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CLASSIFICATION OF PLANTS IN THE SOUTH DRYING BOTTOM OF THE ARAL SEA

This work presents the results of floristic investigations of the dry seafloor of Aral Sea in its south part. For the first time 216 species of the higher plants have been shown to be growing in the south drying seafloor of Aral Sea. Analysis of genera and species according to the family shows that the large 7 families: *Chenopodiaceae*, *Asteraceae*, *Brassicaceae*, *Polygonaceae*, *Poaceae*, *Fabaceae*, *Boraginaceae* unite make up 158 species. The largest family is *Chenopodiaceae* includes 24 genera and 59 species. Other 6 large families compose 58 genera and 99 species; 20 families have only one genus and one species. Refs 43. Figs 2.

Keywords: Aral Sea, flora, system, family, genus, species.

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КЛАССИФИКАЦИЯ РАСТЕНИЙ ЮЖНОЙ ВЫСОХШЕЙ ЧАСТИ ДНА АРАЛЬСКОГО МОРЯ

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В данной работе приведены результаты флористических исследований южной части высохшего дна Аральского моря. Впервые было выявлено, что в южной части высохшего дна Аральского моря произрастают 216 видов высших растений. Анализ распределения родов и видов по семействам показывает, что 7 крупных семейств: *Chenopodiaceae*, *Asteraceae*, *Brassicaceae*, *Polygonaceae*, *Poaceae*, *Fabaceae*, *Boraginaceae* объединяют 158 видов. Самое большое семейство *Chenopodiaceae* объединяет 24 рода и 59 видов. Остальные 6 крупных семейств составляют 58 родов и 99 видов; 20 семейств имеют только по одному роду и виду. Библиогр. 43 назв. Ил. 2.

Ключевые слова: Аральское море, флора, система, семейство, род, вид.

Introduction. Biodiversity of dry seafloor of the Aral Sea is one of the least explored areas. Peculiar floristic composition, vegetation, soil and climate make this region different from neighboring (desert) areas. As to its physical and geographical location, the Aral Sea is a continuation of the Turan Lowland lying between Kazakhstan (Aktobe and Kyzylorda provinces) in the north and Uzbekistan (Karakalpakstan autonomous region) in the south.

Due to the Aral Sea drying, a typical dry desert and large saline-sand complex landscape originated in its territory. This man-made desert named "Aralkum" emerged as a new natural area of Central Asia [1, p. 277–283]. Aralkum is the youngest desert in the world. According to recent data, the total area of the dried Aral Sea is about 5.5 million hectares. Its southern part located in Karakalpakstan makes up 2.5–3 million hectares. Dry seafloor of the Aral Sea emerged in Central Asia as an open, deserted and unique "laboratory". The dried areas of the Aral Sea region contain variety of salty soils and sands.

Every year, 170–200 tons of salt and dust rise into the air and fall on the territory of the Republic of Karakalpakstan [2]. On average, seawater in the world's oceans has a salinity of about 3.5% (35 g/L). In 1940–60s original salinity of the Aral Sea was 10 g/L, within past years it increased to 40–50 g/L producing a devastating effect on its ecosystem

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[3]. The vegetation of the former coast comprising the Aral terraces and the dune areas is a very complex one. It includes halophytic, psammoaphytic and tugai species (small trees and shrubs of the delta and river floodplains) generating seeds for the formation of new plant communities at the dry seafloor [4].

Review of botanical researches. There are many famous names among contributors to floristic studies of coastline and islands of the Aral Sea.

Lieutenant Alexey Butakov, a commander of Russian warship "Constantine", was the first to explore the Aral Sea region during the expedition in 1848–1849 [5]. Neither geographer nor botanist, he made a detailed map of the Aral Sea and collected more than 75 herbarium samples around the north, west and south coasts of the Aral Sea, and on its islands. A. Butakov showed that desert forests mainly consisted of species of *Haloxylon*, *Tamarix* and *Salsola* genera.

