

Ecological and technological aspects of increasing sustainability of vegetation cover of caspian oil and gas provinces

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Abstract. The article presents the results of the study of the vegetation cover, in particular, the floristic and phytocenotic features of the territory of oil and gas extraction of the North-Eastern coast of the Caspian Sea, the southeast of the Caspian lowland are determined. Also, modern ecological and technological methods and a monitoring program are reflected, which will allow us to identify and assess the level of man-made impact, to develop a system of compensation processes that balances the ecological system as a whole. It is shown that the production activity of the oil and gas industry remains one of the main reasons for the negative impact on the stability of the vegetation cover of the studied areas.

1. Introduction

The high resource potential of the hydrocarbon raw materials of the Caspian Sea region, the economic and political interests of a number of countries stipulate an increase in the rates of extraction of raw materials and development of the infrastructure of the oil and gas industry in this region. In the course of geological engineering survey, construction and operation of wells and related infrastructure there is a regular increase in the area of industrial areas which leads to the transformation of natural ecosystems and biodiversity change, especially a change in vegetation [1-3].

In this regard, the problem of studying the present state of vegetation, the search for scientific-technological solutions of minimizing the man-caused impact and increasing the sustainability and adaptive potential of phytocenoses is urgent.

The purpose of this work was to study the current state of the vegetation cover of the North-Eastern part of the Caspian Sea in conditions of technogenic impact of oil and gas industry.

Modern high ecological and technological solutions and the ecosystem approach based on multi-level monitoring studies will not only reduce man-made pressure and keep the modern state of vegetation but also enhance the stability, the level of environmental adaptation North-eastern Caspian phytocenoses.

2. Materials and methods

Field research was carried out for a long time during 2010-2015. The study area is the territory of oil and gas production of the Northeast coast of the Caspian Sea, the southeast of the Caspian lowland.

Floristic and phytocenological studies were performed according to generally accepted methods of Sukachev (1928), Lavrenenko (1956, 1965, 1970), Tolmachev (1986), Rabotnov (1992), Ramenskiy (1952), Serebryakov (1962-1964)

The reconnaissance studies were carried out by a route method. The network of linear routes passed through all land-landscape-geomorphological units of the study area. The reconnaissance studies were supplemented with cartographic material, normative legal and project literature.

Floristic and geobotanical studies were carried out at the level of plant communities. During the study, a herbarium of vascular plants was collected, in the amount of 600 herbarium sheets. To clarify the species identity, the following were used: "The Flora of Kazakhstan" (1956 -1966), "The Flora of the USSR" (1934 -1960), "The Flora of the Southeast of the European part of the USSR" (1927 - 1936), N.P. Ogar, L.L. Stogova (2002) "The Flora of the Orenburg region" (2009), etc.

The nomenclature was checked according to the summary of S.K. Cherepanov (1995). With geobotanical descriptions, 10 x 10 m (100 m²) plots were laid. A total of 360 descriptions were made according to the generally accepted techniques of Bykov (1957), Shennikov (1961), etc. The study took into account the total projective coverage, species composition, abundance of each species, the name of the communities was carried out by the dominant classification.

3. Results and discussion

The classification of the ecosystems of the North-Eastern part of the Caspian Sea is presented at the mesostructural level; in the studied area five main types of ecosystems are identified: plains ecosystems, intrazonal ecosystems, aquatic ecosystems, agroecosystems, urban ecosystems.

Taking into account the macroforms of the relief, two main classes of ecosystems are distinguished at the macrostructural level: equal (desert) and aquatic ecosystems, the formation of which determines the hydrological factor.

3.1. Floristic and phytocenological characteristics of the study area

As a result of long-term field research, 173 species of sessile plants belonging to 34 families were identified on the territory.

The analysis of the systematic affiliation of the species of the investigated flora showed that the main number of species in the flora refers to angiosperms, they contain 97.6% of the total number of species, 80.91% of them occur in dicots and 18.52% in monocot plants. The most numerous families of the studied area are the families Chenopodiaceae, Asteraceae, Poaceae, Fabaceae, Brassicaceae. The leading position in the number of species is taken by the family Chenopodiaceae, which includes 37 representatives, which is 21.4% of all identified plants. The second place is occupied by the family Asteraceae with 22 species-12.7%, and the third - Poaceae with 19 species-11%. Further, the number of species in the flora under study is followed by the families Fabaceae and Brassicaceae - 18 species (10.4%).

