Nomination

THE VOLGA DELTA

(RUSSIAN FEDERATION)

For inscription on the
UNESCO WORLD CULTURAL
AND NATURAL HERITAGE LIST

Prepared by:

Natural Heritage Protection Fund
Astrakhansky State Nature Biosphere Reserve
Geography Institute of the Russian Academy of Sciences
The Lomonosov Moscow State University
Russian Research Institute for Cultural and Natural Heritage

With the support of:

EURONATUR FOUNDATION
The UNDP/GEF project "Conservation of Wetlands Biodiversity in the Lower Volga Region"

2008

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RESUME

State Party	Russian Federation
State, Province or Region	Astrakhan Region, Kamyzyaksky, Ikryaninsky and Volodarsky Districts
Name of the Property	The Volga Delta
Geographical coordinates to the nearest second	The territory of the Astrakhansky State Nature Biosphere Reserve consists of three clusters located in the eastern, central and western parts of the Volga delta. Coordinates of the extreme points of the Reserve: Damchiksky cluster: NW: N 45°51′50″; E 47°48′50″; SW: N 45°30′30″; E 47°50′40″; NE: N 45°53′00″; E 47°53′50″; SE: N 45°28′30″; E 47°55′40″. Trekhizbinsky cluster: NW: N 46°16′20″; E 48°53′10″; SW: N 46°11′15″; E 49°00′20″; NE: N 46°21′50″; E 49°02′50″; SE: N 46°08′30″; E 49°09′45″. Obzhorovsky cluster: NW: N 46°04′25″; E 48°57′40″; SW: N 45°56′50″; E 48°30′10″; NE: N 46°02′45″; E 48°33′40″; SE: N 45°57′20″; E 48°33′40″.
Textual description of the boundary(ies) of the nominated property	DAMCHIKSKY CLUSTER Description of boundary: From the mouth of Biryuchenok branch along its right side upstream the right sides of Novaya Protoka branch, Kulkov and Koklyui rivers till the turning point N9, where the boundary goes along the upland in directions: NE: 82°27′, NE: 72°54′, NE: 76°16′, 079 1081 851 NE: 76°14′, NE: 76°48′, NE: 76°57′, NE: 49°10′, then the boundary 1055 1003 1019 104 turns to the south and goes downstream along the left side of the Bystraya branch till the point N20, then along the upland in directions: SE: 9°44′, SW: 2°47′, SE: 9°52′, SW: 1°06′, 487 905 951 893 SE: 3°10′, SE: 7°10′, SE: 7°56′, SE: 2°29′, SE: 7°34′, 677 906 1576 482 1310

Textual description of the boundary(ies) of the nominated property

SE: 55°51′, SE: 64°01′, SE: 41°71′, SE: 49°54′, then along the
645 858 723 208
waters in directions: SE: 1°06′, SW: 0°02′,
889 350
then along the lower current of the Pravaya Gornaya branch and Babushkinsky fish bypass channel for 450 km, then in direction SW: 30° till the northwestern point of the Bolshoi Ziudev island
6000
and along the western coast in directions SE:15°, S: 0°, SE: 35°,
3500 10000 6000
then turns to the west in direction SW: 88°59′,
11185
then the boundary turns to the north and goes along bearing NE: 0°21′, NW: 0°01′, NW: 13°51′, across Chupinskaya and
14913 8200 624
Babinskaya spits till Sazaniy branch, then to CB: 13°51′
1549
and finally to the mouth of Biryuchenok branch.

TREKHIZBINSKY CLUSTER

Description of boundary:
Starting from the junction of rivers Nizhnyaya Beluzh'ya and Trekhizbinka, downstream along the left side of Nizhnyaya Beluzh'ya river to Beluzh'ya river, then downstream along left side of Beluzh'ya river till Romashkin branch , then along Romashkin branch till Proransky branch to the intersection with the corner point of quarter 40, then along the upland in directions
SE: 20°45′, SW: 6°50′, SW: 90°, SW: 42°, SW: 45°, SW: 47°,
475 780 1265 375 712 323
SW: 57°, SW: 70°30′, SW: 84°50′, NW: 87°, NW: 57°, NW: 35°30′,
435 570 620 230 845 360
NW: 9°, NE: 12°, NW: 34°, NW: 19°, NW: 18°, NW: 17°,
345 715 240 875 935 1185
NW:17°30′, NE: 20° till the intersection with Popov branch, then
1370 290
200 m upstream Popov branch, then along the upland in direction NW: 65°, till intersection with Kalnovsky branch, then upstream
100
Kalnovsky branch till its junction with Boldushka branch, then upstream along right side of Boldushka branch till the turning point N1, then along the upland in directions
NE: 25°, NE: 26°, NE: 27°, NE: 74°, NE: 38°, till the N3 point,
1965 480 1620 90 550
Then in directions SE: 69°, SE: 71°, SE: 72°, SE: 72°30′,
380 375 775 215
SE: 72°, SE: 71°30′, SE: 71°, SE: 70°, till intersection with
495 485 890 570
Trekhizbinka river, then upstream Trekhizbinka river till junction of rivers Trekhizbinka and Nizhnyaya Beluzh'ya.

Textual description of the boundary(ies) of the nominated property	OBZHOROVSKY CLUSTER Description of boundary: Along the left side of Ostovaya branch till its outlet, then along the kultuk zone in direction SE: 83° (630), then turns and goes in the direction SE: 20° 31′ (150), meets the main swath and goes along in direction SE: 41°11′ (1358), SE: 37°07′ (1976), SE: 37°06′ (2273), SE: 41°32″ (2358), SW: 55°27″ (848), SW: 1°52′ (1520), SW: 0°4′ (1306), SW: 7°34′ (1161), SW: 10°49′ (2587), then along the eastern, southern and western coast of Blinov island in directions SE: 14°59′ (2738), SE: 17°41′ (524), SE: 30°02′ (2347), SE: 10°08′ (1999), SE: 19°35′ (606), SE: 18°58′ (80), SW: 67°08′ (1018), SW: 4°22′ (997), turning northwest till the right Ufimtsev branch, then along the west coast of Ufimtsev branch, upstream till Blinov branch, along Blinov branch upstream till its junction with Koroviy branch. Then the boundary turns to the northeast in directions NE:46° 29′ (4315), NE: 46°44′ (5954), NE: 45°08′ (2767), till Ostov branch downstream till the junction of Ovchinnikov branch.

A4 (or “letter”) size map of the nominated property, showing boundaries and buffer zone	A2. Topographic map with precise indication of boundaries of the Reserve and its buffer zone. Scale 1:200 000.

Justification Statement of Outstanding Universal Value

The Volga Delta forms where the Volga River - great Russian river, the largest river in Europe, and the true symbol of Russia - meets the Caspian Sea. The Caspian Sea is the Earth's largest landlocked water reservoir that does not connected to the sea in the modern geological period. The sea is characterized by rapid and significant water level fluctuations accompanied by changes in the water surface area and water volume. The average rate of the most recent Caspian sea level rise was 100 times greater than that of the eustatic global mean sea level rise; the last Caspian sea-level cycle (1929-1995) has resulted in a 3-meter water level drop.

The Volga Delta is one of the world's most dynamic river deltas. It has a very specific hydrological regime as a result of the interaction between a large Volga River and a landlocked basin of the Caspian Sea.

The Volga Delta is the largest delta in Europe and one of the world's largest deltas. It is situated in the Caspian Depression, which is one of the lowest points on the Earth (27 meters below sea level). The Volga Delta bank and underwater slope gradients are the lowest among large river deltas throughout the world (less than 5 cm/km). The delta thereof has extremely complicated hydrographic system and is characterized by an extensive avandelta (the subaqueous part of the delta) with depths of 1,5-2,5 meters that stretches 35-50 kilometer out into the sea. River waters slowly flow down over a shallow avandelta off to the sea and thus the zone of river and sea water mixing is located several tens of kilometers away from the delta's marine edge. The total area of the Volga Delta (incl. avandelta) is over 20 000 square kilometers.

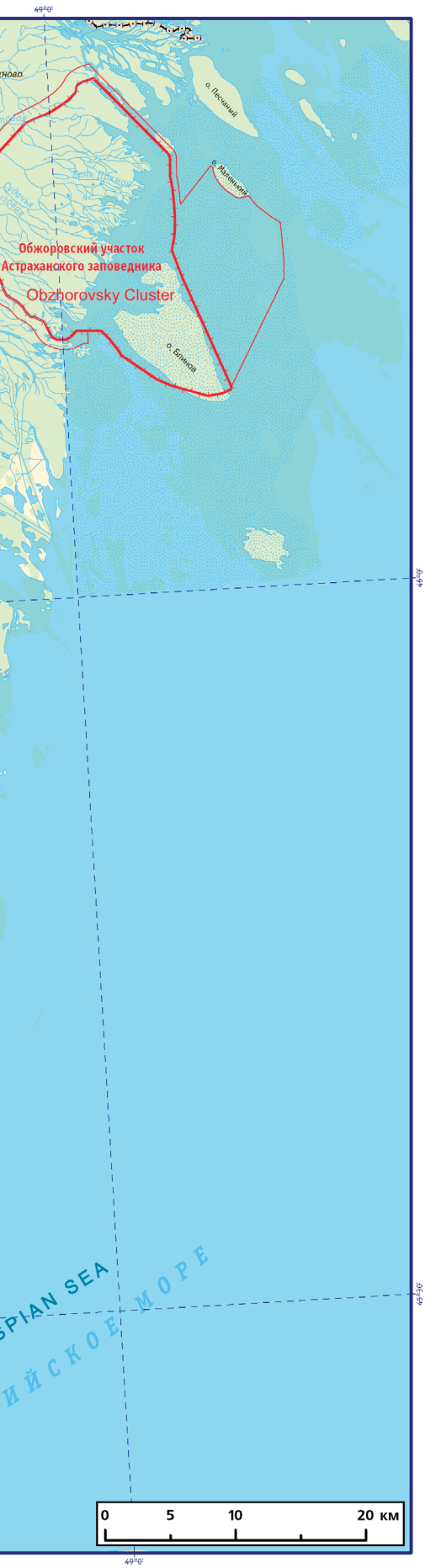
The Volga Delta has probably the most complicated hydrographic network in the world. Approximately 1 000 waterways reach the marine edge of the delta. That very tangled network of channels and lakes in combination with rich vegetation makes the landscape very peculiar. It is also makes the delta an oasis-looking area placed against a background of flat and monotonous, water- and vegetation-lacking deserts and semideserts.

Volga Delta is a region where mass concentration of migratory birds is observed, including many rare and endangered species. Many of them form large nesting colonies. There are a number of bird species in the territory of the Astrakhansky Reserve listed in the International Red Data Book, including *Pelecanus crispus, Aythya nyroca, Anas angustirostris, Falco cherrug, Coracias garrulus, Otis tarda* and *Tetrax tetrax*. The Reserve's territory is of great importance not only for rare and endangered nesting species. It is also a vital migratory stop-over site and wintering area for threatened migratory species.

Justification Statement of Outstanding Universal Value	The Volga Delta is a unique natural property possessing outstanding universal value and therefore is worthy of inscription on to the World Heritage List. Despite of showing resemblance in some characteristics to other large river delta systems, the Volga Delta as a natural complex is notably different from any of existing World Heritage sites. The distinguishing features of the Volga Delta are as follows: huge size, extensive subaqueous part of the delta (avandelta), the zone of river and sea water mixing that is "moved" tens kilometers off to the sea, remarkably complicated hydrographic network, a very indented coastline, plenty of lakes, high dynamics of natural processes due to rapid Caspian Sea level fluctuations. Expansive lotus fields add a special charm and peculiarity to the Volga Delta landscape. During the blooming period of the Caspian Lotus (*Nelumbo caspica*) the Delta becomes an area of exceptional natural beauty and aesthetic importance.
Criteria under which property is nominated	vii, viii, ix, x
Name and contact information of official local institution/ agency	Astrakhansky State Nature Biosphere Reserve. Address: Russia 414021 Astrakhan Tsarev river embankment, 119 Tel.: (8512) 30-50-74, 30-17-91, 30-17-44 Fax: (8512) 30-17-64 E-mail: abnr@astranet.ru Website: Director of the Astrakhansky State Nature Biosphere Reserve: Nina A. Litvinova.

A2. Topographic map with precise indication of boundaries of the Reserve and its buffer zone. Scale 1:200 000. (reduced copy)

The Astrakhansky State Nature Biosphere Reserve



Legend:

- Astrakhansky Reserve
- Reserve's Buffer Zone
- Aquatic vegetation

Прозрачный мир
НЕКОММЕРЧЕСКОЕ ПАРТНЕРСТВО

The boundaries of Federal SPAs are given in accordance with the GIS Database on the Federal SPAs of the Russian Federation, 2002-2008

1

IDENTIFICATION OF THE PROPERTY

1. IDENTIFICATION OF THE PROPERTY

1a. Country (and State Party if different)

Russian Federation

1b. State, Province or Region

Astrakhkan Region, Kamyzyaksky, Ikryaninsky and Volodarsky Districts

1c. Name of Property

"The Volga Delta".
The nominated property is located within boundaries of the Astrakhansky State Nature Biosphere Reserve.

1d. Geographical coordinates to the nearest second

The territory of the Astrakhansky State Nature Biosphere Reserve consists of three clusters located in the eastern, central and western parts of the Volga delta.

Coordinates of the extreme points of the Reserve:
Damchiksky cluster:
NW: N 45°51'50"; E 47°48'50";
SW: N 45°30'30"; E 47°50'40";
NE: N 45°53'00"; E 47°53'50";
SE: N 45°28'30"; E 47°55'40".

Trekhizbinsky cluster:
NW: N 46°16'20"; E 48°53'10";
SW: N 46°11'15"; E 49°00'20";
NE: N 46°21'50"; E 49°02'50";
SE: N 46°08'30"; E 49°09'45".

Obzhorovsky cluster:
NW: N 46°04'25"; E 48°57'40";
SW: N 45°56'50"; E 48°30'10";
NE: N 46°02'45"; E 48°33'40";
SE: N 45°57'20"; E 48°33'40".

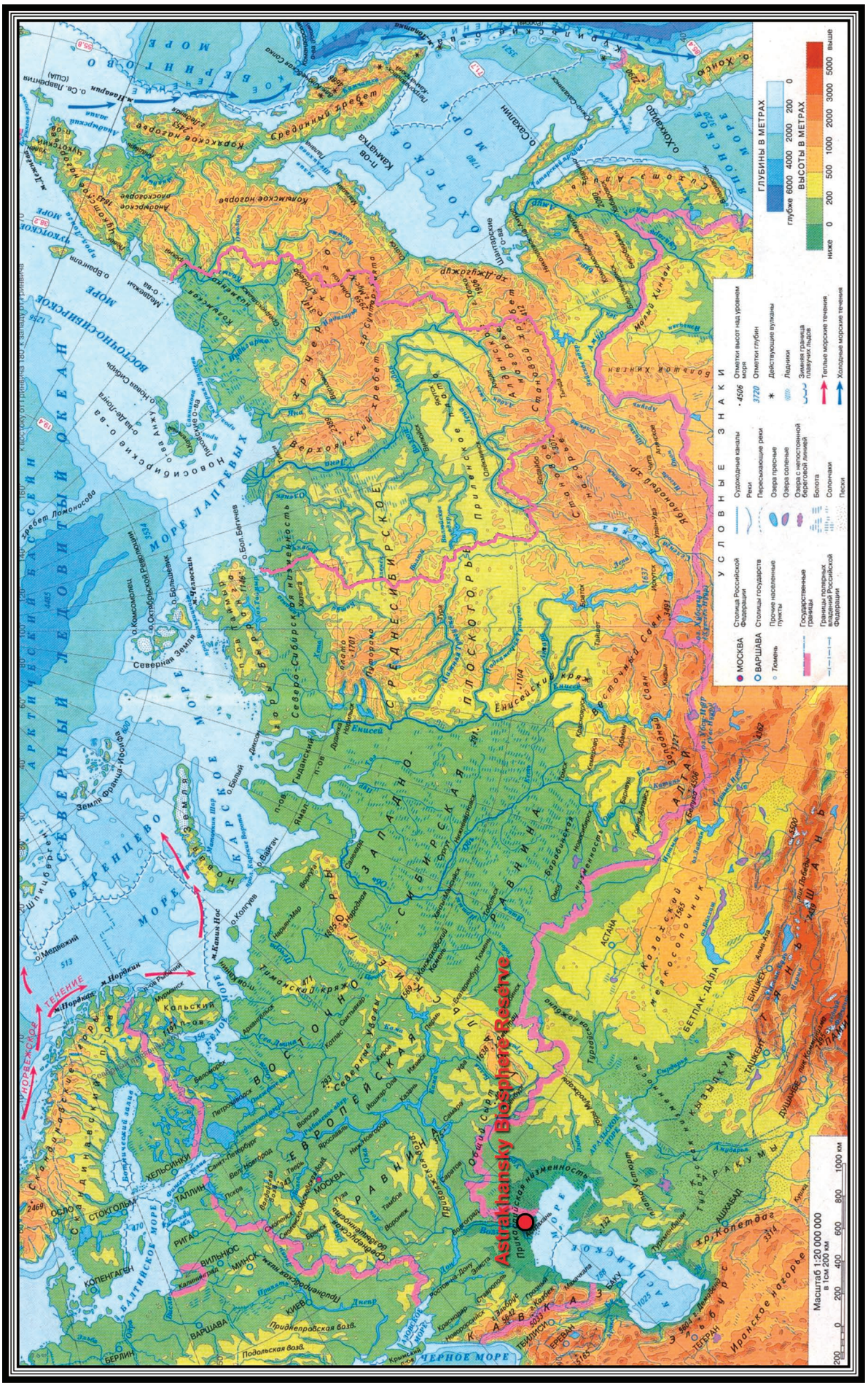
1e. Maps and plans, showing the boundaries of the nominated property and buffer zone

A1. Location of the Astrakhansky Reserve on the map of Russia.
A2. Topographic map with precise indication of boundaries of the Reserve and its buffer zone. Scale 1:200 000.
A3. Specially protected natural areas of the Lower Volga. Scale 1:1 600 000.
A4. Wetlands of the lower Volga delta. Scale 1:200 000.
A5. Blue lotus *Nelumbo nucifera* in the coastal waters of the Volga Delta. Scale 1:200 000.

1f. Area of nominated property (ha.) and proposed buffer zone (ha.)

Area of the Reserve is 67 917 ha. Area of the buffer zone makes 31 000 ha. Area spreading between clusters is shown in table 1.

		Area (ha)		
		Total area:	Including sea aquatory	Buffer zone
Astrakhansky Reserve		67917	12212	31000
Clusters:				
№	Name			
1	Damchiksky cluster	30050	9430	9000
2	Trekhizbinsky cluster	9460	232	3000
3	Obzhorovsky cluster	28407	2550	19000



A1. Location of the Astrakhansky Reserve on the map of Russia.

A3. Specially protected natural areas of the Lower Volga. Scale 1:1 600 000. (reduced copy)

SPECIALLY PROTECTED NATURAL AREAS OF THE LOWER VOLGA

Legend:

Federal SPAs:

- State reserve, Game reserve
- Natural monument
- Reserve's Buffer Zone

Regional SPAs:

- Game reserve
- Natural monument

- Game reserve (<500 hectares)
- Natural monument (<500 hectares)

Wetlands:

- Ramsar wetland The Volga Delta

The map is prepared with the support of the Euronatur (European Nature Heritage Fund).

Authors (cartographers): A. Kostikova, E. Tsibikova, M. Dubinin, A. Knizhnikov

The boundaries of Federal SPAs are given in accordance with the GIS Database on the Federal SPAs of the Russian Federation, 2002-2007

2
DESCRIPTION

2. DESCRIPTION

2a. Description of Property

The Astrakhansky Biosphere Reserve lies in the Volga Delta intrazonal region of the Caspian biogeographical province, in the desert zone. According to Udvardy's classification of biogeographical provinces (extended by A. Voronov and V. Kucheruk) the reserve's area belongs to the desert Prikaspiysko-Bekpakdalinsky Province of the Palearctic Realm and immediately neighbors the Caspian Province. The region possesses natural features belonging to various biomes as the result of its location at the meeting point of two biogeographical provinces combined with the intrazonality and complex geological history of the region.

Geology

The Volga Delta sits within two structural-tectonic zones; the interzonal boundary lies approximately at the latitude of the Astrakhan' city. The northern portion of the delta is located within the limits of the Caspian syneclise, which is the East European Platform's largest depression. The southern portion of the delta lies within the borders of two platforms: the Epihercynian Scythian Platform and the Turan Platform. Geostructural features of the delta and of the adjacent water area of the northern Caspian Sea were the key factors determined the development of an extensive, flat subaqueous part of the delta (avandelta) and an extremely shallow sea area adjacent to the avandelta. Both subaerial and subaqueous parts of the delta have very gentle slopes (about 0,0002) that, in its turn, determined the development of the world's most complicated and ramified network of distributaries channels and the active sediment accumulation at the marine edge of the delta .

Photo by G. Rusanov

Photo by G. Rusanov

Landforms

The Volga Delta is situated in the Pre-Caspian Lowland, which is a dried seabed exposed as a result of the Hvalynian Sea recession in the Late Quaternary Period. The distinctive feature of the lowland is that the major part of it is located below sea level. The relief is low and flat; its monotony is relieved only by salt domes with outcrops of more ancient Paleozoic and Mesozoic rock formations (Ulagan and Bolshoye Bogdo mountains), numerous lakes, sand dunes and hollows.

Basing on geomorphic characteristics, the Volga Delta can be divided into 3 zones, from its upper landward point to the marine edge of the delta: Upper Zone, Middle Zone and Lower or Coastal Zone.

The Upper Zone (about 60 kilometers along the stream) is the most ancient section of the delta with mean elevation of above – 23, 5 meters BS (Baltic mean sea level). It is characterized by prevalent development of large distributaries channels and by a relatively simple structure of a waterway network. *The Middle Zone* is situated at a height of -24 -25 meters BS. It possesses a ramified network of well-developed, large waterways connected to one another through a limited number of intermittent side

channels. *The Lower, or Coastal Zone* extends from the Middle Zone southward for 20-40 kilometers to the marine edge of the delta It emerged from the water in 19-20-th centuries mainly because of sea level drop. It has a highly fragmented waterway network with the interchange of stream junction/separation segments and active streamflow redistribution between the channels.

There are relatively low and high landforms that can be observed in the Volga Delta (in cross direction). The low landforms are inter-ridge hollows and other depressions occupied with lakes, *il'men's* and *staritsas*. To high landforms relate levees along existing and intermittent waterways with heights of 2-3 meters in the Upper Zone and 0,3-0,4 meters in the Lower Zone, alluvial ridges up to 2 meters in height (former mouth spits), marine ridges (former marine islands) and Baer mounds. Baer mounds are low hills of disputable origin stretching from east to west. They are 0, 5-8 km in length, 100-500 meters in width and 2-12 meters in height. There are no Baer mounds in *the Upper Zone*, only a few of them are located in *the Lower Zone*, but there are over 400 Baer mounds in *the Middle Zone*.

The modern marine edge of the delta is the youngest and most rapidly evolving section of the delta. Modern relief formation processes take place here as a result of the accumulation of river alluvia and marine sediments. Thanks to extensive shallows covered with land and underwater vegetation and numerous open and isolated bays (*kultuk*) this piece of the delta looks very peculiar.

The distinctive feature of the Volga Delta's Lower Zone is an extensive avandelta (a subaqueous part of the delta), which is basically a wide platform gently inclined towards the sea. It juts out 35-50 kilometers into the sea and averages about 2 meters

Photo by G. Rusanov

in depth (while the Caspian Sea level is –27 m BC). Flat relief of the zone becomes more complicated here because of numerous sandbanks and islands, natural furrows and artificial shipping channels, fish bypass channels and spoil banks along the channels. River waters slowly flow down over a shallow avandelta off to the sea and thus the zone of river and sea water mixing is located several tens of kilometers away from the marine edge of the delta.

All three clusters of the Astrakhansky Reserve lie within *the Lower Zone* of the Volga Delta.

Hydrological conditions

The Volga River (also called Ra in ancient times and Itil' in the Middle Ages) belongs to the rivers with so-called East European type of hydrological regime and is characterized by well-defined periods of annual spring floods, autumn overflows, summer and winter low-water periods. The river is fed primarily by snowmelt.

The hydrographic network of the Volga Delta is a very complicated system of water reservoirs and watercourses that includes large distributaries channels, smaller waterways, erikas (narrow channels less than 30 meters in width), il'men's (small lakes), bankas (large natural reservoirs at the delta mouth where the runoff from the delta channels and smaller waterways accumulates before going further to the avandelta).

Mean velocity of water flow within the delta depends on the volume of river water coming into the delta, ice regime, wind direction as well as geomorphic structure and morphometric characteristics of water reservoirs. The current velocity reaches its maximum during the spring/summer flooding period.

The channels' beds are cut through the deltaic and even pre-deltaic deposits. The waterway network becomes more and more branched as approaching the delta's shoreline. 223 waterways run across the Lower Delta plain but there are up to 900 channel outlets at the marine edge of the delta that means approximately 5-6 outlets per each kilometer of the shoreline. Some channels continue further through the subaqueous delta plain as natural furrows or more often as artificially deepened shipping or fish bypass channels. Those channels are best developed and serve as the main waterways for the freshwater to flow out to the sea.

Annual inflow to the Volga Delta varies significantly, mainly for climatic reasons. Mean annual inflow is about 250 km3; during the 20-th century, the swing was from 200 to 270 km3. The hydrological regime of the Volga Delta has been seriously altered after the construction of a cascade of water reservoirs and power stations on the Volga River and on its large tributaries. This especially refers to the 1959 construction of the Volga Hydroelectric Power Station and the Volgograd Water Reservoir (the two culminating points of the Volga Power Plant Cascade).

Photo by S. Fomin.

Such «regulation» of the river flow has resulted in changes in the volume (reduced) and time of annual floods. Before the cascade construction, about 50% of the annual inflow occurred during the high-water period (April - June), while today it's only 40% for the same period of time. The flooding period now starts later and finishes earlier and in general it has become about 45 days shorter than in previous years.

Climate

Climate of the Reserve's area is formed under influence of Asian anticyclone. Solar radiance duration is up to 2400 h/year, total solar radiation reaches 118 ccal/sq.cm. Sum of air temperatures above +10° C makes 3500-3600° C. Duration of the warm period is over 250 days. Upon the average annually falls about 167 mm of precipitation, generally as summer showers. Total annual evaporation makes 1177 mm. All this determines air and soil dryness, drought frequency.

Influence of the Caspian Sea over the climate of the Reserve's clusters is seen in lower daily and higher nightly air temperatures (by 1-2 degrees) and 10-14 % higher air humidity than in the other parts of the delta. Due to this, the frost-free period is 15-30 days longer.

Monthly average temperatures		Annual precipitation level (mm)
January	July	
-2,0	+24,3	217

	North	East	South	West
Wind frequency (%%)	2,1	21,1	1,7	8,3
	Northeast	Southeast	Southwest	Northwest
Wind frequency (%%)	7,9	8,8	3,0	6,6

Soils

The Reserve's soils are presented by alluvial sediments in their initial stages of the soil forming process. Alluvial sediments of different texture are transforming into meadow-marsh (meadow-*ilmen*), peat meadow-marsh (marsh-*ilmen*) and meadow-sod soils. At the islands of the Reserve, especially at its northern boundary, are found salinized soils of mosaic spreading.

As the soil formation factors analysis showed at Damchiksky cluster, the area of the cluster, and of the Reserve as a whole, can be divided into upper, lower and *kultuk* zones.

The upper zone is relatively old. It exists since 1920-s. The upper zone is located between absolute heights of -24.7 and -25.7 m. In its relief rise above elevated parts with sharply defined levee 1-2 m above the waterline, insular lower parts with ridges and dead channels and also the vast depression occupied by the drying Damchik ilmen.

