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Қ. И. Сәтпаев атындағы Қазақ ұлттық техникалық зерттеу университеті

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НАН РК сообщает, что научный журнал «Известия НАН РК. Серия геологии и технических наук» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК. Серия геологии и технических наук в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по геологии и техническим наукам для нашего сообщества.

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A. K. Karynbayev[1], D. A. Baimukanov[1], D. M. Bekenov[1],
Yu. A. Yuldashbayev[2], A. E. Chindaliev[1]

[1]Educational Scientific and Production Center Bayserke-Agro LLP, Talgar district, Almaty region, Kazakhstan,
[2]Russian State Agrarian University – Moscow Agricultural Academy named after K. A. Timiryazev,
Moscow, Russia.
E-mail: *Uzniijr*taraz@mail.ru, dbaimukanov@mail.ru, unpcbayserke-agro@mail.ru,
zoo@rgau-msha.ru, achindaliyev@rambler.ru

ENVIRONMENTAL MONITORING OF PASTURES AND DETERMINATION OF CARRYING CAPACITY UNDER THE INFLUENCE OF ANTHROPOGENIC FACTORS

Abstract. The survey by Bayserke-Agro LLP of the Kerbulak area of Almaty region marked the following groups of pasture types: Agropyretafragilismixed-wormwood partly shrub pastures on hilly and plain sands, wormwood-saltwort, rarely sod grass pasture on brown and grayish-brown soils.

Analysis of the nutritional value of the main groups' grass stand eaten by animals shows that in Spring, during the mass vegetation period, almost all species have high total and protein nutritional value. In 1 kg of dry eaten pasture feed from shrub-ephemeral-mixed herbs sandy pastures, in the specified period, it contains 0.79-0.81 fodder units and up to 125 g of digestible protein.Ephemeral and subshrub-ephemeral pastures have a similar nutritional value, and when being eaten they contribute to a good weight gain in the Kazakh Bactrian camel breed and Kazakh Jabe horses.

The relatively high feed value is preserved by the eaten fodder mass of shrub-ephemeral pastures and in the summer season of their use at the level of 0.70-0.78 fodder units and 70-90 g of digestible protein.

Keywords: monitoring, pastures, gross and eaten yields, carrying capacity.

Introduction. To ensure a high-productive status of pastures, it is necessary to develop a natural fodder resources management system, an essential element of which should be pasture monitoring.

According to B.A. Bykov [1] more than 1,200 plant species that belong to 16 main families participate in the formation of the vegetation cover of the North-Turanian (Kazakhstani) deserts. Among them goosefoot family dominates, characterizing the originality of the Turanian flora. It is represented by more than 160 ecobiomorphs, that is, groups of species that have similar life forms of growth and development (trees, shrubs, subshrubs, and dwarf semishrub, grass).

Desert plants have different biological rhythms, which are especially evident in the duration of active vegetation from 30-60 days (ephemera and ephemeroids) to 300 days a year or more (dwarf semishrubs and shrubs). Given the various adaptations to live in conditions of insufficient moisture, they are divided into xerophytes, mesophytes, hygrophytes, as well as their adjacent groups (B.A. Bykov [2], S.A.Bedarev [3]).

The vegetation cover in the desert usually is not closed in the aboveground part, that does not exclude the closeness of the root systems of plants (B. A. Bykov [4]). The projective soil cover by vegetation is 25–50% with a possible decrease on takyrs to 0–5% and an increase to 80–100% in floodplains of rivers and in interhill depressions (churots) with meadow-tugaibrush woods.

The combination of individual plant species (ecobiomorph), by definition of V.N. Sukachev [5], forms an elementary unit of vegetation cover on Earth - a biocenosis (phytocenosis) or community of plants, or a type of pasture. Phytocenoses of the sandy desert have the most comprehensive structure.

The composition of edificators in the sandy desert community is usually polydominant, with a predominance of shrubs and subshrubs [6, 7].