The number of species in the families varies from 1 to 37. In the flora, 24 families with 1 genus are noted, including 33 species representing about 20% of the total species composition, a significant number of families with 1 genus indicates a relative taxonomic diversity of the flora of the studied district. The most numerous are the genera *Astragalus*, *Artemisia*, *Lappula*, *Salsola*, *Climacoptera*, *Anabasis*, *Petrosimonia*, *Atraphaxis*, *Limonium*, *Tamarix*.

Together they contain 43 species, which is about 25% of the total species composition [4,5].

The revealed flora unites plants of various life forms. The ratio of biomes in the composition of the flora according to Serebryakov's classification (1962, 1946) is as follows: annuals and biennials - 42.8% of species composition (74 species), herbaceous perennials - 41% (71 species), shrubs - 10.4% (18 species), semi-shrubs - 5.2% (9 species), trees - 1 species.

There is a clear predominance of herbaceous perennials, there is only 1 species of trees, a significant number of flora species occur in one- and two-year-old plants (42.8%) which determines the desert type of flora of the investigated area[6,7].

The following phytocenotic groups are distinguished on the study territory: desert-steppe, solonetz-steppe, meadow-steppe, meadow-solonchak, coastal-aquatic and aquatic.

Analysis of ecological groups of the flora shows that the vegetation cover of the investigated area is composed mainly of xerophytes and mezoxerophytes, xerophytes are dominant in desert and halophytic desert communities.

The species that are extremely rare in the territory under consideration include: goldbachiya hanging, tau-Sheriya pubescent, shaking of Krashenninikov. A little bit more often, but on the whole also comparatively rare to be seen in the territory under study: the Kurchatov invisible, the Dubstinsky goat skater, the large-winged parsnip, the Tatar rhubarb, the two-flowered tulip, and some other species[8-10].

To the category of rare species that grow in Pre-Caspian region refers a Ylutichna shield - *Clypeola jonthlaspi* L., which occurs in spring in the area of Bolshaya and Malaya Prorva. The ephemeral nature of the biology of this species in combination with the diffuse type of growth in unfavorable dry years can lead to a significant reduction in its abundance.

The revealed features of the systematic composition and distribution by life forms indicate that the flora under study is a typically desert flora.

In communities with *Artemisia arenaria*, *Agropyron fragile*, with the participation of *Tamarix ramosissima*, are distributed on small and medium hilly sands. In the early spring period, the same incompatibility with ephemerals and ephemerooids is also characteristic. In the basins of blowing, the vegetation cover is strongly out of shape, the *Elymus giganteus* groupings are common. Saline depressions are occupied by communities dominated by halophytic halophytes *Halocnemum strobilaceum*, *Kalidium foliatum*, *Kalidium caspicum*. In the regions with a close groundwater tableau, there is a tier of annual halophytes *Suaeda altissima*, *Suaeda acuminata*, *Climacoptera crassa*, *Salicornia europaea* and halophyte cereals - *Aeluropus litoralis*. For deep inter-ridge and inter-hillside depressions, the belt structure of vegetation around lakes and sites with the exclusion of groundwater is typical. Rapidly changing one another as the humidification decreases, communities form an ecological series from hydro- and hygrophytic cornaceous ones with *Typha angustifolia*, *Typha latifolia*, reed with *Phragmites australis*, mesophytic azhuretic *Aeluropus litoralis*, - annual glaophytic *Climacop-tera crassa*, *Suaeda acuminata* to mesocrophytic cockpit with *Atriplex cana*, gluon - *Halimione verrucifera* or in-stool - *Kalidium foliatum*, *Kalidium caspicum* communities[11-13].

Solonchak-solonetz complexes with *Artemisia pauciflora*, *Atriplex cana* and *Limonium suffruticosum* are formed on elevated sites.

Barkhan sands are a secondary form of relief, formed as a result of loosening of the surface during overgrazing. They are usually not fixed, easy to move and serve as a source of deflation. Obbarchanic ridges and dunes are typical for the outskirts of populated areas and wintering grounds, they are also distributed along the southern boundary of the sandy massif. In the basins of barkhan sands are formed groups of weeds *Vexibia alopecuroides*, *Peganum harmala*, *Ceratocarpus arenarius*.