Iliya Borshchov, a specialist in taxonomy, physiology and anatomy of plants, made exploration of the Aral-Caspian region flora [6]. In the region of the Aral Sea coasts he found the existence of several species of plants, such as *Tamarix elongota, T. laxa, T. hispida, T. leptostachya, Halostachys belangeriana, Ammodendron sieversii, A. karelini, Calligonum leucocladum, C. calliphysa, Eremosparton aphyllum, Nitraria schoberi, Zygophyllum brachypterum, Acanthophyllum spinosum* and others. Pavel Smirnov, a botanist, florist and taxonomist, collected the herbarium materials of southern and northern coasts of the Aral Sea [7]. A botanist, florist and botany-geographer, Dmitry Litvinov was the first to show that more than 219 species of plants existed in the Aral Sea region [8]. Famous geographer and natural scientist-encyclopedist, Lev Berg made a comprehensive survey of the Aral Sea, identified great number of plants growing in the Aral Sea region including islands and peninsulas, and made a list of higher and lower plant species based on herbarium materials he collected during the expeditions in 1899–1902 [9].

Professor Bazarbai Sherbaev identified the flora composition of the former southeastern islands and peninsulas of the Aral Sea [10]. He compared flora of the former islands and peninsulas with the floras of the northwestern Kyzyl Kum and Beltau ridge. Sherbaev explored flora of the southern coast of the Aral Sea and identified 239 species of higher plants belonging to 35 families and 136 genera.

Dimeyeva and Kuznetsov presented 300 species of vascular plants belonging to 40 families and 143 genera and growing on the Kazakh coastal strip of the Aral Sea [11]. In addition, they performed taxonomic, biomorphological, geographical, and comparative analysis of floristic species. The flora of Karakalpakstan coast was compared with the one of Kazakh coastal strip.

Bakhiev, Butov and Tadjitdinov found 65 species of higher plants belonging to 22 families and 50 genera in the Karabayli Archipelago, whereas on Takmak Aty island they identified 68 species belonging to 21 families and 49 genera [12]. Sh. Kamalov reported on effect of salt clay phytomelioration on the Aral Sea dried bottom and the Amu Darya delta [13, 14].

Results of floral investigation of the northern part of the Aral Sea dry seafloor can be seen in publications of many authors [11, 15–26].

Liliya Dimeyeva studied the floristic features of the coasts of the Caspian and Aral basins [20, pp. 9–10]. This author adduced 414 species of 43 families and 192 genera in the Aral northern coastal strip. *Calligonum* (33 species), *Artemisia* (14 species), *Astragalus* (14 species), *Suaeda* (13 species), *Atriplex* (12 species), *Tamarix* (9 species), *Salsola* (9 species), *Cli-*

macoptera (6 species), *Lepidium* (6 species), *Petrosimonia* (6 species), *Strigosella* (5 species), *Corispermum* (5 species), *Stipa* (5 species) are among the Aral coastline largest genera.

Dimeyeva, Breckle and Wucherer investigated the composition of the flora demonstrating that the vascular plants of the Aralkum are represented by 368 species belonging to 43 families and 178 genera [22]. Thirteen key families comprise 310 species belonging to 136 genera. Chenopodiaceae, Asteraceae, Polygonaceae, Brassicaceae and Poaceae are the families prevailing in this area. *Calligonum* (35 species), *Artemisia* (14 species), *Salsola* (13 species), *Atriplex* (12 species), *Astragalus* (11 species), *Tamarix* (10 species), *Suaeda* (9 species), *Climacoptera* (5 species) and *Corispermum* (5 species) are the most important genera.

Formation of a new natural complex structure and its dynamics, trends and changes of the sea bottom, a hydrogeological regime as well as formation of new salt composition of the soil, life and migration of plants in the Aral Sea region are among the issues requiring a thorough study. An integrated approach to the study on biodiversity of the South Aralkum will make it possible to determine and to use the promising plant species to fix free-moving dune sands and salt marshes. The work was initiated to determine the floristic composition of the South Aralkum area variety and to reveal the species requiring protection.

Materials and methods. *The area to study.* The Aral Sea is a major saline lake in Central Asia located at the boundary between Uzbekistan and Kazakhstan (Fig. 1a). Until early 1960s, the lake surface level was stable at about 53.5 m above the ocean level. In 1960, the Aral Sea, which was considered as a lake at the time, was the fourth largest lake on Earth with the capacity of about 1,070 km3 and the area over 65,000 km^2. Due to deficiency in its water budget, continuous shrinking of the Aral Sea started in 1961. A combination of natural and anthropogenic factors seems to underlie the process of its desiccation [27]. The geographic location of the Aral Sea is shown in Fig. 1.

