Natural and anthropogenic factors influence on the botanic natural sanctuary vegetation cover dynamics of the river Volga delta

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Abstract. The river Volga state assessment and landscape functioning is an extremely necessary part for stable and ecologically safe region development. One of the most important this assessment components is vegetation monitoring organization and conduction, which is the necessary part of modern ecosystem exploitation. Monitoring investigations brief results of the botanic natural monuments vegetation cover situated in the eastern part of the river Volga delta are shown in this work. Environment major factors change impact defining main ecological properties if deltoid landscape vegetation cover: some climatic characteristics, the river Volga hydrological regime changes and flooding conditions, vegetation cover differentiation peculiarities in dependence on deltoid land forms and confined processes to it are considered for the monitoring period. It was revealed during the monitoring that abrupt water-soluble salts amount increase in soils occurred, also toxicity level and soil salinization type from chloride- sulfate to sulfate-chloride, that affects vegetation cover: total biomass decrease, projective cover degree decrease on the all deltoid landscape high level, sedges and gramineous plant involvement degree decrease and herbs increase in vegetation cover due to ariditization degree and desert advancing caused either by natural or anthropogenic impact.

1 Introduction

Estuarine natural complexes in the drainage basin system have a closing position, therefore anthropogenic activity disamenities are accumulated in the deltas, occurring in the whole basin that reflects primarily on the vegetation cover state, which tenderly reacts on the all ecological conditions changes. Complex approach necessity either to the protection site investigation and ecological conditions and factors, influencing it or to the account of the whole people natural-anthropogenic activity in considered one of the botanic diversity safe starting points of botanic diversity conservation.

Natural systems transformation processes of different extent receive extensive development in conditions of deltoid landscapes unsustainable environment, however it is necessary to pay more attention to local transformations. It is very perspective to

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investigate them as firstly they allow to reveal reasons and mechanisms of current dynamics tendencies on the landscape level and possible perspective of their further development, secondly, planning environment state control and undesirable and aggressive processes prevention is possible on the early stages of their development based on their indicator role [1, 2, 3].

2 Models and Methods

The river Volga delta vegetation cover monitoring investigations have been carried out in the stationary profile since 1978, with the purpose of more representative measure of occurred changes, on the stationary areas runs. Stationary areas were established under the guidance of V.B. Golub in the eastern part of the Volga delta, where hydrological regime anthropogenic changes and vegetation cover franked in a less degree than in the western part (figure 1). According to Astrakhan regional soviet of people's deputies executive committee decision № 616 from 04.10.985 investigation stationary areas (research points) were transferred into the natural sanctuary [4, 5].

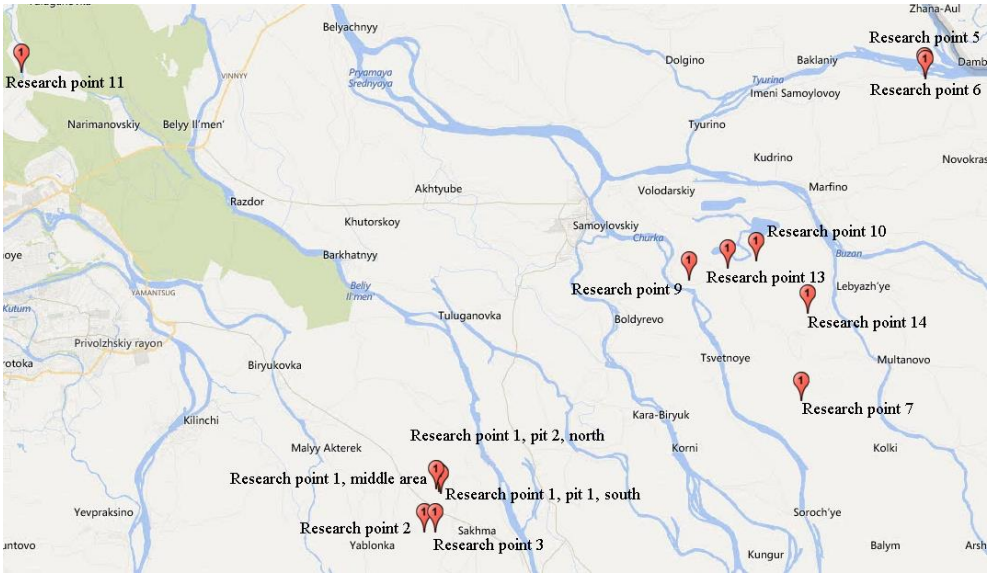

Figure 1. Schematic layout of the river Volga delta stationary areas (base of the map came from https: //wego.here.com/).

