# INFLUENCE OF CROWN EXPOSURE ON THE MORPHOLOGICAL NEEDLE TRAITS OF NINE CONIFERS

# UTJECAJ EKSPOZICIJE KROŠNJE NA MORFOLOŠKA SVOJSTVA IGLICA DEVET ČETINJAČA

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#### **SUMMARY**

The aim of this research was to investigate if the crown exposure of some conifers influenced to needle properties. The leaf morphological traits of sixty-six trees of nine conifers: Atlas cedar, Austrian pine, Blue spruce, Douglas fir, European spruce, European yew, Serbian spruce, Silver fir, and White fir, from six Belgrade parks, were analyzed. Five needles were measured from each of the four main crown exposures. Length, width, area and perimeter of needles were investigated. Species, parks in which they were found, as well as crown exposures, differed mostly in needle length and needle width. Correlations between measured needle traits were determined by linear regression analysis. Strong positive correlations were found between the length, perimeter, and area of needles. The differences among the species in terms of light requirement determine species for individual planting as lightloving or partial shade species (Atlas cedar, European spruce, Serbian spruce, Blue spruce, Austrian pine and Douglas fir), or for group planting as shade-loving species (Silver fir, White fir and European yew).

KEY WORDS: conifers, correlations, exposure, needle morphology, parks.

# INTRODUCTION

UVOD

The influence of light exposure on the tree crown, among other ecological factors is very important for the successful development of a species. In parks, where crowns are almost open, it is relevant whether a species is light or shadeloving. Other habitat conditions such as habitat exposition, geological substratum, soil, assemblage, air pollution, etc. also influence tree growth (e.g. Hällgren and Fredriksson 1982; Donovan et al. 2005; Freer-Smith et al. 2005).

Silver fir (*Abies alba* Mill.) is a tall, European high-mountain species, growing on silicate and limestone. As it tolerates dry air, arid soil, and polluted air of urban city very poorly, it is rarely used in parks. White fir (*Abies concolor* / Gordon/Lind. ex Hildebr.) is a tall, high-mountain species though sometimes it can be found below 1000 MSL. It in-

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habits the Western USA. It is resistant to frost, wind and drought, as well as dust and harmful gases in the air and has modest soil requirements. Atlas cedar (Cedrus atlantica /Endl./ Mann. ex Carrière) is a tall, high-mountain fastgrowing conifer native to Algeria and Morocco. It is resistant to climate extremes and can grow near the sea, as well as in mountainous regions at low elevations. It is an alkalophilic and heliophilic species. European spruce (Picea abies /L./ Karst.) is a tall, European mountain species that requires plenty of humidity both in the air and the soil. It grows on silicate substrate and acidic soil, though some plant communities also grow on serpentinite or limestone substrate. It has poor tolerance for polluted urban area and industrial air. Serbian spruce (Picea omorika /Panč./ Purkyně) is a tall, high-mountain species, tertiary relict and endemite of the Balkan Peninsula (Bosnia and Herzegovina and Serbia, Europe). Grows mostly on limestone, as well as silicate and swampy soil. Because of its resistance to city conditions, it is very common in parks. Blue spruce (Picea pungens Engelm.) is a tall, North American high-mountain species, growing on humid podzolic, acidic and carbonated soils. It tolerates severe frost, as well as dry air and summer droughts, and urban area conditions. Austrian pine (Pinus nigra J. F. Arnold) is a medium-height mountain species spreading from east Spain to Asia Minor and Crimea. It is a pioneer species, heliophilic, widely used for the afforestation of arid stony areas. It grows on steep limestone, dolomite and serpentinite cliffs. It is resistant to drought, and wind, it tolerates urban area conditions. Douglas fir (Pseudotsuga menziesii /Mirb./ Franco), is a tall species, native to the Pacific zone of North America and requires enough relative air humidity and acidic soil. It is widely cultivated in Serbian parks and forest cultures. European yew (Taxus baccata L.) is slow-growing but long-living species, often shrubby and naturally distributed from North and South Europe to the Mediterranean, Algeria, Morocco, Asia and the Caucasus. It can grow in shade, as well as in open positions, on shallow and poor or deep and rich soils. It is widely cultivated in parks (Vukićević 1982).

Up to now, examinations of the interacting effects of drought and light intensity (e.g. Holmgren, 2000; Aranda et al. 2005; Dutilleul et al. 2015) were performed almost exclusively on seedling growth. Gebauer et al. (2019) examined the impact of drought stress on the growth of one-year needles of *Picea abies* and ascertained that drought stress was correlated with tree assemblage and needle morphological traits. They also discovered that the differences in needle shape cross-section correlated to light intensity i.e. that the cross-section of needles exposed to light was quadrangular, while for the ones in the shade was ellipsoid.

To date, research has focused on the influence of crown light exposure on tree growth i.e. tree height and diameter (Wyckoff and Clarck 2005; Osada 2012; etc.), as well as tree mortality (Shenkin et al. 2018). The correlation of air polution with morphoanatomical traits of the needles of conifers living in urban areas had been previously examined (Nikolić et al. 2019 and refs. cited therein).

The aim of present paper is to examine the influence of crown exposure on the needle morphology of nine conifer species from different genera found in the parks of Belgrade, Serbia. To our knowledge, there has been no similar research conducted in Serbia with adult trees published to date.

### **MATERIALS AND METHODS**

MATERIJALI I METODE

Geographic and geologic characteristics of the study parks and their position in town were presented in Table 1 and Figure 1, respectively). Sixty-six trees of nine conifer species: *Abies alba* (3 trees), *Abies concolor* (5 trees), *Cedrus atlantica* (14 trees), *Picea abies* (3 trees), *P. omorika* (7 rees), *P. pungens* (6 trees), *Pinus nigra* (10 trees), *Pseudotsuga menziesii* (6 trees), and *Taxus baccata* (12 trees) (Table 2) were analyzed. One to four trees of every species per park were analyzed, as was indicated in Table 2. One-year old needles were collected from the tips of lower third of the crown of solitary trees. Five needles (ca. 20 needles per tree) were analyzed from each of the four crown exposures (E, N, S, W). Four morphological needle properties (length, width, area, and perimeter) were measured using *SigmaScan Pro* 



**Figure 1.** Position of analyzed Belgrade parks: PS – palace 'Serbia' park, AC – Academic park, PP – Pioneer park, MM – Milutin Milanković park; TP – Topčider park, and BB – park at Banovo Brdo.

Slika 1. Položaj analiziranih beogradskih parkova: PS – park palate 'Srbija', AC – Akademski park, PP – Pionirski park, MM – park Milutina Milankovića; TP – Topčiderski park i BB – park na Banovom Brdu.

Park	Area	Latitude	Longitude	Pollution	Sub	stratum
Faik	(ha)	(N)	(E)	Follution	Geologic	Pedologic
Park	<i>Površina</i> (ha)	Zemljopisna širina (N)	Zemljopisna dužina (E)	Onečišćenje	Su	ıpstrat
Faik	rovisilia (lla)			Uneciscenje	geološki	pedološki
AC	1.45	44° 49' 10.33"	20° 27' 28.17"	moderate	limestone	loam/hortisol
BB	10.90	44° 46' 43.72"	20° 25' 07.16"	moderate	serpentinite	loam/hortisol
MM	0.01	44° 47' 55.84"	20° 27' 52.97"	excessive	limestone	loam
PP	3.02	44° 48' 37.39"	20° 27' 51.96"	excessive	limestone	loam
PS	41.95	44° 49' 12.16"	20° 25' 39.05"	excessive	limestone	loam/clay loam
TP	13.00	44° 46' 51.55"	20° 26' 25.31"	slight	limestone	loam

 Table 1. Geographic and geologic characteristics of the study parks

 Tablica 1. Geografske i geološke značajke proučavanih parkova

Legend: AC – Academic park; BB – park at Banovo Brdo; MM – Milutin Milanković park; PP – Pioneer park ; PS – Palace 'Serbia' park; TP – Topčider park. Pollution: moderate, excessive, slight; Geologic substrate: limestone, serpentinite; Pedologic substratum: loam/hortisol, loam, loam/clay loam.

Legenda: AC – Akademski park; BB – park na Banovom Brdu; MM – park Milutina Milankovića; PP – Pionirski park; PS – Park palate 'Srbija'; TP – Topčiderski park. Onečišćenje: umjereno, prekomjerno, malo; Geološki supstrat: vapnenac, serpentinit; Pedološki supstrat: ilovača/hortizol, ilovača, ilovača, ilovača.

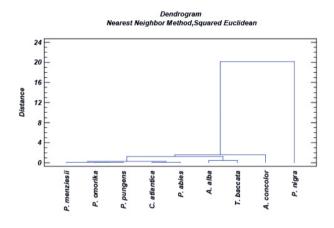


Figure 2. Cluster analysis of nine conifer species based on four morphological traits of needles (length, width, area and perimeter). Slika 2. Klasterska analiza devet vrsta četinjača temeljena na četiri morfološka svojstva iglica (duljina, širina, površina i opseg).

*5.0* image analysis software (Systat Software, Inc., San Jose, CA, USA).

Mean values and differences between the species' needle morphology were examined using the Cluster Analysis (Nearest Neighbor Method, Squared Euclidean Distance, Figure 2), while differences between parks and exposures were examined by ANOVA and LSD test at 95% level, using *Statgraphics Centurion* XVI, Version 16.1.11., (USA) statistical program (Figures 3 and 4; Table 2; Table 3). Correlations between the four measured needle traits of nine conifer species were determined by linear regression analyses (presented as text in Results section).

#### RESULTS

#### REZULTATI

Geographic and geologic characteristics of the study parks were presented in Table 1. For TP park slight air pollution was found. AC and BB parks had moderate, but MM, PS and PP parks excessive air pollution (according to distance from trafic). Geologic substrata also differ between parks, but pedologic substrata were almost same (limestones), with the exception of BB park (serpentinite).

Mean values of four morphological needle traits (length, width, area and perimeter) influenced by the crown exposure of all nine investigated species were presented in Tables 2,3 and 4 and Figures 2,3 and 4. The mean values of all quoted morphological traits were almost published before (Nikolić et al. 2019) (all histograms which were marked as "Mean" in Figures 3 and 4, and in Table 2).

*Pinus nigra* possessed the highest needle trait values (Table 2, Figure 2). *Abies concolor, Taxus baccata* and *Abies alba* also had larger needles in comparison to other investigated conifers.

Strong positive linear correlations were found between length and perimeter (r = 0.94 - 1.00), length and area (r = 0.82 - 0.96), and area and perimeter (r = 0.84 - 0.97) (results were not presented). Predominantly weak positive correlations were found between width and area (r = 0.10 - 0.80). Negative correlations between width and length and width and perimeter (r = -0.37 and r = -0.29, resp.) were found for *C. atlantica*. There were strong positive correlations (r > 0.75) between almost all four traits of *P. pungens*.

Means for each analyzed park were presented in Table 2. Mean values for four main exposures (E, N, S, W) had been presented in Table 2 too, as well as for every of analyzed park (Figure 3 a-i and Figure 4 a-i). Statistical signification was presented in Table 3.

In *Abies alba* needles, the mean values of the four measured traits (length, width, area and perimeter) were presented (Table 2, Figure 3a, Figure 4a), with statistically approved differences between parks BB and PP for needle length (Ta-

 Table 2. Influence of parks and crown exposure (E, N, S, W) on needle morphological traits of nine conifers

 Tablica 2. Utjecaj parkova i izloženosti krune (E, N, S, W) na morfološka svojstva iglica devet četinjača

			a) <i>Abies alba</i>			
Park	Trait	E	Ν	S	W	Mean
	Length	21.05 a	30.87 b	21.89 a	18.69 a	23.13
BB	Width	1.99 ab	2.14 ab	1.91 a	2.30 b	2.08
n=1)	Area	36.87 a	52.15 b	38.52 a	38.50 a	41.51
	Perimeter	46.08 a	66.02 b	47.61 a	41.99 a	50.42
	Length	18.68 ab	20.32 b	16.11 a	15.99 a	17.78
P	Width	2.13 a	2.12 a	1.92 a	1.90 a	2.02
n=2)	Area	33.41 ab	38.71 b	28.45 a	29.42 a	32.50
	Perimeter	41.62 ab	44.88 b	36.06 a	25.78 a	39.58
			b) Abies concolor			
Park	Trait	E			W	Mean
	Length	43.03 ab	43.60 ab	49.81 b	37.23 a	42.82
В	Width	2.59 c	2.53 bc	2.14 a	2.26 ab	2.38
n=3)	Area	90.88 a	92.14 a	92.30 a	77.08 a	87.40
	Perimeter	91.24 ab	92.26 ab	103.89 b	78.99 a	90.40
	Length	49.34 b	46.88 b	34.70 a	41.07 ab	43.02
P	Width	2.40 b	20.90 ab	2.30 b	1.87 a	2.17
n=2)	Area	97.40 b	79.61 ab	70.59 a	70.99 a	79.64
	Perimeter	103.67 b	97.95 b	73.98 a	85.88 ab	90.37
			c) Cedrus atlantica			
Park	Trait	E			W	Mean
	Length	13.31 ab	14.15 b	13.41 b	11.32 a	13.05
С	Width	1.48 b	1.35 ab	1.25 a	1.39 ab	1.37
i=3)	Area	17.30 a	16.78 a	15.40 a	14.58 a	16.02
	Perimeter	34.52 ab	36.24 b	34.45 ab	29.18 a	33.60
	Length	13.93 a	14.55 a	13.22 a	12.51 a	13.42
В	Width	1.26 bc	1.40 c	1.21 ab	1.08 a	1.22
n=3)	Area	16.15 ab	18.97 b	13.96 a	12.90 a	15.08
	Perimeter	35.88 a	37.57 a	32.78 a	30.84 a	33.78
	Length	8.31 a	10.37 ab	17.02 c	15.62 bc	14.42
P	Width	1.30 bc	1.01 a	1.15 ab	1.33 c	1.20
n=4)	Area	8.90 a	9.82 a	18.23 b	19.40 b	16.03
	Perimeter	20.72 a	25.65 a	41.17 b	39.33 b	35.50
	Length	13.37 a	12.29 a	14.17 a	11.53 a	12.89
S	Width	1.34 a	1.40 a	1.32 a	1.163 b	1.42
n=4)	Area	16.42 a	15.34 a	16.45 a	16.36 a	15.72
	Perimeter	33.43 a	32.43 a	35.37 a	29.70a	32.90
			d) Picea abies			
Park	Trait	E	N		W	Mean
	Length	20.10 c	17.88 b	15.96 a	17.56 b	17.87
B	Width	1.65 b	1.59 ab	1.43 a	1.72 b	1.60
n=1)	Area	31.70 c	28.24 b	23.12 a	28.93 b	28.00
n=I)						

	Length	12.90 a	20.90 b	14.10 a	14.65 a	15.52
PP	Width	1.22 a	1.39 bc	1.29 ab	1.48 c	1.35
(n=2)	Area	14.80 a	28.58 c	17.36 ab	19.20 b	19.99
	Perimeter	28.26 a	44.58 c	30.79 a	31.28 a	33.73
			e) Picea omorika			
Park	Trait	E	N	S	W	Mean
	Length	20.66 a	20.15 a	19.21 a	19.17 a	19.80
BB	Width	1.50 a	1.82 b	1.64 b	1.55 a	1.63
(n=2)	Area	29.52 ab	34.35 b	29.29 ab	28.61 a	30.44
	Perimeter	44.31 a	43.94 a	41.70 a	41.44 a	42.85
	Length	13.53 a	15.91 a	13.97 a	14.31 a	14.43
MM	Width	1.31 a	1.68 c	1.44 ab	1.53 bc	1.49
(n=2)	Area	16.46 a	25.96 b	19.70 a	21.51 ab	20.91
	Perimeter	29.69 a	35.18 b	30.81 ab	31.69 ab	31.84
	Length	23.55 b	21.14 ab	21.84 ab	19.90 a	21.61
PS	Width	1.90 b	1.73 ab	1.79 ab	1.62 a	1.76
(n=2)	Area	39.52 b	30.06 a	37.39 b	31.02 a	34.50
	Perimeter	50.88 b	45.76 ab	47.25 ab	43.03 a	46.73
	Length	22.69 b	15.24 a	20.71 b	17.89 a	19.13
ТР	Width	1.60 ab	1.49 a	1.65 b	1.50 ab	1.56
(n=1)	Area	32.96 b	20.33 a	30.88 b	23.12 a	26.82
	Perimeter	48.57 b	33.44 a	44.73b	38.78 a	41.38
			f) Picea pungens			
Park	Trait	E	N	S	W	Mean
	Length	28.93 c	12.45 a	17.03 b	17.65 b	19.01
MM	Width	1.77 b	1.21 a	1.35 a	1.29 a	1.40
(n=2)	Area	23.49 b	14.97 a	42.44 c	22.90 b	25.95
	Perimeter	61.40 c	27.30 a	36.78 b	37.87 b	40.84
	Length	29.22 c	22.80 b	21.59 b	17.83 a	22.86
РР	Width	1.90 b	1.68 ab	1.46 a	1.55 a	1.65
(n=2)	Area	44.83 c	33.34 b	30.58 ab	25.01 a	33.44
	Perimeter	62.23 c	48.95 b	46.11 b	38.77 a	49.01
	Length	26.69 b	23.62 a	27.58 b	30.67 b	27.89
PS	Width	1.67 a	1.56 a	1.71 a	1.78 a	1.68
(n=2)	Area	44.20 b	34.32 a	43.37 b	49.55 b	42.86
	Perimeter	62.70 b	50.36 a	58.57 b	64.90 b	59.13
			g) <i>Pinus nigra</i>			
Park	Trait	E	N	S	W	Mean
	Length	118.15 a	123.08 a	118.20 a	129.58 a	122.52
BB	Width	1.18 b	1.01 a	1.07 ab	1.05 ab	1.08
(n=3)	Area	135.66 a	150.53 a	159.44 a	155.69 a	150.33
	Perimeter	238.02 a	247.45 a	237.92 a	260.55 a	245.98

