

Gijduvon 300 MW Wind Farm Republic of Uzbekistan

Environmental and Social Impact Assessment

Volume 4 –
Appendices
Part B



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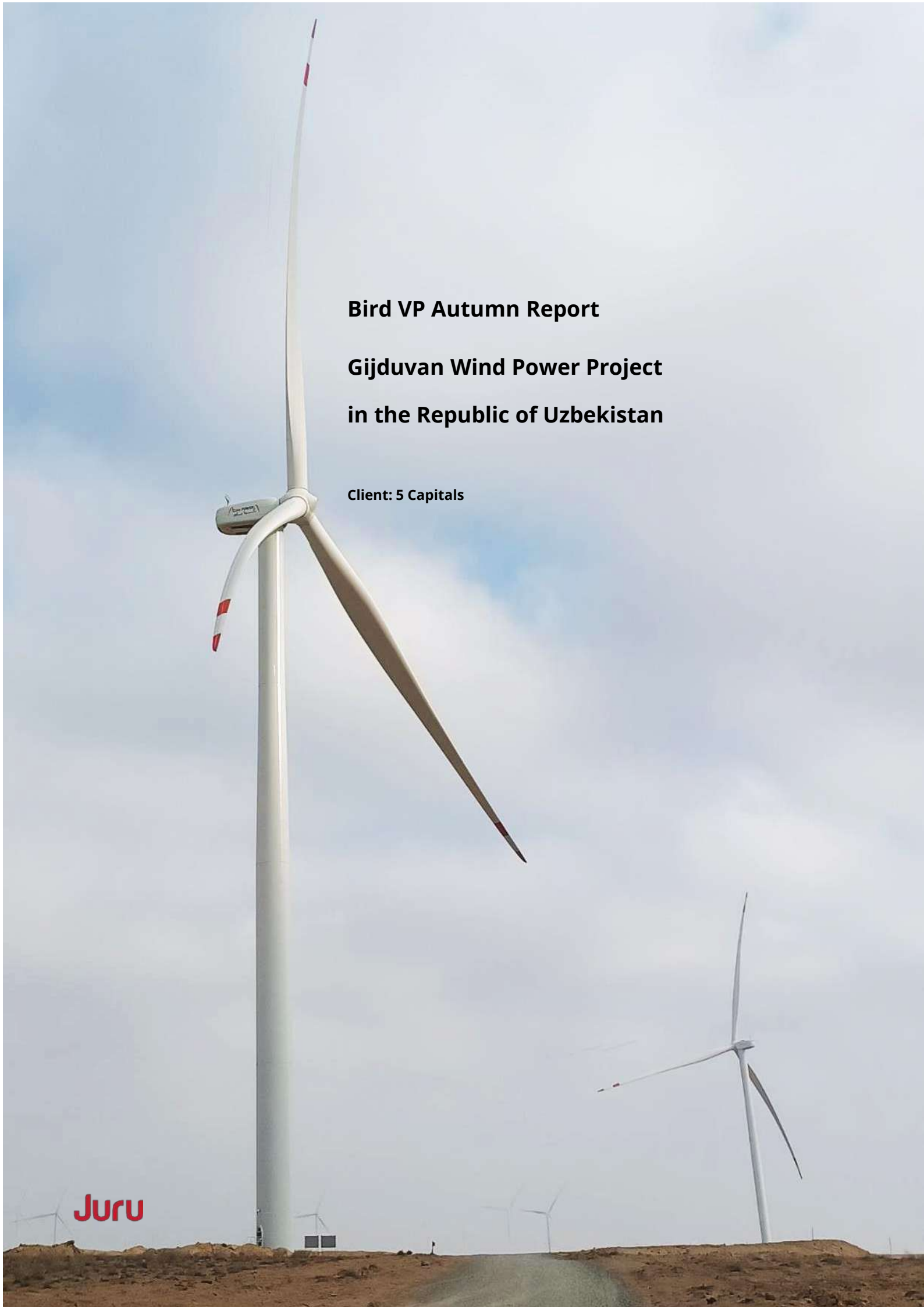
APPENDIX H - DETAILED TERRESTRIAL ECOLOGY SURVEY REPORTS

The following survey reports are included here within

1. Autumn VP Survey Report
2. Spring VP Survey Report
3. Summer VP Survey Report
4. Winter VP Survey Report
5. Asian Houbara Survey Report
6. Raptor Nest Survey Report
7. Autumn Waterbird Survey Report
8. Spring Waterbird Survey Report
9. Bat Roost Search Survey Report
10. Bat Analysis Report
11. Habitat and Botanical Autumn Survey Report
12. Habitat and Botanical Spring Survey Report
13. Full year Collision Risk Modelling Report.pdf
14. Mammal and Phototrapping Survey Report
15. Reptile Autumn Survey Report
16. Reptile Spring Survey Report

Note: Where required, *Coordinates were redacted from the reports to protect species of conservation concern*

1.AUTUMN VP SURVEY REPORT



Bird VP Autumn Report

**Gijduvan Wind Power Project
in the Republic of Uzbekistan**

Client: 5 Capitals

Juru

Document Information

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1. Introduction

The Gijduvon wind power project will involve the establishment of a 300 MW wind farm, collector sub-station and an associated Overhead Transmission Line (OTL) with a capacity of 500 kV, as well as the expansion of an associated sub-station, in Bukhara region, Uzbekistan. The wind farm will include a total of 38 Wind Turbine Generators (WTG), which will be micro-sited within an investigation area measuring approximately 13,645 ha.

The project site is located in the Bukhara region of the Republic of Uzbekistan. The wind farm will consist of one polygon of Wind Turbine Generators (WTG).

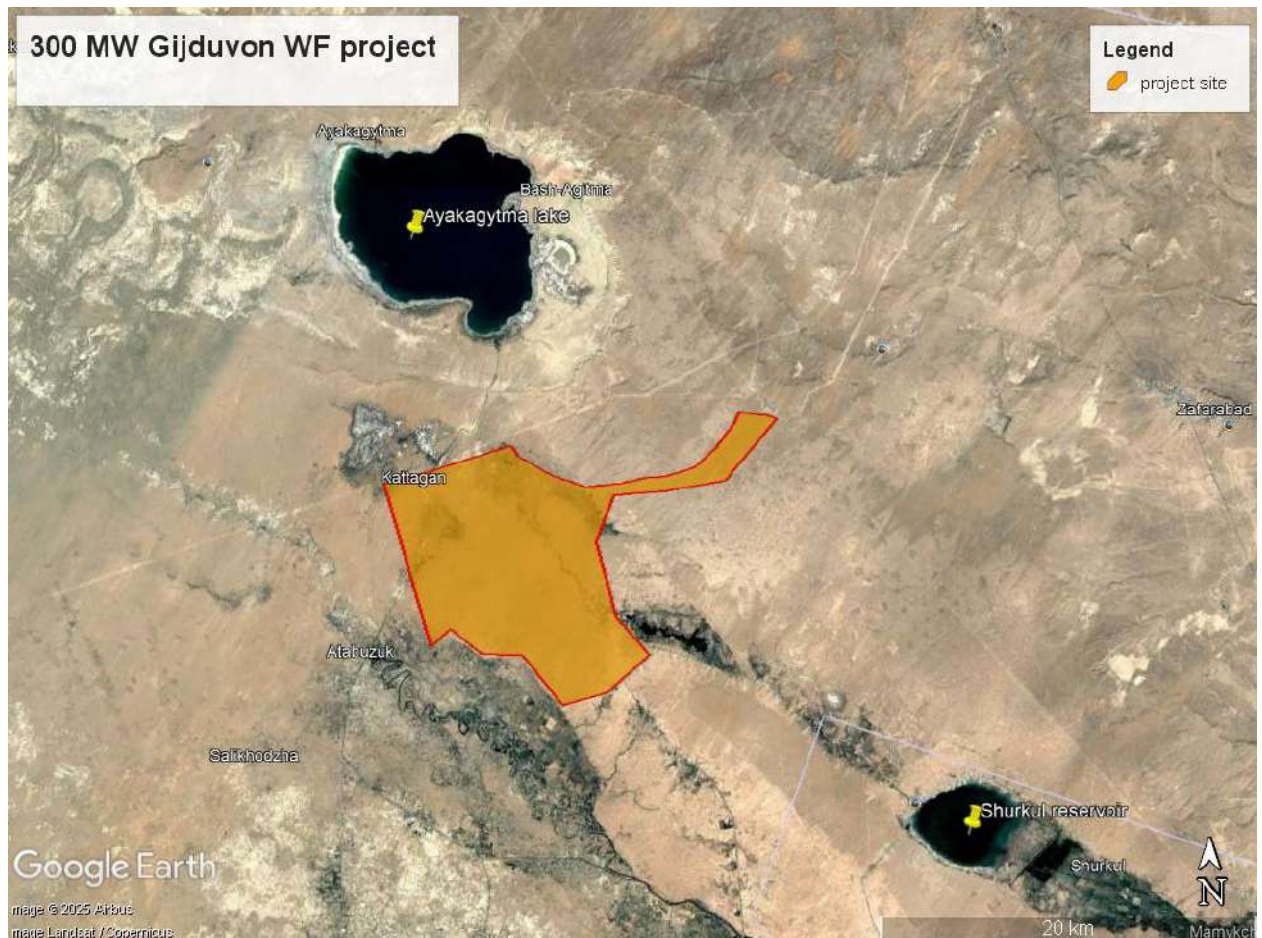


Figure 1: Project site

The report presents data and materials from field bird VP Autumn monitoring and details the findings of the 2024 Autumn survey period, conducted between September 1 – November 10, 2024.

2. Materials and methods Vantage point (VP) bird monitoring on WF

The VP survey is designed to quantify the level of flight activity and the distribution of birds across the survey area. Its primary objective is to gather data for the Collision Risk Model (CRM), which informs the Collision Risk Assessment (CRA) by predicting mortalities resulting from collisions with operational turbines. This data can also provide insights into bird usage of the site, aiding in the assessment of potential impacts such as habitat loss, disturbance, displacement, and barrier effects.

The survey methods adhere to international best practice guidance, particularly the Scottish Natural Heritage: Recommended bird survey methods to inform impact assessment of onshore wind farms (March 2017, v2.) (SNH

guidance 2017¹) and the IFC EHS Guidelines for Wind Energy (2015²). These methods are specifically tailored for use in collision risk assessment models.

Equipment

- Field notebook and writing implements;
- Field survey sheets;
- Weatherproof Clipboard;
- At least two stopwatches / timer watches;
- Compass / GPS unit;
- Binoculars (at least 8x magnification);
- Telescope (minimum 60mm x 25/30 magnification) with tripod;
- Photo camera;
- Laptop with Excel required to write up the field sheets (or have access to them).

VP locations

9 VP locations have been identified for the 300 MW Gijduvon WF site covering the project area with a focus on turbine locations as per the updated RfP.

¹ <https://www.nature.scot/sites/default/files/2018-06/Guidance%20Note%20-%20Recommended%20bird%20survey%20methods%20to%20inform%20impact%20assessment%20of%20onshore%20windfarms.pdf>

² https://www.ifc.org/wps/wcm/connect/b82d0563-b39a-42a7-b94e-0b926b4a82f9/FINAL_Aug%2B2015_Wind%2BEnergy_EHS%2BGuideline.pdf?MOD=AJPERES&CVID=mpusVXy



Figure 2: VP locations (VP01...VP09) survey points

Survey Timing

The VP surveys have been tailored to the ecology of the target bird species involved, with specific considerations for timing and duration. Surveys were conducted by one or two teams of two people (two people per point), rotating across 9 survey points. Following SNH recommendations, each VP session typically lasted 2 to 3 hours to ensure that observers remained alert and bird activity was accurately recorded.

During the Autumn migrating season from September 1 until November 10, 2024, a total of 324 hours were completed for the site, averaging 36 hours per VP location (Table 1). Surveys were conducted under suitable weather conditions with good ground visibility (>2km).

Tier 1 and 2 species

VP Survey Methods:

- Tier 1 Target Species Sampling**

The area in view was scanned until a Tier 1 Target Species was detected, at which point it was followed until it ceased flying or was lost from view. The time the Tier 1 target bird was detected the flight duration was recorded, and the route the bird followed was plotted in the field on the provided maps (Annex 1). The bird's flight height was estimated at the time of detection and then at 15-second intervals thereafter. A 15-second interval was recommended as a practical compromise that aimed to minimize dependency within data while maximizing the sample of observations. The species included as Tier 1 Target Species can be adjusted in the future based on the observations made on site.

- Tier 2 Target Species and "Other" Species Sampling**

Observation of Tier 1 Target Species took priority over recording of Tier 2 Target Species and "other" species, defined as any bird species not listed as a target species. The only differences between the

sampling effort for Tier 2 Target Species and other species compared with Tier 1 Target Species were: 1) flight paths were not mapped for Tier 2 Target Species or other species; and 2) location and flight altitude data were only recorded a single time for any bird or flock of Tier 2 Target Species or other species, instead of every 15 seconds as was the case for Tier 1 Target Species.

The number of birds recorded was the minimum number of individuals that could account for the activity observed.

Data Recording Methods

Data for *Tier 1 Target Species* were recorded on the front of survey forms and mapped on maps of the survey area provided. Different forms were used for different survey periods (*i.e.* data from different VP sessions were not combined into one form or map). Maps clearly identified and cross-referenced to the information on the form on:

- The location of the VP used.
- Date of survey.
- Surveyor name.
- Start and End time of the VP session.
- Flight lines indicating the direction of flight for each individual (birds flying alone) or flock (birds flying in a flock of >1 bird), with a point annotated with estimated flight altitude estimated every 15 seconds as the bird or flock was flying along the mapped flight trajectory. If necessary, use different colours and symbols for each species, including a key on the form.
- Reference number of each flight line corresponding to that on the form.

Where off-site activity of interest is noted and may be linked to site activity (*e.g.* flight lines leading off-site to a known roosting location) this should be recorded in the note's column.

Data for tier 2 target species and other species is recorded on the rear of the forms.

Table 1: Schedule of VP (in hours) during Autumn 2024

VP	N	E	01-Sep	02-Sep	03-Sep	21-Sep	22-Sep	23-Sep	05-Oct	06-Oct	07-Oct	12-Oct	13-Oct	14-Oct	19-Oct	20-Oct	21-Oct	26-Oct	27-Oct	02-Nov	03-Nov	07-Nov	08-Nov	09-Nov	10-Nov	Total hours
VP01					3		3		3	3		3	3			3	3	3	3		3				3	36
VP02					3		3		3	3		3	3			3	3	3	3		3				3	36
VP03						3		3		3	3		3		3		3			3	3	3	3	3		36
VP04						3		3		3	3		3		3		3			3	3	3	3	3		36
VP05					3		3		3	3		3	3			3	3	3	3		3				3	36
VP06						3		3		3	3		3		3		3			3	3	3	3	3		36
VP07			3			3	3		3		3	3		3	3	3		3	3				3			36
VP08			3			3	3		3		3	3		3	3	3		3	3				3			36
VP09			3			3	3		3		3	3		3	3	3		3	3				3			36
																										324

3. RESULTS

During the VP monitoring from September 1 through November 10, 2024, 68 bird species were observed, 12 were listed in the Red Book of Uzbekistan (2019), and 5 were included in the IUCN Red List (2023-1) with VU and EN statuses (Table 2).

Detailed field data is presented in the Excel file attached to this report – 'Gijduvan 300MW WF-VP Autumn.xlsx'.

Table 2: List of birds observed during the Autumn VP Monitoring 2024.

No	Species	Common name	Tier	IUCN Red list	UzRDB 2019	Status ³
1	<i>Anser anser</i>	Greylag Goose	2			M
2	<i>Anas crecca</i>	Green-winged Teal				M
3	<i>Netta rufina</i>	Red-crested Pochard				M
4	<i>Coturnix coturnix</i>	Common Quail				M
5	<i>Columba livia</i>	Rock Pigeon				M
6	<i>Pterocles orientalis</i>	Black-bellied Sandgrouse				R
7	<i>Chlamydotis macqueenii</i>	Macqueen's Bustard	1	VU	VU:D	BM
8	<i>Tetrax tetrax</i>	Little Bustard	2	NT	VU:D	M
9	<i>Anthropoides virgo</i>	Demoiselle Crane	2			M
10	<i>Grus grus</i>	Common Crane	2			M
11	<i>Vanellus vanellus</i>	Northern Lapwing	2	NT		M
12	<i>Tringa nebularia</i>	Common Greenshank				M
13	<i>Glareola pratincola</i>	Collared Pratincole				M
14	<i>Chroicocephalus ridibundus</i>	Black-headed Gull				M
15	<i>Larus cachinnans</i>	Caspian Gull				SM
16	<i>Microcarbo pygmaeus</i>	Pygmy Cormorant	2		NT	M
17	<i>Ardea alba</i>	Great Egret				M
18	<i>Ardea cinerea</i>	Gray Heron				M
19	<i>Circaetus gallicus</i>	Short-toed Snake-eagle	1		VU:D	BM
20	<i>Clanga clanga</i>	Greater Spotted Eagle	1	VU	VU:R	M
21	<i>Hieraetus pennatus</i>	Booted Eagle			VU:D	M
22	<i>Aquila nipalensis</i>	Steppe Eagle	1	EN	VU:D	M
23	<i>Aquila heliaca</i>	Imperial Eagle	1	VU	VU:D	M
24	<i>Aquila chrysaetos</i>	Golden Eagle	1		VU:R	BM
25	<i>Circus aeruginosus</i>	Western Marsh Harrier	2			BM
26	<i>Circus cyaneus</i>	Hen Harrier	2			M
27	<i>Circus macrourus</i>	Pallid Harrier	2	NT	NT	M
28	<i>Accipiter nisus</i>	Eurasian Sparrowhawk	2			M
29	<i>Buteo buteo</i>	Common Buzzard	2			M
30	<i>Buteo rufinus</i>	Long-legged Buzzard	2			BM
31	<i>Buteo hemilasius</i>	Upland Buzzard				M
32	<i>Bubo bubo</i>	Eurasian Eagle-owl	2			R
33	<i>Athene noctua</i>	Little Owl	2			R
34	<i>Merops persicus</i>	Blue-cheeked Bee-eater				M
35	<i>Falco naumanni</i>	Lesser Kestrel	2		NT	BM
36	<i>Falco tinnunculus</i>	Eurasian Kestrel	2			BM
37	<i>Falco columbarius</i>	Merlin				M

³ Status of the observed species: R – resident, W – wintering, M – migrating, B – breeding, S – summering (non breeding)

No	Species	Common name	Tier	IUCN Red list	UzRDB 2019	Status ³
38	<i>Falco cherrug</i>	Saker Falcon	1	EN	EN	BM
39	<i>Lanius excubitor</i>	Great Gray Shrike				B
40	<i>Corvus monedula</i>	Eurasian Jackdaw				M
41	<i>Corvus frugilegus</i>	Rook				M
42	<i>Corvus corone</i>	Carrion Crow				M
43	<i>Calandrella brachydactyla</i>	Greater Short-toed Lark				BM
44	<i>Melanocorypha bimaculata</i>	Bimaculated Lark				M
45	<i>Melanocorypha calandra</i>	Calandra Lark				BM
46	<i>Alauda rufescens</i>	Mediterranean Short-toed Lark				BM
47	<i>Alauda arvensis</i>	Eurasian Skylark				BM
48	<i>Galerida cristata</i>	Crested Lark				R
49	<i>Riparia riparia</i>	Bank Swallow				BM
50	<i>Hirundo rustica</i>	Barn Swallow				M
51	<i>Phylloscopus collybita</i>	Common Chiffchaff				M
52	<i>Scotocerca inquieta</i>	Scrub Warbler				R
53	<i>Curruca curruca</i>	Lesser Whitethroat				M
54	<i>Curruca nana</i>	Asian Desert Warbler				R
55	<i>Curruca communis</i>	Common Whitethroat				M
56	<i>Sturnus vulgaris</i>	European Starling				M
57	<i>Muscicapa striata</i>	Spotted Flycatcher				M
58	<i>Saxicola torquatus</i>	African Stonechat				M
59	<i>Oenanthe isabellina</i>	Isabelline Wheatear				R
60	<i>Oenanthe deserti</i>	Desert Wheatear				R
61	<i>Oenanthe pleschanka</i>	Pied Wheatear				B
62	<i>Passer hispaniolensis</i>	Spanish Sparrow				M
63	<i>Motacilla flava</i>	Western Yellow Wagtail				M
64	<i>Motacilla alba</i>	White Wagtail				M
65	<i>Anthus campestris</i>	Tawny Pipit				M
66	<i>Anthus trivialis</i>	Tree Pipit				M
67	<i>Rhodospiza obsoleta</i>	Desert Finch				R
68	<i>Emberiza calandra</i>	Corn Bunting				M

VP data

The analysis of bird species distribution across various VPs presented below underscores the significance of these locations for migrating bird species.

Table 3: The distribution of bird species Tier 1 and 2 at VPs

No	Species	Tier	IUCN RL	UzRDB	VP01	VP02	VP03	VP04	VP05	VP06	VP07	VP08	VP09	Total number	Total records	Notes
1	Greylag Goose	2				63								63	1	One flock comprising 63 individuals was observed in flight, indicating a migratory movement.
2	Black-bellied Sandgrouse	2			211	174	44	78	85	137	275	124	76	1204	160	160 records: 14 single individuals, 23 pairs, and several small flocks observed.
3	Macqueen's Bustard	1	VU	VU:D					1				1	2	2	Two single birds were observed feeding on the ground at separate locations.
4	Little Bustard	2	NT	VU:D		1								1	1	A single bird was observed in flight.
5	Demoiselle Crane	2			170	141		27			21	73	3	435	10	10 flocks observed, totaling 435 cranes.
6	Common Crane	2				58	5	73	31		250		29	446	9	Nine flocks totaling 446 cranes were recorded, indicating regular migratory passage.
7	Northern Lapwing	2	NT		134						32			166	3	Three flocks totaling 166 birds were recorded.

8	Pygmy Cormorant	2		NT						1				1	1	A single bird was observed perching on a pole at VP6.
9	Short-toed Snake-eagle	1		VU:D						1		1		2	2	Two single birds were observed at VP6 and VP8.
10	Greater Spotted Eagle	1	VU	VU:R					1					1	1	A single bird was observed at VP5.
11	Booted Eagle	2		VU:D								1		1	1	A single bird was observed in flight at VP8.
12	Steppe Eagle	1	EN	VU:D	5	1	13	6	16		4	143	3	191	45	22 single birds and 23 flocks (mostly 2-3 individuals) were observed, totalling 191 birds.
13	Imperial Eagle	1	VU	VU:D			1	1	1	1		1	2	7	6	Five single birds and 1 pair were recorded across the project site. One bird was observed resting on the ground.
14	Golden Eagle	1		VU:R								1		1	1	A single bird was recorded at VP8.
15	Western Marsh Harrier	2			2	5	1			7		1	7	24	23	Twenty-two single individuals and 2 birds were recorded migrating.
16	Hen Harrier	2				2		2		2	1	1	4	12	11	Eleven single birds were observed migrating across various vantage points.
17	Pallid Harrier	2	NT	NT									1	1	1	A single bird was recorded at VP9.

18	Eurasian Sparrowhawk	2			4						2			6	5	Four single and 2 birds were recorded
19	Common Buzzard	2			1				1		1	2	2	7	7	Seven single birds were observed, indicating dispersed migration patterns.
20	Long-legged Buzzard	2			2	3	8	1	4		6	4	3	31	29	Twenty-eight single birds and one flock with four individuals were observed, totalling 31 birds.
21	Upland Buzzard	2			1									1	1	Single bird was recorded at VP1
22	Eurasian Eagle-owl	2						1		1				2	2	Two individuals were observed sitting on perches, likely indicating territorial behavior
23	Little Owl	2			3	1	2		1	1				8	8	Eight individuals were observed either sitting on the ground or perching.
24	Lesser Kestrel	2		NT		1			1				8	10	4	Three individual birds and one flock of seven were observed.
25	Eurasian Kestrel	2				3	1	1	2	7	1	2	2	19	19	Nineteen records of single migrating kestrels were documented. Observations included hunting

																and perching activities.
26	Merlin	2				1								1	1	A single bird was observed in flight.
27	Saker Falcon	1	EN	EN			1							1	1	A single bird was recorded at VP3

4. Key species descriptions

Greylag Goose (*Anser anser*) - tier 2

Status: Migratory and wintering species for Uzbekistan and for the project site.

Habitats: This species migrates and winters in the Kyzylkum desert, in Ayakagytma and Shorkul reservoir.

Autumn VP survey results: One flock comprising 63 individuals was observed in flight.

Black-bellied Sandgrouse (*Pterocles orientalis*) - tier 2

Status: migratory breeding and wintering for Uzbekistan, same for the project site.

Distribution: Widespread in desert and semi-desert areas. Breeds in Central Kyzylkum on the plains surrounding Bukantau, Dzhetymtau, Tamdytau, Aristantau, Beltau, and Sangruntau. To the west, it breeds in a large area between the wells of Aigyrbulak, Buzaubay, and Koskuduk, in southwestern Kyzylkum on the plains surrounding Kuldzhuktau. In southern Kyzylkum, noted for breeding near Gazli and Bukhara, reaching the Amu Darya on one side and the Zarafshan River on the other.

Habitats: Inhabits sandy plains, slightly hilly areas with small gravel and wormwood. Always remains near watering holes. Feeds primarily on seeds.

Autumn VP survey results: The species was observed a total of 160 times, comprising 14 single individuals, 23 pairs, and several small flocks, totaling 1,204 birds across all VPs during all observation seasons. Groups were recorded at heights ranging from 2 to 90 meters, with an average height of 11 m



Figure 3. A flock of Black-bellied Sandgrouse

Macqueen's Bustard (*Chlamydotis macqueenii*) - UzRDB: 2(VU:D); IUCN: VU (Decreasing) - tier 1

Status: Breeding and migratory species for Uzbekistan and for the project site.

Distribution: The Macqueen's Bustard is a breeding and migratory species found primarily in the Kyzylkum Desert, Ustyurt Plateau, Karnabchul steppe. It breeds in these regions and is also observed during seasonal migrations. The nesting population ranges from 1.5 to 3 thousand individuals, amounting to 0.05-0.4 individuals per square kilometre. During migration, the numbers can peak at up to 20 thousand individuals.

Habitats: This species prefers habitats characterized by clayey plains with wormwood grass cover, as well as the outskirts of takyr (salt flats) and salt marshes adorned with various bushes of saltwort and camel thorn. Its diet comprises grasses, seeds, invertebrates, small rodents, and reptiles.

Autumn VP survey results: Two single birds were observed feeding on the ground at separate locations at VP5 and VP9.

Little Bustard (*Tetrax tetrax*) - UzRDB: 2(VU:D); IUCN: NT - tier 2

Status: Migratory and wintering species for Uzbekistan, rare migratory for the project site.

Distribution: Found in desert, semidesert, and plain areas across Uzbekistan.

Autumn VP survey results: A single bird was observed in flight during the autumn survey, indicating the species' rare occurrence at the project site.

Demoiselle Crane (*Anthropoides virgo*) - tier 2

Status: Migratory species in Uzbekistan, observed during migration at the project site.

Distribution: During migration, Demoiselle Cranes are widely distributed across Uzbekistan. Spring migration typically begins in late February to early March and extends until mid-April, while autumn migration starts in the second half of August to early September.

Autumn VP survey results: Ten flocks were observed across six VPs, with group sizes ranging from 3 to 170 individuals, totaling 435 cranes. Most flocks were observed at altitudes over 1,000 meters, with only one flock recorded at a height of 20 meters.

Common Crane (*Grus grus*) - tier 2

Status: Migratory species in Uzbekistan, observed during migration at the project site.

Distribution: During migration, Common Cranes are widely distributed across Uzbekistan. Spring migration typically begins in late February to early March and extends until mid-April, while autumn migration starts in the second half of August to October.

Autumn VP survey results: Nine flocks, with group sizes ranging from 5 to 140 individuals, were recorded, totaling 446 cranes. Most flocks were observed at altitudes over 1,000 meters, with only one flock recorded at a height of 20 meters.

Northern Lapwing (*Vanellus vanellus*) - IUCN: NT (decreasing) - tier 2

Status: Migratory species in Uzbekistan, observed during migration at the project site.

Autumn VP survey results: Three flocks, with group sizes ranging from 17 to 117 individuals and totaling 166 birds, were recorded at VP1 and VP7. Flocks were observed in flight at altitudes between 10 and 20 m.

Pygmy Cormorant (*Microcarbo pygmaeus*) - UzRDB: NT - tier 2

Status: Resident and Migratory species in Uzbekistan, observed during migration at the project site.

Autumn VP survey results: A single bird was observed perching on a pole at VP6.

Short-toed Snake Eagle (*Circaetus gallicus*) - UzRDB: 2(VU:R) - tier 1

Status: Migratory breeding species.

Distribution: This species breeds in the Kyzylkum desert.

Habitats: The Short-toed Snake Eagle nests on bushes, trees, cliffs, and rocks. The primary consideration when choosing a nesting site is the presence of large reptiles with daytime activity and suitable locations for nesting. Its diet consists primarily of lizards, snakes, and occasionally small rodents.

Autumn VP survey results: Two single birds were observed in flight at VP6 and VP8 at altitudes of 20 meters and 100 meters, respectively.

Greater Spotted Eagle (*Clanga clanga*) - UzRDB: 2(VU:R); IUCN: VU (Decreasing) - tier 1

Status: Migrating and wintering in Uzbekistan, and a rare migratory species at the project site.

Distribution: Spring migration occurs from February to May, and autumn migration occurs from October to November. Greater Spotted Eagles migrate singly or in small groups of 2-3 individuals and can be observed across Uzbekistan during these periods. Data on their wintering habits remain limited. The species feeds on small mammals, waterbirds, frogs, and snakes.

Autumn VP survey results: A single bird was observed at VP5 sitting on a *Ferula* sp.



Figure 4: Greater Spotted Eagle observed roosting on a *Ferula* plant

Booted Eagle (*Hieraetus pennatus*) - UzRDB: 2(VU:D) - tier 2

Status: Breeding in mountainous regions of Uzbekistan, and a rare migratory species at the project site.

Autumn VP survey results: A single bird was observed in flight at VP5.

Steppe Eagle (*Aquila nipalensis*) - UzRDB: 2(VU:D); IUCN: EN (Decreasing) - tier 1

Status: Breeding (northern Uzbekistan), migrating and wintering in Uzbekistan and at the project site.

Distribution: The Steppe Eagle inhabits plains and low mountains. Spring migration occurs from February to May, autumn migration from September to November, and winter from December to February. Breeding is confined to the northern part of the Karakalpak Ustyurt.

Habitats: Steppe Eagles construct nests on the ground or on rocks. They primarily feed on rodents, especially great and red-tailed gerbils, and in the Ustyurt region, they also prey on small gophers. Additionally, Steppe Eagles scavenge carrion.

Autumn VP survey results: A total of 22 single birds and 23 flocks (mostly 2-3 individuals) were observed, amounting to 191 birds. Most birds and flocks were recorded at altitudes between 15 and 1,300 meters. Three

birds were observed roosting on the ground, and one bird was recorded perching on a pole. Observations spanned from October 5 to November 3, with 85% of records occurring between October 19 and November 3. This indicates that the primary migration wave occurred during this period.

Imperial Eagle (*Aquila heliaca*) - UzRDB: 2(VU:D); IUCN: VU (Decreasing) – tier 1

Status: migratory and winters in Uzbekistan, with migration also observed at the project site.

Distribution: Spring migration occurs from February to April, during which birds fly alone or in groups of up to 15 individuals. This species is distributed across the Ustyurt plateau and Northern Kyzylkum during breeding. During seasonal migrations, Eastern Imperial Eagles can be found throughout Uzbekistan.

Habitats: Species inhabit plains and foothills. They primarily feed on rodents, hedgehogs, turtles, and carrion.

Autumn VP survey results. Five single birds and 1 pair were recorded across the project site. One bird was observed resting on the ground.

Golden Eagle (*Aquila chrysaetos*) - UzRDB: 2(VU:R) - tier 1

Status: The breeding population is resident with small seasonal movements, the other population migrating and wintering throughout Uzbekistan. It breeds in the Ayakagytma depression.

Distribution: Historically, the Golden Eagle population has been relatively small. In the late 1970s and early 1980s, there were estimated to be 80-100 breeding pairs on the Ustyurt plateau, in the Kyzylkum desert, and across various mountain ranges including Bukantau, Tamdytau, Muruntau, Pistalitau, Nuratau, Gissar, Turkestan, Zarafshan, and Chatkal. During migrations, Golden Eagles can be found throughout Uzbekistan.

Habitats: This species inhabits sandy massifs, remnant mountains in deserts, foothills, and rocky areas in the middle and upper mountain zones, up to elevations of 2,500-3,000 meters above sea level. Its diet includes small mammals, birds, snakes, turtles, and occasionally carrion.

Autumn VP survey results. A single bird was recorded at VP8 in flight at a height of 180 meters. This species breeds in the region, and several nests are known in the Ayakagytma cliffs. However, the species was rarely observed during VP surveys.

Harriers – tier 2

Western Marsh Harrier (*Circus aeruginosus*) – tier 2

Hen Harrier (*Circus cyaneus*) – tier 2

Pallid Harrier (*Circus macrourus*)- UzRDB NT – tier 2

The Hen Harrier and Pallid Harrier are migratory species, with both also wintering in the Kyzylkum Desert. The Western Marsh Harrier is both a breeding and migratory species in the region.

Habitats: Harriers prefer habitats such as cultivated fields, open desert or plains, and the shores of water bodies. These environments provide ample prey, including house mice, mole voles, and small wintering birds.

Autumn VP survey results:

Western Marsh Harrier: Twenty-two individuals were recorded, along with two birds observed migrating.

Hen Harrier: Eleven individuals were observed migrating across various vantage points.

Pallid Harrier: A single individual was recorded at VP09.

Eurasian Sparrowhawk (*Accipiter nisus*) – tier 2

Status: this species is known as a breeding, migrating, and wintering bird in Uzbekistan, and it is a migrating species at the survey site.

Distribution: During spring and autumn migrations, this species is widespread across the flat territories of Uzbekistan, including mountainous areas up to the upper forest boundary. In winter, it is commonly found in tugai forests along river valleys and in agricultural oases, including urban areas.

Habitats: Sparrowhawk is primarily an ornithophage, preying on birds, though it may occasionally feed on small rodents.

Autumn VP survey results. Six individuals were observed in October, including four singles and two birds in flight. These were recorded at VP1 and VP7, flying at heights of up to 12 meters.

Common Buzzard (*Buteo buteo*) – tier 2

Status: Migratory, wintering species in Uzbekistan and in the project site, and it is a migrating species at the survey site.

Distribution: This species is commonly observed during spring and autumn migrations, as well as throughout the winter in Uzbekistan. Significant migration activity is recorded in the valley of the middle Syrdarya, the flat areas of the Tashkent region, and the Mirzachul Steppe. However, its numbers decline westward in the Kyzylkum Desert and Zarafshan Valley. In the middle and lower Amudarya Valley, the species is observed only sporadically.

Habitats: During wintering, birds stick to agricultural areas, river valleys and the adyr zone of the foothills, where there are settlements of mouse-like rodents.

Autumn VP survey results. Seven single individuals were observed flying at five vantage points between September 21 and November 10, 2024. Recorded flight heights ranged from 9 to 120 meters.

Long-legged Buzzard (*Buteo rufinus*) - IUCN: LC (Stable) – tier 2

Status: Breeding migrator, with migrating and wintering populations originating from northern areas.

Distribution: This species is a common breeding bird found throughout the lowland regions of Uzbekistan.

Habitats: This species can be found during migrations, nesting, and wintering periods in various habitats across Uzbekistan, including sandy deserts with saxaul forests, mountainous areas with rocks and ravines, dry riverbeds, river valleys, as well as clayey and sandstone cliffs.

Autumn VP survey results: A total of 31 individuals were recorded between September 21 and November 10, 2024. This included 28 single birds and one flock of four individuals. Observations were made at flight heights ranging from 7 to 1,000 meters, with an average height of 68 meters.

Eastern Buzzard (*Buteo japonicus*) – tier 2

Status: Migrating and wintering species, and it is a migrating species at the survey site.

Autumn VP survey results: A single Eastern Buzzard was recorded at VP1, flying at a height of 8 meters.

Eurasian Eagle owl (*Bubo bubo*) – tier 2

Status: Resident for the region and project site

Distribution: Widely distributed in all lowlands between the Amudarya and the Syrdarya; particularly abundant in low mountains in the central part of the Kyzylkum desert and the foothills of the Pamir-Alai external ranges (Nuratau, Baisuntau and Kugitang Ranges), in the valley of the middle course of the Amudarya and particularly on the shores of huge wastewater lakes (Dengizkul, Aydarkul, Karakir and others). Inhabits the Ustyurt Plateau. Occurs all along the Zeravshan valley, from the source to the lower reaches. Currently, breeds in small numbers in the flatlands and foothills of the Fergana Valley. Recorded in the Surkhandarya and Sherabad river valleys in Surkhandarya Province.

Habitats: Breeding biotopes are steep loess slopes, small caves, the niches and cracks of rocks, saxaul thickets, the eroded walls of deep gullies. Birds' daily activity varies from season to season: in spring and summer they are active only in the dark, while in autumn and winter (particularly on cloudy days) they can be observed during the

day, at least some time before sunset and a little after sunrise. The diet includes small mammals, reptiles, fish, birds and insects.

Autumn VP survey results: Two individuals were observed sitting on perches.

Little Owl (*Athene noctua*) – tier 2

Status: Resident for the region and project site

Distribution: The Little Owl is widespread throughout Uzbekistan, inhabiting oases, mountains, and semi-desert areas across the republic. During daylight hours, they seek shelter. In the autumn-winter period, these owls are typically solitary, while during the breeding season they form pairs.

Habitats: Their nesting habitats are diverse and include settlements, sandy and clayey deserts, river valleys, forest shelterbelts, and other areas. Little Owls are known to inhabit loess cliffs, gardens, old wells, ruins of houses, farmyards, tree hollows, rock cracks, burrows of great gerbils, and thin-toed ground squirrels. They primarily feed on vertebrates such as rodents, small birds, lizards, as well as insects and arachnids.

Autumn VP survey results: Eight individuals were observed either sitting on the ground or perching.

Lesser Kestrel (*Falco tinnunculus*) – tier 2

Status: Migratory breeding species in Uzbekistan, and migratory breeding close to project site.

Distribution: Lesser Kestrels nest in rocky niches, precipitous slopes, and cavities formed by fallen rock fragments. They may also nest in artificial structures such as buildings and towers. Nests are usually made of a few branches placed inside a niche, with eggs sometimes laid directly on the surface without lining. They occasionally use the nests of other bird species, including ravens, rock doves, and jackdaws. Breeding occurs in separate pairs or colonies, sometimes reaching up to 25–30 pairs, often near Common Kestrel nesting sites.

Autumn VP survey results: Three individual Lesser Kestrels and one flock of seven were observed between September 21 and October 12, 2024, flying at heights of 5–35 meters.

Eurasian Kestrel (*Falco tinnunculus*) – tier 2

Status: Migratory breeding and wintering species in Uzbekistan, and migratory breeding in project site.

Distribution: The Eurasian Kestrel is a widespread breeding species in all regions of Uzbekistan, excluding highlands. During the nesting period, it exhibits significant movement and can be encountered in various habitats. In winter, it is a common bird of lowland areas, with individuals from northern populations likely overwintering in the region. The sedentary nature of local breeding populations remains uncertain. Migratory populations from the north pass through Uzbekistan during spring and autumn.

Habitats: Eurasian Kestrels nest in diverse conditions, including rock outcrops, cliffs, saxaul forests, power line supports, triangulation towers, ruins, and other structures. Their diet primarily consists of small mouse-like rodents and insects.

Autumn VP survey results: 19 individual Eurasian Kestrels were observed at all vantage points between September 21 and November 9, 2024, flying at heights ranging from 4 to 20 meters.

Merlin (*Falco columbarius*) – tier 2

Status: Wintering species in the region, including the project site.

Distribution: This species is commonly observed in lowland areas during the winter months.

Autumn VP survey results: A single Merlin was recorded in flight at VP2 on October 15, 2024, at a height of 2 meters.

Saker Falcon (*Falco cherrug*) - UzRDB: EN; IUCN: EN (Decreasing) - tier 1

Status: Breeding and migratory, locally resident bird. Breeding pairs are known to nest on loess cliffs near Ayakagytna Lake, close to the project site.

Distribution: During migration and in winter occurs almost all across the lowlands of Uzbekistan, including farming lands and even the outskirts of urban areas. Commonly makes short-distance migrations to mountainous areas, where it is not so abundant, however. The population has been locally declining, probably, there are a total of 120-150 breeding couples and 500-700 migrating individuals; 100-150 individuals stay for the winter in the south of the country and single birds in all other parts.

Autumn VP survey results: A single bird was recorded at VP3 in flight at a height of 8 meters. This species breeds in the region, and several nests are known in the Ayakagytna cliffs. However, the species was rarely observed during VP surveys.

5. Annual results

Table 4. The total list of bird species observed on VP surveys during winter, spring, summer and autumn surveys

No	Species	Common name	Tier	IUCN Red list	UzRDB 2019	Winter (Jan - Mar 15)	Spring (Mar16- May30)	Summer (June1- Aug30)	Autumn (Sept1- Nov15)	Status
1	Anser anser	Greylag Goose	2			✓	✓		✓	MW
2	Cygnus olor	Mute Swan	2		NT	✓	✓			MW (B in Ayakagytma)
3	Tadorna ferruginea	Ruddy Shelduck				✓	✓			MW (B in Ayakagytma)
4	Tadorna tadorna	Common Shelduck				✓	✓			MW
5	Spatula clypeata	Northern Shoveler					✓			M
6	Mareca strepera	Gadwall					✓			M
7	Anas platyrhynchos	Mallard				✓				W
8	Anas crecca	Green-winged Teal				✓	✓	✓	✓	BMW
9	Netta rufina	Red-crested Pochard							✓	M
10	Coturnix coturnix	Common Quail					✓		✓	M
11	Alectoris chukar	Chukar				✓				low distance wintering movement from Ayakagytma cliffs
12	Columba livia	Rock Pigeon					✓	✓	✓	MB
13	Pterocles orientalis	Black-bellied Sandgrouse	2			✓	✓	✓	✓	RMW
14	Chlamydotis macqueenii	Macqueen's Bustard	1	VU	VU:D	✓	✓	✓	✓	MB
15	Tetrax tetrax	Little Bustard	2	NT	VU:D				✓	M
16	Cuculus canorus	Common Cuckoo					✓			M
17	Caprimulgus europaeus	European Nightjar						✓		M
18	Caprimulgus aegyptius	Egyptian Nightjar					✓	✓		B
19	Apus apus	Common Swift				✓	✓			M

No	Species	Common name	Tier	IUCN Red list	UzRDB 2019	Winter (Jan - Mar 15)	Spring (Mar16- May30)	Summer (June1- Aug30)	Autumn (Sept1- Nov15)	Status
20	Anthropoides virgo	Demoiselle Crane	2				✓		✓	M
21	Grus grus	Common Crane	2			✓			✓	M
22	Burhinus oediconemus	Eurasian Thick-knee					✓			M
23	Himantopus himantopus	Black-winged Stilt					✓	✓		BM
24	Vanellus vanellus	Northern Lapwing	2	NT					✓	M
25	Vanellus gregarius	Sociable Lapwing	1	CR	VU:R	✓				M
26	Vanellus leucurus	White-tailed Lapwing						✓		B
27	Anarhynchus leschenaultii	Greater Sandplover				✓	✓			MB
28	Actitis hypoleucos	Common Sandpiper						✓		S
29	Tringa glareola	Wood Sandpiper						✓		M
30	Tringa nebularia	Common Greenshank							✓	M
31	Glareola pratincola	Collared Pratincole					✓		✓	M
32	Chroicocephalus genei	Slender-billed Gull						✓		S
33	Chroicocephalus ridibundus	Black-headed Gull				✓	✓	✓	✓	BMW
34	Larus canus	Common Gull				✓				W
35	Larus cachinnans	Caspian Gull				✓	✓	✓	✓	nBMW
36	Larus fuscus	Lesser Black-backed Gull					✓			M
37	Sterna hirundo	Common Tern					✓			M
38	Ciconia nigra	Black Stork	2		VU:R		✓	✓		MB?
39	Microcarbo pygmaeus	Pygmy Cormorant	2		NT				✓	M
40	Phalacrocorax carbo	Great Cormorant				✓	✓			MW
41	Pelecanus crispus	Dalmatian Pelican	1	NT	EN	✓	✓			MW
42	Ardea alba	Great Egret				✓	✓	✓	✓	nBMW
43	Ardea cinerea	Gray Heron				✓	✓	✓	✓	BMW
44	Plegadis falcinellus	Glossy Ibis	2		VU:D		✓			M

No	Species	Common name	Tier	IUCN Red list	UzRDB 2019	Winter (Jan - Mar 15)	Spring (Mar16- May30)	Summer (June1- Aug30)	Autumn (Sept1- Nov15)	Status
45	Pandion haliaetus	Osprey	2		VU:R		✓			M
46	Aegypius monachus	Cinereous Vulture	1	NT	NT	✓				W
47	Circaetus gallicus	Short-toed Snake-eagle	1		VU:D	✓	✓		✓	MB(in the region)
48	Clanga clanga	Greater Spotted Eagle	1	VU	VU:R	✓			✓	M
49	Hieraaetus pennatus	Booted Eagle	2		VU:D				✓	M
50	Aquila nipalensis	Steppe Eagle	1	EN	VU:D	✓	✓		✓	MW
51	Aquila heliaca	Imperial Eagle	1	VU	VU:D	✓	✓		✓	MW
52	Aquila chrysaetos	Golden Eagle	1		VU:R	✓	✓		✓	B(in the region)MW
53	Circus aeruginosus	Western Marsh Harrier	2			✓	✓	✓	✓	BMW
54	Circus cyaneus	Hen Harrier	2			✓	✓		✓	MW
55	Circus macrourus	Pallid Harrier	2	NT	NT	✓	✓		✓	MW
56	Circus pygargus	Montagu's Harrier	2				✓			M
57	Accipiter badius	Shikra	2					✓		B(in the region)
58	Accipiter nisus	Eurasian Sparrowhawk	2			✓	✓	✓	✓	MW
59	Milvus migrans	Black Kite	2			✓			✓	MW
60	Haliaeetus albicilla	White-tailed Sea-eagle	1		VU:R	✓				W
61	Buteo buteo	Common Buzzard	2			✓	✓	✓	✓	MW
62	Buteo japonicus	Japanese Buzzard	2			✓	✓			MW
63	Buteo rufinus	Long-legged Buzzard	2			✓	✓		✓	BMW
64	Buteo hemilasius	Upland Buzzard	2						✓	M
65	Bubo bubo	Eurasian Eagle-owl	2					✓	✓	R in the region
66	Athene noctua	Little Owl	2			✓		✓	✓	R
67	Upupa epops	Eurasian Hoopoe					✓	✓		BM
68	Merops persicus	Blue-cheeked Bee-eater					✓	✓	✓	BM
69	Merops apiaster	European Bee-eater					✓	✓		BM

No	Species	Common name	Tier	IUCN Red list	UzRDB 2019	Winter (Jan - Mar 15)	Spring (Mar16- May30)	Summer (June1- Aug30)	Autumn (Sept1- Nov15)	Status
70	Coracias garrulus	European Roller					✓	✓		B
71	Falco naumanni	Lesser Kestrel	2		NT		✓		✓	BM
72	Falco tinnunculus	Eurasian Kestrel	2			✓	✓	✓	✓	BM
73	Falco columbarius	Merlin	2			✓			✓	MW
74	Falco cherrug	Saker Falcon	1	EN	EN				✓	B (in Ayakagytna) M
75	Oriolus oriolus	Eurasian Golden Oriole						✓		M
76	Lanius phoenicuroides	Red-tailed Shrike					✓	✓		B
77	Lanius excubitor	Great Gray Shrike				✓	✓	✓	✓	L.e.excubitor (M) and L.e.pallidirostris (B)
78	Corvus monedula	Eurasian Jackdaw				✓			✓	MW
79	Corvus frugilegus	Rook				✓	✓		✓	MW
80	Corvus corone	Carrion Crow							✓	M (C.corone orienalis and C.corone cornix)
81	Corvus corax	Common Raven				✓				W
82	Calandrella brachydactyla	Greater Short-toed Lark				✓	✓	✓	✓	BMW
83	Melanocorypha bimaculata	Bimaculated Lark							✓	M
84	Melanocorypha calandra	Calandra Lark				✓			✓	MW
85	Alaudala rufescens	Mediterranean Short-toed Lark				✓		✓	✓	BM
86	Alauda arvensis	Eurasian Skylark				✓			✓	MW
87	Galerida cristata	Crested Lark				✓	✓	✓	✓	R
88	Iduna rama	Sykes's Warbler					✓	✓		B
89	Riparia riparia	Bank Swallow						✓	✓	BM
90	Hirundo rustica	Barn Swallow				✓	✓	✓	✓	BM
91	Phylloscopus collybita	Common Chiffchaff					✓	✓	✓	MnB
92	Scotocerca inquieta	Scrub Warbler						✓	✓	B

No	Species	Common name	Tier	IUCN Red list	UzRDB 2019	Winter (Jan - Mar 15)	Spring (Mar16- May30)	Summer (June1- Aug30)	Autumn (Sept1- Nov15)	Status
93	Curruca curruca	Lesser Whitethroat					✓	✓	✓	M
94	Curruca nana	Asian Desert Warbler					✓	✓	✓	R
95	Curruca communis	Common Whitethroat							✓	M
96	Sturnus vulgaris	European Starling				✓	✓	✓	✓	MW
97	Muscicapa striata	Spotted Flycatcher						✓	✓	BM
98	Cercotrichas galactotes	Rufous Scrub-robin						✓		B
99	Luscinia svecica	Bluethroat					✓			B
100	Saxicola torquatus	African Stonechat					✓		✓	M
101	Saxicola caprata	Pied Bushchat					✓			M
102	Oenanthe oenanthe	Northern Wheatear					✓			M
103	Oenanthe isabellina	Isabelline Wheatear					✓	✓	✓	B
104	Oenanthe deserti	Desert Wheatear					✓	✓	✓	B
105	Oenanthe pleschanka	Pied Wheatear				✓	✓	✓	✓	BM
106	Oenanthe finschii	Finsch's Wheatear				✓	✓			M (B in the region)
107	Passer domesticus	House Sparrow				✓	✓	✓		Passer domesticus indicus (B) и P.d. domesticus (M)
108	Passer hispaniolensis	Spanish Sparrow				✓	✓	✓	✓	MW
109	Passer montanus	Eurasian Tree Sparrow					✓			B
110	Motacilla flava	Western Yellow Wagtail					✓	✓	✓	M
111	Motacilla alba	White Wagtail				✓	✓	✓	✓	M (subsp. Masked wagtail B)
112	Anthus campestris	Tawny Pipit					✓		✓	M
113	Anthus trivialis	Tree Pipit					✓		✓	M
114	Fringilla coelebs	Common Chaffinch				✓	✓			WM
115	Fringilla montifringilla	Brambling				✓				W

No	Species	Common name	Tier	IUCN Red list	UzRDB 2019	Winter (Jan - Mar 15)	Spring (Mar16- May30)	Summer (June1- Aug30)	Autumn (Sept1- Nov15)	Status
116	Carpodacus erythrinus	Common Rosefinch						✓		nB
117	Rhodospiza obsoleta	Desert Finch				✓	✓	✓	✓	R
118	Acanthis flammea	Redpoll						✓		nB
119	Emberiza bruniceps	Red-headed Bunting					✓			M
120	Emberiza calandra	Corn Bunting				✓			✓	M

6. Summary

- The Autumn VP survey was conducted between September 1 and November 10, 2024, with a scope of 36 hours per 9 VPs.
- The Autumn survey recorded a total of 68 bird species, with 12 listed in the Red Book of Uzbekistan and 5 with VU and EN included in the IUCN Red List.
- Steppe Eagles was one of the numerous raptor species during autumn monitoring. A total of 22 single birds and 23 flocks (mostly 2-3 individuals) were observed, amounting to 191 Steppe eagles.
- The total 120 bird species were recorded during VP survey in 2024, among them 6 species with VU and EN statuses included in the IUCN Red List and 15 listed in the Red Book of Uzbekistan as CR, EN and VU species.

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ANNEX A: Flight paths

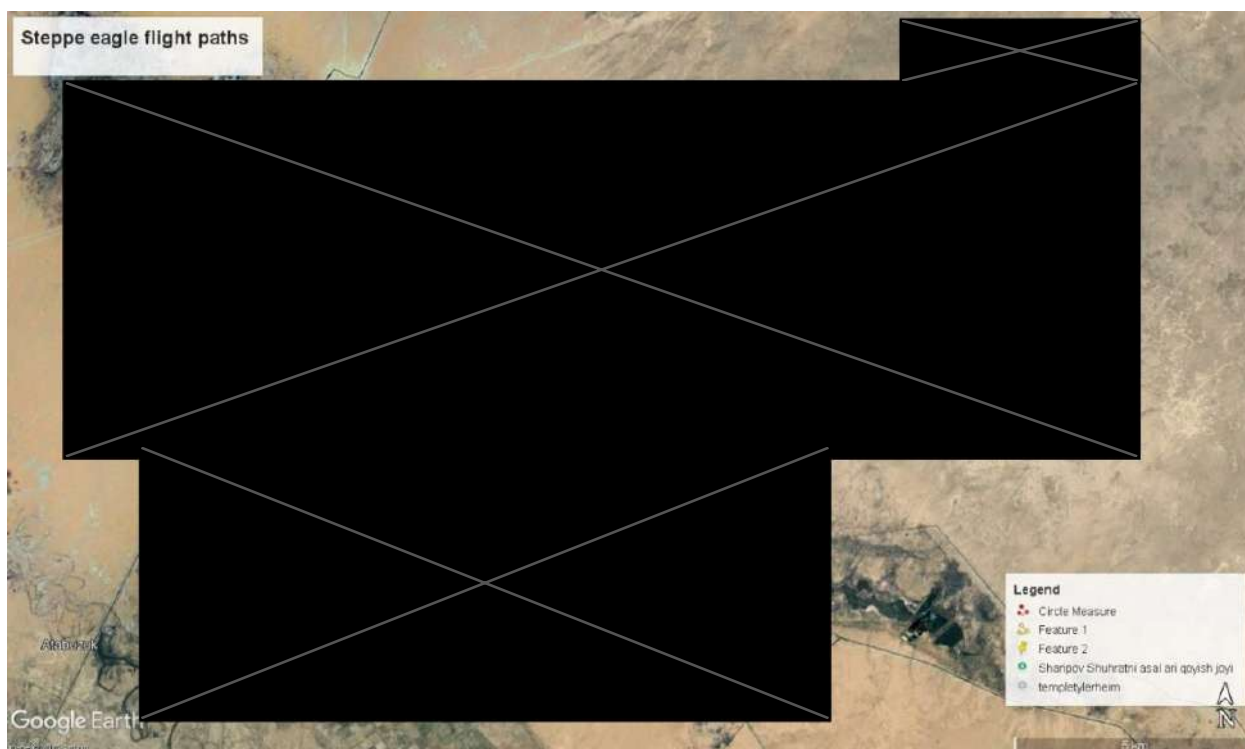


Figure 5: The view of Steppe eagle flight paths at VPs

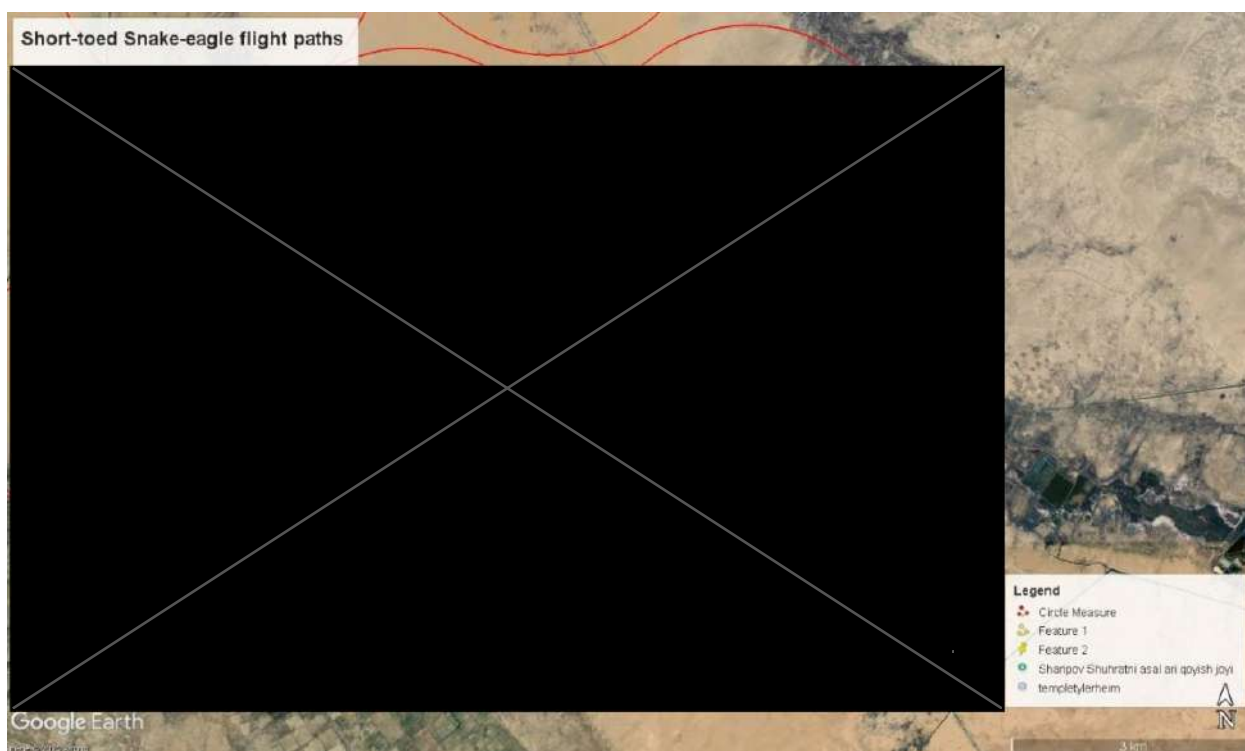


Figure 6: The view of Short-toed Snake eagle flight paths at VP07 and VP08



Figure 7: The view of Golden eagle flight paths at VP08

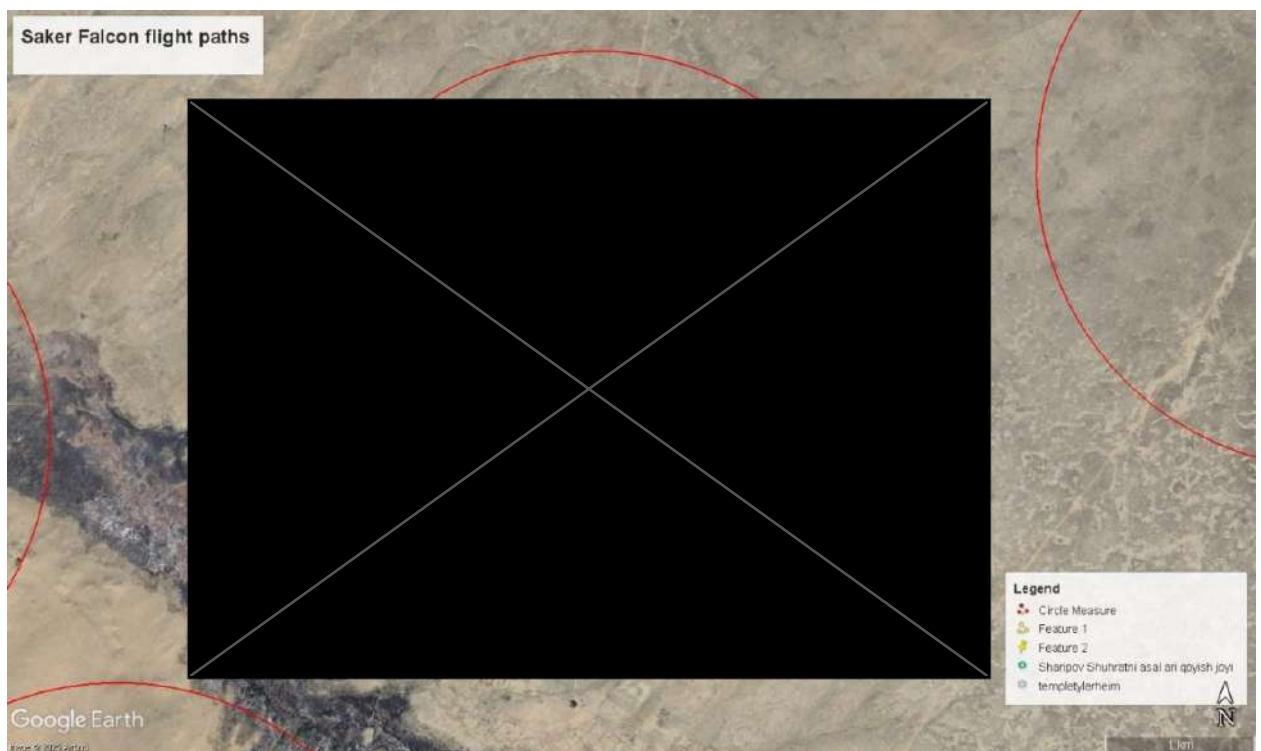


Figure 8: The view of Saker falcon flight paths at VP03



Figure 9 Eastern Imperial Eagle flight paths at VP04, VP06, VP08 and VP09



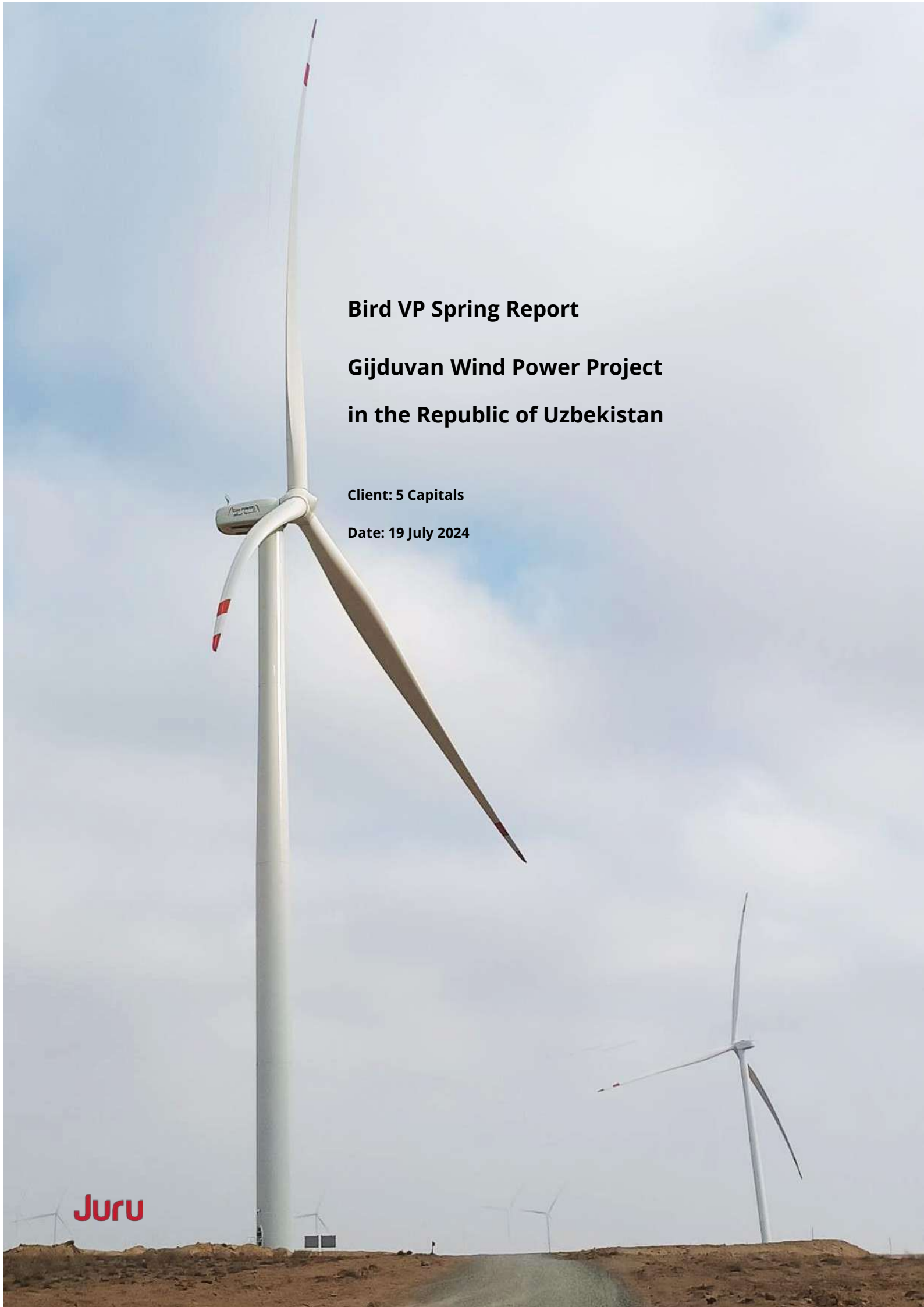
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2. SPRING VP SURVEY REPORT



Bird VP Spring Report

Gijduvan Wind Power Project in the Republic of Uzbekistan

Client: 5 Capitals

Date: 19 July 2024

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1. Introduction

The Gijduvon wind power project will involve the establishment of a 300 MW wind farm, collector sub-station and an associated Overhead Transmission Line (OTL) with a capacity of 500 kV, as well as the expansion of an associated sub-station, in Bukhara region, Uzbekistan. The wind farm will include a total of 38 Wind Turbine Generators (WTG), which will be micro-sited within an investigation area measuring approximately 13,645 ha.

The project site is located in the Bukhara region of the Republic of Uzbekistan. The wind farm will consist of one polygon of Wind Turbine Generators (WTG).

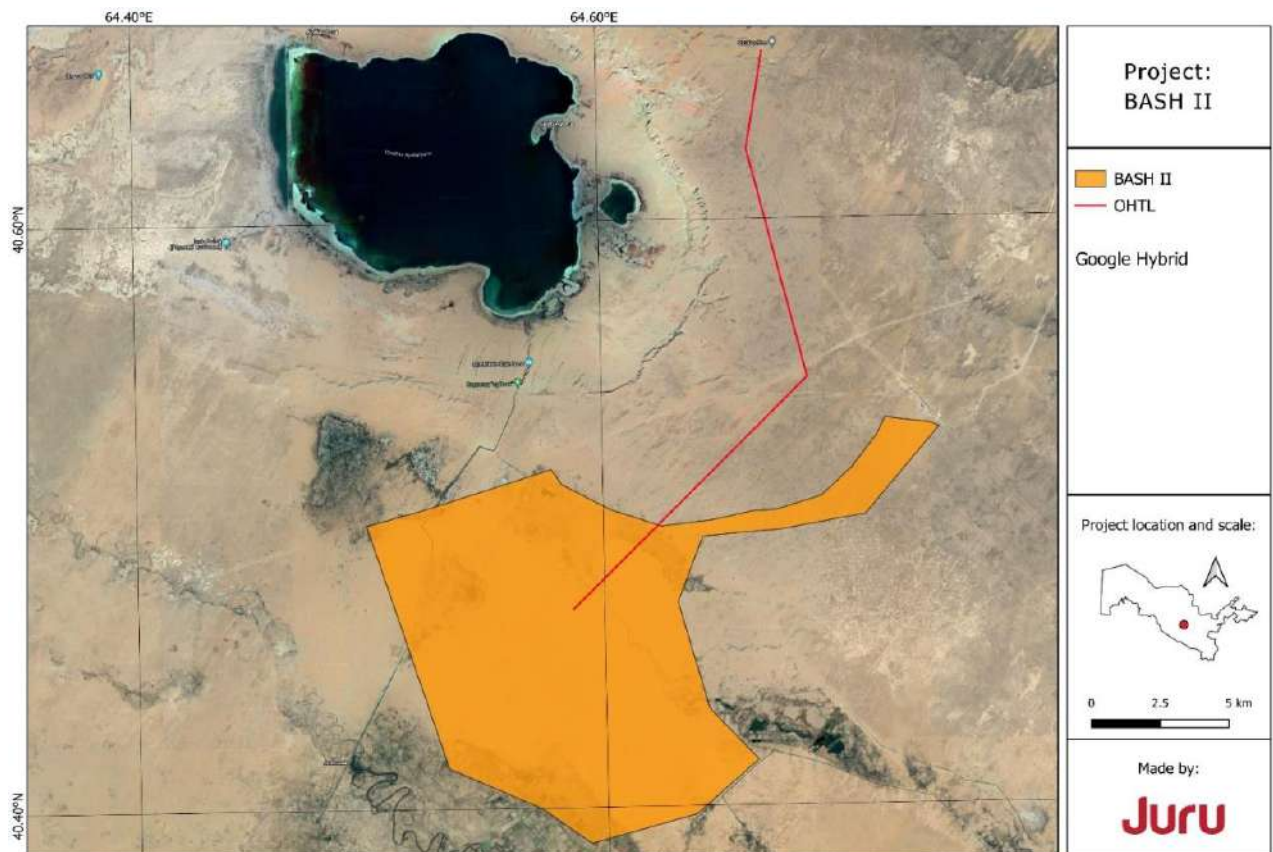


Figure 1: Project area

The report presents data and materials from field bird VP Spring monitoring and details the findings of the 2024 spring survey period, conducted between March 20 – May 13, 2024.

2. Materials and methods Vantage point (VP) bird monitoring on WF

The VP survey is designed to quantify the level of flight activity and the distribution of birds across the survey area. Its primary objective is to gather data for the Collision Risk Model (CRM), which informs the Collision Risk Assessment (CRA) by predicting mortalities resulting from collisions with operational turbines. This data can also provide insights into bird usage of the site, aiding in the assessment of potential impacts such as habitat loss, disturbance, displacement, and barrier effects.

The survey methods adhere to international best practice guidance, particularly the Scottish Natural Heritage: Recommended bird survey methods to inform impact assessment of onshore wind farms (March 2017, v2.) (SNH

guidance 2017¹) and the IFC EHS Guidelines for Wind Energy (2015²). These methods are specifically tailored for use in collision risk assessment models.

Equipment

- Field notebook and writing implements;
- Field survey sheets;
- Weatherproof Clipboard;
- At least two stopwatches / timer watches;
- Compass / GPS unit;
- Binoculars (at least 8x magnification);
- Telescope (minimum 60mm x 25/30 magnification) with tripod;
- Photo camera;
- Laptop with Excel required to write up the field sheets (or have access to them).

VP locations

9 VP locations have been identified for the 300 MW Gijduvon II site covering the project area with a focus on turbine locations as per the updated RfP.



Figure 2: VP locations (VP01...VP09) survey points

¹ <https://www.nature.scot/sites/default/files/2018-06/Guidance%20Note%20-%20Recommended%20bird%20survey%20methods%20to%20inform%20impact%20assessment%20of%20onshore%20windfarms.pdf>

² https://www.ifc.org/wps/wcm/connect/b82d0563-b39a-42a7-b94e-0b926b4a82f9/FINAL_Aug%2B2015_Wind%2BEnergy_EHS%2BGuideline.pdf?MOD=AJPERES&CVID=mpusVXy

Table 1: VPs coordinates

Vantage Points	Coordinates (dd)	
	N	E
VP01		
VP02		
VP03		
VP04		
VP05		
VP06		
VP07		
VP08		
VP09		

Survey Timing

The VP surveys have been tailored to the ecology of the target bird species involved, with specific considerations for timing and duration. Surveys were conducted by one or two teams of two people (two people per point), rotating across 9 survey points. Following SNH recommendations, each VP session typically lasted 2 to 3 hours to ensure that observers remained alert and bird activity was accurately recorded.

During the spring migrating season from March 20 until May 13, 2024, a total of 324 hours were completed for the site, averaging 36 hours per VP location (Table 3). Surveys were conducted under suitable weather conditions with good ground visibility (>2km).

Tier 1 and 2 species

VP Survey Methods:

- Tier 1 Target Species Sampling**

The area in view was scanned until a Tier 1 Target Species was detected, at which point it was followed until it ceased flying or was lost from view. The time the Tier 1 target bird was detected the flight duration was recorded, and the route the bird followed was plotted in the field on the provided maps (Annex 1). The bird's flight height was estimated at the time of detection and then at 15-second intervals thereafter. A 15-second interval was recommended as a practical compromise that aimed to minimize dependency within data while maximizing the sample of observations. The species included as Tier 1 Target Species can be adjusted in the future based on the observations made on site.

- Tier 2 Target Species and "Other" Species Sampling**

Observation of Tier 1 Target Species took priority over recording of Tier 2 Target Species and "other" species, defined as any bird species not listed as a target species. The only differences between the sampling effort for Tier 2 Target Species and other species compared with Tier 1 Target Species were: 1) flight paths were not mapped for Tier 2 Target Species or other species; and 2) location and flight altitude data were only recorded a single time for any bird or flock of Tier 2 Target Species or other species, instead of every 15 seconds as was the case for Tier 1 Target Species.

The number of birds recorded was the minimum number of individuals that could account for the activity observed.

Table 2: Tier 1 and 2 bird species for the Gijduvon II 300 MW Farm Project

Latin name ³	Common name	IUCN ⁴ status	UzRDB ⁵ status	Tier	Notes on Likely Occurrence/Risk
Tier 1 species					
<i>Oxyura leucocephala</i>	White-headed Duck	EN	EN	1	Migrating, recorded on Ayakagytm Lake
<i>Otis tarda</i>	Great Bustard	EN	CR	1	Rare wintering in Kyzylkum desert
<i>Chlamydotis macqueenii</i>	Asian Houbara	VU	VU:D	1	Breeding and migrating in the project area (Koshkin et al, 2016[4])
<i>Vanellus gregarius</i>	Sociable Lapwing	CR	VU:R	1	Rare migrating in Kyzylkum desert
<i>Pelecanus onocrotalus</i>	Great White Pelican	LC	VU:D	1	Migrating and wintering near Ayakagytm and Shorkul lake
<i>Pelecanus crispus</i>	Dalmatian Pelican	NT	EN	1	Migrating and wintering near Ayakagytm and Shorkul lake
<i>Neophron percnopterus</i>	Egyptian Vulture	EN	VU:D	1	Breeding in Kyzylkum desert
<i>Circaetus gallicus</i>	Short-toed Snake-eagle	LC	VU:D	1	Breeding in Kyzylkum desert
<i>Clanga clanga</i>	Greater Spotted Eagle	VU	VU:R	1	Migrating
<i>Aquila nipalensis</i>	Steppe Eagle	EN	VU:D	1	Migrating in the Kyzylkum desert
<i>Aquila heliaca</i>	Imperial Eagle	VU	VU:D	1	Migrating in the Kyzylkum desert
<i>Aquila chrysaetos</i>	Golden Eagle	LC	VU:R	1	Resident in Kyzylkum desert
<i>Haliaeetus leucoryphus</i>	Pallas's Fish-eagle	EN	EN	1	Rare summer visitor in Ayakagytm
<i>Falco cherrug</i>	Saker Falcon	EN	EN	1	Breeding in the region (Ten, Soldatov, 20188)
Tier 2 species					
<i>Anser anser</i>	Greylag Goose	LC	-	2	Migrating and wintering in Ayakagytm and Shorkul
<i>Cygnus olor</i>	Mute Swan	LC	NT	2	Breeding and migrating on Ayakagytm lake
<i>Cygnus cygnus</i>	Whooper Swan	LC	VU:R	2	Migrating, recorded on Ayakagytm Lake and Shorkul
<i>Aythya ferina</i>	Common Pochard	VU	-	2	Migrating, recorded on Ayakagytm Lake
<i>Aythya nyroca</i>	Ferruginous Duck	NT	VU:D	2	Migrating, recorded on Ayakagytm Lake
<i>Phoenicopterus roseus</i>	Greater Flamingo	LC	VU:D	2	Migrating, recorded on Ayakagytm Lake
<i>Podiceps auritus</i>	Horned Grebe	VU	-	2	Migrating, recorded on Ayakagytm Lake
<i>Tetrax tetrax</i>	Little Bustard	NT	VU:D	2	Migrating to Kyzylkum desert
<i>Anthropoides virgo</i>	Demoiselle Crane	LC	-	2	Migrating to Kyzylkum desert
<i>Grus grus</i>	Common Crane	LC	-	2	Migrating to Kyzylkum desert
<i>Vanellus vanellus</i>	Northern Lapwing	NT		2	Migrating to Kyzylkum desert
<i>Ciconia nigra</i>	Black Stork		VU:R	2	Rare migrating
<i>Microcarbo pygmaeus</i>	Pygmy Cormorant	LC	NT	2	Breeding and migrating
<i>Egretta garzetta</i>	Little Egret	LC	VU:D	2	Migrating
<i>Plegadis falcinellus</i>	Glossy Ibis	LC	VU:D	2	Migrating, recorded on Ayakagytm Lake

³ HBW and BirdLife International (2022) Handbook of the Birds of the World and BirdLife International digital checklist of the birds of the world. Version 7. Available at: http://datazone.birdlife.org/userfiles/file/Species/Taxonomy/HBW-BirdLife_Checklist_v7_Dec22.zip

⁴ IUCN Red list www.iucnredlist.org

⁵ Uzbekistan Red Data book. 2019. Vol.2. Animals. Tashkent: Chinor ENK.

<i>Platalea leucorodia</i>	Eurasian Spoonbill	LC	VU:D	2	Migrating, recorded on Ayakagytna Lake
<i>Syrrhaptes paradoxus</i>	Pallas's Sandgrouse	LC	-	2	Breeding and migrating
<i>Pandion haliaetus</i>	Osprey	LC	VU:R	2	Migrating species
<i>Aegypius monachus</i>	Cinereous Vulture	NT	NT	2	Resident in Kyzylkum desert
<i>Gyps fulvus</i>	Eurasian Griffon	LC	VU:D	2	Resident in Kyzylkum desert
<i>Pernis apivorus</i>	European Honey-buzzard	LC	-	2	Migrating to Kyzylkum desert
<i>Pernis ptilorhynchus</i>	Oriental Honey-buzzard	LC	-	2	Migrating to Kyzylkum desert
<i>Circus aeruginosus</i>	Eurasian Marsh- Harrier	LC	-	2	Breeding in Ayakagytna, migrating in Kyzylkum
<i>Circus macrourus</i>	Pallid Harrier	NT	NT	2	Migrating and wintering
<i>Circus cyaneus</i>	Hen Harrier	LC	-	2	Migrating and wintering
<i>Circus pygargus</i>	Montagu's Harrier	LC	-	2	Migrating
<i>Accipiter nisus</i>	Eurasian Sparrowhawk	LC	-	2	Migrating in the region
<i>Accipiter gentilis</i>	Eurasian Goshawk	LC	-	2	Migrating in the region
<i>Milvus migrans</i>	Black Kite	LC	-	2	Migrating
<i>Buteo lagopus</i>	Rough-legged Buzzard	LC	-	2	Wintering in Kyzylkum
<i>Buteo buteo</i>	Common Buzzard	LC	-	2	Migrating and wintering
<i>Buteo japonicus</i>	Eastern Buzzard	LC	-	2	Migrating and wintering
<i>Buteo rufinus</i>	Long-legged Buzzard	LC	-	2	Breeding, migrating and wintering
<i>Buteo hemilasius</i>	Upland Buzzard	LC	-	2	Wintering in Kyzylkum
<i>Haliaeetus albicilla</i>	White-tailed Eagle	LC	VU:R	2	Migrating and wintering near Ayakagytna and Shorkul lake
<i>Bubo bubo</i>	Eurasian Eagle-owl	LC	-	2	Resident in Kyzylkum desert
<i>Athene noctua</i>	Little Owl	LC	-	2	Resident in Kyzylkum desert
<i>Asio flammeus</i>	Short-eared Owl	LC	-	2	Wintering in Kyzylkum
<i>Falco naumanni</i>	Lesser Kestrel	LC	NT	2	Migrating, breeding in mountain habitats in Kyzylkum
<i>Falco tinnunculus</i>	Eurasian Kestrel	LC	-	2	Breeding

i. Data Recording Methods

Data for *Tier 1 Target Species* were recorded on the front of survey forms and mapped on maps of the survey area provided. Different forms were used for different survey periods (*i.e.* data from different VP sessions were not combined into one form or map). Maps clearly identified and cross-referenced to the information on the form on:

- The location of the VP used.
- Date of survey.
- Surveyor name.
- Start and End time of the VP session.
- Flight lines indicating the direction of flight for each individual (birds flying alone) or flock (birds flying in a flock of >1 bird), with a point annotated with estimated flight altitude estimated every 15 seconds as the bird or flock was flying along the mapped flight trajectory. If necessary, use different colours and symbols for each species, including a key on the form.
- Reference number of each flight line corresponding to that on the form.

Where off-site activity of interest is noted and may be linked to site activity (*e.g.* flight lines leading off-site to a known roosting location) this should be recorded in the note's column.

Data for tier 2 target species and other species is recorded on the rear of the forms.

Table 3: Schedule of VP (in hours) during Spring 2024

VP	20-Mar	21-Mar	22-Mar	23-Mar	28-Mar	29-Mar	30-Mar	31-Mar	01-Apr	02-Apr	03-Apr	04-Apr	05-Apr	06-Apr	07-Apr	08-Apr	09-Apr	10-Apr	13-Apr	14-Apr	15-Apr	16-Apr	17-Apr	18-Apr	19-Apr	20-Apr	21-Apr	22-Apr	23-Apr	24-Apr	25-Apr	08-May	09-May	10-May	11-May	12-May	13-May	TOTAL hours
VP01				3	3				3			3			3			3			3			3			3		3			3		3				36
VP02			3		3				3			3			3			3			3			3			3		3			3		3				36
VP03				3			3				3			3			3			3		3				3			3					3			3	36
VP04	3						3			3			3			3			3		3					3			3		3			3			3	36
VP05			3		3				3			3			3			3			3			3			3		3			3		3				36
VP06				3			3			3			3			3			3		3				3			3		3				3			3	36
VP07		3				3		3		3			3			3			3				3		3		3					3				3		36
VP08		3				3		3		3			3			3			3				3		3		3					3				3		36
VP09		3				3		3		3			3			3			3				3		3		3					3				3		36

3. RESULTS

During the VP monitoring from March 20 till May 13, 2024, a 77 bird species were observed, 12 were listed in the Red Book of Uzbekistan (2019), and 5 were included in the IUCN Red List (2023-1) (Table 4).

Detailed field data is presented in the Excel file attached to this report – 'Gijduvan 300MW WF-VP spring_field_2024.xlsx'.

Table 4: List of birds observed during the Spring VP Monitoring 2024.

No	Species	Common name	IUCN RL	UzRDB	Status ⁶
1	<i>Anser anser</i>	Greylag Goose			M
2	<i>Cygnus olor</i>	Mute Swan		NT	M
3	<i>Tadorna ferruginea</i>	Ruddy Shelduck			BM
4	<i>Tadorna tadorna</i>	Common Shelduck			M
5	<i>Spatula clypeata</i>	Northern Shoveler			M
6	<i>Mareca strepera</i>	Gadwall			M
7	<i>Anas crecca</i>	Green-winged Teal			M
8	<i>Coturnix coturnix</i>	Common Quail			M
9	<i>Columba livia</i>	Rock Pigeon			M
10	<i>Pterocles orientalis</i>	Black-bellied Sandgrouse			R
11	<i>Chlamydotis macqueenii</i>	Macqueen's Bustard	VU	VU:D	BM
12	<i>Cuculus canorus</i>	Common Cuckoo			BM
13	<i>Caprimulgus aegyptius</i>	Egyptian Nightjar			BM
14	<i>Apus apus</i>	Common Swift			M
15	<i>Anthropoides virgo</i>	Demoiselle Crane			M
16	<i>Burhinus oedecnemus</i>	Eurasian Thick-knee			M
17	<i>Himantopus himantopus</i>	Black-winged Stilt			BM
18	<i>Charadrius leschenaultii</i>	Greater Sand-Plover			B
19	<i>Glareola pratincola</i>	Collared Pratincole			BM
20	<i>Larus ridibundus</i>	Black-headed Gull			BM
21	<i>Larus cachinnans</i>	Caspian Gull			BM
22	<i>Larus fuscus</i>	Lesser Black-backed Gull			M
23	<i>Sterna hirundo</i>	Common Tern			BM
24	<i>Ciconia nigra</i>	Black Stork		VU:R	M
25	<i>Phalacrocorax carbo</i>	Great Cormorant			M
26	<i>Pelecanus crispus</i>	Dalmatian Pelican	NT	EN	M
27	<i>Casmerodius albus</i>	Great Egret			BM
28	<i>Ardea cinerea</i>	Grey Heron			BM
29	<i>Plegadis falcinellus</i>	Glossy Ibis		VU:D	M
30	<i>Pandion haliaetus</i>	Osprey		VU:R	M
31	<i>Circaetus gallicus</i>	Short-toed Snake-eagle		VU:D	BM
32	<i>Aquila nipalensis</i>	Steppe Eagle	EN	VU:D	M
33	<i>Aquila heliaca</i>	Imperial Eagle	VU	VU:D	M
34	<i>Aquila chrysaetos</i>	Golden Eagle		VU:R	B
35	<i>Circus aeruginosus</i>	Western Marsh Harrier			BM
36	<i>Circus cyaneus</i>	Hen Harrier			M
37	<i>Circus macrourus</i>	Pallid Harrier	NT	NT	M
38	<i>Circus pygargus</i>	Montagu's Harrier			M
39	<i>Accipiter nisus</i>	Eurasian Sparrowhawk			M
40	<i>Milvus migrans</i>	Black Kite			M
41	<i>Buteo buteo</i>	Common Buzzard			M
42	<i>Buteo japonicus</i>	Eastern Buzzard			M
43	<i>Buteo rufinus</i>	Long-legged Buzzard			BM
44	<i>Merops persicus</i>	Blue-cheeked Bee-eater			BM
45	<i>Merops apiaster</i>	European Bee-eater			BM
46	<i>Coracias garrulus</i>	European Roller			BM

⁶ Status of the observed species: R – resident, W – wintering, M – migrating, B – breeding

47	<i>Upupa epops</i>	Eurasian Hoopoe			BM
48	<i>Falco naumanni</i>	Lesser Kestrel		NT	BM
49	<i>Falco tinnunculus</i>	Eurasian Kestrel			BM
50	<i>Corvus frugilegus</i>	Rook			M
51	<i>Calandrella brachydactyla</i>	Greater Short-toed Lark			B
52	<i>Galerida cristata</i>	Crested Lark			B
53	<i>Iduna rama</i>	Sykes's Warbler			B
54	<i>Hirundo rustica</i>	Barn Swallow			BM
55	<i>Phylloscopus collybita</i>	Common Chiffchaff			M
56	<i>Curruca curruca</i>	Lesser Whitethroat			M
57	<i>Curruca nana</i>	Asian Desert Warbler			BM
58	<i>Lanius phoenicuroides</i>	Red-tailed Shrike			M
59	<i>Lanius excubitor</i>	Great Gray Shrike			BM
60	<i>Sturnus vulgaris</i>	European Starling			M
61	<i>Cyanecula svecica</i>	Bluethroat			B
62	<i>Saxicola torquatus</i>	African Stonechat			BM
63	<i>Saxicola caprata</i>	Pied Bushchat			M
64	<i>Oenanthe oenanthe</i>	Northern Wheatear			B
65	<i>Oenanthe isabellina</i>	Isabelline Wheatear			B
66	<i>Oenanthe deserti</i>	Desert Wheatear			B
67	<i>Oenanthe pleschanka</i>	Pied Wheatear			B
68	<i>Oenanthe finschii</i>	Finsch's Wheatear			B
69	<i>Passer domesticus</i>	House Sparrow			B
70	<i>Passer hispaniolensis</i>	Spanish Sparrow			M
71	<i>Passer montanus</i>	Eurasian Tree Sparrow			R
72	<i>Motacilla alba</i>	White Wagtail			M
73	<i>Anthus campestris</i>	Tawny Pipit			M
74	<i>Anthus trivialis</i>	Tree Pipit			M
75	<i>Motacilla flava</i>	Western Yellow Wagtail			M
76	<i>Rhodospiza obsoleta</i>	Desert Finch			B
77	<i>Emberiza bruniceps</i>	Red-headed Bunting			B
	Total		5	12	

VP data

The analysis of bird species distribution across various VPs presented below underscores the significance of these locations for migrating bird species.

Table 5: The distribution of bird species Tier 1 and 2 on VPs

No	Species	IUCN RL	UzRDB	TIER	VP01	VP02	VP03	VP04	VP05	VP06	VP07	VP08	VP09	Total records	Notes
1	Macqueen's Bustard	VU	VU:D	1		1							2	3	3 single displaying males
2	Dalmatian Pelican	NT	EN	1		2								2	2 groups (7 and 4 birds) were observed at heights of 200-450 m
3	Short-toed Snake Eagle		VU:D	1						1				1	1 single bird was observed roosting on a pole and later flying at a height of 30 m
4	Steppe Eagle	EN	VU:D	1		1					1			2	2 single birds observed at heights 15-250m
5	Imperial Eagle	VU	VU:D	1	1						1		1	3	Migrating 3 single birds observed at heights 200-600m
6	Golden Eagle		VU:R	1				1						1	1 bird was seen perched on a pole
7	Mute Swan		NT	2								3		3	Two single and two birds were flying at an average height of 150 m
8	Greylag Goose			2									1	1	1 flock (380 birds) was observed at heights between 30-40 m
9	Demoiselle Crane			2		1								1	1 flock (9 birds) was observed at an average flight height of 250 m
10	Glossy Ibis			2		1								1	1 flock (65 birds) was observed at a height of 300 m
11	Osprey			2			1							1	1 bird was seen perched on a pole
12	Hen Harrier			2	4		2	4	4	7	3	3	1	28	Broad migration of this species was observed. 28 single birds recorded at heights 2-50 m with an average height of 12m
13	Pallid Harrier	NT	NT	2	2	1			1		2		1	7	7 single birds were observed at heights between 3-12 m
14	Montagu's Harrier			2								1	1	2	2 single birds were observed at a height of 4-5m
15	Western Marsh Harrier			2	9	14	3		10	7	14	14	6	77	77 records of single birds were recorded almost on all VPs especially along drainage channels at heights between 3-12 m.
16	Eurasian Sparrowhawk			2	1	1		1	4		2	1	3	13	Broad migration of this species was observed. 13 records of single birds were recorded at heights between 1-250 m.

No	Species	IUCN RL	UzRDB	TIER	VP01	VP02	VP03	VP04	VP05	VP06	VP07	VP08	VP09	Total records	Notes
17	Black Kite			2					1		1		1	3	3 records of birds were recorded at heights between 8 and 600m.
18	Buteo sp.			2		2	1					1		4	4 records of single unidentified buzzards were observed at heights between 40-400m
19	Common Buzzard			2	2	2	1	1	1		5	2		14	8 single birds and 6 small groups (2-5 birds) were observed at heights between 15-600 m
20	Eastern Buzzard			2							2	2	1	5	5 single birds were observed at heights between 7-300m
21	Long-legged Buzzard			2	2	2	1	1	1		4	2		14	13 single birds (both migrating and local movements of breeding in adjacent areas birds) and 1 pair were recorded at heights between 7 and 200m.
22	Lesser Kestrel			2	1		1	2			1			5	5 single birds were observed at heights between 1-150 m
23	Eurasian Kestrel			2	2	2	3	7	4	2	2	2	1	25	25 single birds were observed at heights between 2-40m
24	Black-bellied Sandgrouse			3	13	5	3	2	16	5	14	4	6	68	68 records of local movements of breeding birds among them 15 single birds and small groups (2-16 birds) were recorded at heights between 4 and 30m.

4. Key species descriptions

Macqueen's Bustard (*Chlamydotis macqueenii*) - UzRDB: 2(VU:D); IUCN: VU (Decreasing)

Status: Breeding and migratory species for Uzbekistan and for the project site.

Distribution: The Macqueen's Bustard is a breeding and migratory species found primarily in the Kyzylkum Desert, Ustyurt Plateau, Karnabchul steppe, and Sarykamysh Basin. It breeds in these regions and is also observed during seasonal migrations. The nesting population ranges from 1.5 to 3 thousand individuals, amounting to 0.05-0.4 individuals per square kilometre. During migration, the numbers can peak at up to 20 thousand individuals.

Habitats: This species prefers habitats characterized by clayey plains with wormwood grass cover, as well as the outskirts of takyrs (salt flats) and salt marshes adorned with various bushes of saltwort and camel thorn. Its diet comprises grasses, seeds, invertebrates, small rodents, and reptiles.

Spring VP survey results. At VP02 and VP09 single displaying males were recorded. All data will be used for a separate Asian Houbara report.

Dalmatian Pelican (*Pelecanus crispus*) - UzRDB: 2(VU:R); IUCN: NT (Decreasing)

Status: Migratory nesting and wintering bird in Uzbekistan and migrating for project site.

Distribution: This species undertakes spring migration during March-April. It is distributed in the lower reaches of the Amudarya and Zarafshan rivers, the middle reaches of the Syrdarya River, and across central and southern Uzbekistan. Historically, it was once common in the southern Aral Sea region but has since disappeared from many habitats.

Spring VP survey results. During spring observations at the VP02 two groups (7 and 4 birds) were observed at heights 200-450 m on June 7, 2024. Because of the direction, we suppose that it was a local migration from the roosting site on Ayakagytna Lake to Shorkul Reservoir.

Short-toed Snake Eagle (*Circaetus gallicus*) - UzRDB: 2(VU:R); IUCN: LC (Stable)

Status: Migratory breeding species.

Distribution: This species breeds in the Kyzylkum desert.

Habitats: The Short-toed Snake Eagle nests on bushes, trees, cliffs, and rocks. The primary consideration when choosing a nesting site is the presence of large reptiles with daytime activity and suitable locations for nesting. Its diet consists primarily of lizards, snakes, and occasionally small rodents.

Spring VP survey results. 1 single bird was observed roosting on a pole near VP06 and later flying at a height of 30 m on April 3, 2024.

Steppe Eagle (*Aquila nipalensis*) - UzRDB: 2(VU:D); IUCN: EN (Decreasing)

Status: Breeding in Northern Uzbekistan (Ustyurt), migrating and wintering in Uzbekistan and at the project site.

Distribution: The Steppe Eagle inhabits plains and low mountains. Spring migration occurs from February to May, autumn migration from September to November, and winter from December to February. Breeding occurs exclusively in the northern part of the Karakalpak Ustyurt.

Habitats: Steppe Eagles construct nests on the ground or on rocks. They primarily feed on rodents, especially great and red-tailed gerbils, and in the Ustyurt region, they also prey on small gophers. Additionally, Steppe Eagles scavenge carrion.

Spring VP survey results. Two single birds were observed at VP02 and VP07 in flight at heights between 15 and 250m on March 28 and 30, 2024. The main migration was covered during the Winter VP survey.

Imperial Eagle (*Aquila heliaca*) - UzRDB: 2(VU:D); IUCN: VU (Decreasing)

Status: migratory and winters in Uzbekistan, with migration also observed at the project site.

Distribution: Spring migration occurs from February to April, during which birds fly alone or in groups of up to 15 individuals. This species is distributed across the Ustyurt plateau and Northern Kyzylkum during breeding. During seasonal migrations, Eastern Imperial Eagles can be found throughout Uzbekistan.

Habitats: Species inhabit plains and foothills. They primarily feed on rodents, hedgehogs, turtles, and carrion.

Spring VP survey results. Three single birds were observed at VP01, VP07, VP09 in flight at heights between 200 and 600 m on March 29 and April 4 and 8, 2024.

Golden Eagle (*Aquila chrysaetos*) - UzRDB: 2(VU:R); IUCN: LC (Stable)

Status: The breeding population is resident with small seasonal movements, the other population migrating and wintering throughout Uzbekistan. It breeds in the Ayakagytm depression.

Distribution: Historically, the Golden Eagle population has been relatively small. In the late 1970s and early 1980s, there were estimated to be 80-100 breeding pairs on the Ustyurt plateau, in the Kyzylkum desert, and across various mountain ranges including Bukantau, Tamdytau, Muruntau, Pistalitau, Nuratau, Gissar, Turkestan, Zarafshan, and Chatkal. During migrations, Golden Eagles can be found throughout Uzbekistan.

Habitats: Species inhabits sandy massifs, remnant mountains in deserts, foothills, and rocky areas in the middle and upper mountain zones, up to elevations of 2500-3000 meters above sea level. Its diet includes small mammals, birds, snakes, turtles, and occasionally carrion.

Spring VP survey results. 1 bird was seen perched on a pole near VP04 on March 20, 2024.

Mute Swan (*Cygnus olor*) - UzRDB: 3(NT)

Status: Breeding and migratory species for Uzbekistan and for the project site.

Habitats: This species breeds, migrates and winters in the Kyzylkum desert and Shorkul reservoir.

Spring VP survey results. Two single and two birds were observed flying at VP08 an average height of 150 m on April 8, 2024.

Greylag Goose (*Anser anser*)

Status: Migratory and wintering species for Uzbekistan and for the project site.

Habitats: This species migrates and winters in the Kyzylkum desert and Shorkul reservoir.

Spring VP survey results. Two single and two birds were observed flying at VP08 an average height of 150 m on April 8, 2024.

Spring VP survey results. One flock (380 birds) was observed at VP09 at heights between 30-40 m on April 13, 2024.

Demoiselle Crane (*Anthropoides virgo*) - IUCN: LC (Increasing)

Status: migratory species in Uzbekistan and is observed during migration at the project site.

Distribution: During migration, Demoiselle Cranes are widely distributed across Uzbekistan. Spring migration typically begins in late February to early March and extends until mid-April, while autumn migration starts in the second half of August to early September.

Spring VP survey results. One flock (9 birds) was observed at VP02 at a height of 250 m on March 28, 2024.

Glossy Ibis (*Plegadis falcinellus*)

Status: Breeding and migratory species for project region.

Habitats: This species migrates in the Kyzylkum desert.

Spring VP survey results. One flock (65 birds) was observed at VP02 at a height of 300m on April 10, 2024.

Osprey (*Pandion haliaetus*)

Status: Migratory and wintering species for Uzbekistan and for the project site.

Habitats: This species migrates and winters in the Kyzylkum desert.

Spring VP survey results. One flock (380 birds) was observed at VP09 at heights between 30-40 m on March 23, 2024.

Harriers:

Hen Harrier (*Circus cyaneus*)

Pallid Harrier (*Circus macrourus*)- UzRDB NT

Montagu's Harrier (*Circus pygargus*)

Western Marsh Harrier (*Circus aeruginosus*)

Status: The first three harriers are migratory and also wintering in the Kyzylkum desert; Marsh harrier is breeding.

Habitats: Their preferred habitats include cultivated areas, open desert or plain areas and the shores of water bodies, where they can find prey such as house mice, mole voles, and small wintering birds.

Spring VP survey results.

The broad migration of **Hen Harrier** was observed during spring works: 28 single birds were recorded from March 20 and April 25, 2024, at all VPs (except VP02) usually hunting at heights between 2 and 50 m.

7 single **Pallid Harriers** were observed (VP01, VP02, VP05, VP07 and VP09) hunting at heights between 3-12 m from March 28 and April 18, 2024.

2 single **Montagu's Harriers** were observed (VP08 and VP09) hunting at heights of 4-5m from April 8 and 19, 2024.

Western Marsh Harrier breeds near the project site in reeds of adjacent wetlands. Also migrating individuals could be observed during spring observations. The 77 records of single birds were recorded from March 21 and May 12, 2024, almost on all VPs especially along drainage channels at heights between 3-12 m.

Eurasian Sparrowhawk (*Accipiter nisus*)

Status: this species is known as a breeding, migrating, and wintering bird in Uzbekistan, and it is primarily a migrating species at the survey site.

Distribution: During spring and autumn migrations, Eurasian Sparrowhawks are commonly observed throughout almost the entire flat territory of Uzbekistan, including mountainous areas up to the upper boundary of the forest zone. In winter, they are regularly found in tugai forests along river valleys and in agricultural oases, including large cities.

Habitats: Nesting habitats for Sparrowhawks in Uzbekistan are typically located in the mountain-forest zone, often along river valleys. The Eurasian Sparrowhawk primarily preys on birds (ornithophage), although it may occasionally feed on small rodents.

Spring VP survey results. Broad migration of this species was observed almost on all VPs. 13 records of single birds were recorded at heights between 1-250 m on March 30 and April 24, 2024.

Black kite (*Milvus migrans*)

Status: Migratory and wintering species for Uzbekistan and for the project site.

Spring VP survey results. 3 records of birds were recorded at heights between 8 and 600m.

Buzzards:

Common Buzzard (*Buteo buteo*)

Eastern Buzzard (*Buteo japonicus*)

Status: Migratory, wintering species in Uzbekistan and in the project site.

Distribution: Common migratory birds in spring and autumn, wintering in Uzbekistan. Abundant migration is known for the valley of the middle Syrdarya, the flat part of the Tashkent region and the Mirzachul Steppe. To the west, in Kyzylkum and the Zarafshan valley, the number of this species is noticeably lower, and in the valley of the middle and lower Amudarya, it is found only sporadically.

Habitats: During wintering, birds stick to agricultural areas, river valleys and the adyr zone of the foothills, where there are settlements of mouse-like rodents.

Spring VP survey results.

8 single birds and 6 small groups (2-5 birds) of the Common Buzzard were observed flying at VP01, VP03, VP04, VP05 and VP09 at heights between 25-600 m between March 28 and April 23, 2024

5 single Eastern buzzards were observed at VP07, VP08 and VP09 at heights between 7-300m between March 28 and 31, 2024.

Long-legged Buzzard (*Buteo rufinus*) - IUCN: LC (Stable)

Status: Breeding migrator, with migrating and wintering populations originating from northern areas.

Distribution: The Long-legged Buzzard is a common breeding bird found throughout the lowland regions of Uzbekistan, and it's one of the most numerous birds of prey in the country. This species is known for its nomadic behaviour, migrating to areas with high populations of rodents, which form its main diet.

Habitats: This species can be found during migrations, nesting, and wintering periods in various habitats across Uzbekistan, including sandy deserts with saxaul forests, mountainous areas with rocks and ravines, dry riverbeds, river valleys, as well as clayey and sandstone cliffs.

Spring VP survey results. 13 single birds (both migrating and local movements of breeding in adjacent areas birds) and 1 pair were recorded at heights between 7 and 200m between March 21 and April 25, 2024.

Eurasian Kestrel (*Falco tinnunculus*) - IUCN: LC (Decreasing)

Status: Migratory breeding and wintering species in Uzbekistan, and migratory breeding in project site.

Distribution: Numerous breeding birds in all regions of Uzbekistan, except the highlands. During nesting, it wanders widely and can be found anywhere. A common wintering bird of lowland areas, but apparently, mainly individuals from more northern populations spend the winter, and the question of the sedentary nature of local breeding populations is not clear. In spring and autumn, birds nesting to the north pass through the territory of the republic.

Habitats: The nesting common kestrel is found in a variety of conditions - rock outcrops, cliffs, saxaul forests, power line supports, triangulation towers, ruins, towers, etc. The main role in nutrition is played by small mouse-like rodents and insects.

Spring VP survey results. 25 single birds were observed at all VPs in flight at heights between 2-40m between March 23 and May 13, 2024.

Lesser Kestrel (*Falco tinnunculus*) - IUCN: LC (Decreasing)

Status: Migratory breeding and wintering species in Uzbekistan, and migratory breeding in project region.

Distribution: Numerous breeding birds in all regions of Uzbekistan, except the highlands. During nesting, it wanders widely and can be found anywhere. A common wintering bird of lowland areas, but apparently, mainly individuals from more northern populations spend the winter, and the question of the sedentary nature of local breeding populations is not clear. In spring and autumn, birds nesting to the north pass through the territory of the republic.

Spring VP survey results. 5 single migrating birds were observed at VP01, VP03, VP04 and VP07 at heights between 1-150 m between April 4 and 20, 2024.

Black-bellied Sandgrouse (*Pterocles orientalis*) - IUCN: LC (Decreasing)

Status: migratory breeding and wintering for Uzbekistan, same for the project site.

Distribution: Widespread in desert and semi-desert areas. In Ustyurt it occupies a vast nesting territory. In the valley of the lower reaches of the Amudarya. Breeds in Central Kyzylkum on the plains surrounding Bukantau, Dzhetymtau, Tamdytau, Aristantau, Beltau, and Sangruntau. To the west, it breeds in a large area between the wells of Aigyrbulak, Buzaubay, and Koskuduk, in southwestern Kyzylkum on the plains surrounding Kuldzhuktau. In southern Kyzylkum, noted for breeding near Gazli and Bukhara, reaches the Amu Darya on one side, and the Zarafshan river on the other.

Habitats: Inhabits sandy plains, slightly hilly, with small gravel and wormwood. Always stays near a watering hole. Feeds on seeds.

Spring VP survey results. 68 records of local movements of breeding birds among them 15 single birds and small groups (2-16 birds) were recorded at heights between 4 and 30m on all VPs during all seasons of observation.

5. Summary

- The spring VP survey was conducted between March 20 and May 13, 2024, with a scope of 36 hours per 9 VPs.
- The Spring survey recorded a total of 77 bird species, with 12 listed in the Red Book of Uzbekistan and 5 included in the IUCN Red List.