Soils. Within the upper zone, the most widespread soils are alluvial meadow marsh soils. They are forming in conditions of shallow groundwater occurrence (up to 1.5 m) and rather prolonged surface floods. The *alluvial meadow-marsh soils* (meadow *ilmen* soils, by M.A. Gorbunova) are developed under bluejoint and wheat grass meadows. Humus horizon of these soils is grey or dark grey, poorly peated, loamy, pulverescent and cloddy 15-20 cm thick. Humus content is 3-5%. Lower horizons are distinguished by light texture and pronounced gleization marks. Depth of HCl boiling varies. At areas with thinned vegetation cover, these soils can boil even at the surface.

Alluvial meadow-marsh peated soils (marsh-*ilmen* soils, by M.A. Gorbunova) are developed under reed, cereal-reed and herb-reed meadows. In these soils the upper horizon has sod-peat character, brown-grey color and 10-15 cm thickness. Lower horizons are gleizated. Upper profile part down to the depth of 20-30 cm is composed of loam, the lower, of clay sand and sand. HCl boiling is noted at the lower part of the profile. Groundwater occurs at the depth of less than 1 m.

Under halophytic meadows are developed *alluvial marsh saline soils and meadow and marsh solonchaks*. Their genesis is connected with two reasons. Near the northern boundary of the reserve halogenesis display is connected with close occurrence (about 1 m) of saline "chocolate" clay, near the Damchik village, with human mechanical disturbance of natural vegetation cover. In alluvial meadow-marsh saline soils, freely soluble salts are found in the lower profile horizons, in solonchaks, at the surface.

At levees in the upper zone of the cluster are formed *alluvial meadow saturated soils*. Small levee height combined with significant flood height and duration determines hydromorphic features development in the profile. Soils are characterized by well developed humus horizon up to 20-25 cm thick. A1 horizon is usually loamy, dark-grey with well developed clumpy or granulous texture, no HCl boiling is noted. Underneath lays AC(g) horizon distinguished by grayish brown color with ochre tint or spots and higher humidity. At depth of 30-40 cm it changes into Cg horizon – structureless fine-grained sand with well developed gleization features (bluish grey or ochre tint, rusty spots). In the lower part of the profile is often noted HCl boiling, although carbonates are not morphologically marked. The humus horizon medium is neutral, the lower horizons medium, alkalescent. Humus content is about 3%.

In the drying *ilmens* under beds of reed, reed mace and spire form *alluvial marsh limous-peat-gley soils*. Combination of peat accumulation and silt pieces accumulation processes are typical of them.

The lower zone of the Reserve has dried up at the stage of rapid sea level drop in 1930-1940-s (see Chapter 4). Occupying absolute heights between -25.7 and -26.5 m, this zone includes low delta islands with poorly developed levees with height about 0.5 m above the water level.

Soils of the lower zone are developed in conditions of prolonged flooding (3-4 months and more) and close groundwater occurrence (less than 0.5 m), which determines their strong gleization. Large amount of organic remains coming onto the soils surface, in conditions of overwetting are poorly humified and are accumulated as peat-humus mass. The upper horizons, as a rule, are silted because of suspended solids accumulated by the river in the flood periods.

Photo by G. Rusanov

At the levees under willow forests form *alluvial marsh humus-gley soils*. The upper horizons of these soils hold not fully decomposed peat-humus mass, lower horizons are gleizated. Inside islands under reed meadows form *alluvial marsh limous humus gley soils*. The color of upper horizons varies between reddish black and grayish brown, the soils are viscous, limous, soiling, bearing high amount of peated vegetable remains. At the depth of 10-15 cm they are transformed into wet grayish blue gleizated sand with ochre spots. Soils of the lower zone are characterized by neutral reaction in the upper horizons and alkalescent reaction in the lower ones. Lower horizons, as a rule, demonstrate HCl boiling.

Kultuk zone is the youngest one. The land has been dried up during the prolonged water level drop period in 1950-1970-s. At present time, it is located between heights of -26.5 and -27.0 m.

Soils of the *kultuk* zone occupy intermediate position between underwater soils and alluvial marsh soils typical for the lower zone. The upper horizons of these soils are silted and contain large amount of humus and peated vegetable remains. At the depth of 5-10 cm they convert into strongly gleizated mineral mass represented by sand and siltstone sediments with inclusion of shell detritus. Quite often at the surface is noted reddish oxidated warp. We have classified these soils as *alluvial marsh silt-gley soils*.

Soils of the *kultuk* zone are characterized by neutral pH and reducing medium with Eh from -50 until -150 mB. It is important to note that in the soils of the *kultuk* zone, as well as of the whole cluster, there is no sulfidization display. This is explained by low mineralization level and hydrocarbonate-calcium composition of surface and ground waters. At present time, there is no influence of seawaters. As our investigations at the coastal area showed, the seawater starts influencing the underwater soils much further to the south, near the flooded Bar islands. Evidently, in the *kultuk* zone and in the northern part of the coastal area, decomposition of organic remains in anaerobic conditions goes with methane buildup due to fermentation reactions. Upon the Caspian coast soil and vegetation cover state prognosis, sulphidogenesis in soils will be probably developing in case of further water level rise up to -25.0 m [13].

Thus, the soils of the Reserve are generally presented by different varieties of alluvial meadow-marsh and alluvial marsh soils. Peculiarities of soils are firstly connected with hydrologic conditions (length and height of floods, groundwater occurrence). In the soil cover of the cluster are sharply defined three zones. In the upper zone, hydromorphism is developed poorly than in the others, here is developed humus accumulation process, halogenesis is noted. In the lower zone, hydromorphism intensifies, decomposition of large amount of organic remains periodically takes place in anaerobe conditions, which leads to generation of peat-humus horizons. The *kultuk* zone soils present the transitional formation between underwater soils and alluvial marsh soils. They are characterized by accumulation of peated vegetable remains, silting of surface horizons and strong gleization of the profile.

Flora and vegetation

The flora of the Astrakhansky Reserve includes a total of 314 vascular plant species belonging to 63 families. Vegetation growing in the Reserve can be classified into 4 types: shrub, forest, meadow and aquatic vegetation. There is also another division of the vegetation into several ecological groups based on hydrological and habitat characteristics: hydrophytes, hygrophytes (79 species), mesophytes, xerophytes and halophytes. Six hygrophyte species can also be regarded as hydrophytes (amphibians). There are also a number of true water plants, which appear within communities of terrestrial plants when those communities get flooded in high water periods, and disappear when the water gets low.

The flora of the Reserve is a part of the vegetable gene pool of Russia, and a variety of plants growing here have economically valuable features, such as forage plants (118 species), medicinal herbs (59 species), bee plants (41 species), ornamental plants (40 species), food plants (26), industrial plants (20), essential oil plants (10), dye plants (9), oil plants (6 species). Weeds number 77 species and noxious plants include 7 species.

Wide-spread economically significant plants include *Salix alba, Salix triandra, Rubus caesius, Phragmites australis, Typha angustifolia, Calamagrostis epigeios, Agropyron repens, Phalaris anmdinacea, Agrostis stolonifera L., Trachomitum sarmatiense, Sparganium erectum, Nelumbo caspica, Butomus umbellatus, Trapa natans, Nymphoides peltata, Salvinia natans, Spirodela polyrhiza, Lemna minor, Potamogeton perfoliatus, Potamogeton pectinatus, Vallisneria spiralis* and *Ceratophyllum demersum*.

The vegetation of the Reserve can be divided into 4 types: shrubs, forest vegetation, meadow vegetation and water vegetation.

Summergreen shrubs dominated by *Salix triandra, Tamarix ramosissima* and *Amorpha fruticosa* represent shrub vegetation of the Reserve.

Broadly spread S. triandra-dominated communities grow on new landforms – small islands and spits - at the mouth of the delta channels and *eriks* (shallow and narrow channels located mainly in the Coastal zone of the Volga Delta). The field layer, due to a high density of crowns, is very sparse and is represented by *Phragmites australis, Typha angustifolia, Phalaris anmdinacea, Lucopus europaeus, Agrostis stolonifera L., Calystegia septum,* etc. Sometimes the communities of S. triandra can also be found on old islands in those places where *Salix alba* is burnt out or fell because of age-related changes. The following species prevail in the grass stand of such communities: *Rubus caesius, Carex acutiformis, Phragmites australis, Solanum Dulcamara, Calystegia septum* and some other species.

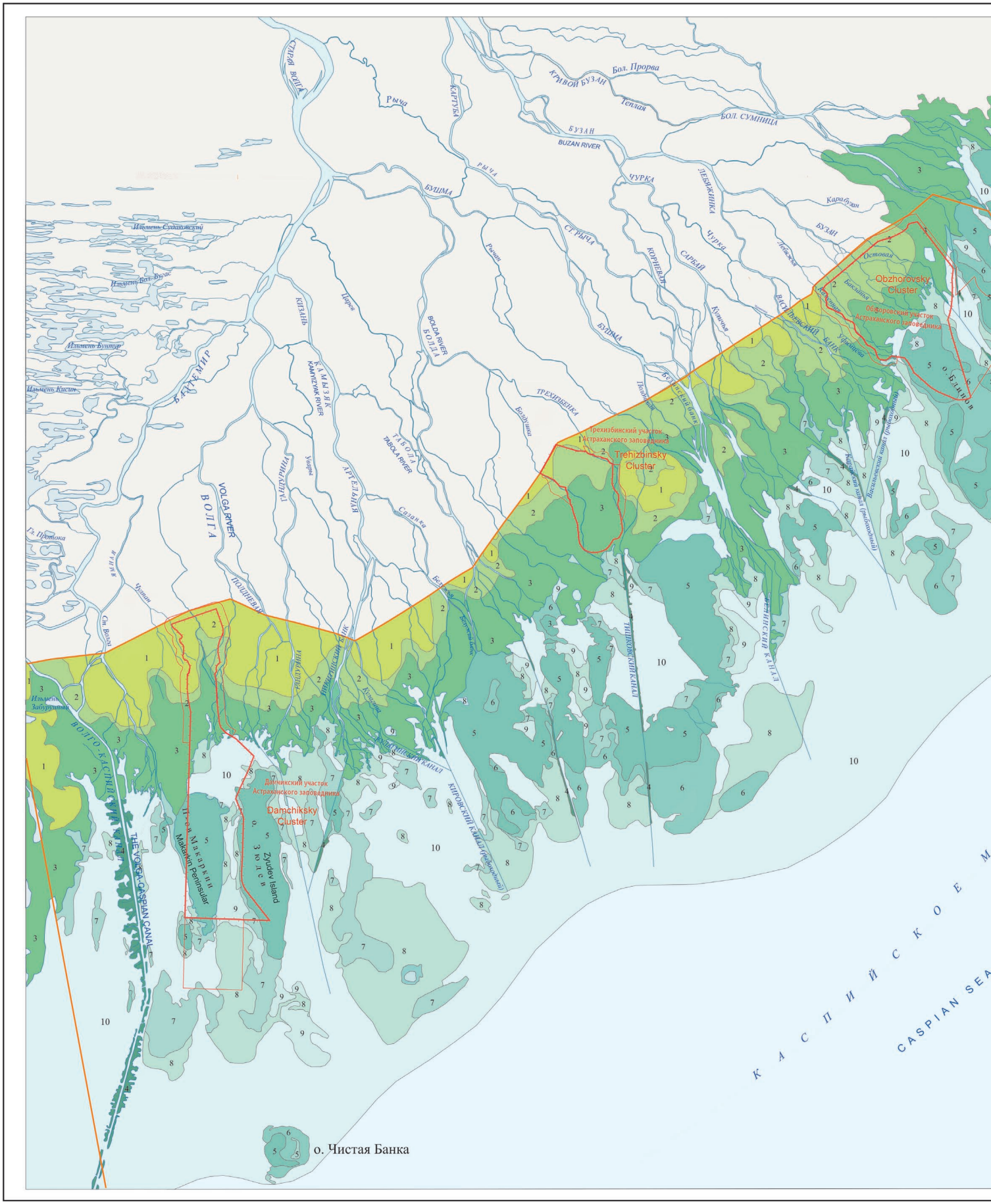
Communities of *Tamarix ramosissima* are confined to salt marshes developed as a result of the influence of either natural or anthropogenic factors. In the latter case the development of salt marshes relates to cattle grazing around the Reserve's settlements, while in the first case it is related to the impact of the population of the wild boar upon the vegetation of those islands, which are inaccessible for livestock.

Photo by S. Fomin

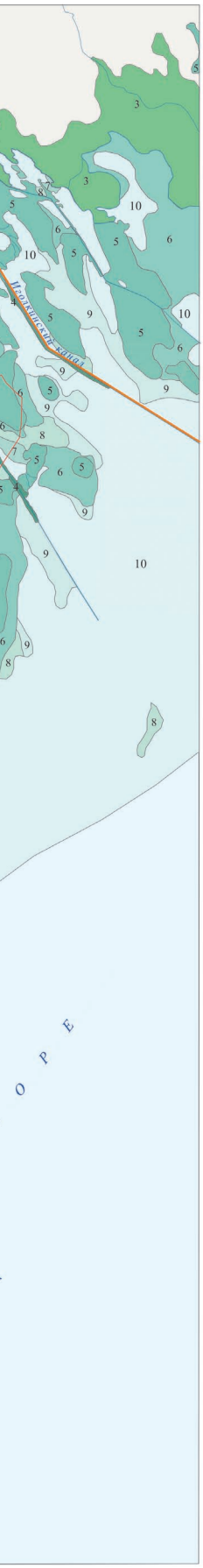
Salt marshes are located mainly on under-flooded tops of islands and on ridges in the inner parts of islands where wild boars gather in high water periods. The soil that is freshly dug up by a wild boar fits perfectly the tastes of T*amarix ramosissima, Aster tripolium, Chenopodium rubrum, Atriplex litoralis* and *Polygonum arenarium*. The communities of *Tamarix ramosissima* and meadow halophytes are commonly found building a complex biocenosis.

The formation of *Amorpha fruticosa* is scarce and appears as solitary bushes or small-sized thinned thickets 2-3 meters in height. It is situated mainly on high banks of islands inundated only in years abounding in water, and in burnt woods. It is also found replacing overmatured *Salix alba* in its communities.

Forest vegetation is an inundated, deciduous forest type composed of different plant communities (lowland herb-grass-sedge, herb and herb-blackberry) generally dominated by *Salix alba*. Initially occurred on spits and islands at the mouth of the delta channels, they gradually develop into dense gallery forests growing along watercourses. The development of one or another forest type is connected to vertical growth of banks of islands. On slightly growing channel banks there are *S. alba* – motley grass-grasses-sedge grass associations, compared to the banks with rapid vertical growth where *S. alba* –motley-grass and S. alba- motley grass-bramble communities can be found.



A4. Wetlands of the lower Volga delta. Scale 1:200 000. (reduced copy)



WETLANDS
OF THE LOWER VOLGA DELTA
(2006)

Wetlands types

Islands of the lower delta

1 — Meadows of grass, herbs and reed with halophites species

2 — Meadows of reed, herbs and sedges

3 — Closed stands of reed and reed mace with willow forests on levees and floating species at the delta fringe

Fill islands along channels at the delta front

4 — Mosaic of stands of reed and reed mace and meadows of reed, herb, grass with willow forests locally

Flooded islands and shoals at the delta front

5 — Closed stands of reed and reed mace

6 — Open stands of reed and reed mace with floating and submerge plants

Water areas at the delta front

7 — Mosaic of isolated and aggregated clones of reed, reed mace, with floating and submerged vegetation, patches of lotus with bur-reed

8 — Isolated clones of reed, reed mace with floating and submerged vegetation, lotus with bur-reed locally

9 — Sparse isolated clones of reed, reed mace with floating and submerged vegetation and patches of lotus

10 — Floating and submerged vegetation

Boundary of Ramsar wetland "The Volga delta"

Astrakhansky Reserve

Reserve's Buffer Zone

0 10 20 км

The map was compiled in aerospace methods laboratory (Faculty of Geography M.V. Lomonosov Moscow State University) basing on satellite imagery by ETM+/Landsat, LISS/IRS, ASTER/Terra, HRV/SPOT (2004-2006) and sources of Astrakhan Biosphere State Reserve with a support of Euronatur (European Nature Heritage Fund)

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At the age of 50 - 60 willow groves begin to thin out and then get gradually crowded out. *S.Alba* -motly grass-grasses communities usually get replaced by macereed associations, *S.Alba* - motley grass-bramble associations - by Bramble (*Rubus caesius*) communities, and *S.Alba* - motley grass communities – by meadow plants, e.g. *Calamagrostis epigeios, Trachomitum sarmatiense*. *Rubus caesius* occupies natural levees of channels and *erics* and ridges of inner oxbows. There are three main types of plant communities dominated by *Rubus caesius* found in the Reserve: a community 100% comprised of *Rubus caesius, Rubus caesius*-sedge grass-macereed and *Rubus caesius* – motley grass-sedge grass communities.

Along with dense gallery forests there is a shrub woodland (typical for the upper zone of the Reserve) developing as willow trees die off. The woodland species include *S. alba, S. triandra, Fraxinus excelsior, Amorpha fruticosa, Ulmus latifolia, Morus nigra*.

Riparian willow forests possess great significance for the protection of water resources. They promote the accumulation of alluvium and restrain erosion processes such as bank caving and shallowing of the delta channels and eriks.

Photo by S. Fomin

Photo by A. Butorin

Meadows can be classified into swamp, regular and steppe meadows. Swamp meadow is comprised of high grass formations (*Phragmites australis, Phalaris anmdinacea and Glyceria arundinacea*); high sedges (*Carex acutiformis and Bolboschoenus maritimus*); low sedges (*Eleocharis palustris and Scirpus supinus*); herbs (*Alisma plantago-aquatica, Veronica anagallis-aquatica, Polygonum hydropiper and Marsilea quadrifolia*), and macereed (*Typha angustifolia*). Waterlogged meadows occupy about 40 000 ha mainly covered by reedbeds and macereed.

Formation dominated by reed grass (*Phragmites*) is comprised of communities of different ecotopes: from monodominant tall and dense coastal thickets where the soil is always covered with water surface, to polydominant thickets on elevated sites flooded for less than a month during high water periods. The abovementioned communi-

ties include monodominant communities of reed grass and communities "reed grass - *Carex acutiformis*", "reed grass - *Calamagrostis epigeios*", "reed grass - *Trachomitum sarmatiense*", "reed grass - *Agropyron repens*", "reed grass - *Phalaris anmdinacea*", "reed grass – *Sonchus arvensis*" and "reed grass – *halophyte grasses*". Macereed (*Typha angustifolia*)-dominated formation includes the following plant communities: monodominant communities of *Typha angustifolia., T. angustifolia. - Phalaris anmdinacea, T. angustifolia - Agrostis stolonifera L., T. angustifolia*. – hydrophyte grasses. Meadows where *Phalaris anmdinacea* and *Carex acutiformis* are dominant species are significantly smaller in size. Halophyte swamp meadow type is represented by genus *Bolboschoenus*.

Regular meadow consists of the following plant formations: high grasses (*Calamagrostis epigeios and Agropyron repens*), small grasses (*Aeluropus, Hierochloe odorata and Agrostis stolonifera L.*), low grasses (*Crypsis*), tall herbs (*Trachomitum sarmatiense, Lepidium latifolium and Aster tripolium*) and small herbs (*Lepidium pinnatifidum, Suaeda confusa, Argusia sibirica and Salicornia europaea*). About 50 % of regular meadows occur at firebreaks along the northern borders of the Reserve's clusters, where their development is driven by annual mowing. Other 50 % are bush grass and kendyr meadows developed as a result of the vertical growth of islands and natural change of vegetation.

10 out of 30 plant formations found in regular meadows are related to the halophyte type. They mostly occur at firebreaks. The following communities occupy major portion of the area covered by regular meadows: "*Aeluropus - Bolboschoenus maritimus - Agropyron repens – halophytes" and "Phragmites australis – halophytes*". Halophyte species found in such communities are *Polygonum arenarium, Atriplex litoralis, Chenopodium rubrum, Suaeda confusa, Cynanchum acutum, Crypsis, Aeluropus, Puccinellia gigantea, Bolboschoenus maritimus, etc*.).

Steppe meadows, formed as a result of mowing and grazing management, consist of several plant formations respectively dominated by *Poa angustifolia, Cynodon dactylon, Glycyrrhiza glabra and Limonium gmelini*. Within this meadow type bluegrass meadows, couch grass meadows and licorice meadows replace bush grass meadows.

Aquatic vegetation includes true aquatic plants and amphibious plants. True aquatic plants cover a total area of 6,7 hectares; they can be grouped into 4 general types: 1) rooted plants with floating leaves (*Trapa natans, Nymphaea candida, , Nuphar luteum, Nymphoides peltata, Potamogeton nodosus*); 2) totally submerged, rooted plants (*Myriophyllym spicatum, Myriophyllym verticillatum, Vallisneria spiralis, Elodea canadensis, Potamogeton perfoliatus, Potamogeton lucens, Potamogeton pectinatus, Potamogeton berchtoldii and Potamogeton crispus, Batrachium eradicatum and Batrachium rionii, Arabis and Caulinia minor*); 3) rootless plants, floating on water surface (*Hydrocharis morsus-ranae, Salvinia natans, Lemna minor, Spirodela polyrhiza*); 4) rootless submersed plants (*Ceratophyllum demersum L., Utricularia vulgaris*).

Aquatic plant communities dominated by floating leaf species - *Trapa natans, Nymphoides peltata, Nymphaea candida, Nuphar luteum* - are best represented in the Reserve. The communities of *Vallisneria spiralis, Potamogeton pectinatus, Potamogeton lucens and Potamogeton nodosus, Ceratophyllum demersum L.* are the most common among the submerged species.

Amphibious vegetation includes tall grasses (formations dominated respectively by *Phragmites australis, Zizania latifolia, Typha angustifolia, Typha latifolia, Typha laxmannii, Scirpus lacustris*) and short grasses (*Nelumbo caspica, Sparganium erectum, Butomus umbellatus, Acorus calamus, Sagittaria sagittifolia and Alisma gramineum)*.

Amphibious plants, such as reed grass, macereed, brunched burr and others, often grow in complex associations with aquatic plants of types 1,2 and 4 (see above).

Four plant species growing in the Reserve are entered into the Red Data Book of the Russian Federation, namely *Nelumbo caspica, Trapa natans, Marsiliea aegyptiaca and Aldrovanda vesiculosa*.

Photo by A. Butorin

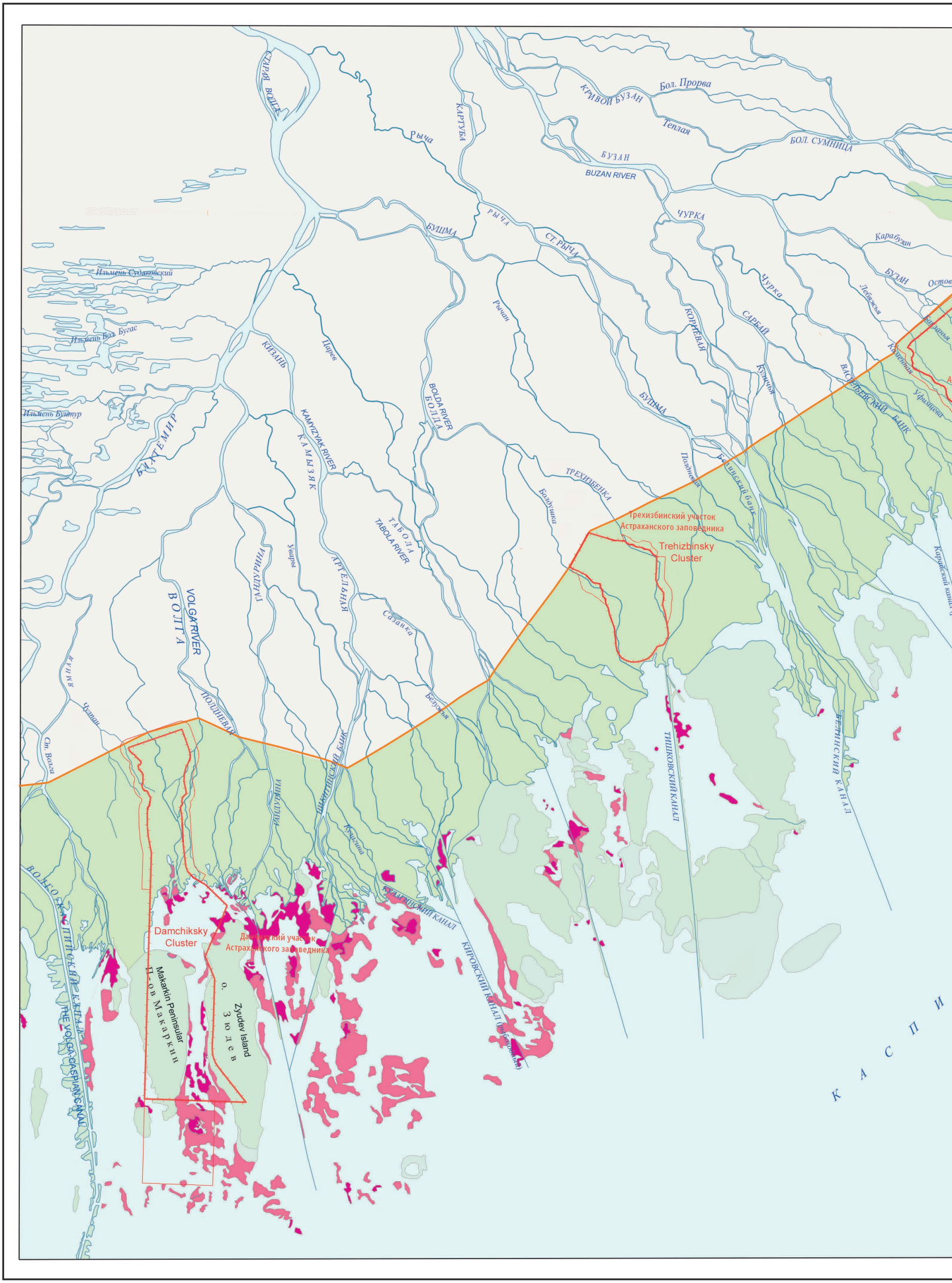
Nelumbo caspica is the most remarkable among the rare and endangered plant species of the Reserve. The history of this relic plant dates back to the Cretaceous Period. It is regarded as a sacred plant in India and China. There are a few hypotheses about how the lotus came to be introduced into the Volga Delta. One of them is that the lotus was brought by migrating birds since the viable lotus seeds were found in their intestines. Other assumption is that the lotus came with the nomadic Kalmucks who also believed that the lotus was a sacred plant. The third hypothesis says the lotus is a native inhabitant of the Volga Delta and has been growing here over millions of years.