Sanctuary nature- botanic, meaning: genofond protection, scientific (botanic, landscape scientific), resources protection, aesthetic (scenically attractive landscape).

Areas are characterized by different according to the ecology grass phytocenosis, affected by artificially regulated spring-summer floods. They are located in the islands central part and each of them include relatively homogenous according to the floristic composition area no more than 300-400 square meters.

In geomorphic concern areas №№2 (botanic sanctuary «Sitnyagovo-quackgrass meadow Yablonsky») and 3 (botanic sanctuary «Arundinaceous meadow Voskhod») are situated within new Caspian deltoid pediment plain, №№7, 9 (botanic sanctuary «Quackgrass-shoreweed meadow Marfinsky»), 10 (botanic sanctuary «Svinoroinyi meadow Meshkovsky»), 13 (botanic sanctuary «Skrytnitsevo-solicornioid meadow Razbugorinsky») and 14 (botanic monument «Shoreweed- mortukovy meadow Yaminsky») – new Caspian coastal plain within Baer knolls distribution [5, 6].

Areas topographic elevations were tied with the help of the gradienter to the measuring rods of the nearest water stage gauge that allows to judge about flooding schedule each of them. Thus areas №№ 1, 2, 3, 5, 6, 13 and 14 are situated in one rather narrow (from the north to the south) physiographic area of the river Volga delta mid part, this gives a possibility to count the height above the low water level without mistakes using the measuring rods of the water stage gauge, situated in the village Bolshoi Mogoi [6].

Quantification and grass canopy tops composition on the stationary areas in investigation years were begun with grass cut on the small areas on the soil level. Size and amount of plots were chosen experimentally so that the mistake of measuring the whole grass mass does not exceeds 15%. It was impossible to achieve less mistake due to the count amount frequency increase or area size on available funds. The count amount frequency varied from 6 till 10, and area size from 0.5x0.5 m till 1.0x1.0. The stronger was grass canopy horizontal inhomogeneity shown the more the count amount frequencies were needed, and more large area size was needed for providing desired accuracy [4, 5].

Freshly excised grass canopy samples were investigated in cameral conditions according to the types and fractures: live plants, dead grass, and ground litter. Herbs fossiled this year were belonged to the dead grass, to the ground litter- last years. All these fractures were dried on the air (14-15% humidity) and were weighed.

3 Results and discussions

It is important to find out the first cause, stipulating development of that or other process and distinguish between natural and anthropogenic agents of its transformation when investigating deltoid landscapes vegetation cover, having a purpose to investigate ecosystem and landscapes components connection. The main factors, influencing on the vegetation cover of the river Volga estuarine natural system, are spring-summer floods, under which aqueous run off for the second quarter is understood conditionally, after hydroelectric stations cascade building and hydrological regime regulation [1, 7, 8]. The water factor importance in the river landscapes functioning is due to the fact that river runoff anthropogenic changes, hydrographic environment conversion, sea level fluctuations stimulates hydrodynamic processes complex development and biogeocenotical cover source area transformation development through the serial ecological relationships line [4, 9].

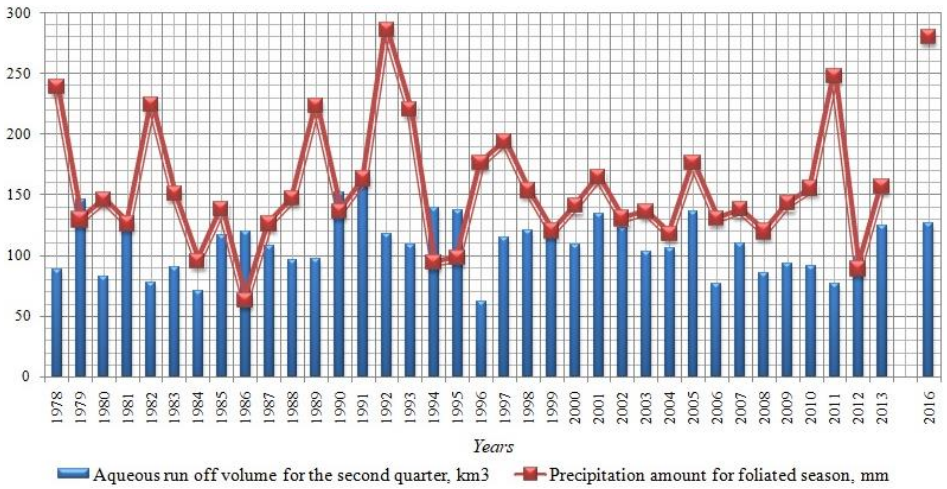

Figure 2. Floods volume dynamics and precipitation amount for the period with the temperature >10°C (according to the Astrakhan Center for Hydrometeorology and Environmental Monitoring).