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	Length	132.80 a	-	176.92 b	137.76 a	149.16
MM	Width	1.58 a	-	1.99 b	1.46 a	1.67
(n=1)	Area	206.97 a	-	312.02 b	192.00 a	237.00
	Perimeter	268.75 a	-	357.80 b	278.45 a	301.67
	Length	122.65 a	138.42 b	136.30 b	119.77 a	129.29
PP	Width	1.41 a	1.84 b	2.03 b	1.24 a	1.63
(n=2)	Area	167.19 a	237.45 b	240.13 b	146.94 a	197.93
	Perimeter	248.13 a	280.54 b	276.67 b	242.02 a	261.84
	Length	148.00 c	114.96 a	128.10 ab	145.25 bc	136.86
PS	Width	1.51 a	1.80 b	1.82 b	1.75 ab	1.68
(n=4)	Area	208.64 a	190.58 a	203.13 a	208.87 a	203.97
	Perimeter	299.02 c	233.51 a	259.86 ab	294.01 bc	277.08
		h)	Pseudotsuga menzie	sii		
Park	Trait	E		S	W	Mean
	Length	26.08 a	32.57 b	22.69 a	24.39 a	26.19
BB	Width	1.66 bc	1.50 a	1.53 ab	1.73 c	1.62
(n=3)	Area	39.66 a	48.51 b	34.40 a	39.12 a	40.12
	Perimeter	55.48 a	68.15 b	48.43 a	52.23 a	55.63
	Length	34.37 b	-	18.84 a	22.43 a	25.21
MM	Width	1.64 ab	-	1.47 a	1.83 b	1.65
(n=1)	Area	52.75 c	-	26.79 a	37.82 b	39.12
	Perimeter	72.02 b	-	40.62 a	48.52 a	53.72
	Length	37.42 b	27.12 a	29.53 a	28.77 a	31.22
	Width	1.54 a	1.64 a	1.51 a	1.67 a	1.58
рр (n=2)	Area	52.38 a	41.67 a	41.95 a	44.88 a	45.73
. ,	Perimeter	77.92 b	57.53 a	62.08 a	60.89 a	65.61
	renneter	77.92 D	i) Taxus baccata	02.00 a	00.09 a	05.01
Park	Trait	E	N		W	Mean
FdIK						
	Length	20.56 b	22.05 b	16.46 a	21.87 b	20.24
BB (n=3)	Width	2.24 bc	2.40 c	1.76 a	2.13 b	2.13
(1-0)	Area	41.54 b	48.97 c	27.49 a	42.84 bc	40.21
	Perimeter	45.61 b	48.90 b	36.44 a	48.01 b	44.74
MM	Length	17.34 a	16.16 a	17.72 a	18.59 a	17.45
(n=3)	Width	2.27 a	2.27 a	2.26 a	2.27 a	2.27
	Area	38.06 a	34.35 a	38.00 a	39.73 a	37.54
	Perimeter	39.22 a	36.86 a	39.96 a	41.73 a	39.44
	Length	21.98 b	20.45 b	18.07 a	19.92 ab	20.10
op (n-2)	Width	2.66 ab	2.70 b	2.37 a	2.63 ab	2.59
(n=2)	Area	49.45 b	48.56 ab	40.11 a	47.75 ab	46.47
	Perimeter	49.28 b	46.30 b	40.88 a	45.10 ab	45.39
	Length	18.89 b	19.81 b	13.58 a	18.52 b	17.70
PS	Width	2.40 ab	2.36 ab	2.23 a	2.57 b	2.39
(n=3)	Area	41.06 b	42.59 b	27.67 a	43.83 b	38.78
	Perimeter	42.57 b	44.34 b	31.63 a	42.20 b	40.18

	Length	16.60 a	19.31 b	18.69 ab	18.90 ab	18.38
ТР	Width	2.17 a	2.24 a	2.22 a	2.27 a	2.25
(n=1)	Area	33.90 a	40.69 a	39.80 a	39.56 a	38.49
	Perimeter	37.55 a	43.10 b	41.82 ab	42.35 ab	41.20

Parks: AC – Academic; BB – Banovo Brdo; MM – Milutin Milanković; PP – Pioneer; PS –

Palace 'Serbia', and TP – Topčider park. Traits: Length, Width and Perimeter in mm, Area in mm<sup>2</sup>.

Crown exposure: E- eastern, N – northern, S – southern, and W – western. a,b,c...: homogeneous groups.

Palata "Srbija" i TP – Topčiderski park. Svojstva: duljina, širina i opseg u mm, površina u mm<sup>2</sup>.

Ekspozicija krune: E-istok, N-sjever, S-jug i W-zapad. a,b,c...: homogene grupe.

Table 3. Summary statistics and ANOVA tables of needle length and width of nine conifers with respect to following factors: park and crown exposure
Table 3.Sumarna statistika i ANOVA tabele dužine i širine iglica devet četinjača u pogledu sledećih faktora: park i izloženost krošnje

	_				a).Abi	s alba, l	NEEDLE	LENGTH											b) 414	as comos?	. NEEDA	E LENGTH					
			Descriptive					-			A Table		and a star				Descriptiv	e Statistics	2		R, NEEDI	A LENGTH			VA Table		
PARK	π.	Average	SD	CV	Min.	Max.	Range	Source	SS	D.f.	MS	F-Ratio	P-Value	PARK	n	Average	SD	CV	Min.	Max.	Range	Source	ŞS.	D.f.	MS	F-Ratio	P-Value
BB	20	23,1285	5,52571	23,89%	16,58	39,8	23,22	groups	381,919	1	381,919	17,19	0,0001	вв	50	42,8184	9,78399	22,85%	21,04	73,02	51,98	Between groups	1337,31	1	1337,31	1,95	0,1662
pp	40	17,7765	4.26236	21.98%	10.64	25.92	15.28	Within	1288.68	58	22.2186		1	pp.	-40	43.019	12,3762	28,77%	23.06	72,51	49,45	Within	60387,6	88	686,223		
11	40	17,005	4.50230	23,39.79	10,04	43,96	13,60	groups	1296,08	-20	44,4100			PP.	40	43,019	12,3786	_28,772k	23,00	16,31	49,45	groups Total	60387,8	88	080,223		
Total	60	19,5605	5,3212	27,20%	10,64	39,8	29,16							Total EXPOS	90	42,9076	10,9468	25,51%	21,04	73,02	51,98	(Corr.)	61724,9	-89		-	-
Total EXPOSE		19,3603	3,3212	27,20%	10,04	39,8	29,10	+				-		EXPOS	URE	<del>.</del> .						Between				-	-
1.00		19,474	3,13181	10000	12.45	23,15	10,70	Between	(anaz-	1	138,756	6,19	0,001	Е	20	46,2305	8,5577	18,51%	29,09	64,05	34,96	groups Within	758,627	3	252,876	2,2	0,0944
n	12.	19,476	3,13181	16,08%	12.45	23,15	10,70	groups Within	416,267	3	138,750	0,19	0,901	N	25	44,9144	9,4834	21,11%	30,56	72,51	41,95	groups	9906,49	86	115,192		
N	15	23,8387	6.88201	28,87%	14,35	39,8	25,45	groups	1254,33	56	22,3988			- 2	20	42.251	12.209	28,90%	25.12	73,02	47.9	Total (Corr.)	10665,1	89			
s	15	18,0373	4,05932	22,51%	10.64	23,9	13.26	Total (Corr.)	1670,6	59				3	20	42,231	12,209	28,9074	42,14	73,02	47,9	(0.007.)	19005,1	-89			-
		1100010		-	10001		1111		10.000	1				w	25	38,7676	12,1183	31,26%	21,04	64,9	43,86						
W	15	16,892	3,99332	23,64%	12,00	24,17	12,17	-	S			();	1.11														
3223	60	19,5605	5,3212	27,20%	10.64	39,8	29.16							Total	90	42,9076	10,9468	25,51%	21,04	73,02	51,98				L		
Total	0	19,5602	5,3212	21,20%				1	<u> </u>										b) 46	ies conco	or. NEED	LE WIDTH					
-	_		Descriptive	Statistics	#1.4b	es alba,	NEEDLE	WIDTH		1.000	ATable				30	<u>,</u>		e Statistics	ang <sup>ana</sup> ang					ANO	VA Table		
PARK	α.	Average	SD	CV	Min	Max.	Range	Source	SS	D.f.		F-Ratio	P-Value	PARK		Average	Standard deviation	Coeff. o variation	Min	Max	Range	Source	Sum of Squares	DE	Mean Square	F-Ratio	P-Value
1		Same		143.00	Sec.	-	1000	Between	-		11000	1.00			1				- Pada			Between					
BB	20	2,083	0.28195	13,54%	1,45	2,68	1,23	groups Within	0,058963	-	0,058963	0,6	0,443	BB	50	2,383	0,423177	17,76%	1,7	3,29	1,39	groups Within	1,04642	1	1,04642	5,18	0,0253
PP	40	2,0165	0,328965	16,31%	1,36	2,72	1,36	groups	5,73093	58	0,098809			PP	40	2,166	0,480858	22,20%	0,84	3,09	2,23	groups	17,7926	88	0,202189		
Total	60	2,03867	0.313263	15,37%	1.36	2.72	1.36	Total (Corr.)	5,78989	59				Total	90	2,28656	0,460081	20,12%	0,84	3,29	2,43	Total (Corr.)	18,839	89			
EXPOSI		Jan Den P			1	-			Section 1		-		2	EXPOS			01400001	ad(147)	0,00	5,69	6,93		10,039	409			
		2,07933	0,245807	11.038	1.67	1.71	1.05	Between	0,354693	1	0.119221	1.33	0.3136	E	20	2,496	0.599011	24,00%	0.80	3.29	2.43	Between	1,896	1	0.631999	3.21	0,0271
6	12			11,82%		2,72		groups Within			0,118231	1,22	0,3116					Course and		1.000		groups Within	Conserved State	-		3,61	9.0271
N	15	2,12467	0,27404	12,90%	1.55	2,68	1,13	groups	5,4352	56	0,097057			N	25	2,3536	0,44439	18,88%	1,45	3,13	1,68	groups	16,943	86	0,197012	_	-
5	15	1,918	0,243111	12,68%	1,45	2,38	0,93	Total (Corr.)	5,78989	59				s	20	2,219	0,250723	11,30%	1.74	2,68	0,94	Total (Corr.)	18,839	89			
					1									0.545													
w	15	2,03267	0,440008	21,65%	1,36	2,56	1.2	<u> </u>						W	25	2,106	0,417911	19,84%	1,23	2,88	1,61	-	<u></u>	-	-	-	-
Total	60	1.03562	0,313263	15,37%	1,36	2.72	1.36	1						Total	90	2,28656	0,460081	20,12%	0.84	3.29	2.43						
1010	.00	2,05867	0,313203	12,27,76	1,30	2412	1,20	_								. allecond	011000001		- Oger		apte				· · · · ·		
														r					0202	0.00	-						
-			Descriptive	Statistics	c) c rava			LELENGTH		ANON	ATable						Descriptio	ve Statistic		ces alies	NEEDL	ELENGTH		ANO	VA Table		
PARK	it	Averiage	SD	CV	Min.	Max.	Range	Scorce Between	55	D.f.	MS	F-Ratio	P-Value	PARK	11	Average	SD	CV	Min.	Max.	Range	Source	85	D.E	MS	F-Ratio	P-Value
AK	60	13,0477	2.91941	22,38%	7,07	17,89	10,82	greeps	60,1975	3	20,0658	1,12	0,3403	BB	20	17.8755	1.66522	9,32%	14,74	20.88	6,14	Between groups	74,1827	1	74,1837	5.82	0.019
88	30	13,4178	3,36549	26,57%	851	23.22	14,71	Within groups	3766.59	211	17,8511	1			-							Within					
PP.		1220.2	1000		6.37	23,74	17,37	Total	1.2.2.2.2	214				10	40	15,5167	4,19521	27,04%	8,63	25,07	16,44	Total	739,079	58	12,7427	-	
PP PS	35.	14,4243	5,96231	41,34%	5,77	24,59	19,12	(Corr.)	3826,79	214	-	-	-	Total	60	16,303	3,71269	22,77%	8,63	25,07	10,44	(Corr.)	813,262	59			
Total EXPOST	215	13,3083	4,22873	31,78%	5,77	24,89	19,12	-		_		-	-	EXPOS	URE	-	-		-	-	-	Between	-	-	-		-
EAROSI					-			Between	-		-			E	15	15,3013	4,13428	27,02%	9,4	20,88	11.48	groups	260,764	2	86,9214	8,81	0,0001
0	45	12,9126	4,97501	38,51%	5,77	24,89	19,12	groups Within	128,719	E.	47,9063	2,45	0,0547	N	15	19,8907	2,79999	14,08%	16,46	25,07	8,61	Within groups	552,498	- 56	9,86603		
N	30	13,109	3,23041	24,64%	7,42	19,23	11,81	groups	3698,07	211	17,5264				10			14,010.8	10,40			Total		-	3,100002		
8	15	14,4334	4,0487	28,05%	6.21	32,17	15.96	Total (Corr.)	3826,79	216				5	15	14,722	3,23634	21,98%	8,63	20,14	11,51	(Corr.)	813,262	- 59			-
228/	1991	Sec.	1. (7.192.5)		1.0	3,60	Same							w	15	15.298	201444	13,17%	11,52	18.69	7,17						
W	.55	17,4836	4,4085	35315	6,23	23,74	17,51	-				-		-	1	CUESO.	- ALANCAR	10010-018	trife	10,49	COLC.		1		Q		
Total	215	13,3083	4,22873	31,78%	5.77	24,89	19.12							Total	60	16,103	3,71269	22,77%	8,63	25,07	16,44		3 3		· · · · ·		
					c) Code	er ettam	ice. NEFT	N.E. WIDTH		_																	
			Descriptive	Statistics	Sum			-			A Table							10000000	d) <i>P</i>	lices able	, NEEDL	E WIDTH			44.075		
PARK	11	Average	\$D.	CV	Min.	Max.	Range	Source Between	- 55	D.f.	MS	F-Ratio	P-Value		1	15		ve Statistic	110	******	10.00%		1	ANO	VA Table		Loca
AK	60	1,3675	0,284269	20,79%	0,78	2.05	1.27	gReps	1,77323	3	0.591078	7,85	0.0001	PARK		Average	sD	CV	Min	. Max	Range	Between	85	D.E	MS.	P-Natio	P-Value
BB	50	1.218	0,238755	19,60%	0.76	1.91	1,15	Within groups	15,8910	211	0,075313			BB	26	1,6005	0,18288	11,439	- 1,1	1,89	0.7	groups	0,853453	1	0,853453	29,58	0,0000
PP		1,20371	0.21769	18,06%	0.37	1.8	1,03	Total	17,6643	214				PP	40	1,3475	0,16313	12,119	0,9	1 1,61	0,64	Within groups	1,67345	58	0.028853		
75	35	1,416	0,31205	22,04%	0.93	2,04	1.11	(Corr.)	(7,5643	214												Total	1				
	215.	1,32186	0,287303	21,73%	0,76	2,08	1,29 .	-			_	-		EXPO	60 SURE		0,29695	14,455	0,9	1,89	0.92	(Corr.)	2,5269	59	-	-	-
EXPOSI	HOR:	Course of	and the second			1.1		Between	S		(				T	100000	3,5424	10000				Between	Ceres in		1000	1,240	35776
E	45	1,36667	0.215797	15,79%	0.93	1.87	0.94	groups Within	0.640203	3	0.213401	2.64	0.0502	6	15	1,3673	0,25084	18,355	0.9	7 1,78	0.81	groups Within	0,438458	3	0,146153	3,92	0,0131
N	50	1,3476	0,27587	20,45%	0,37	1.91	1.14	groups	17,0241	211	0,080683			N	15	1,46	0,18248	12,509	: 33	1,89	0,79	groups	2,08844	- 56	0,037294		
8	-	1,23954	0,285041	23,00%	0.76	2.04	1.28	Total (Corr.)	17,6643	214				s		1,34133	0.17451-	4 15.019	a 10	1.7	0.6	Total (Corr.)	2,5269	- 90			
			- and the second second		100	-			- the second						12	1,34133	0,17450	12,013		1.1	0,0	(cure)	2,200	1			1.1
w	55	1,35909	0,33461	24,62%	0,78	2,05	1,27	-						<b>'B</b> '	.12	1,55867	0,14999	9,62%	1,2	1,8	0,53	-					-
								11.1							1		1			1	1		E				
Total	215	1.32186	0.287303	21,73%	0.76	2.05	1.74							Total	61	1200	0,20695	14,45%	0.9	1.89	0.92						

