu, dok istih kod *P. strictus* nema, što govori o velikoj sličnosti sa građom stabla i listova roda *Cirsium*. Sve ovo navelo nas je na zaključak da možda nije bilo

opravdano da samo na osnovu nekih morfoloških razlika sa vrstama roda *Cirsium* i *Ptilostemon* izdvojiti *Cirsium afrum* iz roda *Cirsium* i svrstati ga u rod *Ptilostemon* kao vrsta *P. afer*.

Međutim i pored toga smatramo da bi za donošenje sigurnijih zaključaka i predloga u smislu njihovog statusa bilo neophodno da se izvrše detaljna morfološka-anatomska proučavanja i na ostalim vrstama roda *Cirsium* i *Ptilostemon*, jer bi se samo tako dobila jasnija slika o taksonomskoj pripadnosti ovih vrsta.

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Prikazi --- Book reviews

III

Lazarević, R., eds (1994): ŠARPLANINSKE ŽUPE GORA, OPOLJE I SREDSKA, ODLIKE PRIRODNE SREDINE. SANU i Geografski institut "Jovan Cvijić", Posebna izdanja, knjiga 40/I: I-VIII+1-335, Beograd

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Publikovanjem prve sveske ove edicije ostvaren je kontinuitet sa prethodnim naučnim projektom istraživanja Šar-planine pod nazivom "Opština Štrpce (Sirinička župa) — kompleksna naučna studija o prirodnim, demografskim, društveno-ekonomskim i kulturnim osnovama razvoja". Monografija sadrži 17 tematskih celina: 14 sa geografskom tematikom, dva sa biološkom tematikom a jedan prilog se odnosi na farmakognoksijsko istraživanje spontane lekovite flore Gore i Opolja. Kako je u predgovoru istaknuto Geografski institut "Jovan Cvijić" SANU je ovo istraživanje izvršio u vrlo kratkom vremenu, u periodu 1991-1994. To je bilo doba hiperinflacije i doba kada je terenski rad bio otežan i skoro onemogućen.

Monografija kao celina pruža obilje dragocenih fundamentalnih informacija o odlikama prirodne sredine ovih šarplaninskih župa. Zahvaljujući tim podacima sada je moguće realizovati floristička, faunistička i primenjena istraživanja u geografiji i biologiji.

Obzirom na istaknute probleme uslovljene sankcijama autori su u svojim prilogima dali napomene o tome šta je ostalo nedostupno istraživanju i šta su zadaci daljih istraživanja. Ali, izražavajući razumevanje za istaknutim okolnostima, možemo ovde uputiti zamerke što pojedini autori nisu koristili već postojeće

literaturne podatke koji bi znatno poboljšali kvalitet teksta. Tako, da istaknemo samo jedan primer, autori o speleološkim objektima nisu koristili čitav niz podataka o pećinama na ovom području: Petrović i Ćukić (1982), Vitošević (1987), Jastrebov (1904, reprint 1995) i dr. Pored pećina i vodeni resursi su ostali još nedovoljno istraženi, ostaje da buduća istraživanja budu usmerena u tom pravcu.

Za razliku od geografskih tekstova dva biološka priloga o vegetaciji i o životinjskom svetu Gore, Opolja i Sredske su nezadovoljavajućeg kvaliteta. U prilogu o vegetaciji je izvršeno kartiranje vegetacije i evidentirana je nova asocijacija *Abietum borisii regis* prov., ali bez fitocenološkog snimka. I za druge navedene asocijacije autori su samo najavili da će fitocenološki snimci biti urađeni kasnije (!). Tekst o životinjskom svetu je trebalo izostaviti iz ove sveske jer ne ispunjava elementarne zahteve nivoa naučnog rada. Nije dat nikakav pregled literature, sistematika životinja je data prema A. E. Bremu (?), za navedene vrste nije označeno mesto i vreme nalaska, itd. I sam tekst je mestimično konfuzan, tako na 276. str. autori pišu: "Ptice predstavljaju brojnu grupu životinja. Ove, često veoma šareno obojene ptice, amateri rado prate, kako u pogledu gnežđenja, tako i kao lovne divljači, veoma su značajna komponenta faune Gore, Opolja i Sredske." U izdanju SANU takav tekst nije smeo da se pojavi i veliki je propust što su oba recenzenta monografije geografi po struci, tj. što nije bilo i biologa recenzenta. Ostaje obaveza SANU, ali i šire društvene zajednice, da se živi svet ovoga područja organizovano istraži i da se rezultati publikuju adekvatno.

P. Jakšić

Accumulation and Distribution of Heavy Metals in Plant Tissues and Organs in the Location of Kosovska Mitrovica

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ABSTRACT

Accumulation and distribution of heavy metals in the tissues and organs of plants, which populate the region of Kosovska Mitrovica, were examined. The examination, in experimental conditions, was also performed on the seeds of pea (*Pisum sativum* L.), corn (*Zea mays* L.) and sunflowers (*Helianthus annuus* L.) and they were treated with different concentrations of Pb-acetate (10^{-5} M, 10^{-4} M, 10^{-3} M, 10^{-2} M and 2×10^{-2} M). For analyzing heavy metals in the samples from Kosovska Mitrovica, root, stem, leaves and fruits were used, and in the conditions of experimental intoxication the separation of seed coat from endosperm, after the germination of the seeds, was carried out. The atomic absorber was used to

determined the content of heavy metals. The highest amount of heavy metals were found in the root (Pb 660 µg/g, Zn 2300 µg/g, Cd 33,25 µg/g) even more in sensitive (*Plantago major*) than in resistant (*Rumex acetosella*). In over-ground organs the highest amounts of heavy metals were found in the leaves (283 µg/g Pb) and than in the fruits (3,5 — 136 µg/g) and vegetables (1,5 — 13 µg/g). The distribution in the seeds, which were treated with Pb-acetate, was uneven. The high lead concentrations were recorded in seed coat (12,7 — 7250 µg/g), and in endosperm (4 — 412 µg/g).

Key words: Plants, heavy metals (Pb, Cd, Zn), accumulation, distribution

INTRODUCTION

It is known that the plants absorb heavy metals through the root from soil and through overground vegetative organs from atmosphere (Kastori, 1993).

The absorption and accumulation of heavy metals is different in various plants and depends on the plant species and the cocentration of metals in the air and soil (Alloway, 1990).

It is established that heavy metals cause morphological, physiological and biochemical changes in plants (Woolhouse, 1983).

So, Barcelo et al. (1988), showed that Cd can lead to strctural changes in chloroplast (membrane destruction, swelling and occurrence of globular layers), and in bean leaves (*Phaseolus vulgaris* L.). The same authors have noticed reduction in number of cell hair on unit area and higher degree in constipation of stoma.

According to our results, and data of other authors (Singh et al., 1991.), it is stated that cadmium is very toxic for plants. The increased concentrations of Cd in wheat cause reduced growth, and symptoms of phytotoxic demonstrates through pale — yellow spots between the nervs of the old leaves, and through the necrosis of tissue in the upper leaves. All this results in diminishing returns. Also, it is shown (Breckle et al., 1988.) that heavy metals can reduce the intensity of transpiration in the beech tree (*Fagus silvatica* L.), and reduce its vegetative period.

According to literary data, heavy metals, especially lead, inhibit the growth of root and leave surface, intensity of photosynthesis, absorption of necessary elements and initiate oxidation of IAA, (Kastori, 1991).

Like cadmium, lead can also cause significant changes in anatomy and morphology (Janjatović, 1991), stimulate activity of nitrate reductase (Petrović et al., 1987) enzyme and peroxidase (Trajković R., 1991) in wheat leaves.

In the plants which are sensitive to heavy metals, high concentration of Zinc inhibit expense of the root, and that is good indicator for its toxic influence (Godbold et al., 1983).

Having in mind harmful consequence caused by affection of heavy metals on plants, we consider that studying of accumulation and distribution of heavy metals in plant organs is of great importance, because the plants are important link on a chain of nutrition, therefore present the danger for living organisms, especially for animals and humans.

For that purpose we have done some research which includes determination of content of heavy metals in plants that populate in the region of Kosovska Mitrovica, which is a zone highly contaminated by heavy metals, and the distribution of lead in the seed during germination in the conditions of experimental intoxication.

MATERIAL AND METHODS

For these experiments we have used whole plants (root, stem, leaves and fruits) which have been collected in the surrounding of Kosovska Mitrovica, during July (autumn fruits), while the control plants have been collected at the same period but in the surrounding of Leposavić.

Collected material was washed in plain water and than with distillate water, and dried for 24hrs in the dryer on 105°C and after that was ground.

In the conditions of experimental intoxication seeds of the plants *Pisum sativum* L., *Zea mays* L. and *Helianthus annuus* L. were used to determinate the distribution of heavy metals.

All type of seeds were prepared for germination and immediatly treated with different concentration of Pb-acetate (10^{-5} M, 10^{-4} M, 10^{-3} M, 10^{-2} M and 2×10^{-2} M), and after 48hrs for peas, 72hrs for corn and 96hrs for sunflower we went down for separation of seed coat from endosperm. Immediately after the separation the material was dried for 24hrs on the teperature of 105°C in dryer and than ground. Each gram of grinned plant material was destroyed with perchloric and nitric acid, and after that the content of heavy metals was measured on atomic absorber.

RESULTS

The results of our research indicate that heavy metals (Pb, Zn Cd) mostly accumulate in tree bark, where we found 1870 mg/g and Cd — 7,0 mg/g (Tab. 1). Next, a high concentration of heavy metals is found into the plant roots. In the plant *Plantago major* root it is found 660 mg/g of Pb, even 2300 mg/g of Zn, and 33,25 mg/g of Cd.

In Tab. 1 we can notice also a smaller content of heavy metals in the leaves. In cabbage the concentration is found to be 49,75 mg/g of Pb, 36,75 mg/g of Zn, and Cd-1 mg/g, counting the dry substance, and in the leaves of *Rumex acetosella* 154,50 mg/g of Pb, 495 mg/g of Zn, and 2,25 of Cd. In the fruits of wild pear it is found 35,75 mg/g of Pb, 56,35 mg/g of Zn, wile the concentration of heavy metals in *Pirus domestica* counts 13,25 mg/g of Pb, 6,75 mg/g of Zn in dry substance. On the other hand a content of only 3,5 mg/g of Pb is found in tomato, 1,5 mg/g of Pb in corn, and 8 mg/g of Pb in potatoes. But in the fruits of blackberry it is found 136 mg/g of Pb, and in *Rosa canina* 24,75 mg/g of Pb. From the results it is seen that the Cd is not found in the fruit trees, and that the content of heavy metals in sample plants from Leposavić is 3 to 10 times smaller than in samples from K. Mitrovica.

In conditions of experimental intoxication we have determined the distribution of Pb in the seeds of peas, corn and sunflower during the germination period and in the presence of different concentrations of Pb-acetate.

The results show (tab. 2) that the highest amounts of lead in all type of seeds accumulate in seed coat. With the highest concentrations of Pb — acetate (2×10^{-2} M), high Pb concentrations were measured and they amount to 7250 mg/g in peas, 1600 mg/g in corn and 3300 mg/g in sunflower.

Lower Pb concentrations accumulate in endosperm of these same seeds and they amount to 250 mg/g in peas, 140 mg/g in corn and 412 mg/g in sunflower, with Pb — acetate concentrations of 2×10^{-2} M.

Tab. 2. Distribution of lead in the endosperm during the germination of the seeds of pease, corn and sunflower, in the conditions of experimental intoxication with different concentrations of Pb — acetate.

Tabela 2. Distribucija olova u semenjači i endospermu u toku klijanja semena graška, kukuruza i suncokreta, u uslovima eksperimentalne intoksikacije različitim koncentracijama Pb-acetata

	<i>Pisum sativum</i> L.		<i>Zea mays</i> L.		<i>Helianthus annuus</i> L.	
	semenjača seed coat	endosperm sa embrionom endosperm from embrio	semenjača seed coat	endosperm sa embrionom endosperm from embrio	semenjača seed coat	endosperm sa embrionom endosperm from embrio
H ₂ O control — kontrola	0,00	0,50	0,50	0,60	0,50	0,05
10^{-5} M Pb-acetat	12,50	23,00	50,00	4,00	50,00	50,00
10^{-4} M Pb-acetat	12,50	25,00	55,00	6,00	50,00	25,00
10^{-3} M Pb-acetat	62,50	25,00	375,00	20,00	150,00	80,00
10^{-2} M Pb-acetat	1250,00	28,50	1375,00	55,00	2100,00	412,00
2×10^{-2} M Pb-acetat	7250,00	250,00	1600,00	140,00	3300,00	412,00

Tab. 1 Content of heavy metals ($\mu\text{g/g}$ dry weight) in vegetative and reproductive organs and in bark of plants collected in the surrounding of K. Mitrovica

Tabela 1. Sadržaj teških metala ($\mu\text{g/g}$ suve težine) u vegetativnim i reproduktivnim organima i kori biljaka prikupljenih u okolini K. Mitrovice.

Samples – Uzorci	Kosovska Mitrovica			Leposavić (kontrola)		
	Pb	Zn	Cd	Pb	Zn	Cd
<i>Robinia pseudo-acacia</i> L. (leaves – listovi biljaka)	283,00	320,00	1,50	29,50	69,25	0,25
<i>Robinia pseudo-acacia</i> L. (bark – kora drveta)	1870,00	762,50	7,00	1205,00	445,00	3,00
<i>Plantago major</i> L. (leaves – listovi biljaka)	265,00	1125,00	17,75	46,25	157,50	1,25
<i>Plantago major</i> L. (fruits and flowers – plodovi i svetovi)	103,25	285,00	4,75	41,50	92,50	0,50
<i>Plantago major</i> L. (root – koren)	660,00	2300,00	33,25	124,00	325,00	2,25
<i>Rumex acetosella</i> L. (leaves, flowers and fruits – listovi, cvetovi i plodovi)	154,50	495,00	2,25	21,25	54,25	0,50
<i>Rumex acetosella</i> L. (root – koren)	59,50	737,50	5,25	45,75	55,00	0,75
<i>Brassica oleracea</i> L. var <i>capitata</i> L. (leaves – listovi biljaka)	49,75	36,75	1,00	28,25	36,00	0,25
<i>Brassica oleracea</i> L. var <i>capitata</i> L. (root – koren)	175,00	16,25	0,00	18,00	40,00	0,25
<i>Phaseolus vulgaris</i> L. (fruits – plodovi)	3,25	65,25	0,25	1,50	72,25	0,00
<i>Solanum tuberosum</i> L. (tuber – krtola)	8,00	38,75	0,25	1,25	34,75	0,25
<i>Zea mays</i> L. ZP. 448 (fruits – plodovi)	5,25	37,50	0,00	1,50	32,50	0,00
<i>Zea mays</i> L. (fruits – plodovi)	1,50	49,50	0,00	0,50	29,00	0,00
<i>Capsicum annuum</i> L. (fruits – plodovi)	13,00	59,25	0,25	10,25	27,50	0,25
<i>Solanum lycopersicum</i> L. (fruits – plodovi)	3,50	19,75	0,25	4,75	39,50	0,25
<i>Malus domestica</i> Borkh (fruits – plodovi)	8,75	4,75	0,25	2,75	8,50	0,00
<i>Pirus domestica</i> Medicus (fruits – plodovi)	13,25	6,75	0,00	2,50	4,00	0,00
<i>Pirus piraster</i> Burgsd. (fruits – plodovi)	35,75	56,25	0,00	1,00	36,75	0,00
<i>Cydonia oblonga</i> mill. (fruits – plodov)	3,50	35,50	0,00	0,75	25,75	0,00
<i>Prunus domestica</i> L. (fruits – plodovi)	26,75	7,75	0,00	0,25	46,75	0,00
<i>Rubus caesius</i> L. (fruits – plodovi)	136,00	36,50	0,25	11,00	31,50	0,25
<i>Rosa canina</i> L. (fruits – plodovi)	24,75	47,25	0,00	4,25	16,50	0,25

DISCUSSION OF RESULTS

The analysis of obtained results indicates the existence of differences in accumulation of heavy metals in different plant organs, tissues and different plant species.

Distribution of heavy metals is unequal and the largest is in the tree's bark which is explained by the time of its exposure to the environmental conditions and its structure (roughness), enabling a larger absorption of heavy metals from the air (aerosol).

After the tree bark, heavy metals are mostly accumulated in the roots and then in the leaves as well as in the plant fruits.

We find similar results in the references: Nishizomo Hiromi et al. (1989), Buzzinski (1989) and Zheng Feug et al. (1992), proved that with the surplus of lead in the soil, plant's roots accumulate 2-3 times as much lead then the overground parts.

According to our results and many published data, we assume that the root represents a barrier for transporting the heavy metals from soil to the overground organs, and that is why more lead is found in the roots than in the leaves of plants.

Not all plants are equally sensitive to heavy metals because there are resistant plants as well. So, the high content of heavy metals (especially Cd) in the organs of plant species — *Plantago major* indicates high sensibility of this species to heavy metals. On the other side, the content of heavy metals of the species — *Rumex acetosella*, which by some authors (Noegel, 1974., Antipov, 1975), belongs to the tolerant species, is 5 times smaller than in *Plantago major*. These data indicate on the resistance of this species which is based on selection, that is, avoiding absorption.

We can compare these results with the results of some investigators (Diehl et al. 1983, Kastori et al. 1991.), on the high tolerance of soya bean and wheat to lead. According to the author's opinion, the wheat yield is being seriously reduced only when the concentration of lead in dry substance of straw reaches 45 mg/kg.

On the other side, spinach is classified as a plant sensitive to larger concentration of lead. The yield of this species is being seriously reduced with the lead concentration of 10 mg/kg of dry substance (Jude i Stenle, 1977).

The plants' tolerance mechanism to surplus of heavy metals is not so clear but is often connected with metabolism of phosphorous.

It is assumed that plants are sensitive to heavy metals, first of all to lead if they are not enough provided with phosphorous.

The experimental data also show, that the content of heavy metals is 2-10 times higher in the plant's fruits of wild species than in the plant's fruit of cultivated species.

Our opinion is that these differences in the content of lead within wild and cultivated species are connected with genetic features of concerned species.

It is also proved that the accumulation of heavy metals is higher in fruit trees than in the products of vegetables and cultivated plants. These results can be connected with the duration of vegetative period of fruit, that is, with the longer period of absorption of heavy metals from the air.

The results also show (Tab. 1) that the content of heavy metals in plant organs reduces with the distance from the emitter. However, with the distance from the source of contamination the concentration of heavy metals declines in the air as well as in the soil, which results in the reduction of heavy metal content in plant organs.

Our results can be compared with already published results, in the sense that the intensity of lead contamination as well as its accumulation in plant organs progressively declines with the distance from the emitter (Page et al., 1971).

Analysis of results obtained in terms of experimental intoxication indicate an unequal distribution of lead in seeds during the germination period and that it depends on the type of seeds and the concentration of Pb-acetate solution.

Within all examined seed samples larger amounts of lead, some 50-80%, accumulate in seed coat, while smaller amounts of lead accumulate in the endosperm.

Positive correlation between accumulation and distribution of Pb in the seeds and Pb — acetate concentrations were recorded.

Seed coat of *Pisum sativum* and *Helianthus annuus* accumulate the highest amounts of lead, approximately 80%, especially with higher concentrations of Pb — acetate (2×10^{-2} M).

Seed coat affinity for accumulation of lead is determined by genetic specifics of seeds and also depends upon pH solution. It is known that plants absorb lead more intensively with the lower values of pH solution. Seed coat represents the first barrier for passing of lead into endosperm and seed embryo. This is why the highest concentrations of lead accumulate in seed coat, which is in connection with the results of Ernest (1972), who have found that the largest quantity, approximately 90%, of lead connects to the cell walls of the root and only a small amount of lead reaches protoplasm i.e. the embryo, and this, according to the author's opinion, represents one of the resistance mechanisms of plants to heavy metals.

Thanks to this form of resistance, significant amounts of heavy metals can be accumulated in plant's tissue and yet not to influence essentially the growth and development, but are of great danger for consumers.

The results indicate high concentration of heavy metals in plant's tissue which goes over the values of MDK.

According to some data, MDK of heavy metals in vegetables amounts to 3 mg/kg for Pb, and 0,3 mg/kg for Cd, in dry substance of fruit or vegetable.

Based on the results of our research and other published data on accumulation and distribution of heavy metals in plant's tissue, we indicate that the high power of seed coat and of roots to accumulate heavy metals represents a form of protection from higher concentrations in external environment for embryo and endosperm, that is for overground parts of a plant.

CONCLUSIONS

Diferent concentrations (1-1870 mg/g) of heavy metals (Pb, Zn, Cd), in plant tissue and organs which originate from Kosovska Mitrovica and Leposavić, have been measured.

Our results showed (they are comparable with some already published) that in resistant plants (*Rumex acetosella*) accumulation of heavy metals was smaller than in sensitive plants (*Plantago major*).

We think this is a result of capability for selective absorption of heavy metals in tolerant plants, this is, one possible mechanism of their resistance.

Distribution of heavy metals in some plant tissue and organs is unequal. The highest amounts of heavy metals remain in the tree bark (Pb — 1870 mg/g, Zn — 762 mg/g, Cd — 7,00 mg/g) then in the roots (Pb — 660 mg/g, Zn — 2300 mg/g, Cd — 33,25 mg/g), which have protective function for the overground part of the plant by keeping a part of heavy metals. In overground parts of a plant the highest accumulation of heavy metals is in leaves (49, 75 — 283 mg/g Pb), then in the fruits but much more in the fruit at trees (Pb 3,5 — 136 mg/g) than in the products of vegetables (Pb 1,5 — 13 mg/g).

Concentration of heavy metals in plant tissues and organs declines with the distance from the source of emission.

In conditions of experimental intoxication we have studied lead distribution in the seeds of various plants during the germination period, and in the presence of different Pb — acetate concentrations.

Distribution of Pb in the seeds is unequal. Measured Pb concentrations (12,5 — 7250 mg/g) were higher in seed coat than in endosperm of seed (4 — 412 mg/g). Accumulation of Pb in seed coat of various seeds is different. Measured Pb concentrations were higher in the various seeds is different. Measured Pb concentrations were higher in the seed of pea than in the seed of sunflower. They were higher with higher Pb-acetate (7250 mg/g) concentrations than they were with lower (62,5 mg/g).

We think that the level of absorption lead content in seed coat depends on Pb-acetate concentrations, pH solution and genetic characteristics of the seed.

We assume that high cumulative capability of seed coat can be used as one form of protections of

embryo from the higher Pb concentrations in experimental environment.

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REZIME

AKUMULACIJA I DISTRIBUCIJA TEŠKIH METALA U BILJNIM TKIVIMA I ORGANIMA POREKLOM IZ KOSOVSKE MITROVICE

Radmila FILIPOVIĆ i Miodrag JABLANOVIĆ

Teški metali (Pb, Zn, Cd), koji se emituju iz emitera industrijskog regiona Kosovske Mitrovice transportuju se na manja ili veća rastojanja i u neizmenjenom ili izmenjenom obliku padaju na zemljinu površinu, odakle ih biljke apsorbuju i akumuliraju u svoja tkiva i organe. U biljkama teški metali izazivaju razne strukturne, fiziološke i biohemijske promene, a u većim koncentracijama predstavljaju i opasnost za druge organizme, jer preko biljaka izazivaju intoksikaciju drugih živih organizama.

U vezi s tim vršili smo ispitivanje akumulacije i distribucije teških metala u različitim biljnim organima i tkivima. Uzorci biljaka (koren, stablo, list i plodovi) za analize potiču iz zagađenog regiona K. Mitrovice. Za određivanje distribucije Pb u eksperimentalnim uslovima korišćena su semena graška, kukuruza i sunčokreta (*Pisum sativum*, *Zea mays*, *Heliathus annuus*).

Merenje sadržaja teških metala vršeno je pomoću atomskog apsorbera.

Dobijeni rezultati pokazuju da je sadržaj teških metala manji kod otpornih biljaka (*Rumex acetosella* 154 µg/g Pb), u odnosu na osetljive biljne vrste (*Plantago major* 265 µg/g Pb), što je verovatno rezultat sposobnosti (otpornih biljaka) selektivne apsorpcije. Najveće količine teških metala zadržavaju se u korenu (Pb — 660 µ, Zn — 2300 µg/g, Cd — 33,25 µg/g), a u nadzemnim organima u listovima (49,75 — 283 µg/g), u plodovima i to više u plodovima voća (3,5 — 136 µg/g Pb) nego u plodovima povrća (1,5 — 13 µg/g). Izgleda da koren ima zaštitnu funkciju za nadzemne organe biljaka.

U uslovima eksperimentalne intoksikacije distribucije olova u semenu registrovan je veći sadržaj Pb u semenjači (12,5-7250 µg/g) nego u endospermu (4-412 µg/g).

Akumulacija olova u semenjači zavisi od koncentracije razvoja Pb-acetata i vrste semena. Što su koncentracije Pb-acetata veće, veći je i sadržaj olova u semenjači, ali je akumulacija različita u semenima ispitivanih biljnih vrsta, što verovatno zavisi od genetskih svojstava i građe semena. Mišljenja smo da semenjača ima zaštitnu funkciju za embrion i endosperm semena.

Koncentracija teških metala, pre svega Pb, u svim ispitivanim biljnim tkivima i organima je iznad MDK vrednosti, stoga predstavljaju veliku opasnost za konzumente.

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Algae of the Lepenac Springs on the Šar-Planina Mt.

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ABSTRACT

Periphyton algae of 19 springs of the Lepenac river on the Šar-planina were explored for the first time in the year 1996. 215 taxon were representing established structure: *Cyanophyta* — 19, *Pyrrophyta* — 1, *Bacillariophyta* — 138, *Xanthophyta* — 2, *Euglenophyta* — 21 and *Rhodophyta* — 1. Each of this springs was characterized by various composition of algae. Community of *Bacillariophyta*, together with *Cyclotella bodanica* species prevailed in quality

and quantity, and was the only one with the common representative in 18 springs.

68 indicated species were established using the saprobity analysis (xenosaprobic 12, oligosaprobic 23, betamesosaprobic 32, alfamesosaprobic 1). They were, mostly indicators for water purity, wich is confirmed by calculated value of index of saprobity (1.0 — 1.60), and spring's water bonity (I and I-II class).

Key words: Algae, Springs, Šar-planina Mt., Saprobity

INTRODUCTION

Former floristic and fitocenolic exploring of the Šar-planina showed that this massif is the richest in flora and have the most complexed vegetation in our contru, and probably in the whole Balcan Peninsula (Stevanović et al., 1990). Except in the great number of plant species, the Šar-planina is also very rich in various and rare fauna. Such complexity and varabiatiy result, among other things, from the rich hydrographic net which represent its natural potencial. Mountain lakes take special place among natural features of this area. Significant contributions in introduction of this part of Yugoslavia were given bu numerous explorers their geographical (Krivokapić, 1969; Ćukić, 1983), hydrogeographic (Labus, 1972; Ilić, 1989; Dinić, 1990; Ocokoljić et al., 1990) and biological (Janković et al., 1990; Stevanović et al., 1990; Urošević, 1994) aspekts.

There are over 250 hidden treasures — springs (Dinić, 1990). Some of them are marked on the maps (Hidrogeological map, 1981; Topographic map., 1984).

The Lepenac river belong to the typical mountain river which arise on the east hillsides of Kodža Balkan (2.035 a.s.l. heights) from two rivers called Tis and Čerenac, and they meet near the village called Sevice (1.120 a.s.l. heights). As bigger left tributary of the Vardar river it belong to river basins of the Egey sea. Having in mind the importance of the Lepenac river for Sirinička district, we have decided to explore algae flora of its 19 springs during 1996.

MATERIAL AND METHODS

We have explored 19 springs of the Lepenac river: 1. Samovilska česma, 2. Kovnik, 3. Donji žar, 4. Murindo, 5. Ravništa, 6. Gradišta, 7. Tisorman, 8. Gornji Tisorman, 9. Budimirica, 10. Čerenacki springs, 11. Stanak, 12. Lazine, 13. Drakanovac, 14. Berevačka Čuka, 15. Budanac, 16. Bigor, 17. Lipovac, 18. Blizumir and 19. Devet korita (Figure 1, Tab 1). We were completing the specimens durin April and June (Devet Korita) od 1966. We have measured physical charac-

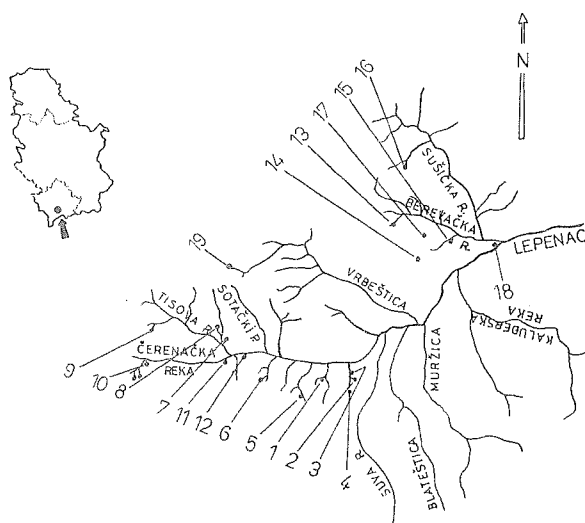


Fig. 1. Numbering of springs on hidrographic map of Lepenac river.

Slika 1. Numeracija izvora na hidrografskoj karti reke Lepenac.

1. Samovilski,
2. Kovnik,
3. Donji žar,
4. Murindo,
5. Ravništa,
6. Gradišta,
7. Tisorman,
8. Gornji Tisorman,
9. Budimirica,
10. Čerenacki,
11. Stanak,
12. Lazine,
13. Drakanovac,
14. Berevački,
15. Budanac,
16. Bigor,
17. Lipovac,
18. Blizumir,
19. Devet korita.

teristics of each spring: water and air temperature (using laab alchochol thermometer) and pH values (using the pH paper). Overgrowing algae were grated from the stone surfaces, from branches in the water and squeezing mosses. Specimens were fixed with 4% phormaldechide on the field. For analyzes of *Bacillariophyta* we have applied a modification method of Hustedt (1930), while the rest of the algae were determined in fixed condition. Microscopic analyzes was carried out using "ERGEVAL" (Zeiss, Jena) mikroskope in the lab of the Department of Biology in Priština. Determination of material is carried out using the following patterns: Dedusenko et al., (1959), Gollerbah et al., (1953), Hustedt (1930, 1961-1965), Hindak et al., (1975), Komarenko et al., (1975), Lazar (1969), Patrick-Reimer (1966), Vodeničarov et al. (1971), Zabelina et al., (1951), Popova (1966), Palmar'— Mondviceva (1982). Indicators for water saprobity were established using Sladeček's method (1973). Index of saprobity is determined according to Pantle and Buck (1955).

Tab. 1. Review of above sea level heights, springs abundance and physical characteristics of 19 springs of Lepenac river.

Tab. 1. Pregled nadmorskih visina, izdašnosti i fizičkih karakteristika 19 izvora Lepenac.

springs izvori	a.s.l. heights nadm. visina	abundance izdašnost l/sec	°C	pH
1. Samovilska česma	1080	0.45	7.0	6.5
2. Kovnik	1182	0.95	7.5	6.0
3. Donji žar	1161	0.81	4.5	5.5
4. Murin do	1280	1.02	5.5	6.0
5. Ravništa	1295	0.36	4.5	6.5
6. Gradišta	1230	0.76	4.5	6.0
7. Tisorman	1150		4.0	6.0
8. Gornji Tisorman	1165		4.0	6.5
9. Budimirica	1660	3.00	6.0	6.5
10. Černački izvor	1610	1.50	5.5	6.0
11. Stanak	1150	8.40	5.5	6.0
12. Lazine	1164	2.35	8.5	6.5
13. Drakanovac	1180	0.22	4.5	5.5
14. Berekvačka čuka	908	4.00	4.5	6.0
15. Budanac	1068	0.36	4.0	6.0
16. Bigor	1300	3.00	4.0	5.5
17. Lipovac	920	0.25	6.0	6.5
18. Blizumir	825	55.4	7.5	6.5
19. Devet korita	1850	4.00	3.9	6.8

RESULTS AND DISCUSSION

During April (and June on the spring called Devet korita) in 1966 we have sampled 19 Lepenac's springs on Šar-planina and established total of 215 taxon of seaweeds from the following groups: *Cyanophyta* (19), *Pyrrophyta* (1), *Bacillariophyta* (1938), *Xantho-*

phyta (2), *Euglenophyta* (21), *Chlorophyta* (33) and *Rhodophyta* (1).

In each (Table 2 and Figure 2) of these explored springs algae group called *Bacillariophyta* are dominated and present in the number of 8 to 36 takson. The same group contained the most represented species *Cyclotella bodanica* whose presence was not recorded only in spring Morindo. This species was in the great quantity in 5 springs, good in 7, while its single presence was recorded in 6 springs.

Although the water temperature Table 1. was very low (3.9 — 8.5°C), green algae were on the second place in the number of taxon (33). Its presence was confirmed in 13 springs. Three of thirteen springs taxons *Microspora tumidula* (Berevačka čuka), *Spirogyra* sp. (Bigor), *Oedogonium* sp. and *Zygnema* sp. (Devet korita) had great frequency. Group *Euglenophyta* is on the third place. In its entire structure it participated with 9.7% or with 21 taxon. Genus *Trachelomonas* with its 20 species was the most numerous. Species of this genus were recorded in 12 springs and its presence goes from only one *Trachelomonas volvocina* species recorded in Tisorman spring to twelve greatly present taxons in Čerenak spring.