Photo by S. Fomin

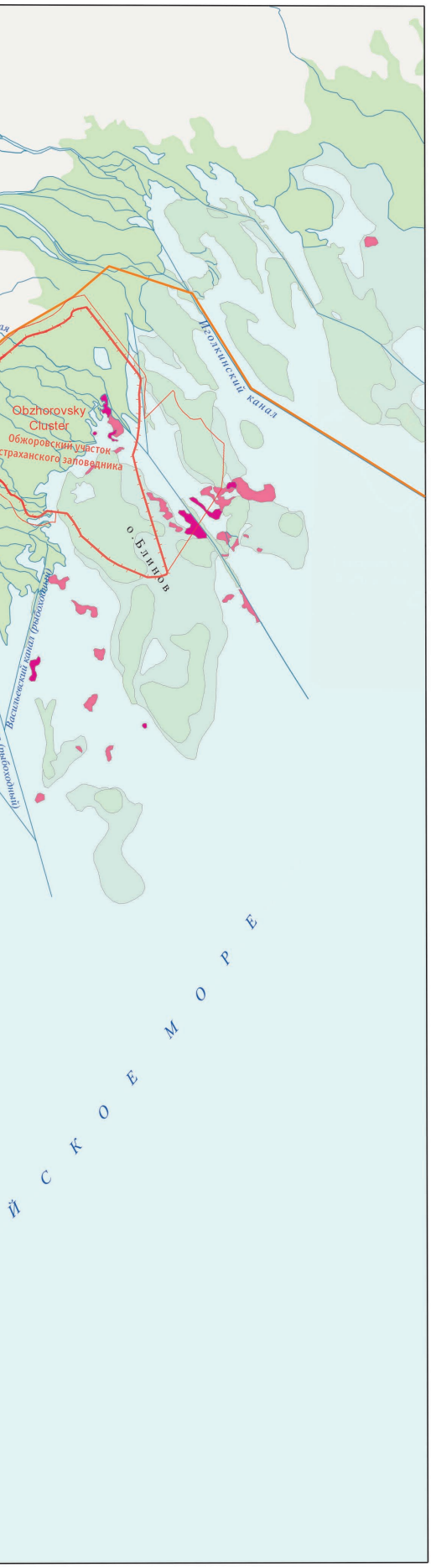
Within the Volga Delta *Nelumbo caspica* is commonly found in *kultuks* (isolated bays) and in shallow water areas with depths of 0,5 – 1,5 meters, and is less common in channels and *eriks*. The key factors promoting the growth of lotus include high summer temperature and muddy ground.

In the Reserve the blooming period of ***Nelumbo caspica*** lasts about 2,5 months, from June until the middle of September. In spring germinated lotus nuts float up and the stream carries them away until something stops them and they root and give birth to a new plantation. Wild boar contributes much to the dissemination of lotus. In spring

Photo by S. Fomin



A5. Blue lotus *Nelumbo nucifera* in the coastal waters of the Volga Delta. Scale 1:200 000. (reduced copy)



THE VOLGA DELTA
LOTUS *(Nelumbo nucifera)*

2006

Plant communities

The delta front

Water areas

Communities of lotus *(Nelumbo nucifera)* with insignificant participation of reed *(Fragmites australis)*, reed mace *(Typha angustifolia)* and bur-reed *(Sparganium erectum)*

Communities of reed *(Fragmites australis)*, reed mace *(Typha angustifolia)* and bur-reed *(Sparganium erectum)* with participation of lotus *(Nelumbo nucifera)*

Flooded islands

Stands of reed and reed-mace at flooded islands: closed

open

Islands of the lower delta

Stands of reed and reed mace, meadows of reed, herbs, grass with willow forests locally

Boundary of Ramsar wetland "The Volga delta"

Astrakhansky Reserve

Reserve's Buffer Zone

0 10 20 км

The map was compiled in aerospace methods laboratory (Faculty of Geography M.V. Lomonosov Moscow State University) basing on satellite imagery by LISS/IRS, HRV/SPOT (2006 г.) and field investigations with a support of Euronatur (European Nature Heritage Fund)

Author: I.A.Labutina

boars root in the lotus fields, leaving fragments of lotus rootstock, which is later often washed away by the high water. At the time when the Reserve was established *N. caspica* could be found only in *kultuks* and occupied only 1.5 ha. Decrease of the Caspian Sea level has resulted in shallowing and sequential vegetal invasion of the avandelta's waters by submergent and emergent vegetation. By 1963, due to the occupation of new shallow areas, the total area of lotus fields in the Reserve increased up to 67 hectares.

Further redistribution of lotus fields is a result of the "regulation" of the Volga River flow due to the construction in 1959 of the Volgograd Hydroelectric Power Station. Decrease in the inflow to the Volga Delta during the high water period led to increasing vegetal invasion of the Delta's shallows by water plants in general and the lotus in particular. In 1970 lotus plants covered over 200 ha of the Reserve's area. In 1978 is was about 1000 ha, and in 1984 it came up to 1 500 ha, compared to 3 000 hectares in the entire Volga Delta. During the last decades lotus fields kept their growth and currently *N. caspica* occupies over 5 000 hectares of the Reserve's area.

Besides being an ornamental plant, the lotus, due to the extension of lotus-covered area, became within the last 20-30 years an important provider of food and refuge to waterfowl, which eat lotus nuts and fruit pulp. Wild boars readily eat lotus roots. In the autumn tens thousands of geese and thousands of swans feed on the lotus fields in the Damchiksky cluster. During summertime molt ducks take shelter under large lotus leaves.

Photo by A. Butorin

Marsiliea aegyptiaca (Willd.) is an extremely rare species. *M. aegyptiaca* along with *Aldrovanda vesiculosa* are low abundance species and both place increased demand on habitat conditions. Within the Reserve *M. aegyptiaca* can be found growing in small groups in flood communities located at sporadically flooded low sites. The fact that *M. aegyptiaca* mainly reproduces vegetatively provides the necessity to preserve its habitats, which is possible only within specially protected areas.

Aldrovanda vesiculosa (L.) is another rare species for the Reserve as well as for the entire *Astrakhanskaya Oblast'*. However, Reserve's habitats allow the species to increase the population size.

Trapa natans is a Tertiary relic species. In the Volga Delta it is found throughout extensive shallow water areas and also in *eriks* and *ilmen's* with poorly running water. It does not form large floating mats but the total area in the Lower Delta covered by *Trapa natans* significantly exceeds that one occupied by *N. caspica*. *T. natans* is most abundant in *kultuks* and between the avandelta islands, while on open avandelta its presence is reduced by the depth growth and hydrological regime changes.

Under constant freshwater conditions typical for the Volga Delta, multi-species communities of submerged and semi-submerged plants may serve as centers of dispersal of the species over water reservoirs of the adjacent arid zone. In relation to gene pool conservation, *Myriophyllum verticillatum, Vallisneria spiralis, Caulinia minor, Potamogeton lucens* are of special importance among the given group of plants.

The flora of the Astrakhansky Reserve exhibits a unique diversity of plant communities developed in intrazonal environment. Due to increasing man-made transformation of landscapes and growing load on natural ecosystems the significance of the Reserve as a protected area also increases. Currently the Reserve provides the proper conservation of floral and coenotic diversity as well as optimum life conditions for numerous plant communities.

Photo by A. Butorin

Fauna

The fauna of the Astrakhansky Reserve belongs mainly to the European fauna type, with the presence of elements of other fauna types. Nonsymbiotic aquatic invertebrates belong to 828 taxonomic units, including protozoa (136 taxons), Rotifera (403), Cladocerae (142), Copepoda (70) and other animal groups (77). High diversity of microclimate conditions gave rise to the coexistance of various ecological groups of insects, from desert to typical mesophilic insects, within a confined area.

Pisces

The diversity of environmental conditions (water depth, lowage and weediness of waters) found in water reservoirs of the Reserve accounts for the diversity of fish species (a total of 56 species belonging to 12 families). The most abundant are Cyprinidae (24 taxons) and Agonidae (11 taxons).

The region is a global scale center known for the diversity and wealth of its fish fauna, with special emphasis on the diversity and richness of sturgeon species *(Acipenseridae)*. *Huso huso, Acipenser gueldenstaedti, A.stellatus* are common here, *A.ruthenus* can also be found in the Reserve.

Among the fish fauna of the Reserve the most common species are freshwater species, mainly Cyprinidae and Percidae: carp, bream, Caspian roach, tench, rudd, silver bream, asp, lookup, and also pike, cat fish, river perch, pike perch, crucian carp and several species of *Cottidae*, while nase, cona, sabre fish and Volga zander are found rarer. Diadromous and semi-anadromous fish, which migrate to the Reserve's area during the spawing season, represent quite a considerable portion of the Reserve's fish fauna, another considerable part of which are marine fish. Anadromous fish species – Acipenserodae and Clupeidae – can be found in the Reserve's waters only when they migrate from the sea to their spawing grounds in the Volga River and back.

There are ongoing changes in the water reservoirs of the Reserve driven by well-defined delta-formation processes. These changes include the weediness of some water bodies and deepening of others, that results in close neighborhood of sites with different environmental conditions (plant composition, hydrologic and thermal regimes). This brings species of different living conditions to coexistance. Those fish species that prefer to live in open water, e.g. silver bream, asp, ablet, perch and pike perch, occupy large and middle-size waterways and eriks of the subaerial Delta, which also serve as migration paths for diadromous and semi-anadromous fish. Inhabitants of vegetated waters, such as rudd, tench, crucian carp, perch, ruff and spined loach, dominate in the reservours with slowly running water (*erickas, il'mens* and *kultuks*) Marine fish, mainly sculpins, are also found in the subaerial Volga Delta.

The avandelta is a zone where representatives of marin fauna (sculpin, pipefish, stickleback, assous) mix with typical freshwater species (pike, tench, rudd, silver bream, crucian carp, cat fish). The significance of freshwater fish reduces as one goes downstream.

Many of the Reserve's reservoirs and waterways are migration paths or spawing grounds of fish. The main spawing grounds are inundated meadows (also called *poloys*) of the subaerial Delta. The water get warm very early here giving rise to the rapid development of hydrobionts. Vegetation grown up before the beginning of the spawing season serves perfectly as a substrate for fish roe. In July-August fry leave

the spowing grounds. Those young fish, which are late to enter the river, perish in detached reservoires. Those, which timely left the grounds, gather in the avandelta. By the middle of summer the avandelta's water is warmed up and covered with water vegetation, so it provides young fish with a shelter and food. Besides being a feeding ground for young fish, the avandelta serves as a secondary spawing ground for intermittently spawing species.

In autumn some fish species migrate to their wintering basins. Cat fish and carp gather and spend winter dormant in large swims.

Not only fry but also larger fish have great significance for the nutrition of birds, animals, amphibias and reptiles inhabiting the Reserve, in every season excepting the time when water is covered with ice.

Amphibias and reptiles

Lake frog is the most abundant of amphibian species of the Reserve. It lives in numerous channels, *eriks, il'mens* and *kultuks*. It is also widespread throughout the avandelta. *Pelobates fuscus* is much rarer. There are also unconfirmed reports on the observation of green toad and common hyla.

The dominant reptile species are grass-snake and common water snake. Pallas' coluber, fresh-water turtle and sand lizard are aslo found in the Reserve.

Photo by G. Rusanov

Photo by G. Rusanov

Mammals

The number of mammal species is relatively small. The theriofauna of the Reserve includes 34 species belonging to 7 orders: Insectivora (4), Chiroptera (8), Lagomorpha (1), Rodentia (8), Carnivora (9), Pinnipedia (1), Artiodactyla (3). However, with the exception of non-resident or unconfirmed species, the site-specific mammal group consists of 20 species, a fifth part of which are introduced species showing no genetic affinity to the Volga Delta. The distinctive features of the Reserve's mammal fauna are high productivity and dynamism of populations of some species. The life of some species, such as common vole, water vole, Old World harvest mouse, field mouse, common weasel, wild boar, otter, *Crocidura suaveolens, Crocidura leucodon, European beaver*, ondatra, racoon dog, American mink, is closely connected to natural conditions of extrazonal coastal landscapes. Other species are widespread throughout the Reserve's area: house mouse, common rat, fox, gray wolf. The third group of species include those occasionally observed in the Reserve (Caspean seal, saiga and elk).

The Insectivora is represented by 3 species: eared hedgehog, a permanent resident of the Reserve, and Crocidura suaveolens and Crocidura leucodon, both are quite abundant.

Russian desman (*Desmana moschata*) is listed in the Red Data Book of the Russian Federation (status 2), Astrakhan Region, and the IUCN Red Data Book (status VU). The information is very scarce about this species. It is a decreasing, rare relic species of Russia.

The *Lagomorpha* is represented by the only species - European (brown) hare (*Lepus europaeus*). It is a typical representative of the steppe-desert faunal complex. During the ice-free period it can be found at fire breaks and in the buffer zone of the Reserve. In winter, as the ice-cover developes, the brown hare enters the Reserve's territory through channels and eriks, and returnes back to its summer habitat in spring.

The *Chiroptera*, an underexplored order of the Reserve's mammals, is represented by *Pipistrellus kuhli, Pipistrellus nathusii, Eptesicus serotinus, Vespertilio murinus* and *Nyctalus noctula*. Some of the abovementioned species visit the Reserve only during their seasonal migrations. *Pipistrellus nathusii* is a permanent resident, though not abundante. The status of other species is unknown and requires special studies.

Only those few mammals able to swim across extensive water areas and to migrate to flood-free areas and back when needed, prolific, reproducing before the high water period and flexible in feeding behavior, manage to live in humid environment of the Lower Delta.

Two out of total of 9 species of *Rodentia* found in the Reserve are naturalized species (European beaver and ondatra), the other 7 species are native ones. European beaver (*Castor fiber*) was imported from the Voronezhsky State Reserve. *Rodentia* usually dwell in lodges and holes they build in *eriks*, and are less common in channels near *kultuks*. The beaver population has been shrinking since 1975. In 1987 the only beaver colony left, containing 3-5 animals. Currently there is no beavers in the Reserve. The main cause of its extinction is the increase in water level in the Delta in winter

season as a result of the evacuation of water from the Volgograd Water Power Plant that causes the inundation of lodges and animal loss. Ondatra (*Ondatra zibethicus*) was introduced to the Volga Delta in 1953-1954. By now the species has - independently or by means of several target in-regional introductions - occupied the entire Delta area and has become an integral component of the Reserve's biocenosis. It lives in holes in the banks of channels and *eriks*, but best hydrological regime and best conditions for its protection, breeding and feeding are in the kultuk area, especially in the avandelta. Currently the size of the ondatra population is steadily declining. *Arvicola terrestris* was common till the late 60-s; now its number reduced. *Microtus arvalis* is commonly found in meadow, willow-motley grasses, reed grass and reed grass-sedge grass stations, though in the last two it is found more often.

The fauna of *Muridae* includes 4 species: *Apodemus agrarius, Mus musculus, Micromus minutus* and *Rattus norvegicus*. It the years with a favorable hydrologic regime the Reserve's populations of *Apodemus agrarius* and *Mus musculus* reach a high level. For a full year witness to the presence of a common rat can be found at cordons and in the nature.

Meriones tamariscinus was for the first time discovered 1989 on a salt marsh near the Babyatsky *erik* in the Damchiksky sector. Today large colonies of *Meriones tamariscinus* thickly settled in the northern part of the Damchiksky sector of the Reserve. In dry years the animals distribute themselves over a significant part of the Reserve's area, however most of them die when high water comes next year.

The *Carnivora* is represented by 3 families: *Canidae, Mustelidae* and *Felidae*. Among the Canidae, *Nyctereutes procyonoides* is the most abundant species. It was naturalized in the Delta in 1936 and in 1939. The *Nyctereutes procyonoides's* best habitats are located in the lower zone of the subaerial Delta – exactly where there is the Reserve's area, which is well protected and has plenty of food. A small number of raccoon dogs inhabit the avandelta's reedbeds and macereed thickets located many kilometers far from land.

Photo by G. Rusanov

Canis lupus is a permanent resident of all the three sectors of the Reserve. For the ice-free season it prefers the northern parts of the Reserve's sectors. Wolf's dens are often found on salt marshes or in thinned reed thickets. When the flood period comes old wolves and broods leave their dens and make several new ones in reed heaps. No disturbance, safe and perfectly protected territory, high density of potential pray (wild boar and raccoon dog), all these factors attract wolves to the Reserve's area.

Vulpes vulpes rather belongs to the biocenosis of the Upper and Middle subaerial Delta, though is quite common in the Reserve, too. In summer the red fox lives in the northern part of the Reserve, in thinned reedbeds and salt marshes. In winter this animal or rather its footprints are found everywhere, even in the *kultuk* zone and in the avandelta. In the Reserve fox usually digs its brood burrows on natural or man-made elevations, near the edge of reed thickets.

Canis aureus was for the first time registered in the Reserve in 1989 in the Damchiksky sector. Today 1-2 families permanently live in this sector. Encounters with this animal in the Obzhorovsky sector have also been reported.

Mustella erminea, Mustella nivalis, Mustella vison and *Lutra lutra* represent the *Mustelidae* family. The most common is *Mustella erminea*. It is found in every of land biotopes. In contrast, *Mustella nivalis* is scarce in the Reserve. *Mustella vison* negatively affects some animal species and is not welcomed in the Reserve's ecosystem in particular and in the Volga Delta in general because the Delta is of global significance as an important habitat of waterfowl and water-related bird species. *M. vison* is an introduced species, which appeared in the Delta in the early 70s as a result of the site-specific adaptation of animals escaped from fur farms.

River otter is an indigenous species of the Delta, which is found throughout the Reserve but is the most abundant in the Damchiksky sector.

The Reserve's Records contain very limited records of *Felis chaus*. According to them, jungle cat was common in the Reserve till the middle 50s. Later it occurred more and more rare and now special research is required to find out any information about the destiny of this species in the Reserve.

The Caspian seal is spotted in the Obzhorovsky and Damchiksky sectors of the Reserve in autumn and in springtime migrating in path of fish shoals, which come to their wintering or spawing grounds to the branches of the Volga River. During this period Caspian seal is found not only in the avandelta's water area but also in the Delta's channels. Since the sea level rose, individual seals are regularly spotted in the Delta's channels almost every year.

Three species of hoofed mammals have been registered within the Reserve, but only one of them, *Sus scrofa*, permanently lives there. This species is one of the key components of the Reserve's biocenosis. It mainly lives on plants: reed grass, macereed, lotus, water chestnut, rush flower. The estrus period starts in the latter half of November and finishes in January. First piglets born in the end of March, mass ferrowing finishes by the middle April.

The wild boar is the only hoofed animal inhabiting the entare area of the Reserve from the subaerial Delta's reedbeds to the avandelta's islands. Thanks to well-developed hydrographic network and the presence of natural levees, the Reserve's area is a «maternity home» for animals of the adjacent low-land «reed grass belt». In recent years from 400 to 800 boars were registered in the Reserve before the ferrowing period. Extensive reed and macereed thickets are very much fit the tastes of the wild boar. However, during the flood period the water rises up, and so it drives the wild boar out from the most low-lying places (*kultuks* and *il'mens*) and up to the levees. Thus, in May-June the bulk of boars gather on the levees. During the high water period, if the water is low or around the average level, adult boars and new-born piglets successfully survive flood gathering on ridges, salt marshes and other elevations. But if the water is high and the flood period is long, which happens in the Delta once in 6-8 years, in that case boars and other animals starve, die of cold or perish of inanition.

Photo by G. Rusanov

To save animals earth mounds for supplementary feeding during the high water period have been built in the Reserve's sectors. For the last two decades wintertime became another difficult period for wild boar as well as for the other mammals living in the Lower Delta. In winter quite unfavorable weather and feeding conditions become even harsher due to the high water level, flooding of islands and ice crust development. All these factors force animals to shift from place to place more frequently, which is often leads to their loss.

Elk (*Alces alces*) and saiga (*Saiga tatarica*) are not the residents of the Reserve. Their sporadic winter visitations of the Reserve's area are caused mainly by unfavorable weather conditions.

Mammals are the key component of an ecosystem. In the Astrakhansky Reserve the composition of mammal species is almost equal for each sector. Hydrological regime is the main factor determining the status and dynamic characteristics of mammal populations.

Avifauna

The Volga river delta is one of the most important areas of birds' accumulation during their seasonal migrations in Eurasia. At the clusters of Astrakhansky Reserve concentration of migrating waterfowl and near-water birds is especially high: *Anseriformes* (14 species), *Limicolae* (25), *Laridae* (7) and *Ciconiiformes* (11). Total migrations duration is 9 month, from March until November. Besides common spring and autumn transitional pass, within the Reserve as well as over the whole delta birds also shift to summer molting areas and back before the beginning of main autumn pass (*Anatinae, Haematopinae*). Also are noted early post nesting movements of many species, fore departure transitions of local populations and non-breeding birds, non-periodical migrations of wintering species, etc. Only in June shifts seemingly subside, but do not end.

During migration period prevail whooper swan (*Cygnus cygnus*) and mute swan (*Gygnus olor*), grey goose (*Anser anser*), mallard (*Anas platyrhynchos*), pintail (*Anas acuta*), European teal (*Anas crecca*), garganey teal (*Anas querquedula*), duck (*Anas strepera*), pochard (*Netta rufina*), diving ducks (*Aythya ferina and A. fuligula*), magpie diver (*Mergus albellus*). In the nesting period are numerous *Ciconiiformes, Pelecaniformes* and *Charadriiformes*, especially great white heron (*Egretta alba*) and common heron (*Ardea cinerea*), cormorant (*Phalacrocorax carbo*), black-headed gull (*Larus ridibundus*), Caspian gull (*Larus cachinnans*), great black-headed gull (*Larus ichthyaetus*), whiskered tern (*Chlidonias hybridus*), white-winged black tern (*Chlidonias leocopterus*) and black tern (*Chlidonias niger*).

Accumulations of migrating birds at Damchiksky cluster are enormous. This area is located at the southwestern part of the lower Volga delta, where ice cover breaks earlier in spring and freezes later in winter. In March and April near Makarkin Island and

Photo by G. Rusanov

at the adjacent waters stay up to 8 000 – 9 000 whooper swans, in October-November, up to 12 000. Local and passing mute swans keep together with them. Many-voiced chorus of whooper swans in the avandelta is the call for mass migrations not only for swans but also for other species of *Anseriformes* as well. Autumn stops of swans are long. Whooper swans keep at shallow waters of *kultuk* area until the river totally freezes over. Before the sea level uplift, at the Damchiksky cluster has formed the largest autumn grey geese accumulation in the Volga delta – up to 30 000 birds. Many swans and geese feed with rhizome and drupes of lotus that grows extensively at the Damchiksky cluster of the Reserve.

The Reserve is located at one of the largest migration routes of waterfowl and near water bird species nesting at the West Siberian plain, Northern Kazakhstan and other regions and wintering at the vast area of the south of Western Europe, Africa and Southwest Asia.

In spring, transitional migrations prevail. Major part of birds stop at the delta for a short time. Birds mostly keep at shallow reed bed areas of the delta. Total number of water birds per season is estimated as 7 million specimens (Krivenko et al., 1998).

Bird fauna of the Reserve counts 279 species, of which 99 nest at the Reserve's area, 155 are met during migrations and wintering and 23 irregularly visit the area (see table). The basis of local bird fauna is made of wetland species nesting on trees or in reed beds, but trophically connected with water reservoirs; over 30 species are forest dwelling birds, only 3 species belong to meadow ecosystems and 3 to synanthropic species. Bird population of the Reserve is distinguished by diversity and large size. Richness of bird fauna is determined by peculiarities of ecological conditions and geographic location.

The Reserve's area is the part of the Wetland of International importance.

Photo by A. Butorin

Bird species of the Astrakhansky Reserve

Order	Total species	Number of nesting species	Passing through, shifting, wintering, aestivating species	Irregularly visiting species
Podicipediformes	4	4	-	-
Pelecaniformes	4	3	1	
Ciconiiformes	12	11	-	1
Phoenicopteriformes	1	-	-	1
Anseriformes	29	10	14	3
Falconiformes	24	8	15	1
Galliformes	3	3	-	-
Gruiformes	13	6	5	2
Charadriiformes	52	8	39	5
Columbiformes	5	3	2	-
Cuculiformes	1	1	-	-
Strigiformes	7	3	3	1
Caprimulgiformes	1	-	1	-
Apodiformes	1	-	1	-
Coraciiformes	4	2	2	-
Upupiformes	1	1	-	-
Piciformes	5	2	2	1
Passeriformes	112	34	70	8
Total	279	99	155	23

Upon the results of zoogeographical analysis, 50% of bird species nesting in the Volga delta belong to transpalearctic group or other even more widespread groups, 24.1% belong to European fauna type, 15.8%, to Mediterranean fauna type, 9.2%, to Mongolian, and 0.9%, to Chinese.

Within the Reserve's area are met 80 % of bird species, which nest over the whole delta of the Volga; during the migrations period was noted 96% of bird species of this category.

The Volga delta is the habitat and temporary dwelling area for a line of rare and disappearing bird species inscribed on the 2006 IUCN Red list (18 species) and into the Russian Federation Red Data Book (42 species). 64 bird species have been inscribed into the Red Data Book of Astrakhansky Region. 27 bird species of the Russian Red Data Book are nesting in the Astrakhansky Reserve, like Dalmatian pelican (*Pelecanus crispus*) (small colonies at Damchiksky and Obzhorovsky clusters), spoon-bill (*Platalea leucorodia*), glossy ibis (*Plegadis falcinellus*), buff-backed heron (*Bubulcus ibis*) (single nest found at Trekhizbinsky cluster), osprey (*Pandion haliaetus*) (3-4 pairs), white-tailed eagle (*Haliaeetus albicilla*) (up to 50-70 pairs on three clusters), saker falcon (*Falco cherrug*) (formerly one pair was nesting at Damchiksky cluster), little bustard (*Tetrax tetrax*) (2-3 pairs at Damchiksky cluster), black-winged stilt (*Himantopus hi-*

Photo by G. Rusanov

mantopus) (several pairs at the same cluster). Upon confirmed data, gallinule (*Porphyrio porphyrio*) is nesting at areas adjacent to Damchiksky cluster. During shifts and migrations are common great black-headed gull (*Larus ichthyaetus*), little cormorant (*Phalacrocorax pygmaeus*), lesser white-fronted goose (*Anser erythropus*), black-winged stilt (*Himantopus himantopus*), peregrine (*Falco peregrinus*); rare but regularly are met during migrations red-breasted goose (*Rufibrenta ruficollis*), golden eagle (*Aquila chrysaetos*), steppe eagle (*Aquila rapax*), white crane (*Grus leucogeranus*), avocet (*Recurvirostra avosetta*), Norfolk plover (*Burhinus oedicnemus*), great bustard (*Otis tarda*), European white pelican (*Pelecanus onocrotalus*). Black stork (*Ciconia nigra*) and flamingo (*Phoenicopterus roseus*) are visiting species; encounters of Bewick's swan (*Cygnus bewickii*), marbled duck (*Anas angustirostris*) and white-headed duck (*Oxyura leucocephala*) are possible although they haven't been met for a long time.

In the above water part of the delta dwell forest birds. Among them are common willow nesting species: great tit (*Parus major*), blue tit (*Parus caeruleus*), starling (*Sturnus vulgaris*), oriole (*Oriolus oriolus*), crow (*Corvus cornix*), magpie (*Pica pica*), tree sparrow (*Passer montanus*), penduline tit (*Remis pendulinus*); numerous are Cetti's Warbler (*Cettia cetti*), ring-dove (*Columba palumbus*), greater spotted woodpecker (*Dendrocopos major*), white-tailed eagle, hobby (*Falco subbuteo*); near the northern boundary of the Damchiksky cluster are met rook (*Corvus frugilegus*) and red-footed falcon (*Falco vespertinus*). In osier-beds and the neighboring reeds dwell pheasants (*Phasianus colchicus*). After high floods and severe winters, the number of pheasants decreases but then their population usually recovers. In the spring and summer period at 1 000 ha of the preserved lands dwell only 50 male specimens, and in autumn on all three clusters – in total about 2 000 pheasants.

For reed and cattail associations is typical reed bunting (*Emberiza schoeniclus*), bearded tit (*Panurus biarmicus*), great reed warbler (*Acrocephalus arundinaceus*) and marsh warbler (*Acrocephalus palustris*), Savi's warbler (*Locustella luscinioides*) and sedge warbler (*Acrocephalus schoenobaenus*). Some species dwell in very diverse lands, like

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the numerous crows, which, beside the osier-beds, have inhabited reeds in the kultuk zone and the avandelta (in the last decade). In the mass nesting areas of water birds and colonial species crow has become an active depredator long time ago, therefore its population is being regulated at the Reserve. Between northern and southern boundary of the Reserve cuckoo (*Cuculus canorus*) is met often, especially at the Obzhorovsky cluster (up to 10 specimens per 10 km of the route). It lays eggs generally into warblers' nests.

