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THE INFLUENCE OF THE PROTECTED AREAS ON THE PRESENT DISTRIBUTION OF THE HIMALAYAN BROWN BEAR (*URSUS ARCTOS ISABELLINUS* HORSFIELD, 1826) POPULATION IN THE TRANS-ILI ALATAU, SOUTH-EAST KAZAKHSTAN

The aim of this study is to assess the current distribution of the Tian Shan brown bear (*Ursus arctos isabellinus* Horsfield, 1826) in two study areas: the Almaty State Nature Reserve (ANR) and in the adjacent territories of the Ile-Alatau State National Nature Park (IANP) between 2005 and 2018. Both areas are characterized by different degrees of anthropogenic transformation and conservation measures.

Data collection was carried out using two techniques: ground survey (GS) in 2005–2013 and a camera trapping survey (CT) in 2013–2018.

The comparison of the data obtained by the two methods, GS and CT, showed that the CT data is more extensive as it confirms and supplements the data collected with traditional GS methods.

The Kilometric Abundance Index (KAI) was 0.56 (± 0.33) individuals per km in the ANR and 0.41 (± 0.23) individuals per km in the IANP. Using CT, the average occurrence index was 4.4 registrations per 100 trap days in ANR, while 2.9 registrations per 100 trap days in IANP. We observed the bears to have different daily activity patterns in the two study areas, with the bears appearing to be active throughout the day in ANR, and mainly active during the night and early morning in IANP.

This study outlines the role of the territory of the ANR as the nucleus for the settlement of brown bear individuals in the Trans-Ili Alatau Mountain range, due to the abundance of the species remaining high for 40 years. The high observation rate (photos and direct observations) suggest that the bear population has a healthy conservation status. The territory of the IANP can serve as a buffer zone where individual groups of bears can function successfully, provided that they are afforded good protection and that low anthropogenic impact is maintained. On the other hand, the presence of bears in the IANP was mainly observed in sectors with low level of human activity.

Key words: Tian Shan (Himalayan) brown bear, Trans-Ili Alatau Mountain range, protected areas.

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Оңтүстік-Шығыс Қазақстанның Іле Алатауындағы Тянь-Шань қоңыр аюы (*Ursus arctos isabellinus*, Horsfield, 1826) популяциясының қазіргі таралуына ерекше қорғалатын табиғи аумақтардың әсері

Бұл зерттеудің мақсаты 2005 жылдан 2018 жылға дейін жүргізілген зерттеу негізінде Тянь-Шань қоңыр аюының екі зерттеу аумағы: Алматы мемлекеттік табиғи қорығы (АМТҚ) және Іле-Алатау мемлекеттік ұлттық табиғи паркінің (ІА МҰТП) іргелес аумақтарындағы замануи таралуын бағалау болып табылады. Екі аумақ әр түрлі дәрежедегі антропогендік өзгерістермен және қорғау режимімен сипатталады. Мәліметтерді жинау екі әдіспен жүргізілді: 2005–2013 жылдар аралығында жүргізілген далалық зоологиялық әдістер және 2013 жылдан бері қолданылып келе жатқан фотоқақпандарды қолдану арқылы тіркеу.

Далалық және қашықтағы әдістермен алынған мәліметтерді салыстыру негізінде фотоқақпандардан алынған алынған деректердің неғұрлым ауқымды және тиімді екені анықталды, олар дәстүрлі далалық әдістермен алынған деректерді растайды және толықтырады.

Түрлердің көптігі индексі (КАІ) Алматы қорығы үшін маршруттың 1 км-іне 0,56 ($\pm 0,33$) дара, Іле-Алатау ұлттық паркі үшін 1 км-ге 0,41 ($\pm 0,23$) дара болды. Қорықта аюдың кездесу индексі, орташа есеппен, 100 фотоқақпан/тәулікке 4,4 тіркелу болды, ал Ұлттық паркте 100 фотоқақпан/тәулікке 2,9 тіркелу құрды.

Зерттелген екі аймақта аюлардың күнделікті белсенділігінің әр түрлі екені байқалынды: Алматы қорығында аюлар күндіз белсенді болса, ІА МҰТП аумағында олар негізінен түнде және таңертеңгі уақытта фотоқақпандарға тіркелді.

Бұл зерттеуде Іле Алатауы жотасындағы қоңыр аю дараларының таралу өзегі ретінде Алматы қорығы аумағының рөлі көрсетілген. Алматы қорығы бұл түрдің Іле Алатауында 40 жыл бойы санының көптігіне болып сақталуына зор үлесін қосуда. Тіркеудің жоғары деңгейі (фотосуреттер және тікелей бақылаулар) аю популяциясының тұрақты табиғатты қорғау мәртебесіне ие екендігін көрсетеді. ІА МҰТП аумағы жақсы қорғалған және төмен антропогендік жүктемені ұстаған жағдайда аюлардың жеке топтары тұрақты тіршілік ете алатын буферлік аймақ ретінде қызмет көрсете алады. Басқа жағынан, ІА МҰТП аумағында аюлар адам белсенділігінің төмен деңгейі бар секторларда көбінесе байқалды.