The most complete studies of the structure and productivity of the vegetation cover of sandy and clay deserts of Kazakhstan, as well as meadow communities, including phytocenotic observations of transpiration, photosynthesis and plant respiration, were carried out in the 60-70s of the XX century under the International Biological Program (IBE) and scientific guidance by B.A. Bykov in the Northern Aral Sea [8], L.Ya.Kurochkina [9] in the South Balkhash, O.M. Demina [10], L.V. Shabanov [11] in the lower reaches of the Shu river, etc.

The vegetation of sandy deserts is rich in species and a variety of their biological and economic traits. The basis is salsola-gray wormwood (*Salsolaarbuscula, Seriphidiumterrae-albae*) andsalsola-biyurgunwithwormwood (*Salsolaarbuscula, Anabasissalsa*) groups of pasture types. Vegetation is sparse and rare, represented by tasbiyuyrgun(*Natophuatonerinakeium*),black salsola (*Salsolaarbusculifomis)*, Arthrophytumand some species of wormwood [12, 13].

Based on the above, we regard that the current direction is monitoring of desert pastures, studying the vegetation of the main classes and types of pastures, nature of its eating by animals in different seasons, establishing the effect of grazing on pasture fodder plants and on the soil cover.

Aim of the research. To conduct environmental monitoring of pastures and to determine the carrying capacityunder the influence of anthropogenic factors and the development of the livestock.

Materials and methods of the research. The object of the research - pastures of the Kerbulak branch of Bayserke-Agro LLP of Talgar district, Almaty region. The crop was determined using the cut-sample method. To do this, in each plant group of forage lands at typical places, vegetation of 10 m^2 was cut with scissors for shearing the sheep or mowed in the form of 10 sites stand-alone 1 m each or 4 sites of 2.5 m^2 each (2.5x1 m). The vegetation on two sites of 10m^2 was taken into account on the leveled thick herbage. The height of plants cut from the soil surface on haymakings is 7-8 cm, on high-grass pastures - 4-6 cm, and on low-grass pastures - 2.3 cm.

For sparse grass stands on the sands, the transect areas of 50x20 m were cut off in 2-4 replications.

For a record of the eaten part of the shrubs, the branches of the test shrubs were cut, counting on the reference area by the number of bushes; the size of the accounting area for the calculation was 100 to 1000 m^2, depending on the density and variegation of shrubs in the territory.

When counting, the shurbs of each plant species were divided into groups according to the size and each group was calculated separately. Test shrubs in the amount of 3-5 for each group were also taken separately.

On pastures with sparse grass and shrub vegetation, the crop was determined on large transects of 50–100 x 1–2 m in a combined way. herewith, the vegetation of the transect was schematically transferred to cross-section paper or to graphed paper. The transect was edged with a cord marked 1 and 5 meters away.The crop within the transect was determined separately for each type of thickets: for shrubs and large grasses using model bushes, for small grasses - by biting method from small areas: 0.05 to 1 m^2, depending on the nature of the vegetation placement. The area was calculated using a schematic transect card.

The determination of the composition and nutritional value of the fodder was carried out using a modern analyzer FOSS NIRS DS 2500 (Sweden).

Results of the research. Ecological conditions of pasture landscapes and their carrying capacityare closely related to the natural features of the territory, the intensity of pasture loads, their types. As a result of unregulated grazing on pastures, the species composition of plants changes, namely: the most valuable feed grasses are being eaten away, trampled, dislodged and the grass cover becomes sparse.

It was established that in Bayserke - Agro LLP of the Almaty region, a considerable part of pastures is heavily damaged and covered with impenetrable herbs. Especially a lot of them in the Kerbulak, where their area in some sites reaches 12-20% of the total stock of grazing lands. This is due not only to the indiscriminate exploitation of lands, but also to the unsatisfactory organized land management system, in particular, the pasture.

