Aktas Energy LLP

# Mirny (Kazakhstan) 1GW Wind Farm Project

ESBS Appendix G - Bats baseline field surveys within Mirny Project during June 2023-May 2024

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Content

## Bat surveys

This report presents information on monitoring of bats (Mammalia, Chiroptera) at the sites of Mirny wind farms in 2023-2024. Field studies were divided into three stages in accordance with the seasons that play an important role in the life of bats: spring (spring migration), summer (breeding period) and autumn (autumn migration).

The need for intensive survey of large areas in a short time determined the choice of research methods, which were based on remote counting of bats using echolocation calls at stationary points and transects spaced apart in space. It was critical to carry out such intensive studies in a short timeframe that use was made of an all-terrain vehicle not only for moving between stationary survey points, but also for direct surveys at night on transects, including those laid along difficult terrain. As an additional method, a survey of potential diurnal roosts of bats was employed. The bat counts at stationary points included both the recording of bat calls in the ground zone and at altitude, using ultrasound detectors installed on meteorological masts at a height of about 50 meters. This is valuable for increasing the chances of detecting higher-flying bat species (particularly those with quieter vocalisations) and for assessing bats present in the turbine blade zone.

## 1 The composition of the team and the distribution of work responsibilities

Vasenkov Denis (Ph.D., Russia, Moscow) – general coordination and planning of work on bat counts, setting up detectors, installing detectors at ground counting points, GPS-reference of stationary survey points and transects, survey of potential bat refuges, identification of bats, photographing, data processing, reporting.

Tomilenko Andrey (Russia, Novosibirsk) – development and testing of routes for transects, coordination of logistics, driving and maintenance of a cross-country vehicle, providing food for the group in the field, surveying potential bat shelters, photographing.

Devyaterikov Nikita (Kazakhstan, Almaty) - high-altitude work on meteorological towers: installation of detectors, photographing.

**2 Brief description of the study sites and potential species composition of bats (Mammalia, Chiroptera)**

The two surveyed sites where the Mirny wind farms are planned to be built are located in the desert zone in the Zhambyl region to the west of Lake Balkhash (Fig. 1). The dimensions of each site are approximately 40*10 km. The site landscape varies. To the north, there is a flatter area ("area C" – "flat" or "plane"), with a smaller elevation difference (Fig. 2) compared to the southern area ("area A" – "mountainous"), where the relief is more rugged (Fig. 3).

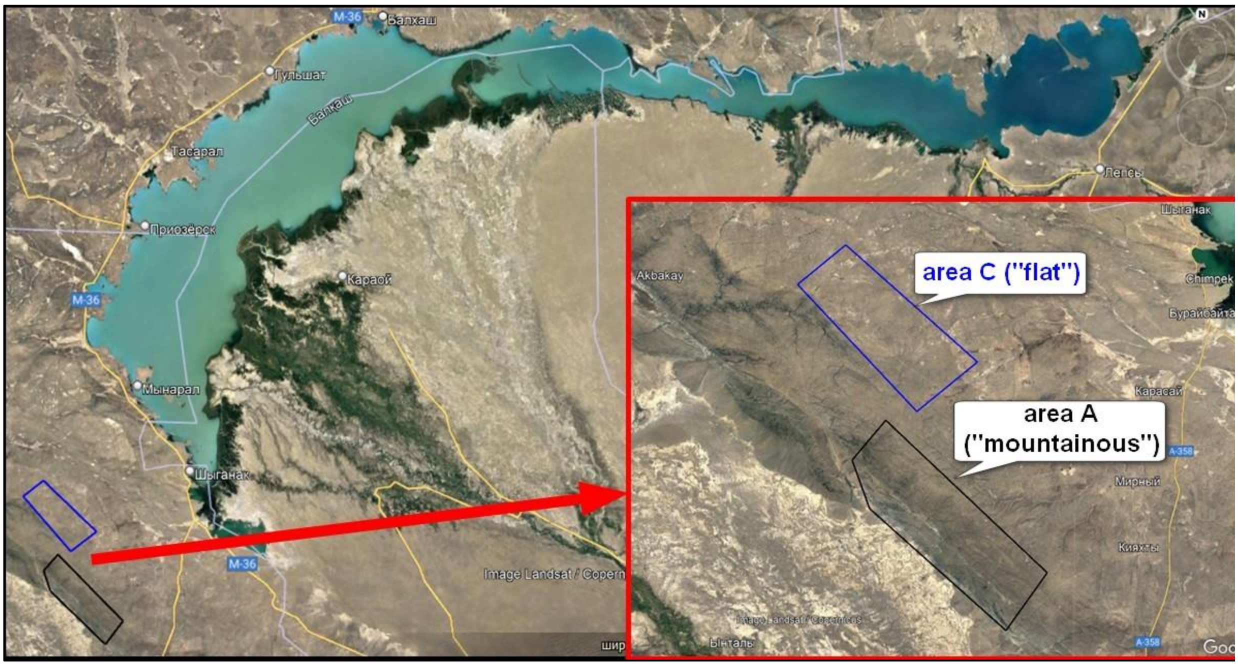


*Fig. 1. Location of sites where data on the distribution of bats southwest of Lake Balkhash (Zhambyl region) were collected.*

Fig. 2. Typical relief of a flat area (“area C”).

Fig. 3. Typical relief of a mountainous area (“area A”).

Differences in relief will cause different distribution densities of potential daytime roosts for bats on the sites. On the northern, flat area, it is expected that, almost exclusively, artificial structures will be used as roosts by bats: bridges and drainage tunnels, as well as crevices and blockages of stones in stone quarries (Fig. 4). On the southern, mountainous site, crevices in numerous natural outcrops of parent rocks may act as roosts for bats (Fig. 5).


Fig. 4. Potential bat roosts in the northern flat area: drainage tunnels under the road (left), blockages of stones in stone quarries (right).

Fig. 5. Potential natural shelters for bats in the southern "mountainous" area – crevices in numerous outcrops of source rocks.

Access to water at the sites is limited during the summer. During the research period in the second half of June, the rivers and streams on the territory of the sites were almost dry. Only in some places small temporary reservoirs with an open water surface remained (Fig. 6).

Fig. 6. A shallow waterbody with open water surface in the southern "mountain" area.

The combination of arid conditions, desert biotopes, topography, remoteness from human settlements results in poor-potential species composition of bats in the study areas. Analysis of the literature (Strelkov, 1980; Butovskij et al., 1985), taking into account modern taxonomy data, showed the potential habitation on the territory of the sites of the following species of bats belonging to the family Vespertilionidae:

1. *Myotis davidii*,

2. *Pipistrellus pipistrellus*,

3. *Hypsugo savii*,

4. *Eptesicus serotinus*,

5. *Nyctalus noctula*,

6. *Vespertilio murinus*.

Because, in the area of the surveyed sites, an intensive study of bats has not been previously carried out, then it is impossible to completely exclude the registration of other species. Indeed, it is reasonable to expect that hitherto unrecorded species will be encountered in the study area.

## 3 Research methods

Bats were surveyed for in the spring, summer and autumn periods. The time of the counts was timed to coincide with the critical periods in the lifecycle of bats. In the second half of spring, the spring migration of bats occurs, when they move from wintering places to summer habitats. In first half of summer, breeding females gather in brood colonies for the time of birth, and then rearing of cubs that are not yet able to fly (Borisenko, 2000). At this time, the ability of females to change shelters is limited, and the biotopes in the vicinity of shelters should provide the opportunity for females to feed effectively in the last stages of pregnancy and during milk feeding until the young fledge. Local bat migrations occur in August, followed by long-distance migrations in the фегеьт, when bats fly from their summer habitats to their wintering grounds. Both sedentary species and long-distance migrants actively migrate during this time.