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ANNEX A: Flight paths



Figure 3: The view on flight paths on all VP points (VP03, VP04, VP05 and VP08 are empty)

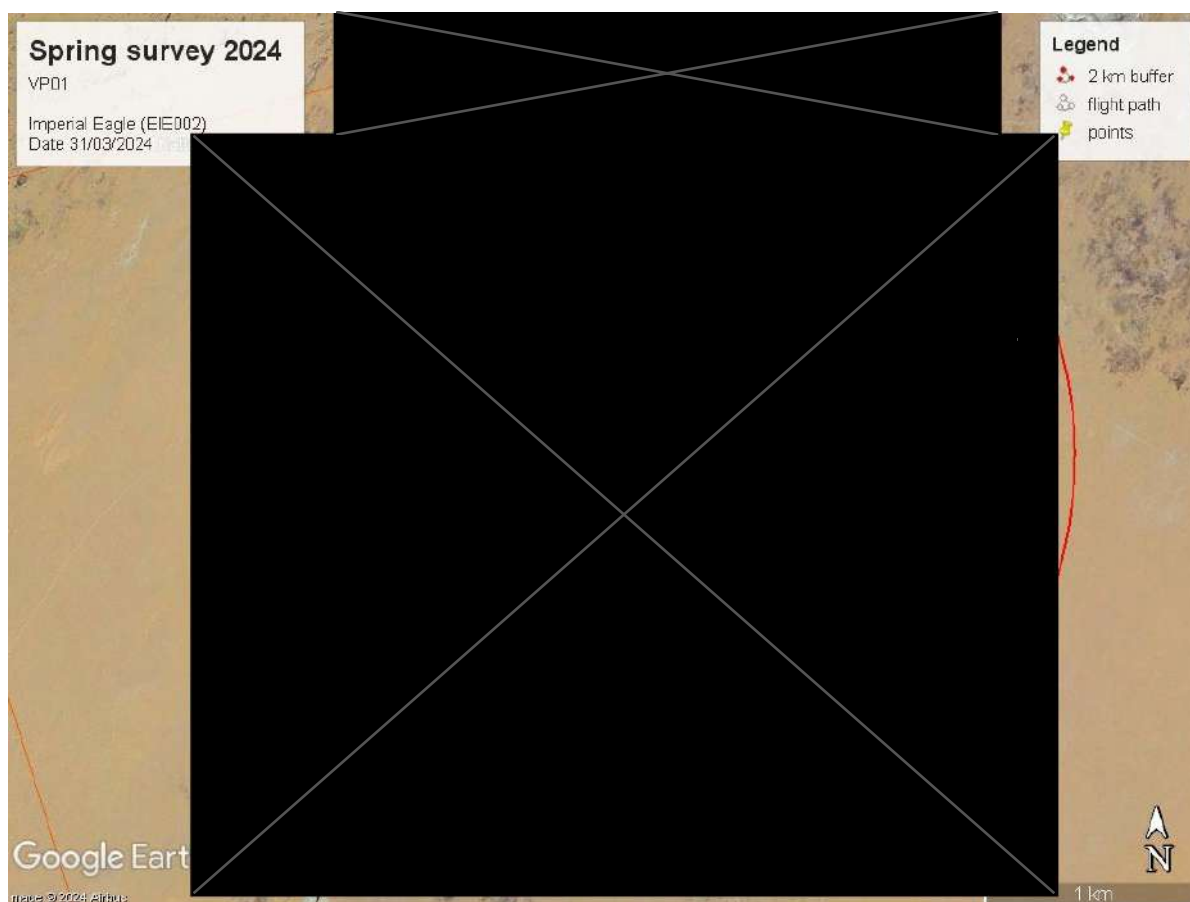


Figure 4: Imperial Eagle EIE002 at VP01 on March 31, 2024



Figure 5: Steppe Eagle SE001 at VP02 on March 28, 2024

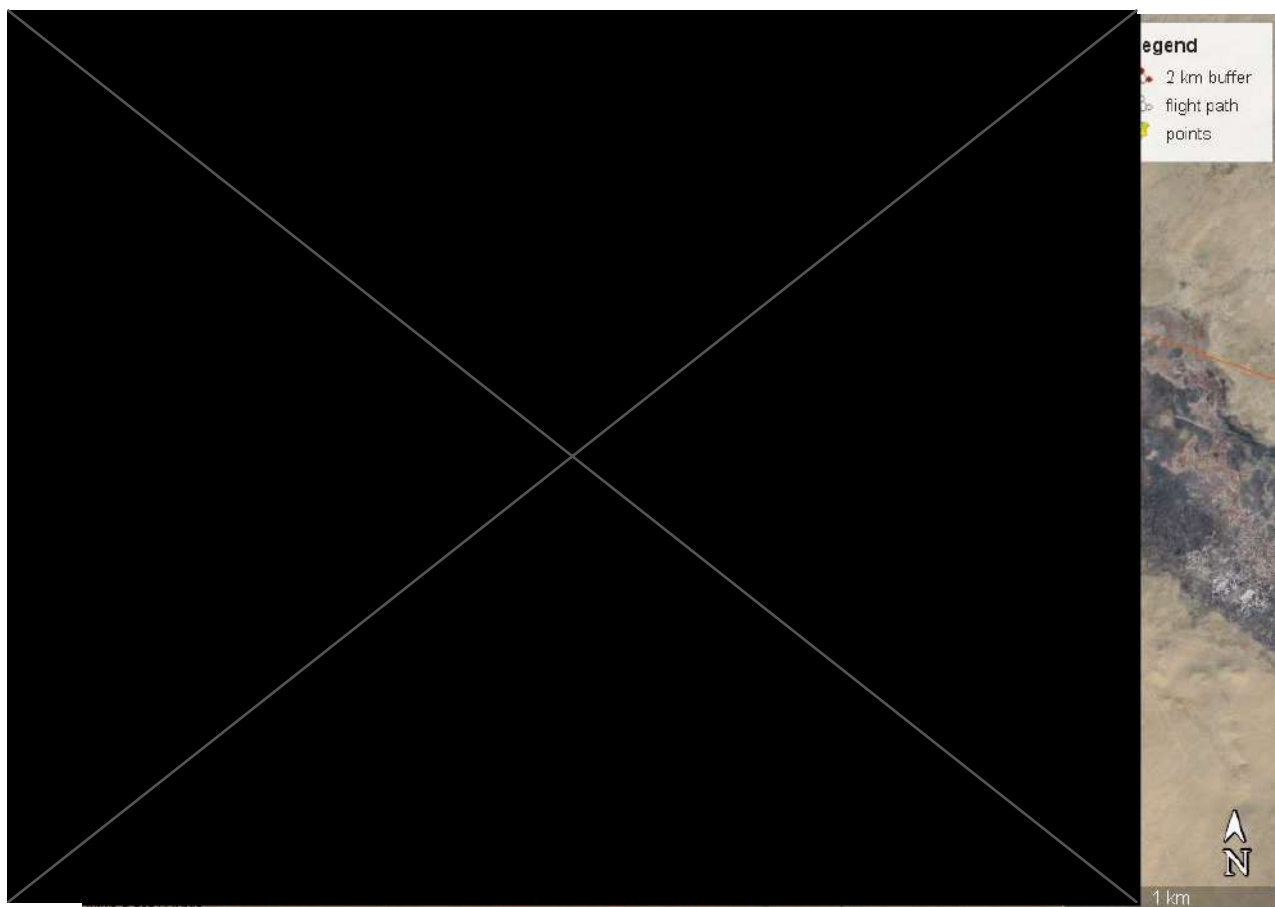


Figure 6: Dalmatian Pelican DP001 at VP02 on April 7, 2024

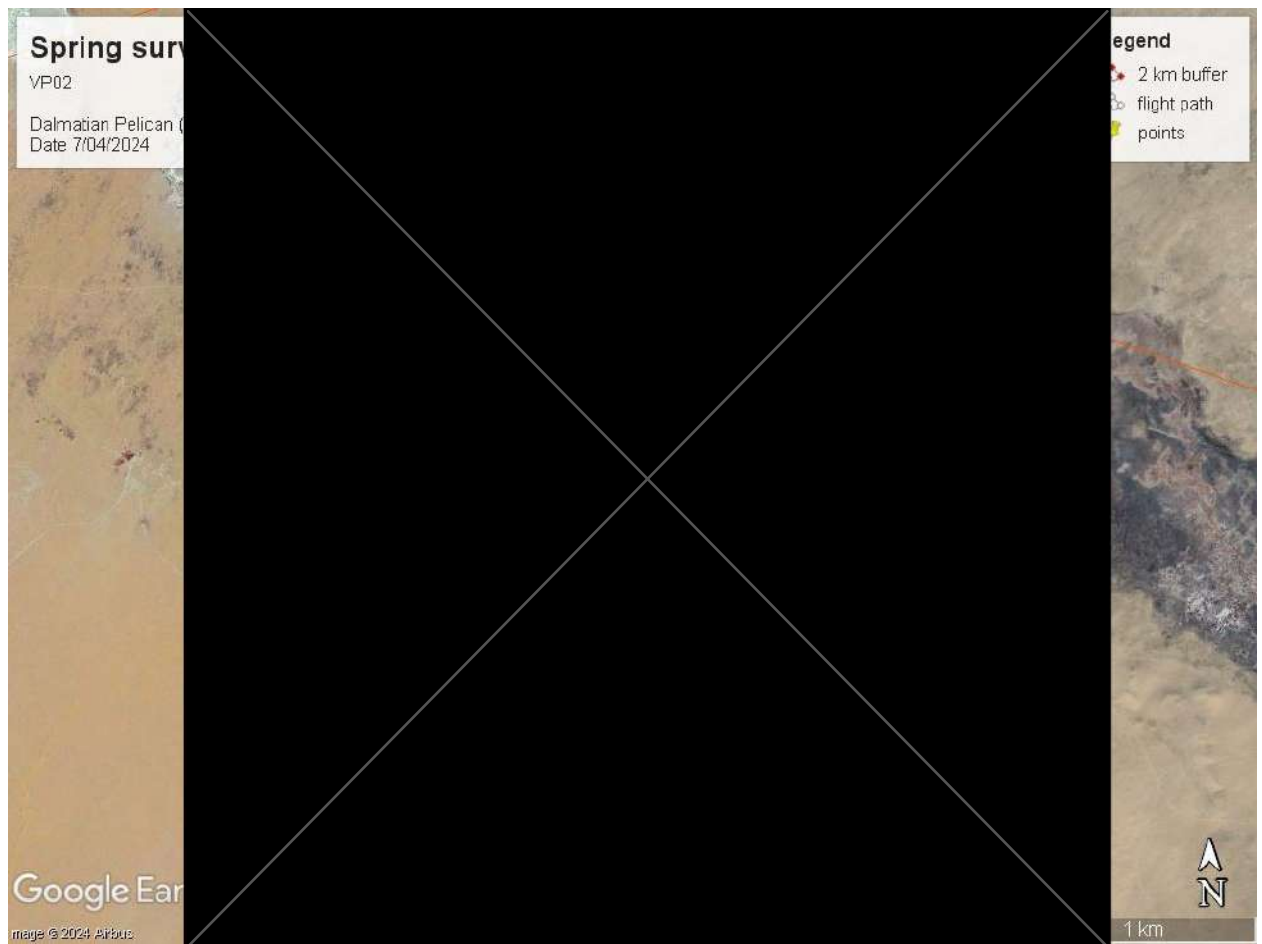


Figure 7: Dalmatian Pelican DP002 at VP02 on April 7, 2024

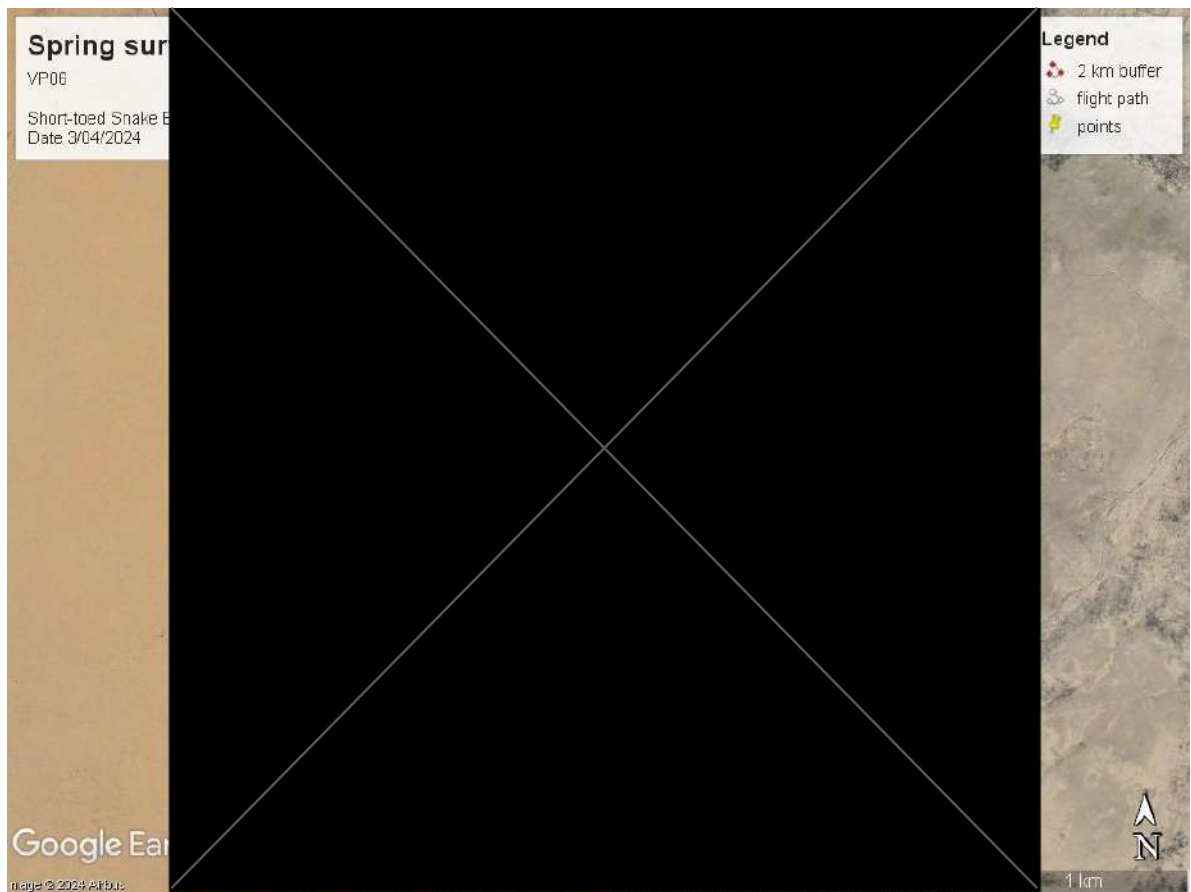


Figure 8: Short-toed Snake Eagle STSE01 at VP06 on April 3, 2024

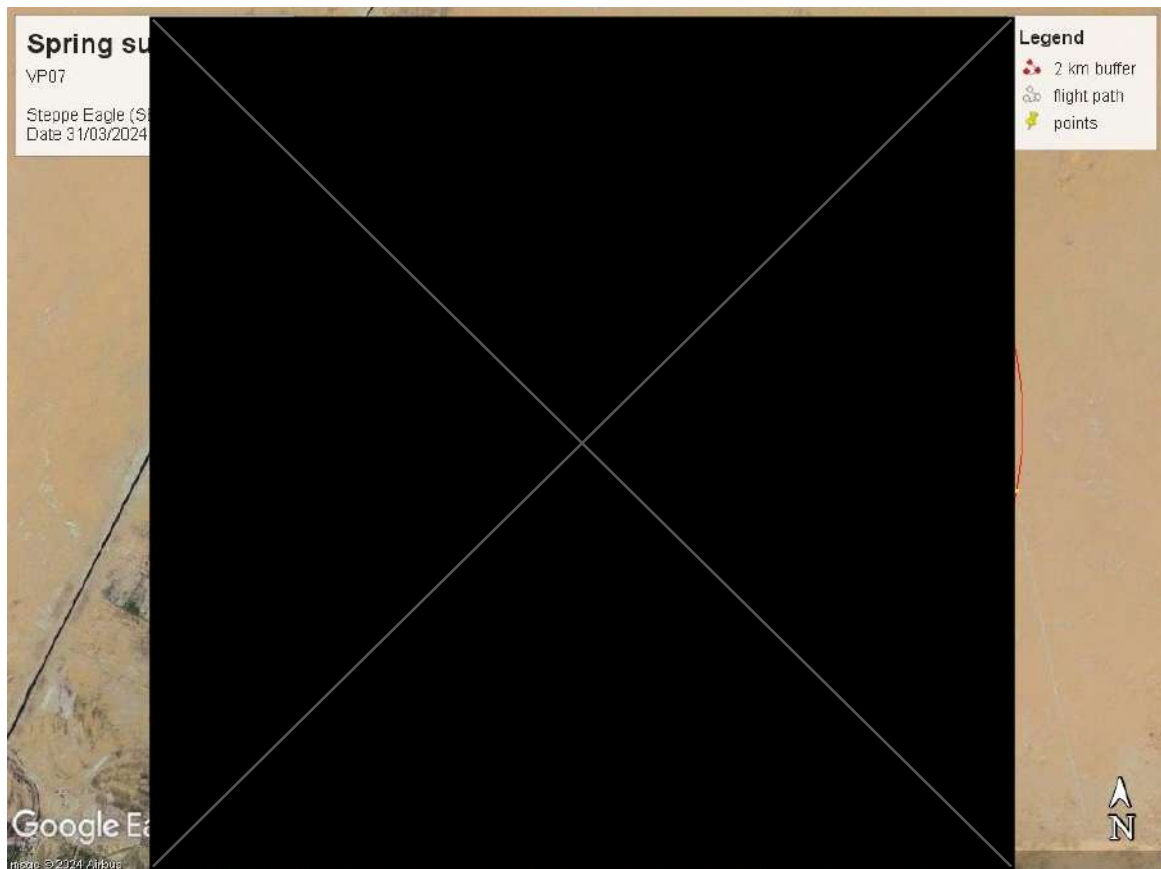


Figure 9: Steppe Eagle SE002 at VP07 on March 31, 2024



Figure 10: Imperial Eagle EIE002 at VP07 on April 8, 2024

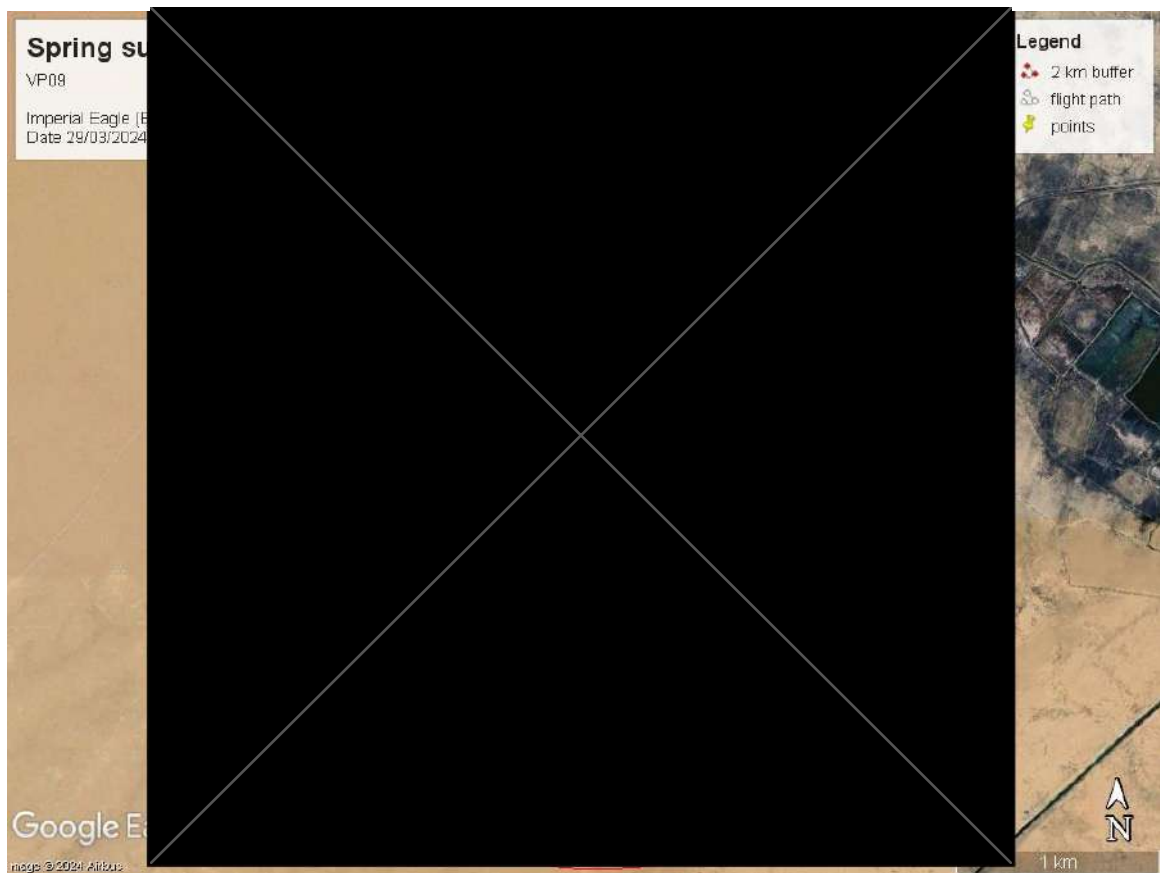


Figure 11: Imperial Eagle EIE001 at VP09 on March 29, 2024



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3.SUMMER VP SURVEY REPORT



Bird VP Summer Report

Gijduvan Wind Power Project in the Republic of Uzbekistan

Client: 5 Capitals

Date: 25 September 2024

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1. Introduction

The Gijduvon wind power project will involve the establishment of a 300 MW wind farm, collector sub-station and an associated Overhead Transmission Line (OTL) with a capacity of 500 kV, as well as the expansion of an associated sub-station, in Bukhara region, Uzbekistan. The wind farm will include a total of 38 Wind Turbine Generators (WTG), which will be micro-sited within an investigation area measuring approximately 13,645 ha.

The project site is located in the Bukhara region of the Republic of Uzbekistan. The wind farm will consist of one polygon of Wind Turbine Generators (WTG).

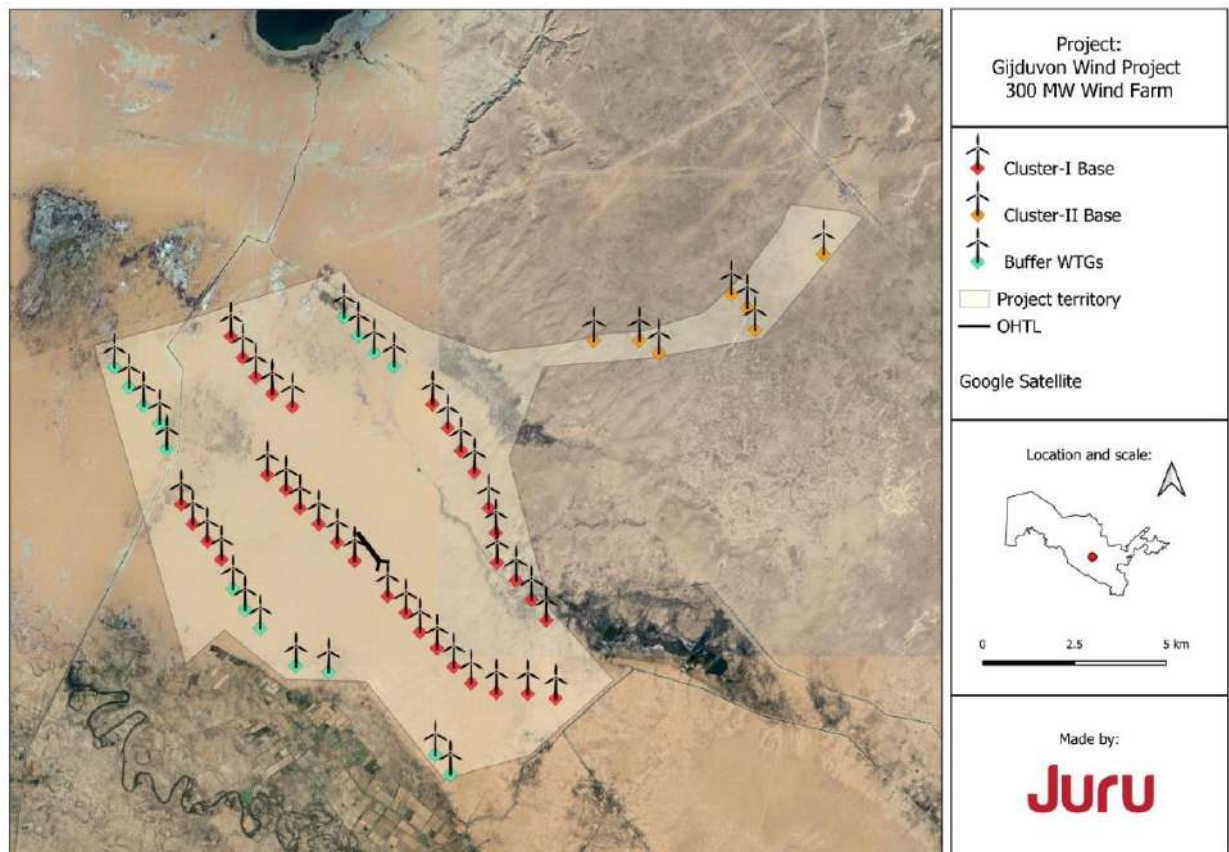


Figure 1: Project area

The report presents data and materials from field bird VP Summer monitoring and details the findings of the 2024 summer survey period, conducted between June 10 – August 27, 2024.

2. Materials and methods Vantage point (VP) bird monitoring on WF

The VP survey is designed to quantify the level of flight activity and the distribution of birds across the survey area. Its primary objective is to gather data for the Collision Risk Model (CRM), which informs the Collision Risk Assessment (CRA) by predicting mortalities resulting from collisions with operational turbines. This data can also provide insights into bird usage of the site, aiding in the assessment of potential impacts such as habitat loss, disturbance, displacement, and barrier effects.

The survey methods adhere to international best practice guidance, particularly the Scottish Natural Heritage: Recommended bird survey methods to inform impact assessment of onshore wind farms (March 2017, v2.) (SNH

guidance 2017¹) and the IFC EHS Guidelines for Wind Energy (2015²). These methods are specifically tailored for use in collision risk assessment models.

Equipment

- Field notebook and writing implements;
- Field survey sheets;
- Weatherproof Clipboard;
- At least two stopwatches / timer watches;
- Compass / GPS unit;
- Binoculars (at least 8x magnification);
- Telescope (minimum 60mm x 25/30 magnification) with tripod;
- Photo camera;
- Laptop with Excel required to write up the field sheets (or have access to them).

VP locations

9 VP locations have been identified for the 300 MW Gijduvon II site covering the project area with a focus on turbine locations as per the updated RfP.

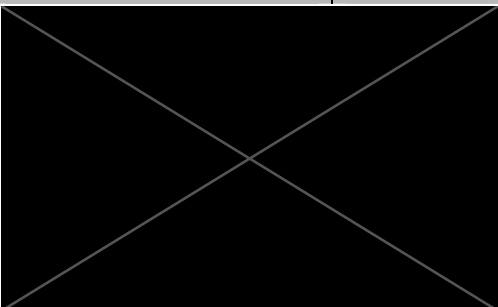


Figure 2: VP locations (VP01...VP09) survey points

¹ <https://www.nature.scot/sites/default/files/2018-06/Guidance%20Note%20-%20Recommended%20bird%20survey%20methods%20to%20inform%20impact%20assessment%20of%20onshore%20windfarms.pdf>

² https://www.ifc.org/wps/wcm/connect/b82d0563-b39a-42a7-b94e-0b926b4a82f9/FINAL_Aug%2B2015_Wind%2BEnergy_EHS%2BGuideline.pdf?MOD=AJPERES&CVID=mpusVXy

Table 1: VPs coordinates

Vantage Points	Coordinates (dd)	
	N	E
VP01		
VP02		
VP03		
VP04		
VP05		
VP06		
VP07		
VP08		
VP09		

Survey Timing

The VP surveys have been tailored to the ecology of the target bird species involved, with specific considerations for timing and duration. Surveys were conducted by two teams of two people (two people per point), rotating across 9 survey points. Following SNH recommendations, each VP session typically lasted 2 to 3 hours to ensure that observers remained alert and bird activity was accurately recorded.

During the summer season from June 10 until August 27, 2024, a total of 324 hours were completed for the site, averaging 36 hours per VP location. Surveys were conducted under suitable weather conditions with good ground visibility (>2km).

Tier 1 and 2 species

VP Survey Methods:

- Tier 1 Target Species Sampling**

The area in view was scanned until a Tier 1 Target Species was detected, at which point it was followed until it ceased flying or was lost from view. The time the Tier 1 target bird was detected the flight duration was recorded, and the route the bird followed was plotted in the field on the provided maps (Annex 1). The bird's flight height was estimated at the time of detection and then at 15-second intervals thereafter. A 15-second interval was recommended as a practical compromise that aimed to minimize dependency within data while maximizing the sample of observations. The species included as Tier 1 Target Species can be adjusted in the future based on the observations made on site.

- Tier 2 Target Species and "Other" Species Sampling**

Observation of Tier 1 Target Species took priority over recording of Tier 2 Target Species and "other" species, defined as any bird species not listed as a target species. The only differences between the sampling effort for Tier 2 Target Species and other species compared with Tier 1 Target Species were: 1) flight paths were not mapped for Tier 2 Target Species or other species; and 2) location and flight altitude data were only recorded a single time for any bird or flock of Tier 2 Target Species or other species, instead of every 15 seconds as was the case for Tier 1 Target Species.

The number of birds recorded was the minimum number of individuals that could account for the activity observed.

Table 2: Tier 1 and 2 bird species for the Gijduvon II 300 MW Farm Project

Latin name ³	Common name	IUCN ⁴ status	UzRDB ⁵ status	Tier	Notes on Likely Occurrence/Risk
Tier 1 species					
<i>Oxyura leucocephala</i>	White-headed Duck	EN	EN	1	Migrating, recorded on Ayakagytm Lake
<i>Otis tarda</i>	Great Bustard	EN	CR	1	Rare wintering in Kyzylkum desert
<i>Chlamydotis macqueenii</i>	Asian Houbara	VU	VU:D	1	Breeding and migrating in the project area (Koshkin et al, 2016[4])
<i>Vanellus gregarius</i>	Sociable Lapwing	CR	VU:R	1	Rare migrating in Kyzylkum desert
<i>Pelecanus onocrotalus</i>	Great White Pelican	LC	VU:D	1	Migrating and wintering near Ayakagytm Lake and Shorkul lake
<i>Pelecanus crispus</i>	Dalmatian Pelican	NT	EN	1	Migrating and wintering near Ayakagytm Lake and Shorkul lake
<i>Neophron percnopterus</i>	Egyptian Vulture	EN	VU:D	1	Breeding in Kyzylkum desert
<i>Circus gallicus</i>	Short-toed Snake-eagle	LC	VU:D	1	Breeding in Kyzylkum desert
<i>Clanga clanga</i>	Greater Spotted Eagle	VU	VU:R	1	Migrating
<i>Aquila nipalensis</i>	Steppe Eagle	EN	VU:D	1	Migrating in the Kyzylkum desert
<i>Aquila heliaca</i>	Imperial Eagle	VU	VU:D	1	Migrating in the Kyzylkum desert
<i>Aquila chrysaetos</i>	Golden Eagle	LC	VU:R	1	Resident in Kyzylkum desert
<i>Haliaeetus leucoryphus</i>	Pallas's Fish-eagle	EN	EN	1	Rare summer visitor in Ayakagytm Lake
<i>Falco cherrug</i>	Saker Falcon	EN	EN	1	Breeding in the region (Ten, Soldatov, 20188)
Tier 2 species					
<i>Anser anser</i>	Greylag Goose	LC	-	2	Migrating and wintering in Ayakagytm Lake and Shorkul
<i>Cygnus olor</i>	Mute Swan	LC	NT	2	Breeding and migrating on Ayakagytm Lake
<i>Cygnus cygnus</i>	Whooper Swan	LC	VU:R	2	Migrating, recorded on Ayakagytm Lake and Shorkul
<i>Aythya ferina</i>	Common Pochard	VU	-	2	Migrating, recorded on Ayakagytm Lake
<i>Aythya nyroca</i>	Ferruginous Duck	NT	VU:D	2	Migrating, recorded on Ayakagytm Lake
<i>Phoenicopterus roseus</i>	Greater Flamingo	LC	VU:D	2	Migrating, recorded on Ayakagytm Lake

³ HBW and BirdLife International (2022) Handbook of the Birds of the World and BirdLife International digital checklist of the birds of the world. Version 7. Available at: http://datazone.birdlife.org/userfiles/file/Species/Taxonomy/HBW-BirdLife_Checklist_v7_Dec22.zip

⁴ IUCN Red list www.iucnredlist.org

⁵ Uzbekistan Red Data book. 2019. Vol.2. Animals. Tashkent: Chino ENK.

<i>Podiceps auritus</i>	Horned Grebe	VU	-	2	Migrating, recorded on Ayakagytna Lake
<i>Tetrax tetrax</i>	Little Bustard	NT	VU:D	2	Migrating to Kyzylkum desert
<i>Anthropoides virgo</i>	Demoiselle Crane	LC	-	2	Migrating to Kyzylkum desert
<i>Grus grus</i>	Common Crane	LC	-	2	Migrating to Kyzylkum desert
<i>Vanellus vanellus</i>	Northern Lapwing	NT		2	Migrating to Kyzylkum desert
<i>Ciconia nigra</i>	Black Stork		VU:R	2	Rare migrating
<i>Microcarbo pygmaeus</i>	Pygmy Cormorant	LC	NT	2	Breeding and migrating
<i>Egretta garzetta</i>	Little Egret	LC	VU:D	2	Migrating
<i>Plegadis falcinellus</i>	Glossy Ibis	LC	VU:D	2	Migrating, recorded on Ayakagytna Lake
<i>Platalea leucorodia</i>	Eurasian Spoonbill	LC	VU:D	2	Migrating, recorded on Ayakagytna Lake
<i>Syrhaptes paradoxus</i>	Pallas's Sandgrouse	LC	-	2	Breeding and migrating
<i>Pandion haliaetus</i>	Osprey	LC	VU:R	2	Migrating species
<i>Aegypius monachus</i>	Cinereous Vulture	NT	NT	2	Resident in Kyzylkum desert
<i>Gyps fulvus</i>	Eurasian Griffon	LC	VU:D	2	Resident in Kyzylkum desert
<i>Pernis apivorus</i>	European Honey-buzzard	LC	-	2	Migrating to Kyzylkum desert
<i>Pernis ptilorhynchus</i>	Oriental Honey-buzzard	LC	-	2	Migrating to Kyzylkum desert
<i>Circus aeruginosus</i>	Eurasian Marsh-Harrier	LC	-	2	Breeding in Ayakagytna, migrating in Kyzylkum
<i>Circus macrourus</i>	Pallid Harrier	NT	NT	2	Migrating and wintering
<i>Circus cyaneus</i>	Hen Harrier	LC	-	2	Migrating and wintering
<i>Circus pygargus</i>	Montagu's Harrier	LC	-	2	Migrating
<i>Accipiter nisus</i>	Eurasian Sparrowhawk	LC	-	2	Migrating in the region
<i>Accipiter gentilis</i>	Eurasian Goshawk	LC	-	2	Migrating in the region
<i>Milvus migrans</i>	Black Kite	LC	-	2	Migrating
<i>Buteo lagopus</i>	Rough-legged Buzzard	LC	-	2	Wintering in Kyzylkum
<i>Buteo buteo</i>	Common Buzzard	LC	-	2	Migrating and wintering
<i>Buteo japonicus</i>	Eastern Buzzard	LC	-	2	Migrating and wintering
<i>Buteo rufinus</i>	Long-legged Buzzard	LC	-	2	Breeding, migrating and wintering
<i>Buteo hemilasius</i>	Upland Buzzard	LC	-	2	Wintering in Kyzylkum
<i>Haliaeetus albicilla</i>	White-tailed Eagle	LC	VU:R	2	Migrating and wintering near Ayakagytna and Shorkul lake
<i>Bubo bubo</i>	Eurasian Eagle-owl	LC	-	2	Resident in Kyzylkum desert
<i>Athene noctua</i>	Little Owl	LC	-	2	Resident in Kyzylkum desert
<i>Asio flammeus</i>	Short-eared Owl	LC	-	2	Wintering in Kyzylkum
<i>Falco naumanni</i>	Lesser Kestrel	LC	NT	2	Migrating, breeding in mountain habitats in Kyzylkum
<i>Falco tinnunculus</i>	Eurasian Kestrel	LC	-	2	Breeding

i. Data Recording Methods

Data for *Tier 1 Target Species* were recorded on the front of survey forms and mapped on maps of the survey area provided. Different forms were used for different survey periods (*i.e.* data from different VP sessions were not combined into one form or map). Maps clearly identified and cross-referenced to the information on the form on:

- The location of the VP used.
- Date of survey.
- Surveyor name.
- Start and End time of the VP session.
- Flight lines indicating the direction of flight for each individual (birds flying alone) or flock (birds flying in a flock of >1 bird), with a point annotated with estimated flight altitude estimated every 15 seconds as the bird or flock was flying along the mapped flight trajectory. If necessary, use different colours and symbols for each species, including a key on the form.
- Reference number of each flight line corresponding to that on the form.

Where off-site activity of interest is noted and may be linked to site activity (*e.g.* flight lines leading off-site to a known roosting location) this should be recorded in the note's column.

Data for tier 2 target species and other species is recorded on the rear of the forms.

Table 3: Schedule of VP (in hours) during Summer VP 2024

VP	10-Jun	11-Jun	12-Jun	13-Jul	14-Jul	19-Jul	20-Jul	21-Jul	27-Jul	28-Jul	03-Aug	04-Aug	05-Aug	06-Aug	07-Aug	08-Aug	09-Aug	20-Aug	21-Aug	22-Aug	23-Aug	24-Aug	25-Aug	26-Aug	27-Aug	Total	Planned
VP01		3		3		3							3		3		3	3		3	3		3	3	3	36	36
VP02		3		3		3							3		3		3	3		3	3		3	3	3	36	36
VP03		3	3		3			3		3		3		3		3			3	3		3	3			36	36
VP04		3	3		3			3		3		3		3		3			3	3		3	3			36	36
VP05		3		3		3							3		3		3	3		3	3		3	3	3	36	36
VP06		3	3		3			3		3		3		3		3			3	3		3	3			36	36
VP07	3		3				3		3		3			3	3			3	3		3	3		3		36	36
VP08	3		3				3		3		3			3	3			3	3		3	3		3		36	36
VP09	3		3				3		3		3			3	3			3	3		3	3		3		36	36

3. RESULTS

During the Summer VP monitoring from June 10 till August 27, 2024, a 54 bird species were observed, 2 are listed in the Red Book of Uzbekistan (2019), and 1 is included in the IUCN Red List (2023-1) (Table 4).

Detailed field data is presented in the Excel file attached to this report – 'UZB-ACWA-Bash II ESIA-VP summer.xlsx'.

Table 4: List of birds observed during the Summer VP Monitoring 2024.

Nº	Species	Common name	IUCN RL	UzRDB	Status ⁶
1	<i>Anas crecca</i>	Common Teal			B
2	<i>Columba livia</i>	Rock Pigeon			R
3	<i>Pterocles orientalis</i>	Black-bellied Sandgrouse			R
4	<i>Chlamydotis macqueenii</i>	Asian Houbara	VU	VU:D	B
5	<i>Caprimulgus europaeus</i>	European Nightjar			M
6	<i>Caprimulgus aegyptius</i>	Egyptian Nightjar			B
7	<i>Himantopus himantopus</i>	Black-winged Stilt			B
8	<i>Vanellus leucurus</i>	White-tailed Lapwing			B
9	<i>Actitis hypoleucos</i>	Common Sandpiper			S
10	<i>Tringa glareola</i>	Wood Sandpiper			S
11	<i>Larus genei</i>	Slender-billed Gull			S
12	<i>Larus ridibundus</i>	Black-headed Gull			B
13	<i>Larus cachinnans</i>	Caspian Gull			B
14	<i>Ciconia nigra</i>	Black Stork		VU:R	M
15	<i>Casmerodius albus</i>	Great Egret			S
16	<i>Ardea cinerea</i>	Grey Heron			B
17	<i>Circus aeruginosus</i>	Western Marsh Harrier			B
18	<i>Accipiter badius</i>	Shikra			B
19	<i>Accipiter nisus</i>	Eurasian Sparrowhawk			M
20	<i>Buteo buteo</i>	Eurasian Buzzard			M
21	<i>Bubo bubo</i>	Eurasian Eagle-owl			B
22	<i>Athene noctua</i>	Little Owl			R
23	<i>Upupa epops</i>	Common Hoopoe			B
24	<i>Merops persicus</i>	Blue-cheeked Bee-eater			B
25	<i>Merops apiaster</i>	European Bee-eater			B
26	<i>Coracias garrulus</i>	European Roller			B
27	<i>Falco tinnunculus</i>	Common Kestrel			B
28	<i>Oriolus oriolus</i>	Eurasian Golden Oriole			M
29	<i>Lanius phoenicuroides</i>	Red-tailed Shrike			B
30	<i>Lanius excubitor</i>	Steppe Grey Shrike			B
31	<i>Calandrella brachydactyla</i>	Greater Short-toed Lark			B
32	<i>Alaudala rufescens</i>	Lesser Short-toed Lark			B
33	<i>Galerida cristata</i>	Crested Lark			R
34	<i>Iduna rama</i>	Sykes's Warbler			R
35	<i>Riparia riparia</i>	Collared Sand Martin			B
36	<i>Hirundo rustica</i>	Barn Swallow			B
37	<i>Phylloscopus collybita</i>	Common Chiffchaff			M
38	<i>Scotocerca inquieta</i>	Streaked Scrub Warbler			R
39	<i>Curruca curruca</i>	Lesser Whitethroat			M
40	<i>Curruca nana</i>	Asian Desert Warbler			R
41	<i>Sturnus vulgaris</i>	Common Starling			B
42	<i>Muscicapa striata</i>	Spotted Flycatcher			B

⁶ Status of the observed species: R – resident, W – wintering, M – migrating, B – breeding

43	<i>Cercotrichas galactotes</i>	Rufous Scrub-robin			B
44	<i>Oenanthe isabellina</i>	Isabelline Wheatear			R
45	<i>Oenanthe deserti</i>	Desert Wheatear			R
46	<i>Oenanthe pleschanka</i>	Pied Wheatear			R
47	<i>Passer hispaniolensis</i>	Spanish Sparrow			B
48	<i>Passer domesticus indicus</i>	House sparrow			R
49	<i>Motacilla flava</i>	Yellow Wagtail			M
50	<i>Motacilla alba</i>	White Wagtail			M
51	<i>Carpodacus erythrinus</i>	Common Rosefinch			M
52	<i>Acanthis flammea</i>	Redpoll			M
53	<i>Fringilla coelebs</i>	Common Chaffinch			M
54	<i>Fringilla montifringilla</i>	Brambling			M
55	<i>Rhodospiza obsoleta</i>	Desert Finch			R
56	<i>Emberiza calandra</i>	Corn Bunting			M
	Total		1	3	

VP data

The analysis of bird species distribution across various VPs presented below underscores the significance of these locations for migrating bird species.

Table 5: The distribution of bird species Tier 1 and 2 on VPs

Nº	Species	TIER	VP01	VP02	VP03	VP04	VP05	VP06	VP07	VP08	VP09	Total records	Notes
1	Macqueen's Bustard	1				1	1	trace			trace	4	2 birds observed on Aug 4, 9; traces on Aug 23, 24.
2	Black stork	2		2								2	Same bird recorded on Aug 23, 24.
3	Black-bellied Sandgrouse	-	17	2	5	4	15	16	18	12	8	97	97 records of 51 single birds, 26 pairs, 20 small groups 3-15 birds

4. Key species descriptions

Macqueen's Bustard (*Chlamydotis macqueenii*) - UzRDB: 2(VU:D); IUCN: VU (Decreasing)

Status: Breeding and migratory species for Uzbekistan and for the project site.

Distribution: The Macqueen's Bustard is a breeding and migratory species found primarily in the Kyzylkum Desert, Ustyurt Plateau, Karnabchul steppe, and Sarykamysh Basin. It breeds in these regions and is also observed during seasonal migrations. The nesting population ranges from 1.5 to 3 thousand individuals, amounting to 0.05-0.4 individuals per square kilometre. During migration, the numbers can peak at up to 20 thousand individuals.

Habitats: This species prefers habitats characterized by clayey plains with wormwood grass cover, as well as the outskirts of takyr (salt flats) and salt marshes adorned with various bushes of saltwort and camel thorn. Its diet comprises grasses, seeds, invertebrates, small rodents, and reptiles.

Summer VP survey results. 2 single feeding birds were observed on Aug 4 and 9, and 2 traces on Aug 23 and 24. The presence of this species after breeding season reflects the meaning of the territory as foraging site.

Black Stork (*Ciconia nigra*) - IUCN: LC; UzRDB : VU:R (Decreasing)

Status: migratory for plain areas.

Distribution⁷: It is distributed in Western Tia-shan and Western Pamir-Alay (breeding), plain waterbodies (migrating). The numbers were always low; at present up to 20 breeding pairs and several dozen migrating individuals are reported.

Summer VP survey results. 2 records of same bird were recorded on Aug 23 and 24 at VP02.

Black-bellied Sandgrouse (*Pterocles orientalis*) - IUCN: LC (Decreasing)

Status: migratory breeding and wintering for Uzbekistan, same for the project site.

Distribution: Widespread in desert and semi-desert areas. In Ustyurt it occupies a vast nesting territory. In the valley of the lower reaches of the Amudarya. Breeds in Central Kyzylkum on the plains surrounding Bukantau, Dzhetymtau, Tamdytau, Aristantau, Beltau, and Sangruntau. To the west, it breeds in a large area between the wells of Aigyrbulak, Buzaubay, and Koskuduk, in southwestern Kyzylkum on the plains surrounding Kuldzhuktau. In southern Kyzylkum, noted for breeding near Gazli and Bukhara, reaches the Amu Darya on one side, and the Zarafshan river on the other.

Habitats: Inhabits sandy plains, slightly hilly, with small gravel and wormwood. Always stays near a watering hole. Feeds on seeds.

Summer VP survey results. 97 records of local movements of breeding birds among them 51 single birds and 46 small groups (2-15 birds) were recorded at heights between 3 and 15 m on all VPs.

5. Summary

- From June 10 to August 27, 2024, a total of 324 hours were spent on site, with an average of 36 hours per VP.
- The summer survey recorded 54 bird species, including 2 in the Red Book of Uzbekistan and 1 on the IUCN Red List.
- Early migration activity was observed for some passerines, waders, raptors, and Black Stork.
- Only Macqueen's Bustard from Tier 1 was observed during the summer, with 2 birds recorded feeding on the ground, so flight path data is not included in this report.

⁷ Uzbekistan Red data book. 2019/ Vol. II. Animals. Tashkent: Chinor ENK, 2019.



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4. WINTER VP SURVEY REPORT



Bird VP Winter Report

Gijduvan wind power project in the Republic of Uzbekistan

Client: 5Capitals

Date: 27 April 2024

Juru

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Cinereous Vulture (<i>Aegypius monachus</i>) - UzRDB: 3(NT); IUCN: NT (Decreasing)	16
Short-toed Snake Eagle (<i>Circaetus gallicus</i>) - UzRDB: 2(VU:R); IUCN: LC (Stable)	16
Greater Spotted Eagle (<i>Clanga clanga</i>) - UzRDB: 2(VU:R); IUCN: VU (Decreasing)	17
Steppe Eagle (<i>Aquila nipalensis</i>) - UzRDB: 2(VU:D); IUCN: EN (Decreasing)	17
Imperial Eagle (<i>Aquila heliaca</i>) - UzRDB: 2(VU:D); IUCN: VU (Decreasing)	17
Golden Eagle (<i>Aquila chrysaetos</i>) - UzRDB: 2(VU:R); IUCN: LC (Stable)	17
Harriers: Hen Harrier (<i>Circus cyaneus</i>) and Pallid Harrier (<i>Circus macrourus</i>) - UzRDB NT	18
Eurasian Sparrowhawk (<i>Accipiter nisus</i>) - IUCN: LC (Stable)	18
White-tailed Eagle (<i>Haliaeetus albicilla</i>) - UzRDB: 2(VU:R); IUCN: LC (Increasing)	18
Buzzards: Common Buzzard (<i>Buteo buteo</i>) - IUCN: LC (Increasing) and Eastern Buzzard (<i>Buteo japonicus</i>) - IUCN: LC	19
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1. Introduction

Gijduvon wind power project, hereafter referred to as 'the Project.' The Project will involve the establishment of a 300 MW wind farm, collector sub-station and an associated 25 km Overhead Transmission Line (OTL) with a capacity of 500 kV, as well as the expansion of an associated sub-station, in Bukhara region, Uzbekistan. The wind farm will include a total of 41 Wind Turbine Generators (WTG), which will be micro-sited within an investigation area measuring approximately 13,645 ha.

The project site is located in the Bukhara region of the Republic of Uzbekistan. The wind farm will consist of one polygon of Wind Turbine Generators (WTG).

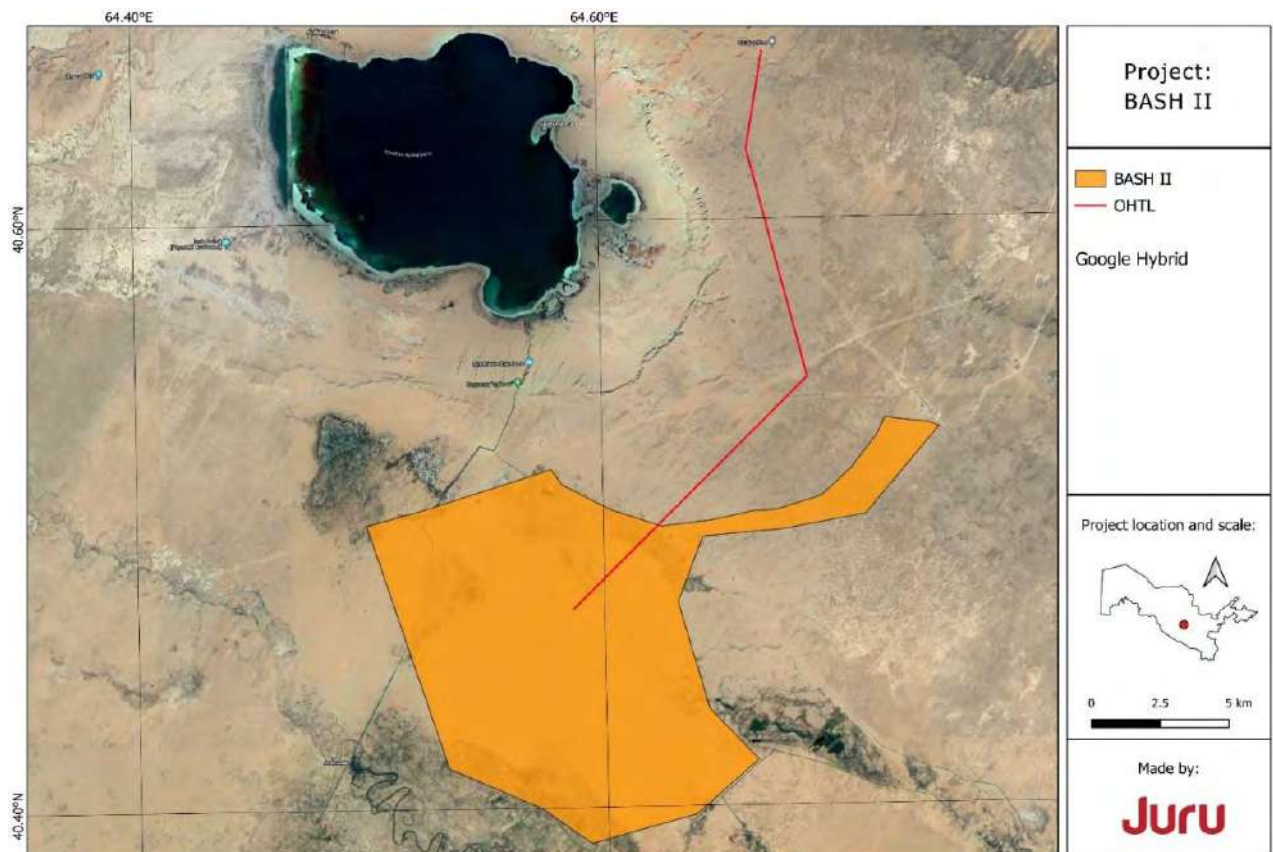


Figure 1: Project area

The report presents data and materials from both field and desktop bird VP Winter monitoring and details the findings of the 2024 winter survey period, conducted between January 9 – March 15, 2024.

2. Materials and methods Vantage point (VP) bird monitoring on WF

The VP survey is designed to quantify the level of flight activity and the distribution of birds across the survey area. Its primary objective is to gather data for the Collision Risk Model (CRM), which informs the Collision Risk Assessment (CRA) by predicting mortalities resulting from collisions with operational turbines. This data can also provide insights into bird usage of the site, aiding in the assessment of potential impacts such as habitat loss, disturbance, displacement, and barrier effects.

The survey methods adhere to international best practice guidance, particularly the Scottish Natural Heritage: Recommended bird survey methods to inform impact assessment of onshore wind farms (March 2017, v2.) (SNH

guidance 2017¹) and the IFC EHS Guidelines for Wind Energy (2015²). These methods are specifically tailored for use in collision risk assessment models.

Equipment

- Field notebook and writing implements;
- Field survey sheets;
- Weatherproof Clipboard;
- At least two stopwatches / timer watches;
- Compass / GPS unit;
- Binoculars (at least 8x magnification);
- Telescope (minimum 60mm x 25/30 magnification) with tripod;
- Photo camera;
- Laptop with Excel required to write up the field sheets (or have access to them).

VP locations

9 VP locations have been identified for the 300 MW Gijduvon II site covering the project area with a focus on turbine locations as per the updated RfP.

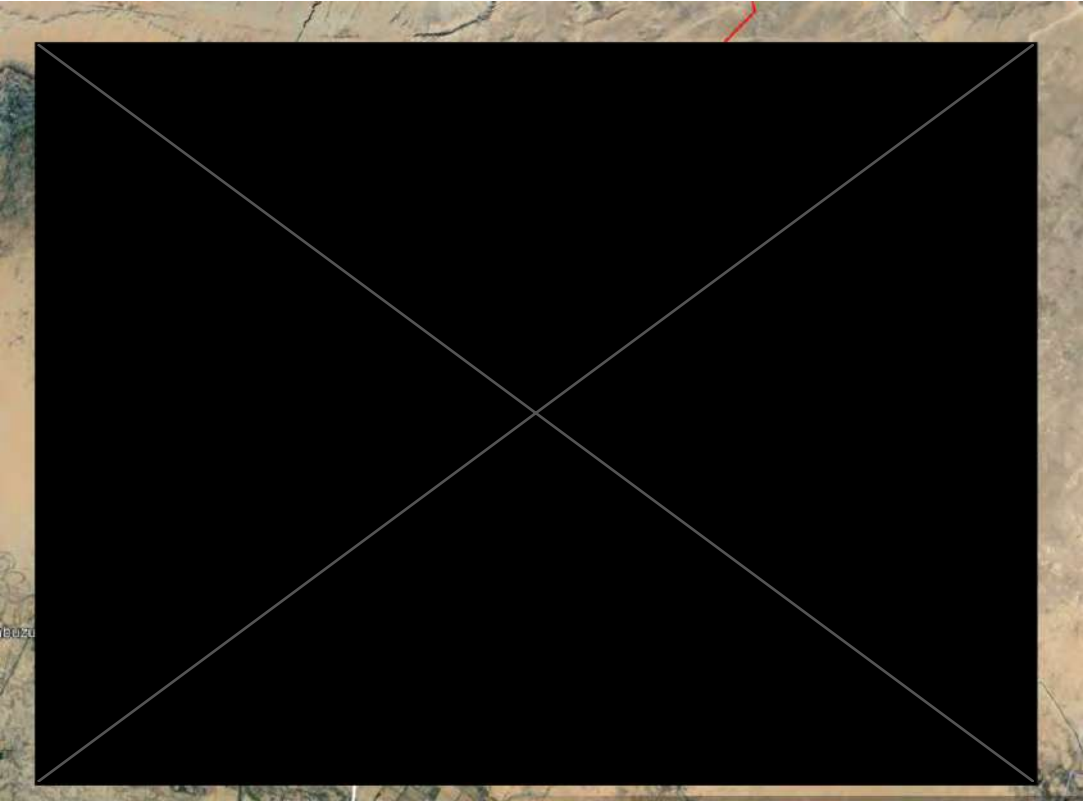


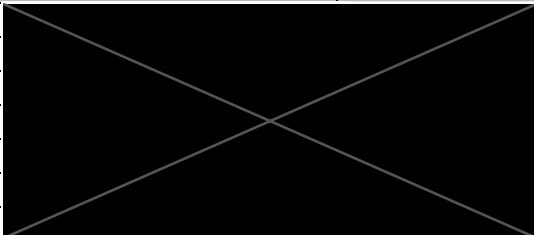
Figure 2: VP locations (VP01...VP09) survey points

Table 1: VPs coordinates

Vantage Points	Coordinates (dd)	
	N	E
VP01		
VP02		

¹ <https://www.nature.scot/sites/default/files/2018-06/Guidance%20Note%20-%20Recommended%20bird%20survey%20methods%20to%20inform%20impact%20assessment%20of%20onshore%20windfarms.pdf>

² https://www.ifc.org/wps/wcm/connect/b82d0563-b39a-42a7-b94e-0b926b4a82f9/FINAL_Aug%2B2015_Wind%2BEnergy_EHS%2BGuideline.pdf?MOD=AJPERES&CVID=mpusVXy

Vantage Points	Coordinates (dd)	
	N	E
VP03		
VP04		
VP05		
VP06		
VP07		
VP08		
VP09		

Survey Timing

The VP surveys have been tailored to the ecology of the target bird species involved, with specific considerations for timing and duration. Surveys were conducted by one or two teams of two people (two people per point), rotating across 9 survey points. Following SNH recommendations, each VP session typically lasted 2 to 3 hours to ensure that observers remained alert and bird activity was accurately recorded.

During the winter season from January 9 until March 15, 2024, a total of 329.5 hours were completed for the site, averaging 36 hours per VP location. Days with some precipitations were acceptable for surveying unless showers were too frequent or prolonged.

Tier 1 and 2 species

VP Survey Methods:

- Tier 1 Target Species Sampling**

The area in view was scanned until a Tier 1 Target Species was detected, at which point it was followed until it ceased flying or was lost from view. The time the Tier 1 target bird was detected the flight duration was recorded, and the route the bird followed was plotted in the field on the provided maps (Annex 1). The bird's flight height was estimated at the time of detection and then at 15-second intervals thereafter. A 15-second interval was recommended as a practical compromise that aimed to minimize dependency within data while maximizing the sample of observations. The species included as Tier 1 Target Species can be adjusted in the future based on the observations made on site.

- Tier 2 Target Species and "Other" Species Sampling**

Observation of Tier 1 Target Species took priority over recording of Tier 2 Target Species and "other" species, defined as any bird species not listed as a target species. The only differences between the sampling effort for Tier 2 Target Species and other species compared with Tier 1 Target Species were: 1) flight paths were not mapped for Tier 2 Target Species or other species; and 2) location and flight altitude data were only recorded a single time for any bird or flock of Tier 2 Target Species or other species, instead of every 15 seconds as was the case for Tier 1 Target Species.

The number of birds recorded was the minimum number of individuals that could account for the activity observed.

Table 2: Tier 1 and 2 bird species for the Gijduvon II 300 MW Farm Project

Latin name ³	Common name	IUCN ⁴ status	UzRDB ⁵ status	Tier	Notes on Likely Occurrence/Risk
Tier 1 species					
<i>Oxyura leucocephala</i>	White-headed Duck	EN	EN	1	Migrating, recorded on Ayakagytna Lake

³ HBW and BirdLife International (2022) Handbook of the Birds of the World and BirdLife International digital checklist of the birds of the world. Version 7. Available at: http://datazone.birdlife.org/userfiles/file/Species/Taxonomy/HBW-BirdLife_Checklist_v7_Dec22.zip

⁴ IUCN Red list www.iucnredlist.org

⁵ Uzbekistan Red Data book. 2019. Vol.2. Animals. Tashkent: Chinor ENK.

<i>Otis tarda</i>	Great Bustard	EN	CR	1	Rare wintering in Kyzylkum desert
<i>Chlamydotis macqueenii</i>	Macqueen's Bustard	VU	VU:D	1	Breeding and migrating in the project area (Koshkin et al, 2016[4])
<i>Vanellus gregarius</i>	Sociable Lapwing	CR	VU:R	1	Rare migrating in Kyzylkum desert
<i>Pelecanus onocrotalus</i>	Great White Pelican	LC	VU:D	1	Migrating and wintering near Ayakagytm and Shorkul lake
<i>Pelecanus crispus</i>	Dalmatian Pelican	NT	EN	1	Migrating and wintering near Ayakagytm and Shorkul lake
<i>Neophron percnopterus</i>	Egyptian Vulture	EN	VU:D	1	Breeding in Kyzylkum desert
<i>Circus gallicus</i>	Short-toed Snake-eagle	LC	VU:D	1	Breeding in Kyzylkum desert
<i>Clanga clanga</i>	Greater Spotted Eagle	VU	VU:R	1	Migrating
<i>Aquila nipalensis</i>	Steppe Eagle	EN	VU:D	1	Migrating in the Kyzylkum desert
<i>Aquila heliaca</i>	Imperial Eagle	VU	VU:D	1	Migrating in the Kyzylkum desert
<i>Aquila chrysaetos</i>	Golden Eagle	LC	VU:R	1	Resident in Kyzylkum desert
<i>Haliaeetus leucoryphus</i>	Pallas's Fish-eagle	EN	EN	1	Rare summer visitor in Ayakagytm
<i>Falco cherrug</i>	Saker Falcon	EN	EN	1	Breeding in the region (Ten, Soldatov, 20188)
Tier 2 species					
<i>Anser anser</i>	Greylag Goose	LC	-	2	Migrating and wintering in Ayakagytm and Shorkul
<i>Cygnus olor</i>	Mute Swan	LC	NT	2	Breeding and migrating on Ayakagytm lake
<i>Cygnus cygnus</i>	Whooper Swan	LC	VU:R	2	Migrating, recorded on Ayakagytm Lake and Shorkul
<i>Aythya ferina</i>	Common Pochard	VU	-	2	Migrating, recorded on Ayakagytm Lake
<i>Aythya nyroca</i>	Ferruginous Duck	NT	VU:D	2	Migrating, recorded on Ayakagytm Lake
<i>Phoenicopterus roseus</i>	Greater Flamingo	LC	VU:D	2	Migrating, recorded on Ayakagytm Lake
<i>Podiceps auritus</i>	Horned Grebe	VU	-	2	Migrating, recorded on Ayakagytm Lake
<i>Tetrax tetrax</i>	Little Bustard	NT	VU:D	2	Migrating to Kyzylkum desert
<i>Anthropoides virgo</i>	Demoiselle Crane	LC	-	2	Migrating to Kyzylkum desert
<i>Grus grus</i>	Common Crane	LC	-	2	Migrating to Kyzylkum desert
<i>Vanellus vanellus</i>	Northern Lapwing	NT		2	Migrating to Kyzylkum desert
<i>Ciconia nigra</i>	Black Stork		VU:R	2	Rare migrating
<i>Microcarbo pygmaeus</i>	Pygmy Cormorant	LC	NT	2	Breeding and migrating
<i>Egretta garzetta</i>	Little Egret	LC	VU:D	2	Migrating
<i>Plegadis falcinellus</i>	Glossy Ibis	LC	VU:D	2	Migrating, recorded on Ayakagytm Lake
<i>Platalea leucorodia</i>	Eurasian Spoonbill	LC	VU:D	2	Migrating, recorded on Ayakagytm Lake
<i>Syrrhaptes paradoxus</i>	Pallas's Sandgrouse	LC	-	2	Breeding and migrating
<i>Pandion haliaetus</i>	Osprey	LC	VU:R	2	Migrating species
<i>Aegypius monachus</i>	Cinereous Vulture	NT	NT	2	Resident in Kyzylkum desert
<i>Gyps fulvus</i>	Eurasian Griffon	LC	VU:D	2	Resident in Kyzylkum desert
<i>Pernis apivorus</i>	European Honey-buzzard	LC	-	2	Migrating to Kyzylkum desert
<i>Pernis ptilorhynchus</i>	Oriental Honey-buzzard	LC	-	2	Migrating to Kyzylkum desert
<i>Circus aeruginosus</i>	Eurasian Marsh- Harrier	LC	-	2	Breeding in Ayakagytm, migrating in Kyzylkum
<i>Circus macrourus</i>	Pallid Harrier	NT	NT	2	Migrating and wintering
<i>Circus cyaneus</i>	Hen Harrier	LC	-	2	Migrating and wintering
<i>Circus pygargus</i>	Montagu's Harrier	LC	-	2	Migrating
<i>Accipiter nisus</i>	Eurasian Sparrowhawk	LC	-	2	Migrating in the region
<i>Accipiter gentilis</i>	Eurasian Goshawk	LC	-	2	Migrating in the region
<i>Milvus migrans</i>	Black Kite	LC	-	2	Migrating

<i>Buteo lagopus</i>	Rough-legged Buzzard	LC	-	2	Wintering in Kyzylkum
<i>Buteo buteo</i>	Common Buzzard	LC	-	2	Migrating and wintering
<i>Buteo japonicus</i>	Eastern Buzzard	LC	-	2	Migrating and wintering
<i>Buteo rufinus</i>	Long-legged Buzzard	LC	-	2	Breeding, migrating and wintering
<i>Buteo hemilasius</i>	Upland Buzzard	LC	-	2	Wintering in Kyzylkum
<i>Haliaeetus albicilla</i>	White-tailed Eagle	LC	VU:R	2	Migrating and wintering near Ayakagytna and Shorkul lake
<i>Bubo bubo</i>	Eurasian Eagle-owl	LC	-	2	Resident in Kyzylkum desert
<i>Athene noctua</i>	Little Owl	LC	-	2	Resident in Kyzylkum desert
<i>Asio flammeus</i>	Short-eared Owl	LC	-	2	Wintering in Kyzylkum
<i>Falco naumanni</i>	Lesser Kestrel	LC	NT	2	Migrating, breeding in mountain habitats in Kyzylkum
<i>Falco tinnunculus</i>	Eurasian Kestrel	LC	-	2	Breeding

i. Tier 1 Target Species Sampling

ii. Data Recording Methods

Data for *Tier 1 Target Species* were recorded on the front of survey forms and mapped on maps of the survey area provided. Different forms were used for different survey periods (*i.e.* data from different VP sessions were not combined onto one form or map). Maps clearly identified and cross-referenced to the information on the form on:

- The location of the VP used.
- Date of survey.
- Surveyor name.
- Start and End time of the VP session.
- Flight lines indicating direction of flight for each individual (birds flying alone) or flock (birds flying in a flock of >1 bird), with a point annotated with estimated flight altitude estimated every 15 seconds as the bird or flock was flying along the mapped flight trajectory. If necessary, use different colours and symbols for each species, including a key on the form.
- Reference number of each flight line corresponding to that on the form.

Where off site activity of interest is noted and may be linked to site activity (*e.g.* flight lines leading off site leading to a known roosting location) this should be recorded in the note's column.

Data for tier 2 target species and other species is recorded on the rear of the forms.

Table 3: Schedule of VP observations (in hours) during Winter 2024

VP	Y	X	09-Jan	10-Jan	11-Jan	12-Jan	13-Jan	08-Feb	09-Feb	10-Feb	14-Feb	15-Feb	16-Feb	17-Feb	18-Feb	19-Feb	20-Feb	21-Feb	22-Feb	23-Feb	07-Mar	08-Mar	09-Mar	10-Mar	11-Mar	12-Mar	13-Mar	14-Mar	15-Mar	TOTAL
VP01	40.48692	64.54138			3	2		2	2	2			5	2	2		3			3	3			3		3			2	37
VP02	40.49303	64.58996		3			3	2	2	2			3	2	2		3			3	3			3		3			2	36
VP03	40.49826	64.6567	3				3	2	2	2		3	2	2		3			3			3					3	3	3	37
VP04	40.50969	64.7153					3	4				3	2	2		3			3				3	3			3	4	3	36
VP05	40.4579	64.5697			3	2		2	2	2			3	2	2		3			3	3	3	3			3				36
VP06	40.46046	64.61906	3	3				2	2	2		3	2	2		3			3			3	3		3	3				37
VP07	40.43796	64.53013						2	2	2	3		2	5	2			3				3	3	3		3			3	36
VP08	40.42331	64.58315	3		2.5	2			2		3		2	3	2			3				3	3	3	3		3			37.5
VP09	40.42397	64.63073				2		2	2	2	3			5	2			3				3	3	3	2		3		2	37

3. RESULTS

This section provides information on the data obtained as a result of the study, focusing on species Tiar 1 and 2. In total of 57 bird species were observed, 12 listed in the Red Book of Uzbekistan (2019), 8 are included in the IUCN Red List (2023-1).

Detailed field data in presented in Excel file attached to this report – 'UZB-ACWA-Bash II ESIA-VP winter_field_2024.xlsx'.

Table 4: List of birds observed during the Winter VP Monitoring 2024

No	Species	Common name	IUCN RL	UzRDB	Status ⁶
1	Anser anser	Greylag Goose			MW
2	Cygnus olor	Mute Swan		NT	BMW
3	Tadorna ferruginea	Ruddy Shelduck			BMW
4	Common Shelduck	Common Shelduck			MW
5	Anas platyrhynchos	Mallard			BMW
6	Anas crecca	Green-winged Teal			BMW
7	Alectoris chukar	Chukar			R
8	Pterocles orientalis	Black-bellied Sandgrouse			R
9	Chlamydotis macqueenii	Macqueen's Bustard	VU	VU:D	BM
10	Apus apus	Common Swift			BM
11	Grus grus	Common Crane			M
12	Vanellus gregarius	Sociable Lapwing	CR	VU:R	M
13	Anarhynchus leschenaultii	Greater Sand-Plover			B
14	Chroicocephalus ridibundus	Black-headed Gull			BMW
15	Larus canus	Common Gull			MW
16	Larus cachinnans	Caspian Gull			BMW
17	Phalacrocorax carbo	Great Cormorant			MW
18	Pelecanus crispus	Dalmatian Pelican	NT	EN	MW
19	Ardea alba	Great Egret			MW
20	Ardea cinerea	Grey Heron			BMW
21	Aegypius monachus	Cinereous Vulture	NT	NT	R
22	Circaetus gallicus	Short-toed Snake-eagle		VU:D	BM
23	Clanga clanga	Greater Spotted Eagle	VU	VU:R	M
24	Aquila nipalensis	Steppe Eagle	EN	VU:D	M
25	Aquila heliaca	Imperial Eagle	VU	VU:D	M
26	Aquila chrysaetos	Golden Eagle		VU:R	RM
27	Circus aeruginosus	Western Marsh Harrier			BMW
28	Circus cyaneus	Hen Harrier			MW
29	Circus macrourus	Pallid Harrier	NT	NT	M
30	Accipiter nisus	Eurasian Sparrowhawk			M
31	Milvus migrans	Black Kite			M
32	Haliaeetus albicilla	White-tailed Eagle		VU:R	MW
33	Buteo buteo	Common Buzzard			MW
34	Buteo japonicus	Eastern Buzzard			MW
35	Buteo rufinus	Long-legged Buzzard			BMW
36	Athene noctua	Little Owl			R
37	Falco tinnunculus	Eurasian Kestrel			BM

⁶ Status of the observed species for project site and adjacent areas: R – resident, W – wintering, M – migrating, B - breeding

38	Falco columbarius	Merlin			W
39	Lanius excubitor	Great Grey Shrike			B
40	Corvus monedula	Eurasian Jackdaw			BMW
41	Corvus frugilegus	Rook			MW
42	Corvus corax	Common Raven			R
43	Calandrella brachydactyla	Greater Short-toed Lark			BMW
44	Melanocorypha calandra	Calandra Lark			BMW
45	Alaudala rufescens	Mediterranean Short-toed Lark			BMW
46	Alauda arvensis	Eurasian Skylark			M
47	Galerida cristata	Crested Lark			R
48	Hirundo rustica	Barn Swallow			BM
49	Sturnus vulgaris	European Starling			M
50	Oenanthe pleschanka	Pied Wheatear			R
51	Oenanthe finschii	Finsch's Wheatear			R
52	Passer domesticus	House Sparrow			R
53	Passer hispaniolensis	Spanish Sparrow			BM
54	Motacilla alba	White Wagtail			M
55	Fringilla coelebs	Common Chaffinch			W
56	Fringilla montifringilla	Brambling			W
57	Rhodospiza obsoleta	Desert Finch			R
58	Emberiza calandra	Corn Bunting			M
	Total		8	12	

During the survey period, we observed several key wintering species - Merlin, Cinereous Vulture, Steppe Eagle. Black-billed Sandgrouse and larks were found in abundant numbers during winter, demonstrating the ecological importance of the site for these species.

The small ponds surrounding the project site play a role, attracting pelicans, swans, and other waterbirds. We observed local movements around these ponds in late February after melting.

Spring migration began in second part of February, with the first wave of migrants overlapping with the winter season.

VP data

The analysis of bird species Tier 1 and 2 distribution across various VPs presented on Table 6 underscores the significance of these locations for wintering and migrating bird species.

Table 5: The distribution of bird Tier 1 and 2 on VPs

№	Species	IUCN	UzRDB	Tier	Observations on VPs (observations)										Number of individuals	Notes
					VP 01	VP 02	VP 03	VP 04	VP 05	VP 06	VP 07	VP 08	VP 09	Number of observations		
1	Mute Swan		NT	2								1		1	15	a flock of 15 birds
2	Greylag Goose			2		1				1				2	9	two flocks of 4 and 5 birds
3	Black-bellied Sandgrouse			other	15	7	8	11	5	18	11	8	6	89	536	13 single birds and 76 groups from 2 to 22 birds
4	Macqueen's Bustard	VU	VU:D	1		1	1							2	2	two records of single birds
5	Common Crane			2									1	1	9	a flock of 9 birds
6	Sociable Lapwing	CR	VU:R	1									1	1	3	a flock of 3 birds
7	Dalmatian Pelican	NT	EN	1		1						3	2	6	95	a single bird and five groups from 3 to 31
8	Cinereous Vulture	NT	NT	1	1				1					2	2	two records of single birds
9	Short-toed Snake-eagle		VU:D	1			1							1	1	a single bird
10	Greater Spotted Eagle	VU	VU:R	1				1		1	1	1		4	4	four records of single birds
11	Steppe Eagle	EN	VU:D	1	3	6	2	13	6	3	6	3	7	49	85	34 records of single birds and 15 groups from 2 to 8
12	Imperial Eagle	VU	VU:D	1				1	1			1		3	4	two records of single birds and group of 2 birds
13	Golden Eagle		VU:R	1		1				1	1			3	3	a single bird and two pairs
14	Western Marsh Harrier			2	1	10	2	1		3	2	8	4	31	31	31 records of single birds

15	Hen Harrier			2	1		5	9		2		1	2	20		20 records of single birds
16	Pallid Harrier	NT	NT	2	1				1					2	2	two records of single birds
17	Eurasian Sparrowhawk			2	2		1				1			4	4	four records of single birds
18	Black Kite			2		1						1		2	4	a single bird and flock of 3 birds
19	White-tailed eagle		VU:R	1									1	1	1	a single bird
20	Common Buzzard			2	1	1	1			2		1		6	6	six records of single birds
21	Eastern Buzzard			2	2				1		1	1		5	5	five records of single birds
22	Long-legged Buzzard			2	1	4	3	6	2	2	3	4	6	31	42	26 single birds and 5 groups from 2 to 7 birds
23	Little Owl			2				1						1	1	a single bird
24	Eurasian Kestrel			2	1	2	5	8	1	3	2	2	3	27	27	27 records of single birds
25	Merlin			2			2		2					4	4	four records of single birds

4. Key species descriptions

Black-bellied Sandgrouse (*Pterocles orientalis*) - IUCN: LC (Decreasing)

Status: migratory breeding and wintering for Uzbekistan, same for project site.

Distribution: Widespread in desert and semi-desert areas. In Ustyurt it occupies a vast nesting territory. In the valley of the lower reaches of the Amudarya. Breeds in Central Kyzylkum on the plains surrounding Bukantau, Dzhetymtau, Tamdytau, Aristantau, Beltau, Sangruntau. To the west it breeds in a large area between the wells of Aigyrbulak, Buzaubay, Koskuduk, in southwestern Kyzylkum on the plains surrounding Kuldzhuktau. In southern Kyzylkum, noted for breeding near Gazli and Bukhara, reaches the Amu Darya on one side, and the Zarafshan river on the other.

Habitats: Inhabits sandy plains, slightly hilly, with small gravel and wormwood. Always stays near a watering hole. Feeds on seeds.

During winter observations at the survey site, the Black-bellied Sandgrouse was notably abundant, with sightings recorded across all survey points (VPs). A total of 89 records were documented, with observations of 13 single birds and 76 groups from 2 to 22 birds. These observations highlight the species' reliance on specific habitats and the importance of suitable wintering grounds for its survival.

Macqueen's Bustard (*Chlamydotis macqueenii*) - UzRDB: 2(VU:D); IUCN: VU (Decreasing)

Status: Breeding and migratory species for Uzbekistan and for project site.

Distribution: The Macqueen's Bustard or Asian Houbara (*Chlamydotis macqueenii*) is a migratory species found primarily in the Kyzylkum Desert, Ustyurt Plateau, Karnabchul steppe, and Sarykamysh Basin. It breeds in these regions and is also observed during seasonal migrations. The nesting population ranges from 1.5 to 3 thousand individuals, amounting to 0.05-0.4 individuals per square kilometer. During migration, the numbers can peak at up to 20 thousand individuals.

Habitats: This species prefers habitats characterized by clayey plains with wormwood grass cover, as well as the outskirts of takyrs (salt flats) and salt marshes adorned with various bushes of saltwort and camel thorn. Its diet comprises grasses, seeds, invertebrates, small rodents, and reptiles.

During winter observations at the survey site, the Macqueen's Bustard was observed twice. These observed birds could either be breeding individuals that have arrived in the area or migrants passing through, as the species also breeds in Kazakhstan and migrates through Kyzylkum desert.

Common Crane (*Grus grus*) - IUCN: LC (Increasing)

Status: migratory and wintering species in Uzbekistan and is observed during migration at the project site.

Distribution: During migration, Common Cranes are widely distributed across Uzbekistan. Spring migration typically begins in late February to early March and extends until mid-April, while autumn migration starts in the second half of August to early September. These birds often fly in flocks ranging from 5-7 to 40-60 individuals, usually at altitudes of 100-500 meters and occasionally above 1000 meters.

Habitats: Common Cranes prefer habitats with well-developed herbaceous vegetation and small ponds or puddles in clay and sandy deserts during resting and feeding periods. Along river valleys, they frequent areas with meadow vegetation. Their diet consists of plant foods such as grain, young shoots, and roots, as well as insects, mollusks, small rodents, and frogs.

During winter observations at the survey site, a group of nine Common Cranes was recorded, highlighting their presence and migration patterns in the monitored area.

Sociable Lapwing (*Chettusia gregaria*) - UzRDB: 2(VU:R); IUCN: CR (Decreasing)

Status: Migrating species for Uzbekistan and project site.

Distribution: Historically, this migratory species was more common, but its numbers sharply declined in the 20th century due to agricultural expansion in the steppes of Kazakhstan. The global population of Sociable Lapwings is currently estimated at 5,600 pairs. During migration, these lapwings are noted in various regions including the Aral Sea area, Lake Aydarkul, Tashkent, Bukhara, Kashkadarya, and Surkhandarya regions. Notably, a record-breaking concentration of 2,210 individuals was observed near Lake Talimarzhan in Uzbekistan, marking the highest known aggregation of lapwings along the Eastern Lapwing Flyway. Spring migration begins at the end of February, the peak occurs in March - early April, single individuals are found until the middle of the month. Autumn migration takes place in September-November.

During winter observations at the survey site, a migrating group of three Sociable Lapwings was recorded.

Dalmatian Pelican (*Pelecanus crispus*) - UzRDB: 2(VU:R); IUCN: NT (Decreasing)

Status: Migratory nesting and wintering bird in Uzbekistan and migrating for project site.

Distribution: This species undertakes spring migration during March-April. It is distributed in the lower reaches of the Amudarya and Zarafshan rivers, the middle reaches of the Syrdarya River, and across central and southern Uzbekistan. Historically, it was once common in the southern Aral Sea region but has since disappeared from many habitats.

During winter observations at the survey site in March, a single bird and five groups from 3 to 31 of pelicans were recorded during their migration, highlighting their presence and migration patterns in the surveyed area.

Cinereous Vulture (*Aegypius monachus*) - UzRDB: 3(NT); IUCN: NT (Decreasing)

Status: Resident species with local seasonal movement in Uzbekistan, and wintering in Project site.

Distribution: Western Tien Shan, Western Pamir-Alai, remnant mountains of Bukantau, Tamdytau. Currently, the number is gradually declining. Adult birds during non-breeding seasons, and juvenile and unmarried birds are found throughout the year almost all over the entire territory of the republic. There are no known seasonally expressed migrations in vultures, only general movements, but they can quickly fly to places where ungulates die and concentrate near them.

Habitats: It nests on trees, bushes and rocks (colonial settlements); depending on the location, the nests last for a different period of time. It feeds on the carrion of ungulates, sometimes on foxes, hares, ground squirrels, and also turtles deserve special attention in the diet of vultures.

During winter observations at the survey site, a total of 2 individual Cinereous Vultures were observed.

Short-toed Snake Eagle (*Circaetus gallicus*) - UzRDB: 2(VU:R); IUCN: LC (Stable)

Status: Migratory breeding species.

Distribution: It undertakes spring migration during March-April and is widely distributed throughout Uzbekistan, being found in almost all regions.

Habitats: The Short-toed Snake Eagle nests on bushes, trees, cliffs, and rocks. The primary consideration when choosing a nesting site is the presence of large reptiles with daytime activity and suitable locations for nesting. Its diet consists primarily of lizards, snakes, and occasionally small rodents.

During winter observations at the survey site, only 1 individual Short-toed Snake Eagle was documented.

Greater Spotted Eagle (*Clanga clanga*) - UzRDB: 2(VU:R); IUCN: VU (Decreasing)

Status: Migratory species.

Distribution: Spring migration occurs from February to May, and autumn migration occurs from October to November. Greater Spotted Eagles fly singly or in groups of 2-3 individuals during migrations and can be found throughout the republic during these periods. There is limited data on the wintering of Greater Spotted Eagles. Greater Spotted Eagles feed on small mammals, waterbirds, frogs, and snakes.

During winter observations at the survey site, a total of 4 individual eagles were documented.

Steppe Eagle (*Aquila nipalensis*) - UzRDB: 2(VU:D); IUCN: EN (Decreasing)

Status: Breeding in Northern Uzbekistan (Ustyurt), migrating and wintering in Uzbekistan and at the project site.

Distribution: The Steppe Eagle inhabits plains and low mountains. Spring migration occurs from February to May, autumn migration from September to November, and winters are from December to February. Breeding occurs exclusively in the northern part of the Karakalpak Ustyurt.

Habitats: Steppe Eagles construct nests on the ground or on rocks. They primarily feed on rodents, especially great and red-tailed gerbils, and in the Ustyurt region, they also prey on small gophers. Additionally, Steppe Eagles scavenge carrion.

During winter observations at the survey site, a total of 34 individual eagles, and 15 small groups ranging from 2 to 8 birds were documented, amounting to a total of 85 Steppe Eagles observed. Some birds were observed roosting on the desert ground (8 records).

Imperial Eagle (*Aquila heliaca*) - UzRDB: 2(VU:D); IUCN: VU (Decreasing)

Status: migratory and winters in Uzbekistan, with migration also observed at the project site.

Distribution: Spring migration occurs from February to April, during which birds fly alone or in groups of up to 15 individuals. This species is distributed across the Ustyurt plateau and Northern Kyzylkum during breeding. During seasonal migrations, Eastern Imperial Eagles can be found throughout Uzbekistan.

Habitats: Species inhabits plains and foothills. They primarily feed on rodents, hedgehogs, turtles, and carrion.

During winter observations at the survey site, a total of 2 individual eagles and group of two birds were documented, totaling 4 Imperial Eagles observed.

Golden Eagle (*Aquila chrysaetos*) - UzRDB: 2(VU:R); IUCN: LC (Stable)

Status: The breeding population is resident with small seasonal movements, the other population migrating and wintering throughout Uzbekistan. It breeds in the Ayakagytna depression.

Distribution: Historically, the Golden Eagle population has been relatively small. In the late 1970s and early 1980s, there were estimated to be 80-100 breeding pairs on the Ustyurt plateau, in the Kyzylkum desert, and across various mountain ranges including Bukantau, Tamdytau, Muruntau, Pistalitau,

Nuratau, Gissar, Turkestan, Zarafshan, and Chatkal. During migrations, Golden Eagles can be found throughout Uzbekistan.

Habitats: Species inhabits sandy massifs, remnant mountains in deserts, foothills, and rocky areas in the middle and upper mountain zones, up to elevations of 2500-3000 meters above sea level. Its diet includes small mammals, birds, snakes, turtles, and occasionally carrion.

During winter observations at the survey site, only 1 individual and 2 pairs Golden Eagle were documented.

Harriers: Hen Harrier (*Circus cyaneus*) and Pallid Harrier (*Circus macrourus*)- UzRDB NT

Status: These harriers are migratory and also wintering in Uzbekistan.

Distribution: In Uzbekistan, both species of harriers are commonly observed during spring and autumn migrations, and they are regular winter visitors to the country.

Habitats: Their preferred habitats during migration and wintering include cultivated areas, open desert or plain areas and the shores of water bodies, where they can find prey such as house mice, mole voles, and small wintering birds.

During winter observations at the survey site, a total of 20 single Hen Harriers and 2 single Pallid Harriers were observed, highlighting their presence in the survey area during migration.

Eurasian Sparrowhawk (*Accipiter nisus*) - IUCN: LC (Stable)

Status: this species is known as a breeding, migrating, and wintering bird in Uzbekistan, and it is primarily a migrating species at the survey site.

Distribution: During spring and autumn migrations, Eurasian Sparrowhawks are commonly observed throughout almost the entire flat territory of Uzbekistan, including mountainous areas up to the upper boundary of the forest zone. In winter, they are regularly found in tugai forests along river valleys and in agricultural oases, including large cities.

Habitats: Nesting habitats for Sparrowhawks in Uzbekistan are typically located in the mountain-forest zone, often along river valleys. The Eurasian Sparrowhawk primarily preys on birds (ornithophage), although it may occasionally feed on small rodents.

During winter observations at the survey site, the Eurasian Sparrowhawk was observed on four occasions.

White-tailed Eagle (*Haliaeetus albicilla*) - UzRDB: 2(VU:R); IUCN: LC (Increasing)

Status: Single breeding pairs in Uzbekistan, mainly migratory and wintering species. Common wintering species in Ayakagytma. Was observed on migration on the project site.

Distribution: The White-tailed Sea-eagle is found as single breeding pairs in the southern Aral Sea region, with irregular presence. It is primarily a migratory and wintering species, with an estimated population of 300-400 individuals during migration and winter, distributed across Uzbekistan excluding the highlands and the Fergana Valley. It inhabits large lowland and foothill reservoirs.

Habitats: This species primarily inhabits large lowland and foothill reservoirs, where it is associated with bodies of water. During winter, White-tailed Sea-eagles may feed away from water bodies if abundant food sources are available, such as meat and fish waste dumps or animal corpses. In water bodies, their diet consists mainly of waterfowl and fish, particularly in shallow waters.

During winter observations at the survey site, a single record of a White-tailed Eagle was documented.

Buzzards: Common Buzzard (*Buteo buteo*) - IUCN: LC (Increasing) and Eastern Buzzard (*Buteo japonicus*) - IUCN: LC

Status: Migratory, wintering species in Uzbekistan and in project site.

Distribution: Common migratory bird in spring and autumn, wintering in Uzbekistan. Abundant migration is known for the valley of the middle Syrdarya, the flat part of the Tashkent region and the Mirzachul Steppe. To the west, in Kyzylkum and the Zarafshan valley, the number of this species is noticeably lower, and in the valley of the middle and lower Amudarya it is found only sporadically.

Habitats: During wintering, birds stick to agricultural areas, river valleys and the adyr zone of the foothills, where there are settlements of mouse-like rodents.

During winter observations at the survey site, a total of 5 individual Japanese Buzzards and 6 individual Eurasian Buzzard were observed.

Long-legged Buzzard (*Buteo rufinus*) - IUCN: LC (Stable)

Status: Breeding migrator, with migrating and wintering populations originating from northern areas.

Distribution: The Long-legged Buzzard is a common breeding bird found throughout the lowland regions of Uzbekistan, and it's one of the most numerous birds of prey in the country. This species is known for its nomadic behavior, migrating to areas with high populations of rodents, which form its main diet.

Habitats: This species can be found during migrations, nesting, and wintering periods in various habitats across Uzbekistan, including sandy deserts with saxaul forests, mountainous areas with rocks and ravines, dry riverbeds, river valleys, as well as clayey and sandstone cliffs.

During winter observations at the survey site, a total of 21 records of Long-legged Buzzards (individuals and small groups) were observed from late February until mid-March.

Eurasian Kestrel (*Falco tinnunculus*) - IUCN: LC (Decreasing)

Status: Migratory breeding and wintering species in Uzbekistan, and migratory breeding in project site.

Distribution: Numerous breeding bird in all regions of Uzbekistan, except the highlands. During nesting, it wanders widely and can be found anywhere. A common wintering bird of lowland areas, but apparently, mainly individuals from more northern populations spend the winter, and the question of the sedentary nature of local breeding populations is not clear. In spring and autumn, birds nesting to the north pass through the territory of the republic.

Habitats: The nesting common kestrel is found in a variety of conditions - rock outcrops, cliffs, saxaul forests, on power line supports, triangulation towers, ruins, towers, etc. The main role in nutrition is played by small mouse-like rodents and insects.

During winter observations at the survey site, a total of 24 individual Kestrels were observed.

Merlin (*Falco columbarius*) - IUCN: LC (Decreasing)

Status: Wintering species in Uzbekistan and project site.

Distribution: A common wintering bird of lowland areas.

During winter observations at the survey site, Merlins were observed on four occasions.

5. Summary

- The winter survey recorded a total of 57 bird species, with 12 listed in the Red Book of Uzbekistan and 8 included in the IUCN Red List.
- Steppe Eagles was one of the numerous raptor species, a total of 34 individual eagles, and 15 small groups ranging from 2 to 8 birds were documented, amounting to a total of 85 Steppe Eagles observed.
- Ponds near the project site attracted waterbirds like pelicans and swans after melting, with local movements observed in late February.
- Spring migration overlapped with the winter season during the survey.

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ANNEX A: SPECIES TIER 1 MAPS



Figure 3: Flight paths of bird species of Tier 1 on VP01

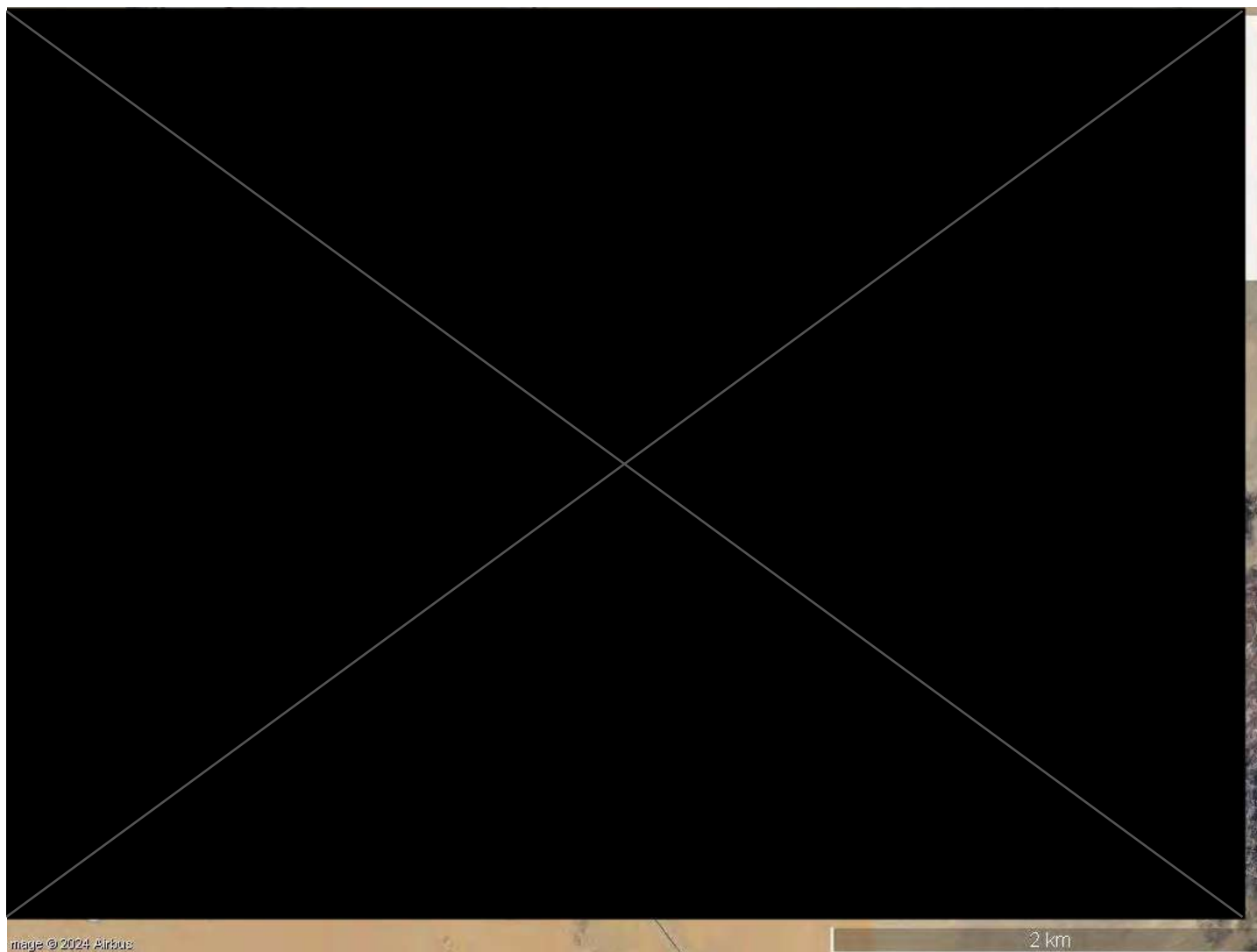


Figure 4: Flight paths of bird species of Tier 1 (except Steppe Eagle) on VP02

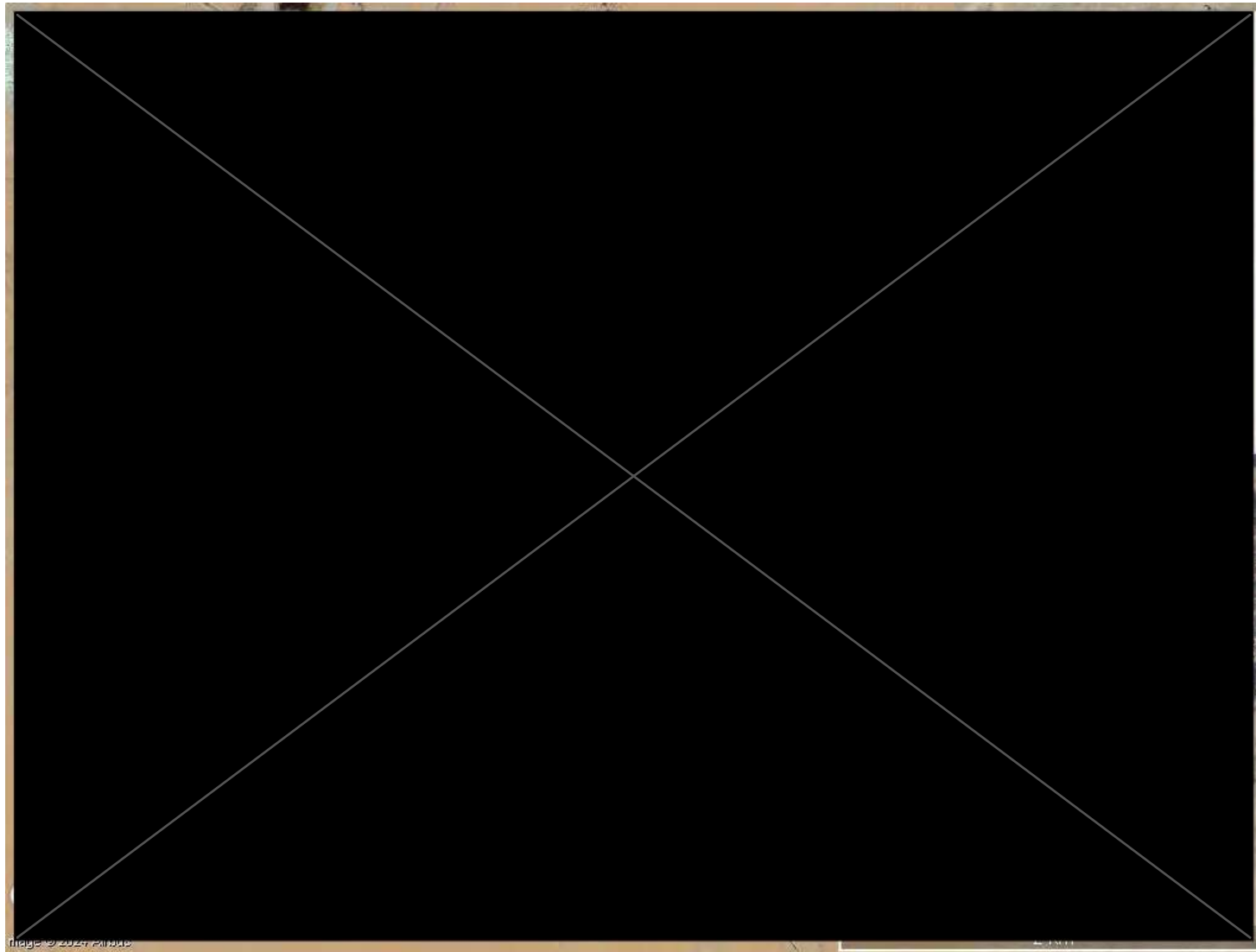


Figure 5: Flight paths of bird species of Tier 1 (Steppe Eagle only) on VP02

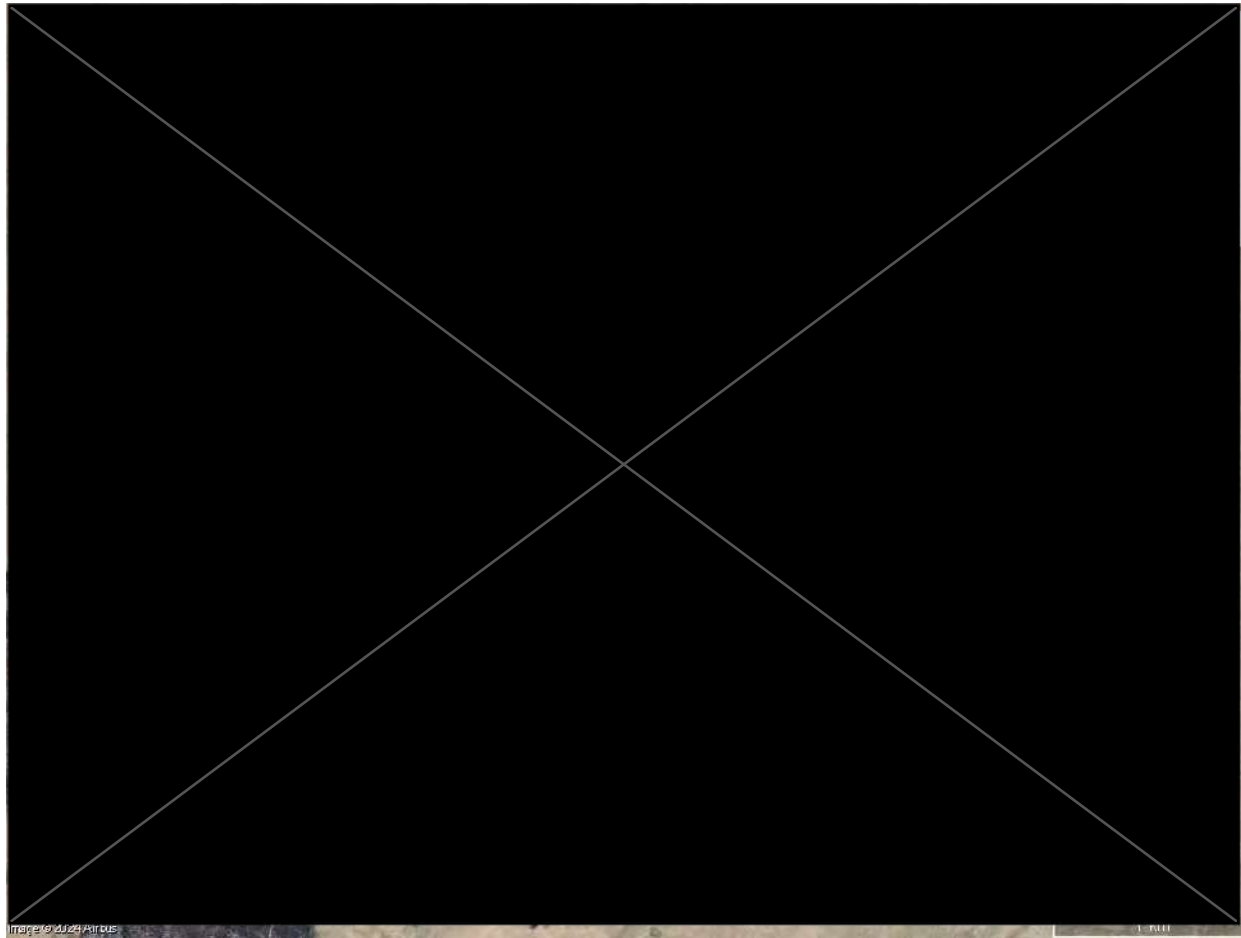


Figure 6: Flight paths of bird species of Tier 1 on VP03

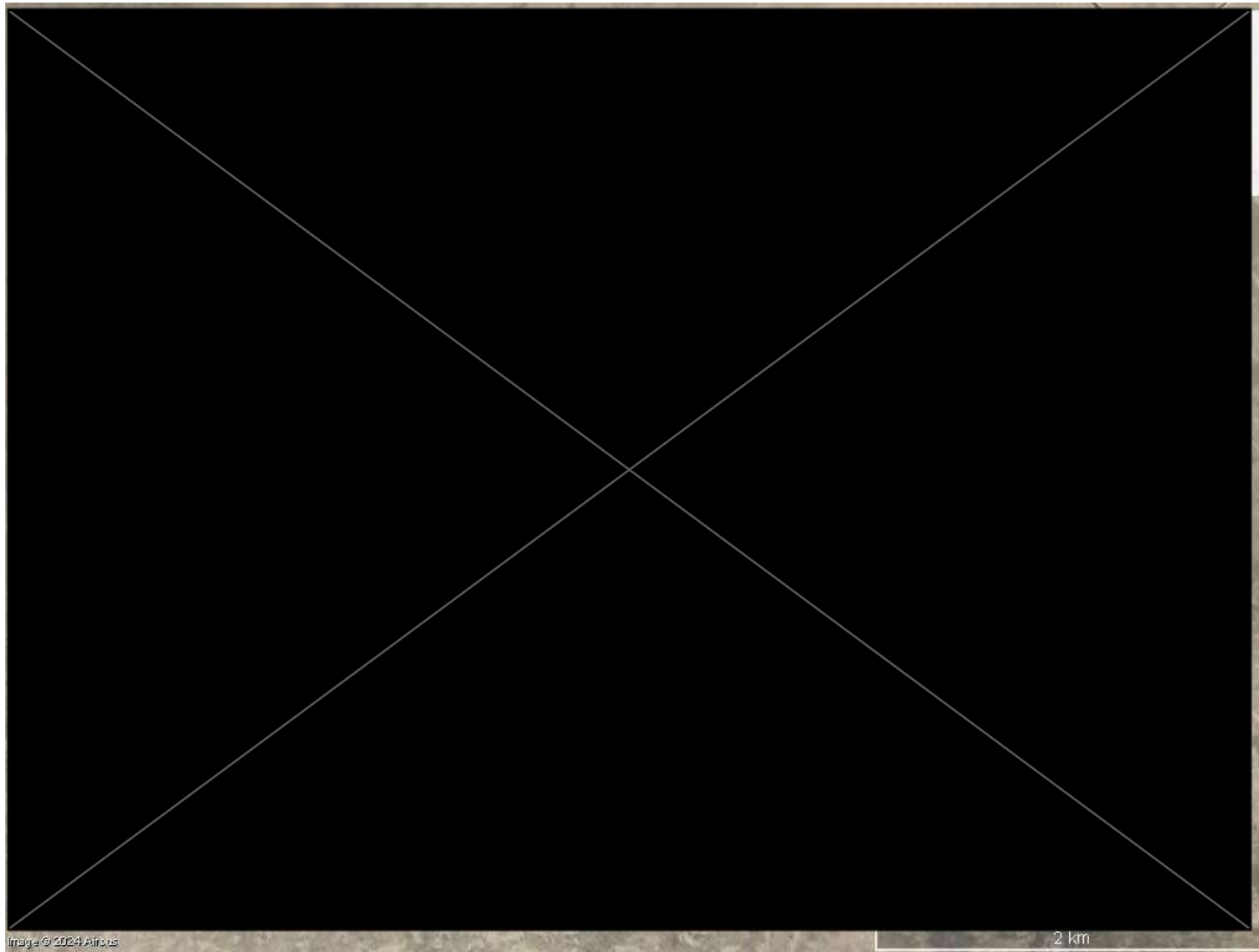


Figure 7: Flight paths of bird species of Tier 1 (except Steppe Eagle) on VP04

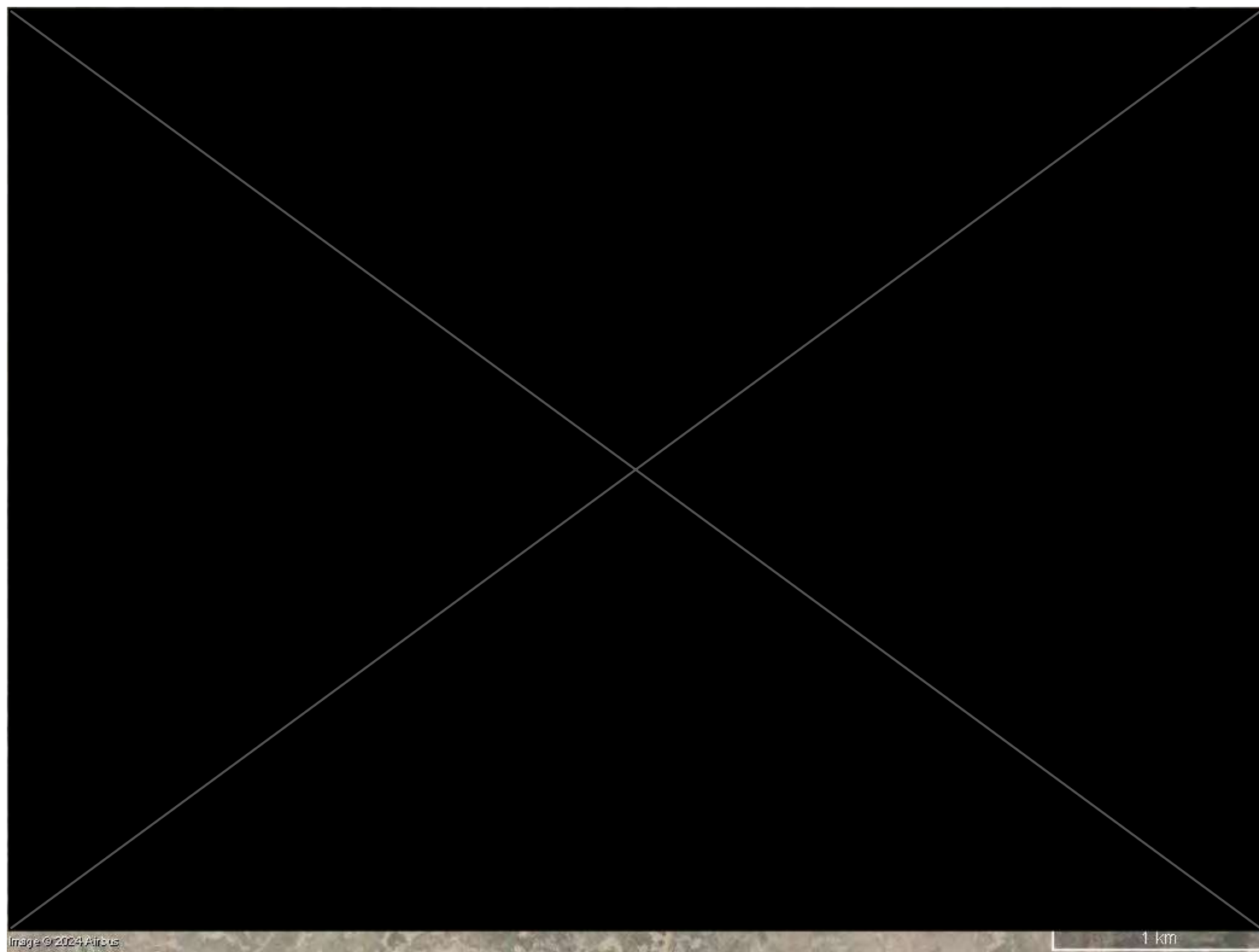


Figure 8: Flight paths of bird species of Tier 1 (Steppe Eagle only) on VP04

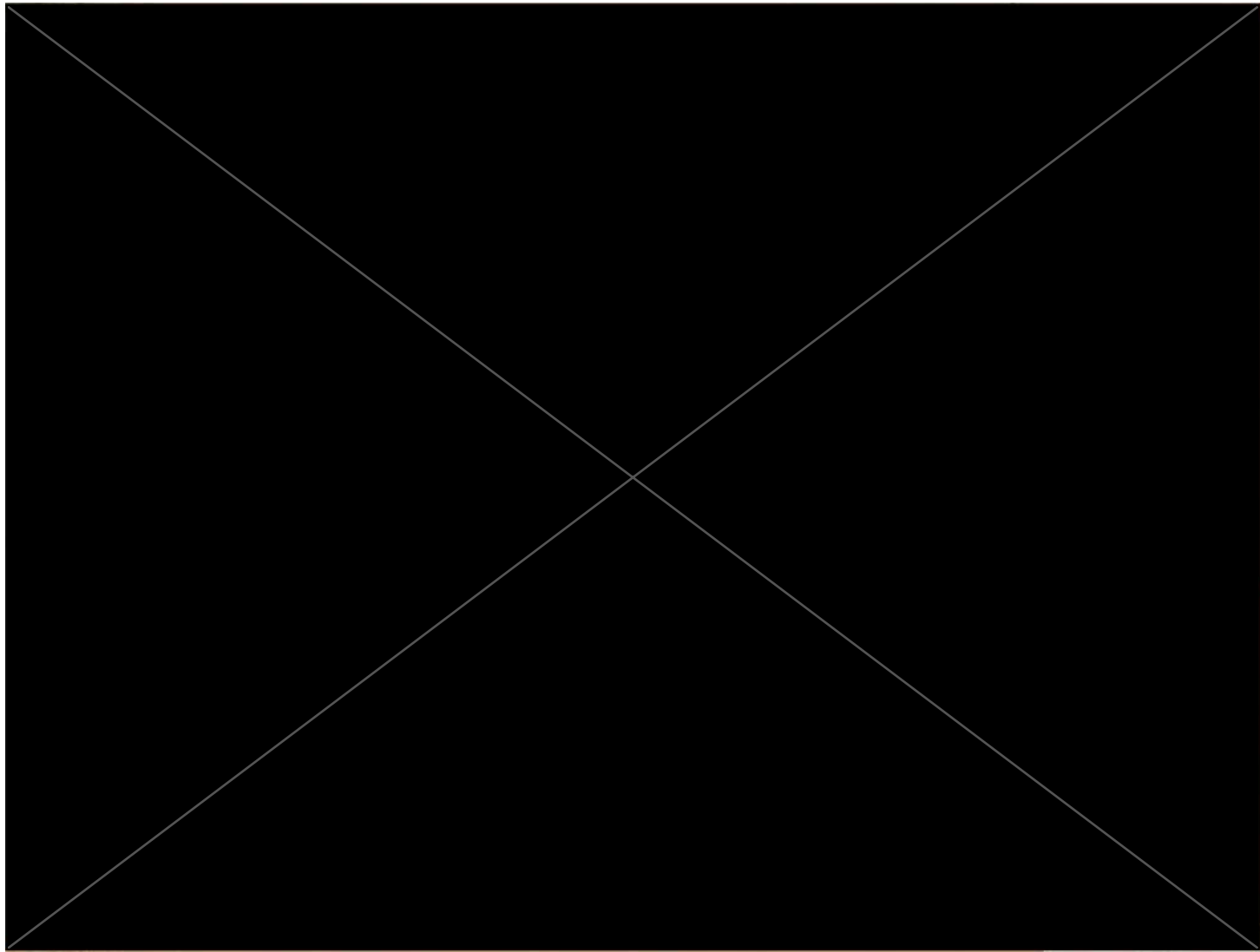


Figure 9: Flight paths of bird species of Tier 1 on VP05

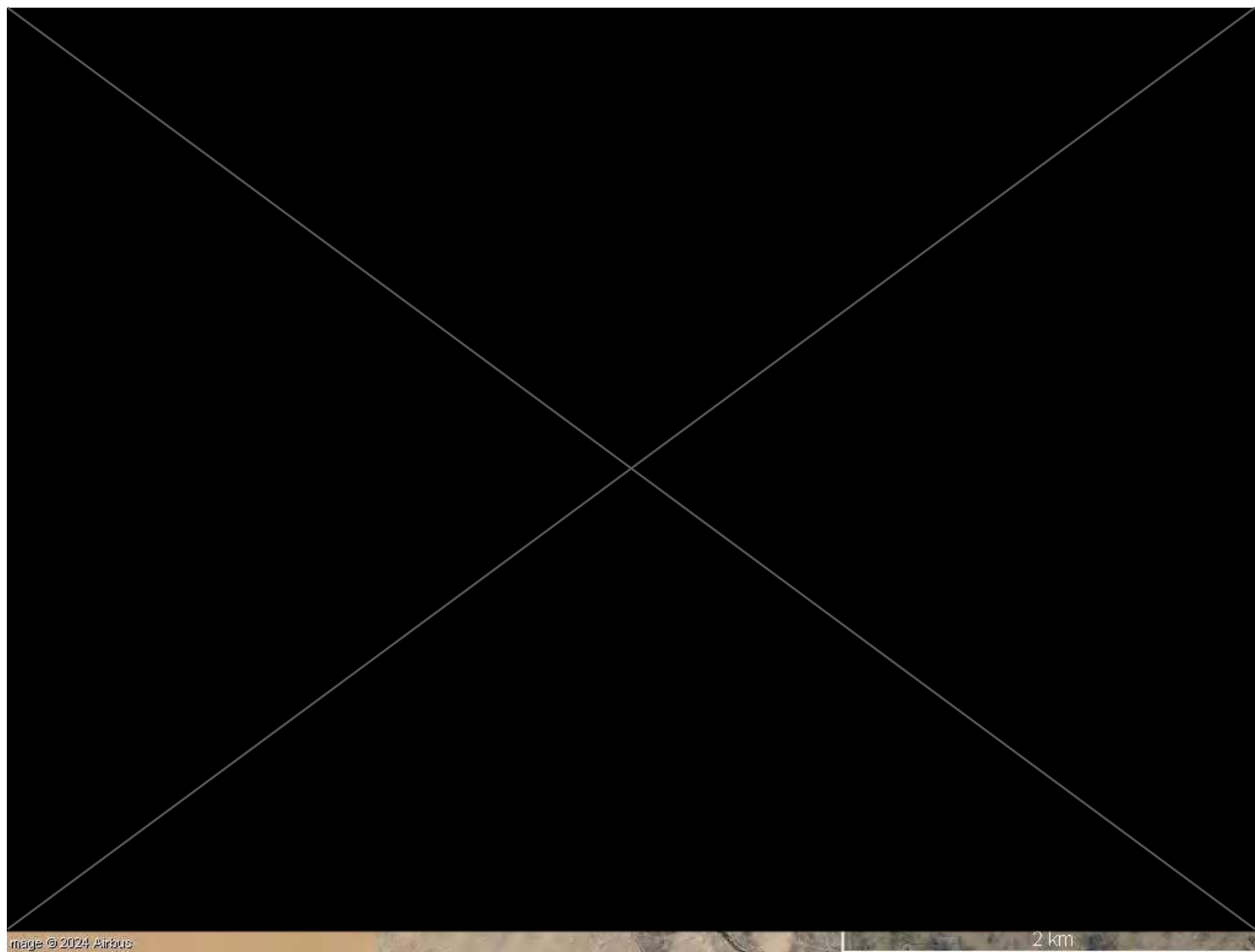


Figure 10: Flight paths of bird species of Tier 1 on VP06

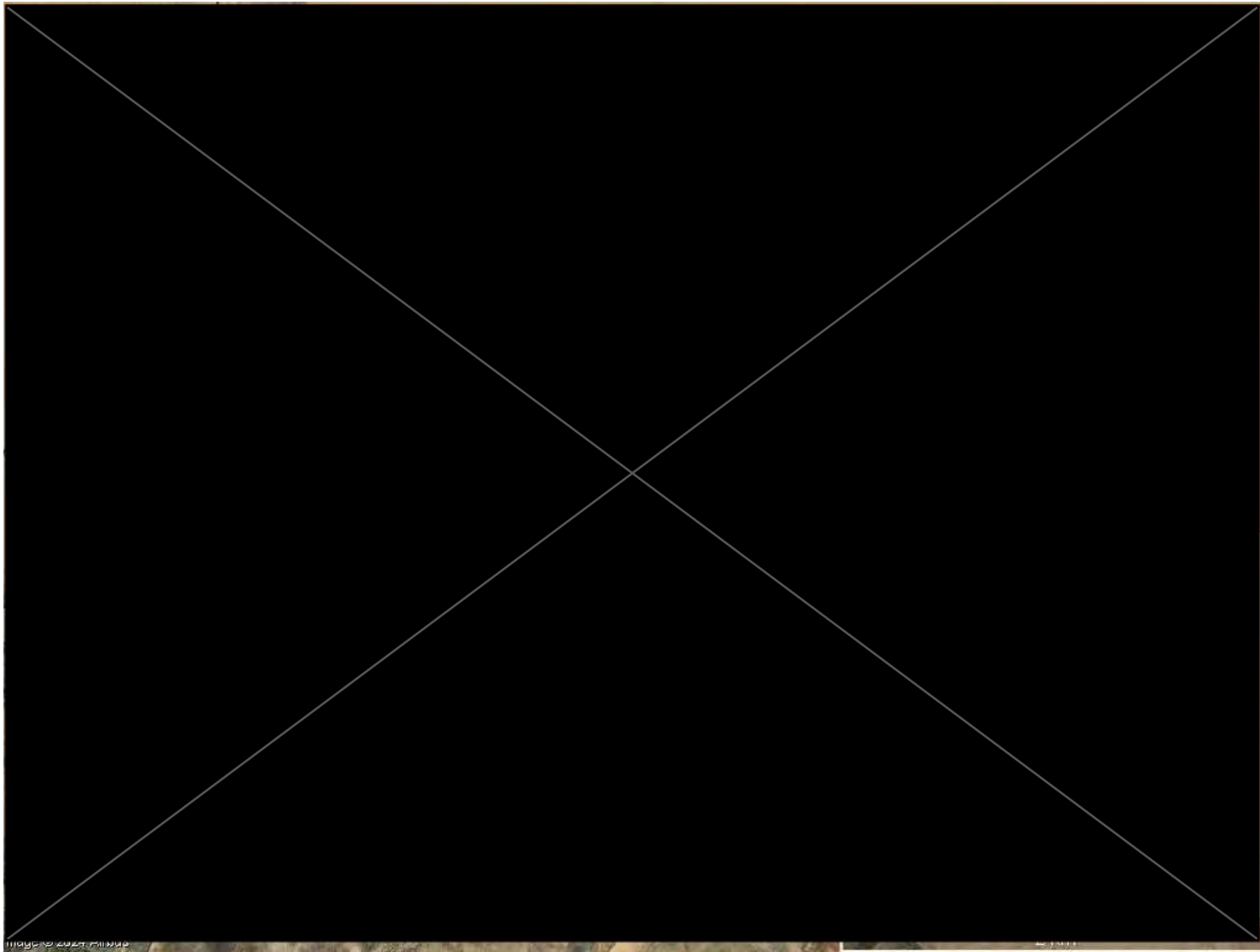


Figure 11: Flight paths of bird species of Tier 1 on VP07

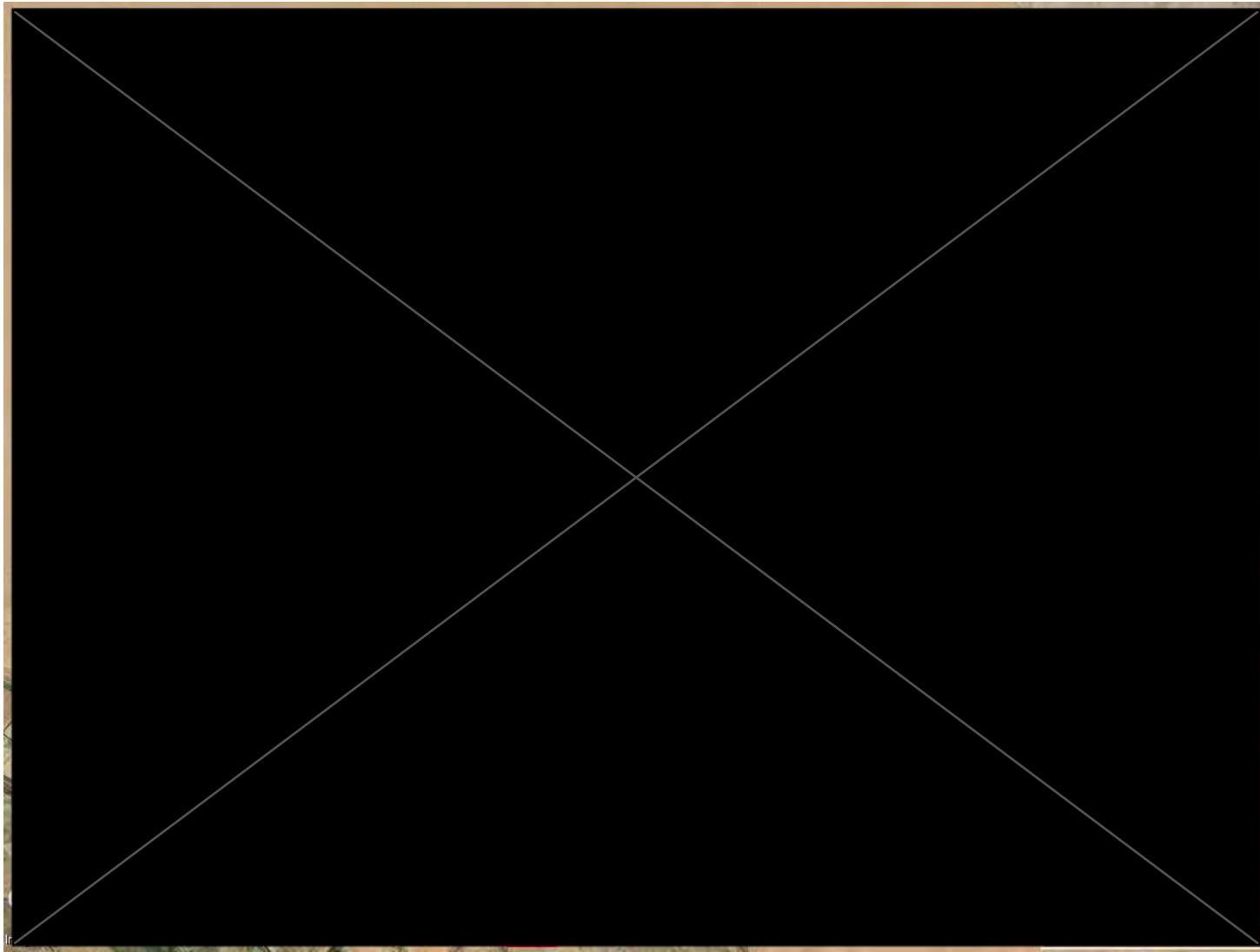


Figure 12: Flight paths of bird species of Tier 1 on VP08

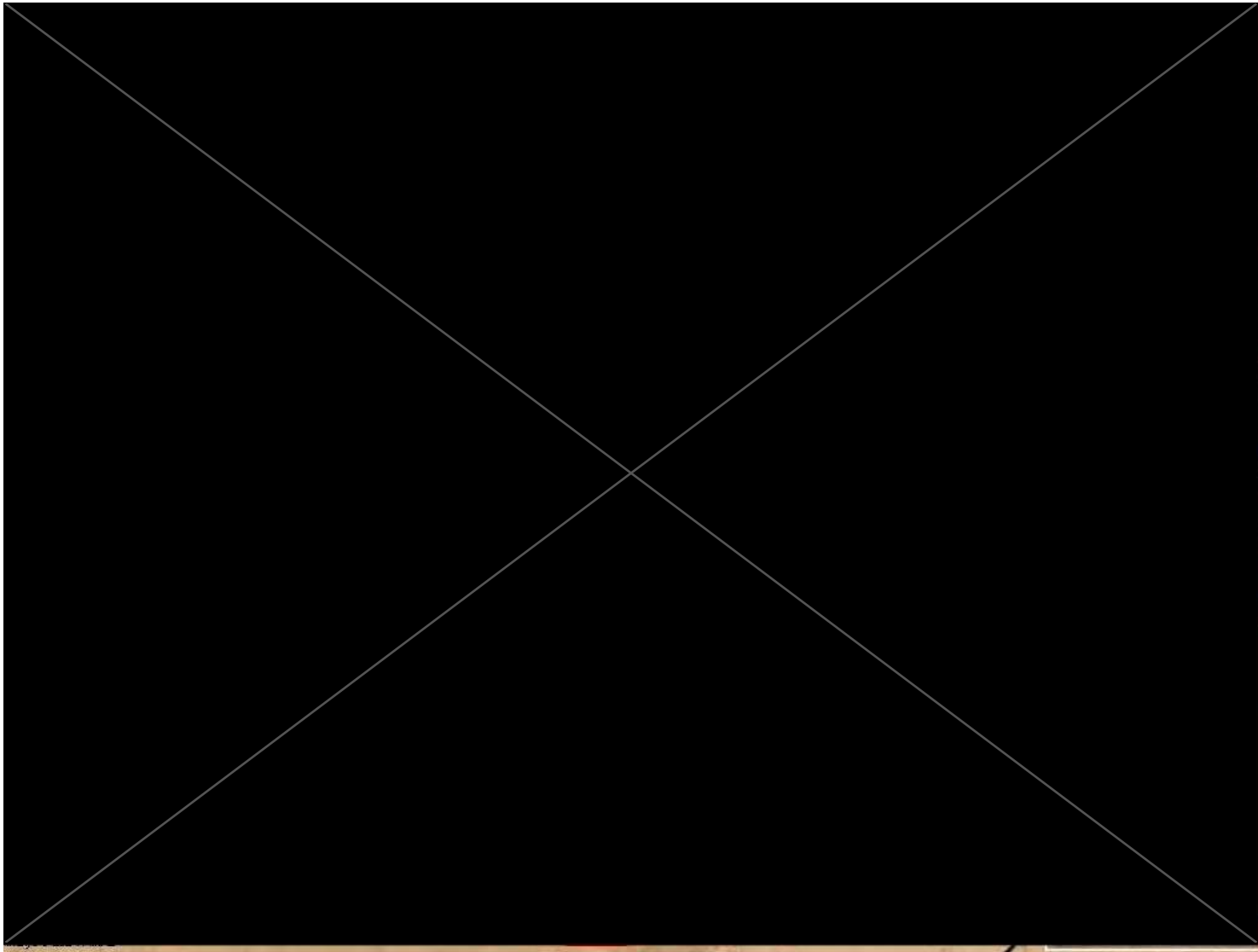


Figure 13: Flight paths of bird species of Tier 1 (except Steppe Eagle) on VP09

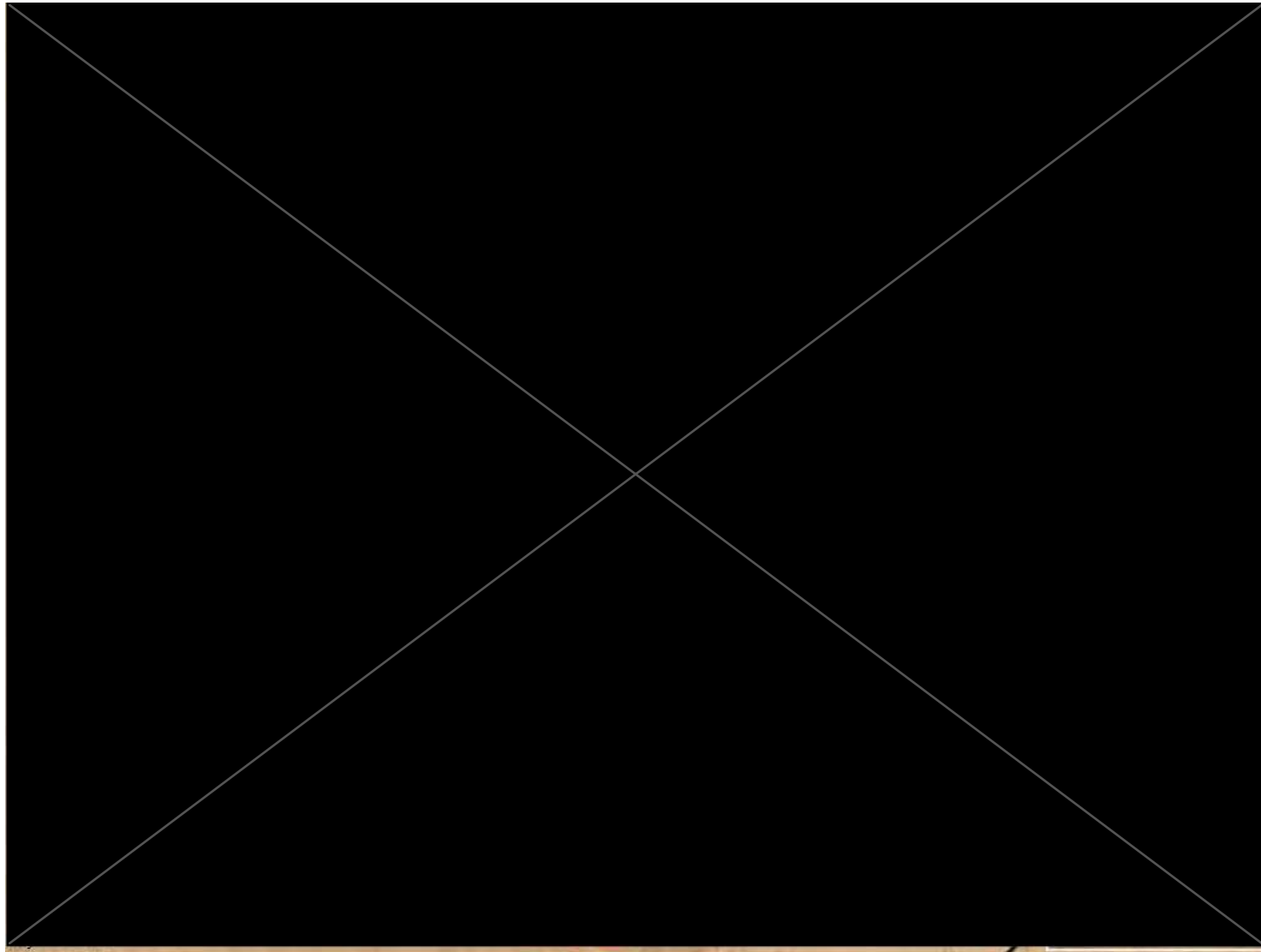


Figure 14: Flight paths of bird species of Tier 1 (Steppe Eagle only) on VP09



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5. ASIAN HOUBARA SURVEY REPORT



Asian Houbara Report
Gijduvan wind power project in
the Republic of Uzbekistan

Client: 5 Capitals

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1. Introduction

The Asian Houbara, or Houbara Bustard (*Chlamydotis macqueenii*), is a large, turkey-like bird inhabiting the deserts and shrub-steppes of Central Asia. It is classified as Vulnerable (VU) on both the Uzbek National¹ and IUCN Global² Red Lists. This classification underscores the need for targeted surveys due to the species' hiding behavior. This report presents findings from an Asian Houbara survey conducted in March and April 2024.