Three species of this genus, which we couldn't find in other explored springs, were present in the highest spring (1850 a.s.l. heights) called Devet korita (Table 2). This variety and mass of *Trachelomonas* genus is discussible because there are no other data on this localities (except geographical), so our observation we state that the richest content of species that belong to the *Trachelomonas* genus is established after the burning of specimens (method for determination of *Bacillariophyta*) from the springs which are overgrown with moss. *Trachelomonas* is well developed in the dark brown humiphicirated waters rich in Ferro compounds, which is not characteristic for other algae species (Gollerbah, 1977). The Species of *Trachelomonas* genus are dominated in Čerenak spring, while the presence of *Cyanophyta* is not established. We came up with the similar results in other springs Tisorman, Budimirica, Bigor and Devet korita, which can be brought into the connection with the water in this springs, which probably passes through chromium foundation before it appears on the surface.

Nineteen *Cyanophyta* taxons were changing flora picture of thirteen Lepenac springs. Its numerous presence (6 taxons) was recorded in Gornji Tisorman (1165 a.s.l. heights) while the mass frequency of the three species *Lyngbya kützingerii*, *Phormidium autumnale* and *Phormidium uncinatum* was recorded in Berevačka čuka.

The *Xanthophyta* group is represented only with *Tribonema* genus which performs 1/3 rd in total number of springs with the species *Tribonema viride* and *Tribonema vulgare*. Common numerous presence of mentioned species was established in Budanac and Blizumir springs (55.4 l/s), but in rare single specimens.

species – vrste	locality – lokaliteti																			saprob. indic. saprob. vredn.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Gocconcis placentula EHR.										1	1				1					b
Gocconcis placentula var euglypta (EHR.) CL.				1							1		1		1					–
Gocconcis placentula var. rouxii (BRUN st HERIB) CL.				1																–
Cyclotella bodanica EULENST.	1	1	3		1	3	3	5	3	1	5	5	5	5	3	3	3	1	1	o
Cyclotella sp.								5												–
Cymatopleura solea (BREB) W. SM.			1		1															b-a
Cymbella aequalis W. SM.				1								1			1		1			–
Cymbella affinis KÜTZ.														1		1				o-b
Cymbella aspera (EHR.) CL.			1	1											1	1	1			b
Cymbella austriaca GRUN.				1									1							–
Cymbella hebridica (GREG.) GRUN.							1							1		1				–
Cymbella lanceolata (EHR.) V.H.			1	1																b
Cymbella sinuata GREG.															1					–
Cymbella tartucensis MOEDLER.				1							1		1							–
Cymbella turgidula GRUN.				1																–
Cymbella ventricosa KÜTZ.							1							1				1		b
Diatoma anceps (EHR.) KIRCHIN.				1				1			1		1		1	1	1		1	o-x
Diatoma elongatum (LYNGB.) AG.													1							–
Diatoma hiemale (LYNGB.) HEIB.				1		1					1		1				1	1		x
Diatoma hiemale var. mesodon (EHR.) GRUN.	1			1			1	3			1	1	1		1	1	1	1		–
Diatoma vulgare BORY	1													1	1	1	1	1		b
Diatoma vulgare var. breve GRUN.													1							–
Diatoma vulgare var. euhrenbergii (KÜTZ.) GRUN.													1							x-o
Diatoma vulgare var. productum GRUN.									1											–
Diploneis elliptical (KÜTZ.) CL.				1																–
Diploneis ovalis (HILSE.) CL.																	1			b
Diploneis sp.		1																		–
Diploneis sp.					1															–
Epithemia argus KÜTZ.				1																–
Epithemia argus var. angustata FRICKE													1				1			–
Epithemia argus var. capitata FRICKE			1	1	1												1			–
Epithemia turgida (EHR.) KÜTZ.								1									1			b
Epithemia turgida var. granulata (EHR.) GRUN.																	1			–
Epithemia zebra var saxonica (KÜTZ.) GRUN.																	3			o-b
Eunotia parallela EHR.							1													–
Eunotia pectinalis var. minor (KÜTZ.) RABENH.							1													o-x
Eunotia valida hust.							1											1		–
Fragilaria crotonensis KITT.								1		1										o-b
Frustulia rhomboides (EHR.) D.T.							1													o-x
Frustulia rhomboides var. saxonica f. undulata (RABENH.) D. T.						1	1	1							1					–
Frustulia vulgaris THIV.		1	1			1	3	1	1								1			o
Gomphonema angustatum (KÜTZ.) RABENH.		1					1			1					1	1				o
Gomphonema angustatum var productum GRUN.														1	1					b-a

species – vrste	locality – lokaliteti																			saprob. indic. saprob. vredn.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Gomphonema constrictum EHR.														1						b
Gomphonema gracile EHR.								1					1			1	1			–
Gomphonema gracile var. auritum (A. BR.) CL.						1														–
Gomphonema intricatum KÜTZ.				1			1							1	1		1			o
Gomphonema intricatum var. pumilum GRUN.		1					1	1					1				1			o
Gomphonema intricatum var. subclavatum f. gracile HUST.							1													–
Gomphonema longiceps var. subclavatum GRUN.			1				1					1			1		1			–
Gomphonema olivaceum (LYNGB.) KÜTZ.			1																	b
Gomphonema olivaceum var. calcareum CL.			1																	b
Gomphonema parvulum (KÜTZ.) GRUN.										1			1		1			1	1	b
Gyrosigma acuminatum (KÜTZ.) RABENH.							1													b
Gyrosigma acuminatum var. gallicum GRUN.								1			1			1	1					–
Gyrosigma acuminatum var. lacustre MEIST.				1																–
Gyrosigma kuetzingii (GRUN.) CL.							1													–
Gyrosigma scalproides (RABENH.) CL.	1													1						–
Hantzschia amphioxys var. amphioxys f. capitata O. MÜLL.	1	1	1			1														–
Hantzschia amphioxys var. compacta HUST.											1									–
Hantzschia amphioxys var. major GRUN.				1	1			1	1				1							–
Hantzschia elongata (HANTZSCH.) HUST.													1			1				–
Hantzschia sp.											1									–
Melosira italica var. valida (GRUN.) HUST.				1																–
Melosira rooseana RABENH.				1				1												x
Melosira scabrosa ØSTR.				5			1					1			1	1		1		–
Melosira varians AG.																		3		b
Meridion circulare AG.			1			3	1		1	1	1			5	3			3		x-o
Meridion circulare var. constrictum (RALFS.) V.H.							1							1	1			1		–
Navicula bacillum EHR.					1															–
Navicula contenta GRUN.						1														–
Navicula contenta f. biceps ARN.		1				1		1			1									–
Navicula menisculus SCHUM.					1															b-a
Navicula pseudogracilis SKV.							1								1		1			–
Navicula pupula KÜTZ.																		1		b
Navicula radiosa KÜTZ.													1				1			o-b
Navicula sp.			1																	–
Navicula sp.																1				–
Neidium affine var. amphirhynchus (EHR.) CL.																1				–
Neidium affine var. affine f. medium CL.						1														–
Neidium affine var. longiceps (GREG.) CL.				1																–
Neidium bisulcatum f. undulata O. MÜLL.									1	1										–
Nitzschia amphibia GRUN.		1																		–
Nitzschia linearis W. SM.	1	1	1	1	1	1							1	1			1			o-b
Nitzschia sinuata (W. SM.) GRUN.				1									1							–
Nitzschia thermanalis var. minor HILSE							1						1		1					–
Nitzschia vermicularis (KÜTZ.) GRUN.							1				1			1	1					b

[illegible]

species – vrste	locality – lokaliteti																			saprob. indic. saprob. vredn.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
RHODOPHYTA																				
Andouinella chalybea (LYNGB.) KYLIN		~												3						o
XANTHOPHYTA																				
Tribonema viride PASCHER													1		5			1	1	o-a
Tribonema vulgare PASCHER							1								3		1	1		x-o
EUGLENOPHYTA																				
Euglena sp.																1				-
Trachelomonas acanthostoma STOKER																1		1		-
Trachelomonas bacillifera PLAYF								5		3			1			1				-
Trachelomonas curta DE CINTIA f. crassatiifera SAFON																1		1		-
Trachelomonas granulosa PLAYF										3						1		1		-
Trachelomonas hispida (PERTY) STEIN																1		1		b
Trachelomonas hispida var. australica LEMM.																			1	-
Trachelomonas hispida var. coronata LEMM.																			1	-
Trachelomonas hispida var. spinulosa SKV.											1									-
Trachelomonas intermedia DONG.								1		3										-
Trachelomonas lucastris DREZ																			1	-
Trachelomonas oblonga LEMM.										3										b
Trachelomonas ornata (SWIR.) SKV.										3										-
Trachelomonas planctonica SWIR.								3		3			1		1	1				b-o
Trachelomonas planctonica var. oblonga DREZ		1						1		3				1						-
Trachelomonas superba SWIR.										3										-
Trachelomonas volvocina EHR.		1					1	5		5			1	1	1	1	1	1		b
Trachelomonas volvocina var. papilo-punctata SKV.																1				-
Trachelomonas woyceickii KOCZWI.								3		3			1		1	1				-
Trachelomonas volvocina var. punctata PLAUF.										3						1				-
Trachelomonas sp.									1											-
CHLOROPHYTA																				
Cladophora glomerata (L.) KTZ.												1								b
Closterium leibleinii KTZ.																		1		-
Closterium parvulum NÄG.																			1	b
Cosmarium anceps LYND.								1												-
Cosmarium blattii WILLE													1							-
Cosmarium boixii var. graminiferum (BREB.) NORDST.												1								-
Cosmarium biretum BREB.																			1	-
Cosmarium homovense GUTW.														1						-
Cosmarium quadratum RALES.								1												-
Cosmarium subcrenatum HANTZSCH.			1																	-
Cosmarium sp.																			1	-
Crucigenia tetrapedia (KIRCHN) W et G. S. WEST								1												o-b
Microspora floccosa (VAUCH.) THUR.														3						-
Microspora timudula HAZEN.														5						-

species – vrste	locality – lokaliteti																			saprob. indic. saprob. vredn.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Oedogonium sp.					1															–
Oedogonium sp.						1														
Oedogonium sp.												1								–
Oedogonium sp.													1							–
Oedogonium sp.															1					–
Oedogonium sp.																	1			–
Oedogonium sp.																		5		–
Oocytis sp.								1												–
Oocytis sp.									1											–
Oocytis sp.												1								–
Staurastrum sp.														1						–
Staurastrum sp.																		1		–
Spirogyra sp.																5				–
Spirogyra sp.																		1		–
Tetradrom minimum (AL.) BR.															1		1			b
Ulothrix tenuissima KTZ.														3						o
Zygnema sp.																	1			o
Zygnema sp.																		5		o

Locality: 1. Samovilski, 2. Kovnik, 3. Donji žar, 4. Murin do, 5. Ravništa, 6. Gradišta, 7. Tisorman
8. Gornji Tisorman, 9. Budimirica, 10. Črnački, 11. Stanak, 12. Lazine, 13. Drakanovac
14. Berevački, 15. Budanac, 16. Bigor, 17. Lipovac, 18. Blizumir, 19. Devet korita

1. Individual sample, 3. well represented, 5. very abundant.

Tab. 3. The index of saprobity and water quality of 19 springs of Lepenac river in the Šar-planina Mt.

Tab. 3. Indeks saprobitnosti i kvalitet voda u 19 izvora Lepenca na Šar-planini

springs – izvori	index of saprobity saprobitni indeks	stage of saprobity saprobitni stupanj	class of bonity klasa boniteta
1. Samovilska česma	1.60	oligo–beta	I – II
2. Kovnik	1.12	oligo	I
3. Donji žar	1.41	oligo–beta	I – II
4. Murin do	1.12	oligo	I
5. Ravništa	1.33	oligo–beta	I – II
6. Gradišta	1.10	oligo	I
7. Tisorman	1.24	oligo	I
8. Gornji Tisorman	1.45	oligo–beta	I – II
9. Budimirica	1.00	oligo	I
10. Črnački izvor	1.60	oligo–beta	I – II

springs – izvori	index of saprobity saprobitni indeks	stage of saprobity saprobitni stupanj	class of bonity klasa boniteta
11. Stanak	1.09	oligo	I
12. Lazine	1.38	oligo–beta	I – II
13. Drakanovac	1.14	oligo	I
14. Berevačka čuka	1.48	oligo–beta	I – II
15. Budanac	1.40	oligo–beta	I – II
16. Bigor	1.50	oligo–beta	I – II
17. Lipovac	1.33	oligo–beta	I – II
18. Blizumir	1.55	oligo–beta	I – II
19. Devet Korita	1.28	oligo	I

The presence of *Peridinium willei* (Pyrrophyta), actually *Audouinella chalybea* (Rhodophyta) species makes Kovnik and Berevačka čuka springs very specific because their presence was not established in other explored springs.

Hidden in beautiful region of the Šar-planina the Lepenac springs are placed on the various height

above sea level from the lowest Blizumir (825 m) up to the highest Devet korita (1850 m) with the difference of 1025 m in height. For this reason water temperature were different from 3.9 to 8.5°C, but mostly the temperature value was 4.5°C (Table 1).

In accordance with the result of Krivokapić (1969) we have also established that the highest

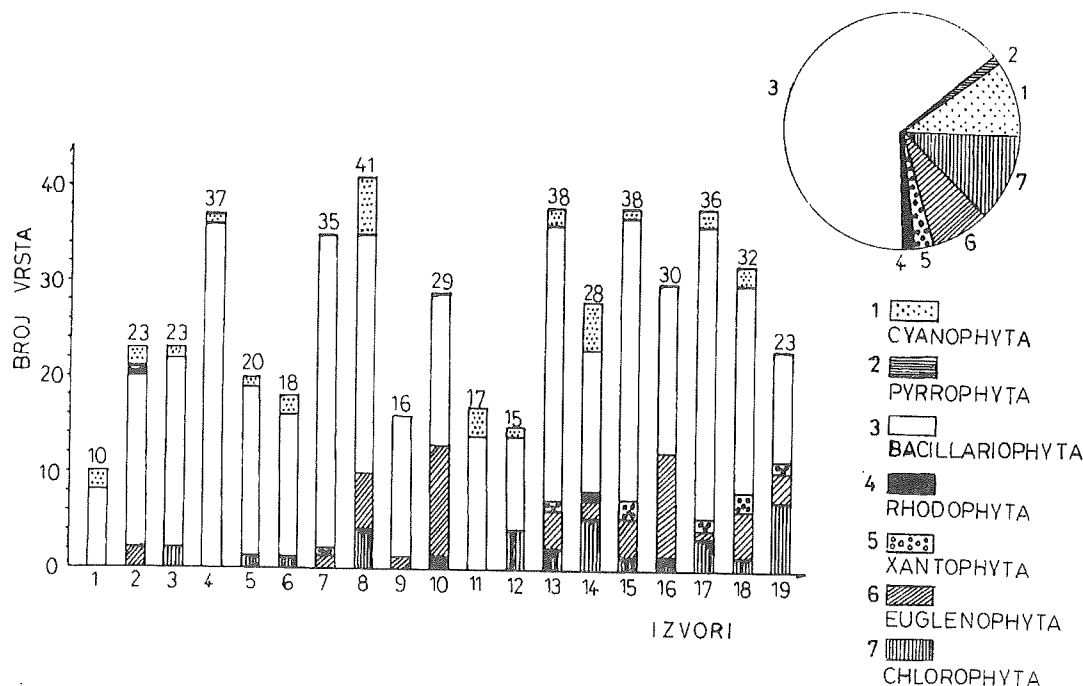


Fig. 2: Number and percent of periphyton taxa in 19 springs of Lepenac river in the Šar-planina Mt. Grafikon 2: Broj i procentualno učešće obraštajnih algi u 19 izvora Lepenca na Šar-planini.

springs were not necessary the coldest and the lowest springs were not necessary the warmest.

From the total number of established taxon (215), 31.6% or 68 species belong to the indicators of water saprobity: 32-betamesosaprobic, 23-oligosaprobic, 12-xenosaprobic and 1-alfamesosaprobic. Only *Phormidium uncinatum* species was established in two springs: Berevačka čuka and Donji žar, and it was well represented.

Index of saprobity was calculated according to indicated value of algae species and their abundance in periphyton community of 19 Lepenac springs on the Šar-planina, and it moved from 1.0 — 1.60 and belonged I and I-II class of water bonity (Table 3). The lowest index of water saprobity was established in Budimirica springs, while the highest index was recorded in Samovil spring, placed near the Sevice village, so its insignificant worse quality, in comparison with others, can be regarded as the influence of anthropogenic factor.

Translated by
Nikoleta Bašić

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REZIME

ALGE IZVORA LEPENCA NA ŠAR-PLANINI

Violeta UROŠEVIĆ i Ana SAVIĆ

U prolećnom periodu 1996. godine prvi put su uzorkovane alge u 19 izvora Lepenca na Šar-planini.

Obraštajna zajednica je zastupljena sa 215 taksona: *Cyanophyta* 19 (8,8%), *Pyrrophyta* 1 (0,4%), *Bacillariophyta* 138 (64,3%), *Xanthophyta* 2 (0,8%), *Euglenophyta* 21 (9,7%), *Chlorophyta* 33 (15,6%) i *Rhodophyta* 1 (0,4%).

Bacillariophyta su dominirale u svakom pojedinačnom uzorku (8 — 36 taksona) i jedine imale zajednički takson (*Cyclotella bodanica*) u 18 izvora.

Niske temperature vode (3,9 — 8,5°C) nisu bile ograničavajući faktor na razvoj pojedinih predstavnika zelenih algi, budući da je njihova prisutnost konstatovana u 13 izvora od kojih su u tri izvora (Berevački, Bigor i Devet korita) imale i masovno zastupljene predstavnike (*Microspora tumidula*, *Spirogyra* sp., *Oedogonium* sp. i *Zygnema* sp.).

U odnosu na ostale rodove, rod *Trachelomonas* je brojem taksona prevazišao sve identifikovane i u smislu raznovrsnog sastava u izvoru Bigor dostigao maksimum brojnosti (12 taksona). Navedeni rod je u izolovanom materijalu bio zastupljen u 11 izvora, dok je njegova prisutnost u ovim vodama najverovatnije u vezi s hromnom podlogom.

Specifičnost ovih izvora ogleda se i u raznovrsnoj vegetaciji, koju pored napred navedenih predstavljaju još i *Cyanophyta*, *Pyrrophyta*, *Xanthophyta* i *Rhodophyta*, dajući pojedinačno najraznovrsniju sliku svakom izvoru: Drakanovcu, Berevačkom, Budancu, Bigoru, Lipovcu i florno bogatstvo izvoru Gornji Tisorman (41 takson) te florno siromaštvo Samovilskom izvoru (10 taksona).

O čistoći vode izvora Lepenca svedoči prisutnost samo jedne alfamezosaprobne indikatorske vrste (*Phormidium uncinatum*) i brojnija prisutnost ksenosaprobnih (12 vrsta ili 17,6%) i oligosaprobnih (23 vrste ili 33,8%) u odnosu na betamezosaprobne indikatorske vrste (32 vrste ili 47,2%). To potvrđuju i dobijeni rezultati niskih vrednosti indeksa saprobnosti (1,0 — 1,60) i obrnuto visok bonitet izvorskih voda (I i II klase).

Izvori su za predele u kojima se nalaze neprocenjena prirodna blaga, u našoj zemlji slabo ili potpuno neistraženi sa biološkog i hemijskog aspekta, te im u smislu detaljne obrade treba posvetiti posebnu pažnju.

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New Residences of Real Floral Species in Šar-Planina and its Metohian Borders

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ABSTRACT

The paper indicates six floral species from the family of *Polygonaceae*, *Asclepiadaceae*, *Orchidaceae*, *Asteraceae* and *Saxifragaceae* that

have not been so far described regarding The Šar-Planina region, and one of these nor regarding The Yugoslavia region too.

Key words: Šar Planina, floral species, new localities

INTRODUCTION

The Šar-Planina massif, due to its turbulent geologic past, refugium character during the last glaciation, specific geographic position, exceptional geologic, geomorphologic, climatic and hydrologic diversity, as well as, the collision of numerous biogeographic provinces, represents the treasure of unique florist resource. Besides detailed florist research during the last, and especially this century, complete registration of its flora has not been finished yet. Continuous recording of the floral species, that have not been evidenced in this area, just indicates in inexhaustible florist diversity.

MATERIAL AND METHODS

Floral material from Šar-Planina was collected and herbariumed in the field, in second half of July 1996. The determination of the material and data on the species dispersion within the compact area had been done by large number of Serbian, Yugoslav and European Flora, as well as, by significant scientific publications.

RESULTS

Rumex scutatus L. (Family *Polygonaceae*) is a hemicryptophyte that belongs to Mideuropean floral element mainly inhabiting carbonate highmountain regions of the Europe, Caucas and Asia Minor. In Serbia, it has been registered so far on the meadows and rocky grounds of Kopaonik (Oštro Polje), Prokletije (Koprivnik, Deravica), Koritnik and Ljuboten, and The Šar-Planina limestone massif. Its new residence was discovered on the rocks of The Šar-Planina border zone of Ostrovica, just under the peak, with an area not larger than 1 square meter.

Cynanchum buteri (Vis. et Aschers.) Pitt. Ex Schum. (Fam. *Asclepiadaceae*) represents a hemicryp-

tophyte belonging to the group of north-western Balkan endemic appearing sporadically in Yugoslavia and Albania. At present, its, the only registered residence in Serbia has been completed in The Ločanska valley at Prokletije. However, during recent field research, we have found it on the southern slopes of Ošljak in the thermophile underbrush above Sredska village and in the bushes of Gabar hill above Prizren.

Euphorbia montenegrina (Bald.) K. Maly. Var. *bertiscea* Rech. (Fam. *Euphobiaceae*) is a hemicryptophyte, Yugoslav endemic related to Herzegovina, Monte Negro and Serbia. The only, at present, described residence of this species in Serbia is located on The Prokletije massif of Kurvala. A new locality has been confirmed in the river basin of Durlev Potok, on Paštrik (Z. Krivošej et al., 1996), in Golemi Bor, the bordering zone of The Šar-Planina massif Kodža Balkan, where, in a thinned out forest of Munika, creates vital population.

Corallorhiza trifida Chatel. (Fam. *Orchidaceae*) belongs to the living form of hemicryptophytes of the boreal-circumpolar dispersion. Its, at present, described localities in Serbia are at Vlasina and Oštrozub. However, it turned out that it is also abundantly present at Šar-Planina. We have registered it in beech woods at the localities of Kopana Voda above Prizren, on the way up between. The Prevalac pass and Sevice village, as well as, on the locality of Kokošinje in the river basin of Klisura river, below the major Šar-Planina range.

Senecio glaberimus (Roch.) Simk. (Syn. *S. transsilvanicus* Boiss.), (Fam. *Asteraceae*) is hemicryptophyte, the Balkan endemic described for Macedonia (Hayek, 1993) and highmountain region of Rila and Pirin in Bulgaria (Stojanov et Stefanov, 1948). The only residence of this species, not only in Serbia, but Yugoslavia too, we have registered on the silicate rocks of Rudoka, where, at an attitude of 2,300 meters occupies an area of less than 1 square meter.

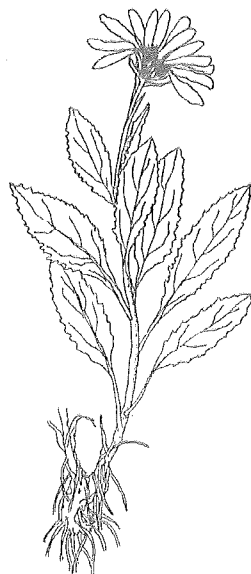


Fig. 1. *Senecio glaberimus*, new species for flora Yugoslavia
Sl. 1. *Senecio glaberimus*, nova vrsta za floru Jugoslavije

Saxifraga oppositifolia L. (Fam. *Saxifragaceae*) is also hemicryptophyte, but of Arctic-alpine and circumpolar dispersion. According to present experience, in The Flora of Serbia, Var. *meridionales* Terr. has been described as the one existing in Deravica at Prokletije only. However, we have discovered another residence of this species in Serbia. The residence is located below The Gornjeselsko Lake in the springs area of Prizrenska Bistrica river, where the species makes loose clods in the fissures of silicate rocks at some 2,350 meters.

DISKUSION AND CONCLUSION

During regular field research, at the area of Šar-Planina, in second half of July 1996., the species were registered for the first time regarding this massif and its bordering zones, as follows: *Rumex scutatus*, *Cynanchum buteri*, *Euphorbia montenegrina*, *Corallorhiza trifida*, *Senecio glaberimus* and *Saxifraga oppositifolia*.

In addition to the three species of the endemic character (*Cynanchum buteri*, *Senecio glaberimus* and *Euphorbia montenegrina*), the others are of Mideuropan (*Rumex scutatus*), Boreal-circumpolar (*Corallorhiza trifida*) and Arctic-alpine and circumpolar (*Saxifraga oppositifolia*) dispersion.

Of the species mentioned, *Senecio glaberimus* is especially important as the new species described in The Flora of Yugoslavia, but also *Corallorhiza trifida* and *Euphorbia montenegrina*, as these are already included in The Flora of Serbia red Book.

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REZIME

NOVA NALAZIŠTA RETKIH BILJNIH VRSTA NA ŠAR-PLANINI I NJENIM METOHIJSKIM OGRANCIMA

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Tokom redovnih terenskih istraživanja krajem jula 1996. godine na Šar-planini i njenim metohijskim ograncima je registrovano šest biljnih vrsta koje do sada nisu opisane za ovaj centralnobalkanski masiv.

Rumex scutatus L. (Fam. *Polygonaceae*) je pronađen na kamenjarima vrha serpentinskog šarskog ogranka Ostrovice, *Cynanchum buteri* (Vis. et Aschers.) Pitt. ex Schm. (Fam. *Asclepiadaceae*) u šikarama južnih padina Ošljaka i žbunjacima uzvišenja Gabar iznad Prizrena, *Euphorbia montenegrina* (Bald) K. Maly var. *bertiscea* Rech. (Fam. *Euphorbiaceae*) u slivu Durlvogog potoka, na Paštriku i Golom boru, obronku šarskog ogranka Kodža Balkana, *Corallorhiza trifida* Chatel. (fam. *Orchidaceae*) u bukovim šumama na lokalitetima Kopane vode, na putu između prevoja Prevalac i sela Sevce i u slivu potoka Klisura, *Senecio glaberimus* (Roch.) Simk. (Fam. *Asteraceae*) na silikatnim kamenjarima Rudoke i *Saxifraga oppositifolia* L. (Fam. *Saxifragaceae*) u pukotinama silikatnih stena ispod Gornjeselskog jezera u izvorištu Prizrenske Bistrice.

Pored tri vrste endemičnog florogenetskog obeležja (*Cynanchum buteri*, *Senecio glaberimus* i *Euphorbia montenegrina*), ostale imaju srednjeevropsko (*Rumex scutatus*), borealno-cirkumpolarno (*Corallorhiza trifida*) i arktičko-alpsko i cirkumpolarno (*Saxifraga oppositifolia*) rasprostranjenje.

Od navedenih vrsta, posebno je značajna *Senecio glaberimus* (sl. 1) kao nova vrsta opisana za floru Jugoslavije, ali i *Corallorhiza trifida* i *Euphorbia montenegrina* koje se nalaze na spisku Crvene knjige flore Srbije.

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Diversity of Hoverflies (Diptera: Syrphidae) in The National Park "Biogradska Gora" (Montenegro, Yugoslavia)

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ABSTRACT

The preliminary investigations in the National Park "Biogradska Gora" have shown the presence of hoverflies species with great faunistic importance: *Hammerschmidtia ferruginea* and *Brachyopa vittata*, are the representatives of the genera which never before have been recorded in Montenegro; *Brachyopa vittata* in for the first time recorded in the F.R. of Yugoslavia; The forest area around the Biogradsko jezero lake is the only known habitat of *Cheilosia melanura rubra*, *C. orthotricha*, *Eristalis rupium*, *Neoascia*

obliqua, *Sphegina clavata*, *S. elegans*, *S. latifrons*, *S. verecunda*, *Xylota coeruliventris* and *X. florum* in Montenegro. The investigated region is rich in species of diversified zoogeographic elements: from endemic species and oromediterranean relicts to Alpine and Central European as well as Mediterranean species. The findings reported here make the National Park "Biogradska gora" the region of exceptional importance for the preservation of biodiversity of Montenegro and Yugoslavia.

Key words: Diptera, Syrphidae, diversity, fauna, Montenegro, "Biogradska Gora"

INTRODUCTION

The hoverflies are one of the best known group of two-winged flies, with around 5000 species known to date, 1600 of which are registered in the Palearctic region. The Balkan Peninsula is a natural habitat for more than 420 hoverfly species with most of them in National Parks which act as centers of hoverfly diversity with well preserved authentic communities. Syrphid species prefer forest ecosystems, largely devastated by the anthropogenic influences. National Parks, as protected regions, are therefore often the only regions providing natural habitats and existence for large number of species, as it has been shown for the National Parks "Durmitor" (Šimić, 1987) and "Fruška Gora" (Vujić and Glumac, 1994), which serve as natural retreats for a number of zoogeographically important species. The fauna of the National Park "Biogradska Gora" has been almost completely unknown so far. Preliminary investigations, reported here, point out to the fauna rich in species unregistered in the region of Montenegro and surrounding regions.

INVESTIGATED AREA

National park "Biogradska Gora" spans through the central parts of the mountain Bjelasica in the north eastern part of Montenegro. Geomorphologically, the mountain is shaped by fluvial, karst and glacial erosions (Mihailović & Radulović, 1991). The rivers Tara and Lim, together with their tributaries, run along the borders of the mountain Bjelasica, while the points of higher altitudes contain marks of glacial erosion such as moraines and glacial lakes ("Biogradsko", "Pešića",

"Veliko i Malo Ursulovačko" and "Veliko i Malo Šiško" lakes) (Stanković, 1975). The "Biogradski lednik" glacier had stopped at the altitude of 1000 m above the sea level making a moraine and forming the "Biogradsko jezero" lake, which has stretched into two main parts: the northwestern and the southeastern (Vlahović, 1991).

According to Fušić (1991) the climate of the National Park "Biogradska Gora" is characterized by the moderately cold and cold continental-mountain climate. Ecologically, the mountain "Bjelasica", due to its geography, geology and climate, is rich in diversified ecosystems. The main part of the National Park is actually an old forest, with, in contrast to the other forests of the same type in the region, numerous tree species (Vizi, 1991). Coniferous woods are especially characteristic for the northern parts of the mountain. This fact has been contributed to the influences of the mediterranean climate, coming to the region from the south, as well as to the specific geographic position of this mountain and related areas, making the region of mountain Bjelasica and exceptional example of well preserved ancient oromediterranean flora (Lakušić et al., 1991).

MATERIAL AND METHOD

The investigations reported here have been conducted during 1990. and 1995. at two localities: "Biogradsko jezero" and "Razvršje". The total number of collected specimens used for the determination was 322, which have been deposited at the collection of the

Institute of Biology in Novi Sad. The standard procedures for determination and preparation of male genitalia were employed. Distribution data were reported according to catalogue (Peck, 1988) and other recently published papers (Speight & Lucas, 1992; Dirickx, 1994; Vujić, 1996).

RESULTS AND DISCUSSION

The analysis of the investigated area has shown the presence of 94 syrphid species, 29 of which have been further analyzed due to their zoogeographical importance. This data make the National Park "Biogradska Gora" an exceptionally important region for preserving biodiversity of Montenegro and Yugoslavia.

1. *Brachyopa vittata* Zetterstedt, 1843.

Range: Europe, West Siberia, Far East; **Europe:** Scandinavia to Pyrenees; Belgium through Central Europe to European Russia; **Balkan Peninsula:** Slovenia, Bosnia and Herzegovina, Montenegro.

Records: Razvršje 17. VII 1995. 1f

Remarks: This is the first record of *Brachyopa* species in Montenegro and the most southern detected population within the range of *B. vittata*. The species is rarely seen and very narrowly localized all over Europe. On the Balkan Peninsula *B. vittata* was collected on Slovenian Alps, the mountains Menina and Jahorina (Vujić, 1991). Speight & Lucas (1992) suggest that this species in European forests indicates an old-forest fauna of world-wide significance. It prefers the *Picea* and *Fagus* forests at higher altitudes.

2. *Brachypalpus lentus* (Meigen, 1822)

Range: Europe, West Siberia; **Europe:** all regions, except Portugal and Bulgaria; **Balkan Peninsula:** Croatia, Bosnia and Herzegovina, Montenegro, Serbia, Macedonia

Records: Razvršje 17. VII 1995, 2m

Remarks: This is the only species of genus *Brachypalpus* in Europe. *B. lentus* occurs in a wide range of forest types, usually at the higher altitudes of the Balkan Peninsula.

3. *Brachypalpus chrysites* Egger, 1859.

Range: Europe; **Europe:** Scandinavia and mountainous part of Europe south to Pyrenees; central Europe to European part of Russia; **Balkan Peninsula:** Slovenia, Croatia, Bosnia and Herzegovina, Montenegro, Serbia.

Records: Biogradsko jezero, 28. IV 1990, 1f.

Remarks: *B. chrysites* is known from only widely scattered localities in North and Central Europe. Any European forest from which the species is recorded deserves particular attention in conservation efforts (Speight & Lucas, 1992). On the Balkan Peninsula, the species occurs on few mountains at high altitudes, preferring the *Fagus* and *Picea* forests.

4. *Cheilosia canicularis* (Panzer, 1801)

Range: palaearctic; **Europe:** Denmark south to the Pyrenees; Belgium and the Ardennes through mountainous part of Central and South Europe to the European part of Russia and Caucasus; **Balkan Peninsula:** all parts except Greece.

Records: Biogradsko jezero, 15-17. VII 1995. 2m 3f.

Remarks: This is one of the largest species of *Cheilosia* occurring in Europe. Adults prefer the clearings along streams and rivers, settle on leaves of *Petasites*, males hover at 1-2 meters. Larva is described by Dušek & Laska (1962); it is internal feeder in the rhizomes of *Petasites* spp. The range of *C. canicularis* covers major part of the Balkan Peninsula. It appears on Pannonic hills as well as up to high Alpine and Dinaric mountains.

