Knotted Pile Rugs of 19th and early 20th Centuries from Caucasia: A Classification of Area, Shape Ratio, Density and Knot Ratio by Statistic

Gaetano Verani*

University of Cagliari, Italy

Corresponding Author: *Gaetano Verani, via Santa Croce 8, 09124 Cagliari, Italy, Email: verani.g@alice.it*

ABSTRACT

Area, shape ratio, density and knot ratio of knotted pile of Caucasian rugs of the 19th and early 20th century have been calculated from their dimension, density and knots number for Kazak, Gendje, Karabagh, Moghan, Talish, Daghestan, Kuba, Shirvan and Baku regions. Histograms have been used todescribe area, shape ratio, density and knot ratio distribution into the regions.

By dividing the regions intosouth-western (Kazak, Gendje, Karabagh, Moghan and Talish)and eastern (Daghestan, Kuba, Shirvan and Baku) sub-groups, area, shape ratio, density and knot ratio were normalized to 100. Most of the Caucasian rugs show area distribution within (0.0-5.0) sq.m.[94% for eastern and 93 % forsouth-western rugs] as well as shape form distribution within (1.0-3.4) [97% for south-western and the 100% of eastern rugs].

Differences between the two sub-groups were found in density and knot ratio.Rugs of south-western regions have density distribution within (400-1,999) knots per s.q.dm. and knot ratio distribution within (0.6-1.8), eastern regions within (600 – 1,999) knots per s.q.dm. and knot ratio distribution within (0.6 - 2.2).

Keywords: *Pile rugs, Caucasia, Shape ratio, Density, Knot ratio, Kazak, Gendje, Karabagh, Moghan, Talish, Daghestan, Kuba, Shirvan, Baku.*

INTRODUCTION

Many scholars from the middle of the last century have been interested in Caucasian carpet classification. Among them, ȘerareYetkin [1] classifying early Caucasian carpets in Turkey starting with the dragon design evolution, through floral, geometric and medallion designs. Latif Kerimov and co-workers [2,3] classified the production of rugs and carpets in the three Soviet Republics of Azerbaijan, Armenia and Georgia also including the Autonomous Republic of Daghestan as a part the Russian Federation. The Azerbaijani rug production was divided into three basic types, Kuba-Shirvan, Gendje-Kazak and Karabagh. Later, Azadi [4] reconsidering the Azeri rugs production, located their provenances from Kuba, Shirvan, Gendje, (Gyanja), Kazak, Karabagh (Karabakh) and Nakhichevan. Ulrich Schürmann [5], through structure, and designs of carpets, localised their production areas into ten districts without any ethnic distinction of weavers and the most of western scholars followed more or less his scheme. Peter Stone [6] studied structure and design of Caucasian rugs belonging to Baku, Daghestan, Gendje, Karabagh, Kazak [7], Kuba, Moghan, Shirvan and Talishregions, Figure 1; further more he described [8] mainly field and border designs including Zakatala to the north of Gendje (not depicted in Figure 1). Richard E. Wright and John T. Wertime [9] studied the weaving culture of Caucasian carpets and covers of 19th century from ethnological, economic, political and technical points of view, subdividing Caucasus into Daghestan, East-, Central- and Western-Transcaucasia. Ralph Kaffel [10] by recounting the complex history of Caucasus [11,12] distributes rugs in two basic groups, the south western highlands, and the eastern area along the Caspian Sea.

I report here about on investigation where the foundation parameters, area, shape ratio, density and knot ratio of knotted pile rugs of 19th and early 20th centuries are analysed in order to verify technical correlation with the above nine areas. Stone's data were chosen in order to compare his results with those here obtained by a different mathematical approach and database.