Plant materials and data analysis. The flora of the dried bottom of the Aral Sea in its southern part (Fig.1b) and herbarium materials (nearly 1,000 samples) collected in various long-term season's expeditions within the period from 2006 to 2014 in the territory of about 2.5 million hectares is the object of the study. Taxonomic identification was performed at the Genomics Laboratory, Institute of Bioorganic Chemistry, and the Laboratory of Central Herbarium (TASH), Institute of the Gene Pool of Plants and Animals, Uzbekistan Academy Sciences as well as in the Educational-Experimental Centre for High Technologies in Tashkent.

Methods. We carried out flora and taxonomy analysis using classical morphological and geographical method of Popov [28]. Various manuals and standard floras, to name "Flora of USSR" [29], "Flora of Uzbekistan" [30], "Flora of Kazakhstan" [31], "Manual for the identification of the Middle Asian plants" [32], "Illustrated manual for the identification of the plants of Karakalpakstan and Khorezm" [33], "Flora and vegetation of Karakalpakstan" [34] were used, as well. Principles of the "The Red Data Book of the Republic of Uzbekistan" [35] following the classification of the International Union for Conservation of Nature were used for study on rare species of plants. Nomenclature follows Cherepanov as a standard reference book for the former USSR [36–38] and International Plant Names Index [39].

Results. To achieve the purpose of the study we determined the floristic composition of the territory. As the result of recent expeditions some new species of plants have been registered and added to the list of well-known plant species botanical diversity of the dry bottom of the Aral Sea [40–42].

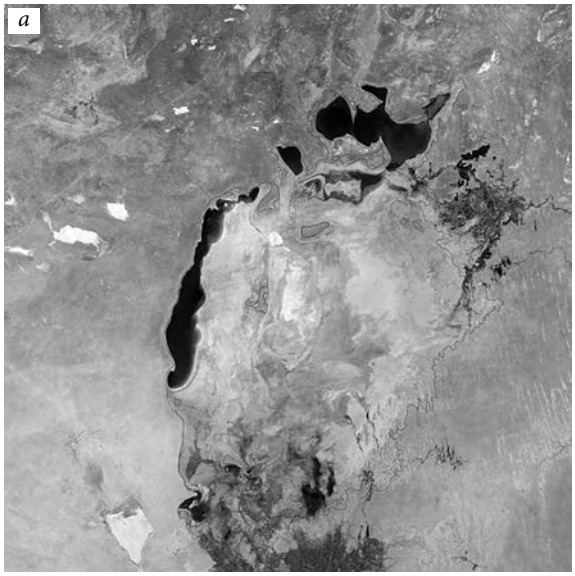

Fig. 1. The geographic location of the Aral Sea:
a — satellite image of Aral Sea, 2014 (http://earthobservatory.nasa.gov/IOTD/view.php?id=84437); *b* — landscape photo of seafloor of Aral Sea, May 2014 (Sherimbetov).

A list of vascular plants recorded on the dried bottom of the Aral Sea in its southern part is presented below.

Alliaceae J. G. Agardh. (1 genus, 1 species): *Allium sabulosum* Stev. ex Bunge.
Apiaceae Lindl. (1 genus, 1 species): *Daucus carota* L.
Apocynaceae Juss. (1 genus, 1 species): *Cynanchum sibiricum* Willd.
Asparagaceae Juss. (1 genus, 1 species): *Asparagus inderiensis* Blum ex Pacz.

Asteraceae Dumort. (16 genera, 25 species): *Aster tripolium* L., *Karelinia caspia* (Pall.) Less., *Xanthium strumarium* L., *Mausolea eriocarpa* (Bunge) Poljak. ex Podlech, *Artemisia austriaca* Jacq., *A. diffusa* Krasch. ex Poljak., *A. ferganensis* Krasch. ex Poljak., *A. schrenkiana* Ledeb, *A. scoparia* Waldst. et Kit., *A. terrae-albae* Krasch., *A. turanica* Krasch., *Jurinea multiloba* Iljin, *Senecio noëanus* Rupr., *S. subdentatus* Ledeb.., *Cirscium ochrolepideum* Juz., *Acroptilon repens* (L.) DC., *Koelpinia tenuissima* Pavlov et Lipsch., *K. turanica* Vass., *Scorzonera sericeolanata* (Bunge) Krasch. et Lipsch., *Takhtajaniantha pusilla* (Pall.) Nazarova (= *Scorzonera pusilla* Pall.), *Chondrilla ambigua* Fisch. ex Kar. & Kir., *Taraxacum officinale* Wigg. s.l., *Tragopogon sabulosus* Krasch. et S. Nikit., *Lactuca tatarica* (L.) C. A. Mey., *L. undulata* Ledeb.