Plain desert areas are occupied by the communities *Artemisia terrae-albae*, *Artemisia lercheana*, *Artemisia monogina*, *Artemisia arenaria* and perennial golophytes *Kochia prostrata*, *Comphorosma monspeliaca*, *Kalidium caspicum* on brown soils of different texture and degree of salinity.

On the sides of operating channels, cane thickets are formed

Phragmites australis in combination with the communities of multi-holophytes *Kalidium caspicum*, *Kalidium schrenkianum*, *Atriplex cana*, *Suaeda physophora*.

Elevated desert areas are occupied by dilated one-year-lophophy-semishrubs - *Anabasis salsa*, *Anabasis aphylla*, *Kochia prostrata*, *Petrosimonia triandra*, *Climacoptera crassa*, *Climacoptera lanata* and Ephemeral-*Artemisia* *Artemisia ter-rae-albae*, *Artemisia lercheana*, *Eremopyrum triticeum*, *Poa bulbosa*. On low plains with a close groundwater table (3-5 m) wormwood shrub communities are formed. The most wide-spread are *Tamarix ramosissima*, *Tamarix hispida*, *Tamarix elongata*

communities on meadow-brown solonchak soils. Subdominant species are *Artemisia terrae-albae*, *Artemisia lerchiana*, *Artemisia monogyna*. *Glycyrrhiza glabra*, *Limonium gmelinii*, *Alhagi pseudalhagi* predominate in the grassy tier. To non-soluble soils of light mechanical composition are associated with the *Ceratoides papposa* community. The de-graded areas are dominated by weeds: *Vexibia alopecuroides*, *Ceratocarpus utriculosus*, *Artemisia lerchiana*. On the sands of widespread ephemeral-cereal with wormwood *Artemisia ter-rae-albae*, *Artemisia lerchiana*, *Agropyron fragile*, *Carex phy-sodes*, *Poa bulbosasoobschestva* with shrubs *Calligonum aphyllum*, *Atraphaxis replicata*.

Previously grow here saxauls *Haloxylon persicum*, *Halox-ylon aphyllum*, having resource-set values as fuel, is almost completely destroyed.

Near settlements Sands obarhaneny, smash-you to the cover of weeds, which are dominated by monodominant community *Peganum harmala*.

Structure and regularities of the spread of vegetation. The vegetation investigated territories allocated 12 groups of formations, formations 16 and 32 associations desert vegetation (table 1).

Table 1. Phytocenological characteristics.