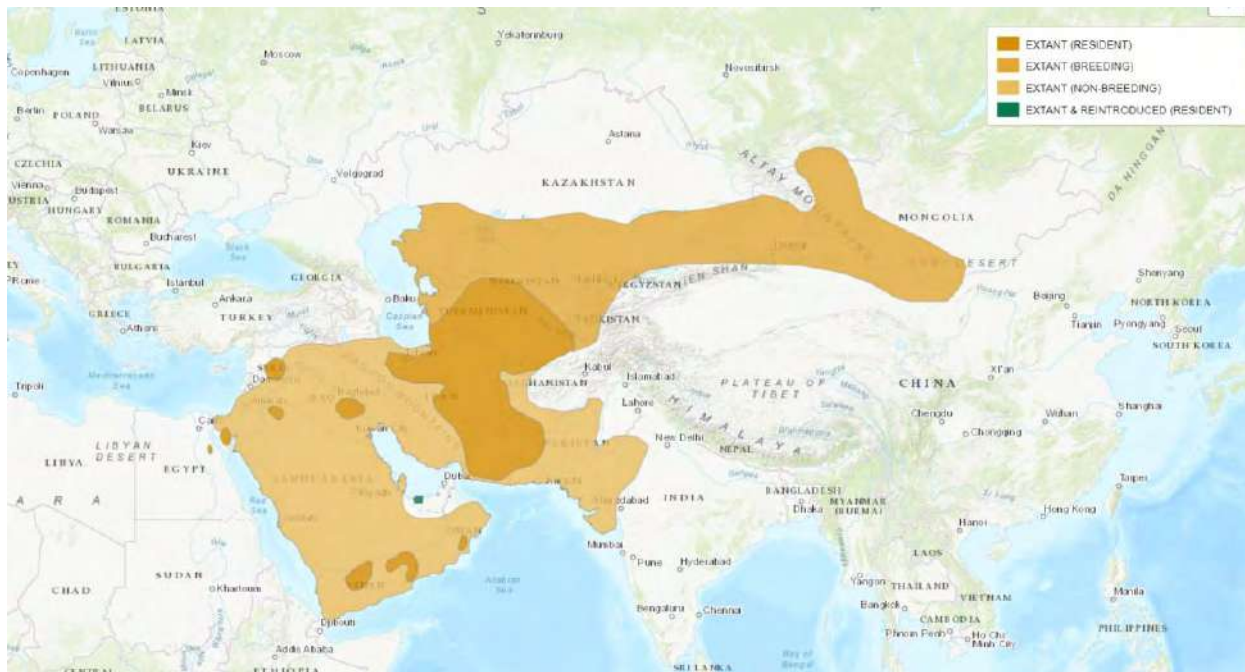


Figure 1: The geographic range of Asian Houbara³

2. Asian Houbara in Uzbekistan and region

The Asian Houbara (hereinafter referred to as the "Houbara") is one of the most characteristic representatives of the avifauna of Uzbekistan. It primarily occurs in the Kyzylkum and Ustyurt regions during nesting and migration seasons and occasionally winters in the southern regions of the country (Kreutzberg-Mukhina, 2003).

The first detailed information about the Houbara in Kyzylkum came from M. N. Bogdanov in 1882, who observed the species nesting throughout suitable areas during his expedition in 1873. Later surveys by N. A. Zarudny (1915), T. Zahidov (1971), and D.L. Lakhanov (1977) contributed to understanding the species' distribution, revealing its preference for the South-Western Kyzylkum region. O. V. Mitropolsky's visits between 1972 and 1985 further mapped the Houbara's nesting grounds.

¹ Uzbekistan Red data book. Vol. II. Animals. Tashkent, 2019.

² BirdLife International. 2021. *Chlamydotis macqueenii*. The IUCN Red List of Threatened Species 2021: e.T22733562A205364424. <https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T22733562A205364424.en>. Accessed on 09 July 2024.

³ <https://www.iucnredlist.org/species/22733562/205364424>

Research into the species' biology and population was conducted by various scientists, including O. S. Bakaev (1972), A. F. Alekseev (1980), and T. S. Ponomareva (1979, 1983, 1985). The Ecocenter "Jeyran" also studied Houbara nesting biology and captive breeding in the 1980s.

From 2011, specialists from the University of East Anglia, with support from the Ahmed bin Zayed Charitable Foundation and the Emirates Bird Breeding Center for Conservation, conducted comprehensive surveys in southern Kyzylkum. Their work included estimating the Houbara population over a 14,300 km² area and studying nesting biology, migration routes, and threats like predators and power lines. They also researched the adaptation of captive-bred Houbaras to natural conditions and used telemetry to track movement patterns and survivorship rates.

Since 2008, the Emirates Bird Breeding Center for Conservation has released approximately 14,000 captive-bred Houbaras in the Bukhara region as part of a conservation program. Despite extensive studies in Kyzylkum, data on the Houbara's distribution in the project area are limited.

ECOLOGY

The Houbara is an iconic inhabitant of the steppe and semi-desert regions in Central Asia and the Middle East. This highly terrestrial bird is capable of long-distance migration, with some individuals traveling over 7,500 km annually (Combreau et al. 2011). In Uzbekistan, the Houbara is a locally common breeding and passage migrant and an occasional overwinterer.

Habitat and Distribution.

The Houbara prefers flat areas with sparse vegetation and dense soil, which provides a good all-round view essential for its survival. It inhabits clay plains with sagebrush grass cover, solonchaks with scattered saltwort and camel thorn shrubs, and the clay-solonchak plains of the ancient Amu Darya delta (Alekseev, 1981; Zahidov, 1971). According to N.A. Zarudny (1915), the Houbara favors slightly undulating spaces with sandified surfaces and low shrubs, avoiding loose sand dunes and human-transformed landscapes (Meklenburtsev, 1990). The bird abandons areas where roads or increased livestock are present (Alekseev, 1981; Koshkin et al., 2016).

Migration

During migrations, the Houbara remains within its nesting area. In northern Kyzylkum, migration occurs in widely spread flocks. In central Kyzylkum, the migration starts in late March and continues until the end of April, with pairs remaining afterwards (Meklenburtsev, 1990). Autumn migration in north-western Kyzylkum begins in late September and continues until late October, with some birds observed as late as mid-November (Alekseev, 1980). The main direction of migration is southwest, and the birds are active and migrate during the day, similar to the Great Bustard (Meklenburtsev, 1990).

A significant portion of the population, numbering tens of thousands, migrates through Uzbekistan biannually. Northward migration peaks in mid-March, while southbound migration occurs mainly in mid-October (O. Combreau in litt. 2014). In summer, birds have been observed across the country, with an estimated breeding population of 6,000 to 9,000 individuals (Goriup, 1997). Overwintering has been reported in the Uzbek part of the Kyzylkum desert (O. Combreau in litt. 2014).

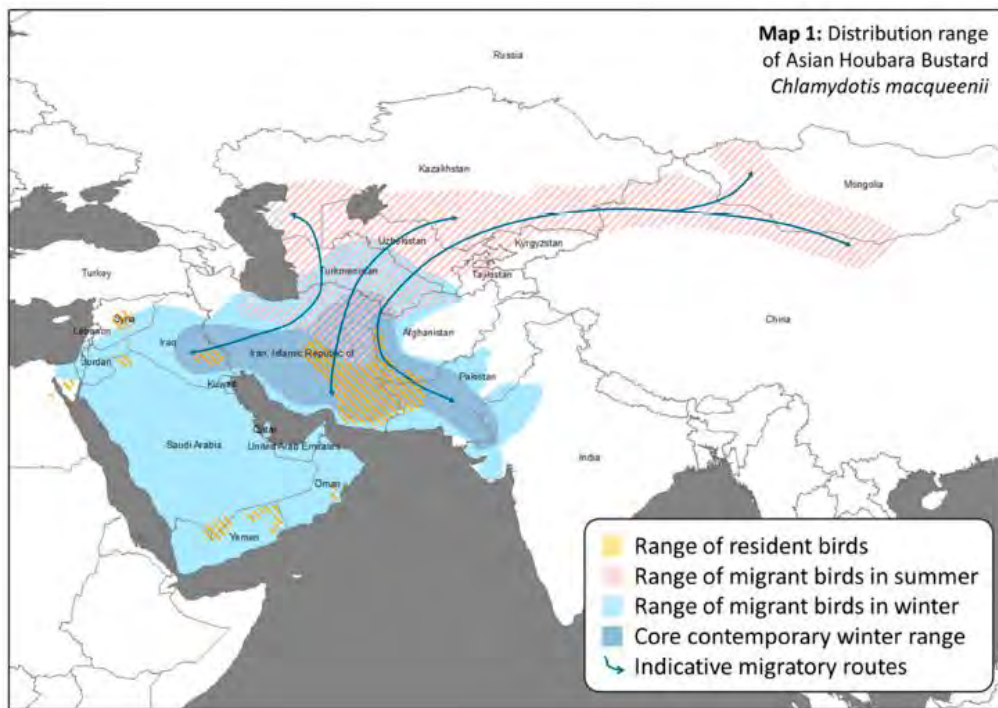


Figure 2: Migration paths and breeding and wintering ranges of Asian Houbara (resource: O. Combreau in litt. 2014).

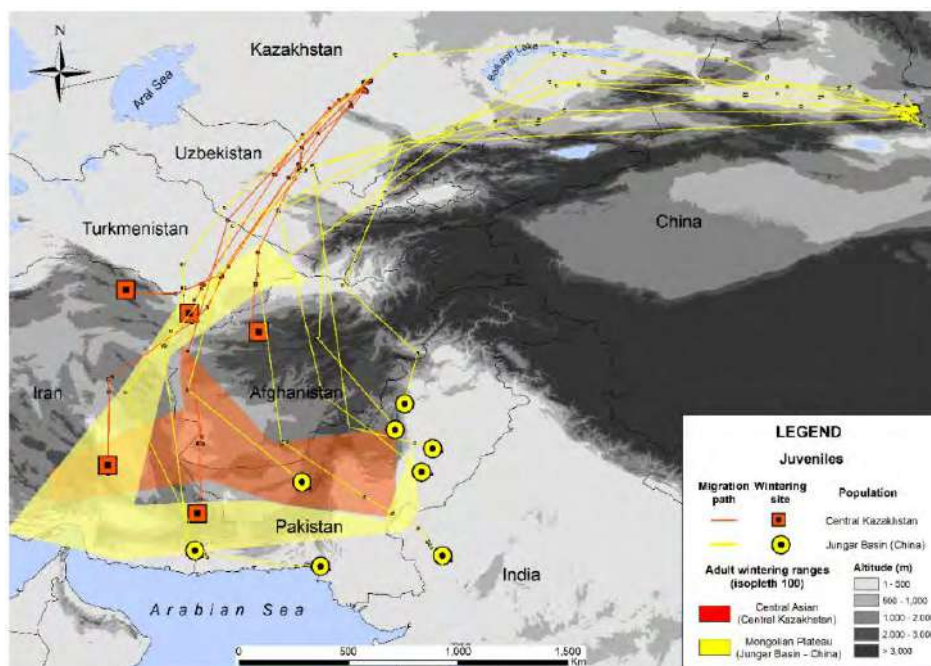


Figure 3: Migration paths and wintering ranges of juvenile Asian Houbara bustards originating from Central Kazakhstan and Jungar Basin with reference to wintering ranges of adults (Resource: Combreau et al., 2011⁴).

Breeding and Courtship

Male Houbaras attract mates with extravagant courtship displays performed at the same site each year. The display includes strutting, retracting the head within an ornamental shield of neck feathers,

⁴ 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>

running, and low-frequency booming calls (Gaucher et al. 1996). In the Bukhara breeding center, males begin displaying immediately after arrival, occupying specific areas where females appear about 10 days later (Mukhina, 1990).

Males do not participate in rearing the young. Females create shallow scrapes in the ground to lay 3-4 eggs, occasionally up to six in long-distance migrants (Collar 1996, Combreau et al. 2002). The female incubates the eggs for 21-23 days, with chicks hatching within one day (Bakaev, 1972; BirdLife International 2014). Chicks fledge in 30-35 days and become mature by two months of age, with most chicks fledging by the end of June (Ponomareva, 1980). Satellite tracking indicates that females and their young separate after 3-4 months, forming mixed-age pre-migration groups in autumn (O. Combreau 2014).



Figure 4: Displaying Houbara male, Kyzylkum desert (Valentin Soldatov)

3. Materials and methods

The survey was conducted during the 2024 breeding season, from the end of March to the end of April, within the project area. The primary objective was to assess the presence and distribution of Houbara.

11 survey points were systematically placed at intervals across the project site to maximize coverage and minimize observer bias (Figure 5).

The methodology implemented for this survey consisted of point counts, and taking advantage of the visual observability of males' courtship displays, as Houbara are shy and difficult to observe at other times of the year. During the peak courtship season in Uzbekistan (March–May), displaying males (and floating males) are conspicuous and can be observed from long distances. This provides an opportunity for male population assessment with a relatively high degree of accuracy (Koshkin et al., 2016a⁵).

⁵ Koshkin, Maxim & Collar, Nigel & Dolman, Paul. (2014). Do sheep affect distribution and habitat of Asian Houbara *Chlamydotis macqueenii*? *Journal of Arid Environments*. 103. 53–62. 10.1016/j.jaridenv.2014.01.002.

Figure 5 and Table 1 show the 11-point count locations where Houbara spring point count surveys were conducted.

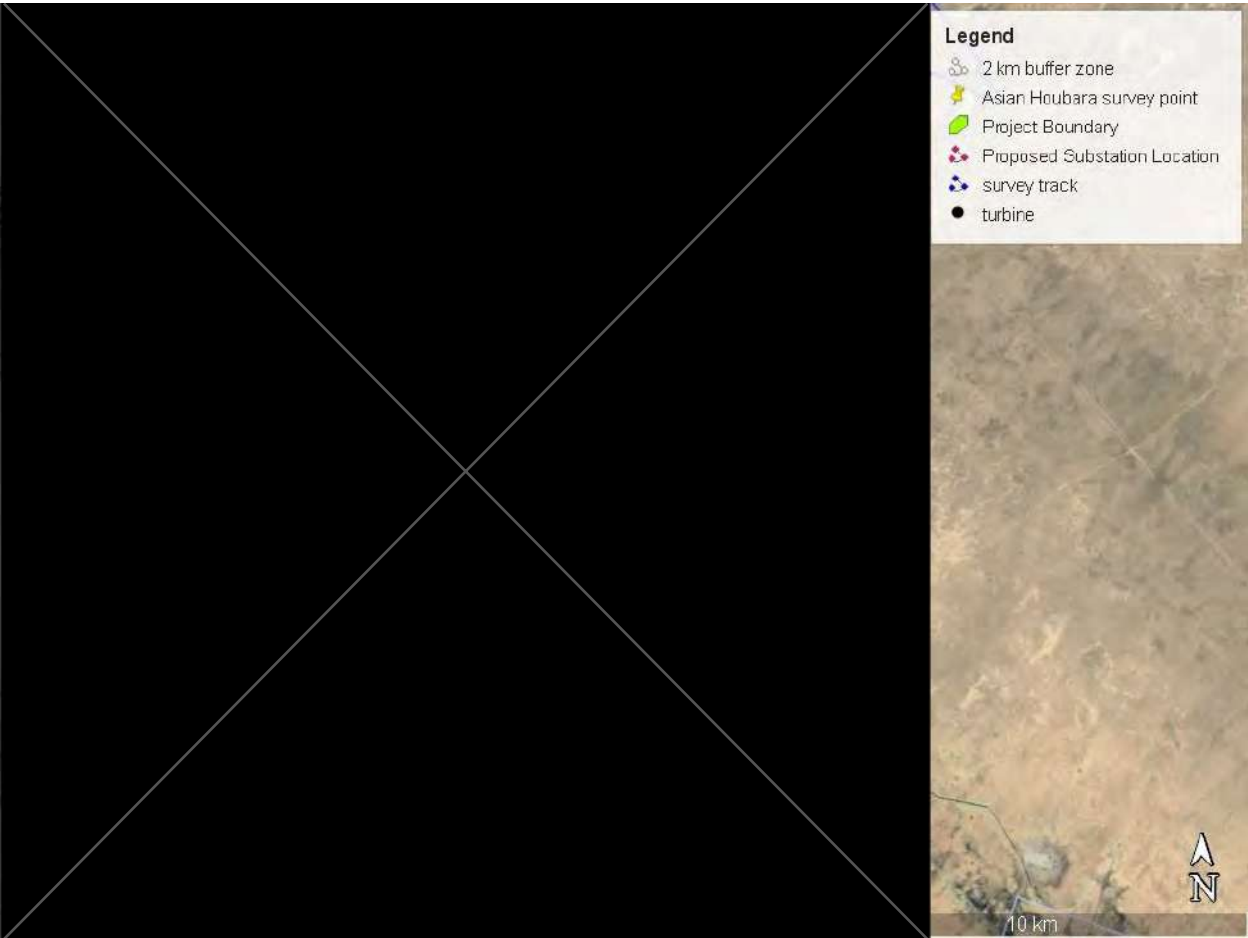


Figure 5: Survey point locations and tracks

Table 1: Asian Houbara survey point locations

N	Point	N	E	Habitat
1	AH01			Sagebrush sandy desert
2	AH02			Sagebrush sandy desert with rare saxaul trees
3	AH03			Sagebrush sandy desert
4	AH04			Sagebrush desert with <i>Peganum harmala</i>
5	AH05			Sparse low shrubland with <i>Ferula</i>
6	AH06			Sparse low shrubland with <i>Ferula</i>
7	AH07			Sagebrush sandy desert
8	AH08			Sagebrush sandy desert
9	AH09			Sagebrush sandy desert
10	AH10			Sparse low shrubland with <i>Ferula</i>
11	AH11			Sagebrush sandy desert

Survey Timing

Two rounds of surveys were conducted:

- First Round: March 25-29, 2024;
- Second Round: April 24-26, 2024.

Weather conditions during both survey periods were generally favorable for conducting counts

Data recording methods

The following data was recorded on the survey forms:

- Location of each survey point
- Date and duration of each count
- Weather conditions (wind and haze ratings 1-4)
- Surveyor details
- Biotopes observed
- Group composition of Houbaras (male, female, unknown)
- Distance and bearing for each observed group
- Behavioral observations (e.g., displaying, flying, standing)
- Additional notes

Survey equipment included:

- Optical instruments: Nikon binoculars (x8 magnification), Swarovski telescope (x60 magnification), and a laser rangefinder
- Photography equipment: Nikon D20 digital camera with a 300mm lens and mobile phones for video recording using digiscoping techniques
- Compass for directional measurements

4. RESULTS

Habitat Characteristics

All survey points within the study area were characterized by suitable breeding habitat for Asian Houbara, predominantly consisting of sagebrush desert (*Artemisia diffusa*) and sparse low shrublands.

Observations

During the surveys conducted in March and April 2024, a total of 5 Asian Houbaras were observed, comprising 4 males and 1 female (Table 2).

Figure 6 provides visual documentation of displaying Asian Houbara males observed during the surveys.



Figure 6: Displaying Asian Houbara male (AH male#1(3)) observed on AH04 (photo by Valentin Soldatov)

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

Round	Date	VP	Time start	Time end	Asian Houbara	Activity	Distance	Azimuth	BirdID
1	26/03/2024	AH05	08:10	08:30					
1	26/03/2024	AH06	08:40	09:00					
1	26/03/2024	AH06	08:40	09:00					
1	26/03/2024	AH06	08:40	09:00	1	displaying male	1200	350	AH male#3(5)
1	26/03/2024	AH06	08:40	09:00	1	displaying male	2000	85	AH male#4(6)
1	26/03/2024	AH14	16:20	16:50					
1	27/03/2024	AH04	08:10	08:30	1	displaying male	1000	163	AH male#1(3)
1	27/03/2024	AH04	08:10	08:30	1	displaying male	2000	220	AH male#2(4)
1	27/03/2024	AH07	08:40	09:10					
1	27/03/2024	AH08	09:10	09:40					
1	27/03/2024	AH09	09:50	10:20					
1	27/03/2024	AH11	10:50	11:20					
1	27/03/2024	AH13	17:20	17:50					
1	27/03/2024	AH12	18:00	18:30					
1	27/03/2024	AH12	18:00	18:30					
1	27/03/2024	AH12	18:00	18:30					
1	28/03/2024	AH10	10:15	10:45					
2	24/04/2024	AH09	16:00	16:20					
2	24/04/2024	AH08	16:30	17:00					
2	24/04/2024	AH07	17:10	17:40					
2	24/04/2024	AH04	17:50	18:20					
2	25/04/2024	AH05	10:00	10:30					
2	25/04/2024	AH11	16:10	16:40					
2	25/04/2024	AH13	17:00	17:30					
2	25/04/2024	AH12	16:00	16:20					
2	25/04/2024	AH10	17:40	18:00					
2	25/04/2024	AH06	18:10	18:40	1	female feeding	600	40	AH female#1
2	26/04/2024	AH14	08:15	08:45					

Density

Maxim Koshkin and his colleagues (2016⁵) assessed density of Asian Houbara on sagebrush desert (*Artemisia* sp) as 0.090 (0.081-0.1) birds (males)/km² (95% CI). Density assessment was conducted for observed males across different habitat types within the study area (Table 3).

Table 3: Asian Houbara density

N	Habitat	Surveyed area, km ²	Number of observed males	Density observed, birds (males)/km ²
1	Sagebrush sandy desert	100.56	4	0.039
2	Sparse low shrubland	37.71	0	0

The density of detected males on Gijduvon WF on same habitat type is 0.039 (males)/km² lower than 0.090 (0.081-0.1) birds (males)/km² (95% CI). The lower density could be connected with construction works on Bash WF and OHTL (Bash-Karakul).

Population Estimates

Based on the surveyed area and observed densities, the **estimated male population** within the sandy desert habitat (=100.56 km²) study site is approximately 4 **individuals**. Extrapolating for females with an assumed 1:1 sex ratio (Combreau et al., 2002), the total breeding population could be estimated to be between **8 individuals**.

Distribution Patterns

Observations indicated that Houbaras were predominantly located along the planned OHTL line and near turbines situated on the eastern branch of the WF project site (Figure 6). Breeding birds were not breeding in the part of WF located between the two Ayakagytna drainage channels, but were regularly observed during VP surveys.

Risk Assessment

Figure 9 illustrates the locations of recorded Asian Houbaras and highlights that the main risk for this species within the study area is associated with the planned OHTL. This infrastructure poses a significant threat to the habitat and potentially affects the breeding and migrating Houbaras in the region.

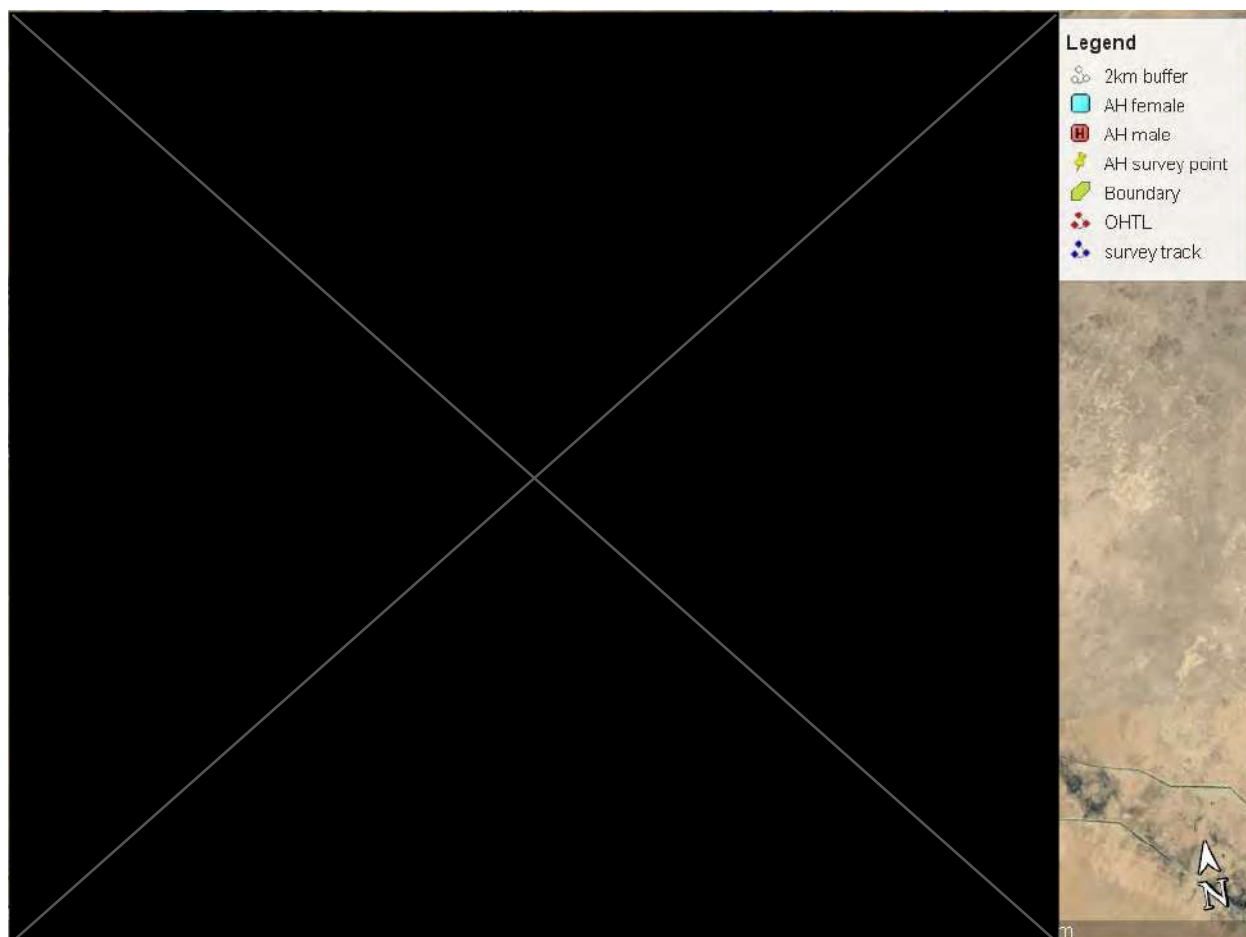


Figure 7: The distribution pattern, emphasizing the absence of Houbara in specific areas of the main project site.

5. Asian Houbaras recorded on during VP surveys

The Asian Houbara was recorded seven times (including two findings of fresh traces) during VP bird monitoring surveys (Winter, Summer and Autumn) from mid-March to late October 2024 (Table 4). The earliest sighting occurred on March 15 at VP3, where one bird was observed in flight. In August and September, survey teams repeatedly noted adult birds feeding (VP4, VP5, VP9) and found fresh traces (VP9, VP6). The last record during this period was made on October 26, 2024, at VP9, where a feeding bird was also observed.

Table 4: The records of Asian Houbara during VP surveys

VP	Y	X	Date	Species	Activity	Number
3			15/03/2024	Asian Houbara	flight	1
4			04/08/2024	Asian Houbara	feeds	1
5			09/08/2024	Asian Houbara	feeds	1
9			23/08/2024	Asian Houbara		fresh traces
6			24/08/2024	Asian Houbara		fresh traces
5			03/09/2024	Asian Houbara	feeding	1
9			26/10/2024	Asian Houbara	feeding	1

During the nesting period, the birds were mainly observed in the northeastern part of the project

area, while in other seasons they were recorded across the rest of the territory. This pattern is presumably linked to available feeding resources and lower disturbance.

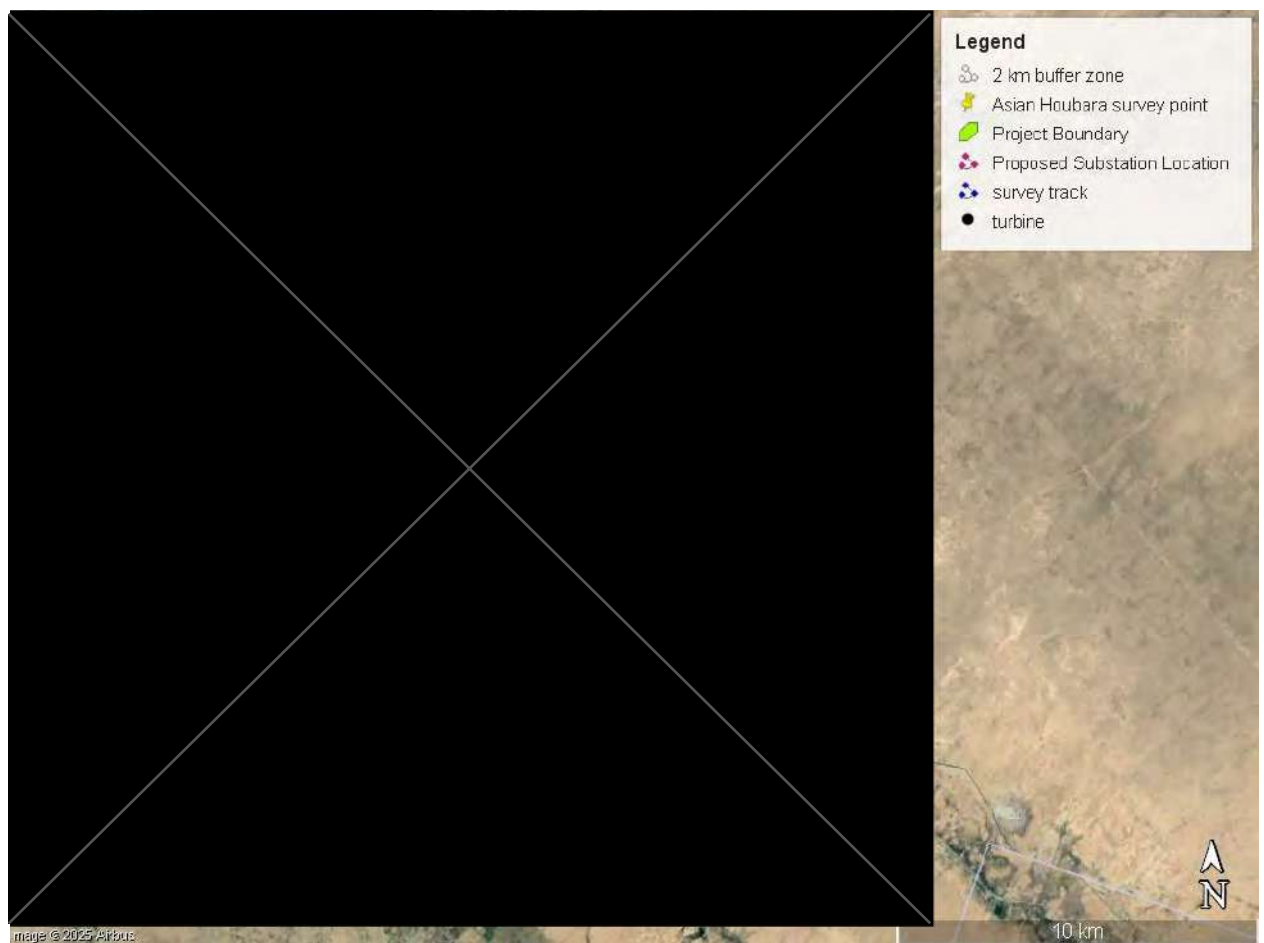


Figure 8: Observations of Asian Houbara withing VP bird monitoring surveys

6. Summary

- **Observations:** A total of 5 Asian Houbaras were recorded during the surveys, comprising 4 males and 1 female.
- **Distribution:** They were primarily observed near turbines on the eastern branch of the project site.
- **Density:** The density of observed males in sagebrush desert habitats was lower (0.039 males/km²) compared to previous studies (0.090 males/km²), potentially influenced by ongoing construction activities on Bash I WF and the OHTL.
- **Population Estimates:** Based on observed densities, the estimated male population within the study site is between 4 individuals, suggesting a total breeding population of 8 individuals assuming a 1:1 sex ratio.
- The Asian Houbara was recorded seven times (including two findings of fresh traces) from mid-March to late October 2024.
- During nesting, birds were mainly observed in the northeastern part of the project area, while in other seasons they were more widely distributed—likely due to food availability and lower disturbance.

These findings underscore the importance of considering habitat disturbance from infrastructure projects like the OHTL and WF when managing and conserving Asian Houbara populations. Understanding their distribution preferences and responding to specific risks can inform better conservation strategies in similar habitats.

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6. RAPTOR NEST SURVEY REPORT



Raptor nest survey

Report 2024

**Environmental and Social Impact Assessment (ESIA)
for Gijduvan 300 MW Wind Farm in
Bukhara District, Uzbekistan**

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1. Introduction

Birds of prey, or raptors, broadly defined to include falcons, vultures, and owls in addition to hawks, eagles, and other raptors within the Accipitridae, are highly sensitive to wind farm developments due to potential impacts such as habitat disturbance and collision risks. The purpose of this report is to assess breeding raptors (broadly defined, as above) within the Gijduvon 300 MW WF project area and 5 km buffer zone. The Project site includes a WTG polygon covering approximately 13,645 hectares (see Figure 1).

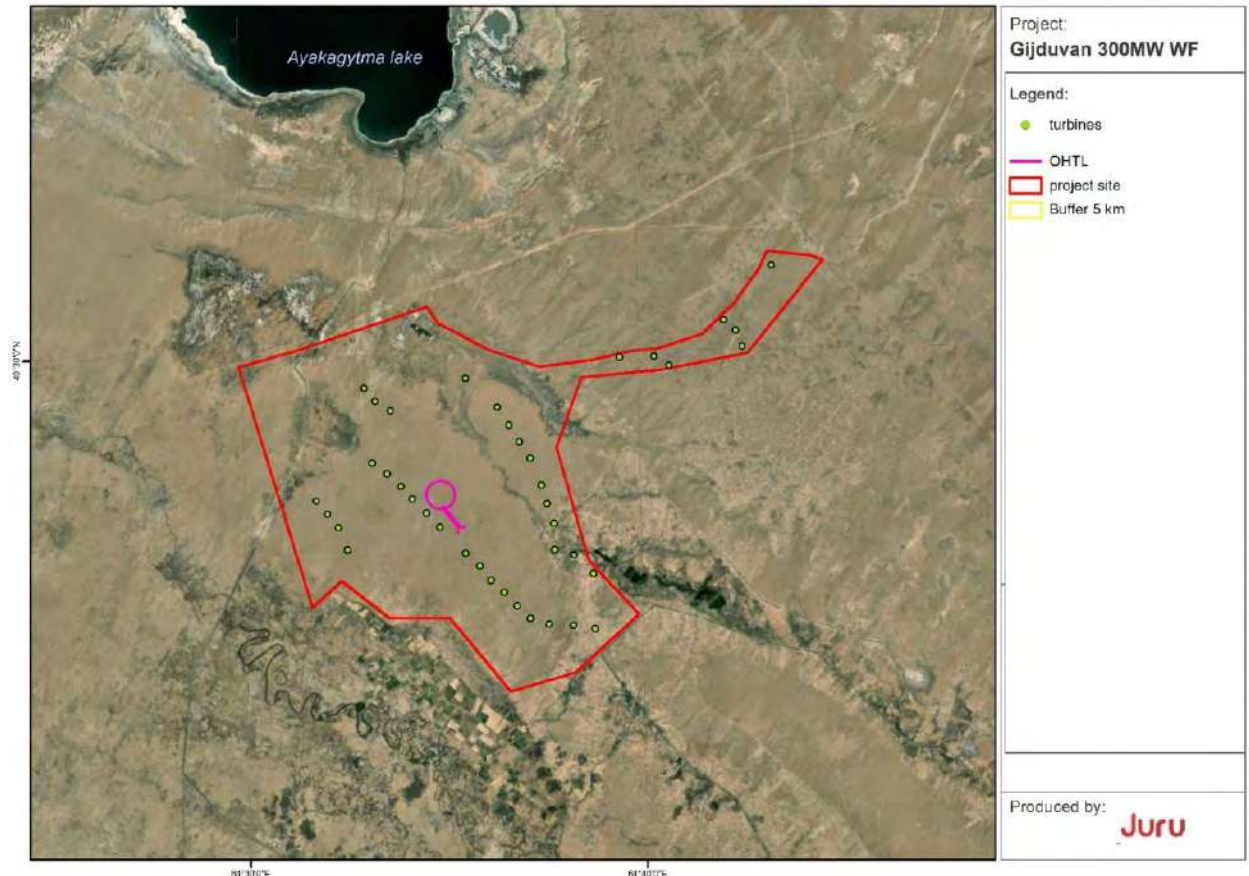


Figure 1. Project site

The specialized raptor nest survey focused on vultures, falcons, hawks, eagles, buzzards, kites, and harriers, given the sensitivity of these species to large infrastructure projects like wind farms.

The potential list of breeding raptors and owls in this area is as follows:

- Saker falcon *Falco cherrug* (IUCN EN, UzRDB EN)
- Egyptian vulture *Neophron percnopterus* (IUCN EN, UzRDB VU)
- Common kestrel *Falco tinnunculus*
- Lesser kestrel *Falco naumanni* (UzRDB NT)
- Golden eagle *Aquila chrysaetus* (UzRDB VU)
- Long-legged buzzard *Buteo rufinus*
- Western marsh harrier *Circus aeruginosus*
- Eagle owl *Bubo bubo*
- Little owl *Athene noctua*

2. Materials and methods

The breeding season for most of these species typically extends from March to August, with some species potentially commencing nesting activity one or two months earlier (e.g. Eagle Owls). Nesting substrates include cliffs, bushes, karst caves, OHTL poles, and abandoned buildings. These substrates are generally rare within the project area, meaning raptor nesting activity is expected to be limited.

Two rounds of raptor nest surveys were conducted during the 2024 breeding season: one in April and a second round in June. The methodology employed a combination of field transect surveys across the project site and a 5 km buffer zone. Due to the remoteness of the area, its size, and the relatively flat terrain, transects were conducted by vehicles with stops at potential nesting sites (trees, bushes, power line poles, cliffs, escarpments, and karst sinkholes). Vantage point (VP) observations were also used to identify potential nesting locations.

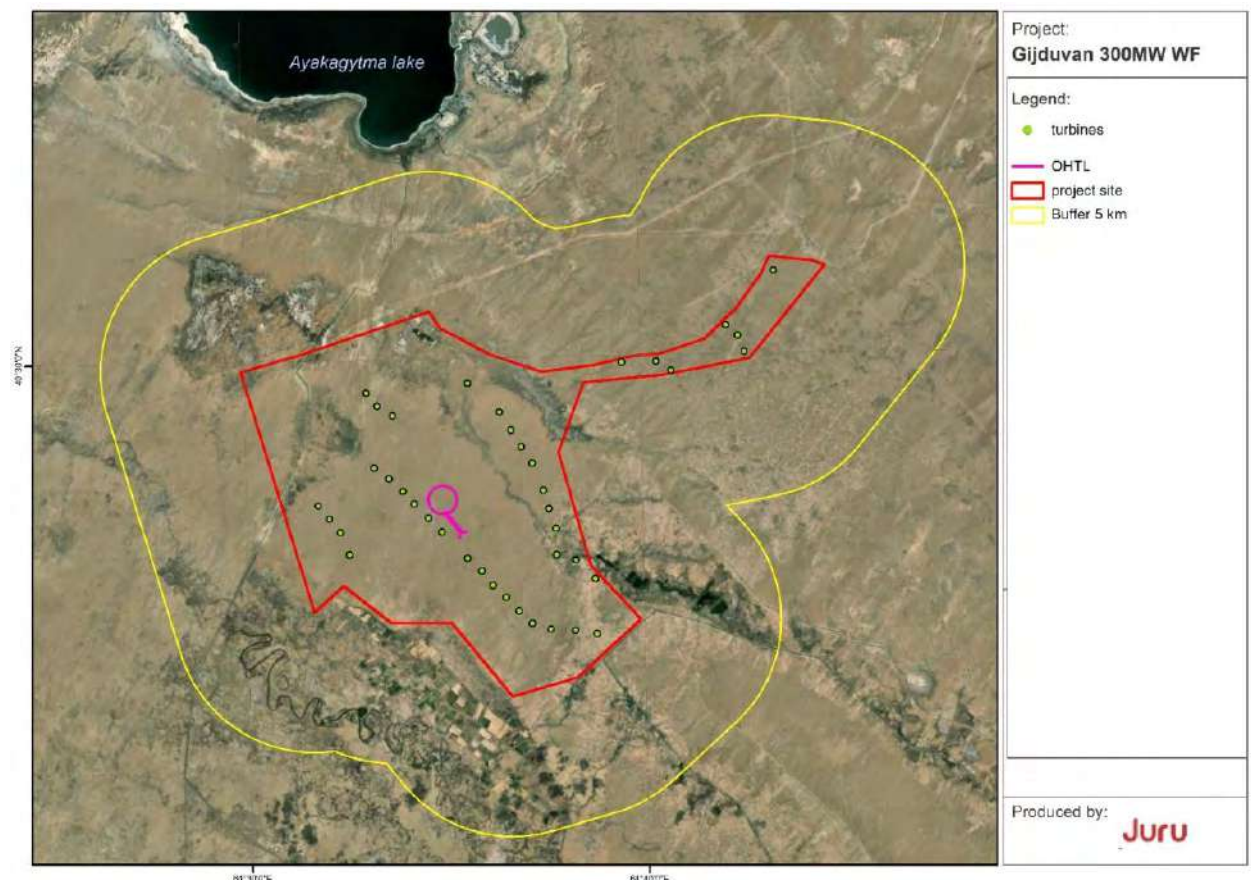


Figure 2: Raptor nest survey area, including the 5 km buffer

Raptor sightings and nest/roosting sites were recorded, and their locations were mapped. The area was observed using telescopes (x60), and nest registration included GPS coordinates, photographs, and special documentation forms.

Research on the potential nesting of the Marsh Harrier was conducted alongside studies of waterfowl (see report). Finding Marsh Harrier nests in dense reed beds is very difficult. The most suitable nesting sites were identified at permanent ponds surrounded by dense reed beds.

Survey Timing

Two rounds of surveys were conducted:

- First Round: April 24-26, 2024;
- Second Round: June 9-10, 2024.

Weather conditions during both survey periods were generally favorable for conducting counts. The coverage of the area by survey tracks is shown in Figure 3.

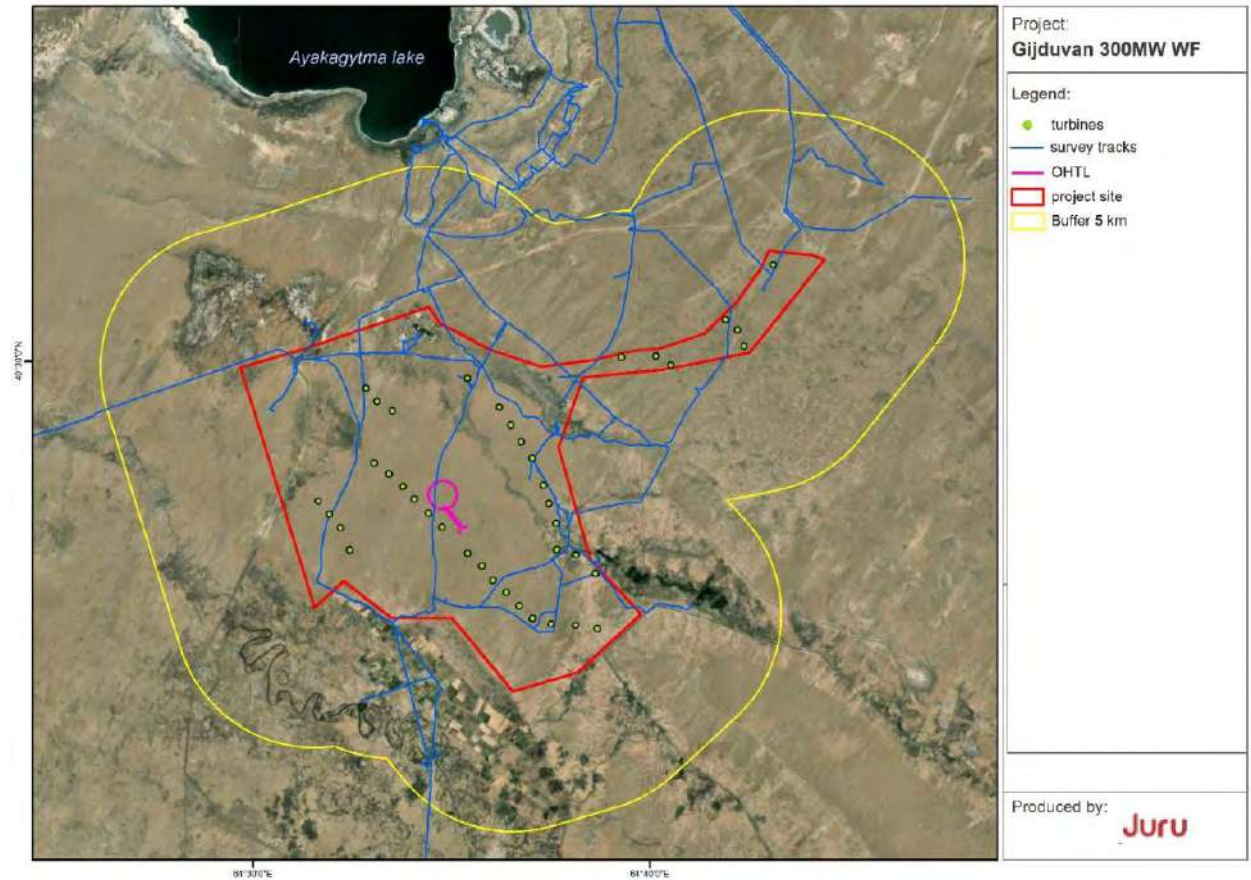


Figure 3: Survey tracks

3. RESULTS

Based on the 2024 survey results, two old nests, likely belonging to the Long-legged Buzzard, were recorded, along with one active nest of an Egyptian Vulture observed near the 5 km buffer zone. No nests were found within the project site, but in the 5 km buffer zone, they were primarily located on cliffs, Saxaul bushes and in reed beds near waterbodies.

The Western Marsh Harrier nests in dense reed beds, making its nest nearly impossible to locate. However, based on waterbird surveys, nesting pairs were identified, with one confirmed within the project area.

The results are presented in Table 1 and Figure 4Error! Reference source not found..

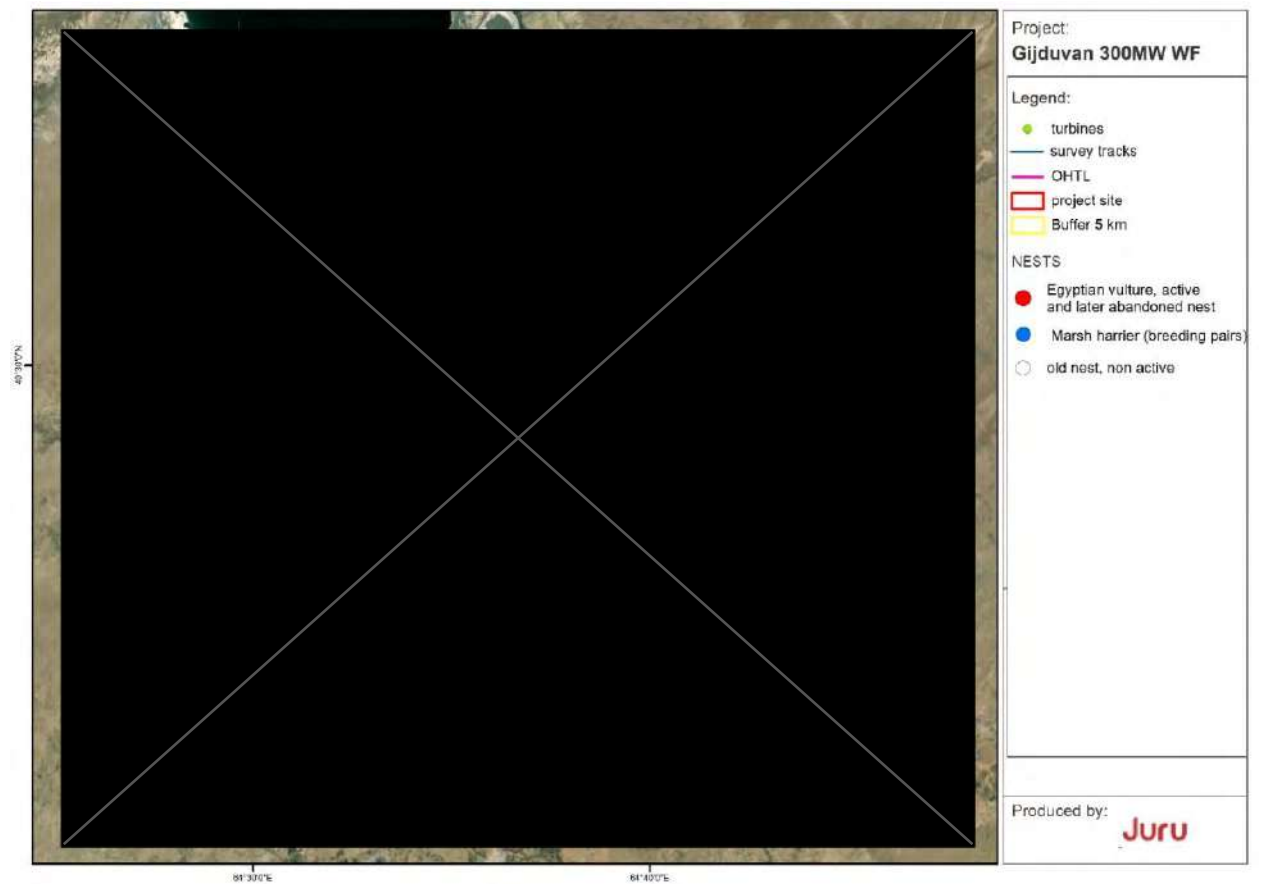
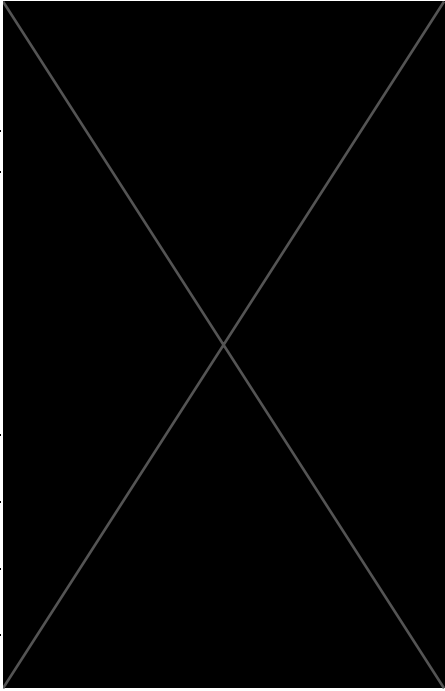


Figure 4: Locations of the nests in frame of survey area

Table 1: Field data

ID	pointN	pointN	Nest owner	NestN	Nest E	Date	Activity 1 visit	Date 2 visit	activity
N01			unknown potentially Long legged buzzard	40.551763	64.770075	25.04.2024	non active		
N26			unknown	40.546807	64.606792	25.04.2024	non active	10.06.2024	non active
N28			Egyptian vulture	40.55118	64.618407	25.04.2024	active, adult bird in the nest and another adult nearby	10.06.2024	nest is failed, though two adult birds were observed near the shore the day before
N29			Western Marsh Harrier			13.05.2024			
N30			Western Marsh Harrier			13.05.2024			
N31			Western Marsh Harrier			13.05.2024			
N32			Western Marsh Harrier			13.05.2024			

Egyptian vulture

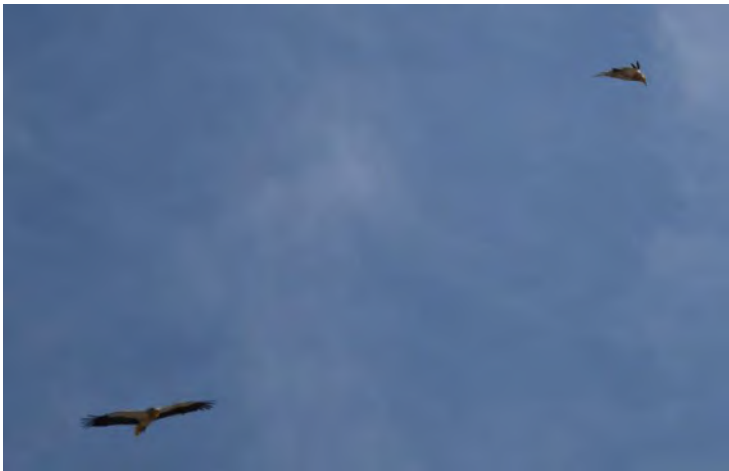


Figure 5: Adults near nest N28

Nest ID N28 (40.553370, 64.617358)
On April 25, 2024, it was active, with an adult bird in the nest and another adult nearby. However, during the second visit on June 10, 2024, the nest was empty, though two adult birds were observed near the shore the day before.

Breeding population. 1 pair of Egyptian Figure vulture in survey area.

Table 2: Egyptian vulture nest

NestID	N	E	Date record	of	1 round 24-26 April	2 round 9-10 June
N28			25.04.2024		active	failed



Figure 6: Active Nest N28 – Egyptian Vulture adult observed in the nest on April 25. The nest was abandoned and classified as failed during the second survey round on June 10, 2024.

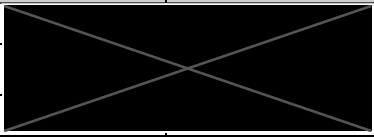
Long-legged buzzard

Two old nests were recorded within the 5 km buffer zone, potentially belonging to a Long-legged Buzzard.

Western Marsh Harrier

The nesting of the Marsh Harrier was identified as part of the waterfowl survey (see report) in April-May 2024. Since nests are difficult to locate in dense reed beds, the nesting assessment was based on expert sightings and observations. It is estimated that at least 4 pairs of Marsh Harriers are likely nesting within the project area.

Table 3: Marsh Harrier nesting locations

Point	N	E	Common name	Breeding pair
WB01			Western Marsh Harrier	1
WB04			Western Marsh Harrier	1
WB06			Western Marsh Harrier	2

Summary

Table 3: The nest survey findings

N	Species	Active nests	Failed nests	Old nests	Total nests	Breeding
1	Egyptian vulture	1	1		1	1 pair
2	Long legged buzzard			2?		Unknown
3	Western marsh harrier					4 pairs

4. Conclusion

1. No nests were found within the project area.
2. The discovered nests were recorded in the 5 km buffer zone — on the cliffs of the Ayakagitma depression, on saxaul bushes and in the reed beds around ponds.
3. Information on breeding raptors:
 - Egyptian Vulture — 1 pair;
 - Marsh Harrier — 4 pairs;
 - Long-legged Buzzard — unknown, the discovered potential nests were old.

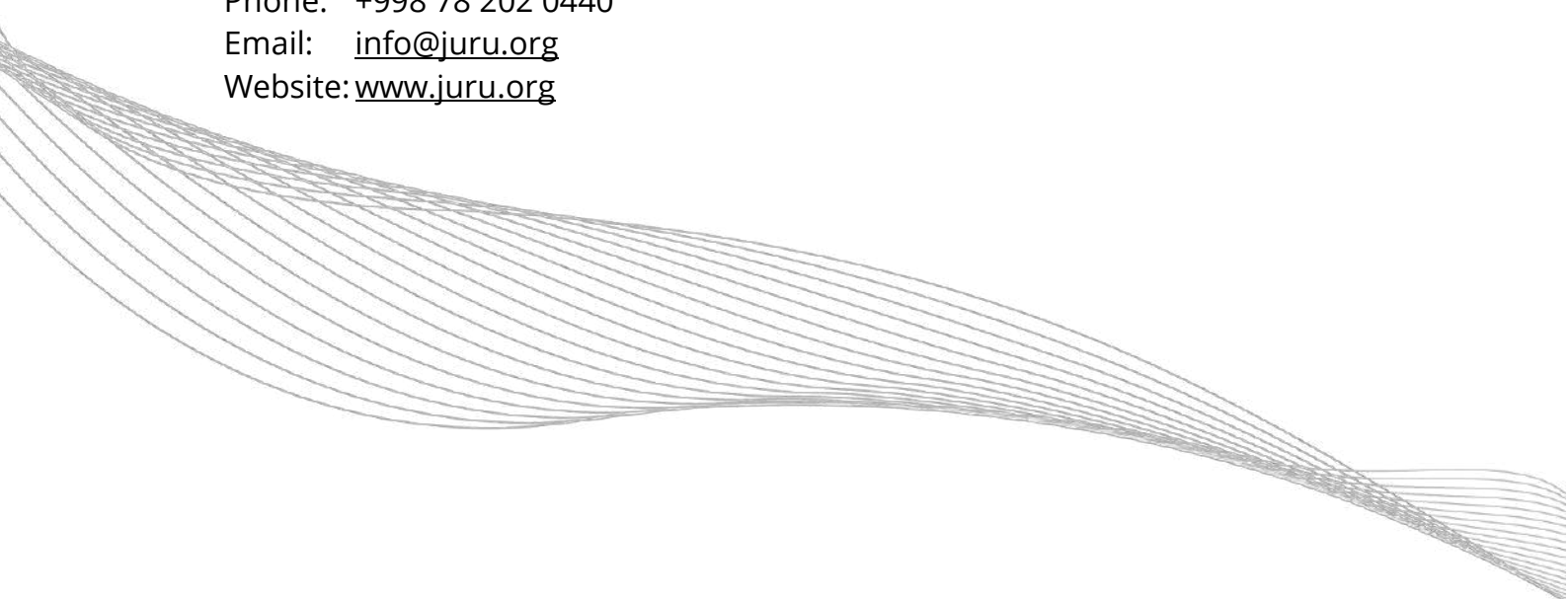


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7.AUTUMN WATERBIRD SURVEY REPORT

Waterbird Autumn survey report

Gijduvan wind power project in the Republic of Uzbekistan

Client: 5 Capitals



Document Information

Project Name	Gijduvan wind power project in the Republic of Uzbekistan
Document Title	Waterbird Autumn survey Report
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1. Introduction

The purpose of this document is to present results of waterbird autumn survey for the Gijduvon 300 MW Wind Farm in Bukhara Province, Uzbekistan (Figure 1).

The project, located in the Kyzylkum desert, involves establishing a 300MW wind farm, including a polygon of Wind Turbine Generators (WTG) spanning approximately 13,645 ha, and an associated Overhead Transmission Line (OTL) extending 24.9 km.

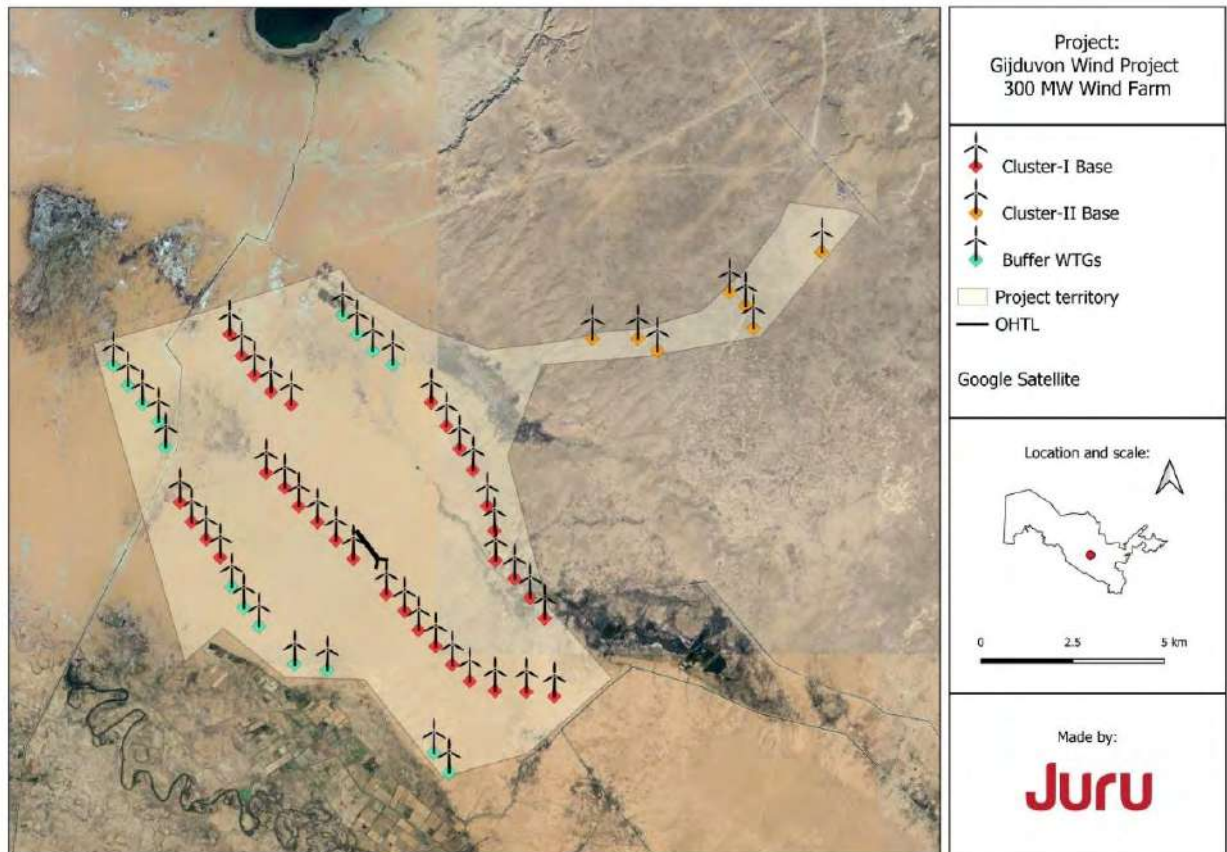


Figure 1: Proposed Gijduvon 300 MW Wind Farm area

The survey was focused on small waterbodies and wetlands adjacent to the project site. Small ponds and water bodies, including temporary ones, can play a significant role during the migration period.

2. Materials and methods

The waterbird survey for the Gijduvon Wind Farm project was carried out in the autumn of 2024 at nine survey points (WB01–WB09) across different aquatic habitats within the project area. The survey was conducted over three rounds: the first on September 23, 2024, the second on October 6 and 7, 2024, and the third on November 13.



Figure 2: Survey map – points and tracks

Table 1: Survey points

Survey Points	Coordinates (dd)		1 st round	2 nd round	3 rd round	Habitat
	N	E				
WB01				06-07.10.2024	13.11.2024	Pond
WB02			23.09.2024			Waterbody
WB03			23.09.2024		13.11.2024	Wetland
WB04			23.09.2024		13.11.2024	Pond
WB05			23.09.2024		13.11.2024	Pond
WB06				06-07.10.2024		Overgrown reedbed waterbody
WB07				06-07.10.2024		Pond
WB08				06-07.10.2024		Temporary wetland
WB09				06-07.10.2024		Takyr (saltmarsh)

Survey points were strategically allocated across a variety of waterbodies, including:

- Artificial ponds (WB01, WB04, WB05, WB07): characterized by reeds, Tamarix bushes, and perennial grasses.

- Wetlands (WB03, WB08): both temporary and permanent wetlands, with shallow saline water and *Tamarix sp.* fringes.
- Reedbeds (WB06): overgrown waterbodies dominated by reeds, surrounded by *Tamarix* vegetation.
- Takyr (saltmarsh) (WB09): saline areas prone to flooding after rain, providing suitable habitat for migrating waders.



Figure 3: Overview of survey point WB01



Figure 4: Overview of survey point WB03



Figure 5 : Overview of survey point WB04



Figure 6: Overview of survey point WB05

Point count surveys

Observers conducted point count surveys at each of the nine designated survey points. At each point, observers recorded all bird species seen and heard, with a focus on waterbirds and migratory species. The count duration ranged from 15 to 40 minutes, depending on the habitat complexity and bird activity.

All observed species were identified to the species level, where possible, and their relative abundance was noted. Special attention was given to identifying species of conservation concern, particularly those listed on the IUCN Red List or the Uzbekistan Red Data Book.

Weather conditions during all survey periods were generally favorable for conducting counts.

3. RESULTS

During the surveys, 31 bird species were recorded, none of which are currently listed as globally threatened under the IUCN Red List categories of CR, EN, or VU.

The first round of the survey was conducted on 23 September. The second round was conducted on 6 and 7 October. The final, third round was conducted on 13 November.

Table 2: Checklist of bird species observed during waterbird survey

ID	Species	Common name	IUCN Red List	Uzbekistan Red data book
1.	<i>Anser anser</i>	Greylag Goose	LC	LC
2.	<i>Tadorna ferruginea</i>	Ruddy Shelduck	LC	LC
3.	<i>Anas platyrhynchos</i>	Mallard	LC	LC
4.	<i>Anas crecca</i>	The Eurasian Teal	LC	LC
5.	<i>Netta rufina</i>	Red-crested Pochard	LC	LC
6.	<i>Phasianus colchicus</i>	Ring-necked Pheasant	LC	NT
7.	<i>Anthropoides virgo</i>	Demoiselle Crane	LC	LC

8.	<i>Pterocles orientalis</i>	Black-bellied Sandgrouse	LC	LC
9.	<i>Tringa totanus</i>	Common Redshank	LC	LC
10.	<i>Tringa ochropus</i>	Green Sandpiper	LC	LC
11.	<i>Tringa glareola</i>	Wood Sandpiper	LC	LC
12.	<i>Chroicocephalus genei</i>	Slender-billed Gull	LC	LC
13.	<i>Chroicocephalus ridibundus</i>	Black-headed Gull	LC	LC
14.	<i>Larus cachinnans</i>	Caspian Gull	LC	LC
15.	<i>Ardea alba</i>	Great White Egret	LC	LC
16.	<i>Ardea cinerea</i>	Grey Heron	LC	LC
17.	<i>Circus aeruginosus</i>	Western Marsh Harrier	LC	LC
18.	<i>Merops persicus</i>	Blue-cheeked Bee-eater	LC	LC
19.	<i>Curruca curruca</i>	Lesser Whitethroat	LC	LC
20.	<i>Curruca nana</i>	Asian Desert Warbler	LC	LC
21.	<i>Scotocerca inquieta</i>	Scrub Warbler	LC	LC
22.	<i>Phylloscopus collybita</i>	Common Chiffchaff	LC	LC
23.	<i>Luscinia svecica</i>	Bluethroat	LC	LC
24.	<i>Phoenicurus ochruros</i>	Black Redstart	LC	LC
25.	<i>Lanius excubitor</i>	Great Gray Shrike	LC	LC
26.	<i>Galerida cristata</i>	Crested Lark	LC	LC
27.	<i>Alaudala rufescens</i>	Mediterranean Short-toed Lark	LC	LC
28.	<i>Rhodospiza obsoleta</i>	Desert Finch	LC	LC
29.	<i>Passer hispaniolensis</i>	Spanish Sparrow	LC	LC
30.	<i>Sturnus vulgaris</i>	European Starling	LC	LC
31.	<i>Motacilla alba</i>	White Wagtail	LC	LC
Total			0	0

0

Table 3. Species distribution table

Species	WB01	WB02	WB03	WB04	WB05	WB06	WB07	WB08	WB09	Total number
Greylag Goose				250						250
Ruddy Shelduck	2									2
Mallard	6				18					24
Eurasian Teal	19				57					76
Red-crested Pochard					5					5
Ring-necked Pheasant						1				1
Demoiselle Crane	54									54
Black-bellied Sandgrouse					2					2
Common Redshank	4									4
Green Sandpiper	2									2
Wood Sandpiper	8									8
Slender-billed Gull	25			1	15		2			43
Black-headed Gull	8									8
Caspian Gull	3									3
Great White Egret	5									5
Grey Heron	1				2					3
Western Marsh Harrier	1			3	7	3	1			15

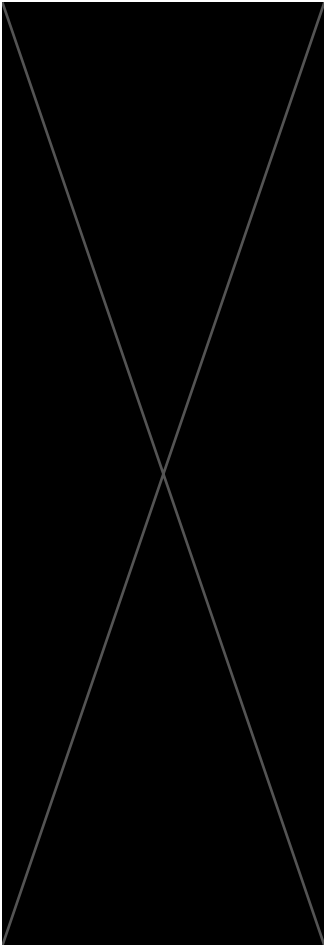
Blue-cheeked Bee-eater					15					15
Lesser Whitethroat		1	2		2	4	1	8	4	22
Asian Desert Warbler		1			2					3
Scrub Warbler		1						2	1	4
Common Chiffchaff		4	2	3	4	2		3		18
Bluethroat		2			1					3
Black Redstart								1		1
Great Gray Shrike			1							1
Crested Lark	3	7	2	10	6	2	5	12	3	50
Mediterranean Short-toed Lark	14		6	15	30					65
Desert Finch						17	8	18	11	54
Spanish Sparrow				20	60	16				96
European Starling			4							4
White Wagtail		4	5	9	8	5	2			33
Grand Total	16	7	7	10	18	8	6	6	4	82

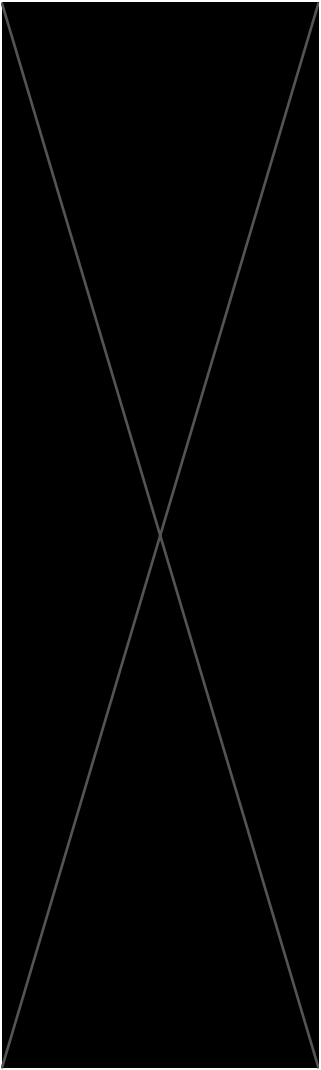
4. Summary

- A total of 31 bird species were observed across three survey periods.
- No species listed in the IUCN or the Red Data Book of Uzbekistan were encountered during this period.

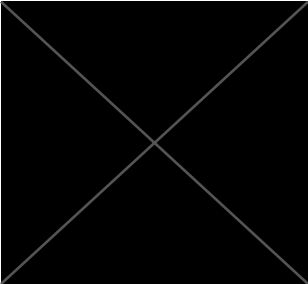
Annex I: Field data

Table 4: Field data from waterbird observations at nine survey points

ID	Point	N	E	Date	Time start	Time end	Species	Common name	Number
1	WB05			23.09.2024	9:40	10:20	Motacilla alba	White Wagtail	8
2	WB05			23.09.2024	9:40	10:20	Phylloscopus collybita	Common Chiffchaff	4
3	WB05			23.09.2024	9:40	10:20	Curruca nana	Asian Desert Warbler	2
4	WB05			23.09.2024	9:40	10:20	Passer hispaniolensis	Spanish Sparrow	60
5	WB05			23.09.2024	9:40	10:20	Circus aeruginosus	Western Marsh Harrier	3
6	WB05			23.09.2024	9:40	10:20	Pterocles orientalis	Black-bellied Sandgrouse	2
7	WB05			23.09.2024	9:40	10:20	Galerida cristata	Crested Lark	6
8	WB05			23.09.2024	9:40	10:20	Ardea cinerea	Grey Heron	7
9	WB05			23.09.2024	9:40	10:20	Luscinia svecica	Bluethroat	1
10	WB05			23.09.2024	9:40	10:20	Curruca curruca	Lesser Whitethroat	2
11	WB05			23.09.2024	9:40	10:20	Merops persicus	Blue-cheeked Bee-eater	15
12	WB04			23.09.2024	10:35	10:50	Circus aeruginosus	Western Marsh Harrier	1
13	WB04			23.09.2024	10:35	10:50	Chroicocephalus genei	Slender-billed Gull	1
14	WB04			23.09.2024	10:35	10:50	Phylloscopus collybita	Common Chiffchaff	3
15	WB04			23.09.2024	10:35	10:50	Passer hispaniolensis	Spanish Sparrow	20
16	WB04			23.09.2024	10:35	10:50	Motacilla alba	White Wagtail	9
17	WB04			23.09.2024	11:10	11:30	Galerida cristata	Crested Lark	4
18	WB02			23.09.2024	11:10	11:30	Galerida cristata	Crested Lark	7
19	WB02			23.09.2024	11:10	11:30	Phylloscopus collybita	Common Chiffchaff	4
20	WB02			23.09.2024	11:10	11:30	Curruca nana	Asian Desert Warbler	1
21	WB02			23.09.2024	11:10	11:30	Luscinia svecica	Bluethroat	2
22	WB02			23.09.2024	11:10	11:30	Scotocerca inquieta	Scrub Warbler	1
23	WB02			23.09.2024	11:10	11:30	Motacilla alba	White Wagtail	4

ID	Point	N	E	Date	Time start	Time end	Species	Common name	Number
24	WB02			23.09.2024	11:10	11:30	<i>Curruca curruca</i>	Lesser Whitethroat	1
25	WB03			23.09.2024	11:45	12:00	<i>Galerida cristata</i>	Crested Lark	2
26	WB03			23.09.2024	11:45	12:00	<i>Motacilla alba</i>	White Wagtail	5
27	WB03			23.09.2024	11:45	12:00	<i>Phylloscopus collybita</i>	Common Chiffchaff	2
28	WB03			23.09.2024	11:45	12:00	<i>Curruca curruca</i>	Lesser Whitethroat	2
29	WB08			06.10.2024	9:50	10:20	<i>Galerida cristata</i>	Crested Lark	12
30	WB08			06.10.2024	9:50	10:20	<i>Curruca curruca</i>	Lesser Whitethroat	8
31	WB08			06.10.2024	9:50	10:20	<i>Phylloscopus collybita</i>	Common Chiffchaff	3
32	WB08			06.10.2024	9:50	10:20	<i>Rhodospiza obsoleta</i>	Desert Finch	18
33	WB08			06.10.2024	9:50	10:20	<i>Scotocerca inquieta</i>	Scrub Warbler	2
34	WB08			06.10.2024	9:50	10:20	<i>Phoenicurus ochruros</i>	Black Redstart	1
35	WB09			06.10.2024	10:40	10:55	<i>Galerida cristata</i>	Crested Lark	3
36	WB09			06.10.2024	10:40	10:55	<i>Scotocerca inquieta</i>	Scrub Warbler	1
37	WB09			06.10.2024	10:40	10:55	<i>Curruca curruca</i>	Lesser Whitethroat	4
38	WB09			06.10.2024	10:40	10:55	<i>Rhodospiza obsoleta</i>	Desert Finch	11
39	WB01			06.10.2024	11:00	11:20	<i>Chroicocephalus ridibundus</i>	Black-headed Gull	8
40	WB01			06.10.2024	11:00	11:20	<i>Chroicocephalus genei</i>	Slender-billed Gull	25
41	WB01			06.10.2024	11:00	11:20	<i>Larus cachinnans</i>	Caspian Gull	3
42	WB01			06.10.2024	11:00	11:20	<i>Ardea alba</i>	Great White Egret	4
43	WB01			06.10.2024	11:00	11:20	<i>Tringa ochropus</i>	Green Sandpiper	2
44	WB01			06.10.2024	11:00	11:20	<i>Tringa glareola</i>	Wood Sandpiper	8
45	WB01			06.10.2024	11:00	11:20	<i>Tringa totanus</i>	Common Redshank	4
46	WB01			06.10.2024	11:00	11:20	<i>Anas crecca</i>	Eurasian teal	19
47	WB01			06.10.2024	11:00	11:20	<i>Anas platyrhynchos</i>	Mallard	6
48	WB01			06.10.2024	11:00	11:20	<i>Tadorna ferruginea</i>	Ruddy Shelduck	2
49	WB01			06.10.2024	11:00	11:20	<i>Circus aeruginosus</i>	Western Marsh Harrier	1

ID	Point	N	E	Date	Time start	Time end	Species	Common name	Number
50	WB01			06.10.2024	11:00	11:20	Anthropoides virgo	Demoiselle Crane	54
51	WB07			07.10.2024	16:50	17:10	Chroicocephalus genei	Slender-billed Gull	2
52	WB07			07.10.2024	16:50	17:10	Circus aeruginosus	Western Marsh Harrier	1
53	WB07			07.10.2024	16:50	17:10	Motacilla alba	White Wagtail	2
54	WB07			07.10.2024	16:50	17:10	Galerida cristata	Crested Lark	5
55	WB07			07.10.2024	16:50	17:10	Rhodospiza obsoleta	Desert Finch	8
56	WB07			07.10.2024	16:50	17:10	Curruca curruca	Lesser Whitethroat	1
57	WB06			07.10.2024	17:25	17:50	Circus aeruginosus	Western Marsh Harrier	3
58	WB06			07.10.2024	17:25	17:50	Galerida cristata	Crested Lark	2
59	WB06			07.10.2024	17:25	17:50	Motacilla alba	White Wagtail	5
60	WB06			07.10.2024	17:25	17:50	Phasianus colchicus	Ring-necked Pheasant	1
61	WB06			07.10.2024	17:25	17:50	Curruca curruca	Lesser Whitethroat	4
62	WB06			07.10.2024	17:25	17:50	Rhodospiza obsoleta	Desert Finch	17
63	WB06			07.10.2024	17:25	17:50	Passer hispaniolensis	Spanish Sparrow	16
64	WB06			07.10.2024	17:25	17:50	Phylloscopus collybita	Common Chiffchaff	2
65	WB05			13.11.2024	7:45	8:15	Ardea cinerea	Grey Heron	2
66	WB05			13.11.2024	7:45	8:15	Anas platyrhynchos	Mallard	18
67	WB05			13.11.2024	7:45	8:15	Anas crecca	Eurasian teal	57
68	WB05			13.11.2024	7:45	8:15	Chroicocephalus genei	Slender-billed Gull	15
69	WB05			13.11.2024	7:45	8:15	Circus aeruginosus	Western Marsh Harrier	4
70	WB05			13.11.2024	7:45	8:15	Alaudala rufescens	Mediterranean Short-toed Lark	30
71	WB05			13.11.2024	7:45	8:15	Netta rufina	Red-crested Pochard	5
72	WB04			13.11.2024	8:25	8:40	Anser anser	Greylag Goose	250
73	WB04			13.11.2024	8:25	8:40	Circus aeruginosus	Western Marsh Harrier	2
74	WB04			13.11.2024	8:25	8:40	Alaudala rufescens	Mediterranean Short-toed Lark	15
75	WB04			13.11.2024	8:25	8:40	Galerida cristata	Crested Lark	6

ID	Point	N	E	Date	Time start	Time end	Species	Common name	Number
76	WB03			13.11.2024	8:50	9:15	Alaudala rufescens	Mediterranean Short-toed Lark	6
77	WB03			13.11.2024	8:50	9:15	Sturnus vulgaris	European Starling	4
78	WB03			13.11.2024	8:50	9:15	Lanius excubitor	Great Gray Shrike	1
79	WB01			13.11.2024	9:30	9:55	Ardea cinerea	Grey Heron	3
80	WB01			13.11.2024	9:30	9:55	Ardea alba	Great White Egret	1
81	WB01			13.11.2024	9:30	9:55	Galerida cristata	Crested Lark	3
82	WB01			13.11.2024	9:30	9:55	Alaudala rufescens	Mediterranean Short-toed Lark	14



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8. SPRING WATERBIRD SURVEY REPORT

Waterbird survey Report

Gijduvan wind power project in the Republic of Uzbekistan

Client: 5 Capitals

Date: 10 September 2024



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1. Introduction

The purpose of this document is to present results of spring waterbird survey for the Gijduvon 300 MW Wind Farm in Bukhara Province, Uzbekistan (Figure 1).

The project, located in the Kyzylkum desert, involves establishing a 300MW wind farm, including a polygon of Wind Turbine Generators (WTG) spanning approximately 13,645 ha, and an associated Overhead Transmission Line (OTL) extending 24.9 km.

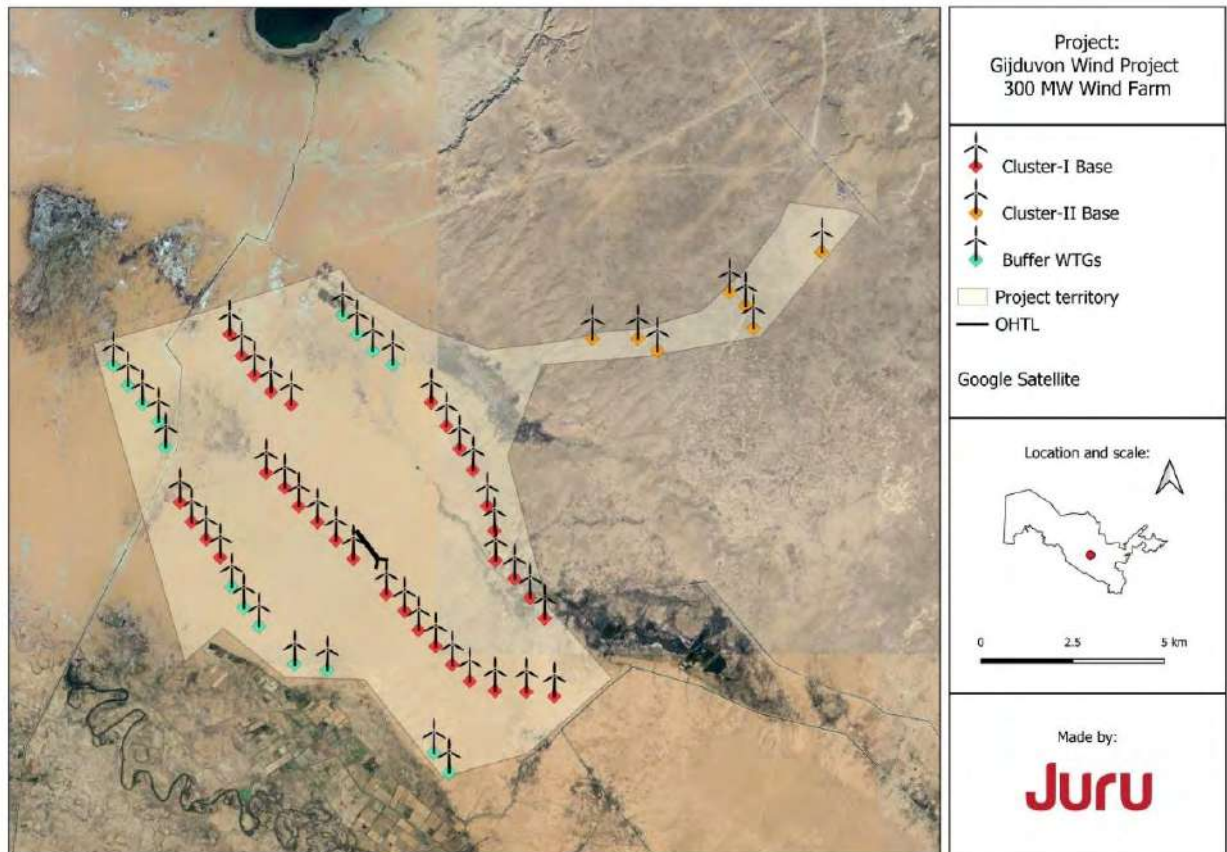


Figure 1: Proposed Gijduvon 300 MW Wind Farm area

The project site is located between two lakes - Ayakagitma Lake and Shorkul water reservoir, and some small waterbodies and wetlands locate in project and in surrounding areas.

Ayakagitma Lake is classified as an Important Bird Area (IBA) by BirdLife International, which, therefore, qualifies it as a Key Biodiversity Area (KBA), per IFC PS6. The ornithological importance of this IBA is multifaceted, and includes nesting activity of Endangered raptors and vultures, as well as importance for a wide variety of waterbirds, who utilize the aquatic and coastal habitats of the Lake. Different waterbird species utilize the Lake during different seasons. For example, a wide variety of waders (or "shorebirds") utilize the littoral habitats along the edge of the Lake, especially during spring and autumn migrations. During the winter season, the Lake is recognized to have special ornithological significance because its salinity prevents the Lake from freezing, even when temperatures drop below 0°C. This feature is exploited by a wide variety of water birds that overwinter on the Lake, including some sensitive species. This lake was monitored during biodiversity baseline surveys for BASH I, and were conducted in 2022.

The survey was focused on small waterbodies and wetlands adjacent to the project site. Small ponds and water bodies, including temporary ones, can play a significant role during the migration period.

2. Materials and methods

The waterbird survey for the Gijduvon Wind Farm project was carried out in the spring of 2024 at nine survey points (WB01–WB09) across different aquatic habitats within the project area. The survey was conducted over two rounds: the first on March 30, 2024, during the peak spring migration period, and the second on May 13, 2024, during the early breeding season. These dates were selected to capture both migratory and breeding bird species using the area. (Figure 2Error! Reference source not found.).

Phototrap survey. In addition to visual observations, the data from four camera traps were used. The cameras were installed for mammal survey at watering places (wetlands and drainage canals within the survey area). The camera traps were active throughout the survey period and provided supplementary data on species presence, particularly for elusive species or those active outside of survey hours (Figure 2).



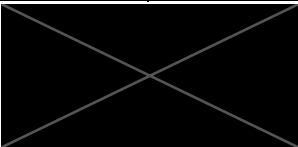
Figure 2: Survey map – points and tracks, and location with trail cameras

Table 1: Survey points

Survey Points	Coordinates (dd)		1 st round	2 nd round	Habitat
	N	E			
WB01			30/03/2024	13/05/2024	Pond
WB02			30/03/2024	13/05/2024	Waterbody
WB03			30/03/2024	13/05/2024	Wetland
WB04			30/03/2024	13/05/2024	Pond
WB05			30/03/2024	13/05/2024	Pond
WB06			30/03/2024	13/05/2024	Overgrown reedbed waterbody

Survey Points	Coordinates (dd)		2 nd round	2 nd round	Habitat
	N	E			
WB07			30/03/2024	13/05/2024	Pond
WB08			30/03/2024	13/05/2024	Temporary wetland
WB09			30/03/2024	13/05/2024	Takyr (saltmarsh)

Table 2: Locations of trail cameras

Survey Points	Coordinates (dd)		Start day	End day	Habitat
	N	E			
Pht45			30/03/2024	13/05/2024	Drainage canal
Pht46					Drainage canal
Pht48					Wetland
Pht52					Drainage canal

Survey points were strategically allocated across a variety of waterbodies, including:

- Artificial ponds (WB01, WB04, WB05, WB07): characterized by reeds, Tamarix bushes, and perennial grasses.
- Wetlands (WB03, WB08): both temporary and permanent wetlands, with shallow saline water and *Tamarix sp.* fringes.
- Reedbeds (WB06): overgrown waterbodies dominated by reeds, surrounded by Tamarix vegetation.
- Takyr (saltmarsh) (WB09): saline areas prone to flooding after rain, providing suitable habitat for migrating waders.



Figure 3: Overview of survey Point WB01 – a typical artificial pond in the region, characterized by dense reedbeds, Tamarix bushes, and perennial grasses such as *Karelinia caspia* and Camel-thorn.



Figure 4: Survey Point WB03 – a wetland with shallow saline waters, fringed by Tamarix bushes, supporting a variety of waders and waterbirds.



Figure 5: Survey Point WB06 – an overgrown reedbed waterbody surrounded by Tamarix bushes, providing breeding habitat for waterbirds and passerines



Figure 6: Survey Point WB08 – a temporary wetland with saline takyr, surrounded by Tamarix bushes, flooded after seasonal rains, attracting migratory shorebirds.



Figure 7: Survey Point WB09 – a saline takyr habitat during the spring season.

Point count surveys

Observers conducted point count surveys at each of the nine designated survey points. At each point, observers recorded all bird species seen and heard, with a focus on waterbirds and migratory species. The count duration ranged from 15 to 30 minutes, depending on the habitat complexity and bird activity.

All observed species were identified to the species level, where possible, and their relative abundance was noted. Special attention was given to identifying species of conservation concern, particularly those listed on the IUCN Red List or the Uzbekistan Red Data Book.

Weather conditions during both survey periods were generally favorable for conducting counts.

3. RESULTS

During the surveys, 55 bird species were recorded, none of which are currently listed as globally threatened under the IUCN Red List categories of CR, EN, or VU. However, two species with a national conservation status in Uzbekistan were observed: Glossy Ibis (*Plegadis falcinellus*) and Black Stork (*Ciconia nigra*), both classified as Vulnerable (VU) in the Uzbekistan Red Data Book.

The first round of surveys, conducted in late March, identified a higher number of migratory species, as many waterbird species use the site as a stopover during spring migration. In the second round, conducted in mid-May, a shift toward breeding species was observed. The most common breeding waterbirds included ducks (e.g., Mallard, Ruddy duck), waders (e.g., Black-winged Stilt; White-tailed Lapwing), and terns (e.g., Little Tern). Non-waterbird species breeding in the riparian vegetation surrounding waterbodies included the Clamorous Reed-warbler (*Acrocephalus stentoreus*), Bank Swallow (*Riparia riparia*), and Rufous-tailed Scrub-robin (*Cercotrichas galactotes*) et al.

Table 3: Checklist of bird species observed during waterbird survey

ID	Species	Common name	IUCN Red List	Uzbekistan Red data book
1	<i>Tadorna ferruginea</i>	Ruddy Shelduck		
2	<i>Curruca curruca</i>	Lesser Whitethroat		
3	<i>Spatula clypeata</i>	Northern Shoveler		
4	<i>Anas platyrhynchos</i>	Mallard		
5	<i>Anas crecca</i>	Green-winged Teal		
6	<i>Netta rufina</i>	Red-crested Pochard		
7	<i>Alectoris chukar</i>	Chukar		
8	<i>Pterocles orientalis</i>	Black-bellied Sandgrouse		
9	<i>Cuculus canorus</i>	Common Cuckoo		
10	<i>Apus apus</i>	Common Swift		
11	<i>Rallus aquaticus</i>	Water Rail		
12	<i>Himantopus himantopus</i>	Black-winged Stilt		
13	<i>Charadrius dubius</i>	Little Ringed Plover		
14	<i>Vanellus leucurus</i>	White-tailed Lapwing		
15	<i>Anarhynchus alexandrinus</i>	Kentish Plover		
16	<i>Phalaropus lobatus</i>	Red-necked Phalarope		
17	<i>Tringa ochropus</i>	Green Sandpiper		
18	<i>Tringa totanus</i>	Redshank		
19	<i>Tringa glareola</i>	Wood sandpiper		
20	<i>Calidris pugnax</i>	Ruff		
21	<i>Calidris minuta</i>	Little Stint		
22	<i>Glareola pratincola</i>	Collared Pratincole		
23	<i>Chroicocephalus ridibundus</i>	Black-headed Gull		
24	<i>Larus cachinnans</i>	Caspian Gull		

25	<i>Sternula albifrons</i>	Little Tern		
26	<i>Chlidonias hybrida</i>	Whiskered Tern		
27	<i>Ciconia nigra</i>	Black Stork		VU:R
28	<i>Ardea alba</i>	Great Egret		
29	<i>Ardea cinerea</i>	Grey Heron		
30	<i>Ardea purpurea</i>	Purple Heron		
31	<i>Plegadis falcinellus</i>	Glossy Ibis		VU:D
32	<i>Circus aeruginosus</i>	Western Marsh Harrier		
33	<i>Buteo rufinus</i>	Long-legged Buzzard		
34	<i>Upupa epops</i>	Eurasian Hoopoe		
35	<i>Merops persicus</i>	Blue-cheeked Bee-eater		
36	<i>Merops apiaster</i>	European Bee-eater		
37	<i>Coracias garrulus</i>	European Roller		
38	<i>Lanius isabellinus</i>	Isabelline Shrike		
39	<i>iduna rama</i>	Syke's warbler		
40	<i>Galerida cristata</i>	Crested Lark		
41	<i>Acrocephalus stentoreus</i>	Clamorous Reed-warbler		
42	<i>Riparia riparia</i>	Bank Swallow		
43	<i>Hirundo rustica</i>	Barn Swallow		
44	<i>Phylloscopus collybita</i>	Common Chiffchaff		
45	<i>Curruca curruca</i>	Lesser Whitethroat		
46	<i>Muscicapa striata</i>	Spotted Flycatcher		
47	<i>Cercotrichas galactotes</i>	Rufous-tailed Scrub-robin		
48	<i>Passer domesticus</i>	House Sparrow		
49	<i>Passer hispaniolensis</i>	Spanish Sparrow		
50	<i>Passer montanus</i>	Eurasian Tree Sparrow		
51	<i>Motacilla flava</i>	Western Yellow Wagtail		
52	<i>Motacilla citreola</i>	Citrine Wagtail		
53	<i>Motacilla alba</i>	White Wagtail		
54	<i>Carpodacus erythrinus</i>	Common Rosefinch		
55	<i>Emberiza bruniceps</i>	Red-headed Bunting		
			0	2

4. Summary

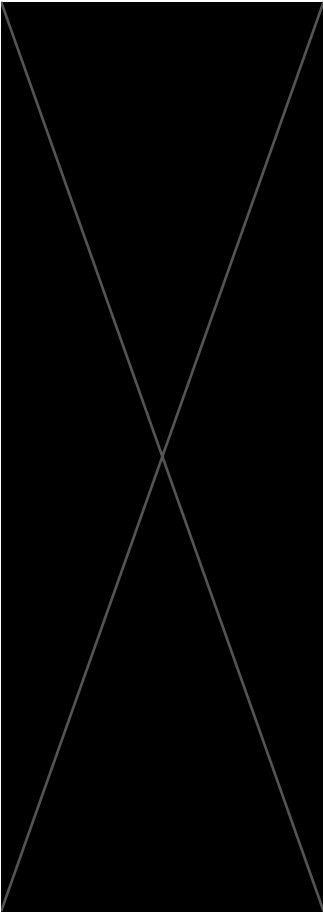
A total of 55 bird species were observed across two survey periods, with two species (Glossy Ibis and Black Stork) holding Vulnerable conservation status in Uzbekistan.

Although no globally threatened species were recorded, the presence of nationally vulnerable species underlines the ecological importance of the area, particularly for migratory birds.

Future surveys will take place during the autumn migration to provide a more comprehensive understanding of bird movements through the project area.

