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1997

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The communities of cl. *Quercus-Fagetum* BR.-BL. & VLIEGER in VLIEGER 1937 of the Lower Volga Valley

With one Map and 5 Tables

Summary

The present paper is a continuation of a set of investigations aimed at description of the Lower Volga valley vegetation (GOLUB & MIRKIN 1986; GOLUB & ČORBADZE 1989; GOLUB et al. 1991; GOLUB 1994; GOLUB & TCHORBADZE 1995; GOLUB & KUZMINA 1996). The communities preliminary related to the cl. *Quercus-Fagetum* BR.-BL. & VLIEGER in VLIEGER 1937 are considered in the article. In the Lower Volga Valley they occur in natural state only in the Volga-Akhtuba floodplain and are absent in the Volga delta. The new alliance – Poo-Ulmion – and the two new associations – Poo angustifolia-*Quercetum roburi* and Poo angustifoliae-Ulmetum – as well as the one unranked community (*Prunus spinosa*) is distinguished.

Zusammenfassung

Die Arbeit bildet die Fortsetzung einer Serie von Untersuchungen, die der Beschreibung der Vegetation im Tal der Unteren Wolga gewidmet sind (GOLUB & MIRKIN 1986; GOLUB & ČORBADZE 1989; GOLUB et al. 1991; GOLUB 1994; GOLUB & TCHORBADZE 1995; GOLUB & KUZMINA 1996). Der Beitrag beschäftigt sich mit den Pflanzengesellschaften, die vorläufig der Klasse *Quercus-Fagetum* BR.-BL. & VLIEGER in VLIEGER 1937 zugeordnet werden. Die Gesellschaften kommen im natürlichen Zustand nur im Tiefland der Unteren Wolga in der Wolga-Achtuba-Aue vor. Im Wolga-Delta selbst treten sie nicht auf. Ein neuer Verband (Poo-Ulmion), zwei neue Assoziationen (Poo angustifoliae-*Quercetum roburi* und Poo angustifoliae-Ulmetum) sowie eine ranglose Gesellschaft werden aufgestellt (*Prunus spinosa* Ges.).

Introduction

The present paper is a continuation of the Lower Volga valley vegetation description based on the principles of Braun-Blanquet approach. Earlier the Lower Volga valley was given a characteristic of desert, meadow, halophytic, aquatic and hydrophytic vegetation (GOLUB & MIRKIN 1986; GOLUB & ČORBADZE 1989; GOLUB et al. 1991; GOLUB 1994; GOLUB & TCHORBADZE 1995; GOLUB & KUZMINA 1996). The present paper is the first attempt to classify forest communities on the Lower Volga valley territory.

General description of the investigation area, its climate and working procedure was conducted in the six above mentioned papers. Thus in order to save place we are not discussing in detail these items in the present paper. We shall pay the attention only to those meteorological and hydrologi-

cal factors which were changing during the last decades and thus affected the state of forests in the Lower Volga valley.

From the sixties the Lower Volga valley moistening level was noticed to go up as a result of sedimentation increase and from the eighties the above level was additionally enhanced as a result of ambient temperature lowering in warm periods of the year (Table 1).

Much more, a hydrological state of the Volga river changed even to a bigger extent than meteorological factors. By 1958 the construction of a water reservoir cascade on the Volga river and its major tributaries was mainly completed. Actual operation of these reservoirs caused a redistribution of the water discharge and its levelling during the year. For instance, before the construction of water reservoirs more than 60% of water discharge occurred in the period of spring-

Table 1

Climatic indices (data of hydrometeorological station at Volgograd)

Meteorological data of 1941-1943 years are absent

Years	Average precipitation amount for the period with temperatures >10 °C, mm	Average accumulated temperatures for the period with temperatures >10 °C	Selyaninov's hydrothermal factor	Average annual precipitation amount, mm	Long-time average temperature, t °C
1940-1949	154	3104	0.50	340	7.7
1950-1959	122	3419	0.36	294	7.7
1960-1969	146	3223	0.45	375	8.0
1970-1979	196	3415	0.57	408	8.1
1980-1989	205	3286	0.62	412	8.1

Table 2

Hydrological indices of the spring-summer flooding by Volgograd depth gauge

Height above low water level, m	Probability of flooding, %			Mean duration of flooding of marks, days		
	1916-1958	1959-1977	1978-1990	1916-1958	1959-1977	1978-1990
7.8	2	0	0	16	0	0
7.3	24	0	8	17	0	19
6.8	44	5	8	24	15	20
6.3	61	26	23	30	16	21
5.8	73	95	100	34	18	22
5.3	83	100	100	38	19	23
4.8	95	100	100	41	23	24
4.3	100	100	100	47	27	28
2.8	100	100	100	53	31	33
2.3	100	100	100	58	34	38
1.8	100	100	100	68	41	45

summer flooding. At present this value has lowered to 40-45%. In flood-time the levels of water rise have become lower. On the contrary the levels of water are recorded to go up: by 500-700 mm in summer and by 1000 mm in winter. It is known that ground water level in the Volga-Akhtuba flood-plain and the Volga delta repeats fluctuations of water level in the streams in a smooth and delayed manner (TUMAS 1885; KUZIN 1938; GOLUB et al. 1988). Therefore we can assume that during spring-summer floods the water levels have become lower and during another time they have become higher.

In Volgograd-city area forests of class *Quercus-Fagetum* are marked at the level of 8-9 m

above low water stage¹. Before the Volga water discharge became regulated ecotopes with forests of cl. *Quercus-Fagetum* moistened during spring-summer floods because of highly rising ground waters. After the water discharge regulation, which completion is usually dated by 1958, lowering of the level of water rise during flood-time (and, correspondingly of ground waters) have resulted deterioration of moistening of the ecotopes occupied by the forests (Table 2).

In recent years a distinct growth of the water discharge was reported. For example, within the period from 1970 to 1979 a mean water discharge at the Volgograd hydroelectric station was 228 cubic km annually, during flood-time it amounted to 95 cubic km. Within the period from 1980 to 1990 these values were 254 and 299 cubic km correspondingly. Increased water discharge of

¹ The Volga level with water discharge in the section of the Volgograd hydro-electric power station of 4000 cubic m/sec is adopted as a low water level.

the Volga river resulted in rising of Caspian Sea water level by more than 2 meters.

