National Academy of Sciences of Ukraine
Ministry of Education and Science of Ukraine

Bogdan Khmelnitsky Melitopol State Teachers' Training University, the Research Institute for Biodiversity of Ukraine's Terrestrial and Water Ecosystems, Biodiversity Research and Training Centre, the Azov and Black Sea Interdepartmental Ornithological Station at I.I. Shmalgauzen Zoology Institute of the National Academy of Sciences of Ukraine and Bogdan Khmelnitsky MSTTU, Laguna Ecological Non-Government Organization

SCIENTIFIC REPORT

on Development of the Scientific and Technical Product on the Project Section:

Description of Species Composition and Territorial Distribution of Bats in the Course of Spring and Autumn Migration, Breeding within the Site of EUROCAPE Wind Park and Adjacent Territories

(Stage I – information report, 2016)

Contract No. 03l/07 - 16 dated 02.08.2016

Melitopol, 2016

AUTHORS

P.I. Gorlov, Candidate of Biological Science, Senior Researcher (Biodiversity Research and Training Centre, the Research Institute for Biodiversity of Ukraine's Terrestrial and Water Ecosystems, the Azov and Black Sea Ornithological Station)

V.D. Siokhin, Associate Professor, Correspondent Member of the Ukrainian Ecological Academy of Sciences, Candidate of Biological Science (Biodiversity Research and Training Centre, the Research Institute for Biodiversity of Ukraine's Terrestrial and Water Ecosystems, the Azov and Black Sea Ornithological Station)

A.M. Volokh, Doctor of Biological Science (Tavria State Agrotechnological University, Melitopol)

I.K. Polishchuk, Senior Research Fellow (Askania Nova Biosphere Reserve)

I.B. Salnykova-Budenko, Research Fellow (Biodiversity Research and Training Centre, the Research Institute for Biodiversity of Ukraine's Terrestrial and Water Ecosystems)

V.I. Dolynnyi, Junior Research Fellow (Biodiversity Research and Training Centre, the Research Institute for Biodiversity of Ukraine's Terrestrial and Water Ecosystems)

O.A. Ilyichov, Leading Engineer (Biodiversity Research and Training Centre)

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SCIENTIFIC REPORT

concerning the Development of the Scientific and Technical Product on the Topic

DESCRIPTION OF SPECIES COMPOSITION, DISTRIBUTION, NUMBERS AND ACTIVITY OF BATS AT THE SITES OF EUROCAPE WIND PARK AND IN THE ADJACENT TERRITORIES

(Stage I – interim report)

Melitopol, 2016

AUTHORS

V.D. Siokhin, Associate Professor, Correspondent Member of the Ukrainian Ecological Academy of Sciences, Candidate of Biological Science (the Research Institute for Biodiversity of Ukraine's Terrestrial and Water Ecosystems, the Azov and Black Sea Ornithological Station)

A.M. Volokh, Doctor of Biological Science (Tavria State Agrotechnological University, Melitopol)

I.K. Polishchuk, Senior Research Fellow (Askania Nova Biosphere Reserve)

P.I. Gorlov, Candidate of Biological Science, Senior Researcher (the Research Institute for Biodiversity of Ukraine's Terrestrial and Water Ecosystems, the Azov and Black Sea Ornithological Station)

V.I. Dolynnyi, Research Fellow (the Research Institute for Biodiversity of Ukraine's Terrestrial and Water Ecosystems)

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CHAPTER 1. Technical Approaches to Organizational Management and Research Techniques

1.1. Methodological foundation of the selection of points for listening to bats

Taking into consideration the necessity of thorough study of bats' behaviour within the territory being investigated [1, 2], 12 points for listening to bats have been selected, which cover in full the territory being planned for the construction of the wind park, buffer zones and human settlements (Table 1, Fig. 1).

Territory of the wind park

Planning layout diagram of wind turbine generators within the whole territory of the wind park enables to draw conventionally a boundary line between slightly lesser its northern part and larger southern one (Fig. 1). 7 points in all for listening to space by means of ultrasonic detectors are located within the wind park (3 at the north part and 4 at the southern one). The territory is represented by almost continuous agricultural lands, where 6 points are placed (Points No.No. 3, 5, 7 - 10). Only in the north (near Mordvynivka Village of Melitopol District) woodland (700 x 800 m) is situated, one more point is located just at its boundary (Point No. 2).

Buffer zones

To study bats, which may pass long distances during search of food owing to peculiarities of their biology, it is worth to research the situation with animals' activity in the territories adjacent to the wind park sites. Two points located to the west of the wind park turned out to be the most interesting, at the coast of the Molochnyi Estuary in its upper (Point No. 1) and lower part (Point No. 11).

Human settlements

It is generally known that bats are attracted by human settlements owing to more favourable conditions for feeding. Building lights and street lighting attract many insects and moths, which are objects of bats' hunting. Just because we have placed two listening points in the Villages of Mordvynivka (Point No. 4) and Nadezhdine, Pryazovske District (Point No. 6) to reveal the level of bats' activity, species composition and to record the beginning and ending of some phenological phenomena (seasonal migrations, feeding, start of wintering).

Control point

To check the assumption, existent in the literature, that the main migratory corridors of bats pass along beds of big rivers, the estuaries and seashores, we have placed a control observation point at the coast of the Sea of Azov near the Village of Stepanivka Persha, Pryazovske District (Point No. 12).

So, selected layout chart of points for listening to bats in the region of researches meets completely the requirements of objective assessment of the situation with chiropterous fauna.

Landscape and biotopical detailing of points for listening to bats is presented in Fig. 2.

Table 1. Description of Monitoring Points for Listening to Space by means of Pettersson D240x Ultrasonic Detector in the territory of Zaporizhia Wind Park

Point No.	Coordinates		Biotope	Functional zone
	N	E		
1	46.670399	35.354463	Coast of the Molochnyi Estuary	Buffer zone
2	46.744717	35.413738	Woodland / agrocenosis	Wind park
3	46.732325	35.408498	Agricultural hedgerow / agrocenosis	Wind park
4	46.726005	35.371171	Human settlement	Mordvynivka Village
5	46.728152	35.481045	Agricultural hedgerow / agrocenosis	Wind park
6	46.692744	35.443862	Human settlement	Nadezhdine Village
7	46.669649	35.442083	Agricultural hedgerow / agrocenosis	Wind park
8	46.633546	35.479755	Agricultural hedgerow / agrocenosis	Wind park
9	46.639117	35.528214	Agricultural hedgerow / agrocenosis	Wind park
10	46.593254	35.455593	Agricultural hedgerow / agrocenosis	Wind park
11	46.534509	35.380800	Coast of the Molochnyi Estuary	Buffer zone
12	46.456500	35.505613	Coast of the Sea of Azov	Control point

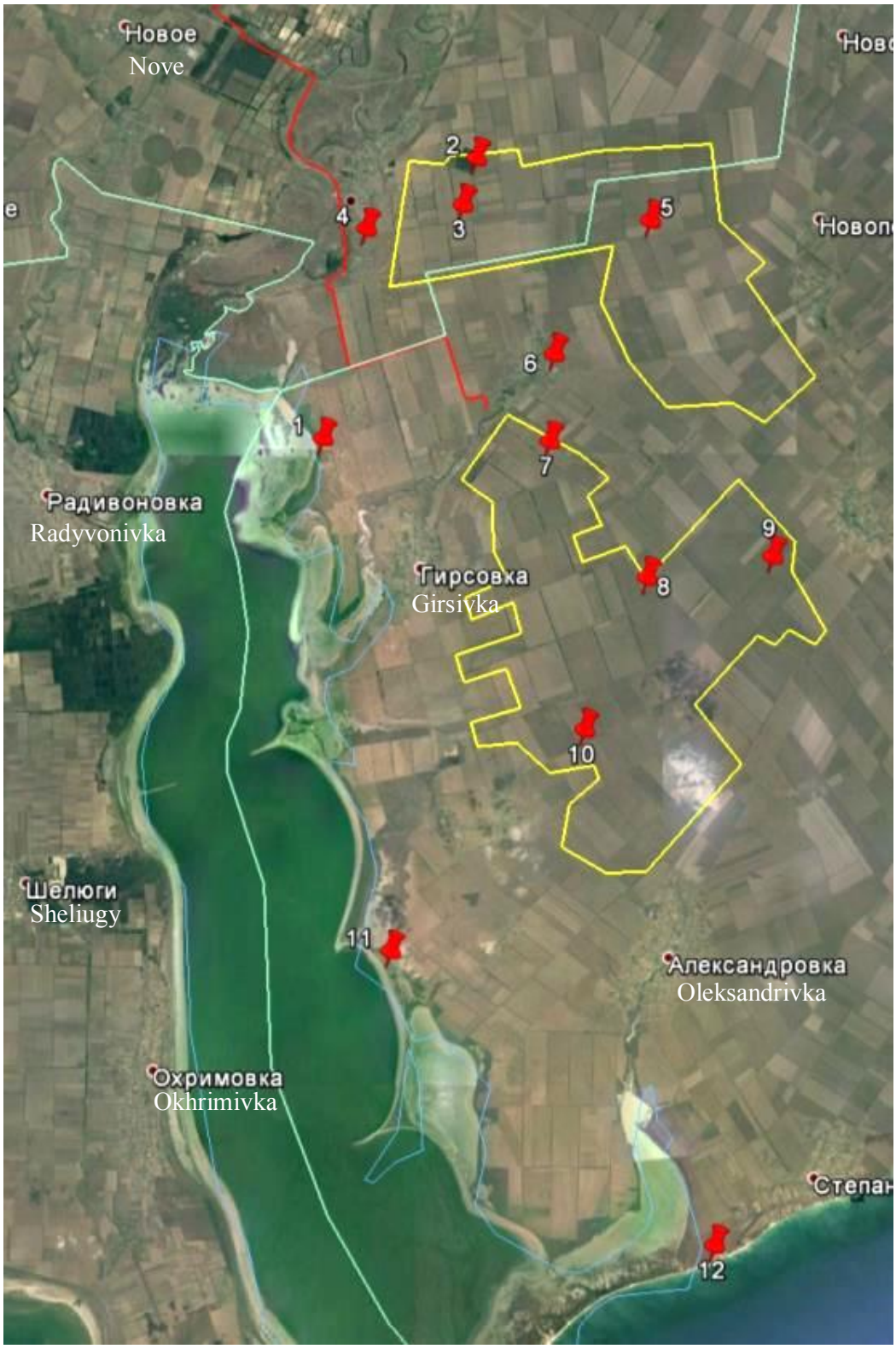


Fig. 1. Layout diagram of monitoring points for listening to bats by means of Pettersson D240x ultrasonic detector
(- boundaries of EuroCape Wind Park; - 330 kV OTL)

Point No. 1

Point No. 2

Point No. 3

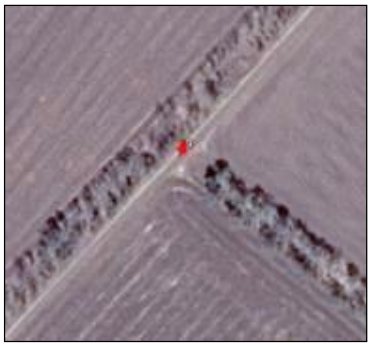
Point No. 4

Point No. 5

Point No. 6

Point No. 7

Point No. 8



Point No. 9

Point No. 10

Point No. 11

Point No. 12

Fig. 2. Landscape and biotopical detailing of points for listening to bats (1 - 12)

1.2. Research techniques

Spatial distribution and flying activity of bats have been determined at 12 stationary points, with counting of quantity of sounds received by Pettersson D 240x ultrasonic detector within 10 minutes of listening to air space. While moving by motor car from point to point, we have also carried out visual observation, as far as illumination permits.