Annex I: Field data

Table 4: Field data from waterbird observations at nine survey points

ID	Point	N	E	Date	Time start	Time end	Species	Common name	Number
1	WB08			30/03/2024	06:45	07:10	<i>Chroicocephalus ridibundus</i>	Black-headed Gull	6
2	WB08			30/03/2024	06:45	07:10	<i>Anas crecca</i>	Green-winged Teal	35
3	WB08			30/03/2024	06:45	07:10	<i>Tringa ochropus</i>	Green Sandpiper	2
4	WB08			30/03/2024	06:45	07:10	<i>Plegadis falcinellus</i>	Glossy Ibis	5
5	WB08			30/03/2024	06:45	07:10	<i>Pterocles orientalis</i>	Black-bellied Sandgrouse	15
6	WB09			30/03/2024	07:15	07:25	<i>Curruca curruca</i>	Lesser Whitethroat	1
7	WB09			30/03/2024	07:15	07:25	<i>Pterocles orientalis</i>	Black-bellied Sandgrouse	2
8	WB09			30/03/2024	07:15	07:25	<i>Riparia riparia</i>	Bank Swallow	5
9	WB01			30/03/2024	07:30	07:45	<i>Anas crecca</i>	Green-winged Teal	6
10	WB01			30/03/2024	07:30	07:45	<i>Tadorna ferruginea</i>	Ruddy Shelduck	4
11	WB01			30/03/2024	07:30	07:45	<i>Circus aeruginosus</i>	Western Marsh Harrier	2
12	WB01			30/03/2024	07:30	07:45	<i>Motacilla flava</i>	Western Yellow Wagtail	10
13	WB01			30/03/2024	07:30	07:45	<i>Hirundo rustica</i>	Barn Swallow	3
14	WB01			30/03/2024	07:30	07:45	<i>Riparia riparia</i>	Bank Swallow	10
15	WB01			30/03/2024	07:30	07:45	<i>Pterocles orientalis</i>	Black-bellied Sandgrouse	12
16	WB02			30/03/2024	08:00	08:15	<i>Circus aeruginosus</i>	Western Marsh Harrier	3
17	WB02			30/03/2024	08:00	08:15	<i>Anas platyrhynchos</i>	Mallard	30
18	WB02			30/03/2024	08:00	08:15	<i>Tadorna ferruginea</i>	Ruddy Shelduck	8
19	WB02			30/03/2024	08:00	08:15	<i>Anas crecca</i>	Green-winged Teal	10
20	WB02			30/03/2024	08:00	08:15	<i>Netta rufina</i>	Red-crested Pochard	12
21	WB02			30/03/2024	08:00	08:15	<i>Sternula albifrons</i>	Little Tern	2
22	WB02			30/03/2024	08:00	08:15	<i>Plegadis falcinellus</i>	Glossy Ibis	7

ID	Point	N	E	Date	Time start	Time end	Species	Common name	Number
23	WB03			30/03/2024	08:25	08:40	<i>Plegadis falcinellus</i>	Glossy Ibis	15
24	WB03			30/03/2024	08:25	08:40	<i>Circus aeruginosus</i>	Western Marsh Harrier	2
25	WB03			30/03/2024	08:25	08:40	<i>Curruca curruca</i>	Lesser Whitethroat	2
26	WB03			30/03/2024	08:25	08:40	<i>Galerida cristata</i>	Crested Lark	2
27	WB04			30/03/2024	09:30	09:55	<i>Chroicocephalus ridibundus</i>	Black-headed Gull	4
28	WB04			30/03/2024	09:30	09:55	<i>Larus cachinnans</i>	Caspian Gull	10
29	WB04			30/03/2024	09:30	09:55	<i>Circus aeruginosus</i>	Western Marsh Harrier	4
30	WB05			30/03/2024	10:05	10:30	<i>Ardea alba</i>	Great Egret	3
31	WB05			30/03/2024	10:05	10:30	<i>Himantopus himantopus</i>	Black-winged Stilt	6
32	WB05			30/03/2024	10:05	10:30	<i>Tringa glareola</i>	Wood sandpiper	1
33	WB05			30/03/2024	10:05	10:30	<i>Tringa totanus</i>	Redshank	3
34	WB05			30/03/2024	10:05	10:30	<i>Anas platyrhynchos</i>	Mallard	8
35	WB05			30/03/2024	10:05	10:30	<i>Spatula clypeata</i>	Northern Shoveler	40
36	WB05			30/03/2024	10:05	10:30	<i>Ardea cinerea</i>	Grey Heron	2
37	WB05			30/03/2024	10:05	10:30	<i>Pterocles orientalis</i>	Black-bellied Sandgrouse	20
38	WB07			30/03/2024	11:45	12:30	<i>Anas crecca</i>	Green-winged Teal	8
39	WB07			30/03/2024	11:45	12:30	<i>Chroicocephalus ridibundus</i>	Black-headed Gull	2
40	WB07			30/03/2024	11:45	12:30	<i>Circus aeruginosus</i>	Western Marsh Harrier	1
41	WB07			30/03/2024	11:45	12:30	<i>Pterocles orientalis</i>	Black-bellied Sandgrouse	2
42	WB06			30/03/2024	11:10	11:30	<i>Riparia riparia</i>	Bank Swallow	10
43	WB06			30/03/2024	11:10	11:30	<i>Circus aeruginosus</i>	Western Marsh Harrier	3
44	WB06			13/05/2024	06:30	06:50	<i>Curruca curruca</i>	Lesser Whitethroat	11
45	WB06			13/05/2024	06:30	06:50	<i>Cercotrichas galactotes</i>	Rufous-tailed Scrub-robin	2
46	WB06			13/05/2024	06:30	06:50	<i>Acrocephalus stentoreus</i>	Clamorous Reed-warbler	10

ID	Point	N	E	Date	Time start	Time end	Species	Common name	Number
47	WB06			13/05/2024	06:30	06:50	<i>Phylloscopus collybita</i>	Common Chiffchaff	19
48	WB06			13/05/2024	06:30	06:50	<i>Circus aeruginosus</i>	Western Marsh Harrier	7
49	WB06			13/05/2024	06:30	06:50	<i>Motacilla alba</i>	White Wagtail	3
50	WB06			13/05/2024	06:30	06:50	<i>Emberiza bruniceps</i>	Red-headed Bunting	2
51	WB06			13/05/2024	06:30	06:50	<i>Glareola pratincola</i>	Collared Pratincole	3
52	WB06			13/05/2024	06:30	06:50	<i>Cuculus canorus</i>	Common Cuckoo	1
53	WB06			13/05/2024	06:30	06:50	<i>Motacilla flava</i>	Western Yellow Wagtail	6
54	WB06			13/05/2024	06:30	06:50	<i>Galerida cristata</i>	Crested Lark	3
55	WB06			13/05/2024	06:30	06:50	<i>Coracias garrulus</i>	European Roller	2
56	WB06			13/05/2024	06:30	06:50	<i>Passer montanus</i>	Eurasian Tree Sparrow	7
57	WB06			13/05/2024	06:30	06:50	<i>Merops apiaster</i>	European Bee-eater	5
58	WB06			13/05/2024	06:30	06:50	<i>Passer hispaniolensis</i>	Spanish Sparrow	18
59	WB06			13/05/2024	06:30	06:50	<i>Ardea purpurea</i>	Purple Heron	1
60	WB06			13/05/2024	06:30	06:50	<i>Iduna rama</i>	<i>Sykes's warbler</i>	8
61	WB06			13/05/2024	06:30	06:50	<i>Lanius isabellinus</i>	Isabelline Shrike	1
62	WB07			13/05/2024	07:15	07:35	<i>Upupa epops</i>	Eurasian Hoopoe	2
63	WB07			13/05/2024	07:15	07:35	<i>Merops persicus</i>	Blue-cheeked Bee-eater	6
64	WB07			13/05/2024	07:15	07:35	<i>Merops apiaster</i>	European Bee-eater	7
65	WB07			13/05/2024	07:15	07:35	<i>Cercotrichas galactotes</i>	Rufous-tailed Scrub-robin	2
66	WB07			13/05/2024	07:15	07:35	<i>Acrocephalus stentoreus</i>	Clamorous Reed-warbler	4
67	WB07			13/05/2024	07:15	07:35	<i>Ardea purpurea</i>	Purple Heron	1
68	WB07			13/05/2024	07:15	07:35	<i>Hirundo rustica</i>	Barn Swallow	3
69	WB07			13/05/2024	07:15	07:35	<i>Apus apus</i>	Common Swift	2
70	WB07			13/05/2024	07:15	07:35	<i>Chlidonias hybrida</i>	Whiskered Tern	3
71	WB07			13/05/2024	07:15	07:35	<i>Circus aeruginosus</i>	Western Marsh Harrier	2
72	WB07			13/05/2024	07:15	07:35	<i>Curruca curruca</i>	Lesser Whitethroat	2

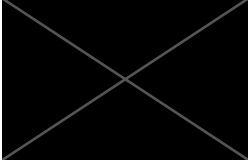
ID	Point	N	E	Date	Time start	Time end	Species	Common name	Number
73	WB07			13/05/2024	07:15	07:35	<i>Passer montanus</i>	Eurasian Tree Sparrow	1
74	WB07			13/05/2024	07:15	07:35	<i>Galerida cristata</i>	Crested Lark	3
75	WB07			13/05/2024	07:15	07:35	<i>Motacilla alba</i>	White Wagtail	4
76	WB08			13/05/2024	11:04	11:20	<i>Passer hispaniolensis</i>	Spanish Sparrow	200
77	WB08			13/05/2024	11:04	11:20	<i>Iduna rama</i>	<i>Sykes's warbler</i>	3
78	WB08			13/05/2024	11:04	11:20	<i>Galerida cristata</i>	Crested Lark	7
79	WB08			13/05/2024	11:04	11:20	<i>Glareola pratincola</i>	Collared Pratincole	4
80	WB08			13/05/2024	11:04	11:20	<i>Curruca curruca</i>	Lesser Whitethroat	2
81	WB08			13/05/2024	11:04	11:20	<i>Phylloscopus collybita</i>	Common Chiffchaff	6
82	WB08			13/05/2024	11:04	11:20	<i>Circus aeruginosus</i>	Western Marsh Harrier	1
83	WB08			13/05/2024	11:04	11:20	<i>Hirundo rustica</i>	Barn Swallow	3
84	WB08			13/05/2024	11:04	11:20	<i>Merops apiaster</i>	European Bee-eater	5
85	WB09			13/05/2024	11:43	11:53	<i>Rallus aquaticus</i>	Water Rail	1
86	WB09			13/05/2024	11:43	11:53	<i>Galerida cristata</i>	Crested Lark	7
87	WB09			13/05/2024	11:43	11:53	<i>Passer hispaniolensis</i>	Spanish Sparrow	200 (гнездовой колония)
88	WB09			13/05/2024	11:43	11:53	<i>Iduna rama</i>	<i>Sykes's warbler</i>	3
89	WB09			13/05/2024	11:43	11:53	<i>Anarhynchus alexandrinus</i>	Kentish Plover	4
90	WB09			13/05/2024	11:43	11:53	<i>Riparia riparia</i>	Bank Swallow	1
91	WB09			13/05/2024	11:43	11:53	<i>Chroicocephalus ridibundus</i>	Black-headed Gull	1
92	WB09			13/05/2024	11:43	11:53	<i>Motacilla alba</i>	White Wagtail	3
93	WB09			13/05/2024	11:43	11:53	<i>Iduna rama</i>	<i>Sykes's warbler</i>	2
94	WB09			13/05/2024	11:43	11:53	<i>Muscicapa striata</i>	Spotted Flycatcher	1
95	WB09			13/05/2024	11:43	11:53	<i>Cercotrichas galactotes</i>	Rufous-tailed Scrub-robin	3
96	WB09			13/05/2024	11:43	11:53	<i>Phylloscopus collybita</i>	Common Chiffchaff	8

ID	Point	N	E	Date	Time start	Time end	Species	Common name	Number
97	WB01			13/05/2024	12:00	12:20	<i>Cuculus canorus</i>	Common Cuckoo	1
98	WB01			13/05/2024	12:00	12:20	<i>Riparia riparia</i>	Bank Swallow	6
99	WB01			13/05/2024	12:00	12:20	<i>Galerida cristata</i>	Crested Lark	2
100	WB01			13/05/2024	12:00	12:20	<i>Merops apiaster</i>	European Bee-eater	2
101	WB01			13/05/2024	12:00	12:20	<i>Cercotrichas galactotes</i>	Rufous-tailed Scrub-robin	1
102	WB01			13/05/2024	12:00	12:20	<i>Motacilla flava</i>	Western Yellow Wagtail	3
103	WB01			13/05/2024	12:00	12:20	<i>Curruca curruca</i>	Lesser Whitethroat	2
104	WB01			13/05/2024	12:00	12:20	<i>Muscicapa striata</i>	Spotted Flycatcher	1
105	WB01			13/05/2024	12:00	12:20	<i>Phylloscopus collybita</i>	Common Chiffchaff	1
106	WB03			13/05/2024	12:43	13:00	<i>Vanellus leucurus</i>	White-tailed Lapwing	13
107	WB03			13/05/2024	12:43	13:00	<i>Himantopus himantopus</i>	Black-winged Stilt	7
108	WB03			13/05/2024	12:43	13:00	<i>Plegadis falcinellus</i>	Glossy Ibis	1
109	WB03			13/05/2024	12:43	13:00	<i>Motacilla alba</i>	White Wagtail	2
110	WB03			13/05/2024	12:43	13:00	<i>Galerida cristata</i>	Crested Lark	3
111	WB03			13/05/2024	12:43	13:00	<i>Motacilla flava</i>	Western Yellow Wagtail	1
112	WB03			13/05/2024	12:43	13:00	<i>Tringa ochropus</i>	Green Sandpiper	2
113	WB03			13/05/2024	12:43	13:00	<i>Motacilla citreola</i>	Citrine Wagtail	1
114	WB03			13/05/2024	12:43	13:00	<i>Cercotrichas galactotes</i>	Rufous-tailed Scrub-robin	3
115	WB03			13/05/2024	12:43	13:00	<i>Curruca curruca</i>	Lesser Whitethroat	2
116	WB03			13/05/2024	12:43	13:00	<i>Phylloscopus collybita</i>	Common Chiffchaff	4
117	WB02			13/05/2024	14:35	15:00	<i>Motacilla flava</i>	Western Yellow Wagtail	3
118	WB02			13/05/2024	14:35	15:00	<i>Muscicapa striata</i>	Spotted Flycatcher	3
119	WB02			13/05/2024	14:35	15:00	<i>Phylloscopus collybita</i>	Common Chiffchaff	6
120	WB02			13/05/2024	14:35	15:00	<i>Vanellus leucurus</i>	White-tailed Lapwing	2
121	WB02			13/05/2024	14:35	15:00	<i>Riparia riparia</i>	Bank Swallow	16
122	WB02			13/05/2024	14:35	15:00	<i>Himantopus himantopus</i>	Black-winged Stilt	3

ID	Point	N	E	Date	Time start	Time end	Species	Common name	Number
123	WB02			13/05/2024	14:35	15:00	<i>Motacilla alba</i>	White Wagtail	5
124	WB02			13/05/2024	14:35	15:00	<i>Galerida cristata</i>	Crested Lark	2
125	WB02			13/05/2024	14:35	15:00	<i>Cercotrichas galactotes</i>	Rufous-tailed Scrub-robin	2
126	WB02			13/05/2024	14:35	15:00	<i>Curruca curruca</i>	Lesser Whitethroat	3
127	WB02			13/05/2024	14:35	15:00	<i>Calidris minuta</i>	Little Stint	13
128	WB04			13/05/2024	13:20	13:35	<i>Plegadis falcinellus</i>	Glossy Ibis	8
129	WB04			13/05/2024	13:20	13:35	<i>Himantopus himantopus</i>	Black-winged Stilt	2
130	WB04			13/05/2024	13:20	13:35	<i>Merops apiaster</i>	European Bee-eater	3
131	WB04			13/05/2024	13:20	13:35	<i>Riparia riparia</i>	Bank Swallow	6
132	WB04			13/05/2024	13:20	13:35	<i>Motacilla alba</i>	White Wagtail	3
133	WB04			13/05/2024	13:20	13:35	<i>Circus aeruginosus</i>	Western Marsh Harrier	1
134	WB04			13/05/2024	13:20	13:35	<i>Galerida cristata</i>	Crested Lark	2
135	WB05			13/05/2024	13:20	13:35	<i>Circus aeruginosus</i>	Western Marsh Harrier	1
136	WB05			13/05/2024	13:20	13:35	<i>Himantopus himantopus</i>	Black-winged Stilt	5
137	WB05			13/05/2024	13:20	13:35	<i>Vanellus leucurus</i>	White-tailed Lapwing	4
138	WB05			13/05/2024	13:20	13:35	<i>Riparia riparia</i>	Bank Swallow	70
139	WB05			13/05/2024	13:20	13:35	<i>Hirundo rustica</i>	Barn Swallow	3
140	WB05			13/05/2024	13:20	13:35	<i>Glareola pratincola</i>	Collared Pratincole	4
141	WB05			13/05/2024	13:20	13:35	<i>Motacilla alba</i>	White Wagtail	3
142	WB05			13/05/2024	13:20	13:35	<i>Motacilla flava</i>	Western Yellow Wagtail	1
143	WB05			13/05/2024	13:20	13:35	<i>Calidris minuta</i>	Little Stint	9
144	WB05			13/05/2024	13:20	13:35	<i>Phalaropus lobatus</i>	Red-necked Phalarope	18

Table 5: Phototrap survey data, listing species captured on camera

N	Phototrap	N	E	Species	Common name
1	Pht45			<i>Pterocles orientalis</i>	Black-bellied Sandgrouse
2	Pht45			<i>Circus aeruginosus</i>	Western Marsh Harrier
3	Pht45			<i>Larus cachinnans</i>	Caspian Gull
4	Pht45			<i>Alectoris chukar</i>	Chukar
5	Pht45			<i>Merops persicus</i>	Blue-cheeked Bee-eater
6	Pht45			<i>Galerida cristata</i>	Crested Lark
7	Pht45			<i>Carpodacus erythrinus</i>	Common Rosefinch
8	Pht45			<i>Ardea purpurea</i>	Purple Heron
9	Pht45			<i>Glareola pratincola</i>	Collared Pratincole
10	Pht45			<i>Passer domesticus</i>	House Sparrow
11	Pht45			<i>Plegadis falcinellus</i>	Glossy Ibis
12	Pht46			<i>Circus aeruginosus</i>	Western Marsh Harrier
13	Pht46			<i>Galerida cristata</i>	Crested Lark
14	Pht46			<i>Upupa epops</i>	Eurasian Hoopoe
15	Pht46			<i>Coracias garrulus</i>	European Roller
16	Pht46			<i>Tadorna ferruginea</i>	Ruddy Shelduck
17	Pht46			<i>Motacilla alba</i>	White Wagtail
18	Pht46			<i>Pterocles orientalis</i>	Black-bellied Sandgrouse
19	Pht46			<i>Merops persicus</i>	Blue-cheeked Bee-eater
20	Pht46			<i>Ardea cinerea</i>	Grey Heron
21	Pht46			<i>Riparia riparia</i>	Bank Swallow
22	Pht46			<i>Buteo rufinus</i>	Long-legged Buzzard
23	Pht46			<i>Passer domesticus</i>	House Sparrow
24	Pht48			<i>Tadorna ferruginea</i>	Ruddy Shelduck
25	Pht48			<i>Anas platyrhynchos</i>	Mallard
26	Pht48			<i>Galerida cristata</i>	Crested Lark
27	Pht48			<i>Circus aeruginosus</i>	Western Marsh Harrier
28	Pht48			<i>Motacilla alba</i>	White Wagtail
29	Pht48			<i>Motacilla alba</i>	White Wagtail
30	Pht48			<i>Motacilla flava</i>	Western Yellow Wagtail
31	Pht48			<i>Himantopus himantopus</i>	Black-winged Stilt
32	Pht48			<i>Tringa ochropus</i>	Green Sandpiper
33	Pht48			<i>Anas crecca</i>	Green-winged Teal
34	Pht48			<i>Spatula clypeata</i>	Northern Shoveler
35	Pht48			<i>Ciconia nigra</i>	Black Stork
36	Pht48			<i>Phalaropus lobatus</i>	Red-necked Phalarope
37	Pht48			<i>Calidris pugnax</i>	Ruff
38	Pht48			<i>Anarhynchus alexandrinus</i>	Kentish Plover
39	Pht52			<i>Galerida cristata</i>	Crested Lark
40	Pht52			<i>Ardea alba</i>	Great Egret
41	Pht52			<i>Ardea cinerea</i>	Grey Heron
42	Pht52			<i>Anas crecca</i>	Green-winged Teal
43	Pht52			<i>Ardea purpurea</i>	Purple Heron

N	Phototrap	N	E	Species	Common name
44	Pht52			<i>Coracias garrulus</i>	European Roller
45	Pht52			<i>Passer domesticus</i>	House Sparrow
46	Pht52			<i>Upupa epops</i>	Eurasian Hoopoe
47	Pht52			<i>Merops persicus</i>	Blue-cheeked Bee-eater



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9. BAT ROOST SEARCH SURVEY REPORT



Gijduvon Wind Project 300 MW Wind Farm

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1. Introduction

This report presents the results of one element of the bat (Chiroptera) baseline study for the Gijduvan Wind Project (the "Project"). This report includes a brief review of bats potentially occurring in the area (literature-based), supplemented with bat roost surveys conducted at the site at the end of summer.

The Project is located in the Kyzylkum Desert about 6 km to the south from the Ayakagytna lake. The region presents a typical desert showing flat relief with smooth hills. Places that are likely to serve as bat roosts such as natural caves, and abandoned mines; rocky cliffs are absent, as well as the territory is situated far from high mountains. Some water canals have small crevices in their steep loess or clayey sides but the role of these as bat roosts is unclear. Most suitable potential bat roosting structures such as bridges, buildings (abandoned or sometimes inhabited) and ruins are common.

A field visit was carried out on 25-29 August 2024. The main purpose of the site visit was to confirm the presence/absence of bats in potential roosting places identified based on a topographic map. In the case of bat finds, it was planned to determine the species, their number and reproductive status (breeding/non-breeding individuals), and the presence of maternal colonies.

2. Materials and Methods

The survey methodology consisted of two stages:

Desktop preparation which was an analysis of detailed *Google Earth* satellite images and literature sources. The maps identified the locations (GPS coordinates) of potential bat roosts – bridges and buildings. Car and hiking trails were also laid out. Those locations and trails were transferred to the *Locus Map Pro* smartphone application for further use in the field.

Fieldwork. Fieldwork was conducted between 25 and 29 August 2024, and included a survey of potential roosts identified during the desktop stage (Figure 1). When a roost was found, it was thoroughly examined, both for the presence of bats (visually or by voice), and for signs of their presence – droppings (excrement). Using flashlights, all crevices in vertical walls in buildings were examined. As for ceilings, it's often made of numerous wooden planks or branches covered with reeds which gives almost unlimited possibilities for bats to hide with no evidence of their presence as soon as their droppings mix with sheep and other farm animals' excrements on the ground.

Each surveyed object was mapped and photographed; a brief description was made, including notes on the suitability of the objects for bats.

When bats were detected, their species, sex, age, and number were determined. Species identification was carried out according to generally accepted methods (Kuzyakin, 1950; Bogdanov, 1953; Kozhurina, 1997). The captured bats were examined, photographed, and released within the same territory they had been captured.

Mist-netting was conducted in 4 localities (Figure 11) from sunset (20:00) to 00:00-02:00 in places suitable for bat feeding and drinking water.

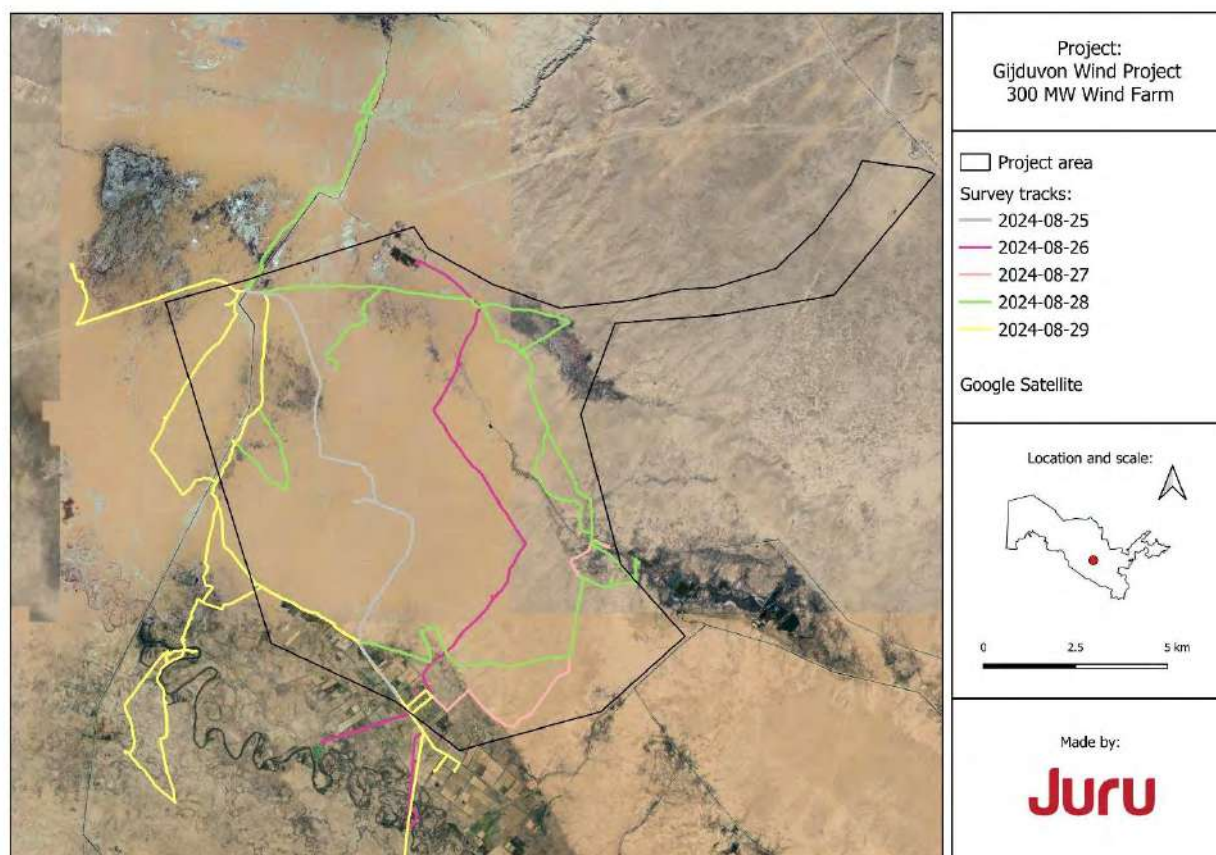


Figure 1. Transects across the project area and 5 km buffer zone

To navigate the terrain and record tracks, a smartphone (*Redmi Note 11S*) was used with the *Locus Map Pro* application installed.

The following equipment was taken into the field for the examination of bat roosts: a flashlight (4), gloves (2), a 0-150 mm calliper (1), an electronic scale (1), nets (3 nets 10 and 8 meters wide, to choose 2 of them), echo meter.

All the surveyed roosts and bats registration locations were mapped in the *Locus Map Pro* smartphone application.

3. Findings and Results

The project area is covered mostly by the following biotopes: fixed and semi-fixed hilly sands (Figure 2, Figure 3), sandy and sandy-loamy plain (Figure 4, Figure 5), sometimes with saxaul plantations (Figure 6), saline land (Figure 7). The lack of water is offset with artificial water objects – canals (Figure 8) and ponds (Figure 9).



Figure 2. Semi-fixed hilly sands.



Figure 3 Fixed hilly sands



Figure 4. Sandy-loamy plain



Figure 5. Sandy and sandy-loamy plain



Figure 6. Saxaul plantations on a sandy plain



Figure 7. Saline land



Figure 8. Canal with reeds and bushes – potential place for bat feeding and drinking



Figure 9. Old fish ponds surrounded by reeds

The area demonstrates the lack of natural roosts combined with the lack of water. This results in the increased value of anthropogenic roosts (different buildings with crevices), especially situated near water objects, both permanent and temporary (seasonal), as feeding habitat (with huge number of insects) and source of drinking water for bats.

As a result of the literature review, a list of 20 species potentially inhabiting the area was compiled (presented in Table 1 below). Due to the fact that bats are poorly studied in the region combined with their bird-like way of life (including active flight, seasonal migrations taken by certain species, change of winter and summer roosts, not to mention swarming in some third place) it should be taken into consideration that even species seemingly not so likely to inhabit the territory may be still found here under some special circumstances once in several years or decades.

Table 1. List and status of bats species potentially inhabiting the project area (**species found during our field search** are marked with bold font)

ID	Species	IUCN Red list	UzRDB (2019)	CMS	Source and notes
1	Greater Horseshoe Bat (<i>Rhinolophus ferrumequinum</i> Schreber, 1774)	LC	-		Bogdanov, 1953; Gritsina et al., 2013. Lives in caves, mines and other underground roosts, stone buildings (mosques and other).
2	Bukhara Horseshoe Bat (<i>Rhinolophus bocharicus</i> Kastschenko et Akimov, 1917)	LC	-		Bogdanov, 1953; Gritsina et al., 2013 Lives in caves, mines and other underground roosts, stone buildings.
3	Lesser Horseshoe Bat (<i>Rhinolophus hipposideros</i> Bechstein, 1800)	LC	2(VU:D)		Rare species in Uzbekistan found in the Eastern mountainous part of the country (UzRDB). Lives in caves, mines and other underground roosts, abandoned buildings.
4 (?)	Blyth's Horseshoe Bat (<i>Rhinolophus lepidus</i> , Blyth, 1844)	LC	-		There are no records in Uzbekistan, but it was found relatively recently in the region and could be confused with <i>Rhinolophus bocharicus</i> during identification (Khabilov et al, 2018)
5	Lesser Mouse-eared Bat (<i>Myotis blythii</i> Tomes, 1857)	LC	-		Bogdanov, 1953; Gritsina et al., 2013. Caught in the Kyzylkum desert in 2012 in Navoi region (Gritsina et al., 2013).
6	Geoffroy's Bat (<i>Myotis emarginatus</i> Geoffroy, 1806)	LC	-		Bogdanov, 1953: Rare, met mostly in oases.
7 (?)	Bukhara Mouse-eared Bat (<i>Myotis buharensis</i> Kuzyakin, 1950)	DD	1 (CR)		Endemic to Uzbekistan and Tajikistan. In 2019, a male <i>Myotis buharensis</i> was captured near the Zeravshan river in Tajikistan, confirming that the species is still present there (Kazakov et al., 2020). Thy only find of species in Uzbekistan was a colony in

					sandstone tunnels near Samarkand in 1957-1963 until the place was destroyed (UzRDB).
8 (?)	Long-fingered bat (<i>Myotis capaccinii</i> Bonaparte, 1837)	VU	-		1 specimen in Nukus in 1875 (Bogdanov, 1953), no other finds since then.
9	<i>Myotis davidii</i> Peters, 1869 (previously reported in the literature as <i>Myotis mystacinus</i> Kuhl, 1817)	LC	-		Bogdanov, 1953: Rare, met mostly in oases.
10	Asian Barbastelle (<i>Barbastella</i> cf. <i>walteri</i> Bianchi, 1916, previously detected as <i>B. caspica</i> Satunin, 1908 / <i>Barbastella leucomelas</i> Cretzschmar, 1830)	LC	-		Smirnov et al., 2021. Poorly studied species met mostly in mountains and foothills, in Uzbekistan known only from the Eastern part of the country.
11	Long-eared Bat (<i>Plecotus strelkovi</i> Spitzenberger, 2006) / <i>Plecotus</i> sp (taxonomic status needs further research)	LC	-		Bogdanov, 1953; Gritsina et al., 2013. Few finds in Uzbekiatan, all specimens detected in settlements, 2 of 4 locations in Samarkand.
12	Noctule Bat (<i>Nyctalus noctula</i> Schreber, 1774)	LC	-		Bogdanov, 1953: Rare, met mostly in cities and oases.
13	Common pipistrelle bat (<i>Pipistrellus pipistrellus</i> Schreber, 1774)	LC	-		Bogdanov, 1953; Gritsina et al., 2013. Most common bat species in cities and other settlements, easily occupies roosts in different buildings.
14	Kuhl's pipistrelle (<i>Pipistrellus kuhlii</i> Kuhl, 1817)	LC	-		Bogdanov, 1953: 1 specimen caught in Uzbekistan 26-07-1873 in the city garden of Atadjan in Khiva by M.N. Bogdanov. The species is known for significant enlargement of its range to the north in Eastern Europe during recent decades; possibly, it explores new territories in Uzbekistan, too.
15	Savi's Pipistrelle (<i>Hypsugo savii</i> Bonaparte, 1837)	LC	-		Bogdanov, 1953: Few specimen obtained in Uzbekistan in 1914 in Kugitangtau Range.
16	Serotine Bat (<i>Eptesicus serotinus</i> Schreber, 1774)	LC	-		Bogdanov, 1953: Common in deserts of Uzbekistan.
17	Botta's serotine (<i>Eptesicus ognevi</i> Bobrinskoy, 1918)	LC	-		Bogdanov, 1953; Gritsina et al., 2013. Mountain foothills, deserts, including caves in loess walls of river canyons. Found in

					Kyzylkum in Navoi region in drainage pipe (Gritsina et al., 2013).
18	Particoloured Bat (<i>Vespertilio murinus</i> Linnaeus, 1758)	LC	-		Bogdanov, 1953; Gritsina et al., 2013. Widespread bat species inhabiting different biotopes, often synanthropic.
19	Hemprich's Long-eared Bat (<i>Otonycteris hemprichi</i> Peters, 1859)	LC	2(VU:R)		Rare species in Uzbekistan found mostly in the Eastern mountainous part of the country, can be met in desert flats, too. Lives in caves, mines, rock cracks, abandoned buildings (UzRDB).
20	European Free-tailed Bat (<i>Tadarida teniotis</i> Rafinesque, 1814)	LC	2(VU:R)	II	Inhabits mountains and foothills, hides in deep cracks and cravices in rocks (UzRDB).

UzRDB – Red Data Book of Republic of Uzbekistan. CMS - Convention on the Conservation of Migratory Species of Wild Animals, Appendix I, II (effective 17 May 2024).

Thus, the area planned for construction may potentially be a habitat, feeding, breeding or migratory site of 20 species of bats met in Uzbekistan. This list contains species that hardly can be found on this territory, though this cannot be completely excluded. The only species included in the IUCN Red List with the status of threat (Vulnerable) is the Long-fingered bat known for the whole territory of Uzbekistan by 1 specimen found in Nukus in 1875 – 150 years ago, which gives this species the status of “extinct” in the country and means 0% possibility to find it on the project area. Nevertheless, it can hardly ever be 0% or 100% confidence with bats. Four species are included in the Red Data Book of the Republic of Uzbekistan – Lesser Horseshoe Bat, Asian Barbastelle, Hemprich's Long-eared Bat and European Free-tailed Bat. All four are found in the Eastern mountainous part of the country so far. Two species – the Bukhara Horseshoe Bat and Bukhara Mouse-eared Bat – are endemics of Central Asia. Two (or more) species with unclear taxonomic status and range – Asian Barbastelle (now regarded here as a new species *Barbastella walteri*, not as *B. leucomelas*), and representatives of “bottae group” – may be endemics of Central Asia, too. One species is included in II Appendix of CMS (Table 1).

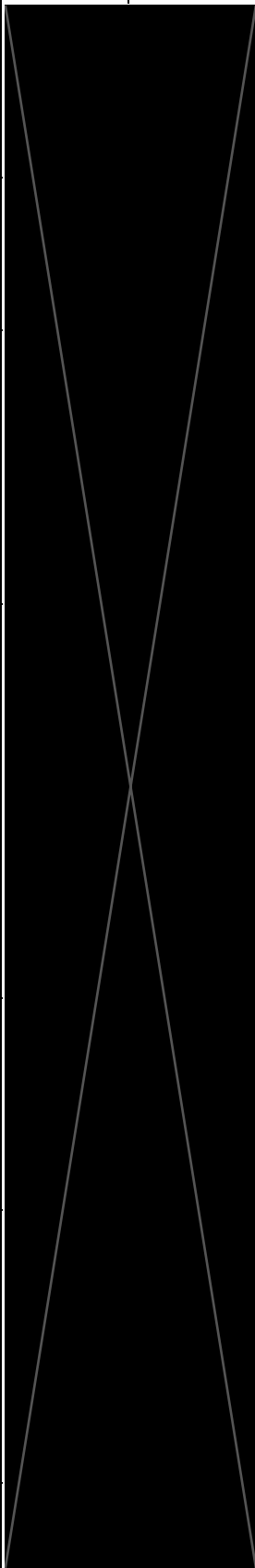
As long as natural potential roosts are scarce or absent in the studied area we concentrated on different buildings in our survey (Table 2), photos presented in Appendix I.



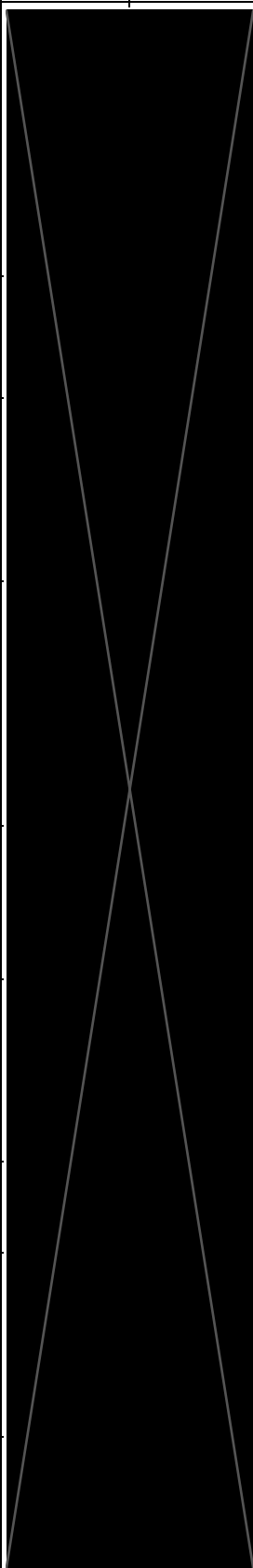
Figure 10. Locations of surveyed anthropogenic roosts (bridges and buildings). See description in Table 2.

Table 2. Survey locations in the project area and its 5 km buffer

№	Place of Observation	Coordinates		Comments	Expected number of individuals in the suitable season
		N	E		
1	Pipe			Two drainage pipes connecting canals under a road, with reeds by canal sides. No bats were found, only wasps.	0
2	Building			Single building – a mud (clay) construction with walls painted in white, with few cracks. The ceiling is made of wooden logs and branches – suitable for bats. There are canals nearby.	0
3	Group of buildings			A mud (clay) construction with an additional shed, and few cracks in walls. Fish ponds and canals nearby.	0-20
4	Herd shed			A three-wall sheep shed made of bricks and with a ceiling made of wooden logs, united with a small empty house (bricks covered with clay). Located near a canal. A small amount of bat droppings and many wasp nests with wasps were found	1-50

				in the cracks of the walls and narrow spaces between bricks.	
5	Building			Half-ruined small building with two rooms, one kept the roof. The walls are made of bricks covered with clay a long time ago (crevices). The type of building looks suitable for bats.	0-20
6	Farm			A complex of farm buildings including mud constructions and herd sheds with walls made of bricks. Bat droppings were found mostly between bricks.	1-50
7	Building			A farmhouse consisting of two rooms and a gap with a roof between them. Inside a closed room with a broken window, a few bat droppings were found, as well as traces of rodents, lizards, birds and a bird nest. The walls were covered with clay, with almost no cracks.	1-50
8	Bridge			A concrete bridge over a canal. Bat droppings on concrete beams under vertical crevices (in the places of beams' contact). Under one of crevices a conglomerate of dried small bat corpses (about 15 bats together) was found, and three more were detected in crevices – A common pipistrelle bat. A significant accumulation of bat droppings under the crevices in the ceiling of the bridge indicates the long-term residence of bats, presumably a maternal colony.	51-500
9	Farm			A complex of farm buildings including mud constructions and herd sheds with walls made of bricks. There was a house with a blue mosaic on the outer walls, which was also a white mud construction.	0-10
10	Group of buildings			Living house – a mud (clay) construction with no cracks. Henhouse is built of foam blocks with numerous crevices (and bat droppings in them). The size of bat droppings indicates the presence of 2 different bat species (smaller ones, pipistrelle-size, and some larger species).	51-500
11	Bridge			A concrete bridge over a canal. Few bat droppings on concrete beams under vertical crevices (in the places of beams' contact).	1-50

12	Farm		A large farm with several buildings surrounded by saxauls. Most walls were covered by clay, and part of the herd shed was built with foam blocks; bat droppings were found there under a piece of matting on the wall in the donkey pen.	0-10
13	Farm		Farm near tamarix shrubs. Most walls were covered with clay (no cracks, no bat droppings, except for a narrow shelf of clay wall under the ceiling), herd shed was built with foam blocks, and bat droppings were found there.	0-10
14	Canyon		A wide canyon cutting through a sand-loess formation, with vertical walls 10-40 meters high with suitable cavities in the upper part of the walls (inaccessible for visual survey), in the lower part a watercourse and coastal shrub vegetation. A perspective place for bat search by mist-netting. The canyon is situated to the North of the Project area.	51-500
15	Bridge		A concrete bridge over a canal. Few bat droppings on concrete beams under vertical crevices (in the places of beams' contact). Bat droppings indicate a bat maternal colony earlier in summer.	51-500
16	Building		A single building on top of a hill in the desert - a mud (clay) construction with few cracks and dead wasps inside the cracks.	0
17	Group of buildings		A farm with several buildings. The living house and toilet are covered with clay, herd shed walls are made of foam blocks with cracks.	0-10
18	Building		A single mud (clay) construction with no cracks, comprises a toilet (foam blocks, but no roof.	0
19	Group of buildings		Living house - a mud (clay) construction with no cracks, barn the same. The owner said a bat flew away from the barn while he was moving packs (supposedly, it was roosting between bags in the barn). There are fish ponds nearby, grass, reeds, and bushes.	1-50
20	Bridge		A concrete bridge over a canal. A few bat droppings on concrete beams under	1-50

				vertical crevices were found (in the places of beams' contact).	
21	Farm			A farm in saxaul plantings, many buildings. Some walls were covered with clay, some were made of foam blocks. Bat droppings were found between blocks and inside cavities in wooden logs (part of the roof in a clay construction with no other cracks). The owner saw flying bats at night.	51-500
22	Building			A single mud (clay) construction with no cracks, but the ceiling had numerous crevices.	0-10
23	Building			Single mud (clay) construction with two rooms, partly ruined (one room had a fallen outer wall, the second room was still used by people); the ceiling had numerous crevices.	0
24	Farm			Garage-looking large cattle shed with small buttresses, with the walls built of bricks covered with clay; there were cracks and crevices with bat droppings. Abandoned at the time of the survey. Three mud constructions nearby (no bat droppings).	51-500
25	Farm			A farm with a garden. All walls are covered with clay but have several cracks, in many buildings the ceiling has many crevices.	1-10
26	Farm			A farm with goats. The walls of sheds are covered with clay and have deep crevices used by bats. Numerous bat droppings and a living male of Kuhl's pipistrelle were found.	51-500
27	Building			Two ruined buildings without roofs, brick walls covered with clay.	0
28	Group of buildings			Half-ruined long building with clay-covered walls (with some cracks and many wasps), brick building with many wasps and few bat droppings in the crevices.	1-51
29	Bridge			A concrete bridge over a canal. Bat droppings on concrete beams under vertical crevices (in the places of beams' contact).	1-51

To identify species in their potential feeding places we took mist-netting in 4 different locations (Figure

11, Figure 12, Figure 13, Figure 14, Figure 15).



Figure 11. Places of mist-netting.

Table 3. Locations of mistnetting

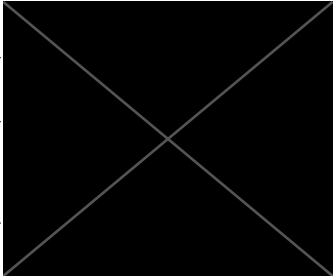
N	Date	Location	Habitat	Results
1	25.08.2024		Canal with reed	<i>Vespertillio murinus</i> (1)
2	26.08.2024		Fish pounds	<i>Vespertillio murinus</i> (2)
3	27.08.2024		Canal with reeds and steep clay-sandy sides	<i>Vespertillio murinus</i> (9), <i>Pipistrellus kuhlli</i> (1)
4	28.08.2024		Canal with reeds and bushes	<i>Pipistrellus kuhlii</i> (3)



Figure 12. Mist-netting 25.08.2024 (№1), near bridge over canal with reed



Figure 13. Mist-netting 26.08.2024 (№2), fish ponds



Figure 14. Mist-netting 27.08.2024 (№3), canal with reeds and steep clay-sandy sides



Figure 15. Mist-netting 28.08.2024 (№4), canal with reeds and bushes, sandy sides

Three bat species have been detected during our fieldwork (Table 3):

Table 3. Bats caught on the project area

Nº	Species	Sex, Age	Body mass (M), g	Forearm (FA), mm	Notes	Date	Place
1	Vespertillio murinus	M, ad	13.7	45.3	Mating, noticeable cheek glands	25.08.2024	1
2	Vespertillio murinus	M, ad	18.95	45.0	Mating, noticeable cheek glands	26.08.2024	2
3	Vespertillio murinus	M, ad	19.05	43.5	Mating, noticeable cheek glands	26.08.2024	2
4	Vespertillio murinus	M, ad	18.2	45.2	Mating, noticeable cheek glands	27.08.2024	3
5	Vespertillio murinus	M, ad	14.85	43.3	Mating, noticeable cheek glands	27.08.2024	3
6	Vespertillio murinus	F, ad	16.0	44.4	Hasn't bred before. Mating, noticeable cheek glands	27.08.2024	3
7	Vespertillio murinus	M, ad	15.5	46.6	Mating, noticeable cheek glands	27.08.2024	3
8	Vespertillio murinus	F, ad	17.0	45.1	Hasn't bred before, cheek glands are hardly visible	27.08.2024	3
9	Vespertillio murinus	M, ad	15.6	45.5	Mating, noticeable cheek glands	27.08.2024	3
10	Pipistrellus kuhlii	M, ad	5.6	30.0	Mating, noticeable cheek glands and testicles	27.08.2024	3
11	Vespertillio murinus	F, ad	20.3	46.1	Hasn't bred before. Mating, noticeable cheek glands	27.08.2024	3
12	Vespertillio murinus	F, ad	23.4	46.1	Hasn't bred before. Mating, noticeable cheek glands	27.08.2024	3
13	Vespertillio murinus	F, ad	13.2	44.4	Hasn't bred before. Cheek glands were visible but not so big.	27.08.2024	3
14	Pipistrellus kuhlii	F, ad	5.0	32.2	Hasn't bred before. Cheek glands slightly visible.	28.08.2024	4
15	Pipistrellus kuhlii	F, young	5.15	31.1	Hasn't bred before. Cheek glands slightly visible.	28.08.2024	4
16	Pipistrellus kuhlii	F, young	5.1	32.0	Hasn't bred before. Cheek glands slightly visible.	28.08.2024	4

Age was detected by epiphyses of fingers in wings, but at the end of summer, most young (born this season) bats have even ossification along the entire length of bones giving no possibility for 100% identification of young specimens.

On 25 August 2024, windy weather throughout mist-netting may have caused low bat activity. One *Vespertillio murinus* was caught at 10:20 pm.

On 26 August 2024, it was less windy; two males of *Vespertillio murinus* were caught between 9:30-9:45 pm.

On 27 August 2024, the weather was windless; a significant number of mosquitoes and bats were active from sunset till 2:30 am (maybe later, but we stopped mist-netting). 9 *Vespertillio murinus* (4 males, 5 females) and 1 male *Pipistrellus kuhlii* were caught.

On 28 August 2024, the weather was windy, and the wind weakened by midnight. Three females of *Pipistrellus kuhlii* were caught between 0:30-0:45 am. Some larger bats were noticed at higher levels (15-20 m above).



Figure 16. Male *Vespertillio murinus* caught by mist-netting near fishing ponds 26.08.2024. Cheek glands are seen on the right photo



Figure 17. *Vespertilio murinus* caught by mist-netting over a canal with reeds 27.08.2024

1. Parti-coloured Bat (*Vespertilio murinus* Linnaeus, 1758) – a widespread species with huge range covering most of Northern Eurasia and significant habitat lability, found in different climatic zones and known for its progressing synanthropy. Flies fast and high, hunts on insects at heights of around 20–40 m in open landscape (for example, over steppe, desert or meadows, over streams and lakes and above forests). Migratory species sometimes cover more than 100 km between winter and summer roosts. Females form maternity roosts at the beginning of summer and generally give birth to twins. After the pups are weaned, which takes about six weeks, females leave the maternity roost.

At the end of August in the studied area the caught parti-coloured bats showed signs of mating period – both males and females had noticeable cheek glands and specific odor. The species was detected by mist-netting in three different places (№№ 1-3, see figure 3-10).



Figure 18. Male *Pipistrellus kuhlii* caught by mist-netting over a canal with reeds 27.08.2024 (N40.43738 E64.64072).

2. Kuhl's pipistrelle (*Pipistrellus kuhlii* Kuhl, 1817) – a small bat species common in the Mediterranean region, Eastern Europe, and Western Asia. Inhabits open landscapes, including anthropogenic ones, in mountains up to 2,600 m; often lives in human settlements. It settles in buildings, rock cracks and other slit-like shelters. Begins feeding at early dusk, and hunts small flying insects low over reservoirs, wastelands, streets, etc. The flight is fast and manoeuvrable. Sedentary, it winters in stone buildings in the north of its range. Mating after the end of lactation or on wintering grounds. Maternal colonies, up to several dozen, less often hundreds of individuals, males keep apart.

We found Kuhl's pipistrelles in three locations – twice by mist-netting (№№ 3 and 4, Figure 14, Figure 15) and once in a roost (№26 in Table 2). One living specimen was found during a roosting survey in a crevice between bricks covered with clay – an adult male showing all signs of reproductive activeness (noticeable testicles and cheek glands).



Figure 19. Adult male of Kuhl's pipistrelle found in a crevice between bricks (see below).



Figure 20. Kuhl's pipistrelle's day roost in a crevice between bricks covered with clay, 29.08.2024



Figure 21. Bat roost in a crevice between bricks covered with clay, droppings in crevices indicate bat presence. 29.08.2024 (location 26 in Table 2, XXXXXXXXXX)

3. Common pipistrelle (*Pipistrellus pipistrellus* Schreber, 1774) – a small bat species, one of the most widespread and common species of bats in Uzbekistan, whose habitats are mainly confined to human buildings, less frequently observed in caves. It forms rather large colonies, sometimes together with other species. Males usually live alone.

No live common pipistrelles were observed during our survey, though small bat dropping in many locations could belong to this species (impossible to distinguish from other small bats' droppings). We found dead bats under a concrete bridge (location 8 in Table 2). It was a conglomerate of dried small bat corpses (about 15 bats together), three more detected in crevices. Later bats were detected by measurements of forearms (30-31 mm) and condylobasal length of the skull (10-11 mm). Supposedly, mass at-a-time death of bats could be caused by an unexpected late frost. Droppings on dead bats indicate that survived bats continued to use this roost. It's impossible to say whether these bats died this year or earlier.



Figure 22. Bat droppings and dead bats (yellow oval) under a concrete bridge (location 8 in Table 2,



Figure 23. Common pipistrelle's skull. From dead bats conglomerate found under a concrete bridge (location 8 in Table 2, [REDACTED])

4. Threats

During the survey conducted within the project area, roosting sites were discovered, which are used by bats as resting places during the day and, presumably, for breeding. The expected number of individuals that may be found during the most favourable season is provided in the last column of Table 2. According to the South African Best Practice Guideline for Pre-construction Monitoring of Bats at Wind Energy Facilities, the following buffer zones are required for wind turbine developments, including all parts of the blades and towers:

- 200 meters – from the Important bat territories (riparian zone, outer wetland zone, outbuildings (all structures considered as potentially important for bats – farm buildings, bridges, artificial roosts);
- 500 meters – from a colony of 1-50 Least Concern (LC) bats and/or Low fatality Risk bats;
- 1000 meters from a colony of 50-500 LC bats and/or Low fatality Risk bats or 1-50 Medium, Medium-High and High Fatality Risk and/or Conservation Important bats;

The map shows important bat territories, roosting sites within the project site where direct and indirect evidence of the presence of bats was discovered and the buffer zone for each feature.

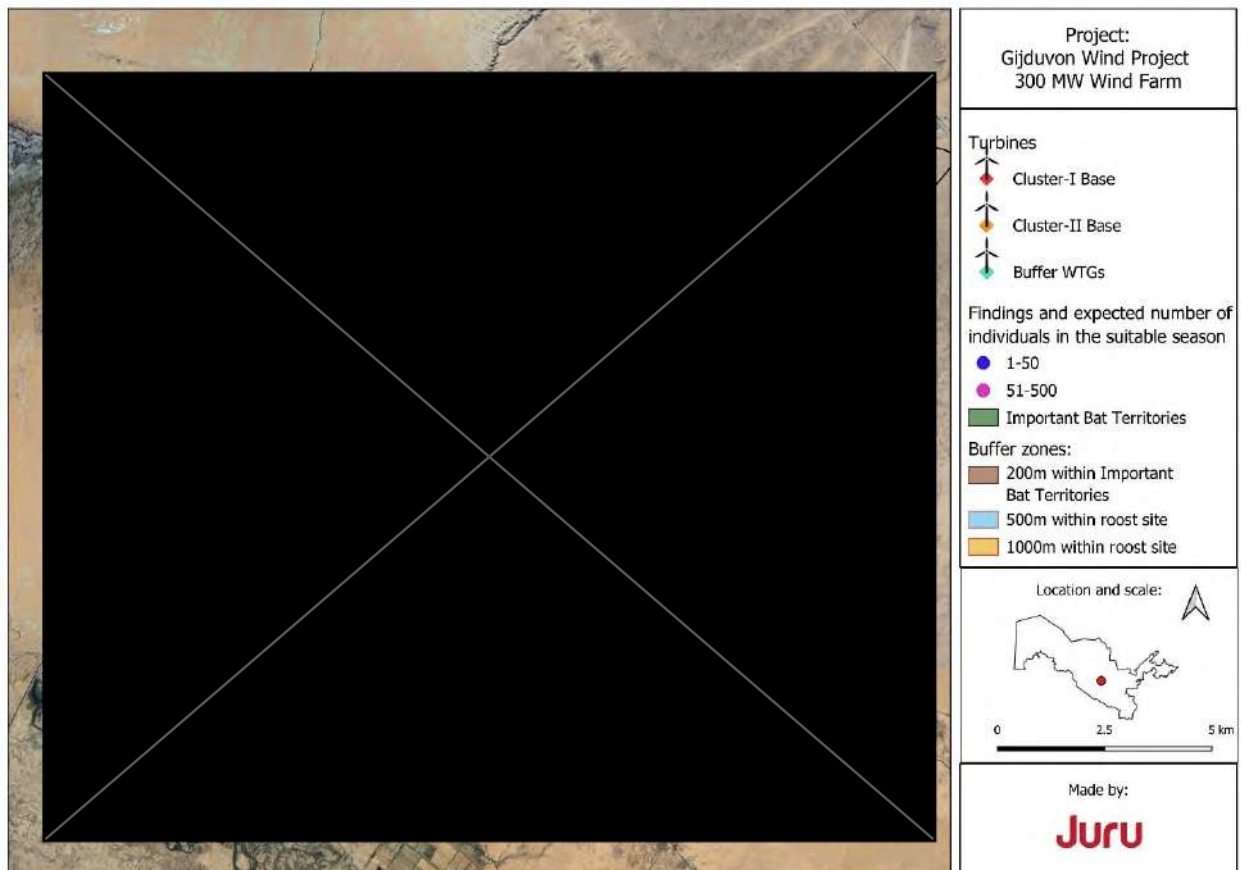


Figure 24. Required buffer zone according the South African Best Practice Guidelines for Pre-construction Monitoring of Bats at Wind Energy Facilities

Besides, some kind of risk represents demolition of constructions, where bats can roost.

5. Conclusion

This roost survey was carried out in the last week of summer when most bats turned out to quit their maternal colonies and other summer roosts. The majority of bats caught during mist-netting showed signs of mating status.

As a result of the field study, 29 locations with anthropogenic roosts have been surveyed, including 5 concrete bridges over canals and numerous buildings made of different materials (mud/clay constructions, with or without cracks, bricks or foam blocks, and others). All bridges are inhabited by bats forming, very likely, maternal colonies earlier in summer. Of the other 24 locations, in 10 places bat droppings were found and a living bat in one of them. The other 14 locations had no clear evidence of bat presence but many of them look suitable for bats. It should be taken into consideration that clay-covered walls with no cracks during our survey may receive cracks and crevices as time passes, and thus, become more suitable for bats.

The level of existing anthropogenic threats to bats in the studied territory is associated with human activity, potentially – with building and bridge reconstruction while bats are present inside, especially during the nursing period in maternal colonies. Of farmers, no one showed a negative attitude towards bats in talks.

The presence of 3 species was confirmed – Common pipistrelle bat (*Pipistrellus pipistrellus*), Kuhl's pipistrelle (*Pipistrellus kuhlii*) and Parti-coloured bat (*Vespertillio murinus*). Further 17 species listed for Uzbekistan could potentially be recorded, particularly during seasonal migrations, most likely for 9-12 species of that list. Four species included in the Red Data Book of the Republic of Uzbekistan (Lesser Horseshoe Bat, Asian Barbastelle, Hemprich's Long-eared Bat and European Free-tailed Bat) haven't been found.

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7. Appendix 1. Photos of observed objects

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10. BAT ANALYSIS REPORT

BAT ACOUSTIC SURVEY REPORT

Gjduvan 300 MW Wind Power Project

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1. Introduction

1.1 Project description

This Project is part of a broader modernisation in the renewable energy sector of Uzbekistan, aimed at increasing energy production while reducing fuel consumption. The project represents itself extending the existing Bash Wind Farm and encompasses 39 wind turbines on the area of 12,645 ha.

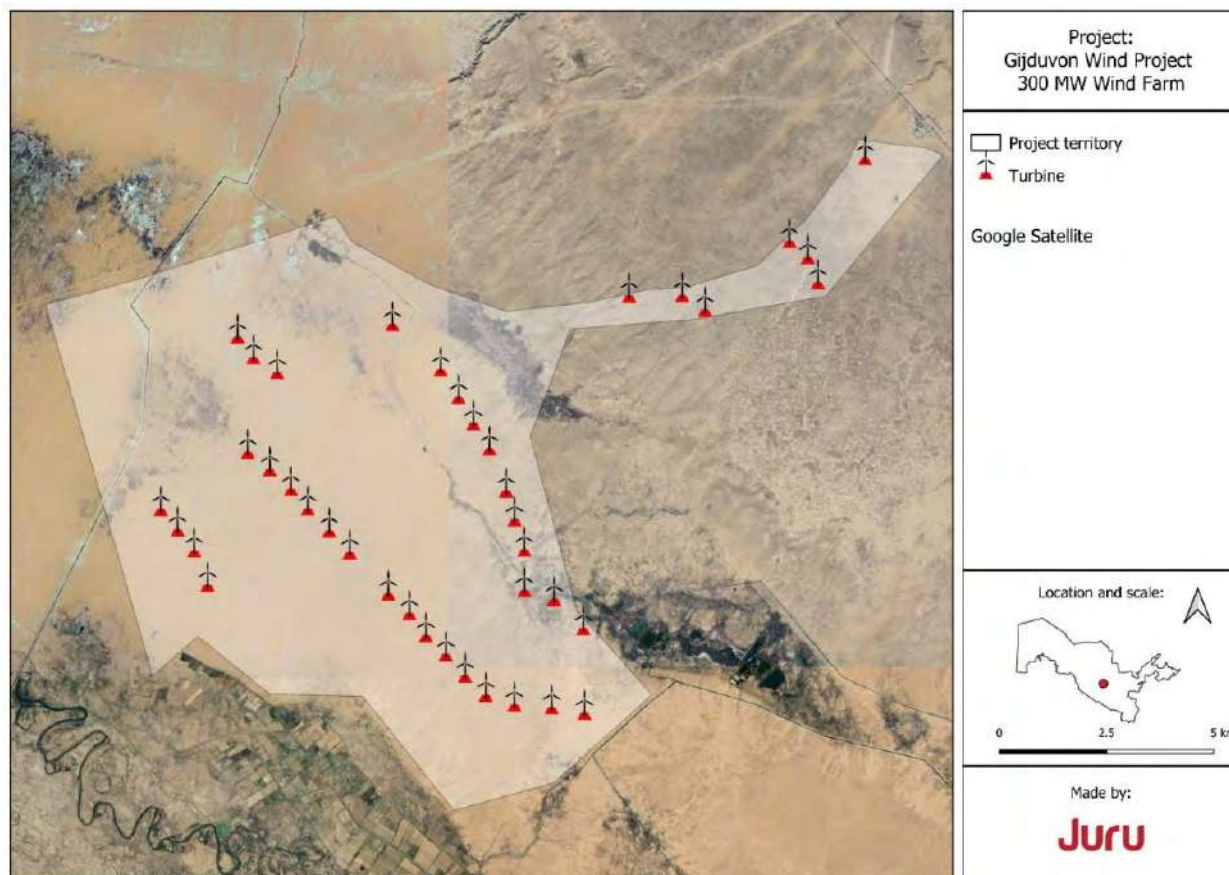


Figure 1. Project features

1.2 Bats & Problem description

Bats are an order of placental mammals characterised by active flapping flight and, for many species, echolocation. Currently, more than 1,200 species of bats are known worldwide, belonging to 20-21 families (Dietz, 2016). In Uzbekistan, at least 21 species of bats from 11 genera and 4 families have been recorded, but due to the difficulty in studying this group, the actual number of species inhabiting the country may be higher (Bogdanov, 1953; Kruskop, 2024).

Bats are a crucial component of ecosystems both globally and locally. As the primary consumers of flying insects at night, they play a significant role in regulating insect populations, including blood-sucking insects and agricultural pests (Cleveland et al., 2006). As noted in the journal Science, the decline in bat populations is leading to increased use of insecticides in agriculture, which is leading to increased child mortality rates Frank, 2024. Earlier, back in 1953, Bogdanov wrote about the important role of bats in the ecosystem of Uzbekistan and emphasised the need for comprehensive protection of these animals (Bogdanov, 1993).

Bats follow a clearly expressed K-strategy of reproduction, characterised by a small number of offspring (1, very rarely 2 per season), increased mortality in the first year of life (O'Shea et al., 2004),

long lifespans (averaging 2–6 years (Rakhmatulina, 2005), but some individuals reaching up to 41 years of age (Podlutsky et al., 2005)), and the high significance of each individual within the population. As a result, population growth is slow, and in cases of sharp population decreases, for instance, because of collisions with wind turbines during spring or autumn migration, the population may face extinction (Sowler et al., 2020).

In the wild, bats have few specialised predators, and the main causes of mortality are infectious diseases, injuries, and climatic events.

Wind farms represent a significant threat to bat populations, with bat fatalities exceeding bird fatalities by a ratio of 10:1. For instance, post-construction fatality surveys from 73 wind energy facilities in Canada and the U.S.A. between 2000 and 2012 estimated that 650,104 to 1,308,378 bats were killed during this period. In 2012, studies reported approximately 888,000 bat fatalities in the USA, while another study estimated over 600,000 bat deaths in the same year (Sowler et al., 2020).

The main threats to bats include:

1. Destruction of roosts
2. Reduction and transformation of hunting grounds
3. Persecution by humans
4. Noise and light pollution
5. Decrease in insect populations
6. Construction and operation of wind farms
7. Climate change
8. Water resources contaminating
9. Other

The impact of Wind farms on bats has three main branches (Voigt et al., 2024)

Direct mortality (Collision and barotrauma)

1. Habitat loss
2. Avoidance

1. Direct Mortality (Collision and Barotrauma): Bats collide with turbine blades, leading to fatalities from direct impact or barotrauma caused by pressure changes. Mortality rates vary by region, reaching several tens of thousands of bats per year in countries with high population density (Voigt, 2024), (Dietz, 2016). High-risk species include fast-flying bats and those migrating over long distances (up to 400-450 km per night for some species) (Vasenkov, 2023; Vasenkov, 2024)

2. Habitat Loss: Wind turbine installations often require land clearing, which destroys key habitats such as wetlands, reducing available areas for foraging and roosting for forest-dwelling bat species. Additionally, roads built around wind farms contribute to habitat fragmentation, creating barriers for low-flying bat species.

3. Avoidance: *Some* bat species avoid areas around turbines due to noise, vibrations, and moving parts, leading to reduced activity near wind farms. This behaviour, observed up to 1 km from turbines, shrinks available habitats (Dietz, 2016).

1.3 Area description

The project area of Bash II (Gijduvan) is a highly attractive natural habitat for bats. It is situated between two critical landmarks—the Bukhara Oasis, from the south entering the project area, and the Ayakagitma depression, 6 km to the north (Figure 2). Two drainage canals traverse the area, and within a 2 km buffer zone, there are fish farms. The cultivated fields adjoining the area from the south serve as breeding and congregation sites for insects, which are primary prey for bats. All these water and irrigated features are of significant interest to bats as sources of water and/or hunting grounds, as confirmed by bat captures at four locations during roosting site surveys (Figure 3).



Figure 2. Critical surroundings for bats near the project site

The project territory contains several concrete bridges and clay/foam block structures that can potentially serve as roosting, breeding, and possibly wintering shelters. During the roosting site survey conducted in late August 2024, live and deceased bats were found in such structures, along with numerous bat droppings. To the north of the project area lies an extensive canyon with vertical walls up to 40 meters high, which is highly attractive for both roosting and foraging activities of bats.

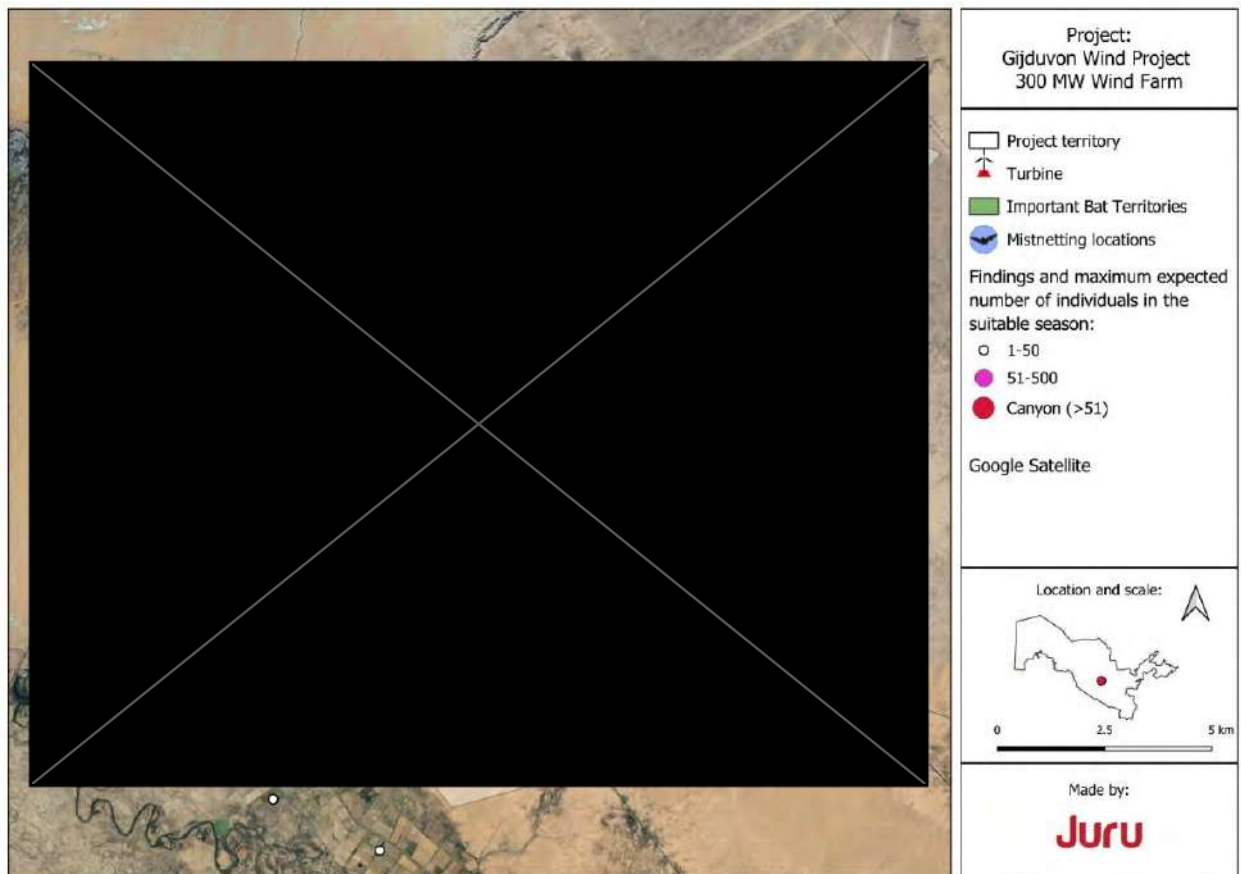


Figure 3. Important bat territories and some of the findings of bat individuals or their signs within the project site

1.4 Bat fauna of the project site

The bat fauna of Uzbekistan (Table 1) is still insufficiently studied, and reliable data on the presence or absence of many bat species in the area are lacking. Additionally, there is no information on the seasonal movements of bats, including the height of their migration. While certain species, such as *Pipistrellus pipistrellus*, *Vespertilio murinus*, *Eptesicus serotinus*, *Eptesicus ognevi*, *Nyctalus noctula*, *Tadarida teniotis*, and others, are known to be at risk of collisions with turbine blades, the possibility of collisions cannot be entirely ruled out even for species with low sensitivity to such risks. This may be particularly relevant during migration periods when some species move through other natural areas or hunt at low altitudes (Rydell et al., 2012).

Table 1. Bat fauna of the Uzbekistan

	Latin name	Common name	High WF direct collision susceptibility	IUCN status	Uzbekistan Red Data Book status
1	<i>Rhinolophus ferrumequinum</i>	Greater horseshoe bat	-	LC:D	
2	<i>Rhinolophus bocharicus</i>	Bokhara horseshoe bat	-	LC:S	
3	<i>Rhinolophus</i>	Lesser horseshoe bat	-	LC:D	VU:D

	Latin name	Common name	High WF direct collision susceptibility	IUCN status	Uzbekistan Red Data Book status
	<i>hipposideros</i>				
4	<i>Rhinolophus lepidus</i>	Blyth's horseshoe bat	-	LC:U	
5	<i>Myotis blythii</i>	Lesser mouse-eared bat	+	LC:D	
6	<i>Myotis emarginatus</i>	Geoffroy's bat	-	LC:S	
7	<i>Myotis bucharensis</i>	Bokhara whiskered bat	++	DD	CR
8	<i>Myotis capaccini</i>	Long-fingered bat	-	VU:D	
9	<i>Myotis davidii</i>	David's myotis	-	(LC:U)	
10	<i>Plecotus turkmenicus</i>	Turkmen long-eared bat	-	(LC:U)	
11	<i>Plecotus strelkovi</i>	Strelkov's long-eared bat	-	(LC:U)	
12	<i>Barbastella leucomelas</i>	Arabian barbastelle	?-	(LC:U)	
13	<i>Nyctalus noctula</i>	Noctule Bat	+	LC:U	
14	<i>Pipistrellus pipistrellus</i>	Common Pipistrelle	+	LC:S	
15	<i>Pipistrellus kuhlii</i>	Kuhl's Pipistrelle	+	LC:U	
16	<i>Hypsugo savii</i>	Savi's pipistrelle	?	LC:S	
17	<i>Vespertilio murinus</i>	Parti-colored bat	+	LC:S	
18	<i>Eptesicus ognevi</i>	Ognev's Serotine	+	LC:U	
19	<i>Eptesicus serotinus</i>	Serotine	+	LC:S	
20	<i>Otonycteris leucophaea</i>	Turkestani long-eared bat	-	DD	VU:R
21	<i>Tadarida teniotis</i>	European free-tailed bat	+	LC:U	VU:R

1.5 Research Objectives and Tasks

The research is conducted to determine the species composition of bats in the project area, assess their relative abundance, habitat preferences, and the timing and features of their spring and summer migrations, as well as to evaluate the potential threats posed by the construction and operation of the facility.

2. Materials and Methods

2.1 General overview

This report combines two independent but complementary studies: stationary acoustic research and transect-based acoustic research.

These studies were conducted following international standards and methodologies. The South African Best Practice Guidelines for Pre-construction Monitoring of Bats at Wind Energy Facilities (Sowler et al., 2020) formed the basis of the approach.

The study was carried out in three stages:

1. **Desk-based stage:** During this phase, satellite images of the area were analysed, data collection points were selected and approved by an international expert, literature data were reviewed, and data from operational meteorological masts were requested.
2. **Fieldwork stage:**
 - a) **Stationary research**, during which stationary bat detectors were installed and serviced monthly (data collection, battery replacement).
 - b) **Active research**, during which acoustic surveys were conducted at 22 points at appropriate times.
3. **Data processing and reporting stage:** This phase involves analysing species composition, and distribution on the territory, comparing bat activity based on season, time, wind speed, and other factors.

2.2 Methodology of data collection (Passive & Active)

2.2.1 Passive Acoustic Survey

Bat detectors Song Meter SM4Bat FS by Wildlife Acoustics were installed at the Bash II Windfarm on April 19, 2024, and deinstalled on November 8, 2024. Since there are two met masts available on the project site, and two Bat Detectors were installed on each mast (13 and 63m - but hereinafter we will use rounded values of 10 and 60 m respectively) and additional 2 detectors were installed at height of 4-5 meters next on the outbuilding near the fish ponds. The locations for their installation (5m) were selected based on the availability of water sources and in consultation with local herders (Figure 4), (Table 2).

During the conversation, it was agreed with the herders that they would keep an eye on the bat detectors to prevent them from being stolen.

The operation of the detectors was programmed to start half an hour before sunset and stop half an hour after sunrise.

During a check on September 20, a malfunction was discovered in Detector #9 (a problem with its clock), and the detector was replaced. Unfortunately, data from this detector for the period from August 26 to September 20 is unavailable.

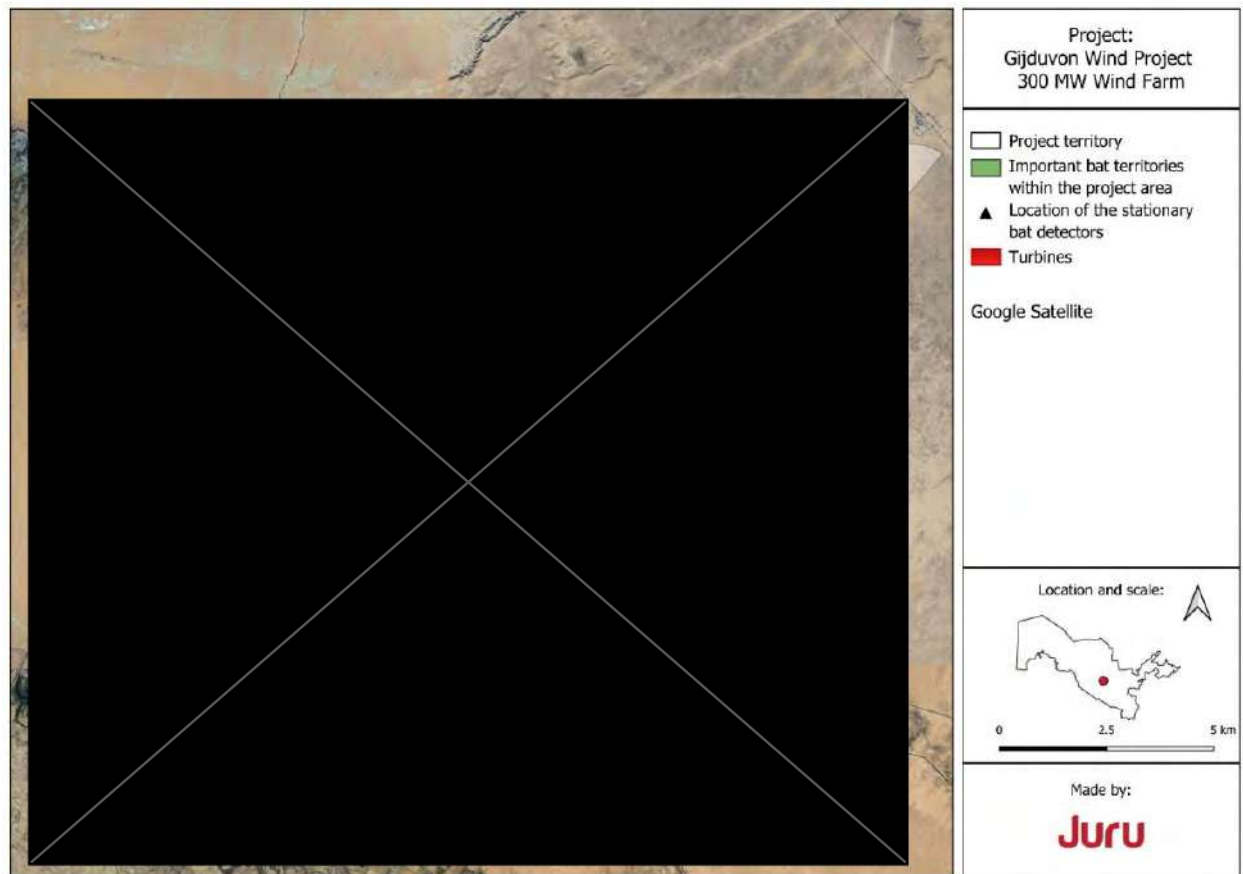


Figure 4. Location and height of the stationary bat detectors

Table 2. Installed bat detectors, their location and heights

N	Bat detector number	Height of installation	N	E	Comments
1	BD09	4-5 meters			On a hut in the northern part of the area near the fish ponds
3	BD03	10 meters			North mast
2	BD02	60 meters			North mast
6	BD04	4-5 meters			On a hut in the southern part, 1800 meters from the project area, near the fish ponds
5	BD07	10 meters			South mast
4	BD20	60 meters			South mast



BD09 (Northern herder's hut - 4-5 meters)



BD03 (North mast - 10 meters)



BD02 (North mast - 60 meters)



BD04 (Southern herder's hut - 4-5 meters)



BD07 (South mast - 10 meters)



BD20 (South mast - 60 meters)

Figure 5. Bat detectors installed on the project site at the different height

Table 3. Schedule of rounds (replacing SD cards and batteries)

Round N	Start date	End date
1st round	April 19	May 19
2nd round	May 19	June 11
3rd round	June 11	July 23

4th round	July 23	August 26
5th round	August 26	September 19
6th round	September 19	October 12
7th round	October 12	November 8

2.2.2 Active Acoustic Survey

The active acoustic survey consisted of transects with stops at designated points, where bat calls were recorded using the Echo Meter Touch 2 on a monthly basis from May to October.

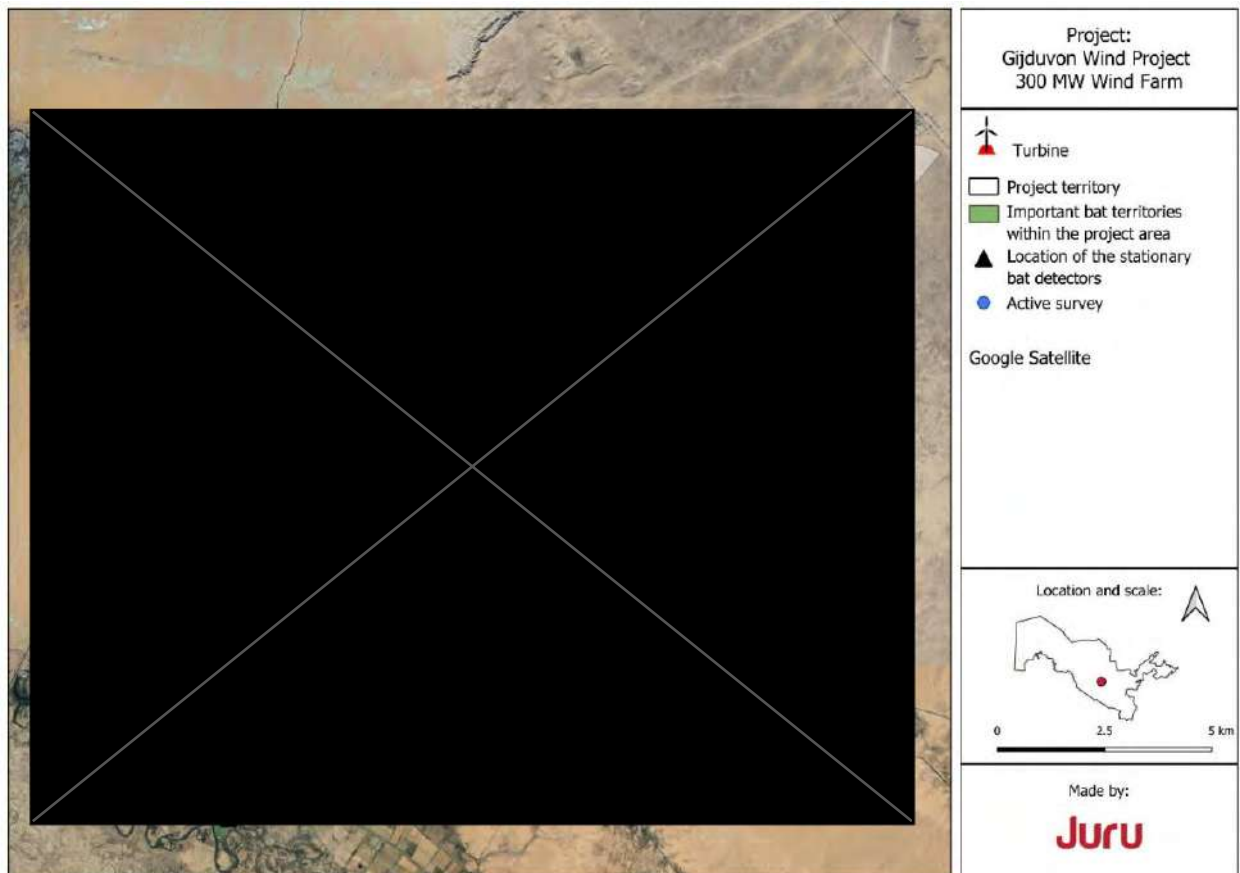


Figure 6. Points of the active survey

Table 4. Schedule of the monthly transects

Round	Date
1st round	May 19-20
2nd round	June 11-12
3rd round	July 23-24

4th round	August 28-29
5th round	September 19-20
6th round	October 12-13

Active transect surveys were conducted monthly from May to October. A total of 23 points were established, with distances between them ranging from 500 to 3,000 meters. These points were evenly distributed across the entire area, covering various habitats. Since the area along the existing canals is an attractive location not only for bats but also for terrestrial mammals and birds, to reduce time spent on initially high-value territories, we established only one point near water in the north-eastern part of the project area.

The duration of stops at each point was 10 minutes from May to August and 6 minutes in September and October. To survey the points at different times, the routes were altered, and the first point was chosen randomly each time.

Travel between points was carried out by car using minimal lighting. Upon arrival at a point, the car engine was turned off, and researchers exited the vehicle. For 10 (or 6) minutes, they performed a pedestrian transect in a random direction away from the car and then returned.

During recording, the detector was held pointing away from the researcher at an angle of approximately 45 degrees to the ground. Researchers aimed the microphone in various directions, tracing a circle to capture the maximum number of bat calls.

2.3 Data processing description (Stationary & Active)

In the first stage of identifying bats, we separated bat calls from noise automatically using the Kaleidoscope program with a set of European species' calls (Liberal).

In addition, an analysis of bat activity dependence on **season, time of day, and wind speed** was conducted. For this, the collected data were filtered using the Auto ID (Conservative) function of the Kaleidoscope program with a filter of species inhabiting Uzbekistan. In cases where the program could not identify a specific species but detected a bat call, the recording was assigned the status "No ID." In cases where multiple bat calls were present in a single recording, they were counted as one.

Unfortunately, no equipment works perfectly, and for reasons beyond our control, part of the data became unavailable. For instance, due to a clock failure and the absence of date and time information in some files (a total of 980 files from 1st round – BD04, 3rd round – BD 2A), we used rounds instead of months for analysing seasonal activity distribution. To enable correct comparisons of rounds with varying durations, the data were normalized to relative values by dividing the results of each round by the corresponding number of days and multiplying by the average number of days for the entire period ($203/7 = 29$).

After filtering, a summary table was compiled, in which questionable data were marked as invalid and excluded from graphical analysis.

To compare bat activity with wind speed data provided by the client, the following steps were taken: Anemometers installed on two meteorological masts at a height of 130 meters recorded wind speed every 10 minutes. Therefore, the time of bat activity registrations was rounded to the nearest 10 minutes. If two or more bat signal recordings fell within the same 10-minute interval, they were

ignored. Subsequently, using the built-in Excel function VLOOKUP, bat activity data were compared with wind speed values.

Identification of bat species by calls using automatic recognition programs is fast and allows processing large volumes of recordings, but does not allow accurate identification of species and can lead to a high percentage of misidentifications. For accurate identification of bat species, manual recognition by an experienced specialist is required (Barataud, 2015; Russo et al., 2018). Manual 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. Dr. Vasenkov's experience includes studying bats for about 20 years, including 13 years working with time expansion and real-time bat detectors. Dr. Vasenkov worked with bats and their ultrasonic calls from various regions of Russia (European and Asian parts), Uzbekistan, Kazakhstan, Ethiopia and Vietnam. Dr. Vasenkov has experience in analyzing bat ultrasound calls using **BatSound**, **SonoBat** and **Kaleidoscope** software. We used the Kaleidoscope Pro Auto Analysis program with "preloaded" parameters of ultrasonic calls from "European" bats found in Uzbekistan for the primary processing of audio recordings. After that, we used the BatSound 4 program to measure the call parameters and check the identification of bat calls made by the Kaleidoscope Pro Auto Analysis program. We used bat call parameters known for European bat populations (Barataud, 2015) and bat species from Uzbekistan neighboring countries (Benda et al., 2012).

We identified bat calls to species whenever it was possible (the term "bat call" refers to one file with any bat species calls). Because the "border" between calls of *Eptesicus serotinus* and *Eptesicus ognevi* is unknown; we identified their calls only up to the genus level (*Eptesicus* spp.). Similarly, *Myotis* bats and long-eared bats were determined down to the genus level: *Myotis* spp. (*Myotis blythii* et al.) and *Plecotus* spp. (*Plecotus strelkovi* and *Plecotus turkmenicus*).

As mentioned above, stationary detectors were installed at three heights, in the ground layer (at a height of 5 m near the fish ponds and at a height of 10 m at the bottom of the meteorological masts) and at a height of 60 m. As is known, bat calls can be detected by detectors at a distance of 5 to 100-150 m depending on the species (Barataud, 2015). Data from all detectors were used for selective manual identification of all species inhabiting the territory of the planned wind farm. Audio recordings from detectors installed at a height of 60 m were used to determine the relative abundance of bat species. Detectors installed at this height recorded bat activity in the potential zone of damage by wind turbine blades, which is primarily relevant for medium- and high-flying species.

3. Findings and Results

3.1 Stationary

3.1.1 Raw and filtered data. Data distribution across detectors and rounds

A total of 1.457 TB (295,876 files) of data were recorded during the Stationary Acoustic Survey, of which about 346 GB (72,360 files) were bat calls, including social calls. The detectors were operated for a total of 203 nights (1,193 for all detectors).

Table 5. Volume of the raw data

	Number of nights:		BD 09 (N5m) ¹	BD 03 (N10m)	BD 02 (N60m)	BD 04 (S5m)	BD 07 (S10m)	BD 20 (S60m)	Overall:
1st round	26	Files	7.110	2197	19635	2364	8056	6152	45514
April 19- May 15		Size (GB)	30.5	9.71	115.0	9.07	36.1	14.6	214.98
2nd round	29	Files	2555	6025	1938	2359	8571	2212	23660
May 15- June 11		Size (GB)	9.3	32.6	8.48	10.4	49.5	5.05	115.33
3rd round	40	Files	12419	7.074	1189	19645	12144	6360	58831
June 11- July 23		Size (GB)	48.8	36.9	4.14	115	69.9	14.7	289.44
4th round	34	Files	3529	17870	9571	1562	16014	3319	51865
July 23- August 26		Size (GB)	12.8	110	53.3	6.69	77.6	7.60	267.99
5th round	25	Files	Detector failure	16447	728	16341	12045	1563	47124
August 26- September 19		Size (GB)	Detector failure	118	3.07	77.0	61.8	3.60	263.47
6th round	22	Files	14174	13042	3047	2691	10690	2539	46183
September 19- October 12		Size (GB)	59.7	68.0	12.4	11.7	48.9	5.8	206.5
7th round	27	Files	5776	6582	2004	4820	919	2598	22699
October 12- November 8		Size (GB)	25.2	34.1	7.97	22.8	3.47	5.91	99.45

¹ BD09 – Bat detector with internal Juru number 09. N – North part of the territory, 5 m – height of the installation.

	Number of nights:		BD 09 (N5m) ¹	BD 03 (N10m)	BD 02 (N60m)	BD 04 (S5m)	BD 07 (S10m)	BD 20 (S60m)	Overall:
Overall:	203	Files	45563	69237	38112	49782	68439	24743	295876
		Size (GB)	186.3	409.31	204.36	252.66	347.27	57.26	1457.16

Table 6. Volume of the bat calls

	Number of nights:	Num of files/ Size	BD 09 (N5m)	BD 03 (N10m)	BD 02 (N60m)	BD 04 (S5m)	BD 07 (S10m)	BD 20 (S60m)	Overall:
1st round	26	Files	6584	364	205	1040	320	89	8602
April 19- May 15		Size (GB)	29.4	2.04	1.46	4.26	2.25	0.34	39.75
2nd round	29	Files	2100	122	28	2167	65	9	4491
May 15- June 11		Size (GB)	8.37	0.89	0.14	10.0	0.59	0.04	20.03
3rd round	40	Files	5710	1216	911	205 (SD card/Detector failure)	903	25	8765
June 11- July 23		Size (GB)	24.3	9.2	3.59	1.48 ²	6.51	0.09	43.69
4th round	34	Files	2867	649	98	1304	970	27	5915
July 23- August 26		Size (GB)	10.7	4.68	0.64	5.72	6.27	0.09	28.1
5th round	25	Files	detector failure	794	73	15844	1180	76	17967
August 26- September 19		Size (GB)	detector failure	6.41	0.51	76	7.92	0.26	91.1
6th round	22	Files	12800	726	127	2640	394	35	16722

² limited data due to detector failure

	Number of nights:	Num of files/ Size	BD 09 (N5m)	BD 03 (N10m)	BD 02 (N60m)	BD 04 (S5m)	BD 07 (S10m)	BD 20 (S60m)	Overall:
September 19- October 12		Size (GB)	57.1	4.61	0.77	11.6	2.45	0.12	76.65
7th round	27	Files	5079	81	17	4708	1 (SD card/D etector failure)	13	9898
October 12- November 8		Size (GB)	23.7	0.57	0.08	22.5	0.01	0.05	46.91
Overall:	203	Files	35140	3952	1459	27703	3832	274	72360
		Size (GB)	153.57	34.81	7.7	206.08	33.92	1.25	346.23

Figure 7 illustrates the number of bat calls recorded during each round after auto-filtering. The auto-filtering was performed in Kaleidoscope Pro software using an automatic mode with a conservative filter.

As we can see, in almost all rounds, the highest number of calls was recorded by detectors installed at a height of 5 meters near water bodies (a total of over 62,843 call files).

Most likely, the large number of recordings is associated with the locally increased activity of bats in areas near water bodies, where they forage. Additionally, this could be influenced by the territorial behaviour of males (social calls) near the detectors. Although this fact does not provide insight into the actual bat population size, it highlights the significant importance of water bodies in the lives of bats.

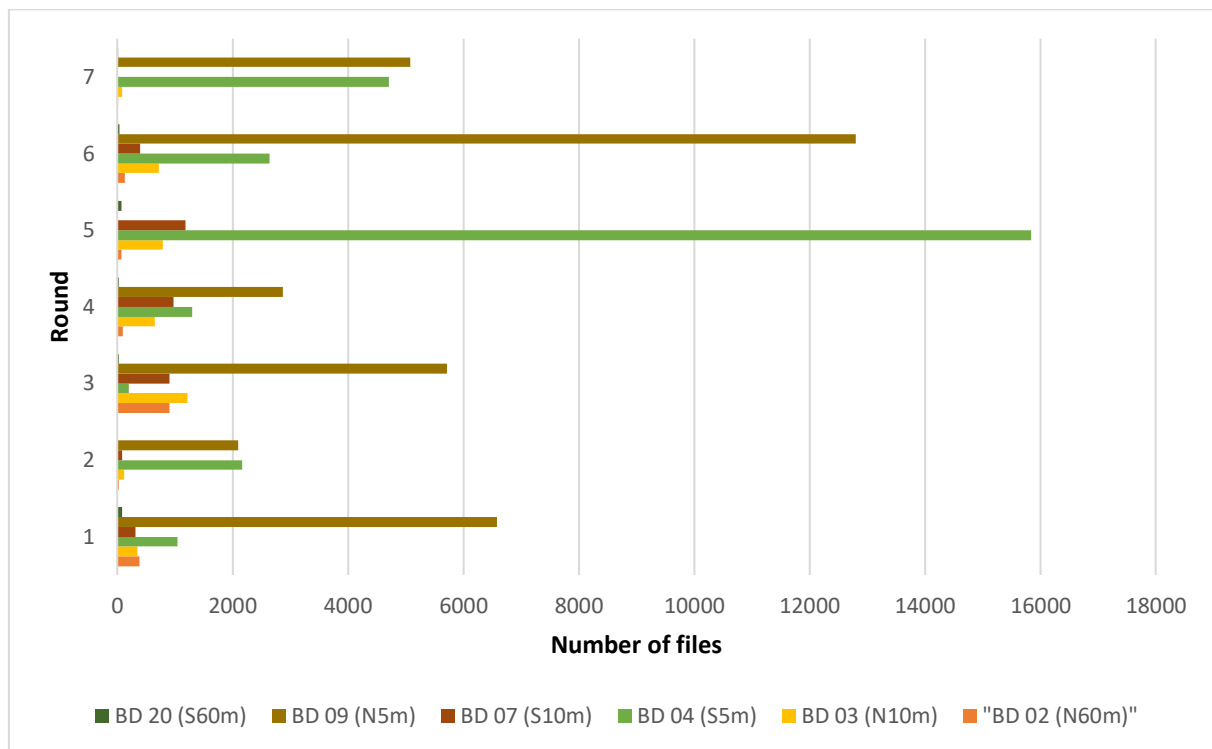


Figure 7. Number of bat calls recorded by bat detectors per round

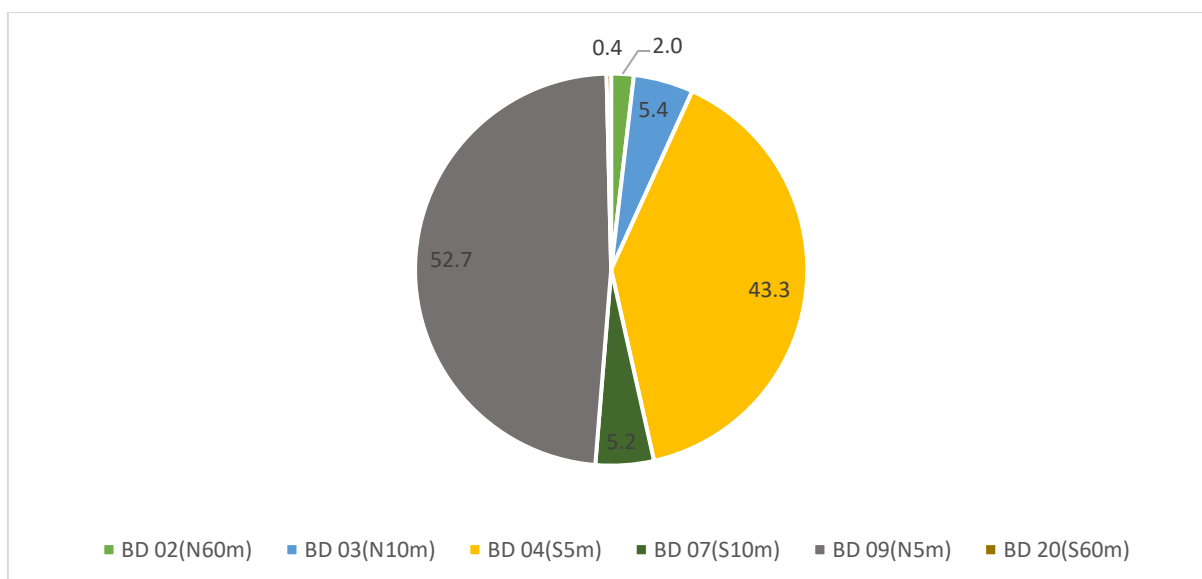


Figure 8. Percentage distribution of bat calls recorded by each bat detector over the entire study period.

More than 7,784 recorded calls were detected by the detectors placed at a height of 10 meters, and 1,733 or more were recorded by detectors installed at a height of 60 meters.

Given that the records from these detectors are the most representative, further data analysis is focused primarily on them. Fish ponds, as sources of drinking and feed, are points of attraction in arid areas for a wide variety of bat species. Thus, the maximum species diversity of bats can be identified near them. However, such attractiveness of these ponds does not allow using the counts near them to assess the usual activity of bats and the relative abundance of different species. Therefore, in some cases, data from detectors installed at a height of 5 meters near fish ponds were completely excluded from the analysis.

3.1.1 By month (corrected round = 29 days)

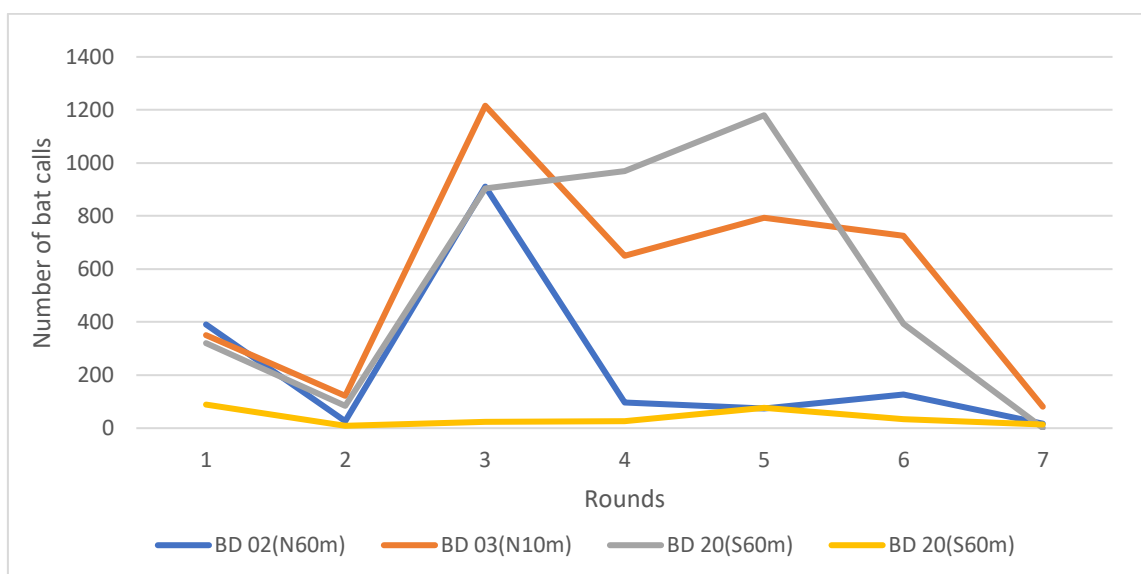


Figure 9. Actual number of bat calls per round recorded by bat detectors elevated at heights of 10 m and 60 m.

Figure 9 shows the total number of bat calls recorded by detectors installed at heights of 10 m and 60 m during each of the 7 observation rounds. It is evident that the dynamics of call numbers vary significantly between rounds and also depend on the height at which the detectors were installed.

Figure 10 presents the data after adjustments accounting for the varying durations of the rounds. To standardise the results, the recorded calls were recalculated based on the average round duration (29 days). For this, the total number of recorded calls was multiplied by the average round length (29 days) and divided by the actual number of days in each round. For example:

- The third round lasted 11 days longer than the average (40 days).
- The fifth round was shorter than the average (25 days).

This adjustment allowed the normalization of the data for analysing bat activity at different heights. The highest average number of calls (~1,400 calls per 29 days) was observed for detectors at a height of 10 m during round 5. For detectors placed at a height of 60 m, the highest activity also occurred in round 5, but its level was significantly lower (around 180 calls per 29 days).

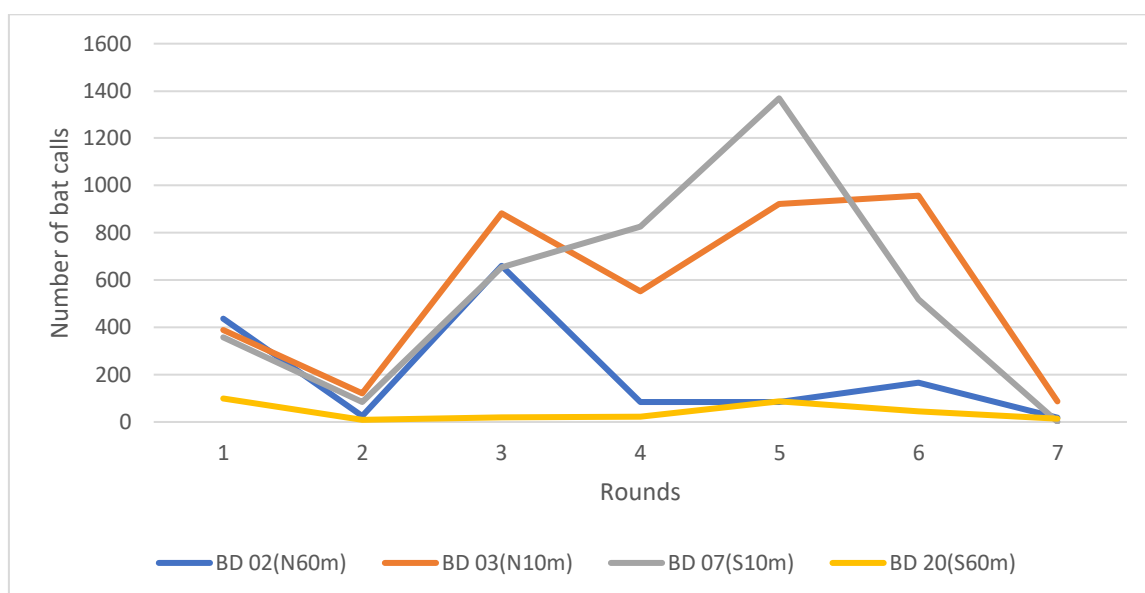


Figure 10. Adjusted number of bat calls per round recorded by bat detectors elevated at heights of 10 m and 60 m (normalised by the number of active days per round and scaled to the average number of days)

The highest bat activity across rounds was observed during round 1 (late April to mid-May) as well as during rounds 3 to 6 (June 11 – October 12).

In all rounds, bat activity at a height of 10 m was significantly higher than at 60 m (Figure 11). This difference was especially pronounced in round 5 (August 26 – September 19), where the maximum average value reached approximately 1,400 calls per 29 days at 10 m, while only about 90 calls were recorded at 60 m during the same period for each detector.

The lowest activity at both heights was recorded during rounds 2 and 7. However, even during these periods, detectors at 10 m consistently registered more calls than those at 60 m.

Thus, significantly higher bat activity was detected by the detectors installed at a height of 10 m, with the most pronounced activity observed from mid-April to mid-May and from July 23 to October 12. Most likely, this is due to the large species diversity of bats in the near-earth layer and the sounds of other animals found near the ground (birds, orthoptera). The automatic filtering program Kaleidoscope Pro cannot always filter out the sounds of birds and insects from the calls of bats.

However, at a distance from the ground, at a height of 60 meters, almost exclusively bat calls are recorded.

3.1.2 By hour

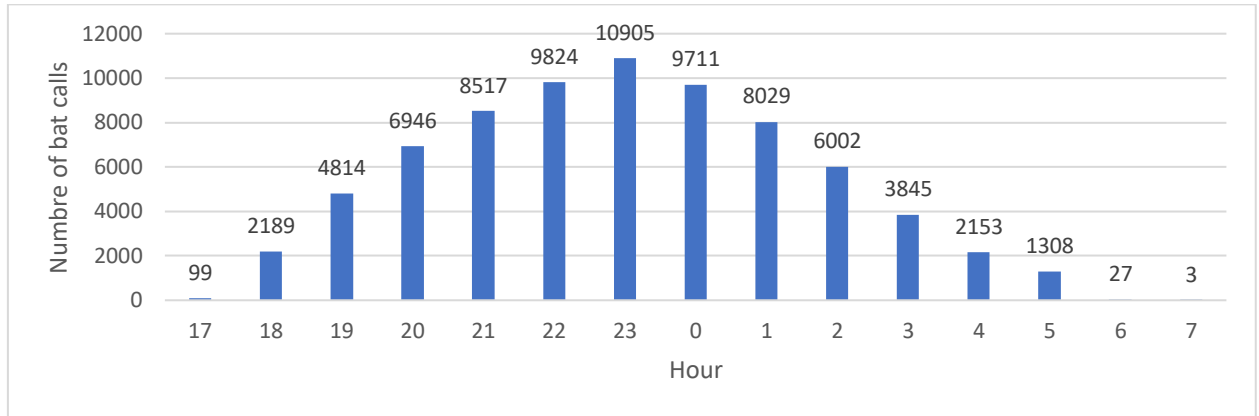


Figure 11. Hourly distribution of bat calls recorded by detectors elevated at height 5, 10, and 60 meters

Figure 11 shows the distribution of bat calls by time of day throughout the study period, based on data from six detectors. The distribution has a distinct pattern, with activity peaking at 11 PM. The period from 8 PM to 3 AM accounts for more than 80% of all recorded calls.

From 7 AM to 5 PM, bats exhibit almost no activity. Low-activity periods also include 6–8 AM and 5–6 PM, during which a relatively small number of calls were recorded.

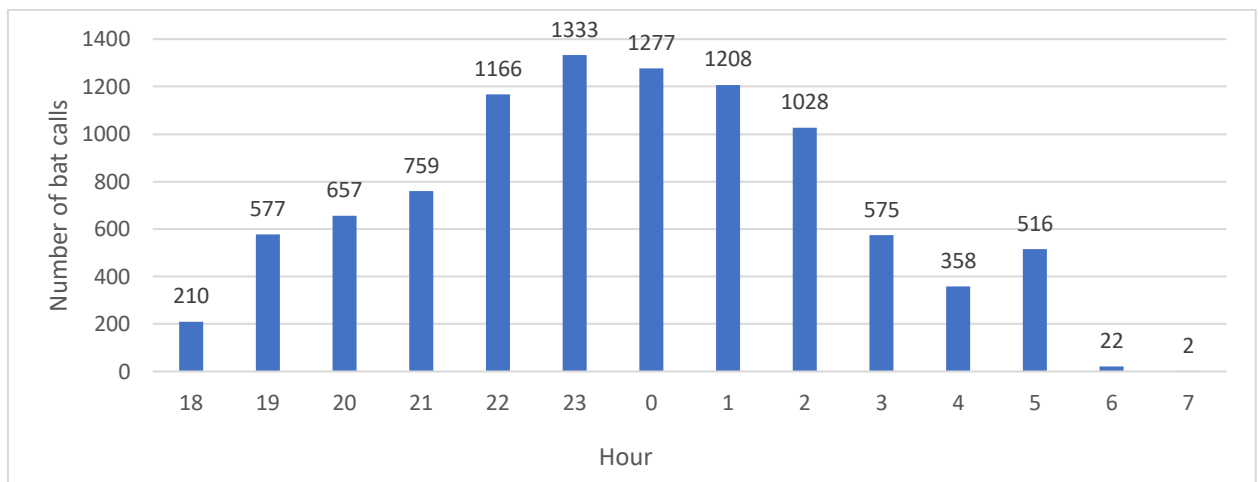


Figure 12. Hourly distribution of bat calls recorded by detectors elevated at heights 10 and 60 meters

When analysing recordings from detectors installed at heights of 10 and 60 meters, the distribution changes slightly. The highest bat activity occurs between 10 PM and 2 AM, accounting for 60% of all recordings. Activity during the period from 7 PM to 5 AM covers 97% of all recorded calls.

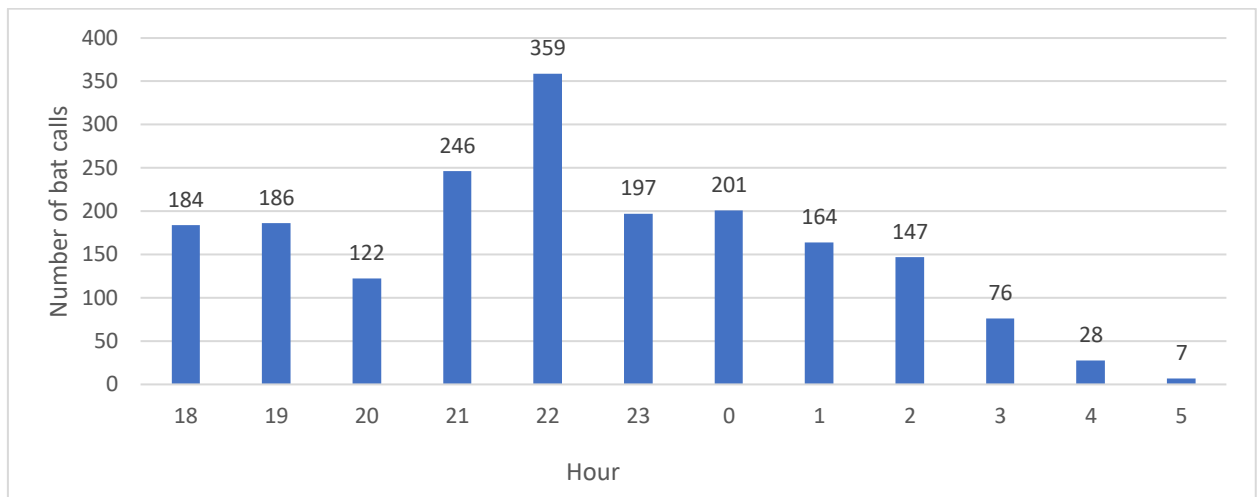


Figure 13. Hourly distribution of bat calls recorded by detectors elevated at a height of 60 meters

The distribution of bat calls over time for detectors installed at a height of 60 meters (the height of wind turbine blades) has a different pattern. Bats show activity immediately after sunset, which peaks around 10 PM and gradually declines after midnight.

3.1.3 By wind speed

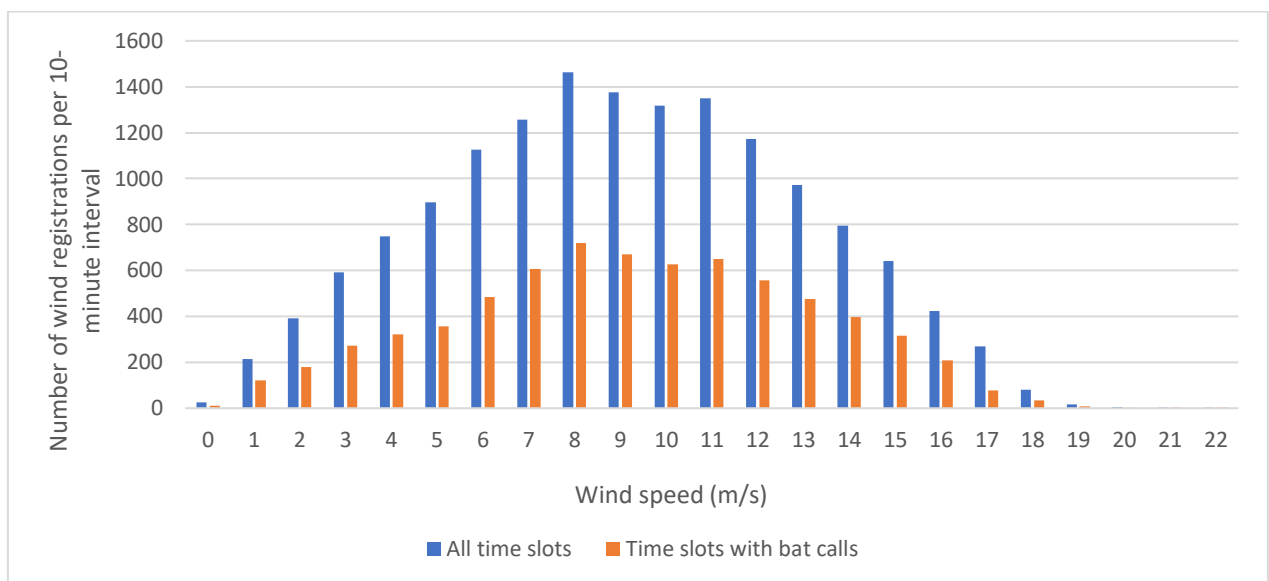


Figure 14. Wind registrations per 10-minute intervals with and without bat calls

When analysing the distribution of bats in relation to wind speed, we analysed not the bat calls themselves, but 10-minute time slots in which either calls were registered or not. Wind speed was recorded at a height of 130 meters.

The graph shows the wind speed distribution for all recorded 10-minute slots during the observation period and the slots in which bat calls were detected. On average, the number of slots with bat registrations differs from the total number of slots by only a factor of two.

This indicates that from 6 PM to 6 AM, on average, at least one bat call was registered on one of the six detectors approximately every 20 minutes.

When analysing the ratio of slots with bat calls to the total number of slots at different heights, the following results emerge:

At a height of 5 meters, the distribution of activity is generally uniform and shows almost no dependence on wind speed.

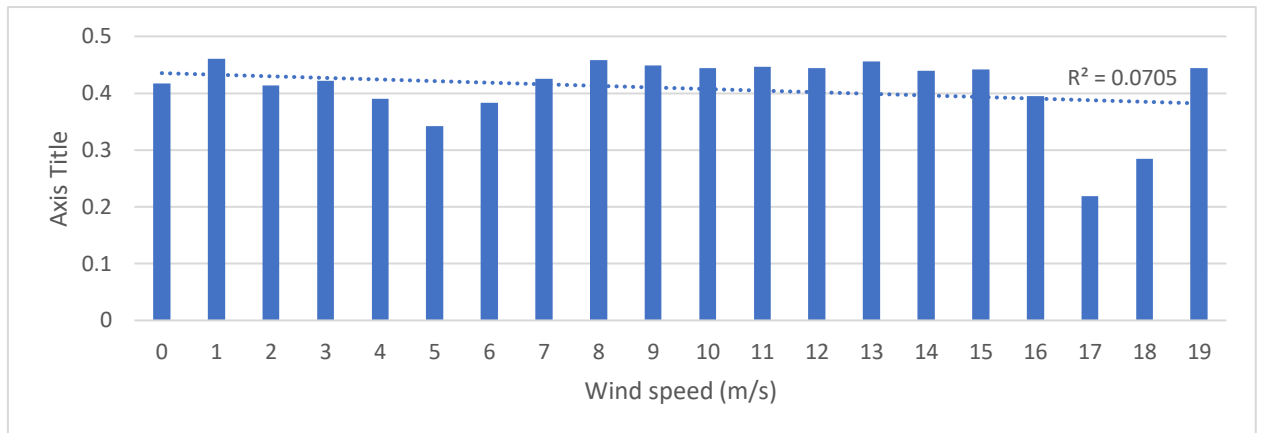


Figure 15. Proportion of time slots with bat call detections recorded at a height of 5 m relative to the total number of time slots, distributed by wind speed.

When analysing bat activity at a height of 10 meters, two peaks in activity are observed: one at wind speeds of 2–4 m/s and another at 15–18 m/s.

It is likely that the first peak is associated with local movements, while the second may be linked to transit flights, as bats could utilize wind currents to facilitate their movement.

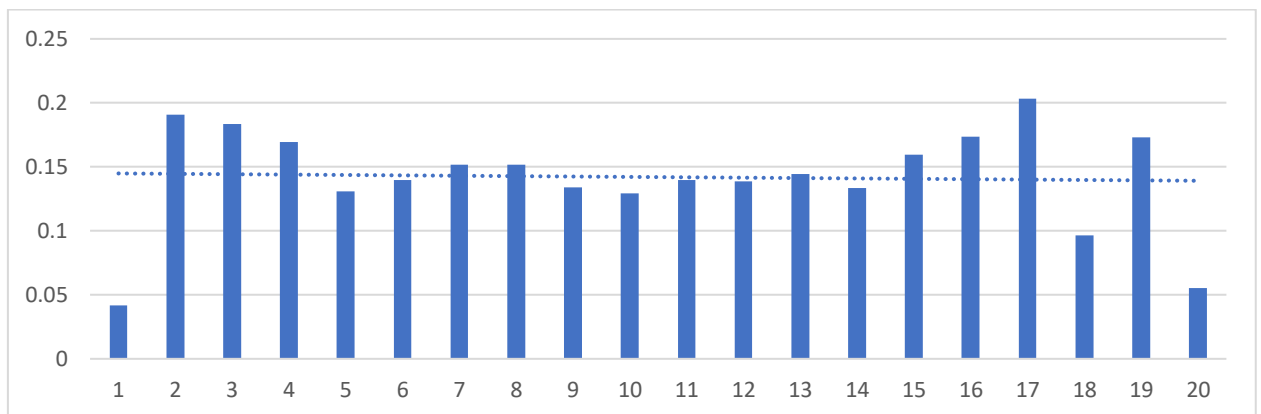


Figure 16. Proportion of time slots with bat call detections recorded at a height of 10 m relative to the total number of time slots, distributed by wind speed.

