Environmental and Social Impact Assessment

PUBLIC

Project Number: 58290-001
Draft
August 2024

Uzbekistan: Samarkand 1 Solar PV and BESS Project

Appendixes – Part 11

Prepared by ACWA Power for the Asian Development Bank (ADB).

Table 6: Survey transect on Solar 400 MW PV, Solar 500 MW PV and pooling station (April 2024).

No	Name of transect	Date and time	Length	Biotope
1	1	18/04/24	1.4	Deposited lands
2	2	18/04/24	2.5	Deposited lands
3	3	18/04/24	1.5	Deposited lands
4	4	18/04/24	2.7	Gravelly-clay plain
5	5	18/04/24	4	Gravelly-clay plain
6	6	18/04/24	2	Gravelly-clay plain

3.3 Karakul BESS and access road

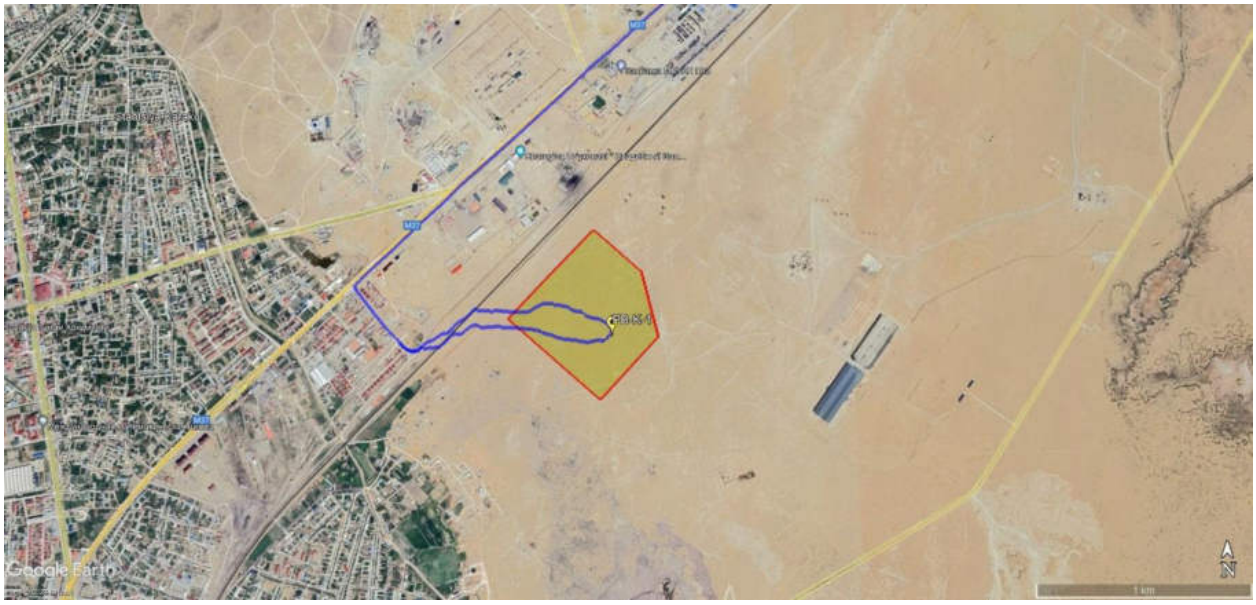

Figure 27: Survey map including survey points and transects on Karakul BESS (June 2023)

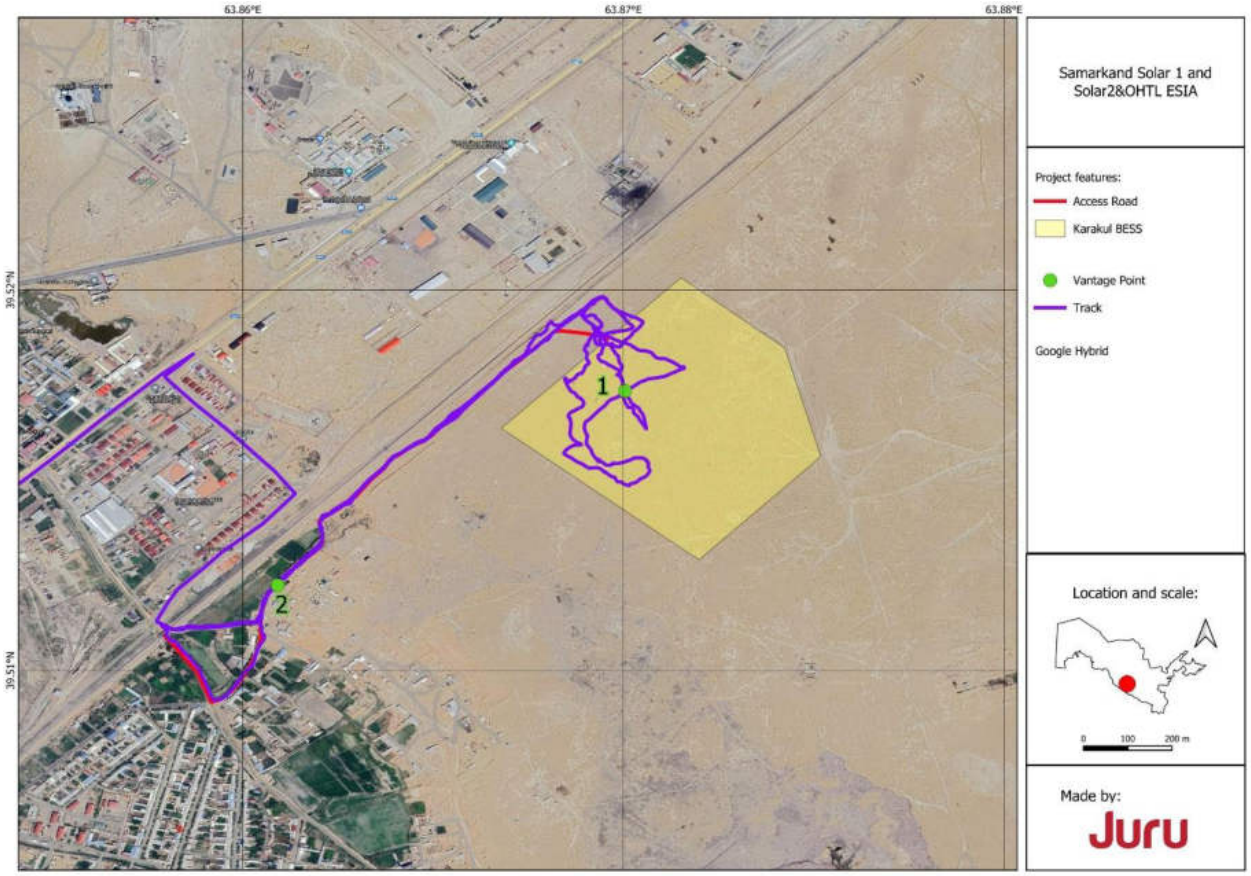

Figure 28: Survey map including survey points and transects on Karakul BESS and access road (March 2024)

Table 7: Survey points on Karakul BESS (June 2023)

No	Name of point	Date and time	N (dd format)	E (dd format)	Biotope	t air °C	t soil, °C	humidity, %
1	PB-K-1	27/06/23	39.515641°	63.872612°	Fixed sands, significant anthropogenic pressure in the form of a landfill and quarry.	34,2	44,7	21

Table 8: Survey transect on Karakul BESS (June 2023)

No	Name of transect	Date and time	Length	Biotope	t air °C	t soil, °C	humidity, %
	PB-K-1	27/06/23	1 km	Fixed sands, significant anthropogenic pressure in the form of a landfill and quarry.	34,2	44,7	21

Table 9: Survey transect on Karakul BESS (March 2024)

No	Name of point	Date and time	N (dd format)	E (dd format)	Biotope
1	Karakul_1	13/03/2024	39.517277	63.87006	Fixed sands, significant anthropogenic pressure in the form of a landfill and quarry.
2	Karakul_2	13/03/2024	39.512386	63.861006	Sandy desert with significant anthropogenic pressure in the form of a landfill and quarry.

3.4 Khalka substation and 360 km 550 kV OHTL

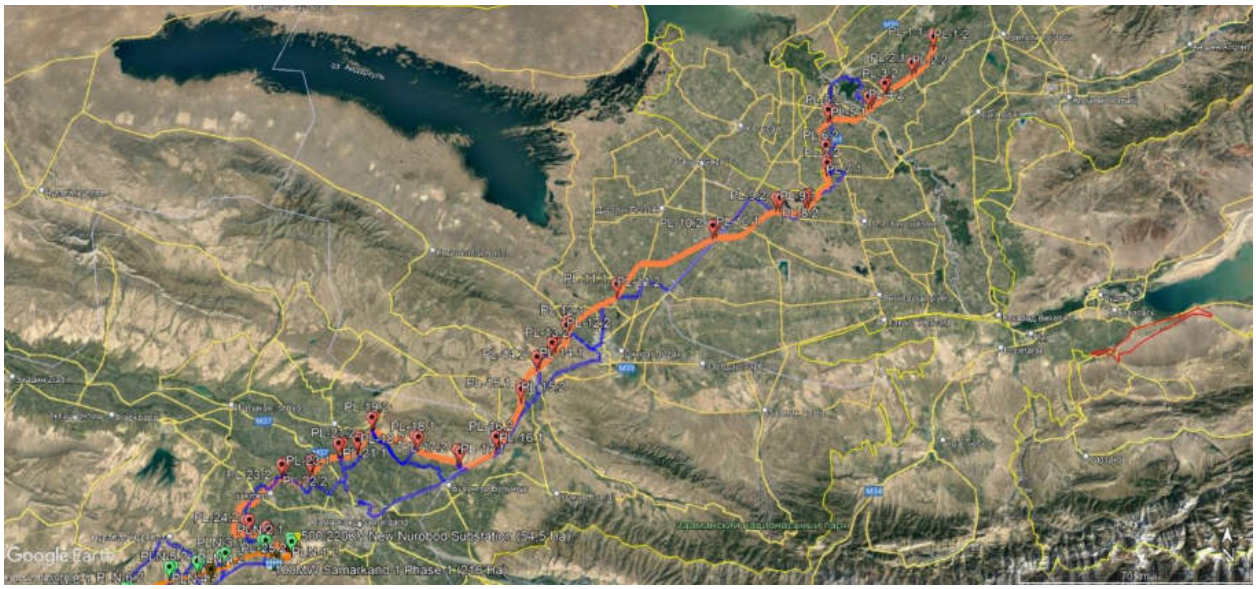

Figure 29: Survey map including survey points and transects on Khalka substation and 360 km 550 kV OHTL

Table 10: Survey transect on Khalka substation and 360 km 550 kV OHTL

No	Name of point	Date and time	Begin of transect N, E (dd format)	End of transect N, E (dd format)	Length, km	Biotope	t air °C	t soil, °C	humidity, %
1	PL-1	29/08/23	41.009074° 69.088070°	41.000085° 69.088619°	1.18	Agro-landscape, agricultural fields (potatoes, corn), irrigation canal	25,5	27,4	45
2	PL-2	29/08/23	40.927882° 69.013745°	40.921705° 68.999866°	1.36	Agro-landscape, agricultural fields (wheat, corn) poplar trees, mulberry trees along the roadside	25,7	31,9	48
3	PL-3	29/08/23	40.867007° 68.899121°	40.859601° 68.890741°	1.07	Arable land, irrigation canal, poplars, substation.	26,5	35,4	40

4	PL-4	29/08/23	40.823383° 68.838828°	40.819106° 68.825991°	1.20	Syrdarya river bank, agrolandscape	27,5	51,4	42
5	PL-5	29/08/23	40.817258° 68.824683°	40.810098° 68.813126°	1.28	Syrdarya river bank with outcrops of sandy loam and saline soils overgrown with tamarisk	30,4	40,2	36
6	PL-6	29/08/23	40.784544° 68.680706°	40.784279° 68.678717°	1.14	Intersection with highway M-39, discharge collector, agro-landscape wheat, cotton	29,2	38,9	36
7	PL-7	29/08/23	40.687323° 68.657145°	40.675166° 68.656544°	1.33	Agro-landscape, agricultural fields (wheat, cotton), forest belts mulberry, poplar trees	31,4	40,2	34
8	PL-8	29/08/23	40.604429° 68.664132°	40.594365° 68.665601°	1.19	Agro-landscape, agricultural fields (wheat, cotton), canals	32,5	42,7	30
9	PL-9	29/08/23	40.535790° 68.591190°	40.532299° 68.580521°	1.04	Fallow lands, rural lands, agricultural fields (corn) tamarisk, alhagi	33,0	47,8	27
10	PL-10	29/08/23	40.445996° 68.240662°	40.440287° 68.234253°	1.16	Agro-landscape, cotton, fallow land	32,3	46,9	27
11	PL-11	29/08/23	40.282841° 67.877850°	40.273823° 67.873416°	1.14	Agro-landscape, wheat, mulberry, brackish soils	31,1	47,5	29
12	PL-12	29/08/23	40.171953° 67.695034°	40.158500° 67.692292°	1.52	Foothills of the Nurata Ridge, rock outcrops	29,4	38,4	30
13	PL-13	29/08/23	40.117938° 67.653120°	40.109239° 67.640821°	1.44	Dry slopes, sparse almond trees	28,7	37,7	30
14	PL-14	29/08/23	40.074335° 67.595727°	40.069893° 67.586395°	1.11	Agro-landscape, ravine, mulberry tree	28,3	36,5	31
15	PL-15	29/08/23	39.991426° 67.533282°	39.980926° 67.532629°	1.14	Agro-landscape, ravines, railway track	27,5	34,2	32
16	PL-16	29/08/23	39.859089° 67.457731°	39.852144° 67.447448°	1.18	Very transformed foothills, flooded from well downs, vegetable gardens and orchards	26,2	29,1	33
17	PL-17	30/08/23	39.811038° 67.322477°	39.815622° 67.312110°	1.03	Agro-landscape, dry slopes	33,1	41,3	25
18	PL-18	30/08/23	39.849533° 67.171532°	39.854307° 67.160080°	1.10	Agro-landscape, dry slopes	32,7	40,2	25
19	PL-19	30/08/23	39.905546° 67.011410°	39.900958° 67.002427°	1.28	Agro-landscape, dry slopes	32,5	40,4	26
20	PL-20	30/08/23	39.847503° 66.960472°	39.839299° 66.954797°	1.01	Agro-landscape	32,2	40,3	26

21	PL-21	30/08/23	39.831264° 66.901851°	39.829731° 66.887918°	1.17	Akdarya river bank, floodplain forest	31,5	32,3	34
22	PL-22	30/08/23	39.784889° 66.800132°	39.775917° 66.790644°	1.29	Karadarya river bank, floodplain forest	31,1	31,3	36
23	PL-23	30/08/23	39.750304° 66.655288°	39.740929° 66.653193°	1.24	A pond covered with reeds	32,8	33,4	31
24	PL-24	30/08/23	39.621763° 66.576407°	39.621429° 66.588599°	1.06	Agro-landscape, flooded fields, canal	31,3	38,6	29
25	PL-25	30/08/23	39.604790° 66.651092°	39.596863° 66.659992°	1.18	Agro-landscape, agricultural fields (corn, cotton) irrigation systems	29,5	40,3	28

3.5 Nurabad SS – Pooling station – 70km OHTL

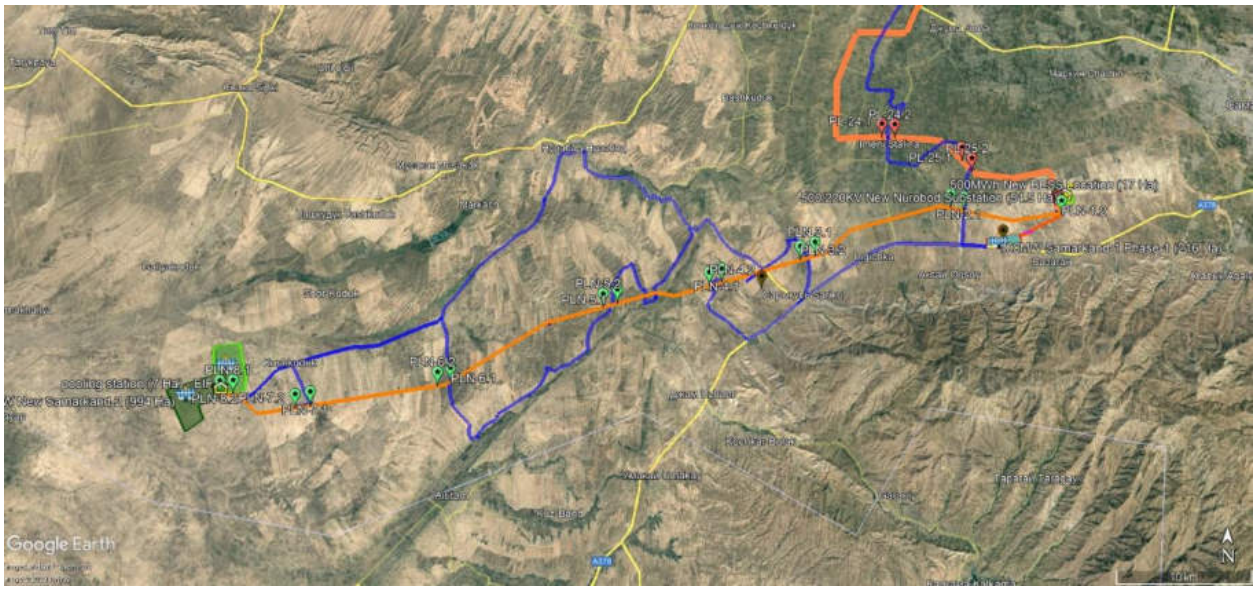

Figure 30: Survey map including survey points and transects on Nurabad SS – Pooling station – 70km

Table 11: Survey transect on Nurabad SS – Pooling station – 70km

No	Name of point	Date and time	Begin of transect N, E (dd format)	End of transect N, E (dd format)	Length, km	Biotope	t air ºC	t soil, ºC	humidity, %
1	PLN-1	30/08/23	39.576059° 66.737745°	39.566393° 66.742018°	1.13	Sazagan site	24,6	26,8	32
2	PLN-2	30/08/23	39.568289° 66.651061°	39.569996° 66.639031°	1.06	Wheat fields, fallow land, ravine	28,3	47,7	32
3	PLN-3	30/08/23	39.533276° 66.512261°	39.530160° 66.498623°	1.26	A ravine, a scour	28,4	32,6	32
4	PLN-4	30/08/23	39.512995° 66.426383°	39.510381° 66.414994°	1.04	Bagara foothills through which the gas pipeline passes	28,4	31,9	30
5	PLN-5	30/08/23	39.504631° 66.367995°	39.503814° 66.361326°	1.06	The natural hilly landscape	25,4	37,8	30
6	PLN-6	30/08/23	39.439060° 66.180656°	39.435895° 66.169032°	1.07	The hills between the bagara	27,0	47,0	29
7	PLN-7	30/08/23	39.420389° 66.054487°	39.418424° 66.040842°	1.2	Small-scale transformation of the territory near the village, steppe area	29,2	38,9	32
8	PLN-8	30/08/23	39.427239° 65.983609°	39.426674° 65.971470°	1.05	Well-preserved steppe site with salinization	31,0	35,7	28

Table 12: Survey transects on 70 km OHTL 15 May 2024

No	Name of point	Date and time	Begin of transect N, E (dd format)	End of transect N, E (dd format)	Length, km	Biotope
1	70km OHTL_1	15/05/24	39.499133 66.346217	39.505922 66.345690	2 km	Dry grassland
2	70km OHTL_2	15/05/24	39.436137 66.175653	39.435445 66.175692	2 km	Dry grassland
3	70km OHTL_3	15/05/24	39.427084 65.995941	39.423554 65.993406	3 km	Dry grassland and fallow lands

3.6 LILO 11 km, LILO 19 km

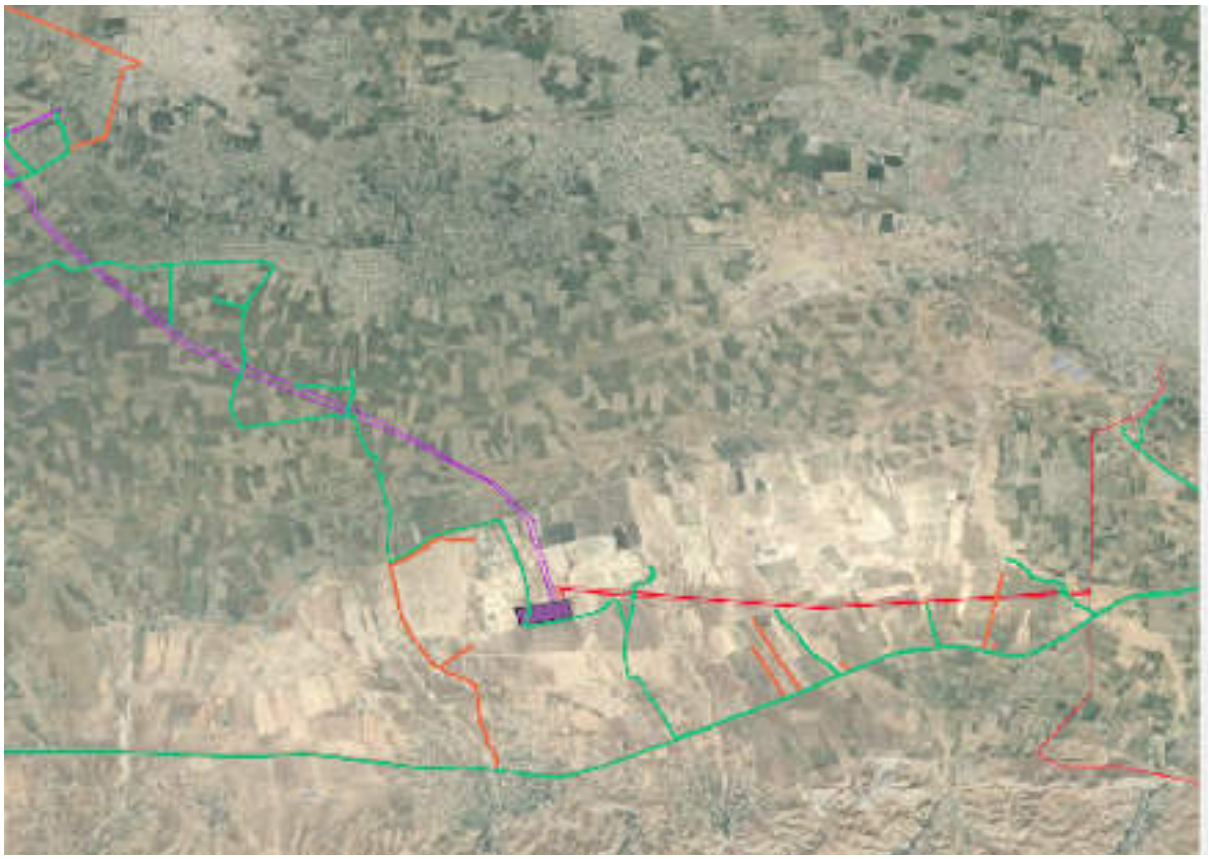

Figure 31: Red – LILO 11 km, Purple – LILO 19 km, orange – track 11 March, green – track 6 April

Table 13: Survey points on LILO 11 (March 2024)

No	Name of point	Date and time	N (dd format)	E (dd format)	Biotope
1	LILO11km_1	11/03/24	39.579708	66.855531	Vinegard
2	LILO11km_2	11/03/24	39.579296	66.838477	Fallow lands
3	LILO11km_3	11/03/24	39.576897	66.802835	Temporary stream and riverbed

4. Herpetofauna

Each of the types of habitats of the study area is characterized by a historically established set of species inhabiting it - a faunistic complex of amphibians and reptiles. Each species is adapted to a certain set of environmental factors and this determines its relationship with specific ecosystems and habitats. As part of any faunal complex, two groups of species can be distinguished:

1. Species closely associated with a limited set of environmental factors (stenobiont species). These are characteristic species only for a particular type of habitat. With a favorable combination of the necessary conditions, characteristic species can be quite numerous - background ones. Any changes in habitat conditions have a negative impact on the characteristics of the distribution and the state of abundance of characteristic species. Therefore, they are indicators of the degree of conservation/disturbance of natural habitats.