5. *Cheilosia carbonaria* Egger, 1860.

Range: Europe, Siberia; **Europe:** Scandinavia to Pyrenees; South England through Central Europe to the European part of Russia; **Balkan Peninsula:** all parts except Macedonia and Greece.

Records: Biogradsko jezero, 15-17. VII 1995. 1f.

Remarks: The species has a wide range, but it is not particularly frequent. On the Balkan Peninsula *C. carbonaria* appears at higher altitudes on Slovenian Alps and few Dinaric mountains.

6. *Cheilosia illustrata* (Harris, 1780)

Range: Europe, West Siberia; **Europe:** all regions, except Portugal and Greece; **Balkan Peninsula:** all parts except Greece.

Records: Biogradsko jezero, 15. VII 1995. 1m.

Remarks: *C. illustrata* is a very distinct *Cheilosia* species with mimic coloring of body hairs, unusual within the genus. The species is found on many Balkan mountains, in forest clearings, visits the flowers of Apiaceae, especially *Heracleum spondylium*.

7. *Cheilosia melanura rubra* Vujić, 1996.

Range: Balkan Peninsula: South Dinaric mountains; **Balkan Peninsula:** Montenegro, Serbia, Macedonia, Greece.

Records: Biogradsko jezero, 15-17. VII 1995, 2f (paratypes).

Remarks: *C. melanura rubra* is an endemic subspecies of the South Dinaric mountains with the habitats at high altitudes of Šar-planina and Verno mountains (Greece). It appears at the same altitudes and similar habitat types as subspecies *C. melanura melanura* in other parts of the Balkan Peninsula and Central European mountains. Biogradsko jezero lake is the only known locality of *C. melanura rubra* to date, besides the South Dinaric mountains. The findings asserts the idea of "Biogradska Gora" as a refugial area for oromediterranean species.

8. *Cheilosia orthotricha* Vujić et Claussen, 1994.

Range: Europe; **Europe:** Central Europe, from Belgium through Germany, Switzerland, Czech Republic, Slovakia and Hungary to Balkan Peninsula;

Balkan Peninsula: Croatia; Bosnia and Herzegovina, Montenegro, Serbia.

Records: Biogradsko jezero, 28. IV 1990, 3m 1f (paratypes)

Remarks: *C. orthotricha* is closely related to *C. canicularis*, differing in early spring appearance of adults always before *C. canicularis*. *C. orthotricha* is recently separated from its "sibling species" *C. canicularis*. It is found on Central European mountains at lower altitudes.

9. *Chrysogaster solstitialis* (Fallen, 1817)

Range: West Palearctic; **Europe:** all regions, except Portugal and Greece; **Balkan Peninsula:** all parts except Greece.

Records: Biogradsko jezero, 15. VII 1995. 1f.

Remarks: This is the second record of *C. solstitialis* in Montenegro, after the mountain Durmitor (Šimić 1987). The species is distributed in the forest communities on many Balkan mountains, but is highly localised in southern areas.

10. *Chrysotoxum fasciatum* (Müller, 1764)

Chrysotoxum arcuatum auct., nec Linnaeus, 1758

Range: Europe, Siberia, Far East; **Europe:** Finland and Scandinavia to Pyrenees and North Spain; Ireland through North and mountainous parts of Central and South Europe to the European part of Russia; **Balkan Peninsula:** Slovenia, Croatia, Montenegro, Serbia, Macedonia, Bulgaria.

Records: Biogradsko jezero, 15. VII 1995, 1m.

Remarks: *C. fasciatum* resembles the wasp *Vespa rufa* with mimic characters and flight. The species occurs at high altitudes of Central European mountains. It is very rare on the Balkan Peninsula, recorded in Montenegro only on the mountain Durmitor (Šimić, 1987).

11. *Dasysyrphus pynastri* (De Geer, 1776)

Dasysyrphus lunulatus auct., nec Meigen, 1822.

Range: Holarctic; **Europe:** all regions, except Portugal and Greece; **Balkan Peninsula:** Croatia, Montenegro, Bulgaria.

Records: Razvršje, 17. VII 1995. 1m.

Remarks: This is the *D. lunulatus* of Šimić (1987) from Durmitor. This species is very frequent on Alpine conifer forests, but on the Balkan Peninsula the species is collected only on few mountains.

12. *Eristalis jugorum* Egger, 1858.

Range: Europe, Caucasus, Turkey and Iran; **Europe:** Poland south to the Pyrenees; Belgium through Central and South Europe to the European part of Russia; **Balkan Peninsula:** Croatia, Bosnia and Herzegovina, Montenegro, Serbia.

Records: Razvršje, 17. VII 1995. 1 m.

Remarks: *E. jugorum* is a species of mountain forests, with its centre of distribution in the Alps. It is recorded on few high Balkan mountains (Šimić & Vujić, 1990).

13. *Eristalis rufum* Fabricius, 1805.

Range: Holarctic; **Europe:** all regions, except Ireland, Hungary and Portugal; **Balkan Peninsula:** Montenegro and Serbia.

Records: Biogradsko jezero, 15. VII 1995. 1 f.

Remarks: This is the first record of *E. rufum* in Montenegro. It is a species of the northern and mountainous parts of Europe, rarely occurring at altitudes lower than 1000 m above the sea level on the Balkan Peninsula (Šimić & Vujić, 1990). *E. rufum* is found only on two Balkan mountains (Kopaonik and Stara Planina) besides the record from Biogradsko jezero.

14. *Eumerus olivaceus* Loew, 1848.

Range: Europe; **Europe:** South Europe; **Balkan Peninsula:** Montenegro, Serbia, Macedonia.

Records: Razvršje, 17. VII 1995. 4 m.

Remarks: This is the largest species of genus *Eumerus* in Europe, recorded on high mountains in South Europe. *E. olivaceus* is probably an oromediterranean species. As far as the Balkan Peninsula is concerned this species occurs on South Dinaric mountains and the mountain Durmitor (Šimić, 1987).

15. *Hammerschmidtia ferruginea* (Fallen, 1817)

Range: Europe, Siberia, Far East; **Europe:** all regions, except south; **Balkan Peninsula:** Montenegro, Serbia, Macedonia.

Records: Biogradsko jezero: Razvršje, 17. VII 1995. 1 m.

Remarks: This is the first record of the only European species of genus *Hammerschmidtia* in Montenegro. *H. ferruginea* is a rarely found on the Balkan Peninsula, with only few records from the mountains Tara and Stara Planina (Vujić, 1991).

16. *Neoscia annexa* (Müller, 1776)

Range: Europe, Caucasus; **Europe:** Poland to Pyrenees; Denmark through Central and South Europe to Russia and Caucasus; **Balkan Peninsula:** all parts except Greece.

Records: Biogradsko jezero, 15. VII 1995. 2m.

Remarks: This species is largely confined to the mountainous parts of Europe, though it occurs at lower altitudes (for instance Kučaj mountains and the mountain Fruška Gora in Serbia). In Montenegro, *N. annexa* is found on the mountain Durmitor (Vujić, 1990).

17. *Neoscia obliqua* Coe, 1940.

Range: Europe, Caucasus; **Europe:** Poland to Spain; England through Central Europe to Armenia; **Balkan Peninsula:** Slovenia, Montenegro, Serbia.

Records: Biogradsko jezero, 15. VII 1995. 2m.

Remarks: This is the first record of *N. obliqua* in Montenegro. On the Balkan mountains this species is often accompanied by *N. annexa*, occurring along forest streams. It is frequent on many mountains in Serbia, but is still not registered in the other areas of the Balkan Peninsula (Vujić, 1990).

18. *Pipizella bispina* Šimić, 1987.

Range: Balkan Peninsula, mountainous parts; **Balkan Peninsula:** Montenegro.

Records: Razvršje, 17. VII 1995. 1m.

Remarks: *P. bispina* is a species known only from the type-locality — the mountain Durmitor, until now. The restricted range of this species must be taken as provisional only, due to the uncertainty regarding (great similarity in) the drawings of male genitalia and described characters of *Pipizella bispina* (Šimić, 1987) and *Pipizella* spec. reported by Van der Goot (1981: 133). *Pipizella* spec. occurs in European Russia, Belgium and Switzerland.

19. *Sphagina clavata* Scopoli, 1763.

Range: Europe; **Europe:** Netherlands to Pyrenees; mountainous parts of Central Europe and South Europe to South-west Russia; **Balkan Peninsula:** Slovenia, Montenegro, Serbia, Bulgaria.

Records: Biogradsko jezero, 15. VII 1995. 1m.

Remarks: This is the first record of *S. clavata* in Montenegro. It occurs (Vujić, 1990) on few low Balkan mountains (Fruška Gora, Vršacke Planine) and at lower altitudes of some high mountains (Kopaonik, Savinjske Alpe). The isolated records of this species in south Europe. (Dirickx, 1994) makes any locality at which it is found a site of exceptional interest.

20. *Sphagina chunipes* (Fallen, 1816)

Range: Europe, Siberia, Caucasus; **Europe:** all regions, except Portugal and Greece; **Balkan Peninsula:** all parts except Greece.

Records: Biogradsko jezero, 15. VII 1995. 19m 8f.

Remarks: *S. chunipes* is the most widely distributed and most frequent species of genus in Europe. The species has been registered on the mountain Durmitor only, as far as Montenegro is concerned. Forest areas of the Balkan Peninsula, close to rivers, streams and lakes are typical for this species which can be easily found.

21. *Sphagina elegans* Schummel, 1843.

Range: Europe, Siberia, Caucasus; **Europe:** all regions, except Slovakia, Italy and Portugal; **Balkan Peninsula:** Slovenia, Serbia, Bulgaria, Greece.

Records: Biogradsko jezero, 15. VII 1995. 4 m. 10f.

Remarks: This is the first record of *S. elegans* in Montenegro. It is cited for few mountains in Serbia, but confirmed only for Kopaonik (Vujić, 1990) and Fruška Gora (Vujić & Glumac, 1994). In central Europe, *S. elegans* is frequently found together with *S. chunipes*, but in wetter localities, beside streams (Speight & Lucas, 1992).

22. *Sphagina latifrons* Egger, 1865

Range: Central Europe, Cantabrian mountains; **Balkan Peninsula:** Slovenia, Montenegro, Serbia, Bulgaria.

Records: Biogradsko jezero, 15. VII 1995, 2m 1f.

Remarks: This is the first record of *S. latifrons* in Montenegro. The species occurs on higher mountains in Central Europe within the *Picea* and *Fagus* forests, besides streams, in colder habitats. In South Europe, *S. latifrons* is rarely found, recorded on few higher

Balkan mountains: Slovenian, Alps, Kopaonik and Stara Planina (Vujić, 1990).

23. *Sphagina verecunda* Collin, 1937.

Range: Europe; **Europe:** from England through Central Europe to North-west Russia; **Balkan Peninsula:** Slovenia, Montenegro.

Records: Biogradsko jezero, 15. VII 1995. 6m 1f; Razvršje, 17.VII 1995. 1f.

Remarks: This is the first record of *S. verecunda* in Montenegro and the most southern locality within the range of the species. It is distributed on some Central European mountains from Denmark to Slovenian Alps. The population from investigated area seems to be isolated from the continuous part of its range stressing the importance of a forests along the Biogradsko jezero lake in conservation of the zoogeographically important species.

24. *Spilomyia manicata* (Rondani, 1865)

Range: Europe, Caucasus; **Europe:** Central and South Europe; **Balkan Peninsula:** Montenegro, Serbia, Macedonia, Greece.

Records: Razvršje, 17. VII 1995. 1m.

Remarks: *S. manicata* is a species with the centre of its distribution in South Europe, mediterranean and some parts of Central Europe. On the Balkan Peninsula the species is recorded in Macedonia (Glumac, 1968) and on few localities from Adriatic coast in Montenegro (Glumac, 1956). The record of this species from "Biogradska Gora" enlarged the diversity of zoogeographical faunal elements in this area, besides Alpine and Central European high mountainous species, with Mediterranean flies.

25. *Temnostoma vespiforme* (Linnaeus, 1758)

Range: Palaearctic; **Europe:** Central Scandinavia to North Spain; France to European part of Russia; Balkan Peninsula: Croatia, Bosnia and Herzegovina, Montenegro, Serbia, Macedonia.

Records: Biogradsko jezero, 15. VII 1995. 1m.

Remarks: *T. vespiforme* is now becoming progressively localised over much of its European range. This very attractive species with distinct mimic characters resembling *Vespula* wasps is rarely found on the Balkan Peninsula. Any habitat of this species should receive special attention towards its protection and conservation.

26. *Xylota coeruleiventris* (Zetterstedt, 1838)

Range: Palaearctic; **Europe:** predominantly North and Central Europe; **Balkan Peninsula:** Slovenia, Bosnia and Herzegovina, Montenegro, Serbia.

Records: Biogradsko jezero, 15. VII 1995. 2f.

Remarks: *X. coeruleiventris* occurs on few Balkan mountains in Slovenia, Bosnia and Herzegovina and Serbia (Milankov et al., 1995). The record from investigated area is the first for Montenegro (Vujić & Milankov, in press) making the "Biogradska Gora" the most southern habitat of this species over its range.

27. *Xylota florum* (Fabricius, 1805)

Range: Palaearctic; **Europe:** all regions, except Portugal, Bulgaria and Greece; **Balkan Peninsula:** Slovenia, Bosnia and Herzegovina, Montenegro, Serbia, Macedonia (?).

Records: Biogradsko jezero, 15. VII 1995. 2m.

Remarks: *X. florum* is a rarely found species on the Balkan Peninsula (Milankov et al., 1995) and the record from Biogradsko jezero is the first for Montenegro (Vujić & Milankov, in press). It is very localised in South Europe, distributed only in highly preserved autochthonous habitats.

28. *Xylota sylvarum* (Linnaeus, 1758)

Range: Palaearctic; **Europe:** all regions; **Balkan Peninsula:** all parts.

Records: Razvršje, 17. VII 1995. 1f.

Remarks: *X. sylvarum* prefers the habitats along forests streams and mountainous rivers. It occurs on many Balkan mountains to above 1500 m altitude.

29. *Hylota xanthocnema* (Collin, 1939)

Range: Europe; **Europe:** all regions (except extreme north and south); **Balkan Peninsula:** Croatia, Bosnia and Herzegovina, Montenegro, Serbia, Macedonia.

Records: Biogradsko jezero, 15. VII 1995. 1m; Razvršje, 17. VII 1995. 3m 1f.

Remarks: The fourth species of the genus, making the area exceptionally diversified. *X. xanthocnema* prefers the high mountains in Central Europe and it is very rare on the south of the continent. The species occurs in the forest habitats of beech and coniferous woodlands.

CONCLUSIONS

Great diversity of the investigated region's hoverfly fauna has been shown by the findings of faunistically important species:

Hammerschmidtia ferruginea and *Brachyopa vittata*, both representatives of the genera never recorded in Montenegro before, the later being the first record of the species in the F.R. of Yugoslavia;

Eristalis rupium, *Noascia obliqua*, *Sphegina clavata*, *S. elegans*, *S. latifrons* and *S. verecunda* are the newly established species in the fauna of Montenegro;

The forest area around the Biogradsko jezero lake is the only known habitat of *Cheilosia melanura rubra*, *C. orthotricha*, *Xylota coeruliventris* and *X. florum* in Montenegro;

Chrysogaster solstitialis, *Chrysotoxum fasciatum*, *Dasysyrphus pynastri*, *Neoascia annexa* and *Pipizzella bispina* were only collected in the woodlands of the National Park "Biogradska Gora" and on the mountain Durmitor as far as the region of Montenegro is concerned.

It was also shown that the region is rich in representatives of diversified zoogeographic elements: from endemic species and oromediterranean relicts to Al-

pine and Central European as well as Mediterranean species.

The preliminary results reported here necessitate further investigations of the fauna of the National Park "Biogradska Gora" in attempt to preserve and protect extreme diversity of the region's ecosystems.

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REZIME

DIVERZITET OSOLIKIH MUVA (DIPTERA SYRPHIDAE) U NACIONALNOM PARKU "BIOGRADSKA GORA" (CRNA GORA, JUGOSLAVIJA).

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Preliminarna istraživanja područja Nacionalnog parka "Biogradska gora" su ukazala na izuzetnu raznovrsnost faune osolikih muva koju najbolje ilustruju nalazi vrsta od posebnog faunističkog značaja:

vrste *Hammerschmidtia ferruginea* i *Brachyopa vittata*, pripadaju rodovima koji do sada nisu bili poznati za Crnu Goru, a nalaz vrste *Brachyopa vittata* sa Razvršja, je prvi za područje SR Jugoslavije;

vrste *Eristalis rupium*, *Neoascia obliqua*, *Sphegina clavata*, *S. elegans*, *S. latifrons* i *S. verecunda* su prvi put registrovane za Crnu Goru;

šumski ekosistemi oko Biogradskog jezera su jedina do sada poznata staništa vrsta *Cheilosia melanura rubra*, *C. orthotricha*, *Xylota coeruliventris* i *X. florum* u Crnoj Gori;

vrste *Chrysogaster solstitialis*, *Chrysotoxum fasciatum*, *Dasyrphus pynastri*, *Neoascia annexa* i *Pipizzella bispina* su u Crnoj Gori pored Nacionalnog parka "Biogradska Gora" registrovane još samo na Durmitoru.

Na istraživanom području je utvrđeno prisustvo izuzetno različitih zoogeografskih elemenata, od endema i oromediteranskih relikata, alpskih i centralno-evropskih taksona, do mediteranskih vrsta.

Dosadašnji rezultati ukazuju na potrebu daljeg istraživanja faune sirfida Nacionalnog parka "Biogradska gora" zbog izraženog biodiverziteta, kao i na neophodnost doslednog sprovođenja svih mera zaštite kako bi se taj izuzetan genofond očuvao.

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Contribution to Knowledge of Distribution of Species Genus *Aplocera* Stephens, 1827 In Serbia (*Lepidoptera*, *Geometridae*)

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ABSTRACT

Data on finding five species of genus *Aplocera* Stephens, 1827 (syn.: *Anaitis* Duponchel, 1829) on Serbian territory were given. *A. plegiata* L. was found in Priština (Grmija, 700m), *A. efformata* Guenée was also found in Priština (Grmija, 700m). *A. praeformata* Hübner was found on Šar-planina Mt., *A. simplicata* Treitschke was found in the area of Đeravica lakes (Prokletije

Mt.) and *A. lythoxylata* Hübner was found on Šar-planina Mt. (Piribeg). Allopatric relations between four species, caused by ecological differentiation, were established. Only two species were sympatric and synchronic. Their reproductive isolation was achieved by the differences in anatomy of male genitalia.

Key words: *Aplocera* Stephens, 1827, Serbia

INTRODUCTION

An important advance in intensing of elaboration of our fauna was made by elaboration of fauna pro-drome of Serbian's Lepidoptera (Zečević, 1996). Numerous scattered literature data were merged and for the first time it became possible to give supplements to knowledge of Serbian's Lepidoptera by revising existing incomplete collection. Also, the new directed field exploring enabled supplementation of existing list of species.

Genus *Aplocera* Stephens, 1827 (syn.: *Anaitis* Duponchel, 1829) is presented with five species in fauna of Serbia. During our field exploring and by revising of existing material in the collection of Dr. P. Jakšić all five species of this genus were fortified. Here are some data on their findings, but it is important to mention that we deal with the species which are rare and hardly accessible.

MATERIALS AND METHODS

The investigations reported here have been conducted from 1973. to 1996. at three localities: Šar-planina Mt. (Brezovica, 1.000m), Priština (Grmija Mt., 700m) and Prokletije Mt. (Đeravičko jezero, 2.309m). The total number of collected specimens used for the determination was 10, which have been deposited at the collection of the Department of Biology in Priština and in collection of Dr. P. Jakšić. The standard procedures for determination and preparation of male genitalia were employed. Distribution data were reported according to catalogue (Zečević, 1996) and other published paper (Rebel und Zerny, 1931; Živojinović, 1950; Pinker, 1968; Zečević i Radovanović, 1974; Zečević, 1976 and Tomić et all., 1990).

RESULTS AND DISCUSSION

1. *Aplocera plagiata* Linneaus, 1758.

First data on findings of this species for Serbia (Hoča, Prizren and Novo Selo) were given by Rebel (1917). According to Živojinović (1950) this species can be often found in the area of Majdanpek. According to Zečević and Radovanović (1974) it is also often found in Timočka Krajina. We have found three specimens of this species in Jakšić's collection, and all of them were found in the area of Priština, Grmija Mt., 700m: one femele, 30. VIII 1973. one male, 27. IX 1973. and one male 25. IX 1973. Species is spread in forest community *Quercetum fernetto — cerris scardicum* Krasnići, 1972. Food plants for caterpillars belong to *Hypericum* species. According to Pinker (1968) it is often present in lower parts of Macedonia, and according to Tomić et all. (1990) it is rare in lower zone of Durmitor (Tara Canyon). This species is Eurasiatic element of fauna (Fig. 2:3 and 4).

1. *Aplocera efformata* Guenée, 1857. (syn.: *pallidata* Stgr.)

Zečević and Radovanović (1974) found this species in Timočka Krajina and it is considered to be the only finding in Serbia. We have found it in the collection of Jakšić. Material aroused from surrounding of Priština, grmija Mt., 700m: one femele, 30. VIII 1973., 1 femele, 25. III 1974. and 1 femele 6. VI 1976. Practically, this is the second finding of this species in Serbia. The species live in community *Quercetum fernetto — cerris scardicum* Krasnići, 1972. Food plant for this caterpillar is *Hypericum perforatum*. According to Pinker (1968) this species is present in higher localities

of Macedonia. The species is Eastern-Mediterranean element of fauna.

3. *Aplocera praeformata* Hübner, (1826)

First data for this species for Serbia were given by Rebel (1917) for Paštrik Mt. and Žljeb Mt. Zečević (1976) have found this species in Stol Mt. near Zaječar. We have found it in a collection of Jakšić. Material arouse from Šar-planina Mt., Brezovica, 1.000m: 1 female, 1. VII 1974. and 1 male, 5. VII 1974. (Fig. 1: 3 and 4). The species lives in community of *Fagetum submontanum* Jov. Food plants for this caterpillars belong to *Hypericum* species. Pinker (1968) found this on Macedonian side of Šar-planina Mt. and in many other mountain areas to Perister Mt. According to Tomić et al. (1990) it is often found in Durmitor Mt. This is Eurasiatic element of fauna.

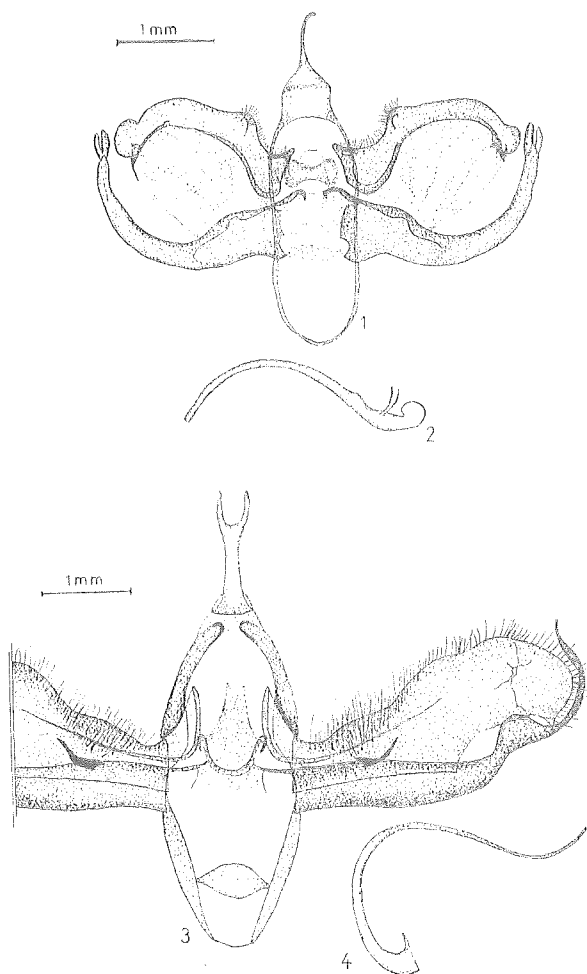


Fig. 1. Male genitalia of *Aplocera simpliciatata* Tr., Prokletije Mt., Derovička jezera, 2309 m, Prep. no. 2135: 1. valva, uncus and tegumen, 2. aedeagus; *Aplocera praeformata* Hbn., Šar-planina Mt., Brezovica, 1000m, Prep. no. 2139: 3. valva, uncus and tegumen, 4. aedeagus.

Sl. 1. Genitalije mužjaka *Aplocera simpliciatata* Tr., Prokletije, Derovička jezera, 2309 m, Prep. no. 2135: 1. valva, uncus i tegumen, 2. aedeagus; *Aplocera praeformata* Hbn., Šar-planina, Brezovica, 1000m, Prep. no. 2139: 3. valva, uncus i tegumen, 4. aedeagus.

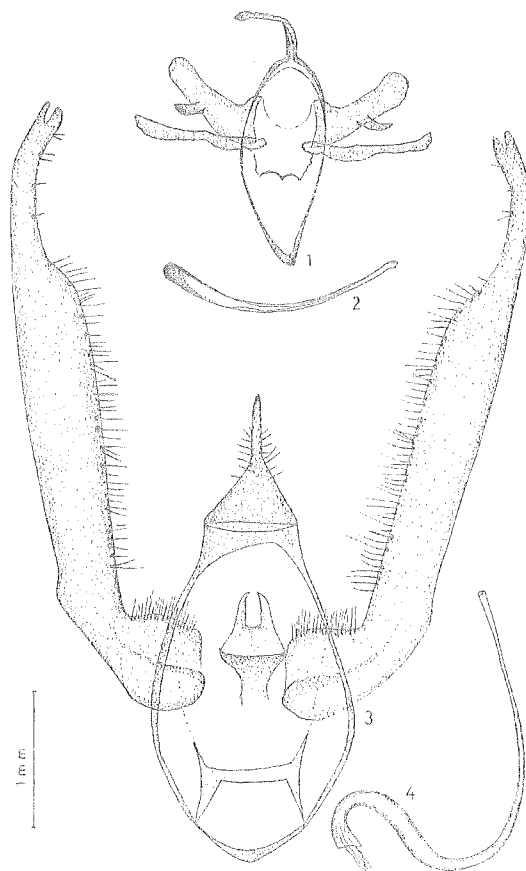


Fig. 2. Male genitalia of *Aplocera lythoxylata* Hbn., Šar-planina Mt., Piribeg, 1900m, Prep. no. 16: 1. valva, uncus and tegumen, 2. aedeagus; *Aplocera plagiata* L., Priština, Grmija Mt., 700m, Prep.no. 14: 3. valva, uncus and tegumen, 4. aedeagus.

Sl. 2. Genitalije mužjaka *Aplocera lythoxylata* Hbn., Šar-planina, Piribeg, 1900m, Prep. no. 16: 1. valva, uncus i tegumen, 2. aedeagus; *Aplocera plagiata* L., Priština, Grmija, 700m, Prep. no. 14: 3. valva, uncus i tegumen, 4. aedeagus.

4. *Aplocera simpliciatata* Treitschke, (1835)

First data on findings this species in Serbia were given by Buresch (1915). Also, according to Rebel (1917) it can be found on Paštrik Mt., Korab Mt., Dobri Dol, Žljeb Mt., Novo Selo i Novi Pazar (Priboj). During the field exploring, which was organized by Section for fauna (Department of Biology, Faculty of Science, Priština), we have found this species on Prokletije Mt. in the area of Đeravica lakes, 2.309m: one male and two female, 2. VIII 1996., Ristić Gordana leg (Fig. 1: 1 and 2). This species is present in higher mountain's section in biome of Alpine and High Nordic rock-grounds, pastures and snow patches in the community of *Seslerio* — *Ostryetum* Horvat et Horvatić, 1950.

Caterpillar of this species also lives on *Hypericum* species. Pinker (1968) found it on Macedonian side of Šar-planina Mt., and on other high mountains all the way to Perister Mt. According to Tomić et al. (1990) it is present on Durmitor Mt. The species has Mediterranean-asiatic distribution.

5. *Aplocera lythoxylata* Hübner, (1799)

First finding of this species are recorded by Rebel (1917) for Paštrik Mt. and Žljeb Mt. We have found this species in the collection of Jakšić. Material originate from Šar-planina Mt., Piribeg, 1.900m: one male, 1. VIII 1979. (Fig. 2: 1 and 2). This is the third locality from which the species is known in Serbia. The species lives in community of *Pinetum mugī* HT., 1938. Caterpillars live on *Hypericum perforatum* L. The species is not found in Macedonia, but it is known from Durmitor Mt. (Rebel und Zerny, 1931; Tomić et al., 1990). The species is Oro-mediterranean element of fauna.

CONCLUSION

New faunistical data on five analyzed species of *Aplocera* genus listed in this work. Allopatric relation between four species is noticed, and it is related with their ecological adaptations. So, the *A. plagiata* L. species is present in the community of *Quercetum fernetto* — *ceris scardicum* Krasnići, 1972. in mountain zone, than *A. praeformata* Hbn. is present in the community of *Fagetum submontanum* Jov. prior to mountain zone, while *A. lythoxylata* Hbn. species is present in the community of *Pinetum mugī* HT in the mountain zone, and *A. simplicata* Tr. is present in the community of *Seslerio* — *Ostryetum* H. et H. in the high mountain zone. Sympatrical relation exist only between *A. plagiata* and *A. efformata* Guenée species from the area of Grmija Mt. We believe that isolation relation between these two species is realized on the base of difference in anatomy of male genitalia (Fig. 1 and Fig. 2).

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REZIME

DOPRINOS POZNAVANJA RASPOSTRANJENJA VRSTA RODA *APLOCERA* STEPHENS, 1827 U SRBIJI (*LEPIDOPTERA*, *GEOMETRIDAE*)

Gordana RISTIĆ

Publikovanjem prodromusa faune Lepidoptera Srbije (Zečević, 1996) ostvaren je uvid u nivo faunističke istraženosti ove grupe. Ujedno, stvorene su pretpostavke da se obavi usmereno istraživanje onih grupa koje su ostale nepotpuno ili delimično istražene. Familija *Geometridae* je jedna od tih grupa koja zaslužuje veću pažnju i taksonoma i faunista. Mi smo u ovome radu dali doprinos faunističkom i zoogeografskom poznavanju pet vrsta roda *Aplocera* Stephens, 1827 (= *Anailis* Duponchel, 1829) sa područja Kosova i Metohije.

Vrste *A. plagiata* L. i *A. efformata* Guenée su nađene u okolini Prištine, Grmija, 700m i međusobno su simpatrične i sinhronne. Njihova reproduktivna izolovanost je ostvarena krupnim razlikama u građi genitalnog aparata mužjaka. Vrste *A. praeformata* Hbn. je nađena na Šar-planini, Brezovica, 1000m (sl. 1: 1 i 2) u zajednici *Fagetum submontanum* Jov. Vrsta *A. simplicata* Tr. je nađena na Prokletijama u okolini Derovičkih jezera, na području zajednice, *Seslerio* — *Ostryetum* Horvat et Horvatić, 1950. Najzad, vrsta *A. lythoxylata* Hbn. je nađena na Šar-planini, Piribeg, 1900m u zajednici *Pinetum mugī* HT., 1938. Tako između ove tri vrste postoji odnos alopatrije, uslovljen njihovom ekološkom adaptiranošću. Ujedno, ove tri vrste su alopatrijske i u odnosu na vrste *A. plagiata* L. i *A. efformata* Guenée koje egzistiraju u zajednici *Quercetum fernetto* — *ceris scardicum* Krasnići, 1972.

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Prikazi --- Book reviews

IV

Zbornik radova FIZIČKO-GEOGRAFSKI PROCESI NA KOSOVU I METOHIJI — I, Naučna monografija., Univerzitet u Prištini, Prirodno-matematički fakultet, Odsek za geografiju, Godina I, Broj 1: 1-134, Priština, 1996.

YU ISSN 0354 — 8597
UDK 911

Ovo je novopokrenuti časopis u sklopu projekta "Fizičko-geografski procesi na Kosovu i Metohiji", finansiranog od strane Republičkog ministarstva za nauku i tehnologiju Srbije. U prvoj svesci su objavljene dve kategorije radova: uz Predgovor urednika nalazi se još devet radova vezanih za projektne teme, drugu kategoriju čini pet ostalih radova nastavnika i saradnika Odseka za geografiju. U ovim radovima su tretirane fizička geografija, antropogeografija, ekonomska geografija, hidrobiologija i zagađenje životne sredine. Radovi se najvećim delom odnose na Kosovo i Metohiju, ali i na Crnu Goru, južnu Srbiju i Svet. Iz iznetog prikaza sadržaja ove sveske vidi se da je u pitanju zbornik radova, a ne monografija, jer ona podrazumeva ... "naučnu raspravu koja se podrobno bavi samo jednim predmetom neke nauke" (Vujaklija, 1954).

U uvodnom radu pod naslovom "Fizičko-geografski procesi na Kosovu i Metohiji", čiji su autori Ivanović R. i Ilić R., date su glavne geografske crte Kosova i Metohije. Autori su propustili da istaknu podelu ove teritorije na regione (Kosovo, Gornja Morava i Izmornik, novobrdská Kriva Reka, četiri šarplaninske župe, i dr.) koje su ne samo geografske celine već i svojevrsna tapija srpskog entiteta na ovim prostorima.