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Parkovi: AC – Akademski; BB – Banovo Brdo; MM – Milutin Milanković; PP – Pionirski; PS –

Table 3. Continued Table 3. Nastavak

PARK		Average	Descriptive	CV	Min.	Max.	Ringe	Source	- 55	D.f.	A Table MS	T-Ratio	P-Volue
		S						Batween	1				1
BB	40	19,7990	3,46399	17,59%	13,04	25,93	12,89	proeps	1119,45	3	375,144	34,17	0,0000
MM	40	14,4300	2,92821	20,24%	9.81	19,13	9.52	Within	1415.32	136	10,9215		
2024	.40	14,4300	2,92023	20,24%	9,81	19,15	9.52	groups Total	1410.32	136	10:9215	-	
195	40	21,6075	3,41966	15,02%	14,87	30,25	15,38	(Corr.)	2604,75	139			
TP	20	19,1295	3,46942	18,14%	14,27	28,33	14,96				19 19	2	-
Total	140	1680,81	4,32888	25,17%	9,81	30,25	20,44		3		2	1	-
EXPOS	URE				-	-		Between	-		-	-	_
E	35	19,7366	4,90104	24,83%	9.81	28.33	18.92		66,5431	12	22.181	1,19	0,316
		10,1,000	5,70104				10pca	prosps Within	10000		44,101	14.7	142.004
N	15	18,5214	4,04172	21,82%	12,95	30,25	17.27	groups	2538,21	136	18,5533		
100		1993	0.8420		1.000	26.0	1000	Total	124337	100			
-5	39	18,678	4,66269	24,96%	11.76	27,18	15,42	(Corr.)	2604,75	139	-	-	-
W	35	17,8083	3,54414	19,98%	9,94	22,75	12,39						
	100	dones."	100000		10.00	13100	10.00					1	
Total	1-89	18,6801	4,32888	23,17%	9,81	30,25	20,44		6 - N				<u>.</u>
					a) Pice	r omerit.	a NETDI	E WIDTH					
			Descriptive	Statistics				I		ANON	A Table		
PARK	4	Average	ND	CV	Min	Max.	Range	Source	- 55	D.C	MS	F-Ratio	P-Valu
200		100.000	0.0357	1002en	1000	100		Between	12221	1.0	1.336.5	1000	36.56
88	40	1,62625	0,28648	17,62%	1.02	2.2	1,18	groups	1,51274	1	0,50425	7,81	0,000
101	40	7.001	0.11667	14 765		1.44		Within	1 7077	1.54	posies.		
MM	40	1,491	0,22886	15,35%	-1,1	1,48	9,88	Total	8,78278	136	0,05458	-	
PS .	40	1.79925	0,28653	16,29%	0,91	2,36	1,45	(Cort.)	10,2955	139			
17	20	1,56000	0,13310	8,53%	1.2H 0.91	1,79	0,51				Ş		-
Tetal		1,61614	0,27215	16,84%	0.91	2,36	1,45		1		2	2	2
EXPOS	URE	18					_	-			3	-	3
т	35	1,57513	0,31742	20,17%	1,02	2,17		Bebreen	0,47635 T	3	0,15879		
- t	13	1,27340	9,71742	20,17%	1,04	.411	1,11	groups Within	1	1	9,15979	2,2	0,091
N	35	1,70657	0,19435	11,39%	136	22	0,84	groeps	9,81916	136	0.0722		
								Total					
- 5	75	1,62743	0,32248	10,82%	0,91	2,35	1,45	(Corr.)	10,2955	139			
		Same	and the second		6				V				
W	35	1,55714	.0,21511	15,81%	1,19	1.93	:0,74	_					
			A 1011 Carlos										
Total	140	1,61614	0,27216	16,84%	0.91 g) Pin	2,36 as aigra,	1,45 NEEDLE	LENGTH					
Total	140	1,61614	0,27236 Descriptiv							ANO	A Table		
	140			e Statistics			NEEDLE	LENGTH	55	ANO	A Table MS	E- Ratio	P.Vak
Tatal PARK	Ň	Average	Descriptis SD		g) Pin Min.	as aigra. Max				D£	MS	F. Ratio	
	140 		Descriptiv	e Statistics	g) Pîn	as nigra, i	NEEDLE	Source Between groups	.5S 10296,8	1.1.1	11000	Fa Ratio	
PARK	<i>R</i> 60	Average 122,253	Description SD 17,0954	e Statistics CV 13,98%	g) Pin Min. 91,28	Max. 155,25	Range 63,97	Source Between groups Within	10296,8	D.C 3	MS 3432,27		
PARK	Ň	Average	Descriptis SD	e Statistics CV	g) Pin Min.	as aigra. Max	Range	Source Between groups Within groups		D£	MS		
PARK	<i>R</i> 60	Average 122,253 149,159	Descriptis SD 17,0964 21,3491	e Statistics CV 13,98% 14,31%	g) Pin Min. 91,28 124,79	Max. 155,25 194,09	Range 63,97 69,9	Source Between groups Within groups Total	10296,8 39826	D.f. 3 136	MS 3432,27		P.Valu 0,000
PARK BB MM PP PS	n 60 15 40 25	Average 122,253 149,159 129,288 136,864	Descriptis SD 17,0964 21,3491 13,0529 18,9378	e Statistics CV 13,98% 14,31% 16,79% 13,84%	g) Pin Min. 91,28 124,79 93,66 93,5	Max. 155,25 194,69 162,59 191,28	Range 63,97 60,9 62,93 07,78	Source Between groups Within groups	10296,8	D.C 3	MS 3432,27		
PARK BB MM PP PS Total	80 15 40 25 140	Average 122,253 149,159 129,288	Descriptio SD 17,0964 21,3491 13,0529	e Statistics CV 13,98% 14,31%	g) Pin Min. 91,28 124,79 99,66	Max. 155,25 194,69	Range 63,97 69,9	Source Between groups Within groups Total	10296,8 39826	D.f. 3 136	MS 3432,27		
PARK BB MM PP PS	80 15 40 25 140	Average 122,253 149,159 129,288 136,864	Descriptis SD 17,0964 21,3491 13,0529 18,9378	e Statistics CV 13,98% 14,31% 16,79% 13,84%	g) Pin Min. 91,28 124,79 93,66 93,5	Max. 155,25 194,69 162,59 191,28	Range 63,97 60,9 62,93 07,78	Source Between groups Within groups Total (Corr.)	10296,8 39826	D.f. 3 136	MS 3432,27		
PARK BB MM PP PS Total EXPO	n 60 15 40 25 140 SURE	Average 122,253 149,159 129,288 136,864 129,754	Descriptis SD 17,0984 21,3491 13,0520 18,0578 18,0094	e Statistics CV 11,58% 14,31% 10,79% 13,84% 14,63%	g) Pin Min. 91,28 124,79 99,66 93,5 91,28	Max. 155,25 194,69 162,59 191,28 194,09	Range 63,97 69,9 62,93 97,78 103,4	Source Between groups Withis groups Total (Corr.) Between	10296,8 39826 50122,8	D.f. 3 136 139	MS 3432,27 292,838	13,72	0,000
PARK BB MM PP PS Total	80 15 40 25 140	Average 122,253 149,159 129,288 136,864	Descriptis SD 17,0964 21,3491 13,0529 18,9378	e Statistics CV 13,98% 14,31% 16,79% 13,84%	g) Pin Min. 91,28 124,79 93,66 93,5	Max. 155,25 194,69 162,59 191,28	Range 63,97 60,9 62,93 07,78	Source Between groups Within groups Total (Corr.)	10296,8 39826	D.f. 3 136	MS 3432,27		0,000
PARK BB MM PP PS Total EXPO	n 60 15 40 25 140 SURE	Average 122,253 149,159 129,288 136,864 129,754	Descriptis SD 17,0984 21,3491 13,0520 18,0578 18,0094	e Statistics CV 11,58% 14,31% 10,79% 13,84% 14,63%	g) Pin Min. 91,28 124,79 99,66 93,5 91,28	Max. 155,25 194,69 162,59 191,28 194,09	Range 63,97 69,9 62,93 97,78 103,4	Source Between groups Withis groups Total (Corr.) Between groups Within	10296,8 39826 50122,8	D.f. 3 136 139	MS 3432,27 292,838	13,72	0,000
PARK BB MM PP PS Total EXPO E N	80 15 40 25 140 SURE 40 30	Average 122,253 149,159 129,288 136,864 129,754 128,572 126,841	Descriptis SD 17,0954 21,3491 18,9520 18,9520 18,9528 18,9594 18,571 14,3072	e Statistics CV 13,98% 14,31% 16,79% 13,84% 14,65% 14,44%	g) Pin Min. 91,28 124,79 93,56 93,5 91,28 98,81 93,5	Max. 155,25 194,69 162,59 191,28 194,09 191,28 194,09	Range 63,97 69,9 62,93 97,78 103,4 92,47 69,09	Source Between groups Tital (Corr.) Between groups Within groups Total	10295,8 30826 50122,8 726,236 49395,6	D.f. 3 136 139 3 136	MS 3432.27 292,838 342,079	13,72	0,000
PARK BB MM PP PS Total EXPO	# 60 15 40 25 140 SURE 40	Average 122,253 149,159 129,288 136,864 139,754 128,572	Descriptis SD 17,0954 21,3491 13,0520 18,0378 18,0378 18,0378	e Statistics CV 13,98% 14,31% 14,85% 14,65%	g) Pin Min. 91,28 124,79 93,56 93,5 91,28 98,81	Max. 155,25 194,69 162,59 191,28 191,28	Range 63,97 69,9 62,93 97,28 103,4 92,47	Source Between groups Total (Corr.) Between groups Within groups	10296,8 39826 50122,8 726,236	D.£ 3 136 139 3	MS 3432.27 292,838 342,079	13,72	0,000
PARK BB MM PP PS Total EXPO E N S	# 60 15 40 25 140 8URE 40 30 35	Average 122,253 149,159 129,288 136,864 129,754 128,572 126,841 133,173	Descriptis SD 17,0984 21,3491 13,0529 18,0378 18,0378 18,0378 18,072 26,0471	e Statisties CV 11,38% 14,31% 10,79% 10,84% 14,44% 11,28% 19,56%	g) Pin Min. 91,28 124,79 93,66 93,5 91,28 93,5 91,28	Max. 155.25 194,69 162,99 162,99 191,28 194,69 191,28 162,59	ReeDLe Range 63,97 69,9 62,93 97,78 103,4 92,47 69,09 103,4	Source Between groups Tital (Corr.) Between groups Within groups Total	10295,8 30826 50122,8 726,236 49395,6	D.f. 3 136 139 3 136	MS 3432.27 292,838 342,079	13,72	0,000
PARK BB MM PP PS Total EXPO E N	80 15 40 25 140 SURE 40 30	Average 122,253 149,159 129,288 136,864 129,754 128,572 126,841	Descriptis SD 17,0954 21,3491 18,9520 18,9520 18,9528 18,9594 18,571 14,3072	e Statistics CV 13,98% 14,31% 16,79% 13,84% 14,65% 14,44%	g) Pin Min. 91,28 124,79 93,56 93,5 91,28 98,81 93,5	Max. 155,25 194,69 162,59 191,28 194,09 191,28 194,09	Range 63,97 69,9 62,93 97,78 103,4 92,47 69,09	Source Between groups Tital (Corr.) Between groups Within groups Total	10295,8 30826 50122,8 726,236 49395,6	D.f. 3 136 139 3 136	MS 3432.27 292,838 342,079	13,72	0,000
PARK BB MM PP PS Total EXPO E N S W	80 15 140 25 140 30 30 35 35	Average 122,253 149,159 129,288 136,864 129,754 128,572 126,841 133,173 130,185	Descriptiv SD 17,0964 21,3491 13,0529 18,0578 18,0594 18,571 14,3072 26,0471 14,2897	e Statistics CV 13,98% 14,31% 16,79% 13,9% 14,45% 14,45% 14,45% 19,56% 10,98%	g) Pin Min. 91,28 124,79 93,56 93,5 91,28 93,5 91,28 107,99	Max. 155,25 194,69 162,59 191,28 191,28 162,59 194,69 155,25	Range 63,97 60,9 62,93 97,78 103,4 92,47 69,09 103,4 47,26	Source Between groups Tital (Corr.) Between groups Within groups Total	10295,8 30826 50122,8 726,236 49395,6	D.f. 3 136 139 3 136	MS 3432.27 292,838 342,079	13,72	0,000
PARK BB MM PP PS Total EXPO E N S	# 60 15 40 25 140 8URE 40 30 35	Average 122,253 149,159 129,288 136,864 129,754 128,572 126,841 133,173	Descriptis SD 17,0984 21,3491 13,0529 18,0378 18,0378 18,0378 18,072 26,0471	e Statisties CV 11,38% 14,31% 10,79% 10,84% 14,44% 11,28% 19,56%	g) Pin Min. 91,28 124,79 93,56 93,5 91,28 93,5 91,28 107,99 91,28	Max. 155,25 194,69 162,59 191,28 191,28 162,59 194,69 155,25 194,69	Range 63,97 62,93 97,78 103,4 92,47 69,09 103,4 47,26 103,4	Source Between groups Wilhin groups Within groups Total (Corr.)	10295,8 30826 50122,8 726,236 49395,6	D.f. 3 136 139 3 136	MS 3432.27 292,838 342,079	13,72	0,000
PARK BB MM PP PS Total EXPO E N S W	80 15 140 25 140 30 30 35 35	Average 122,253 149,159 129,288 136,864 129,754 128,572 126,841 133,173 130,185	Descriptis SD 17,0954 21,3491 13,0520 18,0520 18,0520 18,0520 18,0521 18,0594 18,571 14,3072 26,0471 14,3897 18,0894	e Statistics CV 13,98% 14,31% 14,31% 14,65% 14,65% 14,65%	g) Pin Min. 91,28 124,79 93,56 93,5 91,28 93,5 91,28 107,99 91,28	Max. 155,25 194,69 162,59 191,28 191,28 162,59 194,69 155,25	Range 63,97 62,93 97,78 103,4 92,47 69,09 103,4 47,26 103,4	Source Between groups Wilhin groups Within groups Total (Corr.)	10295,8 30826 50122,8 726,236 49395,6	D.£ 3 136 139 3 136 139	MS 3432.27 292,838 342,679 363,21	13,72	
PARK BB MM PP PS Total EXPO E N S W	80 15 140 25 140 30 30 35 35	Average 122,253 149,159 129,288 136,864 129,754 128,572 126,841 133,173 130,185	Descriptiv SD 17,0964 21,3491 13,0529 18,0578 18,0594 18,571 14,3072 26,0471 14,2897	e Statistics CV 13,98% 14,31% 14,31% 14,65% 14,65% 14,65%	g) Pin Min. 91,28 124,79 93,56 93,5 91,28 93,5 91,28 107,99 91,28	Max. 155,25 194,69 162,59 191,28 191,28 162,59 194,69 155,25 194,69	Range 63,97 62,93 97,78 103,4 92,47 69,09 103,4 47,26 103,4	Source Between groups Within groups Total (Corr.) Between groups Within groups Total (Corr.)	10295,8 30826 50122,8 726,236 49395,6	D.£ 3 136 139 3 136 139	MS 3432.27 292,838 342,079	13,72	0,000
PARK BB MM PP PS Total E N S W W Total	# 60 15 40 25 140 25 5 5 0 40 30 35 35 140	Average 122,253 140,159 129,284 128,572 126,841 133,173 130,185 129,754	Descriptiv SD 17,0954 21,3491 13,0520 18,0578 18,0578 18,0578 18,0578 18,0578 18,571 14,3072 26,0471 14,3072 18,0094 18,0094	e Statistics CV 13,98% 14,31% 14,43% 13,84% 14,63% 14,65% 19,56% 10,98% 16,55% 16,55%	g) Pin Min. 91,28 124,79 99,66 95,5 91,28 95,51 91,28 107,99 91,28 107,99 91,28	Miss. Miss. 15525 194,69 162,59 191,28 162,59 191,28 162,59 194,69 155,25 154,69 155,25 194,69	Ranpc 63,97 69,9 62,91 97,78 92,47 103,4 47,26 103,4 47,26	Source Between groups Wilhin groups Within groups Total (Corr.)	10296,8 39826 59122,8 7726,236 49396,6 59122,8	D.£ 3 136 139 3 136 139	MS 3432.27 292,838 242,079 363,21 363,21	13,72 0.67	0,000