Additional observations were also carried out in the territories adjacent to the sites of Zaporizhia Wind Park by means of more powerful ultrasonic detector Pettersson D 500x. Following places were selected as stationary listening points: Melitopol City (in the middle of the area of single story buildings); Stepanivka Persha Village (in 500 m from Point No. 12; see Table 1 and Fig. 1 and 2); the Obytichna Spit (woodland) and Botieve Village (agricultural hedgerow). Such researches enable to collect material for revealing species diversity of bats in the region, to compare them with the data obtained within Zaporizhia Wind Park, and the overall picture of seasonal migrations of animals gives grounds for objective comparison of processes both within the wind park, which is planned, and in the adjacent territories.

Detailed description of field visits is presented in Table 2.

Table 2. Description of Field Studies of Bats in August - October, 2016

Date		Pettersson D 240x			Pettersson D 500x			Total		
		sounds	minutes	records	sounds	minutes	place	sounds	minutes	records
August 06 - 07, 2016		78	289	45	172	433	Melitopol City	250	**722**	**217**
August 07 - 08, 2016		93	299	50	-	-		93	**299**	**50**
August 23 - 24, 2016		81	342	59	377	533	Stepanivka Persha Vil.	458	**875**	**436**
August 27 - 28, 2016		-	-	-	506	560	Stepanivka Persha Vil.	506	**560**	**506**
September 03-04, 2016		-	-	-	420	569	Stepanivka Persha Vil.	420	**569**	**420**
September 14-15, 2016		-	-	-	616	571	the Obytichna Spit	616	**571**	**616**
September 15-16, 2016		49	338	37				49	**338**	**37**
September 16-17, 2016		-	-	-	137	505	Melitopol City	137	**505**	**137**
September 17-18, 2016		-	-	-	300	614	Stepanivka Persha Vil.	300	**614**	**300**
September 20-21, 2016		46	323	38	-	-		46	**323**	**38**
October 06 - 07, 2016		41	327	33	29	465	Botieve Village	70	**792**	**62**
October 11 - 12, 2016		6	388	4	-	-		6	**388**	**4**
October 12 - 13, 2016		0	0	0	-	-		0	**0**	**0**
October 28 - 29, 2016		23	337	20	-	-		23	**337**	**20**
Total	**abs.**	**417**	**2,643**	**286**	**2,557**	**4,250**		**2,974**	**6,893**	**2,843**
	average	**46.3**	**293.7**	**31.8**	**319.6**	**531.3**		**212.4**	**492.4**	**203.1**

Species of bats have been identified by spectrograms of their signals, created by means of BatSound414 computer program (Fig. 3; Table 3).

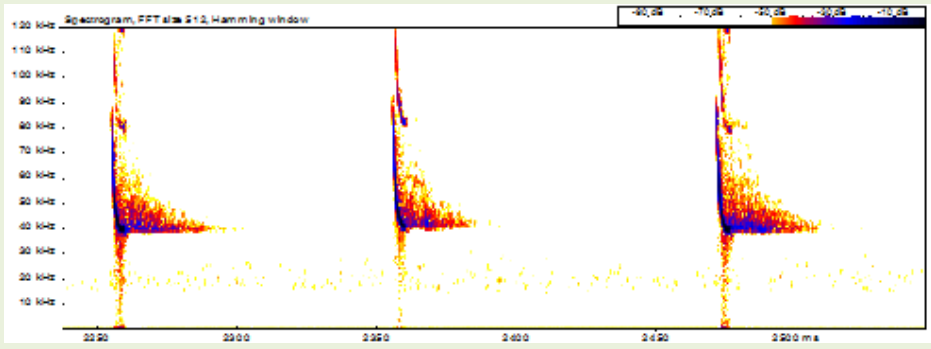
File	Average interpulse interval, ms	Pulse duration, ms	Upper limit, kHz	During the maximum sound power, kHz	Lower limit, kHz
M00316	**101.2**	**7.62**	**95.4**	**39.5**	**36.2**
Kuhl's pipistrelle *Pipistrellus kuhlii* (Kuhl, 1817)					
					

Fig. 3. Sonogram of Kuhl's pipistrelle (*Pipistrellus kuhlii*) and its basic parameters

Table 3. Basic Parameters of Sound Signals of European Bats

Species	Pulse duration, ms	Frequency, kHz				Source of information
		upper	central	during max sound power	lower	
Lesser horseshoe bat *Rhinolophus hipposideros* (Bechstein, 1800)	–	–	–	110 (110 – 117)	–	[3]
	21.6	110.6	–	107.5	89.8	[4]
	45 ± 10.46	93.88 ± 3.42	111.82 ± 1.46	111.57 ± 0.98	91.31 ± 4.88	[5]
Greater horseshoe bat *Rhinolophus ferrumequinum* (Schreber, 1774)	–	–	–	83 (80 – 90)	–	[3]
	22.7	84.1	–	79.7	69.1	[4]
	55.93 ± 20.69	67.4 ± 2.37	82.69 ± 0.43	82.26 ± 0.27	63.95 ± 3.66	[5]
Greater mouse-eared bat *Myotis myotis* (Borkhausen, 1797)	–	–	–	35 (30 – 35)	–	[3]
	6.0	86.0	–	37.1	22.2	[4]
Bechstein's bat *Myotis bechsteinii* (Kuhl, 1817)	–	–	–	45 (45)	–	[3]
	4.3	103.5	–	48.4	26.5	[4]
	1.84 ± 0.48	117.57 ± 13.78	75.37 ± 7.5	71.92 ± 4.74	37.47 ± 3.45	[5]
Natterer's bat *Myotis nattereri* (Kuhl, 1817)	4.1	108.6	–	40.4	14.0	[4]
	3.17 ± 3.5	125.49 ± 20.97	73.24 ± 27.88	60.29 ± 27.85	24.9 ± 2.46	[5]
Geoffroy's bat *Myotis emarginatus* (Geoffroy, 1806)	–	–	–	50	–	[3]
	3.6	113.1	–	45.7	27.5	[4]
Brandt's bat *Myotis brandtii* (Eversmann, 1845)	–	–	–	45	–	[3]
	4.6	103.6	–	45.7	27.5	[4]
	4.15 ± 1.19	106.93 ± 10.01	60.06 ± 7.8	53.96 ± 3.36	31.13 ± 7.39	[5]
Whiskered bat *Myotis mystacinus* (Kuhl, 1817)	–	–	–	45	–	[3]
	3.6	99.7	–	46.8	27.9	[4]
	2.64 ± 0.83	106.2 ± 19.28	63.79 ± 9.4	54.32 ± 7.87	33.16 ± 8.66	[5]
Pond bat *Myotis dasycneme* (Boie, 1825)	–	–	–	35	–	[3]
Daubenton's bat *Myotis daubentonii* (Kuhl, 1817)	–	–	–	45 (45 – 50)	–	[3]
	3.9	81.2	–	42.7	27.3	[4]
	2.72 ± 1.28	87.86 ± 6.89	56.42 ± 4.31	55.13 ± 6.24	31.87 ± 4.31	[5]
Brown long-eared bat (common long-eared bat) *Plecotus auritus* (Linnaeus, 1758)	–	–	–	25.45	–	[3]
	2.9	55.7	–	37.7	22.7	[4]
	0.82 ± 0.53	52.73 ± 17.72	51.17 ± 18.01	50.47 ± 19.70	37.4 ± 19.88	[5]
Grey long-eared bat *Plecotus austriacus* (Fischer, 1829)	–	–	–	25.45	–	[3]
	5.8	45.3	–	36	18.0	[4]

Species	Pulse duration, ms	Frequency, kHz				Source of information
		upper	central	during max sound power	lower	
Western barbastelle *Barbastella barbastellus* Schreber, 1774	–	–	–	35.65	–	[3]
	4.3	48.3	–	36.0	25.7	[4]
	2.91 ± 1.22	38.76 ± 9.04	34.45 ± 6.89	34.24 ± 6.89	27.99 ± 6.46	[5]
Lesser noctule *Nyctalus leisleri* (Kuhl, 1817)	–	–	–	25 – 30	–	[3]
	9.3	49.4	–	27.4	22.1	[4]
	7.37 ± 3.34	63.48 ± 16.84	32.23 ± 4.88	31.01 ± 3.91	26.86 ± 4.48	[5]
Common noctule *Nyctalus noctula* (Schreber, 1774)	–	–	–	20 (18 – 24)	–	[3]
	14.4	33.8	–	22.1	17.7	[4]
	15.56 ± 10.91	36.4 ± 20.46	24.55 ± 5.24	23.68 ± 4.62	21.75 ± 4.03	[5]
Giant noctule *Nyctalus lasiopterus* (Schreber,1780)	–	–	–	20	–	[3]
Kuhl's pipistrelle *Pipistrellus kuhlii* (Kuhl, 1817)	–	–	–	38 – 40	–	[3]
	6.3	63.6	–	39.6	33.6	[4]
Nathusius' pipistrelle *Pipistrellus nathusii* (Keyserling, Blasius, 1839)	–	–	–	35 – 38	–	[3]
	6.9	61.5	–	41.3	36.1	[4]
Common pipistrelle *Pipistrellus pipistrellus* (Schreber, 1774)	–	–	–	58 (40 – 50)	–	[3]
	6.3	73.8	–	47.4	42.6	[4]
	5.23 ± 2.94	81.31 ± 15.11	47.61 ± 3.47	46.63 ± 2.67	44.92 ± 3.15	[5]
	–	–	–	45	–	[6]
Pygmy pipistrelle *Pipistrellus pygmaeus* (Leach, 1825)	6.0	84.1	–	56.2	51.5	[4]
	7.47 ± 2.59	95.7 ± 20.51	53.22 ± 2.27	52.73 ± 2.08	50.82 ± 3.32	[5]
	–	–	–	55	–	[6]
Savi's pipistrelle *Hypsugo savii* (Bonaparte, 1837)	–	–	–	35	–	[3]
	7.3	48.2	–	24.6	20.2	[4]
Parti-coloured bat or rearmouse *Vespertilio murinus* Linnaeus, 1758	–	–	–	28	–	[3]
	15.0	35.8	–	24.6	20.2	[4]
Serotine bat *Eptesicus serotinus* (Schreber, 1774)	–	–	–	25 (26 – 32)	–	[3]
	10.9	47.2	–	26.8	22.4	[4]
	6.83 ± 3.83	64.45 ± 8.78	34.67 ± 5.18	33.20 ± 5.20	26.37 ± 4.39	[5]
Eptesicus lobatus *Eptesicus lobatus* (Zagorodniuk,2009)	–	–	–	–	–	[7]
Northern bat *Eptesicus nilssonii* (Keyserling, Blasius, 1839)	–	–	–	27 – 32	–	[3]
	10.7	48.2	–	29.8	24.6	[4]
Common bentwing bat *Miniopterus schreibersii* (Kuhl,1817)	6.2	87.3	–	53.9	47.4	[4]

Weather data obtained via the free available Internet site for such meteorological stations:
Melitopol - https://www.gismeteo.ua/weather-melitopol-5103/
Botieve - https://www.gismeteo.ua/weather-botiyeve-13417/
Kyrylivka - https://www.gismeteo.ua/weather-kyrylivka-13424/

1.3. Instrumental methods (detectors, dictating machines, GPS, pad, weather station, cameras)

Research of bats requires usage of modern high-technology equipment owing to such peculiarities of animals' biology as echolocation, activity at night time, small physical dimensions, breeding in hiding places, visually unnoticeable migration, and long-term periods of hibernation. While carrying out works, we have used following research instruments in accordance with chosen purpose and tasks coordinated with the Customer.