Biebersteiniaceae Endl. (1 genus, 1 species): *Biebersteinia multifida* DC.

Boraginaceae Juss. (7 genera, 10 species): *Heliotropium arguzioides* Kar. et Kir., *H. dasycarpum* Ledeb., *Heterocaryum rigidum* DC., *H. szovitsianum* (Fisch et C. A. Mey.) A. DC., *Lappula semiglabra* (Ledeb) Guerke, *L. spinocarpos* (Forssk.) Aschers., *Rochelia retorta* (Pall.) Lipsky, *Onosma staminea* Lebed., *Arnebia decumbens* (Vent.) Coss. et Kral., *Nonnea caspica* (Willd.) G. Don.

Brassicaceae Burnett (13 genera, 21 species): *Descurainia sophia* (L.) Webb ex Prantl, *Arabidopsis pumila* (Steph.) N. Busch., *Isatis boisseriana* Reichenb., *I. emarginata* Kar. et Kir., *I. minima* Bunge, *Strigosella africana* (L.) Botsch., *S. brevipes* (Bunge) Botsch., *S. circinata* (Bunge) Botsch., *S. intermedia* (C. A. Mey.) Botsch., *S. scorpioides* (Bunge) Botsch., *Leptaleum filifolium* (Willd.) DC., *Matthiola chenopodiifolia* Fisch et C. A. Mey., *Tetracme quadricornis* (Steph.) Bunge, *Chorispora tenella* (Pall.) DC., *Alyssum desertorum* (Stapf) Botsch., *Litwinowia tenuissima* (Pall.) Woronov ex Pavl., *Lepidium latifolium* L., *L. obtusum* Basiner, *L. perfoliatum* L., *Crambe edentula* Fisch. et C. A. Mey. ex Korsh., *Octoceras lehmannianum* Bunge.

Capparaceae Juss. (1 genus, 1 species): *Capparis spinosa* L.

Caryophyllaceae Juss. (1 genus, 1 species): *Acanthopyllum borsczowii* Litv.

Ceratophyllaceae S. F. Gray. (1 genus, 2 species): *Ceratophyllum demersum* L., *C. submersum* L.

Chenopodiaceae Vent. (24 genera, 59 species): *Atriplex dimorphostegia* Kar. et Kir., *A. moneta* Bunge, *A. pratovii* Sukhor., *A. tatarica* L., *Kraschenninnikovia ewersmanniana* (Stschegl. ex Losinsk.) Grub., *Ceratocarpus arenarius* L., *C. urticulosus* Bluk., *Bassia hyssopifolia* (Pall.) O. Kuntze, *Kochia prostrata* (L.) Schrad., *K. scoparia* (L.) Schrad., *Corispermum aralo-caspicum* Iljin, *C. lehmannianum* Bunge, *Agriophyllum lateriflorum* (Lam.) Moq., *Kalidium caspicum* (L.) Ung.-Sternb., *Halostachys belangeriana* (Moq.) Botsch., *Halocnemum strobilaceum* (Pall.) M. Bieb., *Salicornia europaea* L., *Horaninovia anomala* (C. A. Mey.) Moq., *H. excellens* Iljin, *H. ulicina* Fisch. et C. A. Mey., *Salsola arbuscula* Pall., *S. arbusculaeformis* Drob., *S. australis* R. Br., *S. dendroides* J. Pall., *S. deserticola* Iljin, *S. foliosa* (L.) Schrad., *S. gemmascens* J. Pall., *S. implicata* Botsch., *S. incanescens* C. A. Mey., *S. micranthera* Botsch., *S. nitraria* J. Pall., *S. orientalis* S. G. Gmel., *S. paletzkiana* Litv., *S. paulsenii* Litv., *S. richteri* (Moq.) Kar. ex Litv., *Halothamnus subaphylla* (C. A. Mey.) Aellen, *Haloxylon aphyllum* (Minkw.) Iljin, *H. persicum* Bunge ex Boiss., *Ofaiston monandrum* (Pall.) Moq., *Girgensohnia oppositiflora* (Pall.) Fenzl, *Anabasis salsa* (C. A. Mey.) Benth., *Nanophyton erinaceum* (Pall.) Bunge, *Halimocnemis karelinii* Moq., *H. mollissima* Bunge, *H. sclerosperma* (J. Pall.) C. A. Mey., *Gamanthus gamocarpus* (Moq.) Bunge, *Climacoptera aralensis* (Iljin) Botsch., *C. affinis* (C. A. Mey.) Botsch., *C. brachiata* (Pall.) Botsch.,