Willow associations occupy small areas near the northern boundary of the preserved clusters, that is why bird species peculiar to osier-beds are few in number. These are rarely nesting little bustard, quail (*Coturnix coturnix*) and blackcap (*Saxicola torquata*).

In winter water reservoirs of the Reserve usually freeze. At few ice-holes and the avandelta may winter swan, smew, merganser and tufted duck. The number of white-tailed eagles increases due to shifts from other regions. In warm summers some duck, heron and perching bird species remain at the Reserve.

The most numerous are water and near-water birds: swans, geese, river and diving ducks, cormorants, herons, gulls and terns.

The most numerous duck species, mallard and pintail, start migration in early March, mass migrations fall on mid and late March. Such widespread species like European teal, tufted duck and golden-eye pass in late March and early April.

Photos by G. Rusanov

Of geese, the main migrant is grey goose, generally of local population, which appears in the Volga delta among the first arriving species.

Whooper swan is transit specie, numerously passing by among the first coming species. Migrations of mute swan are noted starting from mid March. Mute swans are mostly presented by local birds and the significant number of specimens nesting and casting feathers in Kazakhstan.

Of other groups is noted the pass of black-headed gull and some northern species of Limicolae genus.

In autumn, transit migrations of many species are poorly expressed, except whooper swan, and partly, white-fronted goose (Anser albifrons). Total number of migrant birds in different years is estimated from 5 to 10 million specimens. Last years, due to increasing of depths, the role of the Volga delta as stopover area for migrating water birds has significantly decreased. Upon aircraft counts, the number of migrating Anseriformes in the avandelta of the Volga has last years made up to 3 million specimens, including 160-190 thousands of swans and over 2 million of diving ducks.

Species composition of water birds coincides with the spring one. Significant increase of migrating birds is noted in early October. Mass flight falls on late October and November.

Photo by G. Rusanov

Anseriformes are the most diverse in species and most numerous in the wetland species group. Many mute swans, grey geese, mallards and pochards are nesting. Mute swan demonstrates the positive influence of the Reserve to its population in the Volga delta. Restoration of the mute swan population has first begun at the Reserve's territory. The first nest was found at Obzhorovsky cluster in 1938. In late 1940-s nesting has become regular, and in 1953 15 pairs have been noted here. At the Trekhizbinsky cluster first swans' nests have been discovered in 1952, at Damchiksky cluster, in 1953. Mute swans began settling outside the Reserve's area, especially on lands near Obzhorovsky cluster. In 1961 at Obzhorovsky cluster 215 pairs were nesting, 162 of which were situated in groups by 5-7 nests, and one group even counted 30 nests. The total number of the delta population has reached 755 pairs in 1963. In 1967, the swan population size has reached its maximum of 327 pairs, and then started reducing as birds settled the adjacent areas. In 1981-1984 at Damchiksky clusters nested from 270 to 400 pairs, at Trekhizbinsky, from 4 to 11 pairs, at Obzhorovsky, from 250 to 350 mute swan pairs. The total number of pairs within the whole delta made 4-5 thousand pairs. In early 1990-s, due to the water level rise, the number of nesting pairs sharply decreased. At present time the number of nesting pairs has stabilized. In conditions of changing hydrological regime, the mute swan is the most ecologically flexible specie.

Before the establishment of the Reserve, there was still a rather high delta grey goose population. After the organization of the Reserve and taking other measures for the bird fauna protection the number of grey geese has significantly increased. In mid 1920-s at the Reserve's clusters geese nested "in immense quantities". The population decrease has started in 1984 and kept almost unchanged until the beginning of the current century.

Photo by G. Rusanov

The common coot (*Fulica atra*) dwells at all wetlands but is especially numerous in the kultuk zone and the avandelta, where it nests in reed beds and bur-reed beds (was nesting formerly before the water level rise). In late summer flocks of 1500-2000 mature and young coots shift along shallow areas near avandelta islands; in autumn many thousands coots accumulate at open reaches of the avandelta.

Before the Caspian Sea level rise a huge number of ducks (mallards, pintails, garganey teals, European teals, gadwalls, wigeons and red-crested pochards) spent the summer molting period within the Reserve. Accumulations (displays) of molting ducks start forming from June. First come mallards, then pintails, gadwalls, later, teals. The displays are situated in solitary areas not attended by people, with rich pabular vegetation and good flowage. Here in July-August form accumulations of 0.2-6 thousands of molting ducks. At Obzhorovsky cluster they are concentrated in the coastal waters near Blinov island, at Damchiksky cluster, near Makarkin island. Due to low flowage, no massive ducks molting areas are formed at the Trekhizbinsky cluster. In mid August, molted ducks remain in molting areas, and then shift to open shallow waters of the avandelta. Annually up to 25 thousand ducks molted within the Reserve.

Of special interest are colonies of Ciconiiformes and Pelecaniformes. Willow forests serve as their main nesting areas. Here is noted the rare phenomenon: for many years at all clusters exist colonies where nest together grey heron, pond heron (*Ardeola*

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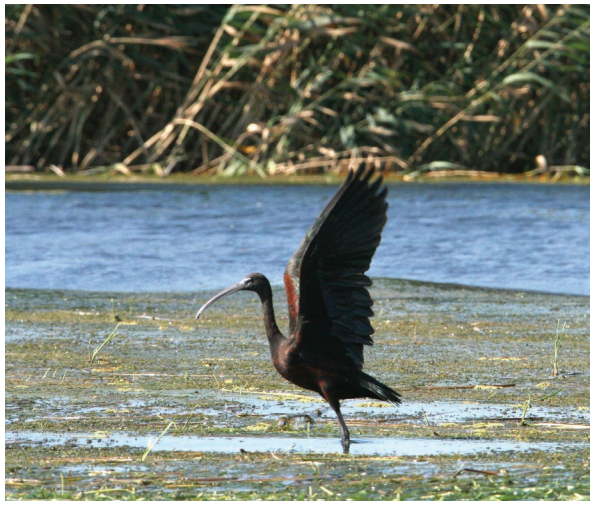
ralloides), great egret, little egret (*Egretta garzetta*), night heron (*Nycticorax nycticorax*), spoon-bill (*Platalea leucorodia*), glossy ibis (*Plegadis falcinellus*), and rarely buff-backed heron (*Bubulcus ibis*). Cormorants nest separately, but also may settle in herons' colonies. In 1981-1985, 7500-9000 cormorants and 1800-4700 Ciconiiformes have been nesting within the Reserve. The population size of these species has been changing within natural limits peculiar to local populations. Cormorants and herons fly feeding to the shallow sea armlets, or kultuks, and to spring floods rich with fish and water invertebrates.

In varying conditions cormorant is the most ecologically flexible specie. In colonies of the Reserve nest about 30% of their total delta amount. Especially large colony has been formed at Obzhorovsky cluster (7250 nests).

Colonies of cormorants and Ciconiiformes play an important role in ecosystems of the lower Volga delta ecosystems. In areas of mass nesting a large amount of mineral (excrement) and organic matter (eructation, dead nestlings, eggs) come into water, which influences the biogenic matter concentration in kultuks and channels. Feeding on fish, colonial birds take part in transformation of live organic matter through water reservoirs of the lower delta.



Many animals keep at colonies of the fish-feeding birds. Wild boar likes to come here to eat nestling food remains or nestlings that dropped out of their nests. For the same reason here comes wels. White-tailed eagle catches fish eructated by cormorant. Among nests of cormorants and herons constantly whisk numerous ravens (*Corvus cornix*),

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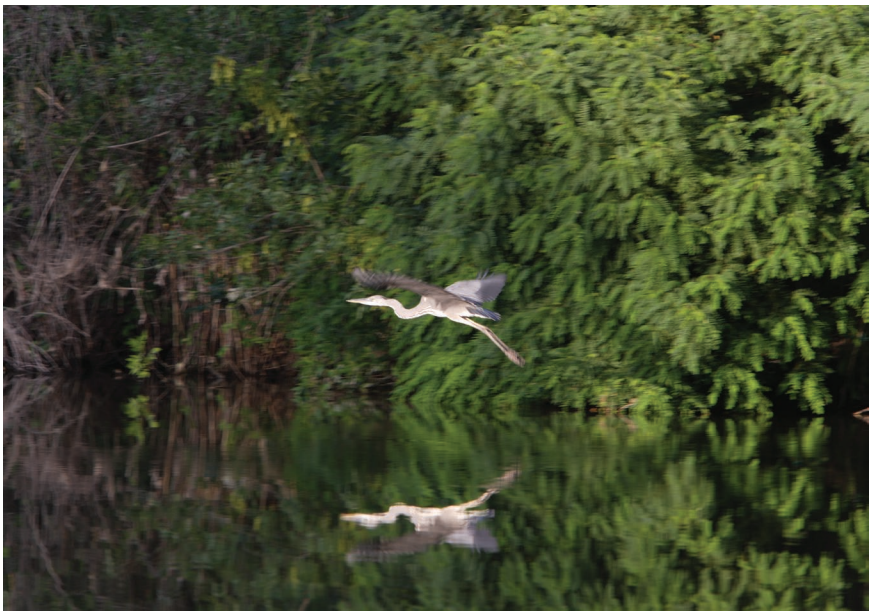

Photo by G. Rusanov

gathering abundant tribute of eggs and nestlings. The colony lives intensively starting from the coming of first cormorants in March until late July, when all the nestlings spread their wings and leave their birthplace. Heron, spoon-bill and glossy ibis do not visit colonies until the next year; cormorant comes to colony overnight if it is located in the kultuk zone, until late Autumn.

Formerly numerous pelicans were nesting at Damchiksky cluster but due to environment change their nesting areas have moved to the avandelta outside the Reserve over 20 years ago. Last years several Dalmatian pelicans (*Pelecanus crispus*) (up to 10 pairs) were nesting near the southern boundary of the Damchiksky cluster. Annually in July-August near the southern boundary of the Obzhorovsky cluster's buffer zone form accumulations of migrating Dalmatian pelicans of 3000-4500 specimens. In September they usually shift, but under favorable conditions may stay here the whole autumn.

Great-crested grebe (*Podiceps cristatus*) is numerous in waters of the kultuk zone and the avandelta. It prefers nesting in reed mace beds and by the sides of reed beds and also in open water at the most shallow areas of the avandelta forming colonies up to 100 and more pairs. The largest accumulation of 350 nests has been discovered near the southern boundary of the buffer zone of Obzhorovsky cluster.

Photo by A. Butorin

Whiskered tern, black tern, white-winged tern and common tern (*Sterna hirundo*) are common within the Reserve. Especially numerous is whiskered tern, which forms colonies in July-August over floating aquatic vegetation at kultuk zone and near avandelta islands. Zooplankton at terns' colonies is significantly richer than outside. Bird accumulation attracts predacious fish species – wels, pike, and also large lake frogs which feed on tern nestlings. After young terns learn to fly, numerous flocks of whiskered tern and other terns keep to nesting areas for a short time and in September shift away from the lower delta.

White-tailed eagle is the most numerous prey bird specie. It can be considered as the landscape specie of the seashore part of the delta. Long-term monitoring of its population has showed that the population is stable, within the Reserve the population is increasing. In autumn one can observe the unique scene of white-tailed eagle accumulation – up to 10 birds sitting on one tree, including young and migrating birds.

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Photo by G. Rusanov

Groups of forest and reed complex, especially perching birds, are distinguished by high diversity and number.

Rare bird species.

Species inscribed into the International Red Data Book:

Dalmatian pelican (*Pelecanus crispus*) – rare nesting specie. From 1930 until 1967, Dalmatian pelicans were nesting within the Astrakhansky Reserve. Shallowing and overgrowing of the seashore caused their resettlement to the south, to deeper areas of the North Caspian. In the beginning of the current century, small nesting colonies have again appeared at Damchiksky and Obzhorovsky clusters. The Volga delta population size is 30-240 pairs with decreasing tendency. Dalmatian pelican has been inscribed on the 2006 IUCN Red List as vulnerable specie (VU).

Ferruginous duck (*Aythya nyroca*) - molting, passing by and a very rarely nesting specie. Ferruginous duck is nesting at hard to reach areas (insular reed timbers) which determines exceptional scarse nest findings. It molts also in hard to reach areas at small insular water reservoirs and at flooded reed beds. Formerly in early autumn ferruginous duck has formed small accumulations at areas with abundant aquatic vegetation (often together with common coot) at Damchiksky cluster. Autumn pass lasts until late November. Ferruginous duck has been inscribed on the IUCN Red List 2006, the population size decreases.

Marbled teal (*Anas angustirostris*) seems to be extinct in the Volga delta. The disappearing specie. No marbled teals were found in ducks capture for ringing in 1961-1983. Was noted in the Volga delta.

Saker falcon (*Falco cherrug*) - few cases of nesting registered. Specie with a decreasing population.

Rolle (*Coracias garrulus*) - nesting and passing by specie. Stays at the delta from late April until late September. Roller is nesting in hollows and tree cracks. Is regularly met on communication and power lines.

The Reserve's area plays an important role not only as a nesting area for rare species, but also as a stopover place and rare species' wintering area. Of water birds such rare species as **lesser white-fronted goose** (*Anser erythropus*) and **red-breasted goose** (*Rufibrenta ruficollis*), an endemic of Western Siberia, the only relic representative of Branta genus, are met on passage.

White-headed duck (*Oxyura leucocephala*), the relic specie under threat of extinction, is occasionally visiting the area.

Photo by G. Rusanov

The most valuable prey birds are steppe and forest steppe representatives which often visit the reserved area during movements. These are **pale harrier** (*Circus macrourus*), Eurasian steppe endemic, **spotted eagle** (*Aguila clanga*) and the disappearing **lesser kestrel** (*Falco naumanni*).

For the disappearing **white crane** (*Grus leucogeranus*), the passing specie, the Reserve plays an important role in conservation of its Ob population. White cranes wintering in Iran stop over here. Since 1928 till 1985, from 2 to 22 white cranes have been observed at Damchiksky cluster of the Reserve. In March 1991, 5 birds were seen near the eastern boundary of this cluster. During last decades, 1-4 birds have been observed at Obzhorovsky cluster during spring and autumn flights.

Otidae family is presented by two species, **great bustard** (*Otis tarda*) and **little bustard** (*Tetrax tetrax*), both inscribed on the 2006 IUCN Red List. Small number of great bustards is noted during migrations: between 1976 and 1985 at Damchiksky cluster were registered 6 encounters of single birds and flocks of 4-11 specimens. Little bustard has been irregularly nesting near the northern boundary of this cluster, in autumn here appeared migrating flocks of up to 100 birds.

The threatened **sociable lapwing** (*Chettusia gregaria*), endemic of Russia and Kazakhstan, and **black-winged pratincole** (*Glareola nordmanni*) are rarely visiting the northern boundary of the Reserve.

For the List of bird species of the Astrakhansky Reserve, please, see Annex C1.
The List of mammal species of Astrakhansky Reserve is provided in Annex C2.
For the List of the Red Data Book species of the Astrakhansky Reserve, please, see Annex C3.

Photo by G. Rusanov

2b. History and development

Geologic history

The history of the development of the Volga Delta is tightly connected with that of the Caspian Sea. The Caspian Sea level fluctuations are much higher in frequency and amplitude than those of the global sea level. The Caspian Sea level reached its maximum high stand of +50 m AMSL in the Upper Pleistocene and was at its minimum low stand of – 100 m AMSL in the Early Holocene. The average amplitude of sea-level fluctuations was found to be about 25 meters in the late-Holocene sea level cycle (about 2 500 years long) and about 3 meters in the instrumental observation period (i.e. during the last 150 years).

The causes of cyclic changes in the Caspian sea level still stay unclear but most scientists believe that they are caused mainly by climate change. The Volga provides most of the Caspian fresh water inflow which increases with increasing precipitation in the Volga Basin. At least during the instrumental observation period, a tight correlation has been observed between variations of the Volga River discharge and the Caspian sea-level fluctuations.

Caspian sea-level changes were accompanied by respective changes in the location of the sea coastline. Thus, in Late Pleistocene, during the period of maximum marine transgression the northern border of the Caspian Sea approached the foot of Obshiy Syrt. The subsequent regression resulted in the drying up of the entire northern Caspian Sea area bordered by the Mangyshlak sill. Therefore, over the course of its geologic history, the Volga Delta migrated hundreds of kilometers north and south from its current position.

The modern Volga Delta began to form about 9 000 years ago when the Neocaspian transgression followed the significant Mangyshlak regression. At the first stage of the transgression the sea level culminated at -26 … -25 meters AMSL and remained stable over a long period of time. During that period the earlier Volga Delta formed at the present site of the Upper Volga Delta but it was flooded due to renewed sea level rise. Then, during the subsequent Derbent regression the Volga Delta moved forward into the southern part of the modern northern Caspian Sea. Since the final stage of the Neocaspian transgression finished 2 500 years ago, the Volga Delta kept growing southward while the position of its top point remained constant. In that period the delta system possessed a high susceptibility to short-term fluctuations of generally decreasing sea level: a sea level fall caused the seaward grouth of the delta while an increase in sea level led to the delta's vertical grouth and the accumulation of a fine sediment layer over the earlier alluvial deposits within the delta plain.

Clusters of the Astrakhansky Reserve are located in the Lower Delta plain which started to shrink in the middle of the 19th century. The major growth of the area was registered during the 1929-1977 sea level fall.

The Volga Delta obtained its current shape between 1929 and 1995 during the last sea-level cycle which was characterized by 2, 5 meter sea level fluctuations.

During the 1929-1977 sea level fall the delta area significantly increased in size. Thus, the sub aerial delta edge prograded 5-7 kilometers seaward. The avandelta's shoals became large size delta islands (Makarkin Island, Zudev and Blinov islands and others). Reed thickets occupied a considerable part of the delta's shallow water. In this period the total area of the Volga Delta (incl. islands) increased 1, 5 times.

In 1978 a sea-level rise-up started. Deepening of the avandelta and the subsequent change in the sea wave regime led progressively to almost utter flooding of the delta's islands and to a significant reduction of the reed bed area. At the same time not only marine edge of the delta remain stable but it also prograding in some places (in the Damchinsky sector of the Astrakhansky Reserve, for example) though not so fast as before.

History of development

Sparse population of the Lower Volga Delta region and, as a concequence, better conservation of natural complexes here in comparison with other Delta areas were a good ground for the establishment of the Reserve here. However, even these once rich ecosystems were significantly disturbed by the time of the establishment of the Reserve. Hunters camped on the seashore and on the banks of the Delta channels far from settlements. They hunt almost the year round on the seashore and near the ilmen's. As a result, breeding sites of mute swan (Cygnus olor) totally dissapeared and populations of gray goos (Anser anser), pheasant and wild boar significantly reduced greatly. Some Coconiiformes species (Egretta alba, Egretta garzetta, Platalea leocordia) were critically engangered because of severe hunting for beautiful coat and feather.

After the establishment of the Reserve economic activities were stopped and conservation measures were provided due to which the population level of many species were restored. No economic activity carried on in the territory of the Reserve but activities aimed at wildlife mitigation, scientific researches and environmental education.

Natural complexes of the Reserve were affected mostly by the regulation of the Volga River flow by the cascade of water power plants, the last of which – Volzhskaya Hydropower Plant – was built up in 1958 near Volgograd. It caused a decline in the water level and duration of seasonal spring and summer floods; it also caused the change of flood water level rise rate and period of duration of flood phases. It also raised winter water level up to the level observed in high water periods.

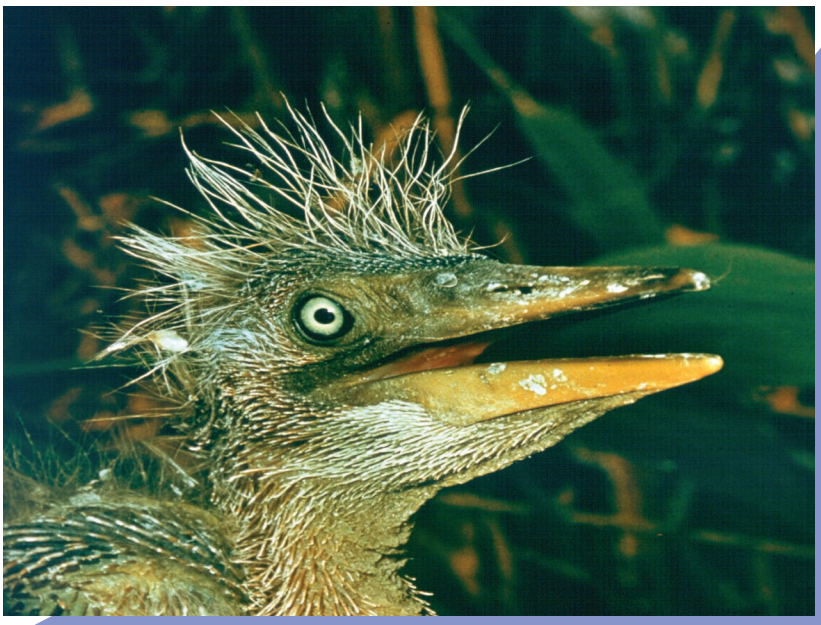
In 1963 r. steadily increasing reed harvesting for the pulp and paper industry started in the Delta areas, including those adjacent to the territory of the Reserve. Industrial-scale winter reed cutting, grazing, hay making and unsufficient water inflow in certain years led to fast reduction of reed fields gradually replaced by grass meadows and even by salt marshes.

The significance of agricultural activity in the Delta region grew with launching in 1965 in the former USSR a long-term program for the development of irrigated agriculture in the Volga River basin. Rice cultivation become important, which resulted in a continuous growth of leveed and irrigated areas in the Delta region, outside of the Reserve's borders. Irrigating draft grew in proportion to irrigated areas, which caused the pollution of waters by crop treatment products. Many flood inundation areas, which had served as spawning grounds, were leveed.

In 1990s, after the collapse of the USSR, many agricultural lands were abandoned due to the change of social and economic system. Application of fertilizers and pesticides was reduced at once. The water pollution reduced as well owing to a significant drop in industry's output and shipping. Environmental situation in the Delta got much better. However, at the same time scientific and economic ties between Caspian states were cut, which created favourable conditions for illegal and uncontrolled use of natural resources such as large-scale poaching of sturgeon and other fish species and vandal waterfowling. Exploration and production of natural gas and oil has started on the Northen Caspian shelf.

In this situation the territory of the Reserves becomes of great importance as a sample of natural complexes of the Volga Delta. A part of the Reserves territory - located in the Lower Delta plain - formed after the establishment of the Reserve. This recently formed virgin area has never been affected by economic activity.

3
JUSTIFICATION FOR INSCRIPTION



S. FOMIN

3. JUSTIFICATION FOR INSCRIPTION

3a. Criteria under which inscription is proposed (and justification for inscription under these criteria)

The Volga Delta natural site is nominated for World Heritage status under the following criteria:

vii Contains superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance.

Because of its mosaic structure where water landform elements (narrow and wide river channels, gulfs and open water areas) are naturally combined with terrestrial landform elements (islands of different size, shoals) and vegetation (gallery osier and reed beds, mace reed, wet meadows) the Volga Delta has an low-key but very much aesthetically pleasant, pacifying landscape. But during the blooming season of the lotus (also called Caspian Rose) the delta has an eye-catching, magnificent look thanks to floating carpets made of hundreds of splendid rose-colored flower buds!

viii Outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features.

The Volga Delta is Europe's largest river delta and one of the world's biggest river delta systems. The Volga River flows into the Caspian Sea, the Earth's largest landlocked water body that does not connected to the ocean in the present geological era.

The history of the development of the Volga Delta is tightly connected with that of the Caspian Sea. The Caspian Sea level fluctuations are much higher in frequency and amplitude than those of the global sea level. The Caspian Sea level reached its maximum highstand of +50 m AMSL in the Upper Pleistocene and was at its minimum lowstand of – 100 m AMSL in the Early Holocene. The average amplitude of sea-level fluctuations was found to be about 25 meters in the late-Holocene sea level cycle (about 2 500 years long) and about 3 meters in the instrumental observation period (i.e. during the last 150 years).

Over the course of its geologic history the Volga Delta changed its location in connection with the Caspian sea-level changes. Thus, the delta migrated hundreds of kilometers north and south from its current position. The modern Volga Delta began to form about 9 000 years ago when the Neocaspian transgression followed the significant Mangyshlak regression. The final stage of the Neocaspian transgression finished 2 500 years ago, since then the Volga Delta kept growing southward while the position of its top point remained unchanged. In that period the delta system possessed a high susceptibility to short-term fluctuations of generally decreasing sea level.

The causes of cyclic changes in the Caspian sea level still stay unclear but most scientists believe that they are caused mainly by climate change. The Volga provides most of the Caspian fresh water inflow which increases with increasing precipitation in the Volga Basin.

Photo by A. Butorin

In the last tens years the Caspian Sea coast is drawing the attention of scientists in relation to global environmental changes. Global warming has sped up worldwide sea levels rise that has resulted in coastal line changes. The forecast of the impact on the coastal ecosystems proves difficult because of a slow rate of the sea level growth (by 13 centimeters in the 20-th century). The average rate of the most recent Caspian sea level rise was 100 times greater than that of the eustatic global mean sea level rise. In connection to this, the Caspian Sea is an important natural laboratory to study short-term sea level fluctuations and their effects on a coastal zone (Kroonenberg et al., 2000). The Caspian Sea provides a unique chance to monitor in natural conditions the mechanism of response of the coastline to water level rise and to use the obtained information further to build and test different forecast models.

The modern Volga Delta bank and underwater slope gradients are the lowest among large river deltas throughout the world (less than 5 cm/km). As a result, the delta has extremely complicated hydrographic system that includes large distributary channels, smaller waterways, *erikas* (narrow channels less than 30 meters in width), *ilmens* (small lakes) and isolated bays (*kultuks*). The delta also possesses an extensive avandelta (subaqueous part of the delta) with depths of 1,5-2,5 meters that stretches 35-50 kilometer out into the sea. River waters flow down slowly over a shallow avandelta off

to the sea and thus the zone of river and sea water mixing is located several tens of kilometers away from the subaerial delta sea edge. The total area of the Volga Delta (incl. the avandelta) is over 20 000 square kilometers. The entire Volga River mouth area occupies 120 000 square kilometers (Mikhailov, 1997).

Therefore, the Volga Delta as a world scale unique natural property notably different from any of existing World Heritage river delta sites. The distinctive features of the Volga Delta are as follows: huge size, vast subaqueous part of the delta (avandelta), the zone of river and sea water mixing that is "moved" tens kilometers off to the sea, remarkably complicated hydrographic network, a very indented coastline, plenty of islands, high velocity of natural processes influenced by rapid Caspian sea level fluctuations.

ix **be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals.**

The Volga Delta is an integral part of the Caspian Sea ecosystem, which development during geological time in many respects depended on cyclic sea-level fluctuations of the Caspian Sea. In the periods of marine transgressions the Caspian Sea flooded extensive plains adjacent to the sea and became connected to the World Ocean. During the periods of marine regressions the area of the sea significantly decreased, sometimes to the limits of the South Caspian Basin, that led to the drying up of large portions of the seabed. As a result, the Caspian biota includes representatives of both southern and northern flora and fauna. The sturgeons, the herrings, the bullheads are all the remnants of the Tertiary fauna that underwent considerable changes over the course of a rich geological history of the Caspian Sea. Another group of the Caspian biota includes species came from northern seas, such as Caspian seal, salmon and white salmon, which still demonstrate some traits of cold-water behavior (e.g., winter breeding). Some factors, including a significant length of the Caspian Sea, combination of extensive shallows and deep-water zones and the diversity of environment, helped the biota to adapt to frequently changing environmental conditions.