Pettersson D 500x ultrasonic detector

It is the most convenient detector of standalone installation at a listening point, which may record bat voices in a given mode for a long time. Detector trigger has four susceptibility levels, which is highly important for filtering background noises (wind, insects) at different periods of listening.

Remote microphone enables the detector to operate being placed in a car, in a building, or in hiding place. In addition, a container housing of the device enables to use it in bad weather without additional protective measures. The detector creates files in WAV format and saves them on memory cards. D500X recorder is equipped with four slots for easily accessible CF flash memory cards. The total capacity is 128 GB, using four cards of 32 GB each. Such memory capacity and special regimes of economy, when record shall be carried out only for signals from bats during exceeding a given sound level, a length of individual signal record varies from 0.3 to 30 s (in our conditions 1 - 5 s is enough), as well as time of observations shall be specified in such manner that the device is "sleeping" in the daytime, enable autonomous operation in the course of weeks. However, we had taken the detector away from the place of location at the wind park site every morning after night listening, and carried out operational pre-processing of the results. BatSound program gives such possibility. Synchronization of the time, date and coordinates also is an advantage of this detector. In other words, there is a possibility of mapping a point (or points) of listening by means of Google Earth during processing the results of night observations for each date, and chronometric indices are a basis for determination of the dynamics of bats' activity during scanning time.

Pettersson D 240x ultrasonic detector

Compact universal detector, which enables to scan space within a range of the entire spectrum (10 - 120 kHz) and on a real-time basis. It does not have embedded memory, that is why it needs an additional device for sound recording. The possibility to recreate sounds both on a real-time basis and in Time Expanded mode (10x expanded), for the purpose of more quality processing of an audio file in order to determine the species, is an advantage of D 240x. Usage of common batteries of AA type enables the device to operate during 12 - 16 hours. We had used accumulators of the same type, including also a spare set, which provided the autonomy of our work at the site by means of a charging device (stationary and car one) for a long time.

ZOOM Handy Recorder H2 digital dictating machine

For preservation of information received by means of Pettersson D 240x detectors, the manufacturing company advises to use digital dictating machine ZOOM Handy Recorder H2. This compact device shall be connected to the detector through cable junction. Embedded memory card enables to save records over a certain period of time. In our case, we have used MicroSD 1GB cards, but it should be remembered that it will not be enough such card during the period of bats' high activity. Results must be periodically copied to separate information carrier in order to save them, or a spare card shall be used. Usually, 1 GB card was sufficient for 2 - 3 nights during the most active bats' flight and the maximum necessity of sound recording. Files are created in WAV format, which enables to analyse them in many special programs for editing audio files.

GARMIN GPSMAP 78s navigator

Classic navigator of marine type has a waterproof case, intuitively understandable menu and meets all requirements of a researcher of any specialization. Embedded internal storage of 1.7 GB may be extended by means of MicroSD cards (we used 2 GB). However, it was enough internal storage during four years, in the course of rather large load on the device. The possibility of connection to a computer is a traditional function. Files created by the navigator are well processed in Google Earth program (KMZ and KML files). 2 batteries of AA type ensure uninterrupted operation during 24 hours. But in the course of frequent use at night, when screen light is required, the operation time of the device shortens. Problem solving is spare batteries (accumulators) and a charging device (stationary and car one). In addition to the navigator, we have recently used a pad Samsung Galaxy Tab 2 10.1 P5100 16GB for orientation in space, which also has car charging device. The possibility of remote access to the Internet also is an advantage of this pad.

The mobile set for detecting scanning of bat sounds is presented in Fig. 4. Photographing of interesting processes and objects, biotopes, hiding places, bats required use of cameras (Fig. 5). We have used NIKON D7000, NIKON D80 and CANON EOS 550D cameras. Each frame was accompanied by EXIF metadata (the date, coordinates, and photography conditions).

Pettersson D 240x

Pettersson D 500x

Fig. 4. Sets of devices for researches of bats

Common noctule *Nyctalus noctula* Schreber, 1774

Kuhl's pipistrelle *Pipistrellus kuhlii* Kuhl,1817

Nathusius' pipistrelle *Pipistrellus nathusii* Keyserling, Blasius,1839

Parti-coloured bat *Vespertilio murinus* Linnaeus, 1758

Fig. 5. Photographing of the objects of researches

Besides these main instruments required for quality professional research of bats, methods of visual observations have also been used. Sometimes we used binoculars, when we had to observe the space over the water area, or to determine dimensions of a bat at high altitudes.

Motor transport that we have used in the course of carrying out works at the wind park sites is characterized by manoeuvrability, high qualities of off-road vehicles and certain comfortability. Two groups of researches used VAZ 21213 NIVA and Chevrolet Niva motor cars.

1.4. Mapping of the results of researches (GPS track, KML files, AutoCAD, Google Earth)

Results of researches have been presented in different formats. Mapping is one of methods, which enables to assess the event being described, in space and time. The Customer of the works at the wind park sites has provided with the schematic maps of project documentation. In addition, at certain stages of works we use scanned copies of maps of the General Staff with a scale of 2 km in 1 cm, sometimes - 2.5 km in 1 cm. They are the most suitable for plotting of information directly in the field. While carrying out a field visit, using of GPS navigator is a mandatory requirement, a track of which may be reflected in Google Earth program in the form of KML file (Fig. 6 and 7).

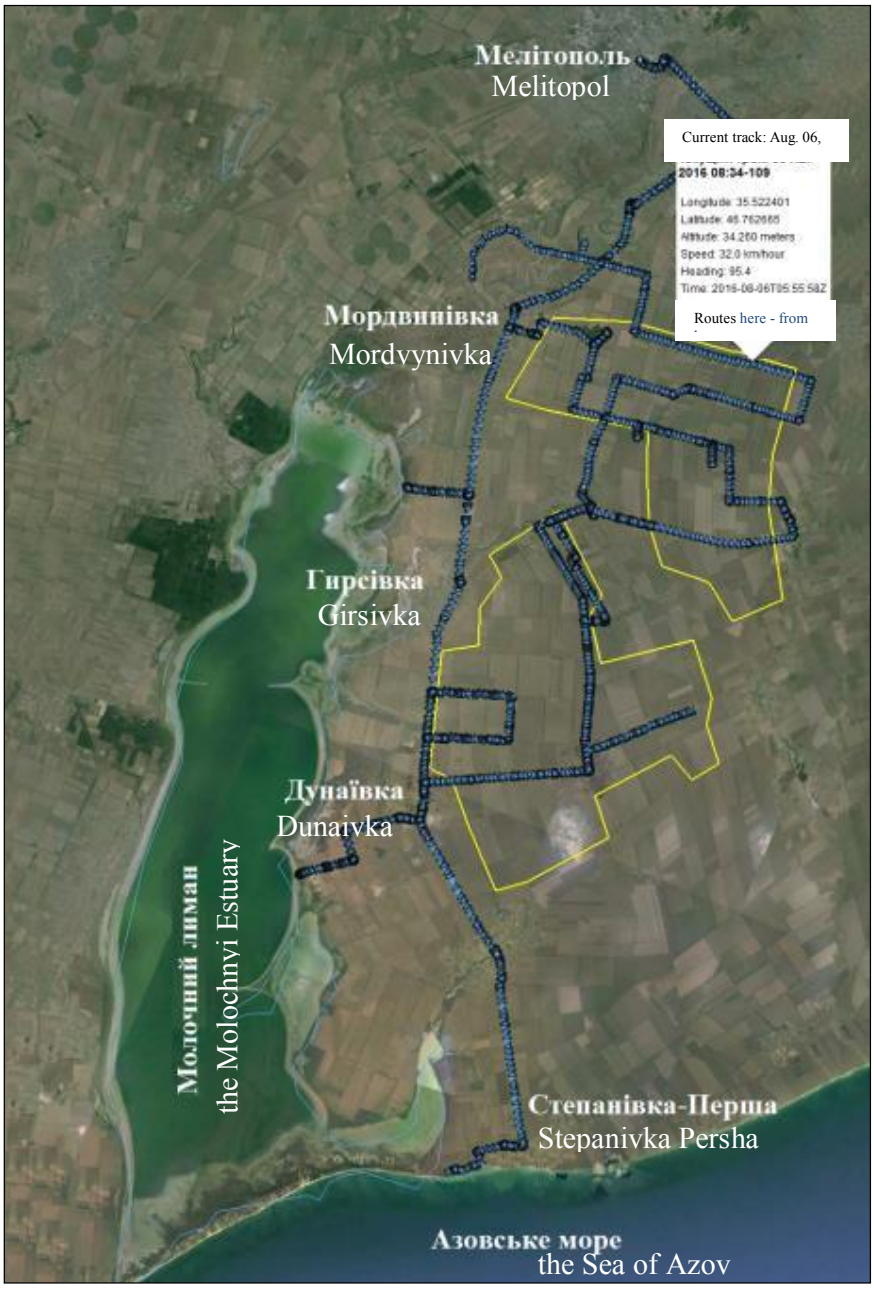


Fig. 6. Classic route for carrying out of researches (birds and bats)
(- boundaries of EuroCape Wind Park; - GPS- track)

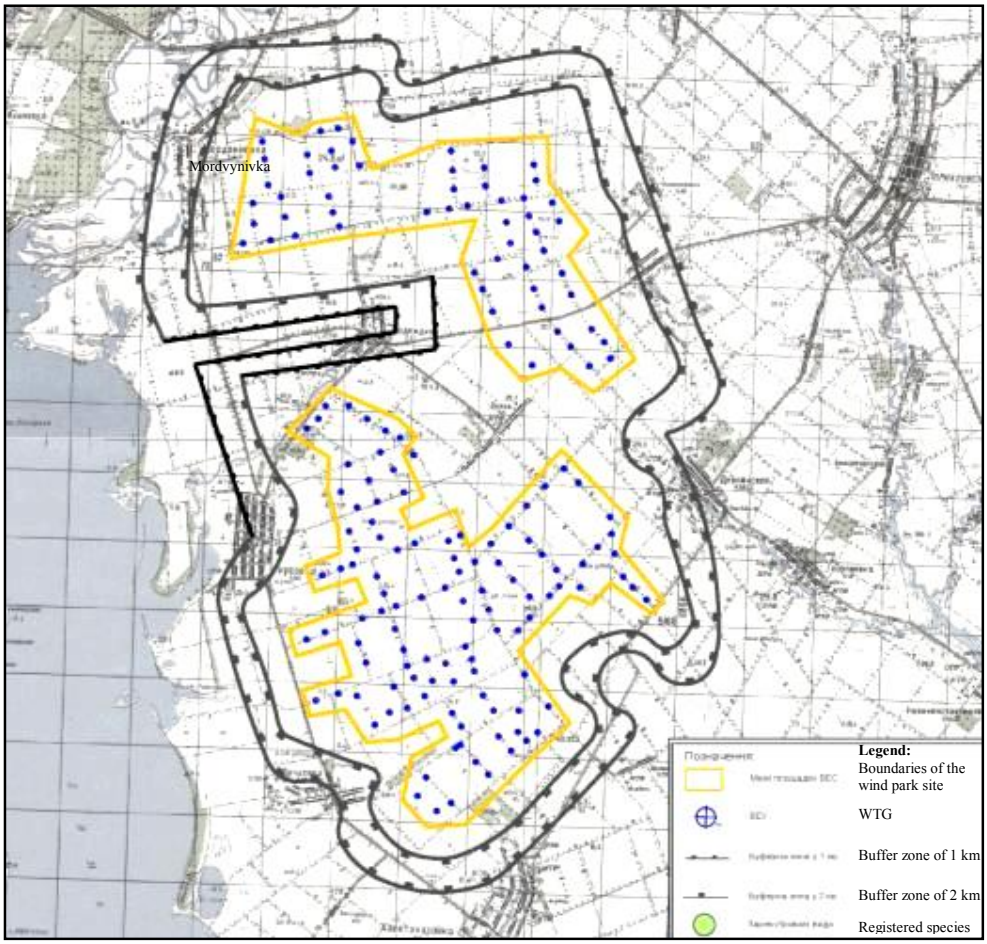


Fig. 7. Cartographic basis for using in the field

Each field trip (visit) was accompanied by plotting of the results of listening on maps, which provided a notion about spatial dynamics of bats' activity (Fig. 8).