In the project area, these species are mainly biome (Turkestan thin-toed gecko, Schneider's skink and Central Asian Cobra), semiaquatic species (Turan toad).

2. Species capable of adapting to a wider range of habitat conditions (ecologically plastic, or eurybiont species). This causes their wide distribution and occurrence in various types of habitats, higher resistance to anthropogenic impacts. Many species of this group are economically significant, can reach a high abundance and provide a food base for predators, incl. rare species. Such species inhabiting the project area include Rapid Racerunner and Spotted whip snake.

In addition to these faunal complexes, it should be noted that synanthropic reptile species inhabit the territory near the settlements, which include Turkestan thin-toed gecko and Spotted whip snake. Occasionally, the rare Caspian Monitor (RDB Uz, 2019) and Central Asian Cobra (RDB Uz, 2019) visit the villages in search of prey. Rapid Racerunner and Steppe Agama and Sand racer live along the fields, on soil ejections along canals and ditches, along cliffs and along them.

5. Findings and Results

5.1 Nurabad Substation and access road 5320 m, OHTL 4,9 km, Nurabad BESS, Solar 100 MW PV and access road 70 m

During the herpetological research conducted in the Sazagan area, several species of reptiles were discovered. None of these species are considered rare or endemic, and they have a wide distribution range. However, the timing of the research did not align with the period of activity of the Central Asian tortoise, which was in a state of aestivation during that time. It was recommended that targeted studies specifically for this species be conducted in the project area in Spring 2024.

The area itself experiences significant anthropogenic pressure, being utilized for agriculture, primarily for cultivating wheat and barley, with some portions also serving as pasture land (PS-1, PS-2).

The Spring survey conducted in March 2024 did not detect the presence of tortoises. However, it is anticipated that tortoises may still be present on the project site, albeit in low numbers.

Table 14: Primary data and the density of reptiles at the accounting points on Sazagan (Nurabad Substation, Nurabad BESS, Solar 100 MW PV) – June 2023

No	Species	Survey point/transect	No. of recorded animals	Population density on the site, inds/ha	Notes
1	*Trapelus sanguinolentus*	PS-1	1	0.9	
2	*Ablepharus pannonicus*	PS-5	2	10.4	
3	*Eremias arguta*	PS-1, PS-2	3,2	9.1; 8.3	

Table 15: Primary data and the density of reptiles at the accounting points on Sazagan (Nurabad Substation, Nurabad BESS, Solar 100 MW PV) – June 2023

No	Species	Survey point/transect	No. of recorded animals	Population density on the site, inds/ha	Notes
1	*Trapelus sanguinolentus*	PS-1	1	0.9	
2	*Ablepharus pannonicus*	PS-5	2	10.4	
3	*Eremias arguta*	PS-1, PS-2	3,2	9.1; 8.3	

Table 16: Primary data and the density of reptiles at the accounting points on Sazagan (Nurabad Substation, Nurabad BESS, Solar 100 MW PV) – March 11

No	Species	No. of recorded animals	Point	Date and time
1	No records	-	Nurobod BESS	11/03/24
2	No records	-	Nurobod SS	11/03/24

Table 17: Primary data and the density of reptiles at the accounting points on Sazagan (Nurabad Substation, OHTL 4.9 km, Nurabad BESS, Solar 100 MW PV) – May 2024

No	Species	Survey point/transect	No. of recorded animals	Population density on the site, inds/ha	Length	Population density on the site, inds/ha	Notes
1	*Testudo horsfieldii*	100 MW_2024-05-14 15:50_1.2km	2	14/05/2024	1.2	1.6	
2	*Testudo horsfieldii*	Nurabad SS_ 2024-05-14 15:22_1.12km	1	14/05/2024	1.12	0.89	

5.2 Nurabad Solar 400 MW, pooling station, Nurabad Solar 500 MW PV and access road 696 m

During the herpetological research carried out in the Nurabad area (400 and 500 MW), several reptile species were identified in June 2023. None of these species are classified as rare or endemic, and they exhibit a wide distribution range. However, the timing of the research did not coincide with the period of activity of the Central Asian tortoise, which was in a state of aestivation at that time. It was recommended that targeted studies specifically for this species be conducted in the project area in Spring 2024.

The area itself is subject to significant anthropogenic pressure, primarily due to grazing activities and partial use for rain-fed agriculture, particularly for wheat and barley cultivation.

The Spring survey conducted in April 17-19, 2024 revealed the presence of tortoises. **The population density of Central Asian Tortoise for the 400 MW site and pooling station was estimated at 0.66 individuals per hectare, totalling 533 individuals for this site (***Table 19***). Similarly, for the 500 MW**

site, the population density was calculated at 0.63 individuals per hectare, amounting to 626 individuals for this site (*Table 13*).

Table 18: Primary data and the density of reptiles at the accounting points on Solar 400 MW PV and pooling station, Solar 500 MW PV) recorded in June 2023

No	Species	Survey point/transect	No. of recorded animals	Population density on the site, inds/ha	Notes
1	*Tenuidactylus fedtschenkoi*	P-4	4	3.8	
2	*Trapelus sanguinolentus*	P-4,P-5	1,2	0.6; 1	
3	*Phrynocephalus helioscopus*	P-3,P-5	2,3	4.1; 2.1	
4	*Eremias velox*	P-3, P-4, P-5	2,1,2	2.9; 1.6; 1.8	

Table 19: Primary data and the density of tortoises on Solar 500 MW PV), April 2024

No	Species	Number of specimens on 2.0 km	Number of specimens on 2.7 km	Number of specimens on 4.0 km	Average density (Ind/ ha)	Assessed number of tortoises
1	*Testudo horsfieldii*	7	3	11	**0.63**	**626**
2	*Trapelus sanguinolentus*	1				**-**

Table 20: Primary data and the density of tortoises on Solar 400 MW PV and pooling station, April 2024

No	Species	Number of specimens on 1.5 km	Number of specimens on 1.4 km	Number of specimens on 2.5 km	Average density (Ind/ ha)	Assessed number of tortoises
1	*Testudo horsfieldii*	3	2	2	**0.66**	**533**
2	*Trapelus sanguinolentus*	1				**-**

Figure 32: Habitat on Solar 500 and 400 MW PV, April 17-19 2024

During the research, it was noted that fresh trenches were observed nearby the project area, which local residents use to demarcate their territory. Such trenches not only harm the soil cover but also pose a danger to local fauna. They can become traps for many animals, especially tortoises, which may perish from heat and hunger trapped within them.

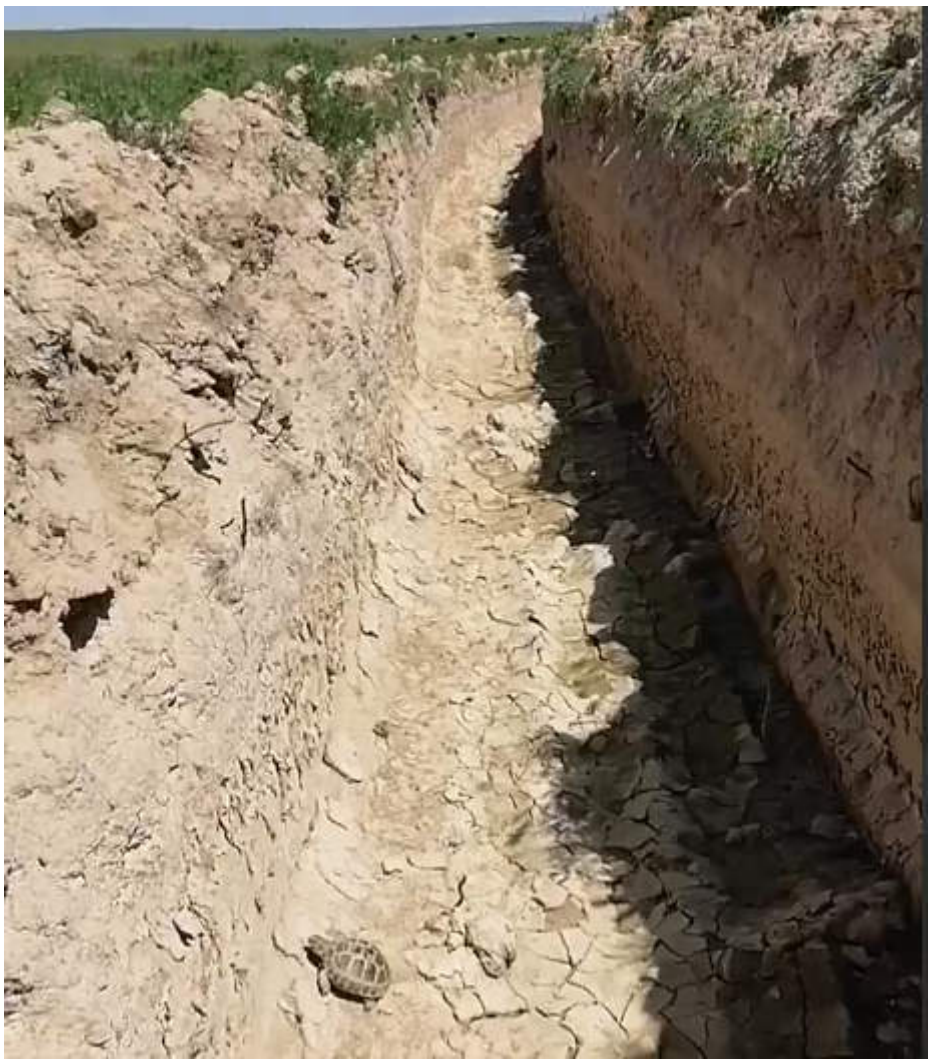

Figure 33: Tortoise in trench

During the **Access road** 696 m (March 11 2024) survey, 7 central Asian tortoises were observed on the asphalt road during the spring observation.

Table 21: Primary data and the density of tortoises on Access road 696m, March 2024

No	**Species**	**Number of specimens on 696m**	**Average density (Ind/ ha)**
1	*Testudo horsfieldii*	7	16.76

Figure 34. Central Asian tortoise on the asphalt road

Figure 35. Central Asian tortoise on the asphalt road

5.3 Karakul BESS and access road

During June 2024, no reptile species were observed on the construction site of the BESS "Karakul". Although the weather conditions were suitable for most species, the area is significantly affected by human activities. Adjacent to the site, there is a municipal waste dump, and a considerable amount of garbage and carcasses were found within the vicinity, including quarry-like ravines.

There were no signs of reptile presence during Spring survey conducted on March 13th. No burrows of Central Asian tortoises or evidence of other reptile activities were identified. The absence of reptiles in the project area can be attributed to factors such as littering, human disturbance, the presence of stray dogs.

Figure 35: Contamination of the area from the neighboring landfill

5.4 Khalka substation and 360 km 550 kV OHTL

Almost the entire length of the projected 360 km 550 kV OHTL runs through agro-landscape and lands under rather strong anthropogenic pressure. Exceptions are a few points where the landscape has preserved more or less natural structure (floodplains of the Akdarya and Karadarya rivers, as well as the lowlands of the Nurata Range). However, these territories also experience sufficient anthropogenic load. No rare reptiles were found during the survey period of August 29-30, 2023. A total of 25 points along the entire length of the proposed transmission line were surveyed, totaling 15.08 km. During the transects in the project area we detected 4 species of reptiles mainly along

irrigation canals, rivers and reservoirs. The detected species are widespread and often abundant herpetofauna. However, the timing of the survey is not the best period for amphibian and reptile activity, especially for some species such as Central Asian Tortoise. Some reptile and amphibian species potentially present in some areas were also not encountered during the survey period due to secretive behavior, short survey periods and the overlap of the highest activity period with the survey period.

Table 22: Primary data and the density of reptiles at the accounting points on Khalka substation and 360 km 550 kV OHTL

No	Species	Survey point/transect	No. of recorded animals	Population density on the site, inds/ha	Notes
1	*Pelophylax ridibundus*	PL-1, PL-2, PL-3, PL-4, PL-6, PL-7, PL-22, PL-23	1, 8, 12, 16, 11, 8, 11, 3	6.2; 13.5; 22.3; 38.9; 25.3; 16.2; 24.3; 9.1	
2	*Ablepharus deserti*	PL-1, PL-3, PL-4, PL-22,	1, 3, 2, 1	3.2; 8.4; 6.7; 2.8	
3	*Eremias velox*	PL-12, PL-13, PL-14, PL-19, PL-22, PL-23	2,3,1,3,2,2	4.3; 7.9; 2.2; 9.1; 4.7; 5.1	
4	*Natrix tessellata*	PL-3, PL-6,	1,2	0.4; 1.2	

5.5 70 km OHTL (Nurabad SS – Pooling station)

The area through which the proposed Nurabad SS - Pooling station - 70km transmission line passes is located on a hilly plain with rain-fed agricultural fields and grazing livestock. The area is often crossed by scouring temporary watercourses, creating precipices and depressions. During the site survey period, 8 points along the entire proposed transmission line were surveyed, totaling 8.87 km. During the transects, 3 reptile species were observed in the project area, one of which Central Asian Tortoise is listed in the Red Data Book of the Republic of Uzbekistan (2019) with the status 2(VU), as well as in the IUCN Red List with the status VU. The remaining two species Steppe Agama and Rapid Racerunner are widespread and numerous species. It should be noted that the area is good habitat for Central Asian Tortoise and during the period of activity of this species it is possible that this species will be found in the project area quite frequently.

During the site visit on May, no tortoises were found.

Table 23: Primary data and the density of reptiles at the accounting points on Nurabad SS - Pooling station - 70km OHTL

No	Species	Survey point/transect	No. of recorded animals	Population density on the site, inds/ha	Notes
1	*Testudo horsfieldii*	PLN-3, PLN-5, PLN-7, PLN-8,	4 holes and 1 ad, 1 hole, 4 holes and 1 carapax, 1 hole,	-	Mostly burrows, carapax were found, but one active adult was also encountered
2	*Trapelus sanguinolentus*	PLN-3, PLN-6, PLN-7, PLN-8,	1, 1, 3, 1	1.4; 2.1; 4.6; 2.2.	
3	*Eremias velox*	PLN-7, PLN-8,	3, 2	7.4; 3.2	

5.6 LILO 11 km, LILO 19 km

During the site visit on March, 11 and April, 5-6 to the project area, no reptiles were found. Signs of the presence of the Central Asian tortoise (shell, burrows) were also absent.

Table 22: Primary data and the density of reptiles at the accounting points on Khalka substation and 360 km 550 kV OHTL

No	Species	Survey point/transect	No. of recorded animals	Population density on the site, inds/ha	Notes
1	*No species*				
2	*Np species*				

6. Key species descriptions

CLASS AMPHIBIA

FAMILY TOADS (BUFONIDAE)

TURAN TOAD

***Bufotes turanensis* (Hemmer, Schmidtler & Böhme, 1978)**

Figure 36. Turan toad. Photo by Abduraupov T.V

Body length with head up to 140 mm. It is light gray-olive or gray-green on the upper side with black spots or without them. The male has an internal vocal sac under the skin of the throat. During the breeding period, black calluses appear on the first two or three fingers of the front legs of the male. The inner edge of the prepollex has a longitudinal skin fold. The pupil is horizontal. The hind toes are

partially connected by a webbed membrane. Parotid glands, well developed behind the eyes. The spawn is in the form of strings.

An economically significant species that destroys harmful insects in enormous quantities. Occasionally collected by the local population for preparing remedies in traditional medicine.

In February and March, toads lead a diurnal lifestyle. During this time, they bask in the sun or mate and lay eggs in furrows, puddles, and swamps. Then they switch to a nocturnal lifestyle, which continues until late autumn.

In the flat part of the range, the majority of toads go into hibernation at the end of October or the beginning of November, and they often appear on the surface as early as mid-February, but the mass emergence from hibernation occurs in early March.

The peak of activity for the green toad coincides with the spawning period, which begins at the end of February and lasts until the end of May.

The Turkestan toad is found in various locations. It can be found in river valleys, plains, foothills, fields of various crops, gardens, settlements, and even deserts where there are any sources of water, even temporary ones. They use the burrows of various rodents and cracks in the soil as shelters.

In the Samarkand region, in Ulus, Kattakurgan, and in the Zeravshan Valley, A. P. Fedchenko discovered these toads (Nikolsky, 1899a).

We observed this species near the village of Tim in 2011.

CLASS REPTILIA

FAMILY TORTOISES (TESTUDINIDAE)

CENTRAL ASIAN TORTOISE

***Testudo horsfieldii* (Gray, 1844)**

Figure 37. Central Asian tortoise. Photo by Abduraupov T.V

Steppe Tortoise - a vulnerable, declining Central Asian endemic species. Included in the IUCN Red List [VU] and the Red Book of the Republic of Uzbekistan 2(VU) (2019), as well as listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Apart from southern Kazakhstan, Turkmenistan, Uzbekistan, Kyrgyzstan, and Tajikistan, it is also found in northern and eastern Iran, Afghanistan, northwest China, and northern Pakistan (Ananjeva et al., 1998; Bogdanov, 1960, 1965).

Carapace length up to 286.4 mm. The carapace is flat with weakly serrated edges. The front edge notch is shallow. Front legs have four claws. The forelimbs are covered with six to seven transverse rows of shield-like scales. The hind thighs have several horn-like bumps arranged in a group. The horn scales of the shell are usually monochromatic, yellowish or brown-olive tones, sometimes with black wide spots, more pronounced on the plastron.

It inhabits deserts, both sandy and clay, plains, mountain slopes, depressions, valleys, gorges, and mountain steppes, reaching altitudes of up to 1150 m above sea level (Dahl, 1936, 1937). Occasionally settles in agricultural lands: on the outskirts of fields, orchards, gardens, and orchards. Avoids areas with dense grass cover and places with intense livestock grazing.

It has a strictly diurnal lifestyle. During hot weather, it is only active in the morning and before sunset. In the middle of the day, animals hide from the heat in temporary shelters under bushes, where they partially bury themselves in the soil, in rodent burrows, or their own burrows. In a day, tortoises can travel distances from 120 m to 2 km. At night, they bury themselves in shallow pits or sometimes stay on the surface.

After winter diapause, tortoises appear on the surface in March to early April, and in warm winters and in the southern part of their range, as early as February. Mating begins a few days after emerging. The breeding period extends from late March to the end of May. Hatchlings with a carapace length of 30-50 mm hibernate underground and usually emerge on the surface in the spring of the following year.