Iza pomenutog uvodnog rada sledi osam radova iz projektne teme. Među tim radovima prva četiri su iz domena fizičke geografije (hidrologija, klimatologija), jedan je rad iz domena hidrobiologije a tri su iz domena antropogeografije. Četiri pomenuta rada iz domena fizičke geografije (hidrologija i klimatologija) iznose fundamentalne podatke od teoretskog i praktičnog značaja. Obzirom da je ovo prva godina rada na projektnoj temi možemo zaključiti da je projekat dobro

koncipiran a rad na njemu osmišljen. Zainteresovani stručnjaci mogu očekivati nove značajne rezultate u narednim sveskama ovoga časopisa. Ovde smatramo da se još jednom mora preispitati naslov časopisa, tj. naslov projekta. Naime, pošto je časopis štampan ćirilicom onda bi iz njegovog naziva trebalo izostaviti reč "proces" kao stranu, kao reč koje nema u srpskom jeziku (Rečnik srpskohrvatskog književnog jezika, Matica Srpska, 1973). Umesto nje treba da stoji reč "promene", jer ta reč ima značenje: ... "menjanje brzine i pravca kretanja, preobraćanje u nešto novo, uzročno-posledična izmena ..." (cit. po istom delu). Ako se, dakle, radi o fizičko-geografskim promenama onda je izvesno da preostala četiri rada (iz domena hidrobiologije i antropogeografije) sadržajno ne odgovaraju projektnoj temi. Verujemo da su oni mogli biti svrstani u drugu kategoriju radova — ostali radovi nastavnika i saradnika Odseka za geografiju.

Iz druge grupe radova koji nisu striktno vezani za projekat naročitu pažnju privlači rad pod naslovom "Zemljine katastrofe, biblija i Nojin potop" autora P. Radičevića. U podnaslovu ovoga rada je postavljeno suštinsko pitanje: Šta se stvarno desilo? Autor je razmatrao pitanja prirodnih i izazvanih katastrofa kroz ljudsku istoriju a naročita pažnja je posvećena potopu. Međutim, izostala je originalna naučna rasprava o potopu. Nije primenjena naučna metoda (u ovom slučaju analitičko-sintetički metod, metod indukcije i pored apagoških dokaza). Izostalo je i utvrđivanje kauzalne veze između potopa kao posledica i odgovarajućih geoloških okolnosti ("lavora" i tesnog kanala, kao u analognom slučaju sa Karibima) kao uzroka. Činjenica da je Crno More do pre 9.000 godina bilo slatkovodno i da mu je tada nivo podignut za 60 metara, kao i da se seizmički profil stare obale lako identifikuje, ukazuje da bi to moglo biti područje potopa. Odgovori na ova vrlo interesantna pitanja, sa značajnim reperkusijama na ljudsku civilizaciju i živi svet Drevnog Mediterana, su izostali. Zato ovaj rad ne može biti klasifikovan kao originalni naučni rad. Ostajemo sa nadom da će autor nastaviti sa radom na ovoj izuzetno interesantnoj temi.

P. Jakšić

Coevolution of Some of the Aposematic and Mimetic Species of Spiders and Insects in the Region of Yugoslavia

Gojko SAVIĆ, Gordana RISTIĆ and Predrag JAKŠIĆ

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ABSTRACT

Numerous cases of the existence of the aposematic species of insects, as well as, mimetic species of spiders and insects have been determined in the region of Yugoslavia. Their interrelationship has been analyzed through a coevolutionary context. Coevolution has been

illustrated through the example of a reciprocal response between *Scolia maculata* L., *Vespa crabro* L. and other species as a model, and on the other hand, between various representatives of spiders and insects which manifest mimicry toward these two models.

Key words: Coevolution, Aposemy, Mimicry.

INTRODUCTION

One of the results of the evolution has been organism's adaptability to the conditions prevailing in their surround, i.e., any characteristic which is useful for the survival of the species. According to Darwin's theory, the adaptability neither depends solely on the organisms nor exclusively on the surrounding, but it has been built on their interaction. In the course of this process, the natural selection plays an extremely important part. Special adaptation enable related organisms to live in different ecological conditions. The new combinations of genes are source of special adaptations, while the general type of the body structure and physiological functions remain the same.

There are numerous forms of special adaptations in insects. The adaptations most frequently observed are those in the body structure, by which the surrounding is imitated (rod-like forms, Orange Oakleaf Butterflies and others), i.e., camouflage; or they attain the color of the surrounding, that is protective or cryptic coloration. Many insects fend off their enemies by means of poisonous glands or unpleasant odor, i.e. chemical agents. In hornets, wasps, bees, spiders, some *Coleoptera* and others these mechanisms have been exceptionally well developed. A great number of insects of this group, beside presence of the poisonous or malodorous glands, also possess conspicuously colored body, thus indirectly emphasizing their characteristics to their enemies and protecting themselves. This type of colorations which warns off potential predators is called a warning (aposematic) coloration. Finally, certain insects, which otherwise do not possess special protective mechanisms, protect themselves by way of attaining similarity in shape and color of body and wings, with the wings which are aposematically colored. This phenomenon has been referred to as Mimicry (mimesis).

Two types of mimicry in insects are well investigated at the present. In some cases, a tasty species masks itself as a distasteful one, and it is Batesian mimicry. The other case is when several distasteful species appear convergently, where each one of the species attain protection on the bases of its similarity to the other species. This type of mimicry has been referred to as Müllerian mimicry. Geographical factor, that is, sympatry and synchrony of the aposematic species, as well as, mimicry manifesting species, i.e., mimetic mimicry cannot be overlooked in the studies of the cases of mimicry. A case of mimesis in Hover Flies (*Syrphidae*) and some other insects have already been investigated in the region of Yugoslavia (Grozđanić, 1951, 1952; Glumac, 1962).

MATERIAL AND METHODS

By conducting the field work, our team tried to determine the existence of sympatry and synchrony of the mimetic species toward aposematic ones. *Scolia maculata* L. and *Vespa crabro* L. are certainly dominant aposematic models in the Balkan region and Yugoslavia within. Those two species are distributed throughout the entire Balkans, thus enabling the whole series of spider's and insects' species to develop and manifest mimetic characteristics. By carrying on the field work, our team has determined that the existence of the sympatry and synchrony among aposematic and mimetic species is always of the local character, whereas the mimetic species is the rare one. Beside available literature on the subject, some new cases of mimicry, particular for fauna of the Balkans has been presented in this paper.

We would like to thank to Mr. Miroslav Vasić for help with translation and correction to the English text.

RESULTS

A. The aposematic species

1. *Vespa crabro* L. (*Vespidae*)
Near Niš, 200m, 1 male, 21. VI 1996; 3 male, 13. VII 1996. and 1 female, 21. IX 1996., Ristić Gordana leg.
2. *Paravespula germanica* Fbr. (*Vespidae*)
Near Niš, 200m, 1 male, 20. VII 1995. and 1 female, 25. VI 1996., Ristić Gordana leg; Beograd, Borča, 100m, 1 male, 19. IV 1996., Panić E. leg.; Sjenica, 1000m, 1 female, 20. IX 1995., Kolašinac M. leg.; Bor, Savača, 500m, 1 male, 9. VIII 1994., Jakšić P. leg.
3. *Scolia maculata* L. (*Scoliidae*)
Bor, Stol, 800m, 1 male, 22. VIII 1996., Jakšić P. leg.; Paštrik, Mereja, 1500m, 2 male, 2. VII 1996., Jakšić P. leg.
4. *Ichneumon suspiciosus* (Ichneumonidae)
Peć, Rugovska klisura, 560m, 1 female, 26. VI 1993., Jakšić P. leg.
5. *Oplomerus spinipes* (Eumenidae)
Prokletije, Grbaja, 1100m, 1 male, 21. VII 1994., Jakšić P. leg.

B. The mimetic species

1. *Argiope bruennichii* Scop. (*Araneae*)
In Serbia the species was reported only from the Podunavlje (Pančić, 1863) and from Jagodina, Šabac, Beograd and Užice (Stojićević, 1929). Also, Marinković et al. (1954) refer for this species in the surrounding of Beograd. We collect *A. bruennichii* on new localities:
Ibarska klisura, Košutovac, 500m, 1 male, 8. VIII 1992., Jakšić P. leg.; Julor Mt., Rastavci, 200m, 4 male and 3 female, 13. VIII 1995., Ristić Boban leg., and Bor, Stol, 800m, 1 female, 22. VIII 1996., Jakšić P. leg. Also, few specimens was collected on Adriatic coast, Budva, 50m, 25. IX 1992., Jakšić P. leg.
2. *Sesia apiformis* Clerck (*Sesiidae*)
Stara planina Mt., Topli Do, 750m 1 female, 10. VII 1992., Jakšić P. leg.
3. *Pennisetia tabaniformis* Rott. (*Sesiidae*)
Pristina, Grmija Mt., 700m, 1 female, 12. VI 1993., Jakšić P. leg.
4. *Stratiomys chamaelon* (*Stratiomyidae*)
Dečanska Bistrica, Kožnjari, 1100m, 1 female, 28. VI 1994., Jakšić P. leg.
5. *Asilus crabroniformis* L. (*Asilidae*)
Bor, Stol Mt., 800 m, 2 male, 22. VIII 1996., Jakšić P. leg.
6. *Volucella zonaria* Poda (*Syrphidae*)
Prokletije, Grbaja, 1100m, 1 female, 21. VII 1994., Jakšić P. leg.
7. *Phelophylus paralellus* Harris (*Syrphidae*)
Prokletije, Volušnica, 1500m, 1 male, 29. VII 1994., Jakšić P. leg.

Each of single mimetic species have on's own aposematic species as model:

the aposematic model	the mimetic species
<i>Vespa crabro</i> L.	<i>Sesia apiformis</i> Clerck
	<i>Asilus crabroniformis</i> L.
	<i>Argiope bruennichii</i> Scop.
<i>Paravespula germanica</i> Fbr.	<i>Volucella zonaria</i> Poda
	<i>Phelophylus paralellus</i> Harris
<i>Scolia maculata</i> L.	<i>Stratiomys chamaelon</i>
<i>Oplomerus spinipes</i>	<i>Pennisetia tabaniformis</i> Rott.

DISCUSSION

Two groups of adaptation could be clearly differentiated in butterflies inhabiting central Balkans. One group of adaptation consists of protective or cryptic coloration, when butterflies attain the color of the surroundings. The species *Nymphalis polychloros* L. and *Inachis io* L. (fam. *Nymphalidae*) possess summer diapause or winter hibernation which are carried on in the hollows of the trees and the like, so that with color and the patterns of their wings folded perfectly blend with the surroundings. Butterfly species *Pieris napi* L. and *Anthocharis cardamines* L. (fam. *Pieridae*) possess wing pattern harmonized with the surrounding grass blades and bush leaves, thus becoming hard to spot when motionless.

As opposed to this passive protection, there is, also, an active one by means of adaptive coloration. Moths from the family of *Saturniidae* and *Sphingidae* comprise the first group of these species which could be found in the Balkans and Yugoslavia, as well caterpillars *Deilephila elpenor* L. possess large eye-like spots in the frontal part of their bodies. When threatened they stand erect assuming attacking position which scares off bird which mistakes it for a snake.

Similar examples could be also given for other species of the caterpillars from this family. Pelzer (1992) assumes that even in caterpillar species of *Hyloicus pinastri* L. (fam. *Sphingidae*), this type of mimesis could be observed, though in rudimentary state. The same mechanism of the large-eye imitation can be, also, found on the wings of the moths of *Smerinthus ocellatus* L. (fam. *Sphingidae*), *Aglis tau* L., *Eudia pavonia* L., *Saturnia pyri* (D. und S.), all from the *Saturniidae* family.

The cases of spiders, flies and moths which imitate certain species of *Hymenoptera*, constitute the second type of active protection by means of adaptive coloration as exemplified by the results of our research. An adaptive coloration has in this case, been attained by coevolutionary relationship between forementioned groups of insects toward the given aposematic model of *Hymenoptera*. The mechanism for

acquiring mimesis has been based on an expression of the aposematic yellow color on the dorsal side of the chest and abdomen. The chitin's yellow color, probably, comes from the xanthopterin which the larval stage derives, passively, from food.

CONCLUSIONS

The paper presents the new cases of aposematic coloration of some insects' species of Yugoslavia and mimetic species of spider and insects. Those are the new cases of mimicry for this geographic region.

Aposematic model is always of a numerous population and it always outnumbers the mimetic species. The mimetic species that have been determined by our team, is so scarce that there must, apparently, be a resistance of the environment and depressive actions of some other ecological factors.

Aposematic pattern and mimetic model, in biogeographical aspect are always sympatric and synchronic. It is worth stressing that the aposematic species are with considerably wider area as compared to the mimetic species which are always the local ones. Mimetic model which imitates a given aposematic species, always, by its habitus, distances itself from its closest relatives.

A similarity between a pattern and a model is always and only external and a superficial one. The essential morphological and anatomical elements indicate that no taxonomical relation between them exists. For example, in clearwings *Sesia crabroniformis* Lewin, the wings are glassy as are the wings of the aposematic *Vespa crabro* L., but it has been attained by the reduction of the wing scales, which could, still, be observed under a microscope.

As an apparent example of a coevolutionary relationship, the cited cases of mimicry can be defined as Müllerian mimicry.

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REZIME

KOEVOLUCIJA NEKIH APOSEMIČKIH I MIMETIČKIH VRSTA PAUKOVA I INSEKATA NA PROSTORU JUGOSLAVIJE

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Razmatrali smo adaptivnost organizama kao jedan od rezultata evolucije na primeru paukova i insekata. Ta adaptivnost se izražava u formi kamuflaže, kriptične obojenosti, preko produkcije hemijskih agenasa, i preko opominjuće (aposemičke) obojenosti. Najzad, pojedini insekti koji inače nemaju posebne zaštitne mehanizme štite se tako što poprimaju sličnost u obliku i boji tela i krila sa insektima koji su aposemički obojeni. Ovakva pojava je označena kao mimikrija (mimetizam).

Kroz terenski rad smo nastojali da utvrdimo postojanje simpatrije i sinhronije aposemičkih vrsta sa mimetičkim vrstama. Kao dominantne aposemičke modele prostora Balkana, pa i Jugoslavije, možemo lako definisati vrste *Scolia maculata* L. i *Vespa crabro* L., ali i vrste *Paravespula germanica* Fbr., *Ichneumon suspectus* i *Oplomerus spinipes*. Ove smo vrste nalazili na raznim lokalitetima u Jugoslaviji. U odnosu na ove aposemičke modele čitav niz vrsta paukova i insekata ispoljava mimetizam. Mi smo na prostoru Jugoslavije kao mimetičke utvrdili sledeće vrste: *Argiope bruennichi* Scop., *Sesia apiformis* Clerck, *Pennisetia tabaniformis* Rott., *Stratiomys chamaelon*, *Asilus crabroniformis* L., *Volucella zonaria* Poda i *Phelophylus parallelus* Harris. Ovde je adaptivna obojenost dostignuta koevolutivnim odnosom mimetičke prema aposemičkoj vrsti. Mehanizam postizanja mimetizma je baziran na ekspresiji aposemičkog žutog kolorita na dorzalnoj strani grud i abdomena.

Sličnost između obrasca i modela uvek je samo spoljna. Bitni elementi morfologije i anatomije uvek ukazuju da srodstvo između aposemičke i mimetičke vrste ne postoji. Na pr. kod leptira-staklokrila *S. crabroniformis* Lewin krila su staklasta poput aposemičke vrste *V. crabro* L., ali je to postignuto redukcijom krilnih ljuski, koje se pojedinačno još uvek uočavaju pod binokularom.

Kao očigledan primer koevolutivnih odnosa navedeni primeri mimikrije se mogu definisati kao slučaj Milerove mimikrije.

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On the Need For Redefining the Terms of Primary and Secondary Sense Cells

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ABSTRACT

The question of genesis of sense cells was discussed. Present classification of sense cells on primary sense cells, neurosensory cells and secondary sense cells, represented by Wolf (1903), was critically analyzed. Sense cells are considered as highly specialized epithelial cells. Support for this statement is found in Hadzi's turbellarian theory (1944, 1970), actually it is in its part which speaks of development of

neurosensory system. Represented statements are supported by scientific evidences in the domain of cytology, embryology, comparative anatomy and evolution. Explanation for the mistake in treating photoreceptors as neuro cells was given on example of photoreceptors as epithelial cells. The new, original classification of receptors was represented.

Key words: Sense cells, Photoreceptor, Ependymal cells

INTRODUCTION

Sensory receptors are special type of epithelial cells. Each cell's cytoplasm possesses has the ability to receive stimuli, but such a characteristic has been profoundly expressed within the group called receptor cells. Among this type of cells the process of specialization towards receiving specific kind of stimuli took place. According to the nature of stimuli, as well as to the part of the body and type of the stimuli genesis, sensory cells can be divided into different groups.

This paper addressed the question of sensory cells genesis. Current biological and biomedical literature gives us the insight into this matter. It is generally believed that sensory cells arise in different ways:

1. By the differentiation of the ectodermal (and endodermal) epithelium, during the process the distal part of these cells carries out the sensitive process, while the proximal one is prolonged into the part of the cell which leads to the neuron. This kind of cell receives a stimulus and transduces it towards the proximal end. This type has been termed primary sense cell. They can be found as parts of all invertebrate senses and parts of vertebrate olfactory and photoreceptors. Sense cells of ependymal layer and infundibular organ belong to this type of cells as well.

2. Special type of sense cell, when the body of the primary sense cell with its nucleus lies beneath the body surface with the belonging elongated parts remaining superficial, is called neurosensory cell. During the phylogenetic development these cells gave rise to neurons. They can be found as parts of pain, pressure, temperature, hunger or thirst receptors, or as free neural endings or parts of the tactile buds (Krause's end-bulbs, Vater's corpuscle, etc.).

3. Some of the sense cells lose their appendages and transmit the signal to free neural endings of the

neurons with which they are connected. This sort of sensory cells can be found within the vertebrate sensory organs (senses of taste and hearing as well as tactile sense, e.g. Merkel's corpuscle) and have been termed secondary sense cells.

4. Some authors mention a specific type of receptors (neuroepithelial cells), termed as tertiary, where epithelial cells differentiate as the receptor part of a sense organ and are connected to sensory neuron's endings. These can be found in Grandry's, Merkel's, Herbst's and Meissner's corpuscles.

The concept given above have been represented in the biological literature by Stanković (1950), Pašić (1987), Davidović (1988), Kalezić (1991) and Petrović and Radojičić (1995). From the biomedicine viewpoint, Kostić (1968) is also in favor of this concept, while Guyton (7th ed., 1986) is of the opinion that receptor cells are actually modified epithelial cells, with the exception of olfactory receptors, which he considers to be bipolar neurons, originated from the CNS itself. The same author gives no explanation on the origin of photoreceptors, while Zečević (1990) considers them as neurons.

We would like to state here that the ideas about the origin of different types of sense cells given here are not generally accepted ones, and that there is considerable amount of disagreement between authors. Petrović and Radojičić (1995), for example, consider primary sensory cells as neurons, and the secondary ones as modified epithelial cells. This idea is, therefore, contrary to the one of Stanković (1950). The other example of opposed standing points is the view on olfactory sense's receptors: Stanković (1950) considers them to be epithelial, while Guyton (1986) is of the opinion that they are bipolar neurons.

All the view points given here have their foundations in the Wolf's (1903) idea that sensory cells have first originated in the skin, and then the part of these cells have been transferred into the deeper parts of the skin and gave rise to the neurons, which have then been organized into the nervous system, the diffuse one at first, and then to the more complicated ones. According to Wolf (1903) primary sensory cells of vertebrates, which are of greatest importance here, have been completely separated from the body surface and transformed themselves into the sensory neurons of the spinal ganglia. Leaving beside the contradictory statements of these examples, there are more important reasons why we are opposed to the given classification and the idea underlying the understanding of primary and secondary sensory cells. We would like to emphasize the fact that Hadzi's turbellarian theory (1944, 1970) gives us solid foundations for understanding the development of nervous and sensory systems. This is why we have taken this theory as a key stone for further discussion.

METHODS

As a review article this is the article which deals with different ideas and standind points. This is why it was necessary to apply analytical methods that would allow us to dissect a complex entirety of questions to determine its specific elements. The method of synthesis also was applied in order to reconstruct analyzed phenomena. We have also applied the method of induction to incorporate previously general and specific ideas. The refute of thesis by proving the antithesis correct has been applied as well. We would like to thank to Miss Nikoleta Bašić and Mr. Miloš Tanurdžić for help with translation and correction to the English text.

RESULTS

Cytological characteristics of epithelial and nerve cells

One of the main causes of the existing confusion lies in the fact that anatomists and physiologists have drawn their conclusions without taking into the consideration the cytological characteristics of the receptor cells, which is the key to the solution. The process of their genesis have not also been take into the consideration. Other causes of the existing confusion will be discussed later. We must, therefore point out to the basic cytological characteristics and the process of genesis of the cells included in the process of receiving and transmitting stimuli.

a) Cytological characteristics of epithelial cells

Epithelial cells are polarized: towards the outer side of the body they turn their distal part, and on basal membrane lies the proximal part. The lateral surface communicates with the surrounding cells. The distal

surface makes numerous protuberances; receptor cells are characterized by typical stereocilia, kinocilia, protoplasmic filaments and photoreceptor discs. They consist of the inner skeleton's components, and are penetrated by the microtubules with the basal body and the pair of centrioles. This distal surface is exposed to the outer environment and therefore constantly wearing out, but the core of the cell makes it possible for these cells to renew themselves. The lateral sides of the epithelial cells communicate with the surrounding cells by the means of maculae adherens and the gap junction. Epithelium is not characterized by the presence of blood and lymph vessels; its nutrition is rather based on diffusion through basal membrane.

b) Cytological characteristics of the nerve cells

The typical neuron consist of the cell body, comprising the nucleus, numerous shorter appendages called dendrites and a longer one at the other side of the cell, called axon. The cell body has a complex system of membranes covered with ribosomes, surrounding the nucleus. This complex structure is called Nissl's bodies. This is the place where the process of protein synthesis takes place. From that point proteins are transported by the axon transport towards the axon and the synaptic space. The cell body and especially the dendrites are rich in microtubules (made from the protein called tubulin) which provide the development of the cytoskeleton and the transport of the cell products. Axons comprises of neurofilament (spiral proteins) in addition to microfilaments.

c) Embryogenesis of the nerve cells and the cells of the sensory epithelium

In invertebrates (Insecta) the skin, nervous system and the sensory organs all originate from the ectoderm. At the level of the germ discs a clear distinction between the parts that would give rise to the skin and the sensory organs and the part giving rise to the nervous system (neuroblast) is readily visible (Ingham, 1988). Neuroblast, on the other hand, by unequal cleavage gives rise to numerous ganglionic cells that would, after segmentation of the germ discs, unite into pairs. The brain develops from the first three ganglia. By the thickening of the hypoderma of the eye field and by the multiplication of the one-layer epithelium starts the development of the eye, i.e. the photoreceptors. Cornea cells, the crystal cone and pigment cells develop outwards, while retina and basal cells develop inward.

In vertebrates the skin, nervous system and the sensory organs originate from the ectoderm as well. At the moment of fertilization, parts giving rise to the ectoblast (i.e. the skin) and those giving rise to the neuroblast (i.e. nervous system) are clearly distinguished. Formation of the neural ectoderm is influenced by the notochord and the surrounding mesoderm, which makes this process a nice example of the primary neural induction. This discovery has been made possible by the famous Speman's experi-

ment (Spemann and Mangold, 1924) during which a part of the salamander's gastrula's upper part of the blastoporus has been transplanted into a gastrula of another animal. Saxen (1980) supposed that the part of the mesoderm which lies within the dorsal part of the embryo, underneath the ectoderm, induces the development of the ectoderm into the neural plate, by a diffusible substance. Proliferation and migration of the neuroblast's cells will make the neural plate on the dorsal side of the embryo. Afterwards, the plate recesses in the middle giving rise to the neural furrow, with its borders called neural folds. The neural furrow, then, during the process of tubulation, closes itself into a neural tubes. The tube is open in the front at the beginning (neuroporus anterior), as well as at the back (neuroporus posterior). Neural fold's cells will give rise to ganglionic cells of the spinal ganglia, sympatic ganglia, pigment cells, diffuse endocrine cells, odontoblasts and meninges.

The cells of the neural tube then undergo a complex process of differentiation. Undifferentiated cells are called primordial cells. They are settled in the ventricular zone of the neural tube, that is why they are also called ventricular cells. Sauer (1935) has termed the cells of the neural tube as neuroepithelial cells, which makes the corresponding epithelium pseudostratified, the fact being proven by Sauer and Walker (1959). Primordial cells further diverge into two different groups of cells: nerve and glia cells, or neuroblasts and glioblasts. These cells cannot be easily distinguished at the beginning, according to their superficial characteristics. Using the antibodies raised against the glial acidis protein and the method of retroviruses labeling showed that among the primordial cells from the ventricular zone one of the cells can give rise to several types of neurons, while specific cell clones have the possibility of giving rise the glia cells as well as neurons. According to Levitt et al. (1981) and Sanes (1989) separation between these two cell lines takes place early in the development. Creation of a neuron goes through several phases. First, the proliferation through mitosis of the primordial cells takes place, which leads to the formation of neuroblasts. Neuroblasts, then, mature and grow their dendrites and axons. Finally, they migrate from the neural tube towards the surface and their final position, using glia cells as guidelines. The role of glia cells as guides during the process of neuron's transposition is due to the specific structure of the axon's membrane, which has specific antigens, enzymes (proteases), glycoproteins (laminin, integrin, etc.) and receptors, which allow chemotropism to take place (Dodd and Jessell, 1988). During maturation and migration axon is being surrounded by the myelin sheet. This process is quite unequal in main. In the statoacoustic apparatus of man this process is over within the ninth month of intrauterine life, in optical nerves last for as long as five months after birth and in acoustics nerves up to three

years after birth (Yakovleva and Lecours, 1967). Most of the primate neurons are formed during embryonic development, whilst only small number of cerebellum's, hippocampus's and olfactory neurons are formed postnatal.

Besides neuroblasts, primordial cells differentiate into glioblasts as well. This process is also influenced by specific inductors. Glioblasts genesis runs parallel to neuroblasts genesis into several different directions. They also migrate outwards the neural tube. During this process they differentiate into oligodendrocytes and astrocytes. Oligodendrocytes take part in the process of myelinization, while the astrocytes are engaged in the process of development of the brain's outer sheet. When the primordial cells run out of their proliferative capabilities they transform themselves into ependymal cells which slander brain ventricles. These cells are typical epithelial cells with cilia and microvilli at the apical surface and maculae adherens and communicans type of junction at the lateral surfaces. Within the group of lower vertebrates the ependymal cells are connected by gap and tight junctions. In the brain ventricular system of mammals there are no tight junction, instead there are an intramembranous orthogonal channel for the exchange of particles. Exclusively, the ependym of the chorioid plexus has the tight junction type of intercellular connection, with no orthogonal channel noticed (Hristić et al., 1992). The nucleus of the ependym cell is large, euchromatic, with the nucleolus. Cytoplasm of these cells is with seared and small endoplasmatic reticulum and all of the other cellular organelles. Besides the typical ependymal cells, this layer consists of secretory cells, tanocytes, bipolar neurons and, on the other side, at the apical surface, it consist of multipolar, supraependymal neurons. Studying tanocytes of the fish *Mystus gulio* (Hamilton) in its third brain ventricle, Rath and Thomas (1991) have shown that these cells appear in several different shapes. They can be branched, smooth, rough or with appendages. The ends of these cells make connections with blood vessels or neurons, in different directions. The apical part of the tanocyte is also different, it is either with cillia or it can be flattened due to the secretion. The same authors have found spider cells in the brain of the same fish.

d) The course of the development of the mammalian eye

At the time when the neural tube is not completely closed, optical vesicles can be seen at the rostral end. The ectoderm above these vesicles starts to thicken, which will eventually lead to the formation of the lenses. The part of the vesicle across the lens also thickens and leads to the formation of retina and one-layer pigmented epithelium. The front end of the tube then curves making place for the lens plat. Now, the walls of this formation are separated by the ventricular cavity connected to the third ventricle of the diencephalon. After the division of the cells from this

area they migrate towards the cavity of the eye cup, giving axon forwarded to the corpus vitreum. The walls of the cup then unite terminating the existence of the ventricular cavity. At the last stages, ciliary processes are developed from the neural epithelium, together with the iris and the muscles of the pupilla (Mann, 1964). In the retina itself, nerve cells differentiate into ganglion cell layer, amacrine cells, horizontal cells, bipolar cells and finally into photoreceptor cells: cones and rods.

DISCUSSION AND CONCLUSION

By comparing the characteristics of sense cells with the stated characteristics of epithelial and nerve cells, it is possible to come up with the conclusion on their classification. Photoreceptors (cones and rods) seems to be the most suitable for such comparison, which may serve as the evidence that photoreceptor cells are epithelial, not neural cells. Distal segment of photoreceptor cells (Fig. H, 1) contain photoreceptor's discs which develop through invagination of lateral sphere of cell's apical pole, which means that they are the products of apical sphere. This reparation process of apical sphere is typical for epithelia. Photoreceptor's conjugated discs proteins rhodopsin and iodopsin are transmembran repairing proteins, while the stimulating mediators in neuron cannot be repaired. Internal segment of photoreceptor's cells (Fig. H, 3) contains plain cytoplasm with plain cytoplasmatic organeles, which means that Nissl's substances, characteristic for neurons, is not present. Photoreceptor cells communicate with adjacent Muller's cells through adhesive intracellular junctures, which is the feature of epithelia. In the base of upper segment with discs, rudimental cilia (Fig. H, 5) with centrioles in its basis is present, and that, too, is the feature of epithelia. Synaptic pole (basal sphere) of photoreceptor cells has either the shape of spherula (in rods) or the shape of enervated (branchy) stalk (in cones) with synaptic process and vesicula which differ from classic neuron synapses. Feeding the external layer of retina, including external segments of cones and rods, mostly depend on diffusion in blood vessels of choroid, and once again it is typical for epithelia because capillary branches do not penetrate them. Stated evidences, in a certain way, ambiguously impose the conclusion that photoreceptor cells belong to the epithelia cells, not to the nerve cells. According to the stated classification of receptors, explained in the introduction, based on Wolf's conception, photoreceptors would be primary sense cells by origin of epithelium. On the other side we have a statement from Petrović and Radojičić (1995) that primary sense cells are nerve cells. Both positions are contradictory, but based on a represented evidences we come to a conclusion that photoreceptor cells are epithelia cells, not nerve cells.

But this statement does not clear the confusion. The second part of definition of sense cells, also explained in the introduction, says that primary sense cells at its proximal end have a sort of process which leads to the nerve cell, while secondary sense cells do not have that process, but the free neural endings are stretching out up to the cells to receive the impulse. Photoreceptors do not posses such process and neural branches are reaching them, so, according to it, they would be the secondary sense cells. The creators of this classification include photoreceptors, however, into the primary cells ...

In order to clear up this confusion, we have come to a conclusion that the two groups are actually responsible for this errors: functioning and genesis of photoreceptors. Depolarization of plasmatic membrane and forming of receptor's potential are the reactions of all photoreceptors on exterior stimulus. This potential induces the impulse in neural fibers which is in connection with receptor. Through desintegration of rhodopsin from photoreceptor's discs permeability for Na^+ of external segment membrane is induced. This process cause hiperpolarization which means the forming of receptor's potential. The internal segment in receptor's potential of photoreceptors, is pumping Na^+ toward outside causing the negative charge in the cell. Through ionophors, which are permeable for Na^+ in the dark, Na^+ is able to penetrate inside continuously and regulate electronegativity. But in the light ionophores of photoreceptors are closing which induces the penetration of Na^+ inside but the pumping of Na^+ towards outside is lasting, and that is forming already mentioned hiperpolarization. Depolarization of membrane is caused by entrance of Na^+ because of high concentration outside and this represent the active potential of neuron. Through this process interior electronegativity changes into electropozitivity. So, during the stimulation of photoreceptors and neurons, in both cases the depolarization of membrane will occur, but the nature of these processes is different.

Interpretation of photoreceptor's genesis is the second reason for confusion in clasification of sense cells. In contemporary literature it is stated that external layer of double layered goblet (optical cone) forms the pigment epithelia, and the inner layer differentiate pohotoreceptor's cells of retina. This type of genesis lead to a conclusion that the eye (except the optical lense) is a part of the brain. This may lead to another conclusion that photoreceptor cells are highly differentiated nerve cells, but we have seen that it cannot be related to the truth. Four types of tissue participate in histological differentiation of the eye, nerve tissue with its neuroblasts form retina giving afferent component, as mentioned in section d) of a previous chapter. It is possible that a certain group of glioblasts forms receptor components — cones and rods. We have to mention that the induction of glioblasts is independent and specific comparing to induction of neuroblasts. Oli-

godendrocytes, as a part of glia, create myelin sheath and they are not the source of photoreceptors. On the other side, astrocyte, as a second component of glia, could be a source of photoreceptor's cells. Astrocyte takes part in creating exterior brain layer, more exactly the part which differentiate embryo of the eye. Astrocyte also have contact with corpuscles of nerve cells, and that too is characteristic for receptors. For that reason we can assume with a high degree of reliability that one category of these cells is involved in forming photoreceptor's cells. Unfortunately, the studies on optical region astrocyte are still at the beginning. Hughes et al. (1988) report that optical nerve region have at least two types of astrocyte: type-1 astrocyte and type-2 astrocyte.

The root of this confusion is in identifying ectoderm with neuroblast. The terms like "neural plate" and "neural tube" are inadequately chosen because they suggest that neuron form this structure. As we already know, neural tube is formed by primordial cells (main cells) but only the few of them will create neurons through neuroblasts. Experiment with analysis of neurulation proved that ectoderm is not the source mass for nerve system. If certain parts of ectoderm in gastrular level are cultivated in vitro than the atypical ectoderm will be formed. But if we cultivate the certain part of ectoderm with hordomesoderm than this cultivated ectoderm will give nerve system. This means that mesoderm induce the development of nerve system in gastrular ectoderm. It is possible that induction is done under the influence of protein synthesized in hordomesoderm (Brachet, 1973).