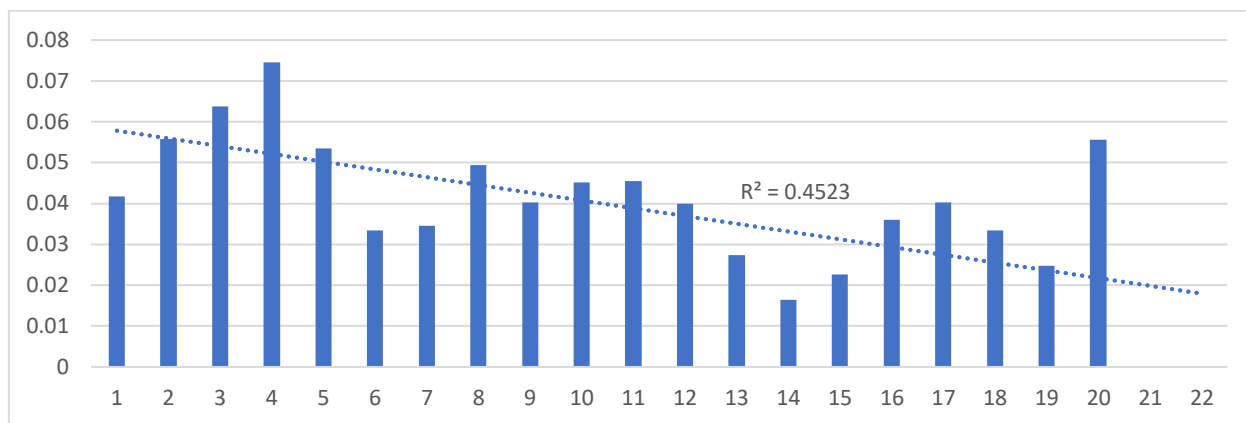


Figure 17. Proportion of time slots with bat call detections recorded at a height of 60 m relative to the total number of time slots, distributed by wind speed.

At a height of 60 meters, bats tend to fly in calmer wind conditions. The maximum ratio of slots with bat calls to all-time slots is observed at wind speeds of 3–4 m/s.

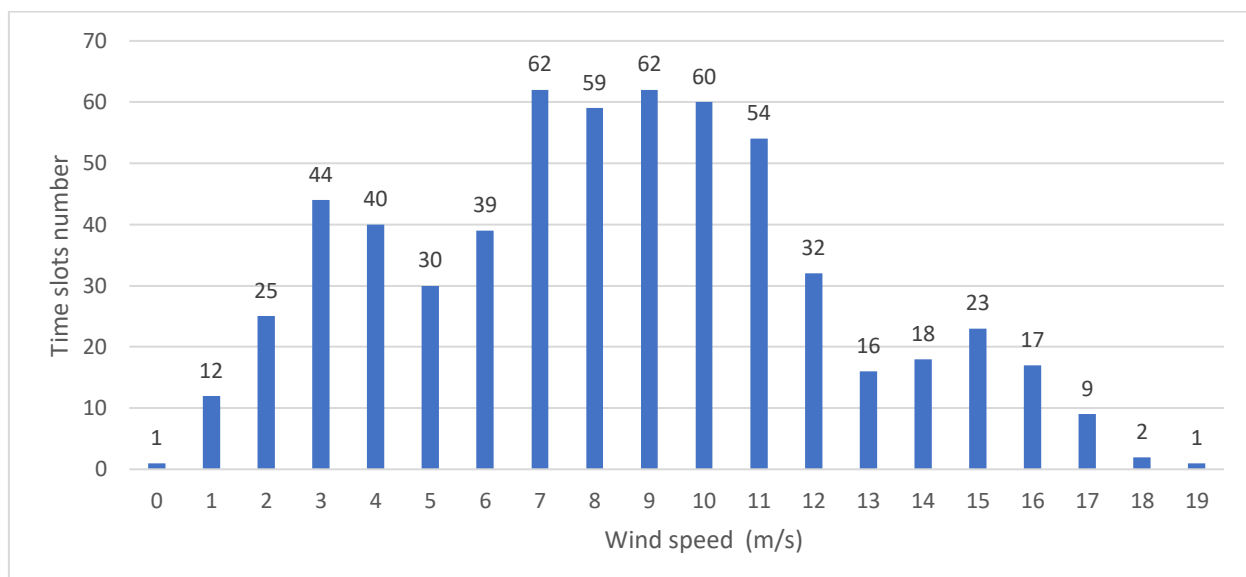


Figure 18. Number of 10-minute slots when the bat signals recorded at 60 meters relative to wind speed.

The graph shows the number of 10-minute intervals during which bat signals were recorded at a height of 60 m in relation to wind speed. Maximum activity is observed at wind speeds of 7 to 9 m/s. Moreover, bat activity was detected even at higher wind speeds, up to 19 m/s.

3.1.4 Species composition and spatiotemporal dynamics of bat activity at the heights of wind turbine blades (60 m)

In the surveyed area, ultrasound calls of at least 8 bat species were recorded: *Eptesicus* spp., *Myotis* spp., *Plecotus* spp., *Pipistrellus pipistrellus*, *Pipistrellus kuhlii*, *Rhinolophus bocharicus*, *Vespertilio murinus* and *Tadarida teniotis*. Some of the calls have been identified only to the genus level, since the differences in the call parameters are not yet known (Bogdanov, 1953; Benda et al., 2011; Benda et al., 2012; Gritsina et al., 2013; Barataud, 2015; Dietz, Kiefer, 2016; Hackett et al., 2017). *Eptesicus* sp. may include the species *Eptesicus serotinus* and *Eptesicus ognevi*, whose ranges include the territory of the project site, and the differences in the parameters of the ultrasound calls are unknown. Also unknown are the differences in the genus *Plecotus* (*Plecotus* spp.) calls parameters, which may be found in Uzbekistan: *Plecotus turkmenicus*, *Plecotus strelkovi*.

The calls of two species were recorded only in the north at two separate points. The calls of *Rhinolophus bocharicus* were recorded along the fish pond at the location BD09 (Fig. 4; Table 2). The calls of *Tadarida teniotis* were recorded by an ultrasonic detector from the northern tower (BD03) at a height of 10 m.

In the north and south of the planned wind farm, bat calls were recorded from meteorological masts at a height of 60 m (Fig. 4, 5; Table 2). At this height, the blades of industrial wind turbines operate. In the surveyed area, ultrasound calls of at least 5 bat species were recorded: *Eptesicus* spp. (*Eptesicus ognevi* + *Eptesicus serotinus*), *Pipistrellus kuhlii*, *Pipistrellus pipistrellus*, *Plecotus* spp. and *Vespertilio murinus* (Tabl. 7).

The highest activity at this height was recorded by *Pipistrellus pipistrellus* – 70% of all registered bat calls. The next most numerous species was *Vespertilio murinus* (22%). Ultrasound calls of *Eptesicus* spp. were even rarer (7%). Single calls of *Pipistrellus kuhlii* and *Plecotus* spp. were also recorded (0.2% each).

Table 7. Bat calls recorded by detectors on meteorological masts in the north and south of the site at a height of 60 m.

Round	North/ South masts	<i>Plecotus</i> spp.	<i>Pipistrellus</i> <i>pipistrellus</i>	<i>Pipistrellus</i> <i>kuhlii</i>	<i>Vespertilio</i> <i>murinus</i>	<i>Eptesicus</i> spp. (<i>ognevi</i> + <i>serotinus</i>)	All species :	Total:	
								calls	%
1 round (15 April- 15 May)	N mast (BD02)	0	57	0	134	16	207	296	18, 0
	S mast (BD20)	0	17	0	56	16	89		
2 round (15 May-13 June)	N mast (BD02)	0	7	0	6	1	14	23	1,4
	S mast (BD20)	0	5	0	3	1	9		
3 round (13 June- 23 July)	N mast (BD02)	0	776	0	30	30	836	861	52, 4
	S mast (BD20)	0	25	0	0	0	25		
4 round (23 July- 26 August)	N mast (BD02)	3	61	0	15	17	96	122	7,4
	S mast (BD20)	0	18	0	6	2	26		
5 round (26 August- 20 September)	N mast (BD02)	0	27	0	30	16	73	149	9,1
	S mast (BD20)	0	51	1	18	6	76		
6 round (22 September - 12 October)	N mast (BD02)	0	73	3	44	7	127	162	9,9
	S mast (BD20)	0	25	0	9	1	35		
7 round (October 12 - November 8)	N mast (BD02)	0	4	0	13	0	17	30	1,8
	S mast (BD20)	0	6	0	5	2	13		
Total	N mast (BD02)	3	1005	3	272	87	1370	1643	100

Round	North/ South masts	<i>Plecotus</i> <i>spp.</i>	<i>Pipistrellus</i> <i>pipistrellus</i>	<i>Pipistrellus</i> <i>kuhlii</i>	<i>Vespertilio</i> <i>murinus</i>	<i>Eptesicus</i> <i>spp.</i> (<i>ognevi</i> + <i>serotinus</i>)	All species :	Total:	
								calls	%
	S mast (BD20)	0	147	1	97	28	273		
Total (N+S masts)	calls	3	1152	4	369	115	1643		
	%	0,2	70,1	0,2	22,5	7,0	100		

It should be noted that the distribution of bat activity across the territory of the planned wind farm is uneven both in space and time. The highest period of the bat activity was in late June – early July (round 3). More than half (52%) of all bat calls recorded from April to November were registered during this period. Bats were most active in the northern part of the planned wind farm. The detector on the northern meteorological mast recorded five times more calls (1370 versus 273) than the detector on the southern meteorological mast (Table 7).

3.2 Spatial-temporal study of bats using acoustic transects.

Figures 19–26 illustrate encounters with various bat species during each survey round, represented by points. The area shows heightened activity during the third and fifth rounds, with a noticeable concentration of bats in the upper part of the territory. In total, 5–6 bat species were identified using acoustic transects.

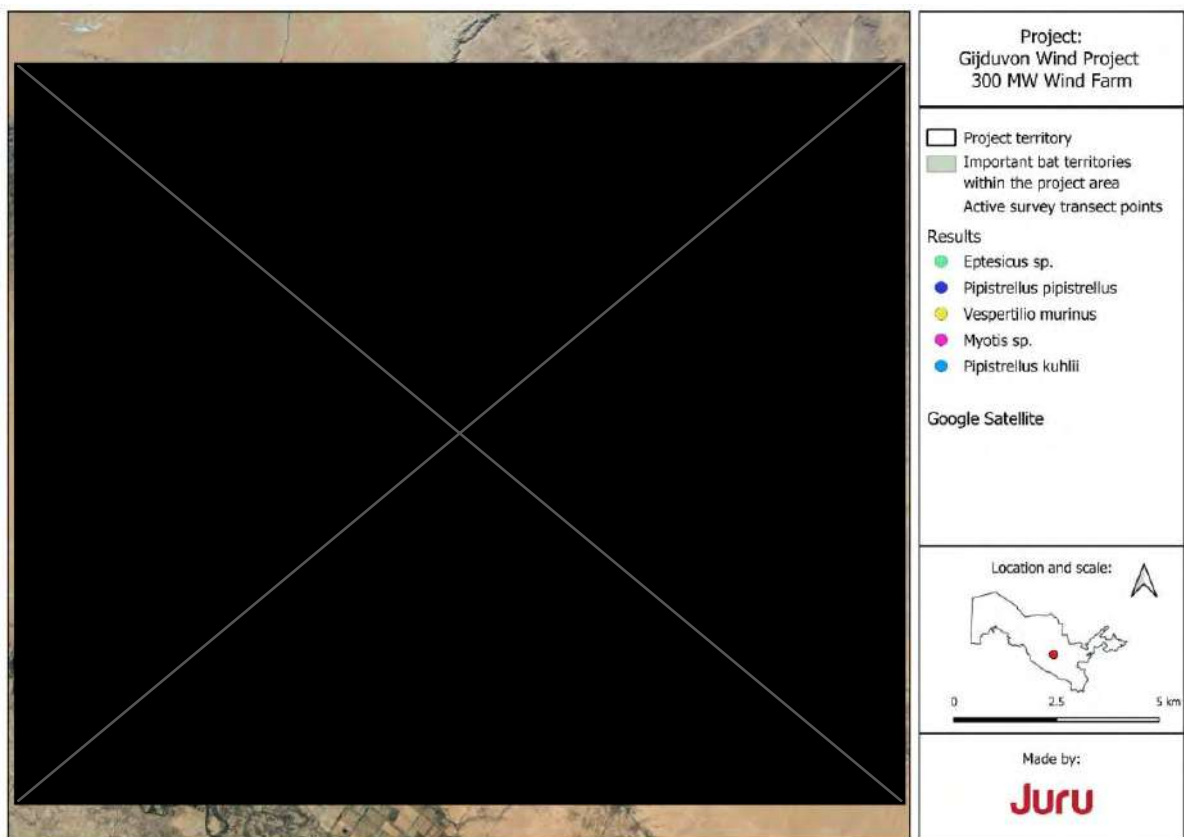


Figure 19. Results of the 1st active round

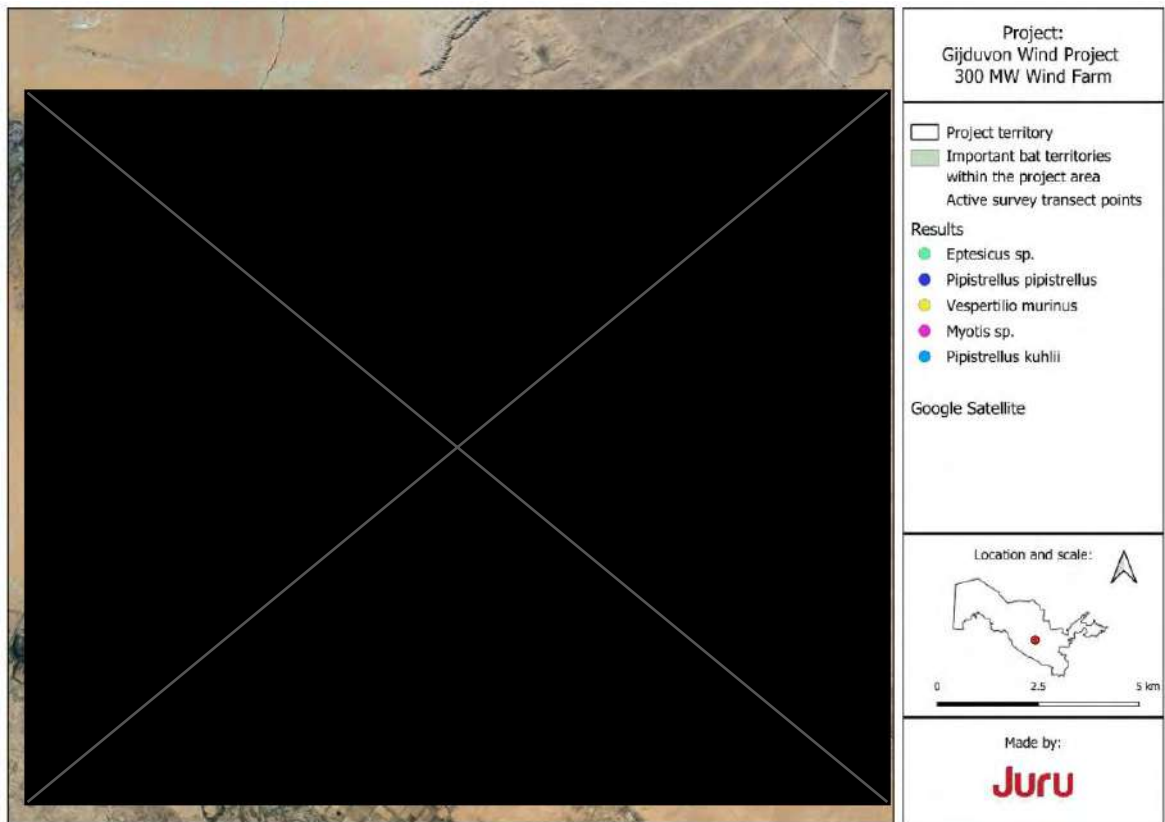


Figure 20. Results of the 2nd active round

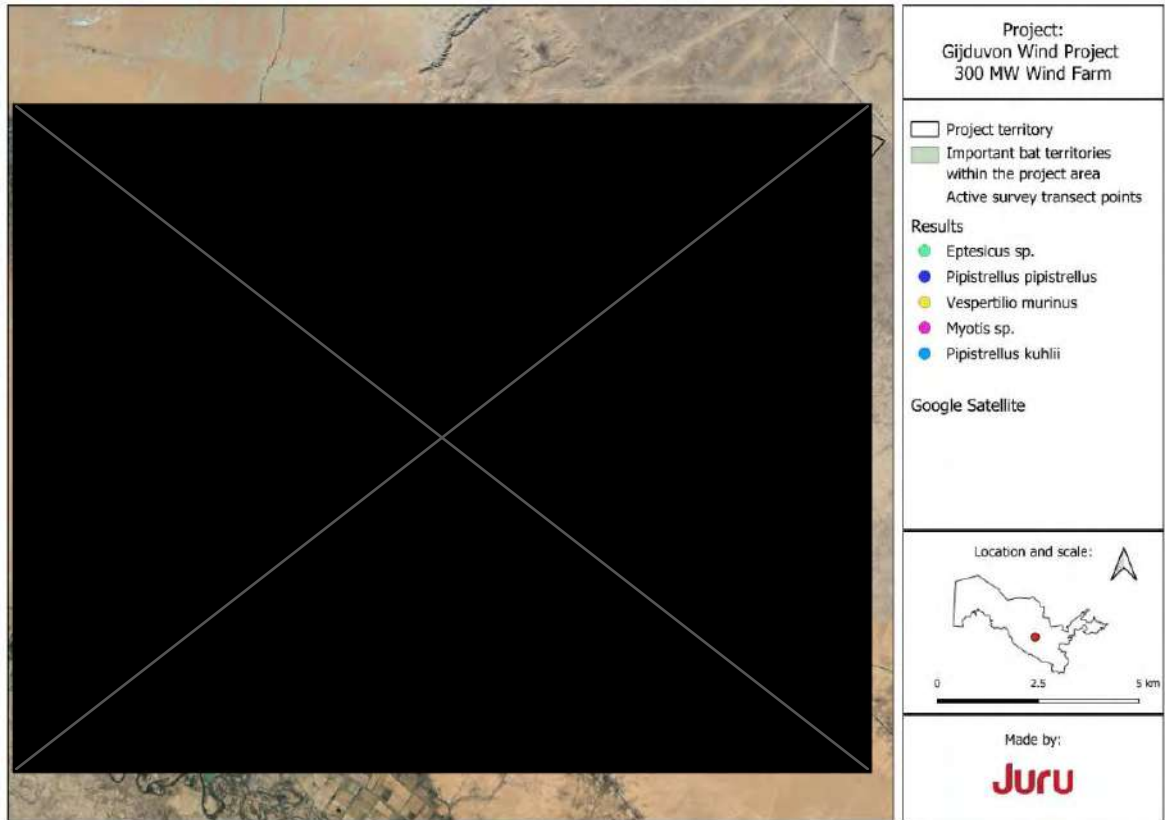


Figure 21. Results of the 3rd active round

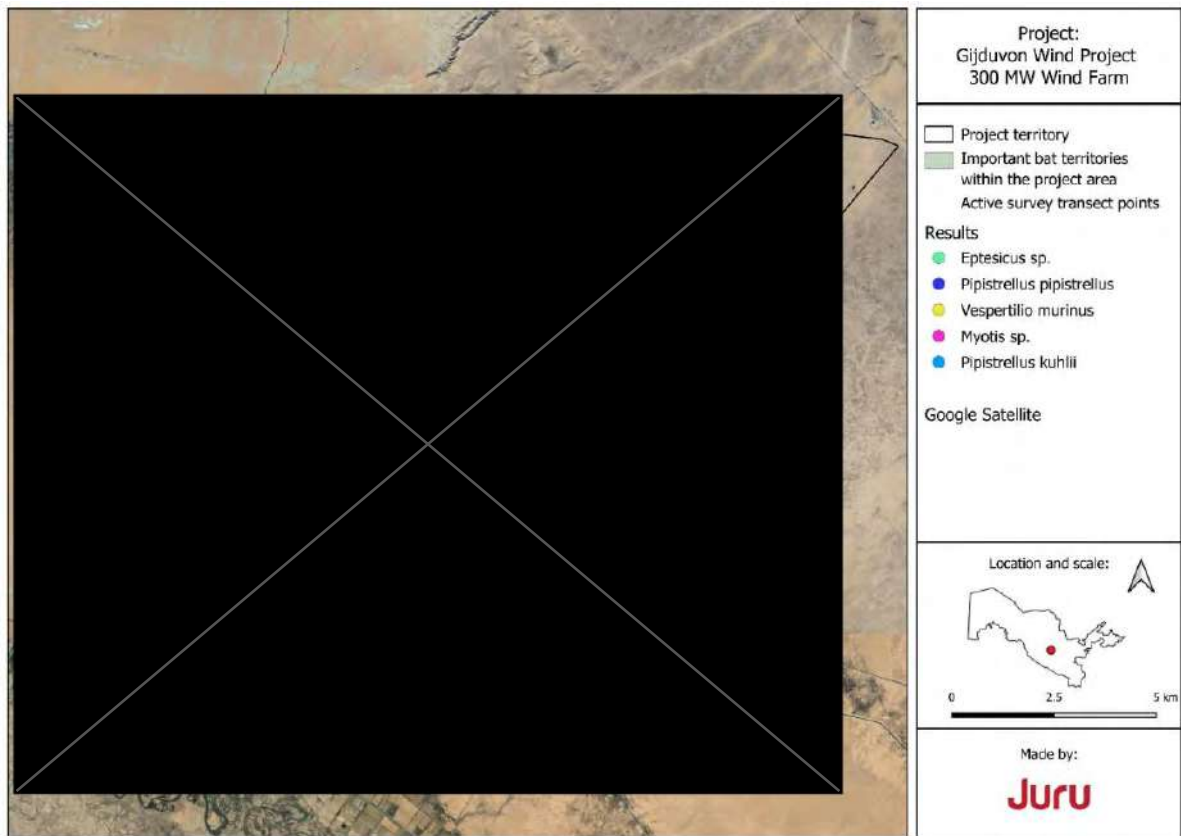


Figure 22. Results of the 4th active round

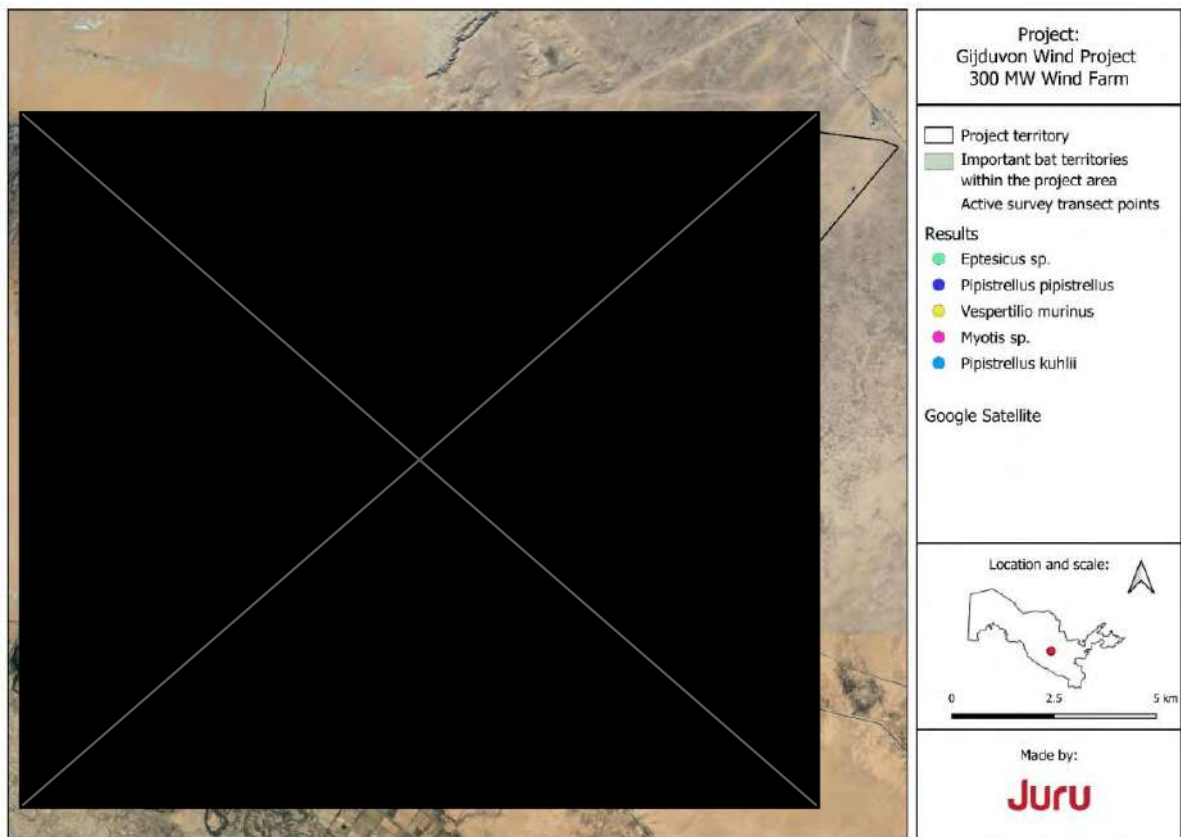


Figure 23. Results of the 5th active round

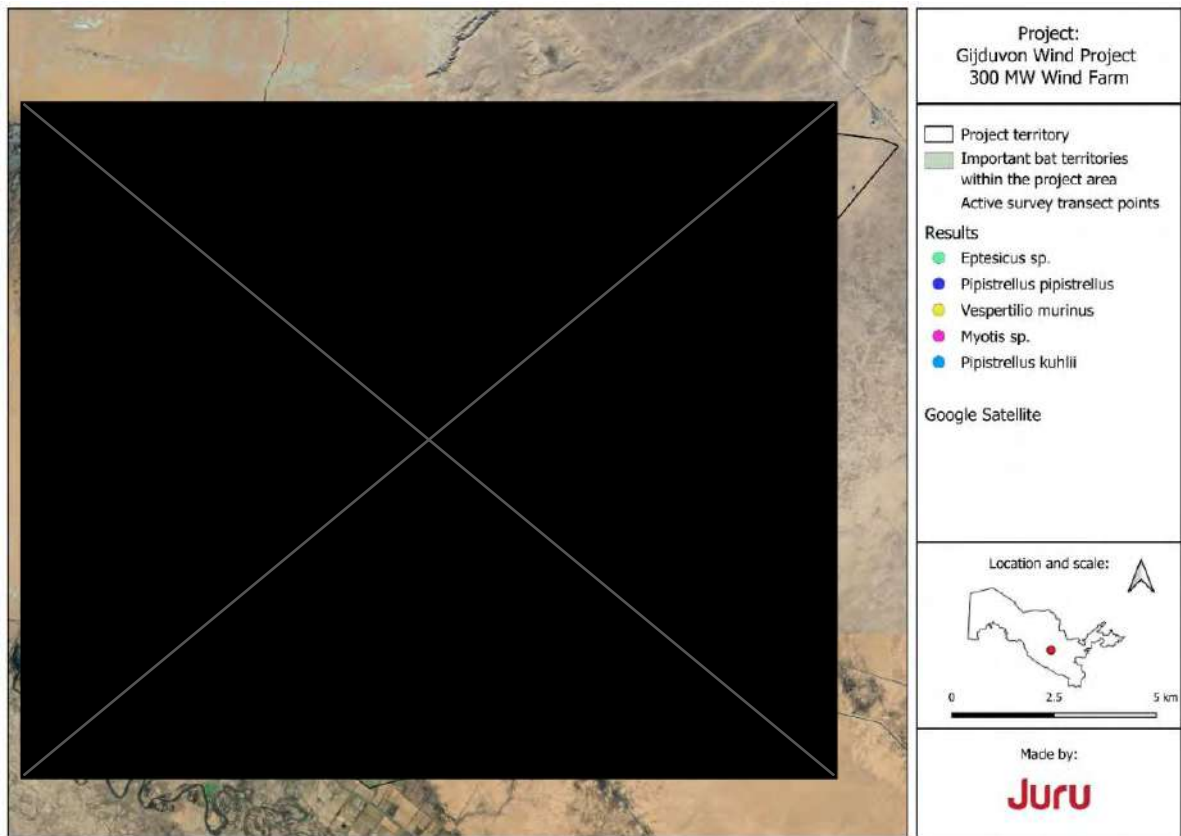


Figure 24. Results of the 6th active round

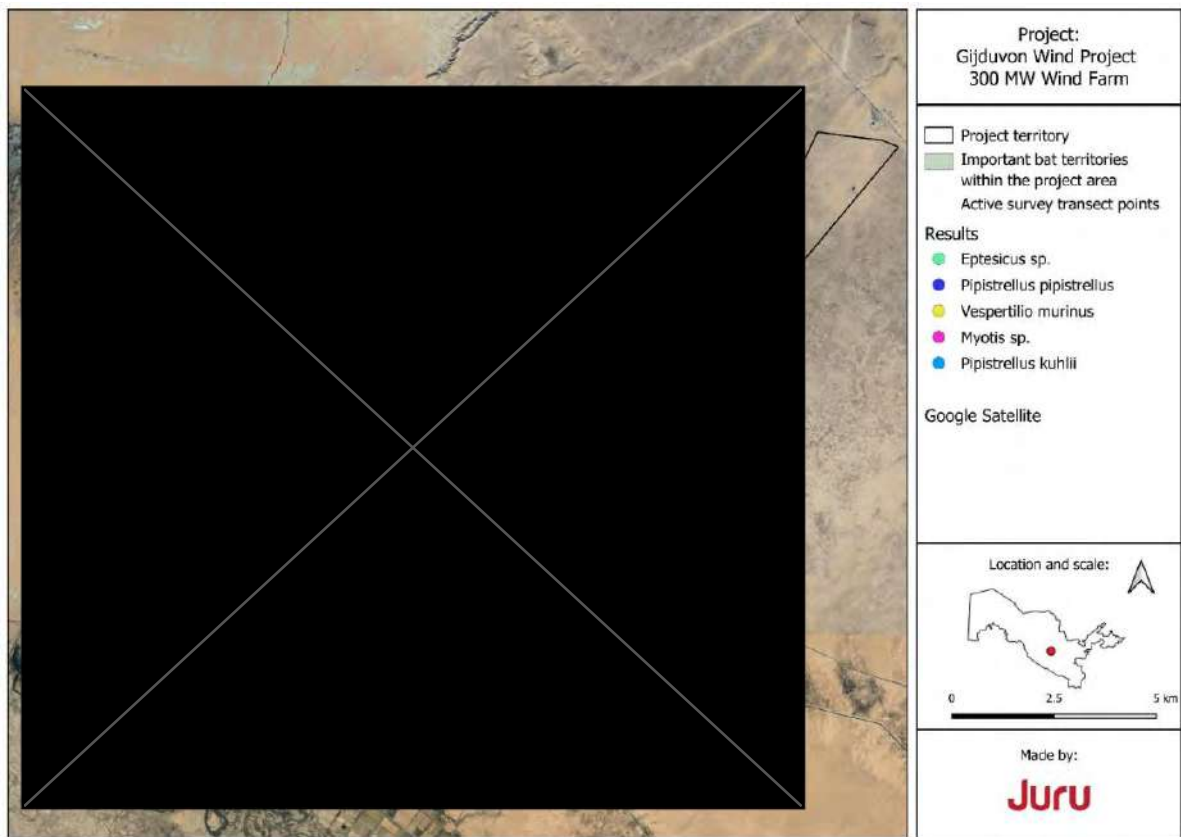


Figure 25. Summary of the all accountings with bat species at survey points

Survey point	N	E	Eptesicus sp.	Myotis sp.	P. kuhlii	P. pipistrellus	Social calls	V. murinus
1						3		
2								
3								1
4								
5						1		
6						1		
7			2			23	1	
8						43		5
9			3			6		1
10						1		
11						21		
12						15		
13			1			7		
14			1			8		
15						3		
16			2	1		19		
17						52	22	
18						14		
19						8		
20						21		
21			1		1	8		
22						6		
23								

3.3 Essays on the Species Found (based on data from Kruskop, 2024)

Rhinolophus bocharicus

IUCN Status: LC: Stable

A narrowly distributed species found in Central Asia, from southern Turkmenistan to northern Afghanistan.

Inhabits desertified foothills. Roosts include caves and mines. It emerges to hunt in deep twilight, typically feeding at low altitudes, catching moths, beetles, and other insects. The species is sedentary, overwintering in caves and mines. Mating occurs after lactation and during hibernation. In mid-June, females give birth to a single pup. Maternity colonies can number up to several hundred individuals. The biology of this species is poorly studied. Lifespan is up to 8 years.

***Tadarida teniotis***

IUCN Status: LC: Unknown

RDB of Uzbekistan: VU: Rare

Found from the Mediterranean region through the Caucasus, Asia Minor, and Central Asia to eastern and southeastern China, inhabiting mountains up to 3,100 meters above sea level. Occupies diverse landscapes ranging from deserts to forests, including anthropogenic areas. Primary roosts include caves and vertical rock crevices (often at high, inaccessible elevations) as well as human structures. The species may undertake seasonal migrations of up to 1,600 km but is more often sedentary.

Hunts flying insects at very high altitudes, with a swift and straight flight. Gives birth to one pup per year. Its lifestyle is poorly studied. The lifespan is up to 10 years.

***Pipistrellus pipistrellus******IUCN Status: LC: Stable***

Found from Northern Europe and the Mediterranean (including northwest Africa) to the Pre-Ural region, Central Asia, and Kashmir. Inhabits various landscapes but prefers anthropogenic areas; it is often found in human settlements, including cities. Roosts in human structures, less frequently in tree cavities and other narrow shelters, often alongside other bat species. It emerges to hunt in early twilight, preying on small flying insects at low altitudes over forest edges, clearings, alleys, streets, and similar areas. Its flight is fast and agile. In the northeastern part of its range, it undertakes seasonal migrations of up to 1,150 km. Overwinters in buildings and various underground shelters. Mating occurs after lactation, with a pronounced rut, or during hibernation. Autumnal mating colonies are often located in tree cavities and under bridges. Females typically give birth to 1–2 pups. Maternity colonies can consist of several dozen to hundreds of individuals, while males remain solitary. The lifespan is up to 16 years (average 3–5 years).



Pipistrellus kuhlii

IUCN Status: LC: Stable

Found in arid and semi-arid regions of the Mediterranean, North and possibly East Africa, the Middle East, Kashmir, southern Central Europe, Ukraine, the Caucasus, the Pre-Caucasus, and the Volga region. Locally present in Central Asia, with isolated records in central parts of European Russia. Inhabits open landscapes, including anthropogenic areas, and is found in mountainous regions up to 2,600 meters above sea level. Frequently resides in human settlements, roosting in buildings, rock crevices, and other narrow shelters. It emerges to hunt in early twilight, preying on small flying insects at low altitudes over water bodies, wastelands, streets, and similar areas. Its flight is fast and agile. Echolocation calls are of medium to high intensity, with a peak frequency of about 40 kHz. This species is mostly sedentary, overwintering in stone buildings in the northern parts of its range. Mating occurs after lactation, with a pronounced rut, or during hibernation. Maternity colonies typically consist of several dozen, and less commonly, hundreds of individuals, while males remain solitary. The lifespan is approximately 4–8 years.

***Vespertilio murinus***

IUCN Status: LC: Stable

Found in the temperate and subtropical zones of Eurasia, ranging from Europe through the Near and Central Asia, Southern Siberia, and Mongolia to the Far East and northeastern China. Inhabits a wide variety of landscapes, including anthropogenic environments, and can be found in mountainous areas up to 3,000 meters above sea level. Roosts include human structures and tree cavities. It emerges to hunt in early twilight, preying on flying insects at high altitudes, usually over open spaces and less commonly over forests or water bodies. The species may undertake seasonal migrations of up to 1,300 km, although in many regions it is sedentary. Overwinters mainly in human structures and less frequently in underground shelters. Mating occurs in autumn, with a weakly expressed rut, or at the beginning of hibernation. Births take place in early to mid-summer, with litters of 1–3 (usually 2) pups. Maternity colonies can number several hundred females, while males remain solitary. The average lifespan is around 3–5 years.



***Myotis* spp. (*M. blythii*, *M. emarginatus*, *M. bucharensis*, *M. capaccini*, *M. davidii*)**

Myotis blythii

IUCN Status: LC: Decreasing

Found from the Mediterranean through the Caucasus, the Near and Central East, to southern Kazakhstan, the Altai, and possibly northern China.

Inhabits forested and arid landscapes. Roosts include caves, grottos, and human structures. It emerges late to hunt, with a calm and manoeuvrable flight. Typically forages in open landscapes, either in the air or by collecting orthopterans and other insects from the ground. Reproduction occurs in early summer, with maternity colonies reaching up to several thousand individuals. Males often roost alongside females, frequently sharing shelters with other bat species. This species is sedentary, overwintering in various underground refuges in the northern parts of its range. Mating occurs after lactation or during hibernation. Births take place in late May to June, with one pup per litter.

***Myotis bucharensis***

IUCN Status: DD

Myotis emarginatus

IUCN Status: LC: Stable

Found from Central Europe and the Mediterranean to the Caucasus, Central Asia, and the Middle East.

Prefers open landscapes, particularly arid ones. Roosts include caves, grottos, and attics of large buildings. Often forms mixed colonies with horseshoe bats. It emerges to hunt in deep twilight, flying low to the ground along forest edges, hedgerows, and similar areas, often within dense vegetation. Feeds on insects both in the air and on the surface of leaves. Its flight is slow and highly manoeuvrable. This species is sedentary, overwintering in various underground shelters. Mating occurs during hibernation. Reproduction takes place in early to mid-summer, with maternity colonies reaching several hundred females. Males remain solitary. Pregnancy lasts approximately three months, with one pup per litter. Lactation lasts about one month. Lifespan is up to 15 years.

***Myotis capaccini***

IUCN Status: VU: Decreasing

RDB Uz Status: CR A critically endangered, locally distributed sedentary species. Active from April to October during the night, it shelters during the day in abandoned buildings, caves, rock crevices, and old mines. Known for spring and autumn movements of up to 100 km. Young are born in June–July, with juveniles starting to fly in July–August.	Found in arid regions of the Mediterranean and the Middle East, with a single record in Uzbekistan. Prefers areas near water bodies. Roosts include caves and rock crevices, often sharing shelters with other bat species. Its biology is poorly studied. The flight is relatively fast and straight. Feeds over water bodies, hunting aquatic insects either in the air above the water's surface or collecting them directly from the water. Due to only a single record of this species in Uzbekistan, the likelihood that it was indeed this species is quite low.
<i>Myotis davidii</i> IUCN Status: LC:U Found in southern and southeastern Europe, the Lower Volga region, the Caucasus, Asia Minor, Western, Central, and Middle Asia, the Himalayas, Transbaikalia, western and northern China, and Korea. Inhabits various landscapes, primarily arid ones, from the southern forest zone to semi-deserts. It is usually associated with open habitats, including anthropogenic areas. Roosts include narrow crevices in buildings, rock cracks, and caves, while in forested areas, it may also use tree hollows. Emerges to hunt after twilight, preying on flying insects at low altitudes. Its flight is relatively fast and maneuverable. This species is sedentary or undertakes minor seasonal movements, overwintering in various underground shelters. Reproduction occurs in early to mid-summer, with maternity colonies comprising up to several dozen females. Males usually remain solitary. Litters consist of one pup.  (c) S. Gazaryan	

<i>Plecotus strelkovi</i> IUCN Status: LC: Unknown	<i>Plecotus turkmenicus</i> IUCN Status: LC: Unknown

Found in the foothills and mid-mountain regions of Tajikistan, Kyrgyzstan, Eastern Turkmenistan, Eastern Kazakhstan, Western China, Afghanistan, and Western Mongolia. Inhabits arid and semi-arid landscapes with a sharply continental climate. Roosts include caves and mines, and possibly human-made structures. It emerges to hunt at dusk, typically over open spaces, near isolated trees, hedgerows, and similar areas. Feeds on insects, which it catches either in the air or on surfaces. Its flight is slow, highly maneuverable, and it can hover in place. This species is sedentary, overwintering in mines, caves, and rock crevices. Mating occurs in spring or early summer, with a single offspring per litter.



A poorly studied species with insufficient data for proper assessment.

Found in the Western Karakum Desert, the Kopet Dag, Ustyurt, and Mangyshlak. There is an unverified report of this species being found in Mongolia.

Inhabits arid landscapes. Roosts include caves, mines, cliff crevices, and wells. Its biology is poorly studied. Feeds on insects, which it catches either in the air or on surfaces. The flight is generally slow and highly maneuverable. This species is sedentary, overwintering in mines, caves, and rock crevices. Mating occurs in spring or early summer, with a single offspring per litter.

Eptesicus serotinus* and (or) *Eptesicus ognevi

Eptesicus serotinus

IUCN Status: LC: Stable

Found from Northern Europe and the Mediterranean to the Lower Volga region, Kazakhstan, Central Asia, Kashmir, the Himalayas, and southeastern China. Inhabits various landscapes, predominantly anthropogenic ones. Typically roosts in human structures, less often in rock crevices. It emerges to hunt in deep twilight. The flight is unhurried, calm, but maneuverable. Feeds on insects, catching them both in the air, sometimes at very high altitudes, and on surfaces. This species is sedentary. Maternity colonies consist of several dozen to hundreds of females, while males remain solitary. Births occur in early summer, with litters of 1-2 (occasionally up to 3) pups. Maximum lifespan is up to 19 years.



Eptesicus ognevi

IUCN Status: LC: Unknown

Arid (including mountainous) regions from the South Caucasus, the Near East, and Central Asia eastward to southwestern Mongolia. Roosts include rock crevices, caves, ruins, and human structures. It emerges late to hunt, presumably feeding on flying insects. Echolocation calls range from 66 to 30 kHz, with a peak frequency around 40 kHz. The biology of this species is poorly studied. Maternity colonies consist of several dozen females, occasionally exceeding 100 individuals, while males remain solitary. Births occur in mid-summer, with litters typically consisting of 2 pups, less frequently 1.



4. Discussion

General bat activity distribution

At least eight species of bats use the territory of the projected wind farm. These eight species include one species listed in the Red Data Book of Uzbekistan (2019), *Tadarida teniotis*. Calls of this species were recorded in the northern part of the planned wind farm.

Our study in 2024 found that bat activity was highest in the northern part of the planned wind farm area. To the north of the planned wind farm area, there is a deep canyon with steep walls and a water channel at the bottom. We believe that this area is home to bat breeding colonies, where part of the local bat population reproduces. This assumption is supported by a sharp increase in bat activity in late June - July. This is exactly the period when young bats in temperate latitudes begin to fly out of maternity roosts (Dietz, Kiefer, 2016).

It is well known that water plays a crucial role in the lives of bats. Due to their large body surface area (including wing membranes), these animals are highly sensitive to excessive dryness or lack of water. Moreover, water bodies serve as attractive sites for insects, which are a primary food source for bats (Benda et al., 2011; Benda et al., 2012; Dietz, Kiefer, 2016). It is, therefore, unsurprising that areas adjacent to water bodies exhibit a high concentration of bats. Graphs showed that, on average, bat activity was detected every 20 minutes throughout the night (from 6:00 PM to 6:00 AM) using acoustic detectors. In addition to echolocation calls, a significant number of social calls were recorded, potentially linked to territorial activity by males.

Installation of wind turbines in the northern part of the surveyed area may pose a threat to the reproduction of the local bat population. If a decision is made to build a wind farm in this area, it is strongly recommended not to install wind turbines closer than 500 m from the northern boundary of the wind farm (Sowler et al., 2020).

In the central desert zone, where other detectors were placed at heights of 10 and 60 meters, bat activity was significantly lower. However, considering the flight patterns and altitudes of the detected species, as well as the fact that the area is surrounded by water bodies, we hypothesize that this desert area is used by bats as a transit zone—both between local water bodies and potentially for long-distance movements during migration or nomadic behavior.

Seasonal activity and probable migration features

The observed activity dynamics, calculated per survey round, suggest possible bat migrations or nomadic movements through the project area. Considering the high bat activity near water bodies, it is likely that these areas serve as important nodes along migration routes. The project site is surrounded by water bodies on various sides, making it plausible that bats frequently move between the water bodies to the north and south, as well as between the canals to the east and west.

As mentioned above, increased bat activity within the planned wind farm area was recorded at the end of June and in July (during the third survey round). This sharp rise in activity is likely due to the emergence of juvenile bats from maternity roosts in late June to early July, leading to a twofold or greater increase in the local population size.

Bat Activity Dependence on Wind Speed

Our study confirmed increased bat activity during low wind speeds of up to 5 m/s. This is consistent with observations by colleagues from different countries where wind farms were operating (Arnett et al., 2011; Wellig et al., 2018; Voigt et al., 2021). In our research, this pattern was identified using ultrasonic detectors installed at a height of 60 meters, which corresponds to the lower range of wind

turbine blade operation. At heights of 5 and 10 meters, no correlation between bat activity and wind speed was observed.

Furthermore, the absolute maximum of bat activity (ignoring the relative dominance of wind speed) was recorded at wind speeds of 7–11 m/s, suggesting that cut-in wind speed and/or feathering of blades based on wind speed thresholds may not be effective enough in this area to prevent excess bat mortality from wind turbine operation. When analysing and discussing the graphs, it is important to consider that we are working with data from a relatively small sample collected from only two elevated observation points (detectors at a height of 60 m on meteorological masts).

It is worth noting that, although the literature frequently describes a sharp decline in bat activity at high wind speeds, in the surveyed area, bats demonstrated high activity even at wind speeds of up to 18 m/s (measured at a height of 130 meters).

5. Threats

The highest level of bat activity within the proposed wind farm site was observed near water bodies. Particularly high activity of bats was observed in June and July in the northern part of the project area on the side of the canyon with a water channel. Most likely, juveniles from breeding colonies were flying out at this time, which led to a sharp local increase in numbers in the northern part of the project area. Installing wind turbines in close proximity to these areas could result in increased bat mortality, as bats may visit the water bodies from surrounding territories for foraging and drinking.

Also, in the northern part of project area, calls of European free-tailed bat (*Tadarida teniotis*), a species listed in the Red Book of the Republic of Uzbekistan (2019), were recorded.

The risk of harming local bat populations can be mitigated by maintaining buffer distances at least of 280 meters between water bodies and wind turbines, as recommended by the "South African Guidelines" (Sowler et al., 2020). Additionally, implementing measures such as limiting cut-in wind speed and/or feathering turbine blades to 5 m/s can further reduce the impact.

The potential negative impact of wind turbines on bats (death from collisions, barotrauma) in the project area can be minimised if automated ultrasonic detectors are used to estimate the activity and identity of bats in the zone of highest mortality risk at wind turbines in order to formulate mitigation schemes, such as increased curtailment speeds to prevent casualties (Voigt et al., 2021). The economic damage from such stops will be minimal because high bat activity in the project area occurs once every 10 days and most likely occurs at nights with low wind speed when the efficiency of power generation is low (Arnett et al., 2011). As known, an increase of the cut-in wind speed and/or feathering of blades during low wind speed conditions reduces bat mortality (Arnett et al., 2011). Cut-in wind speed and/or feathering of blades can be especially important on days when a high activity of bats is registered. This will prevent the massive death of bats and the associated risks of "environmental" damage.

6. Conclusion

Acoustic bat surveys for the Bash II (Gijduvan) project were successfully completed in full compliance with the plan. Six stationary detectors were installed at various heights and operated for a total of 1,193 detector nights, covering 203 nights from mid-April to early November. Maintenance of the detectors, including battery replacement and data collection, was performed every 22–40 days. In total, seven rounds of maintenance were conducted.

The stationary detectors recorded 1.457 TB (295,876 files) of data, of which 346 GB (72,360 files) contained bat calls.

Active transect surveys of bats were conducted monthly from April to October. Six rounds were completed at 22 points evenly distributed across the area, avoiding water bodies, over six nights using a hand-held bat detector, Echo Meter Touch 2. In total, 1,530 files (approximately 3.51 GB) were collected, and bat calls were detected in 302 of these files.

Throughout the study, the calls of at least eight bat species were detected and identified. Due to the limited knowledge of regional bat species, only five species were identified at the species level, while the remaining three or more were identified to the genus level.

Among the detected species, one is listed in the Red Book of Uzbekistan with a status of VU:R. All identified species, except *Rhinolophus bocharicus*, *Myotis* sp., and *Plecotus* sp., have a high risk of mortality at wind farms (Rydell et al., 2012). The risk for *Myotis* species could not be assessed due to insufficient information about the specific species.

Overall, the project area is highly attractive to bats due to its geographic location and surrounding water and semi-aquatic habitats, as confirmed by the surveys.

Bats were active at various heights, from 5 to 63 meters and beyond. A significant number of bat signals were recorded at the detector placed at 60–63 meters, with activity observed at wind speeds of 7–11 m/s (measured at 130 meters). The maximum wind speed at which bats were recorded flying reached 19 m/s.

If a decision is made to build a wind farm in the project area, it is strongly recommended to take measures to reduce the mortality of bats from operating wind turbines.

1. Do not install wind turbines in the northern part of the project area (no closer than 280 m from the northern border (Sowler et al., 2020), where increased activity of bats, most likely the breeding part of the population, is observed).
2. Limit the operation of wind turbines during the period of highest bat activity (second half of June - July).
3. Limit the cut-in wind speed and/or feathering of blades to 5 m/s at night from April to October.
4. Install automated ultrasonic detectors are used to estimate the activity and identity of bats in the zone of highest mortality risk at wind turbines in order to formulate mitigation schemes, such as increased curtailment speeds to prevent casualties (Voigt et al., 2021).

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11. HABITAT AND BOTANICAL AUTUMN SURVEY REPORT

Habitat and Flora Autumn survey report

**Environmental and Social Impact Assessment (ESIA) for
Gijduvan 300 MW Wind Farm in Bukhara District, Uzbekistan**

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1 Introduction

The report is the result of a botanical survey for the proposed 300 MW Gijduvan Wind Farm (WF) project. The project comprises the construction of a 300 MW wind farm and a 500 kV overhead transmission line in the Gijduvan and Shofirkan districts of Bukhara region, Uzbekistan.

The main objective of this study is to provide an overview of the botanical survey within the project area. To achieve this objective, the expert botanist has performed the following tasks:

- Conducted an extensive field botanical survey in the autumn of 2024, with particular focus on the planned turbine locations, substation, and the 25 km overhead transmission line route
- Validated habitat mapping results from April with a re-survey conducted in September 2024
- Compiled a checklist of plant species recorded within the project site (in particular, threatened species included in the Red Data Book of Uzbekistan and/or the IUCN Red List)
- Processed and analyzed all collected field data to produce this report.

2 Project area

The project area of about 17x22 km is situated in Gizhduvan and Shafirkan administrative districts of the Bukhara Province of Uzbekistan, in the surroundings of depression Ayakagytna, 6 km to the south and southeast of the lake Ayakagytna, and about 30 km to the north of towns Gizhduvan and Shafirkan. Figure 1 shows the planned locations of wind turbines and an OTHL route in the project area.



Figure 1. Study area. Red polygon – border of Gijduvan project site, green markers – planned turbine locations, blue circle – substation, black line – OTHL.



Figure 2: Survey points

3 Literature review

The review of literature and previous botanical surveys, as well as a short description of flora and vegetation of the project region have been represented in the report on the springtime survey.

4 Materials and methods

The field research in the project area was conducted on September 14–15, 2024, by traditional methods of botanical survey commonly used for sampling and mapping of native non-forest vegetation and recognition of floristic composition and spatial patterns of plant communities (Field geobotany, 1959–1976; Granitov, 1980; Kent, 2011). The survey included inspections of all planned turbine locations, the substation site, and the 25-km OTHL route. Checklists of plant species were compiled at each survey point.

To study plant community structures, we established 100x100 m geobotanical sample plots across the project area. For each plot, the following data were systematically recorded:

- Plant Species: A checklist was made of all plant species within each sample plot, which contributed to a summary checklist of the flora across the wind park project area.
- Photographic Documentation: Landscape and vegetation photos were taken using a digital camera to visually document each plot.
- Environmental Parameters: Data on location and physical environment were recorded, including GPS coordinates, elevation, topography, and soil type.

- Vegetation and Land Use: Observations included the state of vegetation, land use type, and disturbance factors such as grazing and nearby roads.
- Plant Community and Cover: Each plot's plant community type, canopy cover (%), and presence of all plant species were noted, along with details on species cover, abundance, phenological stage, and average height.

Coordinates of populations of endemic, redlisted or alien plant species, number of individuals and area occupied by population also were recorded.

Species abundance was determined using the Braun-Blanquet cover-abundance scale (+/- occasional and less than 1% cover of the sample plot area; 1 – abundant with low cover, or less abundant but with higher cover, 1–5% of the sample plot area; 2 – abundant with >5–25% of the sample plot area, irrespective of the number of individuals; 3 – >25–50% cover of the sample plot area, irrespective of the number of individuals; 4 – >50–75% cover of the sample plot area, irrespective of the number of individuals; 5 – >75% cover of the sample plot area, irrespective of the number of individuals) and the DACFOR scale: D – Dominant; A – Abundant, C – Common, F – Frequent, O – Occasional, R – Rare.

Plant species were identified using special literature, as “*Conspectus Florae Asiae Mediae*” (1963–1993), “*Flora of Uzbekistan*” (1941–1963, 2016, 2017, 2019, 2022, 2023a, 2023b) and “*Flora of USSR*” (1934–1964). Available publications and online databases (Nikitin, 1983; IUCN/ISSG, 2014; CABI, 2017; Sennikov et al., 2018) were used for identification of alien species, while the Red Data Book of Uzbekistan (1984, 1998, 2006, 2009, 2019) and the IUCN Red List¹ were used for identification of threatened species. Other relevant data published on flora and vegetation of the region also has been analyzed (listed below in References).

The final checklist of plant species recorded within the project area is provided in Annex C. Species in the checklist are arranged in taxonomical order in accordance with the APG system (APG IV, 2016). Accepted scientific names were verified using the global databases Plants of the World Online², International Plant Names Index³ and Global Biodiversity Information Facility⁴, as well as with recently published treatments of different taxonomical groups of the flora of Uzbekistan (Sennikov, 2016, 2017, 2019, 2022, 2023a, 2023b).

The habitat and LULC map (represented in the springtime report) was created using QGIS 3.32 free software on the basis of visual interpretation of Google Earth free satellite imagery, topographic maps (1:100,000, available online for free at <http://loadmap.net/>), and the data of field survey. Since Uzbekistan has not developed the national system of classification of habitats, we used IUCN Habitats Classification Scheme, ver. 3.1 (<https://www.iucnredlist.org/resources/habitat-classification-scheme>) and typology of native vegetation published in the “*Vegetation cover of Uzbekistan*” (1971–1984) for the classification of habitats of project area. As far it was applicable to the local conditions, we also followed the pan-European system, EUNIS habitat classification scheme.

¹ www.iucnredlist.org

² www.plantsoftheworldonline.org

³ www.ipni.org

⁴ www.gbif.org

In September, all identified habitat types were re-surveyed to confirm the results of vegetation descriptions and habitat mapping initially conducted in April 2024. This re-survey verified habitat types and their boundaries within the project area.

As defined by the International Finance Corporation (IFC) Performance Standard 6 (PS6) and EBRD Performance Requirement 6 (PR6), critical habitats are areas with high biodiversity value which meet at least one following criteria:

- Criterion 1. Habitat of significant importance to Critically Endangered and/or Endangered species;
- Criterion 2. Habitat of significant importance to endemic and/or restricted-range species;
- Criterion 3. Habitat supporting globally significant concentrations of migratory species and/or congregatory species;
- Criterion 4. Highly threatened and/or unique ecosystems;
- Criterion 5. Areas associated with key evolutionary processes.

Numerical thresholds have been defined for the first four critical habitat criteria, based on these published by IUCN in “A Global Standard for the Identification of Key Biodiversity Areas” (2016) and “IUCN Red List Categories and Criteria” (2012). Assessment parameters are: i) number of mature individuals, ii) area of occupancy, iii) extent of suitable habitat, iv) range, v) number of localities, vi) distinct genetic diversity.

According to the IFC Guidance Note 6, quantitative thresholds of critical habitat are following:

Criterion 1. CR/EN species: a) habitat required to sustain at least 10% of global population of CR or EN species, where there are known, regular occurrences of the species and where that habitat could be considered a discrete management unit for that species; (b) habitat with known, regular occurrences of CR or EN species where that habitat is one of 10 or fewer discrete management sites globally for that species; (c) habitat supports the regular occurrence of a single individual of a CR species and/or habitat containing regionally important concentrations of a red-listed EN species where that habitat could be considered a discrete management unit for that species/subspecies; (d) habitat of significant importance to CR or EN species that are wide-ranging and/or whose population distribution is not well understood and where the loss of such a habitat could potentially impact the long-term survivability of the species; (e) as appropriate, habitat containing nationally/regionally important concentrations of an EN, CR or equivalent national/regional listing.

Criterion 2. Endemic / restricted range species: (a) habitat known to sustain $\geq 95\%$ of the global population of an endemic or restricted-range species where that habitat could be considered a discrete management unit for that species (e.g. a single-site endemic); (b) habitat known to sustain $\geq 1\%$ but $< 95\%$ of the global population of an endemic or restricted-range species where that habitat could be considered a discrete management unit for that species, where data are available and/or based on expert judgment.

Criterion 3 (migratory species) is inapplicable for plants. As for Criterion 4, unfortunately, the officially approved national list of highly threatened and/or unique ecosystems and habitats does not exist in Uzbekistan. For Criterion 5, there are no numerical thresholds.

5 Findings and results

5.1 Habitat assessment

A field survey has been conducted on 14–15 September 2024. Following habitat types and vegetation communities were identified within the project area as a result of visual interpretation of satellite imagery and spring field survey.

Natural habitats prevail within the study area; they are represented with 3 types:

- Sandy and sabulous-loamy plain covered by communities of sagebrush, saltworts, desert bindweed and ephemeroïds, sometimes with plantations of black saxaul. This is a natural habitat type which prevails in the Project area.
- Fixed and semi-fixed sands covered by communities of psammophilous shrubs, subshrubs, sagebrush and desert sedge.
- Saline lands.

Modified habitats occupy a small part of the Project site; they are represented with 2 types:

- Saline fallow lands (abandoned fields) with secondary communities with domination of tamarisk, annual and perennial saltworts and camel thorn, similar with natural those growing on saline lands.
- Farmsdeads (shepherds houses, corrals and wells surrounded with tramped areas).

A detailed description of these habitat types and their classification according IUCN Habitats Classification Scheme, EUNIS habitat classification scheme and typology of native vegetation published in the “Vegetation cover of Uzbekistan” (1971–1984) have been represented in the report on the springtime survey. In September, all habitat types were resurveyed, and the results of vegetation description and habitat mapping performed in April 2024 were confirmed (habitat types and their boundaries). Thus, **the correction of the habitat map created after the spring expedition is not needed.**

Some corrections were made in the checklists of species recorded within survey plots and in the general checklist of flora. The main difference between spring and autumn aspect of vegetation of the project area is the high abundance of ephemers and ephemeroïds and low abundance of annual saltworts in spring season. After end of growing season (late April-early May), ephemers and ephemeroïds fade quickly and begin a long dormant period which continues for nine months. Since at the end of June the dry above-ground part of these plants has already been eaten by livestock and scattered by the wind, their abundance decreased. The autumn aspect of vegetation is dominated mainly by shrubs (*Tamarix*, *Lycium*, *Calligonum*, *Haloxylon*, *Xylosalsola*), subshrubs (*Artemisia*, *Astragalus villosissimus*, *Convolvulus hamadae*), xerophytic perennials (*Alhagi pseudalhagi*, *Acanthophyllum elatius*, etc.) and annual and perennial representatives of the family Amaranthaceae (*Salsola*, *Suaeda*, *Caroxylon*, *Climacoptera*, *Halimocnemis*, *Ceratocarpus*, etc.) blooming and bearing fruits in late summer and autumn.

5.2 Flora assessment

In total, 111 plant species of 30 families were recorded within the project area as a result of spring and autumn surveys (47 annuals, 38 perennials, 12 subshrubs, 14 shrubs and small trees) (Annex C). None of them are included in the IUCN Red List as CR, EN or VU, one species is Near Threatened (NT), and 4 species are included in the Red Data Book of Uzbekistan. Alien species were not found.

Nationally redlisted are following 4 plant species:

1. ***Calligonum zakirovii*** (Khalk.) Czerep. (Polygonaceae). This is a small shrub, national endemic of Uzbekistan listed in the Red Data Book of Uzbekistan (2019) with the category 1 (endangered, disappearing), but not evaluated by IUCN. Three populations (27 specimens in total) were found in April at [REDACTED]

2. ***Climacoptera amblyostegia*** (Botsch.) Botsch. (Amaranthaceae). The species is annual herb included in the Red Data Book of Uzbekistan (2019) with the category 2 (rare), but not evaluated by IUCN. Four populations (100-200 specimens each) were found at [REDACTED]

3. ***Eremostachys eriolarynx*** Pazij et Vved. (Lamiaceae), perennial, endemic to Kyzylkum Desert (Uzbekistan, Kazakhstan) included in the Red Data Book of Uzbekistan (2019) with the category 1 (endangered, disappearing), but not evaluated by IUCN. Two small populations with 8 and 17 specimens were found [REDACTED]

[REDACTED] During the autumn field survey, *Eremostachys eriolarynx* was not recorded (the aboveground part of this plant dries in late May-June).

4. ***Tulipa lehmanniana*** (Liliaceae), vulnerable species of Irano-Turanian deserts with decreasing range and populations, listed in the Red Data Book of Uzbekistan (2019) with the category 3 (reducing), listed in the IUCN Red List under category Near Threatened (NT). The species is nationally redlisted also in Kazakhstan, Tajikistan and Turkmenistan. *Tulipa lehmanniana* is quite widely spread in the desert zone of Irano-Turanian region of Tethyan (Ancient Mediterranean) floristic subkingdom of Holarctic (Takhtajan, 1986), in Uzbekistan, Kazakhstan, Tajikistan, Turkmenistan, Afghanistan, Pakistan, and Iran. *Tulipa lehmanniana* occurs sporadically within the Project area, its relative abundance according the DAFOR scale is R (rare) to F (frequent), population density varies from solitary specimens to several thousand per 1 hectare.

Populations of *Tulipa lehmanniana* were recorded in majority of sample plots and vegetation communities in sandy plain and fixed hilly sands. Population density on different plots is 1–3 to 50–70 generative specimens per 100 m². For example:

- [REDACTED] flat-wavy sandy plain, ephemeroide-sagebrush community with *Ferula foetida*, *Iris songarica* and solitary black saxaul (remains of plantations). Sparse population with 1–3 generative specimens per 100 m².
- [REDACTED] sandy plain, overgrazed *Ferula*-sagebrush-ephemeroide community with sparse black saxaul plantation in surroundings of a farmstead. Population density is 3–4 to 8–10 generative specimens per 100 m².
- [REDACTED] sandy plain with *Iris*-sagebrush-ephemeroide vegetation with solitary *Ferula foetida* and black saxaul (remains of plantations). Large population of several thousand plants, with a density up to 50–70 generative specimens per 100 m².

- [REDACTED] sandy-loamy plain, Iris-ephemeroid-saltwort-sagebrush community with solitary *Ferula foetida*. Sparse population with 1–3 generative specimens per 100 m².
- [REDACTED] sandy plain, *Ferula*-*Astragalus*-sagebrush-desert bindweed community. Sparse population with 1–3 generative specimens per 100 m².

During the autumn field survey, *Tulipa lehmanniana* was not recorded (it is ephemeroid, the aboveground part of this plant dries in May).

Most of the species recorded for the project are typical for desert zone of Central Asia and more or less common and widely spread. The number of plant species recorded per sample plot in September varies from 14 to 27 species. The final checklist of flora is represented in Annex C.

5.3 Results of the field survey

In total, 54 sample plots were described within the wind park area and along the planned OHTL. Check-lists of plants recorded for each sample plot are presented below (Tables 1–54). Photographs are represented in Annex A. The vegetation within the Project area is typical for south-western Kyzylkum.

Table 1. Check-list of plants recorded for [REDACTED] fixed gentle hilly-wavy sands, *Ferula*-desert sedge-sagebrush-desert bindweed-*Calligonum* community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	30-40	R	+	fruiting
2. <i>Agriophyllum minus</i>	annual	20–25	R	+	fruiting
3. <i>Artemisia diffusa</i>	subshrub	30-40	F	1	Flowering, fruiting
4. <i>Astragalus villosissimus</i>	subshrub	30-40	F	1	fruiting
5. <i>Calligonum microcarpum</i>	shrub	70-100	O	1	vegetation
6. <i>Carex physodes</i>	perennial	12-15	F	1	dried
7. <i>Ceratocarpus arenarius</i>	annual	15-20	F	1	fruiting
8. <i>Ceratocephala falcata</i>	annual	4-5	R	+	dried
9. <i>Convolvulus hamadae</i>	subshrub	20–25	F	1	Flowering, fruiting
10. <i>Cousinia sogdiana</i>	perennial	25-30	R	+	fruiting
11. <i>Euphorbia turczaninowii</i>	annual	7–10	R	+	dried
12. <i>Ferula foetida</i>	perennial	70-150	F	1	dried
13. <i>Peganum harmala</i>	perennial	25-30	F	1	fruiting
14. <i>Salsola paulsenii</i>	annual	30-35	R	+	fruiting
15. <i>Smirnowia turkestanica</i>	subshrub	30-40	O	+	fruiting
16. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50-70	R	+	fruiting

Table 2. Check-list of plants recorded for [REDACTED] fixed gentle hilly-wavy sands, *Ferula*-desert sedge-*Astragalus*-desert bindweed-*Calligonum* community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	O	+	fruiting
2. <i>Agriophyllum minus</i>	annual	20–25	R	+	fruiting

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
3. <i>Artemisia diffusa</i>	subshrub	30-40	F	2	Flowering, fruiting
4. <i>Astragalus villosissimus</i>	subshrub	30-40	C	2	fruiting
5. <i>Calligonum leucocladum</i>	shrub	50-70	R	+	fruiting
6. <i>Calligonum microcarpum</i>	shrub	50-70	R	+	fruiting
7. <i>Carex physodes</i>	perennial	12-15	F	1	dried
8. <i>Caroxylon scleranthum</i> (<i>Salsola sclerantha</i>)	annual	15-20	O	+	fruiting
9. <i>Ceratocarpus arenarius</i>	annual	15-20	F	1	fruiting
10. <i>Convolvulus hamadae</i>	subshrub	20-25	A	2	Flowering, fruiting
11. <i>Cousinia hamadae</i>	perennial	20-25	R	+	fruiting
12. <i>Cousinia sogdiana</i>	perennial	20-25	R	+	fruiting
13. <i>Ferula foetida</i>	perennial	70-150	A	1	dried
14. <i>Halothamnus subaphyllus</i>	subshrub	30-40	R	+	Flowering, fruiting
15. <i>Horaninovia ulicina</i>	annual	20-25	R	+	fruiting
16. <i>Iris songarica</i>	perennial	30-35	R	+	dried
17. <i>Salsola paulsenii</i>	annual	30-35	F	1	fruiting
18. <i>Smirnowia turkestanica</i>	subshrub	30-40	R	+	fruiting
19. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50-70	O	1	fruiting

Table 3. Check-list of plants recorded for [redacted] wavy sandy plain, *Ferula*-desert sedge-*Astragalus*-desert bindweed community [redacted]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	O	+	fruiting
2. <i>Alhagi pseudalhagi</i>	perennial	25-30	R	+	fruiting
3. <i>Artemisia diffusa</i>	subshrub	30-40	F	2	Flowering, fruiting
4. <i>Astragalus villosissimus</i>	subshrub	30-40	F	1	fruiting
5. <i>Calligonum leucocladum</i>	shrub	50-70	R	+	fruiting
6. <i>Calligonum microcarpum</i>	shrub	50-70	R	+	fruiting
7. <i>Carex physodes</i>	perennial	12-15	F	1	dried
8. <i>Caroxylon scleranthum</i> (<i>Salsola sclerantha</i>)	annual	15-20	O	+	fruiting
9. <i>Ceratocarpus arenarius</i>	annual	15-20	F	1	fruiting
10. <i>Ceratocephala falcata</i>	annual	4-5	R	+	dried
11. <i>Convolvulus hamadae</i>	subshrub	20-25	A	2	Flowering, fruiting
12. <i>Cousinia hamadae</i>	perennial	20-25	R	+	fruiting
13. <i>Cousinia sogdiana</i>	perennial	20-25	R	+	fruiting
14. <i>Ferula foetida</i>	perennial	70-150	A	1	dried
15. <i>Halothamnus subaphyllus</i>	subshrub	30-40	R	+	Flowering, fruiting
16. <i>Horaninovia ulicina</i>	annual	20-25	R	+	fruiting
17. <i>Iris songarica</i>	perennial	30-35	R	+	dried
18. <i>Salsola paulsenii</i>	annual	30-35	F	1	fruiting
19. <i>Smirnowia turkestanica</i>	subshrub	30-40	O	+	fruiting

20. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50-70	O	1	fruiting

Table 4. Check-list of plants recorded for [REDACTED] sandy plain, *Ferula-Iris-ephemeroid-desert* bindweed community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	fruiting
2. <i>Alhagi pseudalhagi</i>	perennial	25-30	R	+	fruiting
3. <i>Artemisia diffusa</i>	subshrub	30-40	F	1	Flowering, fruiting
4. <i>Astragalus villosissimus</i>	subshrub	30-40	F	1	fruiting
5. <i>Carex physodes</i>	perennial	12-15	O	+	dried
6. <i>Caroxylon scleranthum</i> (<i>Salsola sclerantha</i>)	annual	15-20	O	+	fruiting
7. <i>Ceratocarpus arenarius</i>	annual	15-20	F	1	fruiting
8. <i>Convolvulus hamadae</i>	subshrub	25-30	A	2	Flowering, fruiting
9. <i>Cousinia hamadae</i>	perennial	25-30	O	+	fruiting
10. <i>Ferula foetida</i>	perennial	70-150	C	1	dried
11. <i>Halothamnus subaphyllus</i>	subshrub	30-40	R	+	Flowering, fruiting
12. <i>Horaninovia ulicina</i>	annual	20-25	R	+	fruiting
13. <i>Iris songarica</i>	perennial	30-35	O	+	dried
14. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	O	+	fruiting
15. <i>Peganum harmala</i>	perennial	25-30	R	+	fruiting
16. <i>Poa bulbosa</i>	perennial	15-20	O	+	dried
17. <i>Salsola paulsenii</i>	annual	20-25	O	+	fruiting
18. <i>Smirnowia turkestanica</i>	subshrub	30-40	O	+	fruiting
19. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50-70	R	+	fruiting

Table 5. Check-list of plants recorded for [REDACTED] sandy plain, *Ferula-Iris-desert* bindweed-ephemeroid-sagebrush community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	fruiting
2. <i>Alhagi pseudalhagi</i>	perennial	25-30	R	+	fruiting
3. <i>Artemisia diffusa</i>	subshrub	30-40	F	2	Flowering, fruiting
4. <i>Astragalus villosissimus</i>	subshrub	30-40	O	1	fruiting
5. <i>Carex physodes</i>	perennial	12-15	O	+	dried
6. <i>Caroxylon scleranthum</i> (<i>Salsola sclerantha</i>)	annual	15-20	O	+	fruiting
7. <i>Ceratocarpus arenarius</i>	annual	15-20	O	+	fruiting
8. <i>Convolvulus hamadae</i>	subshrub	25-30	C	2	Flowering, fruiting
9. <i>Ferula foetida</i>	perennial	70-150	F	1	dried
10. <i>Halothamnus subaphyllus</i>	subshrub	30-40	R	+	Flowering, fruiting
11. <i>Iris songarica</i>	perennial	30-35	O	+	dried

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
12. Oreosalsola arbusculiformis (Salsola arbusculiformis)	shrub	30-40	R	+	fruiting
13. Peganum harmala	perennial	25-30	R	+	fruiting
14. Poa bulbosa	perennial	15-20	O	+	dried
15. Smirnowia turkestanica	subshrub	30-40	O	+	fruiting
16. Xylosalsola arbuscula (Salsola arbuscula)	shrub	50-70	R	+	fruiting

Table 6. Check-list of plants recorded for [REDACTED] sandy plain, Iris-Ferula-sagebrush-desert bindweed community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Acanthophyllum elatius	perennial	25-30	R	+	fruiting
2. Alhagi pseudalhagi	perennial	25-30	R	+	fruiting
3. Artemisia diffusa	subshrub	25-30	F	2	Flowering, fruiting
4. Artemisia turanica	subshrub	25-30	O	+	Flowering, fruiting
5. Astragalus villosissimus	subshrub	30-40	O	+	fruiting
6. Bromus tectorum	annual	12-15	O	+	dried
7. Carex physodes	perennial	12-15	O	+	dried
8. Caroxylon scleranthum (Salsola sclerantha)	annual	15-20	O	+	fruiting
9. Convolvulus hamadae	subshrub	25-30	A	2	Flowering, fruiting
10. Cousinia hamadae	perennial	15-20	O	+	fruiting
11. Ferula foetida	perennial	70-150	F	+	dried
12. Halothamnus subaphyllus	subshrub	30-40	R	+	Flowering, fruiting
13. Haloxylon ammodendron	Small tree	70-100	R	+	vegetation
14. Iris songarica	perennial	30-35	F	1	dried
15. Peganum harmala	perennial	25-30	R	+	fruiting
16. Poa bulbosa	perennial	15-20	O	+	dried
17. Smirnowia turkestanica	subshrub	20-30	R	+	fruiting

Table 7. Check-list of plants recorded for [REDACTED] saline land and old fallow land near the Agytma discharge channel, camel thorn-saltwort-tamarisk community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Aeluropus litoralis	perennial	15-20	O	+	fruiting
2. Alhagi pseudalhagi	perennial	30-40	C	2	fruiting
3. Bromus tectorum	annual	12-15	R	+	dried
4. Ceratocarpus arenarius	annual	15-20	F	1	fruiting
5. Climacoptera amblyostegia	annual	25-30	O	+	fruiting
6. Climacoptera lanata	annual	25-30	F	1	fruiting
7. Ferula foetida	perennial	70-150	R	+	dried
8. Halocharis hispida	annual	15-20	O	+	Flowering, fruiting

9. <i>Karelinia caspia</i>	perennial	40-50	F	1	Flowering, fruiting
10. <i>Lycium ruthenicum</i>	shrub	40-50	F	1	Flowering, fruiting
11. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	O	1	fruiting
12. <i>Peganum harmala</i>	perennial	25-30	F	1	fruiting
13. <i>Phragmites australis</i>	perennial	100-150	F	1	fruiting
14. <i>Salsola paulsenii</i>	annual	25-30	O	1	fruiting
15. <i>Suaeda altissima</i>	annual	40-50	O	+	fruiting
16. <i>Suaeda arcuata</i>	annual	25-30	O	+	fruiting
17. <i>Tamarix laxa</i>	shrub	150-170	F	1	vegetation
18. <i>Tamarix hohenackeri</i>	shrub	150-200	F	1	fruiting
19. <i>Typha latifolia</i>	perennial	100-150	F	1	fruiting
20. <i>Zygophyllum oxianum</i>	perennial	25-30	O	+	fruiting

Table 8. Check-list of plants recorded for [redacted] fixed sands, *Ferula*-desert sedge-*Astragalus*-desert bindweed-*Calligonum* community [redacted]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Artemisia diffusa</i>	subshrub	30-40	F	1	Flowering, fruiting
2. <i>Astragalus villosissimus</i>	subshrub	30-40	F	1	fruiting
3. <i>Calligonum leucocladum</i>	shrub	100-120	O	1	fruiting
4. <i>Calligonum microcarpum</i>	shrub	70-100	O	1	fruiting
5. <i>Carex physodes</i>	perennial	12-15	F	1	dried
6. <i>Caroxylon scleranthum</i> (<i>Salsola sclerantha</i>)	annual	15-20	R	+	fruiting
7. <i>Ceratocarpus arenarius</i>	annual	15-20	F	1	fruiting
8. <i>Convolvulus hamadae</i>	subshrub	25-30	O	1	Flowering, fruiting
9. <i>Cousinia hamadae</i>	perennial	25-30	R	+	fruiting
10. <i>Cousinia sogdiana</i>	perennial	25-30	R	+	fruiting
11. <i>Ferula foetida</i>	perennial	70-150	F	1	dried
12. <i>Iris songarica</i>	perennial	30-35	R	+	dried
13. <i>Peganum harmala</i>	perennial	25-30	R	+	fruiting
14. <i>Poa bulbosa</i>	perennial	15-20	F	1	dried
15. <i>Salsola paulsenii</i>	annual	25-30	F	1	fruiting
16. <i>Smirnowia turkestanica</i>	perennial	25-30	O	1	fruiting

Table 9. Check-list of plants recorded for [redacted] fixed sands, *Calligonum*-desert sedge-sagebrush-desert bindweed community [redacted]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Allium sabulosum</i>	perennial	25-30	R	+	dried
2. <i>Artemisia diffusa</i>	subshrub	30-40	F	1	Flowering, fruiting
3. <i>Astragalus villosissimus</i>	subshrub	30-40	F	1	fruiting
4. <i>Calligonum leucocladum</i>	shrub	100-120	O	1	fruiting
5. <i>Calligonum microcarpum</i>	shrub	70-100	O	1	fruiting
6. <i>Calligonum zakirovii</i>	shrub	50-70	R	+	fruiting

7. <i>Carex physodes</i>	perennial	12-15	C	1	dried
8. <i>Ceratocarpus arenarius</i>	annual	15-20	F	1	fruiting
9. <i>Ceratocephala falcata</i>	annual	4-5	R	+	dried
10. <i>Convolvulus hamadae</i>	subshrub	25-30	F	1	Flowering, fruiting
11. <i>Cousinia hamadae</i>	perennial	25-30	R	+	fruiting
12. <i>Cousinia sogdiana</i>	perennial	25-30	R	+	fruiting
13. <i>Ferula foetida</i>	perennial	70-150	F	1	dried
14. <i>Iris songarica</i>	perennial	30-35	R	+	dried
15. <i>Peganum harmala</i>	perennial	25-30	R	+	fruiting
16. <i>Poa bulbosa</i>	perennial	15-20	F	1	dried
17. <i>Salsola paulsenii</i>	annual	25-30	F	1	fruiting
18. <i>Smirnowia turkestanica</i>	perennial	25-30	R	+	fruiting

Table 10. Check-list of plants recorded for [redacted] gentle wavy-hilly fixed sands, *Calligonum*-desert sedge-*Astragalus*-desert bindweed community [redacted]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Artemisia diffusa</i>	subshrub	30-40	O	1	Flowering, fruiting
2. <i>Astragalus villosissimus</i>	subshrub	25-30	C	2	fruiting
3. <i>Calligonum leucocladum</i>	shrub	100-120	O	1	fruiting
4. <i>Calligonum microcarpum</i>	shrub	50-70	F	1	vegetation
5. <i>Carex physodes</i>	perennial	12-15	F	1	dried
6. <i>Ceratocarpus arenarius</i>	annual	15-20	F	1	fruiting
7. <i>Convolvulus hamadae</i>	subshrub	20-25	C	2	Flowering, fruiting
8. <i>Ferula foetida</i>	perennial	70-150	F	1	dried
9. <i>Halothamnus subaphyllus</i>	subshrub	30-40	R	+	Flowering, fruiting
10. <i>Iris songarica</i>	perennial	30-35	R	+	dried
11. <i>Salsola paulsenii</i>	annual	25-30	O	+	fruiting
12. <i>Smirnowia turkestanica</i>	subshrub	30-40	O	+	fruiting

Table 11. Check-list of plants recorded for [redacted] gentle wavy-hilly fixed sands, *Calligonum*-desert sedge-*Astragalus*-desert bindweed community [redacted]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	O	+	fruiting
2. <i>Artemisia diffusa</i>	subshrub	30-40	F	1	Flowering, fruiting
3. <i>Astragalus villosissimus</i>	subshrub	25-30	C	2	Flowering, fruiting
4. <i>Calligonum microcarpum</i>	shrub	50-70	F	1	vegetation
5. <i>Carex physodes</i>	perennial	12-15	F	1	dried
6. <i>Caroxylon scleranthum</i> (<i>Salsola sclerantha</i>)	annual	15-20	O	+	fruiting
7. <i>Convolvulus hamadae</i>	subshrub	20-25	C	2	Flowering, fruiting
8. <i>Ephedra strobilacea</i>	shrub	70-100	R	+	vegetation
9. <i>Ferula foetida</i>	perennial	70-150	O	+	dried

10. <i>Halothamnus subaphyllus</i>	subshrub	30-40	O	+	Flowering, fruiting
11. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	O	1	fruiting
12. <i>Salsola paulsenii</i>	annual	25-30	O	+	fruiting
13. <i>Smirnowia turkestanica</i>	subshrub	30-40	O	+	fruiting
14. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	70-100	O	1	fruiting

Table 12. Check-list of plants recorded for [REDACTED] gentle wavy-hilly fixed sands, *Calligonum*-desert sedge-*Astragalus*-desert bindweed community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	O	+	fruiting
2. <i>Artemisia diffusa</i>	subshrub	30-40	F	1	Flowering, fruiting
3. <i>Astragalus villosissimus</i>	subshrub	25-30	C	2	Flowering, fruiting
4. <i>Calligonum microcarpum</i>	shrub	50-70	F	1	vegetation
5. <i>Carex physodes</i>	perennial	12-15	F	1	dried
6. <i>Caroxylon scleranthum</i> (<i>Salsola sclerantha</i>)	annual	15-20	O	+	fruiting
7. <i>Convolvulus hamadae</i>	subshrub	20-25	C	2	Flowering, fruiting
8. <i>Ephedra strobilacea</i>	shrub	70-100	R	+	vegetation
9. <i>Ferula foetida</i>	perennial	70-150	O	+	dried
10. <i>Halothamnus subaphyllus</i>	subshrub	30-40	O	+	Flowering, fruiting
11. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	O	1	fruiting
12. <i>Salsola paulsenii</i>	annual	25-30	O	+	fruiting
13. <i>Smirnowia turkestanica</i>	subshrub	30-40	O	+	fruiting
14. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	70-100	O	1	fruiting

Table 13. Check-list of plants recorded for [REDACTED] fixed hilly sands, *Ferula*-*Astragalus*-white saltwort-*Calligonum* community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	fruiting
2. <i>Agriophyllum minus</i>	annual	20-25	R	+	fruiting
3. <i>Artemisia diffusa</i>	subshrub	30-40	O	1	Flowering, fruiting
4. <i>Astragalus villosissimus</i>	subshrub	30-40	C	2	fruiting
5. <i>Bromus tectorum</i>	annual	12-15	O	+	dried
6. <i>Calligonum microcarpum</i>	shrub	100-120	F	1	fruiting
7. <i>Caroxylon scleranthum</i> (<i>Salsola sclerantha</i>)	annual	15-20	R	+	fruiting
8. <i>Carex physodes</i>	perennial	20-25	O	+	dried
9. <i>Ceratocarpus arenarius</i>	annual	15-20	F	1	fruiting
10. <i>Ceratocephala falcata</i>	annual	4-5	R	+	dried

11. Convolvulus hamadae	subshrub	20-25	C	2	Flowering, fruiting
12. Euphorbia turczaninowii	annual	5-7	R	+	dried
13. Ferula foetida	perennial	70-150	F	1	dried
14. Halothamnus subaphyllus	subshrub	30-40	O	+	Flowering, fruiting
15. Iris songarica	perennial	30-35	R	+	dried
16. Mausolea eriocarpa	subshrub	40-50	R	+	fruiting
17. Oreosalsola arbusculiformis (Salsola arbusculiformis)	shrub	30-40	R	+	fruiting
18. Poa bulbosa	perennial	15-20	O	+	dried
19. Salsola paulsenii	annual	25-30	O	+	fruiting
20. Xylosalsola arbuscula (Salsola arbuscula)	shrub	70-100	O	1	fruiting

Table 14. Check-list of plants recorded for [REDACTED] fixed hilly sands, surroundings of farmstead, overgrazed Ferula-Astragalus-desert bindweed-sagebrush community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Agriophyllum minus	annual	20-25	R	+	fruiting
2. Artemisia diffusa	subshrub	30-40	F	1	Flowering, fruiting
3. Astragalus villosissimus	subshrub	30-40	F	1	fruiting
4. Bromus tectorum	annual	12-15	O	+	dried
5. Calligonum microcarpum	shrub	100-120	R	+	vegetation
6. Carex physodes	perennial	20-25	F	1	dried
7. Caroxylon scleranthum (Salsola sclerantha)	annual	15-20	R	+	fruiting
8. Ceratocarpus arenarius	annual	15-20	A	2	fruiting
9. Ceratocephala falcata	annual	4-5	O	+	dried
10. Convolvulus hamadae	subshrub	20-25	C	2	fruiting
11. Ferula foetida	perennial	70-150	F	1	dried
12. Halothamnus subaphyllus	subshrub	30-40	O	+	Flowering, fruiting
13. Haloxylon ammodendron	Small tree	50-70	R	+	vegetation
14. Iris songarica	perennial	30-35	R	+	dried
15. Koelpinia linearis	annual	12-15	O	+	dried
16. Oreosalsola arbusculiformis (Salsola arbusculiformis)	shrub	30-40	R	+	fruiting
17. Peganum harmala	perennial	30-35	R	+	fruiting
18. Poa bulbosa	perennial	15-20	O	+	dried
19. Salsola paulsenii	annual	25-30	O	+	fruiting
20. Xylosalsola arbuscula (Salsola arbuscula)	shrub	70-100	R	+	fruiting

Table 15. Check-list of plants recorded for [REDACTED] fixed hilly sands, Ferula-desert sedge-desert bindweed-sagebrush community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Artemisia diffusa	subshrub	30-40	A	3	Flowering, fruiting

2. <i>Astragalus villosissimus</i>	subshrub	30-40	O	1	fruiting
3. <i>Bromus tectorum</i>	annual	12-15	O	+	dried
4. <i>Calligonum microcarpum</i>	shrub	100-120	O	1	vegetation
5. <i>Carex physodes</i>	perennial	15-20	F	1	dried
6. <i>Caroxylon scleranthum</i> (<i>Salsola sclerantha</i>)	annual	15-20	O	+	fruiting
7. <i>Ceratocarpus arenarius</i>	annual	15-20	C	2	fruiting
8. <i>Convolvulus hamadae</i>	subshrub	20-25	C	2	Flowering, fruiting
9. <i>Ferula foetida</i>	perennial	70-150	F	1	dried
10. <i>Iris songarica</i>	perennial	30-35	R	+	dried
11. <i>Koelpinia linearis</i>	annual	12-15	R	+	dried
12. <i>Mausolea eriocarpa</i>	subshrub	40-50	R	+	fruiting
13. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	R	+	fruiting
14. <i>Poa bulbosa</i>	perennial	15-20	O	+	dried
15. <i>Smirnowia turkestanica</i>	subshrub	30-40	F	1	fruiting
16. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	70-100	O	1	fruiting

Table 16. Check-list of plants recorded for [redacted] gentle wavy sandy plain, *Ferula*-*Iris*-desert bindweed-ephemeroid-sagebrush community [redacted]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Agriophyllum minus</i>	annual	20-25	R	+	fruiting
2. <i>Artemisia diffusa</i>	subshrub	30-40	A	2	Flowering, fruiting
3. <i>Astragalus villosissimus</i>	subshrub	30-40	R	+	fruiting
4. <i>Calligonum leucocladum</i>	shrub	50-70	R	+	fruiting
5. <i>Carex physodes</i>	perennial	12-15	F	1	dried
6. <i>Caroxylon scleranthum</i> (<i>Salsola sclerantha</i>)	annual	15-20	O	+	fruiting
7. <i>Ceratocarpus arenarius</i>	annual	15-20	F	1	fruiting
8. <i>Convolvulus hamadae</i>	subshrub	25-30	A	2	Flowering, fruiting
9. <i>Ferula foetida</i>	perennial	70-150	F	1	dried
10. <i>Halothamnus subaphyllus</i>	subshrub	30-40	O	+	Flowering, fruiting
11. <i>Haloxylon ammodendron</i>	Small tree	100-150	R	+	vegetation
12. <i>Iris songarica</i>	perennial	30-35	O	+	dried
13. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	O	1	fruiting
14. <i>Peganum harmala</i>	perennial	25-30	O	+	fruiting
15. <i>Poa bulbosa</i>	perennial	15-20	A	1	dried
16. <i>Salsola paulsenii</i>	annual	25-30	F	1	fruiting
17. <i>Smirnowia turkestanica</i>	subshrub	30-40	F	1	fruiting
18. <i>Stipagrostis pennata</i>	perennial	30-40	R	+	fruiting
19. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50-70	R	+	fruiting

Table 17. Check-list of plants recorded for [REDACTED] fixed gentle hilly-wavy sands, Ferula-desert sedge-desert bindweed-sagebrush-white saxaul community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Acanthophyllum elatius	perennial	25-30	R	+	fruiting
2. Artemisia diffusa	subshrub	30-40	C	2	Flowering, fruiting
3. Astragalus villosissimus	subshrub	30-40	O	+	fruiting
4. Atriplex dimorphostegia	annual	10-15	R	+	fruiting
5. Bromus tectorum	annual	12-15	O	+	dried
6. Calligonum microcarpum	shrub	70-100	R	+	vegetation
7. Carex physodes	perennial	15-20	F	1	dried
8. Ceratocarpus arenarius	annual	15-20	O	+	fruiting
9. Convolvulus hamadae	subshrub	20-25	F	1	Flowering, fruiting
10. Cousinia sogdiana	perennial	25-30	R	+	fruiting
11. Ferula foetida	perennial	70-150	F	1	dried
12. Haloxylon ammodendron	Small tree	150-170	F	2	vegetation
13. Haloxylon persicum	Small tree	150-170	F	2	vegetation
14. Halothamnus subaphyllus	subshrub	30-40	O	+	Flowering, fruiting
15. Iris songarica	perennial	30-35	O	+	dried
16. Oreosalsola arbusculiformis (Salsola arbusculiformis)	shrub	30-40	O	1	fruiting
17. Peganum harmala	perennial	20-25	R	+	fruiting
18. Poa bulbosa	perennial	15-20	F	1	dried
19. Salsola paulsenii	annual	25-30	O	+	fruiting
20. Smirnowia turkestanica	subshrub	30-40	O	+	fruiting
21. Stipagrostis pennata	perennial	30-40	O	+	fruiting
22. Xylosalsola arbuscula (Salsola arbuscula)	shrub	50-70	O	1	fruiting

Table 18. Check-list of plants recorded for [REDACTED] fixed gentle hilly-wavy sands, Ferula-desert sedge-desert bindweed-sagebrush-saxaul community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Acanthophyllum elatius	perennial	25-30	R	+	fruiting
2. Agriophyllum minus	annual	20-25	R	+	fruiting
3. Artemisia diffusa	subshrub	30-40	C	2	Flowering, fruiting
4. Astragalus villosissimus	subshrub	30-40	F	1	fruiting
5. Calligonum microcarpum	shrub	70-100	R	+	vegetation
6. Carex physodes	perennial	15-20	F	1	dried
7. Ceratocarpus arenarius	annual	15-20	R	+	fruiting
8. Convolvulus hamadae	subshrub	20-25	C	2	Flowering, fruiting
9. Cousinia hamadae	perennial	15-20	R	+	fruiting
10. Cousinia sogdiana	perennial	25-30	R	+	fruiting
11. Ferula foetida	perennial	70-150	F	1	dried
12. Haloxylon ammodendron	Small tree	150-170	F	2	vegetation
13. Halimocnemis gamocarpa	annual	15-20	R	+	Flowering, fruiting

14. Halothamnus subaphyllus	subshrub	30-40	F	1	Flowering, fruiting
15. Haloxylon ammodendron	Small tree	150-170	F	2	vegetation
16. Haloxylon persicum	Small tree	150-170	F	2	vegetation
17. Iris songarica	perennial	30-35	O	+	dried
18. Oreosalsola arbusculiformis (Salsola arbusculiformis)	shrub	30-40	O	1	fruiting
19. Poa bulbosa	perennial	15-20	F	1	dried
20. Salsola paulsenii	annual	25-30	F	1	fruiting
21. Smirnowia turkestanica	subshrub	30-40	O	+	fruiting
22. Stipagrostis pennata	perennial	30-40	F	1	fruiting
23. Xylosalsola arbuscula (Salsola arbuscula)	shrub	50-70	O	1	fruiting

Table 19. Check-list of plants recorded for [redacted] fixed gentle hilly-wavy sands, Ferula-desert sedge-desert bindweed-sagebrush-saxaul community [redacted]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Acanthophyllum elatius	perennial	25-30	R	+	fruiting
2. Agriophyllum minus	annual	20-25	R	+	fruiting
3. Artemisia diffusa	subshrub	30-40	C	2	Flowering, fruiting
4. Astragalus villosissimus	subshrub	30-40	F	1	fruiting
5. Calligonum microcarpum	shrub	70-100	R	+	vegetation
6. Carex physodes	perennial	15-20	F	1	dried
7. Ceratocarpus arenarius	annual	15-20	R	+	fruiting
8. Convolvulus hamadae	subshrub	20-25	C	2	Flowering, fruiting
9. Cousinia hamadae	perennial	15-20	R	+	fruiting
10. Cousinia sogdiana	perennial	25-30	R	+	fruiting
11. Ferula foetida	perennial	70-150	F	1	dried
12. Haloxylon ammodendron	Small tree	150-170	F	2	vegetation
13. Halimocnemis gamocarpa	annual	15-20	R	+	Flowering, fruiting
14. Halothamnus subaphyllus	subshrub	30-40	F	1	Flowering, fruiting
15. Haloxylon ammodendron	Small tree	150-170	F	2	vegetation
16. Haloxylon persicum	Small tree	150-170	F	2	vegetation
17. Iris songarica	perennial	30-35	O	+	dried
18. Oreosalsola arbusculiformis (Salsola arbusculiformis)	shrub	30-40	O	1	fruiting
19. Poa bulbosa	perennial	15-20	F	1	dried
20. Salsola paulsenii	annual	25-30	F	1	fruiting
21. Smirnowia turkestanica	subshrub	30-40	O	+	fruiting
22. Stipagrostis pennata	perennial	30-40	F	1	fruiting
23. Xylosalsola arbuscula (Salsola arbuscula)	shrub	50-70	O	1	fruiting

Table 20. Check-list of plants recorded for [redacted] fixed gentle hilly-wavy sands, Ferula-desert sedge-desert bindweed-sagebrush community with black saxaul plantations [redacted]

Species	Life form		Abundance

		Height, cm	DACFOR	Braun- Blanquet	Phenol. Stage
1. Acanthophyllum elatius	perennial	25-30	R	+	fruiting
2. Agriophyllum minus	annual	20-25	R	+	fruiting
3. Artemisia diffusa	subshrub	30-40	C	2	Flowering, fruiting
4. Astragalus villosissimus	subshrub	30-40	F	1	fruiting
5. Calligonum microcarpum	shrub	70-100	R	+	vegetation
6. Carex physodes	perennial	15-20	F	1	dried
7. Ceratocarpus arenarius	annual	15-20	R	+	fruiting
8. Convolvulus hamadae	subshrub	20-25	C	2	Flowering, fruiting
9. Cousinia hamadae	perennial	15-20	R	+	fruiting
10. Cousinia sogdiana	perennial	25-30	R	+	fruiting
11. Euphorbia turczaninowii	annual	5-7	R	+	dried
12. Ferula foetida	perennial	70-150	F	1	dried
13. Haloxylon ammodendron	Small tree	150-170	F	2	vegetation
14. Halimocnemis gamocarpa	annual	15-20	R	+	Flowering, fruiting
15. Halothamnus subaphyllus	subshrub	30-40	O	+	Flowering, fruiting
16. Haloxylon ammodendron	Small tree	150-170	F	2	vegetation
17. Iris songarica	perennial	30-35	O	+	dried
18. Oreosalsola arbusculiformis (Salsola arbusculiformis)	shrub	30-40	O	1	fruiting
19. Poa bulbosa	perennial	15-20	F	1	dried
20. Salsola paulsenii	annual	25-30	O	+	fruiting
21. Smirnowia turkestanica	subshrub	30-40	O	+	fruiting
22. Stipagrostis pennata	perennial	30-40	R	+	fruiting
23. Xylosalsola arbuscula (Salsola arbuscula)	shrub	50-70	O	1	fruiting

Table 21. Check-list of plants recorded for [REDACTED] sandy plain, Ferula-desert bindweed-saltwort-sagebrush community with black saxaul plantations [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun- Blanquet	
1. Acanthophyllum elatius	perennial	25-30	O	+	fruiting
2. Artemisia diffusa	subshrub	25-30	C	2	Flowering, fruiting
3. Artemisia turanica	subshrub	25-30	O	+	Flowering, fruiting
4. Astragalus villosissimus	subshrub	30-40	R	+	fruiting
5. Bromus tectorum	annual	12-15	O	+	dried
6. Carex physodes	perennial	15-20	F	1	dried
7. Ceratocarpus arenarius	annual	15-20	O	+	fruiting
8. Ceratocephala falcata	annual	4-5	R	+	dried
9. Convolvulus hamadae	subshrub	20-25	C	2	Flowering, fruiting
10. Cousinia hamadae	perennial	15-20	R	+	fruiting
11. Ferula foetida	perennial	70-150	F	1	dried
12. Halimocnemis gamocarpa	annual	15-20	O	+	Flowering, fruiting

13. <i>Halothamnus subaphyllus</i>	subshrub	30-40	O	+	Flowering, fruiting
14. <i>Haloxylon ammodendron</i>	Small tree	150-170	F	2	vegetation
15. <i>Iris songarica</i>	perennial	30-35	O	+	dried
16. <i>Lycium ruthenicum</i>	shrub	40-50	R	+	Flowering, fruiting
17. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	F	2	fruiting
18. <i>Peganum harmala</i>	perennial	20-25	R	+	fruiting
19. <i>Poa bulbosa</i>	perennial	15-20	O	+	dried
20. <i>Salsola paulsenii</i>	annual	25-30	O	+	fruiting
21. <i>Smirnowia turkestanica</i>	subshrub	30-40	R	+	fruiting
22. <i>Sophora pachycarpa</i>	perennial	20-25	R	+	vegetation
23. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50-70	O	1	fruiting

Table 22. Check-list of plants recorded for [REDACTED] sabulous-loamy plain, *Ferula*-desert bindweed-saltwort-sagebrush community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	fruiting
2. <i>Alhagi pseudalhagi</i>	perennial	25-30	O	1	fruiting
3. <i>Artemisia diffusa</i>	subshrub	25-30	F	1	Flowering, fruiting
4. <i>Artemisia turanica</i>	subshrub	25-30	F	1	Flowering, fruiting
5. <i>Astragalus villosissimus</i>	subshrub	30-40	R	+	fruiting
6. <i>Carex physodes</i>	perennial	15-20	O	+	dried
7. <i>Caroxylon scleranthum</i> (<i>Salsola sclerantha</i>)	annual	15-20	O	+	fruiting
8. <i>Ceratocarpus arenarius</i>	annual	15-20	O	+	fruiting
9. <i>Convolvulus hamadae</i>	subshrub	20-25	C	2	Flowering, fruiting
10. <i>Ferula foetida</i>	perennial	70-150	O	+	dried
11. <i>Halimocnemis gamocarpa</i>	annual	15-20	O	+	Flowering, fruiting
12. <i>Halothamnus subaphyllus</i>	subshrub	30-40	R	+	Flowering, fruiting
13. <i>Haloxylon ammodendron</i>	Small tree	50-70	R	+	vegetation
14. <i>Iris songarica</i>	perennial	30-35	F	1	dried
15. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	F	2	fruiting
16. <i>Peganum harmala</i>	perennial	20-25	O	+	fruiting
17. <i>Poa bulbosa</i>	perennial	15-20	F	+	dried
18. <i>Smirnowia turkestanica</i>	subshrub	30-40	R	+	fruiting
19. <i>Tulipa lehmanniana</i>	perennial	15-20	R	+	dried
20. <i>Tulipa sogdiana</i>	perennial	10-12	R	+	dried

Table 23. Check-list of plants recorded for [REDACTED] sabulous-loamy plain, *Ferula*-desert bindweed-saltwort-sagebrush community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	

1. Acanthophyllum elatius	perennial	25-30	R	+	fruiting
2. Alhagi pseudalhagi	perennial	25-30	O	1	fruiting
3. Artemisia diffusa	subshrub	25-30	F	1	Flowering, fruiting
4. Artemisia turanica	subshrub	25-30	F	1	Flowering, fruiting
5. Astragalus villosissimus	subshrub	30-40	R	+	fruiting
6. Carex physodes	perennial	15-20	O	+	dried
7. Caroxylon scleranthum (Salsola sclerantha)	annual	15-20	O	+	fruiting
8. Ceratocarpus arenarius	annual	15-20	O	+	fruiting
9. Convolvulus hamadae	subshrub	20-25	C	2	Flowering, fruiting
10. Ferula foetida	perennial	70-150	O	+	dried
11. Halimocnemis gamocarpa	annual	15-20	O	+	Flowering, fruiting
12. Halothamnus subaphyllus	subshrub	30-40	R	+	Flowering, fruiting
13. Haloxylon ammodendron	Small tree	50-70	R	+	vegetation
14. Iris songarica	perennial	30-35	F	1	dried
15. Oreosalsola arbusculiformis (Salsola arbusculiformis)	shrub	30-40	F	2	fruiting
16. Peganum harmala	perennial	20-25	O	+	fruiting
17. Poa bulbosa	perennial	15-20	F	+	dried
18. Smirnowia turkestanica	subshrub	30-40	R	+	fruiting
19. Tulipa lehmanniana	perennial	15-20	R	+	dried
20. Tulipa sogdiana	perennial	10-12	R	+	dried

Table 24. Check-list of plants recorded for  sabulous-loamy plain, Ferula-sagebrush-saltwort-Iris community with solitary black saxaul 

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Acanthophyllum elatius	perennial	25-30	R	+	fruiting
2. Artemisia diffusa	subshrub	30-40	F	1	Flowering, fruiting
3. Artemisia turanica	subshrub	30-40	O	+	Flowering, fruiting
4. Astragalus villosissimus	subshrub	30-40	R	+	fruiting
5. Carex physodes	perennial	15-20	O	+	dried
6. Caroxylon scleranthum (Salsola sclerantha)	annual	15-20	O	+	fruiting
7. Ceratocarpus arenarius	annual	15-20	O	+	fruiting
8. Ceratocephala falcata	annual	4-5	R	+	dried
9. Convolvulus hamadae	subshrub	20-25	F	1	Flowering, fruiting
10. Cousinia hamadae	perennial	15-20	O	+	fruiting
11. Diarthron vesiculosum	annual	12-15	O	+	dried
12. Ferula foetida	perennial	70-150	O	+	dried
13. Halimocnemis macrantha	annual	12-15	R	+	Flowering, fruiting
14. Halothamnus subaphyllus	subshrub	30-40	O	+	Flowering, fruiting

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
15. Haloxylon ammodendron	Small tree	100-150	R	+	vegetation
16. Iris songarica	perennial	30-35	O	+	dried
17. Oreosalsola arbusculiformis (Salsola arbusculiformis)	shrub	30-40	F	1	fruiting
18. Peganum harmala	perennial	20-25	O	+	fruiting
19. Poa bulbosa	perennial	15-20	O	+	dried
20. Zygophyllum miniatum	perennial	10-12	R	+	fruiting

Table 25. Check-list of plants recorded for [REDACTED] saline lands and old fallows land near the Agytma discharge channel, camel thorn-saltwort-tamarisk community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Aeluropus littoralis	perennial	15-20	F	1	fruiting
2. Alhagi pseudalhagi	perennial	30-40	F	1	vegetation
3. Artemisia subsalsa	subshrub	25-30	O	+	budding
4. Bromus tectorum	annual	12-15	R	+	dried
5. Caroxylon scleranthum (Salsola sclerantha)	annual	20-25	O	+	fruiting
6. Ceratocarpus arenarius	annual	15-20	F	1	fruiting
7. Climacoptera ferganica	annual	25-30	O	+	fruiting
8. Climacoptera lanata	annual	25-30	F	1	fruiting
9. Climacoptera minkvitzi	annual	25-30	O	+	fruiting
10. Convolvulus hamadae	subshrub	20-25	F	1	Flowering, fruiting
11. Cousinia hamadae	perennial	25-30	O	+	fruiting
12. Ferula foetida	perennial	70-150	O	+	dried
13. Halocharis hispida	annual	15-20	O	+	Flowering, fruiting
14. Halostachys caspica	shrub	70-100	O	1	Flowering, fruiting
15. Halothamnus subaphyllus	subshrub	30-40	O	+	Flowering, fruiting
16. Karelinia caspia	perennial	40-50	F	1	Flowering, fruiting
17. Lycium ruthenicum	shrub	50-70	F	1	Flowering, fruiting
18. Peganum harmala	perennial	25-30	F	1	fruiting
19. Phragmites australis	perennial	100-150	C	2	fruiting
20. Poa bulbosa	perennial	15-20	O	+	dried
21. Salsola paulsenii	annual	25-30	O	+	fruiting
22. Sophora pachycarpa	perennial	20-25	O	+	fruiting
23. Suaeda arcuata	annual	25-30	O	+	fruiting
24. Tamarix laxa	shrub	150-170	F	1	vegetation
25. Tamarix hohenackeri	shrub	150-200	F	1	fruiting
26. Tamarix ramosissima	shrub	150-200	F	1	Flowering, fruiting
27. Typha latifolia	perennial	100-150	O	1	fruiting
28. Zygophyllum oxianum	perennial	25-30	O	1	fruiting

Table 26. Check-list of plants recorded for [REDACTED] saline lands and old fallows land near the Agytma discharge channel, camel thorn-saltwort-tamarisk community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Aeluropus litoralis	perennial	15-20	F	1	fruiting
2. Alhagi pseudalhagi	perennial	30-40	F	1	vegetation
3. Artemisia subsalsa	subshrub	25-30	O	+	budding
4. Bromus tectorum	annual	12-15	R	+	dried
5. Caroxylon scleranthum (Salsola sclerantha)	annual	20-25	O	+	fruiting
6. Ceratocarpus arenarius	annual	15-20	F	1	fruiting
7. Climacoptera ferganica	annual	25-30	O	+	fruiting
8. Climacoptera lanata	annual	25-30	F	1	fruiting
9. Climacoptera minkvitiae	annual	25-30	O	+	fruiting
10. Convolvulus hamadae	subshrub	20-25	F	1	Flowering, fruiting
11. Cousinia hamadae	perennial	25-30	O	+	fruiting
12. Ferula foetida	perennial	70-150	O	+	dried
13. Halocharis hispida	annual	15-20	O	+	Flowering, fruiting
14. Halostachys caspica	shrub	70-100	O	1	Flowering, fruiting
15. Halothamnus subaphyllus	subshrub	30-40	O	+	Flowering, fruiting
16. Karelinia caspia	perennial	40-50	F	1	Flowering, fruiting
17. Lycium ruthenicum	shrub	50-70	F	1	Flowering, fruiting
18. Peganum harmala	perennial	25-30	F	1	fruiting
19. Phragmites australis	perennial	100-150	C	2	fruiting
20. Poa bulbosa	perennial	15-20	O	+	dried
21. Salsola paulsenii	annual	25-30	O	+	fruiting
22. Sophora pachycarpa	perennial	20-25	O	+	fruiting
23. Suaeda arcuata	annual	25-30	O	+	fruiting
24. Tamarix laxa	shrub	150-170	F	1	vegetation
25. Tamarix hohenackeri	shrub	150-200	F	1	fruiting
26. Tamarix ramosissima	shrub	150-200	F	1	Flowering, fruiting
27. Typha latifolia	perennial	100-150	O	1	fruiting
28. Zygophyllum oxianum	perennial	25-30	O	1	fruiting

Table 27. Check-list of plants recorded for [REDACTED] sandy plain at the edge of fallow lands near the Agytma discharge channel, degraded Iris-Ferula-deset sedge-sagebrush community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Alhagi pseudalhagi	perennial	30-40	A	3	fruiting
2. Artemisia diffusa	subshrub	30-40	F	1	Flowering, fruiting
3. Artemisia subsalsa	subshrub	25-30	R	+	budding
4. Astragalus villosissimus	subshrub	30-40	R	+	fruiting

5. <i>Bromus tectorum</i>	annual	12-15	O	+	dried
6. <i>Carex physodes</i>	perennial	12-15	O	+	dried
7. <i>Caroxylon scleranthum</i> (<i>Salsola sclerantha</i>)	annual	20-25	O	+	fruiting
8. <i>Ceratocarpus arenarius</i>	annual	15-20	O	+	fruiting
9. <i>Climacoptera amblyostegia</i>	annual	25-30	O	+	fruiting
10. <i>Climacoptera ferganica</i>	annual	25-30	O	+	fruiting
11. <i>Climacoptera lanata</i>	annual	25-30	F	1	fruiting
12. <i>Convolvulus hamadae</i>	subshrub	25-30	F	1	Flowering, fruiting
13. <i>Cousinia hamadae</i>	perennial	25-30	R	+	fruiting
14. <i>Ferula foetida</i>	perennial	70-150	O	+	dried
15. <i>Halocharis hispida</i>	annual	15-20	F	1	Flowering, fruiting
16. <i>Halothamnus subaphyllus</i>	subshrub	30-40	F	1	Flowering, fruiting
17. <i>Iris songarica</i>	perennial	30-35	O	+	dried
18. <i>Karelinia caspia</i>	perennial	40-50	F	1	Flowering, fruiting
19. <i>Lycium ruthenicum</i>	shrub	50-70	R	+	Flowering, fruiting
20. <i>Peganum harmala</i>	perennial	25-30	F	1	fruiting
21. <i>Poa bulbosa</i>	perennial	15-20	O	+	dried
22. <i>Smirnowia turkestanica</i>	subshrub	20-30	R	+	fruiting
23. <i>Sophora pachycarpa</i>	perennial	15-20	O	+	fruiting
24. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50-70	R	+	fruiting
25. <i>Zygophyllum oxianum</i>	perennial	25-30	O	1	fruiting

Table 28. Check-list of plants recorded for [REDACTED] sandy-loamy plain at the edge of fallow lands near the Agytma discharge channel, *Iris-Ferula-bulbous bluegrass-desert bindweed-sagebrush* community

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	fruiting
2. <i>Alhagi pseudalhagi</i>	perennial	30-40	O	+	fruiting
3. <i>Artemisia diffusa</i>	subshrub	30-40	C	2	Flowering, fruiting
4. <i>Astragalus villosissimus</i>	subshrub	30-40	R	+	fruiting
5. <i>Bromus tectorum</i>	annual	12-15	R	+	dried
6. <i>Caroxylon scleranthum</i> (<i>Salsola sclerantha</i>)	annual	15-20	O	+	fruiting
7. <i>Ceratocarpus arenarius</i>	annual	15-20	O	+	fruiting
8. <i>Ceratocephala falcata</i>	annual	4-5	R	+	dried
9. <i>Climacoptera lanata</i>	annual	20-25	O	+	fruiting
10. <i>Convolvulus hamadae</i>	subshrub	25-30	A	2	Flowering, fruiting
11. <i>Cousinia hamadae</i>	perennial	25-30	O	+	fruiting
12. <i>Cousinia prolifera</i>	annual	10-12	R	+	fruiting
13. <i>Ferula foetida</i>	perennial	70-150	O	+	dried
14. <i>Halimocnemis macrantha</i>	annual	12-15	R	+	Flowering, fruiting

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
15. <i>Halothamnus subaphyllus</i>	subshrub	30-35	R	+	Flowering, fruiting
16. <i>Iris songarica</i>	perennial	30-35	O	1	dried
17. <i>Peganum harmala</i>	perennial	30-35	O	+	fruiting
18. <i>Poa bulbosa</i>	perennial	15-20	A	1	dried