The need to survey large areas in a short time determined the choice of research methods, the main of which was the remote counting of bats using echolocation calls (Barataud, 2015) at stationary points and transects. As an additional method, a survey of potential diurnal roosts of bats was used. Remote accounting is based on the registration of ultrasonic echolocation calls emitted for orientation in space by all species of bats living in Kazakhstan. The distance at which an ultrasonic call can be recorded by a detector depends on the bat species and varies from 100–150 m for the most "long-range" species to 10–20 m for the "quietest" species (Barataud, 2015).

Such a relatively small distance of registration of bats required the survey team to utilise as many points of registration of ultrasonic calls as possible over the surveyed sites and to combine two methods of counting: counting at stationary points and counting on transects.

### 3.1 Audio accounting on transects

Bat calls were recorded using the Echo Meter program through a mobile ultrasonic detector Echo Meter Touch 2 Pro (Wildlife Acoustics Inc., USA) connected to a smartphone. The detector was tuned to register ultrasonic calls with frequencies up to 128 kHz.

This type of census was carried out on a cross-country vehicle on transects about 13 km long (Fig. 7), relatively evenly distributed over both census sites (4 transects per site). Before the night survey, each transect along country roads was preliminarily surveyed in the daytime, both in the plains and in the mountains, to assess the possibility of safe passage along it at night. When conducting surveys, in order to counter the influence of weather conditions and the direction on the results, each transect was usually passed in opposite directions on two different days.

To exclude the influence of the noise produced by the car on the quality of audio recordings, the latter were made during stops on the transect every 500 m. At each stop, the car engine was turned off, after which the mobile detector, oriented upwards, was switched on to record ultrasonic calls for 3 minutes (Fig. 8). Thus, on each transect 13 km long, audio recordings were made at 27 reference points (including the starting point) for 3 minutes, i.e. the total detector operating time per transect was 81 minutes, or 162 minutes per transect run twice on different days. Counting on the transects began 40–80 minutes after sunset (Hogue, McGowan, 2018). The duration of work on transects (recording at survey points + time for movement between them) was about 2.5-3 hours.

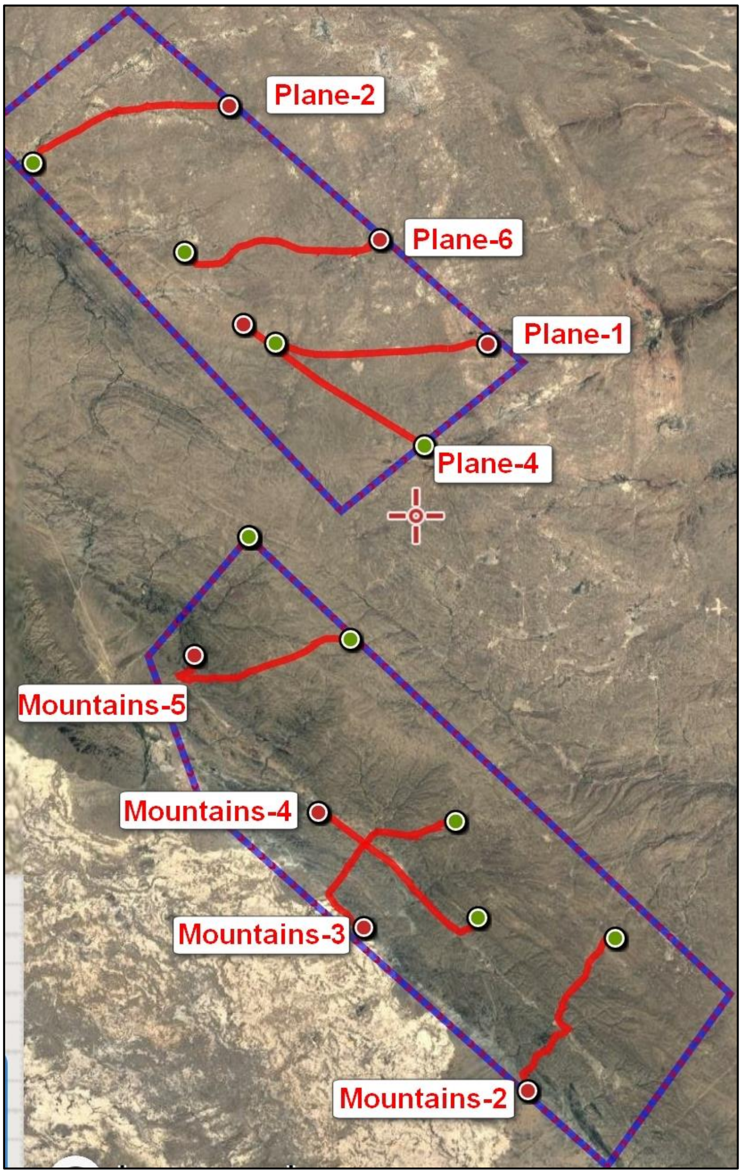


*Fig. 7. Transects of accounting for the activity of bats using a mobile detector in summer.*

*Fig. 8. Accounting of bats using a mobile detector on the transect (photo by A.A. Tomilenko).*

### 3.2 Audio accounting at stationary points

This type of accounting was carried out using four stationary detectors "Song Meter SM4BAT FS" (Wildlife Acoustics Inc., USA). All stationary detectors were tuned to record ultrasonic calls with a frequency of up to 128 kHz from sunset to sunrise. The detector installation points were relatively randomly distributed over the sites (Fig. 9; Annex). Where possible attempts were made to raise the remote microphones of the detectors at the counting points as high as possible, using low trees or telescopic folding stands 2 to 5 m high (Fig. 10). On mountain slopes, the microphone was fixed in stones, oriented away from smooth surfaces (Fig. 11). All this was supposed to reduce extraneous noise on the records, both from insects and reflected calls from large smooth surfaces (Barataud, 2015).

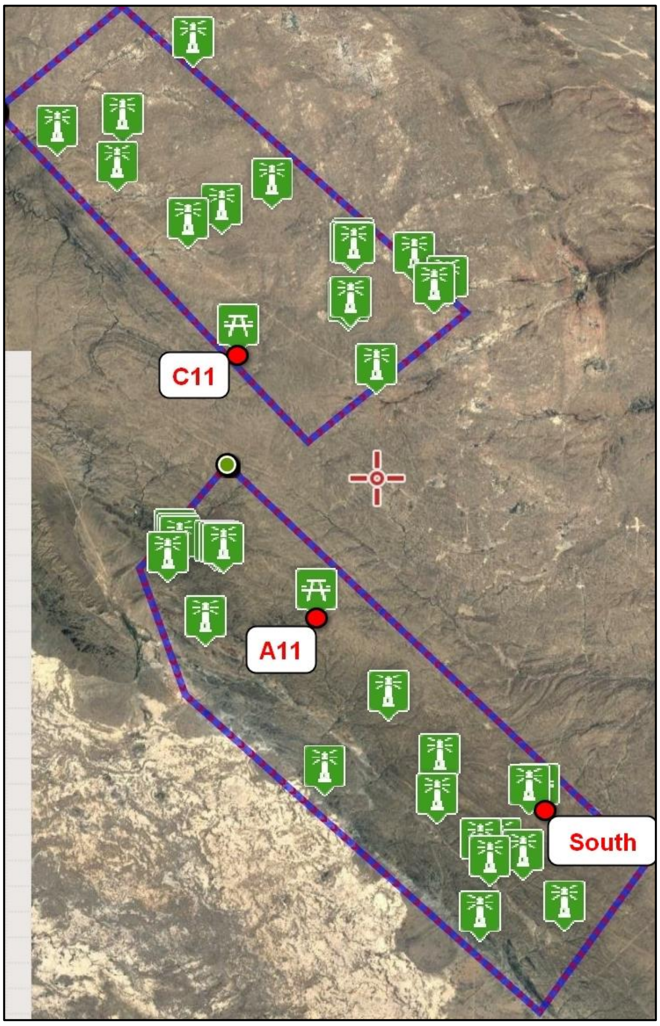


*Fig. 9. Points of accounting by stationary detectors (red circles - meteorological towers).*