Pasture vegetation is not only very sensitive to environmental disturbances, but also it most clearly reflects changes in the ecological situation on the territory as a result of anthropogenic impact. Therefore,

it is important to be well informed about the initial state of the research object as the most important indicator of the ecosystem state.

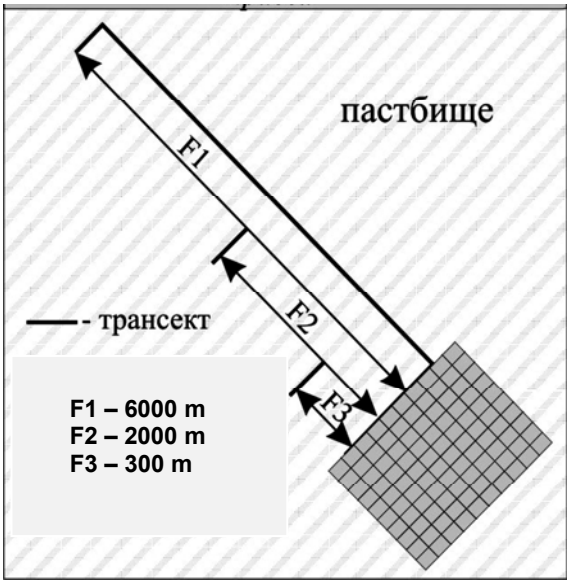
Shifts in the total biomass, species composition of vegetation and, first of all, the disappearance of edificators, their replacement with other species, often categorized as not being eaten, spareness and suppression of vegetation, reduced in their capacity and feed value, were considered as indicators of anthropogenic impact on the natural habitat in the process of monitoring.

To assess the actual feeding–ecological status of pasture areas of various ecological zones, the most appropriate form, in our opinion, is comparative monitoring (tracking changes in vegetation under the influence of grazing) of pastures according to a specially developed scheme: a pasture section with untouched natural vegetation; a pasture section used with optimal load; a section used in violation of scientifically based grazing parameters. All these points must be included in the coordinate system and be fixed.

From there, on the territory of the Kerbulak site, monitoring studies were performed to determine the effect of animal grazing on the forage and botanic composition and anthropogenic changes in pasture vegetation.

The relief of the site along 1300-2000 m is leveled (slope 0-2°), and from the middle of the transect there is a small south-western uniform slope (8-12 °), turning into a “saucer-shaped” decrease (area 25×12 m). Then the relief is changed to a uniformly gentle slope (3-7 °) and turns into a leveled area.

The studies were conducted using common methods on Aktandak natural pasture. The stationary section is represented by a transect of 6000, 2000, 300 m length, which ends with a livestock point (figure).



Transect of pastures

By study periods, changes in vegetation under the grazing influence were monitored and data were collected to determine pasture crop.

According to the conducted monitoring studies, it was established that, under the influence of grazing, pasture vegetation varies quite rapidly. Thus, in areas with a low load, active growth of grasses is observed. When overgrazing, the development of grasses is inhibited and the growth of wormwood increases that is poorly eaten in spring and summer (table 1).

The degree of animal loading on pastures had a significant impact on carrying capacityin general and on its eaten part (table 2).

The results of determination of carrying capacityfor 2019 (April-May) show that, in terms of gross crop yield, pasture areas (F1) exceeded by 34.0% and (F2) and by 81.2% (F3).

The eaten feed stock in April – May 2019 was 21.35% in the F1 area of gross crop yield, 62.34% in the F2 area, and 15.38% in the F3 plot.