Sites especially important for the ecosystem of the Caspian Sea are so-called «life concentration zones», that means first river deltas. The most significant of them for the Northern Caspian Sea (as well as for the entire Caspian Sea) is the Volga Delta. Tens of fish species (incl. river, anadromous and semi-anadromous fish) concentrate there; it is also a home to a number of rare water plants, such as the lotus, *Trapa natans*, *Salvinia natans* and some other species. Vast wetlands make the Volga Delta one of the most important bird habitats in Eurasia. During the flood period, the *poloi* system of the delta with its temporary water reservoirs takes on special significance as breeding and feeding ground for the young of many fish species. In general, the Volga Delta ecosystem possesses the highest biodiversity in the Caspian Sea region.

Periodic marine transgressions and regressions caused periodic changes in the water and salt balance of the Caspian Sea, which, in its turn, had certain effect on the evolution of aquatic organisms. Sea-level fluctuations influenced not only the evolution of marine ecosystems but also the development of the entire Caspian Sea drainage area. The Caspian Sea is the base level of tens of large, middle-size and small rivers. A sea-level fall intensifies sediment flow-out and results in deeper cutting in of the riv-

ers, while a sea-level rise slows down the river flow, reduces solid sediment flow-out, causes ground water level rise, underflooding of coastal area, salinization of soils and, as a result, it causes changes in the species composition of coastal communities, etc.

In relation to the climatic conditions, the Lower Volga is Europe's most arid region. Only here in the Peri-Caspian area desert phytocoenosis form zonal vegetation types. The region has an acutely continental climate. But it wasn't always like that. During only the Holocene period climatic changes repeatedly caused fundamental reorganization of plant communities. Periods of the climate humidification coincided with marine transgressions and were characterized by the prevalence of forest and steppe ecosystems with considerable presence of broad-leaved species (*Carpinus gen., Fagus, Ulmus gen., Quercus*) and coniferous species (*Pinus, Picea, Abies*). On the contrary, dehumidification of the climate led to the sea-level fall and therefore defined the prevalent development of steppe-desert and desert ecosystems.

Thus, the mouth area of the Volga River is an illustrative example of significant long-term ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals. The processes have resulted in the development of plant and animal communities capable to adapt to frequent and rapid changes of environmental conditions.

Photo by G. Rusanov

X **contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.**

The flora of the Astrakhansky Reserve exhibits a unique diversity of plant communities developed in intrazonal environment. Due to increasing man-made transformation of landscapes and growing load on natural ecosystems the significance of the Reserve as a protected area has also increased. Currently the Reserve provides proper conservation of floral and coenotic diversity as well as optimum life conditions for numerous plant communities. The flora of the Astrakhansky Reserve includes a total of 314 vascular plant species, with 4 species included in the Red Data Book of the Russian Federation: *Nelumbo caspica, Trapa natans, Marsiliea aegyptiaca and Aldrovanda vesiculosa*.

The diversity of environmental conditions (water depth, lowage and weediness of waters) found in water reservoirs of the Reserve accounts for the diversity of fish species (a total of 56 species belonging to 12 families). The region is a global scale center known for the diversity and wealth of its fish fauna, with special emphasis on the diversity and richness of sturgeon species (*Acipenseridae*). *Huso huso, Acipenser gueldenstaedti, A.stellatus* are common here, *A.ruthenus* can also be found in the Reserve.

The Volda Delta is a crossroad of flyways of many migratory waterfowl and water-related bird species. The Astrakhansky Reserve is located within the global transcontinental flyway that means that the area is of an outstanding value for biodiversity conservation. 80% of species nesting within the Volga Delta are found in the Reserve's area, while during the migration season 96% of species of this category can be observed.

Photo by G. Rusanov

Photo by G. Rusanov

The Volga Delta provides habitat or temporary refuge for a variety of rare and endangered birds, which are inscribed on to the IUCN Red Data Book (18 species, as of 2006) or to the Red Data Book of the Russian Federation (42 species). 64 bird species are entered in the Red Data Book of the Astrakhanskaya Oblast'.

Bird species listed in the International Red Data Book include *Pelecanus crispus, Aythya nyroca, Anas angustirostris, Falco cherrug, Coracias garrulus, Otis tarda* and *Tetrax tetrax*.

The nominated property is not only the habitat of rare and endangered nesting species. It is also a vital migratory stop-over site and wintering area for threatened migratory birds. Regarding waterfowl, some rare species are found here on passage, for example, *Anser erythropus* and *Rufibrenta ruficollis*, an endemic species of the Western Siberia and the only relic representative of this genus. *Oxyura leucocephala*, another threatened relic species, has also been observed occasionally in the Reserve. Among Falconiformes the most valuable species are *Circus macrourus*, an endemic of *Eurasian steppes*, *Aguila clanga*, and endangered *Falco naumanni*. The Reserve plays an important role in the conservation of the Ob population of *Grus leucogeranus*, a threatened migratory species, as a stop-over point for cranes migrating to their wintering ground in Iran. Visitations of *Glareola nordmanni* and *Chettusia gregaria*, an endangered endemic species of Russia and Kazakhstan, have also been registered.

3b. Proposed Statement of Outstanding Universal Value

The Volga Delta forms where the Volga River - great Russian river, the largest river in Europe, and the true symbol of Russia - meets the Caspian Sea. The Caspian Sea is the Earth's largest landlocked water reservoir that does not connected to the sea in the modern geological period. The sea is characterized by rapid and significant water level fluctuations accompanied by changes in the water surface area and water volume. The average rate of the most recent Caspian sea level rise was 100 times greater than that of the eustatic global mean sea level rise; the last Caspian sea-level cycle (1929-1995) has resulted in a 3-meter water level drop.

The Volga Delta is one of the world's most dynamic river deltas. It has a very specific hydrological regime as a result of the interaction between a large Volga River and a landlocked basin of the Caspian Sea.

The Volga Delta is the largest delta in Europe and one of the world's largest deltas. It is situated in the Caspian Depression, which is one of the lowest points on the Earth (27 meters below sea level). The Volga Delta bank and underwater slope gradients are the lowest among large river deltas throughout the world (less than 5 cm/km). The delta thereof has extremely complicated hydrographic system and is characterized by an extensive avandelta (the subaqueous part of the delta) with depths of 1,5-2,5 meters that stretches 35-50 kilometer out into the sea. River waters slowly flow down over a shallow avandelta off to the sea and thus the zone of river and sea water mixing is located several tens of kilometers away from the delta's marine edge. The total area of the Volga Delta (incl. avandelta) is over 20 000 square kilometers.

The Volga Delta has probably the most complicated hydrographic network in the world. Approximately 1 000 waterways reach the marine edge of the delta. That very tangled network of channels and lakes in combination with rich vegetation makes the landscape very peculiar. It is also makes the delta an oasis-looking area placed against a background of flat and monotonous, water- and vegetation-lacking deserts and semideserts.

Volga Delta is a region where mass concentration of migratory birds is observed, including many rare and endangered species. Many of them form large nesting colonies. There are a number of bird species in the territory of the Astrakhansky Reserve listed in the International Red Data Book, including Pelecanus crispus, Aythya nyroca, Anas angustirostris, Falco cherrug, Coracias garrulus, Otis tarda and Tetrax tetrax. The Reserve's territory is of great importance not only for rare and endangered nesting species. It is also a vital migratory stop-over site and wintering area for threatened migratory species.

The Volga Delta is a unique natural property possessing outstanding universal value and therefore is worthy of inscription on to the World Heritage List. Despite of showing resemblance in some characteristics to other large river delta systems, the Volga Delta as a natural complex is notably different from any of existing World Heritage sites. The distinguishing features of the Volga Delta are as follows: huge size, extensive subaqueous part of the delta (avandelta), the zone of river and sea water mixing that is "moved" tens kilometers off to the sea, remarkably complicated hydrographic network, a very indented coastline, plenty of lakes, high dynamics of natural processes

due to rapid Caspian Sea level fluctuations. Expansive lotus fields add a special charm and peculiarity to the Volga Delta landscape. During the blooming period of the Caspian Lotus (Nelumbo caspica) the Delta becomes an area of exceptional natural beauty and aesthetic importance.

3c. Comparative analysis of the property in relation to similar properties

1. GEOGRAPHIC ANALYSIS

1.1. The Udvardy scheme-based analysis (biogeographic realm level)

The Volga Delta (Astrakhansky State Biosphere Reserve) is located in Eastern Palearctic that, according to the Udvardy's realm, biome and province classification (1975) is one of the largest biogeographic kingdoms. However, this vast biogeographic region contains a comparatively small part of World Heritage (hereafter WH) properties (about 20 WH sites of 166 in total). Besides that, the sites are distributed disproportionately and located mainly in the central and eastern parts of the region (in Siberia, Russian Far East, China, Korea and Japan), while the western part of Eastern Palearctic, that possesses a wide range of ecosystems from arctic tundra on the Taymyr peninsula and taiga plains in Western Siberia to the Western Asia's uplands and Arabian deserts, until recently has been represented by the only WH site – the Arabian Oryx Sanctuary in Oman (in 2007 the sanctuary became the first site removed from the WH List since the List was established).

Thus, the Volga Delta is situated in a region with an obvious deficiency of WH sites and the designation the Astrakhansky Reserve as a WH property will be a step towards a more balanced and representative WH List.

1.2. Thematic analysis (IUCN's Global Themes)

Currently the WH List includes more than 60 properties, which can be (fully or partly) defined as wetlands. Terrestrial wetlands together with coastal and marine areas, mountains and tropical forests are best-represented biomes on the List. Wetlands most commonly found in WH sites are sea gulfs, waterlogged river valleys, lowland lake and marsh complexes, estuaries and other types of river deltas. But there are only a few sites containing large river deltas of classic (trigonal) shape. Therefore, the Volga Delta has great potential for inscription on the World Heritage List as a typical wetland and a classic-shape large river delta.

Besides, the Volga and Lena river deltas are listed among the areas that have been defined by IUCN as priorities for selecting from them new WH sites.

It is also appropriate to mention that the Astrakhansky Reserve neighbors two specific natural areas of great scientific significance: the Ilmenno-Bugrovoy region and Caspian semi-deserts and deserts. The Ilmenno-Bugrovoy region adjoins the Volga Delta on the west; the region and the delta share a common geological origin. It is an extremely exotic landscape composed of shallow, elongated lakes divided by latitude-oriented hills (the so-called Baer mounds). Caspian semi-deserts and deserts adjacent to the Volga Delta pertain to the type of continental (cold-winter) deserts - a biome that is currently under-represented on the UNESCO WH List. The only WH example

of it in Eurasia is a small desert area within the Uvs Nuur Basin (transboundary Russian-Mongolian WH site). Therefore, it seems reasonable to include the two above-mentioned areas as clusters into the Volga Delta nominating property as it would contribute to better credibility and representativeness of the WH List. These clusters can also be inscribed on the List later as an extension to an existing WH property (the expansion of existing sites is a common World Heritage practice).

2. COMPARISON WITH OTHER SIMILAR WORLD HERITAGE PROPERTIES

The Volga Delta is a unique natural phenomenon, there is no exactly the same site existing in the world. However, as follows from a comparison of some general characteristics of the Volga Delta and other World Heritage properties containing river deltas, they have some certain similarity. It is probably best illustrated by the results of a comparison of the Volga Delta with the deltas of its nearest geographical neighbors - large Eurasian rivers (see Table 1).

CRITERION VII - **natural phenomenon/ scenic site**

Because of its mosaic structure where water landform elements (narrow and wide river channels, gulfs and open water areas) are naturally combined with terrestrial landform elements (islands of different size, shoals) and vegetation (gallery osier and reed beds, mace reed, wet meadows) the Volga Delta has an unshowy but very much aesthetically pleasant, pacifying landscape. But during the blooming season of the lotus (also called Caspian Rose) the delta has an eye-catching, magnificent look thanks to floating carpets made of hundreds of splendid rose-coloured flower buds! The presence of the lotus in the landscape is the main visual difference between the Volga

Photo by S. Fomin

Table 1. The Volga Delta in comparison with the Eurasian delta systems belonging to natural World Heritage sites.

Name of a WH property and criteria for its inscription on the UNESCO WH List	Approximate measurements/area of an entire delta complex	WH property: – name – area / % of an entire delta complex	WH property: General characteristics: a) climate zone b) annual precipitation c) geological period when the development of the delta began	WH property: Biota: a) Number of mammal species b) Number of bird species c) Number of fish species d) Number of vascular plant species
Volga Delta (Russian Federation) Proposed criteria: **vii viii ix x**	150x200 kilometers/ about 2 million ha (1 million ha is an avandelta)	Astrakhansky Biosphere Reserve (3 clusters with buffer zones) 100 000 ha / 5,5 %	a) Southern temperate zone, desert zone b) about 200 mm c) Early Holocene	a) about 30 b) about 280 c) about 60 d) over 300
Danube Delta (Romania) **vii x**	70x100 kilometers/ 800 000 ha	Danube Delta Biosphere Reserve 680 000 ha / 85%	a) Southern temperate zone, steppe zone b) about 450 mm c) Late Pleistocene (Wurm-III)	a) about 40 b) over 300 c) about 60 d) about 70
Guadalquivir river delta - Marismas (Donana National Park WH site) (Spain) **vii ix x**	20x15 kilometers/ approx. 25 000 ha	Donana National Park 50 000 ha / 100 %	a) Mediterranean zone, sclerophyll forest zone b) about 550 mm c) Holocene	a) about 30 b) about 360 c) about 20 d) over 700
Ganges-Brahmaputra Delta (Sundarbans WH site, India-Bangladesh) **ix x**	300x300 kilometers/ about 8 million ha	Sundarbans National Park (India) and 3 sanctuaries (Bangladesh) with a total area of 300 000 ha / about 4%	a) Subequatorial zone, Monsoon zone b) 2000-3000 mm c) Holocene	a) about 50 b) over 300 c) over 120 d) over 300

Delta and two other European river deltas - Guadalquivir River Delta and Danube Delta - inscribed on the UNESCO WH List under criterion vii (aesthetic value; see Table 1).

Besides that, the avandeltas of the two abovementioned deltas are either weekly developed (Danube) or not developed at all (Guadalquivir River). In contrast to them, the Volga Delta in the Astrakhansky Reserve possesses numerous islands, bays, channels and shallows that make the landscape very picturesque.

CRITERION VIII – geology / paleontology / terrain

The Volga Delta is a unique landform occurred as a result of interaction between two large hydrological systems of Eurasia, the Volga River and the Caspian Sea.

World Heritage river delta complexes geographically closest to the Volga Delta are the Danube Delta (Romania), Guadalquivir Delta, (Spain) and Ganges-Brahmaputra Delta (India-Bangladesh). These sites (especially the Danube Delta) show maximum similarity to the Volga Delta (Table 1).

Some other WH sites containing river delta systems are St. Lucia Wetland Park (united inner deltas of a few rivers in the South African Republic), Djoudj Sanctuary (the inner delta of the Senegal River, West Africa, Senegal), Wood Buffalo National Park (the largest North American inner delta, Canada), Kakadu National Park (estuaries on the north coast of Australia). Being the Ramsar wetlands of international importance like the

Photo by S. Fomin

Photo by G. Rusanov

Volga Delta they, however, have not much in common with the nominating property. These delta complexes are located in other continents, have significantly different biota and their evolution goes under principally different natural conditions. None of them belongs to that classic (trigonal) type of a river delta that has been formed at the mouth of the Volga River.

There are also quite a few well-known river deltas comparable with the Volga Delta in terms of size and configuration and empting directly into the sea (for example, Lena Delta (total area about 3 million ha), Nile Delta (about 2,5 million ha), Orinoco Delta (about 2 million ha), Mississippi Delta (1 million ha)), which for some reason were not entered in the World Heritage List. But even if they did there would be no repetition since the Volga Delta is essentially different from any of them.

Let's consider, for example, another potential Russian World Heritage site - the delta of the greatest Siberian river Lena. Lena River flows into the Laptev Sea (Arctic Basin); its mouth is located in the subarctic zone that is characterized by severe climate, permafrost and the prevalence of swampy tundra. Therefore, since the Lena Delta and the Volga Delta occupy the opposite sides of the Earth's largest continent and lie within very different climate zones they can be regarded as continental-scale antipodes.

The world's largest estuarine deltas such as the deltas of Amazon, Ob, Parana and Enisey rivers, are not included in the WH list, either.

CRITERION IX – ecological processes

The key factors determining site-specific features of ecological processes in the Volga Delta are as follows:

1) Huge size of the delta. It's Europe's largest river delta and one of the world's largest delta systems. Among river delta complexes presently enjoying World Heritage status the Volga Delta is exceeded only by the Ganges-Brahmaputra Delta (Table 1) whereas all others are significantly smaller. The Nile Delta and the Lena Delta are larger than the Volga Delta but they are not designated as World Heritage sites yet.

2) Well-developed avandelta. It is a 40-50-kilometer-wide, mildly sloping, shallow intermediate zone where natural processes are the most intensive. Water level here is highly changeable, the coastline is very indented and the landscape structure is especially diverse. Among natural WH sites containing river deltas a similar avandelta can only be found in the Ganges-Brahmaputra Delta with its vast mangrove thickets growing below the highest tide level and plenty of small and large islands. Monsoon climate contributes much to significant seasonal changes in the life of this delta. The Danube Delta is considerably elevated in relation to the Volga Delta. Its coastline is formed mainly by sandy hills and therefore it is relatively smooth. There is no such abundance of small coastal islands here as in the Volga Delta. Even in spite of annual spring floods, hydrological regime of the Danube Delta is comparatively more stable

than that of the Volga Delta. The Guadalquivir Delta is a landlocked delta, however seasonal changes (floods in the winter rain season, for example) have also been observed here.

3) Distinctive hydrological features of the Volga Delta area, namely the absence of lakes (to compare, there is a great many round-shaped lakes in the Danube delta) and a complicated network of small channels (eriki) that serve as a connecting link between larger waterways (similar channels can also be found in the Danube Delta, but the network is well-developed only in the northern part of the delta).

4) Location in the lowland zone. Some areas within the Volga Delta lie at the level of Caspian Sea, i.e. 27 meters below sea level! This phenomenon is thought to be caused by the low-lying location and landlocked situation of the Caspian Sea. The Danub Delta, Guadalquivir Delta and the Ganges-Brahmapurta Delta lead into the Black Sea, the Atlantic Ocean and the Bay of Bengal opening to the Indian Ocean, respectively, and so they lie approximately at sea level (zero elevation). Thus, talking about the Volga Delta we mean the lowest part of one of the world's lowest lands.

5) Desert environment of the adjacent areas also plays a significant role. It contrasts with steppe areas surrounding the Danube Delta, subequatorial mangrove thickets of Sundarbans and mediterranean-type sclerophyllous vegetation of the Guadalquivir Delta region. The Volga Delta is characterized by a pronounced continental climate (annual temperature swing is from -30°C to + 40°C).

Thus, the Volga Delta is characterized by large scale, highly intensive and very specific natural processes that make the nominated property an important scientific research polygon. It is relevant to mention that the three clusters of the Astrakhansky Reserve proposed for inscription on to the World Heritage List though not completely but adequately represent the whole delta complex. The clusters are located in western, central and eastern portions of the delta and include both upper delta and avandelta, thereby representing the most interesting and dynamic section of the Volga Delta, which is directly dependent on the water conditions of the Caspian Sea.

CRITERION X **– biodiversity/ rare and endangered species**

The Volga Delta is an oasis surrounded by arid areas. The highest biodiversity and species richness of main taxonomic groups of this region can be compared with that of those delta systems, which have already received WH status (Table 1).

Birds is the most representative group of the vertebrates tightly connected with the delta landscape. Let's compare the avifauna of the Volga Delta with that of its closest neighbor - the Danube Delta.

On the one hand, the number of bird species is approximately the same (280 and 300, respectively). Besides, mass gathering of waterfowl including some duck species (mallard duck, gadwall, teal, pochard and others), goose and swan species (whooper swan and mute swan) have been observed in both sites. Other bird inhabitants of both the Danube and the Volga deltas are ibises, storks and herons, cormorants, glossy ibises, different terns and sandpipers and also tDalmatian and white pelicans. Thus the list of bird species looks quite similar for both properties, at least in relation to

the most mass waterfowl and water-related species.

On the other hand, the avifauna of the Volga Delta has some site-specific features, for example:

- High number of white-tailed eagles (about 60-70 nesting pairs and numerous young birds). The species is listened in the International Red Data Book;
- White crane (International Red Data Book). Small number, but regularly seen on passage;
- Buff-backed heron (RF Red Data Book) is nesting though not regularly in the Volga Delta;
- A very rare phenomenon: common nesting of great white heron and little heron, glossy ibis, mallard duck, spoonbill, pond heron.

With regard to the vegetation of the Astrakhansky State Reserve, the blue lotus (*Nelumbo nucifera*) is the most remarkable of protected plant species in the reserve. It is one of the most beautiful water plants in the world, the floral symbol of Lower Volga, and a relic species that is scarce in Russia and therefore is entered into the Red Data Book of the Russian Federation. The lotus has a wide geographic range: it is found in north-east Australia, in Malaysian Archipelago, in Sri Lanka and Philippines, in the south of Japan, in Hindustan and Indo-China. In these countries it became a sacred plant, a symbol of traditional religions and faiths. There is also a small colony of lotus located at the mouth of the Kura River (Azerbaijan). Of course, the lotus is found in some WH sites located within its geographic range (i.e. in East and Southeast Asia), but it is nowhere so abundant as in the Volga Delta. In Russia the lotus is found only in three places: in the Northern Caspian region (Volga Delta), in the south of the Russian Far East (Priamur'ye and the Lake Khanka area) and on the east coast of the Sea of Azov (*limans* of the Kuban River Delta), but the two last places are not existing or potential WH sites.

Photo by G. Rusanov

Thus, we can make the inference that the Astrakhansky Reserve plays major role in the maintenance of natural populations of *Nelumbo nucifera* in Russia. In the reserve its natural plantations cover about 5 000 ha. Some scientists regard the lotus growing in the Volga Delta as an isolated species, the Caspian Lotus (*Nelumbo Caspica*).

CONCLUSION

The Volga Delta forms where the Volga River - great Russian river, the largest river in Europe, and the true symbol of Russia - meets the Caspian Sea. The Caspian Sea is the Earth's largest landlocked water reservoir that does not connected to the sea in the modern geological period. The sea is characterized by rapid and significant water level fluctuations accompanied by changes in the water surface area and water volume. The average rate of the most recent Caspian sea level rise was 100 times greater than that of the eustatic global mean sea level rise; the last Caspian sea-level cycle (1929-1995) has resulted in a 3-meter water level drop.

The Volga Delta is the largest delta in Europe and one of the world's largest deltas. It is situated in the Caspian Depression, which is one of the lowest points on the Earth (27 meters below sea level). The Volga Delta bank and underwater slope gradients are the lowest among large river deltas throughout the world (less than 5 cm/km). The delta thereof has extremely complicated hydrographic system and is characterized by an extensive avandelta (the subaqueous part of the delta) with depths of 1,5-2,5 meters that stretches 35-50 kilometer out into the sea. River waters slowly flow down over a shallow avandelta off to the sea and thus the zone of river and sea water mixing is located several tens of kilometers away from the delta's marine edge of the delta. The total area of the Volga Delta (incl. avandelta) is over 20 000 square kilometers.

The Volga Delta has probably the most complicated hydrographic network in the world. Approximately 1 000 waterways reach the seafront of the delta. That very tangled network of channels and lakes in combination with rich vegetation makes the landscape very peculiar. It is also makes the delta an oasis-looking area placed against a background of flat and monotonous, water- and vegetation-lacking deserts and semi-deserts.

Volga Delta is a region where mass concentration of migratory birds is observed, including many rare and endangered species. Many of them form large nesting colonies. The delta also plays an important role in the development of fishing industry.

The Volga Delta is a unique natural property possessing outstanding universal value and therefore is worthy of inscription on to the World Heritage List. Despite of showing resemblance in some characteristics to other large river delta systems, the Volga Delta as a natural complex is notably different from any of existing World Heritage sites. The distinguishing features of the Volga Delta are as follows: huge size, extensive subaqueous part of the delta (avandelta), the zone of river and sea water mixing that is "moved" tens kilometers off to the sea, remarkably complicated hydrographic network, a very indented coastline, plenty of lakes, high dynamics of natural processes due to rapid Caspian sea level fluctuations. Expansive lotus fields add a special charm and peculiarity to the Volga Delta landscape.

The Volga Delta is situated in the Eastern Palearctic where a deficiency of WH sites has been recognized. If the delta achieves World Heritage status it will be a significant contribution to the elimination of a disbalance in global distribution of natural World Heritage sites as well as to strengthening the credibility of the World Heritage List. Despite the List already contains quite a number of wetland sites, the Volga Delta would be the first large river delta of classic trigonal type, having such complicated hydrographic network, and situated in arid and semi-arid environment. The high dynamics of natural processes in the Volga Delta caused by rapid Caspian Sea level changes deserves special attention. In the 20th century the rate of the Caspian sea level rise was 100 times higher than that of the eustatic global mean sea level rise, and so we can consider the Caspian seashore as a natural laboratory for studying and forecasting the effects of sea level changes on coastal wetland ecosystems.

It hardly seems possible to include into the World Heritage List the total area of the Volga Delta that is huge in size, so the purpose is to obtain World Heritage status for though comparatively small but best preserved, most valuable and rapidly developing portions of the delta: lower delta and avandelta, which are represented by the three clusters of the Astrakhansky State Biosphere Reserve.

Photo by G. Rusanov

3d. Integrity and/or Authenticity

Integrity

Justification for the integrity of the nominated property is provided in accordance with the *Operational Guidelines for the implementation of the WH Convention*.

Paragraph 88:

(a) The clusters of the Astrakhansky Reserve nominated for the inscription on the WH List are parts of one natural complex; they share a common origin, history, and dynamics of natural development, and include all elements necessary to express the outstanding universal value of the whole Volga Delta.

(b) The size of the nominated property (68 000 ha) is sufficient to maintain the functioning of the key natural ecosystems of the Volga Delta, and is adequate to ensure the complete representation of the features and processes which convey the significance of the Delta.

The Reserve's buffer zone (31 000 ha) and a currently established biosphere ground provide additional guarantees of integrity. The fact that the Reserve lies within a Ramsar site «Volga Delta» should also be considered.

(c) Various human activities existed in the Volga Delta before the establishment in 1919 of the Astrakhansky Reserve made a negligible impact on the Reserve's ecosystems and left them almost undisturbed. The nominated property possesses the highest protection status in Russia (*State Nature Reserve*) and the Reserve's management team and staff provide proper and sufficient protection measures based on legislative acts and governmental rules.

Paragraph 90:

Biophysical processes and natural landform features of the nominated property are intact.

Paragraph 92:

The nominated property includes every element necessary to maintaining the beauty of the property. Mosaic landscape of the Delta includes water landform elements (narrow and wide river channels, gulfs and open water areas) perfectly balanced with terrestrial landform elements (islands of different size, shoals) and vegetation (gallery osier and reed beds, mace reed, wet meadows). During the blooming season of the lotus (also called Caspian Rose) the Delta becomes a fairy show. Due to a common origin of all three nominated clusters all the elements making the Delta an area of the outstanding scenic value are intimately related to each other.

Paragraph 93:

The territory of the Astrakhansky Reserve contains all the key interrelated and interdependent elements in their natural relationships. It includes an extremely complicated hydrographic network of the Volga Delta that consists of large distributary channels, smaller waterways, *erikas* (narrow channels less than 30 meters in width), *il'men's* (small lakes), *kultuks* (freshwater marine bays) and an extensive avandelta (shallow subaqueous part of the delta) stretching 35-50 kilometer out into the sea.

Paragraph 94:

The nominated property contains all the necessary elements essential for the long-term conservation of the unique ecosystems of the Volga Delta and the biological diversity they possess.