Figure1. *Approximate description of Caucasian regions*

STRUCTURAL ELEMENTS

Knotted pile rug structural elements are materials for warp, weft and pile, types of knot, finishes of sides and ends, shapes and number of knots. These elements for Caucasian rugs vary as follows: i) the warp is wool of sheep, occasionally camel and goat. Normally colour ranges from ivory to dark brown. Warp is formed of two/three threads spun then plied. Warps are, in some regions, on the same level giving a flat plane on the back, in others, alternate warps may be more or less depressed, Figure2.
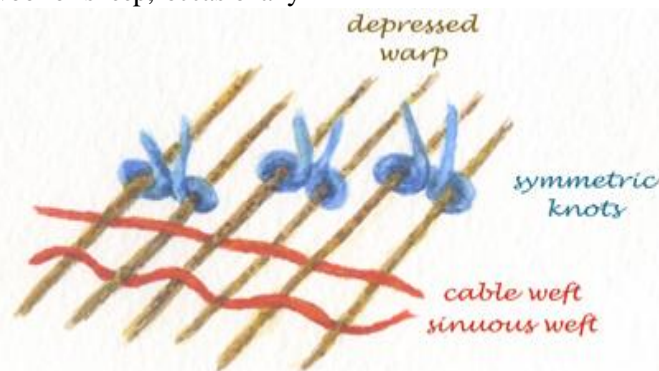
Figure2. *Depressed warp, symmetric knots, cable and sinuous weft*

Cotton alone or mixed with wool may also be used for warps. In a three threats warp, one should be cotton the others wool or vice-versa. Silk is rarely used as warp. Cotton may also be used in the weft. The thickness of the warp is higher than that of the weft and this latter is often coloured. Two wefts between rows of knots are common but there are also rugs with three or more wefts of varying thickness. Pile is made with one, two or three threads of wool, one thread in Figure 2, and its height may be low, medium or high. ii) The knot is symmetric as in Figure 2, rarely asymmetric.iii) Finishes of sides are obtained by weaving the weft on one or two pairs of warps forming a flat figure of eight; finishes of ends are very variable, and the top might be different from the bottom.

The most antique carpets and rugs have original sides and ends missing or repaired.

Area, Shape Ratio, Density and Knot Ratio

These are obtained from dimensions (length and width) and knot numbers (in 1dm. of warp or weft) of a rug. In fact, the area of the surface is obtained by multiplying length and width, while the shape ratio, by dividing length and width. Since rugs have usually shape that varies from square to rectangular, the shape number indicates the length of the rug. If the ratio, length/width, is close to unity the shape of the rug is pseudo-square, if higher it is a rectangle. This way of indicating the shapes simplifies different terminologies used in the Middle East. Shapes depend on the loom, tradition of weavers

and trading requests. Length and width are here measured in centimetres (cm) or meters (m), area in square metre (sq.m.) units, the ratio is a dimensionless quantity.

When a row of knots is tied on the loom, weavers insert one or more wefts and, with a comb, press down the wefts packing the knots. Knot numbers in a decimetre of warp and in a decimetre of weft are characteristic of the rug structure. Their product, the number of knots per square decimetre (knots per sq.dm.),is the knot density. Their ratio is instead a dimensionless quantity and its value is one, when the number of knots along the warp is the same as along the weft when the number is larger than one, i.e. the number of knots along the warp is larger than along the weft the rug is compressed. Density and knot ratio depend on thickness of materials, depression of the warp as well as from the hand of the weaver, usually a woman.

EXPERIMENTAL

Data Sources

All knotted pile rugs are dated within 19th and early 20th century. Data sources of dimension, density and knots are obtained from literature [2,4,5,10,13,14,15,16,17,18,19,20,21] and used to calculate area, shape ratio and knot ratio.

The number of rugs considered for each Caucasian region is reported in Table 1. As shown, the description of a rug gives; dimension, sometimes density and less frequently knot number. This because for all rugs dimension, density and number of knots are not simultaneously assigned. Although the number of rugs is limited with respect to their production, here a selected choice of rugs is considered and it is well known that the success of statistic depends on the choice of the samples.

Table1. *Number of rugs used as data sources of dimension, density and knotsfor Caucasian regions*

Region	Dimension	Density	Knots
Kazak	186	128	119
Gendje	60	53	50
Karabagh	96	74	69
Moghan	21	14	11
Talish	42	26	23
Daghestan	66	43	37
Kuba	178	161	141
Shirvan	157	129	118
Baku	29	23	21
TOTAL	**835**	**651**	**589**

Statistical Treatment

Area, shape ratio, density and knot ratio distributions of nine Caucasian regions are studied by histograms where the number of rugs is counted within incrementing intervals of 1.0 sq.m. (area), 0.3 (shape ratio), 200 knots per sq.dm. (density) and 0.2 (knot ratio). Thirty-six histograms are obtained but, to save space, only four will be here presented in Figures 3-6 as examples. All the data are synthetized as distributions in Table 2 and, all histograms and references for each rug will be available on request to the author.