Syntaxonomy

The list of forest communities of cl. Quercu-Fagetea established in Lower Volga valley is as follow:

Quercu-Fagetea BR.-BL. et VLEIGER in VLEIGER 1937

Ord.?

Poo-Ulmion GOLUB all. nova

Poo angustifoliae-Quercetum roburi ass. nova

Poo angustifoliae-Quercetum roburi var. *Acer tataricum*

Poo angustifoliae-Quercetum roburi var. *Galium verum*

Poo angustifoliae-Ulmetum ass. nova

Poo angustifoliae-Ulmetum typicum subass. nova

Poo angustifoliae-Ulmetum nigrae subass. nova

All.?

Community *Prunus spinosa*

Description of the communities

To characterize communities of class Quercu-Fagetea we have made 56 relevés (42 – Poo angustifoliae-Quercetum roburi, 10 – Poo angustifoliae-Ulmetum, 4 communities with *Prunus spinosa*).

Class Quercu-Fagetea BR.-BL. & VLEIGER in VLEIGER 1937

Diagnostic species (d.s. = character and differential species): *Quercus robur*², *Convallaria majalis*, *Malus sylvestris*, *Geum urbanum*.

Class Quercu-Fagetea includes communities of mesophytic and xeromesophytic deciduous forests.

In terms of diagnostic species of the class, we have adopted such species indicated at one and the same time in not less than two papers

² Latin names of vascular plant species are given according to S. K. CHEREPANOV (1981).

describing communities of class Quercu-Fagetea (JURCO 1958; SIMON 1960; KRAUSCH 1965; SOÓ 1968; GUINOCHE 1970; ELLENBERG 1978; SCHUBERT et al. 1979; MATUSZKIEWICZ 1981; MORAVEC et al. 1983; PIOTROWSKA 1983; RAUN 1985; KOROTKOV & MOROZOVA 1986, 1988; POP et al. 1988; KOTOWSKA & NOWAKOWSKI 1989).

As it is seen the above species remain in a very small number. Out of traditional diagnostic species of class Quercu-Fagetea only one species, i.e. *Quercus robur*, is well represented. Others occur with a constancy not exceeding the first point of the scale BRAUN-BLANQUET. Thus the inclusion of the above communities into class Quercu-Fagetea shall be considered as preliminary.

We have obtained from determination of an order. However, our communities seem to be very close to order Fagetalia sylvaticae PAWLOWSKI 1928.

All. Poo-Ulmion all. nova

D.s.: *Ulmus laevis*, *Poa angustifolia*, *Carex melanostachya*, *C. praecox*, *Rubus caesius*, *Cannabis ruderalis*, *Medicago caerulea*, *Lactuca serriola*, *Lactuca tatarica*, *Convolvulus arvensis*, *Eryngium planum*, *Glycyrrhiza glabra*, *Xanthoria parietina*, *Physcia stellaris*.

Forests of alliance Poo-Ulmion are drawn towards heightened areas of the Volga-Akhtuba flood-plain though not the highest. More often these are channel-adjacent and well-drained ridges of dead streams. Soils are loamy with superficial, light and laminated alluvial sediments.

Communities of all. Poo-Ulmion in the extremely northern part of the Lower Volga valley are located throughout its width. From Srednyaya Akhtuba to Leninsk they grow only in the channel-adjacent areas of rivers Volga and Akhtuba and below – only in the channel-adjacent areas of river Volga. In the central part of islands they do not advance because of a heavy mechanical content of soils and soil salination. Forests of this alliance are not found in areas below the village Kosika Enotaevskiy district Astrakhan region.

The nomenclatural type of the all. Poo-Ulmion is ass. Poo angustifoliae-Quercetum roburi.

Ass. *Poo angustifoliae-Quercetum roburi* ass. nova

D.s.; *Quercus robur* (dominant), *Taraxacum officinale*, *Euphorbia palustris*, *Artemisia pontica*, *Carex riparia*, *Calamagrostis epigeios*, *Aristolochia clematitidis*, *Lathyrus incurvus*, *Elytrigia repens*, *Agrimonia eupatoria* (Table 3).

The floristic composition of the communities of the ass. *Poo angustifoliae-Quercetum roburi* is

uniform throughout their range of spreading. A small difference in the floristic composition of oak forest communities in the northern and southern parts of their area in the Volga-Akhtuba flood-plain enabled us to determine only two geographical variants: *Acer tataricum* and *Galium verum*. The first one is characteristic for the northern part of Volga-Akhtuba flood-plain oak forests while the second – for the southern part.

Table 3
Ass. *Poo angustifoliae-Quercetum roburi*

Column	1	2	3	4	5	6	7	8	9	10	11	12	
Shrub layer (B): number of species	5	5	3	2	4	3	1	1	4	5	4	2	
Area analyzed, m ²	300	400	250	900	1000	600	900	800	800	1000	1200	620	
Arboreous layer (A): crown density	0.5	0.6	0.7	0.5	0.4	0.4	0.6	0.4	0.5	0.5	0.5	0.4	
height, m	15	15	13	10	15	15	18	15	15	15	15	15	
number of species	3	2	4	1	1	2	1	2	1	2	2	1	
Small shrub layer (C): number of species		2		2	1								
Epiphytes (E): number of species	4	1	4	4	3	3	3	4	4	6	7	5	
Herbaceous layer: total cover, %	15	25	5	15	10	25	10	10	40	10	15	30	
number of species	30	28	20	31	32	32	32	38	26	36	37	39	
Total number of species	42	30	31	40	51	38	40	43	35	48	48	47	
	var. <i>Acer tataricum</i>						var. <i>Galium verum</i>						
D. s. of cl. <i>Quercus-Fagetea</i>													
A <i>Quercus robur</i> L. (d.s of ass.)	4	4	4	4	4	3	4	4	4	4	3	4	V
<i>Convallaria majalis</i> L.	+	-	1	-	-	-	-	-	-	-	-	-	I
A <i>Malus sylvestris</i> MILL.	-	-	1	-	-	-	-	-	-	+	-	-	I
<i>Geum urbanum</i> L.	-	-	+	-	-	-	-	-	-	-	-	-	I
D. s. of all <i>Poa-Ulmion</i> and ass. <i>Poo angustifoliae-Quercetum roburi</i>													
E <i>Xanthoria parietina</i> BELT.	+	+	+	+	+	+	+	+	+	+	+	+	V
E <i>Physcia stellaris</i> (L.) NYL.	+	-	+	+	+	+	+	+	+	+	+	+	V
B <i>Ulmus laevis</i> PALL.	+	2	2	1	1	+	2	+	1	1	+	+	V
<i>Poa angustifolia</i> L.	1	+	+	2	+	1	+	+	1	1	+	1	V
<i>Carex melanostachya</i> BIEB. ex WILLD.	1	+	1	1	1	2	1	+	+	1	1	1	V
<i>Calamagrostis epigeios</i> (L.) ROTH	1	+	-	1	+	+	1	+	1	1	1	1	V
<i>Aristolochia clematitidis</i> L.	1	1	-	+	1	+	1	1	1	1	+	+	V