Growth is slow. Sexual maturity is reached at the age of 10-13 years with a carapace length of 11 cm. In the wild, they can live for at least 30 years.

In June, when ephemeral vegetation dries up, the Central Asian tortoise enters a period of estivation (summer dormant state), digging burrows up to 1 m long. They disappear from deserts by the end of May, but in the mountains or irrigated lands, individual specimens can still be found in June and even July. Estivation often transitions to hibernation (winter dormant period).

The population of tortoises undergoes significant fluctuations (Bogdanov, 1965), which depend on winter and spring meteorological conditions, as well as the productivity of the habitats where the animals live. Land cultivation, livestock grazing, and habitat disturbance have a significant impact on reducing the population.

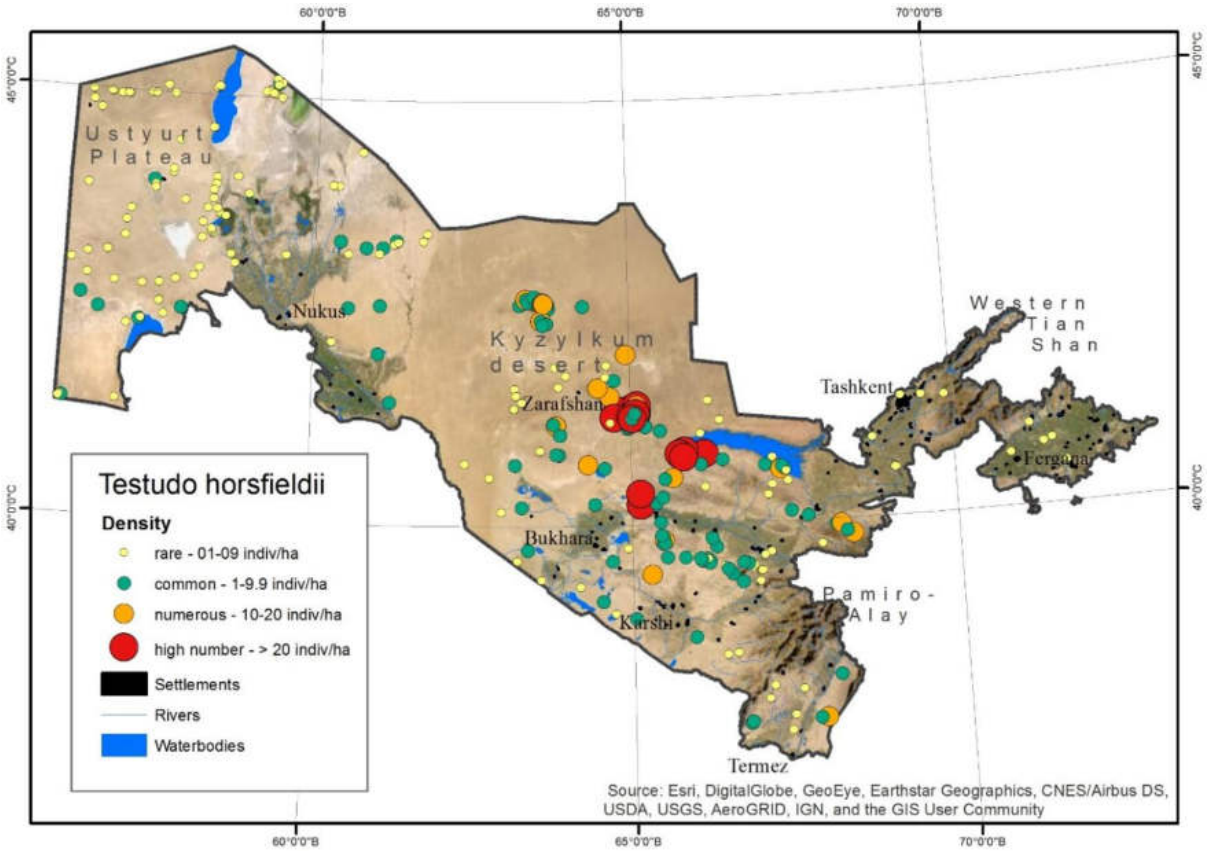

Figure 38. Map of the turtle population density in various regions of the Republic.

Distribution in Project region

Widely distributed in the Samarkand region, from the Karnabchul Steppe to the foothills of the Zeravshan and Nuratau Ranges. It is found in Karnabchul, north of the Shorsaysko-Dultalin Depression (Bondarenko, Peregoncev, 2017[5]), between the villages of Sepki and Tim (Dahl, 1937), on the gentle foothills of the Zirabulak Mountains, in the vicinity of the village of Tashkuduk (Bondarenko, Peregoncev, 2017[5]), and Tim (Abduraupov et al., 2021), in the area of Sengirbulak village (Dahl, 1937), in the southeast part of the Ziyadin Mountains, on loess-covered grassy-ephemeral foothills near the village of Karnab (Bondarenko, Peregoncev, 2017[5]). Observed 4 km west of the village of Sazagan, 39°31' N, 66°41' E (Bondarenko, Peregoncev, 2006); 3.5 km north of the village of Ibraimata, 39°30' N, 66°24' E (D.A. Bondarenko, V.G. Starkov, 2002, communication); 20 km south of the village of Karatepe (Bogdanov, 1962); and 3.5 km east of the village of Jam, 39°24' N, 66°31' E (Bondarenko, Peregoncev, 2006).

The population of tortoises undergoes significant fluctuations (Bogdanov, 1965), which depend on winter and spring meteorological conditions, as well as the productivity of the habitats where the animals live. Land cultivation, livestock grazing, and habitat disturbance have a significant impact on reducing the population.

Secondary data on Central Asian Tortoise density

In the Karnabchul Steppe north of the Shorsai-Dultalin Depression, the population of the Central Asian tortoise ranged from 7.9 to 11.5 individuals per hectare. Near Zirabulak Mountains, the loess plains give way to stony and clayey deposits, leading to a decrease in population density.

[5] Bondarenko D. A., Peregontsev E. A. Distribution of the Central Asian Tortoise Agrionemys horsfieldii (Gray, 1844) in Uzbekistan (Range, Regional and Lanrscape Distribution, Populations Density). Current Studies in Herpetology, 2017, vol. 17, iss. 3–4, pp. 124–146 (in Russian). DOI: 10.18500/1814-6090-2017-17-3-4-124-146.

Between the villages Sepki and Tim S. K. Dal (1937) noted a population density of only 0.2 individuals per hectare.

On the gentle foothills of the eastern end of these mountains, in the vicinity of the village of Tashkuduk, the tortoise population density, according to our data, increased to 6.1±3.5 individuals per hectare. A similar value of 5.5 individuals per hectare was recorded in the Sengirbulak village area in the 1930s (Dal, 1937).

Increased population density of the species was also observed in the southeastern part of the Ziadin Mountains. On the loess-covered ephemeral foothills near the village of Karnab, a density of 16.1±5.5 individuals per hectare was recorded[5].

The discussion on tortoise density on project area

As 400 MW PV plant is located in a plain steppe area with no foothills, it's important to consider the potential differences in habitat and ecological conditions compared to the areas where tortoise populations were previously recorded, such as Tashkuduk and Sengirbulak, which are mostly foothills of the mountains. Habitats vary significantly in terms of vegetation, climate, soil types, and other factors, which can influence tortoise populations.

In this case, it might not be appropriate to directly extrapolate the population density from the foothill areas to the plain steppe area.

Without specific data on tortoise populations in plain steppe areas of the region, it's challenging to accurately estimate the population density. Ideally, conducting surveys and studies in the plain steppe habitat during active season of the Central Asian tortoise would provide a more accurate understanding of the tortoise population in that specific area.

The discovery of three tortoise carapaces during a scoping site visit in July and August within the territories of the 400MW and 500MW PV plants, along with confirmation from local shepherds that tortoises inhabit the area, suggests the presence of a tortoise population in the region. The carapaces are indicative of tortoises being present in the past or currently within the vicinity.

Figure 40.Tortoise carapace. 2023-07-13 11:27 (N 39°27'1.46", E 65°57'50.17")

Figure 41. Tortoise carapace. .2023-08-18 (17:2N 39°24'57.88", E 65°55'55.65")

Figure 42. Tortoise carapace. 2023-08-18 17:17 (N 39°25'14.79", E 65°56'4.42")

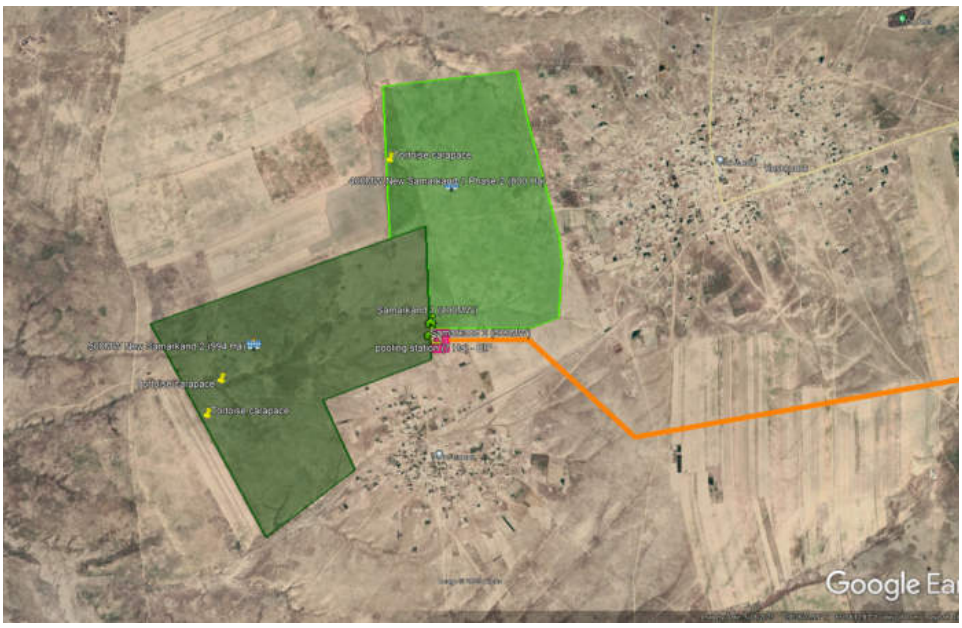

Figure 43. Points where tortoise carapaces were found.

However, it's important to note that carapaces alone might not provide a complete picture of the population size, distribution, or health. Tortoise populations can be influenced by various factors such as habitat suitability, food availability, predation, and human activities.

In situations where habitat conditions vary significantly, it's best to rely on direct observations and data collection within the specific habitat of interest to make more accurate population estimates.

Results of tortoise count 2024 on project area 400 and 500 MW Solar.

The Spring survey conducted in April 2024 revealed the presence of tortoises. **The population density of Central Asian Tortoise for the 400 MW site and pooling station was estimated at 0.66 individuals per hectare, totalling 533 individuals for this site (***Table 14***). Similarly, for the 500 MW site, the population density was calculated at 0.63 individuals per hectare, amounting to 626 individuals for this site** (*Table 13*).

FAMILY GEKKOS (GEKKONIDAE)

TURKESTAN THIN-TOED GECKO

***Tenuidactylus fedtschenkoi* (Strauch, 1887)**

Figure 44. Turkestan Thin-Toed Gecko. Photo by Abduraupov T.V

The body length including the head: newborns 24 mm, males up to 74 mm, females up to 75 mm. The head is pronounced, and the body is noticeably flattened from top to bottom. The upper side of the body is brownish with a grayish shade, featuring 4-5 dark irregular transverse stripes on the neck and body. The tail also has dark transverse stripes. The underside of the body is white without spots.

It emerges from hibernation in March, often in February. During this time, the Turkestan gecko can frequently be seen basking in the sun. In the hot period of the year, it switches to exclusively nocturnal activity. However, in the morning and evening hours, it comes out of its hiding place and takes sunbaths. During the day, it hides in shelters or in the shade on vertical surfaces. It hibernates in the same crevices where it hides during the daytime, burrowing to a depth of 20-30 cm. During hibernation, it forms clusters of 10-30 individuals in one place.

A bionomic species. In the wild, the Turkestan gecko is found on rocks in mountain gorges, on loess cliffs, and on cliffs of dried-up mountain rivers. It often settles in urban habitats - on the walls of houses, where it gathers insects near streetlights at night. Various crevices and cracks in rocks, loess cliffs, and gaps between bricks in buildings serve as shelter for this species.

M.V. Kaluzhina (1951) found it in the Zeravshan Range, near Ibragim-Ata, Kuchkurli, Zirabulak Heights, near the villages of Sypli, Guz, and Tym, at the Kermin station, and in the Katta-Kurgan Reservoir area. S.K. Dahl (1937) discovered the gecko between Kyrgyz-Bulak and Mount Karauz, near Lake Malikkul and in the vicinity of Sengir-Bulak.

We observed this species in karst niches of the Zirabulak Mountains, north of the village of Tim in 2011.

The status of the species in the territory of the Republic of Uzbekistan does not raise concerns.

FAMILY AGAMIDAE

STEPPE AGAMA

***Trapelus sanguinolentus aralensis* (Lichtenstein, 1823)**

Figure 45. Steppe agama. Photo by Abduraupov T.V

Steppe Agama, of medium size. The overall length of the Steppe Agama does not exceed 300 mm, with a body length including the head up to 120 mm, and the tail is 1.3 to 2 times longer than the body.

It inhabits sandy, clayey, and rocky deserts and semi-deserts, preferring areas with shrubby or semi-woody vegetation. It is also found on gentle rocky slopes in foothills, along the edges of loosely fixed sands, on riverbanks and in thickets, on the outskirts of settlements, and on roadsides. As shelters, it uses burrows of sand rats, ground squirrels, small lizards, hedgehogs, and tortoises, as well as voids under rocks and cracks in the soil. During hot periods, agamas often climb onto the branches of shrubs, thus protecting themselves from overheating on the scorching ground. While perched on an elevation, males survey their territory, defending it against intruding rivals. After hibernation, they emerge in mid-February, March, or early April depending on the weather conditions of that period, with males emerging from winter shelters before females.

In Uzbekistan, it is widely distributed in arid zones. In the Samarkand region, it was noted by S.K. Dahl (1937) and M.V. Kaluzhina (1951) in the Zirabulak Heights. M.V. Kaluzhina (1951) also captured this species near Kattakurgan, in the desert between KyzyI-Tepe and Malik, and in the vicinity of Kuljakyul, Bitkana, Dengi-Ali. A.P. Fedchenko (1870) observed steppe agamas between the settlements of Karasu and Kattakurgan.

The status of the species in the territory of the Republic of Uzbekistan does not raise concerns.

Sunwatcher toadhead agama

***Phrynocephalus helioscopus sergeevi* Solovyeva, Dunayev & Poyarkov, 2012**

Figure 46: Sunwatcher toadhead agama. Photo by Abduraupov T.V.

The body length including the head of newborns is 18–25 mm, males can reach up to 57 mm, and females up to 62 mm. The upper surface of the snout sharply transitions to the front part, sloping steeply towards the lips. Nostrils are not visible when viewed from above. The tail, flattened and wide at the base, narrows sharply and becomes round in cross-section. The body coloration and pattern vary greatly: from ash-gray to dark gray or brown-gray on top, with transversely arranged dark brown, brown, or black spots. These spots can be poorly developed or sometimes absent. On the upper surface of the neck, there are 2 small, more or less oval red or pink spots with blue or light blue borders. The upper tail and limbs often have transverse spots and stripes.

The first individuals of the sandy toadhead agama appear in early March after hibernation. The last ones were observed in November before going into hibernation. They are active throughout the warm season, during daylight hours.

Occasionally, they ascend to foothills up to 778 meters above sea level. They prefer solid ground with sparse vegetation.

An economically significant species.

S.K. Dahl (1937) noted the toadhead agama in the vicinity of Sengir-Bulak (eastern end of the Zirabulak Heights). A.P. Fedchenko (1870) encountered this lizard between Karasu and Kattakurgan. According to A.M. Nikolsky (1915), it was found in Ziatdin by G.V. Loudon.

We have repeatedly observed this species in previous field trips on the studied territory.

FAMILY ANGUIDAE

European glass lizard

***Pseudopus apodus* (Pallas, 1775)**

Figure 47. European glass lizard. Photo by Abduraupov T.V

A large legless lizard with a snake-like body, reaching lengths of 45-50 cm with a tail approximately one and a half times longer. The coloration of adults is olive-brown, dirty-yellow, or reddish-brown, sometimes with scattered irregular dark spots. Juveniles have a distinct coloration from adults. Their bodies are yellowish-gray with 16-22 transverse rows of brownish-brown zigzag-like stripes that continue along the tail as elongated spots. Similar stripes are present on the underside and on the sides of the head, forming a unique pattern on the upper part. As the animal grows, the juvenile body color gradually fades, with traces of the transverse stripes sometimes remaining in individuals up to 200 mm in length, which is the age of up to three years.

It inhabits foothill plains and river valleys, populating sparse deciduous forests and tugai forests, forest clearings, shrubs, gullies, various types of thickets, and treeless foothill elevations. It is also found in mountainous semi-deserts and steppes, often in close proximity to water, where it can retreat when pursued, as it is a good swimmer. In some places, it is common in cultivated areas such as gardens, vineyards, and crops. In the mountains, it is known to exist up to an altitude of 2300 meters above sea level. It uses burrows, spaces under rocks, and spaces among shrub roots as shelters.

After wintering, it appears in March to mid-April. With the onset of summer heat, it is rarely seen on the surface, entering a summer dormant state, which in some places transitions to a winter dormant state. In July, its activity sharply decreases, and only individual specimens are observed at sunset and twilight, mostly in the mountains or river valleys.

It lays 6-10 eggs with an average size of 20 x 38 mm in mid-June to early July. Young individuals, about 100-125 mm in length (excluding the tail), appear from late July to September. Sexual maturity is reached at about four years of age with a body length of 310-320 mm.

An economically significant species. A. P. Fedchenko (1870) wrote that the yellow-bellied legless lizard is quite common in the Zeravshan Valley. M. V. Kaluzhina (1951) caught it on Miankal Island, in Ravatkhoja, Ziatdine, and Kattakurgan.

FAMILY: SKINKS (SCINCIDAE)

Schneider's skink

***Eumeces schneideri princeps* Eichwald, 1839**

Figure 48: Schneider's skink . Photo by Abduraupov T.V.

A large lizard, reaching a length of 165 mm, with a tail that is approximately twice as long and thickened at the base.

The upper part of the body is brown, brown-gray, brown-olive, or olive-gray in colour, with yellow-orange, orange, pinkish, pink-red, or brick-red spots scattered in more or less regular longitudinal or transverse rows; the number of these spots varies greatly, and sometimes they are absent; small dark brownish spots may also be present on the dorsal scales. From the fifth to the seventh upper labial scale, through the ear opening, and further along the sides of the body, there is an orange, pink-red, or red narrow stripe, usually extending onto the sides of the tail, where it becomes lighter. The underside of the body is yellowish or yellow-orange. In young individuals, the colour stripes on the sides of the body are not well developed. In this subspecies, the coloured spots on the back do not form regular longitudinal or transverse rows.

It is closely associated with foothills and foothill plains, inhabiting both loamy and clayey soils, as well as rocky slopes with sparse semi-shrub and herbaceous vegetation. It is also found in thickets and ventures onto adjacent semi-fixed sands. It lives in gardens, vineyards, on the edges of cotton fields, embankments of ditches, and ruins. In the mountains, it is known up to elevations of 1200-1500 m. It uses gaps between rocks, soil fissures, burrows of burrowing animals, as well as its own burrows up to 2 m long and up to 60 cm deep as shelters. It can climb onto the lower branches of shrubs and low trees.

This lizard emerges from winter shelters in the foothills of the central part in late May. According to M. V. Kalugin (1951), it goes into hibernation at the end of September or beginning of October.

In spring and early summer, it is primarily active during the day, while in the hot summer months, it only emerges from shelters in the morning and evening and may enter a so-called "summer torpor," which sometimes transitions into winter torpor.

Economically significant species. However, in recent times, its population has sharply declined. This might be related to the use of insecticides targeting locusts. Practically in all habitats where it used to be a common species, it has become rare nowadays.

M. V. Kalugin (1951) observed this species in the area of the Ak-Tyube Ridge, on the southern slopes of the Zirabulak Heights, and in the vicinity of the Kattakurgan Reservoir.

FAMILY TRUE LIZARDS LACERTIDAE

Rapid racerunner

***Eremias velox velox* (Pallas, 1771)**

Figure 49. Rapid racerunner. Photo by Abduraupov T.V.

Length of body with head up to 84 mm, males up to 84 mm, females up to 81 mm. In young individuals, three straight black-brown or black stripes run along the back, with the middle stripe bifurcated at the neck. On the sides of the body, there is one stripe of the same color, with round light spots located on them. In adults (with the main color of the upper surface being gray or sandy, often with an olive or brown tint), these stripes break up into separate spots. On the sides of the body, there are light, black-bordered, rounded spots, which become blue in the front part of the body, especially in males. It should be noted that the pattern of this lizard is highly variable. The belly and throat are white. In young individuals, the underside of the tail and sometimes the small scales of the thighs and shins are red or reddish-orange.

Economically significant species. One of the most widespread and numerous lizard species in the Palearctic region. Widely distributed in Uzbekistan.

After winter hibernation, they appear in the second half of March. Mass emergence is observed in early April. They enter hibernation at the end of October to early November. During summer, these lizards are primarily active in the morning and evening hours.