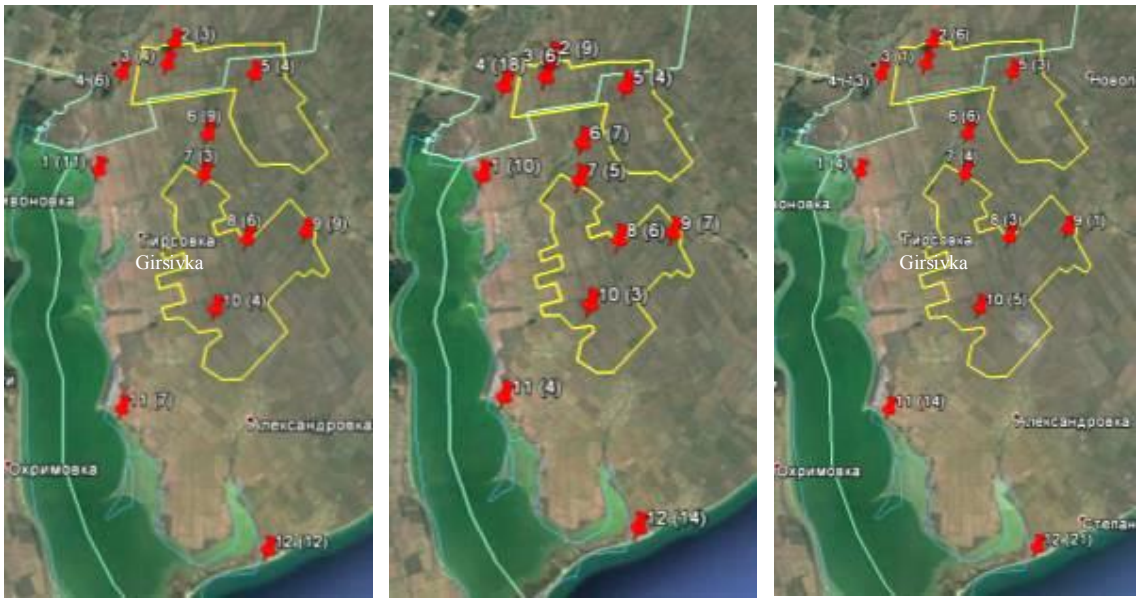


Fig. 8. Examples of plotting information for each listening

1.5. Processing of field materials. Result interpretation

When the weather had permitted, we carried out preliminary analysis of sounds directly at the wind park site. So, all records of bats' voices received by means of Pettersson D 500x detector had been listened for availability of noises; the records, which were not belonging to bats, were rejected (insects). When it was necessary, part of files (or all ones) has been exported to other carriers. It is enough low-cost office laptop and USB cable for it (Fig. 9).

Identification of species has been carried out according to known parameters of sound signals (Table 3), while comparing them with the indices of spectrograms created by means of BatSound program.

Processing of other materials (species composition, dynamics of diurnal and seasonal activity, activity dependence on weather conditions, distribution of bats throughout the wind park site, revealing of protected species, description of phenological phenomena, clarification of statistical regularities and so on) has been executed according to standard procedure [1 - 2].

Observations of bat migrations had been carried out additionally in the adjacent territories, which enabled to react promptly to the beginning of migratory waves. These additional places of observations are located relatively not far from the wind park site and within the main migration route of chiropterous animals (Fig. 10).

Cameral processing of signals consisted in the identification of all records according to belonging to one or another bat species by means of BatSound program (Fig.11). A sonogram has been decoded for this purpose by the basic parameters (Fig. 3).

Fig. 9. Ultrasonic space scanning at the coast of the Molochnyi Estuary

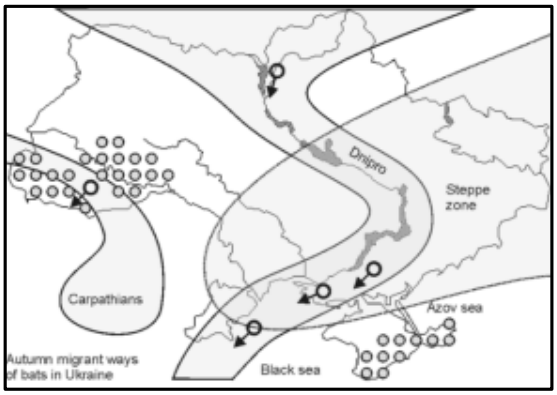


Fig. 10. Schematic map of the main direction of migration flows of bats in Ukraine [3]

Fig. 11. Processing of field materials (primary on the left, and cameral on the right)

Climatic conditions of the period of researches (August - October) were characterized by change of cyclone and anticyclone weather patterns and average statistical humidity (Fig. 12).

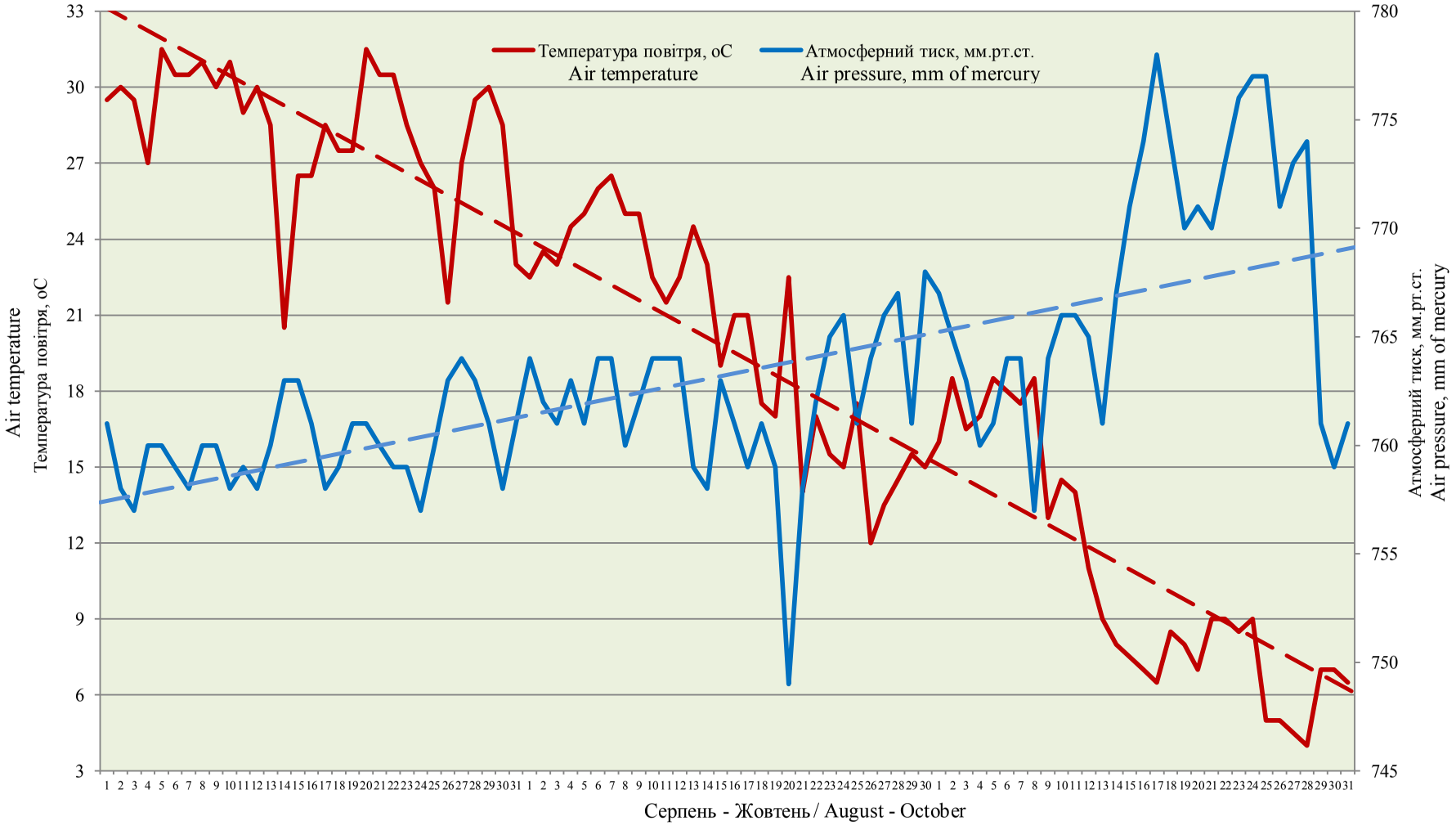


Fig. 12. Weather conditions in the course of observations of bats during August - October of 2016 (Melitopol meteorological station)

CHAPTER 2. Description of Species Composition, Distribution, Numbers and Activity of Bats

2.1. Description of territorial distribution and migratory activity of bats in August - October of 2016 (field material)

To obtain objective description of territorial distribution and activity of bats in the region of investigations, we shall briefly cite the results of each field visit.

Fig. 13. Results of space listening by means of Pettersson D240x ultrasonic detector on the 6 - 7 of August 2016

The weather conditions favoured activity of insects during researches of chiropterous fauna on the 6 - 7 of August 2016, which reflected also in the results of space listening (Fig. 13; Table 4). Availability of voice activity of animals has been recorded at all 12 observation points. Most voices were recorded at Points 1 (11) and 12 (12), or 29.5% of the total quantity.

Table 4. Materials of Bat Observation on the 6 of August, 2016

Place (according to Fig. 1)	Time	File	Number of sounds
2	20:45 - 21:00	045	3
3	21:07 - 21:17	046 - 047	4
4	21:29 - 21:39	048 - 054	6
5	21:55 - 22:05	055 - 058	4
6	22:23 - 22:33	059 - 065	9
1	22:47 - 22:57	066 - 075	11
7	23:12 - 23:22	076 - 077	3
8	23:30 - 23:40	078 - 079	6
9	23:53 - 00:03	080 - 083	9
10	00:10 - 00:20	084 - 086	4
11	00:45 - 00:55	087 - 088	7
12	01:24 - 01:34	089	12
Total	**289 minutes**	**45**	**78**

Notes: (2, 3, 5, 7 - 10) – points of space listening within the wind park; (1, 11, 12) – at the coast of the Molochnyi Estuary and the Sea of Azov; (4, 6) – in human settlements.

Next night, on the 7 - 8 of August 2016, when daily average air temperatures reached 31 °C, feeding conditions for bats continued (Fig. 14; Table 5). Animals' maximum activity over the whole period of observations has been recorded during this listening – 93 voices. However, in addition to traditional area of hyperactivity at the coast of the Sea of Azov (Point No. 12; 14 voices), rather high indices have been obtained in the Village of Mordvynivka (Point No. 4; 18 voices). These two points made up 34% of the total quantity.

The next listening was carried out at night on the 23 - 24 of August 2016 (Fig. 15, Table 6). Air temperature as well as air pressure somewhat reduced, in comparison with previous observations, but bats' activity was also high. The total quantity of registered voices was equal to 81. The beginning of bats' active migration is a peculiarity of this period (the end of August). The results of listening showed that the points at the coast of the Molochnyi Estuary (Point No. 11; 14 voices) and the Sea of Azov (Point No. 12; 21 voices) had been the most effective ones. These points (taken together) made up 43% of the total quantity. The least activity was observed within the wind park planned for construction (Points No. 3 and 9; 1 voice at each).