Table 1 – The frequency of occurrence of the main forage plants under the influence of livestock loading

Indicators	Load		
	April-may		
	heavy	mean	light
Whitesaxaul (Haloxylonpersicum)	*	+	++
Small-fruited calligonum (Calligonummicrocarpum)	*	+	++
Sandhill wattle conolyi (Ammodendronconolyi)	*	+	++
Physocarpous sedge (Carexphysodes)	+	++	+++
Bulbous bluegrass (PoabulbosaL)	+	++	+++
Cheatgrass (Bromustectorum.)	+	++	+++
Sierozemicwormwood (Artemisiaterrae-albae)	+	++	+++
Whitishwormwood (Artemisialeucodes)	+	+++	+
Eeurotia (Krascheninnikoviaceratoides)	+	+++	+++
Sand ceratocarpus (Ceratocarpusarenarius)	+++	++	+
Notes: frequency of occurrence: +++ abundantly; ++ sparsely; + single; * - falling out of grass stand.			

Table 2 – Carrying capacityof grass stand of the main shrub - mixed herb and shrub - ephemeral types of pastures depending on a load of their use

Carrying Capacityand Feed Value Indicators	Load		
	Heavy F3	Mean F2	Light F1
Gross crop yield, kg/ha of dry mass (August 2018)	1.39	1.88	2.52
Eaten feed stock, kg/ha of dry mass (August 2018)	0.25	0.97	1.71
Gross crop yield, kg/ha of dry mass (April-May 2019)	1.82	2.39	3.84
Eaten feed stock, kg/ha of dry mass (April-May 2019)	0.28	1.49	2.11

The monitoring carried out in August 2018 showed that the ratio of the feed stock to gross crop yield was in the F1 area - 67.85%, F2 - 51.605% and F3 - 18.00%.

As a result of the investigation and monitoring the following groups of pasture types: Agropyretafragilismixed - wormwood partly shrub pastures on hilly and plain sands, wormwood-saltwort, rarely sod grass pasture on brown and grayish-brown soils.

The most common association: eurotia-grayish wormwood - Agropyretafragilis, prostrate summer cypress-mixed wormwood with Agropyretafragilis, Agropyretafragilis- sierozemic with prostrate summer cypress, mixed wormwood prostrate summer cypress- eurotia, Poaceae- Ceratocarpetionarenarii - grayish wormwood with Salsolaarbuscula, mixed herbs- grayish wormwood with ferrule. On strongly damaged mostly well areas, a radial change of vegetation is noted.

There are different weeds such as Ceratocarpus, orach, wormwood (Seratocarpus arenarius, S. utriculosus, Atriplex cana) with estimated coverage to 10%, occasionally there are stunted damaged small shrubs of eurotia and agropyreta fragilis, the Eurotia-Kochia prostrata-Agropyreta fragilis Association appears (Kochia arenaria, Krascheninnikivia ceratoides, Agropyron fragile).When moving away from the well, the plants are in good condition according to their phenological phase: eurotia and prostrate summer cypress (Kochia) - flowering phase; Agropyretafragilis - fructification, drying; mixed herbs, ceratocarpus - drying; wormwoods Artemisiaarenaria and Artemisiascoparia - fructification and drying. The reed (Phragmitescommunis) of 80–120 cm high participates in low places in the structure of the Mixed herbs–Eurotia-Kochia association, with a slight abundance, eurotia bushes with a diameter of 85–100 cm and a height of 60–80 cm are in flowering phase.

It was established that the chemical composition and nutritional value of forage are largely determined by the botanical composition of the vegetation (table 3). In general, all the studied samples of the main pasture plants are characterized by relatively high protein content and biological full value of their amino acid composition at the level of the optimal sample with some dynamics depending on the type, place of growth and season of use.