*Fig. 10. Options for placing microphones of stationary detectors outside the mountain slopes (above - the detector microphone is fixed on the top of a small tree; below - the microphone is raised on telescopic stands 2-5 m high).*


*Fig. 11. A variant of hidden placement of a microphone (marked with a red arrow) of a stationary detector in stones on mountain slopes (on the left - before the detector was masked by stones, on the right - after masking).*

### 3.3 Audio accounting at stationary points on meteorological masts

Three detectors (marked "A02", "A03", "A04") were installed on three meteorological masts in the vicinity of the surveyed sites at heights of about 50 m (Fig. 12).

| Name of the meteorological mast | Coordinates | |
|---|---|---|
| | N | E |
| Meteomast "South" | 44.553869 | 73.562146 |
| Meteomast A11 | 44.673725 | 73.370256 |
| Meteomast C11 | 44.835734 | 73.30304 |

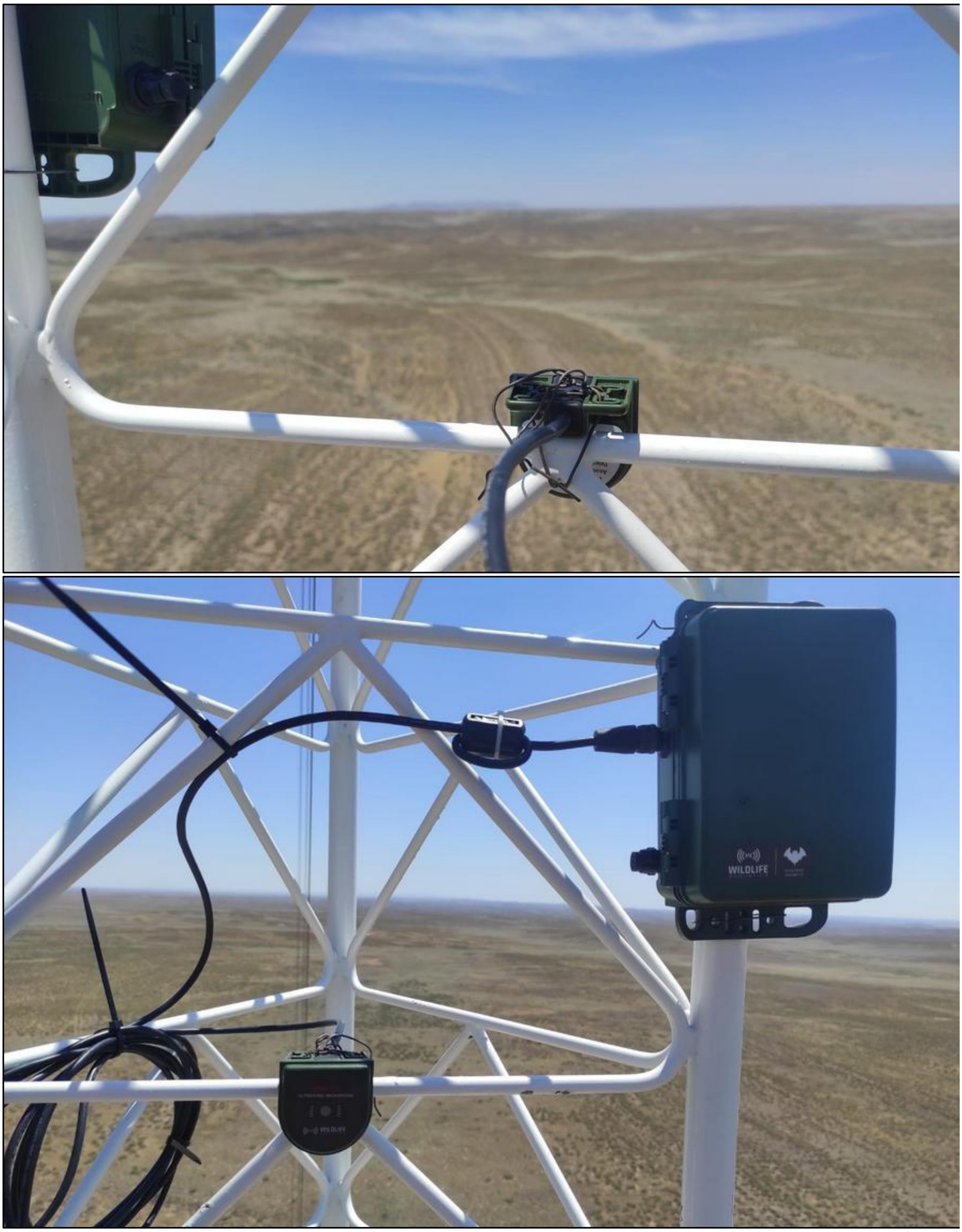


Fig. 12. Stationary detector at a height of 50 m on a meteorological tower (photo by N.A. Devyaterikov; top - panoramic view of the microphone counting sector, bottom - general view of the detector and microphone placement).

For all bat calls we calculated "Relative abundance". Relative abundance is the frequency at which calls of some species are recorded among all types of calls (excluding noise, social calls and unidentified calls).

### 3.4 Accounting in shelters (in summer)

In addition to the work on counting bats on night transects, as well as rearranging detectors and reconnaissance of routes for transects during the daytime, we conducted a survey of potential refuges for bats in culverts (bridges and drainage tunnels) under the asphalt road in the northern "flat" section (Fig. 13; Annex 2). Cracks and cavities inside engineering structures accessible for inspection were examined (Fig. 14), which could potentially be shelters for bats.