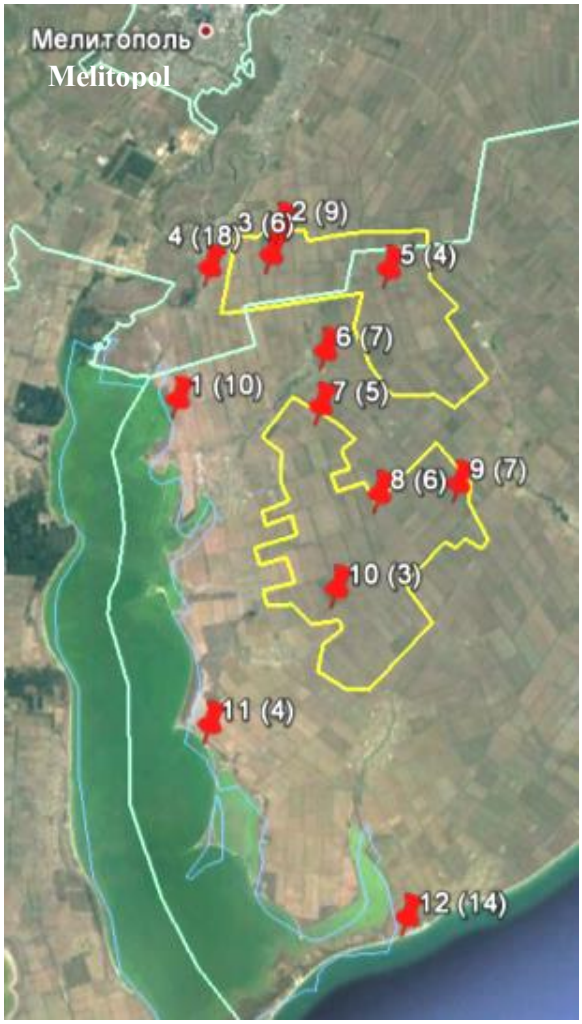


Fig. 14. Results of space listening by means of Pettersson D240x ultrasonic detector on the 7 - 8 of August 2016

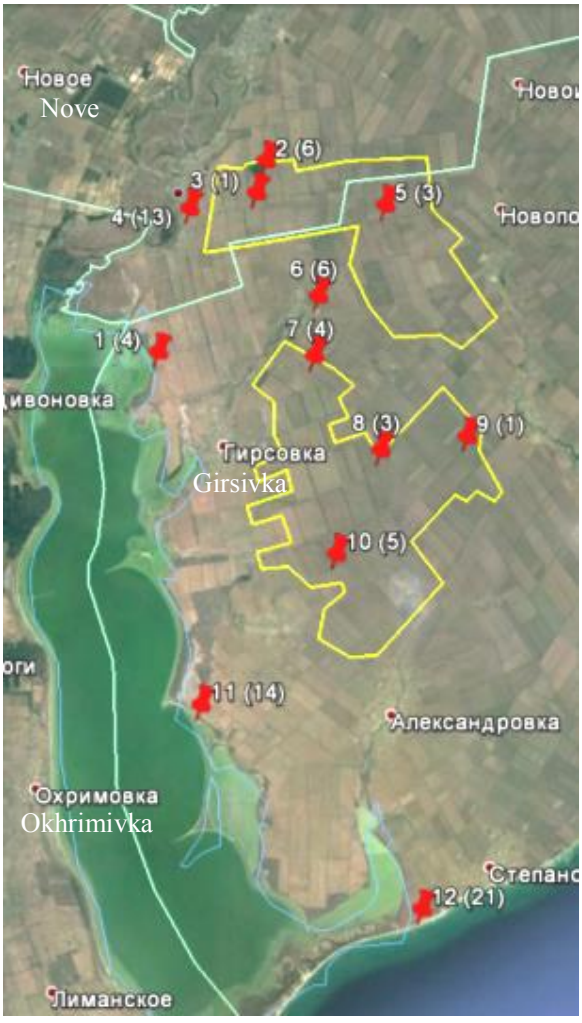


Fig. 15. Results of space listening by means of Pettersson D240x ultrasonic detector on the 23 - 24 of August 2016

Table 5. Materials of Bat Observation on the 7 - 8 of August 2016

Place (accord. to Fig. 1)	Time	File	Number of sounds
12	20:45 - 21:05	000 - 011	14
11	21:33 - 21:43	012 - 013	4
10	21:58 - 22:08	014	3
9	22:21 - 22:31	015 - 016	7
8	22:46 - 22:56	017 - 022	6
7	23:10 - 23:20	023 - 025	5
1	23:34 - 23:44	026 - 034	10
6	00:00 - 00:10	035 - 036	7
5	00:30 - 00:40	037	4
4	00:55 - 01:00	038 - 046	18
3	01:15 - 01:25	046 - 047	6
2	01:34 - 01:44	048 - 049	9
Total	**299 minutes**	**50**	**93**

Table 6. Materials of Bat Observation on the 23 - 24 of August 2016

Place (accord. to Fig. 1)	Time	File	Number of sounds
2	20:25 - 20:35	048 - 049	6
3	20:50 - 21:00	046 - 047	1
4	21:17 - 21:27	038 - 046	13
1	21:48 - 21:58	026 - 034	4
5	22:25 - 22:35	037	3
6	22:50 - 23:00	035 - 036	6
7	23:15 - 23:25	023 - 025	4
8	23:43 - 23:53	017 - 022	3
9	00:08 - 00:18	015 - 016	1
10	00:31 - 00:41	014	5
11	01:12 - 01:22	012 - 013	14
12	01:57 - 02:07	000 - 011	21
Total	**342 minutes**	**59**	**81**

Notes: (2, 3, 5, 7 - 10) – points of space listening within the wind park; (1, 11, 12) – at the coast of the Molochnyi Estuary and the Sea of Azov; (4, 6) – in human settlements.

It has already been mentioned in methodological part of the report that data obtained in the course of researches in the adjacent territories by means of Pettersson D500x device were used simultaneously with listening by means of Pettersson D240x ultrasonic detector. Such information enables to appraise diurnal dynamics of bats' activity, to describe species composition of chiropterous fauna more completely.

So, the device was installed in Melitopol City (46.855511 N / 35.88485 E) in 12 km from the north boundary of the wind park planned for construction on the 6 - 7 of August 2016. 172 bat sounds in all have been registered. The first registration took place at 20:57, the last one – at 4:10, which amounted to 433 minutes of observations. The maximum quantity of voices was recorded within the interval of 23:10 - 23:20 (14 voices, or 8% of the total). 54 voices were recorded by the device during the period of 22:40 - 23:40, or 31.4% of all ones over the night, following which bats' activity gradually went down till the end of listening (Fig. 16).

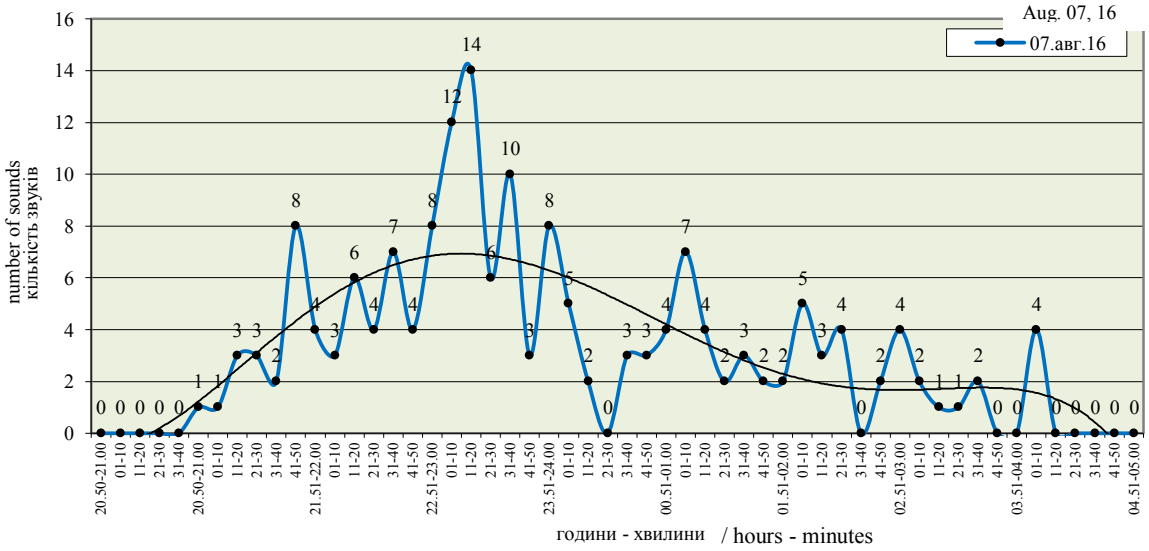


Fig. 16. Dynamics of bats' activity in Melitopol City on the 6 - 7 of August 2016 (D500x; n = 172 sounds)

At night on the 23 - 24 of August 2016 the detector was installed on the outskirts of Stepanivka Persha Village (46.458543 N / 35.509099 E) in 15 km to the southern east from the south boundary of the wind park. The researches showed that dynamics of bats' flying activity had somewhat changed (Fig. 17).

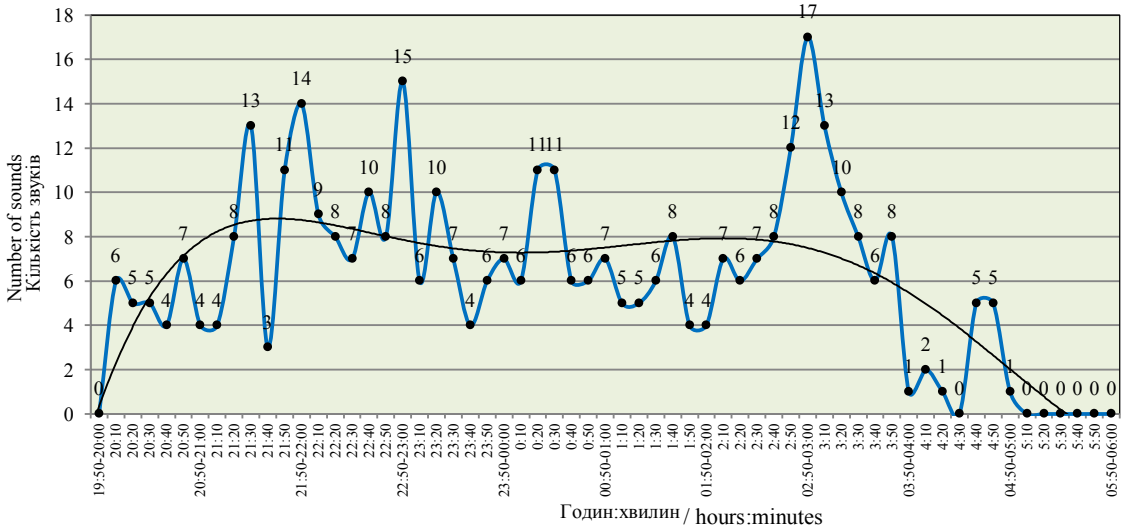


Fig. 17. Dynamics of bats' activity in Stepanivka Persha Village on the 23 - 24 of August, 2016 (D500x; n = 377 sounds)

The first bat was registered at 20:01, the last one - at 04:54. 377 sounds in all. The total duration of bats' activity – 8 hours 53 minutes. The maximum activity was within the interval of 02:50 – 03:00; 17 sounds within 10 minutes (4.5%). In spite of recorded maximum in the second half of the night, the main activity of bats was registered within the interval of 21:20 - 23:20, when 114 sounds had been recorded, or 30.2% of all ones over the night.