The definition of sense-nerve cells which says that if ones specialized sense cell undergo a new specialization will give nerve cell, would be in opposition with theoretical supposition of evolution. According to the evolutive law of unspecialization only non-specialized organic types are capable for the evolution (Depere, 1922). It is very important to emphasize that the specialization is not related to whole organism, but only to its organic systems, organs, tissue or cells — sense cells in this case. In the same context beside evolution, also the embryology offers the evidence that hypothesis on the origin of primary sense cells cannot be adopted: potential characteristics of determined cell influence its differentiation. Supplemental dedifferentiation is possible (in experimental conditions of tissue culture) but redifferentiation of dedifferentiated cell in third form is slightly possible. From physiological aspect, the fact that one type of function (receiving stimulus) is performed by two types of cells (epithelia and nerve) does not leave the space for a suspicion because it is always in the matter of demonstrating the irritable features of cytoplasm of living cell. In the case of sense, nerve and muscle cells this feature is highly expressive and this three types of cells are reacting on stimulus through various organelles and in the various manners.

Homology (morphological similarity) of receptor's cells of different senses in insects with the typical nerve cell is one of the causes for presented confusion about primary and secondary sense cells. That morphological similarity is only external, superficial and does not exists at all on the level of cytostructure which can be proved with detailed analysis of organellae. The analogy (similarity in function) between receptor cells of sense of sight, hearing, teste and sense of balance on one side and bipolar neuron ependymal epithel as well as bipolar neuron of sense of smell in vertebrate on the other side has to be confined. And, at the end, there is one more insufficiently checked and accepted opinion. Many authors are reporting on the hydra's primary sense cells. According to their interpretation it is a differentiated sense cell located in ectoderm with extension which leads to the effector (muscles) in mesogloea. Such cell is designated as sense-nerve cell. Hadzi (1970) ephasized that hydra is a product of regressive evolution, originated by simplifying the middle layer (mesogloea). It contains highly differentiated nerve cells in mesogloea, connected into the netlike nerve system. Mistake about extension of sense-nerve cells results from the fact that ectodermal and endodermal cells of hydra are mutually connected through cytoplasmatics extensions.

According to the fact stated above, we can accept Hadzi's turbellarian theory (1944, 1970), actually the part which is saying about development of nerve and sense system. Contrary of Wolf's understanding the development of nerve system according to Hadzi's theory run parallel to development of receptor's elements. Neurons are formed on the account of fibers in cytoplasm with increased sensitivity and capability for conducting the stimulus. They are not formed on the account of receptor's epithel which "sank" beneath the surface. In his theory Hadzi has pointed out on regionalization of ciliated protoplasm and that fact has to be starting point for examining the genesis of this two systems. Enclosed illustrations (Fig. 1) present the development of photoreceptors out of epithelia cell.

We can finally present a proposition about leaving behind the theory of primary and secondary sense cells based on Wolf's understanding of origin of nervous system (which is presented in the introduction). We are also representing the proposition about new understanding of primary and secondary sense cells based on Hadzi's turbellarian theory. According to this understanding the reception can be done by:

1. Morphologically and functionally specialized cells of epithelial origin — **epithelial receptore cells**, which are:

- sense of taste of invertebrates,
- sense of taste of vertebrates,
- a statocyte or geoperceptive cells of sense of equilibrium (ballance),
- phonoreceptive cells of sense of hearing,
- electromagnetic receptors (photoreceptory cells of sense of seeing).

2. Morphologically and functionally specialized epithelial cells in cooperation with sensitive endings of neurons — **epithelial-nervous receptor cells**, which are:

capsuled endings of nerves (Pacinian corpuscle, Krause's end-bulbas, Meissner's corpuscle, Grandry's corpuscle etc.). Epithelial perceptive cell forms here a capsule in which the sensitive endings of neurons are penetrating. To the same type but morphologically a little different structure there also belong:

structures about the root of the hair (tactile hair or sensyles of Arthropoda), Ajmer's corpuscle in mole, the nerve circles in the pig's nose etc.,

the endings with widened top (Igg's corpuscle with Merkel's corpuscle),

the endings in branches (Ruffini's organs of mammals).

3. Morphologically and functionally specialized cells are **nerves receptor cells**, to which belong:

free uncapsuled endings of nerves,

endings in muscles and joints,

neurons for osmotic reception in supraoptical centres of mammals (a sense of smell),

baroreceptors of glosopharynx (Hering's nerves) in the arteries,

hemoreceptors (oxygen, CO₂, glucosis etc. in the blood),

stiboreceptive cells of the sense of smell,

bipolar neurons from ependymal epithel (infundibular organ of Amphioxus and fish — ?).

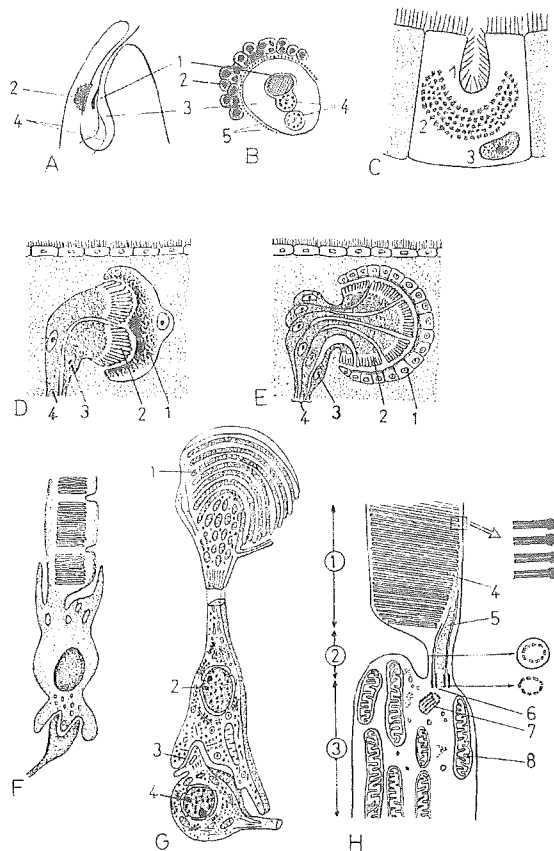


Fig. 1. Evolutionary development of photoreceptive cell (schemes).

A — B. Longitudinal cut (A) and transversal cut (B) of Euglena "pharynx" with reservoir.

1. paraphlagellar body (photoreceptor)

2. stigma

3. reservoir

4. centriole in the basis of flagellum

5. mitochondria

(according to Leedal from Robards)

C, D, E. Three different types of ocelli in Turbellaria

C. Simple optical macula

1. light sensitive microvillus

2. granular pigment cup

3. nucleus

D. Optical macula with differentiated pigment cell

1. unicellular pigment cup

2. light sensitive microvillus

3. nucleus

4. basal process of receptor cell

E. Compound optical macula with pigment goblet

1. multicellular pigment cup other mark like in fig. D

(according to Poljanskij, 1987)

F. Photoreceptive cell of lower vertebrata

(according to Mirzozn, 1980)

G. Fish pineal gland (pinealocyte)

1. photoreceptive discs

2. nucleus

3. synaptical distal part of pinealocyte

4. neuron

(according to Collin, Arendi et Gern, 1989)

H. Central part of human photoreceptive cell, detail of structure.

1. distal segment

2. neck region

3. cell body

4. photoreceptive discs

5. rudimentary cilia

6. centriole 1

7. centriole 2

8. mitochondria

(according to Avers, C., 1976)

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REZIME

O POTREBI REDEFINISANJA POJMOVA PRIMARNIH I SEKUNDARNIH RECEPTORSKIH (SENZITIVNIH) ČELIJA

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Receptorske (senzitivne) ćelije se prema poreklu i genezi dele na a) primarne čulne ćelije, b) čulno-nervne ćelije i v) sekundarne čulne ćelije. Ova je podela bazirana na klasičnim postavkama Wolfa (1903). U aktuelnoj biomedicinskoj literaturi ova podela nije jedinstveno prihvaćena a često susrećemo i dijametralno suprotstavljena mišljenja. Tako, na pr., Petrović i Radojičić (1995) smatraju da su primarne čulne ćelije nervne ćelije, dok za sekundarne čulne ćelije smatraju da su to modifikovane epitelske ćelije; takvo shvatanje je potpuno suprotno onom koga zastupa Stanković (1950). Ili, Stanković (1950) receptore čula mirisa smatra za epitelske ćelije, dok ih Guyton (1986) smatra za bipolarne neurone. Mi smo zauzeli stav da su receptorske ćelije visokospecijalizovane epitelske ćelije. Uporište ovom shvatanju smo našli u Hadžijevoj turbelarijskoj teoriji (1944, 1970), tj. onom njenom delu koji govori o razvoju nervnog i čulnog sistema. Izneti stav smo potkrepili brojnim dokazima:

a) Citološki dokazi. Epitelske ćelije su polari-zovane a u svim slučajevima receptorske ćelije na apikalnoj površini imaju organele tipične za epitele, dok kod njih odsustvuju organele tipične za nervne ćelije.

b) Embriološki dokazi. Najdelikatnije je pitanje embriogeneze fotoreceptora. Dokazano je da nervnu cev grade ependimske ćelije, koje su epiteli a ne neuroni. Samo deo ependimskih ćelija, označen kao neuroblasti, daje neurone, dok fotoreceptori najverovatnije nastaju od klase glioblasta označenih kao astrociti.

v) Dokazi uporedne anatomije. Homologija (morfološka sličnost) receptorskih ćelija raznih čula insekata sa tipičnom nervnom ćelijom je jedan od uzroka konfuzije. Ta je sličnost samo površina, spoljašnja, dok detaljna analiza organela opovrgava istovetnost ovih receptora sa neuronom. Takođe je analizirana i analogija (sličnost u funkciji) između fo-

toreceptora, čula sluha, čula ukusa i čula ravnoteže sa jedne strane i bipolarnog neurona iz ependimskog epitela i bipolarnog neurona čula mirisa kičmenjaka sa druge strane. Na primeru funkcije fotoreceptora dokazano je da receptorski potencijal nije isto što i akcioni potencijal jer kod prvog slučaja imamo hiperpolarizaciju a kod drugog depolarizaciju.

g) Evolucionari dokazi. Prema evolutivnom zakonu nespecijalizacije za evoluciju su sposobne samo nespecijalizovane ćelije i tkiva (Depere, 1922). Shodno tome epitelne ćelije specijalizovane za recepciju draži

ne mogu pretrpeti dodatnu novu specijalizaciju da bi dale nervnu ćeliju.

Nova, originalna, podela receptorskih ćelija podrazumeva postojanje sledećih kategorija receptora:

- 1) epitelne receptorske ćelije,
- 2) epitelne receptorske ćelije u saradnji sa senzitivnim završecima neurona, to su epitelno-nervne receptorske ćelije, i
- 3) nervne receptorske ćelije.

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GENETIC HOMOZYGOSITY IN SAMPLES OF STUDENTS FROM SPECIAL AND REGULAR SCHOOLS IN ALEKSINAC

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ABSTRACT

Population — genetic research on 20 chosen mono and oligogenically determined morphophysiological traits, was carried out in the group of 95 students of special school for mentally retarded children and in control group of 95 students of regular school. The results of the research on the presence of homozygously recessive traits indicated an increased degrees of genetical homozygosities in samples of students from a special school than in control group,

which indicated a different degree of genetic loads in researched groups. The differences were also noticed in the type of frequency distribution of homozygously recessive traits, so that six traits were more frequently present in the sample group from special school than in the control group. High individual variability in two samples of school children, which can initiate their potential for different forms of adaptation including their mental abilities was also noticed.

Key words: Genetic homozygosity, human population, homozygously-recessive characters.

INTRODUCTION

Genetical structure of human populations is the object of examination of numerous authors. Among many others approaches for analyzing the human population there is a phenotype (morphophysiological) approach. Based on inheritance manner and the type of variability it is established that many morphophysiological features appear as mono and oligogenically determined qualitative traits. (Chattopadhyay, 1968; Winchester 1958, 1973; Černý, 1987) They can be used for population genetic researches which are carrying out to establish the size and the type of genetic predisposition for appearance of some disease, medical or biological phenomenon. Estimation of population — genetic variabilities in special samples of human population. Can also be used as a base for estimation homozygosities degree of various chromosome. We have tried to establish the degree of genetical homo- and heterozygosities by comparing the samples from special school with the samples of students that attend the regular school.

MATERIAL AND METHODS

We have chosen the schools in Aleksinac for our examination and it was performed on 190 school children. The samples were taken from 95 mentally retarded children, age 6-15, who the students of special school in Aleksinac. Control group included 95 students of regular elementary school and of the same age.

As a manifestation of genetical homozygosity, the presence of 20 phenotypic traits (known to express themselves as homozygously recessive) has been detected in everyone of inspected children, we were using the HRC-test, which include series of recessive morphophysiological human features.

During the work individual features of alternative types of 20 analyzed phenotypic systems were determined with direct observation with the cooperation of children.

Gathered data were used for comparing the frequency of some mono and oligogenically controlled qualitative traits in two samples.

We have calculated the quantity of genetical loads for both groups as well as the incidence of some genic alleles.

Statistical importance of differences in recessive phenotype frequency, type and volume of variability between samples of children from special school and control group, were done with t-test and f-test.

RESULTS AND DISCUSSION

Quantity presence and relative frequency of recessive alel for 20 analyzed homozygously recessive traits is shown on Table 1.

Average homozygosity in A specimen amounts to $8,58 \pm 0,28$, which is in relation with B sample ($6,29 \pm 0,18$) statistically important difference and this is confirmed with t-test $A/B = 2,29$. ($p < 0,01$).

The total cumulative chi-square difference for 20 observed morpho-physiological characteristics amounted to $\chi^2 = 485,4$ (df = 24; p = 0,001), which indicate that distributed frequency of these traits in samples taken from special school's students and samples taken from regular school's students are statistically different.

Individual comparative variability in children from special and regular school is shown in picture 1. The two distribution curves are mutually different, which indicate the presence of significant difference in type and variability volume of 20 observed homozygously recessive traits in these two samples of school children.

Table 1. The frequencies of homozygously recessive morphophysiological traits in two samples of school children

A — in special school of Aleksinac

B — in regular elementary school of Aleksinac

Tabela 1. Frekvencija homozigotno recesivnih morfolofizioloških osobina kod dva uzorka školske dece

A — uzorak dece iz specijalne škole

B — uzorak dece iz redovne škole

No.	Recessive traits	$A \frac{N=95}{No} q$		$B \frac{N=95}{No} q$		χ^2
1.	Straight hair Prava kosa	65	0,82	66	0,83	0
2.	Light hair Plava kosa	15	0,39	6	0,25	13,5***
3.	Soft hair Mekana kosa	23	0,49	25	0,51	0,1
4.	Flat scalp Ravan skalp	58	0,78	46	0,69	3,1
5.	Blue eyes Plave oči	23	0,49	22	0,48	0,0
6.	Linked ear lobe Vežan ušni režanj	44	0,68	58	0,78	3,3
7.	Ear without Darwinian knot Odsustvo Darwinove kvržice	43	0,67	27	0,53	9,4**
8.	Inability to roll tongue Nemog. uzd. savijanja jezika	66	0,83	12	0,35	243,0**
9.	Inability to curve tongue Nemog. popr. savijanja jezika	42	0,66	15	0,39	48,6***
10.	Right thumb overlapping Desni palac preko levog	46	0,69	40	0,64	0,9
11.	Absence of tiny hair on the 2nd segment of hand fingers Odsustvo dlaka na II čl. prstiju	86	0,95	75	0,85	1,6
12.	Hyperextensibility of thumb Hiperestenzibilnost palca	25	0,51	40	0,64	5,6*
13.	Digital index 4th vs. 2nd Digitalni indeks	46	0,69	37	0,62	2,1
14.	Nail abnormalities Nenormalni nokti	39	0,64	13	0,36	52,0***
15.	Three steaks in hand base Tri žile u korenu šake	44	0,68	15	0,39	56,0***
16.	Left-handedness Levorukost	7	0,27	6	0,25	0,1
17.	Campo-streptomicrodactilia Nepravilnost malog prsta	67	0,83	35	0,60	29,2***

No.	Recessive traits	$A \frac{N=95}{No} q$		$B \frac{N=95}{No} q$		χ^2
18.	Thin lips Tanke usne	23	0,49	13	0,36	7,6**
19.	Narrow nostrils Uzane nozdve	36	0,61	23	0,49	7,3**
20.	Spottyness Pegavost	17	0,42	24	0,50	2,0

p<0,05* p<0,01** p<0,001*** Total $\chi^2=485,4$

Ukupno $\chi^2=485,4$

q — Relative frequency of the recessive allele

q — Relativna frekvencija recesivnih alela

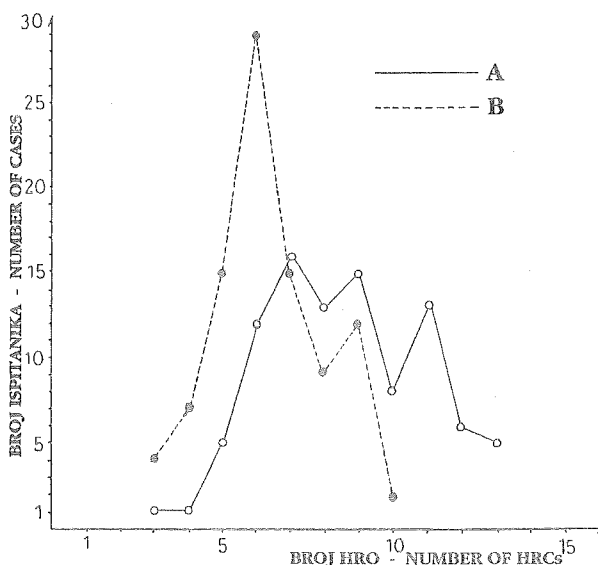


Fig. 1. Distribution of HRCs in inspected individuals
A — sample of children from a special school
B — sample of children from a regular elementary school
Slika 1. Distribucija HRO kod ispitivanih individua
A — uzorak dece iz specijalne škole
B — uzorak dece iz redovne škole

Comparative analyzes of the degree of genetical homo- and heterozygosities in children from special and regular schools is performed in Belgrade and Kragujevac, and it indicated the increased presence of recessive traits in the student of special school than in the students of regular school.

Our results also indicate increased presence of recessive traits, more exactly the increase in proportion of homozygous loci in sample group from special school, and increased genetic loads can be the reason for partly decreased capabilities for hearing, speech or intelligence in general.

Differences in population — genetical structure of observed groups are the results of differences in the average number and frequency distribution of the observed (1-20) homozygously recessive morphophysiological traits which, on the other side, points out the different degree of genetic loads in each of the sampled groups.

Genetical variability present in out samples is the results of lower, or higher degree of general homozygosity, which can induce their potential for different kind of adaption, including their mental abilities.

*Translated by
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REZIME

GENETIČKA HOMOZIGOTNOST U UZORKU UČENIKA SPECIJALNIH I REGULARNIH ŠKOLA U ALEKSINCU

Gojko SAVIĆ i Slavko BRANKOVIĆ

Analiza 20 mono i oligogenski determinisanih morfofizioloških karakteristika obavljena je u uzorku 95 učenika specijalne škole za decu sa smanjenim koeficijentom inteligencije (IQ 80), kao i u kontrolnom uzorku 95 učenika redovne osnovne škole, pri čemu je korišćen HRO -test, kao manifestacija genetičke homozigotnosti.

Rezultati istraživanja recesivnih varijanti analiziranih morfofizioloških svojstava, ukazuju na uvećani stepen genetičke homozigotnosti kod uzorka dece iz specijalne škole (prosečno 8,6 HRO), u odnosu na kontrolni uzorak (6,3).

Takođe utvrđene su i razlike u tipu distribucije učestalosti (Tabela 1) kod jedne trećine analiziranih osobina, tako da je 6 homozigotno recesivnih osobina značajno češće bilo prisutno kod uzorka ispitanika iz specijalne škole u odnosu na kontrolni uzorak.

Uočena je i značajna razlika u pogledu tipa varijabilnosti homozigotno recesivnih morfofizioloških odlika (Slika 1), između dva uzorka ispitanika koja ukazuju na postojanje (prisustvo) velike individualne varijabilnosti kod naših ispitanika, pri čemu ona može podstaći njihov potencijal za različite vrste prilagođavanja uključujući i njihove mentalne sposobnosti.

Uvećana genetička opterećenja ispoljena kod uzorka učenika iz specijalne škole, mogu biti jedan od uzroka delimičnog smanjenja sposobnosti na opštu inteligenciju.

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THE PROFILE OF FACE AS A FIGURATIVE REPRESENTATION OF THE DEFORMATIONS OF FIGURES AT WORLD MAPS

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Abstract

Dimensions and distribution of the deformations at geographic maps are usually represented in the three ways: by the tables of deformations with values of extreme line scales, by a contour method and by a indicatrices method. The deformations at geographic maps can be represent graphically by the profile of a human head which has a role of same big geographic object. It can be make in the same way. The chosen profile of a face in a plane is observed

like it is yet represented in Zenithal equidistant projection (Postel Projection). After that, the profile is "returned to the globe surface", that is - you order the geographic coordinates of sufficient number of its points. When it is finished then you can easy represent the profile in any of map projections like a demonstration of a deformation of shapes. This way is attractive and understandable to everyone.

Key words: geographic map, map projection, deformation, graphic way of representation deformation

Deformations are inevitable companion of geographic maps. During transformation process from the Earth's spherical surface into the plane, lengths, angles and surfaces are deformed. What will be deformed, and in which extent, as well as the distribution of deformations, depends on a projection, size, location and extending of a concrete geographic object. Dimensions of deformations can be exactly calculated in any point of a map, in any direction. Length deformations are expressed in elementary scale calculated under assumption that main scale is equal to one. Elementary scale of lengths - line scale - can be expressed in any direction, usually with its extreme values (a , b) given. Elementary scale of surfaces (p) is similarly expressed.

If line scale, or surface scale is equal to one, that means that deformations in the point are no existent; if the scales are different than one, that difference is easy to be transformed in percents of increase or decrease of a given line segment or surface. Deformations of angles are expressed by their maximum value (2ω) in the point.

Values of extreme line scales (a , b), surface scales (p) and maximum angle deformations (2ω) are usually presented in tables of deformations for some circular step (usually 10° or 15°) of latitude or zenith distances, depending on types of cartographic projections. The second way of presentation of deformation are known as isocoles, rarely isodeformates. The third way of

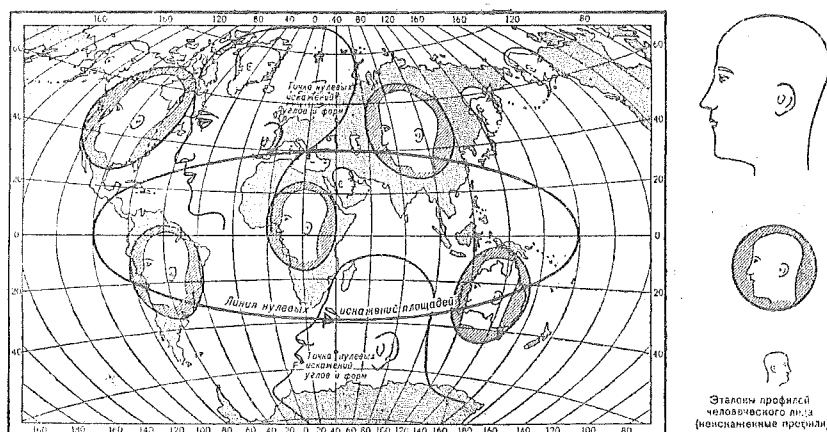


Fig.1. Profiles of face in three dimensions, as a demonstration of deformations in semiconic projection CNIIGAiK, the variant from 1950. (A.V.Gedymin, 2, p.99.)
Sl.1. Profili lica u tri veličine, kao pokazatelji deformacija u polikonusnoj projekciji CNIIGAiK, varijanta iz 1950.g. (A.V. Gedymin, 2, str.99)

presentation is also graphic as the previous one, and consists of construction of deformation ellipses - indicatrices - in characteristic points of map net of that of the used projection. Namely, each boundless small circle from spherical surface is copied into the plane as infinitely small ellipse which could be, by choosing an adequate unit, conditionally increased, giving a true "index of deformation" of forms, surfaces and lengths in all directions: location of ellipse axes directs to directions of line scales, main directions of deformation, while their lengths express extreme line scales.

Beside the three mentioned ways regularly used in cartography textbooks, and some specialized atlases, an unusual way of deformations presentation is known - by normal profile of a human head chosen to change some large geographic objects. They are used by A.B. Gedymin (1, 2) (Fig.1), but without any explanation of used procedure. What is it about?

I

A head profile chosen as a standard could be made in several sizes (extending along the whole Earth hemisphere, covering individual continents, or other large geographic objects) and then directly draw in a globe surface (Fig.2). After that, geographic coordinates of points of intersection of profiles and lines of geographic coordinate net, as well as other profile refraction points should be precisely measured. When all geographic coordinates of all points are determined, they are easy to be transferred to other cartographic nets made in any projection: spherical coordinates are converted into plain, according to formulas valid for given projection.

Disadvantage of the procedure is that it is impossible to draw profile exactly within a spherical surface: it is impossible to copy without distortion from a

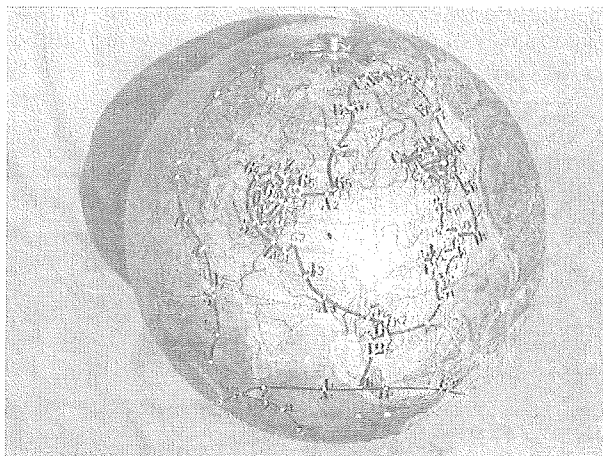


Fig.2. Profile with marked key points directly traced into the Northern hemisphere of an old globe directly.
Sl.2. Profil sa naznačenim ključnim tačkama direktno ucrtan na sjevernu hemisferu starog globusa.

spherical surface to the plane and opposite. Then, in a globe, geographic coordinates of profile key points (especially longitudes) are not possible to be determined precisely. These are reasons why some more precise and elegant way is necessary to be found, preserving some school globe from ambitious draftsmen.

II

Instead drawing the human head's profile directly onto the globe, let's just do in a sheet of paper - it is much simple. Instead "lwsogo čeloveka" from Fig.1., let's choose some more modern profile, for example the one presented in right down corner of Fig.3 (from Famous Artists Course, New York, 1960), suitable because it is very geometrized. If all key points of the profile are marked, linked by straight line, and enlarged, Fig.3 is obtained. From nearly determined profile center, an approximate circle is made, outlining the profile. Radius of the circle is equal to one ($r=1$), and polar coordinates (ρ , δ) are measured from distinguished profile points. In outer line of profile, 40 points are separated, with ordinal numeral beside each fifth one, and points in inner lines (line of hair, ear, eyebrow, eye, jaw, mouth and nose) are separately numbered. In the Table enclosed, in the first column, ordinal numbers of points are presented, in the second - angles (azimuths, α), and in the third - relative polar distances (ρ/r). In such way, discussed profile is exactly determined in the plane.

In the next step, previously made profile has to be transferred to the globe surface (Fig.4). Certainly, it is impossible to be done without deformations, and the

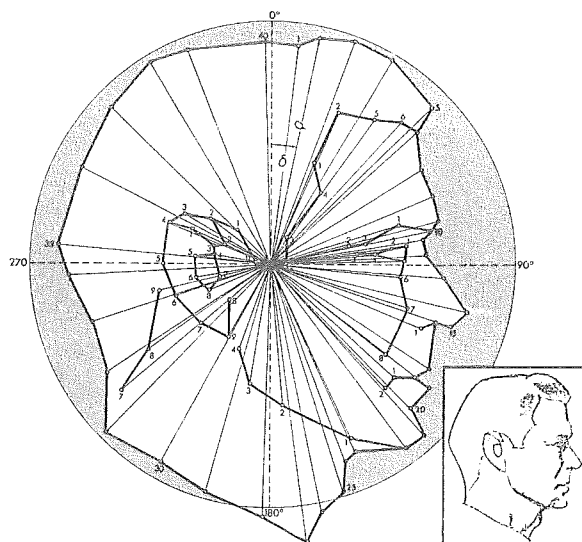


Fig.3. Profile with marked key points. Starting point is that profile is shown in azimuthal equidistant cartographic projection
Sl.3. Geometrizovani profil s naznačenim ključnim tačkama. Polazi se od toga da je profil prikazan u Postelovoj kartografskoj projekciji..

aim is to perform that transfer with as small error as possible.

Firstly, in the globe, a point coinciding with center of our profile has to be determined with meridian of the point: center of the profile for the whole hemi-

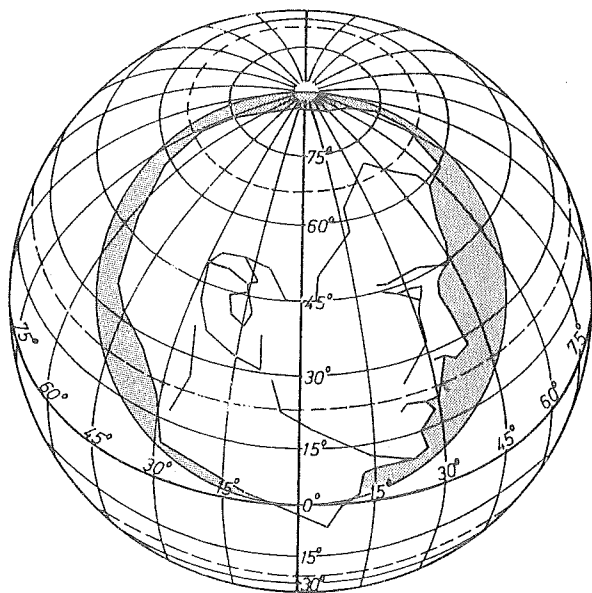


Fig.4. Profile from Fig.3, replaced on globe and shown in orthographic oblique projection.

Sl.4. Profil sa slike 3, vraćen na globus i prikazan u ortografskoj horizontskoj projekciji: $T_0(\varphi_0=45^\circ, \lambda_0=0^\circ)$.

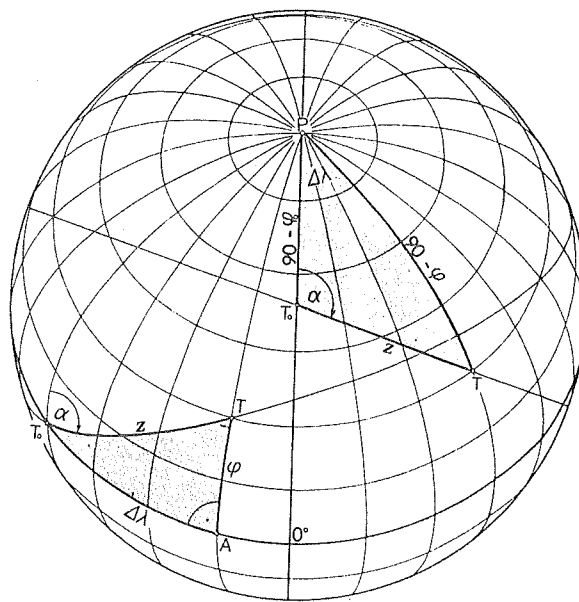
sphere will be in the determined point in $\varphi=45^\circ$ parallel, center for Africa will be in the $T(\varphi_0=0^\circ, \lambda_0=20^\circ)$, for Australia in $T(\varphi_0=-25^\circ, \lambda_0=135^\circ)$, etc. Then, the profile size is determined, in other words - spherical radius of surrounding circle. For example, profile for the whole hemisphere has to be spread from equator to the Pole, with spherical radius $r=45^\circ$, for Africa: $r=35^\circ$, for Australia: $r=15^\circ$. Further, each point of the profile is transferred to the globe surface, with unchanged azimuth and distance. In the enclosed Table, spherical distances of profile points are presented (zenith distances - z), for Northern hemisphere (the 4th column) and Africa (the 7th column), obtained by multiplication of values from the 3rd column and appropriate spherical radius values ($r=45^\circ$ and $r=35^\circ$).

Spherical polar coordinates (z, α) are enough for calculating geographical coordinates on the basis of formulas of spherical trigonometry. Let the T_0 be a center of human's head profile in the globe surface, and T - some of profile key points, which position was determined by spherical polar coordinates z and α (Fig.5). From an acute spherical triangle T_0PT , according to a cosine formula for sides,

$$\sin\varphi = \sin\varphi_0\cos z + \cos\varphi_0\cos\alpha \quad (1)$$

and to a sine formula,

$$\sin\Delta\lambda = \sin\alpha\sin z\cos^{-1}\varphi \quad (2)$$



Sl.5.

Fig.5.

where,

$$l = \lambda_0 + \Delta\lambda \quad (3)$$

In a case that center of the profile is located at equator, that is $\varphi_0=0^\circ$ (Africa), mentioned formulas are reduced. From a rectangular spherical triangle (Fig.5) T_0AT , by Neper rule:

$$\sin\varphi = \sin\alpha\sin z \quad (4)$$

$$\tan\Delta\lambda = \sin\alpha\tan z \quad (5)$$

According to the formulas: 1, 2 and 3, geographic coordinates of all profile key points for a hemisphere are calculated and results given in the 5th and 6th column of the table. According to the formulas: 4, 5 and 3, geographic coordinates for profile presenting Africa are calculated and results given in the 8th and 9th column of the table. So, the profiles are exactly determined by all their key points, even in two ways: by spherical polar (z, α) and geographic (φ, λ) coordinates. The first ones are suitable for calculations in azimuthal cartographic projections, and the second - in all others.