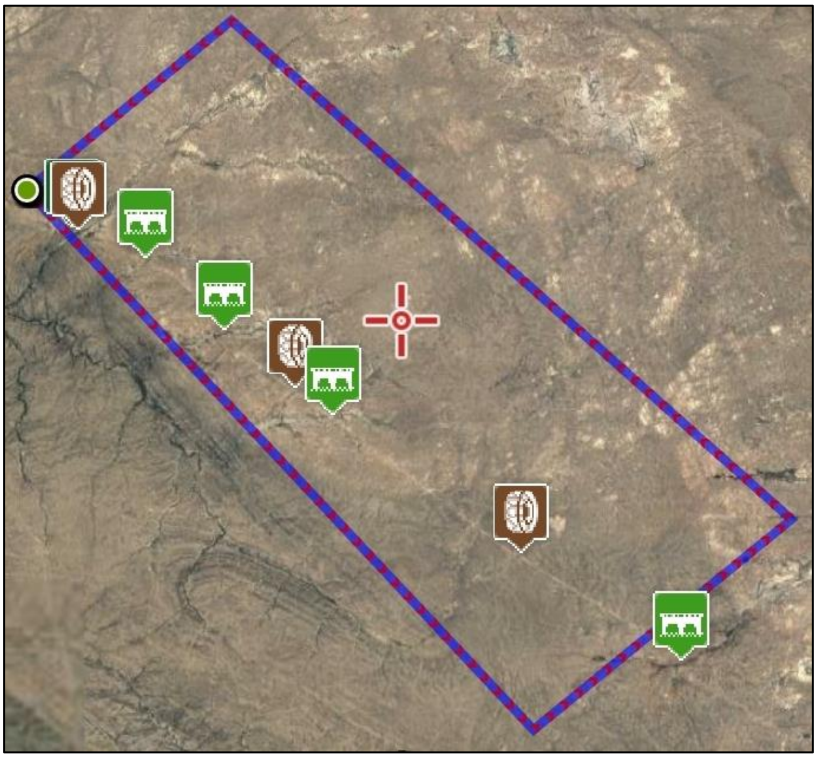

*Fig. 13. A map of the location of culverts along the road on a flat area that can potentially be used by bats as daytime shelters (green icons - bridges, brown icons - drainage tunnels).*

*Fig. 14. Bridge, the cavities inside which can serve as shelters for bats.*

In total, 8 tunnels and bridges were checked in the northern section and at its borders. When bats were found, they were photographed, their approximate number was counted, and, if possible, individual animals were taken out for morphometric measurements, photographing, and clarifying the species definition “in hands”. After measurements, inspection and photographing, the animals were immediately released at the place of capture.

## 4 Data collected during the reporting period

The study covered various periods of the bat life cycle, from early spring to late autumn. This period included spring migration, breeding, local migrations in late summer, and autumn migration (Table).

Table. Number of surveys conducted in different seasons.

| stage of the life cycle of bats | | | start of spring migration | spring migration | breeding | local and autumn migration | autumn migration | end of autumn migration | Total: |
|---|---|---|---|---|---|---|---|---|---|
| season | | | spring | spring | summer | summer-autumn | autumn | late autumn | |
| dates | | | 06.04-24.04 (2024) | 25.04-14.05 (2024) | 18.06-03.07 (2023) | 10.08-12.09 (2023) | 16.09-11.10 (2023) | 07.10-05.11 (2023) | |
| calendar nights | | | 19 | 20 | 16 | 34 | 26 | 30 | 145 |
| type of accounting | stationary ground-based detectors, | nights | | 80 | 51 | | 72 | | 203 |
| | stationary detectors on meteo-masts, | nights | 57 | | | 101 | | 89 | 247 |
| | transects, | evenings | | 20 | 16 | | 14 | | 50 |
| | transects, | km | | 260 | 208 | | 182 | | 650 |

### 4.1. Spring (2024)

The most numerous species according to accounting in the spring on meteorological masts is *Eptesicus serotinus*, followed by *Nyctalus noctula*.

#### 4.1.1 Audio accounting at stationary points on meteorological masts

| Species | Spring (6-24 Apr 2024) | | | Total: | Total (%): |
|---|---|---|---|---|---|
| | Meteomast C11 (A04) | Meteomast A11 (A03) | Meteomast "South" (A02) | | |
| *Eptesicus serotinus* | 14 | 17 | 105 | 136 | **73,9** |
| *Hypsugo savii* | 0 | 0 | 4 | 4 | **2,2** |
| *Nyctalus noctula* | 7 | 7 | 27 | 41 | **22,3** |
| *Pipistrellus pipistrellus* | 0 | 0 | 3 | 3 | **1,6** |
| *Vespertilio murinus* | 0 | 0 | 0 | 0 | **0,0** |
| Total: | **21** | **24** | **139** | **184** | **100,0** |
| Total (%): | **11,4** | **13,0** | **75,5** | | |

#### 4.1.2 Audio accounting at stationary points

The most numerous species according to detection in the spring on “ground” points is *Vespertilio murinus*, followed by *Eptesicus serotinus*.

| Species | Files with bat calls | Relative abundance, % |
|---|---|---|
| *Eptesicus serotinus* | 406 | 22,6 |
| *Hypsugo savii* | 252 | 14,0 |
| *Myotis sp.* | 205 | 11,4 |
| *Nyctalus noctula* | 116 | 6,5 |
| *Pipistrellus pipistrellus* | 3 | 0,2 |
| *Vespertilio murinus* | 812 | 45,3 |
| Total: | 1794 | 100,0 |

### 4.1.3 Audio detections on transects

The most numerous species according to recorded detections in the spring on transects is *Eptesicus serotinus*, followed by *Hypsugo savii*.

| Date | *Eptesicus serotinus* | *Hypsugo savii* | *Myotis sp.* | *Nyctalus noctula* | Total: | Total (%): |
|---|---|---|---|---|---|---|
| 25.04.2024 | 0 | 0 | 1 | 0 | ***1*** | **0,2** |
| 27.04.2024 | 1 | 0 | 0 | 1 | ***2*** | **0,3** |
| 28.04.2024 | 26 | 0 | 6 | 1 | ***33*** | **5,3** |
| 29.04.2024 | 50 | 2 | 0 | 9 | ***61*** | **9,8** |
| 30.04.2024 | 21 | 0 | 0 | 0 | ***21*** | **3,4** |
| 01.05.2024 | 14 | 0 | 0 | 0 | ***14*** | **2,2** |
| 02.05.2024 | 20 | 3 | 0 | 10 | ***33*** | **5,3** |
| 03.05.2024 | 13 | 19 | 0 | 0 | ***32*** | **5,1** |
| 04.05.2024 | 37 | 5 | 0 | 1 | ***43*** | **6,9** |
| 05.05.2024 | 0 | 0 | 0 | 2 | ***2*** | **0,3** |
| 06.05.2024 | 9 | 0 | 0 | 0 | ***9*** | **1,4** |
| 07.05.2024 | 35 | 0 | 0 | 0 | ***35*** | **5,6** |
| 08.05.2024 | 99 | 0 | 0 | 4 | ***103*** | **16,5** |
| 09.05.2024 | 48 | 23 | 0 | 0 | ***71*** | **11,4** |
| 10.05.2024 | 50 | 0 | 0 | 13 | ***63*** | **10,1** |
| 11.05.2024 | 7 | 28 | 0 | 1 | ***36*** | **5,8** |
| 12.05.2024 | 10 | 2 | 0 | 3 | ***15*** | **2,4** |
| 13.05.2024 | 17 | 0 | 0 | 0 | ***17*** | **2,7** |
| 14.05.2024 | 32 | 2 | 0 | 0 | ***34*** | **5,4** |
| Total: | **489** | **84** | **7** | **45** | **625** | **100,0** |
| Total (%): | **78,2** | **13,4** | **1,1** | **7,2** | **100,0** | |

### 4.2. Summer (2023)

#### 4.2.1 Audio accounting at stationary points on meteorological masts

The most numerous species according to accounting in the summer on meteorological masts is *Vespertilio murinus*, followed by *Eptesicus serotinus*.

| Species | Summer (10 Aug-13 Sept 2023) | | | Total: | Total (%): |
|---|---|---|---|---|---|
| | Meteomast C11 (A04) | Meteomast A11 (A03) | Meteomast "South" (A02) | | |
| *Eptesicus serotinus* | 81 | 56 | 191 | 328 | **29,8** |
| *Hypsugo savii* | 3 | 3 | 8 | 14 | **1,3** |
| *Nyctalus noctula* | 32 | 40 | 65 | 137 | **12,5** |
| *Pipistrellus pipistrellus* | 0 | 1 | 6 | 7 | **0,6** |
| *Vespertilio murinus* | 200 | 186 | 227 | 613 | **55,8** |
| Total: | **316** | **286** | **497** | **1099** | **100,0** |
| Total (%): | **28,8** | **26,0** | **45,2** | | |

#### 4.2.2 Audio accounting at stationary points

During the reporting period, stationary detectors were installed at 38 registration points, 3 of which are meteorological towers (see Annex). In total, stationary detectors recorded data for 52 detector days, not taking into account the time spent by three detectors on meteorological towers. During this time, 20,009 audio files were recorded with a total size of about 61 GB (see Table 15).