In Uzbekistan, the swift runner lizard is a typical inhabitant of river valleys, where it is most numerous. However, this lizard is also found in various other habitats, and its distribution depends on the presence of other lizard species.

According to the observations of M. V. Kalugin (1951), this species of lizard is the most common in the Zeravshan valley, from Karakul to Pendjikent (near Bitkana, between Kyrgyz-Bulak and Dengi-Ali, in the area of Sengir-Bulak, in Dzhuma-Bazar, and Kattakurgan). S. K. Dal (1936, 1937) also reports the presence of the swift runner lizard in the same valley, having encountered it near Lake Karangi, in the vicinity of Arap-Khana, around Sengir-Bulak, at the lakes Kuljaku and Khodjcab, in the vicinity of Vaganz, in the Bitkona area, in the Malikkulya area, in the Zeravshan heights between the villages of Sypki and Tym.

This species has been observed multiple times in the studied territory.

Uzbek desert racer

***Eremias arguta uzbekistanica* Tschernow, 1934**

Figure 50. Uzbek desert racer. Photo by Abduraupov T.V.

The length of the body with the head is up to 95 mm, for males up to 95 mm, and for females up to 94 mm. The upper part of the body is gray in color with olive, brown, brownish, or greenish shades, along with irregular blackish or black transverse spots or stripes. The legs have light-colored circles surrounded by dark spots on top. The underside is white. The pattern of even very young lizards generally does not differ from that of adults.

It is found in the foothills and deserts of the Zeravshan Valley. It prefers soft loamy chestnut soils covered with dense vegetation and partially wormwood desert with soft soils, situated at the foot of mountains. Occasionally, it can be found on stabilized sands. Burrows of various rodents, soil cracks, and its own burrows, which the lizard often digs in soil piles, serve as shelters.

After winter hibernation, it appears in late February to early March. In the spring, the lizards are active during midday hours, during summer only in the morning and evening, and in the fall, activity is more pronounced in the second half of the day. It hibernates in October.

An economically important species, this lizard is one of the most widespread and numerous lizard species in the Palearctic region.

M.V. Kalugin (1951) observed the rainbow lizard near Kattakurgan, near Ibragim-Ata, and by Lake Khodja-Kab. S.K. Dal (1937) found it in the Zeravshan Heights between the villages of Sypki and Tym, between Kyr-Bulak (western part of Zeravshan Heights), and Mount Karaus, as well as in the area of Sengir-Bulak (southern end of the Zeravshan Heights).

FAMILY VARANIDAE

Desert monitor

***Varanus griseus caspius* (Eichwald, 1831)**

Figure 51. The desert monitor. Photo by Abduraupov T.V.

The declining population species has been listed in the Red Book of the Republic of Uzbekistan (2019) with a status of 2 (VU:D).

This species is the largest lizard in Uzbekistan and neighboring countries, with a body length of up to 520 mm. The upper side of the body is grayish-brown, yellowish-brown, or reddish-brown in color, adorned with numerous dark spots and small markings. There are two to three longitudinal brown stripes on the upper side of the neck, and several similar colored transverse stripes are present on the back and tail. In young individuals, these stripes are very pronounced and are either black or almost black in color.

Following their winter hibernation, the first individuals appear relatively late, in early to mid-April. Throughout April, they remain active throughout the day. In May, they become active mainly during the morning and evening hours. They enter their winter hibernation period in September or October. Often, the gray monitor lizard undergoes a period of aestivation (summer dormancy) that transitions smoothly into hibernation (winter dormancy). During this process, they enter summer dormancy by the end of June or beginning of July.

These lizards primarily inhabit fixed and semi-fixed sandy, clayey, and stony-gravelly soils, as well as saline soils. They are occasionally found in foothills, with elevations of up to 1000 meters above sea level.

In the region of the Zeravshan Mountains, they are encountered near the village of Tim (Abduraupov, 2013; Abduraupov et al., 2021), and also in the vicinity of the village of Ibroghim-Ata (Kaluzhina, 1951).

Family: Boidae

Eastern sand boa

***Eryx tataricus tataricus* (Lichtenstein, 1823)**

Figure 52. Eastern sand boa. Photo by Abduraupov T.V.

The Eastern Sand Boa (Eryx tataricus tataricus) is a medium-sized snake species. Females can reach lengths of up to 1050 mm with a tail length of 60-70 mm, while the length of smaller males can be around 950 mm with a tail length of 70-80 mm. Female individuals are usually slightly longer than males by 5-10 cm. The tail is blunt and rounded.

This subspecies of Eastern Sand Boa is closely related to vulnerable species. It's listed in the Red Book of the Republic of Uzbekistan (2019) with a status of 3 (NT), indicating it's near threatened. It's also included in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

These snakes inhabit clayey and loamy deserts, semi-deserts, foothills, hill slopes with ephemeral vegetation, stony-gravel foothills with shrub thickets, open wormwood-saline steppe areas. They can also be found on sandy soils, in depressions between rows of sand dunes, on loosely consolidated mounds, and occasionally on scattered sands. They are sometimes found in cultivated lands such as gardens and fields. In mountainous areas, they can be found up to altitudes of 1500-1600 meters above sea level.

Eastern Sand Boas are active from March to early April until October to early November. During hot months, they adopt a nocturnal and crepuscular lifestyle, hiding during the day in burrows of rodents, turtles, and other burrowing animals, as well as in the spaces at the base of shrub saplings and under roots. They are capable of burrowing into dry sand and moving significant distances within it. Mating occurs in late March to April. In July to August, females give birth to 10-21 offspring, which can reach up to 20 cm in length. They feed on lizards, rodents, small passerine birds, and insects.

The population of Eastern Sand Boas is believed to be low in the studied region. Currently, their population is decreasing due to intensified poaching for traditional medicine use, excessive export for trade, and land development activities.

In the vicinity of the studied area, Eastern Sand Boas have been observed near the village of Yangiaryk (Nikolsky, 1899), in the valley between the western end of the Zirabulak Mountains and Mount Karaus (Dahl, 1937), at the Churkindi well (Fedchenko, 1870, 1950), near the village of Kattakurgan (Nikolsky, 1905; 1916), near the village of Khairov (Nikolsky, 1908), and around the Kattakurgan reservoir (Didusenko, 1956).

FAMILY COLUBRIDAE

Spotted whip snake

***Hemorrhois ravergieri* (Menetries, 1832)**

Figure 53. Spotted whip snake . Photo by Abduraupov T.V.

The length of the body with the head reaches up to 1180 mm; ventral shields in males are 202–213, in females 207–224; subcaudal scales in males are 90–103, in females 86–99. The head is clearly differentiated from the neck, with a bluntly rounded snout. The upper part of the body is gray in color, with a brown or yellowish hue. Along the back, there is a series of dark (almost black) transverse stripes or spots, with smaller spots in between on the sides of the body. Diagonal dark stripes are present on the sides of the head from the eyes to the corners of the mouth, and additional stripes are found beneath the eyes. The belly is light-colored, often with scattered small spots. In Central Asia, alongside the typically colored individuals, there are black-headed specimens (both males and females) and almost black individuals. There are also individuals with nearly monochromatic bodies, lacking spots or stripes. They are among the most variable in coloration among the snakes of Central Asia.

After winter hibernation, they emerge in the second decade of March. During this time, they are observed on the surface only around midday. In April and May, the multicolored ratsnake becomes active during the morning and evening hours. In September, they are active again around midday. They enter hibernation in October.

Typical habitats for this species include foothills with ravines or rodent colonies, as well as cliffs bordering river valleys and human settlements in the foothills and mountains. They are occasionally found in the submontane clay deserts.

An economically significant species, it is one of the most numerous and widely distributed snake species in Uzbekistan. In the vicinity of the studied area, it was noted by P. V. Khorev and Ya. M. Finkelstein (Nikolsky, 1908) near the Nagornaya railway station (near Kattakurgan).

Steppe ribbon racer

***Psammophis lineolatus* (Brandt, 1838)**

Figure 54. Steppe ribbon racer. Photo by Abduraupov T.V.

The length of the body with the head reaches up to 840 mm, males up to 840 mm, females 710 mm. The number of ventral scales ranges from 181 to 204, and subcaudal scales from 83 to 105 pairs. The body is slender. The upper surface of the snout is concave, with a longitudinal groove. The body is olive-gray or sandy-gray in color, with the edges of the scales lighter than their centers. There are four dark stripes starting on the head and running along the body, although in some individuals, only traces of these stripes may remain in the form of dark or black streaks along the scales. Sometimes, the pattern on the body is absent. The belly is white with grayish, brownish, or olive-gray spots, which are larger in the front part of the body.

Single individuals may appear as early as February after winter hibernation. Mass emergence is observed at the end of March to early April. During this time, the snake is active throughout the day. In May, they switch to activity in the morning and evening hours. They enter winter hibernation in October-November.

The stripe-bellied sand snake inhabits plains and extends into foothills up to an altitude of 1100-1200 meters above sea level. However, it prefers more stabilized and mobile sands, gravel plains, mountains, and broken gray soils near settlements. The stripe-bellied sand snake is often found in places where dense vegetation areas alternate with open patches. Therefore, in areas with dense vegetation cover, it can always be found on small cliffs, mounds, and the like.

A.P. Fedchenko (1870, 1950) encountered the stripe-bellied sand snake near the Churkanchi well to the south of Kattakurgan. S.K. Dale (1937) found it in the desert from Kyrgyz-Bulak (western part of the Zirabulak Heights) to Mount Karaus and in the area of Malikquli.

FAMILY ELAPIDAE

CENTRAL ASIAN COBRA

***Naja oxiana* (Eichwald, 1831)**

Figure 55. Central Asian cobra. Photo by Abduraupov T.V.

A closely related, mosaic-distributed species. The species is listed as Data Deficient (DD) by the IUCN and is included in the Red Book of the Republic of Uzbekistan (2019) with a status of Near Threatened (NT).

It is a large snake, with a body length including tail usually reaching 1600-1800 mm. The pupil is round.

The coloration of the body varies greatly, ranging from flesh-colored and yellowish to olive, dark brown, brown, or black. There is no pattern resembling spectacles on the widening part of the body. Young Naja oxiana have dark (black) transverse stripes along the body, the anterior of which also extends onto the lower surface. In adults, the belly is usually light and without spots.

It inhabits foothills, clayey and gravelly lowlands, rock formations, and mountains up to 2000 m above sea level, river floodplains, and oases, occasionally in deserts and semi-deserts. It is often found among shrubs and is frequently encountered in abandoned structures. It lives in tugai forest belts, as well as in reed beds, Arundo and camelthorn thickets. The snake uses non-inhabited rodent burrows, cracks and fissures in clay cliffs, and small crevices in the soil as shelters. It settles in embankments along irrigation canals, gardens, orchards, and fallow lands. It is encountered in fallow fields and is common among sown crops of millet.

During the hot season, it only emerges to the surface in the morning and evening hours. Cobras appear on the surface after overwintering in late March to April, and their period of activity continues until the end of October.

When disturbed, the cobra raises the front part of its body, expands its hood, and hisses. It is highly venomous, but cases of human bites are extremely rare. The venom is neurotoxic and is used in the production of medicinal preparations.

In the Samarkand region, the Central Asian cobra is mainly found in the foothills and lowlands of the Zarafshan Range, specifically on the Katratepin Mountain Range. It is less frequently found in the submontane plain and foothills of the Zirabulak Mountains (Abduraupov, Fundukchiev, 2013). It has also been discovered in the Zirabulak Mountains near the village of Tim (Abduraupov, Fundukchiev, 2013; Abduraupov et al., 2021).

7. Impact of Solar projects on Reptiles and Amphibia

According to literature sources, Nurabad substation, Nurabad BESS, Solar 100 MW PV plant, Solar 400 MW PV plant and pooling station, Nurabad SS and Pooling station have a sufficient number of Central Asian Tortoise and the project area is located in the range of Central Asian Cobra whose numbers are steadily decreasing.

Due to the intensive development of the renewable energy industry worldwide, the number of scientific studies has increased on a comprehensive assessment of the impact of the use of alternative energy on various biocenoses (Thaker et al. 2018; Shuster et al. 2015; Thaxter et al. 2015 etc.). And in most cases, thanks to these studies, it is possible to identify the deep processes of the negative impact of the development of "green" energy on the environment and biodiversity. Accordingly, this understanding helps to develop effective ways to reduce the negative pressure on nature and preserve rare and endangered species of plants and animals.

1. Development of natural habitats for many reptile species (including rare ones) threatens to kill part of the population
2. Animals (insects, amphibians, reptiles, birds, mammals) may get into the excavations and trenches created during construction, which may lead to their damage and death. These trenches are particularly dangerous for Central Asian Tortoise and Glass lizard;
3. Earthworks, disturbance of the existing topography will result in partial loss of habitat for animals inhabiting the project area;
4. If construction activities begin during the winter season, some reptile populations (including rare reptiles) may die;
5. Linear structures to the construction site will also pose a threat to most reptiles, especially Central Asian Tortoise and Caspian Monitor.

The construction phase is mainly related to the withdrawal of land resources for permanent and temporary communications, and will include a set of activities with negative impact on the environment, such as laying an additional road or increasing the level of use of existing unpaved roads, use of roadside vehicles and construction machinery, construction of temporary bases and settlements, soil extraction, etc.

Many reptiles do not dig deep burrows. Their burrows are located in the upper layers of soil, which is primarily affected by any construction works on the territory. Excavation of the upper layers of soil destroys burrows, crushes clutches of eggs in soil cracks and kills the animals themselves, which are located in the burrows.

Any highway poses a threat to the fauna of the project area and serves as an additional element fragmenting the existing desert ecosystem. The main types of impacts include: death of reptiles during the day and especially at night; fauna is negatively affected by transportation emissions. The frequency of animal deaths depends on the degree of demand, use of the road, as well as its quality. It should be noted that mortality is much lower on unpaved roads than on asphalt roads - this is due to the fact that asphalt heats up quickly in the morning hours and cools down slower in the night hours, and since reptiles receive heat from the substrate, asphalt attracts them very strongly in the morning and after sunset.

The noise generated by construction works and the constant presence of people on the territory frightens animals, they will be afraid to approach watering sources, negative anxiety affects the

natural cycles such as feeding, breeding, hibernation, etc., which in the best case will entail a change of habitats, in the worst case will lead to death.

8. Conclusion

In general, the majority of the territory consists of agricultural land, fallow land, or pasture areas. There are no unique reptile habitats within these territories, and no endemic reptile species have been discovered. However, in April 2024, Central Asian tortoises were found in the western part of the project area associated with the Karnabchul steppe.

Based on processed information sources and personal data, the Solar sites currently harbor 2 species of amphibians and 19 species of reptiles. This comprises 40% of the total amphibian diversity in Uzbekistan and 30.6% of the reptile biodiversity in the country. Among the reptiles, 4 species are listed in the Red Book of the Republic of Uzbekistan (2019), accounting for 21.1% of the total species in the project area. Additionally, 2 species are included in the Red List of the International Union for Conservation of Nature (IUCN Red List).

Literature sources have not identified any narrow-range endemic reptile species in the area. However, it is worth noting that the territory hosts a relatively isolated population of the Central Asian Cobra. Other reptile species are widely distributed throughout the republic.

The population of the Central Asian Steppe tortoise (IUCN VU) was assessed to be 533 individuals for Solar 400 MW and 696 individuals for Solar 500 MW in April 2024. Also 2 tortoises were found on Solar 100 MW, and one tortoise – Nurabad BESS and SS. Considering the conservation status of this species, relocation measures may be recommended for these territories.

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23. Annex A. Amphibian and Reptile Check lists

Site 1: Khalka substation and 360 km 550 kV OHTL (Samarkand 2 project) - Amphibian and Reptile Check List

Table 24: List of reptile species potentially inhabiting Khalka substation and 360 km 550 kV OHTL

№	Species	Species presence acc. to literary sources	Species noted during surveys	Abundance	Endemism	Conservation status		
						UzRDB	IUCN	CITES
1	*Turan toad* *Bufotes turanensis*	+		Common	UZ, TJ, TM			
2	Eurasian marsh frog *Pelophylax ridibundus*	+	+	Common				
3	Central Asian Tortoise *Testudo horsfieldii*	+		Common		2 (VU)	VU	II
4	Turkestan thin-toed gecko *Tenuidactylus fedtschenkoi*	+		Common	UZ, TJ, TM, KZ			
5	Steppe Agama *Trapelus sanguinolentus*	+		Common				
6	Sunwatcher toad-headed agama *Phrynocephalus helioscopus*	+		Not numerous				
7	Glass lizard *Pseudopus apodus*	+		Not numerous				
8	Desert Lidless Skink *Ablepharus deserti*	+	+	Common				
9	Rapid Racerunner *Eremias velox*	+	+	Common				
10	Steppe racerunner *Eremias arguta*	+		Not numerous				
11	Tatary sand boa *Eryx tataricus*	+		Rare		3 (NT)		II
12	Sand racer *Psammophis lineolatus*	+		Common				
13	Spotted whip snake *Hemorrhois ravergieri*	+		Common				
14	Dice snake *Natrix tessellata*	+	+	Common				

Notes: UzRDB– species/subspecies listed in the Red Data Book of Uzbekistan (2019) (VU – vulnerable; NT – near-threatened); IUCN – species included in the Red List of the International Union for Conservation of Nature (VU - vulnerable); CITES I, II – species listed in the appendices (I, II) to the Convention on International Trade in Endangered Species of Wild Fauna and Flora; Endemism: AF – Afghanistan; CN – China; KZ – Kazakhstan; IR – Iran; TM – Turkmenistan; KG – Kyrgyzstan; TJ – Tajikistan; UZ – Uzbekistan.

Site 2: Nurabad substation (Samarkand 2 project) - - Amphibian and Reptile Check List

Table 25: List of amphibian and reptile species potentially inhabiting Nurabad substation (Samarkand 2 project)

№	Species	Species presence acc. to literary sources	Species noted during surveys	Abundance	Endemism	Conservation status		
						UzRDB	IUCN	CITES
1	*Turan toad* *Bufotes turanensis*	+		Common	UZ, TJ, TM			
2	Central Asian Tortoise *Testudo horsfieldii*	+		Common		2 (VU)	VU	II
3	Turkestan thin-toed gecko *Tenuidactylus fedtschenkoi*	+		Common	UZ, TJ, TM, KZ			
4	Steppe Agama *Trapelus sanguinolentus*	+	+	Common				
5	Asian snake-eyed Skink *Ablepharus pannonicus*	+	+	Common				
6	Schneider's skink *Eumeces schneideri*	+		Not numerous				
7	Glass lizard *Pseudopus apodus*	+		Not numerous				
8	Rapid Racerunner *Eremias velox*	+	+	Common				
9	Steppe racerunner *Eremias arguta*	+		Not numerous				
10	Tatary sand boa *Eryx tataricus*	+		Rare		3 (NT)		II
11	Sand racer *Psammophis lineolatus*	+		Common				
12	Spotted whip snake *Hemorrhois ravergieri*	+		Common				
13	Central Asian cobra *Naja oxiana*	+		Rare	UZ, TM, TJ, IR, AF, PK	3 (NT)	DD	II

Notes: UzRDB– species/subspecies listed in the Red Data Book of Uzbekistan (2019) (VU – vulnerable; NT – near-threatened); IUCN – species included in the Red List of the International Union for Conservation of Nature (VU - vulnerable); CITES I, II – species listed in the appendices (I, II) to the Convention on International Trade in Endangered Species of Wild Fauna and Flora; Endemism: AF – Afghanistan; CN – China; KZ – Kazakhstan; IR – Iran; TM – Turkmenistan; KG – Kyrgyzstan; TJ – Tajikistan; UZ – Uzbekistan.

Site 3: Nurabad BESS (Samarkand 1 project) - Amphibian and Reptile Check List

Table 26: List of amphibian and reptile species potentially inhabiting the Nurabad BESS (Samarkand 1 project)

№	Species	Species presence acc. to literary sources	Species noted during surveys	Abundance	Endemism	Conservation status		
						UzRDB	IUCN	CITES
1	*Turan toad* *Bufotes turanensis*	+		Common	UZ, TJ, TM			
2	Central Asian Tortoise *Testudo horsfieldii*	+		Common		2 (VU)	VU	II
3	Turkestan thin-toed gecko *Tenuidactylus fedtschenkoi*	+		Common	UZ, TJ, TM, KZ			
4	Steppe Agama *Trapelus sanguinolentus*	+	+	Common				
5	Asian snake-eyed Skink *Ablepharus pannonicus*	+	+	Common				
6	Schneider's skink *Eumeces schneideri*	+		Not numerous				
7	Glass lizard *Pseudopus apodus*	+		Not numerous				
8	Rapid Racerunner *Eremias velox*	+	+	Common				
9	Steppe racerunner *Eremias arguta*	+		Not numerous				
10	Tatary sand boa *Eryx tataricus*	+		Rare		3 (NT)		II
11	Sand racer *Psammophis lineolatus*	+		Common				
12	Spotted whip snake *Hemorrhois ravergieri*	+		Common				
13	Central Asian cobra *Naja oxiana*	+		Rare	UZ, TM, TJ, IR, AF, PK	3 (NT)	DD	II

Notes: UzRDB– species/subspecies listed in the Red Data Book of Uzbekistan (2019) (VU – vulnerable; NT – near-threatened); IUCN – species included in the Red List of the International Union for Conservation of Nature (VU - vulnerable); CITES I, II – species listed in the appendices (I, II) to the Convention on International Trade in Endangered Species of Wild Fauna and Flora; Endemism: AF – Afghanistan; CN – China; KZ – Kazakhstan; IR – Iran; TM – Turkmenistan; KG – Kyrgyzstan; TJ – Tajikistan; UZ – Uzbekistan.