Paragraph 95:

Since the Astrakhansky Reserve preserves the key territories of the Volga Delta, it therefore can be regarded as an important property for the conservation of biological diversity:

The flora of the Astrakhansky Reserve includes a total of 314 vascular plant species, with 4 species included in the Red Data Book of the Russian Federation: *Nelumbo caspica, Trapa natans, Marsiliea aegyptiaca and Aldrovanda vesiculosa*;

The diversity of environmental conditions (water depth, lowage and weediness of waters) found in water reservoirs of the Reserve accounts for the diversity of fish species (a total of 56 species belonging to 12 families);

The region is a global scale center known for the diversity and wealth of its fish fauna, with special emphasis on the diversity and richness of sturgeon species (*Acipenseridae*). *Huso huso, Acipenser gueldenstaedti, A.stellatus* are common here, *A.ruthenus* can also be found in the Reserve;

The Astrakhansky Reserve is located within the global transcontinental flyway that means that the area is of an outstanding value for biodiversity conservation. The following bird species listed in the International Red Data Book are found in the territory of the Reserve: *Pelecanus crispus, Aythya nyroca, Anas angustirostris, Falco cherrug, Coracias garrulus, Otis tarda* and *Tetrax tetrax*;

The nominated property is not only the habitat of rare and endangered nesting species. It is also a vital migratory stop-over site and wintering area for threatened migratory birds;

The nominated property is also the habitat of many endemic, rare and endangered plant and animal species. (See Annex C3).

4

STATE OF CONSERVATION AND FACTORS AFFECTING THE PROPERTY

4a. Present state of conservation

The territory of the Reserve is an undisturbed river delta landscape. A part of the territory - located in the Lower Delta plain - formed after the establishment of the Reserve and has never been affected by economic activity.

4b. Factors affecting the property

(i) Development of the property (development, adaptation, agriculture, mining)

No economic activity conducted directly in the territory of the Reserve, except for special nature-conservation and scientific-research activities.

Natural complexes of the Reserve were affected mostly by the regulation of the Volga River flow by water power plants. It caused a decline in the water level and duration of seasonal spring and summer floods; it also caused the change of flood water level rise rate and period of duration of flood phases. It also raised winter water level up to the level observed in high water periods.

Human impact to the northern parts of the Reserve's areas is, first of all, grass and forest fires coming from the adjacent delta area.

(ii) Ecological factors (natural pollution, climate changes, desertization, etc.)

(iii) Natural disasters (earthquakes, floods, fires, etc.) and the level of emergency preparedness.

Natural complexes of the Reserve are threatened first of all by grass fires, which are caused by uncontrolled grass burning in the adjacent area. Every year the Reserve takes fire prevention measures, which include mowing of fire breakes along the Reserve's borders, purchasing of fire-fighting equipment, 24-hour watches. In case the fire would enter the Reserve's area, the Reserve established cooperation for firefighting activities with Emergencies and Disaster Response Service. They also conduct educational and public awareness activities among local population of the adjacent area.

(iv) Visitors

The total number of visitors in 2007: 1415

Including: 1097 adults and 318 children

(v) Population of the site's area and its buffer zone

Number of inhabitants:

The territory of the nominating property:

85 people, including 57 Reserve employees (another 28 are children and family members of the Reserve employees)

The territory of the buffer zone:

No permanent residents

Total: 85 people

Year: 2007

5
PROTECTION AND MANAGEMENT OF THE PROPERTY

5a. Ownership

The Reserve's territory is a federal property.

Russian Federation
Moscow, Krasnopresnenskaya embankment
Government House
Prime Minister

5b. Protective designation

State nature reserve.

Juridical status is determined by the following state legislative acts:

1. Law of Russian Federation "On specially protected nature areas" of 14.03.1995 #33-FZ, (Annex B1);

2.Decree of the Soviet of the People's Commissars of RSFSR of 24.11.1927 on establishment of the Astrakhansky Reserve as a natural property of state significance (Annex B2);

3. Decree of the Soviet of Ministers of RSFSR #46 of 21.01.1976 "On measures for protection of wetlands of international importance especially as waterfowl habitat" (establishment of conservation zones of Obzhorovsky and Damchiksky clusters);

4. Decision of the Astrakhan Regional Executive Committee of 06.12.1982 #713 "On measures for improvement of territory structure of the Astrakhansky State Reserve due to inscription on the list of biosphere reserves".

The Reserve's territory is inscribed on the list of wetlands of international importance especially as waterfowl habitat (as part of "The Volga Delta" wetland area) in accordance with the International Ramsar Convention of 02.02.1971 and Decree of the Soviet of Ministers of RSFSR "On measures for fulfillment of commitments of the Soviet Party arising from the Convention on Wetlands of International Importance especially as Waterfowl Habitat" of 26.12.1971 #1046.

In 1984, UNESCO has given the Reserve the biosphere status on the basis of the decision of the Bureau of the International Coordinating Council of the Programme on Man and the Biosphere (certificate of 15.02.1985).

5c. Means of implementing protective measures

The Reserve's protection is executed by state inspectors constantly dwelling within the preserved area and by the constantly acting patrol under administration of the Reserve.

Staff of the Protection Department (by 31.12.2007)

Position	Number of employees
1. Vice-Director for protection	1
2. Senior state inspector	6
3. District state inspector	2
4. State inspector	20
Total	29

Other employees of the Reserve having state inspector's rights:

Total	Employees of the Science Research Department	Employees of the Eco Education Department	Other employees
17	8	1	8

Special devices available

Rubber batons	Gas containers	Masks	Body armors	Hand-cuffs	Alarm guns	Hunting smooth-bore
1				8		13

5d. Existing plans related to municipality and region in which the proposed property is located (e.g., regional or local plan, conservation plan, tourism development plan)

5e. Property management plan or other management system

The Reserve's management is executed on the basis of "Regulations of the Astrakhansky State Nature Reserve" approved by the Department of Environment and Ecological Safety of the Ministry of Nature Resources of Russian Federation on 24.04.2001 with alterations approved by the Order of the Ministry of Nature Resources of RF on 17.03.2005. Revision of the Regulations is foreseen every 5 years.

The management plan of the Reserve is in the development stage within the frames of Euronatur/Natural Heritage Protection Fund project "Specific Nature Conservation Projects in the Volga delta" (Annex B4).

5f. Sources and levels of finance

Information of the sources and levels of the Reserve's finance in 2007 (in thousands of RuR)

1. FEDERAL BUDGET MEANS	14 356,0
Maintenance costs	12376,0
Fire prevention costs	1980,0
2. ASTRAKHANSKY REGIONAL BUDGET MEANS (including budget ecological funds)	00,0
3. MUNICIPAL (LOCAL) BUDGET MEANS	00,0
4. MEANS RECEIVED FROM REGIONAL AND MUNICIPAL NON-BUDGET FUNDS	00,0
5. GRANTS RECEIVED FROM FOREIGN FUNDS	1 584,0
WWF grants	277,0
UNDP/GEF project grants	1307,0
6. CHARITABLE CONTRIBUTIONS OF RUSSIAN SPONSORS	400,0
Natural Heritage Protection Fund	300,0
Private persons	100,0
7. INCOMINGS FROM THE RESERVE'S OWN ACTIVITY	3 952,8
Fines and claim fees	308,6
Fares	0,8
Entrance fees	10,6
Photo and video filming fees	1,5
Guiding service fees	5,8
Income from hotels and tourist centers	305,9
Nature Museum entrance fees	7,0
Income from other services, including transportation	1242,2
Income from contractual scientific research projects	1209,6
Income from carrying out ecological training and eco camps	533,6
Other own activity	327,2
TOTAL BUDGET:	**20 292,8**

In 2007 weighted USD/RuR rate made 1:25.

5g. Sources of expertise and training in conservation and management techniques

Of 33 Reserve's employees having higher education, 6 are candidates of science and 1 is doctor of science. During 2007, the Reserve's employees took part in the following training projects.

1. Bioreservates and national parks conservation and management experience exchange work trip (March, Austria, Germany).

2. International seminar for protection department officials of the natural conservation areas of Ukraine (May, Kanevsky Reserve, Ukraine).

3. Management planning of the Ramsar areas of Eastern, Middle and Western Europe Training seminar (October, Vilm Island, Germany).

4. Training seminar for studying successful experience in organization of links between State power bodies, municipalities, business society and the natural protected area (November, Austria).

5. UNESCO EuroMaB conference 2007 (November, Turkey).

5h. Visitor facilities and statistics

Since 1957 at Damchiksky cluster functions the **Nature Museum**. It occupies separate two-storeyed building, where the exposition is placed in 4 rooms: 1st room "The history of the Reserve", 2nd, "Science research", 3rd, "Flora and fauna" and 4th, "Landscape diorama". Total exposition area is about 300 sq.m.

Excursions are led by the eco education department specialist and also by the Reserve's scientists. In 2007 the Museum has been visited by 389 people (including 97 schoolchildren, 157 students and 134 adults).

The Nature Museum has an equipped lecture-hall where visitors can attend to short lectures and leave their comments in a guest book. Beside thematic lectures, here all visitors attend to accident prevention briefing and get acknowledged with the Reserve's behavior rules.

In June 2007, the new **Information Center** has been opened at Damchiksky cluster. Presently the Center is equipped only for carrying out seminars and trainings for different kinds of visitor groups. In future, it is planned to equip the Center for organization of other kinds of eco education events like excursions, etc.

In the **eco education room** located in the Astrakhan office of the Reserve the information point is open where one can find necessary information (books, booklets, articles, etc.) regarding ecological education and enlightenment. Consultations for school teachers are made here.

	Amount	Number of attendants	Number of visitors in 2007	Number of lectures read
Nature and ethnography museum	1	1	389	37
Visit center	1	2	114	66
Information point in the Reserve's Administration Office	1	3	27	15

In 2007 the Reserve has run **7 exhibitions**, including:

Permanent exhibitions - 1:
In the Astrakhan State Museum of History and Architecture (Museum of regional studies) functions permanent exposition of the Astrakhansky Reserve (consists of 2 information panels).

Photo exhibition - 1:
In November 2007 at the Astrakhan Library after N.K. Krupskaya has run the 75-year anniversary photo exhibition of D.V. Bondarev, one of the Reserve's specialists (40 visitors).

Children art exhibitions - 2:
• In June 2007 in the Astrakhan office of the Reserve has run the exhibition of children's drawings named "The Crane, bird of Peace" which was dedicated to annual Iinternational Day of the Crane (150 visitors).

• Permanent exhibition of children art (drawings, articles of natural materials, compositions, etc.) made by schoolchildren of Grushevo school (located not far from the northern boundary of the Reserve) has been equipped at the Trekhizbinsky cluster.

Other exhibitions - 3:
• In February 2007 within the frames of school ecological papers contest in cooperation with Astrakhan Library after N.K. Krupskaya the Reserve has prepared an exhibition of ecological school periodicals "Ecological press: the journalist workshop" (55 visitors).

• In November 2007 within the frames of D.V. Bondarev's books presentation in cooperation with Astrakhan Library after N.K. Krupskaya the Reserve has prepared an exhibition of personal publications of D.V. Bondarev (40 visitors).

• In December 2007 within the frames of the seminar "Actual issues of the Russian State Nature Reserves at the modern stage of development" in Sochi the Reserve has prepared the exhibition of educational, scientific and advertisement printing materials and a photo stand demonstrating basic kinds of the Reserve's activities.

Eco trails and excursion routes of the Reserve and its buffer zone.

№ п/п	Route	Type of the route	Location	Length	Equipment	Comment
1	Damchiksky cluster: 6 routes	By water	Along small river branches neighboring the buffer zone	79 km	Not equipped	Water routes are not specially equipped, however, embarkation and debarkation of passengers is carried out only in specially assigned spots at cordons of Damchiksky and Obzhorovsky clusters. Stops and debarkation along the routes are prohibited.
2	Obzhorovsky cluster: 5 routes	By water	Along small river branches neighboring the buffer zone	150 km	Not equipped	
3	Trekhizbin-sky cluster: 1 route	By water	Along small river branches neighboring the buffer zone	9 km	Not equipped	
4	Damchiksky cluster:1 route	By foot	Along the buffer zone	5,1 km	Not equipped	The route goes along the road accompanied by the tour-guide.

At the territory of two cordons of the Reserve are located **temporary accommodation facilities for tourists:** hostel for 4 persons with kitchen, shower room and toilet at Damchiksky cluster, hostel for 8 persons with kitchen, 2 shower rooms and 2 toilets at Obzhorovsky cluster. Hostels are a property of the Astrakhansky Reserve. The working regime of hostels is determined by Tourist service contracts. When free, the hostels are used for accommodation of the Reserve's employees working at the clusters.

All kinds of service (tourist guiding, accommodation, transportation and feeding) are certificated in the stated order.

Visitor statistics

In total, the Reserve has been visited by 489 persons in 2007, including 24 excursion groups (363 persons) and 26 tourist groups (126 persons).

	Number of ecotrails and excursion routes	Total length (km)	Number of groups		Number of visitors		Average duration of visit (days)
			Total	Including foreigners	Total	Including foreign-ers	
Within the Reserve's area	12	238	26	3	489	5	3
Within the buffer zone of the Reserve	1	51	26	3	489	5	3
Within areas under authority of the Reserve	0	0	0	0	0	0	0

5i. Policies and programmes related to the presentation and promotion of the property

In 2007, the Reserve's employees have published 15 scientific articles and 3 books: "The Reserve in the Volga Delta", "Nature stories" and "Hunter's stories" (written by D.B. Bondarev). The next issue #10 of the "Conservation news" bulletin has been published in 1000 copies.

Working with mass media in 2007

Articles published in press			TV appearances			Radio broadcasts			Own newspaper or column, number of issues
Local	Re-gional	Federal	Local	Re-gionaly	Federal	Local	Re-gional	Federal	
0	4	7	11	0	0	5	0	0	The "Con-servation news" bul-letin #10, 1000

In 2007 with the support of the UNDP/GEF project "Conservation of Wetlands Biodiversity in the Lower Volga Region" has been published the following printing trades:

- booklets "Reptiles and amphibian", "Flora", "Birds", "Insects" and "Fish" (500 copies each);
- set of 10 15x21 cards (100 copies);
- set of 10 21x9 cards (100 copies);
- notebooks "Studying and conserving wetlands of the Lower Volga" (300 copies).

In April 2006 has started the "Conservation News" website project at http://www.zapvesti.narod.ru/. The website contains issues of the bulletin and other information. In 2007 the website has been visited by 4660 web readers.

In 2007 the following TV companies have been making video films for translation on the local TV channels: "Lotus", "Channel 7+", "Astrakhan'gazprom", "ATV". The Ark Ecological Center has made a 25 minute video "The Volga Delta – the promised waters".

Work with schoolchildren in 2007:

Type of activities	Number of events	Number of schoolchildren attended
Permanent ecological course	0	0
Separate lectures	2	20
Seminars and conferences	1	19
Contests and quizzes	5	347
Hobby groups	0	0
Expeditions	0	0
Children's forestries and ecological patrols	0	0
Concerts and shows	2	107
Feasts, festivals and marathons	2	124
Land improvement	0	0
Ecological camps	4	61
Excursions	6	97
Thematic meetings	0	0
Round tables	0	0
Sociological research	0	0
Video shows	0	0
Science research	2	8
Other events	0	0

Eco education and conservation promoting activities:

№ п/п	Activities	Number of activities	Number of participants
	Seminars, conferences and round tables:		
1	Scientific and practical conference "Problems of using objects of intellectual property in innovational activity".	1	20
2	Training seminar "Involving representatives of state, commercial and public organizations into conservation of the Lower Volga wetlands".	1	19
3	Training seminar for managers of the Kazakhstan protected areas at the Astrakhansky Biosphere Reserve.	1	23
4	Round table for biology, geography and ecology teachers of city schools "Modern methods of ecological enlightenment of the new generation".	1	73
5	Opinion poll of the schoolteachers re ecological education and enlightenment.	1	52
	Contests and activities involving schoolchildren:		
6	III Interregional contest of school ecological newspapers	1	60
7	Contest of essays "How would I solve the garbage problem if I were the Head of a village council"	1	9
8	Remote contest "Birds questions"	1	34
	Mass events and feasts:		
9	March of the Parks – 2007	3	103
10	February, 2 – the Day of Wetlands feast	1	64
11	Day of the Crane feast	2	286
12	"Cleaning up litter once a year is not enough" action	3	325

Within the frames of the March of the Parks 2007 the following events have been carried out.

1. The Second Festival of children's ecological theaters has been run together with the Astrakhan Municipal Environmental Protection Department. 10 drama troupes from 6 schools (60 children) have been participating in the Festival. The winners chosen by jury have been praised with diplomas and incentive prizes. The winner of the first place (drama troupe of Secondary school #13) got the free permit for excursion to the lotus fields of the Astrakhansky Reserve.

2. Together with the Regional Ecological and Biological Center the Reserve has run the Scientific and Practical Conference for schoolchildren "Young nature researchers". Employees of the Ecological education department of Astrakhansky Reserve attended as jury members at the "Environmental protection and reasonable use of nature resources" section (16 persons).

3. Together with the Astrakhansky Regional Environmental Protection and Nature Use Service the Reserve has run the "Take part in paper recycling – make a gift to nature and children!" used paper collection action in June 2007, where took part 9 organizations and 27 persons. 1192 kg of used paper has been collected. The funds raised have been used for acquisition of prizes for children taking part in the Contest of essays "How would I solve the garbage problem if I were the Head of a village council" and in the "Birds questions" Remote contest.

4. Interaction with public ecological organizations:

Within the frames of cooperation with Wetlands International, Moscow UNESCO Bureau, "Zapovedniki" EcoCenter and "Facilitating the Environmental Protection" Astrakhan Regional Public Organization, the Reserve keeps its work under projects aimed to biodiversity conservation and ecological awareness raising for the benefit of the Volga Delta wetlands.

Within the frames of cooperation with the Greenpeace Russia, the Reserve continues the "Stop the grassland fires" program. The Greenpeace leaflets "Burning fire is a crime!", "Attention! Forest needs your help!", "Make your choice", "Stop the forest fires" and "Forest is our home – don't burn it!" are spread over the Astrakhansky Region.

Within the frames of cooperation with the Biodiversity Conservation Center (BCC), the Reserve has run the annual March of the Parks International Ecological Action. BCC sends supporting materials and grants prizes for winners of the All-Russian Children's Drawing Contest "The World of the Preserved Nature".

Within the frames of cooperation with the Eurasian Crane Workshop (ECW), the Reserve runs annual "Day of the Crane" feast. ECW sends the supporting materials and grants prizes for winners of the creative contests.

The "Conservation of Wetlands Biodiversity in the Lower Volga Region" UNDP/GEF project has rendered assistance to the Reserve during the 2007. The project has provided finance support in running such mass events like III Interregional contest of school ecological newspapers and the "Cleaning up litter once a year is not enough" action. Beside these, in July-August 2007 the UNDP/GEF Project supported organization of the first "Reserve's successors" ecological camp for schoolchildren to run at Astrakhansky Reserve. Also the project has supported the publication of ecological and educative printing trades.

5j. Staffing levels (professional, technical, maintenance)

By the end of 2007 the Reserve's staff includes 164 employees, including:

Departments	Employees
Director	1
Bookkeeping and planning department	5
Science research department	33
Area protection department	38
Ecological education department	6
Maintenance department	80
Total	164

6
MONITORING

6a. Basic variables for the assessment of the state of conservation of the WH site

Indicator	Test frequency	Records storage place
Condition of vegetation	Annually	Astrakhansky Biosphere Reserve, Science Division
Condition of fauna	Annually	Astrakhansky Biosphere Reserve, Science Division
Air and water pollution	Annually	Integrated baseline monitoring station and the Astrakhansky gauging and monitoring station
Meteorological parameters	Annually	Astrakhansky Biosphere Reserve, Science Division and Astrakhansky gauging and monitoring station

6b. Administrative monitoring measures

Scientific Researches

Scientific staff of the Astrakhansky reserve carries out long-term research and monitoring programs in the Reserve's area. They study all basic components of natural complexes, from the geomorphology of the Volga Delta, hydrology, hydrobiology and ichthyology to avifauna, mammals and parasites. Such integrated approach provides a comprehensive idea of the behavior and changes in the Delta ecosystem processes.

- Phenological, geobotanic and ornithological observations since 1920s;
- Gauging station (daily 4 times observations) since 1937;
- Geomorphological, hydrobiological, parasitological and theriological observations since 1930s;
- Regular hydrobiological observations since 1947;
- Regular ichthyological studies since 1950s;
- Entomological studies since 1960s;
- Regular advanced avifauna studies since 1960s;
- Integrated baseline monitoring station - since 1986.

Other research institutes and universities also carry out scientific researches in the territory of the reserve. Thus, in the last 20 years extensive geochemical and geomorphological studies have been carried out by the Geography faculty of the Moscow State University in cooperation with the Technical University of Delft, Netherlands.

7
DOCUMENTATION

7a. Photographs, slides, image inventory and authorization table and other audiovisual materials

VISUAL ATTACHMENTS INVENTORY
AND PHOTO- AND AUDIOVISUAL MATERIALS AUTORISATION TABLE

№	Format (slide/ photo/ video)	Caption	Date (month/ year)	Photographer/ director of video)	Copyright owner (if different from photographer/ director of video)	Contact details of the copyright owner (name, address, tel/fax, e-mail)	Non-exclusive cession of rights
1	Video						
2	Photo						
3	Photo						
4	Photo						
5	Photo						
6	Photo						
7	Photo						
8	Photo						
9	Photo						
10	Photo						
11	Photo						
12	Photo						
13	Photo						
14	Photo						
15	Photo						

7b. Texts relating to protective designation, copies of property management plans or documented management systems and extracts of other plans relevant to the property

Documentation is presented in Annex B.

B1. Extract from the Federal law of Russian Federation “On specially protected natural areas”.
B2. Decree of the Soviet of the People’s Commissars of RSFSR of 24.11.1927 on establishment of the Astrakhansky Reserve as a natural property of state significance.
B3. Decree of the All-Russian Central Executive Committee of the Soviet of People’s Commissars of 10.02.1935 on establishment of the network of reserves of state significance.
B4. Executive Summary of The Frame Management Plan for Astrakhansky Reserve.
B5. Letter of Governor of Astrakhansky region of 19.01.2006 on representation of the Astrakhansky Reserve for inscription on the UNESCO World Heritage List.

7c. Form and date of most recent records or inventory of property

1. “Astrakhan encyclopedia” Vol.1 Nature. – Astrakhan, 2007
2. “The Nature Chronicles” Vol. 2007,
3. “The Nature Chronicles” Vol. 2006,
4. “The Nature Chronicles” Vol. 2005,
5. “The Nature Chronicles” Vol. 2004,
6. “The Nature Chronicles” Vol. 2003

7d. Address where inventory, records and archives are held

Federal service for supervision in the sphere of nature use (Rosprirodnadzor).
Address:
Moscow, 123995
Bolshaya Gruzinskaya st., 4/6, D-242, GSP-5.

Astrakhansky state nature biosphere reserve.
Address:
Astrakhan, 414021
River Tsarev embankment, 119.

7e. Bibliography

Annex D contains over 100 titles of the most significant research papers dedicated to the Astrakhansky Reserve.

8

CONTACT INFORMATION OF RESPONSIBLE AUTHORITIES

8a. Preparer

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3. German Rusanov
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Moscow, Russia
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Fax: +7 495 150 92 93
E-mail: petrovskayaekaterina@yandex.ru

8b. Official Local Institution/Agency

The Reserve is a federal state institution under the jurisdiction of Department of specially protected nature areas and under resolving activity of the Federal service for supervision in the sphere of nature use (Rosprirodnadzor):
123995 Moscow, GSP-5,
Bolshaya Gruzinskaya st., 4/6, D-242.
Tel: +7 (095) 2547938,
Fax: +7 (095) 2544310
Department Head, Dmitriy V. Fedotkin

At the local level the property management is executed by the Astrakhansky State Nature Biosphere Reserve: На местном уровне менеджмент объекта осуществляется Астраханским государственным биосферным заповедником:
414021, River Tsarev embankment, 119
414021 Astrakhan, Russia
Tel.: +7 (8512) 305074, 301791, 301744
Fax: +7 (8512) 301764
E-mail: abnr@astranet.ru
Director, Nina A. Litvinova.

9

SIGNATURE ON BEHALF OF THE STATE PARTY

Vice-Minister of Nature Resources of Russian Federation

ANNEX

ANNEX A
MAPS AND PLANS

A1. LOCATION OF THE ASTRAKHANSKY RESERVE ON THE MAP OF RUSSIA.
A2. TOPOGRAPHIC MAP WITH PRECISE INDICATION OF BOUNDARIES OF THE RESERVE AND ITS BUFFER ZONE. SCALE 1:200 000.
A3. SPECIALLY PROTECTED NATURAL AREAS OF THE LOWER VOLGA. SCALE 1:1 600 000.
A4. WETLANDS OF THE LOWER VOLGA DELTA. SCALE 1:200 000.
A5. BLUE LOTUS *NELUMBO NUCIFERA* IN THE COASTAL WATERS OF THE VOLGA DELTA. SCALE 1:200 000.

ANNEX B
REGULATION DOCUMENTS

B1. EXTRACT FROM THE FEDERAL LAW OF RUSSIAN FEDERATION "ON SPECIALLY PROTECTED NATURAL AREAS".
B2. DECREE OF THE SOVIET OF THE PEOPLE'S COMMISSARS OF RSFSR OF 24.11.1927 ON ESTABLISHMENT OF THE ASTRAKHANSKY RESERVE AS A NATURAL PROPERTY OF STATE SIGNIFICANCE.
B3. DECREE OF THE ALL-RUSSIAN CENTRAL EXECUTIVE COMMITTEE OF THE SOVIET OF PEOPLE'S COMMISSARS OF 10.02.1935 ON ESTABLISHMENT OF THE NETWORK OF RESERVES OF STATE SIGNIFICANCE.
B4. EXECUTIVE SUMMARY OF THE FRAME MANAGEMENT PLAN FOR ASTRAKHANSKY RESERVE.
B5. LETTER OF GOVERNOR OF ASTRAKHANSKY REGION OF 19.01.2006 ON REPRESENTATION OF THE ASTRAKHANSKY RESERVE FOR INSCRIPTION ON THE UNESCO WORLD HERITAGE LIST.

ANNEX B1

ON SPECIALLY PROTECTED NATURAL AREAS

The Federal Law of the Russian Federation dated March 14, 1995

Specially protected natural areas are defined as terrestrial and aquatic areas including atmospheric spaces above them, hosting natural complexes and objects presenting outstanding value for the environmental protection, science, culture, as well as for recreation and human health rehabilitation and thus are entirely or partially exempt for economic activity by virtue of the decision made by governmental bodies and are subject to regimen of special protection.

Specially protected natural areas are considered to be objects of national heritage.

1. State Natural Reserves (Astrakhansky State Natural Biosphere Reserve):

Article 6.

1. Specially protected natural complexes and objects (natural sites, aquatories, sub-surface, flora and fauna) possessing an outstanding environmental and educational, scientific and nature protection values being samples of natural environments, typical or rare landscapes, sites of genetic resource conservation for wildlife flora and fauna are to be completely withdrawn from economic activities within the areas of the State Natural Reserves.

The State Natural Reserves are institutions of nature protection, scientific research and environmental education, aimed at preservation and research of the natural mechanism of the processes and phenomena, genetic resource of the flora and fauna, individual wildlife species and plant and animal communities, as well as typical and unique environmental systems.

Article 9.

1. An activity, contradictory to the objectives of the State Natural Reserve, the regime of special protection set forth by the provision on the above mentioned Reserve is prohibited within it's grounds.

Introduction of any alive species into the grounds of the State Natural Reserve aimed at the acclimatization of the aforementioned species is prohibited.