What has been, in fact, done in previous stages? Chosen geometrized human's head profile (Fig.3), taking a way of translating to the globe surface into consideration, could be regarded as presented in zenithal equidistant projection. Hence, profile in that projection has absolutely true appearance, which means that it has been "positively deformed" during transferring, and its real appearance is subsequently determined, transferring the profile into the globe. Such image deformation can be correctly calculated since cartographic projection, as well as a zenith distance - spherical radius of a circle outlining the profile, are known. Maximum angle deformation (2ω) in zenithal equidistant projection: $\sin\omega = z/\sin z$, for $z=45^\circ$, is equal to: $2\omega=6^\circ 01'$, and for: $z=35^\circ$ (Africa) : $2\omega=3^\circ 36'$, which

T	Polar coordinates Polarni koordinate				Profile for Northern hemisphere Profil za Sjevernu hemisferu				Profile for Africa Profil za Afriku			
	a		r/r	z°	φ		λ	z°	φ		λ	z°
	°	'			°	'			°	'		
1	7	00	0.905	40.725	83	36	45	33	31	25	24	18
2	12	00	0.950	42.750	81	24	70	35	33.250	32	26	27
3	20	20	0.979	44.055	75	45	78	58	34.265	31	52	33
4	30	10	0.975	43.875	68	59	76	08	34.125	29	01	38
5	45	10	0.922	41.490	59	19	67	00	32.270	22	07	44
6	47	10	0.809	36.405	58	42	56	54	28.315	18	49	34
7	57	20	0.731	32.895	53	14	49	48	25.585	13	29	41
8	67	00	0.721	32.445	48	09	47	45	25.235	9	35	43
9	75	20	0.710	31.950	44	00	45	25	24.850	6	06	44
10	78	00	0.657	29.565	43	26	41	39	22.995	4	40	42
11	80	30	0.631	28.395	42	39	39	37	22.085	3	33	41
12	86	40	0.635	28.575	39	50	38	27	22.225	1	16	42
13	94	30	0.713	32.085	34	43	40	07	24.955	-1	54	44
14	103	50	0.825	37.125	27	30	41	21	28.875	-6	38	48
15	109	10	0.780	35.100	26	26	37	20	27.300	-8	40	46
16	109	10	0.717	32.265	28	18	34	56	25.095	-8	00	43
17	123	20	0.780	35.100	20	48	30	55	27.300	-14	36	43
18	127	50	0.752	33.840	20	14	27	57	26.320	-15	47	41
19	127	50	0.825	37.125	17	35	30	00	28.875	-17	14	43
20	135	45	0.825	37.125	14	57	25	51	28.875	-20	14	41
21	137	50	0.943	42.435	9	41	27	21	33.005	-23	48	43
22	143	20	0.935	42.075	8	20	23	51	32.725	-25	42	41
23	155	20	0.845	38.025	9	17	15	06	29.575	-26	39	33
24	159	00	0.868	39.060	7	39	13	10	30.380	-28	10	31
25	162	00	0.982	44.190	2	12	12	12	34.370	-32	28	31
26	168	00	1.038	46.710	-1	04	8	42	36.330	-35	25	28
27	172	15	1.149	51.705	-6	25	6	07	40.215	-39	46	26
28	-178	20	1.058	46.710	-1	42	-1	13	36.330	-36	19	18
29	-164	10	0.969	43.605	2	27	-10	51	33.915	-32	28	9
30	-151	00	0.926	41.670	6	43	-18	56	32.410	-27	57	2
31	-135	50	0.968	43.560	9	57	-29	11	33.880	-23	34	-5
32	-123	30	0.808	36.360	19	46	-31	41	28.280	-15	10	-4
33	-108	10	0.773	34.785	27	04	-37	30	27.055	-8	09	-9
34	-93	40	0.836	37.620	32	10	-46	02	29.260	-1	47	-9
35	-85	10	0.880	39.600	35	39	-51	25	30.800	2	28	-10
36	-63	20	0.876	39.420	48	20	-58	43	30.660	13	14	-7
37	-46	00	0.921	41.445	58	00	-66	43	32.235	21	45	-4
38	-31	20	0.965	43.425	68	20	-74	37	33.775	28	21	0
39	-21	50	0.946	42.570	74	50	-73	03	33.110	30	28	6
40	-1	50	0.912	41.040	85	50	-16	52	31.920	31	54	18
Eye line - Linija oka												
1	81	45	0.557	25.065	43	07	35	03	19.495	2	45	39
2	82	20	0.499	22.455	43	36	31	31	17.465	2	18	37
3	82	40	0.355	15.975	44	48	22	37	12.425	1	34	32
4	84	40	0.425	19.125	43	36	26	46	14.875	1	22	34
5	88	20	0.546	24.570	40	40	33	14	19.110	0	33	39
6	95	15	0.532	23.940	38	19	31	00	18.620	-1	40	38
7	107	20	0.585	26.325	32	42	30	12	20.475	-5	59	39
8	128	05	0.600	27.000	25	23	23	03	21.000	-12	46	36
Eyebrow line - Linija obrve												
1	73	00	0.546	24.570	46	48	35	31	19.110	5	30	38
2	76	20	0.330	14.850	46	35	21	14	11.550	2	43	31
3	78	00	0.394	17.730	45	55	25	21	13.790	2	50	33
Nose line - Linija nosa												
1	113	00	0.669	30.105	28	14	31	38	23.415	-8	56	31
Mouth line - Linija usta												
1	132	30	0.684	30.780	21	17	23	53	23.940	-15	54	38
2	137	10	0.694	31.230	19	37	21	59	24.290	-17	53	37
Jaw line - Linija vilice												
1	154	45	0.787	35.415	11	52	14	38	27.545	-24	43	32
2	175	00	0.582	26.190	18	53	2	20	20.370	-20	17	21
3	-170	20	0.496	22.320	22	55	-3	58	17.360	-17	06	17
4	-160	00	0.369	16.605	29	12	-6	26	12.915	-12	07	15
Hair line - Linija kose												
1	22	10	0.457	20.565	63	08	17	03	15.995	14	47	26
2	23	50	0.685	30.825	69	50	36	54	23.975	21	49	30
3	30	30	0.127	5.715	49	50	4	30	4.445	3	50	22
4	35	40	0.362	16.290	57	08	17	32	12.670	10	16	27
5	35	40	0.731	32.895	64	55	48	20	25.585	20	32	35
6	42	15	0.794	35.730	61	36	55	39	27.790	20	11	39
7	-130	00	0.806	36.270	17	32	-28	23	28.210	-17	41	-2
8	-125	00	0.610	27.450	26	08	-24	52	21.350	-12	03	2
9	-103	00	0.487	21.915	36	38	-26	57	17.045	-3	47	3
10	90	00	0.063	2.835	44	56	4	00	2.205	0	00	22
11	-90	00	0.063	2.835	44	56	-4	00	2.205	0	00	17
Ear line - Linija uha												
1	-45	40	0.195	8.775	50	44	-9	56	6.825	4	46	15
2	-52	50	0.308	13.860	52	05	-18	06	10.780	6	29	11
3	-59	40	0.411	18.495	51	37	-26	10	14.385	7	12	7
4	-67	35	0.453	20.385	49	11	-29	31	15.855	5	59	5
5	-90	00	0.446	20.070	41	37	-27	19	15.610	0	00	4
6	-108	50	0.415	18.675	36	38	-22	11	14.525	-4	39	6
7	-130	20	0.376	16.920	32	55	-15	19	13.160	-8	28	9
8	-130	20	0.223	10.035	38	04	-9	43	7.805	-5	03	14
9	-150	15	0.348	15.660	31	00	-8	59	12.180	-10	33	13
Ear inner line - Unutrašnja linija uha												
1	-66	00	0.355	15.975	49	22	-22	43	12.425	5	01	8
2	-66	00	0.202	9.090	48	03	-12	28	7.070	2	52	13
3	-72	00	0.249	11.205	47	24	-15	51	8.715	2	41	11
4	-80	40	0.237	10.665	45	44	-15	10	8.295	1	20	11
5	-83	30	0.316	14.220	44	50	-20	08	11.060	1	15	9
6	-100	00	0.315	14.175	40	57	-18	37	11.025	-1	54	9
7	-104	30	0.216	9.720	41	50	-12	40	7.560	-1	53	12
8	-113	40	0.277	12.465	38	59	-14	44	9.695	-3	53	11

is within limits of visual bearableness. Namely, according to empirical exploration of visual recognizableness, of the image deformations we come to the knowledge that image distortions are clearly obvious at $2\omega > 8^\circ$ (2,4). Therefore, our profile, compensatory deformed in the zenithal aquidistant projection, turning back on globe does not become essentially deformed on the wholeness.

III

The tables of deformity are dull non-obvious, izocoles are often complicated and not always clear to everybody, indicatrices are obvious indicators of the deformations but only to those that are not unfamiliar with the infinite small values. That could be some general estimations of propriety of these ways of showing all three kinds of deformations. Out of all deformations the image deformations are first to observe, because, what the user see when he look at the geographic map: Surfaces of the geograph objects? The lengths of some linear objects? Neither of both: he/she first sees the images and notice their eventual distortions. The tables of deformations contain the maximal values of the deformations angles, izocoles are drawn for the integer number of degrees for the maximal angle deformations and that, at first sight, tells very little

to the user of the geographical map, especially to those that is not familiar with the mathematical cartography. Beside the already noted reservation, indicatrices are much more appropriate. but, indicatrices show the distortions of the infinitely small circles in precisely specified points on map, and not of the complete geographical object. For example, indicatrice designed on some world map in the center of Africa is not general indicator of the deformation of that continent. There emerge the space for the application of the human head profile as the indicator of the image deformation of the geographical object on the wholeness.

Not every user of the geographical map has every day globe with the geographical objects on it, with true image of the natural shapes, in front of his/her eyes, not every user of the geographical map is necessary the geographer so that he/she has the images of the geographical objects inscribed in the mind so that he/she can observe their distortions on the world maps and maps of the Earth hemisphere at the first sight. But everyone remembers the image of the normal human head profile and immediately notice the caricature distortions, and if we replace the geographical objects with such profiles we obtain the attractive way for everyone to notice the image deformations, their size and pattern.

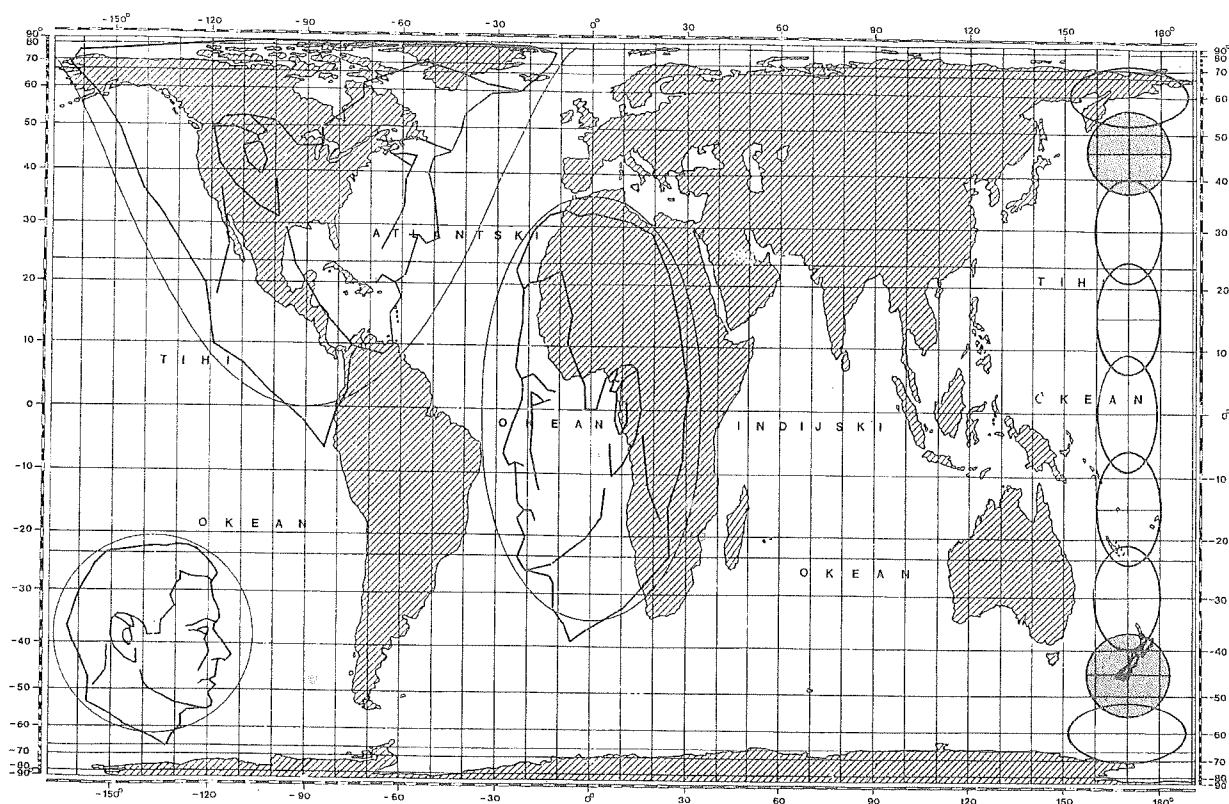


Fig.6. Map of world in projection by Peters. In the down left corner is the nondistorted profile. Right, along the meridian $\lambda=170^\circ$, indikatrixes are constructed at each 15° latitude. The profile, which has a role of Africa, is here turned round for 180° with center moved away to point $T_0(\varphi_0=0^\circ, \lambda_0=0^\circ)$.

Sl.6. Karta svijeta u Petersovoj projekciji. U donjem lijevom uglu je nedeformisan profil. Desno su duž meridijana $\lambda=170^\circ$ konstruisane indikatrixe na svakih 15 geografske širine. Profil koji je u ulozi Afrike ovdje je zaokrenut za 180° s centrom pomaknutim u tačku $T_0(\varphi_0=0^\circ, \lambda_0=0^\circ)$.

As the example, we take the recently very popular world map designed in so called Peter's projection. With only respect toward the simplicity of the construction, it is equivalent cylindrical projection with quite modest characteristics, and blown by an aggressive advertisement, inappropriate for the cartographic practice. (It is understandable since the maker of this projection is Arno Peters, primarily the expert for propaganda.) Eagerly trying to unmask Peter's cartographic demagoguery, German cartographers achieved quite opposite effect: the map was sold even better. The author personally, and through his cartography "advocates", was excited the polemics forcing the honorable cartographers to prove things to much: in that why he was making even better advertisement for himself and completely absorbed critics. And there was nothing to be proved. It was enough to, for example, use our profiles (Fig.6), one for the whole hemisphere and one for Africa. To see the excessive image deformations there is no need to have cartographic experience nor any mathematical and geographical knowledge.

So, adding the selected well known human head profile, recognizable to everyone, to certain geographical objects and Earth hemispheres, and its drawing on the cartography nets for the geographical world maps and maps of the Earth hemispheres, it is possible to present and explain image deformations in various cartographic projections not only obviously, but also in convincing and interesting way. It is an attractive and effective way, applicable in popular papers for non-cartographers, in cartographic polemics, lectures and, especially, in the teaching of geography. Enclosed table makes the procedure accessible to everyone: by assigning the data from it to concrete formulas for rectangular and polar coordinates, anyone can draw the suggested profile in cartographic net in any projection.

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REZIME

PROFIL LICA KAO SLIKOVIT POKAZATELJ DEFORMACIJA LIKOVA NA KARTAMA SVIJETA

Milutin TADIĆ

Pored uobičajnih načina prikazivanja veličine i rasporeda deformacija na geografskim kartama urađenim u raznim kartografskim projekcijama (tablice deformacija, izolinijske, indikaurise) postoji i jedan atraktivan slikovit način kod koga se geografski objekti zamjenjuju profilom ljudske glave primjerene veličine (sl.1, sl.2.). Kako se to radi?

1. Pretpostavi se da je normalni profil ljudskog lica, kao, na primjer, onaj na sl.3, već prikazan u Postelovoj kartografskoj projekciji - t.j. pretpostavi se da je profil pri prelazu sa globusa na ravan "pozitivno deformisan". Izabere se tačka u centru profila i u odnosu na nju odrede polarne koordinate (ρ , α) svih prelomnih tačaka profila.

2. U drugoj fazi se profil "vraća na globus" (sl.4) tako što se iz poznatih obrazaca za polarne koordinate u Postelovoj kartografskoj projekciji prvo odrede sferne polarne koordinate (z , α) svih izabranih tačaka profila na globusu, a potom, prema obrascima 1-5, i geografske koordinate (ϕ , λ) istih tačaka (priložena tabela).

3. Kada su poznate geografske koordinate svih ključnih tačaka profila, onda ga je lako prikazati, u ulozi datog geografskog objekta, na mreži konstruisanoj u bilo kojoj kartografskoj projekciji, kao što je to ovdje urađeno (sl.6) na mreži tzv. Petersove projekcije da bi se pokazalo kako je njena vrijednost naduvana agresivnom reklamom.

Ovdje prikazani slikoviti način prikazivanja deformacija likova geografskih objekata je atraktivan i svima razumljiv: korisnik geografske karte može da ne uoči razmjere deformacija nekog geografskog objekta (jer, recimo i ne zna kako taj objekat izgleda na globusu), ali zato odmah opaža i najmanje iskrivljenje profila ljudskog lica.

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The Research of Radioactive Elements Content in The soil Within The Zone of Influence of the Kosovian Coal Power Plants

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ABSTRACT

The content of natural radionuclides in the samples of uncultivated soil from 17 measuring spots, that are located in certain zones of influence by the Kosovian coal power plants, as well as from the 3 measuring spots of an insignificant influence, has been determined by the gamma spectrometric method. The distribution of natural radionuclides, in closer and further surrounding of the Kosovian coal power plants, has

been monitored as was its vertical migration in various types of soil.

Specific activities of natural radionuclides in the samples researched, varied from 13.1 to 46 Bq/kg for ²²⁶Ra; from 16.3 to 53 Bq/kg for ²³²Th; from 0.8 to 3.1 Bq/kg for ²³⁵U; from 18 to 68 Bq/kg for ²³⁸U and from 91 to 595 Bq/kg for ⁴⁰K.

Key words: natural radionuclides, soil, gamma spectrometry, coal power plants

INTRODUCTION

By burning the coal, as well as during the process of its drying, crashing and gasification, numerous pollutants of chemo-toxic and radio-toxic activities are emitted in the environment. Coal power plants represent one of greater causes of natural radioactivity redistribution, since, by burning the organic components in the coal, the coal volume decreases to slag and ash, that inevitably leads to the concentration of radioactive material within. Therefore, the concentration of natural radionuclides in the ash and slag from the coal power plants, is significantly larger, compared to the concentration in the earth's crust (1).

As radionuclides reach the soil, their vertical and horizontal migration takes place. Their migration ability primarily depends on the physical-chemical characteristic of the soil and of the chemical form of certain radionuclides with the soil is a very complex one and is characterized by the processes of adsorption, absorption, ionic exchange and depositing.

The greatest danger for the population of Obilić, Kosovo Polje, Priština, as well as, of even remote area from coal power plants, regarding not only chemo-toxic but also radio-toxic contaminants, comes from the flying ash, emitted by the chimneys of Kosovo A coal power plant. Kosovo A coal power plant represents a real ecological challenge for this region, as it emits into the atmosphere, through its chimneys, over 15% of ash produced (2).

MATERIAL AND METHODS

The inspection of radionuclides content in the soil has been done on the samples collected from 20 measuring spots. The measuring spots were distributed within the range of 40 km, with the Kosovo A and Kosovo B coal power plants being in the center. To compare the measuring results, the samples were taken from the 3 measuring spots that were out of the coal power plants influence.

The collection of samples was made from incultivated soil by a special drill, that enabled the sampling from the depths ranging from 0-5 cm, 5-10 cm and 10-15 cm. The soil samples were cleaned from the herbal material and after complex quartering and drying at a temperature of 105°C, ground to the granulation of fine powder and brought down to constant mass. Besides grinding and drying, the samples were not exposed to any other physical or chemical treatment. After the homogenization was done and the samples were brought down to a constant mass, the samples were measured and filled into Marinelli beakers (0.5 l). Then, Marinelli beakers were closed by the bee wax for the purpose of air-tightness and were left to be kept for 30 days (before the beginning of measuring) in order to establish radioactive equilibrium.

The measuring of the radioactive material gamma activity in the samples inspected, was implemented by a multi-channel ORTEC gamma analyzer, by the HP GE detector of 20% relative efficiency, and by the resolution of 1.8 keV at an energy of 1332 keV ⁶⁰Co. The spectrometer energy calibration has been done by a series of standard point sources (Coffet d'etalon ECGS

— 2, Sacle) that contains radionuclides of ^{133}Ba , ^{60}Co , ^{137}Cs , ^{22}Na and ^{241}Am (the activity of 1461 Bq/kg dated Nov. 25, 1977). Geometric efficiency of the spectrometer was determined by the reference material — soil, contaminated by a series of radionuclides: ^{22}Na , ^{57}Co , ^{60}Co , ^{88}Y , ^{133}Ba and ^{137}Cs of the activity between 122-355 Bq/kg determined with a total uncertainty of 5% (3).

Identification of certain radionuclides was done through characteristic series of total absorption of gamma radiation. The ^{226}Ra and ^{232}Th activity was determined through their ^{214}Bi , ^{214}Pb and ^{228}Ac descendants, the ^{208}Tl , respectively. The ^{235}U activity was determined at an energy of 185.83 keV, with the corrected ^{226}Ra (186 keV). The ^{40}K activity was determined on the basis of only gamma transition at 1460.8 keV. The impulse time collecting, the spectrum screening time respectively, amounted from 10^5 — $3 \cdot 10^5$ s depending on the sample activity.

THE RESULTS

The results of determination of the natural radionuclides specific activities (Bq/kg) in the soil samples from 20 inspected locations are shown in Table 1.

Table 1 indicates that inspected natural radionuclides are identified in the samples of the soil from all the locations. In the soil samples that were tested in the coal power plants immediate vicinity, such are the samples from the location No. 5 — coal power plant yard, then the samples from the location No. 9 — Kruševac settlement, location No. 14 — Obilić, location No. 16 — Plemetina settlement, location No. 17 — Ade village, location No. 7 — Mazgit settlement, as well as, the samples from the location No. 18, 11 — Kosovo Polje, the activities concentrations of the majority of natural radionuclides are the greatest. The locations mentioned are from 1-6 km away from the coal power plants.

Figure 1 present specific activities natural radionuclides (Bq/kg) of the collective samples from certain localities, dependent of the distance from the Kosovan coal power plants.

Locations away from 6-15 km from coal power plants, are as follows: Belačevac (No. 4), Kuzmin (No. 15), Priština (No. 13), Laplje Selo (No. 19), Sofalija (No. 3), Babin Most (No. 8), Lebane (No. 10) and Breznica (No. 6). The specific activity radionuclides of the soil from these locations has got wide range of values (from 21-30 Bq/kg for ^{226}Ra , 21-39 Bq/kg for ^{232}Th , 26-48 Bq/kg for U and 176-439 Bq/kg for ^{40}K).

Measured activities of the samples from the soil from the locations of Mramor (No. 20), Dobrotin (No. 12) and Batlava (No. 2) were used for the purpose of the results comparison, since the coal power plants influence on the above mentioned locations is minimal and irrelevant. The activities concentrations in these samples for comparison were present in the following

range: 14-19 Bq/kg for ^{226}Ra , 17-20 Bq/kg for ^{232}Th , 20-25 Bq/kg for ^{238}U and 105-117 Bq/kg for ^{40}K .

Natural radionuclide activities in the soil samples at a depth of 0-5 cm were present in the following range: ^{226}Ra activity ranged from 15-46 Bq/kg, ^{232}Th activity was within the interval of 16-53 Bq/kg, ^{235}U activity from 1.2-3.1 Bq/kg, ^{238}U activity from 26-67 Bq/kg and ^{40}K activity was within the interval of 109-595 Bq/kg.

The levels of the natural radionuclide activities in the soil samples at a depth 5-10 cm were of the following range: ^{226}Ra activity ranged from 13-41 Bq/kg, ^{232}Th activity was within the interval of 15-48 Bq/kg, ^{235}U activity from 1.1-2.9 Bq/kg, ^{238}U activity from 23-62 Bq/kg and ^{40}K activity was within the interval of 104-589 Bq/kg.

Natural radionuclide activities in the soil samples at a depth of 10-15 varied within the following limits: ^{226}Ra activity ranged from 12-39 Bq/kg, ^{232}Th activity was within the interval of 16-45 Bq/kg, ^{235}U activity from 0.8-2.2 Bq/kg, ^{238}U activity from 18-56 Bq/kg and ^{40}K activity was within the interval of 91-489 Bq/kg.

DISCUSSION AND CONCLUSIONS

Significant fluctuations were observed in the radiation level of the soil samples. The research results indicate significant increase of the activity concentrations in the soil samples collected near by the coal power plants. The settlements, situated in an enormous quantity of emitted fly ash from the chimneys during windless period, with a monthly dust deposits volume in Obilić, Kruševac and surrounding settlements near by the coal power plants, ranging even over $2.500 \text{ mg/m}^2 \text{ d}$.

However, the increase of the soil samples radioactivity is also present within larger distance from the coal power plants, primarily on the locations situated within the range of dominant wind routes with the wing distributed fly ash emitted from huge unprotected deposits of ash and coal dust. Figure 2 presents the wind rose, based on the data observed in the climatological terms for the period of 1975-1985 in the measuring station of Priština.

The wind rose presented indicates the dominant winds are N (7.20%), SSW (7.00%), SW (6.80%), NE (5.90%) and NNE (3.80%). The soil samples from the locations, influenced by the winds of the routes mentioned (location No. 15 — Kuzmin, location No. 4 — Belačevac, the location No. 10 — Lebane, location No. 8 — Babin Most, location No. 6 — Breznica), contain increased levels of activity, although some of these are far away from the power plants over 15 km.

Location No. 13 — Priština-Sunčani Breg, then location No. 3 — Sofalija, as well as, location No. 1 — Janjevo, situated within the range of the E, ESE, SE wind routes, do have significantly lower levels of activity compared to the locations situated within the

Table 1. Specific activities natural radionuclides in the soil samples (Bq/kg) in closer and further surrounding of the Kosovian coal power plants

Tabela 1. Specifične aktivnosti prirodnih radionuklida u uzorcima zemlje (Bq/kg) u neposrednoj i daljoj okolini kosovskih termoelektrana

Locality Lokalitet	Soil Depth Dubina tla (cm)	²²⁶ Ra	²³² Th	²³⁵ U	²³⁸ U	⁴⁰ K
1	0 - 5	20.1 ± 1.9	17.4 ± 1.9	1.0 ± 0.1	23 ± 2	109 ± 10
	5 - 10	19.3 ± 1.8	17.1 ± 1.9	1.2 ± 0.1	27 ± 3	110 ± 12
	10 - 15	17.1 ± 1.5	16.5 ± 1.8	1.2 ± 0.1	25 ± 2	103 ± 10
2	0 - 5	17.3 ± 1.6	19 ± 2.2	0.9 ± 0.1	20 ± 2	132 ± 11
	5 - 10	16.2 ± 1.5	20 ± 2.2	1.0 ± 0.1	22 ± 2	130 ± 11
	10 - 15	17.0 ± 1.5	21 ± 2.3	1.1 ± 0.2	24 ± 2	99 ± 10
3	0 - 5	25 ± 3	28 ± 3	2 ± 0.2	43 ± 5	354 ± 24
	5 - 10	21 ± 2	18 ± 2	1.8 ± 0.3	41 ± 4	312 ± 20
	10 - 15	17.5 ± 1.6	17.2 ± 1.5	1.6 ± 0.2	35 ± 4	310 ± 19
4	0 - 5	35 ± 4	46 ± 4	2 ± 0.2	43 ± 6	358 ± 28
	5 - 10	33 ± 3	30 ± 3	1.5 ± 0.2	32 ± 4	340 ± 27
	10 - 15	26 ± 3	29 ± 3	1.3 ± 0.2	28 ± 4	310 ± 25
5	0 - 5	34 ± 3	50 ± 5	2.4 ± 0.3	52 ± 5	508 ± 34
	5 - 10	35 ± 4	43 ± 4	2.5 ± 0.3	54 ± 5	554 ± 36
	10 - 15	33 ± 3	38 ± 4	2.1 ± 0.3	46 ± 4	380 ± 28
6	0 - 5	30 ± 3	47 ± 5	2.3 ± 0.3	50 ± 6	512 ± 35
	5 - 10	29 ± 3	36 ± 4	2.1 ± 0.3	46 ± 4	440 ± 29
	10 - 15	22 ± 2	24 ± 3	1.8 ± 0.2	41 ± 5	280 ± 25
7	0 - 5	35 ± 3	50 ± 5	3.0 ± 0.3	66 ± 7	454 ± 31
	5 - 10	38 ± 4	31 ± 3	2.8 ± 0.3	62 ± 6	450 ± 30
	10 - 15	33 ± 4	29 ± 3	2.7 ± 0.3	58 ± 6	320 ± 25
8	0 - 5	34 ± 3	45 ± 4	2.6 ± 0.3	57 ± 5	570 ± 31
	5 - 10	30 ± 3	44 ± 4	2.5 ± 0.3	54 ± 5	520 ± 41
	10 - 15	26 ± 3	29 ± 3	1.4 ± 0.2	30 ± 3	460 ± 36
9	0 - 5	46 ± 5	51 ± 5	3.1 ± 0.3	68 ± 7	593 ± 49
	5 - 10	44 ± 4	40 ± 4	3.0 ± 0.3	66 ± 7	587 ± 45
	10 - 15	36 ± 3	39 ± 4	2.8 ± 0.2	60 ± 6	489 ± 34
10	0 - 5	34 ± 3	47 ± 4	2.4 ± 0.3	52 ± 6	471 ± 32
	5 - 10	33 ± 3	35 ± 3	2.1 ± 0.2	46 ± 5	456 ± 31
	10 - 15	26 ± 3	36 ± 3	2.2 ± 0.2	48 ± 4	390 ± 26

Tabele 1 - continued
Tabela 1 - nastavak

Locality Lokalitet	Soil Depth Dubina tla (cm)	^{226}Ra	^{232}Th	^{235}U	^{238}U	^{40}K
11	0 - 5	42 ± 4	48 ± 4	3.0 ± 0.3	66 ± 7	458 ± 41
	5 - 10	36 ± 3	45 ± 4	2.9 ± 0.3	63 ± 6	389 ± 35
	10 - 15	28 ± 3	31 ± 3	2.6 ± 0.3	56 ± 6	230 ± 21
12	0 - 5	13.1 ± 1.8	16.3 ± 1.8	0.9 ± 0.1	20 ± 2	118 ± 10
	5 - 10	15.3 ± 1.8	17.4 ± 1.9	1.0 ± 0.1	22 ± 2	129 ± 12
	10 - 15	14.8 ± 1.7	19.1 ± 1.9	0.8 ± 0.1	18 ± 2	99 ± 10
13	1 - 5	34 ± 4	21 ± 2	1.3 ± 0.2	29 ± 3	240 ± 23
	5 - 10	25 ± 3	22 ± 2	1.3 ± 0.2	28 ± 3	205 ± 15
	10 - 15	23 ± 3	18 ± 2	1.2 ± 0.2	26 ± 3	91 ± 10
14	0 - 5	40 ± 4	49 ± 4	1.9 ± 0.2	41 ± 4	448 ± 36
	5 - 10	32 ± 3	45 ± 4	2.1 ± 0.2	46 ± 5	393 ± 31
	10 - 15	31 ± 3	48 ± 4	1.7 ± 0.2	37 ± 4	430 ± 35
15	0 - 5	37 ± 4	45 ± 4	2.0 ± 0.2	43 ± 4	298 ± 28
	5 - 10	27 ± 3	34 ± 4	1.8 ± 0.2	40 ± 4	251 ± 23
	10 - 15	26 ± 3	36 ± 4	2.1 ± 0.2	45 ± 5	238 ± 22
16	1 - 5	42 ± 4	47 ± 4	3.1 ± 0.3	67 ± 7	595 ± 53
	5 - 10	41 ± 4	41 ± 4	2.7 ± 0.3	59 ± 6	589 ± 51
	10 - 15	32 ± 3	34 ± 3	2.5 ± 0.3	55 ± 6	368 ± 33
17	0 - 5	44 ± 4	53 ± 5	2.3 ± 0.3	50 ± 5	575 ± 45
	5 - 10	34 ± 3	43 ± 4	2.2 ± 0.3	48 ± 5	549 ± 44
	10 - 15	39 ± 4	36 ± 4	2.0 ± 0.2	43 ± 4	489 ± 39
18	0 - 5	39 ± 4	39 ± 4	2.3 ± 0.2	50 ± 5	499 ± 42
	5 - 10	35 ± 4	36 ± 3	2.4 ± 0.2	52 ± 5	445 ± 32
	10 - 15	33 ± 3	35 ± 3	2.1 ± 0.2	46 ± 5	380 ± 34
19	1 - 5	24 ± 2	36 ± 4	1.6 ± 0.2	34 ± 4	297 ± 28
	5 - 10	25 ± 2	22 ± 2	1.5 ± 0.2	32 ± 3	268 ± 24
	10 - 15	23 ± 2	20 ± 2	1.5 ± 0.2	33 ± 3	198 ± 20
20	1 - 5	16.3 ± 1.7	19 ± 2	1.2 ± 0.1	26 ± 2	113 ± 12
	5 - 10	16.4 ± 1.7	21 ± 2	1.1 ± 0.1	23 ± 2	104 ± 11
	10 - 15	15.1 ± 1.7	19 ± 2	1.1 ± 0.1	22 ± 2	99 ± 10