Table 3 (continued)

Column	1	2	3	4	5	6	7	8	9	10	11	12	
<i>Lathyrus incurvus</i> (ROTH)	+	+	+	+	-	-	+	+	1	1	1	2	V
ROTH													
<i>Elytrigia repens</i> (L.) NEVSKI	1	+	-	-	+	+	+	+	+	1	+	1	V
<i>Agrimonia eupatoria</i> L.	1	+	+	-	+	+	-	+	+	+	+	+	V
<i>Lactuca tatarica</i> (L.) C. A. MEY.	+	-	-	+	+	+	1	+	+	+	+	1	V
<i>Rubus caesius</i> L.	-	+	-	+	+	+	1	-	+	1	-	1	IV
<i>Carex praecox</i> SCHREB.	1	+	+	-	1	-	+	1	+	-	1	+	IV
<i>Carex riparia</i> CURT.	+	+	+	+	+	-	+	+	-	+	-	-	IV
<i>Convolvulus arvensis</i> L.	+	+	-	+	+	1	+	+	+	-	-	1	IV
<i>Artemisia pontica</i> L.	+	-	-	+	+	1	+	-	+	+	+	1	IV
<i>Euphorbia palustris</i> L.	-	+	-	+	+	+	+	-	+	+	-	1	IV
<i>Cannabis ruderalis</i> JANISCH.	+	+	+	+	-	+	1	+	-	+	+	-	IV
<i>Medicago caerulea</i> LESS. ex LEDEB.	+	-	+	-	-	+	+	+	+	+	1	+	IV
<i>Lactuca serriola</i> L.	+	+	-	+	+	+	+	-	+	+	+	+	IV
<i>Taraxacum officinale</i> WIGG.	+	-	-	+	+	+	-	+	+	+	+	+	IV
A <i>Ulmus laevis</i> PALL.	-	-	-	-	-	1	-	+	-	-	-	-	I
D. s. of var. <i>Acer tataricum</i>													
<i>Glechoma hederacea</i> L.	-	+	+	+	+	+	-	-	-	-	-	+	III
B <i>Acer tataricum</i> L.	+	2	+	-	+	-	-	-	-	-	-	-	II
<i>Cynoglossum officinale</i> L.	+	+	-	-	+	+	-	-	-	-	-	-	II
<i>Poa palustris</i> L.	1	-	-	+	+	+	-	-	-	-	-	-	II
<i>Vicia cracca</i> L.	-	-	+	+	+	+	-	-	-	-	-	-	II
D. s. of var. <i>Galium verum</i>													
<i>Galium verum</i> L.	+	-	-	-	-	+	+	+	+	+	+	1	IV
<i>Glycyrrhiza glabra</i> L.	-	-	-	-	+	-	+	-	2	+	+	+	III
<i>Atriplex aucheri</i> MOQ.	-	-	-	-	-	-	+	-	-	+	+	+	II
Other species													
Aggr. <i>Cirsium setosum</i> (WILLD.) BESS. +													
<i>C. incanum</i> (S. G. GMEL.) FISCH.	+	+	-	+	+	1	+	+	-	-	-	+	IV
<i>Eryngium planum</i> L.	+	-	-	+	-	-	+	+	+	-	+	+	III
<i>Sonchus arvensis</i> L.	+	-	-	+	-	-	+	+	+	-	+	+	III
<i>Artemisia austriaca</i> JACQ.	-	-	-	+	-	+	-	+	-	1	+	+	III
E <i>Pseudoleskiella nervosa</i> NYH.	+	-	+	-	-	+	-	-	+	+	+	+	III
<i>Leonurus glaucescens</i> BUNGE	-	+	+	-	-	+	-	-	-	1	+	+	III
<i>Euphorbia uralensis</i> FISCH. ex LINK	-	-	-	-	+	+	+	-	+	+	-	+	III
<i>Arctium lappa</i> L.	+	+	-	+	-	+	+	+	-	-	+	-	III
Aggr. <i>Linaria ruthenica</i> BLONSKI + <i>L. vulgaris</i> MILL.	+	+	-	+	-	-	-	+	-	-	+	+	III
B <i>Rhamnus cathartica</i> L.	+	-	1	-	-	+	-	-	+	1	+	-	III
E <i>Parmelia sulcata</i> TAYL.	+	-	-	+	-	+	-	-	+	+	+	+	III
B <i>Prunus spinosa</i> L.	+	-	-	-	+	+	-	-	-	2	+	+	III
<i>Erysimum cheiranthoides</i> L.	-	-	-	+	-	-	+	+	-	-	-	+	II
E <i>Evernia prunastri</i> (L.) ACH.	-	-	-	+	-	-	-	+	-	+	+	+	II
<i>Rubia tatarica</i> (TREV.) FR. SCHMIDT	-	-	-	-	-	-	+	+	-	-	-	+	II

Table 3 (continued)