C. crassa (M. Bieb.) Botsch., *C. ferganica* (Drob.) Botsch., *C. lanata* (Pall.) Botsch., *C. olgae* (Iljin) Botsch., *C. turcomanica* (Litv.) Botsch., *Halogeton glomeratus* C. A. Mey., *Suaeda acuminata* (C. A. Mey.) Moq., *S. crassifolia* J. Pall., *S. dendroides* (C. A. Mey.) Moq., *S. linifolia* Pall., *S. microphylla* Pall., *S. microsperma* (C. A. Mey.) Fenzl, *S. salsa* (L.) Pall.

Convolvulaceae Juss. (1 genus, 3 species): *Convolvulus arversis* L., *C. erinaceus* Ledeb., *C. fruticosus* Pall.

Cyperaceae Juss. (2 genus, 3 species): *Bolboschoenus popovii* Egor., *Carex pachystylis* J. Gay, *C. physodes* M. Bieb.

Elaeagnaceae Juss. (1 genus, 1 species): *Elaeagnus turcomanica* Kozlowsk.

Ephedraceae Dumort. (1 genus, 3 species): *Ephedra distachya* L., *E. lomatolepis* Schrenk, *E. strobilacea* Bunge.

Equisetaceae Rich. ex DC. (1 genus, 1 species): *Equisetum ramosissimum* Desf.

Euphorbiaceae Juss. (1 genus, 1 species): *Euphorbia seguieriana* Neck.

Fabaceae Lindl. (7 genera, 13 species): *Ammodendron conollyi* Bunge ex Boiss., *A. karelinii* Fisch. et C. A. Mey., *A. lehmanni* Bunge ex Boiss., *Eremosparton aphyllum* (Pall.) Fisch. et Mey., *Halimodendron halodendron* (Pall.) Voss, *Astragalus ammodendron* Bunge, *A. brachypus* Schrenk, *A. lehmannianus* Bunge, *A. villosissimus* Bunge, *A. kirghisorum* Schrenk, *Alhagi pseudalhagi* (M. Bieb.) Desv., *Glycyrrhiza glabra* L., *Medicago sativa* L.

Frankeniaceae S. F. Gray (1 genus, 1 species): *Frankenia hirsuta* L.

Geraniaceae Juss. (1 genus, 1 species): *Geranium transversale* (Kar. et Kir.) Vved.

Hypecoaceae Nakai (1 genus, 1 species): *Hypecoum parviflorum* Kar. et Kir.

Lamiaceae Lindl. (3 genera, 3 species): *Thuspeinantha persica* (Boiss.) Briq., *Eremostachys tuberosa* (Pall.) Bunge, *Lagochilus acutilobus* (Ledeb.) B. Fisch. et C. A. Mey.

Liliaceae J. Juss. (3 genera, 4 species): *Gagea afghanica* Terr., *Rhinopetalum karelinii* Fisch. ex D. Don., *Tulipa biflora* Pall., *T. buhseana* Boiss.

Najadaceae *Juss*. (1 genus, 1 species): *Najas marina* L.

Nitrariaceae Lindl. (1 genus, 2 species): *Nitraria schoberi* L., *N. sibirica* Pall.

Orobanchaceae Vent. (2 genera, 2 species): *Cistanche salsa* (C. A. Mey.) G. Beck., *Orobanche cernua* Loefl.

Papaveraceae Juss. (1 genus, 2 species): *Roemeria hybrida* (L.) DC., *R. refracta* DC.

Peganaceae (Engl.) Tiegh. ex Takht. (1 genus, 1 species): *Peganum harmala* L.