2. The grounds of the State Natural Reserves allow for the following undertakings and activities intended to:

a) Reserve the natural condition of the wildlife complexes, including rehabilitation and prevention of changes to occur in the natural complexes and their components resulting from human impacts;

b) maintain the conditions securing sanitary and fire safety;
c) prevent the conditions capable of causing natural disasters dangerous for human life and settlements;
d) implement environmental monitoring;
e) carry out research and investigation tasks;
f) promote environmental education and awareness;
g) implement overseeing and controlling functions.

Article 10. State Natural Biosphere Reserves

1. The State Natural Reserves, which are included in an international system of biosphere Reserves, realising global ecological monitoring have status of the State Natural Biosphere Reserves.

2. Biosphere polygon territories, including those with differentiated condition of the special guards and functioning can be joined to territories of state natural biosphere Reserves with the purposes of realisation of scientific researches, ecological monitoring, and also for approbation and introduction of rational nature management methods, not destroying environment and not exhausting biological resources.

Article 11.

2. State Nature Reserves use the following financial assets at their discretion and according to the existing procedure:

- income of scientific and nature protection activities, advertising and publishing, as well as other activities non-contradictory to the purposes of the State Natural Reserves;
- payments in compensation of damage caused to natural complexes and objects, located within the grounds of the State Natural Reserves;
- revenue from the sale of legitimately expropriated poaching implements and the products resulting from illegal use if the natural resources
- free donations and charity contributions.

Decree of the All-Russian Central Executive Committee of the Soviet of People's Commissars of 10.02.1935 on establishment of the network of reserves of state significance.

The All-Russian Central Executive Committee and the Soviet of People's Commissars DECREES:

1. To approve the following network of full reserves of the state significance under the jurisdiction of the Committee for Reserves of the Presidium of the All-Russian Executive Committee and financed from the State Budget of RSFSR:

1) Kavkazsky; Centralno-Lesnoy; Pechoro-Ilychsky; Naurzumsky; Altaisky; Astrakhansky; Krymsky; Sikhote-Alinsky; Laplandsky; Oksky; Klyazminsky; Khopersky.

2. To establish the following boundaries and aims for the reserves mentioned in point 1.

6) Astrakhansky State Reserve in the Volga Delta (Stalingradsky Krai) consisting of three separate clusters of the total area of about 23 234 ha within boundaries:

a) Obzhorovsky cluster located in Volodarovsky Administrative District of the total area of 11 373 ha limited by the upland boundary of the restricted coastal line of 1865 from the north; river Kara-Buzan with Pjany Bank and Ambarny branches (eriks) from the east; Blinov branch and river Ufimtseva from the west;

b) Damchiksky cluster of the total area of 4 430 ha located in Kamyzyaksky District limited by the upland boundary of the restricted coastal line of 1865 from the north; river Bystraya from the east; river Pryamoy Kokluy with its branches Kulkov, Novaya Protoka and Birjuchenok (Ushakovsky); Caspian Sea limits both Obzhorovsky and Damchiksky clusters from the south where no above water vegetation or newly generated land is found.

c) Trekhizbinsky cluster of the total area of 7 431 ha is located in Volodarsky District and has the following boundary. Starting from the point of intersection of Boldushka river with the upland boundary of the coastal line stated in 1927/26, it follows the directions along line measures:

ANNEX B3

Line 1 NE 26°51 Line 2 NE 28°08 Line 3 SE 65°17
2039,3 2761,5 2957,5

Line 4 SE 65°03 Line 5 SE 78°26 Line 6 NE 88°37
1333,5 2418,0 1875,5

Line 7 SE 15°50 Line 8 SE 13°0 Line 9 SE 10°38
1001,5 956,0 1503,0

Line 10 SE 317°39 Line 11 water line SW 11°42
366,5 2237,7

Line 12 SW 39°13 Line 13 SW (water) 77 °25 Line 14 NW 25°04
34,74 3436,0 4691,0

Till intersection by Levaya Boldushka river branches, Kolnovsky erik, then upstream the Kolnovsky erik and Levaya Boldushka (the boundary goes the right side of the river and erik) back to the starting point, i.e. the NE 2051° line.
2039,3

The line 12 is nominal, as after the further dry out of the near delta waters here extended Boldushka river with its mouths will be running to the Sea.

Main aims of the Reserve are: conservation and accumulation of nature resources and genetic funds of the Volga Delta and Caspian coast; studying the dynamics of delta genesis and the life of its coenosis for management of natural productive power of the delta and conservation of nesting and stop by areas of waterfowl, fish spawning grounds and pits, and also rare flora species like lotus, water chestnut, etc.

ANNEX B4

THE FRAME MANAGEMENT PLAN for Astrakhansky State Biosphere Nature Reserve as World Heritage Site

(EXECUTIVE SUMMARY) Moscow-Astrakhan 2008

European Nature Heritage Fund - Euronatur

Wetlands International Russia Programme

1. The background for management goals

The management of the Nature Reserve should provide the maintenance of ecosystems status in accordance with demands of World Heritage Convention and hence obligations of Russian Federation when area is designated as World Heritage (WH) Site.

The following minimal points should be addressed by management:

- The area meets criteria according which it is nominated to WH status;
- The mechanisms of sustainability of integrity and authenticity of the object and maintenance of key ecological features;
- The mechanism for monitoring of ecosystem status.

2. The key parameters of the object of management

<u>The territorial and organization features:</u>

- Nature Reserve has a federal status, all land within the core area belongs to the State and excluded from the land use
- The status and all borders of core area are legally defined by the special documentation, all documents of title for the land are avowed
- There are two disputable matters on the lands – in northern part on land and in southern part at the sea border.
- The buffer zone lands belong to different owners, including State, and are used by different enterprises and individuals.
- The status and regularities of land use in buffer zone are defined by the Statute endorsed by regional authorities, but only partly defined in the land users' documentation.

- The Nature Reserve area is composed from three isolated clusters, situated as on land so in the sea.
- The largest part of buffer zone is in the sea area, the narrowest – on the land area.
- The negotiations are currently on the agenda to agree extension of the buffer zone with local authorities.
- The access to the Nature Reserve borders is easy both by car from the land and by boat from the sea.

Organization and management

- Astrakhansky State Biosphere Nature Reserve is managed by administration which has status of Federal Unitary Enterprise and reports to Rosprirodnadzor
- Nature Reserve is nature conservation and scientific organization carrying out functions of protection, study and monitoring, public relational and environment education.
- Nature reserve is funded form the Federal budget. According the Federal legislation funding is not possible from local and regional budgets
- Nature Reserve as organization and staff members as experts participate in local expertise, national and international projects, get investigation grants etc.
- The permanent staff is 133 units, among them 32 rangers, 15 scientific staff and 13 scientific technicians, 5 communication, education and public awareness (CEPA) experts
- The main office is situated in Astrakhan city, the local offices – in each clusters, the rangers are permanently working in the area.
- The land users around the Nature Reserve are mainly presenting local and regional interests
- The sources of the negative impact on the Nature Reserve area are as from federal, so from local and regional objects and development projects
- The guard is working effectively but is limited in resources, including equipment etc.
- Scientific research and monitoring is carried out by permanent staff and with participation of the guest organizations – Institutes of Russian Academy of Sciences, Universities, Sectorial specialized Institutes. The results are not totally integrated in decision making and not adequately stored.
- The CEPA activity is under good development but not adequate comparatively to the potential conflicts with land users and population to be solved
- The Nature Reserve is included in the Statutory Framework of Biosphere Nature Reserves since 1985.
- Nature Reserve is a part of the Wetlands of International Importance (Ramsar site) “Volga Delta”

- The organization has good capacity for reactive monitoring, but it should be adequately structured
- The organization has good capacity for regular reporting, but it should be adequately structured

Natural features

- The territory of the reserve represented typical natural ecosystems of the lover course of the Volga delta.
- The area presents extremely gentle onshore to offshore gradient of 5 cm km"
- The area is very rich in oil, gas and other hydrocarbons.
- The area is under strong influence of the natural fluctuations of the Caspian Sea level and changes in the Volga river outflow
- The climate of the Lower Volga region is the most arid and continental in the European part of Russia – that is the cause of ecosystems vulnerability
- The last years the region is affected by the natural disasters – droughts, floods, fires etc. and climate shifts to very unstable.
- Three main flyways of waterfowls are situated in the region – Eastern African, Mediterranean, Central Asian-Indian.
- The waters within the Nature Reserve serve as migrating routs for fish from the Caspian Sea to the Volga Delta and upstream.
- There is high potential for the invasive species distribution due to water circulation, migration corridors, sea transport development and high dynamic of climatic parameters.
- The high potential for epizootic developments due to migration routs

Socio-economic features

- The nature reserve had been organized 90 years ago, the most of the time it have been acting within the Soviet system as protected area isolated from the local population
- The Delta is under the influence of one of the largest Volga cascade hydropower dams – Volgogradskaya. The ecological values till now are in misbalance with income of the power production.
- More than 70 % of local population depends on the local nature resources such as fish, game, berries and other.
- Anyway population does not consider the access to resources being related to natural ecosystem status, do not understand values and ecological services provided by Nature Reserve
- Main forms of agricultural production in kolkhozes and farmsteads of the lower Volga Delta are great cattle husbandry, crop production, and, in some farmsteads, fish rearing.

- The land use and land ownership vary very significantly in the adjacent areas
- The area is source of the income of large corporations and of federal level management providing such valuable globally resources as oil, gas, black caviar, surgeon
- The nature reserve area borders with significant marine transportation routs
- The Volga Delta area is long term object of hunting and fishing tourism, including international
- In the area there is background for conflicts between sectors and between management levels – local, regional and federal.
- The Volga Delta many years attracts international society including nature conservation, science and tourism as area of high biodiversity and global significance for migrating and endangered species.

The main impacts

- The changes in hydrological regime
- Water and air pollution
- The hunting pressure
- The fishing pressure
- The fires
- Overgrazing
- The abundance of meliorated lands with further salinization and degradation
- Invasive species
- The disturbance of breeding populations

Current ecosystem status and trends

- The ecosystems of the Nature Reserve are in the permanent dynamic due o water level fluctuations. The rends are cyclic – there was 4 cycles designated during the Nature Reserve times
- The water flow regulation by hydropower plant and dam leads to the strong tendency in decreasing of number and diversity of fish population
- The annual forest and reed fires lead to irreversible changes in the vegetation structure and hence biotope and habitat quality and ecological features
- The introduction of invasive species cause changes in habitat types – especially fast growing trees
- The often epizootic interventions cause decrease of endangered species populations resistance
- Migrating bird species give up biotopes in Nature Reserve due to their changes and shift to non protected areas, where they are endangered to be hunted.

ANNEX B4

3. The key activities of management plan

The management plan includes long term and emergent activities both meeting key planning goals derived from evaluation of key parameters of the object of management.

Emergent measures

Long term management goal	**Mid & short term management goal**	**Short term objective**
1. The maintenance of the legal status of the area and borders	Defining borders legally	To implement the land surveying procedure
	Defining land use legally	To introduce servitudes in the land use certificates
2. Maintenance of protection regime	Improvement of protection	To involve of local population to assist guard
	Improvement of protection status	To submit of nomination for World Heritage Status
3. Optimization and zoning of the territory	Protection of the land part of Nature Reserve by mitigation of the impact	To develop and legalize the transition zone of cooperation in the northern areas
	Protection of the sea part of Nature Reserve by exclusion of the impact	To develop and legalize the biosphere polygon on the southern areas
4. Management improvement: organization	Improvement of the information background for decision making	To develop GIS as planning and management instrument
	The same	To focus on the monitoring of critical parameters as typical characteristic of ecosystems integrity and sustainability
	Improvement of organization capacity for management	To evaluate staff effectiveness
	The same	To coordinate involvement of the partner organizations
	The same	To cooperate effectively with UNDP/GEF project “Volga Delta Wetlands Biodiversity Conservation”

ANNEX B4

Long term management goal	Mid & short term management goal	Short term objective
5. Management improvement: natural processes	Mitigation of invasive species impact	To carry out inventory and mapping of invasive species, sketches on invasive species biology
	Mitigation of the impact of epizootics	To develop urgent measures to control the epizootic situation
	Sustaining *Sus scrofa* population	To undertake further biotechnical activities to avoid impact of floods on the *Sus scrofa* population
	Sustaining of balance in carnivores populations	To organize monitoring of carnivores populations
	Sustaining breeding grounds of key fish species	Melioration and protection of breeding grounds
	Fire management	The fire prevention by system of reed swaths
	Control of invasive reforestation	Preventing of ash distribution – mapping and study of consequences of ash cutting.
	Conservation of migration species	To join Wings Over Wetlands (WOW) GEF project for coordination of monitoring and biotope conservation activities
6. Management improvement: involvement of population	Development of incentives for nature resources conservation	To bring clear message to population on the ecological services provided by Nature Reserve
7. Sustainable development of adjacent areas	Mitigation of hydropower plant impact	Development of rules and conditions for hydropower plant in relation to water regime
	Mitigation of impact of the oil and gas industry	Defining of the current impact and the most dangerous plans of oil and gas extractive industry development
	Decrease of poaching press	The development of capacity of guard to stop poaching

ANNEX B4

Long term management goal	Mid & short term management goal	Short term objective
7. Sustainable development of adjacent areas	The same	Organization of awareness company against poaching
	Mitigation of tourism impact	Planning of measures for tourism impact regulation – monitoring, assessment, recommendations
	The same	Conversion of fishing and hunting tourism to ecological tourism

Long term measures

Long term management goal	Long term objective
The maintenance of the legal status of the area and borders	To develop mechanism for the permanent legislation monitoring
	To development capacity for improvement of legislation implementation for maintenance of status and borders
	To maintain international status of the area by more effective integration into existing network of Ramsar sites, Biosphere Reserves and World Heritage sites
Optimization and zoning of the territory	To develop capacity for evaluation of territory zoning effectiveness and implementation of recommendations
Management improvement: organization	To introduce adaptive management approach
	To develop wide partnership for capacity extension
	To develop mechanism for monitoring of Management Plan implementation
	To provide scientific background and feedback mechanism for adaptive management

ANNEX B4

Long term management goal	Long term objective
Management improvement: natural processes	To develop capacity for monitoring and study of key natural processes responsible for biotopes maintenance: hydrology, climate, vegetation dynamic, soil status
	To develop capacity for monitoring of key natural species status
	To organize monitoring and system of management of invasive species populations
	To organize monitoring and system of measures for control of epizootic situation
	To coordinate capacity with partner organizations for migrating species conservation
Management improvement: involvement of population	To provide capacity for regular monitoring of conflictological situation on the adjacent areas
	To develop program for CEPA activities aimed nature conservation incentives development
	To develop mechanism for involvement of local population into monitoring, protection and biotechnical activities
Sustainable development of adjacent areas	To organize cooperation with oil companies and fishery enterprises basing on biosphere polygon capacity
	To develop partnership with Volgograd hydropower plant for mutual consultations on water regime and joint monitoring activities.
	To evaluate land use impacts in mid and long term context
	To promote intersectorial cooperation for development and implementation of wise use principles in the adjacent areas.

ANNEX B5

GOVERNOR
OF ASTRAKHANSKY REGION
Sovietskaya st. 15, Astrakhan, 414008, tel. (8512) 22-85-19, fax (8512) 22-95-14
e-mail: gov@astrobl.ru

19.01.2006

To Vice-Minister of Nature Resources
Of Russian Federation
V.G. Stepankov

Dear Sir,

Within the realization of the UNESCO Convention Concerning World Cultural and Natural Heritage, the Administration of the Astrakhansky Region finds it appropriate to prepare the nomination dossier of the "Volga Delta" natural property (within the boundary of the Astrakhansky State Nature Reserve) for inscription on the World Heritage List.

I am asking you to render assistance to inscription of the "Volga Delta" natural property onto the Tentative List of Russian Federation.

I would also like to express my sincere gratitude for your consideration for environmental issues of the Region and hope for the further assistance in preparation and presentation of the necessary documents to the UNESCO Committee for Russian Federation.

Truly yours,
A.A. Zhilkin

ANNEX C
LISTS OF PLANT AND ANIMAL SPECIES

ANNEX C1

List of bird fauna of the Astrakhansky Reserve

№	Specie	Status	Ecological group	Relative population size
1	2	3	4	5
Podicipediformes				
1	Podiceps ruficolis	N		++
2	Podiceps nigricollis	N		+
3	Podiceps grisegena	N		++
4	Podiceps cristatus	NF		++++
Pelecaniformes				
5	Pelecanus onocrotalus	M		+
6	Pelecanus crispus	N		++
7	Phalacrocorax carbo	NF		++++
8	Phalacrocorax pygmaeus	N		++
Ciconiiformes				
9	Botaurus stellaris	NW		++
10	Ixobrychus minutus	NF		+++
11	Nycticorax nycticorax	NF		+++
12	Ardeola ralloides	NF		+
13	Bubulcus ibis	N		+
14	Egretta alba	NF		++++
15	Egretta garzetta	NF		+++
16	Ardea cinerea	NF		++++
17	Ardea purpurea	NF		+++
18	Platalea leucorodia	NF		+
19	Plegadis falcinellus	NF		+++
20	Ciconia nigra	P		+
Phoenicopteriformes				
21	Phoenicopterus roseus	P		+
Anseriformes				
22	Rufibrenta ruficollis	F		+
23	Anser anser	NF		++++
24	Anser albifrons	F		+++
25	Anser erythropus	F		+
26	Anser fabalis	P		+

ANNEX C1

1	2	3	4	5
27	Gygnus olor	NFP		++++
28	Cygnus cygnus	FP		++++
29	Cygnus bewickii	F		+
30	Tadorna ferruginea	N		+++
31	Tadorna tadorna	F		++
32	Anas platyrhynchos	NFP		++++
33	Anas crecca	F		+++
34	Anas strepera	NF		+
35	Anas penelope	F		++
36	Anas acuta	F		+++
37	Anas querquedula	NF		+
38	Anas clypeata	F		+++
39	Anas angustirostris	P		+?
40	Netta rufina	NF		+++
41	Aythya ferina	NF		++++
42	Aythya nyroca	NF		+
43	Aythya fuligula	FP		++++
44	Aythya marila	F		+
45	Clangula hyemalis	F		+
46	Bucephala clangula	FP		+++
47	Oxyura leucocephala	P		+?
48	Mergus albellus	NFW		+++
49	Mergus serrator	P		+
50	Mergus merganser	FP		+++
Falconiformes				
51	Pandion haliaetus	N		+
52	Pernis apivorus	F		+++
53	Milvus migrans	NF		++
54	Circus cyaneus	FP		++
55	Circus macrourus	F		++
56	Circus pygargus	F		++
57	Circus aeruginosus	N		+++
58	Accipiter gentilis	FP		+
59	Accipiter nisus	FP		++
60	Accipiter brevipes	F		+
61	Buteo lagopus	W		+++
62	Buteo rufinus	F		+
63	Buteo buteo	F		+++
64	Aquila rapax	F		+++

ANNEX C1

1	2	3	4	5
65	Aguila clanga	F		+
66	Aquila chrysaetos	F		+
67	Haliaeetus albicilla	SN		++++
68	Falco cherrug	NF		+
69	Falco peregrinus	P		+
70	Falco subbuteo	NF		++
71	Falco columbarius	F		+
72	Falco vespertinus	NF		+++
73	Falco tinnunculus	NFW		+++
74	Falco naumanni	P		+
Galliformes				
75	Perdix perdix	S		++
76	Coturnix coturnix	NF		+
77	Phasianus colchicus	S		+++
Gruiformes				
78	Grus leucogeranus	F		+
79	Grus grus	F		++
80	Anthropoides virgo	P		+
81	Rallus aquaticus	NF		++
82	Porzana porzana	N?F		+
83	Porzana parva	NF		+
84	Porzana pusilla	NF		+
85	Crex crex	F		++
86	Gallinula chloropus	NF		+++
87	Porphyrio porphyrio	P		+
88	Fulica atra	NF		++++
89	Otis tarda	F		+
90	Tetrax tetrax	NF		+
Charadriiformes				
91	Burhinus oedicnemus	NF		++
92	Pluvilis squatarola	F		+
93	Pluvialis apricaria	P		+
94	Charadrius hiaticula	F		++
95	Charadrius dubius	NF		+
96	Charadrius alexandrinus	F		+
97	Chettusia gregaria	P		
98	Vanellus vanellus	NF		
99	Vanellochettusia leucura	P		++

ANNEX C1

1	2	3	4	5
100	Arenaria iterpres	F		+
101	Himantopus himantopus	NF		++
102	Recurvirostra avosetta	F		++
103	Haematopus ostralegus	NF		++
104	Tringa ochropus	F		+++
105	Tringa glareola	F		+++
106	Tringa nebularia	F		+++
107	Tringa totatus	F		+++
108	Tringa erythropus	F		+
109	Tringa stagnatilis	F		+
110	Actitis hypoleucos	NF		+++
111	Xenus cinereus	F		+
112	Phalaropus lobatus	F		++
113	Philomachus pugnax	F		++++
114	Calidris minuta	F		++
115	Calidris temminckii	F		++
116	Calidris alpina	F		++
117	Gallinago gallinago	F		++++
118	Gallinago media	F		+
119	Scolopax rusticola	F		++
120	Numenius arquata	F		+
121	Numenius phaeopus	F		+
122	Limosa limosa	F		++
123	Limosa lapponica	F		+
124	Glareola pratincola	P		+
125	Glareola nordmanni	P		+
126	Stercorarius parasiticus	P		+
127	Larus ichthyaetus	NF		+++
128	Larus minutus	F		+
129	Larus ridibundus	NFW		+
130	Larus genei	F		++
131	Larus fuscus	FW		++
132	Larus cachinnans	NF		+++
133	Larus marinus	P		+
134	Larus canus	FW		++
135	Chlidonias niger	NF		++
136	Chlidonias leocopterus	NF		++++
137	Chlidonias hybridus	NF		++++

ANNEX C1

1	2	3	4	5
138	Gelochelidon nilotica	F		+
139	Hydroprogne caspia	NF		++
140	Thalasseus sandvicensis	N?		+
141	Sterna hirundo	NF		+++
142	Sterna albifrons	NF		+
Columbiformes				
143	Columba palumbus	NF		+++
144	Columba oenas	F		++
145	Columba livia	S		++
146	Streptopelia decaocto	NFW		+
147	Streptopelia turtur	NF		+
Cuculiformes				
148	Cuculus canorus	NF		+++
Strigiformes				
149	Nyctea scandiaca	P		+?
150	Bubo bubo	FW		+
151	Asio otus	S		+++
152	Asio flammeus	S		+++
153	Otus scops	F		+?
154	Athene noctua	FW		+
155	Strix aluco	S		+++
Caprimulgiformes				
156	Caprimulgus europaeus	F		++
Apodiformes				
157	Apus apus	F		++
Coraciiformes				
158	Coracias garrulus	NF		+++
159	Merops apiaster	F		++++
160	Merops persicus	F		+
161	Alcedo atthis	NFW		+++
Upupiformes				
162	Upupa epops			
Piciformes				
163	Junx torquilla	FW		+
164	Picus canus	S		++
165	Dryocopus martius	P		+
166	Dendrocopos major	S		+++
167	Dendrocopos minor	W		+

ANNEX C1

1	2	3	4	5
	Passeriformes			
168	Riparia riparia	F		+++
169	Hirundo rustica	NF		+++
170	Delichon urbica	F		++
171	Galerida cristata	FW		++
172	Calandrella cinerea	FW		+
173	Calandrella rufescens	F		+
174	Melanocorypha calandra	FW		++
175	Melanocorypha leucoptera	FW		+
176	Melanocorypha yeltoniensis	FW		+
177	Eremophila alpestris	FW		+
178	Lullula arborea	F		+
179	Alauda arvensis	F		+++
180	Anthus campestris	F		++
181	Anthus trivialis	F		++
182	Anthus pratensis	F		++
183	Anthus cervinus	F		+
184	Motacilla flava	NF		++
185	Motacilla feldegg	F		++
186	Motacilla lutea	F		++
187	Motacilla citreola	F		++
188	Motacilla alba	NF		++++
189	Lanius collurio	NF		++
190	Lanius minor	NF		+++
191	Lanius excubitor	FW		++
192	Oriolus oriolus	NF		+++
193	Sturnus vulgaris	NF		++++
194	Sturnus roseus	P		++
195	Pica pica	S		+++
196	Corvus monedula	NF		+++
197	Corvus frugilegus	NFW		++++
198	Corvus cornix	SF		++++
199	Corvus corax	P		+
200	Bombycilla garrulous	W		++
201	Troglodytes troglodytes	N?FW		++
202	Prunella modularis	F		+
203	Cettia cetti	NFW		++++
204	Locustella luscinioides	NF		+++

ANNEX C1

1	2	3	4	5
205	Locustella fluviatilis	NF		+++
206	Locustella naevia	NF		+++
207	Lusciniola melanopogon	NF		+++
208	Acrocephalus schoenobaenus	NF		+++
209	Acrocephalus agricola	NF		+++
210	Acrocephalus dumetorum	F		++
211	Acrocephalus palustris	NF		+++
212	Acrocephalus scirpaceus	NF		+++
213	Acrocephalus arundinaceus	NF		++++
214	Hippolais icterina	P		+
215	Hippolais caligata	P		+
216	Hippolais rama	P		+
217	Sylvia nisoria	F		++
218	Sylvia atricapilla	F		++
219	Sylvia borin	F		++
220	Sylvia communis	F		++
221	Sylvia curruca	F		++
222	Sylvia mystacea	P		++
223	Sylvia nana	P		+
224	Phylloscopus trochilus	F		+++
225	Phylloscopus collybita	F		+++
226	Phylloscopus sibilatrix	F		++
227	Phylloscopus trochiloides	F		+
228	Regulus regulus	W		+
229	Ficedula hypoleuca	F		+
230	Ficedula parva	F		++++
231	Muscicapa striata	F		++++
232	Saxicola rubetra	NF		+
233	Saxicola torquata	NF		++
234	Oenanthe oenanthe	NF		++
235	Oenanthe pleschanka	F		++
236	Oenanthe isabellina	NF		+++
237	Phoenicurus phoenicurus	F		++
238	Erithacus rubecula	FW		++
239	Luscinia luscinia	F		++
240	Luscinia svecica	F		++
241	Turdus pilaris	FW		+++
242	Turdus merula	FW		+++

ANNEX C1

1	2	3	4	5
243	Turdus iliacus	П		++
244	Turdus philomelos	П		+++
245	Turdus viscivorus	ПЗм		++
246	Panurus biarmicus	О		++++
247	Aegithalos caudatus	ГЗм		++
248	Remis pendulinus	ГПЗм		++++
249	Parus montanus	З		+
250	Parus major	ГЗм		+++
251	Parus caeruleus	ГЗм		+++
252	Sitta europaea	Зм		+
253	Certhia familiaris	Зм		+
254	Passer domesticus	О		++
255	Passer montanus	О		++++
256	Fringilla coelebs	ГПЗм		++++
257	Fringilla montifringilla	ПЗм		+++
258	Chloris chloris	ГПЗм		++
259	Spinus spinus	ПЗм		+++
260	Carduelis carduelis	ПЗм		++
261	Acanthis cannabina	ПЗм		++
262	Acanthis flavirostris	З		+
263	Acanthis flammea	ПЗм		++
264	Carpodacus erythrinus	П		++
265	Pinicola enucleator	З		+
266	Loxia curvirostra	З		+
267	Pyrrhula pyrrhyla	ПЗм		++
268	Coccothraustes coccothraustes	ПЗм		++
269	Emberiza calandra	ПЗм		++
270	Emberiza citrinella	ПЗм		++
271	Emberiza leucocephala	ПЗм		+
272	Emberiza schoeniclus	ГПЗм		++
273	Emeriza rustica	З		++
274	Emberiza aureola	З		++
275	Emberiza hortulana	ГП		++
276	Emberiza melanocephala	З		+?
277	Emberiza bruniceps	З		+
278	Calcarius lapponicus	Зм		+
279	Plectrophenax nivalis	Зм		+

Status: S – settled; N – nesting; F – flying over; M – migrant; P – bird of passage; W – wintering;
Relative population size: ++++ numerous specie; +++ common specie; ++ not numerous specie; + rare specie; +? is possibly met within the Reserve's area.