Column	1	2	3	4	5	6	7	8	9	10	11	12	
B	<i>Crataegus ambigua</i> C. A. MEY. ex A. BECK.	-	+	-	-	+	-	-	+	2	+	-	II
	<i>Cichorium intybus</i> L.	-	-	-	-	-	-	-	-	+	+	+	II
	<i>Asparagus officinalis</i> L.	-	-	-	+	-	+	-	-	-	+	+	II
	<i>Artemisia absinthium</i> L.	+	+	-	-	-	-	-	-	-	+	+	II
	<i>Polygonum neglectum</i> BESS.	-	-	+	-	-	-	+	-	+	+	-	II
	<i>Hierochloe repens</i> (HOST) BEAUV.	-	-	-	+	+	-	-	+	-	-	-	II
	<i>Inula britannica</i> L.	-	-	-	-	-	-	+	-	+	+	-	II
	<i>Chaiturus marrubiastrum</i> (L.) REICHENB.	-	-	-	+	-	+	+	-	-	-	-	II
	<i>Melandrium album</i> (MILL.) GARCKE	-	-	-	-	+	+	+	-	+	+	-	II
	<i>Acroptilon repens</i> (L.) DC.	-	-	-	+	-	-	-	+	-	+	-	II
E	<i>Orthorichum pumilum</i> DICKS.	-	-	-	-	+	-	+	-	+	+	-	II
	<i>Vincetoxicum scandens</i> SOMM. & LEVIER	-	+	+	-	+	+	-	-	-	+	-	II
	<i>Torilis japonica</i> (HOUTT.) DC.	-	+	+	-	-	+	-	-	+	-	-	II
	<i>Chenopodium album</i> L.	-	-	-	-	+	-	+	-	-	-	+	II
	<i>Fallopia convolvulus</i> (L.) A. LOVE	+	+	-	-	+	-	-	-	-	+	-	II
	<i>Atriplex patula</i> L.	-	-	-	-	+	-	-	-	+	+	+	II

Besides, the following species with the constancy of 20% and less are noted: *Alliaria petiolata* (BIEB.) CAVARA & GRANDE 1: +, 10: +; *Allium angulosum* L. 9: +; E - *Amorpha fruticosa* L. 9: 1; *Artemisia absinthium* L. 3: +; *A. procera* WILLD. 7: +; *Galium humifusum* BIEB. 10: +; *Atriplex tatarica* L. 8: +; *Bromopsis inermis* (LEYS.) HOLUB 4: +, 9: +; *Camelina microcarpa* ANDRZ. 10: +; *Chelidonium majus* L. 1: +, 2: 1, 5: +; *Chenopodium hybridum* L. 5: +, 7: +; *Cirsium serrulatum* (BIEB.) FISCH. 1: +, 2: +; *Consolida regalis* S. F. GRAY 10: +; *Cuscuta monogyna* VAHL 10: +; *Festuca valesiaca* GAUDIN 2: +; A - *Fraxinus pennsylvanica* MARSH. 2: 1; B - *F. pennsylvanica* MARSH. 2: +, 4: +; C - *F. pennsylvanica* MARSH. 2: +, 4: +, 5: +; *Galium rubioides* L. 9: +; *Humulus lupulus* L. 3: +; E - *Hypnum cupressiforme* HEDW. 8: +, 12: +; *Kochia laniflora* (S. G. Gmel.) BORB. 11: +; *Lithospermum officinale* L. 10: +; B - *Lonicera tatarica* L. 2: +; *Melilotus albus* MEDIK. 10: +; *Melandrium astrachanicum* PACZ. 3: +; A - *Morus alba* L. 3: +; A - *M. nigra* L. 3: 2; E - *Physcia dubia* (HOFFM.) LETT. 3: +, 11: +; *Picris regida* LEDEB. ex SPRENG. 8: +; *Phragmites australis* (CAV.) TRIN. ex STEUD. 7: +; *Polygonum pulchellum* LOISEL. 12: +; *Potentilla argentea* L. 8: +, 11: +; *P. bifurca* L. 8: +, 11: +; *P. reptans* L. 8: +; A - *Pyrus pyraster* BURGD. 1: +, 11: +; C - *P. pyraster* BURGD. 4: +; C - *Quercus robur* L. 2: +; B - *Rosa donetzica* DUBOVIK 10: 1; B - *R. majalis* HERRM. 1: +; *Rumex confertus* WILLD. 12: +; *Scutellaria dubia* TALIEV et SIRJ. 3: +; *Senecio jacobaea* L. 8: +; *Solanum dulcamara* L. 2: +, 7: +; *Stellaria graminea* L. 9: +; *Tragopogon dubius* SCOP. 12: +; *T. podolicus* (DC.) ARTEMOZ. 5: +, 6: +, 9: +; *Tulipa biebersteiniana* SCHULT. et SCHULT. f. 2: +, 12: +; A - *Ulmus carpiniifolia* RUPP ex SUCKOW 1: +; *Verbascum blattaria* L. 5: +, 11: +; *Verbascum thapsus* L. 5: +; *Veronica longifolia* L. 4: +, 8: +; *Viola accrescens* KLOK. 4: +.

Localization of the relevés: 1.-9. 07. 1986: Volgograd region, Svetloyarskiy district, 1.5 km S of pier 'Tuma'; 2.-09. 07. 1986: Volgograd region, Svetloyarskiy district, 2.0 km N of v. Krivusha; 3.-02. 07. 1986: Volgograd region, Sredneakhtubinskiy district, 2.0 km E of v. Kolkhoznaya Akhtuba; 4.-14. 07. 1986: Volgograd region, Sredneakhtubinskiy district, 2.0 km E of v. Bulgakov; 5.-14. 07. 1986: Volgograd region, Leninskiy district, 1.5 km NE of v. Leshchev; 6.-15. 07. 1986: Volgograd region, Svetloyarskiy district, 2.0 km N of v. Gromki; 7.-23. 07. 1986: Astrakhan' region, Akhtubinskiy district, 1.0 km SW of v. Spornyy; 8.-23. 07. 1986: Astrakhan' region, Akhtubinskiy district, 1.0 km N of v. Sadovoe (v. Grachi), 1.0 km SE of v. Bakhmutov; 9.-23. 07. 1986: Astrakhan' region, Chornoyarskiy district, 6.0 km NW of v. Stupino; 10.-23. 07. 1986: Astrakhan' region, Chornoyarskiy district, 3.0 km NW of v. Kal'novka; 11.-26. 07. 1986: Astrakhan' region, Akhtubinskiy district, 3.0 km NW of v. Korochiy; 12.-26. 07. 1986: Astrakhan' region, Akhtubinskiy district, 3.7 km NW of v. Korochiy

D.s. of the communities of the variant *Acer tataricum* are *Acer tataricum*, *Cynoglossum officinale*, *Glechoma hederacea*, *Poa palustris*, *Vicia cracca*, of the variant *Galium verum* are *Galium verum*, *Glycyrrhiza glabra*, *Altriplex aucherii*.