PARK BB MM PP PS Total EXPO E N S W	80 15 140 25 140 30 30 35 35	Average 122,253 149,159 129,288 136,864 129,754 128,572 126,841 133,173 130,185	Descriptis SD 17,0954 21,3491 13,0520 18,0520 18,0520 18,0520 18,0521 18,0594 18,571 14,3072 26,0471 14,3897 18,0894	e Statistics CV 13,98% 14,31% 14,31% 14,65% 14,65% 14,65%	g) Pin Min. 91,28 124,79 93,56 93,5 91,28 93,5 91,28 107,99 91,28	Max. 155,25 194,69 162,59 191,28 191,28 162,59 194,69 155,25 194,69	Range 63,97 62,93 97,78 103,4 92,47 69,09 103,4 47,26 103,4	Source So	10295,8 30826 50122,8 726,236 49395,6	D.£ 3 136 139 3 136 139	MS 3432.27 292,838 342,679 363,21	13,72	0,000
PARK BB MM PP PS Total E N S S W Total PARK	л 60 15 140 30 35 140 35 140	Average 122,253 140,159 129,288 136,804 129,754 128,572 126,841 133,173 130,185 129,754 Average	Descriptis SD 17,0954 21,3491 13,0529 18,0578 18,0578 18,0578 18,0578 18,0579 18,571 14,3072 26,0471 14,3897 18,0894 5D	e Statistics CV 13,98% 14,31% 14,31% 14,45% 14,45% 14,46% 19,56% 16,58% 14,65% 16,58% 14,65%	<ul> <li>g) Pin</li> <li>Min.</li> <li>91,28</li> <li>124,79</li> <li>93,66</li> <li>93,5</li> <li>91,28</li> <li>90,5</li> <li>91,28</li> <li>107,99</li> <li>91,28</li> <li>107,99</li> <li>91,28</li> <li>107,99</li> <li>91,28</li> <li>107,99</li> <li>Min.</li> </ul>	Max, Max, 155.25 194.69 182.29 194.69 191.28 194.69 191.28 194.69 194.59 194.69 194.69 194.69 194.69	Range 63,97 69,9 62,91 97,38 103,4 92,47 60,09 103,4 47,26 103,4 8,20 103,4 8,20 103,4 8,20 103,4 10,4 103,4 10,4 10,4 10,4 10,4 10,4 10,4 10,4 10	Source Between Between Between Between Between Between Between Source Between	10296,8 39826 50122,8 7756,236 49396,6 50122,8 50122,8	D.£ 3 136 139 3 136 139	MS 3432.27 292,838 242,879 363,21 363,21 363,21	13,72 0,67	0,000
PARK BB MM PP PS Tetal EXPO E N S W Tetal PARK BB	л 60 15 140 25 140 30 35 35 35 140 35 140	Average 122,253 149,159 129,288 135,864 128,572 126,881 133,173 130,185 139,754	Descriptis SD 17,0964 21,3491 13,0526 18,0578 18,0578 18,0578 18,0571 14,3072 26,0471 14,3097 18,0994 Descriptis Descriptis	eStatistics CV 13,98% 14,31% 14,31% 14,40% 13,84% 14,40% 11,28% 14,40% 19,50% 10,08% eStatistics CV ig.77%	g) Pin Min. 91,28 124,79 93,66 93,5 91,28 95,31 93,5 91,28 107,99 91,28 107,99 91,28 107,99 91,28	Max. Max. 155.25 194.69 101.28 101.28 101.28 102.59 104.69 155.25 104.69 155.25 104.69 155.25 104.69 155.25 104.69 105.25 104.69 105.25 104.69 104.69 105.25 104.69 105.25 10	Range 63,97 60,9 62,91 103,4 103,4 47,26 103,4 47,26 Range Range	Source Between groups Wihis groups Tetal (Corr.) Between groups Wihis groups Vihis groups Vihis groups Source Between groups	10296,8 3082,6 50122,8 776,336 49396,8 50122,8 5012,9 50,	D.f. 3 136 139 3 136 139 136 139 D.f. 3	MS 3432.27 292,838 342,079 363,21 363,21 363,21 XA Table MS 3,79787	13,72 0.67 F- Ratio 42,93	0,000
PARK BB MM PP PS Total E N S S W Total PARK	л 60 15 140 30 35 140 35 140	Average 122,253 140,159 129,288 136,804 129,754 128,572 126,841 133,173 130,185 129,754 Average	Descriptis SD 17,0954 21,3491 13,0529 18,0578 18,0578 18,0578 18,0578 18,0579 18,571 14,3072 26,0471 14,3897 18,0894 5D	e Statistics CV 13,98% 14,31% 14,31% 14,45% 14,45% 14,46% 19,56% 16,58% 14,65% 16,58% 14,65%	<ul> <li>g) Pin</li> <li>Min.</li> <li>91,28</li> <li>124,79</li> <li>93,66</li> <li>93,5</li> <li>91,28</li> <li>90,5</li> <li>91,28</li> <li>107,99</li> <li>91,28</li> <li>107,99</li> <li>91,28</li> <li>107,99</li> <li>91,28</li> <li>107,99</li> <li>Min.</li> </ul>	Max, Max, 155.25 194.69 182.29 194.69 191.28 194.69 191.28 194.69 194.59 194.69 194.69 194.69 194.69	Range 63,97 69,9 62,91 97,38 103,4 92,47 60,09 103,4 47,26 103,4 8,20 103,4 8,20 103,4 8,20 103,4 10,4 103,4 10,4 10,4 10,4 10,4 10,4 10,4 10,4 10	Source Berween groups Wihits groups Treal (Corr.) Wuby Treal (Corr.) Treal (Corr.) Treal Withis groups Treal (Corr.) Source Between groups Withis groups	10296,8 39826 50122,8 7756,236 49396,6 50122,8 50122,8	D.f. 3 136 139 3 136 139 136 139 0.5	MS 3432.27 292,838 242,879 363,21 363,21 363,21	13,72 0.67 F- Ratio 42,93	0,000
PARK BB MM PP PS Fotal E N S W Total PARK BB MM	* 60 15 40 25 140 30 30 35 35 140 * 40 30 35 140 * 40 30 35 140 * 40 30 35 15 15 15 15 16 16 16 16 16 16 16 16 16 16	Asenge 122,253 149,159 120,284 120,254 120,754 120,754 120,754 130,185 120,754	Descriptin SD 17,0984 21,3491 18,0078 18,0078 18,0078 14,3072 26,0471 14,3072 26,0471 14,3097 14,2097 14,2097 14,2097 14,2097 0,211256 0,32122	eStatistics CV 13,36% 14,31% 14,31% 14,45% 14,45% 14,45% 14,45% 15,56% 0,00%	g) Pin Min. 91,28 124,79 93,55 91,28 95,31 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28	Mr uligne, 1 Max, 155,25 194,69 101,28 102,99 101,28 102,99 101,28 102,99 101,28 102,99 104,69 155,25 104,69 Max, 1,62 2,23	Range 63.97 60.9 07.74 103.4 103.4 47.26 103.4 47.26 Range 1,16 1,2	Source Berecen groups Total (Corr.) Berween groups Total (Corr.) Within groups Total (Corr.) Source Between groups Total (Corr.)	10295,8 39826 59122,8 7756,236 89395,8 59122,8 5912,8 5912,9 5952,9 5952,9 5915,9 5915,9 5912,9 5912	D.f. 3 136 139 136 139 136 139 0.f. 3 136	MS 3432.27 292,838 342,079 363,21 363,21 363,21 XA Table MS 3,79787	13,72 0.67 F- Ratio 42,93	0,000
PARK BB MM PP Total EXPO E N S W Total BB MM	я 60 15 40 25 140 25 80 30 30 35 35 35 140 40 15 40	Average 122,253 146,159 120,258 120,754 120,754 120,754 120,754 130,185 120,754 130,185 120,754 130,185 1,07543 1,07543	Descriptin SD 17,0964 21,3491 18,0078 18,0078 18,0078 18,0078 18,0078 18,0078 18,0078 18,0078 18,0078 14,3097 22,60471 14,3097 14,2097 0,40152 0,40152 0,40152	eStatistics CV 13,36% 14,31% 14,31% 14,46% 13,24% 13,24% 13,24% 13,24% 14,65% 14,65% CV 14,65% CV 14,55% 14,65% 14,65% 14,65% 14,25% 15,25	g) Pin Min. 91,28 124,79 93,66 93,5 91,28 93,5 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 10,99	ww.nigwa. Max. 155.25 194,69 101.28 162.59 194,69 191.28 162.59 194,69 1955,25 194,69 1955,25 194,69 Max. 1,62 2,23 2,4	NEEDLE Range 63,97 69,9 92,91 97,78 103,4 92,47 69,09 92,47 69,09 103,4 47,26 103,4 47,26 103,4 47,26 103,4 47,26 103,4 10,4 10,4 10,4 10,4 10,4 10,4 10,4 10	Source Berween groups Wihits groups Treal (Corr.) Wuby Treal (Corr.) Treal (Corr.) Treal Withis groups Treal (Corr.) Source Between groups Withis groups	10296,8 3082,6 50122,8 776,336 49396,8 50122,8 5012,9 50,	D.f. 3 136 139 3 136 139 136 139 D.f. 3	MS 3432.27 292,838 342,079 363,21 363,21 363,21 XA Table MS 3,79787	13,72 0.67 F- Ratio 42,93	0,000
PARK BB MM PP Fotal EXPO E N S W Total PARK BB MM	* 60 15 40 25 140 30 30 35 35 140 * 40 30 35 140 * 40 30 35 140 * 40 30 35 15 15 15 15 16 16 16 16 16 16 16 16 16 16	Asenge 122,253 149,159 120,284 120,254 120,754 120,754 120,754 130,185 120,754	Descriptib SD 17,0984 21,1491 18,0038 18,0038 18,0038 18,0038 18,0034 18,0094 18,0094 18,0094 0,003125 0,003125 0,003125 0,003125 0,003125	e Studisties CV 13,36% 14,31% 14,31% 14,46% 13,34% 14,65% 14,65% 14,65% CV CV 19,56% CV 19,26% 14,65% 14,25% 15,25%	g) Pin Min. 91,28 124,79 99,66 05,5 91,28 95,81 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 91,29 91,28 91,29 91,29 91,29 91,29 91,20 91,	we stigers, Mass, 155-25 194,09 162,59 191,28 162,59 191,28 162,59 194,09 191,28 162,59 194,09 195,25 194,09 195,25 194,09 19	Range 63,97 69,9 97,78 103,4 47,26 103,4 47,26 103,4 47,26 103,4 47,26 103,4 10,4 10,4 10,4 10,4 10,4 10,4 10,4 10	Source Berecen groups Total (Corr.) Berween groups Total (Corr.) Within groups Total (Corr.) Source Between groups Total (Corr.)	10295,8 39826 59122,8 7756,236 89395,8 59122,8 5912,8 5912,9 5952,9 5952,9 5915,9 5915,9 5912,9 5912	D.f. 3 136 139 136 139 136 139 0.f. 3 136	MS 3432.27 292,838 342,079 363,21 363,21 363,21 XA Table MS 3,79787	13,72 0.67 F- Ratio 42,93	0,000
PARK BB MM PP PS Total E N S S W Total PARK BB MM	x 60 15 40 25 30 30 35 35 35 35 40 140 15 40 25	Aserage 122,253 149,159 120,284 120,784 120,784 120,784 120,784 120,784 120,784 130,784 130,784 130,784 130,784 140,784 140,784 1,6753 1,6753	Descriptin SD 17,0964 21,3491 18,0078 18,0078 18,0078 18,0078 18,0078 18,0078 18,0078 18,0078 18,0078 14,3097 22,60471 14,3097 14,2097 0,40152 0,40152 0,40152	eStatistics CV 13,36% 14,31% 14,31% 14,46% 13,24% 13,24% 13,24% 13,24% 14,65% 14,65% CV 14,65% CV 14,55% 14,65% 14,25% 14,65% 14,25% 15,25	g) Pin Min. 91,28 124,79 93,66 93,5 91,28 93,5 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 10,99	ww.nigwa. Max. 155.25 194,69 101.28 162.59 194,69 191.28 162.59 194,69 1955,25 194,69 1955,25 194,69 Max. 1,62 2,23 2,4	NEEDLE Range 63,97 69,9 92,91 97,78 103,4 92,47 69,09 92,47 69,09 103,4 47,26 103,4 47,26 103,4 47,26 103,4 47,26 103,4 10,4 10,4 10,4 10,4 10,4 10,4 10,4 10	Source Berecen groups Total (Corr.) Berween groups Total (Corr.) Within groups Total (Corr.) Source Between groups Total (Corr.)	10295,8 39826 59122,8 7756,236 89395,8 59122,8 5912,8 5912,9 5952,9 5952,9 5915,9 5915,9 5912,9 5912	D.f. 3 136 139 136 139 136 139 0.f. 3 136	MS 3432.27 292,838 342,079 363,21 363,21 363,21 XA Table MS 3,79787	13,72 0.67 F- Ratio 42,93	0,000
PARK BB MM PP PS Total EXPO EXPO F S MM PP S Total BB MM PP S Total EXPO	n           60           15           40           25           140           30           35           140           30           35           140           30           35           140           30           35           140           80           80           15           140           25           140           25           140           80           80	Average 122,253 149,159 120,284 120,284 120,284 120,284 120,284 120,284 120,284 120,284 120,284 120,284 120,284 120,284 120,284 120,284 120,284 120,284 120,284 120,284 120,284 120,285 140,295 140,285 120,285 140,295 140,20	Descriptify SD 17,0944 21,1491 13,0020 18,0738 18,0738 18,0738 18,0738 18,0738 18,0738 18,0738 18,0738 18,0738 18,0738 14,2897 18,0934 SD 0,217256 0,338122 0,440152 0,245564 0,440152	e Studistics eV 13,985 14,31% 14,45% 14,45% 14,45% 14,45% 14,45% 14,45% 15,25% 24,61% 15,25% 25,10%	g) Pin Min. 91,28 91,26 91,28 91,28 93,5 91,28 91,28 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,66 1,05 91,28 91,29 91,28 91,29 91,28 91,29 91,28 91,29 91,28 91,29 91,28 91,29 91,28 91,29 91,20 91,29 9	Mrs. Mirs. Mirs. 155.25 194,69 19128 192,99 19128 194,69 19429 19429 19429 19429 19429 19429 19429 19429 19449 Mrs. 162 2,23 2,4 2,4 2,4	Range 63,97 69,9 97,78 103,4 47,26 103,4 47,26 103,4 47,26 103,4 47,26 103,4 10,4 10,4 10,4 10,4 10,4 10,4 10,4 10	Source Berecen groups Total (Corr.) Berween groups Total (Corr.) Within groups Total (Corr.) Source Between groups Total (Corr.)	10296,8 30926 59122,4 726,236 59122,4 726,236 59122,4 39122,4 5912,5 5912,5 5912,5 5912,5 5912,5 5912,5 5912,5 5912,5 5912,5 5912,5 5912,5 591	D.f. 3 136 139 136 139 136 139 0.f. 3 136	MS 3402.27 292,433 342,079 363,21 363,21 363,21 0,0193461	11,72 11,72 10,67	0,000