Formation name	Association	Number of species	Total projective coverage, %
halocnenum	<i>Halocnenum strobilaceum</i>	6	40-45
motley grass - halocnenum	<i>Halocnenum strobilaceum</i> + <i>Salsola nitraria</i>	8	45-50
	<i>Halocnenum strobilaceum</i> + <i>Suaeda acuminata</i>	10	50
	<i>Halocnenum strobilaceum</i> + <i>Artemisia monogyna</i>	10-11	50-55
halocnenum - puccinellia corkscrew	<i>Halocnenum strobilaceum</i> + <i>Puccinellia distans</i>	12	55
motley grass - corkscrew	<i>Agropyron fragile</i>	11-12	45-50
	<i>Agropyron fragile</i> + <i>Artemisia terraalbae</i>	12-13	50-55
	<i>Krascheninnikovia ceratoides</i>	10-12	50-55
	<i>Agropyron fragile</i> + <i>Alhagi pseudoalhagi</i>	10	45-50
climacoptera	<i>Climacoptera subcrassa</i>	6-8	50
	<i>Halocnenum strobilaceum</i> + <i>Climacoptera Subcrassa</i>	7	55
	<i>Climacoptera brachiata</i>	6	45-50
	<i>Halocnenum strobilaceum</i> + <i>Climacoptera brachiata</i>	7	50-55
grass-wormwood	<i>Artemisia monogyna</i> + <i>Agropyron fragile</i>	15	50-55
	<i>Artemisia terra albae</i> + <i>Agropyron fragile</i>	15	60
motley-wormwood	<i>Artemisia terra albae</i>	8	55-60
	<i>Artemisia monogyna</i>	9	40-45
	<i>Artemisia terra-albae</i> + <i>Kochia prostrata</i>	11	55-60
	<i>Artemisia monogyna</i> + <i>Salsola paulsenii</i>	15	55
	<i>Artemisia monogyna</i> + <i>Limonium suffruti-cosum</i>	14	45-50
	<i>Artemisia monogyna</i> + <i>Halocnenum strobilaceum</i>	12	40-45
motley grass - ceratoides	<i>Krascheninnikovia ceratoides</i> + <i>Artemisia terra-albae</i>	13	50-55
	<i>Krascheninnikovia ceratoides</i> + <i>Artemisia monogyna</i>	11	40
	<i>Krascheninni-kovia ceratoides</i> + <i>Alhagi pseudoalhagi</i>	8	45
Solcanic	<i>Salsola paulsenii</i> + <i>Kalidium caspicum</i>	9	35 -40
	<i>Salsola paulsenii</i>	8	40
suaeda	<i>Suaeda acuminata</i> + <i>Salsola nitraria</i>	7	40-45
motley-grass-free	<i>Puccinellia distans</i> + <i>Halocnenum strobi-laceum</i>	14	45
	<i>Puccinellia distans</i> + <i>Limonium caspicum</i>	12	40-45
aeluopus	<i>Aeluropus littoralis</i> + <i>Suaeda altissima</i>	6-7	45
tamarix ramosissima	<i>Tamarix ramosissima</i>	7	40
artemisia monogyna	<i>Atraphaxis spinosa</i> + <i>Artemisia monogyna</i>	7	35-40
Reeds	<i>Phragmites australis</i>	5	60

Current state of vegetation. The assessment of the current state of vegetation, in particular the degree of disturbance of the vegetation cover, was made on a five-point scale, where 1 point - vegetation is practically not broken, 2 points - a weak degree of vegetation disturbance; 3 points - the average degree of vegetation damage, 4 points - a strong degree of vegetation damage, 5 points - the vegetation cover is completely absent.

Areas with a violation of vegetation cover, estimated at 4 and 3-2.5 points fall on the territory of oil fields located within the territory under consideration [14-16].

Average mark of disturbances in the vegetation of oil de-posits: Tengiz and Korolevskoye are respectively 2.47 - 2.99; Terenozek-3,6, Dosmukhambet - 3,53, Kara-Arna - 3,17, Cen-tral-Eastern Prorva - 3,15; Western Prorva-2.99; Aktobe - 2.9, Karaton - 2.36.

Violations of soil and vegetation cover in the areas of de-posits are due to the development of deposits, including the development and operation of the road network, etc. In addition, if the sites with a disability of 4 points occupy, as indicated above about 10% of the total area, The degree of impaired, estimated at 3 points, occupies about 25% of the territory[17-19].

Areas with vegetation disturbance, estimated at 2 points and occupying about 29% of the total area, are mainly in the northeastern and central parts of the area under consideration, in particular in the areas of the Bolshaya and Malaya Prorva ducts[20].

Areas with a vegetation violation, estimated at 1 point, are located in the northern and eastern parts of their area is 35% of the area under study. These are areas with vegetation whose characteristics of communities are similar on lands with undisturbed soil-vegetation cover.

4. Conclusion

Thus, the current state of the vegetation cover of the study area is as follows:

- the greatest degree of disturbance of the vegetation cover (4 - 5 points) is confined to the areas where agricultural activities are carried out;
- areas with an average degree of impairment (about 3 points) are confined to deposits, as well as to territories in the area of industrial facilities and infrastructures;
- a weak degree of impairment (1-2 points) is confined to areas least susceptible to man-made impact.

The assessment was carried out taking into account the fact that in the fields around wells and in the territory of fire-hazardous objects the grass must be mowed out in order to eliminate the fire hazard of dry grass stand.

The conducted research shows that the activity of the oil and gas industry remains one of the leading reasons for the negative transformation of the vegetative territory of the territory.

Currently, one of the most effective ways of preserving, restoring the vegetation cover and increasing the adaptive potential of individual species and phytocenoses as a whole is the application of advanced science-intensive and environmentally friendly technologies of geological prospecting, construction and well development and associated infrastructure.

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