Furthermore, area, shape ratio, density and knot ratio distributions have been considered as belonging to south-western (Kazak, Gendje, Karabagh, Moghan and Talish) and eastern (Daghestan, Kuba, Shirvan and Baku)sub-group hence, area, shape ratio, density and knot ratio

distributions have been normalized to 100 for each sub-group and comparatively shown as histograms in Figure 7-10.

Excel 2011 per Mac 14.7.1. and Excel 16.25 (Excel 365) are used in performing both calculations and graphs.

RESULTS AND DISCUSSION

Histograms and Distributions

Columns of histograms, Figures 3-6, show the distributions of area (sq.m.), shape ratio, density (knots per sq.dm.) and knot ratio for Kazak rugs. In Figures 3 and 4, the samples of 186 Kazak rugs spread the areas in the range (0.0-8.0) sq.m. and the shape ratios in the range (1.0-4.0) respectively. In Figure 5 and 6, 128 Kazak rugs spread the densities in the range (400-2,199) knots per sq.dm. and 119 spread their knot ratios in the range (0.6-2.0).
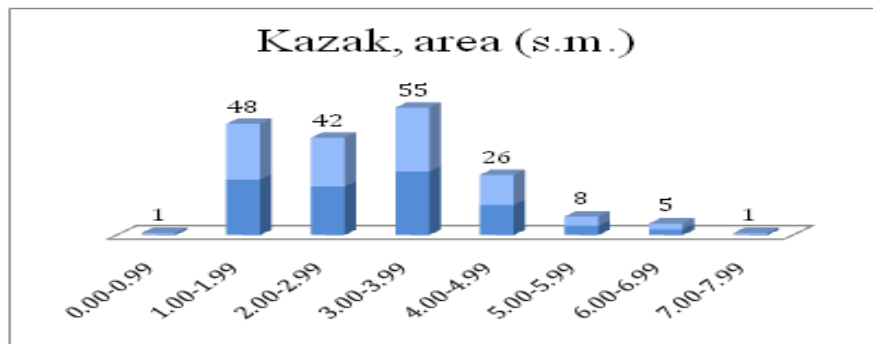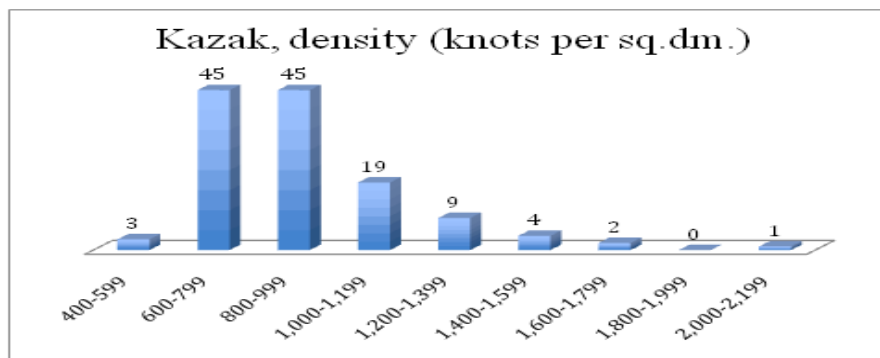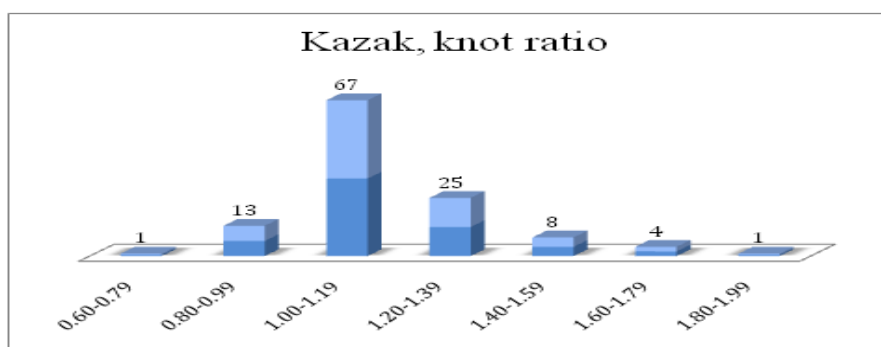
Figure3. *Kazak rugs area distribution*
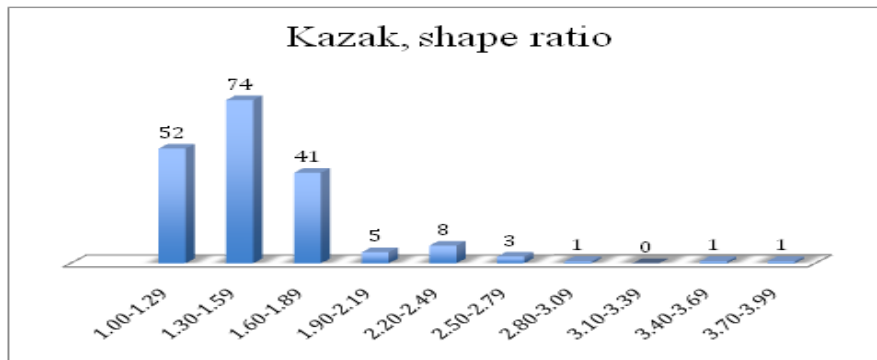
Figure4. *Kazak rugs shape ratio distribution*