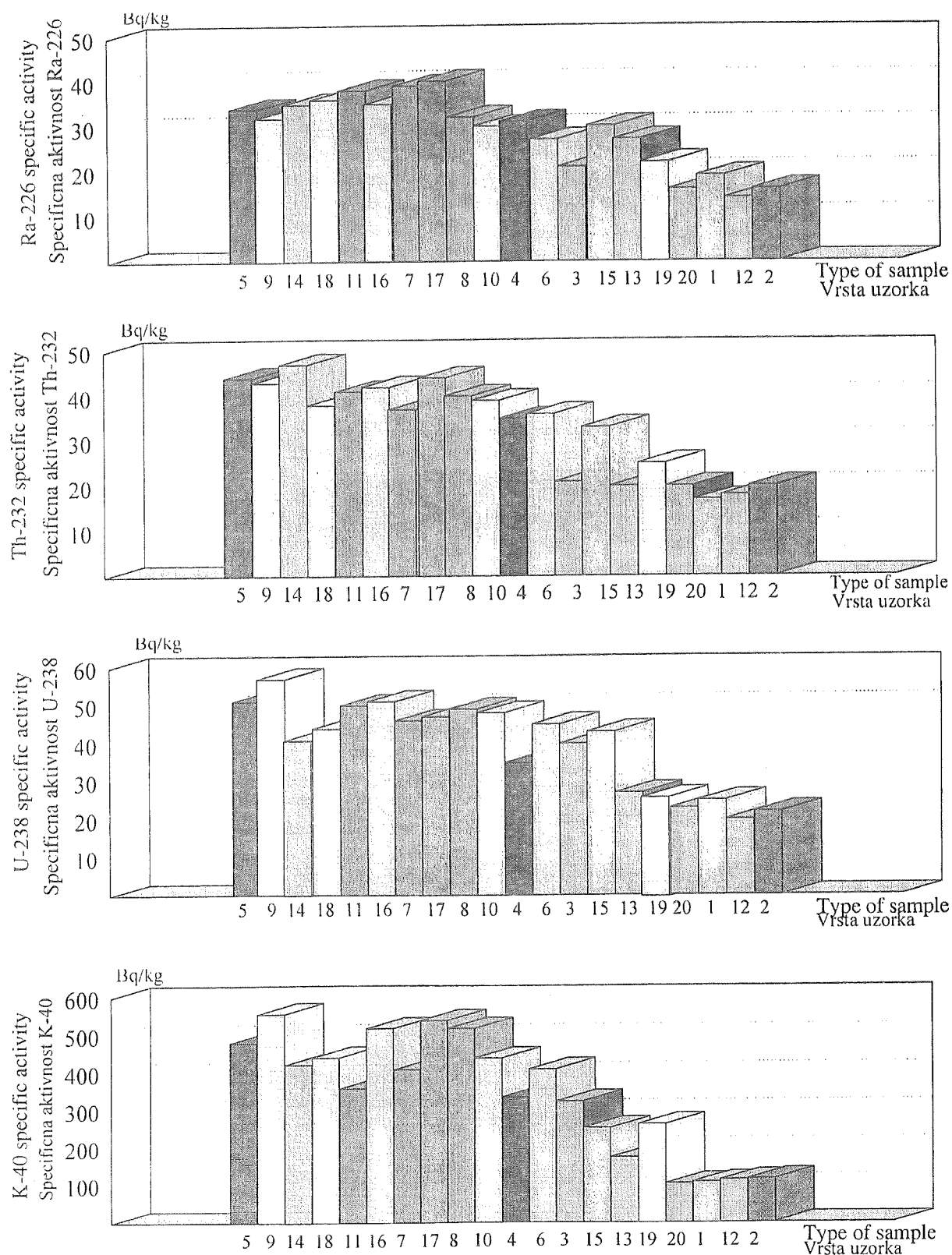


Figure 1. Specific activities of ^{226}Ra , ^{232}Th , ^{238}U & ^{40}K in the collective samples of the soils from the locations that are of a different distance from the Kosovan coal power plants
Slika 1. Specifične aktivnosti prirodnih radionuklida (Bq/kg) zbirnih uzoraka tla u zavisnosti od udaljenosti lokacija od kosovskih termoelektrana

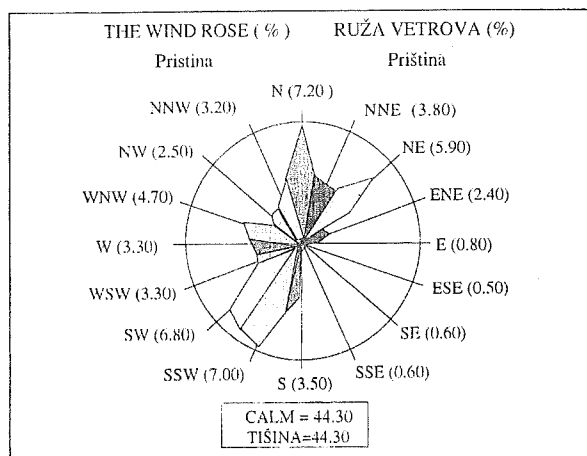


Figure 2. The wind rose of 16 routes, according to data of the measuring station of Priština for the period of 1975-1985 (5). Slika 2. Ruža vetrova od 16 pravaca, prema podacima merne stanice Priština za period od 1975-1985

range of the dominant winds influence (Figure 1). The statement mentioned is the most obvious in the example of No. 13 and 14 samples.

Location No. 13 — Priština (Sunčani Breg) and location No. 4 — Belačevac are situated almost at the same distance from the coal power plants. The soil samples from both of the locations belong to a typical clayey type. The activity concentration in the soil samples from location No. 13 — Priština are of the following ranges: 23-24 Bq/kg for ^{226}Ra , 18-22 Bq/kg for ^{232}Th , 1.2-1.3 Bq/kg for ^{235}U , 2-29 Bq/kg for ^{238}U and 91-240 Bq/kg for ^{40}K , while for the location No. 4 — Belačevac the ranges are the following: 26-35 Bq/kg for ^{226}Ra , 29-46 Bq/kg for ^{232}Th , 1.3-2.0 Bq/kg for ^{235}U , 32-43 Bq/kg for ^{238}U and 310-358 Bq/kg for ^{40}K . It could be seen, the content of the majority of natural radionuclides in the samples of the location No. 4 is almost twice larger compared to the amount of radionuclides in the samples of the location No. 13.

Verical distribution of radionuclides in the soil indicates the following trend: radionuclides concentration in the majority of samples is maximal in the surface layer from 0-5 cm of the soil depth. As the soil depth increases, the radionuclides concentration decreases. It has observed that the degree of the activity concentration in the soil also depends of the type of soil, i.e., the radionuclides vertical distribution is significantly different respective of various types of soil.

In sandy soil (samples of the location No. 6, 12, 19 and 20), radionuclides are mainly distributed regularly per depth profiles, due to low ability of the soil type in absorbing cations, i.e., it has expressed ion-exchanging characteristics, that does not apply to loamy cleyey and humus soil.

In the soil samples of the cleyey type (locations 3, 4, 10, 15, 16, 17 and 18), the radionuclides concentration was the largest in the surface layers, which could be explained by the fact that, board-like particles

of secondary aluminium-silicates, constaning clay, contain plenty of negative surface electricity charge, attracting radionuclides ions to its surface (4).

In the soil samples of the humus (location 5 and 1) the radionuclides concentration was the largest in the depth layer of 10-15 cm, which could be the consequence of the radionuclides re-distribution within the system of soil-herbs. The resorption of certain long-living radionuclide by a herb, greatly depends, of whether the respective remains within the range of absorption of the herb root system, as well as, in which volume the respective is chemically available. The manner, that certain radionuclide is distributed on different fractions, determines the period, the respective may remain at the deposition, so as the volume of its availability to herbs.

The results achieved indicate the need of regular control of the coal power plant surrounding radiation and the data collected for systematic approach to investigate the correlation existing between the increased degree of living environment radioactive contamination and the meteorological conditions, since the atmospheric pollution. Table 2 presents the content of natural radioactive elements in the samples of ash and slag of the Kosovian coal power plants (6).

The Table 2 enclosed indicates that concentration of the majority of natural radionuclides is the greatest in the samples of fly ash from the chimney funnel. The flay ash particles from the chimney funnel are of a very smal diameter ($\approx 20 \mu\text{m}$). As fine powder particles cool faste than the larges ones, the steam containing radioactive nuclides, condense increasingly on the respective during the movement of hot smoke gases on its way from the steam boiler to the chimney. Similar result was achieved by other researches too (7). While the radiation, present in larger ash particles, could be decreased to a tolerant level by using the efficient electrofilter systems, radioactive risk for the population living nearby the coal power plant, resulting from fine fly ash particles could be somewhat moderated by increasing the height of the coal power plant chimney. However, increasing the height of the coal power chimney, the coal power plant influence lengthens to larger area.

As wider research of the field around the Kosovian coal power plants was done, the concentration could be made, the radionuclide content in the soil decreases in accordance with the distance from the respective coal power facilities. Based on the achieved measuring results, a tight link is obvious between the activity concentration of natural radionuclides in the soil and the air-sediments of the Kosovian coal power plants. Therefore, coal exploitation and its burning in the Kosovo A and Kosovo B coal power plants are potentially the most significant processes for the creation of technologically increased levels of natural radiation in closer and more distant environment of the Kosovian coal power plants.

Table 2. Specific activities of natural radionuclids (Bq/kg) in ash and slag from the Kosovian coal power plants
 Tabela 2. Specifične aktivnosti prirodnih radionuklida (Bq/kg) u pepelu i šljaci kosovskih termoelektrana

Sample No. Uzorak br.	Type of sample Vrsta uzorka	^{226}Ra	^{232}Th	^{235}U	^{238}U	^{40}K
1a	ash from bunker pepeo iz bunkera	20 ± 2	20 ± 2	$2,2 \pm 0,2$	48 ± 6	150 ± 13
2a	ash from palletizer pepeo iz paletizatora	67 ± 5	31 ± 3	$6,5 \pm 0,6$	138 ± 13	219 ± 18
3a	ash from electrofilter pepeo iz elektrofiltera	23 ± 2	18 ± 2	$2,0 \pm 0,2$	46 ± 5	228 ± 9
4a	ash from chimney funnel I pepeo iz levka dimnjaka I	48 ± 3	26 ± 2	$4,0 \pm 0,3$	87 ± 8	189 ± 14
5a	ash from chimney funnel II pepeo iz levka dimnjaka II	51 ± 5	22 ± 2	$2,1 \pm 0,2$	45 ± 5	282 ± 21
6a	ash from chimney funnel III pepeo iz levka dimnjaka III	69 ± 6	42 ± 4	$5,9 \pm 0,5$	129 ± 14	236 ± 18
7a	ash from substation pepeo iz podstanice	65 ± 5	30 ± 2	$5,5 \pm 0,5$	119 ± 13	229 ± 17
8a	ash from depository I pepeo sa deponije I	44 ± 3	28 ± 2	$4,8 \pm 0,3$	104 ± 16	210 ± 17
9a	ash from depository II pepeo sa deponije II	41 ± 3	25 ± 2	$4,1 \pm 0,3$	89 ± 8	208 ± 16
10s	ash and slag from laguna pepeo i šljaka sa lagune	$10,1 \pm 1,0$	30 ± 3	$5,0 \pm 0,4$	109 ± 9	211 ± 17
11s	slag from bunker šljaka iz bunkera	$12,5 \pm 1,7$	$13,7 \pm 1,2$	$1,7 \pm 0,1$	37 ± 4	163 ± 15
12s	slag from substation šljaka iz podstanice	20 ± 2	23 ± 2	$2,0 \pm 0,2$	77 ± 7	243 ± 30
13s	slag from depository I šljaka sa deponije I	24 ± 2	26 ± 2	$3,5 \pm 0,3$	77 ± 8	183 ± 14

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REZIME

ISTRAŽIVANJE SADRŽAJA RADIOAKTIVNIH ELEMENATA U ZEMLJIŠTU U ZONI UTICAJA KOSOVSKIH TERMoeLEKTRANA

ADROVIĆ F., PAPOVIĆ R., NINKOVIĆ M. i Dragana TODOROVIĆ

U radu je gama spektrometrijskom analizom određen sadržaj prirodnih radionuklida u uzorcima neobradivog tla sa 17 mernih mesta, koja se nalaze u određenim zonama uticaja kosovskih termoelektrana, kao i sa 3 merna mesta gde je taj uticaj zanemarljiv. Praćena je distribucija prirodnih radionuklida u bližoj i daljoj okolini kosovskih termoelektrana, kao i njihova vertikalna migracija u različitim vrstama tla.

Kako je za merenje radioaktivnosti zemljišta ključno mesto tj. lokacija sa koje se vrši uzorkovanje,

merna mesta su tako izabrana da bi se najverodostojnije mogao proceniti uticaj kosovskih termoelektrana. Da bi se isključio uticaj veštačkih fosfatnih đubriva na nivoe prirodne aktivnosti u zemljištu, uzorkovanje je vršeno sa neobradivog tla.

Opažene su znatne fluktuacije nivoa radioaktivnosti uzoraka zemljišta. Rezultati istraživanja ukazuju na znatnije povećanje koncentracije aktivnosti uzoraka zemljišta sakupljenih u blizini termoelektrana. Naselja koja se nalaze u neposrednoj blizini termoelektrane Kosovo-A, izložena su velikoj količini emitovanog lebdećeg pepela iz dimnjaka za vreme tišina vetra. Međutim, povećanje radioaktivnosti uzoraka tla primetno je i na većim rastojanjima od termoelektrana, prvenstveno na lokacijama koje se nalaze na dominantnim pravcima vetrova, koji raznose lebdeći pepeo ispušten iz dimnjaka, kao i prašinu sa ogromnih nezaštićenih deponija pepela i ugljene prašine.

Jednako je bilo važno standardizovati i dubinu sa koje je uziman uzorak zemljišta zbog vertikalne migracija radionuklida. Uzorkovanje je vršeno sa tri dubine: 0-5 cm; 5-10 cm; i 10-5 cm. Koncentracija aktivnosti prirodnih radionuklida kod većine uzoraka tla je maksimalna u površinskom sloju od 0-5 cm dubine zemljišta. Sa povećanjem dubine tla, koncentracija radionuklida se smanjuje. Uočeno je da stepen koncentrisanja aktivnosti u zemljištu zavisi i od vrste zemljišta, odnosno, distribucija radionuklida po vertikalni bitno je različita kod raznih tipova zemljišta. Kod peskovitog tla (uzorci lokaliteta br. 6, 12, 19 i 20)

radionuklidi su uglavnom uniformno distribuirani po dubinskim profilima, usled slabe sposobnosti ovog tipa zemljišta da adsorbuje katjone, odnosno, ima slabo izražene jonoizmenjivačke osobine, što se ne može reći za ilovastu glinušu, glinušu i crnicu.

U uzorcima zemljišta tipa glinuše (lokaliteti 3, 4, 10, 15, 16, 17 i 18), koncentracija radionuklida daleko je bila najveća u površinskim slojevima, što se može objasniti činjenicom da pločaste čestice sekundarnih aluminijum-silikata, koje sačinjavaju glinu, sadrže obilje negativnog površinskog naelektrisanja koje privlače jone radionuklida ka svojoj površini. U uzorcima zemljišta tipa crnice (lokaliteti 5 i 1) koncentracija radionuklida bila je najveća u sloju dubine 10-15 cm, što može biti posledica preraspodele radionuklida u sistemu zemljište — sitno rastinje.

Neosporno je da postoji ne mali rizik od zagađenja životne sredine u obližnjim urbanim i agrikulturnim sredinama koji dolazi od sistema kosovskih termoelektrana. Kako se prirodni radionuklidi koncentrišu u zemlji, a zatim se ugrađuju metabolički u biljke ili direktno prelaze u životinje i ljude koji se hrane kontaminiranim biljkama, neophodno je preduzeti odlučne korake u smislu rešavanja efikasnosti elektrofilterskog sistema termoelektrana kako bi posledice po zdravlje okolnog stanovništva bile što manje.

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Properties of the radicals of a nonassociative near- ring

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ABSTRACT

In this paper we have examined some properties of the radicals of a nonassociative and nondistributive near-ring, some properties of the radicals of a nonassociative distributively generated (d.g.) near-ring and, in particular, some properties of the radicals of a left d.g. nonassociative near-ring S which satisfy the descending chain condition (d.c.c) for right S -subgroups.

We show that some of the properties of the radicals of associative d.g. near-rings generalize for d.g. nonassociative near-rings (See Th.1., Cor.of Th.1.and Th.5.). Also, in Th.1. we have proved that radical $J(S)$ of a left unitary d.g. nonassociative and nondistributive near-ring S contains all the group-potent right S -subgroups

If a nonassociative d.g. near-ring S satisfies the d.c.c for the right S -subgroups of $(S,+)$ and I a right normal minimal S -subgroup such that the radical $J(S) \supseteq I$, then S has no I -potent right S -subgroups P so that $P \supset I$ if, and only if $J(S) = I$ (Th.3.).

If a unitary d.g. nonassociative near ring S satisfies the d.c.c. for right quasiregular S -subgroups $P^{(i)}$, $i=1,...,n$, $n+1,...$, and $(P^{(n)}, I, P^{(n)}) \subseteq I$, where I is a right S -subgroup so that $P \supseteq I$, then P is I -potent (Th.8. and Cor.1. and 2. of Th.6.)

Following Laxton we gave a number of equivalent conditions for a left d.g. unitary nonassociative near-ring satisfying the d.c.c. for right S -subgroups which has a group-potent radical.

Key words: near- ring, radical, quasiradical, group-potency

INTRODUCTION

The definitions and some properties of the radicals of an associative d.g. near-ring has been done by Laxton (Cf [0], [1] and [2]) as well as some properties of the radicals of a d.g. associative near-ring R which satisfy the d.c.c. for left R -modules of R ([1] and [2]).

This part of theory of the radicals of a nonassociative d.g. near-rings is a generalization of analogous part of theory of radicals of an (associative) d.g. near-ring.

A nonassociative and nondistributive unitary and left unitary near-ring S were defined in [8]. A (nonassociative) near-ring is called distributively generated if the additive group $(S,+)$ of S is generated by a set S of distributive elements in S . The nilpotency of a nonassociative and nondistributive d.g. near-ring were defined in [9].

A right maximal ideal of a near-ring S which is maximal right S -subgroup of S is called a modular right ideal of S . The radical $J(S)$ of a near-ring S is the intersection of all its modular right ideals. The quasiradical, $Q(S)$, of a near-ring S is the intersection of all the maximal right ideals of S . The intersection of all the maximal right S -subgroups of a near-ring S is called the radical subgroup of S .

THE RADICAL, THE QUASIRADICAL, THE RADICAL SUBGROUP AND THE GROUP-POTENCY

Following the concepts of group-potency is a generalization of the concept of the nilpotency.

Definition 1. Let N be a subgroup of S . A subgroup P of S is said to be N -potent (or group-potent) if, and only if a nonnegative integer n exists so that $P^n \subseteq N$.

THEOREM 1. Let S be a left, unitary, (nonassociative), d.g near-ring, $J(S)$ the right radical of S and P a subgroup of $(S,+)$ so that $J(S) \supseteq P$. Then, $J(S)$ contains all the P -potent right S -subgroup of S .

PROOF. Let N be a P -potent right S -subgroup, say $N^p \subseteq P$, for some nonnegative integer p , and I a modular maximal right ideal. Assume that $N \not\subseteq I$. Then, since I a right modular ideal of S , I is maximal normal right S -subgroup of $(S,+)$. From here, $S = I + N$ and any element of S may be written in the form $s = i + n$, $i \in I$, $n \in N$. Accordingly, there exist $n \in N$ and $i \in I$ so that $e = i + n$, where e is identity of S . Let $n_1(n_2(...n_{p-3}(n_{p-2} \vee n_{p-1})...)), ..., ((...((n_1 n_2) n_3) n_4 ...) n_{p-1}), (n_1, n_2, ..., n_{p-1}) \in N$ be generating elements of N^{p-1} . Denote $n_1(n_2(...(n_{p-2} n_{p-1})...)) + ... + (...((n_1 n_2) n_3) n_4 ...) n_{p-1}$ by $n_1 \cdot n_2 \cdot ... \cdot n_{p-1}$. Then $n_1 \cdot n_2 \cdot ... \cdot n_{p-1} = (i + n)(n_1 \cdot n_2 \cdot ... \cdot n_{p-1}) = (i + n)[n_1(n_2(...(n_{p-2} n_{p-1})...)) + ... + (...((n_1 n_2) n_3) n_4 ...) n_{p-1}] = (i + n)[n_1 n_2 (... (n_{p-2} n_{p-1}) ...)] + (i + n)[(...((n_1 n_2) n_3) ...) n_{p-1}] = (i + n)[n_1 n_2 (... (n_{p-2} n_{p-1}) ...)] + (i + n)[(...((n_1 n_2) n_3) ...) n_{p-1}] = (Since for each right ideal I and for each right S -subgroup N of S , $(i + n)s = i' + ns$, for all $i \in I$, $n \in N$, $s \in S$, where $i' \in I$, i.e. $(i + n)s = ns \pmod{I}$), (See L.1.4,[1]) then) =$

$n[n_1(n_2(\dots(n_{p-2} n_{p-1}) \dots))] + \dots + n[(\dots((n_1 n_2 n_3) \dots) n_{p-1})$
 $(\text{mod } I) = n(n_1(n_2(\dots(n_{p-2} n_{p-1}) \dots)) + \dots + (\dots((n_1 n_2 n_3) \dots) n_{p-1}))$
 $(\text{mod } I)$. Since $n(n_1(n_2(\dots(n_{p-2} n_{p-1}) \dots))), \dots, n((\dots((n_1 n_2 n_3) \dots) n_{p-1})) \in N^p$, then
 $n(n_1(n_2(\dots(n_{p-2} n_{p-1}) \dots)) + \dots + (\dots((n_1 n_2 n_3) \dots) n_{p-1})) \in N^p$. Consequently,
 $n_1 \cdot n_2 \cdot \dots \cdot n_{p-1} \in I$ and $N^{p-1} \subseteq I$, because $nN^{p-1} = n(N^{p-2} N) + n(N^{p-3} N^2) + \dots + n(N N^{p-2}) \subseteq N^p \subseteq P$, for all $n \in N$.
 If $n_1(n_2(\dots(n_{p-3} n_{p-2}) \dots)), \dots, (\dots((n_1 n_2 n_3) \dots) n_{p-2})$ are generators of N_{p-2} , then
 $n_1 \cdot n_2 \cdot \dots \cdot n_{p-2} = (i + n)(n_1 \cdot n_2 \cdot \dots \cdot n_{p-2}) = n(n_1(n_2(\dots(n_{p-3} n_{p-2}) \dots)) + \dots + (\dots((n_1 n_2 n_3) \dots) n_{p-2}))$
 $(\text{mod } I)$. But,
 $n(n_1(n_2(\dots(n_{p-3} n_{p-2}) \dots))), \dots, n((\dots((n_1 n_2 n_3) \dots) n_{p-2})),$
 $n(n_1(n_2(\dots(n_{p-3} n_{p-2}) \dots)) + \dots + (\dots((n_1 n_2 n_3) \dots) n_{p-2})) \in N^{p-1} \subseteq I$ and, so, $N^{p-2} \subseteq I$.

Proceeding this way we, finally, prove that N is contained in I and this contradicts our assumption. From this, we conclude that every P -potent right S -subgroup of S is contained in all the modular right ideals of S and so, in the intersection of all right modular ideal of S , that is in the radical $J(S)$ of S .

COROLLARY 1. The radical $J(S)$ of a left unitary d.g. (nonassociative) near-ring S contains all the nilpotent right S -subgroups of S .

COROLLARY 2. If a near-ring S satisfies the conditions wich gave in Th.1, then $S/J(S)$ has no nilpotent right S -subgroup of $(S/J(S), +)$.

COROLLARY 3. The radical $J(S)$ of a left unitary, d.g. associative near-ring S contains all the nilpotent right S -subgroups $(S, +)$, (See [1], Th.1.5.).

COROLLARY 4. If S is a left unitary d.g. associative near-ring and P a subgroup of $(S, +)$ so that radical $J(S)$ of S contains P , then $J(S)$ contains all the P -potent right S -subgroup of S .

COROLLARY 5. If a near-ring S satisfies the conditions of Cor.4, then $S/J(S)$ has no nilpotent right S -subgroup of $(S/J(S), +)$.

Theorem 1. can be extended on a left unitary d.g. nonassociative and nondistributive near-ring that is satisfies the conditions of this theorem if $J(S)$ contains the relative right distributor of I in N .

THEOREM 2. Let S be a left, unitary, d.g. near-ring with the distributor D , P a subgroup of S such that $J(S) \supseteq P$, N a right P -potent S -subgroup of $(S, +)$, I a modular right ideal of S , let each maximal right ideal contain all right distributors of elements of N in relation to the addition of elements

of I and N , then the radical $J(S)$ contains all right P -potent S -subgroup of $(S, +)$.

The proof of this theorem is similar to the ones of the theorems 1. and 5.

Laxton has proved that d.g. right associative near-ring which satisfies d.c.c for left S -modules has no non-zero nilpotent left S -subgroup if, and only if its radical $J(S)$ is the zero-ideal (Cf.Th.2.3.[1]). This theorem can be extended on an unitary nonassociative left d.g. near-ring which satisfy d.c.c. for right S -subgroups if each minimal S -subgroup M_i contains at least an idempotent e_i such that the associator $A = (\{e_i\}, \{e_i\}, \{M_i\}) = \{0\}$. See the proof of Th.1. [1]).

THEOREM 3. If d.g. (nonassociative) near-ring S satisfies the d.c.c. for right S -subgroups, I a minimal right normal S -subgroup such that $J(S) \supseteq I$, then S has no I -potent right S -subgroups P such that $P \supset I$ if, and only if its radical $J(S)$ is equals I .

PROOF. Assume that the radical $J(S) = I$ then, by theorem 1., S contains no I -potent right S -subgroup P such that $P \supset I$. Conversely, let S has no I -potent right S -subgroup P so that $P \supset I$. It is clear that I is the right ideal of S . Since, by theorem 1., $\bar{S} = f S = S/I$ has no nilpotent right S -subgroups and, by Th 3.2. of [1], $J(\bar{S}) = \{ \bar{0} \}$, then $J(S) = I$, because $\bar{A} = (\{ \bar{e}_i \}, \{ \bar{e}_i \}, I) \subseteq I$, therefore, $A = (\{ e_i \}, \{ e_i \}, I) = \{ \bar{0} \}$.

COROLLY. If a left d.g., in general, nonassociative near-ring S satisfies the d.c.c. for right S -subgroups and $J(S)$ the radical of S , then $S/J(S)$ is semisimple d.g. near-ring in the Blacket sense (Cf Th. 2.4.[1]).

THEOREM 4. Let S be a left unitary near-ring with left zero and the distributor D , let the normal subgroup generated by arbitrary right maximal S -subgroup M contain right distributor (r.d.), of the subset M in S and its own distributor in S , then the radical $J(S)$ coincides with the quasiradical $Q(S)$ and the radical subgroup $N(S)$ of S .

PROOF. If M is a maximal S -subgroup, then it is the term in a normal sequence of the group $(S, +)$ (See Th.6.4.10 [5]) and there exists a normal subgroup K of S which contains M . If $K \subsetneq S$ and if we denote the normal subgroup by \bar{M} that generates by M , then $K \supseteq \bar{M}$, i.e. $\bar{M} \neq S$. If $K = S$, then $\bar{M} = M \neq S$. Since M is a maximal S -subgroup, then $\bar{M} = M$. Since M is a right S -subgroup and contains its own distributor and r.d. of M in S , then M is the right ideal of S . Since M is a arbitrary maximal S -subgroup, then $N(S) \supseteq Q(S)$.

Let I be a right maximal ideal of S . Since S has a left zero, then I is a right S -subgroup of $(S, +)$. Every maximal right ideal of S is a maximal right S -subgroup $(S, +)$. Really, let there exist a maximal right S -subgroup P such that $P \supset I$ and let \bar{P} be a normal subgroup which is generated by P . Since, by assumptions of the theorem, it contains r.d. of \bar{P} in S and its own distributor in S , then \bar{P} is a right ideal of S and we obtain a contradiction. Hence, I is a right maximal S -subgroup and a modular ideal of S . From here, $Q(S) \supseteq N(S)$ and $Q(S) = J(S)$. Since $N(S) \subseteq J(S) = Q(S)$ and $Q(S) \subseteq N(S)$, then $N(S) = Q(S) = J(S)$.

COROLLARY. Let S be a left, unitary, distributive near-ring with left zero and let \bar{M} be normal subgroup generates by arbitrary right maximal S -subgroup M , then the radical $J(S)$ coincides with quasiradical $Q(S)$ and the radical subgroup $N(S)$ of S .

THEOREM 5. Let S be a left unitary nonassociative near-ring with distributor D , P is a subgroup of $(S, +)$ such that $J(S) \supseteq P$, N arbitrary left P -potent ideal (subgroup) of S , let each maximal right ideal M of S contain all the associators of the ordered triple (N, N, S) and the relative right distributor (r.r.d), D_r (See [8], D_r 3.), of the subset N with respect to the set S and let S satisfy d.c.c. for ideals (right subgroups), then the radical $J(S)$ of S contains all the left P -potent ideals (subgroups) of S .

PROOF. Let N be P -potent left ideal, i.e. $N^{(k)} \subseteq P$, for a nonnegative integer k . We have to prove that N is contained in every right maximal ideal M of S . If $N^k \subseteq P$, then $N^{(k)} = N^{(k-1)}N + \dots + N N^{(k-1)} \subseteq P$. Assume that $N \not\subseteq M$. We form the minimal right ideal N_d of S which consist N . This ideal contains of thous elements x which can be written as a finite sum of the form $x = \sum_i (s_i + n_i t_i - s_i)$, $s_i, t_i \in S$, $n_i \in N$, for all i .

If $N \not\subseteq M$, then $N_d \not\subseteq M$. Then, $N_d + M$ is an ideal and since $N_d + M \supset N$, then $N_d + M = S$. Since S is unitary, let e be it's identity, then $e = x + m$, $x \in N_d$, $m \in M$ and $n_1 \dots n_{k-1} = (n_1 \dots n_{k-1})e = (n_1 \dots n_{k-1})(x + m) = (n_1 \dots n_{k-1})x + (n_1 \dots n_{k-1})m = (n_1 \dots n_{k-1})x \pmod{M} = (n_1 \dots n_{k-1})(\sum_i (s_i + n_i t_i - s_i)) = \sum_i (n_1 \dots n_{k-1})(s_i + n_i t_i - s_i) = \sum_i ((n_1 \dots n_{k-1})s_i + (n_1 \dots n_{k-1})(n_i t_i) - (n_1 \dots n_{k-1})s_i) = \sum_i ((n_1 \dots n_{k-1})s_i + [(n_1 \dots n_{k-1})n_i]t_i - a + (n n_i)t_i - (n_1 \dots n_{k-1})s_i) = (\text{where } a = (n n_i)t_i - n(n_i t_i) \text{ and } n = n_1 \dots n_{k-1}) = \sum_i ((n_1 \dots n_{k-1})s_i + [0 \cdot t_i - a \cdot t_i + 0 \cdot t_i - (n_1 \dots n_{k-1})s_i]) = 0 \pmod{M}$, because $a \in M$. Hence, $n_1 \dots n_{k-1} \in M$, for all $n_i \in N$, $i = 1, \dots, k-1$. Thus, $N^{k-1} \subseteq M$.

As well as we can prove $(n_1 n_2 \dots n_{k-2}) \in M$, $n_i \in N$, $i = 1, \dots, k-2$. Proceeding in this way we finally prove that N is contained in M and this contradicts

our assumption. Hence we conclude, since the intersection of the all of maximal ideals M of S is contained in $J(S)$, that each left P -potent ideal is contained in $J(S)$.

COROLLARY 1. Let S be a left unitary nonassociative near-ring with distributor D , N arbitrary left P -potent ideal of S , let each maximal ideal of S contains all the associators of the ordered triple (N, N, S) , the r.r.d. D_r of the supset N in S , S satisfies d.c.c. for right ideals and $J(S)$ the radical of S , then $S/J(S)$ has no left nonzero nilpotent ideals.

COROLLARY 2. Let S be a left unitary nonassociative near-ring with distributor D , N arbitrary left nilpotent ideal of S , let each maximal ideal of S contains all the associators of the ordered triple (N, N, S) and the r.d.d D_r of S , then $S/J(S)$ has no left nonzero nilpotent ideals.

COROLLARY 3. Let S be a left unitary associative near-ring with distributor D , N arbitrary left P -potent ideal of S , let S satisfies the d.c.c. for right ideals then $S/J(S)$ has no left nonzero nilpotent ideals.

COROLLARY 4. Let S be a left unitary associative and distributive near-ring, P is a subgroup of $(S, +)$, N arbitrary left P -potent ideal of S and let S satisfies the d.c.c. for the right ideals, then $S/J(S)$ has no left nonzero nilpotent ideals.

THEOREM 6. Let S be a left unitary near-ring with the distributor D which is subset of the commutator subgroup C of $(S, +)$, every right product of n elements of S equals O and every maximal subgroup of the group $(S, +)$ be an S -subgroup. Then $J(S) = Q(S) = N(S)$.

PROOF. By Cor. 10.32. of [6] every maximal subgroup of a group $(S, +)$ is normal and contains the commutator subgroup C of S . Let M be a maximal subgroup of $(S, +)$. Since M is maximal S -subgroup, by the assumption of the theorem, contains the distributor D , then it is a right ideal and a modular right ideal. Hence, $Q(S) \supseteq N(S)$.