The nomenclatural type of the association is relevé No 1 in Table 3.

The Volga-Akhtuba flood-plain oak forests are a multiple shrubwood generation (AGARKOV 1960). Average age of the trunks is 60–70 years. Occasionally one can find trees aged 90 years. They are thinned out and an average crow density is 0.5 to 0.6, i.e. the forest has a park-type character. Average height of trunks is 15 meters, their thickness at the breast level is 0.2–0.3 meter. Every 100 sq. meters usually contains from 5 to 7 oak trunks. At the age of 60–70 years a reserve of wood is 210–260 cubic m per hectare. Among trees – *Quercus robur*, also *Ulmus laevis*, *Malus sylvestris* can be found. In an undergrowth – *Ulmus laevis*, *Fraxinus pennsylvanica*. A shrub layer is represented by *Rhamnus cathartica*, *Acer tataricum*, *Amorpha fruticosa*, *Crataegus ambigua*, *Prunus spinosa*, *Rosa donetzica*, *R. majalis*.

From the Volgograd hydroelectric station dam, approximately to line “village Raygorod – Srednyaya Akhtuba city”, the oak forests are found throughout the Lower Volga valley, being drawn towards higher sites. Below, up to line “village Ushakovka – Leninsk city”, the forests grow only in channel-adjacent areas of Volga and Akhtuba rivers. Further below the oak forests are found only in the channel-adjacent area of the Volga river, on ridges. Usually oak forest tracts, located on ridges, have the appearance of narrow strips 10 to 20 m wide. As a rule, the more to the South the less numerous are forest tracts.

Oak forest soils are characterized by having dark-grey horizon A up to 20 cm thick with a well marked grain size and brown-grey horizon B up to 50 cm thick with a lump-nut structure. Horizon B turns into laminated alluvium with light mechanical content. Humus content in horizon A is 3–7%, in horizon B – 2–3%. An absorbing complex of soil is saturated with calcium and magnesium. In terms of mechanical texture the soil is loamy and clay. Ecotypes with ass. Ground waters in low stage are located at the depth of 3–4.5 meters.

According to investigations carried out in the fifties, sub-oak forest soils were characterized as

unsaline or only sometimes lightly saline to contain not more than 0.5% of water soluble salts (MYALO & RODMAN, 1962). In 1970–1980 the researchers of the All-Russian Research Institute of Agronomy-Forest Melioration (VNIIALMI), namely SHULGA & KULESHOV (1983), SHULGA et al. (1986) found some individual sites of Volga-Akhtuba flood-plain oak forests to have a higher content of salts in the soil: up to 2% and more.

As the VNIIALMI scientists believe, accumulation of salts in oak forest soils takes place mainly at the expense of a high intensity of transpiration by forest vegetation but not at the expense of direct moisture evaporation from the soil surface. Before the river regulation the salts accumulated in soil during a vegetation period were carried by a high level of waters and sometimes also by surface waters of floodings. Under the present conditions when floodings are short-term with a low level of water rise, capillary fringe of ground water level often does not reach the horizon of salt accumulation. The salt accumulation processes in soils under oak forests are considerably marked on diked territories, isolated and located far from active streams (AZOVTSSEV 1986).

A small number of soil samples, taken in oak forests of the Volga-Akhtuba flood-plain and analysed by us, did not contain excessive amount of salts.

At present in many parts of the Volga-Akhtuba flood-plain oaks are distinctly marked by their top wither and drying up processes. As it has been already stated, the VNIIALMI scientists connect these drying up processes with changes of the Volga-river hydrological conditions occurred after its regulation. But the similar processes are observed also in flood-plains whose discharge did not significantly change, for example, in the flood-plain of Koper river (OSIPOV 1989). There are also numerous reports about drying up of oak forests on a flat interfluvium, i.e. on sites which are not related to river waters.

The papers describing conditions of oak forests in the Volga-Akhtuba flood-plain in the last century indicate unsatisfactory conditions of oak forests, their depression, absence or very insignificant seed regeneration. This was ascribed to the haymaking use of the flood-plain, unplanned wood cutting and excessive cattle pasturing (ZAUSNITSKIY 1850; PERKIN 1861; AFANASOVICH 1873). As PERKIN (1861) wrote,

young oak trees of seed origin could be found only in thick blackthorn bushes protecting seedlings against cattle grazing or cutting during a haymaking period. KONARDOV (1888) kept an opinion that conditions of forests were better when the anthropogenous impacts were less rigid. These conclusions KONARDOV made on the basis of old residents' stories and his own observations when in Volga-adjacent settlements he saw big old oak trunks which in his time could not be procured in the Volga-Akhtuba flood-plain.

As it has been already stated, under water regulated discharge conditions the ecotopes with communities of class *Querco-Fagetea* practically ceased to be subject to floodings. In the past when such floodings occurred it was noted (SVIRIDOV 1959) that the oaks poorly withstood long-term (for more than one month) and deep floodings (with water rise above soil surface more than one meter). It was observed that young growth suffered from floodings most of all (KONARDOV 1888, 1892; GODNEV 1959; RUBANOV 1959). However, there are certain records indicating that one of the forestries kept cultivating trees in the Volga-Akhtuba flood-plain under long-term floodings (water level above soil surface up to 3.5 m) during 20 years. But yet a life state of those trees was unsatisfactory (TRESHCHEVSKIY & KONDRAT'EV 1958, 1960).

Once in several years the trees of oaks in the Volga-Akhtuba flood-plain bear fruits. Occasionally one can find there one to two year old specimens of seed origin but we did not find any older trees of seed origin.

Oak forests in the Volga-Akhtuba flood-plain have their natural spreading only in its northern part, within a strip about 100 km long (Map). Their southern border on the right bank of the Volga-river is located at a 2 km distance to the north-west from village Stupino (Chernoyarskiy district, Astrakhan region). A border of the oak forest area on the river's left bank is located about 15 km upstream. The last southern oak forest tract is located near village Duyunov (Akhtubinskiy district, Astrakhan region). To the south from village Stupino, in the Volga-Akhtuba flood-plain and delta Volga, there exist only man-made plantations of oak trees which we have not investigated from a syntaxonomic point of view.