Table 29. Check-list of plants recorded for [REDACTED] sandy-loamy plain, fallow lands with secondary camel thorn-saltwort vegetation near the Agytma discharge channel [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Alhagi pseudalhagi</i>	perennial	30-40	F	1	fruiting
2. <i>Artemisia subsalsa</i>	subshrub	25-30	R	+	budding
3. <i>Bromus tectorum</i>	annual	12-15	R	+	dried
4. <i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	subshrub	25-30	R	+	fruiting
5. <i>Caroxylon scleranthum</i> (<i>Salsola sclerantha</i>)	annual	15-20	O	+	fruiting
6. <i>Ceratocarpus arenarius</i>	annual	15-20	O	+	fruiting
7. <i>Ceratocephala falcata</i>	annual	4-5	R	+	dried
8. <i>Climacoptera lanata</i>	annual	20-25	O	+	fruiting
9. <i>Convolvulus hamadae</i>	subshrub	25-30	R	+	Flowering, fruiting
10. <i>Cousinia prolifera</i>	annual	10-12	R	+	fruiting
11. <i>Cousinia resinosa</i>	perennial	25-30	R	+	fruiting
12. <i>Ferula foetida</i>	perennial	70-150	R	+	dried
13. <i>Halimocnemis gamocarpa</i>	annual	12-15	O	+	Flowering, fruiting
14. <i>Halocharis hispida</i>	annual	20-25	A	2	Flowering, fruiting
15. <i>Iris songarica</i>	perennial	25-30	R	+	dried
16. <i>Karelinia caspia</i>	perennial	25-30	R	+	Flowering, fruiting
17. <i>Papaver pavoninum</i>	annual	12-15	R	+	dried
18. <i>Peganum harmala</i>	perennial	25-30	O	+	fruiting
19. <i>Poa bulbosa</i>	perennial	15-20	O	+	dried
20. <i>Sophora pachycarpa</i>	perennial	20-25	O	+	fruiting
21. <i>Veronica campylopoda</i>	annual	7-10	R	+	dried
22. <i>Zygophyllum oxianum</i>	perennial	25-30	O	+	fruiting

Table 30. Check-list of plants recorded for [REDACTED] fixed sands, *Ferula-Astragalus*-white saltwort-*Calligonum* community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	O	+	fruiting
2. <i>Agriophyllum minus</i>	annual	15-20	R	+	fruiting
3. <i>Artemisia diffusa</i>	subshrub	30-40	F	1	Flowering, fruiting
4. <i>Astragalus villosissimus</i>	subshrub	30-40	F	1	fruiting

5. <i>Bromus tectorum</i>	annual	12-15	O	+	dried
6. <i>Calligonum leucocladum</i>	shrub	100-120	O	1	fruiting
7. <i>Calligonum microcarpum</i>	shrub	100-120	O	1	fruiting
8. <i>Carex physodes</i>	perennial	20-25	F	1	dried
9. <i>Caroxylon scleranthum</i> (<i>Salsola sclerantha</i>)	annual	15-20	O	+	fruiting
10. <i>Ceratocarpus arenarius</i>	annual	15-20	O	+	fruiting
11. <i>Convolvulus hamadae</i>	subshrub	20-25	F	1	Flowering, fruiting
12. <i>Cousinia sogdiana</i>	perennial	20-25	R	+	fruiting
13. <i>Ferula foetida</i>	perennial	70-150	F	1	dried
14. <i>Halothamnus subaphyllus</i>	subshrub	30-40	O	+	Flowering, fruiting
15. <i>Horaninovia ulicina</i>	annual	15-20	R	+	fruiting
16. <i>Iris songarica</i>	perennial	30-35	R	+	dried
17. <i>Koelpinia linearis</i>	annual	12-15	R	+	dried
18. <i>Mausolea eriocarpa</i>	subshrub	40-50	O	1	fruiting
19. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	O	1	fruiting
20. <i>Poa bulbosa</i>	perennial	15-20	O	+	dried
21. <i>Salsola paulsenii</i>	annual	25-30	O	+	fruiting
22. <i>Smirnowia turkestanica</i>	subshrub	30-40	O	+	fruiting
23. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	70-100	F	2	fruiting

Table 31. Check-list of plants recorded for [redacted] sandy plain, *Ferula*-saltwort-*Astragalus*-desert bindweed community [redacted]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	fruiting
2. <i>Alhagi pseudalhagi</i>	perennial	30-40	R	+	fruiting
3. <i>Artemisia diffusa</i>	subshrub	30-40	O	1	Flowering, fruiting
4. <i>Astragalus villosissimus</i>	subshrub	30-40	F	1	fruiting
5. <i>Bromus tectorum</i>	annual	12-15	R	+	dried
6. <i>Carex physodes</i>	perennial	12-15	F	1	dried
7. <i>Ceratocarpus arenarius</i>	annual	15-20	C	2	fruiting
8. <i>Convolvulus hamadae</i>	subshrub	20-25	C	2	Flowering, fruiting
9. <i>Ferula foetida</i>	perennial	70-150	F	1	dried
10. <i>Iris songarica</i>	perennial	30-35	R	+	dried
11. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	O	1	fruiting
12. <i>Peganum harmala</i>	perennial	20-25	R	+	fruiting
13. <i>Salsola paulsenii</i>	annual	25-30	R	+	fruiting
14. <i>Smirnowia turkestanica</i>	subshrub	30-40	O	+	fruiting
15. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50-70	F	1	fruiting

Table 32. Check-list of plants recorded for [redacted] fixed sands, *Ferula*-desert bindweed-*Calligonum*-white saltwort community [redacted]

Species	Life form		Abundance	

		Height, cm	DACFOR	Braun- Blanquet	Phenol. Stage
1. Acanthophyllum elatius	perennial	25-30	R	+	fruiting
2. Alhagi pseudalhagi	perennial	30-40	R	+	fruiting
3. Artemisia diffusa	subshrub	30-40	F	1	Flowering, fruiting
4. Astragalus villosissimus	subshrub	30-40	F	1	fruiting
5. Bromus tectorum	annual	12-15	O	+	dried
6. Calligonum leucocladum	shrub	100-120	O	1	vegetation
7. Calligonum microcarpum	shrub	100-120	O	1	vegetation
8. Carex physodes	perennial	12-15	F	1	dried
9. Caroxylon scleranthum (Salsola sclerantha)	annual	15-20	O	+	fruiting
10. Ceratocarpus arenarius	annual	15-20	A	2	fruiting
11. Ceratocephala falcata	annual	4-5	R	+	dried
12. Convolvulus hamadae	subshrub	20-25	C	2	Flowering, fruiting
13. Cousinia sogdiana	perennial	30-40	R	+	fruiting
14. Ferula foetida	perennial	70-150	F	1	dried
15. Halothamnus subaphyllus	subshrub	30-40	O	+	Flowering, fruiting
16. Haplophyllum robustum	annual	15-25	R	+	fruiting
17. Iris songarica	perennial	30-35	R	+	dried
18. Mausolea eriocarpa	subshrub	40-50	R	+	fruiting
19. Oreosalsola arbusculiformis (Salsola arbusculiformis)	shrub	30-40	F	1	fruiting
20. Peganum harmala	perennial	20-25	R	+	fruiting
21. Salsola paulsenii	annual	25-30	O	+	fruiting
22. Smirnowia turkestanica	subshrub	30-40	R	+	fruiting
23. Sophora pachycarpa	perennial	20-25	R	+	fruiting
24. Xylosalsola arbuscula (Salsola arbuscula)	shrub	50-70	F	1	fruiting

Table 33. Check-list of plants recorded for [REDACTED] fixed sands, Ferula-sagebrush-desert bindweed-
Calligonum-white saltwort community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun- Blanquet	
1. Acanthophyllum elatius	perennial	25-30	R	+	fruiting
2. Artemisia diffusa	subshrub	30-40	C	2	Flowering, fruiting
3. Astragalus villosissimus	subshrub	30-40	F	1	fruiting
4. Bromus tectorum	annual	12-15	O	+	dried
5. Calligonum microcarpum	shrub	100-120	F	1	vegetation
6. Carex physodes	perennial	12-15	O	+	dried
7. Caroxylon scleranthum (Salsola sclerantha)	annual	15-20	O	+	fruiting
8. Ceratocarpus arenarius	annual	15-20	F	1	fruiting
9. Ceratocephala falcata	annual	4-5	R	+	dried
10. Convolvulus hamadae	subshrub	20-25	F	1	Flowering, fruiting
11. Ferula foetida	perennial	70-150	F	1	dried
12. Halothamnus subaphyllus	subshrub	30-40	O	+	dried
13. Iris songarica	perennial	30-35	R	+	budding

14. <i>Salsola paulsenii</i>	annual	25-30	O	+	fruiting
15. <i>Smirnowia turkestanica</i>	subshrub	30-40	O	+	fruiting
16. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	70-100	C	2	fruiting

Table 34. Check-list of plants recorded for [REDACTED] top of the hill with shepherd's house and tramped area with sparse vegetation [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Artemisia diffusa</i>	subshrub	20-25	O	1	Flowering, fruiting
2. <i>Astragalus ammotrophus</i>	perennial	10-12	R	+	fruiting
3. <i>Astragalus villosissimus</i>	subshrub	30-40	O	1	fruiting
4. <i>Bromus tectorum</i>	annual	12-15	R	+	dried
5. <i>Carex physodes</i>	perennial	12-15	O	+	dried
6. <i>Caroxylon scleranthum</i> (<i>Salsola sclerantha</i>)	annual	15-20	F	1	fruiting
7. <i>Ceratocarpus arenarius</i>	annual	15-20	F	1	fruiting
8. <i>Ceratocephala falcata</i>	annual	4-5	R	+	dried
9. <i>Convolvulus hamadae</i>	subshrub	20-25	O	1	Flowering, fruiting
10. <i>Ferula foetida</i>	perennial	20-30	R	+	dried
11. <i>Salsola paulsenii</i>	annual	20-25	O	+	fruiting
12. <i>Sophora pachycarpa</i>	perennial	15-20	F	1	fruiting
13. <i>Tulipa sogdiana</i>	perennial	10-12	R	+	dried
14. <i>Zygophyllum miniatum</i>	perennial	10-12	O	+	dried

Table 35. Check-list of plants recorded for [REDACTED] sandy-loamy plain, ephemeroid-saltwort-sagebrush community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Anabasis eriopoda</i>	perennial	15-20	R	+	fruiting
2. <i>Artemisia diffusa</i>	subshrub	25-30	F	2	Flowering, fruiting
3. <i>Artemisia turanica</i>	subshrub	25-30	O	1	Flowering, fruiting
4. <i>Carex physodes</i>	perennial	12-15	O	+	dried
5. <i>Caroxylon gemmascens</i> (<i>Salsola gemmascens</i>)	subshrub	25-30	R	+	fruiting
6. <i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	subshrub	25-30	O	1	fruiting
7. <i>Ceratocarpus arenarius</i>	annual	15-20	O	+	fruiting
8. <i>Convolvulus hamadae</i>	subshrub	20-25	O	+	Flowering, fruiting
9. <i>Cousinia hamadae</i>	perennial	15-20	R	+	fruiting
10. <i>Ferula foetida</i>	perennial	70-150	O	+	dried
11. <i>Halothamnus subaphyllus</i>	subshrub	30-40	F	1	fruiting
12. <i>Nanophyton erinaceum</i>	subshrub	10-12	R	+	fruiting
13. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	C	2	fruiting
14. <i>Peganum harmala</i>	perennial	20-25	R	+	fruiting

15. <i>Poa bulbosa</i>	perennial	15-20	O	+	dried
16. <i>Tulipa sogdiana</i>	perennial	10-12	R	+	dried

Table 36. Check-list of plants recorded for [REDACTED] sandy-loamy plain, ephemeroid-saltwort-sagebrush community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	fruiting
2. <i>Anabasis eriopoda</i>	perennial	15-20	O	+	fruiting
3. <i>Artemisia diffusa</i>	subshrub	25-30	C	3	Flowering, fruiting
4. <i>Artemisia turanica</i>	subshrub	25-30	O	1	Flowering, fruiting
5. <i>Carex physodes</i>	perennial	12-15	O	+	dried
6. <i>Caroxylon gemmascens</i> (<i>Salsola gemmascens</i>)	subshrub	25-30	O	+	fruiting
7. <i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	subshrub	25-30	O	1	fruiting
8. <i>Ceratocarpus arenarius</i>	annual	15-20	O	+	fruiting
9. <i>Convolvulus hamadae</i>	subshrub	20-25	R	+	Flowering, fruiting
10. <i>Cousinia hamadae</i>	perennial	15-20	R	+	fruiting
11. <i>Ferula foetida</i>	perennial	70-150	O	+	dried
12. <i>Halimocnemis gamocarpa</i>	annual	15-20	R	+	Flowering, fruiting
13. <i>Halothamnus subaphyllus</i>	subshrub	30-40	F	1	fruiting
14. <i>Iris songarica</i>	perennial	30-35	R	+	dried
15. <i>Nanophyton erinaceum</i>	subshrub	10-12	O	+	fruiting
16. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	C	2	fruiting
17. <i>Peganum harmala</i>	perennial	20-25	R	+	fruiting
18. <i>Poa bulbosa</i>	perennial	15-20	F	1	dried

Table 37. Check-list of plants recorded for [REDACTED] sandy plain, *Iris*-ephemeroid-sagebrush community with solitary *Ferula foetida* and black saxaul (remains of plantation) [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	fruiting
2. <i>Artemisia diffusa</i>	subshrub	25-30	C	2	Flowering, fruiting
3. <i>Astragalus villosissimus</i>	subshrub	30-40	O	+	fruiting
4. <i>Bromus tectorum</i>	annual	12-15	R	+	dried
5. <i>Carex physodes</i>	perennial	12-15	F	1	dried
6. <i>Caroxylon gemmascens</i> (<i>Salsola gemmascens</i>)	subshrub	25-30	R	+	fruiting
7. <i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	subshrub	25-30	F	1	fruiting
8. <i>Caroxylon scleranthum</i> (<i>Salsola sclerantha</i>)	annual	15-20	R	+	fruiting
9. <i>Ceratocarpus arenarius</i>	annual	15-20	O	+	fruiting

10. <i>Convolvulus hamadae</i>	subshrub	25-30	O	+	Flowering, fruiting
11. <i>Ferula foetida</i>	perennial	70-150	O	+	dried
12. <i>Halimocnemis gamocarpa</i>	annual	15-20	O	+	Flowering, fruiting
13. <i>Halimocnemis sclerosperma</i>	annual	15-20	R	+	fruiting
14. <i>Halothamnus subaphyllus</i>	subshrub	30-40	F	1	fruiting
15. <i>Haloxydon ammodendron</i>	Small tree	120-150	R	+	vegetation
16. <i>Heliotropium arguzioides</i>	Perennial	15-20	O	+	fruiting
17. <i>Iris songarica</i>	perennial	30-35	F	1	dried
18. <i>Nanophyton erinaceum</i>	subshrub	10-12	O	+	fruiting
19. <i>Peganum harmala</i>	perennial	20-25	R	+	fruiting
20. <i>Poa bulbosa</i>	perennial	15-20	O	+	dried

Table 38. Check-list of plants recorded for [REDACTED] flat-wavy sandy plain, ephemeroide-sagebrush community with *Ferula foetida*, *Iris songarica* and solitary black saxaul (remains of plantations) [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	O	+	fruiting
2. <i>Artemisia diffusa</i>	subshrub	25-30	C	2	Flowering, fruiting
3. <i>Artemisia turanica</i>	subshrub	25-30	R	+	Flowering, fruiting
4. <i>Astragalus villosissimus</i>	subshrub	30-40	O	+	fruiting
5. <i>Carex physodes</i>	perennial	12-15	A	2	dried
6. <i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	subshrub	25-30	O	+	fruiting
7. <i>Caroxylon scleranthum</i> (<i>Salsola sclerantha</i>)	annual	15-20	O	+	fruiting
8. <i>Ceratocarpus arenarius</i>	annual	15-20	O	+	fruiting
9. <i>Ceratocephala falcata</i>	annual	4-5	R	+	dried
10. <i>Convolvulus hamadae</i>	subshrub	25-30	O	+	Flowering, fruiting
11. <i>Cousinia hamadae</i>	perennial	25-30	R	+	fruiting
12. <i>Euphorbia turczaninowii</i>	annual	5-7	R	+	dried
13. <i>Ferula foetida</i>	perennial	70-150	O	+	dried
14. <i>Halimocnemis gamocarpa</i>	annual	15-20	O	+	Flowering, fruiting
15. <i>Halimocnemis sclerosperma</i>	annual	15-20	R	+	fruiting
16. <i>Halothamnus subaphyllus</i>	subshrub	30-40	O	+	fruiting
17. <i>Haloxydon ammodendron</i>	Small tree	70-100	O	1	vegetation
18. <i>Heliotropium arguzioides</i>	Perennial	15-25	R	+	fruiting
19. <i>Iris songarica</i>	perennial	30-35	O	1	budding
20. <i>Nanophyton erinaceum</i>	subshrub	10-12	R	+	fruiting
21. <i>Peganum harmala</i>	perennial	30-35	R	+	fruiting
22. <i>Poa bulbosa</i>	perennial	15-20	O	+	dried
23. <i>Salsola paulsenii</i>	annual	20-25	O	+	fruiting
24. <i>Tulipa sogdiana</i>	perennial	10-12	R	+	dried
25. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50-70	O	1	fruiting

Table 39. Check-list of plants recorded for [REDACTED] sandy plain, overgrazed *Ferula*-sagebrush-ephemeroid community with sparse black saxaul plantation in surroundings of a farmstead [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Agriophyllum minus</i>	annual	15-20	R	+	fruiting
2. <i>Artemisia diffusa</i>	subshrub	15-20	O	1	Flowering, fruiting
3. <i>Astragalus villosissimus</i>	subshrub	30-40	R	+	fruiting
4. <i>Atriplex dimorphostegia</i>	annual	15-20	R	+	dried
5. <i>Bromus tectorum</i>	annual	12-15	O	+	dried
6. <i>Carex physodes</i>	perennial	12-15	O	+	dried
7. <i>Ceratocarpus arenarius</i>	annual	15-20	F	1	fruiting
8. <i>Ceratocephala falcata</i>	annual	4-5	O	+	dried
9. <i>Diarthron vesiculosum</i>	annual	15-20	O	+	dried
10. <i>Ferula foetida</i>	perennial	70-150	O	1	dried
11. <i>Halothamnus subaphyllus</i>	subshrub	30-40	R	+	fruiting
12. <i>Haloxylon ammodendron</i>	Small tree	120-150	O	2	vegetation
13. <i>Iris songarica</i>	perennial	30-35	O	+	dried
14. <i>Peganum harmala</i>	perennial	30-35	O	1	fruiting
15. <i>Poa bulbosa</i>	perennial	15-20	O	+	dried
16. <i>Salsola paulsenii</i>	annual	20-25	O	+	fruiting
17. <i>Tulipa sogdiana</i>	perennial	10-12	R	+	dried

Table 40. Check-list of plants recorded for [REDACTED] sandy-loamy plain, *Iris*-ephemeroid-saltwort-sagebrush community with solitary *Ferula foetida* [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	fruiting
2. <i>Artemisia diffusa</i>	subshrub	25-30	C	2	Flowering, fruiting
3. <i>Astragalus villosissimus</i>	subshrub	30-40	O	+	fruiting
4. <i>Bromus tectorum</i>	annual	12-15	R	+	dried
5. <i>Carex physodes</i>	perennial	12-15	F	1	dried
6. <i>Caroxylon gemmascens</i> (<i>Salsola gemmascens</i>)	subshrub	25-30	R	+	fruiting
7. <i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	subshrub	25-30	F	1	fruiting
8. <i>Caroxylon scleranthum</i> (<i>Salsola sclerantha</i>)	annual	15-20	R	+	fruiting
9. <i>Ceratocarpus arenarius</i>	annual	15-20	O	+	fruiting
10. <i>Convolvulus hamadae</i>	subshrub	25-30	F	1	Flowering, fruiting
11. <i>Cousinia hamadae</i>	perennial	15-20	R	+	fruiting
12. <i>Climacoptera lanata</i>	annual	15-20	R	+	fruiting
13. <i>Ferula foetida</i>	perennial	70-150	O	+	dried
14. <i>Halimocnemis gamocarpa</i>	annual	15-20	O	+	Flowering, fruiting
15. <i>Halothamnus subaphyllus</i>	subshrub	30-40	F	1	fruiting
16. <i>Haloxylon ammodendron</i>	Small tree	120-150	R	+	vegetation
17. <i>Heliotropium arguzioides</i>	perennial	10-15	O	+	fruiting

18. <i>Iris songarica</i>	perennial	30-35	F	1	dried
19. <i>Nanophyton erinaceum</i>	subshrub	10-12	O	+	fruiting
20. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	F	2	fruiting
21. <i>Strigosella brevipes</i>	annual	10-12	O	+	flowering
22. <i>Poa bulbosa</i>	perennial	15-20	O	+	dried
23. <i>Tulipa sogdiana</i>	perennial	10-12	R	+	dried

Table 41. Check-list of plants recorded for [REDACTED] sabulous-loamy plain, *Ferula*-ephemeroid-saltwort-sagebrush community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Anabasis eriopoda</i>	perennial	15-20	R	+	fruiting
2. <i>Artemisia diffusa</i>	subshrub	25-30	C	2	Flowering, fruiting
3. <i>Artemisia turanica</i>	subshrub	25-30	O	1	Flowering, fruiting
4. <i>Carex physodes</i>	perennial	12-15	O	+	dried
5. <i>Caroxylon gemmascens</i> (<i>Salsola gemmascens</i>)	subshrub	25-30	O	+	fruiting
6. <i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	subshrub	25-30	O	1	fruiting
7. <i>Ceratocarpus arenarius</i>	annual	15-20	O	+	fruiting
8. <i>Convolvulus hamadae</i>	subshrub	20-25	R	+	Flowering, fruiting
9. <i>Cousinia hamadae</i>	perennial	15-20	O	+	fruiting
10. <i>Ferula foetida</i>	perennial	70-150	O	1	dried
11. <i>Halimocnemis gamocarpa</i>	annual	15-20	O	+	Flowering, fruiting
12. <i>Halothamnus subaphyllus</i>	subshrub	30-40	F	1	fruiting
13. <i>Iris songarica</i>	perennial	30-35	O	+	dried
14. <i>Nanophyton erinaceum</i>	subshrub	10-12	O	+	fruiting
15. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	C	2	fruiting
16. <i>Peganum harmala</i>	perennial	20-25	R	+	fruiting
17. <i>Poa bulbosa</i>	perennial	15-20	F	1	dried

Table 42. Check-list of plants recorded for [REDACTED] hilly fixed sands and saline depression near the Agytma discharge channel, *Astragalus*-desert sedge-sagebrush-*Calligonum* community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	fruiting
2. <i>Artemisia diffusa</i>	subshrub	30-40	F	1	Flowering, fruiting
3. <i>Astragalus villosissimus</i>	subshrub	30-40	F	1	fruiting
4. <i>Calligonum microcarpum</i>	shrub	50-70	O	1	vegetation
5. <i>Carex physodes</i>	perennial	12-15	F	1	dried
6. <i>Ceratocarpus arenarius</i>	annual	15-20	O	+	fruiting
7. <i>Ceratocephala falcata</i>	annual	4-5	R	+	dried
8. <i>Convolvulus hamadae</i>	subshrub	25-30	C	2	fruiting
9. <i>Cousinia hamadae</i>	perennial	15-20	R	+	fruiting

10. Cousinia sogdiana	perennial	20-25	R	+	fruiting
11. Ferula foetida	perennial	70-150	F	1	dried
12. Peganum harmala	perennial	25-30	R	+	fruiting
13. Salsola paulsenii	annual	15-25	F	1	fruiting
14. Smirnowia turkestanica	subshrub	30-40	F	1	fruiting

Table 43. Check-list of plants recorded for [REDACTED] hilly fixed sands and saline depression near the Agytma discharge channel, Astragalus-desert sedge-sagebrush-Calligonum community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Acanthophyllum elatius	perennial	25-30	R	+	fruiting
2. Artemisia diffusa	subshrub	30-40	F	1	Flowering, fruiting
3. Astragalus villosissimus	subshrub	30-40	F	1	fruiting
4. Calligonum microcarpum	shrub	50-70	O	1	vegetation
5. Carex physodes	perennial	12-15	F	1	dried
6. Ceratocarpus arenarius	annual	15-20	O	+	fruiting
7. Ceratocephala falcata	annual	4-5	R	+	dried
8. Convolvulus hamadae	subshrub	25-30	C	2	fruiting
9. Cousinia hamadae	perennial	15-20	R	+	fruiting
10. Cousinia sogdiana	perennial	20-25	R	+	fruiting
11. Ferula foetida	perennial	70-150	F	1	dried
12. Peganum harmala	perennial	25-30	R	+	fruiting
13. Salsola paulsenii	annual	15-25	F	1	fruiting
14. Smirnowia turkestanica	subshrub	30-40	F	1	fruiting

Table 44. Check-list of plants recorded for [REDACTED] hilly fixed sands near the Agytma discharge channel, Ferula-desert sedge-saltwort-Calligonum community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Acanthophyllum elatius	perennial	25-30	R	+	fruiting
2. Alhagi pseudalhagi	perennial	30-40	F	1	fruiting
3. Artemisia diffusa	subshrub	30-40	O	1	Flowering, fruiting
4. Astragalus villosissimus	subshrub	25-30	F	1	fruiting
5. Calligonum leucocladum	shrub	50-70	F	1	fruiting
6. Calligonum microcarpum	shrub	50-70	F	1	fruiting
7. Carex physodes	perennial	12-15	F	1	dried
8. Caroxylon scleranthum (Salsola sclerantha)	annual	15-20	O	+	fruiting
9. Cousinia dichotoma	annual	12-15	R	+	dried
10. Convolvulus hamadae	subshrub	20-25	F	1	Flowering, fruiting
11. Cousinia sogdiana	perennial	20-25	R	+	fruiting
12. Ferula foetida	perennial	70-150	C	1	dried
13. Halothamnus subaphyllus	subshrub	30-40	O	+	Flowering, fruiting
14. Heliotropium arguzioides	Perennial	20-25	O	+	fruiting
15. Holosteum umbellatum	annual	10-12	O	+	flowering

16. <i>Hypocoum pendulum</i>	annual	15-25	O	+	flowering
17. <i>Isatis minima</i>	annual	15-20	O	+	Flowering, fruiting
18. <i>Iris songarica</i>	perennial	30-35	O	+	dried
19. <i>Peganum harmala</i>	perennial	20-25	R	+	fruiting
20. <i>Poa bulbosa</i>	perennial	15-20	O	+	dried
21. <i>Salsola paulsenii</i>	annual	20-25	F	1	fruiting
22. <i>Smirnowia turkestanica</i>	subshrub	30-40	F	1	fruiting
23. <i>Sophora pachycarpa</i>	perennial	20-25	O	+	fruiting
24. <i>Stipagrostis pennata</i>	perennial	30-40	R	+	fruiting
25. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50-70	F	1	fruiting

Table 45. Check-list of plants recorded for XXXXXXXXXX hilly fixed sands near the Agytma discharge channel, *Ferula*-desert sedge-saltwort-*Calligonum* community XXXXXXXXXX

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	fruiting
2. <i>Aeluropus litoralis</i>	perennial	15-20	O	+	fruiting
3. <i>Alhagi pseudalhagi</i>	perennial	30-40	F	1	fruiting
4. <i>Allium sabulosum</i>	perennial	15-20	R	+	dried
5. <i>Artemisia diffusa</i>	subshrub	30-40	O	1	Flowering, fruiting
6. <i>Astragalus villosissimus</i>	subshrub	30-40	O	1	fruiting
7. <i>Calligonum leucocladum</i>	shrub	50-70	F	1	fruiting
8. <i>Calligonum microcarpum</i>	shrub	50-70	O	1	vegetation
9. <i>Carex physodes</i>	perennial	12-15	F	1	dried
10. <i>Climacoptera amblyostegia</i>	annual	25-30	O	+	fruiting
11. <i>Convolvulus hamadae</i>	subshrub	20-25	C	2	Flowering, fruiting
12. <i>Ephedra strobilacea</i>	shrub	70-100	R	+	vegetation
13. <i>Ferula foetida</i>	perennial	70-150	F	1	dried
14. <i>Heliotropium arguzioides</i>	Perennial	15-20	O	+	fruiting
15. <i>Karelinia caspia</i>	perennial	30-40	O	+	Flowering, fruiting
16. <i>Limonium suffruticosum</i>	subshrub	30-40	O	1	Flowering, fruiting
17. <i>Lycium ruthenicum</i>	shrub	50-70	O	1	Flowering, fruiting
18. <i>Nitraria sibirica</i>	shrub	50-70	R	+	vegetation
19. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	R	+	fruiting
20. <i>Peganum harmala</i>	perennial	20-25	O	+	fruiting
21. <i>Poa bulbosa</i>	perennial	15-20	F	1	dried
22. <i>Salsola paulsenii</i>	annual	30-40	F	1	fruiting
23. <i>Smirnowia turkestanica</i>	subshrub	30-40	F	1	fruiting
24. <i>Sophora pachycarpa</i>	perennial	20-25	O	+	vegetation
25. <i>Suaeda arcuata</i>	annual	15-20	F	1	fruiting
26. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50-70	F	1	fruiting

Table 46. Check-list of plants recorded for [REDACTED] hilly fixed sands near the Agytma discharge channel, Ferula-desert sedge-saltwort-Calligonum community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Acanthophyllum elatius	perennial	25-30	R	+	fruiting
2. Aeluropus littoralis	perennial	15-20	O	+	fruiting
3. Alhagi pseudalhagi	perennial	30-40	F	1	fruiting
4. Allium sabulosum	perennial	15-20	R	+	dried
5. Artemisia diffusa	subshrub	30-40	O	1	Flowering, fruiting
6. Astragalus villosissimus	subshrub	30-40	O	1	fruiting
7. Calligonum leucocladum	shrub	50-70	F	1	fruiting
8. Calligonum microcarpum	shrub	50-70	O	1	vegetation
9. Carex physodes	perennial	12-15	F	1	dried
10. Climacoptera amblyostegia	annual	25-30	O	+	fruiting
11. Convolvulus hamadae	subshrub	20-25	C	2	Flowering, fruiting
12. Ephedra strobilacea	shrub	70-100	R	+	vegetation
13. Ferula foetida	perennial	70-150	F	1	dried
14. Heliotropium arguzioides	Perennial	15-20	O	+	fruiting
15. Karelinia caspia	perennial	30-40	O	+	Flowering, fruiting
16. Limonium suffruticosum	subshrub	30-40	O	1	Flowering, fruiting
17. Lycium ruthenicum	shrub	50-70	O	1	Flowering, fruiting
18. Nitraria sibirica	shrub	50-70	R	+	vegetation
19. Oreosalsola arbusculiformis (Salsola arbusculiformis)	shrub	30-40	R	+	fruiting
20. Peganum harmala	perennial	20-25	O	+	fruiting
21. Poa bulbosa	perennial	15-20	F	1	dried
22. Salsola paulsenii	annual	30-40	F	1	fruiting
23. Smirnowia turkestanica	subshrub	30-40	F	1	fruiting
24. Sophora pachycarpa	perennial	20-25	O	+	vegetation
25. Suaeda arcuata	annual	15-20	F	1	fruiting
26. Xylosalsola arbuscula (Salsola arbuscula)	shrub	50-70	F	1	fruiting

Table 47. Check-list of plants recorded for [REDACTED] hilly fixed sands and saline depression near the Agytma discharge channel, Ferula-desert sedge-saltwort-Calligonum community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Acanthophyllum elatius	perennial	25-30	R	+	fruiting
2. Aeluropus littoralis	perennial	15-20	F	1	fruiting
3. Alhagi pseudalhagi	perennial	30-40	F	1	fruiting
4. Allium sabulosum	perennial	15-20	R	+	dried
5. Artemisia diffusa	subshrub	30-40	O	1	Flowering, fruiting
6. Astragalus villosissimus	subshrub	30-40	F	1	fruiting
7. Calligonum leucocladum	shrub	70-100	O	1	vegetation
8. Calligonum microcarpum	shrub	50-70	O	1	vegetation

9. <i>Carex physodes</i>	perennial	12-15	O	+	dried
10. <i>Ceratocarpus arenarius</i>	annual	15-20	F	1	fruiting
11. <i>Ceratocephala falcata</i>	annual	4-5	R	+	dried
12. <i>Climacoptera amblyostegia</i>	annual	25-30	O	+	fruiting
13. <i>Convolvulus hamadae</i>	subshrub	20-25	F	1	Flowering, fruiting
14. <i>Ferula foetida</i>	perennial	70-150	F	1	dried
15. <i>Halostachys caspica</i>	shrub	40-50	R	+	Flowering, fruiting
16. <i>Karelinia caspia</i>	perennial	30-40	F	1	Flowering, fruiting
17. <i>Limonium suffruticosum</i>	subshrub	30-40	F	2	Flowering, fruiting
18. <i>Lycium ruthenicum</i>	shrub	50-70	O	1	Flowering, fruiting
19. <i>Nitraria sibirica</i>	shrub	50-70	R	+	vegetation
20. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	F	1	fruiting
21. <i>Poa bulbosa</i>	perennial	15-20	F	1	dried
22. <i>Salsola paulsenii</i>	annual	30-40	C	1	fruiting
23. <i>Smirnowia turkestanica</i>	subshrub	30-40	R	+	fruiting
24. <i>Sophora pachycarpa</i>	perennial	15-20	O	+	vegetation
25. <i>Suaeda altissima</i>	annual	30-40	O	+	fruiting
26. <i>Suaeda arcuata</i>	annual	15-20	F	1	fruiting
27. <i>Zygophyllum oxianum</i>	perennial	15-20	O	1	fruiting

Table 48. Check-list of plants recorded for [redacted] gentle wavy sandy plain, surroundings of farmstead, *Ferula*-wild rue-camel thorn-desert bindweed community [redacted]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	fruiting
2. <i>Agriophyllum minus</i>	annual	20-25	R	+	fruiting
3. <i>Alhagi pseudalhagi</i>	perennial	30-40	C	2	fruiting
4. <i>Artemisia diffusa</i>	subshrub	30-40	O	+	Flowering, fruiting
5. <i>Astragalus villosissimus</i>	subshrub	30-40	O	+	fruiting
6. <i>Bromus tectorum</i>	annual	12-15	F	1	dried
7. <i>Carex physodes</i>	perennial	12-15	O	+	dried
8. <i>Caroxylon scleranthum</i> (<i>Salsola sclerantha</i>)	annual	15-20	O	+	fruiting
9. <i>Ceratocarpus arenarius</i>	annual	15-20	F	1	fruiting
10. <i>Convolvulus hamadae</i>	subshrub	20-25	F	1	Flowering, fruiting
11. <i>Cousinia hamadae</i>	perennial	20-25	O	+	fruiting
12. <i>Cousinia prolifera</i>	annual	12-15	R	+	dried
13. <i>Cousinia sogdiana</i>	perennial	20-25	R	+	fruiting
14. <i>Ferula foetida</i>	perennial	70-150	F	1	dried
15. <i>Halothamnus subaphyllus</i>	subshrub	30-40	R	+	Flowering, fruiting
16. <i>Iris songarica</i>	perennial	30-35	R	+	dried
17. <i>Lycium ruthenicum</i>	shrub	50-70	R	+	Flowering, fruiting

18. Oreosalsola arbusculiformis (Salsola arbusculiformis)	shrub	30-40	R	+	fruiting
19. Peganum harmala	perennial	25-30	C	2	fruiting
20. Salsola paulsenii	annual	25-30	O	+	fruiting
21. Sophora pachycarpa	perennial	20-25	F	1	fruiting
22. Xylosalsola arbuscula	shrub	50-70	R	+	fruiting

Table 49. Check-list of plants recorded for [REDACTED] gentle wavy sandy plain, Ferula-desert sedge-Astragalus-desert bindweed community with wild rue and camel thorn [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Acanthophyllum elatius	perennial	25-30	R	+	fruiting
2. Alhagi pseudalhagi	perennial	30-40	F	1	fruiting
3. Artemisia diffusa	subshrub	30-40	F	1	budding
4. Astragalus flexus	perennial	15-17	R	+	flowering
5. Astragalus villosissimus	subshrub	30-40	F	1	fruiting
6. Carex physodes	perennial	12-15	F	1	dried
7. Caroxylon scleranthum (Salsola sclerantha)	annual	15-20	O	+	fruiting
8. Ceratocarpus arenarius	annual	15-20	O	+	fruiting
9. Ceratocephala falcata	annual	4-5	O	+	dried
10. Climacoptera korshinskyi	annual	20-25	R	+	fruiting
11. Climacoptera lanata	annual	20-25	O	+	fruiting
12. Convolvulus hamadae	subshrub	20-25	A	2	Flowering, fruiting
13. Cousinia hamadae	perennial	25-30	R	+	fruiting
14. Diarthron vesiculosum	annual	15-17	O	+	dried
15. Ferula foetida	perennial	70-150	O	+	dried
16. Halimocnemis gamocarpa	annual	12-15	O	+	Flowering, fruiting
17. Halimocnemis macrantha	annual	12-15	O	+	Flowering, fruiting
18. Halothamnus subaphyllus	subshrub	30-40	R	+	Flowering, fruiting
19. Haplophyllum robustum	perennial	25-30	R	+	Flowering, fruiting
20. Iris songarica	perennial	30-35	O	+	dried
21. Lycium ruthenicum	shrub	50-70	R	+	Flowering, fruiting
22. Oreosalsola arbusculiformis (Salsola arbusculiformis)	shrub	30-40	R	+	fruiting
23. Peganum harmala	perennial	30-40	F	1	fruiting
24. Poa bulbosa	perennial	15-20	O	+	dried
25. Smirnowia turkestanica	subshrub	30-40	O	+	fruiting
26. Sophora pachycarpa	perennial	20-25	O	+	fruiting
27. Zygophyllum miniatum	perennial	10-12	R	+	fruiting

Table 50. Check-list of plants recorded for [REDACTED] gentle wavy sandy plain, Ferula-desert sedge-Astragalus-desert bindweed community with wild rue and camel thorn [REDACTED]

Species	Life form		Abundance	

		Height, cm	DACFOR	Braun- Blanquet	Phenol. Stage
1. Acanthophyllum elatius	perennial	25-30	R	+	fruiting
2. Alhagi pseudalhagi	perennial	30-40	F	1	fruiting
3. Artemisia diffusa	subshrub	30-40	F	1	budding
4. Astragalus flexus	perennial	15-17	R	+	flowering
5. Astragalus villosissimus	subshrub	30-40	F	1	fruiting
6. Carex physodes	perennial	12-15	F	1	dried
7. Caroxylon scleranthum (Salsola sclerantha)	annual	15-20	O	+	fruiting
8. Ceratocarpus arenarius	annual	15-20	O	+	fruiting
9. Ceratocephala falcata	annual	4-5	O	+	dried
10. Climacoptera korshinskyi	annual	20-25	R	+	fruiting
11. Climacoptera lanata	annual	20-25	O	+	fruiting
12. Convolvulus hamadae	subshrub	20-25	A	2	Flowering, fruiting
13. Cousinia hamadae	perennial	25-30	R	+	fruiting
14. Diarthron vesiculosum	annual	15-17	O	+	dried
15. Ferula foetida	perennial	70-150	O	+	dried
16. Halimocnemis gamocarpa	annual	12-15	O	+	Flowering, fruiting
17. Halimocnemis macrantha	annual	12-15	O	+	Flowering, fruiting
18. Halothamnus subaphyllus	subshrub	30-40	R	+	Flowering, fruiting
19. Haplophyllum robustum	perennial	25-30	R	+	Flowering, fruiting
20. Iris songarica	perennial	30-35	O	+	dried
21. Lycium ruthenicum	shrub	50-70	R	+	Flowering, fruiting
22. Oreosalsola arbusculiformis (Salsola arbusculiformis)	shrub	30-40	R	+	fruiting
23. Peganum harmala	perennial	30-40	F	1	fruiting
24. Poa bulbosa	perennial	15-20	O	+	dried
25. Smirnowia turkestanica	subshrub	30-40	O	+	fruiting
26. Sophora pachycarpa	perennial	20-25	O	+	fruiting
27. Zygophyllum miniatum	perennial	10-12	R	+	fruiting

Table 51. Check-list of plants recorded for  slightly saline sandy plain, Iris-desert bindweed-saltwort community with wild rue and camel thorn 

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun- Blanquet	
1. Alhagi pseudalhagi	perennial	30-40	F	1	fruiting
2. Artemisia diffusa	subshrub	30-40	O	1	budding
3. Astragalus villosissimus	subshrub	30-40	O	1	fruiting
4. Carex physodes	perennial	12-15	O	+	dried
5. Caroxylon scleranthum (Salsola sclerantha)	annual	15-20	O	+	fruiting
6. Ceratocarpus arenarius	annual	15-20	O	+	fruiting
7. Ceratocephala falcata	annual	4-5	O	+	dried
8. Climacoptera korshinskyi	annual	20-25	R	+	fruiting
9. Climacoptera lanata	annual	20-25	O	+	fruiting

10. Convolvulus hamadae	subshrub	20-25	F	1	Flowering, fruiting
11. Cousinia hamadae	perennial	20-25	R	+	fruiting
12. Diarthron vesiculosum	annual	15-17	O	+	dried
13. Ferula foetida	perennial	50-100	O	+	dried
14. Halimocnemis gamocarpa	annual	12-15	O	+	Flowering, fruiting
15. Halimocnemis macrantha	annual	12-15	O	+	Flowering, fruiting
16. Iris songarica	perennial	30-35	O	+	dried
17. Koelpinia tenuissima	annual	10-12	R	+	dried
18. Oreosalsola arbusculiformis (Salsola arbusculiformis)	shrub	30-40	O	1	fruiting
19. Peganum harmala	perennial	20-25	C	2	fruiting
20. Poa bulbosa	perennial	15-20	F	+	dried
21. Roemeria hybrida	annual	10-12	O	+	flowering
22. Smirnowia turkestanica	subshrub	30-40	R	+	fruiting
23. Zygophyllum miniatum	perennial	10-12	R	+	fruiting

Table 52. Check-list of plants recorded for [REDACTED] sandy plain, Ferula-Astragalus-desert bindweed-sagebrush community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Acanthophyllum elatius	perennial	25-30	R	+	fruiting
2. Artemisia diffusa	subshrub	30-40	A	3	Flowering, fruiting
3. Astragalus villosissimus	subshrub	30-40	F	1	fruiting
4. Calligonum microcarpum	shrub	70-100	R	+	vegetation
5. Carex physodes	perennial	12-15	F	1	dried
6. Caroxylon scleranthum (Salsola sclerantha)	annual	15-20	O	+	fruiting
7. Ceratocarpus arenarius	annual	15-20	C	2	fruiting
8. Convolvulus hamadae	subshrub	25-30	F	1	fruiting
9. Cousinia hamadae	perennial	20-25	R	+	fruiting
10. Cousinia sogdiana	perennial	25-30	R	+	fruiting
11. Ferula foetida	perennial	70-150	F	1	dried
12. Halothamnus subaphyllus	subshrub	30-40	O	+	Flowering, fruiting
13. Iris songarica	perennial	30-35	R	+	dried
14. Oreosalsola arbusculiformis (Salsola arbusculiformis)	shrub	30-40	O	1	fruiting
15. Salsola paulsenii	annual	20-25	O	+	fruiting
16. Smirnowia turkestanica	subshrub	30-40	O	1	fruiting
17. Stipagrostis pennata	perennial	30-40	R	+	fruiting

Table 53. Check-list of plants recorded for [REDACTED] sandy plain, Ferula-desert bindweed-sagebrush community with solitary black saxaul [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Acanthophyllum elatius	perennial	25-30	R	+	Flowering, fruiting
2. Alhagi pseudalhagi	perennial	30-40	R	+	fruiting
3. Artemisia diffusa	subshrub	30-40	F	1	Flowering, fruiting
4. Astragalus villosissimus	subshrub	30-40	O	+	fruiting
5. Caroxylon scleranthum (Salsola sclerantha)	annual	15-20	O	+	fruiting
6. Carex physodes	perennial	12-15	F	1	dried
7. Ceratocarpus arenarius	annual	15-20	O	+	fruiting
8. Convolvulus hamadae	subshrub	20-25	C	2	Flowering, fruiting
9. Cousinia hamadae	perennial	20-25	R	+	fruiting
10. Ferula foetida	perennial	70-150	F	1	dried
11. Halimocnemis macrantha	annual	12-15	R	+	Flowering, fruiting
12. Halothamnus subaphyllus	subshrub	30-40	O	+	Flowering, fruiting
13. Haloxylon ammodendron	Small tree	70-100	R	+	vegetation
14. Iris songarica	perennial	30-35	O	+	dried
15. Oreosalsola arbusculiformis (Salsola arbusculiformis)	shrub	30-40	O	1	fruiting
16. Peganum harmala	perennial	20-25	O	+	fruiting
17. Smirnowia turkestanica	subshrub	30-40	R	+	fruiting
18. Stipagrostis pennata	perennial	30-40	R	+	fruiting

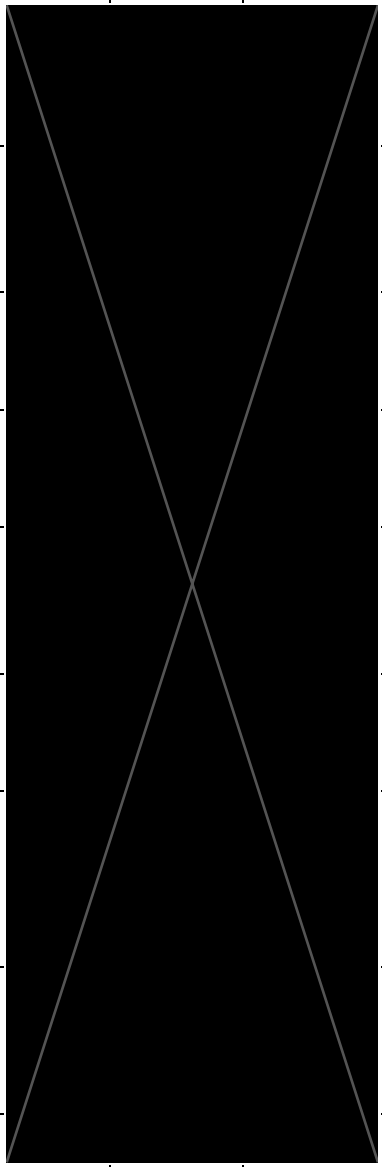
Table 54. Check-list of plants recorded for [REDACTED] sandy plain, Ferula-Astragalus-sagebrush-desert bindweed community with solitary black saxaul [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Acanthophyllum elatius	perennial	25-30	R	+	Flowering, fruiting
2. Alhagi pseudalhagi	perennial	30-40	R	+	fruiting
3. Artemisia diffusa	subshrub	30-40	F	1	Flowering, fruiting
4. Astragalus villosissimus	subshrub	30-40	F	1	fruiting
5. Caroxylon scleranthum (Salsola sclerantha)	annual	15-20	F	1	fruiting
6. Carex physodes	perennial	12-15	F	1	dried
7. Ceratocarpus arenarius	annual	15-20	O	+	fruiting
8. Ceratocephala falcata	annual	4-5	R	+	dried
9. Convolvulus hamadae	subshrub	20-25	A	2	Flowering, fruiting
10. Cousinia hamadae	perennial	20-25	O	+	fruiting
11. Ferula foetida	perennial	70-150	F	1	dried
12. Halimocnemis macrantha	annual	12-15	O	+	Flowering, fruiting

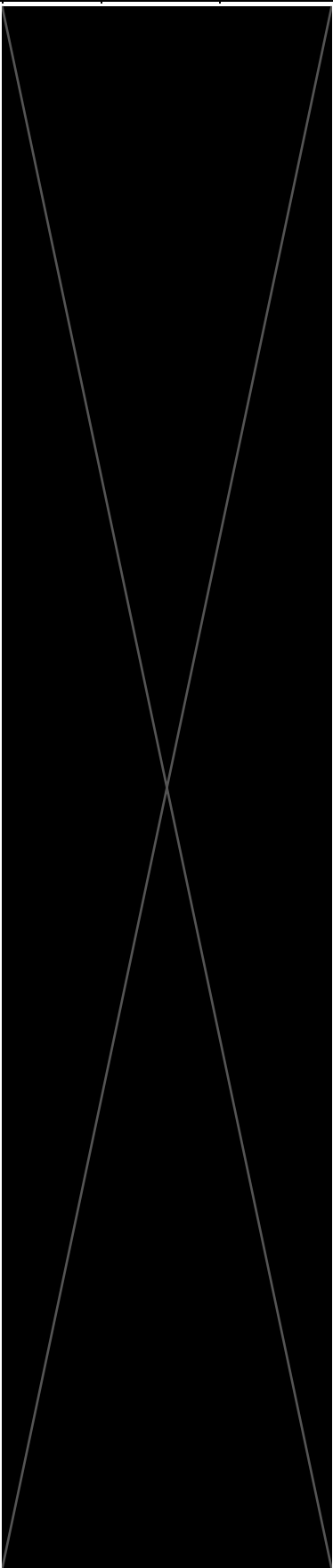
Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
13. <i>Halothamnus subaphyllus</i>	subshrub	30-40	O	+	Flowering, fruiting
14. <i>Haloxylon ammodendron</i>	Small tree	70-100	R	+	vegetation
15. <i>Iris songarica</i>	perennial	30-35	R	+	dried
16. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	O	1	fruiting
17. <i>Peganum harmala</i>	perennial	20-25	O	+	fruiting
18. <i>Smirnowia turkestanica</i>	subshrub	30-40	R	+	fruiting
19. <i>Stipagrostis pennata</i>	perennial	30-40	O	+	fruiting

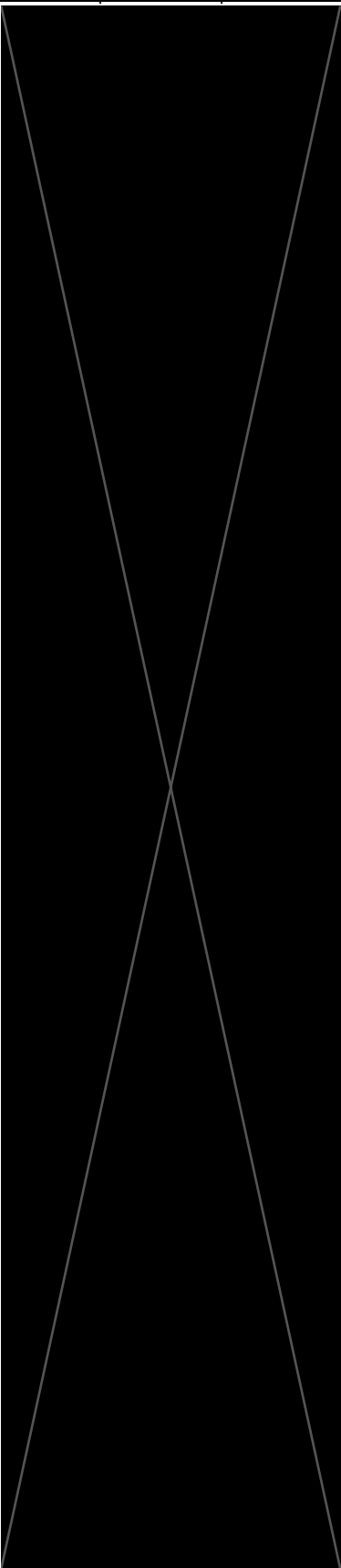
Summary of the field data is presented on Table 55.

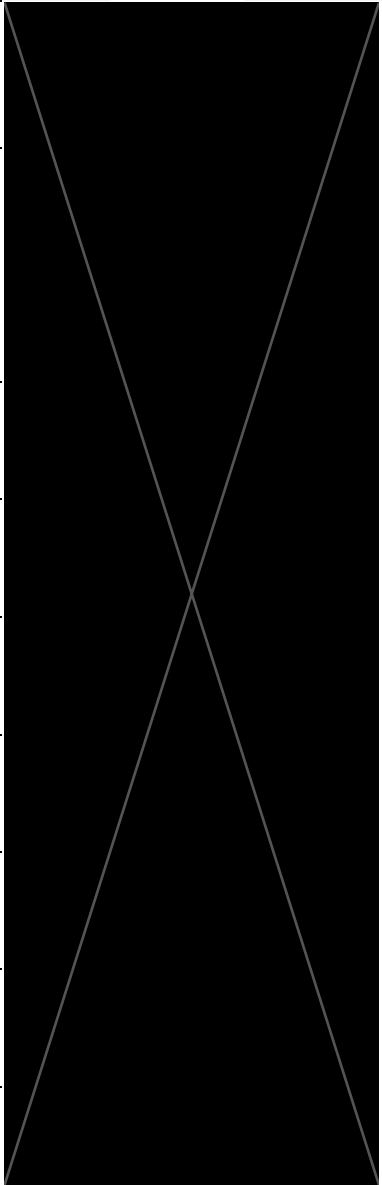
Table 55. Summary of the autumn botanical survey

Point	Turbine	N	E	Number of species	Threatened species	Alien species	Habitat	Plant community
1				16	0	0	fixed gentle hilly-wavy sands	Ferula-desert sedge-sagebrush-desert bindweed-Calligonum community
2				19	0	0	fixed gentle hilly-wavy sands	Ferula-desert sedge-Astragalus-desert bindweed-Calligonum community
3				20	0	0	wavy sandy plain	Ferula-desert sedge-Astragalus-desert bindweed community
4				19	0	0	sandy plain	Ferula-Iris-ephemeroid-desert bindweed community
5				16	0 (spring data <i>Eremostachys eriolarynx</i>)	0	sandy plain	Ferula-Iris-desert bindweed-ephemeroid-sagebrush community
6				17	0 (spring data <i>Eremostachys eriolarynx</i>)	0	sandy plain	Iris-Ferula-sagebrush-desert bindweed community
7				20	<i>Climacoptera amblyostegia</i>	0	line land and old fallow land near the Agytma discharge channel	Camel thorn-saltwort-tamarisk community
8				16	0	0	fixed sands	Ferula-desert sedge-Astragalus-desert bindweed-Calligonum community
9				18	<i>Calligonum zakirovii</i>	0	fixed sands	Calligonum-desert sedge-sagebrush-

Point	Turbine	N	E	Number of species	Threatened species	Alien species	Habitat	Plant community
								desert bindweed community
10				12	0	0	gentle wavy-hilly fixed sands	Calligonum-desert sedge-Astragalus-desert bindweed community
11				14	0	0	gentle wavy-hilly fixed sands	Calligonum-desert sedge-Astragalus-desert bindweed community
12				14	0	0	gentle wavy-hilly fixed sands	Calligonum-desert sedge-Astragalus-desert bindweed community
13				20	0	0	fixed hilly sands	Ferula-Astragalus-white saltwort-Calligonum community
14				20	0	0	fixed hilly sands, surroundings of farmstead	overgrazed Ferula-Astragalus-desert bindweed-sagebrush community
15				16	0	0	fixed hilly sands	Ferula-desert sedge-desert bindweed-sagebrush community
16				19	0	0	gentle wavy sandy plain	Ferula-Iris-desert bindweed-ephemeroid-sagebrush community
17				22	0	0	fixed gentle hilly-wavy sands	Ferula-desert sedge-desert bindweed-sagebrush-white saxaul community
18				23	0	0	fixed gentle hilly-wavy sands	Ferula-desert sedge-desert bindweed-sagebrush-saxaul community
19				23	0	0	fixed gentle hilly-wavy sands	Ferula-desert sedge-desert bindweed-sagebrush-saxaul community
20				23	0	0	fixed gentle hilly-wavy sands	Ferula-desert sedge-desert bindweed-sagebrush-saxaul community
21				23	0	0	sandy plain	Ferula-desert bindweed-saltwort-sagebrush community with black saxaul plantations
22				20	<i>Tulipa lehmanniana</i>	0	sabulous-loamy plain	Ferula-desert bindweed-saltwort-sagebrush community
23				20	<i>Tulipa lehmanniana</i>	0	sabulous-loamy plain	Ferula-desert bindweed-saltwort-

Point	Turbine	N	E	Number of species	Threatened species	Alien species	Habitat	Plant community
								sagebrush community
24				20	0	0	sabulous-loamy plain	Ferula-sagebrush-saltwort-Iris community with solitary black saxaul
25				28	0	0	saline lands and old fallows land near the Agytma discharge channel	camel thorn-saltwort-tamarisk community
26				28	0	0	saline lands and old fallows land near the Agytma discharge channel	camel thorn-saltwort-tamarisk community
27				25	Climacoptera amblyostegia	0	sandy plain at the edge of fallow lands near the Agytma discharge channel	degraded Iris-Ferula-desert sedge-sagebrush community
28				18	0	0	Sandy-loamy plain at the edge of fallow lands near the Agytma discharge channel	Iris-Ferula-bulbous bluegrass-desert bindweed-sagebrush community
29				22	0	0	sandy-loamy plain, fallow lands	secondary camel thorn-saltwort vegetation
30				23	0	0	fixed sands	Ferula-Astragalus-white saltwort-Calligonum community
31				15	0	0	sandy plain	Ferula-saltwort-Astragalus-desert bindweed community
32				24	0	0	fixed sands	Ferula-desert bindweed-Calligonum-white saltwort community
33				16	0	0	fixed sands	Ferula-sagebrush-desert bindweed-Calligonum-white saltwort community
34				14	0	0	shepherd's house and tramped area	sparse vegetation
35				16	0	0	sandy-loamy plain	ephemeroid-saltwort-sagebrush community

Point	Turbine	N	E	Number of species	Threatened species	Alien species	Habitat	Plant community
36				18	0	0	sandy-loamy plain	ephemeroid-saltwort-sagebrush community
37				20	0 (<i>Tulipa lehmanniana</i> – spring data)	0	sandy plain	Iris-ephemeroid-sagebrush community with solitary <i>Ferula foetida</i> and black saxaul (remains of plantation)
38				25	0 (<i>Tulipa lehmanniana</i> – spring data)	0	flat-wavy sandy plain	ephemeroid-sagebrush community with <i>Ferula foetida</i> , <i>Iris songarica</i> and solitary black saxaul (remains of plantations)
39				17	0 (<i>Tulipa lehmanniana</i> – spring data)	0	sandy plain	overgrazed <i>Ferula</i> -sagebrush-ephemeroid community with sparse black saxaul plantation in surroundings of a farmstead
40				23	0 (<i>Tulipa lehmanniana</i> – spring data)	0	sandy-loamy plain	Iris-ephemeroid-saltwort-sagebrush community with solitary <i>Ferula foetida</i>
41				17	0	0	sabulous-loamy plain	<i>Ferula</i> -ephemeroid-saltwort-sagebrush community
42				14	0	0	hilly fixed sands and saline depression near the Agytma discharge channel	<i>Astragalus</i> -desert sedge-sagebrush- <i>Calligonum</i> community
43				14	0	0	hilly fixed sands and saline depression near the Agytma discharge channel	<i>Astragalus</i> -desert sedge-sagebrush- <i>Calligonum</i> community
44				25	0	0	hilly fixed sands near the Agytma discharge channel	<i>Ferula</i> -desert sedge-saltwort- <i>Calligonum</i> community
45				26	<i>Climacoptera amblyostegia</i>	0	hilly fixed sands near the Agytma discharge channel	<i>Ferula</i> -desert sedge-saltwort- <i>Calligonum</i> community

Point	Turbine	N	E	Number of species	Threatened species	Alien species	Habitat	Plant community
46				26	Climacoptera amblyostegia	0	hilly fixed sands near the Agytma discharge channel	Ferula-desert sedge-saltwort-Calligonum community
47				27	Climacoptera amblyostegia	0	hilly fixed sands and saline depression near the Agytma discharge channel	Ferula-desert sedge-saltwort-Calligonum community
48				22	0	0	gentle wavy sandy plain, surroundings of farmstead	Ferula-wild rue-camel thorn-desert bindweed community
49				27	0	0	gentle wavy sandy plain	Ferula-desert sedge-Astragalus-desert bindweed community
50				27	0	0	gentle wavy sandy plain	Ferula-desert sedge-Astragalus-desert bindweed community
51				23	0	0	slightly saline sandy plain	Iris-desert bindweed-saltwort community with wild rue and camel thorn
52				17	0	0	sandy plain	Ferula-Astragalus-desert bindweed-sagebrush community
53				18	0	0	sandy plain	Ferula-desert bindweed-sagebrush community with solitary black saxaul
54				19	0 (<i>Tulipa lehmanniana</i> – spring data)	0	sandy plain	Ferula-Astragalus-sagebrush-desert bindweed community with solitary black saxaul

6 Conclusion

As a result of the field surveys and analysis of satellite imagery, following types of habitats (mapping units) can be identified in the Project site “Gijduvon 300 MW” and along the planned power line:

- Sandy and sabulous-loamy plain covered by communities of sagebrush, saltworts, desert bindweed and ephemerooids, sometimes with plantations of black saxaul. This is a natural habitat type which prevails in the Project area.
- Fixed and semi-fixed sands covered by communities of psammophilous shrubs, subshrubs, sagebrush and desert sedge.
- Saline lands.

- Modified habitats with sparse communities of native weeds, camel thorn, annual saltworts, ephemers, and with solitary black saxaul, wolfberry and tamarisk. This habitat type covers small areas in the surroundings of the desert farmsteads and in surroundings of channels.

An autumn field survey confirmed the results of vegetation description and habitat mapping performed in April 2024 (habitat types and their boundaries). Thus, the correction of the habitat map created after the spring expedition is not needed.

The vegetation of the Project site is represented with native ephemeroid-sagebrush, saltwort-ephemeroid-sagebrush and other subshrub plant communities, with psammophilous shrubs on gentle hilly-wavy sands, and sometimes with saxaul plantations created in the past for fixation of sands. The vegetation of the project site is typical for South-western Kyzylkum (and for the desert zone of Central Asia). Plant communities of the Project region are characterized with rather sparse canopy cover, low to medium species diversity and low to medium level of anthropogenic disturbance. The canopy cover is 20–40% on most areas, up to 40–50% for communities of psammophilous shrubs, and less than 10% (sometimes almost 0%) on strongly disturbed areas.

A total check-list of vascular plants recorded within the Project site during the field surveys in April and September includes 111 plant species of 30 families (47 annuals, 38 perennials, 12 subshrubs, 14 shrubs and small trees). None of them are listed in the IUCN Red List as CR, EN or VU, one species is Near Threatened (NT), and 4 species are included in the Red Data Book of Uzbekistan (*Calligonum zakirovii*, *Climacoptera amblyostegia*, *Eremostachys eriolarynx* and *Tulipa lehmanniana*). Alien species were not found.

At the present, the human impact within the project area is connected mainly with use of rangelands, small-scale agriculture and a network of ground roads.

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Annex C: Checklist of flora

Table 56: The full check list of the plant species recorded during survey

Plant species	Life form	Abundance	Distribution	Habitat	IUCN status	National status
Ephedraceae						
1. <i>Ephedra strobilacea</i>	shrub	R	Regional	Fixed sands	Least Concern (LC)	none
Araceae						
2. <i>Eminium lehmannii</i>	perennial	R-F	Regional	Fixed sands	Not Evaluated (NE)	none
Colchicaceae						
3. <i>Colchicum robustum</i>	perennial	R	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
Liliaceae						
4. <i>Fritillaria karelinii</i>	perennial	R-O	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
5. <i>Gagea divaricata</i>	perennial	R-O	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
6. <i>Tulipa lehmanniana</i>	perennial	R-F	Regional	Sandy plain, fixed sands	Near Threatened (NT)	3 (vulnerable, decreasing)
7. <i>Tulipa sogdiana</i>	Perennial	R-F	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
Iridaceae						
8. <i>Iris longiscapa</i>	perennial	R-O	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
9. <i>Iris songarica</i>	perennial	A-R	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
Amaryllidaceae						
10. <i>Allium sabulosum</i>	perennial	O	Regional	Fixed sands	Not Evaluated (NE)	none
Typhaceae						
11. <i>Typha latifolia</i>	perennial	O	Transcontinental	Saline lands, fallow lands	Least Concern (LC)	none
Cyperaceae						
12. <i>Carex physodes</i>	Perennial	D-F	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
Poaceae						
13. <i>Aeluropus litoralis</i>	perennial	F-O	Regional	Saline lands, fallow lands	Least Concern (LC)	none
14. <i>Bromus tectorum</i>	annual	C-O	Transcontinental	All types	Not Evaluated (NE)	none
15. <i>Phragmites australis</i>	perennial	O	Transcontinental	Saline lands, fallow lands	Least Concern (LC)	none
16. <i>Poa bulbosa</i>	Perennial	F-O	Transcontinental	All types	Not Evaluated (NE)	none
17. <i>Stipagrostis pennata</i>	Perennial	R-O	Regional	fixed sands	Not Evaluated (NE)	none
Papaveraceae						
18. <i>Hypecoum pendulum</i>	annual	R-F	Regional	All types	Not Evaluated (NE)	none
19. <i>Papaver pavoninum</i>	annual	R-O	Regional	All types	Not Evaluated (NE)	none
20. <i>Roemeria hybrida</i>	annual	R-O	Regional	All types	Not Evaluated (NE)	none
Ranunculaceae						
21. <i>Ceratocephala falcata</i>	annual	R-O	Regional	All types	Not Evaluated (NE)	none
22. <i>Delphinium camptocarpum</i>	Perennial	R	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
Zygophyllaceae						

23. <i>Zygophyllum macrophyllum</i>	Perennial	R	Regional	Sandy plain	Not Evaluated (NE)	none
24. <i>Zygophyllum miniatum</i>	Perennial	R-O	Regional	Sandy plain	Not Evaluated (NE)	none
25. <i>Zygophyllum oxianum</i>	Perennial	R-O	Regional	Saline lands, fallow lands	Not Evaluated (NE)	none
Fabaceae						
26. <i>Alhagi pseudalhagi</i>	Perennial	R-F	Regional	All types	Not Evaluated (NE)	none
27. <i>Astragalus ammotrophus</i>	Perennial	O	Regional	Sandy plain	Not Evaluated (NE)	none
28. <i>Astragalus campylorrhynchus</i>	annual	R	Regional	Sandy plain, fixed sands, fallow lands	Not Evaluated (NE)	none
29. <i>Astragalus commixtus</i>	annual	R	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
30. <i>Astragalus flexus</i>	perennial	R-O	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
31. <i>Astragalus rubromarginatus</i>	Perennial	R	Regional	Sandy plain	Not Evaluated (NE)	none
32. <i>Astragalus villosissimus</i>	subshrub	F-R	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
33. <i>Smirnowia turkestanica</i>	subshrub	F-R	Regional	All types	Not Evaluated (NE)	none
34. <i>Sophora pachycarpa</i>	perennial	R-O	Regional	Sandy plain, fixed sands, fallow lands	Not Evaluated (NE)	none
Euphorbiaceae						
35. <i>Euphorbia turczaninowii</i>	annual	R	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
Nitrariaceae						
36. <i>Nitraria sibirica</i>	shrub	R-O	Regional	Saline lands	Not Evaluated (NE)	none
37. <i>Peganum harmala</i>	Perennial	F-R	Regional	All types	Not Evaluated (NE)	none
Rutaceae						
38. <i>Haplophyllum robustum</i>	perennial	R	Regional	Sandy plain, fixed sands, fallow lands	Not Evaluated (NE)	none
Thymelaceae						
39. <i>Diarthron vesiculosum</i>	annual	O	Regional	All types	Not Evaluated (NE)	none
Brassicaceae						
40. <i>Arabidopsis pumila</i>	annual	O	Regional	Saline lands, fallow lands	Not Evaluated (NE)	none
41. <i>Chorispora tenella</i>	annual	R-O	Transcontinental	Sandy plain, saline lands, fallow lands	Not Evaluated (NE)	none
42. <i>Diptychocarpus strictus</i>	annual	R-O	Regional	Sandy desert	Not Evaluated (NE)	none
43. <i>Goldbachia laevigata</i>	annual	R-O	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
44. <i>Goldbachia sabulosa</i> (<i>Spirorrhynchus sabulosus</i>)	annual	O	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
45. <i>Goldbachia torulosa</i>	annual	R	Regional	Sandy plain, saline lands, fallow lands	Not Evaluated (NE)	none
46. <i>Isatis minima</i>	annual	R-O	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
47. <i>Leptaleum filifolium</i>	annual	F-O	Regional	All typed	Not Evaluated (NE)	none

48. <i>Meniocus linifolius</i>	annual	R-O	Regional	All typed	Not Evaluated (NE)	none
49. <i>Strigosella africana</i>	annual	O	Transcontinental	saline lands, fallow lands	Not Evaluated (NE)	none
50. <i>Strigosella brevipes</i>	annual	R-O	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
51. <i>Strigosella turkestanica</i>	annual	O	Regional	All types	Not Evaluated (NE)	none
Tamaricaceae						
52. <i>Tamarix hohenackeri</i>	shrub	F	Regional	saline lands, fallow lands	Not Evaluated (NE)	none
53. <i>Tamarix laxa</i>	shrub	F	Regional	saline lands, fallow lands	Not Evaluated (NE)	none
54. <i>Tamarix ramosissima</i>	shrub	F	Transcontinental	saline lands, fallow lands	Least Concern (LC)	none
Plumbaginaceae						
55. <i>Limonium suffruticosum</i>	subshrub	O	Regional	saline lands	Not Evaluated (NE)	none
Polygonaceae						
56. <i>Calligonum leucocladium</i>	shrub	F-R	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
57. <i>Calligonum microcarpum</i>	shrub	C-R	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
58. <i>Calligonum zakirovii</i>	shrub	R	Endemic	Sandy plain, fixed sands	Not Evaluated (NE)	1 (endangered, disappearing)
Caryophyllaceae						
59. <i>Acanthophyllum elatius</i>	Perennial	R	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
60. <i>Holosteum umbellatum</i>	annual	O	Transcontinental	All types	Not Evaluated (NE)	none
Amaranthaceae						
61. <i>Agriophyllum minus</i>	annual	R-O	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
62. <i>Anabasis eriopoda</i>	Perennial	R	Regional	Sandy plain, saline lands	Not Evaluated (NE)	none
63. <i>Atriplex dimorphostegia</i>	annual	R-O	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
64. <i>Caroxylon gemmascens</i> (<i>Salsola gemmascens</i>)	subshrub	R-O	Regional	Sandy plain	Not Evaluated (NE)	none
65. <i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	subshrub	O	Regional	Sandy plain	Not Evaluated (NE)	none
66. <i>Caroxylon scleranthum</i> (<i>Salsola sclerantha</i>)	annual	R-F	Regional	All types	Not Evaluated (NE)	none
67. <i>Ceratocarpus arenarius</i>	annual	R-F	Regional	All types	Not Evaluated (NE)	none
68. <i>Climacoptera amblyostegia</i>	annual	R-O	Regional	saline lands, fallow lands	Not Evaluated (NE)	2 (rare)
69. <i>Climacoptera ferganica</i>	annual	R-O	Regional	saline lands, fallow lands	Not Evaluated (NE)	none
70. <i>Climacoptera korshinskyi</i>	annual	R-O	Regional	saline lands, fallow lands	Not Evaluated (NE)	none
71. <i>Climacoptera lanata</i>	annual	R-F	Regional	saline lands, fallow lands	Not Evaluated (NE)	none
72. <i>Climacoptera minkvitzae</i>	annual	R-O	Regional	saline lands, fallow lands	Not Evaluated (NE)	none
73. <i>Halimocnemis gamocarpa</i>	annual	R-F	Regional	Sandy plain, saline lands, fallow lands	Not Evaluated (NE)	none

74. <i>Halimocnemis macrantha</i>	annual	R-O	Regional	Sandy plain, saline lands, fallow lands	Not Evaluated (NE)	none
75. <i>Halimocnemis sclerosperma</i>	annual	R-O	Regional	Sandy plain, saline lands, fallow lands	Not Evaluated (NE)	none
76. <i>Halocharis hispida</i>	annual	R-F	Regional	saline lands, fallow lands	Not Evaluated (NE)	none
77. <i>Halostachys caspica</i>	shrub	O	Regional	saline lands, fallow lands	Not Evaluated (NE)	none
78. <i>Halothamnus subaphyllus</i>	subshrub	R-O	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
79. <i>Haloxylon ammodendron</i> (<i>Haloxylon aphyllum</i>)	Small tree	R-F	Regional	Sandy plain	Not Evaluated (NE)	none
80. <i>Haloxylon persicum</i>	Small tree	A-F	Regional	fixed sands	Least Concern (LC)	none
81. <i>Horaninovia ulicina</i>	annual	R	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
82. <i>Nanophyton erinaceum</i>	subshrub	R-O	Regional	Sandy plain	Not Evaluated (NE)	none
83. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	C-R	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
84. <i>Salsola paulsenii</i>	annual	R-F	Regional	All types	Not Evaluated (NE)	none
85. <i>Suaeda altissima</i>	annual	R-F	Regional	saline lands, fallow lands	Not Evaluated (NE)	none
86. <i>Suaeda arcuata</i>	annual	R-F	Regional	saline lands, fallow lands	Not Evaluated (NE)	none
87. <i>Turania sogdiana</i> (<i>Salsola sogdiana</i>)	annual	R	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
88. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	Shrub	F-R	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
Boraginaceae						
89. <i>Heliotropium arguzioides</i>	perennial	O	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
90. <i>Heterocaryum rigidum</i>	annual	O	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
91. <i>Nonea caspica</i>	annual	R	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
Convolvulaceae						
92. <i>Convolvulus hamadae</i>	subshrub	A-R	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
Solanaceae						
93. <i>Lycium ruthenicum</i>	Shrub	R-F	Regional	saline lands, fallow lands	Not Evaluated (NE)	none
Plantaginaceae						
94. <i>Veronica campylopoda</i>	annual	O	Regional	All types	Not Evaluated (NE)	none
Lamiaceae						
95. <i>Chamaesphacos ilicifolius</i>	annual	R	Regional	fixed sands	Not Evaluated (NE)	none
96. <i>Eremostachys eriolarynx</i>	perennial	R	Endemic	Sandy plain	Not Evaluated (NE)	1 (endangered, disappearing)
97. <i>Lallemantia royleana</i>	perennial	R	Regional	Sandy plain	Not Evaluated (NE)	none
Asteraceae						
98. <i>Artemisia diffusa</i>	subshrub	O-A	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none

99. <i>Artemisia subsalsa</i>	subshrub	R-O	Regional	saline lands, fallow lands	Not Evaluated (NE)	none
100. <i>Artemisia turanica</i>	subshrub	R-F	Regional	Sandy plain	Not Evaluated (NE)	none
101. <i>Cousinia dichotoma</i>	annual	R	Regional	Sandy plain, fixed sands, fallow lands	Not Evaluated (NE)	none
102. <i>Cousinia hamadae</i>	perennial	R-O	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
103. <i>Cousinia prolifera</i>	perennial	R	Regional	Sandy plain, fallow lands	Not Evaluated (NE)	none
104. <i>Cousinia sogdiana</i>	perennial	R	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
105. <i>Karelinia caspia</i>	perennial	O	Regional	saline lands, fallow lands	Not Evaluated (NE)	none
106. <i>Koelpinia linearis</i>	annual	R	Regional	All types	Not Evaluated (NE)	none
107. <i>Koelpinia tenuissima</i>	annual	R-O	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
108. <i>Mausolea eriocarpa</i>	subshrub	R-O	Regional	fixed sands	Not Evaluated (NE)	none
109. <i>Scorzonera sericeolanata</i>	perennial	R	Regional	Sandy plain, fixed sands	Not Evaluated (NE)	none
110. <i>Takhtajaniantha pusilla</i> (<i>Scorzonera pusilla</i>)	Perennial	R-O	Regional	Sandy plain, fallow lands	Not Evaluated (NE)	none
Apiaceae						
111. <i>Ferula foetida</i>	Perennial	A-R	Regional	Sandy plain, fixed sands, fallow lands	Not Evaluated (NE)	none

12. HABITAT AND BOTANICAL SPRING SURVEY REPORT



Habitat assessment and Flora report

**Environmental and Social Impact Assessment (ESIA) for
Gijduvan 300 MW Wind Farm in Bukhara District, Uzbekistan**

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1 Introduction

The report is the result of a botanical survey for the proposed 300 MW Gijduvan Wind Farm (WF) project. The project comprises the construction of a 300 MW wind farm and a 500 kV overhead transmission line in the Gijduvan and Shofirkan districts of Bukhara region, Uzbekistan.

The main objective of this study is to provide an overview of the botanical diversity and habitat types within the project area. To achieve this objective, the expert botanist has performed the following tasks:

- Conducted an extensive field botanical survey in the spring of 2024, with particular focus on the planned turbine locations, substation, and the 25 km overhead transmission line route.
- Analyzed and compared previous botanical surveys and other available data (publications, reports, etc.) compared with the results of the field survey conducted in 2024;
- Developed detailed description and GIS-based mapping of habitat types present within the project sites, compilation of Habitat map and LULC (Land Use – Land Cover) map;
- Compiled a checklist of plant species recorded within the project site (in particular, threatened species included in the Red Data Book of Uzbekistan and/or the IUCN Red List);
- Processed and analyzed all collected field data to produce this report.

The data collected and analyzed will serve as an important resource for understanding the local ecosystem and future environmental considerations related to the project.

2 Study area

The project area covers about 17x22 km within the Gizhduvan and Shafirkan administrative districts of Bukhara Province, Uzbekistan. It lies in the vicinity of the Ayakagytna depression, 6 km south and southeast of Lake Ayakagytna, and about 30 km north of Gizhduvan and Shafirkan towns.

Figure 1 below shows the planned locations of 59 wind turbines and the overhead transmission line (OTHL) route within this area.

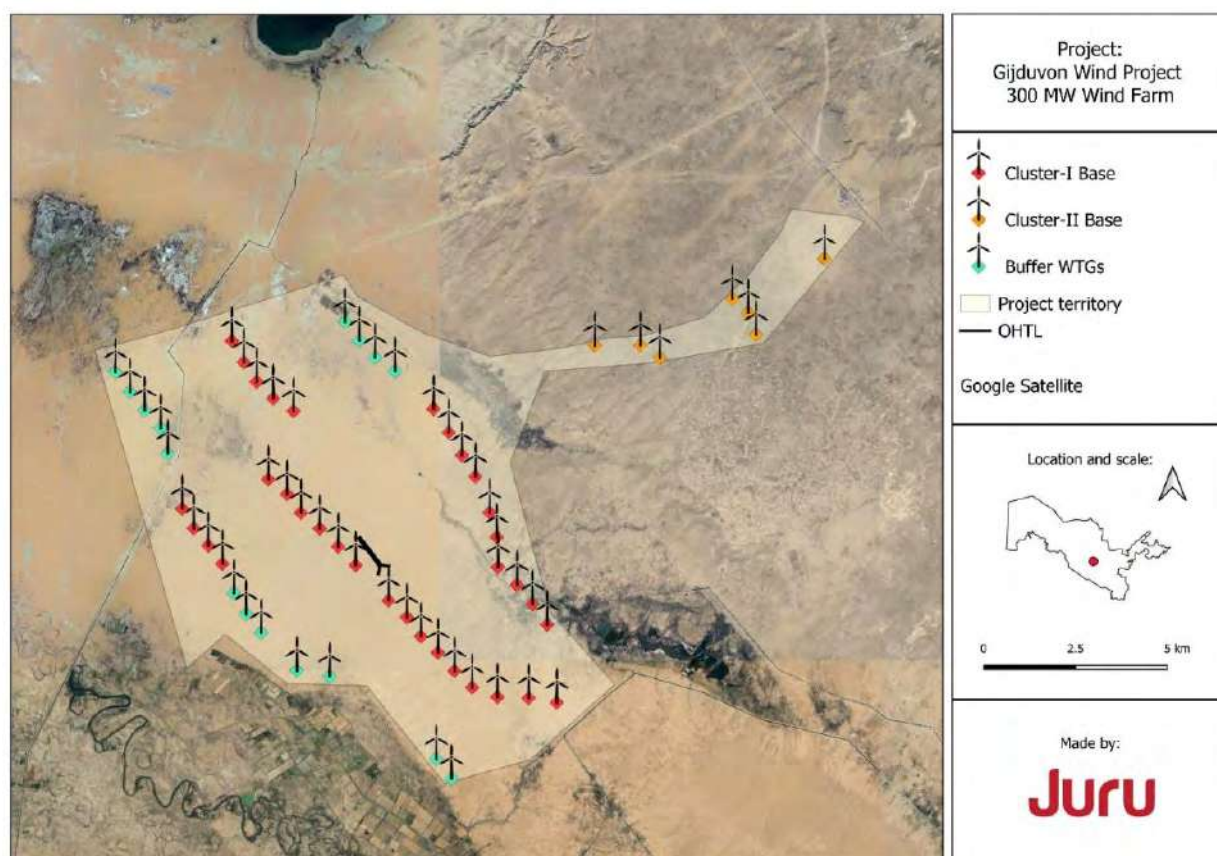


Figure 1. Study area. Red polygon – border of “Gijduvon” project site, green markers – planned turbine locations, blue circle – substation, black line – OHTL.

3 Literature review

The flora of the desert Kyzylkum (including its south-western part) has been well studied. The history of botanical research in this region spans about two centuries. The first scientific data on landscapes and plant diversity of this region have been obtained in the 19th century by European and Russian naturalists (E.A. Ewersmann and G. von Meyendorff in 1820–1821, and A. Lehmann in 1841–1842, A.P. Khoroshkhin in 1872, M.N. Bogdanov and F.I. Lobyshevich in 1873, N. Barbot-de-Marni in 1874, G. Capus and P.G. Bonvalot in 1881, and others). In 1887–1903, Russian botanist Vladimir Lipsky performed large-scale expeditions in Central Asia, including surroundings of Bukhara, and provided one of the first scientific descriptions of the flora and vegetation, as well as published detailed history of botanical research in this region in the 19th Century and early 20th Century in his work “Flora of Central Asia, i.e. Russian Turkestan and Bukhara, and Khiva Khanates” (1902–1905). Many naturalists and officials of the Russian Empire, who worked in Central Asia or visited this region in the late 19th and early 20th centuries, also collected herbarium specimens and contributed to the accumulation of floristic data. A huge amount of herbarium material collected by above mentioned pioneers of the study of Central Asian flora laid the basis for our contemporary knowledge on the plant diversity of the great desert of Kyzylkum. These specimens are kept mainly in the National Herbarium of Uzbekistan in Tashkent (TASH), Herbarium of the Komarov Botanical Institute in St. Petersburg (LE) and Herbarium of the Lomonosov Moscow State University (MW).

In 1908–1917, the Migration Department of Russian government organized a number of expeditions for investigation of soils and vegetation of Central Asia within the framework of colonization of this region. Thus, in 1913–1916, zoologist N.A. Zarudny and botanists E.P. Korovin and M.G. Popov studied some areas of the south-western Kyzylkum. As a result of these large-scale surveys, a huge amount of herbarium was collected, numerous new taxa and a diversity of plant communities were described for the first time, the first geobotanical maps were compiled.

After the completion of the Kenimekh expedition, I.I. Granitov continued studies of the flora and vegetation of south-western Kyzylkum; the results of his long-term research have been summarized in a 2-volume book “Vegetation cover of the South-Western Kyzylkum” (1964, 1967). The monograph contains an essay of the history of botanical research, description of the physiographical and environmental conditions of the region, provides the analysis of the flora and vegetation, and a scheme of phytogeographical division of the territory, as well as the assessment of the influence of humans and wildlife on the vegetation. Granitov provided the list of flora with 580 species from 290 genera and 55 families (272 species of them were reported for relic mountains Kuldzhuktau). Author also identified main types of habitats of south-western Kyzylkum and estimated their floristic diversity as follows: insular relic mountains – 272 species, so-called “kyr” (flat-topped remnant elevations or plateau bounded on at least one side by a steep cliff or slope) – 195 species, sands – 215 species, tugay (riparian habitat) – 157 species, saline depressions – 146 species, agricultural weeds – 108, ruderal weeds – 13. For sands of south-western Kyzylkum, Granitov described 12 plant formations and 24 associations. Until now, this work remains the most fundamental publication on the plant diversity of south-western Kyzylkum.

A significant amount of material was collected by the subsequent geobotanical expeditions of the 1950–1970s focused mainly on the investigation of rangelands. At that period, T.A. Adylov, V.P. Botschantzev, U.P. Prator, M.I. Pryakhin, A.I. Vvedensky, I.F. Momotov, A.D. Li, P.K. Zakirov and other specialists performed numerous field expeditions in Kyzylkum, studied and mapped the vegetation.

The general patterns of vegetation, classification scheme and description of the plant communities of Kyzylkum Desert are given in the 2nd volume of the “Vegetation cover of Uzbekistan and the ways of its practical use” (1971–1984, in 4 volumes). Following 4 main vegetation types are identified for desert zone of Uzbekistan: Psammophyta (psammophilous vegetation of sandy deserts), Gypsophyta (vegetation of gypsum and stony deserts), Halophyta (vegetation of saline lands, solonchak and takyrs) and Potamophyta (riparian vegetation or so-called tugay).

“Vegetation of Central Asia and South Kazakhstan” by E.P. Korovin (1934; 1961, 1962), “Flora of the U.S.S.R.” (1934–1964, in 30 volumes), 1st edition of the “Flora of Uzbekistan” (1941–1962, in 6 volumes), “Conspectus Florae Asiae Mediae” (1963–2015, in 11 volumes), “Flora and vegetation of the Zeravshan River basin” (Zakirov, 1955, 1961), “Weed vegetation of the Bukhara region and measures of its control” (Guzairov, 1951, 1968), “Guide to a botanical excursion to the southern edge of Western Kyzylkum” (Saidov et al., 1975), “Rangelands of the arid and semi-arid zones in Uzbekistan” (Gintzburger et al., 2003), “Botanical geography of Kazakhstan and Middle Asia” by E.I. Rachkovskaya et al. (2003) and recently published first 6 volumes of the 2nd edition of the “Flora of Uzbekistan” (2016,

2017, 2019, 2022, 2023a, 2023b), should be mentioned among the most important sources of information on the plant diversity of the project area.

Several new botanical studies have been performed in the Uzbek part of Kyzylkum Desert since 2000 (Tojibaev, Beshko, 2007; Khassanov et al., 2011; Esanov, 2017, 2019, 2023; Abduraimov, 2017; Akhmedov, 2018; Shomurodov et al., 2018; Shomurodov, 2018; etc.). In particular, F.O. Khassanov et al. (2011) estimated the entire flora of the Kyzylkum desert to be no less than 1043 species with 41 endemic and 11 sub-endemic species and noted that most of endemic species are localized in the relic mountains. However, the most actual data show that some species previously considered to be endemic to Kyzylkum have been found in neighboring areas and should be regarded as sub-endemics (Tojibaev et al., 2017). Shomurodov (2018) estimated the number of fodder plants of Kyzylkum in 908 species of 345 genera and 68 families and provided the following information about their distribution on different habitats: relic mountains – 514 fodder species, sands – 489 species, gypsum and stony desert – 305, saline lands – 268, tugay – 166 fodder species.

The most important results of botanical research in the project region are summarized in recently published books, “Coenopopulations of rare and endangered plant species of remnant low mountains of Kyzylkum” (Shomurodov et al., 2018) which contains detailed data on populations of 12 threatened species, “Inventory of the flora of Uzbekistan: Navoi Province” (Tojibaev et al., 2019), and “Inventory of the flora of Uzbekistan: Bukhara Province” (Tojibaev et al., 2020).

The checklist of the flora of Bukhara Province includes 764 species of vascular plants growing in the wild. The following information for each species is provided: life form, habitat, distribution within the Bukhara Province, conservation status, and economic use. Among them, 543 species are listed for the desert plain of Kyzylkum, 546 species – for lower reaches and ancient delta of Zeravshan River (Bukhara Oasis), and 463 species are recorded for the remnant low mountains Kuldzhuktau; 25 species are red-listed at the national level (15 of them occurs in relic mountains, others grow on desert plains); descriptions, photographs and distribution maps for threatened plant species are included.

The most recent data on the floristic diversity of south-western Kyzylkum and Bukhara Oasis is given in the thesis of Kh.K. Esanov (2023): 795 species of 346 genera and 68 families are reported, among them 671 species are native and 124 are alien; 23 species of the flora of south-western Kyzylkum are red-listed at the national level.

According to the above-mentioned literature, herbarium data and online sources (GBIF, Plantarium, iNaturalist), following 6 species included in the Red Data Book of Uzbekistan can be found in the Project area:

1. *Acanthophyllum cyrtostegium* Vved. (Caryophyllaceae). The species is national endemic of Uzbekistan listed in the Red Data Book of Uzbekistan (2019) with the category 3 (vulnerable, declining species), but not evaluated by IUCN. This is perennial which grows on gypsaceous, gravelly and sandy soils, on sands and outcrops of variegated beds in piedmonts of insular relic mountains of Kyzylkum, and occurs sporadically, solitary or in small populations.

2. *Calligonum zakirovii* (Khalk.) Czerep. (Polygonaceae). The species is national endemic of Uzbekistan listed in the Red Data Book of Uzbekistan (2019) with the category 1 (endangered, disappearing), but not evaluated by IUCN. This is small shrub which grows on gypsaceous, gravelly and sandy soils in piedmonts of insular relic mountains of Kyzylkum, and occurs sporadically, in small groups.

3. *Climacoptera amblyostegia* (Botsch.) Botsch. (Amaranthaceae). The species is included in the Red Data Book of Uzbekistan (2019) with the category 2 (rare), but not evaluated by IUCN. This is annual plant which grows on saline lands, and occurs sporadically in Hungry Steppe, Karshi Steppe, Fergana valley, Bukhara oasis in Uzbekistan and in Syrdarya valley in Kazakhstan.

4. *Eremostachys eriolarinx* Pazij et Vved. (Lamiaceae). The species is included in the Red Data Book of Uzbekistan (2019) with the category 1 (endangered, disappearing), but not evaluated by IUCN. Endemic to Kyzylkum Desert (Uzbekistan, Kazakhstan). This is perennial which grows on gravelly and sandy soils. Only 2 populations of about 200 individuals in total are known in Uzbekistan (both in Bukhara Province).

5. *Phlomoides transoxana* (Bunge) Salmaki (*Paraeremostachys transoxana* (Bunge) Adylov, Kamelin & Makhm.) (Lamiaceae). The species is included in the Red Data Book of Uzbekistan (2019) with the category 2 (rare), but not evaluated by IUCN. National endemic, endemic to Kyzylkum desert (including relic mountains). Perennial, grows on sandy soils and shallow sands in piedmonts of insular relic mountains of Kyzylkum, and occurs sporadically, in small groups.

6. *Tulipa lehmanniana* Merckl. (Liliaceae). Included in the Red Data Book of Uzbekistan with the status 3 (vulnerable, declining species), nationally red-listed also in Kazakhstan, Tajikistan and Turkmenistan. In the IUCN Red List, this species is assessed as Near Threatened (NT). Bulbous perennial. Vulnerable species of Irano-Turanian deserts with decreasing range and populations. Distributed in Kazakhstan, Tajikistan, Turkmenistan, Uzbekistan, Afghanistan, Iran and Pakistan. Recent field studies (Abduraimov, 2017; Shomurodov & al., 2018) showed that large populations with thousands of specimens grow in the Uzbek part of the Kyzylkum desert, in Dzhizak, Samarkand, Navoi and Bukhara Regions.

It should be noted that currently only 289 taxa of more than 4380 species recorded for the flora of Uzbekistan were assessed by IUCN (6.6% of the flora), 27 species of them were included in the IUCN Red List as threatened (7 – CR, 10 – EN, 10 – VU), 17 of them are redlisted at the national level. 12 plant species were assessed as Near Threatened (NT), 227 – Least Concern (LC), and 23 species belong to the category DD (Data Deficient). The majority of species of the flora of Uzbekistan has not yet been assessed by IUCN and belongs to the category NE (Not Evaluated).

To date, 5 editions of the Red Data Book of Uzbekistan have been published. The first (1984) included 163 plant species, the second (1998) – 301, the third (2006) – 302, the fourth (2009) – 321, and an actual, fifth edition (2019), includes 314 plant species. National categories of threatened plants are follows: 0 (probably extinct species) – more or less corresponds to EX or EW categories of the IUCN

Red List (www.iucnredlist.org), 1 (endangered, disappearing species) – meets CR category of IUCN, 2 (rare species) – meets EN category of IUCN and 3 (vulnerable, declining species) – corresponds to VU or NT category of IUCN. In 2023, Institutes of Botany and Zoology of the Academy of Sciences of Uzbekistan began a project supported by the Ministry of Ecology, Environmental Protection and Climate Change, and aimed at bringing the Red Data Book of Uzbekistan to the modern global standards of the IUCN Red List. The publication of the sixth edition of the Red Data Book of Uzbekistan based on the IUCN Red List Categories and Criteria is planned for 2025.

Detailed classification and mapping of habitats, and identification of threatened habitat types (as it was done in EU) has not yet been carried out in Uzbekistan and Central Asia, and this topic is urgent.

4 Materials and methods

The field research in the project area was conducted 10–11 April 2024 by traditional methods of botanical survey commonly used for sampling and mapping of native non-forest vegetation, recognition of floristic composition and spatial patterns of plant communities (Field geobotany, 1959–1976; Granitov, 1980; Kent, 2011). All planned turbine locations, substation site and 25 km OTHL route were inspected, and check-lists of plant species recorded for each survey point compiled.

The structure of plant communities was studied on 100x100 m geobotanical sample plots; check-lists of plant species recorded for each sample plot and a summary check-list of the flora of wind park project area were compiled.

For each sample plot, photographs of the landscape and vegetation were taken using a digital camera, and following data were recorded: location and physical environment (including GPS coordinates, elevation, topography, and soil type), state of vegetation, type of land use and disturbance factors (grazing, roads, etc.), plant community, canopy cover (%), all plant species present at the plot, their cover and abundance, phenological stage and height. Species abundance was determined using the Braun-Blanquet cover-abundance scale (+ – occasional and less than 1% cover of the sample plot area; 1 – abundant with low cover, or less abundant but with higher cover, 1–5% of the sample plot area; 2 – abundant with >5–25% of the sample plot area, irrespective of the number of individuals; 3 – >25–50% cover of the sample plot area, irrespective of the number of individuals; 4 – >50–75% cover of the sample plot area, irrespective of the number of individuals; 5 – >75% cover of the sample plot area, irrespective of the number of individuals) and the DACFOR scale: D – Dominant; A – Abundant, C – Common, F – Frequent, O – Occasional, R – Rare.

Coordinates of populations of endemic, redlisted or alien plant species, number of individuals and area occupied by population also were recorded.

Plant species were identified using special literature, as “*Conspectus Florae Asiae Mediae*” (1963–1993), “*Flora of Uzbekistan*” (1941–1963, 2016, 2017, 2019, 2022, 2023a, 2023b) and “*Flora of USSR*” (1934–1964). Available publications and online databases (Nikitin, 1983; IUCN/ISSG, 2014; CABI, 2017; Sennikov et al., 2018) were used for identification of alien species, while the Red Data Book of Uzbekistan (1984, 1998, 2006, 2009, 2019) and the IUCN Red List (www.iucnredlist.org) were used for identification of threatened species. Other relevant published data on flora and vegetation of the region also has been analyzed (listed below in References).

The final check-list of plant species recorded for the project area was compiled (Annex D). Species in the checklist are arranged in taxonomical order in accordance with the APG system (APG IV, 2016). Accepted scientific names are provided in accordance with the online global databases Plants of the World Online (www.plantsoftheworldonline.org/), International Plant Names Index (www.ipni.org) and Global Biodiversity Information Facility (www.gbif.org), as well as with recently published treatments

of different taxonomical groups of the flora of Uzbekistan (Sennikov, 2016, 2017, 2019, 2022, 2023a, 2023b).

The habitat and LULC maps were created using QGIS 3.32 free software on the basis of visual interpretation of Google Earth free satellite imagery, topographic maps (1:100,000, available online for free at <http://loadmap.net/>), and the data of field survey.

It should be noted that detailed classification and mapping of habitats, and identification of threatened habitat types (as it was done in EU) has not yet been carried out in Uzbekistan and Central Asia, and this topic is urgent. Since Uzbekistan has not developed the national system of classification of habitats, we used IUCN Habitats Classification Scheme, ver. 3.1 (<https://www.iucnredlist.org/resources/habitat-classification-scheme>) and typology of native vegetation published in the “Vegetation cover of Uzbekistan” (1971–1984) for the classification of habitats of project area. As far it was applicable to the local conditions, we also followed the pan-European system, EUNIS habitat classification scheme.

As defined by the International Finance Corporation (IFC) Performance Standard 6 (PS6) and EBRD Performance Requirement 6 (PR6), critical habitats are areas with high biodiversity value which meet at least one following criteria:

Criterion 1. Habitat of significant importance to Critically Endangered and/or Endangered species;

Criterion 2. Habitat of significant importance to endemic and/or restricted-range species;

Criterion 3. Habitat supporting globally significant concentrations of migratory species and/or congregatory species;

Criterion 4. Highly threatened and/or unique ecosystems;

Criterion 5. Areas associated with key evolutionary processes.

Numerical thresholds have been defined for the first four critical habitat criteria, based on these published by IUCN in “A Global Standard for the Identification of Key Biodiversity Areas” (2016) and “IUCN Red List Categories and Criteria” (2012). Assessment parameters are: i) number of mature individuals, ii) area of occupancy, iii) extent of suitable habitat, iv) range, v) number of localities, vi) distinct genetic diversity.

According to the IFC Guidance Note 6, quantitative thresholds of critical habitat are following: Criterion 1. CR/EN species: a) habitat required to sustain at least 10% of global population of CR or EN species, where there are known, regular occurrences of the species and where that habitat could be considered a discrete management unit for that species; (b) habitat with known, regular occurrences of CR or EN species where that habitat is one of 10 or fewer discrete management sites globally for that species; (c) habitat supports the regular occurrence of a single individual of a CR species and/or habitat containing regionally important concentrations of a red-listed EN species where that habitat could be considered a discrete management unit for that species/subspecies; (d) habitat of significant importance to CR or EN species that are wide-ranging and/or whose population distribution is not well understood and where the loss of such a habitat could potentially impact the long-term survivability of the species; (e) as appropriate, habitat containing nationally/regionally important concentrations of an EN, CR or equivalent national/regional listing.

Criterion 2. Endemic / restricted range species: (a) habitat known to sustain $\geq 95\%$ of the global population of an endemic or restricted-range species where that habitat could be considered a discrete management unit for that species (e.g. a single-site endemic); (b) habitat known to sustain $\geq 1\%$ but $< 95\%$ of the global population of an endemic or restricted-range species where that habitat could be considered a discrete management unit for that species, where data are available and/or based on expert judgment.

Criterion 3 (migratory species) is inapplicable for plants. As for Criterion 4, unfortunately, the officially approved national list of highly threatened and/or unique ecosystems and habitats does not exist in Uzbekistan. For Criterion 5, there are no numerical thresholds.

5 Results of the field survey

5.1 Habitat assessment

A field survey has been conducted 10–11 April 2024.

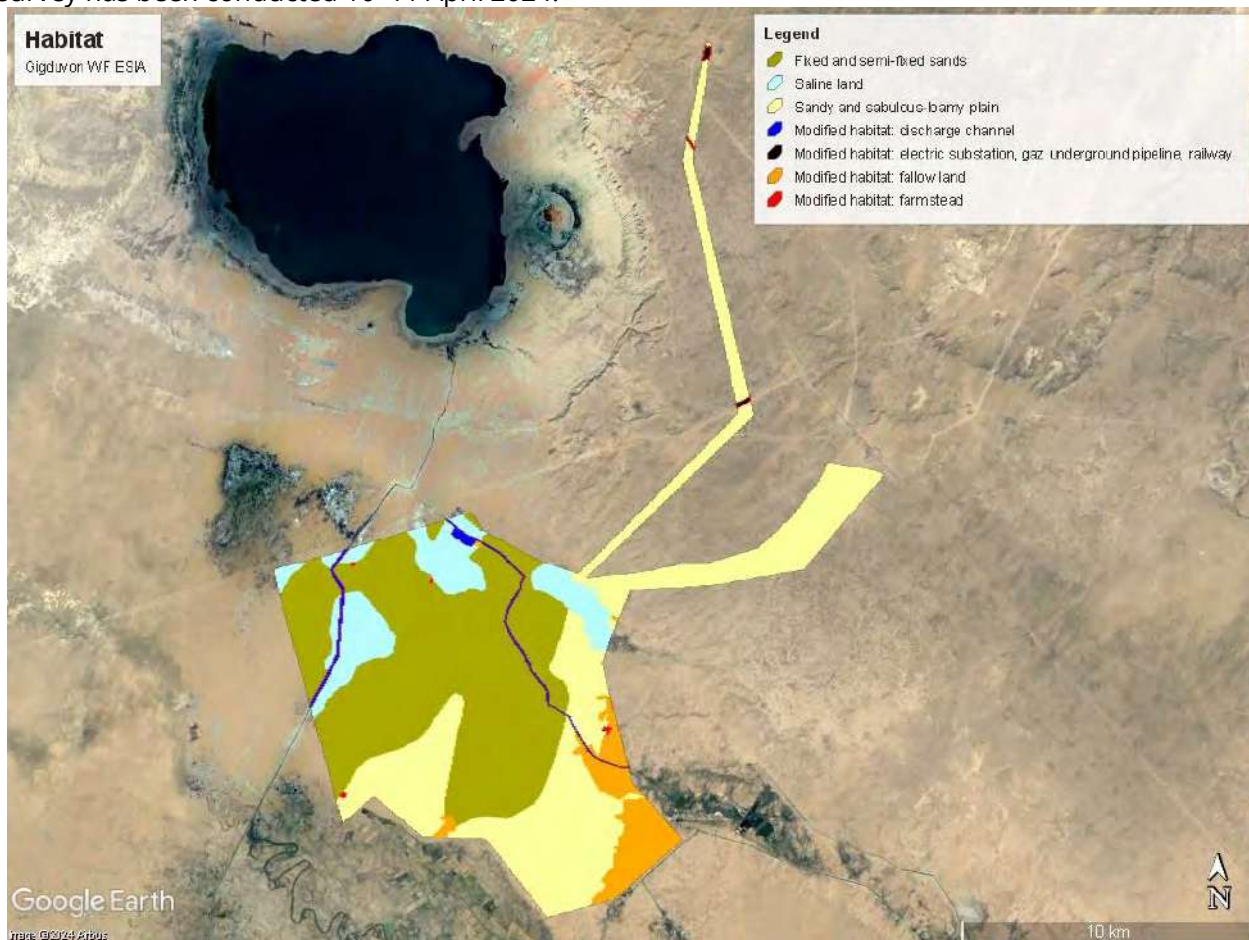


Figure 2: Habitat map

According to typology of native vegetation of Uzbekistan, IUCN Habitats Classification Scheme and EUNIS habitat classification, following habitat types and vegetation communities were identified within the project area:

The field survey showed that natural habitats prevail within the study area; they are represented with 3 types:

Sandy and sabulous-loamy plain

The main habitat type in the eastern and north-eastern part of "Gijduvan" Project site (between the railway and Agytma discharge channel) and along the OTHL is sandy and sandy-loamy desert plain with flat and flat-wavy terrain, and sandy or sandy-loamy soil, covered with various native plant communities with domination of sagebrush (*Artemisia diffusa*), black saltwort *Oreosalsola arbusculiformis* (*Salsola arbusculiformis*), other subshrubs (*Astragalus villosissimus*, *Convolvulus hamadae*), *Iris songarica*, giant Umbelliferae *Ferula foetida*, desert sedge (*Carex physodes*) and bulbous bluegrass (*Poa bulbosa*), with sparse plantations of black saxaul (*Haloxylon ammodendron*) created in the past to prevent erosion and deflation. An average density of saxaul stands is 1–3 to 4–5 trees per 100 m², the height is 1.2–1.7 m.

The plant species diversity is 15 to 30 species per 100x100 m sample plot. The canopy cover is 20–50%.

The main type of land use is pasture; an impact of grazing is low to medium. Local impact is connected with several farmsteads and ground roads situated in the Project site.

According national classification (Vegetation cover of Uzbekistan, 1971–1984), the vegetation belongs to sagebrush (*Artemiseta diffusae*), *Astragalus* (*Astragaleta villosissimae*) and desert bindweed (*Convolvuleta hamadae*) formations and type of psammophytic vegetation of sandy deserts (*Psammophyta*). According IUCN Habitats Classification, ver. 3.1, this habitat belongs to the type 8 Desert and subtype 8.2 Temperate desert. According EUNIS Habitats classification, this habitat more or less corresponds to the type S Heathland, scrub and tundra and subtype S67 Aralo-Caspian semi-desert. This habitat is not included in the Annex I of EU Habitats Directive, but some nationally red-listed and endemic plants occur in this habitat. One nationally red-listed species, *Tulipa lehmanniana*, occurs sporadically within all territory of this habitat type, its abundance is R to F, population density varies from solitary specimens to several thousand per 1 hectare. Another nationally red-listed species, *Eremostachys eriolarynx*, was recorded near the location of Cluster I Base turbines 05 and 06 (11 and 8 individuals, respectively, only 19 specimens in two populations in total).

Fixed and semi-fixed sands

Fixed and semi-fixed hilly sands prevail in the central part of Project area. The vegetation of this habitat type is represented with by various native psammophilous communities composed of desert shrubs (*Calligonum leucocladum*, *C. microcarpum*, *Haloxylon persicum*, *Xylosalsola arbuscula* (*Salsola arbuscula*)), subshrubs (*Astragalus villosissimus*, *Convolvulus divaricatus*, *Convolvulus hamadae*), giant

Umbelliferae *Ferula foetida*, sagebrush (*Artemisia diffusa*) and desert sedge (*Carex physodes*). A boundary between this habitat and flat sandy plain is quite unclear.

The plant species diversity is 20 to 30 species per sample plot. The canopy cover is 40–50%. The density saxaul and *Calligonum* is 2–3 up to 5–6 individuals per 100 m². One nationally red-listed species, *Tulipa lehmanniana*, occurs sporadically within all territory of this habitat type, its abundance is R to O, population density varies from solitary specimens to 900–1000 per 1 hectare. Three populations of another nationally red-listed species, endangered endemic *Calligonum zakirovii* (27 specimens in total) were recorded in this habitat, 130 m to the north of Cluster I Base turbine 01 near the planned OTHL, near Cluster I Base turbines 09 and 10.

The main type of land use is pasture; an impact of grazing is medium; several shepherds houses are situated in this territory. Local impact is connected also with several ground roads.

According national classification (Vegetation cover of Uzbekistan, 1971–1984), the vegetation belongs to *Calligonum* (*Calligoneta varia*), white saltwort (*Salsola arbusculae*) and white saxaul (*Haloxyleta persica*) formations and type of psammophytic vegetation of sandy deserts (*Psammophyta*). According IUCN Habitats Classification, ver. 3.1, this habitat belongs to the type 8 Desert and subtype 8.2 Temperate desert. According EUNIS Habitats classification, this habitat more or less corresponds to the type S Heathland, scrub and tundra and subtype S68 Semi-desert sand dune with sparse scrub.

This habitat is not included in the Annex I of EU Habitats Directive, but psammophilous vegetation, particularly desert woodlands, plays an important ecological role forming a unique landscape of sandy deserts of Central Asia. The roots of plants, especially, the desert sedge, form a dense network fixing sands. The formation of moving sands in Kyzylkum desert is the result of human impact (injurious felling of trees and shrubs for fuel, excessive grazing and various technological disturbance). Therefore, moving sands always occur around settlements, farmsteads, wells, along roads, railways, electric lines and other disturbed areas with broken sands.

Saline lands

Saline lands are situated in depressions and along irrigation and discharge channels and collectors of the irrigation system of Bukhara oasis (Agytma discharge channel, Shurkul channel, etc.). The vegetation is represented by tugay and salt marsh communities with halophilic shrubs (*Tamarix sp.*, *Halostachys caspica*, *Lycium ruthenicum*), reeds (*Phragmites australis*, *Typha latifolia*, *T. minima*), camel thorn (*Alhagi pseudalhagi*), saltworts (*Halocnemum strobilaceum*, *Ceratocarpus arenarius*, *Climacoptera sp.*, *Salicornia europaea*, *Salsola paulsenii*, *Suaeda sp.*), other halophytes, halomesophytes and halohydrophytes, as *Limonium otolepis*, *Karelinia caspia*, and pastoral weeds (*Peganum garmala*, *Sophora pachycarpa*). Canopy cover and species composition are variable in different locations. This habitat type covers rather small area. According IUCN Habitats Classification, ver. 3.1, this habitat belongs to the type 5 Wetlands (inland) and subtype 5.3 Shrub dominated wetlands. According EUNIS Habitats classification, this habitat can be classified as the complex of type S Heathland, scrub and

tundra, subtype S94 Semi-desert riparian scrub, and type R Grasslands and lands dominated by forbs, mosses or lichens, subtype R64 Semi-desert salt pan. This habitat is extremely important as animals watering place. According to the national classification of desert vegetation (Granitov, 1964, 1967; Zakirov, 1971; Vegetation cover, 1971–1984; Shomurodov, 2018), these communities belong to the types of Halophyta and Potamophyta.

Modified habitats

At the present, modified habitats occupy only very small part of the Project site; they are represented with saline fallow lands (abandoned fields) and farmsdeads (shepherds houses, corrals and wells surrounded with tramped areas). Fallow lands are situated in the southern part of the Project site, along Agytma discharge channel and Shurkul channel. According IUCN Habitats Classification, ver. 3.1, fallow lands belong to the type 14 Artificial Terrestrial, subtypes 14.1 Arable Land and 14.2 Pasture Land. It corresponds with EUNIS habitat type V Vegetated man-made habitats, subtype V1 Arable land and market gardens (V15 Bare tilled, fallow or recently abandoned arable land). Old fallow lands are covered with secondary communities with domination of tamarisk, annual and perennial saltworts and camel thorn, similar with natural those growing on saline lands. They can be classified as EUNIS type S Heathland, scrub and tundra, subtype S94 Semi-desert riparian scrub, or type R Grasslands and lands dominated by forbs, mosses or lichens, subtype R64 Semi-desert salt pan.

Tramped and overgrazed areas around farms and wells, as well as technologically disturbed areas in the sandy desert become centers of erosion which can lead to the formation of moving sands. Farmsteads corresponds with EUNIS habitat type J Constructed, industrial and other artificial habitats, subtype J2.1 Scattered residential buildings.

5.2 Flora assessment

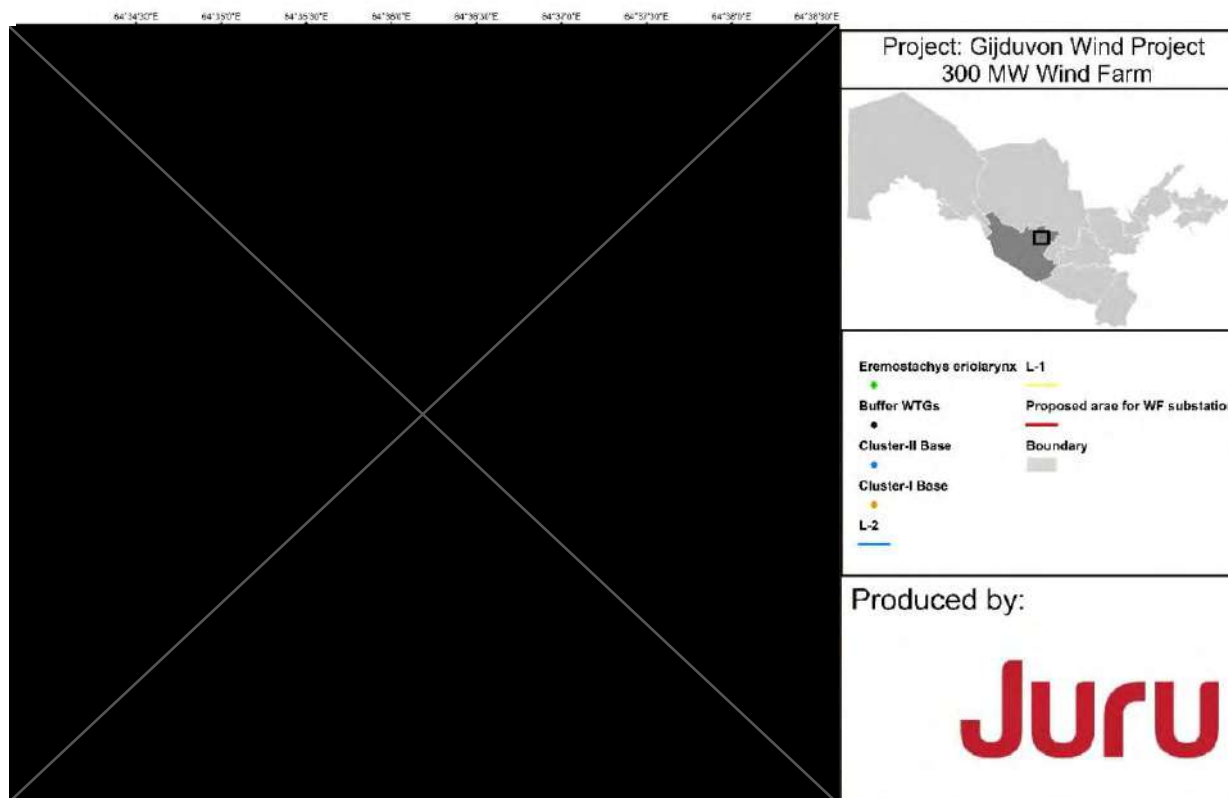
In total, 84 plant species of were recorded within the project area. None of them are included in the IUCN Red List as CR, EN or VU, one species is Near Threatened (NT), and 3 species are included in the Red Data Book of Uzbekistan. Alien species were not found. Nationally redlisted are following 3 plant species:

1. *Calligonum zakirovii* (Khalk.) Czerep. (Polygonaceae). This is a small shrub, national endemic of Uzbekistan listed in the Red Data Book of Uzbekistan (2019) with the category 1 (endangered, disappearing), but not evaluated by IUCN. Three populations (27 specimens in total) were found at 40.48382° N, 64.60738° E, 130 m to the north of Cluster I Base turbine 01, near the planned OTHL, at 40.494058° N, 64.546042° E, Cluster I Base turbine 09, and at 40.489246° N, 64.55021° E, Cluster I Base turbine 10, on fixed sands, among Ferula-desert bindweed-desert sedge-Calligonum community.