Table. Volume of recorded audio files at stationary points

| Date | Detector №1 | | Detector №2 | | Detector №3 | | Detector №4 | |
|---|---|---|---|---|---|---|---|---|
| | Records, Mb | Files | Records, Mb | Files | Records, Mb | Files | Records, Mb | Files |
| 18.06.2023 | 131 | 48 | not installed | | not installed | | not installed | |
| 19.06.2023 | 59 | 29 | 2270 | 883 | 5670 | 1968 | 4750 | 1356 |
| 20.06.2023 | 70 | 34 | | | | | | |
| 21.06.2023 | 85 | 36 | | | | | | |
| 22.06.2023 | 1880 | 698 | 3930 | 1251 | 1140 | 454 | 362 | 159 |
| 23.06.2023 | 416 | 184 | 9560 | 2939 | 14200 | 3569 | 111 | 49 |
| 24.06.2023 | 161 | 65 | | | | | | |
| 25.06.2023 | 155 | 65 | | | | | | |
| 26.06.2023 | 199 | 91 | 126 | 59 | 35 | 15 | 1980 | 785 |
| 27.06.2023 | 35 | 15 | 1090 | 452 | 2170 | 844 | | |
| 28.06.2023 | 4 | 2 | 996 | 426 | 8010 | 2707 | 264 | 99 |
| 29.06.2023 | 66 | 35 | | | | | | |
| 30.06.2023 | 44 | 21 | 698 | 318 | 20 | 10 | not installed | |
| 01.07.2023 | 694 | 318 | detector on meteomast, data not collected | | detector on meteomast, data not collected | | detector on meteomast, data not collected | |
| 02.07.2023 | 40 | 19 | | | | | | |
| 03.07.2023 | 14 | 6 | | | | | | |
| **In total:** | **4053** | **1666** | **18670** | **6328** | **31245** | **9567** | **7467** | **2448** |
| **In total for all detectors:** | | | | | | | **61435** | **20009** |

The most numerous species according to accounting in the summer on “groind” points is *Myotis sp.* (most likely – *Myotis davidii*, see 4.2.4), followed by *Hypsugo savii*.

| Species | Files with bat calls | Relative abundance, % |
|---|---|---|
| *Eptesicus serotinus* | 11 | 1,0 |
| *Hypsugo savii* | 104 | 9,7 |
| *Myotis sp.* | 947 | 88,3 |
| *Nyctalus noctula* | 0 | 0,0 |
| *Pipistrellus pipistrellus* | 0 | 0,0 |
| *Vespertilio murinus* | 11 | 1,0 |
| Total: | 1073 | 100,0 |

### 4.2.3 Audio detections on transects

During the reporting period, the total length of the survey transects was about 208 km (8 transects of 13 km in two repetitions), along which 432 survey points were located (with a step of 0.5 km) with the inclusion of a mobile detector at each point for 3 minutes. The total duration of transect surveys was almost 22 hours (1296 minutes). During this time, 2219 audio files were recorded with a total volume of about 4.2 GB (see Table).

Table. Quantity of recorded audio files on transects.

| Data | Transect ID | Records, Mb | Files |
|---|---|---|---|
| 18.06.2023 | Plain-4 | 641 | 305 |
| 19.06.2023 | Plain-6 | 128 | 80 |
| 20.06.2023 | Plain-2 | 247 | 134 |
| 21.06.2023 | Plain-1 | 93 | 65 |
| 22.06.2023 | Mountains-5 | 186 | 110 |
| 23.06.2023 | Mountains-4 | 221 | 116 |
| 24.06.2023 | Mountains-3 | 181 | 101 |
| 25.06.2023 | Mountains-2 | 395 | 196 |
| 26.06.2023 | Plain-1 | 163 | 95 |
| 27.06.2023 | Plain-6 | 215 | 115 |
| 28.06.2023 | Mountains-2 | 200 | 110 |
| 29.06.2023 | Mountains-3 | 246 | 130 |
| 30.06.2023 | Mountains-5 | 190 | 110 |
| 01.07.2023 | Mountains-4 | 256 | 127 |
| 02.07.2023 | Plain-2 | 386 | 181 |
| 03.07.2023 | Plain-4 | 511 | 244 |
| | **In total:** | **4259** | **2219** |

The most numerous species according to accounting in the summer on transects is *Hypsugo savii*, followed by *Myotis sp.* (most likely – *Myotis davidii*, see 4.2.4) and *Vespertilio murinus*.

| Date | Transect | *Eptesicus serotinus* | *Hypsugo savii* | *Myotis sp.* | *Vespertilio murinus* | Total: | Total (%): |
|---|---|---|---|---|---|---|---|
| 18.06.2023 | Plain-4 | 0 | 0 | 0 | 0 | ***0*** | **0,0** |
| 19.06.2023 | Plain-6 | 0 | 0 | 0 | 0 | ***0*** | **0,0** |
| 20.06.2023 | Plain-2 | 0 | 0 | 0 | 0 | ***0*** | **0,0** |
| 21.06.2023 | Plain-1 | 0 | 0 | 0 | 0 | ***0*** | **0,0** |
| 26.06.2023 | Plain-1 | 0 | 0 | 0 | 0 | ***0*** | **0,0** |
| 27.06.2023 | Plain-6 | 0 | 5 | 0 | 1 | ***6*** | **21,4** |
| 02.07.2023 | Plain-2 | 0 | 4 | 2 | 0 | ***6*** | **21,4** |
| 03.07.2023 | Plain-4 | 0 | 0 | 1 | 0 | ***1*** | **3,6** |
| 22.06.2023 | Mountains-5 | 0 | 0 | 0 | 0 | ***0*** | **0,0** |
| 23.06.2023 | Mountains-4 | 0 | 2 | 0 | 2 | ***4*** | **14,3** |
| 24.06.2023 | Mountains-3 | 0 | 2 | 0 | 0 | ***2*** | **7,1** |
| 25.06.2023 | Mountains-2 | 0 | 0 | 0 | 0 | ***0*** | **0,0** |
| 28.06.2023 | Mountains-2 | 0 | 0 | 0 | 0 | ***0*** | **0,0** |
| 29.06.2023 | Mountains-3 | 0 | 6 | 0 | 0 | ***6*** | **21,4** |
| 30.06.2023 | Mountains-5 | 2 | 1 | 0 | 0 | ***3*** | **10,7** |
| 01.07.2023 | Mountains-4 | 0 | 0 | 0 | 0 | ***0*** | **0,0** |
| **Total:** | | **2** | **20** | **3** | **3** | **28** | **100,0** |
| **Total (%):** | | **7,1** | **71,4** | **10,7** | **10,7** | **100,0** | |

### 4.2.4 Roost survey results

As a result of a survey of potential shelters, only one species of bats, the steppe bat (*Myotis davidii* (Peters, 1869)), was found. Adult individuals of both sexes and pups not yet capable of independent flight were found (Fig. 56, 57). A survey of potential shelters showed the presence of brood colonies of bats in 4 shelters (three bridges and one culvert tunnel). At the time of the check, the total estimated number of brood colonies of the steppe bat dispersed between shelters in the bridges was about 120 individuals (~60 adults and the same number of young).