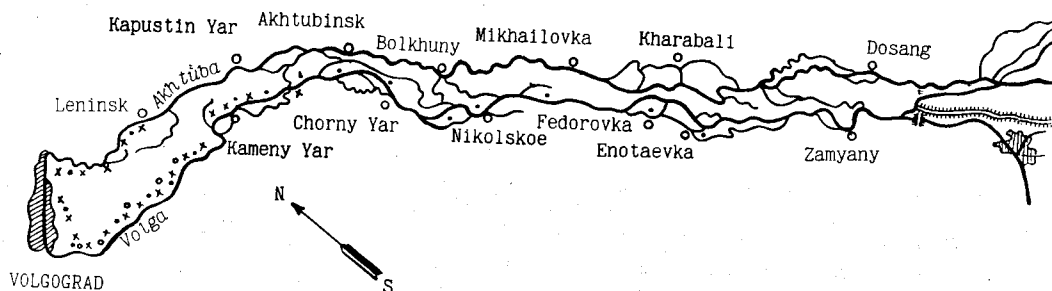
The state of trees in all oak forests along the Volgariver is the same. The life state of oaks at the southern border of natural oak forests, in the area of village Stupino, is not worse than that at the most northern part of the Volga-Akhtuba flood-plain - near Volgograd electric station.

In past in the process of flood-plain landscape development, with heighthening of flood-plain ecotopes above the low water, communities of ass. *Poo angustifoliae-Quercetum roburi* had been substituted communities of association *Poo angustifoliae-Ulmetum* or communities of class *Salicetea purpureae*.

Ass. *Poo angustifoliae-Ulmetum* ass. nova

D.s.: *Ulmus laevis* (dominant).

The association is subdivided into two subassociations: *Poo angustifoliae-Ulmetum typicum* subass. nova and *Poo angustifoliae-Ulmetum po-*



Map
Schematic map of distribution of communities of cl. *Querco-Fagetea* on territory of the Volga-Akhtuba flood-plain

x - *Poo angustifoliae-Quercetum roburi*; ● - *Poo angustifoliae-Ulmetum*; ○ - community *Prunus spinosa*

populetosum nigrae subass. nova. D.s. of the first subassociation = d.s. of the association, d.s. of the second subassociation – *Populus nigra* (Table 4).

The nomenclatural type of the association and subassociation P.a.-U. typicum is relevé No. 2 in Table 4, the nomenclatural type of the subassociation P.a.-U. populetosum nigrae is relevé No. 5 in Table 4.

Crown density in communities of subassociation P.a.-U. typicum amounts to 0.4–0.6; height of *Ulmus laevis* is 10–12 m. A diameter of *Ulmus laevis* trunk at the breast level is 15–20 cm. Among trees, except *Ulmus laevis*, one can find also *Salix alba* and *Elaeagnus angustifolia*, in the undergrowth – *Fraxinus pennsylvanica* and *Morus alba*. A shrub layer is represented by *Amorpha fruticosa*.

Crown density in communities of subassociation P.a.-U. populetosum amounts to 0.6–0.8. Height of *Ulmus laevis* is 10–15 m. A diameter of *Ulmus laevis* trunk at the breast level is 20–25 cm. *Populus nigra* is present and often dominates in the arboreal layer, there also can be found *Quercus robur*, *Malus sylvestris*, *Pyrus pyraeaster*, *Salix alba*; in the undergrowth – *Morus alba*; the shrub layer is formed by *Crataegus ambigua*, *Rhamnus cathartica*, *Prunus spinosa*.

Communities of association Poo angustifoliae-Ulmetum, relative to low water, are found to grow at an average a little lower than communities of association Poo angustifoliae-Quercetum roburi. In the northern part of the Volga-Akhtuba flood-plain where communities of association Poo angustifoliae-Quercetum roburi and communities of association Poo angustifoliae-Ulmetum are found in the past, it is possible, as it has been stated above, that the first ones had been substituted the second in the process of flood-plain landscape development.

In forest tracts where *Ulmus laevis* is dominant the latter has mainly a shrubwood origin while among young trees one can find specimens of a seed origin.

In the Lower Volga valley communities of association Poo angustifoliae-Ulmetum occupy many times a lesser territory than communities of association Poo angustifoliae-Quercetum. In the Volgograd region (the northern part of the Volga-Akhtuba flood-plain) their small tracts are found throughout the whole flood-plain, while downstream, namely in the Astrakhan region,

they are found only in the Volga-adjacent sites. The extreme southern site with this community of ass. Poo angustifoliae-Ulmetum was described by us near village Kosika (Enotaevskiy district, Astrakhan region), i.e. along the Volga-river elm forests, in comparison with oak forests, are spreading more southward.

It should be noted that according to obsolete information of forestry specialists and botanists the elm-tree in the Lower Volga valley was never found lower village Enotaevka (PERKIN 1861; LAKIN 1914; KHLEBNIKOV 1925; RURSAEV 1934). Nevertheless, we have found individual specimens of *Ulmus laevis* at the age of several tens of years on sites along the principal Volga channel up to the delta and also in upper part of the delta. The Astrakhan national park researchers have as well recorded individual specimens of *Ulmus laevis* in the seaside part of the delta (DOBROKHOVA & MIKHAILOVA 1938; ZHIVOGLYAD 1970). Unfortunately, their papers do not indicate age and life state of these elm-trees. It is quite possible that due to climatic and hydrologic changes the elm forests are moving along the Volga river down to the south.

The communities of the subassociation Poo angustifoliae-Ulmetum typicum have been described by us in the southern part of the Volga-Akhtuba flood-plain, the subassociation Poo angustifoliae-Ulmetum populetosum nigrae – in the northern part.

Community *Prunus spinosa*

Among shrub communities of the flood-plain we should note rather rare communities in which *Prunus spinosa* is dominating (Table 5). Usually these communities are found near or inside a tract with oak forest and they occupy, relative to low stage, higher sites. They look like rounded cap-type groups from 8 to 10 m in diameter. We have included them into class Quercu-Fagetea without determining their order and alliance. The height of *Prunus spinosa* is 2 to 6 m. The trees are represented by *Ulmus laevis*. These communities have been described by us in the northern part of the Volga-Akhtuba flood-plain.