Table 3 – Chemical composition and nutritional value of the separated (main) fodder plants in the Kerbulak branch

Fodder plants	Vegetation phase	Content in 1 kg of fodder										
		fodde-runits, kg	diges-tible-pro-tein, g	Ca, G	P, G	caro-tin, mg	dry-mat-ter, g	cru-dep-rotein, g	fat, g	fiber, g	NFES, g	ash, g
Camelthorn, Alhagicamelorum	beginning of budding	0.23	25	4.9	0.5	35	312	38	7	89	153	25
	budding	0.25	28	4.2	0.5	27	332	44	9	101	153	25
	flowering	0.24	26	5.5	0.7	21	370	46	11	109	173	31
	fructification	0.34	30	3.5	0.5	19	486	50	17	145	224	50
Cheatgrass	heading	0.29	29	4.8	1.3	41	350	46	7	97	176	24
	fructification	0.21	35	3.9	1.2	28	464	48	6	171	212	27
Eremopyrumorientale	heading	0.25	52	5.0	0.7	31	274	71	18	59	99	27
	fructification	0.29	45	4.7	0.7	22	375	63	8	114	158	32
Desert carex	vegetation	0.31	54	2.5	0.7	65	293	67	13	58	132	23
	fructification	0.30	39	3.7	2.0	37	437	71	16	97	214	39
Sierozemic wormwood	vegetation	0.30	52	3.0	0.6	54	330	70	11	62	156	31
	budding	0.25	32	3.2	0.5	25	414	54	26	133	168	33
	flowering	0.28	40	7.0	0.7	21	566	68	39	240	187	32
	fructification	0.25	33	4.4	0.4	18	550	64	37	214	199	36
	dead wood	0.29	32	6.5	0.6	–	847	66	30	338	317	96
Turanian wormwood	budding	0.24	26	9.8	1.1	23	383	43	23	120	176	21
	flowering	0.25	36	7.5	1.4	17	475	61	22	166	181	45
	fructification	0.33	40	6.6	1.2	12	576	68	38	192	234	44
Ceratocarpusutriculosus	vegetation	0.25	49	5.8	2.4	65	305	68	7	69	121	40
	flowering	0.30	57	4.7	2.1	60	382	72	7	117	144	42
	fructification	0.35	63	4.5	1.7	32	568	80	8	204	220	56
	dead wood	0.36	41	6.1	2.4	–	885	77	14	323	379	92
Oriental saltwort	vegetation	0.20	26	9.1	0.3	18	289	40	4	66	123	56
	flowering	0.12	21	8.3	0.2	12	419	39	10	130	188	52
	fructification	0.18	27	7.0	0.2	10	496	50	9	102	239	96
	dead wood	0.32	32	9.5	0.4	–	694	50	11	190	312	12.3

A distinctive feature of the pastures of the Kerbulak branch is a pronounced seasonality of their use. Certain species of plants are eaten by animals in different seasons of the year.

The nutritional value of the grass stand of the main groups of pasture types is given in table 4.

Analysis of the nutritional value of the main groups' grass stand eaten by animals shows that in spring, during the mass vegetation period, almost all species have high total and protein nutritional value. Per 1 kg of dry eaten pasture feed from shrub-ephemeral-mixed herbs sandy pastures, in the specified period, it contains 0.79-0.81 fodder units and up to 125 g of digestible protein. Ephemeral and subshrub-ephemeral pastures have a similar nutritional value, and when being eaten they contribute to a good weight gain in the Kazakh Bactrian camel breed and Kazakh Jabe horses [17, 18].

The comparatively high feed value is maintained by the eaten fodder mass of shrub-ephemeral pastures and in the Summer season of their use at the level of 0.70-0.78 fodder units and 70-90 g of digestible protein.

Later, using the obtained data on the carrying capacity and nutritional value of pasture forage, the feed value of the investigated desert pasture groups of the Kerbulak branch was established.

Table 4 – Nutritional value of grass stand for the main groups of desert pasture types according to season of use

Groups of desert pasture types	1 kg of eaten dry feed mass contains			
	Fodder units, kg		Digestible protein, g	
	Spring	Summer	Spring	Summer
Shrub - ephemeral	0.79 –0.81	0.70 –0.78	90 - 125	70 - 90
Subshrub -ephemeral	0.80	0.72	133	89

It has been established that the average annual carrying capacity of subshrub-ephemeral pastures is 2.85 feed-protein units per 1 ha (100%), of the shrub-ephemeral - 1.41 f-p.u. (49.5%) and ephemeral - 0.91 f-p.u. (31.9) conditioned feed-protein units/ha of the dry fodder mass.