Let every product of n elements of S be equal O , then $O s = s O = O$. Let I be a maximal right ideal of S , then it is a right maximal S -subgroup. If there is a maximal right S -subgroup P of $(S, +)$ such that $P \supset I$, then we get a contradiction. Really, since P is a normal subgroup, contains commutator subgroup C (by Cor. 10.32 [6]) and, by the theorem, D , then P is a right ideal. Hence I is a maximal right S -subgroup of $(S, +)$. Then $Q(S) \subseteq N(S)$. So, $Q(S) = N(S) = J(S)$.

COROLLARY. Let S be a left unitary near-ring with the distributor D which is contained in the

commutator subgroup C of S , every maximal subgroup of $(S, +)$ is an S -subgroup and S has a left zero. Then $S/J(S)$ is the commutative and distributive near-ring. In particular, if every maximal subgroup contains the associator-subgroup of S , $A(S)$, then $S/J(S)$ is the ring.

THE QUSIREGULARITY, THE GROUP-POTENCY AND THE RADICALS

Definition 2. An element s of a near-ring S is said to be left quasiregular (l.q.r.) if, and only if there exists $s' \in S$ such that $(e - s)s' = (Cf [4])$.

If z is an element of a d.g. left near-ring S , then N_z denotes the least normal subgroup of $(S, +)$ which contains the group generated by all elements $(x - zx)$, for all $x \in S$. Element y of N_z are finite sums of the form $\sum_i (y_i + x_i - zx_i - y_i)$, $x_i, y_i \in S$, for all i . Let S' be the set elements which additively generate group $(S, +)$ and whose elements are right distributive in S then for $s' \in S'$ we have $(\sum_i (y_i + x_i - zx_i - y_i))s' = \sum_i (y_i s' + x_i s' - (zx_i)s' - y_i s') = \sum_i (y_i s' + x_i s' - z(x_i s') - a - y_i s')$, where $a = (zx_i)s' - z(x_i s')$, $x_i, y_i \in S$. Accordingly, N_z is a right ideal if it contains the normal subgroup generated by all the relative left associators of S' in relation to zS (See 1.2.Š8Ć). By N_z we denote the least right ideal which contains N_z .

Definition 2'. An element z of S is left quasiregular (l.q.r.) if and only if $N_z = S$.

A subgroup of S is said to be quasiregular (q.r.) of only if all its elements are l.q.r. (See Df.1 [1]).

It is clear (by this definition) that an element s of S is l.q.r. if and only if there is a set of elements of S (x_i, s'_i) , $i \in I$, for some finite index set I , for which $\sum_i (x_i + s'_i - ss'_i - x_i) = s$. This definition is equivalent to def.2. (See [2, pp.46-47] and [4], Def. 1. and proof. (2.2.) Th.)

THEOREM 7. Let S be a unitary d.g., left (nonassociative) near-ring, $z \in Q$ and let N_z contain the associator $(z, S, S') = \{a = (zx_i)s' - z(x_i s') \mid x_i \in S, s' \in S'\}$. Then N_z is a right ideal of S and $Q(S)$ of S is the quasiregular (Cf. Th.3.2.[1]).

PROOF. We just proved that N_z is a right ideal of S , if $(z, S, S') \subseteq N_z$. Then the class of all the right ideals of S , containing the right ideal N_z , which doesn't contain identity of S , isn't empty. By Zorn's lemma N_z is contained in a maximal right ideal which doesn't contain the identity of S . Denote this ideal by I . Now, Q is contained in I and, therefore, z is the element of I . Since, $(x - zx) \in I$, for all $x \in S$, then $x \in I$, for all $x \in S$, i.e. $I = S$. This is a contradiction to the property of I not to contain the identity of S . Hence, $N_z = S$ and N_z is q.r.

Let K be the set of all the left quasiregular elements r of S , $S_1 = \{(e - r)/r \mid r \in K\}$ and $S_2 = \{r' \in S / (e - r)r' \mid r \in K\}$.

The associator A of the ordered triple (X, Y, Z) of arbitrary subset X, Y, Z of S is the least subgroup of group $(S, +)$ which contains all associators $a = (xy)z - x(yz)$, $x \in X, y \in Y, z \in Z$.

THEOREM 8. Let S be a left unitary d.g. near-ring which satisfies the d.c.c for right S -subgroups of S , let P be a quasiregular right S -subgroup of S and $P = P^{(1)} \supseteq P^{(2)} \supseteq \dots \supseteq P^{(n)} \supseteq P^{(n+1)} \supseteq \dots$, the d.c.c for right S -subgroup, I a minimal right S -subgroup such that $P \supseteq I$ and $(P^{(n)}, I, P^{(n)}) \subseteq I$, for some nonnegative integer n . Then P is I -potent. In particular, if $A = \{I, S_1, S_2\} = \{0\}$ or $(P^{(n)}, I, P^{(n)}) = \{0\}$, then P is nilpotent.

PROOF. Let P be a nonzero quasiregular S -subgroup of $(S, +)$, then there exists nonnegative integer n so that $P^{(n)} = P^{(n-1)} = \dots$. If $P^{(n)} \subseteq I$, then this theorem is true. Assume that $P^{(n)} \not\subseteq I$. Let $R = P^{(n)}$ and $R \not\subseteq I$, then we get a contradiction. By the assumption of this theorem there is a minimal S -subgroup I be contained in R so that

$R \not\subseteq I$. Thus, there is an element $i \in I$ so that $Ri \not\subseteq I$. Since $IR = I$ then $ir = i$. Also, there

exists $r_1 \in R \setminus I$ so that $r_1 I \not\subseteq I$. Since r is quasiregular, then $e - r$ has no this property. So, from $ir = i$, $(ri)r - r(ir) = a$ it follows $a = ri(r - e) \in I$, for all $r \in R$. Since $r - e \notin P$, then $ri \in I$, for all $r \in R$, a contradiction to $Ri \not\subseteq I$. Thus $R = P^{(n)} \subseteq I$ and P is a I -potent S -subgroup. Let $\{I, S_1, S_2\} = \{0\}$ and if we assume that $R \not\subseteq \{0\}$, then $Ri \not\subseteq \{0\}$ and since R is a quasiregular, then there exists $r' \in S_2$ so that $(e - r)r' = e$. From here and from $ir = i$ it follows $0 = (i(e - r))r' = i((e - r)r') + a'$ and $a' = -i$, where $a' = (i(e - r))r' - i((e - r)r')$. Since, by our assumption, $\{I, S_1, S_2\} = \{0\}$, then $i = a' = 0$, a contradiction to $Ri \not\subseteq \{0\}$. Therefore, $R = \{0\}$ and I is nilpotent.

Also, if $(P^{(n)}, I, P^{(n)}) = \{0\}$, $Ri \neq \{0\}$, then $a = (ri)r - r(ir) = ri(r - e) = 0$, for all $r \in R$. Since $r - e \neq 0$ then $ri = 0$, for all $r \in P^{(n)}$, a contradiction to the assumption $Ri \neq \{0\}$. Thus, $P^{(n)} = \{0\}$, i.e. P is nilpotent.

COROLLARY 1. Let a right S -subgroup P of a left d.g. unitary near-ring S be quasiregular, let S satisfy the d.c.c: $P = P^{(1)} \supseteq \dots \supseteq P^{(n)} \supseteq P^{(n+1)} \supseteq \dots$, $A = (P^{(n)}, I, P^{(n)}) \subseteq I$ and A a normal minimal right S -subgroup generated by A . Then each quasiregular right S -subgroup fP of group $(fS, +) = (S / \bar{A}, +)$ is nilpotent, where I is a minimal right S -subgroup such that $P \supseteq I$.

COROLLARY 2. Let the radical J (the quasiradical Q , the radical subgroup N) of a unitary d.g. left near-ring S be quasiregular, S satisfies the d.c.c.: $J = J^{(1)}$.

$\supseteq \dots \supseteq J^{(n)} \supseteq J^{(n+1)} \supseteq \dots$ ($Q = Q^{(1)} \supseteq \dots \supseteq Q^{(n)} \supseteq Q^{(n+1)} \supseteq \dots$;
 $N = N^{(1)} \supseteq \dots \supseteq N^{(n)} \supseteq N^{(n+1)} \supseteq \dots$) and $A = (J^{(n)}, I, J^{(n)}) \subseteq I$
 $((Q^{(n)}, I, Q^{(n)}) \subseteq I; (N^{(n)}, I, N^{(n)}) \subseteq I)$. Then J (Q
 respectively N) is I-potent, where I is a minimal right
 S-subgroup such that $Q \supseteq I$ ($N \supseteq I$). In particular, if A
 $= \{O\}$, then J is nilpotent.

COROLLARY 3. Let S be a left d.g. near-ring which satisfy the d.c.c. for the right S-subgroup, I a minimal right S-subgroup of $(S, +)$ and Q the quasiradical of S . If $(Q^{(n)}, I, Q^{(n)}) \subseteq I$, then Q is an I-potent right ideal containing all the I-potent right ideals of S . Consequently, S has no I-potent right ideals which aren't contained in I if, and only if it's quasiradical is contained in I .

The proof is similar to the proofs of Th.1. and Th.5.

THEOREM 9. Let S be a left d.g. near-ring satisfying the d.c.c. for right S-subgroups, Q the quasiradical of S and I a minimal right S-subgroup such that $Q \supseteq I$. The ideal-radical $I(S)$ is the ideal $(Q : I)$ which is contained in Q and which contains all the I-potent right ideals of the near-ring S .

THEOREM 10. Let S be a unitary, left, d.g. (nonassociative) near-ring satisfying the d.c.c. for right S-subgroup, I a minimal right S-subgroup, J the radical of S , Q the quasiradical of S , R the ideal-radical and $(Q^{(n)}, I, Q^{(n)}) \subseteq I$ and $(S, S, a_i) \subseteq J$, $a_i \in I_i$, $i = 1, \dots, n$, where I_i are the right minimal nonzero ideals of S . Then, the following conditions are equivalent:

1. The radical is I-potent.
2. The radical is the quasi-radical.
3. Every maximal right ideal is a maximal S-subgroup.
4. The radical is the ideal-radical.
5. Every proper prime ideal is maximal.
6. Every cyclic irreducible S-group is a minimal S-group.

PROOF. 1. implies 2. The radical of S contains the quasi-radical of S and since $(Q^{(n)}, I, Q^{(n)}) \subseteq I$, then the quasi-radical contains all I-potent right ideals of S . Therefore, the radical is the quasiradical if it is I-potent.

2. implies 3. If the radical $J(S)$ is the quasi-radical Q , then every maximal right ideal contains $J(S)$. But $S/J(S)$ is semi-simple d.g. near-ring and so is a direct sum of right ideals $I_i = I_i / I$, $i = 1, \dots, n$, of $S/J(S)$ because $(S, S, a_i) = \{0\}$, for some $a_i \in I_i$, $i = 1, \dots, n$, which are minimal right $S/J(S)$ -subgroups, where $S = S/J$, (Cf Laxton [1] and [10, Th.8.]). It follows that every maximal right ideal is a maximal right S-subgroup.

3. implies 4. If every maximal right ideal is a maximal right S-subgroup, then the radical is the quasiradical and since $(Q^{(n)}, I, Q^{(n)}) \subseteq I$, then it I-potent ideal. But the radical contains the ideal-radical (Cf Df 4. [0]) and since $(R^{(n)}, I, R^{(n)}) \subseteq (Q^{(n)}, I, Q^{(n)}) \subseteq I$

then the ideal-radical contains every I-potent ideal of S (Cf. Th.1. [0]). Therefore, the radical is the ideal-radical if it is I-potent.

4. implies 5. If the $J(S)$ is the ideal-radical then every prime ideal P of S contains $J(S)$ (Cf Df.1. of [1]). Further, $M_1 M_2 \dots M_r \subseteq M_1 \cap M_2 \cap \dots \cap M_r = J(S) \subseteq P$, where M_i , $i = 1, \dots, r$, are maximal ideals of S . (If S satisfied d.c.c. for right S-subgroups, then the radical is, in fact, a intersection of a finite number of maximal ideals). Hence, $M_i \subseteq P$, for some I , and therefore $M_i = P$.

5. implies 6. Let Ω be a cyclic irreducible S-subgroup of S (Df 2. [0]). Then the annihilating ideal $p = (0 : \Omega)$ is prime (Cf Proposition 1. [1]) and is a maximal ideal if condition 5. is satisfied. In this case $S = f S = S/P$ is a simple d.g. near-ring and so is direct sum of isomorphic minimal S/P -subgroups (Cf [1, Th 6.e]). Since Ω is an S/P -subgroup of S/P and has an S/P -generator it follows that it is a direct sum of minimal S/P -subgroups. But Ω is irreducible and so it must be a minimal S/P -subgroups of S . Hence, Ω is a minimal S-subgroup.

6. implies 1. Let M be a maximal right ideal of S . Then S/M is a cyclic irreducible S-subgroup and hence it is a minimal S-subgroup if condition 6. is satisfied.

Thus, M is a maximal right S-subgroup. Therefore, the radical and the quasiradical must be equal in this case and radical $J(S)$ is I-potent.

COROLLARY 1. Let S be left, unitary, d.g. (nonassociative) near-ring satisfying the d.c.c. for right S-subgroups, I a minimal right S-subgroup, J (Q , R) the radical (the quasiradical, the ideal-radical) of S ($Q^{(n)}, I, Q^{(n)} = \{0\}$ and $(S, S, a_i) = \{0\}$, $a_i \in J_i$, $i = 1, \dots, n$, where J_i are the right nonzero minimal ideals of S). Then, the following conditions are equivalent:

1. The radical J is nilpotent.
2. The radical is the quasiradical.
3. Every maximal right ideal is a right maximal S-subgroup.
4. The radical is the ideal-radical.
5. Every proper prime ideal is maximal.
6. Every cyclic irreducible S-group is a minimal S-group.

COROLLARY 2. Let S be a unitary, left, d.g. associative near-ring satisfying the d.c.c. for right S-subgroups. Then, the following conditions are equivalent:

1. The radical J of S is nilpotent.
2. The radical J is quasi-radical Q of S .
3. Every maximal right ideal of S is a maximal right S-subgroup.
4. The radical is the ideal-radical.
5. Every proper prime ideal is maximal.
6. Every cyclic irreducible S-subgroup is a minimal S-subgroup (See [0, Th.6.]).

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REZIME

Svojstva radikala neasocijativnih skoro-prsten
Veljko Vuković

U ovom radu ispituju se svojstva radikala neasocijativnog skoro-prstena; svojstva radikala neasocijativnog, distributivno-generisanog skoro-prstena i svojstva radikala levog, neasocijativnog, distributivno-generisanog skoro-prstena S koji zadovoljava uslov opadajućih lanaca za desne S -podgrupe.

Takođe, pokazano je da se neka svojstva radikala asocijativnih distributivno-generisanih skoro-prstena mogu uopštiti i da važe i za distributivno-generisane (d.g.) neasocijativne skoro-prstene. Analogno asocijativnom, unitarnom, d.g. skoro-prstenu radikal $J(S)$ levog, neasocijativnog i nedistributivnog, unitarnog, d.g. skoro-prstena sadrži sve grupa-potentne desne S -podgrupe.

Ako neasocijativni d.g. skoro-prsten S sadrži uslov opadajućih lanaca za desne S -podgrupe i ako je I desna minimalna normalna S -podgrupa takva da je $J(S) \supseteq I$, tada S nema I -potentnih desnih S -podgrupa P , takvih da je $P \supset I$ ako i samo ako je $J(S)=I$.

Some refinements of Hadamard's inequalities

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ABSTRACT

Some refinements of Hadamard's inequalities in terms of multiple integrals are given.

Key words: refinement, convex function, mappings, Jensen's integral inequality, multiple integrals

INTRODUCTION

The double inequality

$$(1) \quad f\left(\frac{a+b}{2}\right) \leq \frac{1}{b-a} \int_a^b f(x) dx \leq \frac{f(a)+f(b)}{2}$$

which holds for all convex function $f: I \subseteq \mathbb{R} \rightarrow \mathbb{R}$ (I is an interval) $a, b \in I$ with $a < b$, is known in the literature as Hadamard's inequalities. We note that J. Hadamard [5] was not the first to discover them. As is pointed out by D. S. Mitrović and I. B. Lacković [9] the inequalities (1) are due to C. Hermite who obtained them in 1883, ten years before J. Hadamard.

In the recent paper [4], S. S. Dragomir, J. E. Pečarić and J. Sandor have established the following refinement of this result.

Theorem A. Let $f: I \rightarrow \mathbb{R}$ be a convex function and $a, b \in I$ ($a < b$), $n \in \mathbb{N}^*$. Then one has the following inequalities:

$$\begin{aligned} f\left(\frac{a+b}{2}\right) &\leq \frac{1}{(b-a)^{n+1}} \int_a^b \dots \int_a^b f\left(\frac{1}{n+1} \sum_{i=1}^{n+1} x_i\right) dx_1 \dots \\ &\dots dx_{n+1} \leq \frac{1}{(b-a)^n} \int_a^b \dots \int_a^b f\left(\frac{1}{n} \sum_{i=1}^n x_i\right) dx_1 \dots dx_n \leq \dots \\ &\dots \leq \frac{1}{(b-a)^2} \int_a^b \int_a^b f\left(\frac{x_1+x_2}{2}\right) dx_1 dx_2 \leq \frac{1}{b-a} \int_a^b f(x) dx \end{aligned}$$

For a given convex function $f: I \rightarrow \mathbb{R}$ and $a, b \in I$ with $a < b$ we can define the following mappings:

$$H: [0,1] \rightarrow \mathbb{R} \quad H(t) = \frac{1}{b-a} \int_a^b f\left(tx + (1-t)\frac{a+b}{2}\right) dx$$

and

$$F: [0,1] \rightarrow \mathbb{R} \quad F(t) = \frac{1}{(b-a)^2} \int_a^b \int_a^b f(tx + (1-t)y) dx dy.$$

These mappings have some interesting properties which are embodied in the following theorem (see [3, Theorem 1 and 2]):

Theorem B. In the above assumptions, we have:

- (i) H and F are convex on $[0, 1]$; and
- (ii) One has:

$$\inf H(t) = H(0) = f\left(\frac{a+b}{2}\right)$$

$$t \in [0, 1]$$

and

$$\sup H(t) = H(1) = \frac{1}{b-a} \int_a^b f(x) dx;$$

$$t \in [0, 1]$$

- (iii) For all s in $[0, 1/2]$ the following equality holds:
 $F(s + 1/2) = F(1/2 - s)$

- (iv) We have:

$$\inf F(t) = F\left(\frac{1}{2}\right) = \frac{1}{(b-a)^2} \int_a^b \int_a^b f\left(\frac{x+y}{2}\right) dx dy \geq f\left(\frac{a+b}{2}\right)$$

$$t \in [0, 1]$$

and

$$\sup F(t) = F(0) = F(1) = \frac{1}{b-a} \int_a^b f(x) dx;$$

$$t \in [0, 1]$$

- (v) H is monotonous nondecreasing on $[0, 1]$;
- (vi) F is monotonous nonincreasing on $[0, 1/2]$ and nondecreasing on $[1/2, 1]$;
- (vii) The following inequality:
 $H(t) \leq F(t)$ for all t in $[0, 1]$, holds.

For some application of the above results, we refer to [3], [4] and [5] where further references are given.

THE MAIN RESULTS

Now, let T be a nonempty set and m be a natural number with $m \geq 2$. Suppose that $\alpha_1, \dots, \alpha_m: T \rightarrow R$ are m functions with the property:

$\alpha_i(t) \geq 0$ ($i = 1, \dots, m$) and $\alpha_1(t) + \dots + \alpha_m(t) = 1$ for all t in T .

Consider $f: I \subseteq R \rightarrow R$ a given convex mapping on the interval I and $a, b \in I$ with $a < b$. We can define the following sequence of mappings:

$$\begin{aligned} H_1^{[m]}(t) &:= \frac{1}{b-a} \int_a^b f(\alpha_1(t)x_1 + (\alpha_2(t) + \dots \\ &\quad \dots + \alpha_m(t)) \frac{a+b}{2}) dx_1, \\ H_2^{[m]}(t) &:= \frac{1}{(b-a)^2} \int_a^b \int_a^b f(\alpha_1(t)x_1 + \alpha_2(t)x_2 + (\alpha_3(t) \\ &\quad + \dots + \alpha_m(t)) \frac{a+b}{2}) dx_1 dx_2, \\ &\vdots \\ H_{m-1}^{[m]}(t) &:= \frac{1}{(b-a)^{m-1}} \int_a^b \dots \int_a^b f(\alpha_1(t)x_1 + \dots + \\ &\quad + \alpha_{m-1}(t)x_{m-1} + \alpha_m(t) \frac{a+b}{2}) dx_1 \dots dx_{m-1} \end{aligned}$$

and

$$H_m^{[m]}(t) := \frac{1}{(b-a)^{m-1}} \int_a^b \dots \int_a^b f(\alpha_1(t)x_1 + \dots + \alpha_m(t)x_m) dx_1 \dots dx_m$$

where t is T .

It is clear that the above mappings are well-defined for all t in T and the following theorem holds.

Theorem 1. Let f, α_i ($i = 1, \dots, m$) and m be as above. Then:

(i) We have the inequalities:

$$(2) \quad f\left(\frac{a+b}{2}\right) \leq H_1^{[m]}(t) \leq H_{m-1}^{[m]}(t) \leq \frac{1}{b-a} \int_a^b f(x) dx$$

for all t in T .

(ii) If there exist $t_0 \in T$ so that $\alpha_1(t_0) = \dots = \alpha_p(t_0) = 0$ ($1 \leq p \leq m-1$), then:

$$(3) \quad \inf_{t \in T} H_l^{[m]}(t) = H_l^{[m]}(t_0) = f\left(\frac{a+b}{2}\right) \text{ for } 1 \leq l \leq p;$$

(iii) If there is a $t_1 \in T$ so that $\alpha_1(t_1) = 1$ ($1 \leq p \leq m-1$), then

$$(4) \quad \sup_{t \in T} H_l^{[m]}(t) = \sup_{t \in T} H_l^{[m]}(t) = H_l^{[m]}(t_1) = H_l^{[m]}(t) =$$

$$= \frac{1}{b-a} \int_a^b f(x) dx,$$

and

$$\inf_{t \in T} H_q^{[m]}(t) = H_q^{[m]}(t_1) = f\left(\frac{a+b}{2}\right)$$

for all $p \leq l \leq m-1$ and $1 \leq q \leq p-1$.

(iv) If T is a convex subset of a linear space Y and α_i ($i = 1, \dots, m$) satisfy the condition:

$$\alpha_i(\gamma t_1 + \beta t_2) = \gamma \alpha_i(t_1) + \beta \alpha_i(t_2), \quad i = 1, \dots, m;$$

for all t_1, t_2 in T and γ, β with $\gamma + \beta = 1$ and $\gamma, \beta \geq 0$,

then $H_l^{[m]}$ ($1 \leq l \leq m-1$) and $H_m^{[m]}$ are convex mapping on T .

PROOF. (i). By Jensen's integral inequality [7], we have:

$$\begin{aligned} H_1^{[m]}(t) &\geq f\left(\alpha_1(t) \frac{1}{b-a} \int_a^b x_1 dx_1 + (\alpha_2(t) + \dots + \right. \\ &\quad \left. + \alpha_m(t)) \frac{a+b}{2}\right) = f\left(\frac{a+b}{2}\right) \end{aligned}$$

for all t in T , which shows the first inequality in (2).

Now, suppose that $1 \leq l \leq m-2$ and $t \in T$. Then, by Jensen's integral inequality, we also have:

$$\begin{aligned} H_{l+1}^{[m]}(t) &= \frac{1}{(b-a)^{l+1}} \int_a^b \dots \int_a^b f(\alpha_1(t)x_1 + \dots + \alpha_{l+1}(t)x_{l+1} + \\ &\quad + (\alpha_{l+2}(t) + \dots + \alpha_m(t)) \frac{a+b}{2}) dx_1 \dots dx_{l+1} \geq \frac{1}{(a-b)^l} \int_a^b \dots \int_a^b f(\alpha_1(t) \end{aligned}$$

$$\begin{aligned} &\quad x_1 + \dots + \alpha_l(t)x_l + \alpha_{l+1}(t) \frac{1}{b-a} \int_a^b x_{l+1} dx_{l+1} + \\ &\quad + (\alpha_{l+2}(t) + \dots + \alpha_m(t)) \frac{a+b}{2}) dx_1 \dots dx_l = H_l^{[m]}(t), \end{aligned}$$

which shows that the finite sequence $\{H_l^{[m]}(t)\}_{l=1, m-1}$ is monotonous nondecreasing for all t in T .

On the other hand, Jensen's inequality yields that

$$\begin{aligned} H^{[m]}(t) &\geq \frac{1}{(b-a)^{m-1}} \int_a^b \dots \int_a^b f(\alpha_1(t)x_1 + \dots + \alpha_{m-1}(t)x_{m-1} + \\ &\quad + \alpha_m(t) \frac{1}{b-a} \int_a^b x_m dx_m) dx_1 \dots dx_{m-1} = H_{m-1}^{[m]}(t), \end{aligned}$$

for all t in T .

Finally, by the convexity of one has:

$$f(\alpha_1(t)x_1 + \dots + \alpha_m(t)x_m) \leq \alpha_1(t)f(x_1) + \dots + \alpha_m(t)f(x_m)$$

for all t in T and $x_i \in [a, b]$ with $i = 1, \dots, m$.

Integrating this inequality on $[a, b]^m$, we derive:

$$\begin{aligned} & \int_a^b \dots \int_a^b f(\alpha_1(t)x_1 + \dots + \alpha_m(t)x_m) dx_1 \dots dx_m \leq \\ & \leq \int_a^b \dots \int_a^b (\alpha_1(t)f(x_1) + \dots + \alpha_m(t)f(x_m)) dx_1 \dots dx_m = \\ & = (b-a)^{m-1} \int_a^b f(x) dx, \end{aligned}$$

which implies the inequality:

$$H^{[m]}_p(t) \leq \frac{1}{b-a} \int_a^b f(x) dx,$$

for all t in T , and the statement (2) is proven.

(ii) If $\alpha_1(t_0) = \dots = \alpha_p(t_0) = 0$ ($1 \leq p \leq m-1$), then

$\alpha_{p+1}(t_0) + \dots + \alpha_m(t_0) = 1$. Therefore:

$$\begin{aligned} H^{[m]}_p(t_0) &= \frac{1}{(b-a)^p} \int_a^b \dots \int_a^b f((\alpha_{p+1}(t_0) + \dots + \alpha_m(t_0))x) \\ &\quad \cdot \frac{a+b}{2} dx_1 \dots dx_p = f\left(\frac{a+b}{2}\right). \end{aligned}$$

Since

$$f\left(\frac{a+b}{2}\right) \leq H^{[m]}_1(t_0) \leq \dots \leq H^{[m]}_p(t_0) \quad (\text{see (i)}),$$

the statement (ii) is proven.

(iii) If $\alpha_p(t_1) = 1$, then $\alpha_s(t_1) = 0$ for all $s \neq p$ ($1 \leq s \leq m$). Then for $p \leq l \leq m-1$, have:

$$\begin{aligned} H^{[m]}_l(t_1) &= \frac{1}{(b-a)^l} \int_a^b \dots \int_a^b f(x_p) dx_1 \dots dx_l = \frac{1}{b-a} \\ &\quad \int_a^b f(x) dx = \frac{1}{(b-a)^m} \int_a^b \dots \int_a^b f(x_p) dx_1 \dots dx_m = H^{[m]}_1(t_1) \end{aligned}$$

If $1 \leq q \leq p-1$, one has:

$$H^{[m]}_q(t_1) = \frac{1}{(b-a)^q} \int_a^b \dots \int_a^b f\left(\frac{a+b}{2}\right) dx_1 \dots dx_q = f\left(\frac{a+b}{2}\right)$$

Using the statement (i), we obtain easily (4) and (5).

(iv) Let $\gamma, \beta \geq 0$ with $\gamma + \beta = 1$ and $t_1, t_2 \in T$, then by the convexity of, we have:

$$\begin{aligned} & H^{[m]}_l(\gamma t_1 + \beta t_2) = \\ &= \frac{1}{(b-a)^l} \int_a^b \dots \int_a^b f(\alpha_1(\gamma t_1 + \beta t_2)x_1 + \dots + \alpha_l(\gamma t_1 + \beta t_2)x_l + \\ &\quad + (\alpha_{l+1}(\gamma t_1 + \beta t_2) + \dots + \alpha_m(\gamma t_1 + \beta t_2))\frac{a+b}{2}) dx_1 \dots \\ &\quad \dots dx_l = \frac{1}{(b-a)^l} \int_a^b \dots \int_a^b f(\gamma(\alpha_1(t_1)x_1 + \dots + \alpha_l(t_1)x_l + \\ &\quad + (\alpha_{l+1}(t_1) + \dots + \alpha_m(t_1))\frac{a+b}{2}) + \beta(\alpha_1(t_2)x_1 + \dots + \\ &\quad + \alpha_l(t_2)x_l + (\alpha_{l+1}(t_2) + \dots + \alpha_m(t_2))\frac{a+b}{2})) dx_1 \dots dx_l \leq \\ &\leq \gamma H^{[m]}_l(t_1) + \beta H^{[m]}_l(t_2), \end{aligned}$$

for all $1 \leq l \leq m-1$, which shows that $H^{[m]}_l$ is convex on T .

The fact that $H^{[m]}_l$ is convex too on T goes likewise and we will omit the details.

The proof is finished.

Remark. If we choose $T = [0, 1]$, $m = 2$, $\alpha_1(t) = t$ and $\alpha_2(t) = 1 - t$, we recapture a part of Theorem B.

In the above assumptions for f , α_i ($i = 1, \dots, m$) T and m we can define another sequence of mappings connected with $H^{[m]}_l$ ($1 \leq l \leq m-1$) and given by:

$$\begin{aligned} G^{[m]}_1(t) &:= \alpha_1(t) \int_a^b f(x) dx + (\alpha_2(t) + \dots + \alpha_m(t)) f\left(\frac{a+b}{2}\right) \\ G^{[m]}_2(t) &:= \alpha_1(t) + \alpha_2(t) \frac{1}{b-a} \int_a^b f(x) dx + \\ &\quad + (\alpha_3(t) + \dots + \alpha_m(t)) f\left(\frac{a+b}{2}\right), \\ &\dots \dots \dots \end{aligned}$$

$$\begin{aligned} G^{[m]}_{m-1}(t) &:= \alpha_1(t) + \alpha_{m-1}(t) \frac{1}{b-a} \int_a^b f(x) dx + \\ &\quad + \alpha_m(t) f\left(\frac{a+b}{2}\right) \quad \text{for all } t \text{ in } T. \end{aligned}$$

The following theorem also holds.

Theorem 2. In the above assumptions, one has:

(i) The following inequalities:

$$f\left(\frac{a+b}{2}\right) \leq G^{[m]}_1(t) \leq \dots \leq G^{[m]}_{m-1}(t) \leq \frac{1}{b-a} \int_a^b f(x) dx$$

hold, for all t in T ;

(ii) For all $i = 1, \dots, m-1$, one has:

$$H^{[m]}_i(t) + G^{[m]}_i(t) \quad \text{for all } t \text{ in } T;$$

(iii) If there exist $t_0 \in T$ so that

$$\alpha_1(t_0) = \dots = \alpha_p(t_0) = 0 \quad (1 \leq p \leq m-1), \text{ then:}$$

$$\inf_{t \in T} G_l^{[m]}(t) = G_l^{[m]}(t_0) = f\left(\frac{a+b}{2}\right) \text{ for all } 1 \leq l \leq p;$$

(iv) If there exist a $t_1 \in T$ so that $\alpha_p(t_1) = 1$, then:

$$\sup_{t \in T} G_l^{[m]}(t) = G_l^{[m]}(t_1) = \frac{1}{b-a} \int_a^b f(x) dx$$

and

$$\inf_{t \in T} G_q^{[m]}(t) = G_q^{[m]}(t_1) = f\left(\frac{a+b}{2}\right),$$

for all $p \leq l \leq m-1$ and $1 \leq q \leq p-1$;

(v) If T is a convex subset of a linear space

$$Y, f\left(\frac{a+b}{2}\right) \geq 0 \text{ and } \alpha_i (i = 1, \dots, m) \text{ are convex}$$

mappings on T , then $G_l^{[m]}$ are convex on T for all $l = 1, \dots, m-1$.

PROOF. The argument of (i), (iii), (iv) and (v) are obvious by the definition of $G_l^{[m]}$ ($l = 1, \dots, m-1$).

Let prove the statement (ii).

Since f is convex on I , one has:

$$\begin{aligned} H_l^{[m]}(t) &= \\ &= \frac{1}{(b-a)^i} \int_a^b \dots \int_a^b f(\alpha_1(t)x_1 + \dots + \alpha_i(t)x_i + (\alpha_{i+1}(t) + \\ &\quad + \dots + \alpha_m(t))\frac{a+b}{2}) dx_1 \dots dx_i \leq \frac{1}{(b-a)^i} \int_a^b \dots \\ &\quad \dots \int_a^b (\alpha_1(t)f(x_1) + \dots + \alpha_i(t)f(x_i) + (\alpha_{i+1}(t) + \dots + \\ &\quad + \alpha_m(t))f\left(\frac{a+b}{2}\right) dx_1 \dots dx_i = G_l^{[m]}(t), \quad i = 1, \dots, m-1 \end{aligned}$$

for all t in T , which shows the statement (ii).

For other results in connection to Hadamard's inequalities we send to [1-5] and [8-12] where further references are given.

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REZIME

NEKA POBOLJŠANJA ADAMARDOVIH NEJEDNAKOSTI

SEVER S. Dragomir i D. MILOŠEVIĆ

Rad [4] sadrži nejednakosti s višestrukim integralima koje predstavljaju rafiniranja dvojne nejednakosti (1). Ovdje su teoremima 1 i 2 data poboljšanja tih nejednakosti.

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