PARK BB MM PP PS Total EXPO E N S S W Total BB MM PP S Total	#           60           15           40           25           140           30           35           35           140           30           35           140           30           35           140           5           40           15           40           15           40           15           40           140	Aserage 122,253 149,159 120,284 120,784 120,784 120,784 120,784 120,784 120,784 130,784 130,784 130,784 130,784 140,784 140,784 1,6753 1,6753	Descriptib SD 17,0984 21,1491 18,0038 18,0038 18,0038 18,0038 18,0034 18,0094 18,0094 18,0094 0,003125 0,003125 0,003125 0,003125 0,003125	e Studisties CV 13,36% 14,31% 14,31% 14,46% 13,34% 14,65% 14,65% 14,65% CV CV 19,56% CV 19,26% 14,65% 14,25% 15,25%	g) Pin Min. 91,28 124,79 99,66 05,5 91,28 95,81 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 91,29 91,28 91,29 91,29 91,20 91,	we stigers, Mass, 155-25 194,09 162,59 191,28 162,59 191,28 162,59 194,09 191,28 162,59 194,09 195,25 194,09 195,25 194,09 19	Range 63,97 69,9 97,78 103,4 47,26 103,4 47,26 103,4 47,26 103,4 47,26 103,4 10,4 10,4 10,4 10,4 10,4 10,4 10,4 10	Source of the second se	10295,8 39826 59122,8 7756,236 89395,8 59122,8 5912,8 5912,9 5952,9 5952,9 5915,9 5915,9 5912,9 5912	D.f. 3 136 139 136 139 136 139 0.f. 3 136	MS 3432.27 292,838 342,079 363,21 363,21 363,21 XA Table MS 3,79787	11,72 11,72 10,67	0,000
PARK BB MM PP PS Total EXPO E W Total BB MM PP PS Total EXPO E	я 60 15 140 25 140 30 35 35 35 35 140 40 25 140 8URE 40 40 40 40 40 40 40 40 40 40	Average 122,233 146,159 120,284 170,084 170,084 120,754	Descriptify           SD           17,094           21,1491           13,0520           18,0736           18,0736           18,0737           18,0737           14,2097           14,2097           18,0914           0,213256           0,41052           0,410532           0,410532           0,239648           0,239648	e Studioties eV 13,3895 14,31% 14,31% 14,65% 14,65% 14,65% 14,65% 14,65% 14,65% 14,65% 14,65% 14,65% 14,65% 14,65% 14,65% 14,65% 14,55% 14,	g) Pin Min. 91,28 124,79 99,56 90,5 91,28 95,5 91,28 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,40 10,46 1,40 10,46 10,46 10,46 10,46 10,46 10,46 10,46 10,46 10,46 10,47 10	му айдия, 1 155,25 194,69 194,69 191,28 162,59 194,69 191,28 162,59 194,69 194,79 194	Range 63,97 69,9 97,78 103,4 103,4 47,26 103,4 47,26 103,4 47,26 103,4 47,26 103,4 47,26 103,4 103,4 12 1,40 0,85 1,58 1,58 1,58 1,58 1,58 1,58 1,58 1	Source of the second se	10296,8 39826 50122,4 7756,256 49396,6 39122,8 59122,8 59122,8 59122,8 59122,8 11,3956 12,0107 23,4240 1,89621	D.f. 3 136 139 3 136 139 139 0  3 136 139 0  3 136 139	MS 343227 292,838 343,217 363,21 363,21 363,21 4 X Table MS 3,79787 0,088461	F. Ratio 42,95	0,000
PARK BB MM PP PS Total EXPO EXPO F S MM PP S Total BB MM PP S Total EXPO	n           60           15           40           25           140           30           35           140           30           35           140           30           35           140           30           35           140           80           80           15           140           25           140           25           140           80           80	Average 122,253 149,159 120,284 120,285 140,295 140,285 120,285 140,295 140,20	Descriptify SD 17,0944 21,1491 13,0020 18,0738 18,0738 18,0738 18,0738 18,0738 18,0738 18,0738 18,0738 18,0738 18,0738 14,2897 18,0934 SD 0,217256 0,338122 0,440152 0,245564 0,440152	e Studistics eV 13,985 14,31% 14,45% 14,45% 14,45% 14,45% 14,45% 14,45% 15,25% 24,61% 15,25% 25,10%	g) Pin Min. 91,28 91,26 91,28 91,28 93,5 91,28 91,28 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,66 1,05 91,28 91,29 91,28 91,28 91,28 91,28 91,28 91,28 91,29 91,28 91,29 91,28 91,29 91,28 91,29 91,28 91,29 91,28 91,29 91,28 91,29 91,20 91,29 9	Mrs. Mirs. Mirs. 155.25 194,69 101.28 104,09 101.28 162.99 194,69 155.25 194,69 155.25 194,69 155.25 194,69 155.25 194,69 155.25 194,69 155.25 194,69 155.25 194,69 155.25 194,69 155.25 194,69 155.25 194,69 194,29 194	Range 63,97 69,9 97,78 103,4 47,26 103,4 47,26 103,4 47,26 103,4 47,26 103,4 10,4 10,4 10,4 10,4 10,4 10,4 10,4 10	Source of the second se	10296,8 30926 59122,4 726,236 59122,4 726,236 59122,4 39122,4 5912,5 5912,5 5912,5 5912,5 5912,5 5912,5 5912,5 5912,5 5912,5 5912,5 5912,5 591	D.f. 3 136 139 136 139 136 139 0.f. 3 136	MS 3402.27 292,433 342,079 363,21 363,21 363,21 0,0193461	F. Ratio 42,95	0,000
PARK BB MM PP S Total EXPO B PARK BB MM PP PS Total EXPO E N	я 60 15 140 25 140 30 35 35 35 140 30 35 140 40 30 35 140 40 30 35 140 40 30 35 140 30 35 140 30 35 140 30 35 140 30 35 140 30 35 35 140 30 35 140 30 35 140 30 35 140 30 35 35 140 30 35 35 140 30 35 140 30 35 35 140 30 35 140 30 35 140 30 35 140 30 35 35 140 30 35 140 35 140 30 35 140 35 140 35 140 35 140 35 140 35 140 35 140 35 140 35 140 35 35 140 35 140 30 35 35 140 30 35 35 35 140 30 35 35 35 35 35 35 35 35 35 35	Average 122,233 132,234 130,064 130,784 126,784 126,784 133,173 130,185 120,784 126,78	Descriptify           SD           17,0984           21,1491           13,0520           18,0736           18,0736           18,0737           18,571           14,2997           18,0914           0,213256           0,41052           0,41052           0,21356           0,41052           0,21356           0,421357	e Studioties eV 13,3695 14,31% 13,38% 14,45% 13,38% 14,46% 13,28% 14,46% 14,45%14,45% 14,45% 14,45% 14,45%14,45% 14,45% 14,45% 14,45%14,45% 14,45% 14,45%14,45% 14,45% 14,45%14,45%14,45% 14,45%14,45% 14,45%14,45%14,45% 14,45%14,45%14,45%14,45% 14,45%14,45%14,45% 14,45%14,45%14,45%14,45% 14,45%14,45%14,45%14,45% 14,45%14,55%14,55%14,55%14,55%14,55%14,55%14,55%14,55%	g) Fin 91,28 124,79 99,66 93,5 91,28 93,5 91,28 93,5 91,28 91,29 91,28 91,29 91,28 91,29 91,28 91,29 91,28 91,29 91,20 91,29 9	му айдия, 1 155.25 194,69 162,59 194,69 191,28 162,59 194,69 191,28 162,59 194,69 191,28 162,59 194,69 194,79	Range 63,97 69,90 102,47 103,4 47,26 103,4 47,26 103,4 47,26 103,4 47,26 103,4 103,4 103,4 103,4 103,4 103,4 103,4 1,2 1,40 1,40	Source of the second se	10296,8 39826 50122,4 7756,255 49396,6 39122,8 59122,8 59122,8 59122,8 10,996,6 12,0307 23,4343 1,896,21 21,5581	D.£ 3 136 139 3 136 139 0 5 139 0 5 139 0 5 139 136 139 136 139 136 139 139 136 139 136 139 136 139 136 139 139 136 139 136 139 138 138 138 138 138 138 138 138	MS 343227 292,838 343,217 363,21 363,21 363,21 4 X Table MS 3,79787 0,088461	F. Ratio 42,95	0,000
PARK BB MM PP PS Total EXPO E W Total BB MM PP PS Total EXPO E	я 60 15 140 25 140 30 35 35 35 35 140 40 25 140 8URE 40 40 40 40 40 40 40 40 40 40	Average 122,233 146,159 120,284 170,084 170,084 120,754	Descriptify           SD           17,094           21,1491           13,0520           18,0736           18,0736           18,0737           18,0737           14,2097           14,2097           18,0914           0,213256           0,41052           0,410532           0,410532           0,239648           0,239648	e Studioties eV 13,3895 14,31% 14,31% 14,65% 14,65% 14,65% 14,65% 14,65% 14,65% 14,65% 14,65% 14,65% 14,65% 14,65% 14,65% 14,65% 14,55% 14,	g) Pin Min. 91,28 124,79 99,56 90,5 91,28 95,5 91,28 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,40 10,46 1,40 10,46 10,46 10,46 10,46 10,46 10,46 10,46 10,46 10,46 10,47 10	му айдия, 1 155,25 194,69 194,69 191,28 162,59 194,69 191,28 162,59 194,69 194,79 194	Range 63,97 69,9 97,78 103,4 103,4 47,26 103,4 47,26 103,4 47,26 103,4 103,4 47,26 103,4 103,4 103,4 1,2 1,40 0,45 1,20 1,40	Source of the second se	10296,8 39826 50122,4 7756,256 49396,6 39122,8 59122,8 59122,8 59122,8 59122,8 11,3956 12,0107 23,4240 1,89621	D.f. 3 136 139 3 136 139 139 0  3 136 139 0  3 136 139	MS 343227 292,838 343,217 363,21 363,21 363,21 4 X Table MS 3,79787 0,088461	F. Ratio 42,95	0,000
PARK BB MM PP S Total EXPO B PARK BB MM PP PS Total EXPO E N	я 60 15 140 25 140 30 35 35 35 140 30 35 140 40 30 35 140 40 30 35 140 40 30 35 140 30 35 140 30 35 140 30 35 140 30 35 140 30 35 35 140 30 35 140 30 35 140 30 35 140 30 35 35 140 30 35 35 140 30 35 140 30 35 35 140 30 35 140 30 35 140 30 35 140 30 35 35 140 30 35 140 35 140 30 35 140 35 140 35 140 35 140 35 140 35 140 35 140 35 140 35 140 35 35 140 35 140 30 35 35 140 30 35 35 35 140 30 35 35 35 35 35 35 35 35 35 35	Average 122,233 132,234 130,064 130,784 126,784 126,784 133,173 130,185 120,784 126,78	Descriptify           SD           17,0984           21,1491           13,0520           18,0736           18,0736           18,0737           18,571           14,2997           18,0914           0,213256           0,41052           0,41052           0,21356           0,41052           0,21356           0,421357	e Studioties eV 13,3695 14,31% 13,38% 14,45% 13,38% 14,46% 13,28% 14,46% 14,45%14,45% 14,45% 14,45% 14,45%14,45% 14,45% 14,45% 14,45%14,45% 14,45% 14,45%14,45% 14,45% 14,45%14,45%14,45% 14,45%14,45% 14,45%14,45%14,45% 14,45%14,45%14,45%14,45% 14,45%14,45%14,45% 14,45%14,45%14,45%14,45% 14,45%14,45%14,45%14,45% 14,45%14,55%14,55%14,55%14,55%14,55%14,55%14,55%14,55%	g) Fin 91,28 124,79 99,66 93,5 91,28 93,5 91,28 93,5 91,28 91,29 91,28 91,29 91,28 91,29 91,28 91,29 91,20 91,29 9	му айдия, 1 155.25 194,69 162,59 194,69 191,28 162,59 194,69 191,28 162,59 194,69 191,28 162,59 194,69 194,79	Range 63,97 69,90 102,47 103,4 47,26 103,4 47,26 103,4 47,26 103,4 47,26 103,4 47,26 103,4 47,26 103,4 103,4 103,4 1,2 1,2 1,40 1,40	Source of the second se	10296,8 39826 50122,4 7756,255 49396,6 39122,8 59122,8 59122,8 59122,8 10,996,6 12,0307 23,4343 1,896,21 21,5581	D.£ 3 136 139 3 136 139 0 5 139 0 5 139 0 5 139 136 139 136 139 136 139 139 136 139 136 139 136 139 136 139 139 136 139 136 139 138 138 138 138 138 138 138 138	MS 343227 292,838 343,217 363,21 363,21 363,21 4 X Table MS 3,79787 0,088461	F. Ratio 42,95	0,000
PARK BB MM PP FS Total EXPO W W Total BB MM PP PS Total EXPO EXPO E	я 60 15 25 140 30 35 35 140 15 15 140 15 15 140 25 140 25 140 25 140 25 140 25 140 25 140 25 140 25 140 25 140 25 35 35 35 35 35 35 35 35 35 35 35 35 35	Average 122,233 149,199 120,288 170,064 120,754 120,754 126,572 126,881 133,177 130,185 120,754 120,754 120,754 120,754 120,754 120,754 120,754 120,754 120,754 120,754 120,754 120,754 120,754 120,754 120,754 120,754	Descriptify SD 17,0944 21,3491 13,0620 18,0738 18,0738 18,0738 18,0738 18,0738 18,0738 18,0738 18,0738 18,0738 18,0738 14,2897 18,0738 14,2897 18,0738 14,2897 18,0738 14,2897 18,0738 14,2897 18,0738 14,2897 18,0738 14,2897 18,0738 14,2897 18,0738 14,2897 10,2538	e Studioties eV 13,3895 14,3195 14,405 13,3495 14,405 13,2495 14,405 13,2495 14,455	g) Fin 91,28 124,79 99,66 93,5 91,28 93,5 91,28 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,28 107,99 91,66 107,99 91,28 107,99 91,66 107,99 91,68 107,99 91,68 107,99 91,68 107,99 91,68 107,99 91,68 107,99 91,68 107,99 91,68 107,99 91,68 107,99 91,68 107,99 100,99 100,99 100,99 10,99 100,90 100,90 100,90 100,90 100,90 100,90 100,90 100,90 100,90 100,9	w aligns, i, Max, 155.25 194,09 162.59 101.28 162.59 104,09 191.28 162.59 194,09 155.25 104,09 10	Range 63,97 649,0 103,4 47,26 103,4 47,26 103,4 47,26 103,4 47,26 103,4 47,26 103,4 47,26 103,4 103,4 103,4 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,2	Source of the second se	10296,8 39826 50122,4 7756,255 49396,6 39122,8 59122,8 59122,8 59122,8 10,996,6 12,0307 23,4343 1,896,21 21,5581	D.£ 3 136 139 3 136 139 0 5 139 0 5 139 0 5 139 136 139 136 139 136 139 139 136 139 136 139 136 139 136 139 139 136 139 136 139 138 138 138 138 138 138 138 138	MS 343227 292,838 343,217 363,21 363,21 363,21 4 X Table MS 3,79787 0,088461	F. Ratio 42,95	0,000