In addition to the considered above communities in the northern part of Volga-Akhtuba flood-plain exists a small area of forest with *Populus tremula* as dominant. Floristical compo-

Table 4
Ass. Poo angustifoliae-Ulmetum

Column	1	2	3	4	5	6	
Area analyzed, m ²	200	500	250	500	1000	600	
Shrub layer (B): Number of species	1	-	2	-	3	-	
Arboreous layer (A): crown density	0.4	0.6	0.6	0.7	0.6	0.8	
height, m	15	15	10	10	8	12	
number of species	1	3	4	2	4	3	C
Small shrub layer (C): number of species	1	2	-	-	1	1	
Epiphytes (E) number of species	1	-	2	3	2	1	
Herbaceous layer: total cover, %	90	20	70	20	40	10	
number of species	46	12	33	12	24	5	
Total number of species	50	17	41	17	34	10	
			subass. Pa.- U. typicum		subass. Pa.-U. populetosum nigrae		
D.s. of cl. Quercu-Fagetea							
A <i>Quercus robur</i> L.	-	-	1	-	-	-	I
A <i>Malus sylvestris</i> MILL.	-	-	1	-	-	-	I
D.s. of all. Poo-Ulmion							
E <i>Xanthoria parietina</i> BELT.	+	-	+	+	+	+	V
<i>Carex praecox</i> SCHREB.	1	+	+	+	-	+	V
<i>Poa angustifolia</i> L.	+	-	2	+	1	-	IV
<i>Cannabis ruderalis</i> JANISCH.	+	-	+	+	+	-	IV
<i>Medicago caerulea</i> LESS. ex LEDEB.	+	-	2	+	+	-	IV
<i>Rubus caesius</i> L.	-	-	1	1	1	+	IV
<i>Glycyrrhiza glabra</i> L.	2	+	-	+	-	-	III
<i>Lactuca serriola</i> L.	+	-	+	-	+	-	III
<i>Carex melanostachia</i> BIEB. ex WILLD.	1	-	+	-	-	+	III
<i>Lactuca tatarica</i> (L.) C. A. MEY.	+	-	+	-	+	-	III
<i>Eryngium planum</i> L.	+	-	+	-	+	-	III
<i>Convolvulus arvensis</i> L.	+	+	-	+	-	-	III
E <i>Physcia stellaris</i> (L.) NYL.	-	-	+	+	+	-	III
D.s. of all. Poo-Ulmion, ass. Poo angustifoliae-Ulmetum and subass. Pa.-U. typicum							
A <i>Ulmus laevis</i> PALL.	4	4	3	4	3	4	V
D. s. subass. of Pa.-U. popule- tosum nigrae							
A <i>Populus nigra</i> L.	-	-	+	3	3	4	IV

Table 4 (continued)

Column	1	2	3	4	5	6		
Other species								
	<i>Asparagus officinalis</i> L.	+	+	-	+	-	-	III
A	<i>Salix alba</i> L.	-	1	-	-	1	2	III
C	<i>Morus alba</i> L.	-	1	-	-	+	1	III
	<i>Elytrigia repens</i> (L.) NEVSKI	+	-	+	-	-	-	II
	<i>Aristolochia clematitis</i> L.	-	-	1	2	-	-	II
	<i>Agrimonia eupatoria</i> L.	-	-	1	-	+	-	II
	<i>Calamagrostis epigeios</i> (L.)	-	-	+	+	-	-	II
ROTH								
	<i>Lathyrus incurvus</i> (ROTH) ROTH	-	-	+	-	+	-	II
	<i>Artemisia austriaca</i> JACQ.	+	-	+	-	-	-	II
	<i>Sonchus arvensis</i> L.	+	+	-	-	-	-	II
	<i>Solanum dulcamara</i> L.	+	+	-	-	-	-	II
	<i>Polygonum neglectum</i> BESS.	+	-	-	-	+	-	II
	<i>Linaria vulgaris</i> MILL.	+	-	+	-	-	-	II
	<i>Galium rubioides</i> L.	+	1	-	-	-	-	II
C	<i>Fraxinus pennsylvanica</i> MARSH.	+	2	-	-	-	-	II
	<i>Chenopodium album</i> L.	+	-	-	-	+	-	II
	<i>Chaiturus marrubiastrum</i> (L.)	1	-	-	-	-	+	II
REICHENB.								
	<i>Bidens frondosa</i> L.	1	+	-	-	-	-	II
	<i>Althaea officinalis</i> L.	1	+	-	-	-	-	II
	<i>Glechoma hederacea</i> L.	-	-	+	-	-	+	II
	<i>Altriplex aucheri</i> MOQ.	-	-	+	-	+	-	II
	<i>Artemisia vulgaris</i> L.	-	-	1	-	+	-	II
	<i>Arctium lappa</i> L.	-	-	+	-	+	-	II
B	<i>Prunus spinosa</i> L.	-	-	2	-	1	-	II
	<i>Lamium amplexicaule</i> L.	-	-	+	+	-	-	II
	<i>Fallopia convolvulus</i> (L.) A.	-	-	+	-	+	-	II
LOVE								