ANNEX C2

Mammal fauna of the Astrakhansky Reserve

№	Specie	Status or size
1	Hemiechinus auritus	C
2	Desmana moschata	?
3	Crocidura suaveolens	N
4	Crocidura leocodon	N
5	Myotis mystacinus	+
6	Nyctalus leisleri	+
7	Nyctalus noctula	+
8	Pipistrellus nathusii	+
9	Pipistrellus kuhli	+
10	Eptesicus serotinus	+
11	Vespertilio murinus	+
12	Canis lupus	C
13	Vulpes vulpes	C
14	Nyctereutes procyonoides	N
15	Mustella nivalis	R
16	Mustella erminea	N
17	Mustella vison	C
18	Lutra lutra	C
19	Felis chaus	?
20	Lepus europaeus	S
21	Castor canadensis	R
22	Ondatra zibethicus	S
23	Arvicola terrestris	C
24	Microtus arvalis	C
25	Micromus minutus	S
26	Mus musculus	S
27	Rattus norvegicus	C
28	Sus scrofa	C
29	Saiga tatarica	O
30	Pusa caspica	O

Status or size: N – numerous; C – common, S – small, R – rare, O – occasionally, + – present, but requires specification, ? – data deficient.

ANNEX C3

Species inscribed on the Red Data Books of IUCN (2006), Russian Federation and Astrakhan Region

Specie	Status of conservation		
	IUCN	RF	AR
PLANTS			
Nelumbo caspica (DC) Fisch		3	2
Trapa natans L.s.i		1	3
Aldrovanda vesiculosa Linnaeus		3	3
Marsilea aegyptiaca Willd		3	2
INVERTEBRATES			
Classis Insecta			
Ordo Odonata			
Anax imperator Leach.		2	3
Ordo Caleoptera			
Calosoma sycophanta Linnaeus		2	1
Ordo Himenoptera			
Xylocopa valga Gerst		2	4
VERTEBRATES			
Classis Petromyzontes			
Ordo Petromyzontiformes			
Caspiomyzon wagneri Kessler		2	1
Classis Osteichthyes			
Ordo Clupeiformes			
Alosa kessleri volgensis Berg		2	1
Ordo Salmoniformes			
Stenodus leucichthys leucichthys Gul-denstadt			1
Ordo Cypriniformes			
Rutilus frisii kutum Kamensky		2	2
Vimba vimba persa Pallas			4
Ordo Gadiformes			
Lota lota Linnaeus			
Classis Aves			
Ordo Pelecaniformes			
Pelecanus onocrotalus Linnaeus		1	1
Pelecanus crispus Bruch	VU	2	2
Phalacrocorax pygmaeus Pallas		2	5

ANNEX C3

Specie	Status of conservation		
	IUCN	RF	AR
Ordo Ciconiiformes			
Ardeola ralloides Scopoli			2
Bubulcus ibis Linnaeus		3	3
Platalea leucorodia Linnaeus		2	3
Plegadis falcinellus Linnaeus		3	3
Ciconia nigra Linnaeus		3	3
Ordo Phoenicopteriformes			
Phoenicopterus roseus Palas		3	3
Ordo Anseriformes			
Rufibrenta ruficollis Pallas	VU	3	3
Anser erythropus Linnaeus	VU	2	3
Cygnus bewickii Yarrel		5	3
Anas angustirostris Menetries	VU	1	0
Aythya nyroca Guldes	NT	2	2
Oxyura leucocephala Scopoli	EN	1	4
Ordo Falconiformes			
Pandion haliaetus Linnaeus		3	3
Milvus roigrans Boddaert			2
Circus macrourus S.G.Gmelin	NT	2	4
Accipiter gentiles Linnaeus			3
Accipiter brevipes Severtzov		3	3
Buteo rufinus Cretzschmar		3	4
Aguila nipalensis Temminck		3	2
Aguila clanga Pallas	VU	2	3
Aguila chrysaetos Linnaeus		3	3
Haliaeetus albicilla Linnaeus		3	5
Falco cherrug Gray	EN	2	1
Falco peregrinus Tunstall		2	3
Falco columbarius Linnaeus			3
Falco naumanni Linnaeus	VU	1	3
Ordo Galliformes			
Coturnix coturnix Linnaeus			3
Ordo Gruiformes			
Grus leucogeranus Pallas	CR	1	2
Grus grus Linnaeus			3
Anthropoides virgo Linnaeus		5	5
Crex crex Linnaeus	NT		3
Porphyrio porphyrio Linnaeus		3	3

ANNEX C3

Specie	Status of conservation		
	IUCN	RF	AR
Otis tarda tarda Linnaeus	VU	3	3
Tetrax tetrax Linnaeus	NT	3	3
Ordo Charadriiformes			
Burhinus oedicnemus Linnaeus		4	4
Pluvialis squatarola Linnaeus			3
Pluvialis apricaria apricaria		3	3
Charadrius alexandrinus Linnaeus			3
Chettusia gregaria Pallas	CR	1	4
Vanellochettusia leucura Lichtenstein			3
Arenaria iterpres Linnaeus			5
Himantopus himantopus Linnaeus		3	3
Recurvirostra avosetta Linnaeus		3	3
Haematopus ostralegus longipes Buturlin		3	3
Tringa eruthropus, Pallas			3
Tringa stagnatilis, Betchstein			3
Xenus cinereus, Guldenstadt			3
Gallinago media, Latham	NT		3
Numenius arguata Linnaeus		2	2
Numenius phaeopus Linnaeus			3
Limosa lapponica Linnaeus			3
Glareola nordmanni Nordman	NT	2	4
Larus ichthyaetus		5	4
Larus minutus Pallas			3
Larus genei Breme			3
Gelochelidon pilotica Gmelin			3
Hydroprogne caspia Pallas		3	4
Sterna albifrons Pallas		2	3
Ordo Strigiformes			
Bubo bubo Linnaeus		2	3
Ordo Coraciiformes			
Coracias garrulus Linnaeus	NT		
Merops percicus Pallas			3

ANNEX C3

Specie	Status of conservation		
	IUCN	RF	AR
Ordo Passeriformes			
Corvus corax Linnaeus			3
Classis Mammalia			
Ordo Insectivora			
Desmana moschata Linnaeus	VU	2	1
Ordo Carnivora			
Felis chaus Guldenstaedt			0

Extinct, EX
Critically endangered, CR
Endangered, EN
Vulnerable, VU
Near tratened, NT
Data deficient, DD

ANNEX D
BIBLIOGRAPHY

1. Avandelta of the Volga river and its significance for fish industry // Works of the Astrakhansky Reserve. – Astrakhan, 1965. – 446 p.
2. Baidin S.S. Water flow and levels of the Volga delta. Moscow: Hydrometeoizdat, 1962. – 338 p.
3. Baidin S.S., Linberg F.N., Samoilov I.V. Hydrology of the Volga delta. – Leningrad: Hydrometeoizdat, 1956. – 332 p.
4. Barsukova L.A. Biogenic flow of the Volga river before and after its stream has been regulated // Annotations to works by KaspNIIRH in 1963, issue 6. – Astrakhan.
5. Barsukova L.A. Long-term biogenic flow of the Volga river near Astrakhan. // Biology, hydrology and chemistry articles. Works by KaspNIIRH, vol. 26 – Astrakhan, 1971. p 42-53.
6. Belevich E.F. Zonation of the Volga delta // Fauna and ecology of the Volga delta and the Caspian Sea. – Astrakhan, 1963. p 401-421.
7. Belevich E.F. On Volga influence over the delta development // Proceedings of the Academy of Sciences of USSR, Geography, 4. 1964.
8. Belevich E.F. Ilmeny of Astrakhansky Reserve // Works of the Astrakhansky State Reserve, issue 4. – Astrakhan, 1958.
9. Belevich E.F. On Volga delta buildup // Proceedings of the Scientific Session dedicated to the 50th Anniversary of the Astrakhansky State Reserve. – Astrakhan, 1968.
10. Belevich E.F. Development of the lower course of the Volga delta // Proceedings of the Academy of Sciences of USSR, Geography, 1978. p 78-88.
11. Bondarev D.V. Colonial nesting areas of Ciconiiformes and Pelecaniformes at the Northern part of the Caspian Sea (data review and practical recommendations). – Astrakhan, 1975. 30 p.
12. Bondarev D.V. Colonial nesting areas of Ciconiiformes and Pelecaniformes in the Volga delta // Habitat and bird species of the Caspian coast and adjacent surroundings: Works of Kyzyl-Agachsky Reserve, issue 1. – Baku, 1979. p 202-220.
13. Valedinsky V.V., Apollov B.A. The Volga delta // Proceedings of the Harbors and Communications Department. – Vol.1, issue 5. – Tiflis, 1928.
14. Vinetskaya N.I. Dependence of the food fish catch and slowed vobla growth from biogenic flow of the Volga and the primary productivity index of the Northern part of the Caspian Sea // Works of the Russian Institute of Fish Industry and Oceanography. Vol. 60. Moscow: Pischepromizdat, 1966.
15. Vinetskaya N.I. Hydrochemical regime of the Northern part of the Caspian Sea after regulation of the Volga water flow // Works of the Caspian Science Research Institute of the Fish Industry. Vol. 24. – Moscow: Food Industry, 1968.
16. Vinnikov G.J. Mouth channels in the Volga delta // Proceedings of the Scientific Session dedicated to the 50th Anniversary of the Astrakhansky State Reserve. – Astrakhan, 1968. – p. 57 - 60.
17. Vinogradov V.V. To nesting of the grey goose at the Caspian Sea // Geese in USSR: Works of the intergovernmental conference, Estonia, May 1970. – Tartu, 1972. – p. 59-65.
18. Vinogradov V.V. Recommendations for typology and valuation of wetlands of the lower course of the Volga delta. – Astrakhan, 1973.
19. Vinogradov V.V. Grey goose at the Northern and Western Caspian Sea // Moscow Society of Nature Investigators Bulletin. – 1979. – Vol. 84, issue 2. – p. 66-72.
20. Vinogradov V.V. Complex assessment of the Volga delta wetlands as a waterfowl habitat // Natural ecosystems of the Volga delta. – Leningrad, 1984. - p. 109-120.
21. Vinogradov V.V., Reutsky N.D. New data on birds wintering in reeds of the Volga delta and avandelta // Moscow Society of Nature Investigators Bulletin: Biology. – Vol. 87, issue 1. – 1982. - p. 36-37.

ANNEX D
BIBLIOGRAPHY

22. Vorobjev K.A. Saiga in Astrakhansky Reserve // Hunter. – 1929. #2.
23. Ganjushkin M.A. From phenological diaries // Works of the Astrakhansky State Reserve. Vol. 4. – Astrakhan, 1959. – p. 353-366.
24. Gavrilov N.N. Number of near water colonial birds in the lower course of the Volga Delta // Natural ecosystems of the Volga delta. – Leningrad, 1984. - p. 136- 139.
25. Gynetsinskaya T.A. Parasite fauna of ducks of the Volga delta // Scientific works of Leningrad State University: Biology, issue 19. - N 101. – Leningrad, 1949. - p. 81-109.
26. Gynetsinskaya T.A. Parasites of Rallidae and Podicipediformes of the Astrakhansky Reserve // Works of the Leningrad Society of Nature Investigators. - Leningrad, 1952. - Vol. 11, issue. 4. - p. 53-72.
27. Gorbunov K.V. Biological flow of the Volga delta lower reach in the regulated flow period by the example of Bystraya branch. – Togliatti, 1968.
28. Gorbunov K.V. Influence of Volga regulation over biological processes and water flow. - Moscow: Science, 1976. - 220 p.
29. Gudkov M.P. Water reservoirs of the Volga delta // Works of the Caspian basin of the Russian Institute of Fish Industry and Oceanography, 1952. Vol. XII.
30. Dvoichenko G.G., Krivonosov G.A., Kuljukina N.M. Results of re-acclimatization of racoon dog, European beaver and musk-rat in the Astrakhan region // Acclimatization of animals in USSR. – Alma-Ata, 1963.
31. Dobrokhotov V.I. To founding of jungle cat in the Volga delta // Scientific proceedings of the Committee for Reserves. – Issue 3. – 1939.
32. Dubinin V.B. Parasite fauna of wild boars in the Volga delta // Works of the Leningrad Society of Nature Investigators. Vol. 71, issue 4. – Leningrad, 1952. p. 73-81.
33. Dubinina M.N. Ecological research of parasite fauna of lake frog (Rana ridibunda) in the Volga delta. – Collected articles: parasitology. Zoological Institute of the Academy of Sciences of USSR. Vol.12. – 1950. – p. 300-350.
34. Zharkov I.V. European beaver in the Volga delta // Works of Voronezhsky State Reserve. – Issue 9. – Voronezh, 1960.
35. Zhivoglyad A.F. Main changes of vegetation of the Volga delta lower reach for the last 30 years // Volga – 1. 1st conference for the Volga basin reservoirs study. – Togliatti, 1968. – p. 96-97.
36. Zhivoglyad A.F. On changes of flora of the Astrakhansky Reserve for the last 30 years // Works of the Astrakhansky Reserve. – Issue 13. – Astrakhan, 1970. – p. 168-177.
37. Zhivoglyad A.F. Influence of the Volga water flow changes over the vegetation of the delta lowlands // First All-Union Conference for Higher and Near-Water Vegetation: Thesis. – Borok, 1977. – p. 60-61.
38. Zhivoglyad A.F. Vegetation of wetlands of lower course of the Volga delta // Natural ecosystems of the Volga delta. – Leningrad, 1984. – p. 29-43.
39. Zhivoglyad A.F. Flora and vegetation // Astrakhansky Reserve. – Moscow, 1991. – p. 23-49.
40. Zhivoglyad A.F. Water vegetation dynamics of the Astrakhansky Reserve // Reserves of the USSR, their past and present. Part 2. – Voronezh, 1990. – p. 60-63.
41. Zhivoglyad A.F. Structure and productivity dynamics of the Volga avandelta vegetation // Biological resources of the Caspian Sea: Thesis of the First International Conference (September, 1992). – Astrakhan, 1992. – p.113-114.
42. Zhivoglyad A.F. Vegetation changes of the Volga delta lower reach due to the Caspian Sea level rise // Caspian Sea – Past and Future. – Astrakhan, 1995. – p. 77.

ANNEX D
BIBLIOGRAPHY

43. Zhivoglyad A.F. Vascular plants of the Astrakhansky Reserve // Flora and fauna of the Reserves. – Moscow, 1998. – Issue 72. – p. 32.
44. Zhivoglyad A.F. Influence of the Volga water flow and Caspian Sea level rise over the vegetation of ecosystems of Astrakhansky Reserve // State, study and conservation of nature complexes of the Astrakhansky Biosphere Reserve in conditions of the Caspian Sea level rise and the increasing human pressure: thesis of the scientific conference dedicated to the 80th Anniversary of the Astrakhansky Reserve (Astrakhan 23-28 August 1999). – Astrakhan: CNTEP, 1999. p. 24-26.
45. Zhivoglyad A.F., Rusakov G.V. Botanical and geomorphological changes in ecosystems of the Volga delta lower reach // Optimization, forecast and nature conservation: thesis. – Moscow, 1986. – p. 287-289.
46. Zhivoglyad A.F., Rusakov G.V. Influence of hydrological regime change over the structure and functioning of biocoenosis: thesis. – Syktyvkar, 1987. – Part 2. – p. 40-41.
47. Zablotsky V.I. Parasite fauna of raccoon dog and musk-rat reintroduced in the Volga delta // Works of the Astrakhansky Reserve. – Issue 13. – Astrakhan, 1970. – p. 316-381.
48. Ivanov V.M. On apophallosis nidus in the Volga delta // Problems of study of specially protected areas of the Astrakhan region. – Astrakhan, 1990. – p. 25-26.
49. Isakov J.A. Typology and classification of the waterfowl habitats // Waterfowl resources in the USSR, their reproduction and use. – Moscow, 1968. – Part 1. – p. 14-18.
50. Isakov J.A., Krivonosov G.A. Passing and molting of waterfowl in the Volga delta // Works of the Astrakhansky Reserve. – Astrakhan, 1969. – 187 p.
51. Kasatkin V.I. Mammals of the Volga avandelta // Materials of the scientific session dedicated to the 50th Anniversary of the Astrakhansky State Reserve. – Astrakhan, 1968 a. – p. 178-180.
52. Kasatkin V.I. Influence of hydrological regime change and human activity over mammals of the Volga delta // Materials of the scientific session dedicated to the 50th Anniversary of the Astrakhansky State Reserve. – Astrakhan, 1968 b. – p. 181-182.
53. Kasatkin V.I. 1971. Changes in mammals dislocation in the Volga delta in connection with regulation of its water flow and the Caspian Sea regression // Zoological journal. – 1971. – Vol. 50, issue 8. – p. 1220-1227.
54. Kasatkin V.I. 1972. Mammals of the Volga delta in conditions of the regulated water flow and the Caspian Sea regression: Author's abstract for graduation in biology. – Rostov-na-Donu, 1972. – 22 p.
55. Kizina L.P. Changes in distribution and amount of food fish in connection with the Volga delta lower reach ecosystems dynamics. – Leningrad, 1984. – p. 81 - 92.
56. Koblitskaya A.F. Natural fish reproduction in the Volga delta in conditions of the regulated water flow // Volga – 1. Problems of study and management of biological resources of water reservoirs: Materials of the 1st Conference for the Volga basin water reservoirs study. – Kuibyshev: Kuibyshev Publishing House, 1971. – p. 286 - 293.
57. Koblitskaya A.F. Successions of spawning societies of the Volga delta // Ichthyology issues. – Vol. 17, issue 4 – 1977.
58. Kotjukov J.V., Rusanov G.M. Mallard - Anas platyrhynchos L // Migrations of birds of Eastern Europe and Northern Asia. Anatides. Anas. – Moscow: Science, 1977. – p. 7 - 103.
59. Krivenko V.G. Number of eggs in oviposition and waterfowl pullus death in the Volga delta // Resources of the waterfowl game in the USSR, its reproduction and management. – Second All-Union Conference. Part 1. - Moscow, 1968. - p. 109-110.

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BIBLIOGRAPHY

60. Krivenko V.G., Krivonosov G.A. Waterfowl populations size in the Volga delta and their reproduction // Resources of the waterfowl game in the USSR, its reproduction and management. - Moscow, 1972 a. - p. 109 -112.
61. Krivenko V.G., Krivonosov G.A. Grey goose in the Volga delta (ecology, population size, reproduction) // Geese in the USSR: Works of the interagency conference, Estonia, May 1970. – Tartu, 1972 b. – p. 46-58.
62. Krivenko V.G., Krivonosov G.A. Twenty years of studying mute swan in the Volga delta // Biology and migration of swans in the USSR. - M.: Science, 1987. – p. 34-43.
63. Krivonosov G.A. Modern state of the mute swan population (Cygnus olor Gm.) in the Volga delta and measures for protection of its nesting areas // Fauna and ecology of the Volga delta and the Caspian Sea coast: Works of the Astrakhansky Reserve. - p. 8. - Astrakhan, 1963. – p. 235-243.
64. Krivonosov G.A. Types of the water hunting grounds of lower course of the Volga delta // Resources of waterfowl game in the USSR, its reproduction and management. - Moscow, 1968. - Part 1. - p. 18-21.
65. Krivonosov G.A. Waterfowl of the Volga delta (ecology, population dynamics, issues of conservation and management): Author's abstract for graduation in biology. – Astrakhan, 1971.
66. Krivonosov G.A. Ten years of avia-inventory of waterfowl in the Volga avandelta and at the Northern part of the Caspian Sea // Resources of the waterfowl game in the USSR, its reproduction and management. – Moscow, 1972. – Issue 2. – p. 97-98.
67. Krivonosov G.A. Wetlands and waterfowl in the Caspian Sea region // Natural habitat and birds of the Caspian coast and the adjacent lowlands. – Baku, 1979. – p. 5-16.
68. Krivonosov G.A., Bondarev D.V. Destiny of pelicans in the Volga delta // Moscow Society of Nature Investigators Bulletin: Biology. Issue 5. - Moscow, 1978. - p. 42 - 48.
69. Krivonosov G.A., Krivenko V.G. Summer molting of the waterfowl in the lower course of the Volga delta // Works of the Astrakhansky state Reserve. Issue 13. – Astrakhan: Volga Publishing House, 1970. – p. 329 - 346.
70. Krivonosov G.A., Rusanov G.M., Vinogradov V.V., Bondarev D.V. White-tailed eagle at the lower Volga. – 7th All-Union ornithological conference, part 2, Kiev: Naukova Dumka, 1977. – p. 223 - 224.
71. Kuzjakin A.P. Bats. – Moscow: Soviet Science, 1950. – 445 p.
72. Labutiva I.A., Zhivoglyad A.F., Gorbunov A.K., Rusanov G.M. Changes in the state of vegetation cover of the lower course of the Volga delta in conditions of the Caspian Sea level rise upon results of space image analysis and terrestrial observations (by the example of the Damchiksky cluster of the Astrakhansky Reserve) // State, study and conservation of nature complexes of the Astrakhansky Biosphere Reserve in conditions of the Caspian Sea level rise and the increasing human pressure: thesis of the scientific conference dedicated to the 80th Anniversary of the Astrakhansky Reserve (Astrakhan 23-28 August 1999). – Astrakhan: CNTEP, 1999. p. 45-46.
73. Lavrovsky A.A. Wild boar in the Volga delta // Works of the Astrakhansky state Reserve. – Astrakhan, 1962. Issue 7. - 67 p.
74. Litvinov A.P. The role of Astrakhansky Reserve in wild boar conservation in the Volga delta // Works of the Astrakhansky state Reserve. – Astrakhan, 1999 b. – p. 55-56.
75. Litvinov A.P. Population dynamics, age-sexual structure and mortality of the young wild boars in the lower course of the Volga delta // Belovezhskaya Pushcha at the turn of the millennium. – Minsk: Minsk State University Publishing House, 1999. – p. 315-316.

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BIBLIOGRAPHY

76. Materials of the scientific conference dedicated to the 50th Anniversary of the Astrakhansky State Reserve. – Astrakhan, 1968. – 220 p.
77. Moskalenko A.V. Characteristics of the hydrological regime of water reservoirs of the Volga delta lower course // Works of the Astrakhansky state Reserve, issue 10. – Astrakhan, 1965.
78. Moskalenko A.V. To the characteristics of water surface inclination of the Volga delta water reservoirs in conditions of the regulated water flow // Works of the Astrakhansky state Reserve, issue 13. – Astrakhan, 1970. – p. 87-115.
79. Moskalenko A.V., Rusakov G.V. Modern hydrological regime of the water reservoirs of the Volga delta lower course // Nature ecosystems of the Volga delta. – Leningrad, 1984. – p. 12-28.
80. Moshonkin N.N. Recommendations for regulation of the American mink population size in the Volga delta. – Astrakhan, 1985. – 16 p.
81. Moshonkin N.N. Unforeseen introduction of the American mink into the Volga delta // 8th All-Union zoogeographical conference, Leningrad, 6-8 February 1985. – Moscow, 1984. – p. 104-105.
82. Natural ecosystems of the Volga delta. – Leningrad, 1984. – 145 p.
83. Rusakov G.V., Zhivoglyad A.F., Moskalenko A.V. Influence of the hydrological regime change over the Volga delta lower course vegetation // Water resources, 1980. N 4. – p. 178 - 182.
84. Rusanov G.M. Recommendations for conservation and management of bald-coot (Fulica atra L.) based on the study of its ecology in the Volga delta and the northwestern coast of the Caspian Sea. – Astrakhan, 1976. – 23 p.
85. Rusanov G.M. Mallard's modern nesting conditions in the western part of the Volga delta and measures for their improvement // // Natural habitat and birds of the Caspian coast and the adjacent lowlands. – Baku, 1979. – p. 131 - 145.
86. Rusanov G.M. Feeding of ducks in the Volga delta and its change under influence of environmental changes // Natural habitat and birds of the Caspian coast and the adjacent lowlands. – Baku, 1979. – p.146 - 177.
87. Rusanov G.M. Ducks molting in the Volga delta // Moscow Society of Nature Investigators Bulletin: Biology. – Vol. 88, issue 2. - 1983. – p. 3-8.
88. Rusanov G.M. State of natural habitats of the Volga near-delta coastal waters and perspective of their further change // Moscow Society of Nature Investigators Bulletin: Biology. – Vol. 88, issue 5. - 1983. – p. 10-21.
89. Rusanov G.M. Waterfowl wintering at the northern Caspian Sea in 1980-1984 // Modern state of the waterfowl resources (thesis of the All-Union Seminar 20-23 October 1984). – Moscow, 1984. – p. 100-102.
90. Rusanov G.M. State of nesting waterfowl resources in habitats of the lower course of the Volga delta and near-delta coastal waters // Natural ecosystems of the Volga delta. – Leningrad, 1984. – p. 93-108.
91. Rusanov G.M. Bald-coot (Fulica atra L.) in the Volga delta and at the northwestern coast of the Caspian Sea // Moscow Society of Nature Investigators Bulletin: Biology. – Vol. 90, issue 4. – Moscow, Moscow State University Publishing House, 1985. – p. 14 - 28.
92. Rusanov G.M. Reproduction of the grey goose in the Volga delta in 1981-1985 // Fauna resources of the Northern Caucasus: thesis of the scientific conference (19-22 April 1988). – Stavropol, 1988. - p. 140-142.

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BIBLIOGRAPHY

93. Rusanov G.M. Classification and typology of water habitats of wild animals in the Volga delta, sub-steppe ilmens and the Volgo-Akhtubinskaya flood plain // Specially protected nature areas of the Volga river basin (papers of the work meeting, Astrakhan, 20-21 April 1993). – Astrakhan, 1993. p. 36 - 40.
94. Rusanov G.M., Gavrilov N.N. Nesting of Dalmatian pelicans in the Volga delta in 1978-1979 // Scientific basis for investigation of colonial nesting of near-water birds. – Moscow, 1981. – p. 111- 112.
95. Rusanov G.M., Krivonosov G.A., Vinogradov V.V., Reutsky N.D. Changes in bird population of the Volga delta and avandelta under influence of natural and human factors // 8th All-Union zoogeographical conference, Leningrad, 6-8 February 1985. – Moscow, 1984. – p. 122 - 123.
96. Rybak V.S., Rusakov G.V. Hydrological and geomorphological processes in the lower course of the Volga delta in conditions of the sea level rise // International conference "The Caspian Sea – present and future": thesis. – Astrakhan, 1995. - p. 36-38.
97. State, study and conservation of nature complexes of the Astrakhansky Biosphere Reserve in conditions of the Caspian Sea level rise and the increasing human pressure: thesis of the scientific conference dedicated to the 80th Anniversary of the Astrakhansky Reserve (Astrakhan 23-28 August 1999). – Astrakhan: CNTEP, 1999. - 128 p.
98. Works of the Lenin Astrakhansky State Reserve. – Issue 13. – Astrakhan, 1970. - 418 p.
99. Tryapitsina L.N. Peculiarities of fish spreading and biology in the Volga avandelta // The Volga avandelta and its significance for food fish industry: Works of the Astrakhansky Reserve. Issue 10. – Astrakhan, 1965. - 427 p.
100. Bird fauna and ecology of the Volga delta and Caspian coast // Works of the Lenin Astrakhansky State Reserve. – Issue 8. – Astrakhan: Volga Publishing House, 1963. - 427 p.
101. Khlebnikov V.A. Vertebrate enemies of the game birds and food fish of the Astrakhan region. – Astrakhan, 1924. – 82 p.