Түйін сөздер: Тянь-Шань қоңыр аюы, Іле Алатауы жотасы, ерекше қорғалатын табиғи аумақтар.

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Влияние особо охраняемых природных территорий на современное распространение популяции тянь-шаньского бурого медведя (*Ursus arctos isabellinus* Horsfield, 1826) в Заилийском Алатау, Юго-Восточный Казахстан

Целью настоящего исследования является оценка современного распространения тянь-шаньского бурого медведя на двух изучаемых территориях: Алматинском государственном природном заповеднике (АГПЗ) и сопредельных территориях Иле-Алатауского государственного национального природного парка (ИА ГНПП) в период с 2005 по 2018 гг. Обе территории характеризуются разной степенью антропогенной трансформации и режимом охраны.

Сбор данных осуществлялся с использованием двух методов: полевые зоологические методы, проводившиеся с 2005 по 2013 гг., и регистрация с использованием фотоловушек, которая применялась с 2013 по 2018 гг. Сравнение данных, полученных двумя полевыми и дистанционными методами, показало, что данные с фотоловушек более обширны и эффективны, так как подтверждают и дополняют данные, полученные традиционными полевыми методами.

Индекс обилия вида (КАІ) составил 0.56 (± 0.33) особей на 1 км маршрута для Алматинского заповедника и 0.41 (± 0.23) особи на 1 км для Иле-Алатауского национального парка. Индекс встречаемости в среднем для заповедника – 4.4 регистраций на 100 фотоловушко/суток, для национального парка – 2.9 регистраций на 100 фотоловушко/суток.

Отмечено, что медведи имеют различный характер суточной активности в двух исследуемых регионах: медведи проявляли активность в течение дня в АГПЗ, тогда как в ИА ГНПП они регистрировались в основном ночью и ранним утром.

В данном исследовании обозначена роль территории АГПЗ как ядра расселения особей бурого медведя в горном массиве Заилийского Алатау, в связи с тем, что численность вида остается высокой в течение 40 лет. Высокий уровень регистрации (фотографии и непосредственные наблюдения) позволяет предположить, что популяция медведей имеет устойчивый охранный статус. Территория ИА ГНПП может служить буферной зоной, в которой отдельные группы медведей могут успешно функционировать при условии обеспечения им хорошей охраны и сохранения низкой антропогенной нагрузки. С другой стороны, присутствие медведей в ИА ГНПП в основном наблюдалось в секторах с низким уровнем активности человека.

Ключевые слова: тянь-шаньский бурый медведь, горный массив Заилийского Алатау, особо охраняемые природные территории.

Introduction

The brown bear (*Ursus arctos*) has the largest range among the bears (Family Ursidae, Order Carnivora) worldwide [1, 2], and is present in both

large and connected populations, as well as in small and isolated ones, which has resulted in the existence of several subspecies (*U. a. horribilis* Ord, 1815; *U. a. horribilis middendorffi* Merriam; *U. a. pruinus* Blyth 1854; *U. a. isabellinus* Horsfield,

1826; *U. a. jenseiensis* Ognev 1924). In Central Asian populations, there is an uncertainty about the level of isolation of the bear populations in the Tian Shan Mountains of Kyrgyzstan, Kazakhstan, Uzbekistan, and Xinjiang (Northwest China). Tian Shan bears are considered to be separated from bears in the Altai Mountains of Northeastern Kazakhstan and Russia by the Dzhungarian (Zhetisu) mountain system and the less mountainous plains in Northeastern Kazakhstan [3, 4]. Therefore, as a preventive management approach to ensure regional conservation objectives in Kazakhstan and other Central Asian countries, – Uzbekistan, Tajikistan, and Kyrgyzstan, the Tian Shan brown bear (*Ursus arctos isabellinus* Horsfield, 1826) is listed in the Red Data Books. In the latest edition of the Red Data Book of the Republic of Kazakhstan, the Tian Shan bear is listed in the 3rd category (“with the declining range and numbers”) [5]. In 2017, the Tian Shan brown bear was included in the IUCN Red List as a Vulnerable subspecies for the Tian Shan mountains and included in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). One of the challenges for the coming decades is the negative impact of climate change on the quality of Tian Shan bear habitats and consequently to its distribution [6]. In this regard, the primary challenge is to better understand the present distribution and potential of currently available habitats to host the present population, the existing limiting factors as well as human-bear relationships.