1111-Figure. Locations of *Calligonum zakirovii* near the Turbines

2. *Eremostachys eriolarynx* Pazij et Vved. (Lamiaceae), perennial, endemic to Kyzylkum Desert (Uzbekistan, Kazakhstan) included in the Red Data Book of Uzbekistan (2019) with the category 1 (endangered, disappearing), but not evaluated by IUCN. Two small populations with 8 and 17 specimens were found at [REDACTED] on sandy plain, among Ferula-Iris-desert-bindweed-sagebrush community.



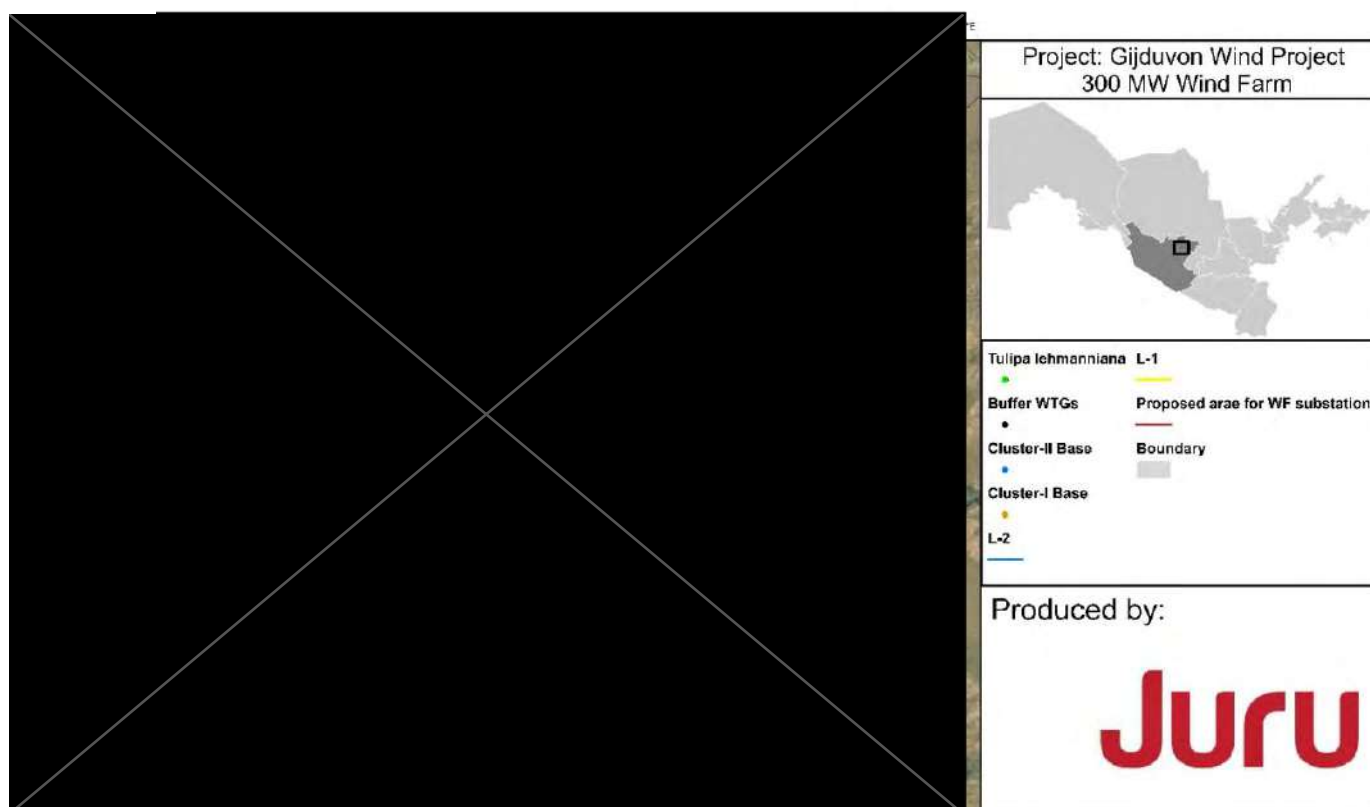
\\111-Figure. Locations of *Eremostachys eriolarynx* near the Turbines

3. *Tulipa lehmanniana* (Liliaceae), vulnerable species of Irano-Turanian deserts with decreasing range and populations, listed in the Red Data Book of Uzbekistan (2019) with the category 3 (reducing), listed in the IUCN Red List under category Near Threatened (NT). The species is nationally redlisted also in Kazakhstan, Tajikistan and Turkmenistan. *Tulipa lehmanniana* is quite widely spread in the desert zone of Irano-Turanian region of Tethyan (Ancient Mediterranean) floristic subkingdom of Holarctic (Takhtajan, 1986), in Uzbekistan, Kazakhstan, Tajikistan, Turkmenistan, Afghanistan, Pakistan, and Iran. *Tulipa lehmanniana* occurs sporadically within the Project area, its relative abundance according the DAFOR scale is R (rare) to F (frequent), population density varies from solitary specimens to several thousand per 1 hectare.

Populations of *Tulipa lehmanniana* were recorded in majority of sample plots and vegetation communities in sandy plain and fixed hilly sands. Population density on different plots is 1–3 to 50–70 generative specimens per 100 m². For example:

- [REDACTED] flat-wavy sandy plain, ephemeroid-sagebrush community with *Ferula foetida*, *Iris songarica* and solitary black saxaul (remains of plantations). Sparse population with 1–3 generative specimens per 100 m².
- [REDACTED] sandy plain, overgrazed *Ferula*-sagebrush-ephemeroid community with sparse black saxaul plantation in surroundings of a farmstead. Population density is 3-4 to 8-10 generative specimens per 100 m².

- [REDACTED] sandy plain with Iris-sagebrush-ephemeroid vegetation with solitary *Ferula foetida* and black saxaul (remains of plantations). Large population of several thousand plants, with a density up to 50-70 generative specimens per 100 m².
- [REDACTED] sandy-loamy plain, Iris-ephemeroid-saltwort-sagebrush community with solitary *Ferula foetida*. Sparse population with 1–3 generative specimens per 100 m².
- [REDACTED] sandy plain, *Ferula*-*Astragalus*-sagebrush-desert bindweed community. Sparse population with 1–3 generative specimens per 100 m².



\111-Figure. Locations of *Tulipa lehmanniana* near the Turbines

Most of species recorded for the project area are typical for desert zone of Central Asia and more or less common and widely spread. The number of plant species recorded per sample plot varies from 15 to 30. Checklist of flora is represented in Annex D.

5.3 Findings and results

In total, 49 sample plots were described within wind farm area and along the planned OHTL. Checklists of plants recorded for each sample plot are summarized below (Tables 1–49). Photographs are represented in Annex A. The vegetation within the Project area is typical for south-western Kyzylkum.

Table 1. Check-list of plants recorded for [REDACTED] fixed gentle hilly-wavy sands, *Ferula*-desert sedge-sagebrush-desert bindweed-*Calligonum* community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	30-40	R	+	vegetation
2. <i>Artemisia diffusa</i>	subshrub	30-40	F	1	vegetation
3. <i>Astragalus flexus</i>	perennial	15-17	R	+	flowering
4. <i>Astragalus villosissimus</i>	subshrub	30-40	O	1	flowering
5. <i>Calligonum microcarpum</i>	shrub	70-100	F	2	vegetation
6. <i>Calligonum zakirovii</i>	shrub	50-70	R	+	vegetation
7. <i>Carex physodes</i>	perennial	12-15	A	2	flowering
8. <i>Ceratocarpus arenarius</i>	annual	10-12	O	+	vegetation
9. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
10. <i>Convolvulus hamadae</i>	subshrub	20-25	F	1	vegetation
11. <i>Cousinia sogdiana</i>	perennial	25-30	R	+	vegetation
12. <i>Eminium lehmannii</i>	perennial	15-20	R	+	flowering
13. <i>Euphorbia turczaninowii</i>	annual	7-10	R	+	flowering
14. <i>Ferula foetida</i>	perennial	70-150	A	3	flowering
15. <i>Gagea divaricata</i>	perennial	7-10	O	+	flowering
16. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
17. <i>Hypocoum pendulum</i>	annual	15-25	O	+	flowering
18. <i>Iris longiscapa</i>	perennial	15-20	O	+	flowering
19. <i>Isatis minima</i>	annual	15-20	O	+	Flowering, fruiting
20. <i>Peganum harmala</i>	perennial	25-30	R	+	vegetation
21. <i>Smirnowia turkestanica</i>	subshrub	30-40	F	1	vegetation
22. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50-70	R	+	vegetation

Table 2. Check-list of plants recorded for [REDACTED] fixed gentle hilly-wavy sands, *Ferula*-desert sedge-*Astragalus*-desert bindweed-*Calligonum* community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	vegetation
2. <i>Artemisia diffusa</i>	subshrub	30-40	F	1	vegetation
3. <i>Astragalus flexus</i>	perennial	15-17	R	+	flowering
4. <i>Astragalus villosissimus</i>	subshrub	30-40	F	1	flowering
5. <i>Calligonum microcarpum</i>	shrub	70-100	F	2	vegetation
6. <i>Carex physodes</i>	perennial	15-20	A	2	flowering
7. <i>Ceratocarpus arenarius</i>	annual	10-12	O	+	vegetation
8. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
9. <i>Convolvulus hamadae</i>	subshrub	20-25	F	1	vegetation
10. <i>Cousinia hamadae</i>	perennial	15-20	R	+	vegetation
11. <i>Cousinia sogdiana</i>	perennial	25-30	R	+	vegetation
12. <i>Ferula foetida</i>	perennial	70-150	A	3	flowering
13. <i>Gagea divaricata</i>	perennial	7-10	O	+	flowering

14. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
15. <i>Hypecoum pendulum</i>	annual	15-25	O	+	flowering
16. <i>Iris longiscapa</i>	perennial	15-20	O	+	flowering
17. <i>Iris songarica</i>	perennial	30-35	R	+	budding
18. <i>Isatis minima</i>	annual	15-20	R	+	Flowering, fruiting
19. <i>Meniocus linifolius</i>	annual	10-12	O	+	Flowering, fruiting
20. <i>Smirnowia turkestanica</i>	subshrub	30-40	F	1	vegetation
21. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50-70	O	1	vegetation

Table 3. Check-list of plants recorded for [REDACTED] wavy sandy plain, *Ferula*-desert sedge-*Astragalus*-desert bindweed community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	vegetation
2. <i>Artemisia diffusa</i>	subshrub	30-40	F	1	vegetation
3. <i>Astragalus flexus</i>	perennial	15-17	R	+	flowering
4. <i>Astragalus villosissimus</i>	subshrub	30-40	C	2	flowering
5. <i>Calligonum microcarpum</i>	shrub	50-70	R	+	vegetation
6. <i>Carex physodes</i>	perennial	12-15	A	2	flowering
7. <i>Ceratocarpus arenarius</i>	annual	10-12	F	1	vegetation
8. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
9. <i>Convolvulus hamadae</i>	subshrub	20-25	A	2	vegetation
10. <i>Cousinia hamadae</i>	perennial	15-20	R	+	vegetation
11. <i>Ferula foetida</i>	perennial	70-150	A	3	flowering
12. <i>Fritillaria karelinii</i>	perennial	7-10	R	+	fruiting
13. <i>Gagea divaricata</i>	perennial	7-10	O	+	flowering
14. <i>Goldbachia laevigata</i>	annual	12-15	R	+	Flowering, fruiting
15. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
16. <i>Hypecoum pendulum</i>	annual	15-25	O	+	flowering
17. <i>Iris longiscapa</i>	perennial	15-20	O	+	flowering
18. <i>Iris songarica</i>	perennial	30-35	R	+	budding
19. <i>Isatis minima</i>	annual	15-20	O	+	Flowering, fruiting
20. <i>Meniocus linifolius</i>	annual	10-12	O	+	Flowering, fruiting
21. <i>Smirnowia turkestanica</i>	subshrub	30-40	F	1	vegetation
22. <i>Strigosella brevipes</i>	annual	10-12	R	+	flowering
23. <i>Tulipa lehmanniana</i>	perennial	15-20	R	+	flowering
24. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50-70	R	+	vegetation

Table 4. Check-list of plants recorded for [REDACTED] sandy plain, Ferula-Iris-ephemeroid-desert bindweed community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Artemisia diffusa	subshrub	30-40	O	1	vegetation
2. Astragalus flexus	perennial	15-17	R	+	flowering
3. Astragalus villosissimus	subshrub	30-40	R	+	flowering
4. Carex physodes	perennial	12-15	F	1	flowering
5. Ceratocephala falcata	annual	4-5	O	+	Flowering, fruiting
6. Convolvulus hamadae	subshrub	20-25	A	2	vegetation
7. Cousinia hamadae	perennial	15-20	O	1	vegetation
8. Ferula foetida	perennial	70-150	C	2	flowering
9. Fritillaria karelinii	perennial	7-10	R	+	fruiting
10. Gagea divaricata	perennial	7-10	O	+	flowering
11. Goldbachia laevigata	annual	12-15	R	+	Flowering, fruiting
12. Holosteum umbellatum	annual	10-12	O	+	flowering
13. Hypecoum pendulum	annual	15-25	O	+	flowering
14. Iris longiscapa	perennial	15-20	O	+	flowering
15. Iris songarica	perennial	30-35	O	1	budding
16. Isatis minima	annual	15-20	O	+	Flowering, fruiting
17. Leptaleum filifolium	annual	5-7	O	+	flowering
18. Meniocus linifolius	annual	10-12	O	+	Flowering, fruiting
19. Poa bulbosa	perennial	15-20	F	1	budding
20. Smirnowia turkestanica	subshrub	30-40	R	+	vegetation
21. Strigosella brevipes	annual	10-12	R	+	flowering
22. Tulipa lehmanniana	perennial	15-20	O	+	flowering
23. Tulipa sogdiana	perennial	10-12	O	+	fruiting
24. Xylosalsola arbuscula (Salsola arbuscula)	shrub	50-70	R	+	vegetation

Table 5. Check-list of plants recorded for [REDACTED] sandy plain, Ferula-Iris-desert bindweed-ephemeroid-sagebrush community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Alhagi pseudalhagi	perennial	25-30	R	+	vegetation
2. Artemisia diffusa	subshrub	30-40	F	2	vegetation
3. Astragalus villosissimus	subshrub	30-40	R	+	flowering
4. Carex physodes	perennial	12-15	A	2	flowering
5. Ceratocephala falcata	annual	4-5	O	+	Flowering, fruiting
6. Convolvulus hamadae	subshrub	25-30	A	2	vegetation
7. Eminium lehmannii	perennial	15-20	R	+	flowering
8. Eremostachys eriolarinx	perennial	15-20	R	+	vegetation

9. <i>Ferula foetida</i>	perennial	70-150	A	3	flowering
10. <i>Fritillaria karelinii</i>	perennial	7-10	O	+	fruiting
11. <i>Gagea divaricata</i>	perennial	7-10	F	+	flowering
12. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
13. <i>Hypecoum pendulum</i>	annual	15-25	O	+	flowering
14. <i>Iris longiscapa</i>	perennial	15-20	O	+	flowering
15. <i>Iris songarica</i>	perennial	30-35	F	1	budding
16. <i>Isatis minima</i>	annual	15-20	O	+	flowering
17. <i>Leptaleum filifolium</i>	annual	5-7	O	+	flowering
18. <i>Meniocus linifolius</i>	annual	10-12	O	+	flowering
19. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	R	+	vegetation
20. <i>Peganum harmala</i>	perennial	20-25	R	+	vegetation
21. <i>Poa bulbosa</i>	perennial	15-20	A	1	budding
22. <i>Smirnowia turkestanica</i>	subshrub	30-40	F	1	vegetation
23. <i>Strigosella brevipes</i>	annual	10-12	R	+	flowering
24. <i>Tulipa lehmanniana</i>	perennial	15-20	O	+	flowering
25. <i>Tulipa sogdiana</i>	perennial	10-12	O	+	fruiting
26. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50-70	R	+	vegetation

Table 6. Check-list of plants recorded for [REDACTED] sandy plain, *Iris-Ferula-sagebrush-desert* bindweed community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Alhagi pseudalhagi</i>	perennial	25-30	R	+	vegetation
2. <i>Artemisia diffusa</i>	subshrub	30-40	F	1	vegetation
3. <i>Artemisia turanica</i>	subshrub	25-30	O	+	vegetation
4. <i>Astragalus villosissimus</i>	subshrub	30-40	R	+	flowering
5. <i>Bromus tectorum</i>	annual	12-15	O	+	budding
6. <i>Carex physodes</i>	perennial	12-15	F	1	flowering
7. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
8. <i>Convolvulus hamadae</i>	subshrub	25-30	A	2	vegetation
9. <i>Cousinia hamadae</i>	perennial	15-20	O	1	vegetation
10. <i>Eremostachys eriolarynx</i>	perennial	15-20	R	+	vegetation
11. <i>Ferula foetida</i>	perennial	70-150	F	2	flowering
12. <i>Fritillaria karelinii</i>	perennial	7-10	O	+	fruiting
13. <i>Gagea divaricata</i>	perennial	7-10	O	+	flowering
14. <i>Haloxydon ammodendron</i>	Small tree	70-100	R	+	vegetation
15. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
16. <i>Hypecoum pendulum</i>	annual	15-25	O	+	flowering
17. <i>Iris longiscapa</i>	perennial	15-20	R	+	flowering
18. <i>Iris songarica</i>	perennial	30-35	F	1	budding
19. <i>Isatis minima</i>	annual	15-20	O	+	flowering
20. <i>Leptaleum filifolium</i>	annual	5-7	O	+	flowering
21. <i>Meniocus linifolius</i>	annual	10-12	O	+	flowering
22. <i>Peganum harmala</i>	perennial	20-25	R	+	vegetation
23. <i>Poa bulbosa</i>	perennial	15-20	A	1	budding
24. <i>Smirnowia turkestanica</i>	subshrub	20-30	R	+	vegetation
25. <i>Strigosella brevipes</i>	annual	10-12	O	+	flowering

26. <i>Takhtajianantha pusilla</i> (<i>Scorzonera pusilla</i>)	Perennial	15-20	R	+	flowering
27. <i>Tulipa lehmanniana</i>	perennial	15-20	O	+	flowering
28. <i>Tulipa sogdiana</i>	perennial	10-12	O	+	fruiting
29. <i>Zygophyllum macrophyllum</i>	perennial	12-15	R	+	vegetation

Table 7. Check-list of plants recorded for [REDACTED] saline land and old fallow land near the Agytma discharge channel, camel thorn-saltwort-tamarisk community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Aeluropus litoralis</i>	perennial	15-20	O	+	flowering
2. <i>Alhagi pseudalhagi</i>	perennial	25-30	F	1	vegetation
3. <i>Bromus tectorum</i>	annual	12-15	O	+	budding
4. <i>Ceratocarpus arenarius</i>	annual	10-12	F	1	vegetation
5. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
6. <i>Ferula foetida</i>	perennial	70-150	R	+	flowering
7. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
8. <i>Hypocoum pendulum</i>	annual	15-25	O	+	flowering
9. <i>Leptaleum filifolium</i>	annual	5-7	O	+	flowering
10. <i>Lycium ruthenicum</i>	shrub	50-70	F	1	vegetation
11. <i>Meniocus linifolius</i>	annual	10-12	O	+	flowering
12. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	O	1	vegetation
13. <i>Peganum harmala</i>	perennial	20-25	F	1	vegetation
14. <i>Phragmites australis</i>	perennial	100-150	O	1	vegetation
15. <i>Strigosella brevipes</i>	annual	10-12	O	+	flowering
16. <i>Suaeda</i> sp.	annual	10-12	O	+	vegetation
17. <i>Tamarix laxa</i>	shrub	150-170	F	+	flowering
18. <i>Tamarix hohenackeriana</i>	shrub	150-200	F	+	vegetation
19. <i>Typha latifolia</i>	perennial	100-150	O	1	vegetation

Table 8. Check-list of plants recorded for [REDACTED] fixed sands, *Ferula*-desert sedge-*Astragalus*-desert bindweed-*Calligonum* community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Artemisia diffusa</i>	subshrub	30-40	O	1	vegetation
2. <i>Astragalus villosissimus</i>	subshrub	30-40	C	2	flowering
3. <i>Calligonum microcarpum</i>	shrub	70-100	F	1	vegetation
4. <i>Carex physodes</i>	perennial	12-15	F	1	flowering
5. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
6. <i>Convolvulus hamadae</i>	subshrub	20-25	F	1	vegetation
7. <i>Cousinia hamadae</i>	perennial	15-20	R	+	vegetation
8. <i>Cousinia sogdiana</i>	perennial	25-30	R	+	vegetation
9. <i>Ferula foetida</i>	perennial	70-150	C	2	flowering
10. <i>Gagea divaricata</i>	perennial	7-10	O	+	flowering
11. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
12. <i>Hypocoum pendulum</i>	annual	15-25	O	+	flowering

13. <i>Iris longiscapa</i>	perennial	15-20	R	+	flowering
14. <i>Iris songarica</i>	perennial	30-35	R	+	budding
15. <i>Meniocus linifolius</i>	annual	10-12	O	+	Flowering, fruiting
16. <i>Smirnowia turkestanica</i>	subshrub	30-40	O	1	vegetation

Table 9. Check-list of plants recorded for [REDACTED] fixed sands, *Calligonum*-desert sedge-sagebrush-desert bindweed community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Artemisia diffusa</i>	subshrub	30-40	F	1	vegetation
2. <i>Astragalus villosissimus</i>	subshrub	30-40	O	1	flowering
3. <i>Calligonum microcarpum</i>	shrub	70-100	O	1	vegetation
4. <i>Calligonum zakirovii</i>	shrub	50-70	R	+	vegetation
5. <i>Carex physodes</i>	perennial	12-15	A	2	flowering
6. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
7. <i>Convolvulus hamadae</i>	subshrub	20-25	F	1	vegetation
8. <i>Cousinia hamadae</i>	perennial	15-20	R	+	vegetation
9. <i>Cousinia sogdiana</i>	perennial	25-30	R	+	vegetation
10. <i>Eminium lehmannii</i>	perennial	15-20	O	+	flowering
11. <i>Ferula foetida</i>	perennial	70-150	F	1	flowering
12. <i>Gagea divaricata</i>	perennial	7-10	O	+	flowering
13. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
14. <i>Hypocoum pendulum</i>	annual	15-25	O	+	flowering
15. <i>Iris longiscapa</i>	perennial	15-20	R	+	flowering
16. <i>Iris songarica</i>	perennial	30-35	R	+	budding
17. <i>Meniocus linifolius</i>	annual	10-12	O	+	Flowering, fruiting

Table 10. Check-list of plants recorded for [REDACTED] gentle wavy-hilly fixed sands, *Calligonum*-desert sedge-*Astragalus*-desert bindweed community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Artemisia diffusa</i>	subshrub	30-40	O	1	vegetation
2. <i>Astragalus villosissimus</i>	subshrub	25-30	C	2	flowering
3. <i>Calligonum microcarpum</i>	shrub	50-70	F	1	vegetation
4. <i>Calligonum zakirovii</i>	shrub	50-70	R	+	vegetation
5. <i>Carex physodes</i>	perennial	12-15	A	2	flowering
6. <i>Ceratocephala falcata</i>	annual	4-5	R	+	Flowering, fruiting
7. <i>Convolvulus hamadae</i>	subshrub	20-25	C	2	vegetation
8. <i>Eminium lehmannii</i>	perennial	15-20	R	+	flowering
9. <i>Ferula foetida</i>	perennial	70-150	F	2	flowering
10. <i>Gagea divaricata</i>	perennial	7-10	O	+	flowering
11. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
12. <i>Hypocoum pendulum</i>	annual	15-25	O	+	flowering
13. <i>Isatis minima</i>	annual	15-20	O	+	Flowering, fruiting

14. <i>Iris longiscapa</i>	perennial	15-20	R	+	flowering
15. <i>Iris songarica</i>	perennial	30-35	R	+	budding
16. <i>Meniocus linifolius</i>	annual	10-12	O	+	Flowering, fruiting
17. <i>Smirnowia turkestanica</i>	subshrub	30-40	O	1	vegetation
18. <i>Zygophyllum miniatum</i>	perennial	10-12	R	+	flowering

Table 11. Check-list of plants recorded for [REDACTED] gentle wavy-hilly fixed sands, *Calligonum*-desert sedge-*Astragalus*-desert bindweed community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	vegetation
2. <i>Artemisia diffusa</i>	subshrub	30-40	O	1	vegetation
3. <i>Astragalus villosissimus</i>	subshrub	25-30	C	2	flowering
4. <i>Calligonum microcarpum</i>	shrub	50-70	F	1	vegetation
5. <i>Carex physodes</i>	perennial	12-15	A	2	flowering
6. <i>Ceratocephala falcata</i>	annual	4-5	R	+	Flowering, fruiting
7. <i>Convolvulus hamadae</i>	subshrub	20-25	C	2	vegetation
8. <i>Eminium lehmannii</i>	perennial	15-20	R	+	flowering
9. <i>Ephedra strobilacea</i>	shrub	70-100	R	+	flowering
10. <i>Ferula foetida</i>	perennial	70-150	F	1	flowering
11. <i>Gagea divaricata</i>	perennial	7-10	O	+	flowering
12. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
13. <i>Hypocymum pendulum</i>	annual	15-25	O	+	flowering
14. <i>Isatis minima</i>	annual	15-20	O	+	Flowering, fruiting
15. <i>Iris longiscapa</i>	perennial	15-20	R	+	flowering
16. <i>Iris songarica</i>	perennial	30-35	R	+	budding
17. <i>Meniocus linifolius</i>	annual	10-12	O	+	Flowering, fruiting
18. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	O	1	vegetation
19. <i>Scorzonera sericeolanata</i>	Perennial	15-20	R	+	flowering
20. <i>Smirnowia turkestanica</i>	subshrub	30-40	O	1	vegetation
21. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	70-100	O	1	vegetation
22. <i>Zygophyllum miniatum</i>	perennial	10-12	R	+	flowering

Table 12. Check-list of plants recorded for [REDACTED] fixed hilly sands, *Ferula*-*Astragalus*-white saltwort-*Calligonum* community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	vegetation
2. <i>Artemisia diffusa</i>	subshrub	30-40	O	1	vegetation
3. <i>Astragalus flexus</i>	perennial	15-17	O	+	flowering
4. <i>Astragalus villosissimus</i>	subshrub	30-40	C	2	flowering
5. <i>Bromus tectorum</i>	annual	12-15	C	1	budding
6. <i>Calligonum microcarpum</i>	shrub	100-120	F	1	vegetation

7. <i>Carex physodes</i>	perennial	20-25	A	2	flowering
8. <i>Ceratocarpus arenarius</i>	annual	10-12	O	+	vegetation
9. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
10. <i>Convolvulus hamadae</i>	subshrub	20-25	C	2	vegetation
11. <i>Euphorbia turczaninowii</i>	annual	5-7	R	+	flowering
12. <i>Ferula foetida</i>	perennial	70-150	C	2	flowering
13. <i>Gagea divaricata</i>	perennial	7-10	R	+	flowering
14. <i>Goldbachia laevigata</i>	annual	12-15	R	+	Flowering, fruiting
15. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
16. <i>Hypochaeris pendulum</i>	annual	15-25	O	+	flowering
17. <i>Isatis minima</i>	annual	15-20	O	+	Flowering, fruiting
18. <i>Iris longiscapa</i>	perennial	15-20	R	+	flowering
19. <i>Iris songarica</i>	perennial	30-35	R	+	budding
20. <i>Koeleria linearis</i>	annual	12-15	R	+	Flowering, fruiting
21. <i>Mausolea eriocarpa</i>	subshrub	40-50	R	+	vegetation
22. <i>Meniocus linifolius</i>	annual	10-12	O	+	Flowering, fruiting
23. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	R	+	vegetation
24. <i>Poa bulbosa</i>	perennial	15-20	F	1	budding
25. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	70-100	O	1	vegetation

Table 13. Check-list of plants recorded for XXXXXXXXXX fixed hilly sands, surroundings of farmstead, overgrazed *Ferula-Astragalus-desert* bindweed-sagebrush community XXXXXXXXXX

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Artemisia diffusa</i>	subshrub	30-40	F	1	vegetation
2. <i>Astragalus villosissimus</i>	subshrub	30-40	F	1	flowering
3. <i>Bromus tectorum</i>	annual	12-15	C	2	budding
4. <i>Calligonum microcarpum</i>	shrub	100-120	R	+	vegetation
5. <i>Carex physodes</i>	perennial	20-25	C	2	flowering
6. <i>Ceratocarpus arenarius</i>	annual	10-12	F	1	vegetation
7. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
8. <i>Convolvulus hamadae</i>	subshrub	20-25	C	2	vegetation
9. <i>Diptychocarpus strictus</i>	annual	12-15	R	+	Flowering, fruiting
10. <i>Eminium lehmannii</i>	perennial	15-20	F	1	flowering
11. <i>Euphorbia turczaninowii</i>	annual	5-7	R	+	flowering
12. <i>Ferula foetida</i>	perennial	70-150	O	1	flowering
13. <i>Gagea divaricata</i>	perennial	7-10	R	+	flowering
14. <i>Goldbachia laevigata</i>	annual	12-15	R	+	Flowering, fruiting
15. <i>Goldbachia sabulosa</i>	annual	15-20	O	+	Flowering, fruiting
16. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering

17. <i>Hypochaeris pendulum</i>	annual	15-25	O	+	flowering
18. <i>Isatis minima</i>	annual	15-20	O	+	Flowering, fruiting
19. <i>Iris songarica</i>	perennial	30-35	R	+	budding
20. <i>Koeleria linearis</i>	annual	12-15	R	+	Flowering, fruiting
21. <i>Menispermum linifolium</i>	annual	10-12	O	+	Flowering, fruiting
22. <i>Oreosola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	R	+	vegetation
23. <i>Poa bulbosa</i>	perennial	15-20	O	+	budding
24. <i>Xylosola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	70-100	R	+	vegetation

Table 14. Check-list of plants recorded for  fixed hilly sands, *Ferula*-desert sedge-desert bindweed-sagebrush community 

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Artemisia diffusa</i>	subshrub	30-40	A	2	vegetation
2. <i>Astragalus villosissimus</i>	subshrub	30-40	O	1	flowering
3. <i>Bromus tectorum</i>	annual	12-15	O	+	budding
4. <i>Calligonum microcarpum</i>	shrub	100-120	O	1	vegetation
5. <i>Carex physodes</i>	perennial	15-20	A	2	flowering
6. <i>Ceratocarpus arenarius</i>	annual	10-12	O	+	vegetation
7. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
8. <i>Convolvulus hamadae</i>	subshrub	20-25	C	2	vegetation
9. <i>Euphorbia turczaninowii</i>	annual	5-7	R	+	flowering
10. <i>Ferula foetida</i>	perennial	70-150	C	2	flowering
11. <i>Gagea divaricata</i>	perennial	7-10	R	+	flowering
12. <i>Goldbachia laevigata</i>	annual	12-15	R	+	Flowering, fruiting
13. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
14. <i>Hypochaeris pendulum</i>	annual	15-25	O	+	flowering
15. <i>Isatis minima</i>	annual	15-20	O	+	Flowering, fruiting
16. <i>Iris longiscapa</i>	perennial	15-20	R	+	flowering
17. <i>Iris songarica</i>	perennial	30-35	R	+	budding
18. <i>Koeleria linearis</i>	annual	12-15	R	+	Flowering, fruiting
19. <i>Mausolea eriocarpa</i>	subshrub	40-50	R	+	vegetation
20. <i>Menispermum linifolium</i>	annual	10-12	O	+	Flowering, fruiting
21. <i>Oreosola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	R	+	vegetation
22. <i>Poa bulbosa</i>	perennial	15-20	F	1	budding
23. <i>Smirnowia turkestanica</i>	subshrub	30-40	F	1	vegetation
24. <i>Tulipa lehmanniana</i>	perennial	15-20	R	+	flowering
25. <i>Xylosola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	70-100	O	1	vegetation

Table 15. Check-list of plants recorded for XXXXXXXXXX gentle wavy sandy plain, *Ferula-Iris-desert bindweed-ephemeroid-sagebrush community* XXXXXXXXXX

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Artemisia diffusa</i>	subshrub	30-40	A	2	vegetation
2. <i>Astragalus commixtus</i>	annual	7-10	R	+	flowering
3. <i>Astragalus villosissimus</i>	subshrub	30-40	R	+	flowering
4. <i>Carex physodes</i>	perennial	12-15	A	2	flowering
5. <i>Ceratocarpus arenarius</i>	annual	10-12	O	+	vegetation
6. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
7. <i>Convolvulus hamadae</i>	subshrub	25-30	A	2	vegetation
8. <i>Ferula foetida</i>	perennial	70-150	F	1	flowering
9. <i>Gagea divaricata</i>	perennial	7-10	O	+	flowering
10. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
11. <i>Hypocymum pendulum</i>	annual	15-25	O	+	flowering
12. <i>Iris longiscapa</i>	perennial	15-20	O	+	flowering
13. <i>Iris songarica</i>	perennial	30-35	F	1	budding
14. <i>Isatis minima</i>	annual	15-20	O	+	flowering
15. <i>Leptaleum filifolium</i>	annual	5-7	O	+	flowering
16. <i>Meniocus linifolius</i>	annual	10-12	O	+	flowering
17. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	R	+	vegetation
18. <i>Peganum harmala</i>	perennial	20-25	R	+	vegetation
19. <i>Poa bulbosa</i>	perennial	15-20	A	1	budding
20. <i>Smirnowia turkestanica</i>	subshrub	30-40	F	1	vegetation
21. <i>Strigosella brevipes</i>	annual	10-12	R	+	flowering
22. <i>Tulipa lehmanniana</i>	perennial	15-20	R	+	flowering
23. <i>Tulipa sogdiana</i>	perennial	10-12	O	+	fruiting
24. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50-70	R	+	vegetation
25. <i>Zygophyllum miniatum</i>	perennial	10-12	R	+	flowering

Table 16. Check-list of plants recorded for XXXXXXXXXX fixed gentle hilly-wavy sands, *Ferula-desert sedge-desert bindweed-sagebrush-white saxaul community* XXXXXXXXXX

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	vegetation
2. <i>Artemisia diffusa</i>	subshrub	30-40	F	1	vegetation
3. <i>Astragalus flexus</i>	perennial	15-17	O	+	flowering
4. <i>Astragalus villosissimus</i>	subshrub	30-40	O	1	flowering
5. <i>Calligonum microcarpum</i>	shrub	70-100	R	+	vegetation
6. <i>Carex physodes</i>	perennial	15-20	A	2	flowering
7. <i>Ceratocarpus arenarius</i>	annual	10-12	R	+	vegetation
8. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
9. <i>Convolvulus hamadae</i>	subshrub	20-25	C	1	vegetation
10. <i>Eminium lehmannii</i>	perennial	15-20	O	+	flowering
11. <i>Euphorbia turczaninowii</i>	annual	5-7	R	+	flowering

12. <i>Ferula foetida</i>	perennial	70-150	F	2	flowering
13. <i>Haloxylon persicum</i>	Small tree	150-170	F	2	vegetation
14. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
15. <i>Hypecoum pendulum</i>	annual	15-25	O	+	flowering
16. <i>Iris longiscapa</i>	perennial	15-20	R	+	flowering
17. <i>Iris songarica</i>	perennial	30-35	O	+	budding
18. <i>Isatis minima</i>	annual	15-20	R	+	Flowering, fruiting
19. <i>Meniocus linifolius</i>	annual	10-12	O	+	Flowering, fruiting
20. <i>Smirnowia turkestanica</i>	subshrub	30-40	O	1	vegetation
21. <i>Tulipa lehmanniana</i>	perennial	15-20	R	+	flowering
22. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50-70	O	1	vegetation

Table 17. Check-list of plants recorded for XXXXXXXXXXXX fixed gentle hilly-wavy sands, *Ferula*-desert sedge-desert bindweed-sagebrush-white saxaul community XXXXXXXXXXXX

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	vegetation
2. <i>Artemisia diffusa</i>	subshrub	30-40	F	1	vegetation
3. <i>Astragalus flexus</i>	perennial	15-17	O	+	flowering
4. <i>Astragalus villosissimus</i>	subshrub	30-40	O	1	flowering
5. <i>Calligonum microcarpum</i>	shrub	70-100	R	+	vegetation
6. <i>Carex physodes</i>	perennial	15-20	A	2	flowering
7. <i>Ceratocarpus arenarius</i>	annual	10-12	R	+	vegetation
8. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
9. <i>Convolvulus hamadae</i>	subshrub	20-25	F	1	vegetation
10. <i>Cousinia hamadae</i>	perennial	15-20	R	+	vegetation
11. <i>Cousinia sogdiana</i>	perennial	25-30	R	+	vegetation
12. <i>Eminium lehmannii</i>	perennial	15-20	O	+	flowering
13. <i>Euphorbia turczaninowii</i>	annual	5-7	R	+	flowering
14. <i>Ferula foetida</i>	perennial	70-150	C	2	flowering
15. <i>Gagea divaricata</i>	perennial	7-10	R	+	flowering
16. <i>Haloxylon persicum</i>	Small tree	150-170	A	3	vegetation
17. <i>Heliotropium arguzioides</i>	Perennial	10-15	O	+	vegetation
18. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
19. <i>Hypecoum pendulum</i>	annual	15-25	O	+	flowering
20. <i>Iris longiscapa</i>	perennial	15-20	R	+	flowering
21. <i>Iris songarica</i>	perennial	30-35	F	1	budding
22. <i>Isatis minima</i>	annual	15-20	R	+	Flowering, fruiting
23. <i>Meniocus linifolius</i>	annual	10-12	O	+	Flowering, fruiting
24. <i>Nonea caspica</i>	annual	10-12	R	+	flowering
25. <i>Smirnowia turkestanica</i>	subshrub	30-40	O	1	vegetation
26. <i>Tulipa lehmanniana</i>	perennial	15-20	R	+	flowering
27. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50-70	O	1	vegetation

Table 18. Check-list of plants recorded for XXXXXXXXXX fixed gentle hilly-wavy sands, Ferula-desert sedge-desert bindweed-sagebrush-white saxaul community XXXXXXXXXX

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Acanthophyllum elatius	perennial	25-30	R	+	vegetation
2. Artemisia diffusa	subshrub	30-40	C	2	vegetation
3. Astragalus flexus	perennial	15-17	O	+	flowering
4. Astragalus villosissimus	subshrub	30-40	F	1	flowering
5. Calligonum microcarpum	shrub	70-100	R	+	vegetation
6. Carex physodes	perennial	15-20	C	1	flowering
7. Ceratocarpus arenarius	annual	10-12	R	+	vegetation
8. Ceratocephala falcata	annual	4-5	O	+	Flowering, fruiting
9. Convolvulus hamadae	subshrub	20-25	C	2	vegetation
10. Cousinia hamadae	perennial	15-20	R	+	vegetation
11. Euphorbia turczaninowii	annual	5-7	R	+	flowering
12. Ferula foetida	perennial	70-150	C	2	flowering
13. Goldbachia sabulosa	annual	15-20	O	+	Flowering, fruiting
14. Haloxylon persicum	Small tree	150-170	F	1	vegetation
15. Holosteum umbellatum	annual	10-12	O	+	flowering
16. Hypecoum pendulum	annual	15-25	O	+	flowering
17. Iris longiscapa	perennial	15-20	R	+	flowering
18. Iris songarica	perennial	30-35	O	+	budding
19. Meniocus linifolius	annual	10-12	O	+	Flowering, fruiting
20. Oreosalsola arbusculiformis (Salsola arbusculiformis)	shrub	30-40	O	1	vegetation
21. Poa bulbosa	perennial	15-20	F	1	budding
22. Smirnowia turkestanica	subshrub	30-40	O	1	vegetation
23. Tulipa lehmanniana	perennial	15-20	R	+	flowering
24. Veronica campylopoda	annual	7-10	O	+	Flowering, fruiting
25. Xylosalsola arbuscula (Salsola arbuscula)	shrub	50-70	O	1	vegetation

Table 19. Check-list of plants recorded for XXXXXXXXXX sabulous-loamy plain, Ferula-desert bindweed-saltwort-sagebrush community with solitary black saxaul (remaining of plantations) XXXXXXXXXX

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Acanthophyllum elatius	perennial	25-30	R	+	vegetation
2. Artemisia diffusa	subshrub	25-30	C	2	vegetation
3. Artemisia turanica	subshrub	25-30	F	1	vegetation
4. Carex physodes	perennial	15-20	A	2	flowering
5. Ceratocarpus arenarius	annual	10-12	R	+	vegetation
6. Ceratocephala falcata	annual	4-5	O	+	Flowering, fruiting
7. Convolvulus hamadae	subshrub	20-25	C	2	vegetation

8. Cousinia hamadae	perennial	15-20	R	+	vegetation
9. Ferula foetida	perennial	70-150	C	2	flowering
10. Gagea divaricata	perennial	7-10	R	+	flowering
11. Goldbachia torulosa	annual	12-15	R	+	Flowering, fruiting
12. Haloxylon ammodendron	Small tree	150-170	O	1	vegetation
13. Holosteum umbellatum	annual	10-12	O	+	flowering
14. Hypecoum pendulum	annual	15-25	O	+	flowering
15. Iris longiscapa	perennial	15-20	R	+	flowering
16. Iris songarica	perennial	30-35	F	1	budding
17. Meniocus linifolius	annual	10-12	O	+	Flowering, fruiting
18. Oreosalsola arbusculiformis (Salsola arbusculiformis)	shrub	30-40	F	2	vegetation
19. Peganum harmala	perennial	20-25	O	1	vegetation
20. Poa bulbosa	perennial	15-20	F	1	budding
21. Smirnowia turkestanica	subshrub	30-40	R	+	vegetation
22. Takhtajianantha pusilla (Scorzonera pusilla)	Perennial	12-15	R	+	flowering
23. Tulipa lehmanniana	perennial	15-20	R	+	flowering
24. Tulipa sogdiana	perennial	10-12	O	+	fruiting
25. Xylosalsola arbuscula (Salsola arbuscula)	shrub	50-70	O	1	vegetation
26. Zygophyllum miniatum	perennial	10-12	R	+	flowering

Table 20. Check-list of plants recorded for [redacted] sabulous-loamy plain, Ferula-desert bindweed-saltwort-sagebrush community [redacted]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Artemisia diffusa	subshrub	25-30	F	1	vegetation
2. Artemisia turanica	subshrub	25-30	F	1	vegetation
3. Carex physodes	perennial	15-20	F	1	flowering
4. Ceratocarpus arenarius	annual	10-12	R	+	vegetation
5. Ceratocephala falcata	annual	4-5	O	+	Flowering, fruiting
6. Convolvulus hamadae	subshrub	20-25	C	2	vegetation
7. Ferula foetida	perennial	70-150	F	1	flowering
8. Gagea divaricata	perennial	7-10	R	+	flowering
9. Goldbachia torulosa	annual	12-15	R	+	Flowering, fruiting
10. Holosteum umbellatum	annual	10-12	O	+	flowering
11. Hypecoum pendulum	annual	15-25	O	+	flowering
12. Iris songarica	perennial	30-35	O	1	budding
13. Meniocus linifolius	annual	10-12	O	+	Flowering, fruiting
14. Oreosalsola arbusculiformis (Salsola arbusculiformis)	shrub	30-40	F	2	vegetation
15. Peganum harmala	perennial	20-25	O	1	vegetation
16. Poa bulbosa	perennial	15-20	F	1	budding
17. Smirnowia turkestanica	subshrub	30-40	R	+	vegetation

18. <i>Takhtajianantha pusilla</i> (<i>Scorzonera pusilla</i>)	Perennial	12-15	R	+	flowering
19. <i>Tulipa lehmanniana</i>	perennial	15-20	R	+	flowering
20. <i>Tulipa sogdiana</i>	perennial	10-12	O	+	fruiting
21. <i>Zygophyllum miniatum</i>	perennial	10-12	R	+	flowering

Table 21. Check-list of plants recorded for [REDACTED] *sabulous-loamy plain, Ferula-sagebrush-saltwort-Iris community* [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	vegetation
2. <i>Artemisia diffusa</i>	subshrub	30-40	O	1	vegetation
3. <i>Astragalus villosissimus</i>	subshrub	30-40	R	1	flowering
4. <i>Carex physodes</i>	perennial	20-25	F	1	flowering
5. <i>Ceratocarpus arenarius</i>	annual	10-12	O	+	vegetation
6. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
7. <i>Convolvulus hamadae</i>	subshrub	20-25	F	1	vegetation
8. <i>Cousinia hamadae</i>	perennial	15-20	O	+	vegetation
9. <i>Ferula foetida</i>	perennial	70-150	F	1	flowering
10. <i>Fritillaria karelinii</i>	perennial	7-10	R	+	fruiting
11. <i>Gagea divaricata</i>	perennial	7-10	R	+	flowering
12. <i>Goldbachia torulosa</i>	annual	12-15	R	+	Flowering, fruiting
13. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
14. <i>Hypocymum pendulum</i>	annual	15-25	O	+	flowering
15. <i>Iris songarica</i>	perennial	30-35	A	2	budding
16. <i>Meniocus linifolius</i>	annual	10-12	O	+	Flowering, fruiting
17. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	F	1	vegetation
18. <i>Peganum harmala</i>	perennial	20-25	O	1	vegetation
19. <i>Poa bulbosa</i>	perennial	15-20	F	1	budding
20. <i>Takhtajianantha pusilla</i> (<i>Scorzonera pusilla</i>)	Perennial	12-15	O	+	flowering
21. <i>Tulipa lehmanniana</i>	perennial	15-20	R	+	flowering
22. <i>Tulipa sogdiana</i>	perennial	10-12	R	+	fruiting
23. <i>Zygophyllum miniatum</i>	perennial	10-12	O	+	flowering

Table 22. Check-list of plants recorded for [REDACTED] *saline lands and old fallows land near the Agytma discharge channel, camel thorn-saltwort-tamarisk community* [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Aeluropus litoralis</i>	perennial	15-20	F	1	flowering
2. <i>Alhagi pseudalhagi</i>	perennial	25-30	F	1	vegetation
3. <i>Arabidopsis pumila</i>	annual	12-15	O	+	Flowering, fruiting
4. <i>Bromus tectorum</i>	annual	12-15	O	+	budding

5. <i>Ceratocarpus arenarius</i>	annual	10-12	F	1	vegetation
6. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
7. <i>Chorispora tenella</i>	annual	10-12	O	+	Flowering, fruiting
8. <i>Convolvulus hamadae</i>	subshrub	20-25	O	1	vegetation
9. <i>Ferula foetida</i>	perennial	70-150	R	+	flowering
10. <i>Halostachys caspica</i>	shrub	70-100	O	1	vegetation
11. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
12. <i>Hypocoum pendulum</i>	annual	15-25	O	+	flowering
13. <i>Leptaleum filifolium</i>	annual	5-7	O	+	flowering
14. <i>Lycium ruthenicum</i>	shrub	50-70	F	1	vegetation
15. <i>Meniocus linifolius</i>	annual	10-12	O	+	flowering
16. <i>Papaver pavoninum</i>	annual	12-15	O	+	flowering
17. <i>Peganum harmala</i>	perennial	20-25	F	1	vegetation
18. <i>Phragmites australis</i>	perennial	100-150	O	1	vegetation
19. <i>Strigosella brevipes</i>	annual	10-12	O	+	flowering
20. <i>Strigosella africana</i>	annual	12-15	O	+	Flowering, fruiting
21. <i>Suaeda</i> sp.	annual	10-12	O	+	vegetation
22. <i>Tamarix laxa</i>	shrub	150-170	F	+	flowering
23. <i>Tamarix hohenackeriana</i>	shrub	150-200	F	+	vegetation
24. <i>Typha latifolia</i>	perennial	100-150	O	1	vegetation

Table 23. Check-list of plants recorded for [REDACTED] sandy plain at the edge of fallow lands near the Agytma discharge channel, degraded *Iris-Ferula-desert sedge-sagebrush* community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Alhagi pseudalhagi</i>	perennial	25-30	O	1	vegetation
2. <i>Artemisia diffusa</i>	subshrub	30-40	F	1	vegetation
3. <i>Astragalus villosissimus</i>	subshrub	30-40	R	+	flowering
4. <i>Bromus tectorum</i>	annual	12-15	O	+	budding
5. <i>Carex physodes</i>	perennial	12-15	F	1	flowering
6. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
7. <i>Convolvulus hamadae</i>	subshrub	25-30	O	1	vegetation
8. <i>Ferula foetida</i>	perennial	70-150	O	1	flowering
9. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
10. <i>Hypocoum pendulum</i>	annual	15-25	O	+	flowering
11. <i>Iris songarica</i>	perennial	30-35	F	1	budding
12. <i>Leptaleum filifolium</i>	annual	5-7	F	+	flowering
13. <i>Meniocus linifolius</i>	annual	10-12	O	+	flowering
14. <i>Peganum harmala</i>	perennial	20-25	O	1	vegetation
15. <i>Poa bulbosa</i>	perennial	15-20	F	1	budding
16. <i>Smirnowia turkestanica</i>	subshrub	20-30	R	+	vegetation
17. <i>Sophora pachycarpa</i>	perennial	15-20	R	+	vegetation
18. <i>Tulipa lehmanniana</i>	perennial	15-20	R	+	flowering
19. <i>Tulipa sogdiana</i>	perennial	10-12	O	+	fruiting
20. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50-70	R	+	vegetation

Table 24. Check-list of plants recorded for [REDACTED] sandy-loamy plain at the edge of fallow lands near the Agytma discharge channel, *Iris-Ferula-bulbous bluegrass-desert bindweed community* [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Artemisia diffusa</i>	subshrub	30-40	O	+	vegetation
2. <i>Astragalus campylorrhynchus</i>	annual	10-12	R	+	flowering
3. <i>Astragalus villosissimus</i>	subshrub	30-40	R	+	flowering
4. <i>Bromus tectorum</i>	annual	12-15	O	+	budding
5. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
6. <i>Convolvulus hamadae</i>	subshrub	25-30	A	2	vegetation
7. <i>Cousinia hamadae</i>	perennial	15-20	O	+	vegetation
8. <i>Ferula foetida</i>	perennial	70-150	O	1	flowering
9. <i>Fritillaria karelinii</i>	perennial	7-10	R	+	fruiting
10. <i>Gagea divaricata</i>	perennial	7-10	R	+	flowering
11. <i>Goldbachia torulosa</i>	annual	12-15	R	+	Flowering, fruiting
12. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
13. <i>Hypocoum pendulum</i>	annual	15-25	O	+	flowering
14. <i>Iris songarica</i>	perennial	30-35	O	1	budding
15. <i>Leptaleum filifolium</i>	annual	5-7	F	+	flowering
16. <i>Meniocus linifolius</i>	annual	10-12	O	+	flowering
17. <i>Peganum harmala</i>	perennial	20-25	O	1	vegetation
18. <i>Poa bulbosa</i>	perennial	15-20	A	1	budding
19. <i>Tulipa lehmanniana</i>	perennial	15-20	O	+	flowering
20. <i>Tulipa sogdiana</i>	perennial	10-12	O	+	fruiting

Table 25. Check-list of plants recorded for [REDACTED] sandy-loamy plain, fallow lands with very sparse secondary vegetation near the Agytma discharge channel [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Alhagi pseudalhagi</i>	perennial	25-30	F	1	vegetation
2. <i>Bromus tectorum</i>	annual	12-15	O	+	budding
3. <i>Ceratocarpus arenarius</i>	annual	10-12	O	+	vegetation
4. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
5. <i>Chorispora tenella</i>	annual	10-12	R	+	Flowering, fruiting
6. <i>Ferula foetida</i>	perennial	70-150	O	1	flowering
7. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
8. <i>Hypocoum pendulum</i>	annual	15-25	O	+	flowering
9. <i>Leptaleum filifolium</i>	annual	5-7	O	+	flowering
10. <i>Meniocus linifolius</i>	annual	10-12	O	+	flowering
11. <i>Papaver pavoninum</i>	annual	12-15	R	+	flowering
12. <i>Peganum harmala</i>	perennial	20-25	R	+	vegetation
13. <i>Poa bulbosa</i>	perennial	15-20	O	+	budding
14. <i>Roemeria hybrida</i>	annual	10-12	R	+	flowering
15. <i>Sophora pachycarpa</i>	perennial	15-20	R	+	vegetation

16. <i>Tulipa sogdiana</i>	perennial	10-12	R	+	fruiting
17. <i>Veronica campylopoda</i>	annual	7-10	O	+	Flowering, fruiting

Table 26. Check-list of plants recorded for XXXXXXXXXX fixed sands, *Ferula-Astragalus-white saltwort-Calligonum* community XXXXXXXXXX

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	vegetation
2. <i>Artemisia diffusa</i>	subshrub	30-40	F	1	vegetation
3. <i>Astragalus flexus</i>	perennial	15-17	O	+	flowering
4. <i>Astragalus villosissimus</i>	subshrub	30-40	F	1	flowering
5. <i>Bromus tectorum</i>	annual	12-15	C	1	budding
6. <i>Calligonum microcarpum</i>	shrub	100-120	F	1	vegetation
7. <i>Carex physodes</i>	perennial	20-25	A	2	flowering
8. <i>Ceratocarpus arenarius</i>	annual	10-12	O	+	vegetation
9. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
10. <i>Convolvulus hamadae</i>	subshrub	20-25	O	1	vegetation
11. <i>Eminium lehmannii</i>	perennial	15-20	O	+	flowering
12. <i>Euphorbia turczaninowii</i>	annual	5-7	R	+	flowering
13. <i>Ferula foetida</i>	perennial	70-150	F	2	flowering
14. <i>Fritillaria karelinii</i>	perennial	7-10	R	+	fruiting
15. <i>Gagea divaricata</i>	perennial	7-10	R	+	flowering
16. <i>Goldbachia laevigata</i>	annual	12-15	R	+	Flowering, fruiting
17. <i>Goldbachia sabulosa</i>	annual	15-20	O	+	Flowering, fruiting
18. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
19. <i>Hypochaeris pendulum</i>	annual	15-25	O	+	flowering
20. <i>Isatis minima</i>	annual	15-20	O	+	Flowering, fruiting
21. <i>Iris longiscapa</i>	perennial	15-20	R	+	flowering
22. <i>Iris songarica</i>	perennial	30-35	R	+	budding
23. <i>Koelpinia linearis</i>	annual	12-15	R	+	Flowering, fruiting
24. <i>Mausolea eriocarpa</i>	subshrub	40-50	O	1	vegetation
25. <i>Meniocus linifolius</i>	annual	10-12	O	+	Flowering, fruiting
26. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	O	1	vegetation
27. <i>Poa bulbosa</i>	perennial	15-20	F	1	budding
28. <i>Smirnowia turkestanica</i>	subshrub	30-40	O	1	vegetation
29. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	70-100	F	2	vegetation

Table 27. Check-list of plants recorded for [REDACTED] sandy plain, *Ferula*-saltwort-*Astragalus*-desert bindweed community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	vegetation
2. <i>Artemisia diffusa</i>	subshrub	30-40	O	1	vegetation
3. <i>Astragalus villosissimus</i>	subshrub	30-40	C	2	flowering
4. <i>Bromus tectorum</i>	annual	12-15	O	+	budding
5. <i>Carex physodes</i>	perennial	12-15	A	2	flowering
6. <i>Ceratocarpus arenarius</i>	annual	10-12	F	1	vegetation
7. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
8. <i>Convolvulus hamadae</i>	subshrub	20-25	C	2	vegetation
9. <i>Euphorbia turczaninowii</i>	annual	5-7	R	+	flowering
10. <i>Ferula foetida</i>	perennial	70-150	F	1	flowering
11. <i>Fritillaria karelinii</i>	perennial	7-10	O	+	fruiting
12. <i>Gagea divaricata</i>	perennial	7-10	O	+	flowering
13. <i>Goldbachia laevigata</i>	annual	12-15	R	+	Flowering, fruiting
14. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
15. <i>Hypocoum pendulum</i>	annual	15-25	O	+	flowering
16. <i>Iris songarica</i>	perennial	30-35	R	+	budding
17. <i>Koelpinia tenuissima</i>	annual	10-12	R	+	Flowering, fruiting
18. <i>Meniocus linifolius</i>	annual	10-12	O	+	Flowering, fruiting
19. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	O	1	vegetation
20. <i>Peganum harmala</i>	perennial	20-25	R	+	vegetation
21. <i>Smirnowia turkestanica</i>	subshrub	30-40	O	1	vegetation
22. <i>Tulipa lehmanniana</i>	perennial	15-20	R	+	flowering
23. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50-70	F	1	vegetation

Table 28. Check-list of plants recorded for [REDACTED] fixed sands, *Ferula*-desert bindweed-*Calligonum*-white saltwort community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	vegetation
2. <i>Artemisia diffusa</i>	subshrub	30-40	F	1	vegetation
3. <i>Astragalus villosissimus</i>	subshrub	30-40	O	1	flowering
4. <i>Bromus tectorum</i>	annual	12-15	O	+	budding
5. <i>Calligonum microcarpum</i>	shrub	100-120	F	1	vegetation
6. <i>Carex physodes</i>	perennial	12-15	F	1	flowering
7. <i>Ceratocarpus arenarius</i>	annual	10-12	O	+	vegetation
8. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
9. <i>Convolvulus hamadae</i>	subshrub	20-25	F	1	vegetation
10. <i>Ferula foetida</i>	perennial	70-150	C	2	flowering

11. <i>Gagea divaricata</i>	perennial	7-10	O	+	flowering
12. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
13. <i>Hypecoum pendulum</i>	annual	15-25	O	+	flowering
14. <i>Iris longiscapa</i>	perennial	15-20	R	+	flowering
15. <i>Iris songarica</i>	perennial	30-35	R	+	budding
16. <i>Meniocus linifolius</i>	annual	10-12	O	+	Flowering, fruiting
17. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	R	+	vegetation
18. <i>Peganum harmala</i>	perennial	20-25	R	+	vegetation
19. <i>Smirnowia turkestanica</i>	subshrub	30-40	O	1	vegetation
20. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50-70	F	1	vegetation

Table 29. Check-list of plants recorded for [redacted] fixed sands, *Ferula*-sagebrush-desert bindweed-*Calligonum*-white saltwort communit [redacted]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	vegetation
2. <i>Artemisia diffusa</i>	subshrub	30-40	C	2	vegetation
3. <i>Astragalus villosissimus</i>	subshrub	30-40	O	1	flowering
4. <i>Bromus tectorum</i>	annual	12-15	C	1	budding
5. <i>Calligonum microcarpum</i>	shrub	100-120	F	1	vegetation
6. <i>Carex physodes</i>	perennial	12-15	F	1	flowering
7. <i>Ceratocarpus arenarius</i>	annual	10-12	O	+	vegetation
8. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
9. <i>Convolvulus hamadae</i>	subshrub	20-25	F	1	vegetation
10. <i>Euphorbia turczaninowii</i>	annual	5-7	R	+	flowering
11. <i>Ferula foetida</i>	perennial	70-150	A	3	flowering
12. <i>Gagea divaricata</i>	perennial	7-10	O	+	flowering
13. <i>Goldbachia laevigata</i>	annual	12-15	R	+	Flowering, fruiting
14. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
15. <i>Hypecoum pendulum</i>	annual	15-25	O	+	flowering
16. <i>Iris longiscapa</i>	perennial	15-20	R	+	flowering
17. <i>Iris songarica</i>	perennial	30-35	R	+	budding
18. <i>Meniocus linifolius</i>	annual	10-12	O	+	Flowering, fruiting
19. <i>Smirnowia turkestanica</i>	subshrub	30-40	O	1	vegetation
20. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	70-100	C	2	vegetation

Table 30. Check-list of plants recorded for [redacted] top of the hill with shepherd's house and tramped area with very sparse vegetation [redacted]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Artemisia diffusa</i>	subshrub	20-25	O	+	vegetation
2. <i>Astragalus ammotrophus</i>	perennial	10-12	O	+	flowering

3. <i>Astragalus villosissimus</i>	subshrub	30-40	R	+	flowering
4. <i>Bromus tectorum</i>	annual	12-15	O	+	budding
5. <i>Carex physodes</i>	perennial	12-15	F	1	flowering
6. <i>Ceratocarpus arenarius</i>	annual	10-12	O	+	vegetation
7. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
8. <i>Convolvulus hamadae</i>	subshrub	20-25	R	+	vegetation
9. <i>Euphorbia turczaninowii</i>	annual	5-7	R	+	flowering
10. <i>Ferula foetida</i>	perennial	20-30	R	+	vegetation
11. <i>Gagea divaricata</i>	perennial	7-10	R	+	flowering
12. <i>Goldbachia laevigata</i>	annual	12-15	R	+	Flowering, fruiting
13. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
14. <i>Hypochaeris pendulum</i>	annual	15-25	O	+	flowering
15. <i>Meniocus linifolius</i>	annual	10-12	R	+	Flowering, fruiting
16. <i>Tulipa sogdiana</i>	perennial	10-12	R	+	fruiting
17. <i>Zygophyllum miniatum</i>	perennial	10-12	O	+	flowering

Table 31. Check-list of plants recorded for [redacted] sandy-loamy plain, ephemeroid-saltwort-sagebrush community [redacted]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Artemisia diffusa</i>	subshrub	25-30	F	1	vegetation
2. <i>Artemisia turanica</i>	subshrub	25-30	O	1	vegetation
3. <i>Carex physodes</i>	perennial	12-15	O	+	flowering
4. <i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	subshrub	25-30	O	1	vegetation
5. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
6. <i>Convolvulus hamadae</i>	subshrub	20-25	R	+	vegetation
7. <i>Ferula foetida</i>	perennial	70-150	R	+	flowering
8. <i>Goldbachia laevigata</i>	annual	12-15	R	+	Flowering, fruiting
9. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
10. <i>Iris songarica</i>	perennial	30-35	O	+	budding
11. <i>Leptaleum filifolium</i>	annual	5-7	O	+	flowering
12. <i>Meniocus linifolius</i>	annual	10-12	O	+	flowering
13. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	C	2	vegetation
14. <i>Strigosella brevipes</i>	annual	10-12	O	+	flowering
15. <i>Poa bulbosa</i>	perennial	15-20	A	2	budding
16. <i>Tulipa sogdiana</i>	perennial	10-12	O	+	fruiting

Table 32. Check-list of plants recorded for [REDACTED] sandy-loamy plain, ephemeroid-saltwort-sagebrush community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Acanthophyllum elatius	perennial	25-30	R	+	vegetation
2. Artemisia diffusa	subshrub	25-30	A	2	vegetation
3. Artemisia turanica	subshrub	25-30	O	1	vegetation
4. Carex physodes	perennial	12-15	C	1	flowering
5. Caroxylon orientale (Salsola orientalis)	subshrub	25-30	O	1	vegetation
6. Ceratocephala falcata	annual	4-5	O	+	Flowering, fruiting
7. Convolvulus hamadae	subshrub	20-25	R	+	vegetation
8. Ferula foetida	perennial	70-150	R	+	flowering
9. Holosteum umbellatum	annual	10-12	O	+	flowering
10. Hypecoum pendulum	annual	15-25	R	+	flowering
11. Iris songarica	perennial	30-35	O	1	budding
12. Leptaleum filifolium	annual	5-7	O	+	flowering
13. Meniocus linifolius	annual	10-12	O	+	flowering
14. Oreosalsola arbusculiformis (Salsola arbusculiformis)	shrub	30-40	F	1	vegetation
15. Strigosella brevipes	annual	10-12	O	+	flowering
16. Poa bulbosa	perennial	15-20	F	1	budding
17. Tulipa lehmanniana	perennial	15-20	R	+	flowering
18. Tulipa sogdiana	perennial	10-12	F	1	fruiting

Table 33. Check-list of plants recorded for [REDACTED] sandy plain, Iris-ephemeroid-sagebrush community with solitary Ferula foetida and black saxaul (remains of plantation) [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Acanthophyllum elatius	perennial	25-30	R	+	vegetation
2. Artemisia diffusa	subshrub	25-30	C	2	vegetation
3. Astragalus campylorrhynchus	annual	10-12	R	+	flowering
4. Astragalus villosissimus	subshrub	30-40	O	+	flowering
5. Bromus tectorum	annual	12-15	O	+	budding
6. Carex physodes	perennial	12-15	A	2	flowering
7. Ceratocephala falcata	annual	4-5	O	+	Flowering, fruiting
8. Convolvulus hamadae	subshrub	25-30	O	+	vegetation
9. Ferula foetida	perennial	70-150	O	1	flowering
10. Haloxylon ammodendron	Small tree	120-150	R	+	vegetation
11. Heliotropium arguzioides	Perennial	10-15	O	+	vegetation
12. Heterocaryum rigidum	annual	12-15	O	+	flowering
13. Holosteum umbellatum	annual	10-12	O	+	flowering
14. Hypecoum pendulum	annual	15-25	O	+	flowering
15. Iris songarica	perennial	30-35	F	2	budding
16. Koelpinia tenuissima	annual	12-15	O	+	flowering
17. Leptaleum filifolium	annual	5-7	O	+	flowering

18. <i>Meniocus linifolius</i>	annual	10-12	O	+	flowering
19. <i>Peganum harmala</i>	perennial	20-25	R	+	vegetation
20. <i>Poa bulbosa</i>	perennial	15-20	A	1	budding
21. <i>Tulipa lehmanniana</i>	perennial	15-20	O	+	flowering
22. <i>Tulipa sogdiana</i>	perennial	10-12	O	+	fruiting

Table 34. Check-list of plants recorded for [REDACTED] flat-wavy sandy plain, ephemeroid-sagebrush community with *Ferula foetida*, *Iris songarica* and solitary black saxaul (remains of plantations) [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	vegetation
2. <i>Artemisia diffusa</i>	subshrub	25-30	C	2	vegetation
3. <i>Artemisia turanica</i>	subshrub	25-30	R	+	vegetation
4. <i>Astragalus campylorrhynchus</i>	annual	10-12	R	+	flowering
5. <i>Astragalus villosissimus</i>	subshrub	30-40	O	+	flowering
6. <i>Carex physodes</i>	perennial	12-15	A	2	flowering
7. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
8. <i>Convolvulus hamadae</i>	subshrub	25-30	O	+	vegetation
9. <i>Euphorbia turczaninowii</i>	annual	5-7	R	+	flowering
10. <i>Ferula foetida</i>	perennial	70-150	O	1	flowering
11. <i>Haloxylon ammodendron</i>	Small tree	70-100	R	+	vegetation
12. <i>Heliotropium arguzioides</i>	Perennial	10-15	O	+	vegetation
13. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
14. <i>Hypocoum pendulum</i>	annual	15-25	O	+	flowering
15. <i>Iris longiscapa</i>	perennial	15-20	R	+	flowering
16. <i>Iris songarica</i>	perennial	30-35	O	1	budding
17. <i>Leptaleum filifolium</i>	annual	5-7	O	+	flowering
18. <i>Meniocus linifolius</i>	annual	10-12	O	+	flowering
19. <i>Poa bulbosa</i>	perennial	15-20	A	2	budding
20. <i>Strigosella brevipes</i>	annual	10-12	R	+	flowering
21. <i>Tulipa lehmanniana</i>	perennial	15-20	O	+	flowering
22. <i>Tulipa sogdiana</i>	perennial	10-12	O	+	fruiting
23. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50-70	R	+	vegetation

Table 35. Check-list of plants recorded for [REDACTED] sandy plain, overgrazed *Ferula*-sagebrush-ephemeroid community with sparse black saxaul plantation in surroundings of a farmstead [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Artemisia diffusa</i>	subshrub	15-20	F	1	vegetation
2. <i>Astragalus campylorrhynchus</i>	annual	10-12	R	+	flowering
3. <i>Astragalus flexus</i>	perennial	15-17	R	+	flowering
4. <i>Astragalus rubromarginatus</i>	perennial	12-15	R	+	flowering
5. <i>Astragalus villosissimus</i>	subshrub	30-40	R	+	flowering
6. <i>Atriplex dimorphostegia</i>	annual	10-12	O	+	flowering

7. <i>Bromus tectorum</i>	annual	12-15	O	+	budding
8. <i>Carex physodes</i>	perennial	12-15	A	2	flowering
9. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
10. <i>Ferula foetida</i>	perennial	70-150	F	2	flowering
11. <i>Haloxylon ammodendron</i>	Small tree	120-150	F	2	vegetation
12. <i>Heterocaryum rigidum</i>	annual	12-15	O	+	flowering
13. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
14. <i>Hypecoum pendulum</i>	annual	15-25	O	+	flowering
15. <i>Iris songarica</i>	perennial	30-35	O	1	budding
16. <i>Koelpinia tenuissima</i>	annual	12-15	O	+	flowering
17. <i>Leptaleum filifolium</i>	annual	5-7	O	+	flowering
18. <i>Peganum harmala</i>	perennial	20-25	R	+	vegetation
19. <i>Poa bulbosa</i>	perennial	15-20	C	1	budding
20. <i>Tulipa lehmanniana</i>	perennial	15-20	O	+	flowering
21. <i>Tulipa sogdiana</i>	perennial	10-12	R	+	fruiting

Table 36. Check-list of plants recorded for [REDACTED] sandy-loamy plain, Iris-ephemeroid-saltwort-sagebrush community with solitary *Ferula foetida* [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	vegetation
2. <i>Artemisia diffusa</i>	subshrub	25-30	C	2	vegetation
3. <i>Astragalus campylorrhynchus</i>	annual	10-12	R	+	flowering
4. <i>Astragalus villosissimus</i>	subshrub	30-40	R	+	flowering
5. <i>Atriplex dimorphostegia</i>	annual	10-12	R	+	flowering
6. <i>Bromus tectorum</i>	annual	12-15	O	+	budding
7. <i>Carex physodes</i>	perennial	12-15	C	1	flowering
8. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
9. <i>Convolvulus hamadae</i>	subshrub	25-30	F	1	vegetation
10. <i>Cousinia hamadae</i>	perennial	15-20	R	+	vegetation
11. <i>Climacoptera</i> sp.	annual	12-15	O	+	vegetation
12. <i>Ferula foetida</i>	perennial	70-150	O	1	flowering
13. <i>Gagea divaricata</i>	perennial	7-10	O	+	flowering
14. <i>Haloxylon ammodendron</i>	Small tree	120-150	R	+	vegetation
15. <i>Heliotropium arguzioides</i>	perennial	10-15	O	+	vegetation
16. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
17. <i>Hypecoum pendulum</i>	annual	15-25	O	+	flowering
18. <i>Iris longiscapa</i>	perennial	15-20	R	+	flowering
19. <i>Iris songarica</i>	perennial	30-35	F	2	budding
20. <i>Lallemantia royleana</i>	annual	7-8	R	+	flowering
21. <i>Leptaleum filifolium</i>	annual	5-7	O	+	flowering
22. <i>Meniocus linifolius</i>	annual	10-12	O	+	flowering
23. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	F	2	vegetation
24. <i>Strigosella brevipes</i>	annual	10-12	O	+	flowering
25. <i>Poa bulbosa</i>	perennial	15-20	A	1	budding
26. <i>Tulipa lehmanniana</i>	perennial	15-20	O	+	flowering
27. <i>Tulipa sogdiana</i>	perennial	10-12	F	1	fruiting

Table 37. Check-list of plants recorded for [REDACTED] sabulous-loamy plain, *Ferula-ephemeroid-saltwort-sagebrush* community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Artemisia diffusa</i>	subshrub	25-30	C	2	vegetation
2. <i>Artemisia turanica</i>	subshrub	25-30	O	1	vegetation
3. <i>Carex physodes</i>	perennial	12-15	O	+	flowering
4. <i>Caroxylon orientale</i> (<i>Salsola orientalis</i>)	subshrub	25-30	O	1	vegetation
5. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
6. <i>Convolvulus hamadae</i>	subshrub	20-25	R	+	vegetation
7. <i>Ferula foetida</i>	perennial	70-150	F	1	flowering
8. <i>Goldbachia laevigata</i>	annual	12-15	R	+	Flowering, fruiting
9. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
10. <i>Iris songarica</i>	perennial	30-35	O	+	budding
11. <i>Leptaleum filifolium</i>	annual	5-7	O	+	flowering
12. <i>Meniocus linifolius</i>	annual	10-12	O	+	flowering
13. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	C	2	vegetation
14. <i>Peganum harmala</i>	perennial	20-25	R	+	vegetation
15. <i>Poa bulbosa</i>	perennial	15-20	A	2	budding
16. <i>Tulipa sogdiana</i>	perennial	10-12	O	+	fruiting

Table 38. Check-list of plants recorded for [REDACTED] hilly fixed sands and saline depression near the Agytma discharge channel, *Astragalus-desert sedge-sagebrush-Calligonum* community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	vegetation
2. <i>Artemisia diffusa</i>	subshrub	30-40	F	1	vegetation
3. <i>Astragalus campylorrhynchus</i>	annual	10-12	R	+	flowering
4. <i>Astragalus villosissimus</i>	subshrub	25-30	F	1	flowering
5. <i>Calligonum microcarpum</i>	shrub	50-70	F	1	vegetation
6. <i>Carex physodes</i>	perennial	12-15	A	2	flowering
7. <i>Ceratocarpus arenarius</i>	annual	10-12	O	+	vegetation
8. <i>Ceratocephala falcata</i>	annual	4-5	R	+	Flowering, fruiting
9. <i>Convolvulus hamadae</i>	subshrub	20-25	C	2	vegetation
10. <i>Cousinia hamadae</i>	perennial	15-20	R	+	vegetation
11. <i>Cousinia sogdiana</i>	perennial	20-25	R	+	vegetation
12. <i>Eminium lehmannii</i>	perennial	15-20	R	+	flowering
13. <i>Ferula foetida</i>	perennial	70-150	C	2	flowering
14. <i>Gagea divaricata</i>	perennial	7-10	O	+	flowering
15. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
16. <i>Hypocoum pendulum</i>	annual	15-25	O	+	flowering
17. <i>Isatis minima</i>	annual	15-20	O	+	Flowering, fruiting

18. <i>Iris longiscapa</i>	perennial	15-20	R	+	flowering
19. <i>Meniocus linifolius</i>	annual	10-12	O	+	Flowering, fruiting
20. <i>Smirnowia turkestanica</i>	subshrub	30-40	F	1	vegetation
21. <i>Tulipa lehmanniana</i>	perennial	15-20	R	+	flowering
22. <i>Tulipa sogdiana</i>	perennial	10-12	R	+	fruiting

Table 39. Check-list of plants recorded for [REDACTED] hilly fixed sands near the Agytma discharge channel, *Ferula*-desert sedge-saltwort-*Calligonum* community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	vegetation
2. <i>Artemisia diffusa</i>	subshrub	30-40	O	1	vegetation
3. <i>Astragalus villosissimus</i>	subshrub	25-30	F	1	flowering
4. <i>Calligonum microcarpum</i>	shrub	50-70	C	2	vegetation
5. <i>Carex physodes</i>	perennial	12-15	A	2	flowering
6. <i>Ceratocephala falcata</i>	annual	4-5	R	+	Flowering, fruiting
7. <i>Convolvulus hamadae</i>	subshrub	20-25	F	1	vegetation
8. <i>Ephedra strobilacea</i>	shrub	70-100	R	+	flowering
9. <i>Euphorbia turczaninowii</i>	annual	7-10	R	+	flowering
10. <i>Ferula foetida</i>	perennial	70-150	A	3	flowering
11. <i>Gagea divaricata</i>	perennial	7-10	O	+	flowering
12. <i>Heliotropium arguzioides</i>	Perennial	10-15	O	+	vegetation
13. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
14. <i>Hypochaeris pendulum</i>	annual	15-25	O	+	flowering
15. <i>Isatis minima</i>	annual	15-20	O	+	Flowering, fruiting
16. <i>Iris longiscapa</i>	perennial	15-20	R	+	flowering
17. <i>Meniocus linifolius</i>	annual	10-12	O	+	Flowering, fruiting
18. <i>Peganum harmala</i>	perennial	20-25	R	+	vegetation
19. <i>Poa bulbosa</i>	perennial	15-20	F	1	budding
20. <i>Smirnowia turkestanica</i>	subshrub	30-40	F	1	vegetation
21. <i>Sophora pachycarpa</i>	perennial	15-20	O	+	vegetation
22. <i>Xylosalsola arbuscula</i> (<i>Salsola arbuscula</i>)	shrub	50-70	F	1	vegetation

Table 40. Check-list of plants recorded for [REDACTED] hilly fixed sands near the Agytma discharge channel, *Ferula*-desert sedge-saltwort-*Calligonum* community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	vegetation
2. <i>Aeluropus litoralis</i>	perennial	15-20	O	+	flowering
3. <i>Alhagi pseudalhagi</i>	perennial	30-40	O	1	vegetation
4. <i>Allium sabulosum</i>	perennial	15-20	O	+	budding
5. <i>Artemisia diffusa</i>	subshrub	30-40	O	1	vegetation

6. Astragalus villosissimus	subshrub	25-30	O	1	flowering
7. Calligonum microcarpum	shrub	50-70	C	2	vegetation
8. Carex physodes	perennial	12-15	A	2	flowering
9. Ceratocephala falcata	annual	4-5	R	+	Flowering, fruiting
10. Convolvulus hamadae	subshrub	20-25	C	2	vegetation
11. Eminium lehmannii	perennial	15-20	R	+	flowering
12. Ephedra strobilacea	shrub	70-100	R	+	flowering
13. Euphorbia turczaninowii	annual	7-10	R	+	flowering
14. Ferula foetida	perennial	70-150	C	2	flowering
15. Gagea divaricata	perennial	7-10	O	+	flowering
16. Heliotropium arguzioides	Perennial	10-15	O	+	vegetation
17. Holosteum umbellatum	annual	10-12	O	+	flowering
18. Hypecoum pendulum	annual	15-25	O	+	flowering
19. Isatis minima	annual	15-20	O	+	Flowering, fruiting
20. Iris longiscapa	perennial	15-20	R	+	flowering
21. Meniocus linifolius	annual	10-12	O	+	Flowering, fruiting
22. Peganum harmala	perennial	20-25	O	+	vegetation
23. Poa bulbosa	perennial	15-20	F	1	budding
24. Scorzonera sericeolanata	Perennial	15-20	R	+	flowering
25. Smirnowia turkestanica	subshrub	30-40	F	1	vegetation
26. Sophora pachycarpa	perennial	15-20	O	+	vegetation
27. Strigosella turkestanica	annual	15-20	O	+	Flowering, fruiting
28. Xylosalsola arbuscula (Salsola arbuscula)	shrub	50-70	F	1	vegetation

Table 41. Check-list of plants recorded for [REDACTED] hilly fixed sands and saline depression near the Agytma discharge channel, Ferula-desert sedge-saltwort-Calligonum community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Acanthophyllum elatius	perennial	25-30	R	+	vegetation
2. Aeluropus littoralis	perennial	15-20	O	+	flowering
3. Alhagi pseudalhagi	perennial	30-40	F	1	vegetation
4. Allium sabulosum	perennial	15-20	O	+	budding
5. Artemisia diffusa	subshrub	30-40	O	1	vegetation
6. Astragalus villosissimus	subshrub	25-30	O	2	flowering
7. Calligonum microcarpum	shrub	50-70	F	1	vegetation
8. Carex physodes	perennial	12-15	A	2	flowering
9. Ceratocephala falcata	annual	4-5	R	+	Flowering, fruiting
10. Convolvulus hamadae	subshrub	20-25	C	2	vegetation
11. Eminium lehmannii	perennial	15-20	R	+	flowering
12. Ephedra strobilacea	shrub	70-100	R	+	flowering
13. Ferula foetida	perennial	70-150	C	2	flowering
14. Gagea divaricata	perennial	7-10	O	+	flowering
15. Holosteum umbellatum	annual	10-12	O	+	flowering
16. Hypecoum pendulum	annual	15-25	O	+	flowering

17. <i>Isatis minima</i>	annual	15-20	O	+	Flowering, fruiting
18. <i>Iris longiscapa</i>	perennial	15-20	R	+	flowering
19. <i>Limonium suffruticosum</i>	subshrub	30-40	O	1	vegetation
20. <i>Lycium ruthenicum</i>	shrub	50-70	O	1	vegetation
21. <i>Meniocus linifolius</i>	annual	10-12	O	+	Flowering, fruiting
22. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	F	1	vegetation
23. <i>Poa bulbosa</i>	perennial	15-20	F	1	budding
24. <i>Scorzonera sericeolanata</i>	Perennial	15-20	R	+	flowering
25. <i>Smirnowia turkestanica</i>	subshrub	30-40	O	1	vegetation
26. <i>Sophora pachycarpa</i>	perennial	15-20	R	+	vegetation
27. <i>Strigosella turkestanica</i>	annual	15-20	O	+	Flowering, fruiting
28. <i>Zygophyllum oxianum</i>	perennial	15-20	R	+	vegetation

Table 42. Check-list of plants recorded for [REDACTED] gentle wavy sandy plain, surroundings of farmstead, *Ferula-wild rue-desert bindweed community* [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	vegetation
2. <i>Alhagi pseudalhagi</i>	perennial	30-40	F	1	vegetation
3. <i>Artemisia diffusa</i>	subshrub	30-40	O	1	vegetation
4. <i>Astragalus flexus</i>	perennial	15-17	R	+	flowering
5. <i>Astragalus villosissimus</i>	subshrub	30-40	O	1	flowering
6. <i>Bromus tectorum</i>	annual	12-15	F	1	budding
7. <i>Carex physodes</i>	perennial	12-15	O	+	flowering
8. <i>Ceratocarpus arenarius</i>	annual	10-12	F	1	vegetation
9. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
10. <i>Chamaesphacos ilicifolius</i>	annual	7-10	R	+	flowering
11. <i>Chorispora tenella</i>	annual	10-12	O	+	Flowering, fruiting
12. <i>Convolvulus hamadae</i>	subshrub	20-25	A	2	vegetation
13. <i>Cousinia hamadae</i>	perennial	15-20	R	+	vegetation
14. <i>Cousinia sogdiana</i>	perennial	20-25	R	+	vegetation
15. <i>Ferula foetida</i>	perennial	70-150	F	2	flowering
16. <i>Goldbachia laevigata</i>	annual	12-15	O	+	Flowering, fruiting
17. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
18. <i>Hypecoum pendulum</i>	annual	15-25	O	+	flowering
19. <i>Iris longiscapa</i>	perennial	15-20	R	+	flowering
20. <i>Iris songarica</i>	perennial	30-35	R	+	budding
21. <i>Lycium ruthenicum</i>	shrub	50-70	R	+	vegetation
22. <i>Meniocus linifolius</i>	annual	10-12	R	+	Flowering, fruiting
23. <i>Nonea caspica</i>	annual	10-12	R	+	flowering
24. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	R	+	vegetation
25. <i>Peganum harmala</i>	perennial	20-25	F	1	vegetation

26. <i>Roemeria hybrida</i>	annual	10-12	O	+	flowering
27. <i>Sophora pachycarpa</i>	perennial	15-20	R	+	vegetation
28. <i>Tulipa lehmanniana</i>	perennial	15-20	R	+	flowering
29. <i>Tulipa sogdiana</i>	perennial	10-12	R	+	fruiting
30. <i>Veronica campylopoda</i>	annual	7-10	O	+	Flowering, fruiting

Table 43. Check-list of plants recorded for [REDACTED] gentle wavy sandy plain, *Ferula*-desert sedge-*Astragalus*-desert bindweed community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	vegetation
2. <i>Alhagi pseudalhagi</i>	perennial	30-40	F	1	vegetation
3. <i>Artemisia diffusa</i>	subshrub	30-40	F	1	vegetation
4. <i>Astragalus flexus</i>	perennial	15-17	R	+	flowering
5. <i>Astragalus villosissimus</i>	subshrub	30-40	F	1	flowering
6. <i>Carex physodes</i>	perennial	12-15	C	1	flowering
7. <i>Ceratocarpus arenarius</i>	annual	10-12	O	+	vegetation
8. <i>Ceratocephala falcata</i>	annual	4-5	F	1	Flowering, fruiting
9. <i>Chamaesphacos ilicifolius</i>	annual	7-10	R	+	flowering
10. <i>Convolvulus hamadae</i>	subshrub	20-25	A	2	vegetation
11. <i>Cousinia hamadae</i>	perennial	15-20	R	+	vegetation
12. <i>Cousinia sogdiana</i>	perennial	20-25	R	+	vegetation
13. <i>Ferula foetida</i>	perennial	70-150	A	3	flowering
14. <i>Fritillaria karelinii</i>	perennial	7-10	O	+	fruiting
15. <i>Gagea divaricata</i>	perennial	7-10	O	+	flowering
16. <i>Goldbachia laevigata</i>	annual	12-15	F	+	Flowering, fruiting
17. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
18. <i>Hypecoum pendulum</i>	annual	15-25	O	+	flowering
19. <i>Iris longiscapa</i>	perennial	15-20	R	+	flowering
20. <i>Iris songarica</i>	perennial	30-35	R	+	budding
21. <i>Nonea caspica</i>	annual	10-12	R	+	flowering
22. <i>Meniocus linifolius</i>	annual	10-12	O	+	Flowering, fruiting
23. <i>Peganum harmala</i>	perennial	20-25	O	1	vegetation
24. <i>Smirnowia turkestanica</i>	subshrub	30-40	O	1	vegetation
25. <i>Tulipa lehmanniana</i>	perennial	15-20	R	+	flowering
26. <i>Tulipa sogdiana</i>	perennial	10-12	R	+	fruiting
27. <i>Turania sogdiana</i> (<i>Salsola sogdiana</i>)	annual	15-20	R	+	vegetation
28. <i>Veronica campylopoda</i>	annual	7-10	O	+	Flowering, fruiting

Table 44. Check-list of plants recorded for [REDACTED] gentle wavy sandy plain, Ferula-desert sedge-Astragalus-desert bindweed community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Acanthophyllum elatius	perennial	25-30	R	+	vegetation
2. Alhagi pseudalhagi	perennial	30-40	O	1	vegetation
3. Artemisia diffusa	subshrub	30-40	F	1	vegetation
4. Astragalus flexus	perennial	15-17	R	+	flowering
5. Astragalus villosissimus	subshrub	30-40	F	1	flowering
6. Carex physodes	perennial	12-15	A	2	flowering
7. Ceratocarpus arenarius	annual	10-12	O	+	vegetation
8. Ceratocephala falcata	annual	4-5	F	1	Flowering, fruiting
9. Colchicum robustum (Merendera robusta)	perennial	15-20	O	+	fruiting
10. Convolvulus hamadae	subshrub	20-25	A	2	vegetation
11. Cousinia hamadae	perennial	15-20	R	+	vegetation
12. Ferula foetida	perennial	70-150	F	2	flowering
13. Fritillaria karelinii	perennial	7-10	O	+	fruiting
14. Gagea divaricata	perennial	7-10	O	+	flowering
15. Goldbachia laevigata	annual	12-15	F	+	Flowering, fruiting
16. Holosteum umbellatum	annual	10-12	O	+	flowering
17. Hypecoum pendulum	annual	15-25	O	+	flowering
18. Iris longiscapa	perennial	15-20	R	+	flowering
19. Iris songarica	perennial	30-35	O	+	budding
20. Lycium ruthenicum	shrub	50-70	R	+	vegetation
21. Meniocus linifolius	annual	10-12	O	+	Flowering, fruiting
22. Oreosalsola arbusculiformis (Salsola arbusculiformis)	shrub	30-40	O	1	vegetation
23. Peganum harmala	perennial	20-25	O	1	vegetation
24. Smirnowia turkestanica	subshrub	30-40	O	1	vegetation
25. Tulipa lehmanniana	perennial	15-20	R	+	flowering
26. Tulipa sogdiana	perennial	10-12	O	+	fruiting
27. Veronica campylopoda	annual	7-10	O	+	Flowering, fruiting

Table 45. Check-list of plants recorded for [REDACTED] slightly saline sandy plain, Iris-desert bindweed-saltwort community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Alhagi pseudalhagi	perennial	30-40	F	1	vegetation
2. Artemisia diffusa	subshrub	30-40	O	1	vegetation
3. Astragalus commixtus	annual	7-10	R	+	Flowering, fruiting
4. Astragalus villosissimus	subshrub	30-40	O	1	flowering

5. <i>Carex physodes</i>	perennial	12-15	F	1	flowering
6. <i>Ceratocarpus arenarius</i>	annual	10-12	O	+	vegetation
7. <i>Ceratocephala falcata</i>	annual	4-5	F	1	Flowering, fruiting
8. <i>Chorispora tenella</i>	annual	10-12	O	+	Flowering, fruiting
9. <i>Colchicum robustum</i> (<i>Merendera robusta</i>)	perennial	15-20	R	+	fruiting
10. <i>Convolvulus hamadae</i>	subshrub	20-25	F	1	vegetation
11. <i>Cousinia hamadae</i>	perennial	15-20	R	+	vegetation
12. <i>Delphinium camptocarpum</i>	annual	10-12	O	+	budding
13. <i>Ferula foetida</i>	perennial	40-50	O	1	vegetation
14. <i>Fritillaria karelinii</i>	perennial	7-10	O	+	fruiting
15. <i>Gagea divaricata</i>	perennial	7-10	O	+	flowering
16. <i>Goldbachia laevigata</i>	annual	12-15	O	+	Flowering, fruiting
17. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
18. <i>Hypocoum pendulum</i>	annual	15-25	O	+	flowering
19. <i>Iris longiscapa</i>	perennial	15-20	R	+	flowering
20. <i>Iris songarica</i>	perennial	30-35	O	+	budding
21. <i>Koelpinia tenuissima</i>	annual	10-12	O	+	Flowering, fruiting
22. <i>Meniocus linifolius</i>	annual	10-12	O	+	Flowering, fruiting
23. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	F	1	vegetation
24. <i>Peganum harmala</i>	perennial	20-25	O	1	vegetation
25. <i>Poa bulbosa</i>	perennial	15-20	F	1	budding
26. <i>Roemeria hybrida</i>	annual	10-12	O	+	flowering
27. <i>Smirnowia turkestanica</i>	subshrub	30-40	R	+	vegetation
28. <i>Tulipa lehmanniana</i>	perennial	15-20	O	+	flowering
29. <i>Tulipa sogdiana</i>	perennial	10-12	O	+	fruiting
30. <i>Veronica campylopoda</i>	annual	7-10	O	+	Flowering, fruiting
31. <i>Zygophyllum miniatum</i>	perennial	10-12	R	+	flowering

Table 46. Check-list of plants recorded for [REDACTED] sandy plain, *Ferula-Astragalus*-desert bindweed-sagebrush community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
18. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	vegetation
19. <i>Artemisia diffusa</i>	subshrub	30-40	A	2	vegetation
20. <i>Astragalus villosissimus</i>	subshrub	30-40	F	1	flowering
21. <i>Calligonum microcarpum</i>	shrub	70-100	R	+	vegetation
22. <i>Carex physodes</i>	perennial	12-15	A	2	flowering
23. <i>Ceratocarpus arenarius</i>	annual	10-12	O	+	vegetation
24. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
25. <i>Convolvulus hamadae</i>	subshrub	20-25	F	1	vegetation
26. <i>Cousinia hamadae</i>	perennial	15-20	R	+	vegetation
27. <i>Ferula foetida</i>	perennial	70-150	F	2	flowering

28. <i>Gagea divaricata</i>	perennial	7-10	O	+	flowering
29. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
30. <i>Hypecoum pendulum</i>	annual	15-25	O	+	flowering
31. <i>Iris longiscapa</i>	perennial	15-20	R	+	flowering
32. <i>Iris songarica</i>	perennial	30-35	R	+	budding
33. <i>Meniocus linifolius</i>	annual	10-12	O	+	Flowering, fruiting
34. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	O	1	vegetation
35. <i>Smirnowia turkestanica</i>	subshrub	30-40	O	1	vegetation

Table 47. Check-list of plants recorded for [REDACTED] sandy plain, *Ferula*-desert bindweed-sagebrush community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun- Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	vegetation
2. <i>Artemisia diffusa</i>	subshrub	30-40	A	2	vegetation
3. <i>Astragalus villosissimus</i>	subshrub	30-40	O	1	flowering
4. <i>Carex physodes</i>	perennial	12-15	F	1	flowering
5. <i>Ceratocephala falcata</i>	annual	4-5	O	+	Flowering, fruiting
6. <i>Convolvulus hamadae</i>	subshrub	20-25	A	2	vegetation
7. <i>Ferula foetida</i>	perennial	70-150	F	2	flowering
8. <i>Gagea divaricata</i>	perennial	7-10	O	+	flowering
9. <i>Holosteum umbellatum</i>	annual	10-12	O	+	flowering
10. <i>Hypecoum pendulum</i>	annual	15-25	O	+	flowering
11. <i>Iris longiscapa</i>	perennial	15-20	R	+	flowering
12. <i>Iris songarica</i>	perennial	30-35	R	+	budding
13. <i>Meniocus linifolius</i>	annual	10-12	O	+	Flowering, fruiting
14. <i>Oreosalsola arbusculiformis</i> (<i>Salsola arbusculiformis</i>)	shrub	30-40	O	1	vegetation
15. <i>Peganum harmala</i>	perennial	20-25	R	+	vegetation
16. <i>Smirnowia turkestanica</i>	subshrub	30-40	O	1	vegetation
17. <i>Tulipa lehmanniana</i>	perennial	15-20	R	+	flowering
18. <i>Veronica campylopoda</i>	annual	7-10	O	+	Flowering, fruiting

Table 48. Check-list of plants recorded for [REDACTED] sandy plain, *Ferula*-*Astragalus*-sagebrush-desert bindweed community [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun- Blanquet	
1. <i>Acanthophyllum elatius</i>	perennial	25-30	R	+	vegetation
2. <i>Alhagi pseudalhagi</i>	perennial	30-40	O	1	vegetation
3. <i>Artemisia diffusa</i>	subshrub	30-40	F	1	vegetation
4. <i>Astragalus flexus</i>	perennial	15-17	R	+	flowering
5. <i>Astragalus villosissimus</i>	subshrub	30-40	F	1	flowering
6. <i>Carex physodes</i>	perennial	12-15	A	2	flowering
7. <i>Ceratocarpus arenarius</i>	annual	10-12	O	+	vegetation

8. Ceratocephala falcata	annual	4-5	F	1	Flowering, fruiting
9. Convolvulus hamadae	subshrub	20-25	A	2	vegetation
10. Cousinia hamadae	perennial	15-20	R	+	vegetation
11. Ferula foetida	perennial	70-150	F	2	flowering
12. Fritillaria karelinii	perennial	7-10	O	+	fruiting
13. Gagea divaricata	perennial	7-10	O	+	flowering
14. Goldbachia laevigata	annual	12-15	R	+	Flowering, fruiting
15. Holosteum umbellatum	annual	10-12	O	+	flowering
16. Hypecoum pendulum	annual	15-25	O	+	flowering
17. Iris longiscapa	perennial	15-20	R	+	flowering
18. Iris songarica	perennial	30-35	R	+	budding
19. Meniocus linifolius	annual	10-12	O	+	Flowering, fruiting
20. Oreosalsola arbusculiformis (Salsola arbusculiformis)	shrub	30-40	O	1	vegetation
21. Peganum harmala	perennial	20-25	O	1	vegetation
22. Smirnowia turkestanica	subshrub	30-40	R	+	vegetation
23. Tulipa lehmanniana	perennial	15-20	R	+	flowering
24. Tulipa sogdiana	perennial	10-12	O	+	fruiting

Table 49. Check-list of plants recorded for [REDACTED] sandy-loamy plain, ephemeroïd-sagebrush community with black saxaul plantation [REDACTED]

Species	Life form	Height, cm	Abundance		Phenol. Stage
			DACFOR	Braun-Blanquet	
1. Acanthophyllum elatius	perennial	25-30	R	+	vegetation
2. Artemisia diffusa	subshrub	25-30	C	2	vegetation
3. Astragalus villosissimus	subshrub	30-40	O	+	flowering
4. Carex physodes	perennial	12-15	A	2	flowering
5. Ceratocephala falcata	annual	4-5	O	+	Flowering, fruiting
6. Convolvulus hamadae	subshrub	25-30	O	+	vegetation
7. Ferula foetida	perennial	70-150	F	1	flowering
8. Haloxylon ammodendron	Small tree	70-100	F	1	vegetation
9. Holosteum umbellatum	annual	10-12	O	+	flowering
10. Hypecoum pendulum	annual	15-25	O	+	flowering
11. Iris songarica	perennial	30-35	O	1	budding
12. Leptaleum filifolium	annual	5-7	O	+	flowering
13. Meniocus linifolius	annual	10-12	O	+	flowering
14. Peganum harmala	perennial	20-25	R	+	vegetation
15. Poa bulbosa	perennial	15-20	A	1	budding
16. Tulipa lehmanniana	perennial	15-20	O	+	flowering
17. Tulipa sogdiana	perennial	10-12	O	+	fruiting

6 Conclusion

As a result of the field survey and analysis of satellite imagery, following types of habitats (mapping units) can be identified in the Project site “Gijduvan” and along the planned power line:

- Sandy and sabulous-loamy plain covered by communities of sagebrush, saltworts, desert bindweed and ephemeroïds, sometimes with plantations of black saxaul. This is a natural habitat type which prevails in the Project area.
- Fixed and semi-fixed sands covered by communities of psammophilous shrubs, subshrubs, sagebrush and desert sedge.
- Saline lands
- Modified habitats with sparse communities of native weeds, camel thorn, annual saltworts, ephemers, and with solitary black saxaul, wolfberry and tamarisk. This habitat type covers small areas in surroundings of the desert farmsteads and in surroundings of channels.

The vegetation of the Project site “Gijduvan” is represented with native ephemeroïd-sagebrush, saltwort-ephemeroïd-sagebrush and other subshrub plant communities, with psammophilous shrubs on gentle hilly-wavy sands, and sometimes with saxaul plantations created in the past for fixation of sands. The vegetation of the project site is typical for South-western Kyzylkum (and for the desert zone of Central Asia). Plant communities of the Project region are characterized with rather sparse canopy cover, low to medium species diversity and low to medium level of anthropogenic disturbance. The canopy cover is 20–40% on most areas, up to 40–50% for communities of psammophilous shrubs, and less than 10% (sometimes almost 0%) on saline depressions and on strongly disturbed areas.

A total check-list of vascular plants recorded within the Project site during the field survey in April includes ... species. None of them are included in the IUCN Red List as CR, EN or VU, one species is Near Threatened (NT), and 3 species are included in the Red Data Book of Uzbekistan (*Calligonum zakirovii*, *Eremostachys eriolarynx* and *Tulipa lehmanniana*). Alien species were not found.

One of nationally red-listed species, *Tulipa lehmanniana*, occurs sporadically within all Project site; its relative abundance according the DAFOR scale is R (rare) to F (frequent), population density varies from solitary specimens to several thousands per 1 hectare. *Tulipa lehmanniana* included in the Red Data Book of Uzbekistan (2019) with the status 3 (reducing), it is nationally red-listed also in Kazakhstan, Tajikistan and Turkmenistan, and assessed as Near Threatened (NT) in the IUCN Red List. The main threats are overgrazing, habitat loss, collection of flowers and bulbs. This species is quite widely spread in the desert zone of Irano-Turanian region of Tethyan (Ancient Mediterranean) floristic subkingdom of Holarctic (Takhtajan, 1986), and it occurs in Uzbekistan, Kazakhstan, Tajikistan, Turkmenistan, Afghanistan, Pakistan, and Iran. Tojibaev & Beshko (2015) noted that this species can be assessed as Least Concern (LC) by the IUCN Red List Categories and Criteria (IUCN, 2012). Taking in the account these facts, the Project site “Gijduvan” is not a critical habitat for this tulip species.

Calligonum zakirovii and *Eremostachys eriolarynx* both are endemics listed in the Red Data Book of Uzbekistan under category 1 (endangered, disappearing species). Critical habitat assessment is necessary for these two species.

Two species endemic to Central Asian deserts, *Cousinia sogdiana* and *Tulipa sogdiana*, also previously were included in the Red Data Book of Uzbekistan, but the results of field surveys performed during the last 20 years showed that these species are common in desert zone of Uzbekistan, and they have been removed from the national Red Data Book.

At the present, the human impact within the project area is connected mainly with use of rangelands, small-scale agriculture and a network of ground roads.

It should be noted that the list of species identified during the April survey is incomplete, additional botanical survey is recommended in autumn (late August to October), the most favorable time for identification of saltworts and other representatives of Amarantaceae family.

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13. FULL YEAR COLLISION RISK MODELLING REPORT

Xenops Environmental, LLC
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February 18, 2025

Lara BouGhanem
Five Capitals Consultancy

Dear Ms. BouGhanem,

This memorandum contains Xenops Environmental, LLC (Xenops)' results for the 2024 year-round bird collision risk modeling (CRM) for the Gijduvon (or Bash II) Wind Energy Project (GWEP), per the contract between Xenops and Five Capitals Consultancy (5C). The GWEP is a 300MW proposed wind energy facility to be located roughly 30 km NNE of the city of Gijduvon in the Bukhara Region, Republic of Uzbekistan. This analysis was performed using the Band (2012) model, following Scottish Natural Heritage (SNH) Guidance recommendations, with collision avoidance rate parameters derived from an original review of technical literature, supported by expert judgment, where specific information on certain species of interest was not available in previously published studies. Input data on bird flight density and heights for the modeling effort were derived from bird Vantage Point surveys conducted by Juru Ltd, based on 1301.5 hours of Vantage Point (VP) survey data collected year-round (January 9 2024 – November 30, 2024) at nine vantage points that cover the site, following the Project's workplan.

In summary, for "target species," a category that includes all raptors and other large-bodied bird species that potentially occur at the site, several of which have elevated national and/or international conservation/protected status, 12 species were recorded inside of the maximum reliable observation radius during the VP survey effort, and the CRM analysis indicated low predicted collision frequencies for all of them. Only one species, Dalmatian Pelican, is expected to experience approximately one collision every 3 years (0.313 collisions per year), while all other target species observed at the project area have fewer than one predicted collision every 14 years. Another notable species of interest is the IUCN Endangered Steppe Eagle, as a substantial number of detections of birds (260) was recorded at the site during autumn migration, including early winter. However, the predicted collision risk for this species, is still relatively low, roughly one collision per 14 years, largely owing to the high flight altitude and fast and direct nature of this species' overflights of the site, which were likely to have been limited to autumn migratory transits.

For "secondary" or "tier 2" target species, a category that includes all other raptors and additional large bird species that could potentially be sensitive issues for the Project, if impacted, 25 species were detected during the VP survey effort, and the CRM analysis indicated relatively low levels of collision risk for all secondary species, with 1.83 collisions predicted each year for the highest risk species (*Anas crecca*), and one collision every 3.9 years for the second-highest risk species (*Circus aeruginosus*). At the collision levels predicted, no serious or outstanding bird collision risk issues were identified for the Project in the CRM analysis. It should be noted that the results of CRM analysis contain significant inherent uncertainty, particularly owing to the lack of empirically-derived collision avoidance behavioral information for most species.

A detailed description of the methods and results of this analysis is included below.

Please do not hesitate to contact me if you have any questions or comments regarding this report.

Sincerely,

A handwritten signature in black ink, appearing to read 'Caleb Gordon', with a stylized flourish at the end.

Caleb Gordon, Ph. D.
Ornithologist, Principal Ecologist
Xenops Environmental, LLC
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2024 Annual Bird Collision Risk Modeling Analysis for the Gijduvon Wind Energy Project

Caleb Gordon and Phoebe Gordon, Xenops Environmental

Introduction

Collision Risk Modeling (CRM) using the model developed and refined by William Band, has become a standard method in international industry practice for obtaining quantitative predictions of estimated fatality rates of birds at wind farms, where suitable field observation data from Vantage Point (VP) surveys have been collected, conforming to the data input assumptions of the Band (2012) model, and following the guidance for such surveys and subsequent CRM promulgated by NatureScot (formerly “Scottish Natural Heritage”) (SNH 2017). The Band CRM predicts the expected collision rates of particular bird species or species groups at a given wind farm based on the specific dimensions and physical characteristics of the turbines, the birds, the wind farm, and the density of bird flights recorded in the wind farm area. The latter parameter is termed “bird density” and is derived from the VP survey data, further differentiated with regard to the altitude of the birds’ flights relative to the rotor swept altitudes of the rotors. While the basic mechanism of the Band model does not incorporate the ability or tendency of birds to alter their flight paths in response to the presence of wind turbines (avoidance), such behavior is believed to be a very important dynamic influencing actual bird collision rates at wind farms (Cook et. al. 2012), hence a “collision avoidance rate” parameter is typically applied for each bird species or species group when conducting CRM for wind farms using the Band model (SNH 2010, Cook et al. 2012, Band 2012, SNH 2018).

We conducted CRM using the Band (2012) model for 2024 year-round VP bird survey data gathered at the GWEP, for the purpose of deriving quantitative prediction of collision rates for target bird species, as well as selected additional species, based on their observed patterns of abundance and use of airspace at the site, as described by observations gathered during VP surveys.

The VP survey protocol was developed with guidance from Xenops and intended to conform with SNH (2017) recommendations, in order to provide input data suitable for performing CRM with the Band (2012) model. In addition to guidance in the form of an initial set of recommendations, Xenops also reviewed and commented on geospatial information regarding the selection and placement of a suitable number of VP survey locations. Furthermore, Xenops also provided input in developing the biodiversity survey workplan. Xenops also communicated requests for additional species-specific data inputs necessary for the CRM through Juru Ltd., based on field observations and expert judgment of the ornithologists who conducted the VP surveys. While this communication provides some assurance that the input data used for this CRM effort conforms to NatureScot guidance and the model’s input assumptions, the reliability of the results of this CRM is ultimately dependent on the qualifications and diligence of the field observers, as well as the veracity of their results, as they were reported to Xenops by Juru Ltd.

The species for which CRM was conducted included all “target” and “secondary” bird species that were observed at the site within the year-round VP survey effort. Target species were defined to include all raptors and large-bodied bird species, including those with elevated conservation concern or protected status on either the national¹ or international² “red lists.” Secondary species were defined to include all additional raptors and vultures that were observed during VP surveys at the site, as well as selected additional large-bodied birds that could become a significant risk concern for the Project, if seriously impacted. The list of such species was developed with input from regional bird experts, and was intended to include all potentially high- or moderate- sensitivity bird species that could occur at the site. The species included within the CRM for the GWEP are shown in Table 1, along with their national and international conservation status, their Project-specific priority level³, and the total number of VP survey observations that were included within the CRM analysis for each season⁴.

¹ Uzbekistan Red Data book. 2019. Vol.2. Animals. Tashkent: Chinor ENK.

² IUCN Red List of Threatened Species, accessed January 27, 2025

³ Project-specific priority levels are based on consideration of likely susceptibility to wind farm impacts and likelihood of occurrence at the site, as well as national and international conservation (protected) status.

⁴ Note that observations that were recorded outside of the maximum reliable observation radius were regarded as “incidental” observations, and were excluded from the analysis.

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Table 1: Summary of conservation/sensitivity status and numbers of VP survey observations in each season for each bird species included within the Collision Risk Modeling analysis for the Gijduvon Wind Energy Project. Conservation/protected status are as follows: EN = Endangered; VU = Vulnerable; NT = Near Threatened; blank = Least Concern (IUCN) or not listed. Color-coding of species' project-sensitivity classification is as follows: orange = target species; yellow = secondary species.

Scientific Name	English Common Name	Uzbek Status	IUCN Status	VP Observations			
				Spring	Summer	Autumn	Winter
<i>Chlamydotis macqueenii</i>	Asian Houbara	VU	VU	0	0	0	1
<i>Vanellus gregarius</i>	Sociable Lapwing	VU	CR	0	0	0	3
<i>Pelecanus crispus</i>	Dalmatian Pelican	EN	NT	11	0	0	92
<i>Aegypius monachus</i>	Cinereous Vulture	NT	NT	0	0	0	3
<i>Circaetus gallicus</i>	Short-toed Snake-Eagle	VU		1	0	2	1
<i>Clanga clanga</i>	Greater Spotted Eagle	VU	VU	0	0	0	4
<i>Hieraaetus pennatus</i>	Booted Eagle	VU		0	0	1	0
<i>Aquila nipalensis</i>	Steppe Eagle	VU	EN	2	0	178	82
<i>Aquila heliaca</i>	Imperial Eagle	VU	VU	3	0	6	4
<i>Aquila chrysaetos</i>	Golden Eagle	VU		0	0	1	5
<i>Aquila sp.</i>	Unidentified Eagle			0	0	0	7
<i>Haliaeetus albicilla</i>	White-tailed Eagle	VU		0	0	0	1
<i>Falco cherrug</i>	Saker Falcon	EN	EN	0	0	1	0
<i>Anser anser</i>	Graylag Goose			380	0	63	9
<i>Cygnus olor</i>	Mute Swan	NT		4	0	0	15
<i>Anas crecca</i>	Green-winged Teal			0	12	220	0
<i>Pterocles orientalis</i>	Black-bellied Sandgrouse			168	192	1182	89
<i>Tetrax tetrax</i>	Little Bustard	VU	NT	0	0	1	0
<i>Anthropoides virgo</i>	Demoiselle Crane			9	0	435	0
<i>Grus grus</i>	Common Crane			0	0	446	9
<i>Vanellus vanellus</i>	Northern Lapwing		NT	0	0	166	0
<i>Ciconia nigra</i>	Black Stork	VU		0	1	0	0
<i>Plegadis falcinellus</i>	Glossy Ibis	VU		65	0	0	0
<i>Ardea alba</i>	Great Egret			0	1	20	0
<i>Ardea cinerea</i>	Gray Heron			0	7	6	0
<i>Accipiter nisus</i>	Eurasian Sparrowhawk			12	2	6	4
<i>Circus aeruginosus</i>	Western Marsh Harrier			83	24	23	29
<i>Circus cyaneus</i>	Hen Harrier			30	0	12	20
<i>Circus macrourus</i>	Pallid Harrier	NT	NT	7	0	1	2
<i>Circus pygargus</i>	Montagu's Harrier			2	0	0	0
<i>Circus sp.</i>	Unidentified Harrier			1	0	0	0
<i>Milvus migrans</i>	Black Kite			3	0	0	4
<i>Buteo buteo</i>	Common Buzzard			26	3	6	0
<i>Buteo rufinus</i>	Long-legged Buzzard			15	0	30	42
<i>Buteo hemilasius</i>	Upland Buzzard			0	0	1	0
<i>Buteo japonicus</i>	Eastern Buzzard			5	0	0	0
<i>Buteo sp.</i>	Unidentified Buzzard			4	0	0	0
<i>Falco naumanni</i>	Lesser Kestrel	NT		5	0	10	0
<i>Falco tinnunculus</i>	Eurasian Kestrel			24	5	18	26
<i>Falco columbarius</i>	Merlin			0	0	1	3

Model Input Data

Data inputs for the year-round CRM analysis were derived from the results of the seasonal VP surveys, as well as various additional sources, depending on the type of information needed. Specific sources and pertinent assumptions for each type of input data used in the CRM are described further below.

Turbine and wind farm data

Our CRM was based on a specific technology and layout scenario currently under consideration for the GWEP at the time of the preparation of the CRM. Specific physical parameters of the turbines, towers, and the specific model input values used to represent this scenario in the CRM analysis are detailed and explained in Table 2.

Table 2: Model input data on physical characteristics of the turbines, towers, and wind farm configuration used in the year-round Collision Risk Modeling for the Gijduvon Wind Energy Project, along with notes and explanations of each.