Site 4: Solar 100 MW PV plant (Samarkand 1 project) - - Amphibian and Reptile Check List

Table 27: List of amphibian and reptile species potentially inhabiting the Solar 100 MW PV plant (Samarkand 1 project)

№	Species	Species presence acc. to literary sources	Species noted during surveys	Abundance	Endemism	Conservation status		
						UzRDB	IUCN	CITES
1	*Turan toad* *Bufotes turanensis*	+		Common	UZ, TJ, TM			
2	Central Asian Tortoise *Testudo horsfieldii*	+		Common		2 (VU)	VU	II
3	Turkestan thin-toed gecko *Tenuidactylus fedtschenkoi*	+		Common	UZ, TJ, TM, KZ			
4	Steppe Agama *Trapelus sanguinolentus*	+	+	Common				
5	Asian snake-eyed Skink *Ablepharus pannonicus*	+	+	Common				
6	Schneider's skink *Eumeces schneideri*	+		Not numerous				
7	Glass lizard *Pseudopus apodus*	+		Not numerous				
8	Rapid Racerunner *Eremias velox*	+	+	Common				
9	Steppe racerunner *Eremias arguta*	+		Not numerous				
10	Tatary sand boa *Eryx tataricus*	+		Rare		3 (NT)		II
11	Sand racer *Psammophis lineolatus*	+		Common				
12	Spotted whip snake *Hemorrhois ravergieri*	+		Common				
13	Central Asian cobra *Naja oxiana*	+		Rare	UZ, TM, TJ, IR, AF, PK	3 (NT)	DD	II

Notes: UzRDB– species/subspecies listed in the Red Data Book of Uzbekistan (2019) (VU – vulnerable; NT – near-threatened); IUCN – species included in the Red List of the International Union for Conservation of Nature (VU - vulnerable); CITES I, II – species listed in the appendices (I, II) to the Convention on International Trade in Endangered Species of Wild Fauna and Flora; Endemism: AF – Afghanistan; CN – China; KZ – Kazakhstan; IR – Iran; TM – Turkmenistan; KG – Kyrgyzstan; TJ – Tajikistan; UZ – Uzbekistan.

Site 5: Solar 400 MW PV plant and pooling station (Samarkand 1 project) - - Amphibian and Reptile Check List

Table 28: List of amphibian and reptile species potentially inhabiting the Solar 400 MW PV plant and pooling station (Samarkand 1 project)

№	Species	Species presence acc. to literary sources	Species noted during surveys	Abundance	Endemism	Conservation status		
						UzRDB	IUCN	CITES
1	*Turan toad* *Bufotes turanensis*	+		Common	UZ, TJ, TM			
2	Central Asian Tortoise *Testudo horsfieldii*	+		Common		2 (VU)	VU	II
3	Turkestan thin-toed gecko *Tenuidactylus fedtschenkoi*	+	+	Common	UZ, TJ, TM, KZ			
4	Steppe Agama *Trapelus sanguinolentus*	+	+	Common				
5	Sunwatcher toad-headed agama *Phrynocephalus helioscopus*	+	+	Not numerous				
6	Rapid Racerunner *Eremias velox*	+	+	Common				
7	Steppe racerunner *Eremias arguta*	+		Not numerous				
8	Caspian Monitor *Varanus griseus caspius*	+		Rare		2 (VU:D)		I
9	Tatary sand boa *Eryx tataricus*	+		Rare		3 (NT)		II
10	Sand racer *Psammophis lineolatus*	+		Common				
11	Spotted whip snake *Hemorrhois ravergieri*	+		Not numerous				
12	Spotted desert racer *Platyceps karelinii*	+		Not numerous				

Notes: UzRDB– species/subspecies listed in the Red Data Book of Uzbekistan (2019) (VU – vulnerable; NT – near-threatened); IUCN – species included in the Red List of the International Union for Conservation of Nature (VU - vulnerable); CITES I, II – species listed in the appendices (I, II) to the Convention on International Trade in Endangered Species of Wild Fauna and Flora; Endemism: AF – Afghanistan; CN – China; KZ – Kazakhstan; IR – Iran; TM – Turkmenistan; KG – Kyrgyzstan; TJ – Tajikistan; UZ – Uzbekistan.

Site 6: Solar 500 MW PV plant (Samarkand 2 project) - - Amphibian and Reptile Check List

Table 29: List of amphibian and reptile species potentially inhabiting the Solar 500 MW PV plant (Samarkand 2 project)

№	Species	Species presence acc. to literary sources	Species noted during surveys	Abundance	Endemism	Conservation status		
						UzRDB	IUCN	CITES
1	*Turan toad* *Bufotes turanensis*	+		Common	UZ, TJ, TM			
2	Central Asian Tortoise *Testudo horsfieldii*	+		Common		2 (VU)	VU	II
3	Turkestan thin-toed gecko *Tenuidactylus fedtschenkoi*	+	+	Common	UZ, TJ, TM, KZ			
4	Steppe Agama *Trapelus sanguinolentus*	+	+	Common				
5	Sunwatcher toad-headed agama *Phrynocephalus helioscopus*	+	+	Not numerous				
6	Rapid Racerunner *Eremias velox*	+	+	Common				
7	Steppe racerunner *Eremias arguta*	+		Not numerous				
8	Caspian Monitor *Varanus griseus caspius*	+		Rare		2 (VU:D)		I
9	Tatary sand boa *Eryx tataricus*	+		Rare		3 (NT)		II
10	Sand racer *Psammophis lineolatus*	+		Common				
11	Spotted whip snake *Hemorrhois ravergieri*	+		Not numerous				
12	Spotted desert racer *Platyceps karelinii*	+		Not numerous				

Notes: UzRDB– species/subspecies listed in the Red Data Book of Uzbekistan (2019) (VU – vulnerable; NT – near-threatened); IUCN – species included in the Red List of the International Union for Conservation of Nature (VU - vulnerable); CITES I, II – species listed in the appendices (I, II) to the Convention on International Trade in Endangered Species of Wild Fauna and Flora; Endemism: AF – Afghanistan; CN – China; KZ – Kazakhstan; IR – Iran; TM – Turkmenistan; KG – Kyrgyzstan; TJ – Tajikistan; UZ – Uzbekistan.

Site 7: Karakul BESS (Samarkand 2 project) - Amphibian and Reptile Check List

Table 30: List of reptile species potentially inhabiting the Karakul BESS (Samarkand 2 project)

№	Species	Species presence acc. to literary sources	Species noted during surveys	Abundance	Endemism	Conservation status		
						UzRDB	IUCN	CITES
1	Caspian thin-toed gecko *Tenuidactylus caspius*	+		Common			LC	
2	Steppe Agama *Trapelus sanguinolentus*	+		Common			LC	
3	Rapid racerunner *Eremias velox*	+		Common			LC	
4	Sand racer *Psammophis lineolatus*	+		Common			LC	
5	Saw-scaled viper *Echis carinatus*	+		Not numerous			LC	

Notes: UzRDB– species/subspecies listed in the Red Data Book of Uzbekistan (2019) (VU – vulnerable; NT – near-threatened); IUCN – species included in the Red List of the International Union for Conservation of Nature (VU - vulnerable); CITES I, II – species listed in the appendices (I, II) to the Convention on International Trade in Endangered Species of Wild Fauna and Flora; Endemism: AF – Afghanistan; CN – China; KZ – Kazakhstan; IR – Iran; TM – Turkmenistan; KG – Kyrgyzstan; TJ – Tajikistan; UZ – Uzbekistan.

Site 8: Nurabad SS – Pooling station – 70km - Amphibian and Reptile Check List

Table 31: List of amphibian and reptile species potentially inhabiting Nurabad substation (Samarkand 2 project)

№	Species	Species presence acc. to literary sources	Species noted during surveys	Abundance	Endemism	Conservation status		
						UzRDB	IUCN	CITES
1	*Turan toad* *Bufotes turanensis*	+		Common	UZ, TJ, TM			
2	Central Asian Tortoise *Testudo horsfieldii*	+	+	Common		2 (VU)	VU	II
3	Turkestan thin-toed gecko *Tenuidactylus fedtschenkoi*	+		Common	UZ, TJ, TM, KZ			
4	Steppe Agama *Trapelus sanguinolentus*	+	+	Common				
5	Asian snake-eyed Skink *Ablepharus pannonicus*	+		Common				
6	Schneider's skink *Eumeces schneideri*	+		Not numerous				
7	Glass lizard *Pseudopus apodus*	+		Not numerous				
8	Rapid Racerunner *Eremias velox*	+	+	Common				
9	Steppe racerunner *Eremias arguta*	+		Not numerous				
10	Caspian Monitor *Varanus griseus caspius*	+		Rare		2 (VU:D)		I
11	Tatary sand boa *Eryx tataricus*	+		Rare		3 (NT)		II
12	Sand racer *Psammophis lineolatus*	+		Common				
13	Spotted whip snake *Hemorrhois ravergieri*	+		Common				
14	Spotted desert racer *Platyceps karelinii*	+		Not numerous				
15	Central Asian cobra *Naja oxiana*	+		Rare	UZ, TM, TJ, IR, AF, PK	3 (NT)	DD	II

Notes: UzRDB– species/subspecies listed in the Red Data Book of Uzbekistan (2019) (VU – vulnerable; NT – near-threatened); IUCN – species included in the Red List of the International Union for Conservation of Nature (VU - vulnerable); CITES I, II – species listed in the appendices (I, II) to the Convention on International Trade in Endangered Species of Wild Fauna and Flora; Endemism: AF – Afghanistan; CN – China; KZ – Kazakhstan; IR – Iran; TM – Turkmenistan; KG – Kyrgyzstan; TJ – Tajikistan; UZ – Uzbekistan.

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Bats Acoustic Survey

Environmental and Social Impact Assessment (ESIA) for the development of a solar power project in Samarkand Region, Uzbekistan

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1	21.06.2024	Bats Acoustic Survey	Denis Vasenkov	Lyudmila Slobodkina	Anna Ten

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Table of Content

1. Introduction

This report presents the results of an ultrasonic study of bats conducted as part of the biodiversity surveys for the UZB-ACWA-Samarkand Solar 1 and Solar2&OHTL ESIA Project.

The study specifically focused on the following facilities:

1. UZB-ACWA-Sam Solar I:

- Western site (500 MW)
- Eastern site (100 MW)

2. UZB-ACWA-Sam Solar II:

- Western site (400 MW)
- Eastern site: Nurabad substation and Nurabad BESS

The ultrasonic survey of bats was conducted over four nights from April 25 to May 15, 2024, across these sites. The primary objectives of the study were to assess the presence of bats in the study areas, determine their species composition using ultrasound calls, and evaluate their activity levels and spatial distribution.

2. Materials and methods

Study area and bat calls recording

Bat activity was monitored using mobile bat detectors Echo Meter Touch (Wildlife Acoustics, USA) along two transects, one at each site (Figures 1-2 and Figures 3-4). The transects were surveyed twice, once in April (25th and 27th) in May (13th and 15th).

Figure 1 . Registration points location on bat acoustic transect at the east site (100 MW)

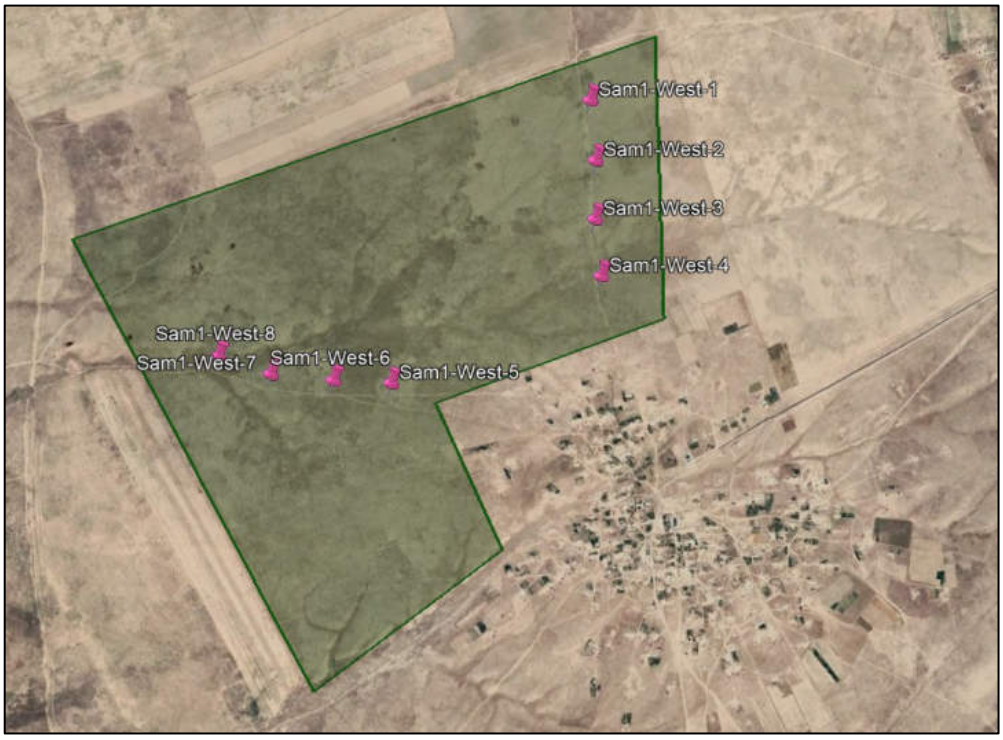

Figure 2. Registration points location on bat acoustic transect at the west site (500 MW)

Solar 2

Figure 3. Registration points location on bat acoustic transect in the east: left (yellow color) - Nurabad BESS site and right (green color) - Nurabad substation site

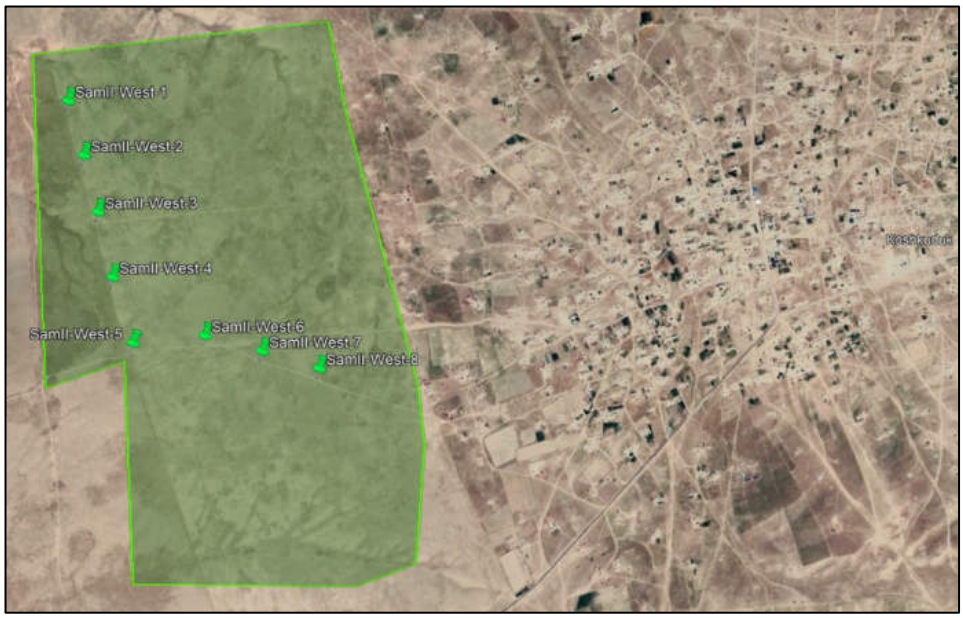

Figure 4. Registration points location on bat acoustic transect in the west (400 MW site)

The transect passed along the route at registration points with a step of about 400 m. A stop was made at each registration point, during which the bat ultrasonic calls were recorded for approximately 10 minutes. After this, the recording stopped and started again at the next point. Continue in this manner until the survey transect's finish. The detector recorded data from 19:50 to 23:40. As a result, the transects were passed twice – in April and May. It was assumed that bats migrating above the survey sites would be counted in April and sedentary species feeding above the survey sites would be counted in May. The total duration of recordings at each site was more than 1 hour in each month of recording (**Error! Reference source not found.**).

Table 1. The total duration of recordings at each site

Project Site		**Month**	**Duration, s**	**Duration, h**
Solar 1	**East (100 MW)**	Apr	3674	1.02
		May	4071	1.13
	West (500 MW)	Apr	4891	1.36
		May	5448	1.51
		Total	**18084**	**5**
Solar 2	**Nurabad Substation**	April	1846	0.51
		May	1987	0.55
	Nurabad BESS	April	612	0.17
		May	662	0.18
	400 MW	April	4878	1.36
		May	5841	1.62
		Total	**15826**	**4.4**

Bat calls identification

A review of existing literature on bat populations in Uzbekistan indicates that up to 18 different bat species could potentially occur in the vicinity of the project area (Table 2).

Table 2. List and status of bats species potentially inhabiting the project area

Species	IUCN Red List	Red Book of the Republic of Uzbekistan (2019)	Parameters of ultrasound calls (references)
Rhinolophus bocharicus	LC (Least concern)	absent	no data (CF-type calls)
Rhinolophus ferrumequinum	LC	absent	Benda et al. (2012)
Rhinolophus hipposideros	LC	**Vulnerable, declining 2(VU:D)**	Benda et al. (2012)
Eptesicus ognevi (formerly *Eptesicus bottae*)	LC	absent	Benda et al. (2012); Hackett et al. (2016)
Eptesicus serotinus	LC	absent	Benda et al. (2012)
Hypsugo savii	LC	absent	Benda et al. (2012)
Myotis davidii	LC	absent	no data
Myotis emarginatus	LC	absent	Barataud (2015)
Myotis blythii	LC	absent	Benda et al. (2012)
Myotis bucharensis	DD (data deficient)	**Critically Endangered 1(CR)**	no data
Nyctalus noctula	LC	absent	Barataud (2015)
Pipistrellus pipistrellus	LC	absent	Benda et al. (2012)
Vespertilio murinus	LC	absent	Barataud (2015)
Plecotus sp. (Gritsina et al., 2013)	?	absent	Barataud (2015), Benda et al. (2012)
Barbastella caspica (*Barbastella leucomelas)*	LC	absent	Benda et al. (2012); Hackett et al. (2016)
Pipistrellus kuhlii	LC	absent	Benda et al. (2012)
Otonycteris leucophaea	DD	**Vulnerable, naturally rare 2(VU: R)**	no data
Tadarida teniotis	LC	**Vulnerable, naturally rare 2(VU: R)**	Benda et al. (2012)

Identification of bats from the acoustic recordings gathered during this study was performed by Dr. Denis Vasenkov, a professional bat biologist affiliated with the A. N. Severtsov Institute of Ecology and Evolution of the Russian Academy of Sciences. With about 20 years of experience in bat research, including 10 years specialising in bat detector technology, Dr Vasenkov has extensive experience in bat signal analysis in various regions including Uzbekistan, Kazakhstan, Russia, Ethiopia and Vietnam. His proficiency with **BatSound**, **SonoBat**, and **Kaleidoscope** software, combined with his broad geographical experience, ensures accurate and reliable species identification.

Some of the bat species inhabiting Uzbekistan are also found in Europe, and ultrasonic parameters are known for European populations of these species. (Barataud, 2015; Dietz, Kiefer, 2016). For some bats of Uzbekistan, the parameters of ultrasonic calls are not known (Table 2). Determination of these species according to ultrasonic calls is a complex process since manual identification is required.

Kaleidoscope Pro Auto Analysis program with "preloaded" parameters of ultrasonic calls from "European" bats found in Uzbekistan, was used for the primary processing of audio recordings. Subsequently, the BatSound 4 program was employed to measure the call parameters and verify the identification of bat calls made by the Kaleidoscope Pro Auto Analysis program.

Bat call parameters known for European bat populations (Barataud, 2015) and bat species from neighbouring countries of Uzbekistan (Benda et al., 2012) were used.

Bat calls were identified to species whenever possible (the term “bat call” refers to one file with any bat species calls). Due to the unknown "border" between *Eptesicus serotinus* and *Eptesicus ognevi*, their calls were identified only to the genus level (Eptesicus sp.).

3. Results

The detectors recorded a substantial amount of data across both sites, with over 15 GB of files from Solar 1 and 7 GB from Solar 2. However, a significant portion of these files contained ambient noise rather than bat ultrasonic signals. Therefore, two-step filtering process, combining automatic and manual methods to separate genuine bat calls from noise. Noisy files were excluded from work. Bat calls were recorded in all sites where mobile detector worked (Table 3). The change in the number of bats calls in all locations over the period of operation of the detectors was analyzed. Bat activity varied greatly between months.