Plantaginaceae *Juss.* (1 genus, 1 species): *Plantago minuta* Pall.

Plumbaginaceae Juss. (1 genus, 3 species): *Limonium gmelini* (Willd.) Kuntze, *L. otolepis* (Schrenk) Kuntze, *L. suffruticosum* (L.) Kuntze.

Poaceae Barnhart (11 genera, 15 species): *Stipagrostis karelinii* (Trin. et Rupr.) Tzvelev, *S. pennata* (Trin.) De Winter, *Stipa szovitsiana* Trin. ex Hohen., *Calamagrostis dubia* Bunge, *Phragmites australis* (Cav.) Trin. ex Steud., *Aeluropus litoralis* (Gouan) Parl., *Poa bulbosa* L., *Anisantha tectorum* (L.) Nevski, *Agropyron fragile* (Roth.) P. Candargy, *Eremopyrum distans* (C. Koch) Nevski, *E. orientale* (L.) Jaub. et Spach, *E. triticeum* (Gaertn.) Nevski., *Elymus kirghizorum* Drob., *E. racemosus* Lam., *Catabrosella humilis* (Bieb.) Tzvel.

Polygonaceae Juss. (3 genera, 15 species): *Rheum tataricum* L., *Atraphaxis frutescens* (L.) C. Koch., *A. replicata* Lam., *A. spinosa* L., *Calligonum acanthopterum* Borszcz., *C. aphyllum* (Pall.) Guerke, *C. aralense* Borszcz., *C. caput-medusae* Schrenk, *C. eriopodum* Bunge, *C. junceum* (Fisch. et C. A. Mey.) Litv., *C. leucocladum* (Schrenk) Bunge, *C. macrocarpum* Borszcz., *C. microcarpum* Borszcz., *C. setosum* (Litv.) Litv., *C. squarrosum* Pavl.

Ranunculaceae Juss. (1 genus, 2 species): *Ceratocephala falcata* (L.) Pers., *C. testiculata* (Crantz) Bess.

Rosaceae Juss. (2 genera, 2 species): *Hulthemia persica* (Michx. ex Juss.) Bornm., *Rosa majalis* Herrm.

Scrophulariaceae Juss. (1 genus, 1 species): *Veronica campylopoda* Boiss.

Solanaceae Juss. (1 genus, 1 species): *Lycium ruthenicum* Murr.

Tamaricaceae Link. (1 genus, 5 species): *Tamarix elongata* Ledeb., *T. florida* Bunge, *T. hispida* Willd., *T. laxa* Willd., *T. ramosissima* Ledeb.

Typhaceae Juss. (1 genus, 1 species): *Typha angustifolia* L.

Zosteraceae Dumort. (1 genus, 1 species): *Zostera minor* (Cavol.) Nolte ex Reichenb.

Zygophyllaceae R. Br. (1 genus, 2 species): *Zygophyllum eichwaldii* C. A. Mey., *Z. oxianum* Boriss.

We identified 8 species under protection. These are *Atriplex pratovii* (the Aral region endemic), *Crambe edentula, Artemisia austriaca, Tulipa biflora, T. buhseana, Rosa majalis, Nanophyton erinaceum* and *Salsola arbusculaeformis*. A list of rare plants in the territories of the Republic of Karakalpakstan, Uzbekistan and Kazakhstan has been extended (Fig. 2).

Prevalence of plants in various floristic areas worldwide is one of the major issues for botanical geography to study. Literature data and analysis of herbarium samples were used to study types of plant areas of Southern Aralkum. We have found 39 types of geoelements in the territory studied. The Turanian plant area comprising 20 species, the European-ancient Mediterranean one including 20 species, the Irano-Turanian plant area having 18 species, and the ancient Mediterranean one comprising 14 species are the predominant areal types.

Existence of other types of species in this region proves a close association with species spread in other floristic areas in the world. Analysis of the findings from study on types of plant areas confirms that plants growing in Southern part of Aralkum are widespread worldwide. It could be illustrated by examples of globally spread species, such as *Atriplex tatarica, Salicornia europaea, Xanthium strumarium, Phragmites australis,* and *Typha angustifolia*. Existence of some species in the southern Aralkum flora founded in East America, Africa, Europe, the ancient Mediterranean, the Himalayas, India and Tibet, may serve as a proof of their global prevalence since time immemorial.