The Tian Shan brown bear was common in the Trans-Ili Alatau range before 1900s, and became rare in the valleys of Big and Small Almatinka Rivers in the 1920s and 1930s. By the 1940s, the bear was exterminated in the Syrdarya Karatau ridge [1, 7], and has not been observed in the region since 1960s. In Kazakhstan, the Tian Shan brown bear is currently found only in the Tian Shan and Dzhungarian Alatau mountain regions. Following the creation of the Ile-Alatau State National Nature Park (IANR) on this territory and the improvement of the conservation measures, bear sightings began to be registered in the Big Almatinka Gorge, becoming increasingly regular [8].

The latest and most comprehensive studies of Tian Shan brown bear ecology in the Almaty State Nature Reserve or Almaty Nature Reserve (ANR) were carried out by V.A. Zhiryakov [9]. According to his data, the brown bear population density was 0.7-1.0 individuals per 10 km² in the spruce forest belt of the reserve. In the first half of the summer (June-July), the animals were distributed more or less evenly across all the high-altitude zones of the

mountains, from deciduous forests to alpine meadows. In the second half of summer and autumn, bears would move to apricot apple forests, where their density reached 5 individuals per 10 km². The total number of bears in the reserve at that time was estimated at 25 individuals [10].

According to the legislation of the Republic of Kazakhstan, the protection status is established over the entire territory of ANR, with the prohibition of any economic, recreational and other activities (hunting, collection of useful plants and mushrooms etc.), considering the peculiar properties of the area. On the territory of the IANP following zones are distinguished: natural reserves, environmental stabilization zones, tourist zones, recreational activity zones and limited economic activity zones. Some limited grazing, red deer (maral) breeding, haymaking, non-professional picking of mushrooms, fruits and berries, and gardening are allowed in the limited economic activity zones. Hunting had also been permitted until a moratorium was introduced in 2017.

This study was conducted in two study areas – the Almaty Reserve (ANR) and in the adjacent territories of the Ile-Alatau National Park (IANP) in the period between 2005 and 2018, where both areas are characterized by different degrees of anthropogenic transformation and conservation status.

Our hypothesis regarding the current distribution is that there has been no change towards an increase in the area used by bears as a result of natural and anthropogenic barriers. We assume that the bear population of the ANR is higher than in the IANR as a result of the bear population of the IANR being influenced by the metropolitan city of Almaty in recent decades due to its constant population growth and expanding infrastructure. The observed negative dynamics can lead to their complete disappearance from their ancestral habitats in the future. The primary reasons for this negative phenomenon are the factor of anxiety as a result of an excessive recreational load, accompanied by the construction of resorts and various infrastructure as well as an unregulated (spontaneous) flow of tourists. In 2018, the IANR set up hiking trails and installed covered gazebos for tourists in the hard-to-reach gorges of Ayusai and Prokhodnoye. This measure made some parts of the mountains which were constant brown bear habitats increasingly accessible to humans.

Due to the different conservation statuses and the effect of anthropogenic transformation, we decided to test our hypothesis about the differences in daily bear activity in these two territories. In particular, our goal was to understand, describe and compare the following data between ANR and IANR: (1) the relative abundance index, (2) the age and sex

structure, (3) temporal activity and behavioral characteristics.

Study area

In order to achieve our goals, the study area which extended over several mountain belts was divided into 6 pilot sites where field monitoring studies were carried out in the mountain gorges of the Trans-Ili Alatau: the Right Talgar River, Middle Talgar River, Big Almatinka River (including the Prokhodnoye River) and the Ayusai, Aksay and Kargaly Rivers (Figure 1).

The Almaty Nature Reserve is located in the south-east of Kazakhstan (N 43° 06'00, E77° 19'00) in the central part of the Trans-Ili Alatau ridge of the Tian Shan mountain system. The reserve has a surface area of 717 km² and the altitude ranges from 1500 to 4979 m above sea level. The main part of the protected area is located on the northern macro slope of the ridge in the basins of the Talgar, Yesik and Turgen Rivers. The western border of the territory runs along the Left Talgar River, the northern border along Right Talgar River and the eastern border along the crest of a high spur dividing the valleys of the Yesik and Turgen Rivers. The southern part of the border passes near Toguzak pass and exits through the Bogatyr glacier to the upper reaches of the Shelek River. Data collection was conducted

mainly in the Middle Talgar Gorge, rarely visited by people, with human disturbance practically absent. We will consider the reserve as a reproductive nucleus where the largest group of bears inhabits the Trans-Ili Alatau.

The Ile-Alatau National Park (N 43° 04'00, E 77° 10'00) is located in the central and the eastern parts of the northern macro slope of the Trans-Ili Alatau. The total area of the park is 2000 km² and the altitude ranges from 600 to 4540 m above sea level. The bears are more negatively affected by humans in this area.