Researches were continued in Stepanivka Persha Village also on the 27 - 28 of August 2016. The first bat - 20:00, the last one over the night - 05:20. 506 sounds in all. The total duration of bats' activity – 9 hours 20 minutes. The maximum activity within the interval of 23:00 – 23:10; 29 sounds within 10 minutes, as well as 10 minutes before (25 sounds), and after (26 sounds) this peak. So, from 22:50 till 23:20 (30 minutes) 80 sounds have been registered (or 15.8% of all sounds over the night). Thus, we can see the traditional activity of animals for this period - during the first half of night (Fig. 18).

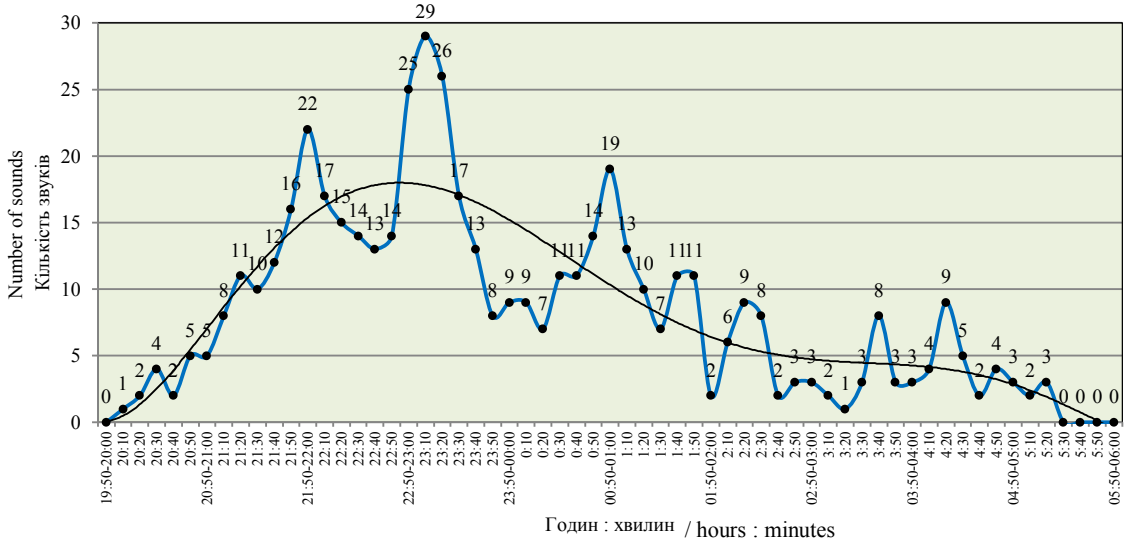


Fig. 18. Dynamics of diurnal flying activity of bats in Stepanivka Persha Village on the 27 - 28 of August 2016 (D500x; n = 506 sounds)

Observations in September have also been continued in Stepanivka Persha Village. The first bat at night of the 3 - 4 of September was registered at 19:58, the last one over the night - 05:27, and the total their quantity – 420 sounds. The duration of bats' activity – 9 hours 29 minutes. The maximum activity within the interval of 22:50 – 23:00; 22 sounds within 10 minutes (5.2%). 90 sounds have been registered within the interval of 22:30 - 23:30, or 21.4% of all ones over the night (Fig. 19).

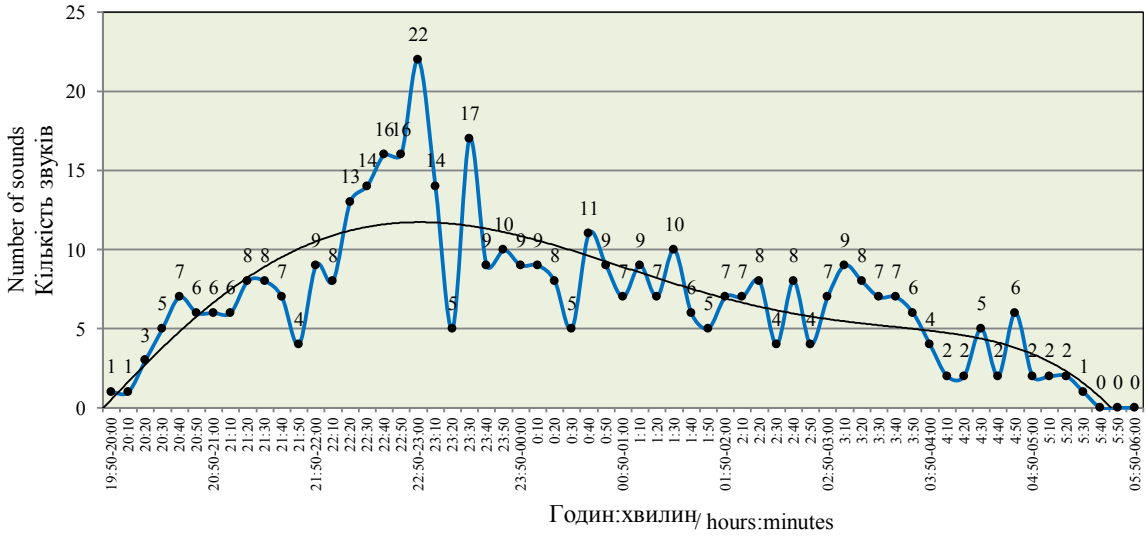


Fig. 19. Dynamics of diurnal flying activity of bats in Stepanivka Persha Village on the 03 - 04 of September 2016 (D500x; n = 420 sounds)

Also, researches have been carried out at the Obytichna Spit (Prymorsk District of Zaporizhia Region; 46.507741 N / 36.149727 E), to obtain additional information in the course of high migratory activity of bats. This observation point is interesting by the fact that this sand spit elongated in the southern direction, where tree vegetation and buildings are almost lacking, there are no steeps and caves at all, is a peculiar bridge for bats, which fly to the spit using the territory and stay there for a short time.

The first bat was recorded at 19:56, the last one - at 05:27. 616 sounds in all have been registered, which is a record for the whole observation period in August - October. The total duration of bats' activity – 9 hours 31 minutes. The maximum activity within the interval of 03:50 – 04:00; 47 sounds (7.6%). Within the interval of 03:50 – 04:30; 195 sounds within 40 minutes, or 31.7% of all ones over the night (Fig. 20).

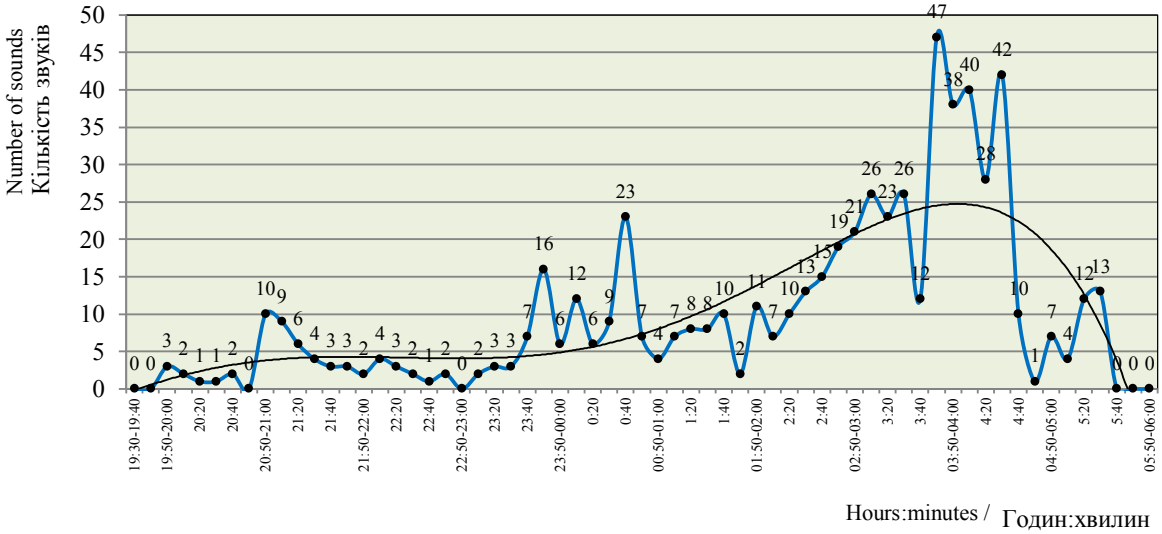


Fig. 20. Dynamics of diurnal flying activity of bats at the Obytichna Spit on the 14 - 15 of September 2016 (D500x; n = 616 sounds)

We can see that the peak of bats' activity fell on the second half of the night. Visual observations of bats have also been carried out at dawn. So, on the 15 of September 2016 we observed bats' activity in the morning when it had already become rather light (Fig. 21).

Fig. 21. Bats' activity in the morning at the Obytichna Spit on the 15 of September 2016 (Prymorsk Distr.)

In the course of ornithological observations, the research team went to the place of monitoring of birds about 5 a. m. After motor car stopover, 12 - 15 bats surrounded it and circled above the warm bonnet. Some animals tried to sit on the car mirror (Fig. 21). There were cases of collisions of animals with the car glass. About ten more animals circled in 50 m from the observers above the information traffic sign, trying to catch hold of it. Such behaviour is caused by a peak of migratory activity (large quantity of animals) and an attempt to find hiding places for day rest in conditions of deficiency of suitable places for it at the Obytichna Spit.

Fig. 22. Results of space listening by means of Pettersson D240x ultrasonic detector on the 15 - 16 of September 2016

49 bat sounds were registered by means of Pettersson D240x detector within the wind park sites at night on the 15 - 16 of September 2016. Analysis of bats' activity at different listening points shows the domination of points located at the coast of the Molochnyi Estuary and the Sea of Azov. 20 sounds in all have been registered at these points (40.8%). The human settlements gave 10 more sounds (20.4%), the rest 19 sounds (38.8%) were distributed unevenly (from 1 to 5 voices) between seven points within the wind park (Fig. 22, Table 7).

Table 7. Materials of Bat Observation on the 15 - 16 of September 2016

Place (according to Fig. 1)	Time	File	Number of sounds
2	19:30 - 19:40	000 - 003	5
3	19:55 - 20:05	004 - 005	2
4	20:17 - 20:27	006 - 009	5
1	21:02 - 21:12	010 - 014	5
5	21:33 - 21:43	015 - 016	2
6	21:58 - 22:08	017 - 020	5
7	22:21 - 22:31	021 - 023	4
8	22:54 - 23:04	-	1
9	23:16 - 23:26	024 - 025	2
10	23:41 - 23:51	026 - 028	3
11	00:11 - 00:21	029 - 033	6
12	00:58 - 01:08	034 - 036	9
Total	**338 minutes**	**37**	**49**

Notes: (2, 3, 5, 7 - 10) – points of space listening within the wind park; (1, 11, 12) – at the coast of the Molochnyi Estuary and the Sea of Azov; (4, 6) – in human settlements.

To ascertain the dynamics of diurnal activity of bats next night (September 16 - 17, 2016), the observations have been carried out by means of Pettersson D500x device in Melitopol City. 137 sounds in all. The first bat - 19:31, the last one over the night - 03:56. The total duration of bats' activity – 8 hours 25 minutes. The maximum activity within the interval of 22:50 – 23:00; 8 sounds (5.8%). Within the interval of 21:20 – 23:00; 58 sounds within 100 minutes, or 42.3% of all ones over the night (Fig. 23). So, analysis of researches carried out at three stationary points enables to assume that the highest activity of bats during the period of autumn migration takes place along the coasts of the sea and estuary. Animals' activity within the wind park was considerably less. Quantity of recorded voices in Melitopol City (16 - 17.09) was 4.5 times fewer in comparison with the Obytichna Spit (14 - 15.09). Such situation was probably caused by unformed as yet populations of animals, which would stay in the city for wintering, and active search of winter hiding places outside of human settlements.