Analysis of plant areas proves that the Aralkum floristic structure is basically similar to those of Holearctic and Paletropic regions. Hence, it is possible to conclude that the flora of Southern Aralkum derived from the Irano-Turanian flora.

The Jaccard index, also known as the Jaccard similarity coefficient (originally coined *coefficient* de *communauté* by Paul Jaccard) [43], is a statistic used for comparing the similarity and diversity of sample sets. Comparing the Aral Sea flora with floras of neighboring plant areas we used the following formula to determine similarity coefficient:

$$J = \frac{100 \times c}{a + b - c}.$$

where J is the Jaccard index, c — number of species common for the given and the comparable floras, a and b — number of species in comparable floras.

Flora of Southwestern Aralkum was compared with floras of six areas, such as the Eastern cliff of the Usturt, the South Aral Sea region, the Lower Amu Darya, the North Aral Sea region, the Eastern Aralkum, the Barsakel'mes sanctuary and dry portion of the

Aral Sea. Except the Lower Amu Darya region all the territories above are either arid or semiarid ones.

Similarity coefficient of the Southern Aralkum flora for the one of the South Aral Sea region was found higher (J=29.86) than those for other comparable floras; the botanical-geographical similarity is obvious, as well.

This fact can be explained by:

— geographical proximity of the region to the territories of the South Aral Sea;

— direct influence of the South Aral Sea flora on the formation of the Southern Aralkum flora;

Fig. 2. The Aral region endemic (*a*) and rare species (*b*, *c*, *d*)

a — Atriplex pratovii (30.04.2013, 44°30'07.6"N, 58°11'09.8"E); *b — Tulipa biflora* (29.04.2013, 43°44'46.2"N, 58°20'02.1"E).

— century long adaptability of the South Aral Sea flora to the climate and soil composition of the sea coast due to drying and plant migration in the territory.

Our findings confirm the similarity of the floras of comparable areas with flora of the Southern Aralkum.

Discussion. The plant species under investigation not only form the main part of botanic variety but also can be used as construction materials or cattle fodder. Wooden part of *Phragmites australis, Typha angustifolia, Haloxylon aphyllum* and many bushes can be used as construction materials and as kindling at any time of year. *Artemisia terrae-albae, A. diffusa, A. turanica, Phragmites australis, Ammodendron conollyi, Alhagi pseudalhagi, Stipagrostis pennata, S. karelinii, Descurainia sophia* and other types of ephemera and