Results of the Bats Acoustic records of the Solar I

Calls for 3-4 bat species were registered in the study area. Among all 77 orientation calls, the majority (42 calls, or 54%) belong to the common pipistrelle bat (*Pipistrellus pipistrellus*). The second most abundant species is the genus *Eptesicus* bat (33 calls, 43%). These calls are similar to the calls of the serotine bat (*Eptesicus serotinus*) and Ognev's serotine bat (*Eptesicus ognevi*). Currently, there are no clear criteria for the call's parameters for the separation of these species (Benda, 2012; Barataud, 2015; Dietz, Kiefer, 2016). Both species ranges include the surveyed territory. In the following, both species will be referred to as *Eptesicus* sp. In addition, rare calls of the genus *Myotis* were recorded (2 calls, 3%). The calls of genus *Myotis* bats cannot always be attributed to one or another species. Only two calls of this type were recorded at the site, and they were of low quality, so it was not possible to identify them to species.

Table 3. Bat calls recorded by detector at sites.

Site	East (100 MW)		West (500 MW)		Total		
Month	April	May	April	May	April	May	All
Duration of recordings, s	3674	4071	4891	5448	8565	9519	18084
Duration of recordings, h	1.02	1.13	1.36	1.51	2.38	2.64	5.0
Calls of *Eptesicus sp.*(*serotinus*+*ognevi*)	0	33	0	0	0	33	33 (43%)
Calls of *Myotis sp.*	0	2	0	0	0	2	2 (3%)
Calls of *Pipistrellus pipistrellus*	2	33	0	7	2	40	42 (54%)
Calls of all species	2	68	0	7	2	75	77 (100%)
Number of species	1	3	0	1	1	3	3
Activity of all species, calls/hour	2.0	60.1	0.0	4.6	0.8	28.4	15.3
Activity of *Eptesicus sp.*(*serotinus*+*ognevii*)	0.0	29.2	0.0	0.0	0.0	12.5	6.6
Activity of *Myotis sp.*	0.0	1.8	0.0	0.0	0.0	0.8	0.4
Activity of *Pipistrellus pipistrellus*	2.0	29.2	0.0	4.6	0.8	15.1	8.4

Very few (only two) bat calls were recorded in April in the study area. Both calls belonged to the same species, the common pipistrelle (*Pipistrellus pipistrellus*). These calls were recorded over the eastern site (100 MW). Over the western site (500 MW), no bat calls were recorded in April.

The main activity of bats occurred in May, with the highest activity recorded at the eastern site, averaging 60.1 calls per hour and including all species. In contrast, bat activity at the western site was significantly lower, with only Pipistrellus pipistrellus detected at 4.6 calls per hour. Overall, bat activity over the survey area was very low in April, at 0.8 calls per hour, but increased in May to 28.4 calls per hour.

Results of the Bats Acoustic records of the Solar II

Calls of 5-6 bat species were recorded at the study area. Among all 170 orientation calls, the majority (82 calls – 48%) belong to genus *Eptesicus* bats. These calls are similar to the calls of the serotine bat (*Eptesicus serotinus*) and Ognev's serotine bat (*Eptesicus ognevi*). Currently, there are no clear criteria for the call's parameters separation of these species (Benda, 2012; Barataud, 2015; Dietz, Kiefer, 2016). Both species ranges include the surveyed territory. In the following, both species will be referred as *Eptesicus* sp. The second species in terms of the number of recorded calls is *Tadarida teniotis* (51 calls - 30%). The calls of *Pipistrellus pipistrellus* are less numerous (33 calls - 19%). The least common calls were the *Eptesicus kuhlii* calls and genus Myotis bats (2 calls each – 3%). The calls of genus *Myotis* bats cannot always be attributed to one or another species. Only two calls of this type were recorded at the site and they were of low quality, so we were unable to identify them to species.

Table 4. Bat calls recorded by detector at sites (- species from Red Book of the Republic of Uzbekistan (2019)).*

Parts	**Eastern**						**Western**		**Total**		
Site	**Nurabad Substation**		**Nurabad BESS**		**Total**		**400 MW**				
Date	**April**	**May**	**April**	**May**	**April**	**May**	**April**	**May**	**April**	**May**	**All**
Duration, s	1846	1987	612	662	2458	2649	4878	5841	7336	8490	15826
Duration, h	0,51	0,55	0,17	0,18	0,68	0,74	1,36	1,62	2,0	2,4	4,4
Eptesicus kuhlii	2	0	0	0	2	0	0	0	2	0	2 (1.2%)
Eptesicus sp. (*serotinus*+ *ognevii*)	25	28	8	13	33	41	8	0	41	41	82 (48.2%)
Myotis sp.	0	1	1	0	1	1	0	0	1	1	2 (1.2%)
Pipistrellus pipistrellus	3	23	0	7	3	30	0	0	3	30	33 (19.4%)
Tadarida teniotis*	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**51**	**0**	**51**	**51 (30,0%)**
Calls all species	30	52	9	20	39	72	8	51	47	123	170 (100%)
Species	3	3	2	2	4	3	1	1	4	4	5
Activity all species, calls/hour	58,5	94,2	52,9	108,8	57,1	97,8	5,9	31,4	23,1	52,2	38,7
Eptesicus kuhlii	3,9	0	0	0	3	0	0	0	1,0	0	0,5
Eptesicus sp. (*serotinus*+ *ognevii*)	48,8	50,7	47,1	70,7	48,3	55,7	5,9	0	20,1	17,4	18,7
Myotis sp.	0	1,8	5,9	0	1,5	1,4	0	0	0,5	0,4	0,5
Pipistrellus pipistrellus	5,9	41,7	0,0	38,1	4,4	40,8	0	0	1,5	12,7	7,5
Tadarida teniotis*	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**31,4**	**0**	**21,6**	**11,6**

The most diverse species composition of bats is in the east of the surveyed territory (Nurabad BESS and Nurabad substation). At these eastern sites, almost all bats species inhabiting throughout the

planned solar station were found, with the exception of the *Tadarida teniotis*. Bats of various species use the eastern sites both in April and May.

Tadarida teniotis calls (Figure 5) were recorded only in the western site (400 MW) and only in May. In April, only a few calls of bats *Eptesicus sp*. were recorded in the western site.

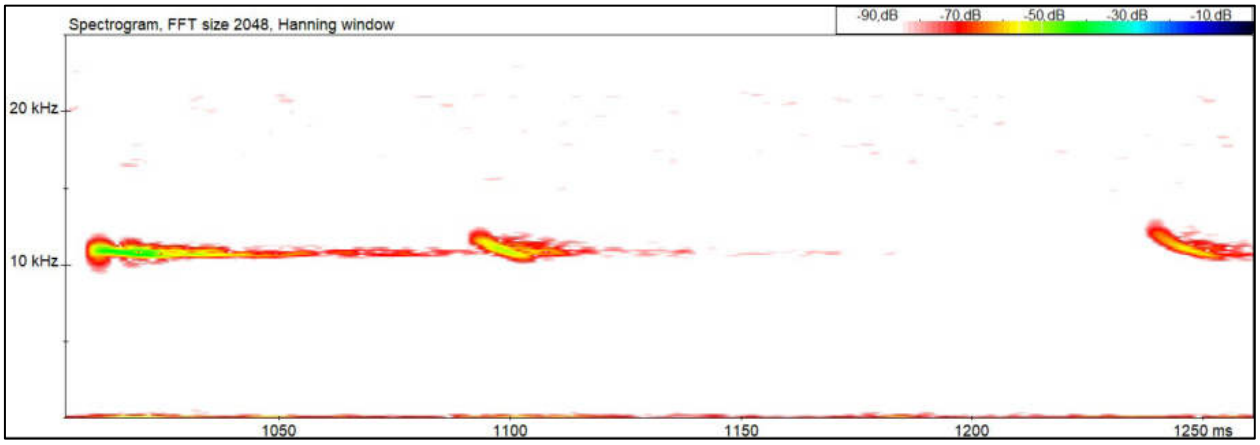

Figure 5. Bat Tadarida teniotis calls were recorded at the western area (400 MW) in May.

4. Conclusion

The ultrasonic study of bats conducted at the planned UZB-ACWA-Sam Solar I and II facilities revealed the presence of 3-6 bat species across the surveyed areas. The species composition and activity levels varied between the April and May surveys, indicating potential seasonal differences in bat presence and behavior.

At least 3-4 bat species use the territory of the projected solar power plant(Solar I) for feeding in May: *Pipistrellus pipistrellus*, Eptesicus sp. (Eptesicus serotinus or/and Eptesicus ognevi), and Myotis sp. In April, only two bat calls were recorded in the study area. These were the calls of the common pipistrelle (Pipistrellus pipistrellus). None of these species are included in the Red Book of Uzbekistan (2019). It is likely that the surveyed area is not important during bat migration since very few bat calls were recorded in April. To a greater extent, the surveyed area (especially its eastern part - 100 MW) may be important for bat feeding in May.

Throughout the entire territory of the planned solar power plant(Solar II), calls of 5-6 bats species were recorded in April and May. Of these, 4-5 species were recorded in April: *Eptesicus kuhlii, Eptesicus sp*. (*Eptesicus serotinus* or/and *Eptesicus ognevi*), *Myotis sp*. and *Pipistrellus pipistrellus*. In May, 4-5 species were also recorded, but instead of *Eptesicus kuhlii* rare calls, quite numerous *Tadarida teniotis* calls were recorded. This species is listed in the Red Book of the Republic of Uzbekistan (2019). On the territory of the planned solar power plant it was discovered only in May and only in the western site (400 MW). *Tadarida teniotis* is a typical dweller of rock crevices (Dietz, Kiefer, 2016). It is a very strong and fast flier that can hunts on high heights within 30-100 km of the roost.

The construction of a solar power plant on the sites may lead to some disruption of natural soil and hydrological conditions, destruction of shrubs and other vegetation (Barré et al., 2023; Tinsley et al., 2023). This can negatively affect the feed supply of insects, which are feed for bats.

The impact is expected to be less critical for the eastern Solar II sites (Nurabad Substation and Nurabad BESS), which cover a relatively small area of less than one square kilometer. Similarly, the western site (500 MW) of Solar I, where low bat activity has been recorded, is also anticipated to experience minimal disruption. However, the eastern site of Solar I, where the highest bat activity has been observed, may requires careful consideration. It may be advisable to conduct a monitoring assessment of bat activity over this site after construction is completed to assess the need for compensatory measures.

None of the bat species observed flying at the eastern sites of Solar I are listed in the Red Book of the Republic of Uzbekistan (2019). In contrast, the western site (400 MW) of Solar II, which spans 8 square kilometers, has recorded activity of Tadarida teniotis, a species included in the Red Book. Current data are insufficient to determine whether this site serves as a feeding ground or merely a transit route for this species. If it is found to be an important feeding site, the construction of a solar power plant could alter the forage suitability of the area for Tadarida teniotis. While the planned solar power plants may have some impact on local bat populations, careful monitoring and appropriate mitigation measures can help minimize these effects, particularly for the Red Book-listed species.

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Spring 2024 Bird Survey for Karakul BESS

Environmental and Social Impact Assessment (ESIA) for the development of a solar power project in Samarkand Region, Uzbekistan

Client: 5 Capitals

Date: 26 June 2024

Juru

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1. Introduction

The project area includes a landfill for BESS with an area of 32.4 hectares and an access road 1735 m long.

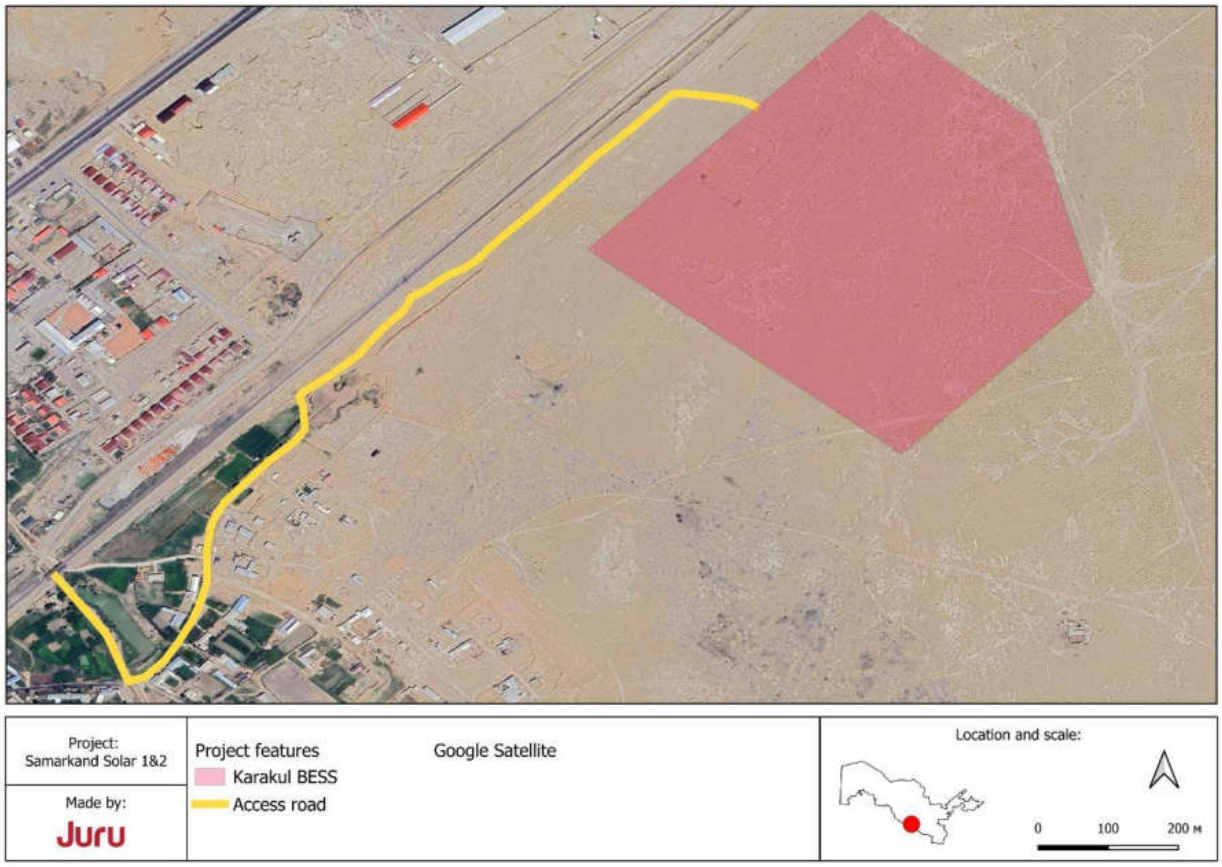

Figure 1. Project settings

The polygon is a plain composed of sandy and sandy loam soils, with sparse shrub vegetation (Figure 2).

Figure 2. Project site

The access road passes through wasteland, agricultural lands, and settlements. Besides, there are artificial waterbodies. The bushes, trees, cellars, and gaps in buildings serve as natural and artificial shelters for birds.

2. Materials and methods

Bird VP monitoring was conducted by Juru biodiversity specialist Elizaveta Ignatieva on March 13 and April 04. Duration of each monitoring is 3 hours.

An ornithological study was conducted on the territory, focusing on assessing potential habitats for the Houbara Bustard and visually counting birds. Bird counting took place for three hours during the day from 13:10 PM to 16:10 on March 13, and from 11:50 to 14:50 on April 4 on the project site.

During the first two hours, observations took place within the BESS station area (vantage point 1), and the third hour was spent on the access road (vantage point 2). A Nikon 8x30 binocular was used for counting.

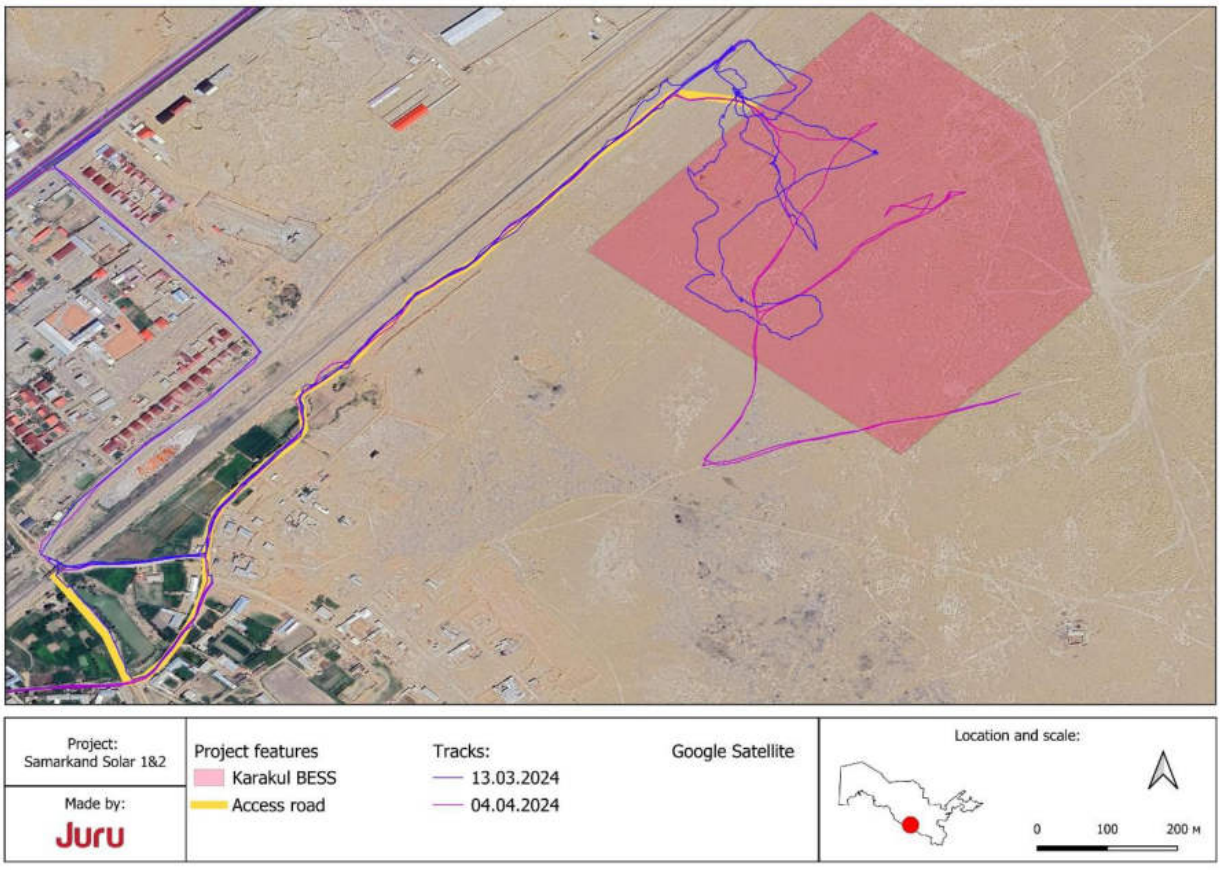

Figure 3. Tracks

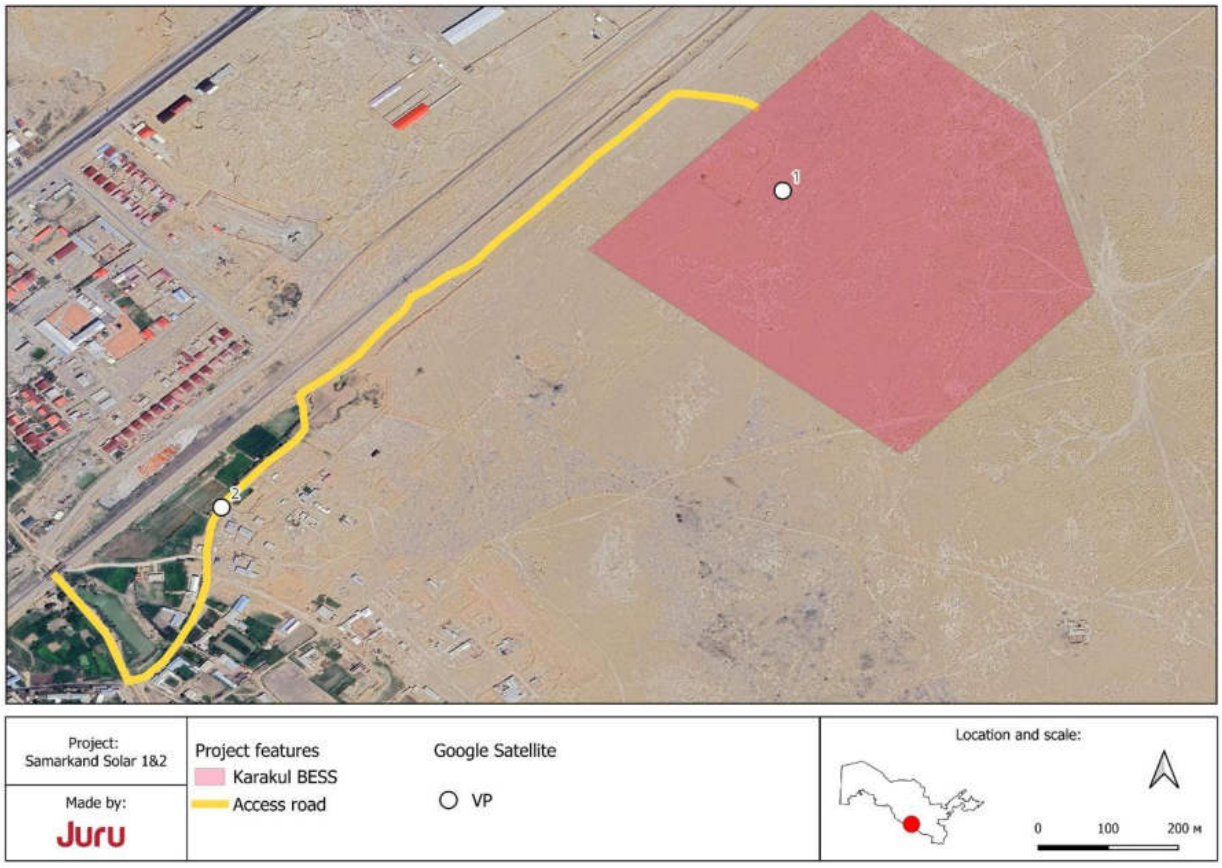

Figure 4. Vantage points

Table 1. Locations of the vantage points

Vantage point	N, °	Y, °
VP 01	39.51731	63.87002
VP 02	39.51205	63.86071

3. Results

As a result of the survey, 15 bird species were recorded in the study area.
Among the recorded birds, no species was listed in the IUCN Red list or the Red Book of Uzbekistan.

