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PROCESSES OF HALOXEROPHYTIZATION OF VEGETATION COVER IN THE LOWER REACHES OF THE AMUDARYA

Annotation. The article examines the current state of halophytic plants of the Lower Amu Darya and the processes of their haloxerophytization.

Keywords: Aral Sea, GIS, soil salinity, Amudarya delta, Landscape, desertification.

In the non-irrigated areas of the desert delta, many processes of the change of the vegetation cover characteristic of arid regions are manifested, first of all, it becomes thinner, the projective cover decreases, and from transition occur grasses to xerophilous shrubs. Complex physico-chemical and biological processes take place between individual plants in the open areas of the soil cover, including the absorption of soil salt solutions with the formation of a surface-saline layer, the formation of a clay-salt crust with an evaporation horizon under it, as well as as the formation of surface communities of soil algae and other organisms that forming a biological crust. During most of the year, in the absence of surface moisture, these communities are inactive, but during wet periods, their activity is critical to the sustainable functioning of desert landscapes. Often biological crusts are complex communities of blue-green algae, lichens, mosses, fungi, and other bacteria, and mycelium and threads of blue-green algae extend deep (on a scale of one millimeter) into these holds the thin surface layer (Fig. 1). This component should also be taken into account when interpreting spring and autumn satellite images, as the vegetative biological cover contributes to the normalized vegetation index. In a number of regions, such crusts form up to two-thirds of the biological cover in plant communities and play an important role in landscape formation processes [1, 2, 3, 6, 7, 8]. In particular, as a natural mulch, they contribute to moisture retention and improve the temperature regime of the root layer. Biological crusts reduce wind and water erosion, fix atmospheric nitrogen and make a significant contribution to enriching the soil layer with organic substances (Pic. 1).

Morphologically, these layers are usually very diverse, forming patches of various sizes and shapes, occupying nitrogen-poor ecological niches between scrubland and flat, open areas. In salt marshes, halophilic blue-green algal assemblages are more typical for depressions. Desert areas, remnants of sand ridges within oases, and shifting sands were mainly covered by lichens, and their increase during the last decade was observed in field studies conducted over the next decade.

As noted by a number of leading ecologists and botanists, biological crusts can be an important biological indicator of the condition of pastures and long-term ecological changes in arid regions. This is due to the fact that, in contrast to higher vascular plants, short-term abiotic factors have a relatively weak effect on the microflora of the upper layer of the soil in arid regions.

Pic. 1. Island biological crust in the soils of the northern part of the delta. A combination of physical and biological crusts is clearly visible.

Biological crusts coexist with an important structural feature of soils in arid regions, physical (abiotic) crusts are also widespread as a residual phenomenon in post-delta landscapes and irrigated fields removed from agriculture due to salinity, periodic flooding . An important factor in the formation of clay crust is rainfall, as raindrops break down accumulated soil particles and release clay substances. Smaller particles are washed into the space between the larger ones, plugging the soil voids and reducing permeability by up to 90%. When it dries, a dense clay crust is formed, the lower part of which is adjacent to the soil, part of which is from dense loam, and the outer part consists of oriented clay particles, usually under the crust lies a porous soil aggregate; An additional role in the strengthening of the abiotic crust is played by salts, lime and gypsum accumulated in the crust and the loose bottom layer when moisture dries. Also, the formation of the earth's crust is facilitated by agricultural cultivation, transport disturbance of the soil layer and overgrazing [4, 5, 6]. Such crusts play an important relief-forming role: due to the low permeability of water in the areas covered by them, sediments accumulate in the form of surface flows, leading to clear water erosion even on small surface slopes. Soils with a deficiency of organic substances and a high clay fraction, sodium and calcium carbonates are especially prone to physical crusting. Such a combination of factors leading to a decrease in the stability of soil particles is also typical for deltaic soils. It can be seen that an increase in the amount of organic substances increases the stability of soils and their resistance to crusting, especially with the formation of hard, hard-to-remove crusts with a strong clay framework. On the other hand, the presence of any vegetation reduces crust formation - directly, by protecting the soil from raindrops, and indirectly, due to the increase in the content of litter and organic substances.