Figure5. *Kazak rugs density distribution*

Figure6. *Kazak rugs knot ratio distribution*

The first column of Table 2lists the nine Caucasian regions, and further four columns record, area, shape ratio, density, and knot ratio. Below each column two sub-columns give the number of rugs (N) and distribution (Δ). A row, below each region, reports the number of rugs (N) used by Stone to calculate mean values (m.v.) to be compared withΔ's values.The values of arithmetic media for identical parameters obtained by Stone [22], with area and density units converted in sq.m. and knot per sq.dm. are reported for comparison.

Table2. *Distribution, Δ, of area, shape ratio, density and knot ratio and Stone's mean values (m. v).*

Region[1]	Area (sq.m.)		Shape ratio		Density (Knots per sq.dm.)		Knot ratio	
	N	Δ	N	Δ	N	Δ	N	Δ
Kazak	186	0.0-8.0	186	1.0-4.0	128	400-2,199	119	0.6-2.0
m.v.	320	3.1	320	1.5	320	930	285	1.1
Gendje	60	1.0-6.0	60	1.0-4.6	53	200-3,199	50	0.6-1.8
m.v.	55	2.9	55	2.2	55	1,007	43	1.1
Karabagh	96	0.0-12.0	96	1.0-5.8	74	400-3,599	69	0.6-1.8
m.v.	109	3.8	109	2.3	109	1,007	81	1.1
Moghan	21	1.3-6.0	21	1.3-3.1	14	600-1,799	11	0.8-1.8
m.v.	23	3.1	23	2.2	23	1,116	17	1.1
Talish	42	0.0-5.0	42	1.3-4.0	26	600-1,799	23	0.8-1.8
m.v.	51	2.8	49	2.2	51	1,286	44	1.1
Daghestan	66	0.0-8.0	66	1.0-3.4	43	800-2,999	37	0.4-2.0
m.v.	73	2.2	67	1.7	73	1,689	57	1,2
Kuba	178	0.0-7.0	178	1.0-4.3	161	600-3,399	141	0.6-2.4
m.v.	202	2.5	202	1.7	202	1,782	172	1.3
Shirvan	157	0.0-7.0	157	1.0-4.6	129	600-8,599	118	0.6-2.2
m.v.	194	2.6	194	1.7	194	1,781	165	1.3
Baku	29	1.0-8.0	29	1.0-2.5	23	800-3,199	21	0.6-2.0
m.v.	36	3.3	34	1.9	36	1,457	31	1.2

[1]Scholars agree with the nine regions, others [3,4] include Moghan (Mokan) and Talish (Talysh) into Karabagh (Karabakh) and Baku into Shirvan.

