SJIF Impact Factor (2023): 8.574| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 8 | Issue: 10 | October 2023 - Peer Reviewed Journal

CURRENT STATE OF PRODUCTIVITY OF TUGAY VEGETATION OF THE LOWER REACHES OF THE AMU DARYA UNDER CONDITIONS OF ANTHROPOGENIC DESERTIFICATION

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ABSTRACT
The article deals with the issues of productivity and current state of the main plant communities of tugay in conditions under the influence of direct and indirect anthropogenic factors, on the floodplains and deltas of the Amudarya river. The paper considers the significance of anthropogenic and natural factors affecting the processes of changing the productivity of the main plant communities of tugay of the Amudarya delta. On the basis of ecological monitoring of tugay of the Amudarya lower reaches it is possible to obtain reliable information on changes in the natural productivity of woody-shrub vegetation and to predict the main direction of successional changes.
KEYWORDS: *Vegetation, aridization, ecosystem, lower reaches of the Amudarya, desertification, tugay, biodiversity, halo-xerophytase, degradation, succession, community ecology, anthropogenic factors, productivity, monitoring, biomass.*

At present, the natural environment of the Amudarya delta is characterised by increased dynamism, development of such negative processes as desertification and aridisation of the territory. This is caused, on the one hand, by a sharp increase in water withdrawal from the river and regulation of its flow, on the other hand, by increasing direct and indirect anthropopressing and changing climatic conditions, which together caused changes in the composition, structure and dynamics of phytocenoses of tugay in the Amudarya delta [1,2,8, 13].

Preservation of tugay flora and vegetation under conditions of regional aridisation and desertification is one of the most important problem of the Aral ecological crisis. The steps taken in this direction are of willful casual nature, are not based on scientifically theoretical ideas about the ways of solving this problem, and are certainly doomed to failure. According to our ideas, in order to solve this problem it is necessary to combine, on the one hand, understanding of the ecology of species and communities, regularities of their spatial and temporal dynamics, and, alternatively, knowledge of the regularities of the evolution of delta landscapes, understanding of their current dynamic state in order to maintain or recreate processes that allow to preserve flora and vegetation of tugay type as a single ecological-dynamic system [1, 3, 4, 8, 14].

In this regard, according to our ideas for rational solution of this problem it is necessary to combine, on the other hand, understanding of ecology of species and communities, regularities of their spatial and temporal dynamics, and on the other hand, knowledge of regularities of evolution of delta landscapes, understanding of their current dynamic state in order to maintain or recreate processes that allow to preserve flora and vegetation of tugay type as a single ecological-dynamic system. Due to changes in hydrological conditions in the lower reaches of the Amudarya and regulation of river flow, directly affected the current state of plant communities, resulting in the violation of ecological stability of phytocenoses and the development of negative processes of anthropogenic desertification and reduction of productivity of vegetation cover. These direct and indirect factors primarily caused the transformation of the composition, structure and functioning of ecosystems. All ecological types of vegetation represented in the lower reaches of the Amudarya River were affected. The most significant changes in delta ecosystems were first of all in tugay-type vegetation communities. The composition and structure of plant communities changed radically, and successional changes occurred.

In the course of formation and development of tugay plant communities, ecological conditions of habitats change, which in turn affect the communities. This mutual influence occurs during the whole period of their existence, reflecting on the accumulation of biological mass. In this regard, it is extremely interesting to consider the dynamics of changes in productivity of riparian

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communities in the lower reaches of the Amudarya.

Our studies provide an opportunity to trace the accumulation of biomass in different communities of riparian ecosystems, reflecting changes in environmental conditions during the formation of phytocenoses, and comparative analysis allows us to identify the main dynamics of changes in biological productivity in different plant communities.

In the early 30s of the last century, the total area of riparian massifs in the lower reaches of the Amudarya river was over 300 thousand ha, and in the 60s 120 thousand ha, now 35 thousand ha [1, 8]. They grew on alluvial-meadow riparian soils of streamside embankments, at groundwater table 1-2.5m. According to degree of salinity salinisation medium and weakly saline varieties. Under these ecological conditions, turang, willow, elk, turang-willow, turang-elk, turang-elk, turang-shrub, mixed herb-turang-elk communities were formed on the levees. At that time, anthropogenic impacts on the formation and development of riparian communities were minimal and did not play a determining role as they do now [1, 4, 5, 7, 9, 10, 14, 15].