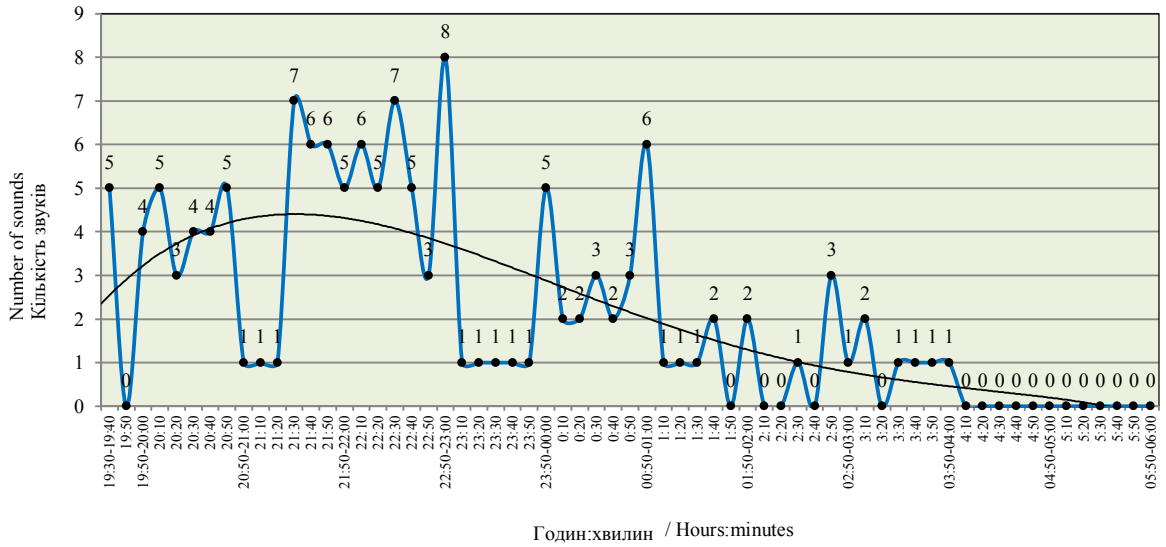


Fig. 23. Dynamics of diurnal flying activity of bats in Melitopol City on the 16 - 17 of September 2016 (D500x; n = 137 sounds)

To check this assumption, Pettersson D500x ultrasonic device was installed in Stepanivka Persha Village at night on the 17 - 18 of September. The results of listening indicate that the first bat appeared at 19:13, the last one over the night - at 05:27. 300 sounds in all have been registered. The total duration of bats' activity – 10 hours 14 minutes. The maximum activity within the interval of 22:10 – 22:20 and 02:50 - 03:00, 11 sounds within each 10 minutes. Within the interval of 02:00 – 03:00; 49 sounds within 60 minutes, or 16.3% of all ones over the night (Fig. 24).

So, it has been revealed that the largest quantity of bats during their migratory activity is observed near the water areas of the Molochnyi Estuary and the Sea of Azov. Peak quantity over the night of listening falls on the second half of night. Voice activity of animals in Melitopol City is considerably less, and a peak of activity takes place during the first half of night. Bats' activity is low in the territory of the wind park planned for construction.

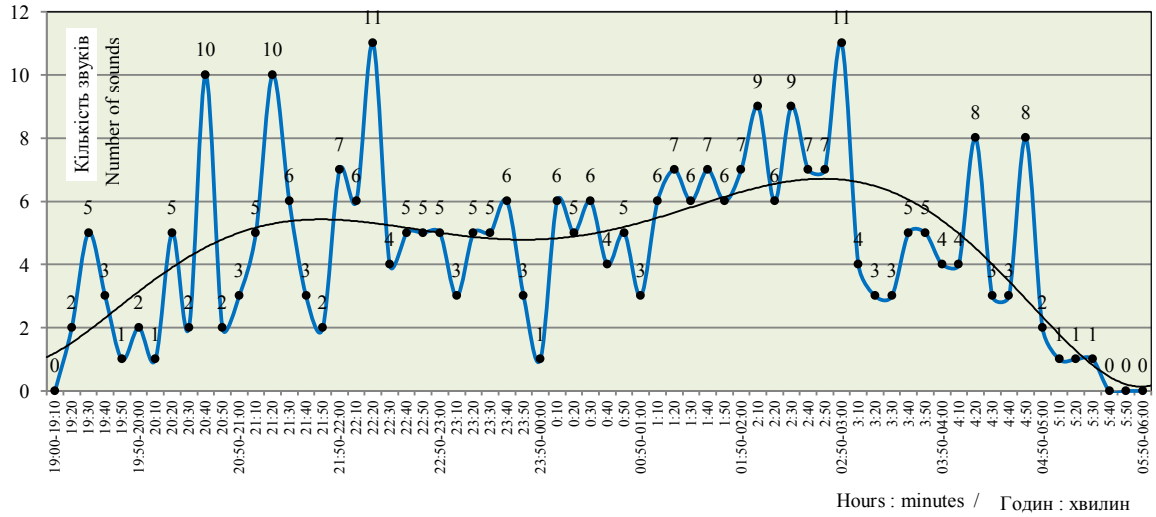


Fig. 24. Dynamics of diurnal flying activity of bats in Stepanivka Persha on the 17 - 18 of September 2016 (D500x; n = 300 sounds)

Researches that had been carried out toward the end of September and at the beginning of October showed further decrease of voice activity, which may indicate ceasing of intensive phase of autumn migration (Fig. 25; Table 8 and Fig. 26; Table 9).

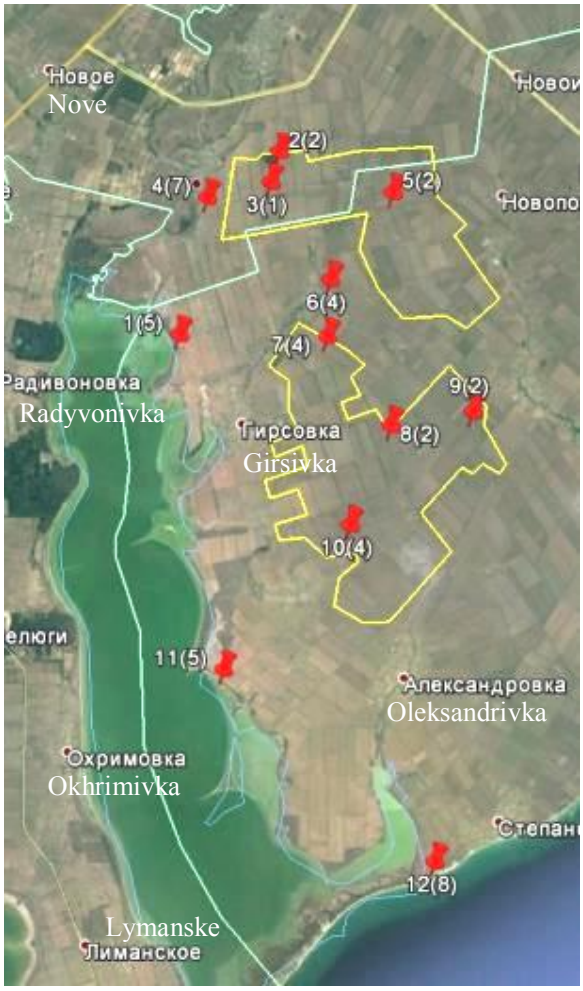


Fig. 25. Results of space listening by means of Pettersson D240x ultrasonic detector on the 20 - 21 of September 2016

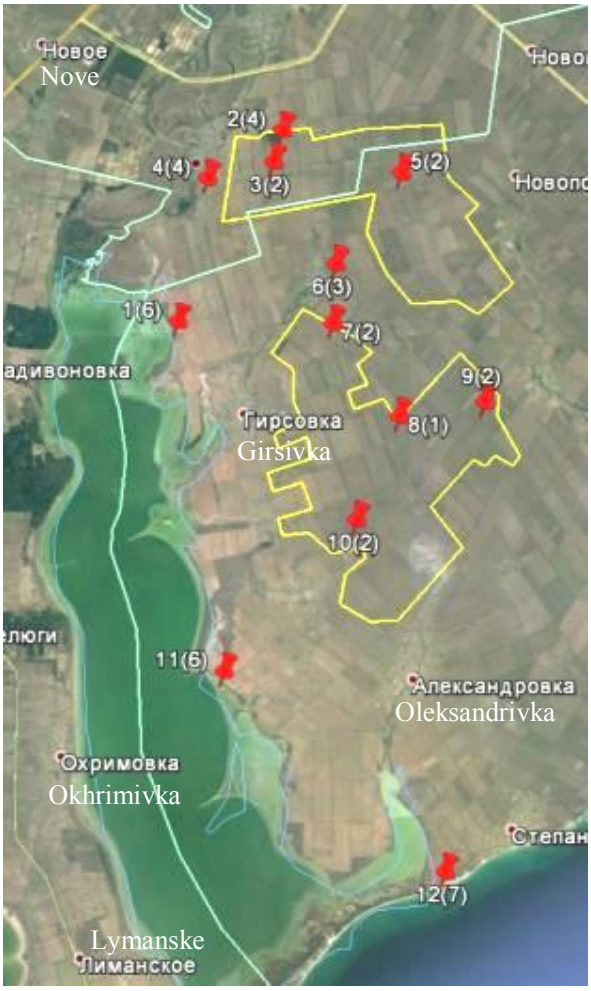


Fig. 26. Results of space listening by means of Pettersson D240x ultrasonic detector on the 6 - 7 of October 2016

Table 8. Materials of Bat Observation on the 20 - 21 of September 2016

Place (accord. to Fig. 1)	Time	File	Number of sounds
2	19:15 - 19:25	037	2
3	19:37 - 19:47	038	1
4	20:06 - 20:16	039 - 044	7
1	20:35 - 20:45	045 - 048	5
5	21:10 - 21:20	049	2
6	21:31 - 21:41	050 - 052	4
7	21:59 - 22:09	053 - 056	4
8	22:18 - 22:28	057	2
9	22:45 - 22:55	058 - 059	2
10	23:11 - 23:21	060 - 063	4
11	23:50 - 00:00	064 - 069	5
12	00:28 - 00:38	070 - 074	8
Total	**323 minutes**	**38**	**46**

Table 9. Materials of Bat Observation on the 6 - 7 of October 2016

Place (accord. to Fig. 1)	Time	File	Number of sounds
2	19:00 – 19:10	013 - 015	4
3	19:18 – 19:28	016 - 017	2
4	19:36 – 19:46	018 - 021	4
1	20:14 – 20:24	022 - 027	6
5	20:50 – 21:00	028 - 029	2
6	21:17 – 21:27	030 - 032	3
7	21:48 – 21:58	033	2
8	22:25 – 22:35	034	1
9	22:50 – 23:00	035 - 036	2
10	23:15 – 23:25	037 - 038	2
11	23:43 – 23:53	039 - 041	6
12	00:17 – 00:27	42; 48 - 50	7
Total	**327 minutes**	**33**	**41**

Notes: (2, 3, 5, 7 - 10) – points of space listening within the wind park; (1, 11, 12) – at the coast of the Molochnyi Estuary and the Sea of Azov; (4, 6) – in human settlements.

Analysis of data collected during this period and presented in Fig. 25 and 26, and in Tables 8 and 9 indicates persistence of the tendency to domination of bats' activity at the observation points located at the coasts. So, on the 20 - 21 of September 18 voices were registered at Points No. 1, 11 and 12 (39.1%), and on the 6 - 7 of October – 19 voices (46.3%).