Inspection of Table2 allows the following remarks: i) Karabagh rug areas have the widest Δ, (0.0-12.0) sq.m. and shape ratio (1.0-5.8)[red marked]; ii) shape ratio for Moghan and Talish rugs has 1.3 as minimum Δ value [blue marked], hence they display a rectangular form, the other regions shape ratio Δ's start from 1.0 hence rugs should have shape varying from pseudo-square to rectangular. For Talish rugs, Bennett [23] pointed out that most of them have a shape ratio in the range (2.0-2.2), suggesting that for a ratio higher than 2.5 the Talish assignment is doubtful; iii)the lowest density found was 372 for a Gendje rug [24], within (200-400) knots per sq.dm., the highest 8,400 for a Shirvan prayer rug [25], within (8,400-8,599) knots per sq.dm.; iv) knot ratio of Kuba rugs within (0.6-2.4) has the highest value 2.24, and Daghestan the lowest, 0.4; v)on the whole all mean values, calculated by Stone, fall inside Δ's values.

Normalization

Attempts to increase the probability of distributions, by cutting head/tails of the columns of the histograms, show that the distributions of area and shape ratio are practically the same for all the Caucasian regions. Density and knot ratio distribution of south-west (Kazak, Gendje, Karabagh, Moghan and Talish)differ from those of eastern regions (Daghestan, Kuba, Shirvan and Baku).Hence, area, shape ratio, density and knot ratio distributions have been grouped into two sub-groups, south-western and eastern. For each sub-group area, shape ratio, density and knot ratio distributions were normalized to 100. The results are comparatively reported as histograms for area, shape ratio, density and knot ratio in Figures 7-10.
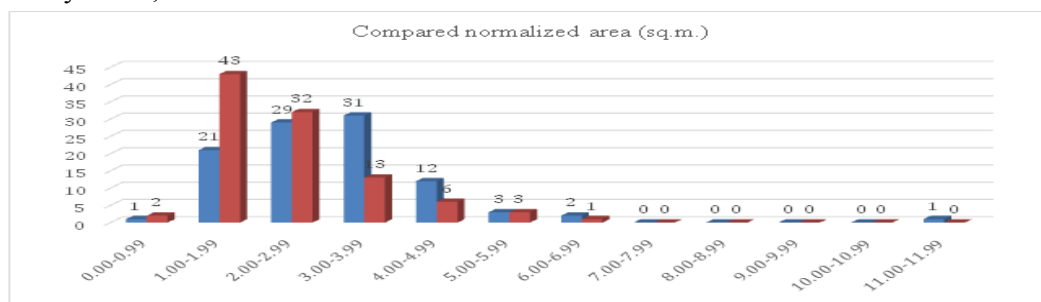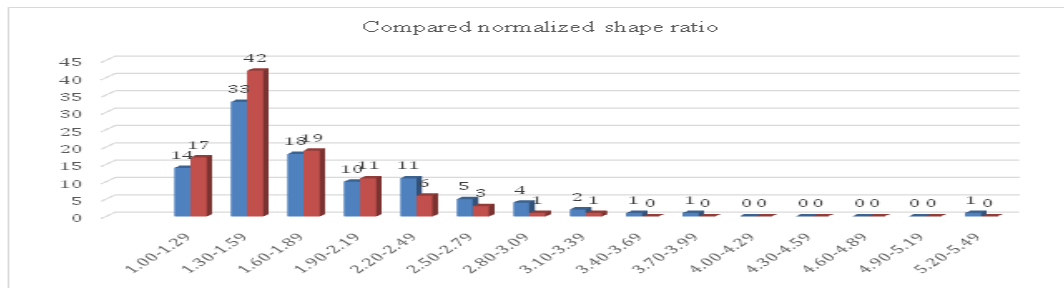