The park has a developed network of walking routes, buildings (campsites, sanatoriums and residential buildings), pastures and roads, including two major roads – to the Big Almatinka Lake in the Big Almatinka Gorge and to the Small Almaty Gorge, with developed infrastructure and residential buildings around the perimeter. The Kargaly Gorge, with a length of 18 km, is located to the west of the Big Almatinka Gorge. Our research was carried out in the basins of the Big Almatinka, Ayusai, Kargaly and Aksai Rivers.

The Big Almatinka River is composed of two sources – Prokhodnoye River and Big Almatinka River itself. In the south, the state border with Kyrgyzstan runs along the main ridge. The area of the Big Almatinka River basin within the mountains is 282.4 km².

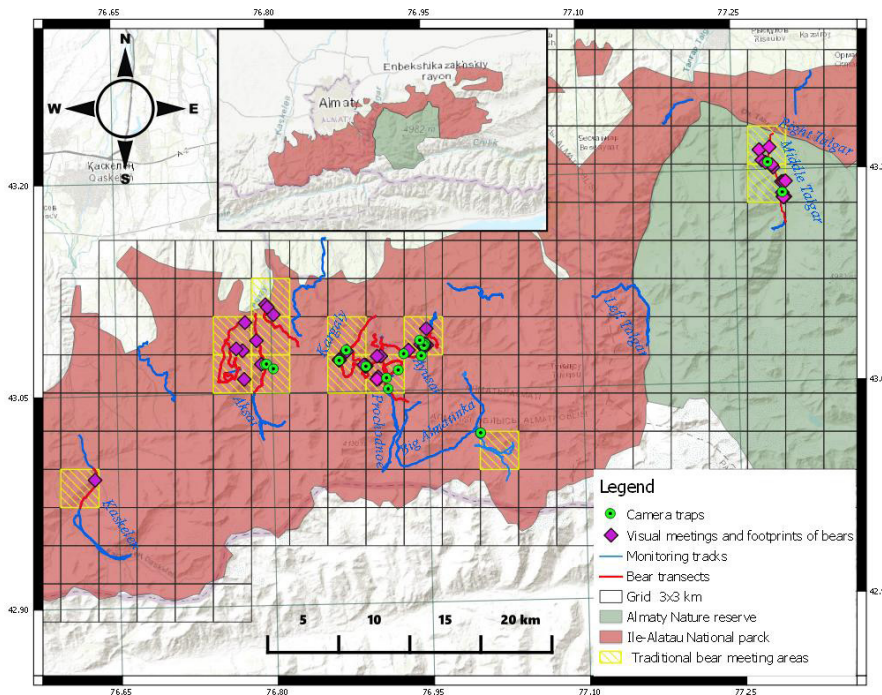


Figure 1 – Map of the research area with places of visual bears meeting, bear signs and installed camera traps

The basins of the Right and Middle Talgar, Aksai, Kargaly and Big Almatinka Rivers are occupied mainly by Schrenk's spruce (*Picea schrenkiana*). The protective conditions for bears are good (Figure 2). The slopes are covered with thickets of sea buckthorn (*Hippophae*

rhamonides), hawthorn (*Crataegus almaatensis*), barberry (*Berberis sphaerocarpa*), wild rose (*Rosa canina*), wild apricot (*Armeniaca vulgaris*) and Sievers' apple tree (*Malus sieversii*). Their fruits are the typical feeds of the Tian Shan brown bear.



Figure 2 – The habitat of the Tian Shan brown bear in the Trans-Ili Alatau

Materials and Methods

Field work was carried out from 2012 to 2018 on the territory of the ANR and from 2016 to 2018 in the adjacent territories of the IANR. It was also analyzed, collected by the ANR Researchers Saltore K. Saparbayev and Altynbek D. Dzhanyspaev, during the accompanying field trips from 2005 to 2013, as well as in 2015 and 2018. The observations were made from April to July (the spring-summer season) and from September to November (autumn season). In the ANR ground surveys were conducted in a total of 37 days of observation. The ground IANP surveys were conducted over a total 40 days of observation.

Data collection was carried out using traditional methods of (1) track and signs ground survey and (2) direct visual observations for mapping the bear

presence. The data obtained using these traditional methods was used to plan and develop a working protocol for (3) the camera trap monitoring activities. Due to the field work conditions in the IANR we focused on recording bear signs, while using direct observation in the ANR. Camera trapping was used in both ANR and IANR.

Track and signs ground survey

We used the footprint measuring method to monitor the bear presence using our ground survey for tracks [11-15]. We used this method to establish the presence of bears at the pilot sites and estimate their relative abundance. The full footprint of a brown bear's front paw on the ground includes the fingerprints of five fingers with claws, a print of a large transversely located palm cushion and a little behind it, closer to the outer edge, the print of a small

round pillow. The large transverse cushion (“callus”) on the forepaw is called a palmar (from the Latin word “palma”, i.e. palm). Its greatest length, lying almost across the track as a whole, serves as the most suitable indicator for measuring the tracks of a bear. This value varies less than others depending on the soil and the speed of the bear. For the sake of simplicity, we will call this measurement the “palm width” in the rest of the manuscript (Figure 3). The front and outer edges of the large palmar cushion and middle fingers leave the best imprints, while all of the other elements may be unclear and completely absent. When a bear is being “tracked”, the measurements of those prints where the edges of the palm are quite clearly visible are used.