WA. NEEDLE LENGT

								E LENGTH					
PARK	4	Average	Descriptive SD	Statistics	Min	Man.	Bance	Section	55	D.L	VA Table MS	F-Batie	P-Value
							Bange	Source Between					
MM	40	19/014	6,53589	34,37%	9,05	33,48	24,03	groups	1584,67	2	792,337	26.31	0,0000
PP	40	22,859	5,31442	23.25%	16,01	37,43	21.42	Within groups	3522,93	117	30,1105		
		Page 1	Second Second	8	mar de	1000	march	Total			S 8		2
PS Total	40	27,889 23,254	4,4012 6,55141	15,78%	17,7	35,65 37,43	17,95 28,38	(Corr.)	5107,6	119		-	8
EXPOS			22.0013		-	-							5
	30	29,2775	3,8111	13,02%	22,99	37,43	14,84	Between groups	1570,14	5	\$23,379	17,16	0,0001
3.0		10000	11.833	1.22201				Within	1.111.11	12.0	10000		
N	30	19,6207	6,47529	33,00%	9,05	31,7	22,65	groups Total	3537,46	116	30,4954		
5	10	22.0680	4,57123	20,71%	15,19	29,29	14,10	(Core.)	\$107,6	119			
В.	30	22.0497	6,68068	30,30%	15,33	35,65	20,32						
Total	120	23,254	6,55141	28,17%	9,05	37,43	78,38	1					_
					D Plo	a autor	us, NEEDI	FWIDTH					
		11	Descriptive	Statistics						ANO	A Table		8
PARK	π.	Average	SD	CV	Min	Min,	Range	Source	55	D.L	MS	F-Ratio.	P-Value
MM	40	1,40575	0.289357	30,58%	0.86	2.14	1.28	Between groups	1,78193	2	0,890966	10.99	0.0000
								Wahie					
PP	40	1,6475	0,307527	18,67%	- Li	2,3	1,2	groups Total	9,4829	117	0,081051		
PS	40	1,87825	0,254658	15,17%	1.1	2,17	1.07	(Corr.)	11.2648	119			
Total EXPOS	120	1,37717	0.307673	19,51%	0,86	2,3	1,44	-	-	_	<u> </u>		2
LAPOS	THE	-		-			-	Between			-		
Ε.	30	1,77933	0,283999	15,94%	Τ,Γ.	7,3	1,7	groups	1,68793	1	0,552543	6,82	0,0003
N	30	1.48135	0.336511	22,72%	0.80	2,17	1.31	Within groups	0.57601	116	0.08256		
-				15203.0			100	Total		1.1	0,000,0		-
5	30	1,50733	0,244511	16,22%	1,02	1,95	11,91	(Corr.)	11,2648	119			
	30	1.54067	0.27709	17.99%	1.03	2,12	1.09						
0	20	1,54067	0,23309	17,99%	1,05	2,12	1.09		-	-	-		<u> </u>
Total	120	1,37717	0.307673	19,31%	0.86	-2.7	1,44						
_							rziesii, NEI						
			Descriptiv			1		Source	1	1	VA Table	- E-	
PARK		Avenue	Descriptiv SD	e Statistics CV	Min.	Max.	Range	Source	85	ANO D.f.	MS MS	F. Ratio	P-Valu
PARK BB	л 59	Avenue 26,191	SD		Min.	1	Range	Source	1	1	MS	Ratio	
BB		26,191	SD 6,2374	CV 23.82%	13,35	Max. 39.04	Range 25,69	Source Between groups Within	SS 940,496	D.f. 2	MS 320,248	6,81	
BB MM	15	26,191	SD 6,2374 8,00369	CV 23,82%	13,35	Max. 39,04 42,75	Range 25,69 26,29	Source Between groups Within groups	SS 640,496 4563,8	D.E. 2 97	MS	6,81	
BB MM PP Total	15 35 100	26,191	SD 6,2374	CV 23.82%	13,35	Max. 39.04	Range 25,69 26,29 26,84	Source Between groups Within	SS 940,496	D.f. 2	MS 320,248	6,81	
BB MM PP	15 35 100	26,191 25,2113 31,2249	SD 6,2374 8,00369	CV 23,82%	13,35 16,46 16,65	Max. 39,04 42,75 43,49	Range 25,69 26,29 26,84	Source Between groups Within groups Total	SS 640,496 4563,8	D.E. 2 97	MS 320,248	6,81	
BB MM PP Total	15 35 100	26,191 25,2113 31,2249	SD 6,2374 8,00369	CV 23,82%	13,35 16,46 16,65	Max. 39,04 42,75 43,49	Range 25,69 26,29 26,84 30,14	Source Between groups Within groups Total Between groups	SS 640,496 4563,8	D.E. 2 97	MS 320,248	6,81	0,9017
BB MM PP Total EXPOS	15 35 100 URE 30	26,191 25,2113 31,2249 27,8059 31,2417	SD 6,2374 8,00369 7,19603 7,25042 7,28229	CV 23.82% 31.75% 23.09% 26.08% 23.31%	13,35 16,46 16,65 13,35 17,13	Max. 39,04 42,75 43,49 43,49	Range 25,69 26,29 26,84 30,14 26,36	Source Between groups Within groups Total Between groups Within	\$5 640,496 4563,8 5204,29 889,278	D.f. 2 97 99 3	MS 320,248 47,0494 296,426	6,81	0,9017
BB MM PP Total EXPOS	15 35 100 URE 30 15	26,191 25,2113 31,2249 27,8059	SD 6,2374 8,00369 7,19603 7,25042	CV 23.82% 31.75% 23.05% 26.08%	13,35 16,46 16,65 13,35 17,13 22,45	Max. 39,04 42,75 43,49 43,49	Range 25,69 26,29 26,84 30,14	Source Between groups Within groups Total Between groups Within groups	88 640,496 4563,8 5204,29	D.f. 2 97 99 3 99	MS 320,248 47,0494	6,81	0,9017
BB MM PP Total EXPOS	15 35 100 URE 30	26,191 25,2113 31,2249 27,8059 31,2417	SD 6,2374 8,00369 7,19603 7,25042 7,28229	CV 23.82% 31.75% 23.09% 26.08% 23.31%	13,35 16,46 16,65 13,35 17,13	Max. 39,04 42,75 43,49 43,49	Range 25,69 26,29 26,84 30,14 26,36	Source Between groups Within groups Total Between groups Within	\$5 640,496 4563,8 5204,29 889,278	D.f. 2 97 99 3	MS 320,248 47,0494 296,426	6,81	0,9017
BB MM PP Total EXPOS E N S	15 35 100 CURE 30 15 25	26,191 25,2113 31,2249 27,4059 31,2417 30,754 24,6536	SD 6,2374 8,00369 7,19603 7,25042 7,25042 7,28229 5,87802 6,61014	CV 23,82% 31,75% 23,05% 26,08% 23,31% 19,11% 26,81%	13,35 16,46 16,65 13,35 17,13 22,45 13,35	Max. 39,04 42,75 43,49 43,49 43,49 39,04 34,21	Range 25,69 26,29 26,84 30,14 26,36 16,59 20,86	Source Between groups Within groups Total Between groups Within groups Total	\$\$ 640,496 4563,8 5204,29 889,278 4315,01	D.f. 2 97 99 3 99	MS 320,248 47,0494 296,426	6,81	0,9017
BB MM PP Total EXPOS E N	15 35 100 URE 30 15	26,191 25,2113 31,2249 27,8059 31,2417 30,754	SD 6,2374 8,00369 7,19603 7,25042 7,28229 5,87802	CV 23,82% 31,75% 23,05% 26,08% 23,31% 19,11%	13,35 16,46 16,65 13,35 17,13 22,45	Max. 39,04 42,75 43,49 43,49 43,49 39,04	Range 25,69 26,29 26,84 30,14 26,36 16,59 20,86	Source Between groups Within groups Total Between groups Within groups Total	\$\$ 640,496 4563,8 5204,29 889,278 4315,01	D.f. 2 97 99 3 99	MS 320,248 47,0494 296,426	6,81	0,9017
BB MM PP Total EXPOS E N S	15 35 100 CURE 30 15 25	26,191 25,2113 31,2249 27,4059 31,2417 30,754 24,6536	SD 6,2374 8,00369 7,19603 7,25042 7,25042 7,28229 5,87802 6,61014	CV 23,82% 31,75% 23,05% 26,08% 23,31% 19,11% 26,81%	13,35 16,46 16,65 13,35 17,13 22,45 13,35	Max. 39,04 42,75 43,49 43,49 43,49 39,04 34,21	Runge 25,69 26,29 26,34 30,14 26,36 16,59 20,86 25,29	Source Between groups Within groups Total Between groups Within groups Total	\$\$ 640,496 4563,8 5204,29 889,278 4315,01	D.f. 2 97 99 3 99	MS 320,248 47,0494 296,426	6,81	P-Valu 0,9017 0,9004
BB MM PP Total EXPOS E N S W	15 35 100 00RE 30 15 25 30	26,191 25,2113 31,2249 27,8059 31,2417 30,754 24,6536 25,523	SD 6,2374 8,00369 7,19903 7,25042 7,28229 5,87802 6,61014 6,55145	CV 23,82% 31,75% 23,07% 23,07% 23,37% 19,17% 26,81% 23,67% 26,08%	13,35 16,46 16,65 13,35 17,13 22,45 13,35 16,65 13,35	Max, 39,04 42,75 43,49 43,49 43,49 39,04 34,21 41,94 43,49	Rampe 25,69 26,29 26,84 30,14 26,36 16,59 20,86 25,29 30,14	Source Between groups Within groups Total Between groups Total (Corr.)	88 640,496 4563,8 5204,29 889,276 4315,01 5204,29	D.f. 2 97 99 3 99	MS 320,248 47,0494 296,426	6,81	0,9017
BB MM PP Total EXPOS E N S W	15 35 100 00RE 30 15 25 30	26,191 25,2113 31,2249 27,8059 31,2417 30,754 24,6536 25,523	SD 6,2374 8,00369 7,19903 7,25042 7,28229 5,87802 6,61014 6,55145	CV 23,82% 31,75% 23,03% 26,08% 23,31% 19,11% 26,81% 25,67% 26,81% 25,67% 26,08%	13,35 16,46 16,65 13,35 17,13 22,45 13,35 16,65 13,35	Max, 39,04 42,75 43,49 43,49 43,49 39,04 34,21 41,94 43,49	Rampe 25,69 26,29 26,84 30,14 26,36 16,59 20,86 25,29 30,14	Source Between groups Within groups Total Between groups Total (Corr.)	88 640,496 4563,8 5204,29 889,276 4315,01 5204,29	D.f. 2 97 99 3 96 99	MS 320,248 47,0494 296,426	6,81	0,9017
BB MM PP Total EXPOS E N S W Total	15 35 100 00RE 30 15 25 30	26,191 25,2113 31,2249 27,8059 31,2417 30,754 24,6536 25,523 27,8059	SD 6.2374 8.00369 7.19603 7.25042 7.25042 5.87802 6.61014 6.55145 7.25042 Descriptiv	CV 23,82% 31,75% 23,03% 26,08% 23,31% 19,11% 26,81% 26,81% 26,81% 26,08% b) 6Statistics	13,35 16,46 18,65 13,35 17,13 22,45 13,35 16,65 13,35 Pseudo	Max. 39,04 42,75 43,49 43,49 39,04 34,25 41,94 43,49 550ga me	Range 25,69 26,29 26,84 30,14 26,36 16,59 20,86 25,29 30,14 wztesił, NE	Source Between groups Within groups Total Between groups Total (Corr.)	\$\$ 640,496 4563,8 \$204,29 889,278 4315,01 5204,29 H	D.f. 2 97 99 99 99	MS 320.248 47,0494 296,426 44,9481	Ratio 6.81 6.50	0,0017
BB MM PP Total EXPOS E N S W	15 35 100 00RE 30 15 25 30	26,191 25,2113 31,2249 27,6059 31,2417 30,754 24,6536 25,523 27,8059 Average	SD 6,2374 8,00369 7,19903 7,28042 7,28229 5,87802 6,61014 6,55145 7,25042	CV 23,82% 31,75% 23,03% 26,08% 23,31% 19,11% 26,81% 25,67% 26,81% 25,67% 26,08%	13,35 16,46 16,65 13,35 17,13 22,45 13,35 16,65 13,35	Max, 39,04 42,75 43,49 43,49 43,49 39,04 34,21 41,94 43,49	Rampe 25,69 26,29 26,84 30,14 26,36 16,59 20,86 25,29 30,14	Source So	88 640,496 4563,8 5204,29 889,276 4315,01 5204,29	D.f. 2 97 99 3 96 99	MS 320,248 47,6494 296,426 44,9481	6,81	0,001
BB MM PP Total EXPOS E N S W Total	15 35 100 00RE 30 15 25 30	26,191 25,2113 31,2249 27,8059 31,2417 30,754 24,6536 25,523 27,8059	SD 6.2374 8.00369 7.19603 7.25042 7.25042 5.87802 6.61014 6.55145 7.25042 Descriptiv	CV 23,82% 31,75% 23,03% 26,08% 23,31% 19,11% 26,81% 26,81% 26,81% 26,08% b) 6Statistics	13,35 16,46 18,65 13,35 17,13 22,45 13,35 16,65 13,35 16,65	Max. 39,04 42,75 43,49 43,49 39,04 34,25 41,94 43,49 550ga me	Range 25,69 26,29 26,84 30,14 26,36 16,59 20,86 25,29 30,14 wztesił, NE	EDLE WIDI Etween groups Within groups Total Between groups Within groups Total EDLE WIDI EDLE WIDI Etween groups	\$\$ 640,496 4563,8 \$204,29 889,278 4315,01 5204,29 H	D.f. 2 97 99 99 99	MS 320.248 47,0494 296,426 44,9481	Ratio 6.81 6.50 6.50	0,0015 0,0004
DB MM PP Total E N S S VW Total PARK BB	15 33 100 URE 50 15 25 30 100	26,191 25,2113 31,2249 27,8059 31,2417 30,754 24,6536 25,523 27,8059 Average 26,191	SD 6,2374 8,00369 7,29602 7,25042 7,28229 5,87802 6,81014 6,55145 7,25042 Descriptiv SD 6,2374	CV 23,82% 31,75% 23,03% 24,03% 26,03% 26,03% 26,03% 26,03% 26,05% b) cStatistics CV 23,82%	13,35 16,46 18,65 13,35 17,13 22,45 13,35 16,65 13,35 16,65 13,35 13,35	Max. 39,04 42,75 43,49 43,49 43,49 43,49 41,94 41,94 41,94 43,49 59,04	Range           25,69           26,28           30,14           26,36           16,59           20,86           25,29           30,14           mplexil, NE           Range           25,89	Source Between groups Within groups Total Between groups Within groups Source Between groups Between Between groups Between groups Between Between groups Between group Between groups Bet	SS 640,496 4563,8 5204,29 4315,01 5204,29 4315,01 5204,29 7H SS SS 3,79693	D.f. 2 97 99 99 99 99 99 06 99 99 99 7 7 99 99 99 99 99 99 99 99 99	MS 320.248 47,0494 296,426 44,9481 44,9481 44,9481 VA Table MS 1,64923	Rario           6,81           6,81           6,50           6,50           8,50           8,50           8,50           13,48	0,0017 0,0004
BB MM PP Total EXPOS E N S Total Total PARK BB MM	15 35 100 URE 30 15 25 30 100	26,191 25,2113 31,2249 27,8059 31,2417 30,754 24,6536 25,523 27,8059 Average 26,191 25,2113	SD 6,2374 8,00369 7,19903 7,25942 7,28229 5,87802 6,81014 6,55145 7,25942 7,25942 7,25942 8,0114 6,55145 8,00369	CV 23,82% 23,03% 25,03% 26,08% 24,03% 26,81% 26,81% 26,81% 26,81% 26,08% 26,08% 20,08% 20,08% 20,08% 20,08% 20,08% 20,02% 20,00% 20,02%	13,35 16,46 16,65 13,35 17,13 22,45 13,35 16,65 13,35 16,65 13,35 16,65 13,35 16,65	Max. 39,04 42,75 43,49 43,49 43,49 39,04 43,49 41,94 41,94 41,94 41,94 41,94 41,94 41,94 42,75	Range 25,69 26,29 26,36 30,14 26,36 16,59 20,86 25,29 30,14 8 8,352 25,29 25,29 26,29 26,29	EDLE WIDI Etween groups Within groups Total Between groups Within groups Total EDLE WIDI EDLE WIDI Etween groups	SS 640,496 4563,8 5204,29 4315,01 5204,29 4315,01 5204,29 70 889,278 4315,01 5204,29 70 889,278 5204,29 4315,01 5204,29 5	D.f. 2 97 99 99 99 99 99 99 99 99 99 99 99 99	MS 320.248 47,0494 296,426 44,9481 44,9481 VA Table MS	Rario           6,81           6,81           6,50           6,50           8,50           8,50           8,50           13,48	0,0017 0,0004
DB MM PP Total E N S S VW Total PARK BB	15 33 100 URE 50 15 25 30 100	26,191 25,2113 31,2249 27,8059 31,2417 30,754 24,6536 25,523 27,8059 Average 26,191	SD 6,2374 8,00369 7,29602 7,25042 7,28229 5,87802 6,81014 6,55145 7,25042 Descriptiv SD 6,2374	CV 23,82% 31,75% 23,03% 24,03% 26,03% 26,03% 26,03% 26,05% b) e Statistics CV 23,82%	13,35 16,46 18,65 13,35 17,13 22,45 13,35 16,65 13,35 16,65 13,35 13,35	Max. 39,04 42,75 43,49 43,49 43,49 43,49 41,94 41,94 41,94 43,49 59,04	Range           25,69           26,28           30,14           26,36           16,59           20,86           25,29           30,14           mplexil, NE           Range           25,89	EDLE WIDT Source Between groups Within groups Within groups Within groups Within groups Within groups Within Source Between groups Within grou	SS 640,496 4563,8 5204,29 4315,01 5204,29 4315,01 5204,29 7H SS SS 3,79693	D.f. 2 97 99 99 99 99 99 06 99 99 99 7 7 99 99 99 99 99 99 99 99 99	MS 320.248 47,0494 296,426 44,9481 44,9481 44,9481 VA Table MS 1,64923	Rario           6,81           6,81           6,50           6,50           8,50           8,50           8,50           13,48	0,0017 0,0004