Table 2. Results of the survey

Date	Time	VP	Species	Number
13.03.2024	13:10	1	*Corvus corone*	3
13.03.2024	13:15	1	*Corvus cornix*	1
13.03.2024	13:18	1	*Galerida cristata*	2
13.03.2024	13:21	1	*Galerida cristata*	1
13.03.2024	13:24	1	*Corvus cornix*	2
13.03.2024	13:25	1	*Galerida cristata*	2
13.03.2024	13:27	1	*Columba livia*	1
13.03.2024	13:41	1	*Corvus corone*	1
13.03.2024	13:44	1	*Motacilla personata*	1
13.03.2024	13:44	1	*Circus spilonotus*	1
13.03.2024	14:14	1	*Corvus corone*	1
13.03.2024	14:21	1	*Columba livia*	8
13.03.2024	14:22	1	*Galerida cristata*	1
13.03.2024	14:22	1	*Corvus corone*	1
13.03.2024	14:48	1	*Corvus corone*	8
13.03.2024	15:18	2	*Circus spilonotus*	1
13.03.2024	15:24	2	*Corvus corone*	1
13.03.2024	15:32	2	*Circus spilonotus*	2
13.03.2024	15:49	2	*Fringilla montifringilla*	10
13.03.2024	15:51	2	*Passer montanus*	35
13.03.2024	16:06	2	*Corvus frugilegus*	1
13.03.2024	16:07	2	*Corvus corone*	3
13.03.2024	16:07	2	*Corvus cornix*	3
13.03.2024	16:09	2	*Corvus cornix*	8
4.04.2024	12:49	1	*Apus apus*	2
4.04.2024	13:55	2	*Columba livia*	2
4.04.2024	13:55	2	*Circus aeruginosus*	1
4.04.2024	13:56	2	*Apus apus*	3
4.04.2024	13:56	2	*Streptopelia senegalensis*	2
4.04.2024	14:01	2	*Columba livia*	10
4.04.2024	14:02	2	*Pica pica*	1
4.04.2024	14:06	2	*Apus apus*	4
4.04.2024	14:09	2	*Columba livia*	3
4.04.2024	14:12	2	*Delichon urbicum*	1
4.04.2024	14:12	2	*Columba livia*	35
4.04.2024	14:24	2	*Corvus corone*	3
4.04.2024	14:38	2	*Corvus corone*	1
4.04.2024	14:38	2	*Columba livia*	5
4.04.2024	14:38	2	*Acridotheres tristis*	1
4.04.2024	14:42	2	*Columba livia*	1
4.04.2024	14:46	2	*Corvus corone*	1
4.04.2024	14:46	2	*Columba livia*	2

4.04.2024	14:46	2	*Delichon urbicum*	2

4. Conclusion

Thus, no rare, vulnerable or endemic species were observed in the Karakul BESS site. The greatest diversity of species was observed in the area of residential buildings, where there are natural and artificial shelters.

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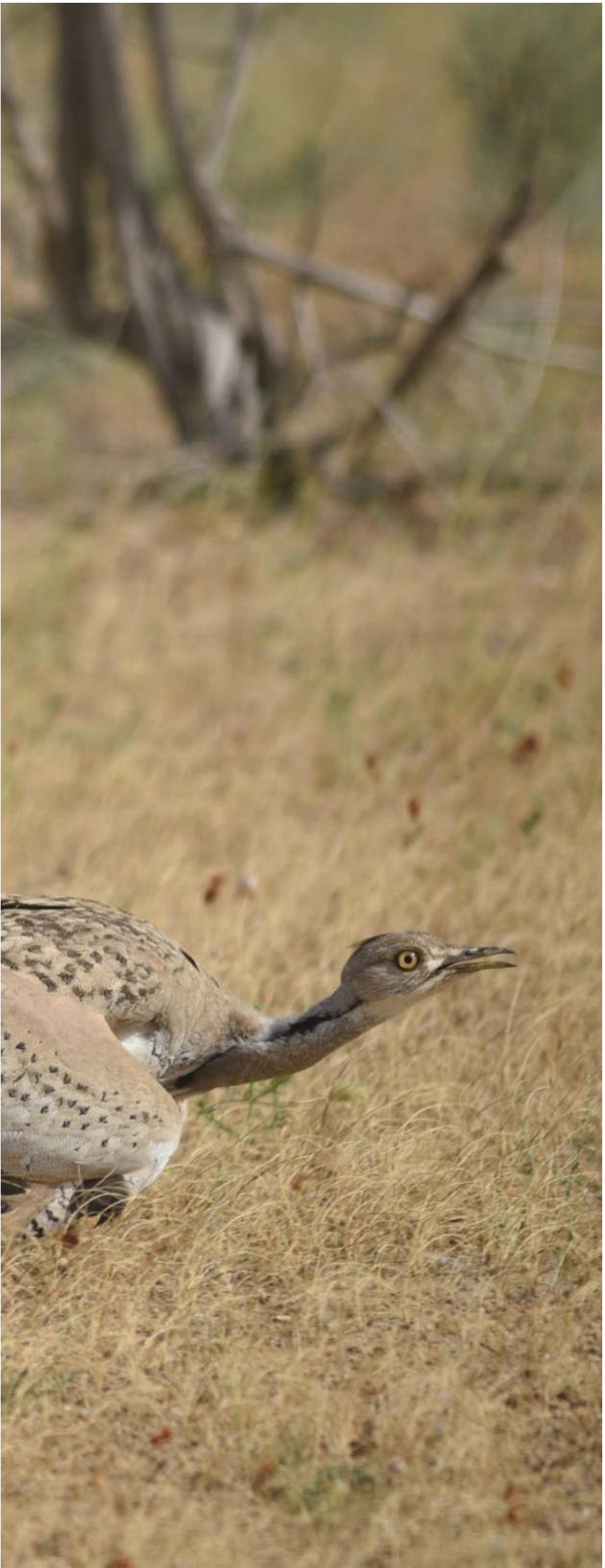

Bird survey report 2024: Breeding bird survey (Asian Houbara)

Environmental and Social Impact Assessment (ESIA) for the development of a solar power project in Samarkand Region, Uzbekistan

Client: 5Capitals

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1. Introduction

In accordance with the Resolutions of the President of the Republic of Uzbekistan No. PP-207 dated July 4, 2023, "On measures for the implementation of the investment project 'Construction of a 500 MW Solar Photovoltaic Power Station, a 334 MW Electric Energy Storage System, and a Substation to support its operation in the Nurabad District of the Samarkand Region — Sazagan Solar 1'," and No. PP-208 dated July 4, 2023, "On measures for the implementation of the investment project 'Construction of a 500 MW Solar Photovoltaic Power Station, a 334 MW Electric Energy Storage System, and a Substation to support its operation in the Nurabad District of the Samarkand Region — Sazagan Solar 2'," investment agreements were signed on April 19, 2023, between the Ministry of Investments, Industry, and Trade of the Republic of Uzbekistan, the company "ACWA Power Company" (Investor), and the companies "ACWA Power Sazagan Solar 1" and "ACWA Power Sazagan Solar 2" (hereinafter referred to as the "Project Companies") (Figure 1).

Under the aforementioned investment agreements, the Project Companies are implementing the projects "Sazagan Solar 1" and "Sazagan Solar 2," within which three solar photovoltaic power stations with a total capacity of 1000 MW and a substation with a capacity of 500/220 kV will be constructed in the Nurabad District of the Samarkand Region. Additionally, two energy storage systems will be built — one in the Nurabad District of the Samarkand Region and another in the Karakul District of the Bukhara Region. Furthermore, two parallel overhead power transmission lines with a voltage of 220 kV and a length of 70 km will be constructed to connect the main project facilities. 360 km overhead transmission line will also connect stations located in Samarkand region with the Khalka substation, located in Tashkent region.

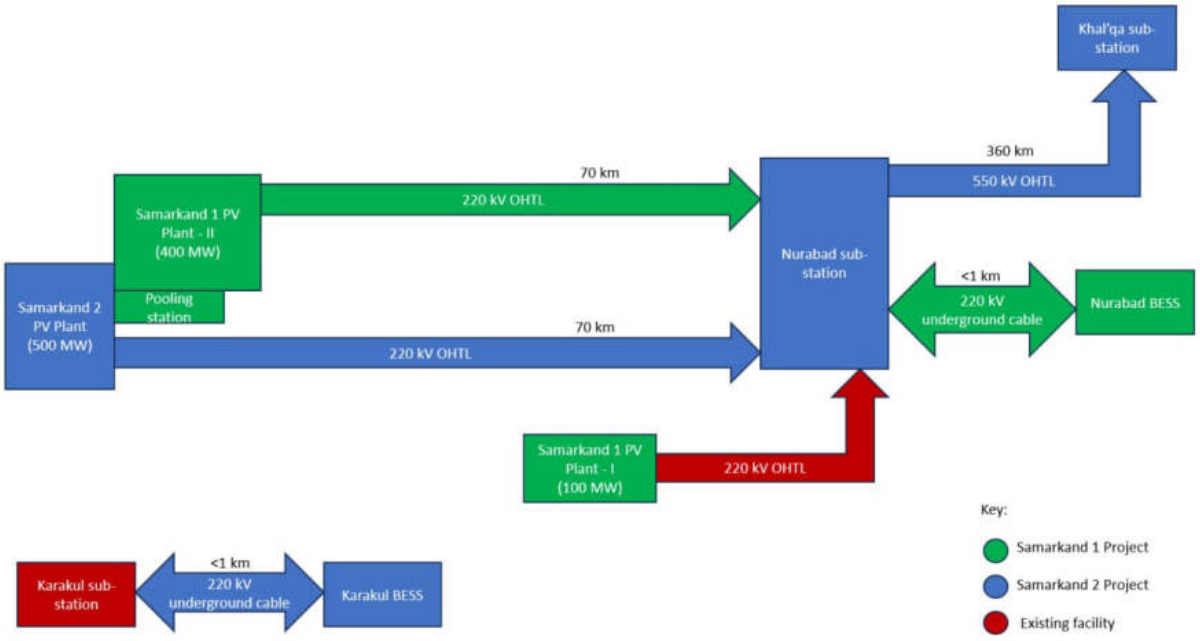

Figure 1: The scheme of project sites

As part of the Environmental and Social Impact Assessment (ESIA), biodiversity baseline surveys are needed to validate assumed status as well as fill any information gaps. The Environmental and Social Impact Assessment process might further identify the need for the project to undergo a Critical Habitat Assessment (CHA) to meet international lender requirements.

The report presents data and materials from both field and desktop bird surveys on breeding bird with focus on Asian Houbara (*Chlamydotis macquennii* IUCN VU) and excluding Raptors (separate

survey will be conducted for these bird group). This report details the findings of the 2024 spring survey period, which included point surveys conducted between March 20- March 29, 2024.

2. Asian Houbara in Uzbekistan and Samarkand region

Asian Houbara, or Houbara Bustard *Chlamydotis macqueenii* (hereinafter the "Houbara") is one of the most characteristic representatives of the avifauna of Uzbekistan, occurring during the nesting and migration mainly on the territory of Kyzylkum, Karshi steppe and Ustyurt, and occasionally wintering in the southern regions of the country (Kreutzberg-Mukhina, 2003).

Due to the intensive development of desert areas since the mid-20th century in Uzbekistan, the area of Houbara's habitat significantly decreased (Meklenburtsev, 1990). In addition, its number has significantly decreased through poaching, including falconry, both in the wintering areas and on flyways. Houbara is included in the Red Data Book of the Republic of Uzbekistan (2019) as a vulnerable species with a declining population. The population of this species has been regularly declining over the past decades, and the habitat is highly fragmented. Consequently, as the Red List Authority for birds on the IUCN Red List, BirdLife has recommended to IUCN that the Houbara be classified as Vulnerable under Criterion A4acd, owing to an estimated population reduction of between 30% and 49% across a period of three generations, starting in the past and projected into the future. Should more accurate trend data become available, future reassessment as Endangered may prove warranted. Conversely, potential population increases driven by expanding captive breeding and release programmes could alternatively necessitate future downlisting (BirdLife International 2014)

Houbara is quite well studied within the Kyzylkum desert. Information about Houbara in Kyzylkum was first given by M. N.Bogdanov (1882), who obtained it during his expedition from Kazalinsk to the Khiva oasis in 1873. In his opinion, Houbara nests everywhere in suitable places. O. V. Mitropolsky regularly visited Kyzylkum from late 1972 to April 1985 and registered Houbara in many places in Central Kyzylkum. The biology of Houbara and the population were studied by O. S. Bakaev (1972), A. F. Alekseev (1980), T. S. Ponomareva (1979, 1983, 1985). In the 1980s the Ecocenter "Jeyran" studied the Houbara's nesting biology and captive breeding (Mukhina, 1988). From 2011 to the present, Robert Burnside, Maxim Koshkin and other specialists from the University of East Anglia, with the financial support of the Ahmed bin Zayed Charitable Foundation, as well as the Emirates Bird Breeding Center for Conservation, have been studying Houbara in the southern part of the Kyzylkum desert within the borders of Bukhara region. During this period, the number of Houbara was estimated on an area of more than 14,300 km^2 based on a comprehensive survey effort, and the nesting biology, migration routes, threats (livestock, predators, power lines), were studied. Since 2008, in the central part of the Kyzylkum desert, the Emirates Bird Breeding Center for Conservation (UAE) has been operating a captive breeding and wild release program for Houbaras. In total they have released approximately 14 thousand captive-bred Houbara to date in the Bukhara region.

In Samarkand region the Houbara was always rare breeding bird[1] (Figure 2). The area of breeding is connected with Karnabchul or Karshi steppe (western corner of the Samarkand region). And in this steppe the main part of Houbara's population locates in Navoi and Bukhara regions. The Asian Houbara monitoring works are ongoing over 10 years by Asian Houbara nursery located in Navoi region (same parallel work as EBBCC).

[1] Abduraupov T.V., Mansurkhojaeva M.U., Vashetko E.V., Esipov A.V., Azimov N.A., Bykova E.A. (2021) Cadastre of rare and endangered vertebrate animals of Samarkand region, Uzbekistan (reptiles, birds, mammals). Tashkent: "EFFECT-D", 128 p

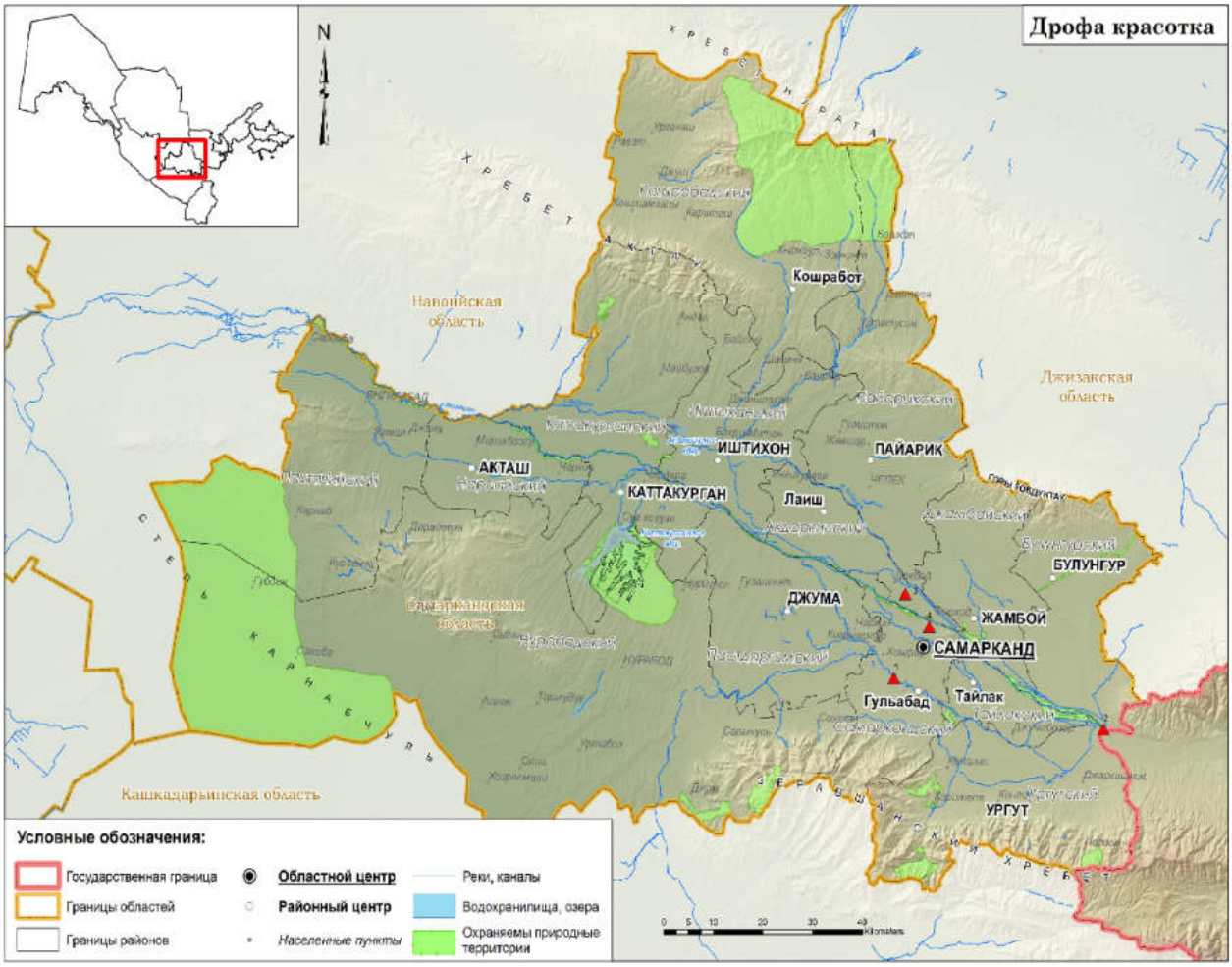

Figure 2: Distribution of Asian Houbara in Samarkand region (Abduraupov et al., 2021[1])

Thus, Houbara is quite well studied within the Karnabchul steppe, overall, but data available on its distribution in the project area, are quite old and much more limited.

3. Ecology of Asian Houbara

Houbara is an iconic inhabitant of steppe and semi-desert in Central Asia and the Middle East. A highly terrestrial bird, capable of going long periods without taking flight, it is nonetheless a true long-distance migrant, with some individuals travelling more than 7,500 km over the course of a single year (Figure 3) (Combreau *et al*. 2011[2]).

All authors consider deserts to be the habitat of Houbara. It seems that a good all-round view is important for this bird, so it prefers to nest in flat areas with sparse vegetation. At the same time, fairly dense soil is important. Houbara can inhabit clay plains with sagebrush grass cover (Zahidov, 1971) and the extremities of takyrs near solonchaks with scattered saltwort and camel thorn shrubs. Houbara also lives on the clay-solonchak plains and Anabasis salsa takyrs of the ancient delta of the Amu Darya (Alekseev, 1981). According to N. A. Zarudny (1915), Houbara prefers slightly undulating spaces with sandified surface, covered with various low shrubs, alternating sagebrush communities and small solonchaks and takyrs. O. V. Mitropolsky (oral report) repeatedly visited Kyzylkum in 1971-

[2] Combreau, O., Riou, S., Judas, J., Lawrence, M., Launay, F. 2011. Migratory Pathways and Connectivity in Asian Houbara Bustards: Evidence from 15 Years of Satellite Tracking. PLoS ONE 6(6): e20570. https://doi.org/10.1371/journal.pone.0020570

1985 and repeatedly encountered Houbara, with only two records in sand areas. The rest were found on piedmont plains, plateaus, takyrs, i.e. on open flat areas with more or less dense vegetation. All authors confidently point out that Houbara is absent in loose sand dunes, as well as in landscapes transformed by humans even to a smallest degree (Meklenburtsev, 1990). Houbara abandons areas where roads appear or the number of livestock increases (Alekseev, 1981, but see Koshkin et. al. 2016).

During migrations, Houbara practically does not go beyond the nesting area. In northern Kyzylkum, it flies in a widely spread flock, in central Kyzylkum, according to R. N. Meklenburtsev (1990), the migration starts in the last third of March, in April the flight still continues, but at the end of April, only pairs remain. The autumn migration is most thoroughly studied for north-western Kyzylkum, where birds begin flying noticeably from the last third of September and continue to fly until late October, with rare individuals recorded on November 15 and 19. The main direction of the flight is south-west (Alekseev, 1980). Houbara is active during the day; and it migrates during the night (oral data of John Burnside). Houbara winters in Uzbekistan, but not regularly. Local residents of the Tamdy oasis in Kyzylkum reported to Zarudny N. A. (2015) about rare encounters in winter.