The data collection protocol included: the establishment of the teams for field work composed by 1-2 individuals; planning and mapping the monitoring routes (considering various types of land use – forest plantations, rocky talus, alpine meadows along the main river valleys, along river banks on long-term animal trails as well as taking the strongly rugged terrain of the Tian Shan mountains into account, where long-term animal trails usually run along river valleys and there is a high concentration of material for ground survey observations); preparation of cartographic materials for GPS units, verification of equipment and instruments; training on safety rules. Observers were provided with GPS units on which spatial information about the bears tracks and signs was recorded. A special training session was conducted to explain the proper method for the measurement of tracks and to avoid measurement errors by making sure that only undistorted impressions of the plantar corns of the forepaw were measured.

All bear tracks were recorded, while the number of tracks, the degree of their freshness, the direction of movement of the animals and the width of the footprint of the plantar callus were registered and used to determine individual bears. We also registered signs of marking activity (scratches, tears and bites on trees).

The data collected was used to calculate Kilmetric Abundance Index (KAI) using the L formula, where n = total life traces and L = track length.

Direct visual observations

The direct visual observation method was used to determine the relative abundance and sex-age composition of the animals. In mountainous conditions, in places where it is possible to view a large area from the elevations of the slopes of the mountains and ranges, we observed bears directly using

binoculars (Bushnell brand – 12x). Given the direct correlation between the number of traces of animal activity and the number of animals recorded visually throughout the entire research period, we mapped traces of animal activity and noted visual encounters [16-18].

The observation routes were surveyed once every 2-3 days, using the following time intervals: 8.00 – 12.00 and 15.00 – 20.00. Historical observation showed that bears are inactive between the 12.00 and 15.00. At the time the animals were inactive between 12.00 to 15.00, the observers moved as far as possible along the track for the greatest possible coverage of the territory. Observations were conducted with good visibility from early April to early June. During the visual observation of the bears, the place and time of the observation, the number of different individuals, their relative position to the observer (the distance and orientation) were recorded. We also opportunistically registered the size, color, gender, direction of movement and type of activity at the time of the observation.

Among the animals encountered, two groups were distinguished: females with cubs and solitary animals (adult and semi-adult males and spring females, which cannot be reliably distinguished).

Camera trapping material

Special studies of different species including bears were carried out using automatic camera trapping cameras [19-22]. Using this method, we tried to obtain primary data on the relative abundance of bears in the territory, their distribution in different biotopes, sex and age composition and daily activity.

Two camera trap surveys have been conducted in the ANR. The first took place between 2013-2014, where 15 automatic security cameras were installed and provided data for 802 camera trapping days, while the second survey carried out in 2014-2015 resulted in 615 camera trapping days.

10 camera traps were also installed in a sector of the IANP of 150 km² in 2016-2018, and they remained active for 956 camera traps-days.

Automatic security cameras (brands Reconyx, Bushnell Trophy Cam HD and Bushnell Trophy Cam HD Aggressor) were used and placed within the forest belt at altitudes from 1770 m to 3083 m above sea level. Camera traps were installed in places where any signs of bear activity were discovered. The traps were placed on trees with flat areas under the crown, if possible and attached at a height of 50-60 cm (the average height at the withers of the Tian Shan brown bear). The main indicators of the opera-

tion of camera traps and the successful capture of animals are as follows: the number of camera trapping days per camera; the number of passes / registrations of individuals; the total number of camera shots; and the animal occurrence index.

When analyzing the data, we performed calculations according to the generally accepted method to determine the animal occurrence index [23, 24]. The animal occurrence index per 100 camera trapping days was determined by the formula: $X = \frac{n \times 100}{M}$, where n = the number of passes of animals and M = total number of camera trapping days.

Results and Discussion

Results of traditional approach

In the ANR, bears we registered bears visually more often than in the IANP. A total of 37 bears and 6 animal traces were recorded, such as broken anthills ($n = 2$), digs ($n = 1$), consumed grass ($n = 2$) and traces of eating carcasses ($n = 1$).

We registered 38 signs of bear presence in the territory of the IANP, including two visual contacts

and four “bear trees” with bites and scratches (Figure 3) [25, 26]. On different substrates, we found footprints of brown bears ($n = 17$). In the fall, before lying in a den, bears eat apple and apricot trees, inflicting some damage to them. We found broken branches and damaged young trees ($n = 10$). During our observation in the Kok-Zhailau plateau (a site between the Big and Small Almatinka Rivers) we did not find any signs of brown bear activity during the entire research period, which was also confirmed by earlier studies in this territory [27, 28].