Monitoring showed that pasture feeding capacity is higher in the Spring season (1.42-1.92 heads/ha), in Summer the feeding capacity of all pastures decreases (up to 0.40-0.90 heads/ha), in Autumn and Winter the capacity drops particularly of ephemeral pastures (up to 0.11 heads/ha and below). This means that with the specified feeding capacity per one head of sheep, an average of 0.52 hectares of wormwood-saltwort-ephemeral pastures is required in Spring, in Summer and Autumn - up to 1 hectare, and in winter - 5 hectares each.

The received data can be widely used in other areas of environmental monitoring [19].

Conclusions. The results of the studies to determine the feed value of the pastures under study show that the subshrub-ephemeral pastures of year-round use were the most valuable in terms of carrying capacity, nutrient yield per unit area and feeding capacity. First of all, almost in all seasons of the year, more pasture grass stand is eaten, the average indices are in Spring - 3.43, in Summer - 2.31, in Autumn - 3.10 per 1 ha of dry eaten forage with good protein nutritional values.

Basis for the research and source of funding. The program of target financing of the Ministry of Agriculture of the Republic of Kazakhstan for 2018 - 2020. IRN: BR06249249-OT-18 Development of a comprehensive system for increasing productivity and improving the breeding qualities of farm animals, using the example of Bayserke-Agro LLP.

А. К. Қарынбаев[1], Д. А. Баймұқанов[1], Д. М. Бекенов[1],
Ю. А. Юлдашбаев[2], А. Е. Чиндалиев[1]

[1]«УНПЦ Байсерке-Агро», Алматы облысы, Қазақстан,
[2]Ресей мемлекеттік аграрлық университеті – К. А. Тимирязев атындағы МСХА, Мәскеу, Ресей

ЖАЙЫЛЫМДАРДЫҢ ЭКОЛОГИЯЛЫҚ МОНИТОРИНГІ ЖӘНЕ АНТРОПОГЕНДІК ФАКТОРЛАРДЫҢ ӘСЕРІНЕН ЖЕМНІҢ ӨНІМДІЛІГІН АНЫҚТАУ

Аннотация. Алматы облысында "Байсерке - Агро" ЖШС-нің "Кербұлақ" учаскесін тексеру нәтижесінде жайылымдар типтерінің келесі топтары белгіленді: бұдырлы және жазық құмдар бойынша еркеков-алуан шөпті-жусанды жартылай бұталы жайылымдар, сұрғылт және сұр қоңыр топырақтарда сораң-жусанды, сирегірек шымқабат астық тұқымдастар жайылымдары.

Көктемгі мезгілде, өсімдіктің барлық түрі дерлік жаппай өсіп-жетілу кезінде, жоғары жалпы және протеинді қоректілке ие екендігін жануарлар жейтін негізгі топтағы шөптердің қоректілік анализі көрсетеді. Көрсетілген кезеңде, құмды жайылымдарда 1 кг құрғақ бұталы-эфемер-алуан шөпті желінетін жайылымдық жемінде 0,79–0,81 азықтық бірлік және 125 г-ға дейін қайнатылған протеин болады. Қазақ бактриан тұқымдас түйелері мен қазақтың жабы тұқымды жылқыларында жеу барысында жақсы салмақ өсіміне ықпал ететін, эфемерлі және жартылай бұталы-эфемерлі жайылымдары ұқсас қоректік құндылық ие.

Бұталы-эфемерлі жайылымдарында желінетін азықтық масса салыстырмалы жоғары азықтық құндылығын сақтайды және жазғы маусымда оларды пайдалану 0,70-0,78 азықтық бірлік және 70-90 г қорытылатын протеин деңгейінде.