Fig. 56. Male bat (*Myotis davidii*) found inside a road bridge.

Fig. 57. Adult females and juveniles of the steppe bat (*Myotis davidii*) from a brood colony in a cavity inside a road bridge.

In total, 8 tunnels and bridges were checked in the northern section and at its borders. When bats were found, they were photographed, their approximate number was counted, and, if possible, individual animals were taken out for morphometric measurements, photographing, and clarifying the species definition “in hands”. After measurements, inspection and photographing, the animals were immediately released at the place of capture.

## 4.3. Autumn (2023)

### 4.3.1 Audio accounting at stationary points on meteorological masts

The most numerous species according to accounting in the autumn on meteorological masts is *Vespertilio murinus*, followed by *Eptesicus serotinus*.

| Species | Autumn (7 Oct-5 Nov 2023) | | | Total: | Total (%): |
|---|---|---|---|---|---|
| | Meteomast C11 (A02) | Meteomast A11 (A03) | Meteomast "South" (A04) | | |
| *Eptesicus serotinus* | 5 | 2 | 9 | 16 | **19,5** |
| *Hypsugo savii* | 0 | 0 | 0 | 0 | **0,0** |
| *Nyctalus noctula* | 1 | 0 | 1 | 2 | **2,4** |
| *Pipistrellus pipistrellus* | 0 | 0 | 1 | 1 | **1,2** |
| *Vespertilio murinus* | 5 | 13 | 45 | 63 | **76,8** |
| Total: | **11** | **15** | **56** | **82** | **100,0** |
| Total (%): | **13,4** | **18,3** | **68,3** | | |

### 4.3.2 Audio detections at stationary points

The most numerous species according to accounting in the autumn on “ground” points is *Pipistrellus pipistrellus*, followed by *Myotis sp.* (most likely – *Myotis davidii*, see 4.2.4), *Nyctalus noctula* and *Hypsugo savii*.

| Species | Files with bat calls | Relative abundance, % |
|---|---|---|
| *Eptesicus serotinus* | 72 | 8,8 |
| *Hypsugo savii* | 88 | 10,8 |
| *Myotis sp.* | 134 | 16,4 |
| *Nyctalus noctula* | 98 | 12,0 |
| *Pipistrellus pipistrellus* | 365 | 44,7 |
| *Vespertilio murinus* | 59 | 7,2 |
| Total: | 816 | 100,0 |

### 4.3.3 Audio accounting on transects

The most numerous species according to accounting in the summer on transects is *Vespertilio murinus*, followed by *Eptesicus serotinus*, *Nyctalus noctula* and *Pipistrellus pipistrellus*.

| Date | *Eptesicus serotinus* | *Hypsugo savii* | *Myotis sp.* | *Nyctalus noctula* | *Pipistrellus pipistrellus* | *Vespertilio murinus* | Total: | Total (%): |
|---|---|---|---|---|---|---|---|---|
| 19.09.2023 | 1 | 0 | 0 | 1 | 4 | 0 | **6** | **11,5** |
| 20.09.2023 | 3 | 1 | 0 | 3 | 0 | 0 | **7** | **13,5** |
| 22.09.2023 | 0 | 0 | 4 | 0 | 0 | 3 | **7** | **13,5** |
| 23.09.2023 | 5 | 0 | 1 | 4 | 3 | 16 | **29** | **55,8** |
| 24.09.2023 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0,0** |
| 25.09.2023 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0,0** |
| 26.09.2023 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0,0** |
| 27.09.2023 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0,0** |
| 28.09.2023 | 0 | 0 | 0 | 0 | 0 | 2 | **2** | **3,8** |
| 29.09.2023 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0,0** |
| 30.09.2023 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0,0** |
| 01.10.2023 | 0 | 0 | 0 | 0 | 1 | 0 | **1** | **1,9** |
| 02.10.2023 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0,0** |
| 04.10.2023 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0,0** |
| Total: | **9** | **1** | **5** | **8** | **8** | **21** | **52** | **100,0** |
| Total (%): | **17,3** | **1,9** | **9,6** | **15,4** | **15,4** | **40,4** | **100,0** | |

## 4.4. Results of the bat survey for spring, summer and autumn

### 4.4.1 Audio detections at stationary points on meteorological masts

The most numerous species according to accounting in the spring, summer and autumn on meteorological masts is *Vespertilio murinus*, followed by *Eptesicus serotinus*.

| Species | Spring, summer and autumn | | | Total: | Total (%): |
|---|---|---|---|---|---|
| | Meteomast C11 | Meteomast A11 | Meteomast "South" | | |
| *Eptesicus serotinus* | 100 | 75 | 305 | **480** | **35,2** |
| *Hypsugo savii* | 3 | 3 | 12 | **18** | **1,3** |
| *Nyctalus noctula* | 40 | 47 | 93 | **180** | **13,2** |
| *Pipistrellus pipistrellus* | 0 | 1 | 10 | **11** | **0,8** |
| *Vespertilio murinus* | 205 | 199 | 272 | **676** | **49,5** |
| Total: | **348** | **325** | **692** | **1365** | **100,0** |
| Total (%): | **25,5** | **23,8** | **50,7** | | |

### 4.4.2 Audio detections at stationary points

The most numerous species according to detections in the spring, summer and autumn at stationary points is *Myotis sp.* (most likely – *Myotis davidii*, see 4.2.4), followed by *Vespertilio murinus*, *Eptesicus serotinus*, *Hypsugo savii* and *Pipistrellus pipistrellus*.

| Species | Spring | | Summer | | Autumn | | Three seasons | |
|---|---|---|---|---|---|---|---|---|
| | Files with bat calls | Relative abundance, % | Files with bat calls | Relative abundance, % | Files with bat calls | Relative abundance, % | Files with bat calls | Relative abundance, % |
| *Eptesicus serotinus* | 406 | 22,6 | 11 | 1,0 | 72 | 8,8 | 489 | 13,3 |
| *Hypsugo savii* | 252 | 14,0 | 104 | 9,7 | 88 | 10,8 | 444 | 12,1 |
| *Myotis sp.* | 205 | 11,4 | 947 | 88,3 | 134 | 16,4 | 1286 | 34,9 |
| *Nyctalus noctula* | 116 | 6,5 | 0 | 0,0 | 98 | 12,0 | 214 | 5,8 |
| *Pipistrellus pipistrellus* | 3 | 0,2 | 0 | 0,0 | 365 | 44,7 | 368 | 10,0 |
| *Vespertilio murinus* | 812 | 45,3 | 11 | 1,0 | 59 | 7,2 | 882 | 23,9 |
| Total: | 1794 | 100,0 | 1073 | 100,0 | 816 | 100,0 | 3683 | 100,0 |

### 4.4.3 Audio detections on transects

The most numerous species according to detections in the spring, summer and autumn on transects is *Eptesicus serotinus*, followed by *Hypsugo savii and Nyctalus noctula*.