The Kilometric Abundance Indices (KAI) in the Almaty Nature Reserve, based on visual observations and in the Ile-Alatau National Park, were determined based on the recording of bear tracks and signs. Two research sites with different conservation statuses and animal habitats as a result of anthropogenic transformation are presented in Table 1. The relative abundance of bears, according to photographic registration and the number of visual encounters of animals, is noticeably higher in the Almaty Reserve as a result of its long-term conservation status.



Figure 3 – Footprints and scratches on the bark of a tree left by bears

The camera trap method made it possible to accurately determine a date when the bear entered its den in the Middle Talgar River on November 16 in

2013. During heavy snowfall, a single bear moved up a rocky slope. After this date, there were no bears registered with camera traps.

Table 1 – The Kilometric Abundance Indices of bears In the Ile-Alatau National Park (by traces of life activity) and Almaty Reserve (by visual observation)

YEAR	Route																							
	Ayusai			Aksai			Prokhdnoye			Kaskelen			Kargalynka			Right Talgar			Middle Talgar					
	Route length & signs	Track & signs	KAI	Route length	Track & signs	KAI	Route length	Track & signs	KAI	Route length	Track & signs	KAI	Route length	Track & signs	KAI	Route length	Track & signs	KAI	Route length	Track & signs	KAI			
2005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	2	0.20	-	-	-			
2006	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	3	0.30	-	-	-			
2007	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	1	0.13			
2008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	3	0.30	-	-	-			
2009	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	6	0.75			
2010	4.3	1	0.23	-	-	-	-	-	-	-	-	-	-	-	-	10	4	0.40	-	-	-			
2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	6	0.75			
2012	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	5	0.63			
2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	2	0.20	-	-	-			
2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
2015	4.3	2	0.47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	3	0.38			
2016	5	4	0.80	6.8	6	0.88	11.2	5	0.45	-	-	-	-	-	-	-	-	-	8	3	0.38			
2017	10	3	0.30	17.1	3	0.18	7.4	3	0.41	-	-	-	-	-	-	-	-	-	8	2	0.20			
2018	21	7	0.33	29.2	8	0.27	12	7	0.58	20	1	0.05	13.6	6	0.44	-	-	-	8	8	1			
ANR Total KAI	88 km																		43 signs			M = 0.56 (±0.33)		
IANP Total KAI	161,9 km																		56 signs			M = 0.41 (±0.23)		

Camera trapping results

Relative abundance

18 bears were registered over 189 camera trapping days in the Almaty Nature Reserve in 2013, from August to November, with an average of 3.92 per 100 trap days. In 2014, from April to August, there were 15 registrations per 343 camera trapping days, with an average of 4.4 per 100 trap

days. From August 2014 to April 2015 there were 31 registrations with an average of 4.8 per 100 trap days.

28 bears were registered in the Ile-Alatau National Park between April and November 2016-2018 over 956 camera trapping days at an average of 2.9 per 100 trap days.

The animals were all registered at an altitude of 1879 to 2480 m above sea level (Figure 4).



Figure 4 – Bears in the field of vision of camera traps

Age and sex composition

In the Almaty Reserve in 2013, the 18 bears recorded on the camera traps included 15 (83.3%) single animals and 3 (16.7%) female bears with cubs. The 15 registrations in 2014 consisted of 12 (80%) single animals and 3 (20%) female bears with cubs.

Of the females recorded by the camera traps in 2013, two had 2 cubs and one had 1, with an average of 1.6 cubs per female. In 2014, three females had one cub each.

In Ile-Alatau National Park in 2016-2018 out of 28 meetings, 26 (92.8%) were single animals and

2 (7.2%) were female bears with cubs. Of the two females, one had 1 cub, the second – two, an average of 1.5.

Daily activity

An analysis of the camera trap data for the entire observation period in the ANR has shown that 6 (9%) of the sightings were registered in the morning, 23 (34.4%) in the afternoon and 38 (56.7%) of the animal encounters were recorded at night ($n = 67$). Bears are mainly active from 18 p.m. to 6 a.m. (Figure 5).

The data for the IANP shows that 6 (18.2%) were recorded in the morning, 5 (15.2%) in the afternoon and 22 (66.7%) encounters took place at night (n = 33) (Figure 6).

To assess whether the pattern of activity differs between the two study areas, we applied the Pearson

chi-square test (Statistics 10.0 After plotting the diagram (Figure 7)), which showed that the level of statistical significance between the difference in ANR and IANP did not show the statistical significance of the chi-square test ($P = 0.339559$) in Table 2.