Түйін сөздер: мониторинг, жайылымдар, жалпы және желінетін өнімділік, жем-шөп құнарлылығы.

А. К. Карынбаев[1], Д. А. Баймуканов[1], Д. М. Бекенов[1],
Ю. А. Юлдашбаев[2], А. Е. Чиндалиев[1]

[1]ТОО «УНПЦ Байсерке-Агро»Алматинская область, Казахстан,
[2]РГАУ-МСХА им. К. А.Тимирязева, Москва, Россия

ЭКОЛОГИЧЕСКИЙ МОНИТОРИНГ ПАСТБИЩ И ОПРЕДЕЛЕНИЕ ПРОДУКТИВНОСТИ КОРМОВ ПОД ВЛИЯНИЕМ АНТРОПОГЕННЫХ ФАКТОРОВ

Аннотация. В результате обследования участка «Кербулак» ТОО «Байсерке-Агро» Алматинской области отмечены следующие группы типов пастбищ: еркеково-разнотравно-полынные, частично закустаренные пастбища по бугристым и равнинным пескам, полынно-солянковые, реже с дерновинными злаками пастбища на бурых и серобурых почвах.

Анализ питательности поедаемого животными травостоя основных групп показывает, что в весенний период, во время массовой вегетации растительности почти все виды имеют высокую общую и протеиновую питательность. В 1 кг сухого поедаемого пастбищного корма кустарниково-эфемерово-разнотравных песчаных пастбищ в указанный период содержится 0,79–0,81 кормовых единиц и до 125 г переваримого протеина. Аналогичную питательную ценность имеют эфемеровые и полукустарниково-эфемеровые пастбища, при поедании способствуют хорошим привесам у верблюдов породы казахский бактриан и казахских лошадей типа жабе.

Сравнительно высокую кормовую ценность сохраняет поедаемая кормовая масса кустарниково-эфемеровых пастбищ и в летний сезон их использования на уровне 0,70-0,78 кормовых единиц и 70-90 г переваримого протеина.

Ключевые слова: мониторинг, пастбища, валовая и поедаемая урожайность, продуктивность кормов.

Information about authors:

Karynbayev Amanbai Kambarbekovich, Doctor of Agricultural Sciences, academician of the Russian Academy of Natural Sciences, academic adviser of the Educational Scientific and Production Center Bayserke-Agro LLP, Talgar district, Almaty region, Kazakhstan; *Uzniijr*taraz@mail.ru; https://orcid.org/0000-0003-4717-6487

Baimukanov Dastanbek Asylbekovich, Doctor of Agricultural Sciences, professor, Corresponding Member of the National Academy of Sciences of the Republic of Kazakhstan, Chief Researcher of the Educational Scientific and Production Center Bayserke-Agro LLP, Talgar district, Almaty region, Kazakhstan; dbaimukanov@mail.ru; https://orcid.org/0000-0002-4684-7114

Bekenov Dauren Maratovich, Master of Natural Sciences and Biotechnology, Director of the Educational Scientific and Production Center Bayserke-Agro LLP, Talgar district, Almaty region, Kazakhstan; unpcbayserke-agro@mail.ru; https://orcid.org/0000-0003-2244-0878

Yuldashbayev Yusupzhan Artykovich, Corresponding Member of the Russian Academy of Sciences, Doctor of Agricultural Sciences, Professor, Dean of the Faculty of Zootechnics and Biology, Professor of the Department of Private Zootechnics, Russian State Agrarian University – Moscow Agricultural Academy named after K. A. Timiryazev, Moscow, Russia; zoo@rgau-msha.ru; https://orcid.org/0000-0002-7150-1131

Chindaliyev Askhat Erbosynovich, Master of Agricultural Sciences, Senior Researcher of the Educational Scientific and Production Center Bayserke-Agro LLP, Talgar district, Almaty region, Kazakhstan; achindaliyev@rambler.ru; https://orcid.org/0000-0002-2468-3809

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