| Date | Bat calls | *Eptesicus serotinus* | *Hypsugo savii* | *Myotis sp.* | *Nyctalus noctula* | *Pipistrellus pipistrellus* | *Vespertilio murinus* | Total: | Total (%): |
|---|---|---|---|---|---|---|---|---|---|
| Spring (25.04-14.05.2024) | files with bat calls | 489 | 84 | 7 | 45 | 0 | 0 | **625** | **88,7** |
| | files with bat calls, % | 78,2 | 13,4 | 1,1 | 7,2 | 0,0 | 0,0 | **100** | |
| Summer (18.06-03.07.2023) | files with bat calls | 2 | 20 | 3 | 0 | 0 | 3 | **28** | **4,0** |
| | files with bat calls, % | 7,1 | 71,4 | 10,7 | 0,0 | 0,0 | 10,7 | **100** | |
| Autumn (19.09-04.10.2023) | files with bat calls | 9 | 1 | 5 | 8 | 8 | 21 | **52** | **7,4** |
| | files with bat calls, % | 17,3 | 1,9 | 9,6 | 15,4 | 15,4 | 40,4 | **100** | |
| Total: | | **500** | **105** | **15** | **53** | **8** | **24** | **705** | |
| Total (%): | | **70,9** | **14,9** | **2,1** | **7,5** | **1,1** | **3,4** | **100** | |

## 5 Conclusions and general recommendations

### 5.1. Species composition

Ultrasonic calls of at least 6 bat species were found in the project area: *Eptesicus serotinus, Hypsugo savii, Myotis davidii, Nyctalus noctula, Pipistrellus pipistrellus, and Vespertilio murinus*. The most common species in the wind farm area are *Vespertilio murinus, Eptesicus serotinus, Nyctalus noctula* according to passive detectors operating at a height of 50 m on meteorological masts. The calls of other species were much less frequent. Findings resulting from the other survey methods are slightly different. In the summer, according to terrestrial ultrasound detectors, calls of the *Myotis* sp. dominated. However,, in both the autumn and in the spring there were not large number of the *Myotis* calls recorded. At the same time, the calls of other bat species in the summer were both numerous in spring and autumn. This is assessed to be as a result of differences in the nature of the utilisation of the of the study area by different species. *Myotis davidii* uses this territory to raise offspring - therefore, its calls were most numerous on ground recordings made by detectors in the summer. Other species are most likely not very actively using this territory in the summer. However, in spring and autumn other species, mainly high- and medium-flying, are very intensively flying over this territory, heading from hibernating sites to summer habitats or vice versa (in the autumn).

All bat species, which calls were detected on the project area, are classified as LC ("Least concern", IUCN) and are not considered threatened. The Red Book of the Republic of Kazakhstan (2010) does not include species of bats recorded in the study area of the planned wind farm. The fact that none of these listed species was detected during the acoustic monitoring effort provides an indication that the Project is not likely to generate impacts to any protected bat species.

But bats, whose calls have been recorded at the site, have a risk of collision with the wind turbine. The four most abundant species at height 50 m (*Nyctalus noctula, Vespertilio murinus, Eptesicus serotinus, Hypsugo savii*) have high to medium collision risk (Roemer et al., 2017; Wellig et al., 2018).

### 5.2. General recommendations

Bats whose calls were recorded on the site (*Nyctalus noctula, Vespertilio murinus, Eptesicus serotinus, Hypsugo savii*) have a risk of colliding with a wind turbines. This risk is particularly high during spring and autumn migration periods. In the case of building a wind farm in this area, it will be necessary to limit the operation of wind turbines for the duration of these migrations using curtailment measures, to be specified. In the spring, this should be taken as April 20 until May 20, when the most intense migration is occurring.. In the autumn, the curtailment of wind turbines will be required from August 20 to the end of September. These curtailments in spring and autumn can be reasonably expected to significantly reduce the mortality of bats that are passaging through the territory of the planned wind park.

According to numerous studies conducted in Europe, these species often suffer mortality when wind turbines are in operation by direct collision or from barotrauma in the absense of mitigation.. Bat reproduction rates are low, producing 1-2 cub per year, which is why they cannot quickly restore their populations after their reduction as a result of any negative impacts (natural disasters or human activity). As measures to reduce bat mortality, two options have been tested that significantly reduce the mortality of these animals with minimal losses for electricity generation. The first option includes the use of special control devices which result in an increase of the cut-in wind speed and / or feathering of blades during low wind speed conditions when bats approach (e.g. SMART system from Wildlife Acoustics - SMART System | Wildlife Acoustics).

The potential negative impact of wind turbines on bats (death from collisions, barotrauma) in the project area can be minimized if automated ultrasonic detectors to estimate the activity and identity of bats in the zone of highest mortality risk at wind turbine will be used 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 bats activity in the project area most likely occurs at nights with low wind speed, when the efficiency of power generation is low (Arnett et al., 2011; Peterson, 2020). As known, 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 in days when a high activity of bats is registered. This will prevent massive death of bats and the associated risks of "environmental" damage.

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Annexes

Annex 1. Coordinates of the “ground” static detection bat points and dates of their observations

| Date | № detector | Points ID | Files |
|---|---|---|---|
| 25.04.2024 | A01 | north3 | 225 |
| 25.04.2024 | A02 | north2 | 72 |
| 25.04.2024 | A03 | north4 | 373 |
| 25.04.2024 | A04 | north5 | 46 |
| 27.04.2024 | A01 | south32 | 24 |
| 27.04.2024 | A02 | south31 | 21 |
| 27.04.2024 | A03 | south30 | 21 |
| 27.04.2024 | A04 | south29 | 96 |
| 29.04.2024 | A01 | south20 | 52 |
| 29.04.2024 | A02 | south19 | 58 |
| 29.04.2024 | A03 | south18 | 80 |
| 29.04.2024 | A04 | south17 | 45 |
| 01.05.2024 | A01 | south25 | 15 |
| 01.05.2024 | A02 | south26 | 20 |
| 01.05.2024 | A03 | south27 | 43 |
| 01.05.2024 | A04 | south28 | 25 |
| 03.05.2024 | A01 | south24 | 51 |
| 03.05.2024 | A02 | south22 | 27 |
| 03.05.2024 | A03 | south21 | 47 |
| 03.05.2024 | A04 | south23 | 43 |
| 05.05.2024 | A01 | north9 | 70 |
| 05.05.2024 | A02 | north7 | 13 |
| 05.05.2024 | A03 | north8 | 22 |
| 05.05.2024 | A04 | north6 | 40 |
| 07.05.2024 | A01 | south32 | 104 |
| 07.05.2024 | A02 | south31 | 114 |
| 07.05.2024 | A03 | south30 | 219 |
| 07.05.2024 | A04 | south29 | 39 |
| 09.05.2024 | A01 | south20 | 233 |
| 09.05.2024 | A02 | south19 | 141 |
| 09.05.2024 | A03 | south18 | 268 |
| 09.05.2024 | A04 | south17 | 158 |
| 11.05.2024 | A01 | south25 | 12 |
| 11.05.2024 | A02 | south26 | 16 |
| 11.05.2024 | A03 | south27 | 36 |
| 11.05.2024 | A04 | south28 | 33 |
| 13.05.2024 | A01 | south24 | 23 |
| 13.05.2024 | A02 | south22 | 39 |
| 13.05.2024 | A03 | south21 | 30 |
| 13.05.2024 | A04 | south23 | 34 |
| Total: | | | 3028 |