Parameter	Value(s) used in Modeling	Explanation
Turbine model	Sany SI-1958.0	Representative turbine technology under consideration at the time of the CRM
# blades	3	from manufacturer's specifications
Rotation speed (rpm)	8.9	Estimated for typical wind speed, given rotor diameter
Rotor radius (m)	95.6204	from manufacturer's specifications
Hub height (m)	130	from manufacturer's specifications
Percent of time operational	Values ranging from 64% - 85%	Project specific data not available, representative values taken from SOSS example
Maximum blade width (m)	4.5	From manufacturer's specifications for a turbine of similar size
Pitch (degrees)	15	Representative value ⁵
# turbines	39	Proposed # turbines
latitude	40	Approximate midpoint of GWEP area
Rotor swept altitude range (risk height, m)	34-226	Based on rotor diameter and hub height

Data on Physical and Observational Characteristics of Birds

In addition to bird densities derived from VP survey data, CRM using the Band model requires certain data on the physical and observational characteristics of each modeled species of bird. Input values used in the CRM analysis are presented in Table 3. As a general rule, data on physical dimensions of birds were derived from Cornell Lab of Ornithology's Birds of the World⁶, while information specific to the VP survey observations, such as maximum effective radius of observation/identification were based on expert judgment.

⁵ Pitch is adjustable on the turbine model selected for the analysis, as well as most currently available wind turbines, depending on wind speed. A representative value of 15 degrees was used, based on a range of values reported for various turbine models at typical, commercially useful wind speeds

⁶ <https://birdsoftheworld.org/bow/home>, accessed 7 February, 2025

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Table 3: Physical and observational characteristics of each bird species included within the Collision Risk Modeling analysis for the Gijduvon Wind Energy Project.

Scientific Name	English Common Name	Length (m)	Wingspan (m)	Flight type ⁷	Flight speed (m/sec) ⁸	Detection distance (km) ⁹
<i>Chlamydotis macqueenii</i>	Asian Houbara	0.65	1.5	Flapping	13.6	0.9
<i>Vanellus gregarius</i>	Sociable Lapwing	0.29	0.7	Flapping	11.9	0.6
<i>Pelecanus crispus</i>	Dalmatian Pelican	1.7	3.28	Gliding	15.6	2
<i>Aegypius monachus</i>	Cinereous Vulture	1.1	2.73	Gliding	11.9	1.6
<i>Circaetus gallicus</i>	Short-toed Snake-Eagle	0.66	1.77	Gliding	11.7	2
<i>Clanga clanga</i>	Greater Spotted Eagle	0.65	1.68	Gliding	11.7	2
<i>Hieraetus pennatus</i>	Booted Eagle	0.47	1.26	Gliding	11.3	2
<i>Aquila nipalensis</i>	Steppe Eagle	0.7	1.9	Gliding	11.9	2
<i>Aquila heliaca</i>	Imperial Eagle	0.71	1.9	Gliding	11.9	2
<i>Aquila chrysaetos</i>	Golden Eagle	0.77	2.03	Gliding	11.9	2
<i>Aquila sp.</i>	Unidentified Eagle	0.73	1.94	Gliding	11.9	2
<i>Haliaeetus albicilla</i>	White-tailed Eagle	0.83	2.19	Gliding	13.6	1.9
<i>Falco cherrug</i>	Saker Falcon	0.51	1.12	Flapping	12.8	0.4
<i>Anser anser</i>	Graylag Goose	0.83	1.64	Flapping	17.1	1
<i>Cygnus olor</i>	Mute Swan	1.4	2.23	Flapping	16.2	2
<i>Anas crecca</i>	Green-winged Teal	0.37	0.61	Flapping	12	0.4
<i>Pterocles orientalis</i>	Black-bellied Sandgrouse	0.36	0.72	Flapping	12	0.4
<i>Tetrax tetrax</i>	Little Bustard	0.44	1.1	Flapping	10.8	1.5
<i>Anthropoides virgo</i>	Demoiselle Crane	0.95	1.6	Gliding	13.6	0.9
<i>Grus grus</i>	Common Crane	0.95	1.6	Gliding	13.6	0.9
<i>Vanellus vanellus</i>	Northern Lapwing	0.3	0.85	Flapping	11.9	1.5
<i>Ciconia nigra</i>	Black Stork	0.98	1.5	Flapping	10.8	2
<i>Plegadis falcinellus</i>	Glossy Ibis	0.57	0.875	Flapping	12.6	1
<i>Ardea alba</i>	Great Egret	0.92	1.55	Flapping	10.8	2
<i>Ardea cinerea</i>	Gray Heron	0.94	1.85	Flapping	10.8	2
<i>Accipiter nisus</i>	Eurasian Sparrowhawk	0.34	0.67	Flapping	11.3	0.3
<i>Circus aeruginosus</i>	Western Marsh Harrier	0.48	1.3	Gliding	11.2	0.5
<i>Circus cyaneus</i>	Hen Harrier	0.46	1.1	Gliding	9.1	0.5
<i>Circus macrourus</i>	Pallid Harrier	0.44	1.11	Gliding	9.6	0.5
<i>Circus pygargus</i>	Montagu's Harrier	0.44	1.125	Gliding	8.4	0.5
<i>Circus sp.</i>	Unidentified Harrier	0.46	1.16	Gliding	9.6	0.5
<i>Milvus migrans</i>	Black Kite	0.55	1.37	Gliding	11.7	1
<i>Buteo buteo</i>	Common Buzzard	0.46	1.23	Gliding	11.6	1
<i>Buteo rufinus</i>	Long-legged Buzzard	0.53	1.3	Gliding	11.6	1
<i>Buteo hemilasius</i>	Upland Buzzard	0.69	1.52	Gliding	11.6	1
<i>Buteo japonicus</i>	Eastern Buzzard	0.518	1.225	Gliding	11.6	1
<i>Buteo sp.</i>	Unidentified Buzzard	0.503	1.252	Gliding	11.6	1

⁷ The model does not permit inclusion of multiple flight styles, hence only the most prevalent flight type was used for each species, based on general flight tendencies of the species.

⁸ Flight speeds derived from Alerstam et. al. (2007) and MEKUN (2024).

⁹ Maximum reliable detection distance determined for each species by Xenops, accounting not only for the distance at which each species could be reliably *observed*, but also the distance at which each species could be reliably *distinguished from other species* (identified).

Scientific Name	English Common Name	Length (m)	Wingspan (m)	Flight type ⁷	Flight speed (m/sec) ⁸	Detection distance (km) ⁹
<i>Falco naumanni</i>	Lesser Kestrel	0.31	0.66	Flapping	10.1	0.4
<i>Falco tinnunculus</i>	Eurasian Kestrel	0.31	0.68	Flapping	10.1	0.4
<i>Falco columbarius</i>	Merlin	0.28	0.63	Flapping	12.8	0.4

VP Survey Data Used to Derive Bird Density

Bird density inputs in CRM analysis represent the density of birds flying within the surveyed area at any given moment in time (or “instantaneous” bird density). These values are calculated based on the observations gathered during the VP surveys, and then further differentiated based on the percent of such flights that occurred within “risk height” equivalent to the range of altitudes swept by the turbines to be installed. The effective survey area is based on the area covered by a single VP survey point, but varies among species based on the maximum effective detection radius (Table 3). For target species and Mute Swan¹⁰, the paths and altitudes of each individual birds’ flights were plotted every 15 seconds while the birds were inside of the specified observation radius (up to 2 km from the observer). For these species, the bird density was calculated by dividing the total number of fractional minutes of the birds’ presence flying within the specified observation radius, by the total number of minutes of VP survey observation for the period, and then dividing that by the effective survey area, as a function of the species-specific maximum reliable detection radius. For observations of level 2 priority species and Booted Eagle¹¹, for which no observation duration times were provided, only a single, representative flight height was recorded for each observation of an individual or flock observed flying within the specified observation radius during the VP surveys. In order to calculate the number of “observation minutes” for these species, we estimated representative observation durations by calculating the time it would take a bird to transit a typical path through the observation area, represented by the diameter of the observation circle, at the species-specific flight speed (Table 3). Summaries of the VP survey data used to calculate bird density values in each season are presented in Tables 4-7. Note that these tables show only cumulative values for each season, but in the CRM analysis, the data are broken down further by month.

Table 4: Observational data from the Vantage Point surveys used to derive bird flux density inputs for the **spring** season Collision Risk Modeling analysis for the Gijduvon Wind Energy Project. For all species, the total duration of observations was equivalent to the total of 324 hours, or 19,440 minutes of VP survey effort conducted at the Project during the spring season.

Scientific Name	English Common Name	Number of observations in spring season	% at rotor swept height	Total bird minutes	Effective survey area (km ²)
<i>Pelecanus crispus</i>	Dalmatian Pelican	11	8.86	158	12.6
<i>Circaetus gallicus</i>	Short-toed Snake-Eagle	1	0	2	12.6
<i>Aquila nipalensis</i>	Steppe Eagle	2	57.1	3.5	12.6

¹⁰ Precise durations were provided for Mute Swan (*Cygnus olor*); however, it is considered a secondary target species in the CRM.

¹¹ No precise durations were provided for Booted Eagle (*Hieraaetus pennatus*); however, it is considered a primary target species in the CRM.

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Scientific Name	English Common Name	Number of observations in spring season	% at rotor swept height	Total bird minutes	Effective survey area (km ²)
<i>Aquila heliaca</i>	Imperial Eagle	3	26.3	9.5	12.6
<i>Anser anser</i>	Graylag Goose	380	100	741	3.14
<i>Cygnus olor</i>	Mute Swan	4	100	16.5	12.6
<i>Pterocles orientalis</i>	Black-bellied Sandgrouse	168	0	187	0.503
<i>Anthropoides virgo</i>	Demoiselle Crane	9	0	19.9	2.54
<i>Plegadis falcinellus</i>	Glossy Ibis	65	0	172	3.14
<i>Accipiter nisus</i>	Eurasian Sparrowhawk	12	8.33	10.6	0.283
<i>Circus aeruginosus</i>	Western Marsh Harrier	83	18.1	124	0.785
<i>Circus cyaneus</i>	Hen Harrier	30	16.7	54.9	0.785
<i>Circus macrourus</i>	Pallid Harrier	7	0	12.2	0.785
<i>Circus pygargus</i>	Montagu's Harrier	2	0	3.97	0.785
<i>Circus sp.</i>	Unidentified Harrier	1	0	1.74	0.785
<i>Milvus migrans</i>	Black Kite	3	0	8.55	3.14
<i>Buteo buteo</i>	Common Buzzard	26	7.69	74.7	3.14
<i>Buteo rufinus</i>	Long-legged Buzzard	15	20	43.1	3.14
<i>Buteo japonicus</i>	Eastern Buzzard	5	0	14.4	3.14
<i>Buteo sp.</i>	Unidentified Buzzard	4	75	11.5	3.14
<i>Falco naumanni</i>	Lesser Kestrel	5	40	6.60	0.503
<i>Falco tinnunculus</i>	Eurasian Kestrel	24	8.33	31.7	0.503

Table 5: Observational data from the Vantage Point surveys used to derive bird flux density inputs for the **summer** season Collision Risk Modeling analysis for the Gijduvon Wind Energy Project. For all species, the total duration of observations was equivalent to the total of 324 hours, or 12,960 minutes of VP survey effort conducted at the Project during the summer season.

Scientific Name	English Common Name	Number of observations in summer season	% at rotor swept height	Total bird minutes	Effective survey area (km ²)
<i>Anas crecca</i>	Green-winged Teal	12	41.7	13.3	0.503
<i>Pterocles orientalis</i>	Black-bellied Sandgrouse	192	0	213	0.503
<i>Ciconia nigra</i>	Black Stork	1	100	6.17	12.6
<i>Ardea alba</i>	Great Egret	1	0	6.17	12.6
<i>Ardea cinerea</i>	Gray Heron	7	0	43.2	12.6
<i>Accipiter nisus</i>	Eurasian Sparrowhawk	2	0	1.77	0.283
<i>Circus aeruginosus</i>	Western Marsh Harrier	24	0	35.7	0.785
<i>Buteo buteo</i>	Common Buzzard	3	0	8.62	3.14
<i>Falco tinnunculus</i>	Eurasian Kestrel	5	0	6.60	0.503

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Table 6: Observational data from the Vantage Point surveys used to derive bird flux density inputs for the **autumn** season Collision Risk Modeling analysis for the Gijduvon Wind Energy Project. For all species, the total duration of observations was equivalent to the total of 324 hours, or 19,440 minutes of VP survey effort conducted at the Project during the autumn season.

Scientific Name	English Common Name	Number of observations in autumn season	% at rotor swept height	Total bird minutes	Effective survey area (km ²)
<i>Circaetus gallicus</i>	Short-toed Snake-Eagle	2	20	5	12.6
<i>Hieraetus pennatus</i>	Booted Eagle	1	100	5.90	12.6
<i>Aquila nipalensis</i>	Steppe Eagle	178	71.2	539	12.6
<i>Aquila heliaca</i>	Imperial Eagle	6	72.7	9.17	12.6
<i>Aquila chrysaetos</i>	Golden Eagle	1	100	0.75	12.6
<i>Falco cherrug</i>	Saker Falcon	1	0	2	0.503
<i>Anser anser</i>	Graylag Goose	63	0	123	3.14
<i>Anas crecca</i>	Green-winged Teal	220	100	244	0.503
<i>Pterocles orientalis</i>	Black-bellied Sandgrouse	1182	0.846	1313	0.503
<i>Tetrax tetrax</i>	Little Bustard	1	0	4.63	7.07
<i>Anthropoides virgo</i>	Demoiselle Crane	435	12.2	960	2.54
<i>Grus grus</i>	Common Crane	446	0	984	2.54
<i>Vanellus vanellus</i>	Northern Lapwing	166	0	697	7.07
<i>Ardea alba</i>	Great Egret	20	0	123	12.6
<i>Ardea cinerea</i>	Gray Heron	6	0	37.0	12.6
<i>Accipiter nisus</i>	Eurasian Sparrowhawk	6	0	5.31	0.283
<i>Circus aeruginosus</i>	Western Marsh Harrier	23	0	34.2	0.785
<i>Circus cyaneus</i>	Hen Harrier	12	0	22.0	0.785
<i>Circus macrourus</i>	Pallid Harrier	1	0	1.74	0.785
<i>Buteo buteo</i>	Common Buzzard	6	33.3	17.2	3.14
<i>Buteo rufinus</i>	Long-legged Buzzard	30	40	86.2	3.14
<i>Buteo hemilasius</i>	Upland Buzzard	1	0	2.87	3.14
<i>Falco naumanni</i>	Lesser Kestrel	10	10	13.2	0.503
<i>Falco tinnunculus</i>	Eurasian Kestrel	18	0	23.8	0.503
<i>Falco columbarius</i>	Merlin	1	0	1.04	0.503

Table 7: Observational data from the Vantage Point surveys used to derive bird flux density inputs for the **winter** season Collision Risk Modeling analysis for the Gijduvon Wind Energy Project. For all species, the total duration of observations was equivalent to the total of 329.5 hours, or 19,770 minutes of VP survey effort conducted at the Project during the winter season.

Scientific Name	English Common Name	Number of observations in winter season	% at rotor swept height	Total bird minutes	Effective survey area (km ²)
<i>Chlamydotis macqueenii</i>	Asian Houbara	1	0	1.25	2.54
<i>Vanellus gregarius</i>	Sociable Lapwing	3	0	3.75	1.13
<i>Pelecanus crispus</i>	Dalmatian Pelican	92	97.2	349.5	12.6
<i>Aegypius monachus</i>	Cinereous Vulture	3	9.09	5.5	8.04
<i>Circaetus gallicus</i>	Short-toed Snake-Eagle	1	100	9.25	12.6

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Scientific Name	English Common Name	Number of observations in winter season	% at rotor swept height	Total bird minutes	Effective survey area (km ²)
<i>Clanga clanga</i>	Greater Spotted Eagle	4	11.3	24.25	12.6
<i>Aquila nipalensis</i>	Steppe Eagle	82	29.8	366.75	12.6
<i>Aquila heliaca</i>	Imperial Eagle	4	100	8	12.6
<i>Aquila chrysaetos</i>	Golden Eagle	5	0	32.25	12.6
<i>Aquila sp.</i>	Unidentified Eagle	7	29.4	12.75	12.6
<i>Haliaeetus albicilla</i>	White-tailed Eagle	1	100	2.25	11.3
<i>Anser anser</i>	Graylag Goose	9	55.6	17.5	3.14
<i>Cygnus olor</i>	Mute Swan	15	0	18.75	12.6
<i>Pterocles orientalis</i>	Black-bellied Sandgrouse	89	0	98.9	0.503
<i>Grus grus</i>	Common Crane	9	0	19.9	2.54
<i>Accipiter nisus</i>	Eurasian Sparrowhawk	4	0	3.54	0.283
<i>Circus aeruginosus</i>	Western Marsh Harrier	29	31.0	43.2	0.785
<i>Circus cyaneus</i>	Hen Harrier	20	5.0	36.6	0.785
<i>Circus macrourus</i>	Pallid Harrier	2	0	3.47	0.785
<i>Milvus migrans</i>	Black Kite	4	0	11.4	3.14
<i>Buteo rufinus</i>	Long-legged Buzzard	42	69.0	121	3.14
<i>Falco tinnunculus</i>	Eurasian Kestrel	26	11.5	34.3	0.503
<i>Falco columbarius</i>	Merlin	3	0	3.13	0.503

Collision Avoidance Parameter

Published, validated collision avoidance (CA) parameters are not available for most of the target species we modeled at the GWEP, yet the CA parameter is well-known to be a very important parameter in Band CRM analysis, with outcomes very sensitive to slight variation in CA (Cook et. al., 2012). For each species included within the CRM analysis for the GWEP, we developed a “most realistic” CA parameter value, bounded by a “conservative” low parameter estimate, and a high estimate, reflecting an upper bound, based on a comprehensive review of available literature, interpreted with species- and site-specific information. The values used for each species are presented in Table 8, and then a brief explanation/justification is presented for each species below.

Table 8: Collision avoidance parameters used in the year-round Collision Risk Modeling analysis for target bird species at the Gijduvon Wind Energy Project (see text for explanation and justification)

Scientific Name	English Common Name	Lower bound value	Most realistic value	Upper bound value
<i>Chlamydotis macqueenii</i>	Asian Houbara	0.95	0.99	0.995
<i>Vanellus gregarius</i>	Sociable Lapwing	0.98	0.998	0.999
<i>Pelecanus crispus</i>	Dalmatian Pelican	0.95	0.99	0.995
<i>Aegypius monachus</i>	Cinereous Vulture	0.98	0.99	0.995
<i>Circaetus gallicus</i>	Short-toed Snake-Eagle	0.981	0.9958	0.999
<i>Clanga clanga</i>	Greater Spotted Eagle	0.981	0.9958	0.999
<i>Hieraetus pennatus</i>	Booted Eagle	0.981	0.9958	0.999
<i>Aquila nipalensis</i>	Steppe Eagle	0.981	0.9958	0.999
<i>Aquila heliaca</i>	Imperial Eagle	0.981	0.9958	0.999
<i>Aquila chrysaetos</i>	Golden Eagle	0.981	0.9958	0.999

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Scientific Name	English Common Name	Lower bound value	Most realistic value	Upper bound value
<i>Aquila sp.</i>	Unidentified Eagle	0.981	0.9958	0.999
<i>Haliaeetus albicilla</i>	White-tailed Eagle	0.95	0.975	0.99775
<i>Falco cherrug</i>	Saker Falcon	0.995	0.998	0.999
<i>Anser anser</i>	Graylag Goose	0.98	0.998	0.999
<i>Cygnus olor</i>	Mute Swan	0.98	0.995	0.999
<i>Anas crecca</i>	Green-winged Teal	0.95	0.99	0.995
<i>Pterocles orientalis</i>	Black-bellied Sandgrouse	0.95	0.99	0.995
<i>Tetrax tetrax</i>	Little Bustard	0.95	0.99	0.995
<i>Anthropoides virgo</i>	Demoiselle Crane	0.95	0.99	0.995
<i>Grus grus</i>	Common Crane	0.95	0.99	0.995
<i>Vanellus vanellus</i>	Northern Lapwing	0.98	0.998	0.999
<i>Ciconia nigra</i>	Black Stork	0.95	0.99	0.995
<i>Plegadis falcinellus</i>	Glossy Ibis	0.95	0.99	0.995
<i>Ardea alba</i>	Great Egret	0.95	0.99	0.995
<i>Ardea cinerea</i>	Gray Heron	0.95	0.99	0.995
<i>Accipiter nisus</i>	Eurasian Sparrowhawk	0.99	0.995	0.999
<i>Circus aeruginosus</i>	Western Marsh Harrier	0.95	0.99	0.999
<i>Circus cyaneus</i>	Hen Harrier	0.95	0.99	0.999
<i>Circus macrourus</i>	Pallid Harrier	0.95	0.99	0.999
<i>Circus pygargus</i>	Montagu's Harrier	0.95	0.99	0.999
<i>Circus sp.</i>	Unidentified Harrier	0.95	0.99	0.999
<i>Milvus migrans</i>	Black Kite	0.98	0.992	0.9985
<i>Buteo buteo</i>	Common Buzzard	0.978	0.995	0.999
<i>Buteo rufinus</i>	Long-legged Buzzard	0.978	0.995	0.999
<i>Buteo hemilasius</i>	Upland Buzzard	0.978	0.995	0.999
<i>Buteo japonicus</i>	Eastern Buzzard	0.978	0.995	0.999
<i>Buteo sp.</i>	Unidentified Buzzard	0.978	0.995	0.999
<i>Falco naumanni</i>	Lesser Kestrel	0.873	0.969	0.999
<i>Falco tinnunculus</i>	Eurasian Kestrel	0.873	0.969	0.999
<i>Falco columbarius</i>	Merlin	0.995	0.998	0.999

Eagles in the genera *Aquila*, *Circaetus*, *Hieraetus*, and *Clanga*

Published estimates of CA were only available for Golden Eagle, so we used these CA values for all eagle species due to the similarity of these species in terms of size, shape, behavior, and flight morphology. The Golden Eagle (*Aquila chrysaetos*) has been the subject of several empirical research studies designed toward the objective of defining the most appropriate Collision Avoidance (CA) parameters for use with this species in modeling its risk of colliding with wind turbines, using the Band CRM. The low bound CA parameter value of 0.981 corresponds to the lowest CA value estimated for Golden Eagles in Whitfield and Madders, 2006a, based on their analysis of data from wind farms in California. This value is likely to be conservative, underestimating the true extent of Golden Eagles' avoidance of collisions with wind turbines, as Whitfield (2009) suggested that a CA parameter of 0.99 is "precautionary" for this species. The CA value selected as "most likely" for the present analysis, 0.9958, corresponds to the mean adjusted CA estimate for Golden Eagles at the Altamont Wind Facility in California, USA, presented by Whitfield (2009), and is very close to the median CA value for this species of 0.995, presented by Whitfield and Madders (2006a) and the value of 0.99 recommended by SNH (2018). The upper bound

CA value of 0.999 was selected based on the upper bound of 100% CA presented for Golden Eagles by Whitfield and Madders (2006a).

White-tailed Eagle

For the White-tailed Eagle (*Haliaeetus albicilla*), a species whose behavior around, and risk of collisions with wind turbines has been extensively studied at the Smøla Wind Farm in coastal Norway, we used the value of 0.95 CA recommended by SNH (2018) as a lower bound, with values of 0.975 and 0.99775 for the most realistic, and upper bound CA values, respectively, based on empirically derived CA parameter values presented in May et. al. (2011) on the basis of satellite telemetry studies conducted at the Smøla Wind Farm.

Dalmatian Pelican, Black Stork, Green-winged Teal, Sandgrouse, Bustards, Cranes, Glossy Ibis, and Herons

No published CA values were available for these species; hence we based our hypothesized CA values for this set of species on the recommendations of Cook et. al. (2012), who suggested using 0.95, 0.99, and 0.995 as a range of CA values to represent species for which no species-specific information is available. We note that these are all relatively large-bodied birds, and that this set of CA values is generally similar to, and a bit conservative in relation to CA values that have been empirically derived for a variety of morphologically similar species, such as swans, geese, and cormorants (Cook et. al. 2012).

Kestrels

We represented the CA value for Eurasian Kestrel (*Falco tinnunculus*) and Lesser Kestrel (*Falco naumanni*) in the model using a range of CA values developed for the congeneric American Kestrel (*Falco sparverius*) based on the analysis of Whitfield and Madders (2006a), with 0.873 representing the lower bound CA value, 0.969 representing the median value (close to the value of 0.95 recommended for kestrels by SNH [2018]), and 0.999 substituted for 1 (100% avoidance), as the upper bound CA value.

Merlin and Saker Falcon

No published CA values were available for these faster-flying species in the genus *Falco*. To fill this gap, we used values empirically derived by Whitfield and Madders (2006a) for the ecologically similar congeneric species, Prairie Falcon (*Falco mexicanus*), with 0.995 representing the low bound, 0.998 representing the median CA value, and 0.999 substituted for 1 (100% avoidance) as the upper bound.

Harriers (genus Circus)

We used published CA values empirically derived for the Hen Harrier (*Circus cyaneus*) to represent the collision avoidance tendencies of all *Circus* species observed during VP surveys at the GWEP. In their review of wind farm impacts to Hen Harriers, Whitfield and Madders (2006b) concluded that a CA value of 0.95, used by some authors for this species, was “too low,” suggesting that a value of 0.99 was “more realistic.” Accordingly, we used the value of 0.95 as a lower bound CA value, and 0.99 as our most likely value, also noting that SNH (2018) recommends using a value of 0.99 for Hen Harrier. We used a CA value of 0.999 as the upper bound for modeling harrier collision risk in our analysis, corresponding to the median CA value for *Circus cyaneus* presented in Whitfield and Madders (2006a).

Accipiter nisus

No published CA values were available for the Eurasian Sparrowhawk (*Accipiter nisus*). For the purpose of the modeling effort, we based our hypothesized CA values for this species on very limited data on susceptibility of *Accipiter* species (including *Accipiter nisus*) to wind farm collisions presented in Whitfield and Madders (2006a), as well as the results of Garvin et al. (2011), which indicated a very

strong tendency for *Accipiter* hawks to avoid collisions with wind turbines (100% avoidance), selecting CA values of 0.99, 0.995, and 0.999 to represent the low bound, most likely, and upper bound parameter estimates, respectively.

Hawks and Buzzards in the genus Buteo

No published CA values were available for the *Buteo* species observed during the VP surveys at the GWEP, hence we relied on CA values empirically derived for a congener, the Red-tailed Hawk (*Buteo jamaicensis*) by Whitfield and Madders (2006a), as follows: lower bound – 0.978; median value (or “most likely” in our analysis) – 0.995; upper bound – 0.999 (substituted for the value of 1, or 100% avoidance, presented as the upper bound CA value by Whitfield and Madders [2006a]).

Black Kite

To represent the CA parameter for the Black Kite (*Milvus migrans*), we used a series of published parameter estimates and recommendations that have been developed for the congeneric, and morphologically similar Red Kite (*Milvus milvus*). SNH (2010) recommends a CA value of 0.98 for Red Kite, and we used this as the lower bound CA value for Black Kite in our analysis. The value of 0.992 that we used as the most realistic CA parameter value is based on the empirical result of Urquhart and Whitfield (2016) for Red Kite. The upper bound value of 0.9985 is based on the data presented in Whitfield and Madders (2006a) regarding fatality rate in proportion to passage rates of Red Kites at wind farms.

Geese and Swans

For Greylag goose (*Anser anser*), we based the lower and middle CA values on guidance from SNH (2018), which recommends a CA value of 0.998 as a default value for geese, which we used as the most realistic value. Similarly, they present 0.995 as the most realistic CA value for all swans, hence this is the middle value we used for Mute swan. For the upper bound CA value for Mute swan, we chose 0.999, justified by a paper by Whitfield (2010), which found that swans collide with turbines less frequently than other at-risk birds. Given the morphological and ecological similarity of geese to swans, we use this upper bound CA value for geese as well.

Cinereous Vulture

To represent the CA values for this species, we used a range of values following the recommendations of Vasilakis et. al. (2016), who generated empirically-based estimates of 0.99 and 0.995 CA parameters for Cinereous Vulture in a study comparing flight behaviors and wind farm collision fatality rates at wind farms in eastern Mediterranean Europe. We used these two values as the median and upper bound CA values, respectively for this species. Vasilakis et. al. (2016) also suggested that the CA value for Cinereous Vulture could be as low as 0.98 taking into account potential sources of error and uncertainty in their analysis, hence we used this as our lower bound CA parameter value.

Lapwings

No published CA values were available for Sociable Lapwing (*Vanellus gregarius*) or Northern Lapwing (*Vanellus Vanellus*). Rather than apply the generic values for large-bodied birds used above, the CA values for Lapwings were based on empirically-derived values from a study by Gittings (2022) on avoidance rates for Golden Plovers at Ballivor wind farm. This is more likely to represent a realistic CA value for Lapwings because the species are behaviorally and morphologically similar and closely related to Golden Plover.

Results and Interpretation

The results of the CRM analysis for the year-round VP surveys at the GWEP are summarized in Tables 9-13. Overall, the seasonal and year-round impacts to all target species at the GWEP area are low. Of the primary target species, Dalmatian Pelican (*Pelecanus crispus*) was at the highest risk, with one collision predicted every 3 years under the most realistic CA value scenario, occurring primarily in winter. However, this estimate is low enough to suggest that biologically significant collision impacts for Dalmatian Pelicans are not likely at the GWEP site. Steppe Eagle (*Aquila nipalensis*) had the second highest risk, with one collision predicted every 14 years. In spite of the low predicted collision risk, we note that the relatively large number of flights of Steppe Eagle recorded at the site (262) indicates that collision risk for this species could be a significant risk factor for the Project, but we also note that the low collision risk prediction resulted from the relatively direct and short-duration of this species' autumn migratory transit flights over the site, as well as the high altitude of many such flights. All other primary target species are expected to experience fewer than one collision every 140 years under the most realistic CA value scenario.

Predicted risk for secondary species was similarly low, with the highest risk species (Green-winged Teal; *Anas crecca*) expected to generate 1.83 collisions per year under the most realistic CA value scenario, primarily during autumn migration. The two other species expected to generate roughly one collision per 5 years are Graylag Goose (*Anser anser*) and Western Marsh Harrier (*Circus aeruginosus*), closely followed by Eurasian Kestrel (*Falco tinnunculus*), with one predicted collision every 5.48 years. We note that all four of these secondary species are widespread and abundant species with no elevated conservation status, hence predicted collision levels would not be expected to generate biologically significant impacts.

Table 9: Estimated rates of collisions per **spring** season for target bird species at the Gijduvon Wind Energy Project, predicted by Band Collision Risk Modeling analysis, under a range of Collision Avoidance (CA) parameter values (see Table 8 for specific CA values for each species, and see text for explanation and justification of each).

English Common Name	Using lower bound CA value		Using most realistic CA value		Using upper bound CA value	
	Collisions/spring	Springs to 1 collision	Collisions/spring	Springs to 1 collision	Collisions/spring	Springs to 1 collision
Dalmatian Pelican	0.0355	28.1	0.00711	140	0.00356	281
Short-toed Snake-Eagle	0	n/a	0	n/a	0	n/a
Steppe Eagle	0.00370	270	0.000817	1220	0.000194	5140
Imperial Eagle	0.00224	447	0.000494	2020	0.000118	8490
Graylag Goose	2.22	<1	0.222	4.51	0.111	9.02
Mute Swan	0.0154	64.7	0.00386	259	0.000772	1290
Black-bellied Sandgrouse	0	n/a	0	n/a	0	n/a
Demoiselle Crane	0	n/a	0	n/a	0	n/a
Glossy Ibis	0	n/a	0	n/a	0	n/a

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English Common Name	Using lower bound CA value		Using most realistic CA value		Using upper bound CA value	
	Collisions/spring	Springs to 1 collision	Collisions/spring	Springs to 1 collision	Collisions/spring	Springs to 1 collision
Eurasian Sparrowhawk	0.0103	97.3	0.00514	194	0.00103	973
Western Marsh Harrier	0.895	1.11	0.179	5.58	0.0179	55.8
Hen Harrier	0.255	3.92	0.0510	19.6	0.00510	196
Pallid Harrier	0	n/a	0	n/a	0	n/a
Montagu's Harrier	0	n/a	0	n/a	0	n/a
Unidentified Harrier	0	n/a	0	n/a	0	n/a
Black Kite	0	n/a	0	n/a	0	n/a
Common Buzzard	0.0133	75.0	0.00303	330	0.000606	1650
Long-legged Buzzard	0.0314	31.8	0.00714	139	0.00143	699
Eastern Buzzard	0	n/a	0	n/a	0	n/a
Unidentified Buzzard	0.0189	52.9	0.00429	233	0.000858	1160
Lesser Kestrel	0.171	5.84	0.0418	23.9	0.00135	742
Eurasian Kestrel	0.292	3.42	0.0713	14.0	0.00230	434

Table 10: Estimated rates of collisions per **summer** season for target bird species at the Gijduvon Wind Energy Project, predicted by Band Collision Risk Modeling analysis, under a range of Collision Avoidance (CA) parameter values (see Table 8 for specific CA values for each species, and see text for explanation and justification of each).

English Common Name	Using lower bound CA value		Using most realistic CA value		Using upper bound CA value	
	Collisions/summer	Summers to 1 collision	Collisions/summer	Summers to 1 collision	Collisions/summer	Summers to 1 collision
Green-winged Teal	0.152	6.56	0.0305	32.8	0.0152	65.6
Black-bellied Sandgrouse	0	n/a	0	n/a	0	n/a
Black Stork	0.00991	100	0.00198	504	0.000991	1000
Great Egret	0	n/a	0	n/a	0	n/a
Gray Heron	0	n/a	0	n/a	0	n/a
Eurasian Sparrowhawk	0	n/a	0	n/a	0	n/a
Western Marsh Harrier	0	n/a	0	n/a	0	n/a
Common Buzzard	0	n/a	0	n/a	0	n/a
Eurasian Kestrel	0	n/a	0	n/a	0	n/a

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Table 11: Estimated rates of collisions per **autumn** season for bird species at the Gijduvon Wind Energy Project, predicted by Band Collision Risk Modeling analysis, under a range of Collision Avoidance (CA) parameter values (see Table 8 for specific CA values for each species, and see text for explanation and justification of each).

English Common Name	Using lower bound CA value		Using most realistic CA value		Using upper bound CA value	
	Collisions/autumn	Autumns to 1 collision	Collisions/autumn	Autumns to 1 collision	Collisions/autumn	Autumns to 1 collision
Short-toed Snake-Eagle	0.00136	736	0.000300	3330	0.0000715	13900
Booted Eagle	0.00806	124	0.00178	561	0.000424	2350
Steppe Eagle	0.225	4.44	0.0498	20	0.0119	84.3
Imperial Eagle	0.00329	304	0.000727	1370	0.000173	5770
Golden Eagle	0.00128	782	0.000282	3540	0.0000672	14800
Saker Falcon	0	n/a	0	n/a	0	n/a
Graylag Goose	0	n/a	0	n/a	0	n/a
Green-winged Teal	9.02	<1	1.80	<1	0.902	1.10
Black-bellied Sandgrouse	0.509	1.96	0.102	9.82	0.0509	19.6
Little Bustard	0	n/a	0	n/a	0	n/a
Demoiselle Crane	0.895	1.11	0.179	5.58	0.0895	11.1
Common Crane	0	n/a	0	n/a	0	n/a
Northern Lapwing	0	n/a	0	n/a	0	n/a
Great Egret	0	n/a	0	n/a	0	n/a
Gray Heron	0	n/a	0	n/a	0	n/a
Eurasian Sparrowhawk	0	n/a	0	n/a	0	n/a
Western Marsh Harrier	0	n/a	0	n/a	0	n/a
Hen Harrier	0	n/a	0	n/a	0	n/a
Pallid Harrier	0	n/a	0	n/a	0	n/a
Common Buzzard	0.0326	30.6	0.00741	134	0.00148	674
Long-legged Buzzard	0.146	6.84	0.0332	30.1	0.00664	150
Upland Buzzard	0	n/a	0	n/a	0	n/a
Lesser Kestrel	0.212	4.72	0.0517	19.3	0.00167	599
Eurasian Kestrel	0	n/a	0	n/a	0	n/a
Merlin	0	n/a	0	n/a	0	n/a

Gijduvon Wind Year-round Collision Risk Modeling Report

Table 12: Estimated rates of collisions per **winter** season for bird species at the Gijduvon Wind Energy Project, predicted by Band Collision Risk Modeling analysis, under a range of Collision Avoidance (CA) parameter values (see Table 8 for specific CA values for each species, and see text for explanation and justification of each).

English Common Name	Using lower bound CA value		Using most realistic CA value		Using upper bound CA value	
	Collisions/winter	Winters to 1 collision	Collisions/winter	Winters to 1 collision	Collisions/winter	Winters to 1 collision
Asian Houbara	0	n/a	0	n/a	0	n/a
Sociable Lapwing	0	n/a	0	n/a	0	n/a
Dalmatian Pelican	1.53	<1	0.306	3.27	0.153	6.54
Cinereous Vulture	0.000577	1730	0.000288	3460	0.000144	6930
Short-toed Snake-Eagle	0.00868	115	0.00192	521	0.000457	2180
Greater Spotted Eagle	0.00175	572	0.000386	2590	0.0000919	10800
Steppe Eagle	0.0814	12.2	0.0180	55.5	0.00429	233
Imperial Eagle	0.00780	128	0.00173	579	0.000411	2430
Golden Eagle	0	n/a	0	n/a	0	n/a
Unidentified Eagle	0.00370	270	0.000818	1220	0.000195	5130
White-tailed Eagle	0.00414	241	0.00207	483	0.000186	5370
Graylag Goose	0.0296	33.7	0.00296	337	0.00148	675
Mute Swan	0	n/a	0	n/a	0	n/a
Black-bellied Sandgrouse	0	n/a	0	n/a	0	n/a
Common Crane	0	n/a	0	n/a	0	n/a
Eurasian Sparrowhawk	0	n/a	0	n/a	0	n/a
Western Marsh Harrier	0.372	2.68	0.0744	13.4	0.00744	134
Hen Harrier	0.0519	19.2	0.0104	96.2	0.00104	962
Pallid Harrier	0	n/a	0	n/a	0	n/a
Black Kite	0	n/a	0	n/a	0	n/a
Long-legged Buzzard	0.313	3.19	0.0711	14.0	0.0142	70.3
Eurasian Kestrel	0.455	2.19	0.111	9.00	0.00358	279
Merlin	0	n/a	0	n/a	0	n/a

Gijduvon Wind Year-round Collision Risk Modeling Report

Table 13: Estimated rates of collisions per **year** for bird species at the Gijduvon Wind Energy Project, predicted by Band Collision Risk Modeling analysis, under a range of Collision Avoidance (CA) parameter values (see Tables 9-12 for predicted seasonal collision rates; see Table 8 for specific CA values for each species, and see text for explanation and justification of each).

English Common Name	Using lower bound CA values for each season		Using most realistic CA values for each season		Using upper bound CA values for each season	
	Collisions/cycle	Years to 1 collision	Collisions/cycle	Years to 1 collision	Collisions/cycle	Years to 1 collision
Asian Houbara	0	n/a	0	n/a	0	n/a
Sociable Lapwing	0	n/a	0	n/a	0	n/a
Dalmatian Pelican	1.56	<1	0.313	3.19	0.156	6.39
Cinereous Vulture	0.000577	1730	0.000288	3460	0.000144	6930
Short-toed Snake-Eagle	0.0100	99.6	0.00222	450	0.000528	1890
Greater Spotted Eagle	0.00175	572	0.000386	2590	0.0000919	10800
Booted Eagle	0.00806	124	0.00178	561	0.000424	2350
Steppe Eagle	0.310	3.22	0.0686	14.5	0.0163	61.2
Imperial Eagle	0.0133	75.0	0.00295	339	0.000701	1420
Golden Eagle	0.00128	782	0.000282	3540	0.0000672	14800
Unidentified Eagle	0.00370	270	0.000818	1220	0.000195	5130
White-tailed Eagle	0.00414	241	0.00207	483	0.000186	5370
Saker Falcon	0	n/a	0	n/a	0	n/a
Graylag Goose	2.25	<1	0.225	4.45	0.112	8.90
Mute Swan	0.0154	64.7	0.00386	259	0.000772	1290
Green-winged Teal	9.18	<1	1.84	<1	0.918	1.08
Black-bellied Sandgrouse	0.509	1.96	0.102	9.82	0.0509	19.6
Little Bustard	0	n/a	0	n/a	0	n/a
Demoiselle Crane	0.895	1.11	0.179	5.58	0.0895	11.1
Common Crane	0	n/a	0	n/a	0	n/a
Northern Lapwing	0	n/a	0	n/a	0	n/a
Black Stork	0.00991	100	0.00198	504	0.000991	1000
Glossy Ibis	0	n/a	0	n/a	0	n/a
Great Egret	0	n/a	0	n/a	0	n/a
Gray Heron	0	n/a	0	n/a	0	n/a
Eurasian Sparrowhawk	0.0103	97.3	0.00514	194	0.00103	973
Western Marsh Harrier	1.27	<1	0.253	3.94	0.0253	39.4

Gjduvon Wind Year-round Collision Risk Modeling Report

English Common Name	Using lower bound CA values for each season		Using most realistic CA values for each season		Using upper bound CA values for each season	
	Collisions/cycle	Years to 1 collision	Collisions/cycle	Years to 1 collision	Collisions/cycle	Years to 1 collision
Hen Harrier	0.307	3.25	0.0614	16.2	0.00614	162
Pallid Harrier	0	n/a	0	n/a	0	n/a
Montagu's Harrier	0	n/a	0	n/a	0	n/a
Unidentified Harrier	0	n/a	0	n/a	0	n/a
Black Kite	0	n/a	0	n/a	0	n/a
Common Buzzard	0.0460	21.7	0.0104	95.7	0.00209	478
Long-legged Buzzard	0.490	2.03	0.111	8.97	0.0223	44.8
Upland Buzzard	0	n/a	0	n/a	0	n/a
Eastern Buzzard	0	n/a	0	n/a	0	n/a
Unidentified Buzzard	0.0189	52.9	0.00429	233	0.000858	1160
Lesser Kestrel	0.383	2.61	0.0934	10.7	0.00301	331
Eurasian Kestrel	0.747	1.33	0.182	5.48	0.00588	170
Merlin	0	n/a	0	n/a	0	n/a

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14. MAMMAL AND PHOTOTRAPPING SURVEY REPORT



Mammal Report

Gijduvan Wind Power Project in the Republic of Uzbekistan

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1. Introduction

The report presents the findings of a field and desktop survey of mammal's fauna in the context of a proposed 300 MW Wind Farm project in the Gijduvon region of Bukhara Province, Uzbekistan. The aim of the survey is to conduct a detailed assessment of mammal species present in the area, particularly emphasizing the identification of threatened species. The report outlines the study area, survey methodology, and provides an analysis of the mammal composition and faunal complexes within the project area.

2. Study Area Description

The territory of the project sites is located in the southern part of the Central Kyzylkum desert, in close proximity to the Ayak-Agitma depression. This is an alluvial plain with a sloping gravelly layer of surface (Figure 6 1) and sandy desert (Figure 2). The entire project area is notably arid. Most of the territory intersects with the Gijduvan forestry area. Tree and shrub vegetation is represented by Calligonum and Saxaul (Figure 4). Southern part of the site located in agricultural land (Figure 5).



Figure 1. Alluvial habitat of Project area



Figure 2. Sandy habitat of Project area



Figure 3. Ayakagitma collector



Figure 4. Gijduvan foresty



Figure 5. Agricultural land

3. Materials and methods

The methodology employed for assessing the species and quantitative diversity of mammals in the project area involved visual censuses at 10 survey points within the project area from April 1 to April 12, 2024.

At each observation point (MS), colonies and burrows of rodents were visually counted within a 250-meter radius, with the counts recalculated to estimate population density per hectare (Figure 6). This technique is widely used to assess the population density of mouse-like rodents in natural plague foci in Central Asia (Kucheruk, 1952, 1963). Additionally, single burrows of jerboas, yellow ground squirrels, and predatory mammals were recorded, along with visual encounters with mammals.

Table 1 shows the coordinates of points and landscape characteristics in the Wind Farm area.

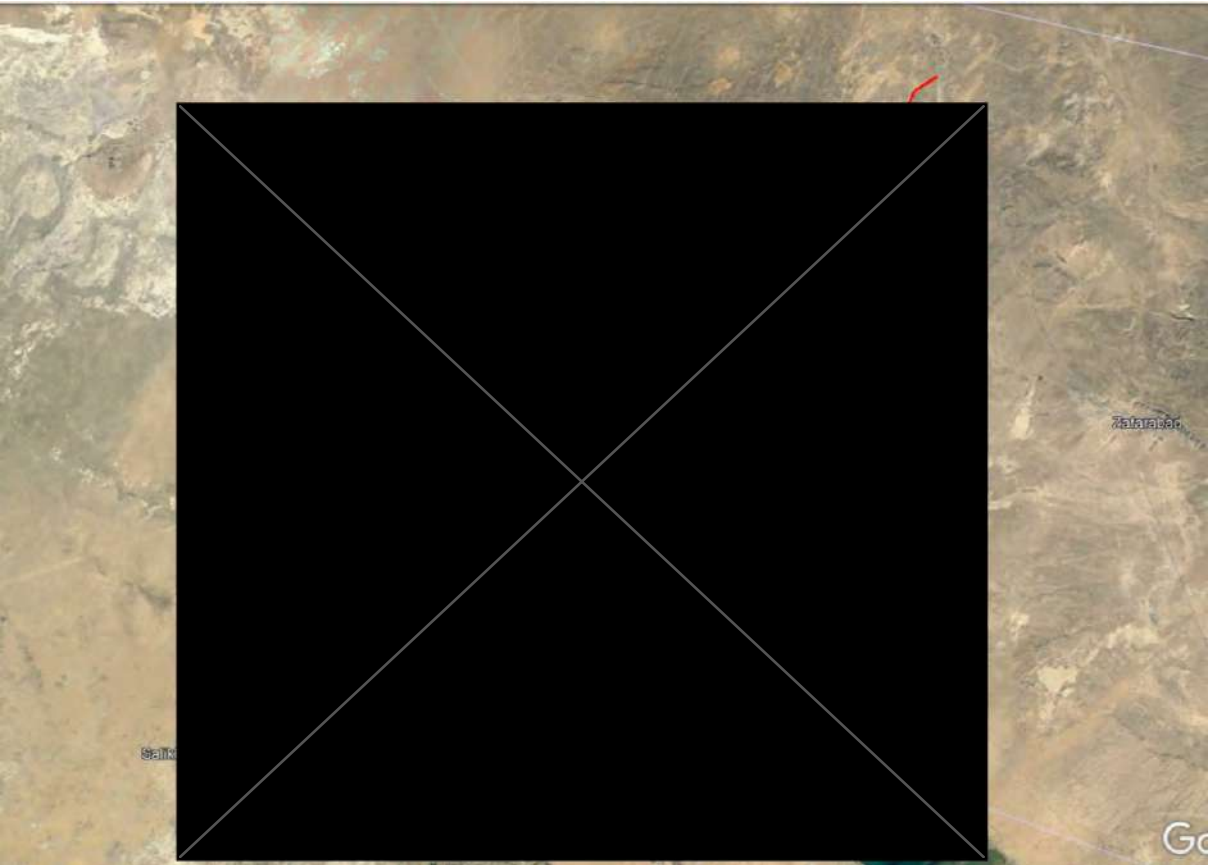
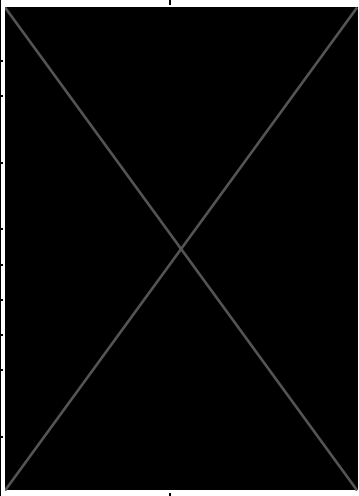


Figure 6. Location of the observation points on the Project territory and the survey track

Table 1: Survey points on Wind Farm area

No	Name of point	N (dd format)	E (dd format)	Biotope
1	MS-1			Access road, Rubbly-sandy desert with shrub vegetation
2	MS-2			Rubbly-sandy desert with shrub vegetation
3	MS-3			Rubbly-sandy desert with shrub vegetation and outcrops of salt marshes and takys
4	MS-4			Rubbly-sandy desert with shrub vegetation and outcrops of salt marshes and takys
5	MS-5			Agricultural field along the canal Ayak-Agitma
6	MS-6			Ephemeral scrub desert
7	MS-7			Wetland scrub semi-desert
8	MS-8			Wetland scrub semi-desert
9	MS-9			Rubbly-sandy desert with shrub vegetation and outcrops of salt marshes and takys
10	MS-10			Access road, Agricultural field along the canal Ayak-Agitma

Special work was carried out to analyze species based on the composition of Little owl pellets (Figure 7). The composition of small mammal communities is almost universally assessed using conventional trapping, which is logistically difficult to scale up for landscape-level assessments. Owl pellets may be a more effective alternative for measuring small mammal community composition over large geographic areas due to the relative ease and cost of field collection (Heisler, 2016). This method is commonly used to study small mammal fauna in Uzbekistan's arid conditions (Mitropolskiy et al., 2018).



Figure 7. Little owl at the Project site for collect pellets

4. Mammals' composition and faunal complexes

Zoogeographically, the study area belongs to the faunal complex of the Iranian-Turanian community of the Palearctic province (Kostin, 1961). Therefore, the most characteristic representatives of the fauna are steppe species of vertebrates. However, the presence of nearby reservoirs (Shorkul Reservoir and Lake Ayakagitma) introduces hydrophilic species (Golden Jackal and Asian badger) into the fauna. The core of the complex consists of typical rodents like the Tolai hare, Yellow ground squirrel, Severtsov's jerboa, Libyan Gerbil and others, and predatory mammals: Fox, Steppe cat, and Weasel.

The mammal fauna recorded at the project area is 29 species (Table 2), which is 27.1% of the total mammalian fauna of Uzbekistan, according to the literature data and archival materials of the author.

Among terrestrial vertebrates, priority for protection is given to globally threatened species and subspecies subject to significant anthropogenic impacts, as well as species for which Uzbekistan has signed international Agreements and Memorandums. Such species in the project area include: Goitered Gazelle (IUCN – VU status) and Brandt's Hedgehog and Corsac fox are included in the Red Book of the Republic of Uzbekistan (2019), 2 species are included in the Annexes of the Convention on International Trade in Species of Fauna and Flora, and 1 species - in the Convention on the Conservation of Migratory Species of Wild Animals.

Table 2: List of mammal species potentially inhabiting the project territory

No.	Scientific name	English name	IUCN 1status	UzSPB ²	Status in Conventions
1	<i>Hemiechinus auritus</i>	Long-eared Hedgehog			
2	<i>Hemiechinus hypomelas</i>	Brandt's Hedgehog	LC	3 (NT)	
3	<i>Suncus etruscus</i>	Etruscan Shrew			
4	<i>Crociodura suaveolens</i>	Lesser Shrew			
5	<i>Myotis mystacinus</i>	Whiskered Bat			
6	<i>Nyctalus noctula</i>	Noctule			
7	<i>Pipistrellus pipistrellus</i>	Common Pipistrelle			
8	<i>Eptesicus serotinus</i>	Serotine			
9	<i>Lepus tolai</i>	Tolai Hare			
10	<i>Spermophilus fulvus</i>	Yellow Ground Squirrel			
11	<i>Allactaga elater</i>	Small Five-toed Jerboa			
12	<i>Allactaga severtzovi</i>	Severtsov's Jerboa			
13	<i>Dipus sagitta</i>	Northern Three-toed Jerboa			
14	<i>Cricetulus migratorius</i>	Grey Hamster			
15	<i>Ellobius tancrei</i>	Zaisan Mole Vole			
16	<i>Microtus buharensis</i>	Bucharian Vole			
17	<i>Meriones libycus</i>	Libyan Gerbil			
18	<i>Meriones meridianus</i>	Midday Gerbil			
19	<i>Meriones tamariscinus</i>	Tamarisk Gerbil			
20	<i>Rhombomys opimus</i>	Great Gerbil			
21	<i>Mus musculus</i>	House Mouse			
22	<i>Canis aureus</i>	Golden Jackal			
23	<i>Vulpes corsac</i>	Corsac Fox	LC	2 (VU:D)	
24	<i>Vulpes vulpes</i>	Fox			
25	<i>Mustela nivalis</i>	Weasel			

¹ IUCN - species included in the Red List of Threatened Species of the International Union for Conservation of Nature

² UzRDB - the species/subspecies is listed in the Red Data Book of the Republic of Uzbekistan (2019)

26	<i>Meles leucurus</i>	Asian badger			
27	<i>Felis lybica</i>	Steppe Cat			Cites II ³
28	<i>Felis chaus</i>	Chaus Cat			Cites II
29	<i>Gazella subgutturosa</i>	Goitered Gazelle	VU	2 (VU:D)	Cites II, CMS ⁴ II

5. Findings and Results

The study revealed a rich and diverse fauna, with 16 out of an estimated 29 mammal species observed, representing a 55.2%. Among the notable findings was the presence of two rare species: Brandt's Hedgehog (*Hemiechinus hypomelas*) and the Goitered Gazelle (*Gazella subgutturosa*).

The survey also captured evidence of species that are vitally associated with water sources such as the Golden Jackal (*Canis aureus*) and Asian Badger (*Meles leucurus*) using camera traps, complementing visual track surveys. These sightings emphasize the importance of water resources in the area. The regular encounters with the Northern Mole Vole (*Ellobius tancrei*) suggest good soil moisture, likely due to water channels along the perimeter of the territory.

Tables 3 present a comprehensive overview of mammal observations across ten monitoring sites (MS-1 to MS-10). The Tolai Hare (*Lepus tolai*) and Red Fox (*Vulpes vulpes*) were found to be widespread, with the present at all ten sites.

Of particular interest was the observation of Goitered Gazelle tracks at two sites (MS-2, MS-6), due to its IUCN Vulnerable (VU) status and general rarity in this region.

³ **CITES II** – a species included in Appendix (I , II) of the Convention on International Trade in Endangered Species of Fauna and Flora

⁴ **CMS II** – species included in Appendix (I , II) of the Bonn Convention

Table 3. Mammal survey (April 2024)

No.	Scientific name	MS-1	MS-2	MS-3	MS-4	MS-5	MS-6	MS-7	MS-8	MS-9	MS-10
1	<i>Hemiechinus auritus</i>	Carcass							Carcass		
2	<i>Hemiechinus hypomelas</i>		Carcass				Track				
3	<i>Lepus tolai</i>	Tracks	Tracks		Tracks	Tracks	Tracks	1	Tracks	1	
4	<i>Spermophilus fulvus</i>		1	Borrows	2	Borrows		Borrows	Borrows	Borrows	1
5	<i>Allactaga sevetsovi</i>		Borrow				Borrow				
6	<i>Allactaga elater</i>					Borrow				Borrow	Borrow
7	<i>Cricetulus migratorius</i>		Borrow			Borrow					Borrow
8	<i>Ellobius tancrei</i>	1-2 tw ⁵ /ga	1-2 tw/ga	3-4 tw/ga		1-2 tw/ga	4-5 tw/ga	3-4 tw/ga	3-4 tw/ga		
9	<i>Rhombomys opimus</i>						1-2 col/ga	1-2 col/ga			
10	<i>Meriones meridianus</i>	1-2 col ⁶ /ga	1-2 col/ga			1-2 col/ga	1-2 col/ga		1-2 col/ga		1-2 col/ga
11	<i>Meriones tamariscinus</i>				Borrows			Borrows	Borrows		
12	<i>Vulpes vulpes</i>	Tracks	1	Tracks	1	Tracks	Tracks	Tracks	1	Tracks	Tracks
13	<i>Canis aureus</i>				Tracks	Tracks		Tracks			
14	<i>Meles leucurus</i>				Track			Track	Track		
15	<i>Felis lybica</i>	Track		Track		Track		Tracks	Track	Track	
16	<i>Gazella subgutturosa</i>		Track				Track				

⁵ col/ga - number of colonies* per 1 ha; tw/ga - number of towns* per 1 ha

Difference: Colonies have burrows, towns do not have open burrows for most of the year, and on the ground, they look like clods of soil.



Figure 8. Skill of *Hemiechinus hypomelas* at MS-02 (10.04.2024)



Figure 9. *Spermophilus fulvus* at MS-10 (08.04.2024)



Figure 10. *Meriones meridianus* at MS-05 (08.04.2024)



Figure 11. Borrow *Allactaga sevetsovi* at MS-06 (10.04.2024)



Figure 12. Towns of *Ellobius tancrei* at MS-01 (09.04.2024)



Figure 13. Towns of *Ellobius tancrei* at MS-07 (09.04.2024)



Figure 14. Red fox (*Vulpes vulpes*)



Figure 15. Wildcat (*Felis lybica*)



Figure 16. Golden jackal (*Canis aureus*)



Figure 17. Asian badger (*Meles leucurus*)

The construction of a wind park will have an impact on the fragmentation of habitats for rare species, among which the most significant are described in the next chapter.

6. Key species descriptions

Brandt's Hedgehog (*Hemiechinus hypomelas*) sporadically inhabits species, including in the latest edition of the Red Book (Kashkarov, 2019). This species has been recorded in the project area. There are no direct threats to the species (Zaytsev et al., 2014), but during construction work, the development of a network of dirt roads and lighting of the territory used by animals to catch food can lead to the death of animals under the wheels of vehicles.

Zaisan Mole Vole (*Ellobius tancrei*) lives in most areas along wetlands as well as among wet depressions in the natural landscape (Minin, 1938). The species is a good indicator of natural habitats (Mardonova et al., 2022). The presence of the species can be easily assessed by characteristic outliers of land (small towns), which can be used after construction work as an assessment of the level of transformation of the territory.

Goitered Gazelle widely inhabits the desert zone of the southern part of the Central Kyzylkum desert. Encounters are quite regular, but most often on slings and droppings, because due to pressure from poachers, the species leads a very reserved and hidden lifestyle (Marmazinskaya, 2019). Only old tracks of this species were found in the southern section. It is necessary to preserve the possibility of free passage of gazelles to water sources.

7. Conclusion

Summary of the overall theriofauna conditions in the study area

In zoogeographical terms, the study area belongs to the faunal complex of the Iranian-Turanian community of the Palearctic province (Kostin, 1961).

The mammal fauna recorded at project area is 29 species (Table 2), which is 27.1% of the total mammalian fauna of Uzbekistan, according to the literature data and archival materials of the author.

Among terrestrial vertebrates, priority for protection is given to globally threatened species and subspecies subject to significant anthropogenic impacts, as well as species for which Uzbekistan has signed international Agreements and Memorandums. Such species in the project area include: Goitered Gazelle (IUCN – VU status) and Brandt's Hedgehog and Corsac fox are included in the Red Book of the Republic of Uzbekistan (2019), 2 species - in the Annexes of the Convention on International Trade in Species of Fauna and Flora, 1 species - in the Convention on the Conservation of Migratory Species of Wild Animals.

Summary information about the Mammal survey and its findings.

During the field survey, 16 species of mammals were noted, which is 55.2% of the total list of potentially inhabiting species on the project territory. Among them were 2 species from the Red Book of Uzbekistan, 1 species from the IUCN List, and 1 species from the lists of the CITES Convention.

No conservation measures are required for the typical and most widespread species.

In general, for the project, the creation of unnecessary access roads for vehicles is not allowed; the choice of laying dirt roads should avoid rodent borrows, all roads should be illuminated; speed limits should be observed, and watered regularly to avoid the accumulation and dispersion of dust. These measures will contribute to the conservation of mammals.

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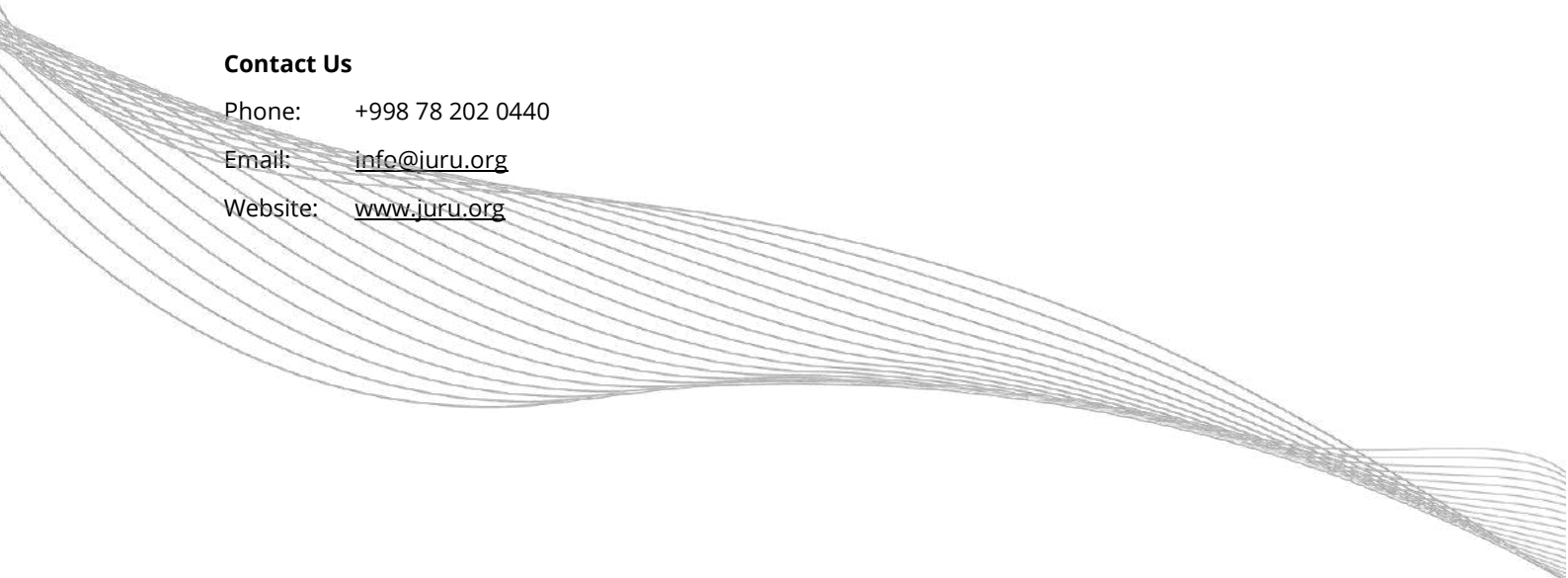
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15. REPTILE AUTUMN SURVEY REPORT



Reptile Report

Autumn 2024

**Environmental and Social Impact Assessment (ESIA)
for Gijduvan 300 MW Wind Farm in
Bukhara District, Uzbekistan**

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1. Introduction

The purpose of this report is to evaluate herpetofauna diversity within the project area as an important component of the biodiversity surveys. The project involves the development of a 300MW Wind Farm. This includes a Wind Turbine Generator (WTG) polygon covering approximately 13,645 hectares and an associated 24.9 km Overhead Transmission Line (OTL) (Figure 1).



Figure 1. Project features

The objectives of the survey conducted in September 2024 were to assess the overall condition of reptile habitats within the study area, document species composition and density, and map territorial distribution, including areas of concentration. To achieve these objectives, the assessment utilized a combination of field surveys and desktop analysis methodologies.

2. Study area

The study area is located in the Kyzylkum Desert within Bukhara Province, Uzbekistan. This region is characterized by an arid climate and a diverse desert ecosystem. The Kyzylkum Desert is one of Central Asia's largest deserts, renowned for its unique fauna, which has adapted to harsh environmental conditions.

Within the project area, four primary habitat types have been identified:

1. **Fixed and semi-fixed sands with Saxaul plantations.** This habitat dominates the central and northwestern parts of the project area. Saxaul trees (genus *Haloxylon*), which are well-

adapted to desert conditions, play a crucial role in stabilizing sand dunes. The most reptile-populated habitats are associated with semifixed sand dunes. The species recorded in this habitat include *Eremias grammica*, *Eremias scripta*, *Eremias velox*, *Phrynocephalus mystaceus*, *Trapelus sanguinolentus*, *Varanus griseus caspius*, *Eryx milliaris*, *Teratoscincus scincus*, and *Crossobamon eversmanni*.

2. **Sandy-loam-gravel plains.** These areas, found on the periphery of the project site, exhibit varying degrees of vegetation cover and are characterized by sandy loam mixed with gravel.
3. **Saline depressions and irrigation network areas.** These lower-lying regions feature saline soils with typical vegetation, notably *Tamarix*, which are associated with saline conditions.
4. **Modified farmland.** The southeastern portion of the project area has been significantly altered by agricultural activities. This anthropogenic habitat type introduces distinct ecological conditions and different potential wildlife interactions compared to the more natural desert habitats.

3. Materials and methods

A field survey was conducted from September 14–16, 2024, by herpetologist Dr. Roman Nazarov to assess the status of reptile populations within the study area.

The research methodology focused on two main objectives:

- Documenting species composition in the study area.
- Determining species distribution across identified habitats.

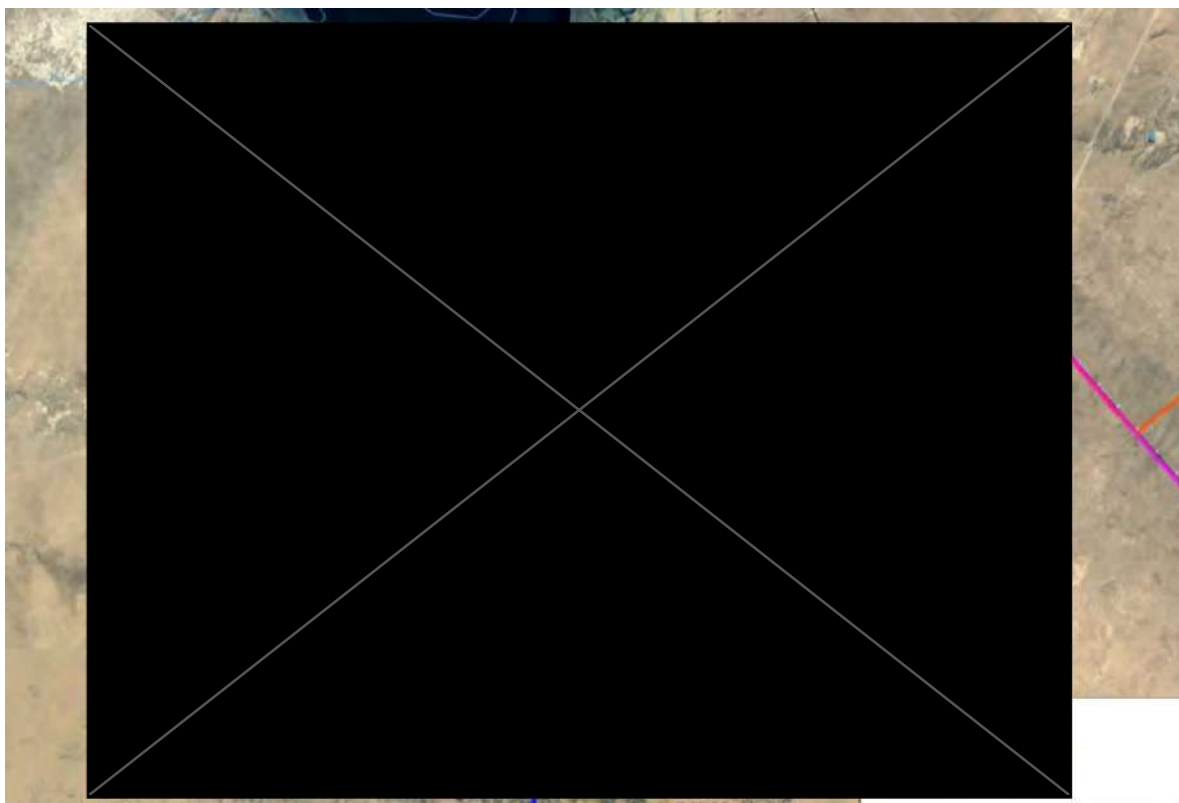


Figure 2. Reptile survey tracks (September 14-16, 2024)

The survey employed standardized zoological methods for species identification, following established guidelines by L. G. Dinesman, M. L. Kaletskaya (1952), V. M. Makeev, A. T. Bozhansky (1988), and D. A. Bondarenko, N. G. Chelintsev (1996). Population density estimations were conducted using the line transect method in representative habitats. For diurnal species, varying census band

widths were employed. Perpendicular distances from the transect line to each individual reptile were recorded to calculate the mean detection distance ($\bar{y}$) and effective census band width (**B**). Population density (**D**) per hectare was calculated using the formula:

$$D = \frac{N}{2BL}; \quad B = \frac{\pi}{2} \bar{y}; \quad \bar{y} = \frac{1}{n} \sum_{i=1}^n y_i,$$

Where **N** is the total number of individual reptiles, **n** is the number of individuals with measured detection distances, and **L** is the route length.

The accuracy of this methodology has been confirmed by comparative analysis across various survey methods (Bondarenko, Chelintsev, 1996). It has been successfully employed in multiple desert reptile species surveys (Bondarenko, 1994; Bondarenko et al., 2008; Bondarenko, Peregontsev, 2018). Mean population densities, along with standard errors ($M \pm SE$), were calculated based on the results of several route sections of similar length.

Equipment Used:

- Infrared thermometer (PE-1 Infrared Temp Gun) for substrate temperature measurements.
- Headlamps for nocturnal surveys.
- Standard field equipment (notebooks, GPS devices, cameras, and measuring tools).

Survey Conditions

Diurnal censuses were conducted in favorable weather conditions—sunny skies, low wind, and no precipitation. Surveys began during peak lizard activity and concluded when lizards retreated from the heat. Substrate temperatures were periodically recorded using an infrared thermometer.

Nocturnal species density estimates were performed using headlamps, with a fixed census band width. The *Teratoscincus* genus was easily identifiable from distances over 100 meters due to the red reflection of light from their eyes. However, the use of wide census bands can underestimate species occurrence. Therefore, the census band for *Teratoscincus* was limited to 35 meters near WTG 5, based on terrain and vegetation cover. Reptiles observed outside the census band were excluded from the analysis. For species like *Crossobamon eversmanni*, a narrower census band of 2 meters was used, as the sand surface near the roots of bushes required closer inspection.

This quantitative assessment method was tailored to the ecology of the species under study, the landscape and geographic conditions, the season, and the type of work being conducted.

4. Findings and Results

Based on literature data and previous observations, a comprehensive list of reptile species potentially occurring in the project area was compiled (Table 1). To verify and update this information, a field survey was conducted over three days and one night, covering approximately 30 km of survey routes.

Table 1. A list of reptile species that may potentially inhabit the project site

	Species	Common name	IUCN RL	Uzbekistan Red data book
	Testudinidae			
1	<i>Testudo horsfieldii</i>	Central Asian tortoise	VU	VU
	Agamidae			
2	<i>Trapelus sanguinolentus</i>	Steppe agama	LC	LC
3	<i>Phrynocephalus mystaceus</i>	Toad-headed agama	LC	LC
4	<i>Phrynocephalus helioscopus</i>	Sunwatcher toadhead agama	LC	LC
5	<i>Phrynocephalus reticulatus</i>	Reticulated toad-headed agama	LC	LC
	Gekkota			
6	<i>Alsophylax laevis</i>	Southern even-fingered gecko	CR	2 (VU:D)
7	<i>Teratoscincus scincus</i>	Common Wonder Gecko	LC	LC
8	<i>Crossobamon eversmanni</i>	Comb-toed Gecko	LC	LC
9	<i>Mediodactylus russowii</i>	Transcaspian Bent-Toed Gecko	LC	LC
	Lacertidae			
10	<i>Eremias grammica</i>	Reticulate racerunner	LC	LC
11	<i>Eremias velox</i>	Rapid racerunner	LC	LC
12	<i>Eremias scripta</i>	Sand Racerunner	LC	LC
13	<i>Eremias intermedia</i>	Aralo-Caspian racerunner	LC	LC
	Scincidae			
14	<i>Ablepharus desertii</i>	Desert Lidless Skink	LC	LC
	Varanidae			
15	<i>Varanus griseus</i>	Desert monitor	LC	2 (VU:D)
	Boidae			
16	<i>Eryx miliaris</i>	Dwarf sand boa	LC	3 NT
	Colubroidea			
17	<i>Hemorrhois ravergieri</i>	Spotted Whip Snake	LC	LC
18	<i>Platycephalus karelini</i>	Spotted Desert Racer	LC	LC
19	<i>Spalerosophis diadema schirazianus</i>	Diadem Snake	LC	LC
20	<i>Psammophis lineolatus</i>	Steppe ribbon racer	LC	LC
21	<i>Natrix tessellata</i>	Dice Snake	LC	LC

During the autumn survey, a total of 86 individual reptiles were observed, representing 10 different species. The three most prevalent reptile species were *Trapelus sanguinolentus*, *Eremias velox*, and *Phrynocephalus helioscopus*. Additionally, *Varanus griseus* footprints were observed at two distinct locations.

Nocturnal surveys provided further insights, revealing a relatively high density of *Teratoscincus scincus*. *Crossobamon eversmanni* and *Eryx miliaris* were also recorded.

Interestingly, some shifts in species dynamics were noted when comparing the autumn survey results with those from the spring survey. For example, *Eremias scripta*, which was not observed during the spring survey, was abundant in autumn. Conversely, the absence of numerous tortoises was notable in autumn, and *Eremias intermedia* appeared to be replaced by *Eremias velox*.

A comparison between the spring and autumn surveys highlights changes in the dominant species composition within the reptile community. The survey also documented indirect evidence of other fauna, such as the presence of bustard tracks in the Saxaul plantations.

All locality data for the observed species are presented in Table 2, providing a detailed record of reptile distribution within the project area.

Table 2. Field data and distribution of reptiles in the project area

Transect ID	Data/ Time	WTG	Length (km)	Species	Distance (m)	N	E
1	14.09.2024 10:08		1	<i>Phrynocephalus helioscopus</i>	1		
				<i>Trapelus sanguinolentus</i>	1		
				<i>Trapelus sanguinolentus</i>	1		
				<i>Eremias velox</i>	2		
				<i>Phrynocephalus helioscopus</i>	1		
2	14.09.2024 10:45		1	<i>Trapelus sanguinolentus</i>	1		
				<i>Trapelus sanguinolentus</i>	3		
				<i>Phrynocephalus helioscopus</i>	1		
				<i>Eremias velox</i>	2		
3	14.09.2024 11:34		1	<i>Trapelus sanguinolentus</i>	1		
				<i>Trapelus sanguinolentus</i>	2		
		<i>Phrynocephalus helioscopus</i>		1			
4	14.09.2024 12:40	1	<i>Phrynocephalus helioscopus</i>	1			
			<i>Eremias velox</i>	1			
5	14.09.2024 13:10	1	<i>Eremias velox</i>	1			
			<i>Eremias intermedia</i>	1			
6	14.09.2024 13:50	1	<i>Eremias intermedia</i>	1			
7	14.09.2024 14:35	1	<i>Trapelus sanguinolentus</i>	1			
			<i>Eremias velox</i>	1			
8	14.09.2024 15:02	1	<i>Eremias intermedia</i>	2			
9	14.09.2024 15:50	1	<i>Trapelus sanguinolentus</i>	2			
10	14.09.2024 16:21	1	<i>Trapelus sanguinolentus</i>	2			
11	14.09.2024 16:45	1	<i>Trapelus sanguinolentus</i>	2			

Transect ID	Data/ Time	WTG	Length (km)	Species	Distance (m)	N	E
12	14.09.2024 17:10		1	<i>Trapelus sanguinolentus</i>	2		
13	14.09.2024 17:25		1	<i>Eremias grammica</i>	2		
				<i>Eremias velox</i>	1		
14	14.09.2024 18:10		1	<i>Vranus griseus caspius</i>	footprints		
				<i>Chlamydotis macqueenii</i>	footprints		
				<i>Eremias velox</i>	1		
15	15.09.2024 09:47		1	<i>Trapelus sanguinolentus</i>	5		
16	15.09.2024 10:34		1	<i>Trapelus sanguinolentus</i>	1		
				<i>Phrynocephalus helioscopus</i>	1		
				<i>Eremias velox</i>	1		
				<i>Eremias velox</i>	3		
				<i>Eremias velox</i>	1		
				<i>Eremias velox</i>	3		
				<i>Trapelus sanguinolentus</i>	2		
				<i>Eremias velox</i>	2		
				<i>Trapelus sanguinolentus</i>	1		
				<i>Eremias velox</i>	2		
				<i>Phrynocephalus helioscopus</i>	1		
17	15.09.2024 11:14		1	<i>Phrynocephalus helioscopus</i>	2		
18	15.09.2024 11:48		1	<i>Trapelus sanguinolentus</i>	3		
				<i>Eremias velox</i>	2		
				<i>Vranus griseus caspius</i>	footprints		
19	15.09.2024 12:04		1	<i>Eremias velox</i>	2		
20	15.09.2024 13:00		1	<i>Eremias velox</i>	3		
21	15.09.2024 13:40		1	<i>Eremias velox</i>	1		
				<i>Eremias velox</i>	1		
22	15.09.2024 21:03		1	<i>Teratoscincus scincus</i>	10		
				<i>Teratoscincus scincus</i>	6		
				<i>Teratoscincus scincus</i>	12		
				<i>Teratoscincus scincus</i>	25		
				<i>Crossobamon eversmanni</i>	1		

Transect ID	Data/ Time	WTG	Length (km)	Species	Distance (m)	N	E
				<i>Teratoscincus scincus</i>	5		
				<i>Teratoscincus scincus</i>	35		
				<i>Teratoscincus scincus</i>	15		
				<i>Teratoscincus scincus</i>	10		
				<i>Crossobamon eversmanni</i>	2		
				<i>Eryx miliaris</i>	1		
				<i>Crossobamon eversmanni</i>	3		
				<i>Crossobamon eversmanni</i>	2		
				<i>Teratoscincus scincus</i>	12		
				<i>Teratoscincus scincus</i>	3		
				<i>Teratoscincus scincus</i>	25		
				<i>Teratoscincus scincus</i>	2		
				<i>Teratoscincus scincus</i>	7		
23	16.09.2024 12:12	XXXX	1	<i>Eremias velox</i>	2		
				<i>Trapelus sanguinolentus</i>	3		
				<i>Trapelus sanguinolentus</i>	2		
				<i>Trapelus sanguinolentus</i>	1		
				<i>Trapelus sanguinolentus</i>	0.1		
				<i>Trapelus sanguinolentus</i>	1		
				<i>Trapelus sanguinolentus</i>	1		
				<i>Trapelus sanguinolentus</i>	0.5		
24	16.09.2024 13:34	XXXX	1	<i>Trapelus sanguinolentus</i>	2		
				<i>Trapelus sanguinolentus</i>	1		
				<i>Eremias scripta</i>	1		
				<i>Trapelus sanguinolentus</i>	2		
				<i>Eremias scripta</i>	1.5		
				<i>Trapelus sanguinolentus</i>	1		
				<i>Eremias grammica</i>	5		
				<i>Eremias grammica</i>	7		

Transect ID	Data/ Time	WTG	Length (km)	Species	Distance (m)	N	E
				<i>Eremias grammica</i>	2		
				<i>Eremias grammica</i>	1		

Table 3: Average density of observed species

N	Species	Common name	IUCN RL	Uzbekistan Red data book	Average Density (inds/ha)	Notes
1	<i>Trapelus sanguinolentus</i>	Steppe agama	LC	LC	3.76	
2	<i>Phrynocephalus helioscopus</i>	Sunwatcher toadhead agama	LC	LC	3.88	
3	<i>Teratoscincus scincus</i>	Common Wonder Gecko	LC	LC	3.1	
4	<i>Crossobamon eversmanni</i>	Comb-toed Gecko	LC	LC	5.5	
5	<i>Eremias grammica</i>	Reticulate racerunner	LC	LC	1.6	
6	<i>Eremias velox</i>	Rapid racerunner	LC	LC	2.72	
7	<i>Eremias scripta</i>	Sand Racerunner	LC	LC	4.9	
8	<i>Eremias intermedia</i>	Aralo-Caspian racerunner	LC	LC	2.5	
9	<i>Varanus griseus</i>	Desert monitor	LC	2 (VU:D)	low number	2 foot print tracks
10	<i>Eryx miliaris</i>	Dwarf sand boa	LC	3 NT	3.1	

5. Conclusion

The number of reptile species recorded in the project area during Autumn survey is 10, and total number recorded both in the Spring and Autumn surveys is 13, which represents over half of the species that could potentially inhabit the region. Among 10 observed species, only 2 species are included in the Red Book of Uzbekistan – Desert Monitor listed as Vulnerable (2VU) and Dwarf sand boa listed as Near Threatened (3 NT) and none in IUCN Red list.

Among the recorded species, Rapid racerunner was the most frequently observed reptile, exhibiting the highest density in terms of individuals per hectare.

The most vulnerable species, such as Southern even-fingered gecko (IUCN CR), is not directly threatened by the project, as the habitat within the project area is unsuitable for this species.

The Central Asian Tortoise was not observed during the autumn survey, due to the seasonal hibernation at this time of year.

Additionally, Desert monitor, listed as Vulnerable (VU) in the Red Book of Uzbekistan, underscores the importance of preserving local biodiversity. However, as a highly intelligent and mobile predator, the Desert monitor is capable of leaving its territory in response to discomfort or danger. Therefore, the primary mitigation measure to minimize negative impacts on this species is to seasonally adjust the

construction schedule. Construction activities should be limited to the period between May and September, when the species is most active.

In conclusion, while the project area supports a diverse reptile community, including species of conservation concern, careful planning and implementation of recommended mitigation measures can significantly reduce potential negative impacts. The proposed strategies, particularly for the Central Asian Tortoise and Desert Monitor, aim to balance development objectives with the preservation of biodiversity.

6. Recommendations

Based on the findings of our study and investigation of the project area, we propose the following recommendations:

Regarding the Smooth Gecko (*Alsophylax laevis*), despite its critically endangered (CR) status, no suitable habitats were identified within the project area. Therefore, its presence can be excluded, and no special research or mitigation measures are required for this species.

The Central Asian Tortoise (*Testudo horsfieldii*) emerges as the key species of concern on the project area. Given the particular vulnerability of tortoises to motorised vehicles and human activities, an appropriate mitigation plan should be developed to reduce adverse impacts on the population of this species.

We recommend implementing a phased construction approach combined with a strategic fencing system. This involves developing a system where relatively small sectors are sequentially fenced off, preventing tortoises from entering construction sites and internal roads. The proposed fence should be 1 meter high, with 40 cm buried and 60 cm above ground, constructed of plastic netting with plastic supports.

For tortoise relocation, we suggest moving individuals from within fenced areas to adjacent suitable habitats within their original range. This relocation should be limited to 25% of the estimated tortoise population and conducted between April and May 2025. All tortoise-related procedures should be carried out only from April to June, respecting their active season. To ensure proper monitoring and accountability, all relocated tortoises should be marked with microchips, and detailed records should be maintained.

The same relocation procedure should be applied to other reptile species or wildlife encountered within fenced construction zones. The proposed fence design, with 60 cm above ground, allows for the movement of other terrestrial animals while restricting tortoise access.

It is to be noted that alternatives such as mass translocation of tortoises and the establishment of long-term holding facilities were considered but found to be impractical due to high population densities, lack of suitable relocation sites, and economic, logistical considerations.

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Annex. Photographs

Habitats of the key species



Figure 3. Semi-Fixed Sand Dunes with Species: *Eremias grammica*, *Eremias scripta*, *Eremias velox*, *Phrynocephalus mystaceus*, *Trapelus sanguinolentus*, *Varanus griseus caspius*, *Eryx miliaris*, *Teratoscincus scincus*, *Crossobamon eversmanni*



Figure 4. Modified habitat area, with *Trapelus sanguinalentus*, *Eremias velox* and *Phrynocephalus helioscopus*.



Figure 5. Dominant Habitats in the Project Area with *Trapelus sanguinalentus*, *Eremias velox*, and *Phrynocephalus helioscopus*

Key species



Figure 6. Steppe agama, *Trapelus sanguinolentus aralensis* (Lichtenstein, 1823)



Figure 7. Sunwatcher Toadhead Agama, *Phrynocephalus helioscopus sergeevi* Dunayev et al. 2012.



Figure 8. Rapid racerunner, *Eremias velox velox* (Pallas, 1771)



Figure 9. Reticulate Racerunner, *Eremias grammica* (Lichtenstein, 1823)



Figure 10. Aralo-Caspian Racetrack Lizard, *Eremias intermedia* (Strauch, 1876)



Figure 11. *Eremias scripta scripta*



Figure 12. *Teratoscincus scincus*



Figure 13. *Crossobamon eversmanni*



Figure 14. The desert monitor *Varanus griseus caspius* (Eichwald, 1831)



Figure 15. *Eryx milliaris*

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16. REPTILE SPRING SURVEY REPORT



Reptile Report

Spring 2024

**Environmental and Social Impact Assessment (ESIA)
for Gijduvan 300 MW Wind Farm in
Bukhara District, Uzbekistan**

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1. Introduction

The purpose of this report is to provide an assessment of reptile fauna with a focus on Central asian tortoise (*Testudo horsfieldi*) in the project area as an important component of the biodiversity surveys for the proposed Gijduvon 300 MW Wind Farm in Bukhara Province, Uzbekistan.

The project, located in the Kyzylkum desert, involves establishing a 300MW wind farm, including a polygon of Wind Turbine Generators (WTG) spanning approximately 13,645 ha, and an associated Overhead Transmission Line (OTL) extending 24.9 km.

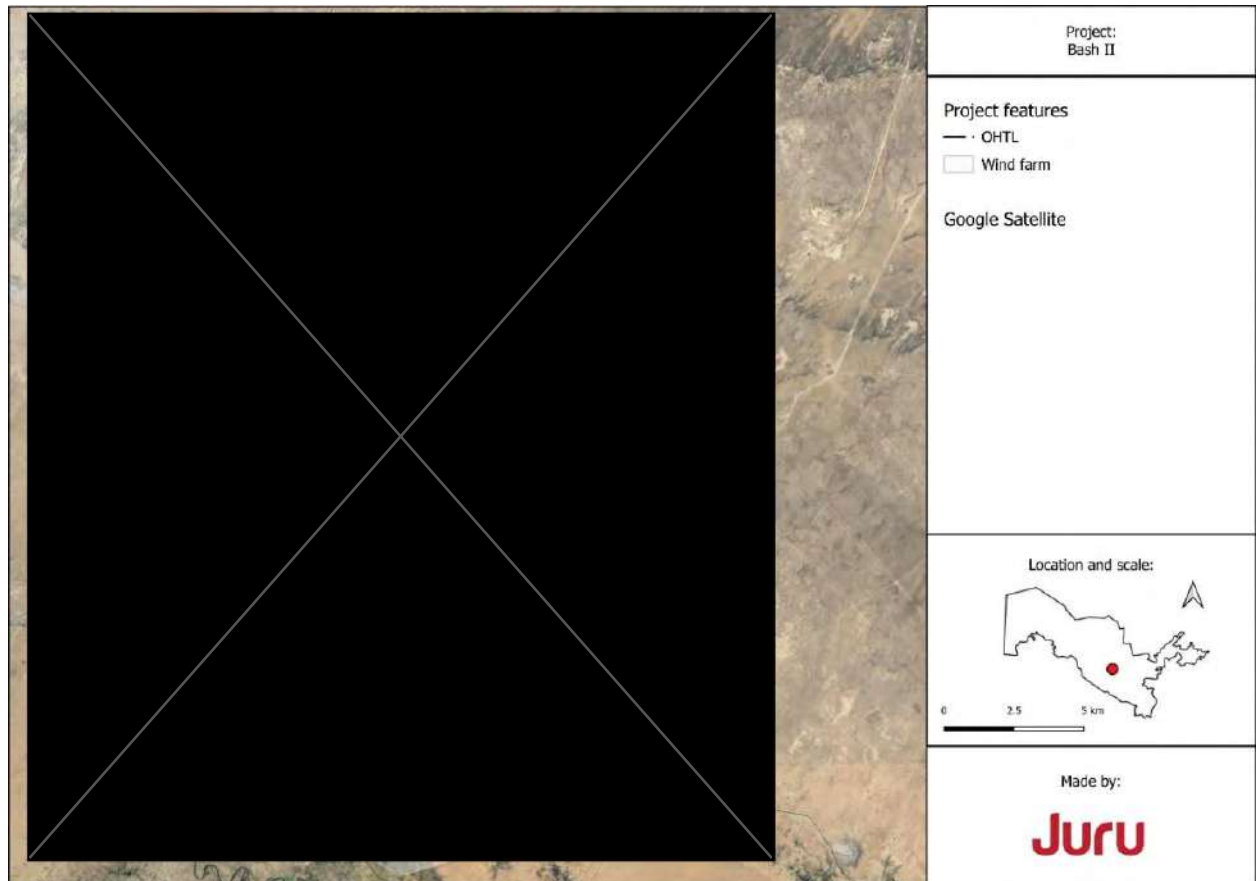


Figure 1. Project features

2. Materials and methods

During a field survey conducted by herpetologist Dr. Roman Nazarov from April 20-22, 2024, the status of reptiles in the study area was assessed. The survey aimed to document the species composition and density, territorial distribution, including areas of concentration, and the overall state of the reptile habitats within the study area. It should be noted that the findings were derived from a combination of field surveys and desktop analysis.



Figure 2. Reptile survey tracks (April 20-22)

Field studies were carried out according to generally accepted zoological methods for identifying species composition. The following methodological guidelines were used in the survey: L. G. Dinesman, M. L. Kaletskaya (1952), V. M. Makeev, A. T. Bozhansky (1988), D.A. Bondarenko, N.G. Chelintsev (1996). Literature sources and statistical data had been processed.

Transect survey method was used as the main research method. Transects for conducting research were outlined at the project monitoring stations in accordance with different types of habitats.

The field research methodology reflects the following aspects:

- species composition in the study area;
- distribution across habitats.

Thus, the method of quantitative assessment was based on the ecology of the species under consideration, landscape and geographical conditions, season and type of work.

The quantitative assessment of reptiles and amphibians was based on the transect survey. The transect method consists of counting individuals along a fixed long line (transect) on both sides of it, with the duration of the survey determined by the known distance, which is selected depending on the type of reptile and the area

In this case, all individuals encountered on the transect are recorded, regardless of the distance at which they were identified. The perpendicular distance between the transect axis and each individual is measured. The results obtained are used to calculate the density of the recorded reptiles.

A 1 km transect was chosen to minimize errors, which can be significant when long transects are used for species with high density, like the Central Asian Tortoise. Such species exhibit daily and seasonal activity fluctuations with high peak values, leading to errors if the minimum survey area is incorrectly selected (Vashetko et al., 2001).

The Central Asian tortoise population density (D) was calculated using the following formula:

$$D = \frac{n}{2LB}$$

where n – number of animal individuals recorded on the transect; L – length of the transect (1 km); B – width of the limited strip on both sides of the transect axis (20 meters).

The abundance of the reptiles in habitats was estimated using the following population density scale for 1 ha (Kuzyakin, 1962): 0.1 – 0.9 – rare, 1.0 – 9.9 – common, 10.0 and higher – abundant.

Table 1: Transect locations

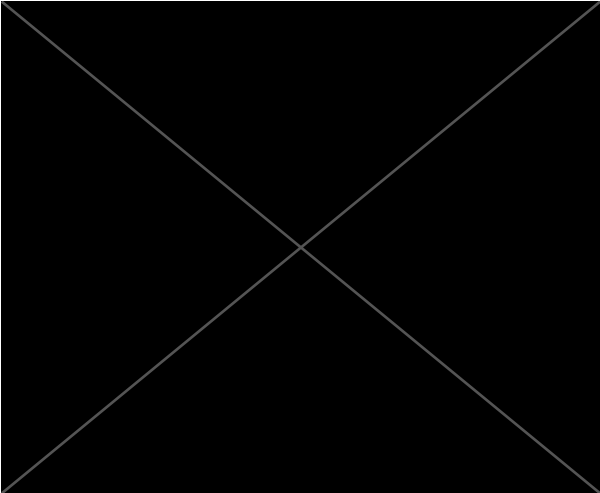
Transect No.	Date	Coordinate N, E°		Length (km)
		Beginning of the transect	End of the transect	
1	20/04/24			3
2	21/04/24			3
3	20/04/24			3.2
4	20/04/24			1.6
5	21/04/24			1.7
6	21/04/24			1
7	21/04/24			2.5
8	21/04/24			1
9	22/04/24			1
10	22/04/24			5.5
11	22/04/24			6.4
12	22/04/24			1
13	22/04/24			1



Figure 3. 13 reptile transects on the project site

3. Findings and Results

During the herpetological research, **nine** reptile species were recorded, including the Central Asian Tortoise, listed as Vulnerable (VU) on both the IUCN Red List and the Red Book of Uzbekistan and Desert monitor, listed as Vulnerable (VU) in the Red Book of Uzbekistan.



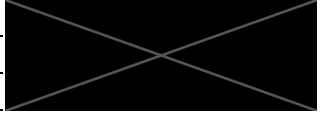
Figure 4. The Central Asian tortoise on the project site

Figure 5. *Varanus griseus*

Table 2. Check list of reptile species founded on project site

Species	Common name	IUCN RL	Uzbekistan Red data book
<i>Testudo horsfieldii</i>	Central Asian tortoise	VU	VU
<i>Trapelus sanguinolentus</i>	Steppe agama	LC	LC
<i>Phrynocephalus mystaceus</i>	Toad-headed agama	LC	LC
<i>Phrynocephalus helioscopus</i>	Sunwatcher toadhead agama	LC	LC
<i>Eremias grammica</i>	Reticulate racerunner	LC	LC
<i>Eremias velox</i>	Rapid racerunner	LC	LC
<i>Eremias intermedia</i>	Aralo-Caspian racerunner	LC	LC
<i>Varanus griseus</i>	Desert monitor	LC	VU
<i>Psammophis lineolatus</i>	Steppe ribbon racer	LC	LC

Table 3. Field data

Track numb	Length (km)	Species	Distance (from transect to animal), meters	N	E	Testudo density (inds/ha)
1	3	<i>Phrynocephalus helioscopus</i>	2			0,1
		<i>Testudo horsfieldii</i>	6			
		<i>Eremias intermedia</i>	1			

Track numb	Length (km)	Species	Distance (from transect to animal), meters	N	E	Testudo density (inds/ha)
		<i>Testudo horsfieldii</i>	20			
		<i>Phrynocephalus helioscopus</i>	1			
		<i>Trapelus sanguinolentus</i>	0.1			
		<i>Eremias intermedia</i>	0.1			
2	3	<i>Testudo horsfieldii</i>	3			0,3
		<i>Trapelus sanguinolentus</i>	2			
		<i>Trapelus sanguinolentus</i>	1			
3	3.2	<i>Testudo horsfieldii</i>	2			2,5
		<i>Testudo horsfieldii</i>	10			
		<i>Testudo horsfieldii</i>	1			
		<i>Testudo horsfieldii</i>	1			
		<i>Testudo horsfieldii</i>	1			
		<i>Trapelus sanguinolentus</i>	2			
		<i>Testudo horsfieldii</i>	5			
		<i>Testudo horsfieldii</i>	1			
		<i>Testudo horsfieldii</i>	4			
4	1.6	<i>Trapelus sanguinolentus</i>	2			2,1
		<i>Testudo horsfieldii</i>	3			
		<i>Testudo horsfieldii</i>	2			
		<i>Testudo horsfieldii</i>	4			
		<i>Trapelus sanguinolentus</i>	2			
		<i>Varanus griseus</i>	15			
		<i>Testudo horsfieldii</i>	6			
		<i>Testudo horsfieldii</i>	8			
5	1.7	<i>Eremias grammica</i>	2			2,4
		<i>Testudo horsfieldii</i>	3			
		<i>Eremias intermedia</i>	1.5			
		<i>Testudo horsfieldii</i>	0.1			
		<i>Eremias intermedia</i>	3			
		<i>Eremias intermedia</i>	2			
6	1	<i>Testudo horsfieldii</i>	1			0,4
		<i>Trapelus sanguinolentus</i>	1			
7	2.5	<i>Testudo horsfieldii</i>	6			0,8
		<i>Testudo horsfieldii</i>	12			
		<i>Testudo horsfieldii</i>	10			
		<i>Testudo horsfieldii</i>	3			
		<i>Testudo horsfieldii</i>	5			
		<i>Testudo horsfieldii</i>	15			
		<i>Eremias grammica</i>	3			
8	1	<i>Testudo horsfieldii</i>	2			2,3
		<i>Testudo horsfieldii</i>	6			
		<i>Testudo horsfieldii</i>	10			
		<i>Eremias grammica</i>	5			
		<i>Eremias intermedia</i>	2			
		<i>Trapelus sanguinolentus</i>	10			
		<i>Trapelus sanguinolentus</i>	2			

Track numb	Length (km)	Species	Distance (from transect to animal), meters	N	E	Testudo density (inds/ha)
		<i>Phrynocephalus mystaceus</i>	7			
		<i>Testudo horsfieldii</i>	4			
9	1	<i>Trapelus sanguinolentus</i>	10			2,9
		<i>Testudo horsfieldii</i>	3			
		<i>Testudo horsfieldii</i>	2			
		<i>Testudo horsfieldii</i>	15			
		<i>Eremias velox</i>	2			
		<i>Testudo horsfieldii</i>	4			
		<i>Testudo horsfieldii</i>	2			
10	5.5	<i>Testudo horsfieldii</i>	4			0,2
		<i>Testudo horsfieldii</i>	6			
		<i>Eremias velox</i>	1			
		<i>Trapelus sanguinolentus</i>	10			
		<i>Psammophis lineolatus</i>	4			
11	6.4	<i>Testudo horsfieldii</i>	6			0,2
		<i>Testudo horsfieldii</i>	10			
		<i>Testudo horsfieldii</i>	5			
112	1	<i>Testudo horsfieldii</i>	1			1,7
		<i>Testudo horsfieldii</i>	20			
		<i>Phrynocephalus helioscopus</i>	0.1			
		<i>Phrynocephalus helioscopus</i>	2			
		<i>Testudo horsfieldii</i>	2			
		<i>Testudo horsfieldii</i>	4			
13	1	<i>Eremias intermedia</i>	2			2,1
		<i>Testudo horsfieldii</i>	4			
		<i>Testudo horsfieldii</i>	2			
		<i>Trapelus sanguinolentus</i>	1			

The average density of *Testudo horsfieldii*, based on nine tracks, was 1.4 individuals per hectare. However, the density is not uniform across the territory, with some areas being more inhabited than others.

4. Key species descriptions

CLASS REPTILIA

FAMILY TORTOISES (TESTUDINIDAE)

CENTRAL ASIAN TORTOISE

Testudo horsfieldii (Gray, 1844)



Figure 6. Central Asian tortoise. Photo by Abduraupov T.V

Steppe Tortoise is 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 is up to 286.4 mm. The carapace is flat with weakly serrated edges. The front edge notch is shallow. The 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 on agricultural lands: on the outskirts of fields, orchards, gardens, and orchards. Avoid 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 in 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 (the 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.

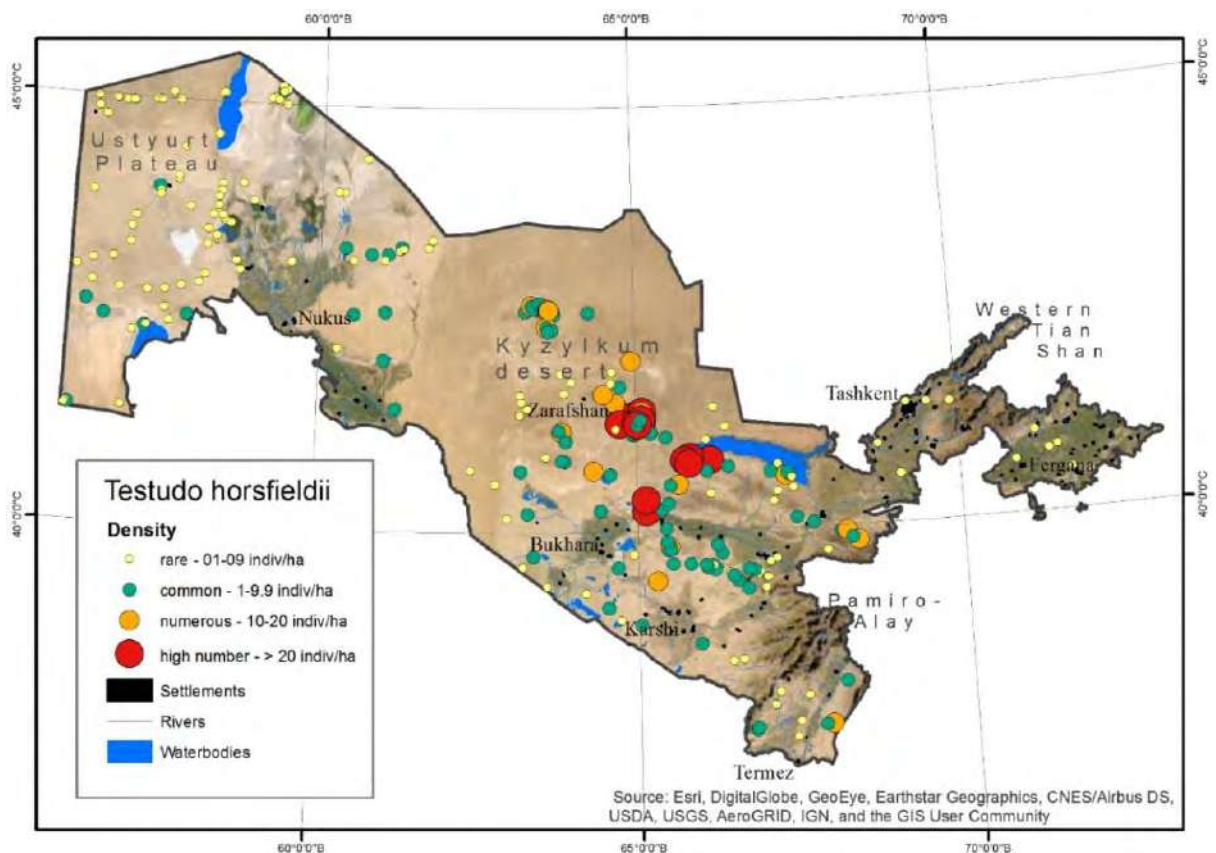


Figure 7. Map of the turtle population density in various regions of the Republic.

FAMILY AGAMIDAE**STEPPE AGAMA*****Trapelus sanguinolentus aralensis* (Lichtenstein, 1823)**

Figure 8. 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.

Secret toadhead agama
***Phrynocephalus mystaceus* (Lichtenstein, 1823)**



Figure 9. Secret Toadhead agama. Photo by R. Nazarov

A medium-sized lizard - body length reaches 11.2 cm, weight - 42.5 g. The head, body and tail are noticeably flattened. The front edge of the muzzle descends vertically to the upper lip, so the nostrils are not visible from above. In the corners of the mouth there are folds of skin - the so-called ears, to which this reptile owes its species name.

The body is covered on top with ribbed, keeled scales. Its upper part is sand-colored with a grayish coating. Against this background, a complex patterned pattern of small dark lines, spots and dots is visible. The underparts are milky white, with a black spot on the chest. Juveniles have creamy underparts, without spots. There may be a dark marbled pattern on the throat. The tail is somewhat flattened, with a black tip.

Inhabits areas with predominantly bare sand dunes. On the slopes of dunes, it digs holes in the form of a straight passage with a slight widening at the end. It often spends the night outside the burrow, burrowing into the sand.

Appears after hibernation from late February to April. It hides in winter shelters in October. Active during the day.

It feeds mainly on various beetles and ants, as well as caterpillars, termites, wasps, bees, ticks, spiders, and small lizards. Sometimes it also feeds on flowers.

FAMILY LACERTIDAE**Rapid racerunner*****Eremias velox velox* (Pallas, 1771)**

Figure 10. 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. A mass emergence is observed in early April. They enter hibernation at the end of October to early November. During the 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.

RETICULATE RACERUNNER***Eremias grammica* (Lichtenstein, 1823)**

Figure 11. Reticulate Racerunner. Photo by T. V. Abduraupov

A medium-sized lizard with a body length of up to 93 mm and a little more than one and a half times, a long tail. The toes bear on the sides long, more or less triangular scales that form combs. The main background of the upper part of the body is gray with a brownish or slightly greenish tint. The back, neck, upper side of the base of the tail and legs are covered with a black-gray or dark brown mesh pattern, often with individual black specks.

It inhabits sandy deserts, inhabiting mainly various kinds of scattered and weakly fixed sands with sparse herbaceous and shrubby vegetation. In some places it temporarily enters the areas of takyr and soddy salt marshes bordering on the sands. It uses the burrows of desert rodents as shelters, as well as its own burrows up to 1 m long and up to 70 cm deep, usually dug at the base of the bushes. They are able to quickly bury themselves in loose sand and move in its thickness for distances of up to 2-3 m.

In the north of the range, it is active from early April to mid-October. In its southern regions, wintering lasts no more than three months - from December to February, but even during this period, in the presence of warm weather, at times it can leave the wintering shelters for heating under the sun.

Economically significant species. The state of the species on the territory of the Republic of Uzbekistan does not cause concern.

ARALO-CASPIAN RACERUNNER
***Eremias intermedia* (Strauch, 1876)**



Figure 12: Aralo-Caspian Racerunner. Photo by T. V. Abduraupov

A small lizard with a body length of up to 65 mm and about one and a half times longer tail. The main background of the upper side of the body is dark gray with a brownish tint. On the body, there are longitudinal rows of round or elongated white or light gray spots, framed by circles of black or dark gray.

In most of the range, it inhabits leveled fixed sands and inter-barnian depressions with saxaul, tamarisk, camel thorn and other sparse herbaceous and shrub vegetation. It also occurs in the anthropogenic landscape. It takes refuge in the holes of rodents, turtles, small own burrows up to 60 cm long.

After wintering, they appear on the surface in late February - early March. In the hot summer months in June-July, adults practically cease to be found on the surface in places and, apparently, go into a state of summer hibernation. It has been suggested that the absence of adult lizards during this period is explained by their natural mass mortality at the end of the breeding cycle. The last individuals hibernate in late October - early November.

The state of the species on the territory of the Republic of Uzbekistan does not cause concern.

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

FAMILY VARANIDAE**Desert monitor*****Varanus griseus caspius* (Eichwald, 1831)**

Figure 13. 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 neighbouring 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 the 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 the foothills, with elevations of up to 1000 meters above sea level.

FAMILY COLUBRIDAE**Steppe ribbon racer*****Psammophis lineolatus* (Brandt, 1838)**

Figure 14. 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.

This species has been observed within a 1 km radius of the studied territory.

5. Impact of Wind farm on Reptiles

Due to the intensive development of the renewable energy industry worldwide, there has been an increase in the number of scientific studies devoted to the integrated assessment of the impact of alternative energy use on various biocenoses (Thaker et al. 2018; Shuster et al. 2015; Thaxter et al. 2015, etc.). And in most cases, these studies have been able to identify the underlying processes of the negative impacts of green energy development on the environment and biodiversity. Accordingly, such understanding helps to develop effective ways to reduce the negative pressure on nature and preserve rare and endangered species of plants and animals.

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

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 a negative impact on the environment, such as laying an additional road or increasing the level of use of existing unpaved roads, the use of roadside vehicles and construction machinery, the 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 are 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 the 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, the use of the road, and 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.

6. Conclusion

A total of nine reptile species were discovered, including two species of particular concern: the Central Asian Tortoise (*Testudo horsfieldii*) and the Desert Monitor (*Varanus griseus*).

The Central Asian Tortoise is listed as Vulnerable (VU) on both the International Union for Conservation of Nature (IUCN) Red List and the Red Book of Uzbekistan, indicating its precarious conservation status. The research revealed a relatively low density of 1.4 individuals per hectare for this species, which falls near the lower end of the common range (1.0 – 9.9 individuals/ha). Notably, these tortoises tend to concentrate around the canals and in the sandy areas located in the central part of the project territory.

Additionally, the Desert Monitor listed as Vulnerable (VU) in the Red Book of Uzbekistan, further highlighting the importance of preserving the local biodiversity.

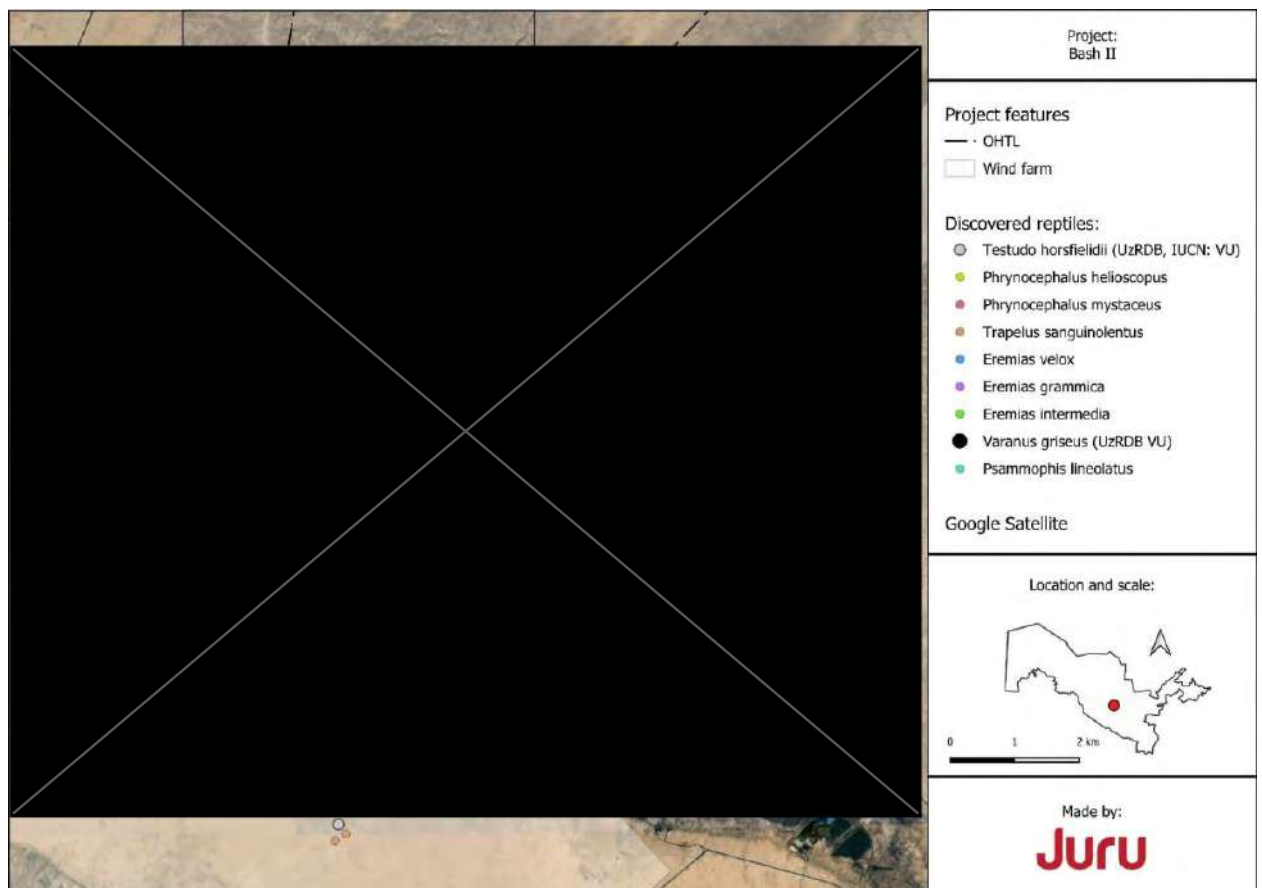


Figure 15: Discovered reptiles

During the survey, footprints of the Houbara Bustard, a threatened bird species, were found in the center of the territory.



Figure 16: Houbara bastard footprint

Furthermore, it's important to note that work on the project is already in progress. The erection of overhead transmission lines (OHTL) is currently ongoing, with construction vehicles actively traversing through the area of Saksaul. During the bat passive-active survey, a crushed tortoise carapace was found near the weather tower.



Figure 17: Current construction and its consequents on the project site

7. Recommendations

One of the key species in this study is the Smooth gecko *Alsophylax laevis* (CR). This species inhabits slopes in clay semi-deserts, saline takyr, and takyr-like soils, which are sparsely vegetated with saltworts, wormwood, and saxaul. It uses cracks in dry soil and voids under peeling takyr crusts as shelters. During the spring survey of the project area, no suitable habitats for the smooth gecko were found, so its presence in the project area can be excluded and no special research is required.

Therefore, the key species of the area is the Central Asian tortoise. Given the particular vulnerability of tortoises to vehicle traffic and human activity, it is necessary to relocate the tortoises from the project area from mid-March to the end of May. For the relocation, studies to identify suitable sites for the transfer are needed, including geobotanical research.

If other rare species of reptiles are encountered, relocation should be organized with the involvement of a state inspector.

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