From the above, it can be seen that biological crusts reduce the formation of physical crusts and vice versa, the resulting clay crusts are biologically active, especially in crust-filling fields and long-term agricultural soils that obstacle the normal formation of algal-microbial communities of crusts. However, in some cases, for slightly saline soils with low sulfate content, the cracked physical crusts of the thallus retain moisture in the topsoil and promote the development of microbial-algal communities. Also, the formation of these communities is influenced by the soil composition as well as the characteristics of the relief, more precisely, the micro- and meso-relief characteristics. In this study, the relationship between different types of crustal formation and terrain features is particularly important. The leading factors of micromorphology include slope and aspect, since algal-microbial communities can only be active in wet conditions and when there is sufficient heat, so the northern and eastern slopes of weak slopes favor the development of biological crusts. The influence of the slope angle is highly nonlinear - when the slope angle exceeds, water erosion interferes with microbial algal communities, and at lower angles, the slope does not play an important role in these processes. Also, second-order elements play an important role in the conditions of the highly saline northern part of the delta. Previously, in previous works on the topic, we classified topographic elements for disturbed lands that were separated by highly effective method and have a large number of remains of anthropogenic elements - abandoned canals, ditches, dams, embankments, etc. and we proposed a highly effective method of detection [4, 5, 6, 8].

Pic. 2. Crustacean automorphic salt, high salinity layer, soil bottom horizon is visible.

The relationship between classified relief elements and the dynamics of the formation of saline soils and the accumulation of salts in the soil profile due to the close occurrence of mineralized groundwater (negative relief elements, local drainage depressions); saline source rocks (residual forms of delta relief, interchannel depressions); the activity of the root system of halophytes - for example, Halostachus caspica, Cynodon dactylon (L.) (flat and slightly inclined areas); accumulation of wind salts, especially from the dry bottom of the Aral Sea (relief mesoforms that help reduce wind speed).); removal of salt products from elevated relief elements to lower ones (negative relief forms surrounded by positive ones). The main feature of the modern geochemical situation related to salt accumulation is a significant dependence on the modern forms of the relief and, therefore, on the classical methods of analysis of relief plastics aimed at determining the regular features of the relief of deltas, channels, river banks, interchannel depressions. and other typical topographic features are functionally associated only with accumulated salts and have little effect on transport in the topsoil (Pic.2).

Also, two main types of salt marshes are associated with topographic features - hydromorphic and automorphic salt marshes.

Hydromorphic salt marshes develop in poor drainage and mineralized groundwater, negative flat forms, for example, at the bottom of dried up lakes, as well as on residual, incompletely destroyed floodplain terraces. Automorphic salt marshes are formed in saline soil-forming rocks with deep (more than 6 m) groundwater.

The quality composition of salinity is reflected in the external (morphological) features of salinity, there are different types of salinity, wet and black salinity.

Cortical - a crust is formed on the surface. This is a result of the presence of NaCl, a type of chloride, in large amounts of salinity in the soil [1,2,3].Wet -

the surface is dense, moist, sticky, contains a lot of CaCl2, MgCl2, they are very hygroscopic.

Complete - the surface horizon with a thickness of 5-7 cm is a completely dry, loose, dusty mass, characterized by the fact that the foot sinks when walking. Soil is high in NaSO4, which crystallizes with water and dries out the soil.

According to the nature of distribution of salts, salt marshes are divided into types: surface (salts in the 0-30 cm layer) and deep profile (salts along the profile down to groundwater). In addition to salt marshes, more or less saline (saline) soils are common.This type of salt marshes is also associated with topographic features.

By comparing the obtained classification with the observed types of crusts - physical and biological, we found that the formation of salt marshes or drains mainly occurs in the negative elements of the relief of post-deserted deltaic landscapes, positive relief elements are connected with elongated negative elements (dry riverbeds, ditches), etc. helps the development of biological crusts based on blue-green algae and other microflora. Thus, the developed methods for analyzing numerical terrain models are shown to be effective tools not only for analyzing but also for predicting soil transformation in decertified post-delta landscapes.

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