| Spring (2024) | | |
|---|---|---|
| Points ID | Coordinates | |
| | N | E |
| north2 | 44° 51.913′ | 073° 28.982′ |
| north3 | 44° 52.775′ | 073° 27.279′ |
| north4 | 44° 54.030′ | 073° 15.585′ |
| north5 | 44° 56.108′ | 073° 11.924′ |
| north6 | 44° 57.424′ | 073° 08.823′ |
| north7 | 44° 56.007′ | 073° 13.121′ |
| north8 | 44° 55.520′ | 073° 11.166′ |
| north9 | 44° 53.930′ | 073° 14.060′ |
| south17 | 44° 28.882′ | 073° 35.586′ |
| south18 | 44° 31.207′ | 073° 33.857′ |
| south19 | 44° 31.983′ | 073° 32.367′ |
| south20 | 44° 33.592′ | 073° 29.425′ |
| south21 | 44° 35.582′ | 073° 27.206′ |
| south22 | 44° 36.663′ | 073° 25.110′ |
| south23 | 44° 37.955′ | 073° 27.242′ |
| south24 | 44° 39.112′ | 073° 20.963′ |
| south25 | 44° 40.922′ | 073° 25.164′ |
| south26 | 44° 42.521′ | 073° 24.033′ |
| south27 | 44° 44.929′ | 073° 17.684′ |
| south28 | 44° 46.106′ | 073° 14.607′ |
| south29 | 44° 46.081′ | 073° 10.475′ |
| south30 | 44° 48.359′ | 073° 09.439′ |
| south31 | 44° 50.642′ | 073° 10.959′ |
| south32 | 44° 50.368′ | 073° 13.843′ |

| Summer (2023) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Date | Detector 1, coord. | | Detector 2, coord. | | Detector 3, coord. | | Detector 4, coord. | |
| | N | E | N | E | N | E | N | E |
| 18.06.2023 | 44.85023 | 73.39798 | not installed | | not installed | | not installed | |
| 19.06.2023 | 44.924707 | 73.332136 | 44.8114 | 73.422041 | 44.879575 | 73.454647 | 44.86522 | 73.483037 |
| 20.06.2023 | 45.011206 | 73.264092 | 44.8114 | 73.422041 | 44.879575 | 73.454647 | 44.86522 | 73.483037 |
| 21.06.2023 | 44.860672 | 73.471923 | 44.8114 | 73.422041 | 44.879575 | 73.454647 | 44.86522 | 73.483037 |
| 22.06.2023 | 44.710181 | 73.248383 | 44.696081 | 73.24238 | 44.707499 | 73.250718 | 44.705875 | 73.252516 |
| 23.06.2023 | 44.572274 | 73.476635 | 44.50938 | 73.519864 | 44.520425 | 73.51179 | 44.547705 | 73.474391 |
| 24.06.2023 | 44.564889 | 73.377441 | 44.50938 | 73.519864 | 44.520425 | 73.51179 | 44.547705 | 73.474391 |
| 25.06.2023 | 44.475672 | 73.511412 | 44.50938 | 73.519864 | 44.520425 | 73.51179 | 44.547705 | 73.474391 |
| 26.06.2023 | 44.885683 | 73.402735 | 44.886263 | 73.399584 | 44.888331 | 73.402334 | 44.900507 | 73.259751 |
| 27.06.2023 | 44.909154 | 73.288789 | 44.957067 | 73.147048 | 44.935137 | 73.198736 | 44.900507 | 73.259751 |
| 28.06.2023 | 44.553517 | 73.553697 | 44.520446 | 73.529176 | 44.513208 | 73.548514 | 44.481721 | 73.584123 |
| 29.06.2023 | 44.611104 | 73.432463 | 44.520446 | 73.529176 | 44.513208 | 73.548514 | 44.481721 | 73.584123 |
| 30.06.2023 | 44.7017 | 73.290266 | 44.702843 | 73.287 | 44.703316 | 73.282794 | | |
| 01.07.2023 | 44.656868 | 73.274811 | standby mode | | standby mode | | standby mode | |
| 02.07.2023 | 44.964473 | 73.20342 | standby mode | | standby mode | | standby mode | |
| 03.07.2023 | 44.852522 | 73.399851 | standby mode | | standby mode | | standby mode | |

| Autumn (2023) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date | № detector | Coordinates | | Date | № detector | Coordinates | |
| | | N | E | | | N | E |
| 17.09.2023 | A01 | 47,68112° | 072,41996° | 29.09.2023 | A01 | 44,57143° | 073,47662° |
| 19.09.2023 | A01 | 44,57143° | 073,47662° | 29.09.2023 | A02 | 44,58122° | 073,42665° |
| 19.09.2023 | A02 | 44,48182° | 073,58425° | 29.09.2023 | A03 | 44,52045° | 073,52918° |
| 19.09.2023 | A03 | 44,51321° | 073,54851° | 29.09.2023 | A04 | 44,56553° | 073,46363° |
| 19.09.2023 | A04 | 44,50938° | 073,51986° | 30.09.2023 | A04 | 44,64002° | 073,30356° |
| 20.09.2023 | A01 | 44,56708° | 073,37548° | 01.10.2023 | A01 | 44,65751° | 073,27394° |
| 20.09.2023 | A02 | 44,52042° | 073,51179° | 01.10.2023 | A02 | 44,61600° | 073,39071° |
| 20.09.2023 | A03 | 44,54770° | 073,47439° | 01.10.2023 | A03 | 44,59155° | 073,36474° |
| 20.09.2023 | A04 | 44,63646° | 073,32229° | 02.10.2023 | A01 | 44,61171° | 073,43235° |
| 21.09.2023 | A01 | 44,70802° | 073,24872° | 02.10.2023 | A04 | 44,62998° | 073,45136° |
| 22.09.2023 | A02 | 44,64002° | 073,30356° | 03.10.2023 | A01 | 44,87167° | 073,24060° |
| 22.09.2023 | A03 | 44,66002° | 073,26516° | 03.10.2023 | A02 | 44,92533° | 073,18611° |
| 22.09.2023 | A04 | 44,68662° | 073,25924° | 03.10.2023 | A03 | 44,93345° | 073,21868° |
| 23.09.2023 | A01 | 44,49215° | 073,51638° | 03.10.2023 | A04 | 44,89883° | 073,23434° |
| 24.09.2023 | A01 | 44,87960° | 073,48555° | 04.10.2023 | A01 | 44,688568° | 073,40274° |
| 24.09.2023 | A02 | 44,81140° | 073,42204° | 04.10.2023 | A02 | 44,688568° | 073,40274° |
| 24.09.2023 | A03 | 44,87958° | 073,45465° | 04.10.2023 | A03 | 44,88443° | 073,39931° |
| 24.09.2023 | A04 | 44,86522° | 073,48304° | 04.10.2023 | A04 | 44,88708° | 073,39968° |
| 25.09.2023 | A01 | 44,85201° | 073,39948° | 06.10.2023 | A01 | 47,73964° | 072,92334° |
| 26.09.2023 | A01 | 44,91259° | 073,26523° | 07.10.2023 | A01 | 47,51878° | 073,79707° |
| 26.09.2023 | A02 | 44,90051° | 073,25975° | 08.10.2023 | A01 | 47,78693° | 074,80240° |
| 26.09.2023 | A03 | 44,93514° | 073,19874° | 09.10.2023 | A01 | 47,97683° | 075,60941° |
| 26.09.2023 | A04 | 44,95707° | 073,14705° | 10.10.2023 | A01 | 48,28404° | 075,55942° |
| 27.09.2023 | A01 | 45,01172° | 073,26429° | 11.10.2023 | A01 | 48,45540° | 075,41896° |
| 28.09.2023 | A01 | 44,91259° | 073,26523° | | | | |