Figure7. *Normalized area for south-western (blue) and eastern group (red)*

Normalization treatments show that distribution of area for south-western sub-group varies within (0.0 – 7.0) sq.m. for 99% of rugs and within (11.0 – 12.0) sq.m. for the remaining 1%.It varies within (0.0 – 7.0) sq.m. for 100%

eastern sub-group rugs. Furthermore the (43+32+13+6) = 94% of eastern rugs have distribution within (1.0 – 5.0) sq.m. whereas for south-western (21+29+31+12) = 93 % have distribution within (1.0 – 5.0) sq.m.
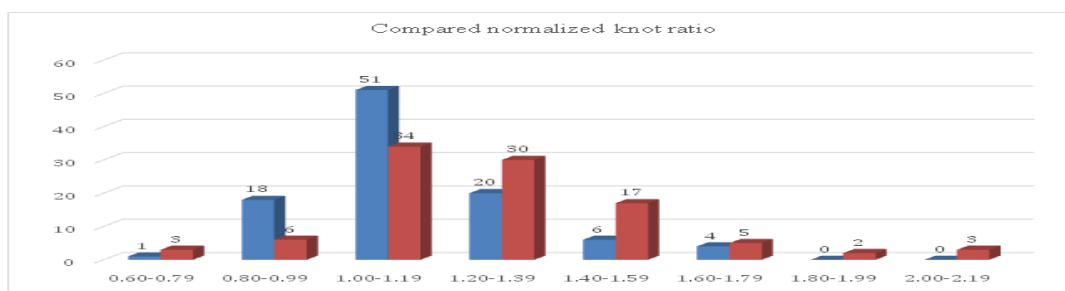

Figure8. *Normalized shape ratio for south-western (blue) and eastern group (red)*

Distribution of shape ratio ranges within (1.0 - 3.4) for the 100% of eastern rugs and within (1.0 -4.0) and (5.2 - 5.5) for 99% and 1% for south-western sub-group. Figure 8 shows that 97% of south-western rugs and the 100% of eastern rugs have a shape form distribution within (1.0 -3.4)

Differences between the two sub-groups are pointed out in the histograms of Figure 9 and 10. The comparison of densities in Figure 9 shows a continuous distribution within (400-1,999) and (600–1,999) knots/s.q. dm. for south-western and eastern sub-groups respectively.
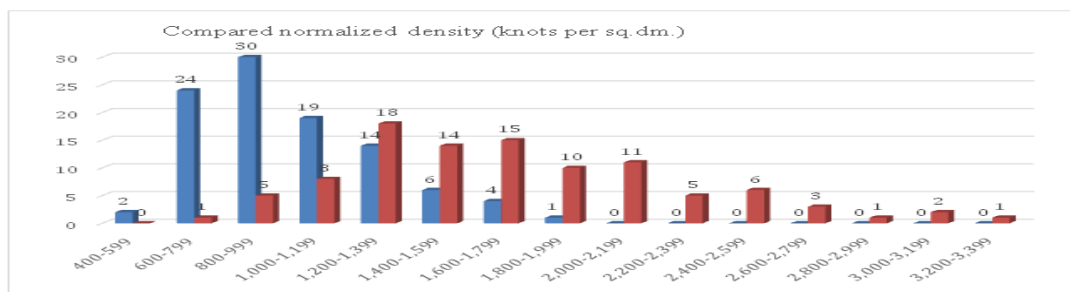
Figure9. *Normalized density for south-western (blue) and eastern group (red)*

Figure10. *Normalized knot ratio for south-western (blue) and eastern group (red)*

Also knot ratio distribution is continuous, within (0.6 - 1.8) for south-western and within (0.6 - 2.2) for eastern sub-group and these latter trend to higher knot ratios.

CONCLUSION

The study, based on dimensions and knots, shows, with only a few exceptions, that most of the Caucasian rugs have area distribution within (0.0-5.0) sq.m. and shape form within (1.0-3.4). This means that the dimensions of the looms have an analogous distribution, with random

percent, on all the Caucasus. Differences instead are found in density and knots ratio for south-west and eastern regions. Rugs of south-western regions have density distribution within (400-1,999) knots/s.q. dm. and knot ratio within (0.6 - 1.8), eastern regions distribution within (600–1,999) knots/s.q. dm. and knot ratio distribution within (0.6 - 2.2).

The results agree with the following Bennett's observations: analysing twelve Moghan rugs [26] raised doubts on the origin of the most of them underlining that they belong to neighbouring

regions. He pointed out difficulties in classifying Daghestan, Kuba, Shirvan and Baku rugs considering both subjective and meaningless to differentiate by structure and design, in particular regarding pray mats, as is also here [27] indicated. Finally, I would like to cite Lord Kelvin:*"I often say that when you can measure what you are speaking about, and express it in numbers, you know something about it"*

REFERENCES

[1] Yetkin Ş., Early Caucasian Rugs in Turkey, 2 vols. London: Oguz Press Limited; 1978.