Besides, the following species with the constancy of 20% and less are noted: B - *Amorpha fruticosa* L. 1: 1; *Artemisia pontica* L. 3: +; *A. procera* WILLD. 1: +; *Bromopsis inermis* (LEYS.) HOLUB 1: +; *Calystegia sepium* (L.) R. BR. 2: +; *Carduus acanthoides* L. 1: +; *C. uncinatus* BIEB. 5: +; *Carex riparia* CURT. 3: +; *Ceratocarpus arenarius* L. 3: +; *Chelidonium majus* L. 3: 1; *Cichorium intybus* L. 5: +; *Cirsium setosum* (WILLD.) BESS. 1: +, 3: 1; B - *Crataegus ambigua* C. A. MEY. ex A. BECK. 5: +; *Cucubalus baccifer* L. 3: 1; *Cuscuta europaea* L. 1: +; *Descurainia sophia* (L.) WEBB ex PRANTL 1: +; *Echinops sphaerocephalus* L. 5: +; A - *Elaeagnus angustifolia* L. 2: +; *Erigeron canadensis* L. 1: 1; *Euphorbia palustris* L. 2: +; *Galium humifusum* BIEB. 5: +; *G. verum* L. 1: +; *Heracleum sibiricum* L. 4: +; *Herniaria glabra* L. 1: +; *Hierochloa stepposum* P. SMIRN. 1: 1; *Inula britannica* L. 1: 1; *Lythrum virgatum* L. 1: +; *Melandrium album* (MILL.) GARCKE 2: +; *Melilotus albus* MEDIK. 5: +; *M. officinalis* (L.) PALL. 5: +; *Microthlaspi perfoliatum* (L.) F. K. MEY. 1: +; *Nepeta cataria* L. 3: +; *Oberna behen* (L.) IKONN. 2: +; *Onopordum acanthium* L. 5: +; E - *Orthotrichum pumilum* SW. 4: +; *Phalaroides arundinacea* (L.) RAUSCHERT 3: +; *Phragmites australis* (CAV.) TRIN. ex STEUD. 1: +; *Plantago major* L. 1: 1; A - *Pyrus pyraaster* BURGSD. 5: +; B - *Rhamnus cathartica* L. 3: 1; B - *Rosa canina* L. 5: 1; *Rumex stenophyllus* LEDEB. 1: +; *Senecio jacobaea* L. 1: +; *Setaria viridis* (L.) BEAUV. 1: +; *Solanum nigrum* L. 1: +; *Taraxacum officinale* WIGG. 1: +; *Torilis japonica* (HOUTT.) DC. 5: +; *Tragopogon dubius* SCOP. 3: +; *Urtica dioica* L. 3: +; *Veronica longifolia* L. 1: +; *Vicia cracca* L. 1: 1; *Xanthium strumarium* L. 1: +

Localization of the relevés: 1. - 05. 08. 1988: Astrakhan' region, Enotaevskiy district, 1.5 km E of v. Kosika; 2. - 13. 08. 1988: Astrakhan' region, Enotaevskiy district, 1.0 km E of v. Fedorovka; 3. - 16. 07. 1986: Volgograd region, Sredneakhtubinskiy district, 800 m NE of v. 5th forestry farm; 4. - 28. 07. 1986: Astrakhan' region, Akhtubinskiy district, 10 km W of v. Bolkhuny; 5. - 25. 07. 1986: Astrakhan' region, Chernoyarskiy district, 600 m NE of v. Razdol'nyy; 6. - 31. 07. 1986: Astrakhan' region, Enotaevskiy district, the territory of Kopanovskoe forestry

Table 5
The communities with predominate of *Prunus spinosa*

Column	1	2	3	4	5	
Area analyzed, m ²	200	100	100	150	100	
Shrub layer (B): number of species	2	1	1	1	1	
Arboreous layer (A): number of species	3		1	1		
Epiphytes (E): number of species				2		C
Herbaceous layer: total cover, %	11	9	11	5	2	
number of species	45	10	25	10	5	
Total number of species	16	10	13	8	3	
B <i>Prunus spinosa</i> L.	5	5	5	5	5	V
<i>Carex melanostachya</i> BIEB. ex WILLD.	-	+	1	+	-	III
<i>Leonurus glaucescens</i> BUNGE	-	+	+	-	+	III
A <i>Ulmus laevis</i> PALL.	1	-	+	+	-	III
<i>Aristolochia clematitis</i> L.	+	-	+	-	+	III
<i>Cannabis ruderalis</i> JANISCH.	+	+	-	+	-	III
<i>Vincetoxicum scandens</i> SOMM. & LEVIER	-	+	-	+	-	III
<i>Melandrium album</i> (MILL.) GARCKE	-	+	1	-	-	II

Besides, the following species with the constancy of 20% and less are noted: *Arctium lappa* L. 1: 1; *Artemisia vulgaris* L. 1: +; *Atriplex tatarica* L. 3: +; *Carex praecox* SCHREB. 2: +; A - *Cerasus vulgaris* MILL. 1: 1; *Chaiturus marrubiastrum* (L.) REICHENB. 2: +; *Chenopodium album* L. 2: +; *Convolvulus arvensis* L. 1: +; *Cuscuta monogyna* VAHL 4: +; *Cynanchum acutum* L. 1: +; *Elytrigia repens* (L.) NEVSKI 3: +; *Galium apparine* L. 3: 1; *Glechoma hederacea* L. 3: +; *Glycyrrhiza glabra* L. 1: +; *Hierochloë repens* (HOST) BEAUV. 2: +; *Humulus lupulus* L. 1: 1; *Lactuca serriola* L. 3: +; *Lathyrus incurvus* (ROTH) ROTH 3: +; A - *Malus sylvestris* MILL. 11; B - *Physcia stellaris* (L.) NYL. 4: +; *Poa angustifolia* L. 3: 1; *Rhamnus cathartica* L. 1: 1; B - *Ribes aureum* PURSH 1: 1; *Rubus caesius* L. 4: +; *Solanum dulcamara* L. 1: +

Localization of the relevés: 1.-05. 07. 1986: Volgograd region, Svetloyarskiy district, 1.5 km S of pier 'Tumak'; 2.-15. 07. 1986: Volgograd region, Svetloyarskiy district, 2.5 km NE of v. Gromki; 3.-16. 07. 1986: Volgograd region, Leninskiy district, 2.0 km NE of v. Karshevitoe; 4.-16. 07. 1986: Volgograd region, Leninskiy district, 0.7 km E of v. Zubarevka; 5.-23. 07. 1986: Volgograd region, Leninskiy district, 2.5 km NE of v. Karshevitoe

sition of this forest briefly described by NEVIDOMOV (1994) allows us to place the community also in the cl. *Querco-Fagetea*.

Conclusions

This is the first paper to give characteristics to intrazonal forest communities in the desert zone of the former USSR from the point of view of Braun-Blanquet approach. The described com-

munities have been included into class *Querco-Fagetea*. However, as it has been shown, their floristic content is far from that of communities of this class described in more northern and north-western territories. Thus inclusion of the communities described by us into class *Querco-Fagetea* should be regarded as preliminary. A more detailed investigation of the Russian vegetation will allow us in future to clarify the position of the above associations in the system of higher units.

Acknowledgements

The researchers are conducted on means of the Russian Found of Basic Researches (Grant 95-04-11007-a).

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Manuscript received: March, 1st, 1996.