Directional growth of average annual aqueous runoff volumes for the second quarter was observed from the beginning of monitoring investigation conduction till the mid 1990-s. The spring-summer floods percent from annual runoff in this period was at average 50% [5] (figure 2). Directional decrease of either spring-summer floods or their percent from annual runoff was observed on the following time segment. The average runoff volume for the second quarter was 93 cubic kilometers (38% from average annual runoff) for the last decades (2006-2015) [1]. The significant maximum water hoisting fluctuations were revealed in the flood period according to the Astrakhan water stage gauge measure. The water hoisting level significantly increased since 1980s, reaching its maximum from the period of 1992 till 2001. The water hoisting maximum level came close to the amount of the 1952-1961 period for the last time (2002-2016) [4].

The next factor defining water availability degree as consequence, delta plant cover functioning specific features is precipitation amount for foliated season. Precipitation amount in the Volga delta for the period with c t°C>10°C fluctuated under general tendency to decrease. Heat amount has certain affect on the grass canopy tops for foliates season. Positive trend was noticed on the dynamics of annual average amount temperatures with t°C>10°C during monitoring conduction. If since 1922 till 1981 temperature amounts fluctuations were at the range of 3400-3600 C, that since 1982 till 2015 fluctuations were at the range of 3600-3900 °C [1]. Climatological characteristics and hydrological regime changes led to changes in the river Volga delta meadow vegetation cover.

We can make a conclusion by summarizing investigation materials on stationary areas, that phenomenon observed on them not exactly give evidence of directional grass canopy changes, which was fixed earlier by us on stationary profile [1], however the main dynamic tendencies of vegetation community are similar.

Dominated vegetation types successions are observed on the low and mid-levels areas №№ 3, 1, 2 under humidity index increase: gramineous representation plants decrease and sedges and herbs participation increase. Grass canopy composition change on the areas № 13 belonged to meadow alkaline lands, besides humidity degree change defined by watersoluble salts dynamics in soil: herbs group representation decreased under directional toxicity decrease to 2016 (halophytes *Suaeda confuse* and *Petrisimonia oppositifolia*), gramineous plants became dominated group (62.3 % from total biomass). Grass canopy composition succession on the area went at some extent on the halopytization way in the mid-1990s that is, it is possible to suppose that under the whole tendency of salt washing out from the river Volga soil, in some cases their overcasting can cause salt content increase and vegetation cover halophytization [2, 4, 10].

Legumes group productivity abruptly increased on the areas №№ 9 and 10 to 2016, however on the area № 10 where legumes were completely displaced by gramineous plant group, such phenomenon belong to successive succession, whereas this process on the area № 9 may be belonged to fluctuation dynamics.

Herbs group on the area № 14 under periodical succession of dominated halophytes *S. confuse* and *P. oppositifolia* types, to which these types are belonged, are absolutely dominated during all monitoring, Artemisia lerchiana type productivity leap (till 13 % from total productivity in 2016) belong to fluctuation dynamics.

4 Conclusion

Maximum biomass productivity values for the whole investigation period were marked on the areas on which monitoring observation were continued in 2016. Probably, this phenomenon connected with that water pass levels in the period of spring-summer floods in the Volzhsky hydroelectric station site in 2016 (runoff volume for the second quarter was 127.3 cubic kilometers), and flood duration and water hoisting levels were maximally

approached to (natural) non over-regulated period (period till 1961- year when Volzhsky hydroelectric station began to work). This aspect is confirmed that flood volume over 120 cubic kilometers were met constantly during monitoring, but floods of 1979, 1990 and 1991 were 146, 152 and 159 cubic kilometers consequently. However graph line shifted to May after over-regulated river runoff, as earlier it was specifically that the floods beginning was from the mid of April, while flood duration decreased. Thus, monitoring investigation results point out on the necessity of Volzhsky hydroelectric station operation hours correction and approaching of water discharge to natural (non over regulated) period.

Nowadays, the rive Volga delta unique vegetation communities damage due to the climatological conditions changes, the river Volga aqueous run off volume, anthropogenic influence, therefore monitoring investigations don't lose its significance and will be continued.

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