BB MM PP Total EXPOS E N S S W Total BB MM PP Total	15 35 100 CURE 50 15 25 30 100 100	26,191 25,2113 31,2249 27,8059 31,2417 30,754 24,6536 25,523 27,8059 Average 26,191 25,2113	SD 6,2374 8,00369 7,19903 7,25942 7,28229 5,87802 6,81014 6,55145 7,25942 7,25942 7,25942 8,0114 6,55145 8,00369	CV 23,82% 23,03% 25,03% 26,08% 24,03% 26,81% 26,81% 26,81% 26,81% 26,08% 26,08% 20,08% 20,08% 20,08% 20,08% 20,08% 20,02% 20,00% 20,02%	13,35 16,46 16,65 13,35 17,13 22,45 13,35 16,65 13,35 16,65 13,35 16,65 13,35 16,65	Max. 39,04 42,75 43,49 43,49 43,49 39,04 43,49 41,94 41,94 41,94 41,94 41,94 41,94 41,94 42,75	Range 25,69 26,29 26,36 30,14 26,36 16,59 20,86 25,29 30,14 8 8,352 25,29 25,29 26,29 26,29	EDLE WIDT Source Between groups Within groups Within groups Within groups Within groups Within groups Within Source Between groups Within grou	SS 640,496 4563,8 5204,29 4315,01 5204,29 4315,01 5204,29 70 889,278 4315,01 5204,29 70 889,278 5204,29 4315,01 5204,29 5	D.f. 2 97 99 99 99 99 99 99 99 99 99 99 99 99	MS 320.248 47,0494 296,426 44,9481 44,9481 44,9481 VA Table MS 1,64923	Rario           6,81           6,81           6,50           6,50           8,50           8,50           8,50           13,48	0,9017
BB MM PP Total EXPOSE E N S Total Total PARK BB MM PP	15 35 100 CURE 50 15 25 30 100 100	26,191 25,2113 31,2249 27,4059 31,2417 30,754 24,6536 25,523 27,8059 Average 26,191 25,2113 31,2249	SD 6,2374 8,00369 7,19603 7,25042 7,25042 6,61014 6,55145 7,25042 7,25042 Descriptiv SD 6,2374 8,00369 7,19603	CV 23,82% 23,05% 28,05% 28,08% 29,05% 26,81% 26,81% 26,81% 26,81% 26,81% 26,81% 26,81% 28,08% 20,08%	13,35 16,46 18,65 13,35 17,13 22,45 13,35 16,65 13,35 16,65	Max, 39,04 42,75 43,49 43,49 43,49 43,49 43,49 41,94 41,94 41,94 41,94 41,94 41,94 42,75 43,49	Range 25,69 26,29 26,34 30,14 26,36 20,36 20,36 20,36 20,36 20,36 20,36 20,36 20,36 20,36 20,36 20,36 20,36 20,36 20,36 20,36 20,20	EDLE WIDT Source Between groups Within groups Within groups Within groups Within groups Within groups Within Source Between groups Within grou	SS 640,496 4563,8 5204,29 4315,01 5204,29 4315,01 5204,29 70 889,278 4315,01 5204,29 70 889,278 5204,29 4315,01 5204,29 5	D.f. 2 97 99 99 99 99 99 99 99 99 99 99 99 99	MS 320.248 47,0494 296,426 44,9481 44,9481 44,9481 VA Table MS 1,64923	Rario           6,81           6,81           6,50           6,50           8,50           8,50           8,50           13,48	0,0015 0,0004
BB MM PP Total E S W Total PARK MM PP Total	13 33 100 URE 30 15 25 30 100 100	26,191 25,2113 11,2249 27,3059 31,2417 30,754 23,6536 25,523 27,3059 26,191 25,2113 31,2249 27,3059	SD 6,2374 8,00769 7,25942 7,25942 6,25145 6,25145 7,25942 6,25145 8,00169 6,2374 8,00169 7,19403 7,25942	CV 23.82% 21.25% 23.05% 23.05% 24.05% 25.05% 26.05% 25.05% 26.05% 23.05% 23.05% 23.05% 23.05% 23.05% 23.05% 23.05% 23.05%	13,35 16,46 18,65 13,35 17,13 22,45 13,35 16,65 13,35 18,46 16,65 13,35	Max. 39,04 42,75 43,49 43,49 39,04 39,04 41,94 41,94 41,94 43,49 43,49 43,49 43,49 43,49	Ramps           25,69         26,29           26,34         30,14           26,36         46,59           20,46         20,46           20,46         20,46           20,46         20,46           20,46         20,46           20,46         20,46           20,46         20,46           20,46         20,46           20,46         20,46           20,46         20,46           20,46         20,46           20,46         20,46           20,46         20,46           20,46         20,46           20,46         20,46           20,46         20,46           20,47         20,46           20,46         20,46	EDLE WIDT Source Between groups Within groups Within groups Within groups Within groups Within groups Within Source Between groups Within grou	\$\$ 640,495 4460,8 520429 889,274 4315,01 520429 520429 7 889,274 4315,01 520429 7 889,274 899,2745 899,274 899	D.f. 2 97 99 99 99 99 99 99 99 99 99 99 99 99	M6S 330.348 47,0494 47,0494 42,0494 44,0481 44,0481 44,0481 44,0481 44,0481 44,0481 44,048 44	Ratio 6.81 6.81 6.81 6.81 6.81 6.81 6.81 6.81	0,0017
BB MM PP Total EXPOS E N S S W Total BB MM PP Total	15 35 100 CURE 50 15 25 30 100 100	26,191 25,2113 31,2249 27,4059 31,2417 30,754 24,6536 25,523 27,8059 Average 26,191 25,2113 31,2249	SD 6,2374 8,00369 7,19603 7,25042 7,25042 6,61014 6,55145 7,25042 7,25042 Descriptiv SD 6,2374 8,00369 7,19603	CV 23,82% 23,05% 28,05% 28,08% 29,05% 26,81% 26,81% 26,81% 26,81% 26,81% 26,81% 26,81% 28,08% 20,08%	13,35 16,46 18,65 13,35 17,13 22,45 13,35 16,65 13,35 16,65	Max, 39,04 42,75 43,49 43,49 43,49 43,49 43,49 41,94 41,94 41,94 41,94 41,94 41,94 42,75 43,49	Range 25,69 26,29 26,34 30,14 26,36 20,36 20,36 20,36 20,36 20,36 20,36 20,36 20,36 20,36 20,36 20,36 20,36 20,36 20,36 20,36 20,20	Source of the second se	SS 640,496 4563,8 5204,29 4315,01 5204,29 4315,01 5204,29 70 889,278 4315,01 5204,29 70 889,278 5204,29 4315,01 5204,29 5	D.f. 2 97 99 99 99 99 99 99 99 99 99 99 99 99	MS 320.248 47,0494 296,426 44,9481 44,9481 44,9481 VA Table MS 1,64923	Ratio 6.81 6.81 6.81 6.81 6.81 6.81 6.81 6.81	0,0017
BB MM PP Total E N S W Total PARK BB MM MM PP Total E E	13 33 100 URE 30 15 23 30 100 100 100 60 60 60 60 60 80 80 80 80 80 80 80 80 80 80 80 80 80	26,191 31,2249 27,0159 31,2417 30,754 24,6536 25,523 27,8059 26,191 25,2113 31,2249 31,2249 31,2417	SD 6,2174 2,01060 7,23042 7,28229 5,87802 6,61014 6,53145 7,25942 Nocriptit SD 6,2374 8,00069 7,219403 7,25942 7,25942	CV 23.82% 21.25% 23.05% 23.05% 24.05% 25.05% 26.05% 28.08% CV 23.05% 23.05% 23.05% 23.05% 24.05% 23.05% 24.05% 25.05% 23.05%	13,35 16,46 16,65 13,35 17,13 22,45 13,35 16,65 13,35 16,65 13,35 16,46 16,65 13,35	Max.           39,04           42,75           43,49           43,49           33,41           43,49           34,21           41,94           43,49           43,49           43,49           43,49           43,49           43,49           43,49           43,49           43,49	Range 25,69 26,30 26,34 26,34 26,34 26,36 16,59 20,46 25,29 20,46 25,29 30,14 Range 25,69 26,29 26,29 26,29 26,29 26,29 26,29 26,29 26,29 26,40 26,29 26,40 26,40 26,40 26,40 20,40,	EDLE WID	\$\$\$ 640,495 4463,8 5204,29 4315,01 5204,29 4315,01 5204,29 7 4315,01 5204,29 7 8 8 8 5,79603 33,2177 33,2177	D.f. 2 97 99 99 99 99 99 99 99 99 99 99 99 99	M6S 330.348 47,0494 47,0494 42,0494 44,0481 44,0481 44,0481 44,0481 44,0481 44,0481 44,048 44	Ratio         Ratio           6,81         -           0 <t< td=""><td>0,0017</td></t<>	0,0017
BB MM PP Total EXPOS S W Total BB MM MB PP Total EXPOSI E N	15 35 100 25 30 15 25 30 100 100 80 60 60 60 60 65 65	26,091 35,2113 31,2249 27,009 31,2417 30,754 23,6536 25,523 26,191 25,2113 31,249 25,2113 31,249 31,2417 30,754	SD 6,2174 2,0000 7,25042 7,25042 7,28229 5,87802 6,61014 6,55145 7,25042 ND 6,5174 SD 6,2374 8,00069 7,29042 7,28429 7,28429 5,87802	CV 23,82% 31,75% 22,05% 23,05% 23,05% 23,05% 28,06% CV 23,05% 24,05% 24,05% 25,05% 24,05% 25,05% 26,05%26,05% 26,05% 26,05% 26,05% 26,05%26,05% 26,05% 26,05% 26,05%26,05% 26,05% 26,05%26,05% 26,05% 26,05%26,05% 26,05% 26,05%26,05% 26,05% 26,05%26,05%26,05% 26,05%26,05%26,05% 26,	13,35 16,65 13,35 17,13 17,13 122,45 13,35 16,65 13,35 16,65 13,35 16,65 13,35 16,65 13,35 16,65 13,35	Max.           39,01           42,75           43,49           43,49           43,49           41,94           41,94           41,94           41,94           41,94           41,94           41,94           41,94           41,94           41,94           43,49           43,49           39,04	Range 25,69 26,79 26,74 26,74 26,74 26,76 26,76 26,76 26,76 26,76 20,76	Source of the second se	55 640,495 4360,38 4360,38 4360,38 4315,01 5204,29 5204,29 5204,29 5204,29 5204,29 5204,29 5204,29 5204,29 5204,29 5204,29 5204,20 5200,20 5204,20 520	ANO 0.6 4 255 297 99 99 06 99 06 99 06 99 06 99 06 99 06 99 06 99 06 99 06 99 99 06 99 99 99 99 99 99 99 99 99 9	M65 320.248 47,0494 47,0494 47,0494 47,0494 44,9481 44,948 44,94	Ratio         Ratio           6,81         -           0 <t< td=""><td>0,0017</td></t<>	0,0017
BB MM PP Total E N S W Total PARK BB MM PP Total E Total	13 33 100 URE 30 15 23 30 100 100 100 60 60 60 60 60 80 80 80 80 80 80 80 80 80 80 80 80 80	26,191 31,2249 27,0159 31,2417 30,754 24,6536 25,523 27,8059 26,191 25,2113 31,2249 31,2249 31,2417	SD 6,2174 2,01060 7,23042 7,28229 5,87802 6,61014 6,53145 7,25942 Nocriptit SD 6,2374 8,00069 7,219403 7,25942 7,25942	CV 23.82% 21.25% 23.05% 23.05% 24.05% 25.05% 26.05% 28.08% CV 23.05% 23.05% 23.05% 23.05% 24.05% 23.05% 24.05% 25.05% 23.05%	13,35 16,46 16,65 13,35 17,13 22,45 13,35 16,65 13,35 16,65 13,35 16,46 16,65 13,35	Max.           39,04           42,75           43,49           43,49           33,41           43,49           34,21           41,94           43,49           43,49           43,49           43,49           43,49           43,49           43,49           43,49           43,49	Range 25,69 26,30 26,34 26,34 26,34 26,36 16,59 20,46 25,29 20,46 25,29 30,14 Range 25,69 26,29 26,29 26,29 26,29 26,29 26,29 26,29 26,29 26,40 26,29 26,40 26,40 26,40 26,40 20,40,	Source of the second se	\$\$\$ 640,495 4463,8 5204,29 4315,01 5204,29 4315,01 5204,29 7 4315,01 5204,29 7 8 8 8 5,79603 33,2177 33,2177	D.f. 2 97 99 99 99 99 99 99 99 99 99 99 99 99	M65 320.248 47,0494 47,0494 47,0494 47,0494 44,9481 44,948 44,94	Ratio         Ratio           6,81         -           0 <t< td=""><td>0,0017</td></t<>	0,0017
BB MM PP Total EXPOS S W Total BB MM MB PP Total EXPOSI E N	15 35 100 25 30 15 25 30 100 100 80 60 60 60 60 65 65	26,091 35,2113 31,2249 27,009 31,2417 30,754 23,6536 25,523 26,191 25,2113 31,249 25,2113 31,249 31,2417 30,754	SD 6,2174 2,0000 7,25042 7,25042 7,28229 5,87802 6,61014 6,55145 7,25042 ND 6,5174 SD 6,2374 8,00069 7,29042 7,28429 7,28429 5,87802	CV 23,82% 31,75% 22,05% 23,05% 23,05% 23,05% 28,06% CV 23,05% 24,05% 24,05% 25,05% 24,05% 25,05% 26,05%26,05% 26,05% 26,05% 26,05% 26,05%26,05% 26,05% 26,05% 26,05%26,05% 26,05% 26,05%26,05% 26,05% 26,05%26,05% 26,05% 26,05%26,05% 26,05% 26,05%26,05%26,05% 26,05%26,05%26,05% 26,	13,35 16,65 13,35 17,13 17,13 122,45 13,35 16,65 13,35 16,65 13,35 16,65 13,35 16,65 13,35 16,65 13,35	Max.           39,01           42,75           43,49           43,49           43,49           41,94           41,94           41,94           41,94           41,94           41,94           41,94           41,94           41,94           41,94           43,49           43,49           39,04	Range 25,69 26,79 26,74 26,74 26,74 26,76 26,76 26,76 26,76 26,76 20,76	Source of the second se	55 640,495 4360,38 4360,38 4360,38 4315,01 5204,29 5204,29 5204,29 5204,29 5204,29 5204,29 5204,29 5204,29 5204,29 5204,29 5204,20 5200,20 5204,20 520	ANO 0.6 4 255 297 99 99 06 99 06 99 06 99 06 99 06 99 06 99 06 99 06 99 06 99 99 06 99 99 99 99 99 99 99 99 99 9	M65 320.248 47,0494 47,0494 47,0494 47,0494 44,9481 44,948 44,94	Ratio         Ratio           6,81         -           0 <t< td=""><td>0,0017 0,0004</td></t<>	0,0017 0,0004
BB MM PP Total EXPOS S W Total PARK BB MM PP Total PP Total PP Total S S	15 33 100 00RE 50 15 25 30 100 100 100 100 00 60 60 40 260 260 260 865 65 65	26,191 31,229 27,0059 31,2407 10,754 23,6556 25,523 27,0059 Average 26,191 25,2113 31,2249 27,0059 31,2447 34,24566 34,24566 34,245	SD 6,2174 2,01369 7,19900 7,25942 7,2829 6,81014 6,55145 7,25942 7,2829 7,2829 8,00169 8,00169 7,19401 7,2829 5,87102 6,81014	CV 23,62% 33,75% 23,05% 35,05% 25,05% 26,05% 25,05% 25,05% 25,05% 23,05% 23,05% 23,05% 23,05% 23,05% 23,05% 23,05% 23,05% 23,05% 23,05% 23,05% 23,05% 23,05% 23,05% 23,05% 23,05% 23,05% 23,05% 24,05%24,05% 24,05% 24,05%24,05% 24,05% 24,05%24,05% 24,05% 24,05%24,05% 24,05%24,05% 24,05% 24,05%24,05% 24,05%24,05% 24,05%24,05% 24,05%24,05% 24,05%24,05% 24,05%24,05% 24,05%24,05% 24,05%24,05% 24,05%24,05% 24,05%24,05% 24,05%24,05% 24,05%24,05% 24,05%24,05% 24,05%24,05% 24,05%24,05%24,05% 24,05%24,05% 24,05%24,05% 24,05%24,05% 24,05%24,05% 24,05%24,05% 24,05%24,05% 24,05%24,05%24,05% 24,05%24,05% 24,05%24,05%24,05% 24,05%24,05%24,05% 24,05%24,05%24,05% 24,05%24,05%24,05%24,05%24,05% 24,05%24,05%24,05%24,05%24,05% 24,05%24,05%24,05%24,05% 24,05%24,05%24,05% 24,05%24,05%24,05% 24,05%24,05%24,05% 24,05%24,05%24,05% 24,05%24,05%24,05%24,05%24,05%24,05%24,05%24,05%24,05%	13,35 16,65 18,65 13,35 17,13 22,45 13,35 16,65 13,35 16,65 16,65 16,65 16,65 13,35 16,65 13,35	Max.           39,04           42,75           43,49           43,49           43,49           43,49           43,49           41,94           41,94           41,94           43,49           43,49           43,49           43,49           43,49           43,49           43,49           43,49           43,49           43,49           43,49           43,49           39,04           43,49           39,04           34,421	Range 25,69 26,79 26,84 26,84 26,84 26,36 26,36 25,29 20,46 25,29 20,46 25,29 20,46 25,29 20,46 25,29 20,46 25,69 26,44 30,14 26,64 4,59 26,64 4,59 26,64 4,59 26,64 4,59 26,64 4,59 26,64 4,59 26,64 4,59 26,64 26,64 26,64 26,64 26,64 26,64 26,64 26,64 20,14,14 20,1	Source of the second se	55 640,495 4360,38 4360,38 4360,38 4315,01 5204,29 5204,29 5204,29 5204,29 5204,29 5204,29 5204,29 5204,29 5204,29 5204,29 5204,20 5200,20 5204,20 520	ANO 0.6 4 255 297 99 99 06 99 06 99 06 99 06 99 06 99 06 99 06 99 06 99 06 99 99 06 99 99 99 99 99 99 99 99 99 9	M65 320.248 47,0494 47,0494 47,0494 47,0494 44,9481 44,948 44,94	Ratio         Ratio           6,81         -           0 <t< td=""><td>0,001 0,000 0,000 0,000</td></t<>	0,001 0,000 0,000 0,000