Figure 5 – Daily activity of bears in the Almaty Reserve (% of the number of encounters)

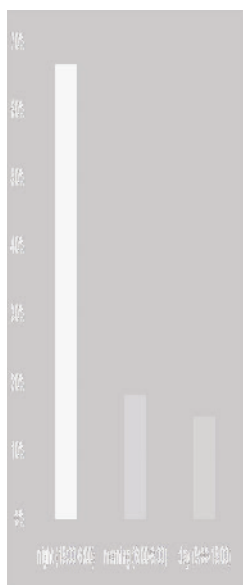
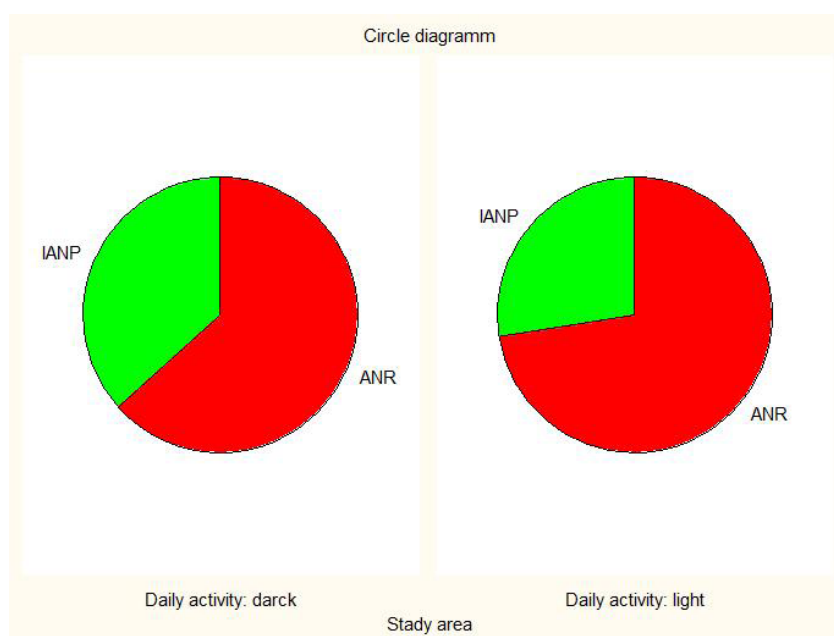


Figure 6 – Daily bear activity in the Ile-Alatau National park (% of the total number of encounters)

Table 2 – Results of the significance of the Pearson chi-square test

Summary table: Expected Frequencies Marked cells have counts > 5 Pirson chi-square: 0.912106; df=1; P=0.339559			
Study area	Daily activity dark	Daily activity light	Row totals
ANR	40.2	26.8	67.0
IANP	19.8	13.2	33.0
Total	60.0	40.0	100.0

**Figure 7** – Diagram of the difference in daily activity in ANR and IANP

Discussion

The group of Tian Shan brown bears occurring on the territory of the ANR has remained stable over the past 40 years due to the isolation of the locations they inhabit, as well as the conservation status of the territory and the restrictions on human incursions. There is no increase in the effect of the presence of humans there. The high level of registration of animals by camera traps and the frequent visual sightings give reason to believe that the bears are relatively evenly distributed over the entire territory suitable for the species habitation. The Kilometric Abundance Index (KAI) of visual animal encounters was $0.56 (\pm 0.33)$ individuals per 1 km of the route. This is confirmed by the available data on bear activity mainly taking place in the hours of the early morning, evening and night [27]. However,

animals also occur during the day, which may be related to weather and food conditions, as well as the disturbance factor. The occurrence index for camera traps showed 4.4 registrations per 100 trap days for the reserve on average.

Bear concentration in the IANP is observed mainly in inaccessible areas with good forage supply and protective conditions where there are practically no traces of human activity. For the Ile-Alatau National Park, the occurrence index was 2.9 registrations per 100 trap days. The Kilometric Abundance Index (KAI) by traces of animal activity was $0.41 (\pm 0.23)$ individuals per 1 km.

As a result, the hypothesis about different daily activity levels in territories with different conservation statuses was not confirmed. However, this difference can be clearly traced and may possibly be associated with other environmental factors (the

forage supply, territorial distribution and protective factors). We plan to find this out in our further studies. It was shown that in the territory with a lower conservation status the activity of animals is noticeably reduced in the daytime.