[2] Kerimov L., Stepanian N., Grigoliya T. and Tsitsishvili D., Rugs and Carpets from the Caucasus. The Russian Collections. Leningrad: Allen Lane/Penguin Books, Aurora Art Publishers; 1984.

[3] Kerimov L., Lyatif Kerimov's Classification of the Rugs of Azerbaijan. London: Hali, vol 3, No 1; 1980.

[4] Azadi S. U., Kerimov L. and Zollinger W., Azerbaijani-Caucasian Rugs. Hamburg: The Ulmke Collection, Switzerland, Production Offizin Paul Hartung; 2001.

[5] Schürmann U., Caucasian Rugs. London: Distributors for Great Britain and the Common wealth, George Allen & Unwin, Ltd. Braunschweig: Verlag Klinkhardt & Biermann; 1961.

[6] Stone P. F., Rugs of the Caucasus: Structure and Design**.** Chicago Il.: Greeleaf Co.; 1984.

[7] Kazak is not a geographic or a historical region but a weaving district in Azerbaijan, Armenia and Georgia. The term has probably originated from a town, Kazak (Kasak, Kazakh, Gazakh), where rugs, coming from surrounding areas, were traded.

[8] Stone P. F., Tribal and Village Rugs. The Definitive Guide to Design, Pattern and Motiv. New York: Thames and Hudson; 2004.

[9] Wright R. E. and Wertime J. T., Caucasian Carpets and Covers the weaving culture. London: Hali Publications Limited in association with Laurence King; 1995.

[10] Kaffel R., Caucasian Prayer Rugs. London: Published by Laurence King Publishing in association with Hali Publications Limited; 1998.

[11] Ferrari A., Breve Storia del Caucaso. Roma: Carocci editore; 2008.

[12] Forsyth J., The Caucasus: A History. Cambridge: University Press; 2015.

[13] Tschebull R., Kazak. New York: The Near Eastern Art Research Center, Incorporated The New York Rug Society Incorporated; 1971.

[14] Banfo C. e Basilico D., Tappeti Orientali, Guida per conoscerli e collezionarli. Milano: Hoepli; 1993.

[15] Benardout R., Caucasian Rugs. London: CTD Printers Twickenham Middlesex; 1978.

[16] Coen L. and Duncan L., The Oriental Rugs. New York: Harper and Row Publisher; 1978.

[17] Curatola G., Tappeti. Milano: Arnoldo Mondadori Editore; 1981.

[18] Ford P. R. J., Il Conoscitore di Tappeti Orientali. Guida ai motivi, disegni e simboli. Milano: Longanesi e C; 1988.

[19] Gans-Ruedin E., Caucasian Carpets. London: Time and Hudson Ltd; 1986.

[20] Sabahi T., L'Arte del Tappeto d'Oriente. Milano: Mondadori Electa Spa; 2007.

[21] Wright R. E., Rugs and Flatweaves of the Transcaucasus. Greensburg Pa: Printed by Chas. M. Henry Printing Co.; 1980.

[22] Stone P. F., Rugs of the Caucasus: Structure and Design, pg 42. Chicago Il.: Greeleaf Co; 1984,

[23] Bennett I., Oriental Rugs, Volume I, Caucasian, pg 152. Woodbridge, Suffolk: Antique Collectors'Club Ltd; 1993.

[24] Wright R. E., Rugs and Flatweaves of the Transcaucasus, Plate 39, pg 86. Greensburg Pa: Printed by Chas. M. Henry Printing Co.; 1980.

[25] Kaffel R., Caucasian Prayer Rugs,Plate 93, pg.149.London: Published by Laurence King Publishing in association with Hali Publications Limited; 1998.

[26] Bennett I., Oriental Rugs, Volume I, Caucasian, pg 166. Woodbridge, Suffolk: Antique Collectors' Club Ltd; 1993.

[27] Bennett I., Oriental Rugs, Volume I, Caucasian, pg 308. Woodbridge, Suffolk: Antique Collectors' Club Ltd; 1993.