Table 1
Estimation of stages of desertification of tugai vegetation in the lower reaches of the Amudarya river

Stages of desertification	The nature of the desertification of successions	Area occupied by desert and halophilic species, %	Assessment of desertification in points
Initial	Episodic penetration of desert and halophytic species into the tugay vegetation	0-10	1
Weakly expressed	Regular presence of desert and halophyte species in meadow plant communities, mainly in atypical microecotopes.	10-20	2
Moderately pronounced	Formation of elements of microphytocenoses of desert and halophyte species	20-35	3
Strongly pronounced	The emergence of elements of desert and halophytic plant communities	35-50	4
Very pronounced	Expansion of desert and halophyte plant communities (increase in the area occupied by desert and halophyte species)	50-75	5
Transformation of tugai vegetation into halo-xerophytic deserts	Gradual displacement of tugay vegetation by desert and halo-xerophyte associations.	>75	6

In the process of desertification of the landscapes of the ecosystems of the Amudarya deltas, when they entered the semi-hydromorphic stage of development, characterized by the absence of flood watering and the occurrence of the groundwater level close to the surface (up to 3 m), water-soluble salts accumulated in soils [3, 5, 9, 11, 14]. Salinization of meadow-tugay takyr soils is very minimal on subconditional ramparts. In interchannel depressions and lacustrine depressions, solonchaks form in place of marsh soils. As can be seen from Table 1, the main stages of desertification are established as a result of field studies of plant communities of the tugay of the Amudarya delta. At present, due to the absence of surface flooding of the tugay of the lower reaches of the Amu Darya, the total area of desertified and haloxerophyte plant communities is expanding, and succession changes are taking place; mixed tree-shrub plant communities appear in place of typical tree tugay.

The main cause of anthropogenic degradation of riparian forests in the lower reaches of the Amudarya is the regulation of river flow, which leads to changes in the regime of flood inundation, changes in the nature and intensity of soil formation (increased salinisation and loss of natural regeneration of riparian tree and shrub communities.

In connection with reduction of flood regime, there was a change in ecological conditions of growing places. Hydromorphic soils are replaced by automorphic soils and there is a widespread xerohalophytisation of riparian plant communities, these processes have affected productivity.

Tugay trees and shrubs are the most highly productive of all plant communities growing in Central Asia. According to S. E. Treshkin (2011), the average phytomass in tugai trees is 91 t/ha, its fluctuations in individual communities are from 70-120 t/ha. Phytomass fluctuations in tugay plant communities are largely due to changes in the environmental conditions of their habitats.

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Thus, with a change in water supply, accompanied by an increase in soil salinity, the share of root biomass increases [1, 7, 8, 9, 10, 14]. Our research makes it possible to trace the formation of biological productivity in the main plant communities of the tugay lower reaches of the Amu Darya, reflecting the main changes in environmental conditions during the formation of tugay phytocenoses, and a comparative analysis allows us to identify the dynamics of biological productivity.

Table 2
Productivity of typical woody tugay of the Amudarya delta (tonnes/ha)

Indicators	Above Ground Mass	Underground Part
Wood tugay	34,7	18,8
Shrub tugay	41,9	33,6
Total phytomass	76,6	52,4

As can be seen from table 2, the average amount of biomass of typical tree tugay is 76.6 t/ha, of which 41.9 t/ha is the underground part, and the average phytomass of shrub tugai is 52.4 t/ha, of which the underground part is 33.6 t/ha, and shrub tugai it is 52.4 t/ha, of which the root system is 33.6 t/ha.

Table 3
Productivity of desertified woody tugay of the Amudarya delta (tonnes/ha)

Indicators	Above Ground Mass	Underground Part
Wood tugay	30,7	14,8
Shrub tugay	39,8	29,6
Total phytomass	69,5	44,4

As can be seen from table 3, the average biomass of deserted woody tugai is 69.5 t/ha, of which 39.8 t/ha is underground part, and shrub tugay average phytomass is 44.4 t/ha, of which 29.6 t/ha is underground part.

Planning of rational nature management in the riverine belt and Amudarya delta should be based on a comprehensive analysis of the ecological and socio-economic state of the region, taking into account, first of all, the interests of environmental protection, and then the requirements of regional economic development. In order to implement long-term planning of rational nature management, it is also necessary to have a comprehensive and accurate forecast assessment of the consequences of the proposed plans of economic development and environmental protection measures. If there is an inevitability of the development of negative consequences, it is necessary to provide measures to mitigate and minimize them.

The critical condition of riparian ecosystems in the Amudarya floodplain and delta emphasises the need to organise integrated monitoring on the basis of existing riparian protected areas, as not only the vegetation and soil cover of the areas, but also the entire faunal riparian complex is subject to changes. In connection with the situation in the lower reaches of the Amudarya, it is necessary to organise protected areas of different protection status throughout the Amudarya floodplain and delta [6 11, 12, 15].

At present, direct and indirect anthropogenic interference has a significant impact on the productivity and changes in the composition and structure of the main plant communities. At present, as a general pattern we can state that if earlier the main edifying species determining the productivity of the main plant communities of tugay of the Amudarya delta were those of introzonal type, then unfortunately today it is more and more often determined by species of zonal type, which is another confirmation of intensive development of desertification and aridisation processes, in which there is also a progressive increase in underground biomass above the soil [1,8,13]. In this connection, in our opinion, only rational water use in the whole Aral Sea basin can be a guarantee of restoration of natural riparian ecosystems and preservation of biodiversity of riparian species and communities. Changing the hydrological regime of the Amudarya delta territory leads to successional change of species composition of the main plant communities, which, in turn, affects the dynamics, structure and productivity of riparian forests.

Thus, after analyzing the collected material on the dynamics of the productivity of trees and shrubs in the tugays of the Amudarya delta, we can conclude that at present it is significantly complicated by direct and indirect anthropogenic interference, which in turn affects biological productivity.

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