Our study concluded that the spatial dynamics of the brown bear population in the specially protected nature areas of the Trans-Ili Alatau show that two of the key areas of its habitat where bears live mainly in gorges have been identified as areas with different levels of anthropogenic transformation. Their daily activity in the two pilot sites remains the same, which indicates a low disturbance factor both in the ANR and in the IANP. The role of the territory of the ANR can be defined as the nucleus for the settlement of individuals of the brown bear in the mountains of the Trans-Ili Alatau, since the abundance of the species there has remained high for the last four decades. The territory of the IANP can serve as a buffer zone, where, subject to good protection and low anthropogenic impact, individual groups of bears can function successfully. The first covers the Kaskelen, Kyrgauldy, Aksai, Karagalinka, Prokhdnoye, Ayusay Gorges and part of the left bank of the Big Almatinka River in the Ile-Alatau National Park. The second is concentrated within the Left, Middle and Right Talgar, Issyk, Turgen and Shelek Gorges (the entire territory of the Almaty Reserve). The insulating barrier between the two groups is an extended section between Small and Big Almatinka Rivers, with a developed network of roads, residential buildings, ski resorts, recreational lodges and other infrastructure with an increased disturbance factor for bears.

Early data from field studies by other theoretical scientists such as S.I. Ognev and A.A. Sludsky for the western part of the Trans-Ili Alatau ridge and in the valleys of the Big and Small Almatinka Rivers shows that Tian Shan brown bears were already quite rare in 1930-1939 [29, 30]. Later references from the 1980s report on the absence of brown bears in the valleys of these rivers. In the mountains of the Trans-Ili Alatau, bears were rare in the valleys of the Small and Big Almatinka Rivers, although animals were still found in the neighboring gorges [27]. After the creation of the Ile-Alatau National Park on this territory in 1996 and an increase in their conservation status, rare visits of bears began to be noted in the Big Almatinka Gorge and then the permanent settlement of bears in the area [31]. At present, a permanent stay of a brown bear is noted

in the Ayusai and Prokhdnoye Gorges within the basin of the Big Almatinka River. These gorges are part of the recreational zones where bears regularly encounter humans and traces of their life. In our work, we tried to supplement the previously conducted research using new technologies (camera traps). Prior to this, there had been no special studies with the use of camera traps conducted in Kazakhstan, so we decided to use this method.

This provided us with results that allowed us to assess the current state of the brown bear population in the territories of two protected areas in the Trans-Ili Alatau in terms of their relative abundance and daily activity.

In September 2018, we discovered a bear's den in the Banditsai canyon (upper reaches of the Karagaly canyon) (Figure 8). The den was among the rocks in a stone cave with a depth of around 2.5-3 meters and with the width of its forehead (entrance) being 80x80 cm. Inside the den, old branches (litter) and a hollow in the ground were discovered, serving as the place for winter hibernation. The den is located 7 km away from local housing estates, at the exact GPS coordinates of N43° 03.886' E76° 52.141' and at a height 2654 m. In the spring, traces of 4 different bears were noted in this area at once. According to our assumptions, several dens can be located in this biotope, since there are many rocky niches and caves on this site, which can potentially serve as shelters for bears.

It is known from a previous publication that bears in the Tian Shan mountains prefer biotopes characteristic of what we found in the Karagalinka canyon at altitudes of 2600-3600 m above sea level [27]. This site is important during the den-building period, which is a key part of the life of brown bears.

However, in the process of conducting out research, limitations to the study of the demographic and spatial structures of the population of this species became apparent. The limited resources and information available have also made it necessary for the authors of this work to continue their research and monitoring of brown bear groups in the Trans-Ili Alatau and throughout its range in Kazakhstan.

As the observations show, an increase in the number and an expansion of the bear's range in those areas where it lived earlier are predicted. In this regard, the most acute problem is the occurrence of conflicts with humans, which will become a threat to both sides.



Figure 8 – View of the bear’s den from the outside and from the inside, September 2018. Photo by M. Bespalov

The main reason for the occurrence of possible conflicts between bears and humans is the increasing tourist load, and, as a result, the large amount of garbage that tourists leave. On the main trails in all the areas studied by us within the recreational areas, garbage and food debris were discovered. It is known that garbage attracts bears and they can eventually lose their fear of humans and traces of their life. To date, we do not know of any cases of bear attacks on humans in the territory of the Ile Alatau National Park. However, we do not exclude that such undesirable confrontations may occur in the near future.

Conclusion

The need for a systematic study of brown bears within their range in our country is long overdue. The last review article on the bear in Central Asia and Kazakhstan was published in 1994, but it is based on materials from the 1970s. Since then, no systemic monitoring studies have been carried out, with the exception of our preliminary attempt to assess the current population of bears in Kazakhstan [32].

The brown bear, as an inhabitant of the mountain forests of Central Asia, plays a comprehensive and substantial biocenotic role: as a predator, as a consumer of a large number of species and number of invertebrates, as well as a distributor of seeds of wild-fruited plants, including rare and endangered species such of apple and apricot trees.

The outlined theses allow us to believe that the research being carried out is relevant, high-priority

and important both in scientific and practical terms. The goals and objectives set here correspond to the requirements of the Convention on Biodiversity (1992) provisions of the “National strategy and action plan for the conservation and balanced use of biological diversity” (1999) and “Ecology of Kazakhstan for 2010-2020” national programs.

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