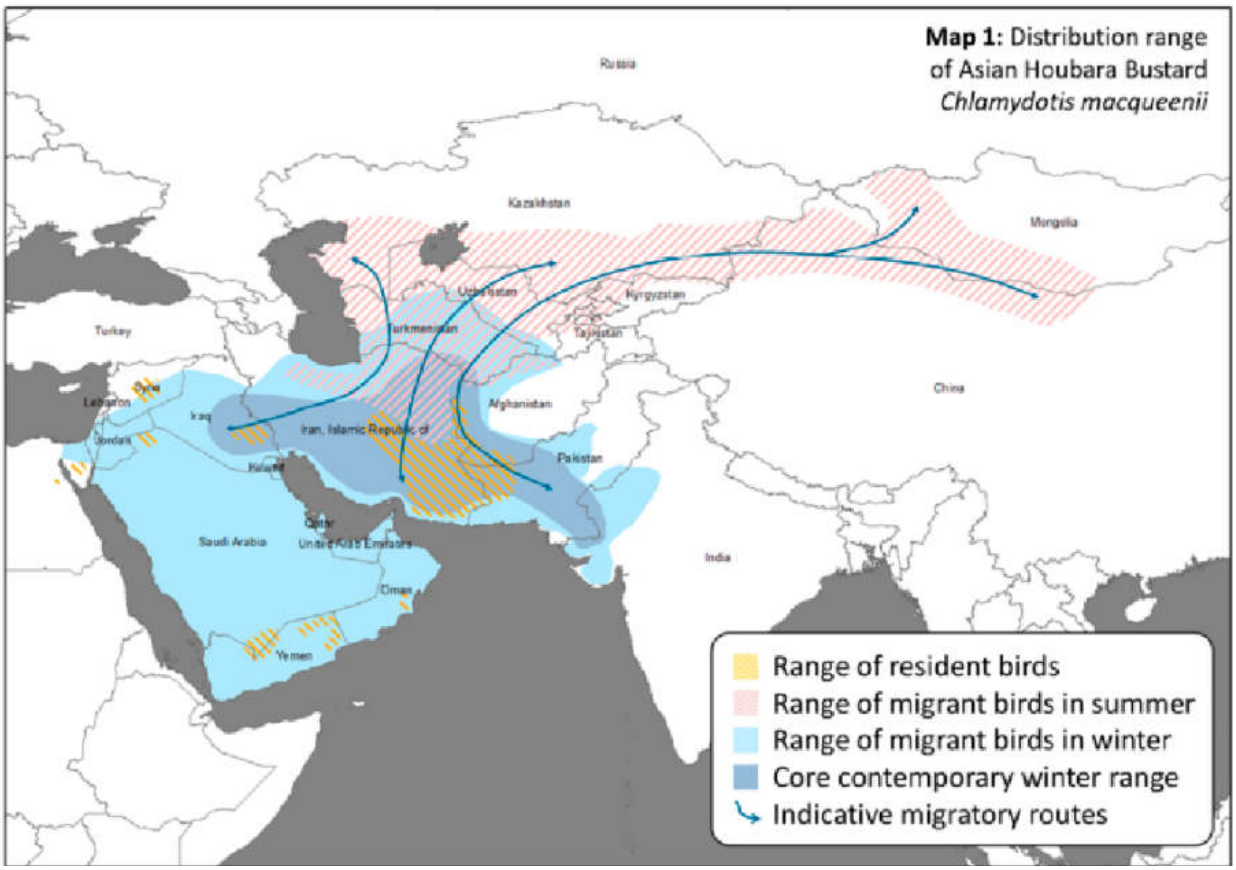

Figure 3: Birds have been observed across much of the country in the summer months, and Goriup (1997) estimated a breeding population of between 6,000 and 9,000 individuals.

Houbara is a locally common breeding and passage migrant and an occasional over-winterer in Uzbekistan. A large proportion of the population, numbering tens of thousands, migrates through Uzbekistan biannually, and birds can be encountered in most lowland regions each spring and autumn. Northward migration peaks in the second and third weeks of March, whilst southbound birds mostly pass through in mid-October (O. Combreau in litt. 2014). Overwintering has been reported in the Uzbek part of the Kyzylkum desert (O. Combreau in litt. 2014). (BirdLife International 2014).

Male Houbara attract their mates with an extravagant courtship display, which they perform at the same site each year. The display begins with a period of strutting and culminates with the male retracting his head within an ornamental shield of erected neck feathers and then running at speed

in either a straight or curved line. The display is often accompanied by a series of low frequency booming calls (Gaucher et al. 1996). In the Bukhara breeding center of rare animals "Jeyran", males began to display behaviour immediately after arrival. Total 7-9 males had display behaviour. Each occupies a certain area, which the other males do not enter. Females appear in these areas about 10 days later, but they do not constantly stay on them, but only visit them (Mukhina, 1990).

Males play no part in rearing the young, and a brood may contain young sired by several different individuals. Females create a shallow scrape in the ground in which they typically lay 3-4 eggs, and occasionally up to six eggs in long-distance migrants (Collar 1996, Combreau et al. 2002).

After tracing the incubation process from beginning to end, S. O. Bakaev (1972) found out that the female incubates the clutch for 21 days. The chicks hatch within one day. According to O. Combreau (BirdLife International 2014), the incubation period is typically 23 days, whilst fledging takes around 30 to 35 days. The growth of chicks was traced by T. S. Ponomareva (1980). According to her, they become mature by 2 months of age, i.e. by the end of July, if the eggs are laid in early April. Most chicks fledge by the end of June. Then broods break up and every bird stays alone. This is also confirmed by modern telemetry data. Satellite tracking has revealed that females and their young separate after three to four months and that pre-migration groups in autumn comprise birds of all ages and sexes (O. Combreau 2014).

In late August 1992, an aggregation of 1,500 migrating Houbaras was observed in the Karnabchul steppe area (A. Nuridjanov, private message, acc. to Kreutzberg-Mukhina 2003). Similar large aggregations of migratory birds were observed in 1994 in Bukhara region (O. Nazarov, personal message, acc. to Kreutzberg Mukhina 2003[3]) - in total, there were about 1,000 birds in the aggregation, which formed sparse groups of several dozen individuals. In recent years, such aggregation are no longer observed, and Houbaras are more often recorded in small groups - from 3-5 to 10-15 individuals. According to E. A. Kreutzberg-Mukhina (2003), the passage aggregations were impacted by the increasing trophy hunting organized within the nesting area, when groups of hunters from Arab countries come to the countries of Central Asia in September-October and spend about a month there, departing in late November and sometimes in early December.

4. Materials and methods

The methodology implemented for this survey effort consisted of spring season point counts, following a method that has been developed by Houbara researchers in Uzbekistan, and taking advantage of the visual and acoustic observability of males' courtship displays, as Houbara are shy and difficult to see at other times of year. During the peak courtship season in Uzbekistan (March–May) displaying males (and also floating males) are conspicuous and can be apparent from long distances. This provides an opportunity for male population assessment with a relatively high degree of accuracy (Koshkin et al, 2016a).

Houbara point count surveys were conducted within the project area and surroundings, during the optimal period for such counts, from March 20-21 and March 29, 2024.

The weather conditions during survey period were generally good for counts, with the exception of several that were considered invalid due to high winds. All such invalidated surveys were subsequently repeated under suitable weather conditions within the same survey period.

[3] Kreutzberg-Mukhina E. A. 2003. The current state of bustards in Uzbekistan (Современное состояние дрофиных птиц в Узбекистане) / / Bustards of Russia and neighboring countries. - 2003. Issue 2. Pp. 64-75

Surveyors with good knowledge of the region identified the most suitable survey locations. Figure 4. Figure 5 and Table 1 show the 15 point count locations where Houbara spring point count surveys were conducted.

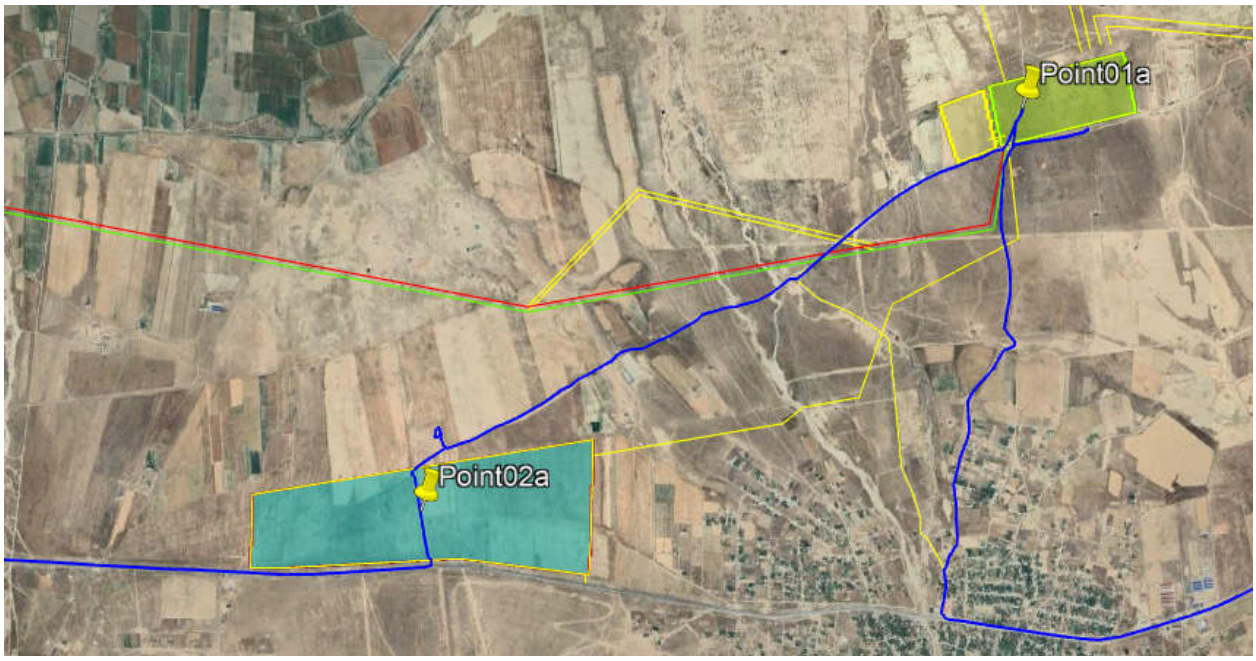

Figure 4: Survey point location in Nurabad BESS and SS and 100 MW Solar

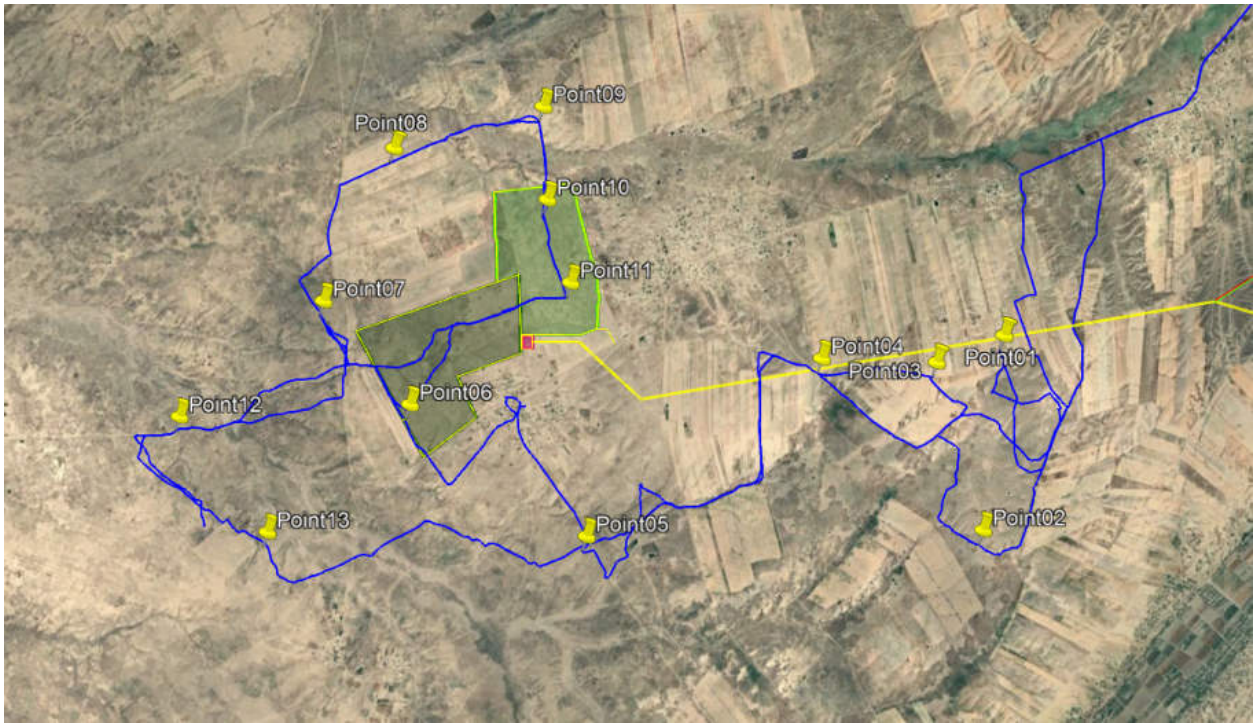

Figure 5: Survey point locations in Nurabad BESS and SS and 100 MW Solar

Optical instruments – binoculars Nikon x8, telescope x60 Swarowski and laser rangefinder, compass were used. Birds were registered on video and photo with mobile phone using dj-scoping and a Nikon D20 digital camera with a 300mm lens.

Each point count survey lasted 20-30 minutes and was undertaken by a single observer during the period of peak male display activity, i.e. within 3 h after sunrise or 2 h before sunset (Combreau and

Launay 1996). A second survey was conducted within suitable weather conditions during the survey period at 10 points listed in Table 1.

All surveys were conducted by Valentin Soldatov, who has extensive previous experience conducting Houbara surveys using this same methodology.

Table 1: Breeding bird survey point locations

N	Point	N	E	1 round	2 round	Note
1	Point01a	39.575788	66.743553	20/03/2024		territory is non suitable for breeding A houbara
2	Point02a	39.546636	66.686862	20/03/2024		territory is non suitable for breeding A houbara
3	Point01	39.425704	66.112718	20/03/2024		territory is non suitable for breeding A houbara
4	Point02	39.381274	66.106821	20/03/2024		territory is non suitable for breeding A houbara
5	Point03	39.419487	66.092786	21/03/2024		territory is non suitable for breeding A houbara
6	Point04	39.420208	66.058907	21/03/2024	29/03/2024	
7	Point05	39.379254	65.989839	21/03/2024	29/03/2024	
8	Point06	39.409087	65.937431	21/03/2024	29/03/2024	
9	Point07	39.432394	65.912392	21/03/2024	29/03/2024	
10	Point08	39.4676	65.932175	21/03/2024	29/03/2024	
11	Point09	39.477331	65.97628	21/03/2024	29/03/2024	
12	Point10	39.456114	65.977649	21/03/2024	29/03/2024	
13	Point11	39.437161	65.984657	21/03/2024	29/03/2024	
14	Point12	39.405917	65.869277	21/03/2024	29/03/2024	
15	Point13	39.379658	65.895582	21/03/2024	29/03/2024	

Figure 6: The overview of the Point05

Data Recording Methods

The following data was recorded on the survey forms:

- The location of the VP used
- Date of survey
- Start and end time of the count
- Weather condition: wind (0-4), wind haze (0-4)
- Surveyor name
- Biotope
- Group size of Houbaras (sex – male, female, unknown)
- Distance (m) for each group
- Bearing (°) for each group
- Behaviour (displaying, flying, standing, et al.)
- Notes

Weather

In general, the weather conditions during the survey period were suitable for winter bird survey.

Time schedule

Winter surveys were conducted in 2 rounds in March 2024:

- 20-21 March 2024,
- 29 March 2024.

5. RESULTS

This section provides information on the data obtained as a result of the study, focusing on Asian Houbara and rare breeding species that have elevated Redlist status on the national and/or IUCN global redlists. In total of 15 bird species were observed, 2 listed in the Red Book of Uzbekistan (2019), 2 are included in the IUCN Red List (2023-1) (Table 2).

Table 2: List of birds observed during the breeding bird survey 2024.

№	Species	Common name	IUCN RL	UzRDB	Status
1	Common buzzard	Buteo buteo			Migrating
2	Rough-legged buzzard	Buteo lagopus			Migrating
3	Long-legged buzzard	Buteo rufinus			Migrating/ Breeding
4	Western marsh harrier	Circus aeruginosus			Migrating
5	Hen Harrier	Circus cyaneus			Migrating
6	Demoiselle crane	Grus virgo			Migrating
7	Great bustard	Otus tarda	EN	CR	Migrating
8	Little bustard	Tetrax tetrax	NT	NT	Migrating
9	Greater Sand Plover	Charadrius leschenaultii			Breeding
10	Merlin	Falco columbarius			Migrating
11	Common Kestrel	Falco tinnunculus			Migrating/ Breeding
12	Black-bellied sandgrouse	Pterocles orientalis			Migrating/ Breeding
13	Rock dove	Columba livia			Migrating
14	Crested Lark	Galerida cristata			Breeding
15	Northern wheatear	Oenanthe oenanthe			Breeding
	Total		2	2	

During the surveys, **Asian Houbara was not observed**. However, the survey revealed breeding activity of Crested larks, Northern wheatear, Greater Sand Plover, and Black-bellied Sandgrouses. Long-legged buzzards typically commence breeding towards the end of March, and observations of this species may primarily relate to migrating birds. It's important to note that the results can only be interpreted for the early breeding season.

Figure 7: Demoiselle crane flock feeding

Detailed records of other bird species can be found in Table 3.

Table 3: The records of Great bustards and other rare species

N	Point	Date	Common species	Number	Status	Note

1	Point01a	20/03/2024	Crested Lark	1	resident	
2	Point02a	20/03/2024	Crested Lark	2	resident	
3	Point01	20/03/2024	Black-bellied sandgrouse	60	migrating	
4	Point01	20/03/2024	Crested lark	30	migrating	
5	Point01	20/03/2024	Northern wheatear	1	breeding	
6	Point01	20/03/2024	Rough-legged buzzard	1	migrating	
7	out of survey point	20/03/2024	Great bustard	1	migrating	
8	Point02	20/03/2024	Demoiselle crane	18	migrating	
9	Point02	20/03/2024	Black-bellied sandgrouse	15	migrating	
10	Point03	21/03/2024	Little bustard	4	migrating	
11	Point03	21/03/2024	Black-bellied sandgrouse	20	migrating	
12	Point03	21/03/2024	Harrier	1	migrating	
13	Point04	21/03/2024	Common buzzard	1	migrating	
14	Point04	21/03/2024	Merlin	1	migrating	
15	Point05	21/03/2024	Black-bellied sandgrouse	4	breeding	
16	Point06	21/03/2024	no birds	0		
17	Point07	21/03/2024	Little bustard	2000	migrating	
18	Point07	21/03/2024	Demoiselle crane	27	migrating	
19	Point07	21/03/2024	Black-bellied sandgrouse	5	breeding	
20	Point08	21/03/2024	Demoiselle crane	30	migrating	
21	Point08	21/03/2024	Greater Sand Plover	1	breeding	
22	Point09	21/03/2024	Little bustard	1	migrating	
23	Point09	21/03/2024	Demoiselle crane	1	migrating	
24	Point10	21/03/2024	Long-legged buzzard	1		
25	Point10	21/03/2024	Harrier	1	migrating	
26	Point11	21/03/2024	Long-legged buzzard	1	breeding	
27	Point12	21/03/2024	Long-legged buzzard	1		
28	Point13	21/03/2024	Long-legged buzzard	1		
29	Point13	21/03/2024	Demoiselle crane	110	migrating	
30	Point13	21/03/2024	Common Kestrel	1		
31	Point13	21/03/2024	Black-bellied sandgrouse	20	migrating	
32	Point08	29/03/2024	Long-legged buzzard	1		
33	Point08	29/03/2024	Black-bellied sandgrouse	4	breeding	
34	Point08	29/03/2024	Hen Harrier	1	migrating	
35	Point09	29/03/2024	Western marsh harrier	1	migrating	local people collect mushrooms in the desert
36	Point10	29/03/2024	Crested Lark	1	resident	
37	Point11	29/03/2024	Hen Harrier	1	migrating	
38	Point06	29/03/2024	Crested Lark	1	resident	
39	Point07	29/03/2024	Black-bellied sandgrouse	7	breeding	

40	Point07	29/03/2024	Crested Lark	1	breeding	local people collect mushrooms in the desert
41	Point12	29/03/2024	Crested Lark	10	breeding	flocks of sheep
42	Point13	29/03/2024	no birds			many flocks of sheep
43	Point05	29/03/2024	Little bustard	1	migrating	
44	Point05	29/03/2024	Hen Harrier	1	migrating	
45	Point05	29/03/2024	Common Kestrel	1	breeding	
46	Point04	29/03/2024	Rock dove	1	resident	
46	out of survey point	21/03/2024	Demoiselle crane	110	migrating	roosting place
47	out of survey point	22/03/2024	Common Kestrel	3	migrating	