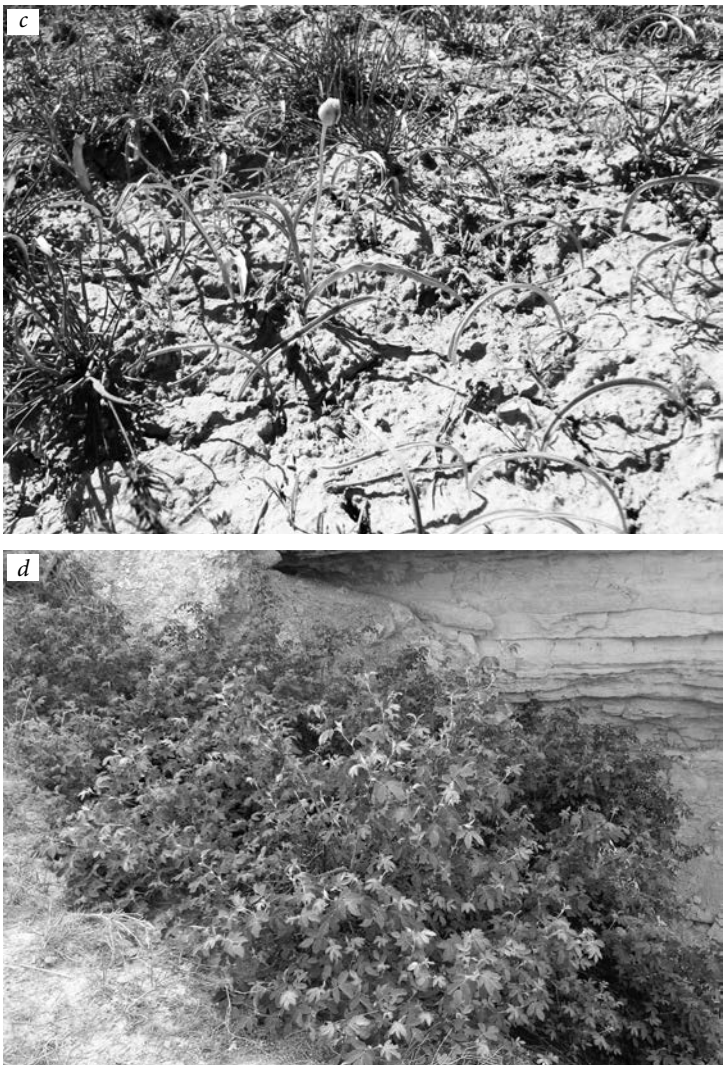

Fig. 2. The Aral region endemic (*a*) and rare species (*b*, *c*, *d*) (ending of Figure 2)
c — Tulipa buhseana (30.04.2013, 44°46'05.8"N, 58°12'06.6"E); *d — Rosa majalis* (06.05.2014, 44°14'37.8"N, 58°16'29.1"E).

ephemerides are cattle fodder. *Peganum harmala, Glycyrrihiza glabra, Alhagi pseudalhagi, Artemisia terrae-albae, A. diffusa* species are used as medicinal plants.

It should be mentioned that most plants forming in this territory are adapted to salty soils and salt marshes, catching ions from the latter. These are *Haloxylon aphyllum, Salsola richteri, S. paletzkiana, Halostachys belangeriana, Tamarix hispida, T. ramosissima, Horaninovia excellens, H. ulicina, Calligonum aphyllum, C. aralense, C. caput-medusae, C. junceum, C. eriopodum, Ammodendron conollyi, Carex physodes, Stipagrostis pennata, S. karelinii* and others. These plants restrain salt and dust from spreading to settlements.

As a result, 216 types of species of vascular plants belonging to 3 divisions, 4 classes, 12 subclasses, 33 orders, 41 families and 122 genera were registered at the dry seafloor of the South Aral Sea. Thus, there are only 3 species in the division of gymnospermous plants (*Pynophyta*) (0.01%). The Division *Magnoliophyta* is represented by 212 species of 216 types of vascular plants of the dry seafloor of the Aral Sea (98.14%). The Class *Magnoliopsida* has 185 species (85.64%; 99 genera and 31 families); *Liliopsida* class (*Monocotyledones*) has 27 species (12.50%; 21 genera and 8 families).

Analysis of genera and species by the family shows that seven large families, such as Chenopodiaceae (59: 27.31%), Asteraceae (25: 11.57%), Brassicaceae (21: 9.72%), Polygonaceae (15: 6.94%), Poaceae (15: 6.94%), Fabaceae (13: 6.01%), Boraginaceae (10: 4.62%) unite 158 species (73.14%). Chenopodiaceae including 24 genera and 59 species is the largest family, the other 6 large families include 58 genera and 99 species (45.83%). 20 families (Equisetaceae, Hypecoaceae, Caryophyllaceae, Frankeniaceae, Capparaceae, Euphorbiaceae, Geraniaceae, Biebersteiniaceae, Peganaceae, Elaeagnaceae, Apiaceae, Apocynaceae, Solanaceae, Scrophulariaceae, Plantaginaceae, Alliaceae, Asparagaceae, Najadaceae, Zosteraceae, Typhaceae) have only one genus and one species (9.25%).

Conclusions. These data are the results of one of the authors' (S. Sherimbetov) 7-year study on the inventory of plants of the Southern Aralkum. The amount of species (216) and hyperspecific taxonomic units certainly may change because of continuous flora formation.

The data on composition and botanical diversity of the species are undoubtedly changed in connection with the formation of vegetation of the Aral Sea dry bottom. The data will be also updated in the future expeditions. The findings from the study can be used in writing scientific papers about the flora of the dry bottom of the Aral Sea as well as in developing an up-to-date system of higher plants of Uzbekistan. Certain types of plants can be used to reinforce free-moving dunes and salt marshes by means of phytomelioration; species with forage value can be used as cattle fodder. Herbarium materials collected during the expedition are of particular importance for replenishment of desert plants at the Laboratory of Central Herbarium (TASH), the Institute of the Gene Pool of Plants and Animals, Uzbekistan Academy of Sciences.

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