ble 3a). Northern crown exposure was the best for needle length, too (Table 3a). In *A. concolor*, needle mean values for BB and PP were nearly identical. Northern exposure had almost the best needle length and width (Figure 3b, Figure 4b), but it was not statistically approved in both properties (only in needle width,Table 3b). In *Cedrus atlantica* needles, great differences in the analyzed traits between parks were found only in needle width (Figure 3c, Figure 4c, Table 3c), where parks AK and BB had statistically the best values. At the same time, we can not conclude that some exposures gave the best results (Table 3c). In *Pi*- *cea abies* needles (Figure 3d, Figure 4d), needle length and width were significantly higher in BB than in PP (Table 3d). The best results were found on northern and western exposure (needle length and width, resp.). In *P. omorika* needles the highest values were statistically approved in park PS (Figure 3e, Figure 4e, Table 3e). The longest needles were found on eastern exposure, but it was not statistically significant. For *P. pungens* needles (Figure 3f, Figure 4f, Table 3f), the highest and statistically approved length and width were found in park PS, while eastern exposure was the best (Table 3f). In *Pinus nigra* needles (Figure 3g, h;



Table	3.	Continued
Table	3.	Nastavak

			age to share	Sec. State	i) Texa	s baccate	NEEDLE	LENGTH			condense.			
			Descriptiv	e Statistics		100.000		ANOVA Tuble						
FARK		Average	SD.	CV	Mia.	Max.	Range	Source	55	nr.	MS	F- Ratio	P-Valu	
585	60	21.24	4,1521	28,51%	11.43	27.6	16,17	Hetsvece groups	393.85	+	89,9124	7,60	0.0000	
- 22								William				1.00	1	
MM	60	17,4545	3,52319	28,21%	10,22	26,52	16.3	(rears	.3015,48	.255	11,8254			
66	- 40, -	20,105	2,78889	13,88%	17,95	26,00	12,05	Total	1115,11	259	0.000000	_	_	
125	-40	17,7012	2,94344	16,62%	8,97	31,43	12,46			-	· · ·	-		
. 12	60	18,5777	3,24865	17,68%	12,35	24,8	12,45	-	-	-		_	-	
Testi .	268	18,7561	3,6099	19,25%	8.97	27,6	18,63	-		-			-	
EXPOS	CHE.				-		-			-	-	-	-	
£	65	18,8657	4,0)855	21,26%	10,22	27,6	17,58	Between groups	266,344	3	88,7815	7,31	0,0001	
100	1.1.1	Charles .	100.021	C. St. Sec.		Sec. Sec.	1.1.1.1	Wishin	Salation	2.5		1.000	10000	
N	65	19,4659	3,24349	18,66%	11,32	26,78	15,46	present.	3166,79	236	12,1437		_	
3	65	17,0722	3,70726	21,72%	8.97	24,44	15,47	Total (Com.)-	3375,13	250				
ŵ	65	19,6166	2,86815	11,62%	141	27,42	13,32							
Tetel	268	18,7561	3,9099	14,25%	8,97	27.6	18,63							
					i) Tar	is harries	A.NEEDLE	WIDTH	2.0					
			Descriptiv	e Statistics	0.120			1		AND	A Table			
PARK	1	Average	SD	cv	Mis.	Max	Rango	Source	- 55	n.c.	MS	F. Batia	P-Yalo	
88	60	2,13063	0,356234	16,72%	1.01	3,13	2.84	Hannest groups	5,79695	+	1,44923	13,44	0,000	
MM	60	2,26833	0,336312	14,83%	1.61	3.40	1.42	Within	27,4208	255	4,107532			
99	-40	2,58975	0,364428	14,07%	1,73	3,25	1.32	Total	33,2177	259				
125	-40	2,19075	0,274033	11,46%	1,81	2,9	1,69		C					
12	60	2,22483	0,295506	13,28%	1,88	2,0	1,21		S					
Total	260	2,29483	0,358125	15,61%	LIL	3,25	2,14		6				-	
EXPO5	URE								÷					
ε	65	2,32692	131127	13,71%	1.61	3,47	1,46	Belivice	1,99806	3	4,666821	5,46	0,9912	
N	65	2,37183	0,342531	14,44%	1.67	3,15	1,48	Within groups	31,2196	256	6,121452			
3.	65	2,14631	0.399186	17.20%	LIL	3.25	2.14	Total (Cont.)	33,2171	259				
w	65	2,34031	0,364533	15,58%	1,7	- 3.25	1.55							
Teal	260	2,29489	0.358125	15,61%	LII	3.25	2.14							

Figure 4g, h), the highest needle length was found in MM and PS (Table 3g). Southern exposure was found to be also statistically the best. In needles of *Pseudotsuga menziesii*, the highest values of length and width were exibited in PP (Table 2, Figure 3h, Figure 4h, Table 3h). The largest needles (statistically approved) according to needle length and width were found on eastern and northern exposures, resp. In needle length of *T. baccata*, park BB was the best (Table 2, Figure 3i, Figure 4i, Table 3i), while in needle width PP was the best. Western and northern exposures were significantly the best, resp.

#### DISCUSSION

#### RASPRAVA

*Abies alba*, according to Jovanović (1967) and Janković (1973), is a sciophilic species (thrives in the shade), which agrees with presented results where the maximum values of needle length on northern exposure was shown, even though, according to Robakowski et al. (2004), young seed-lings require somewhat more light. *A. concolor* is also a shade-loving species, however, it copes well with sunny locations as well and is a desirable park species (Jovanović 1967; Vukićević 1982). Presented results, since no statistical differences in crown exposure were found, confirmed statements of both authors. Furthermore, Mori and Takeda (2004) reported that branches of alpine species, *A. mariesi* and *A. veitchii*, developed more slowly in the shade. Needle masses per area of these species (results of current-year needles!) were lower in the shade. *Cedrus atlantica* is favo-

rite park species which in the examinations presented therein exhibited variability concerning exposure. Its both heliophilic (Vukićević 1982) and xerotherm characters (Jovanović 1967), were not statistically approved in presented results, although on southern exposure needle length was the highest. Picea abies is a species that copes better in the shade (Jovanović 1967) or in partial shade (Janković 1973). The both opinions were approved in presented examination where higher needle length was found on northern, and higher needle width on western exposure. P. omorika, though a sciophilic species, it can thrive in the light as well (Jovanović 1967). In presented results its needle length had the highest mean value on the eastern side, but its needle width was the best on the northern side. It is important to notice that both findings didn't have statistical support. P. pungens is also considered a heliophilic species (Jovanović 1967), which coincides with the maximum values found mostly on eastern exposure (presented results, statistically approved). Furthermore, needle masses per area (of current-year needles) of P. jezoensis (Mori and Takeda, 2004) was lower in the shade. Pinus nigra is a distinct heliophilous (Jovanović 1967; Janković 1973), as confirmed in presented results where maximum values were found on southern exposure, but it was not statistically confirmed. Pseudotsuga menziesii is considered a partial shade species and is successfully grown in forest cultures (Vukićević 1982). It was in accordance with presented evidence where the longest needles were found on southern exposure, but the thickest needles were found on northern exposure. Taxus baccata is a species that tolerates deep shade (Jovanović 1967; Janković 1973; Robakowski et al. 2004), and in presented results it achieved the best results on eastern or northern exposures (needle length and needle width, resp.).

The significant impact between light and shade on leaf mass per area had also been established in some tropical species (Martin et al. 2020) and other leaf physiological traits. It was founded that differences in needle morphology between parks could be consequence of tree maturation, too (quoted in the case of Douglas-fir needles, where length, width, thickness, and roundness of needles grew through the needle age, Apple et al. 2002).

Increased dryness and the poverty of soil led to decreased length and area of needles (Tyukavina et al. 2019a). Needle area of Scots pine forests in taiga was reduced in conditions far from optimal water regime, so consequences in changing the width and thickness of needles occured (Tyukavina et al. 2019b).

In previous study (Nikolić et al. 2019), for all investigated species significant differences in needle morphology (and anatomy) between species as well as between individuals were found, too. Our results is in accordance to general data which was well known (Vukićević et al. 1982).

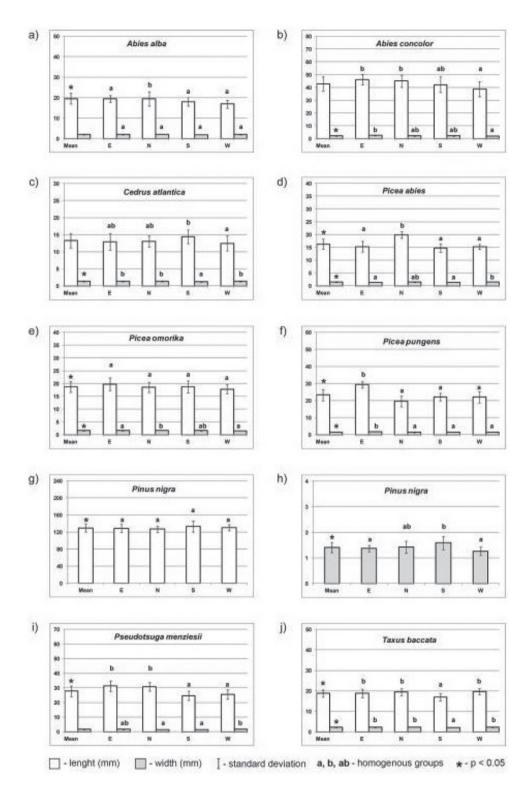
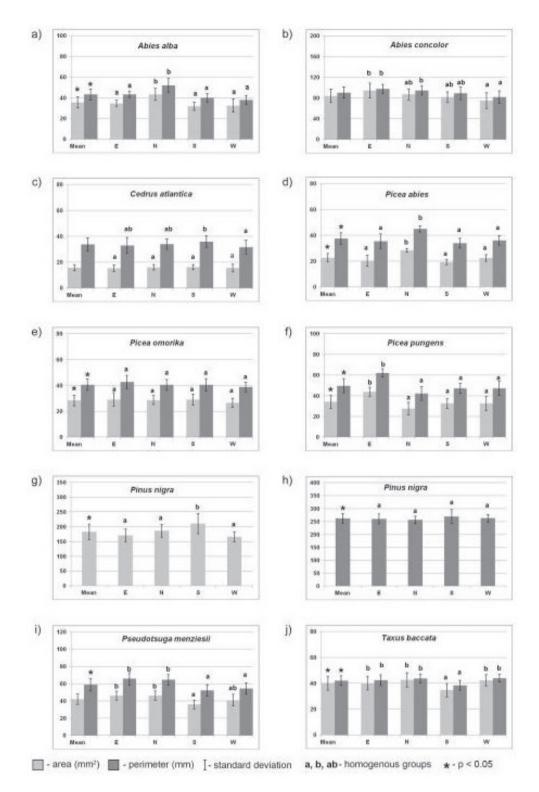


Figure 3. Differences in the length and width of the needles of nine conifers with respect to crown exposure Slika 3. Razlike u duljini i širini iglica devet četinjača s obzirom na izloženost krošnji

BB is the only park on serpentinite ground that has most likely favoured the development of the needles of species *A*. *alba*, *P. abies and T. baccata* (primarily needle length). The remaining six studied species demonstrated better results on limestone surfaces. According to Vukićević (1982), *P. pungens* is not too demanding in terms of soil characteristics but we couldn't approve this since all investigated trees of this species were on same substrat, loam. Speaking of soil properties, this paper's findings and conclusions should be taken with reservation because some of the parks implemented cultivation measures, primarily fertilization (but, unfortunatelly, it was known for sure only for parks AC and BB).

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**Figure 4.** Differences in the needle area and perimeter of the needles of nine conifers with respect to crown exposure Slika 4. Razlike u površini i opsegu iglica devet četinjača s obzirom na izloženost krošnji

#### **CONCLUSIONS**

ZAKLJUČCI

According to obtained results the crown exposure influenced to needle properties in many of analyzed conifers. Species, parks in which they were found, as well as crown exposures, differed mostly in needle length and needle width.

The differences among the species in terms of light requirement found in the present research determined species for individual cooperation in parks (i.e. as solitary trees) as light-loving or partial shade species (*C. atlantica*, *P. abies*, *P. omorika*, *P. pungens*, *P. nigra* and *P. menziesii*), or group cooperation as shade-loving species (*A. alba*, *A. concolor* and *T. baccata*), which is something to be taken into consideration when setting up parks in the future.

#### ACKNOWLEDGEMENTS

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## SAŽETAK

Analizirano je 66 stabala devet vrsta četinjača: atlaskog cedra, crnog bora, bodljikave smreke, duglazije, obične smreke, šumske tise, Pančićeve omorike, koloradske jele i obične jele, iz šest beogradskih parkova. Analizirano je pet iglica sa svake od četiri glavne ekspozicije krošnje. Ispitivana je duljina, širina, površina i opseg iglica. Vrste, parkovi u kojima su pronađene, kao i ekspozicije njihovih kruna, razlikovali su se po duljini i širini iglica. Korelacije između izmjerenih svojstava iglica određene su linearnom regresijskom analizom. Utvrđene su jake pozitivne korelacije između duljine, opsega i površine iglica. Razlike među vrstama u zahtjevima za svjetlom određuju vrste za pojedinačnu sadnju kao vrste koje vole svjetlo ili polusjenu (atlaski cedar, obična smreka, Pančićeva omorika, bodljikava smreka, crni bor i duglazija) ili za grupnu sadnju kao sjenoljubne vrste (obična jela, dugoigličava jela i šumska tisa).

KLJUČNE RIJEČI: četinjače, korelacije, izloženost, morfologija iglica, parkovi.