Within the sites of the wind park, which is planned for construction, 17 sounds were recorded on the 20 - 21 of September (46.0%), and on the 6 - 7 of October – 15 sounds (36.6%).

Thus, the results of these two field visits enable to state low voice activity of bats, which has not changed in the dynamics in the course of at least 20 days.

Researches that have been carried out by means of Pettersson D500x device on the outskirts of Botieve Village (Pryazovske District of Zaporizhia Region) also indicate decrease of bats' activity. Listening point was located in agrocenosis (46.622225 N / 35.819259 E) not far from agricultural hedgerow, in a landscape similar also to the landscape of the wind park owned by EuroCape Company, at the distance about 21 km to the east of the latter.

29 sounds in all have been registered during this night. The first bat - 19:51, the last bat over the night - 03:36. The total duration of bats' activity – 7 hours 45 minutes. The maximum activity of bats was not registered, since there had not been recorded more than 2 sounds within 10- minute interval. Within the interval of 19:50 – 20:40; 6 sounds within 50 minutes, or 22.2% of all ones over the night (Fig. 27). Bats' activity during the night was low. Interruption of flights occurred long before dawn.

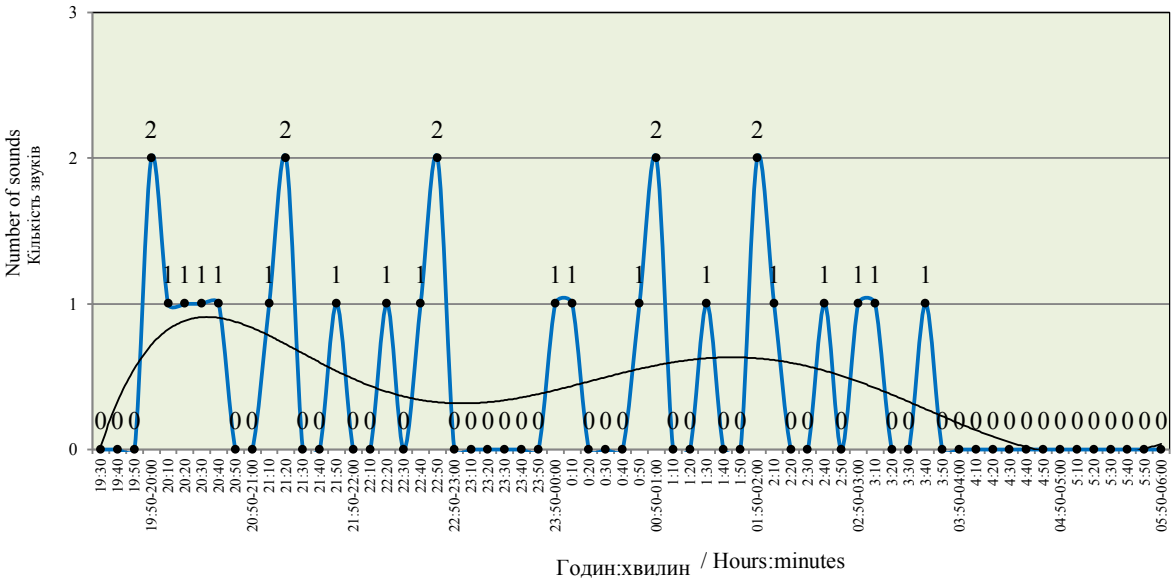


Fig. 27. Dynamics of diurnal flying activity of bats in Botieve on the 6 – 7 of October 2016 (D500x; n = 29 sounds)

The next visit to the sites of the wind park owned by EuroCape Company was carried out on the 11 - 13 of October. The researches were executed during abrupt change of weather conditions, when daily average air temperatures before researches had been equal to 18 – 18.5 ºC, and since 10 of October they dropped to 9 ºC, with the minimum indices at night of 2 - 3 ºC.

Such abrupt change had an effect also on bats' activity. So, at night on the 11 - 12 of October only 6 sounds were registered. And during the next night on the 12 - 13 of October, when low temperatures had been supplemented with continuous precipitation, no one bat was registered (Fig. 28 and 29; Table 10 and 11).

Such cool weather and precipitation continued during the week, but since 20 of October air temperature, and especially indices of air pressure, began to rise gradually.

Researches carried out on the 28 - 29 of October indicate certain intensification of bats' activity, when 23 sounds have been registered, but rather even their distribution throughout the territory of investigations gives grounds for assertion about ceasing of migration. Points 1, 11 and 12 had traditionally been the most effective, 11 sounds were registered there, or 47.8% of the total quantity. From 0 to 3 voices have been recorded at 7 points within the sites, 8 voices in all, or 34.8% of the total quantity (Fig. 30; Table 12).

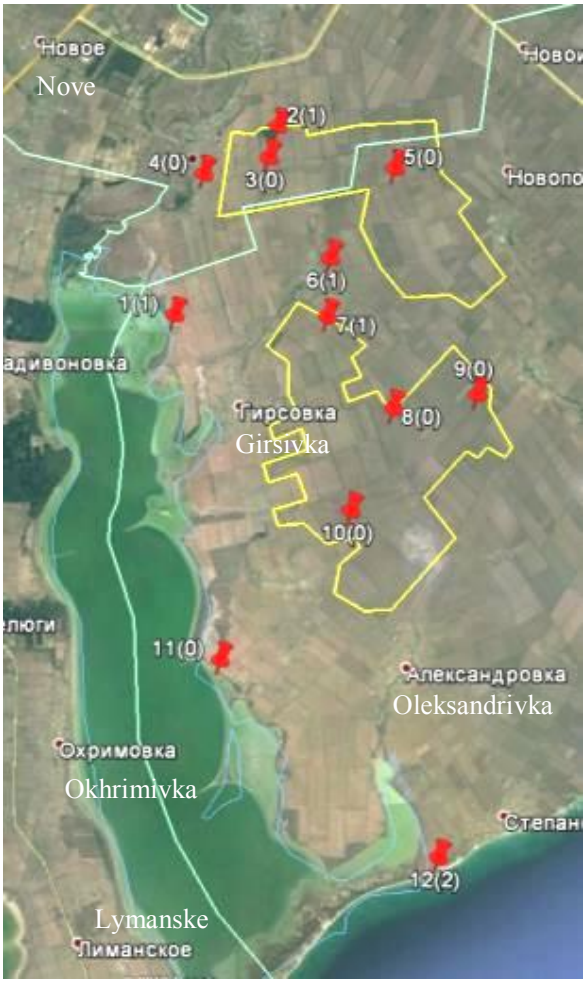


Fig. 28. Results of space listening by means of Pettersson D240x ultrasonic detector on the 11 - 12 of October 2016

Fig. 29. Results of space listening by means of Pettersson D240x ultrasonic detector on the 12 - 13 of October 2016

Table 10. Materials of Bat Observation on the 11 - 12 of October 2016

Place (accord. to Fig. 1)	Time	File	Number of sounds
2	18:45 - 18:55	-	1
3	19:05 – 19:15	-	0
4	19:28 – 19:38	-	0
1	20:10 – 20:20	006	1
5	21:05 – 21:15	-	0
6	21:30 – 21:40	-	1
7	21:58 – 22:08	007	1
8	22:25 – 22:35	-	0
9	22:50 – 23:00	-	0
10	23:25 – 23:35	-	0
11	00:07 - 00:17	-	0
12	01:03 - 01:13	008 - 009	2
Total	**388 minutes**	**4**	**6**

Table 11. Materials of Bat Observation on the 12 - 13 of October 2016

Place (accord. to Fig. 1)	Time	File	Number of sounds
2	18:45 - 18:55	-	0
3	19:05 – 19:15	-	0
4	19:28 – 19:38	-	0
1	20:10 – 20:20	-	0
5	21:05 – 21:15	-	0
6	21:30 – 21:40	-	0
7	21:58 – 22:08	-	0
8	22:25 – 22:35	-	0
9	22:50 – 23:00	-	0
10	23:25 – 23:35	-	0
11	00:07 - 00:17	-	0
12	01:03 - 01:13	-	0
Total	**388 minutes**	**0**	**0**

Notes: (2, 3, 5, 7 - 10) – points of space listening within the wind park; (1, 11, 12) – at the coast of the Molochnyi Estuary and the Sea of Azov; (4, 6) – in human settlements.

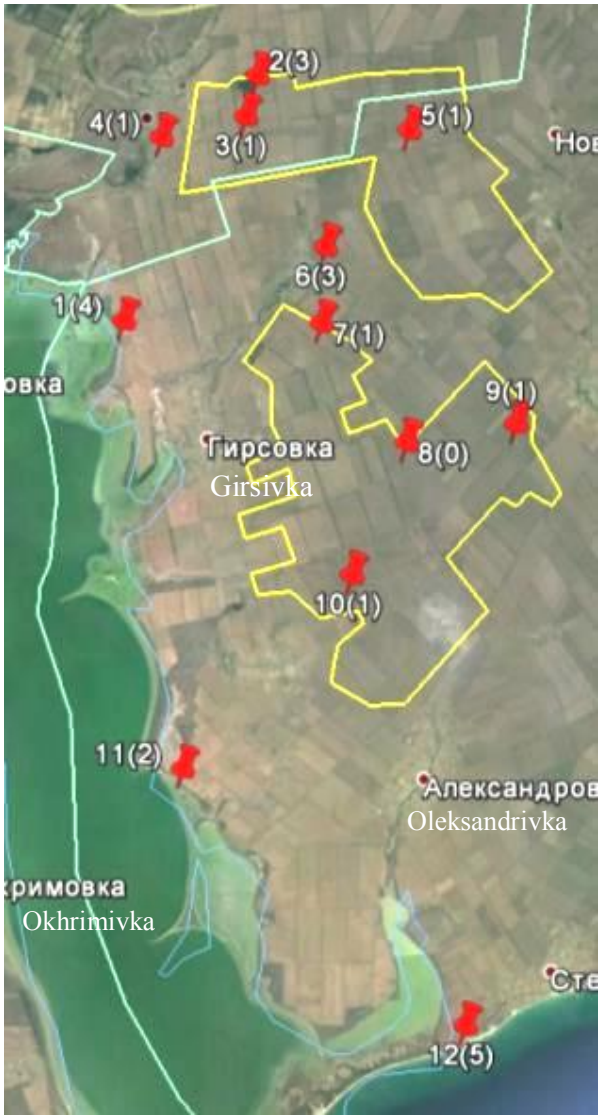


Fig. 30. Results of space listening by means of Pettersson D240x ultrasonic detector on the 28 - 29 of October 2016

Table 12. Materials of Bat Observation on the 28 - 29 of October 2016

Place (according to Fig. 1)	Time	File	Number of sounds
2	18:00 - 18:15	000 - 001	3
3	18:20 - 18:30	002	1
4	18:42 - 18:52	003	1
1	19:23 - 19:33	004 - 007	4
5	19:50 - 20:00	008	1
6	20:19 - 20:29	009 - 011	3
7	20:37 - 20:47	012	1
8	21:12 - 21:22	-	0
9	21:33 - 21:43	013	1
10	22:00 - 22:10	014	1
11	22:38 - 22:48	-	2
12	23:27 - 23:37	015 - 019	5
Total	**337 minutes**	**20**	**23**

Notes: (2, 3, 5, 7 - 10) – points of space listening within the wind park; (1, 11, 12) – at the coast of the Molochnyi Estuary and the Sea of Azov; (4, 6) – in human settlements.

Thus, in the course of 9 field visits to the territory of the wind park, which is planned for construction, as well as in comparison with data obtained in the adjacent territories, using Pettersson D240x and Pettersson D500x ultrasonic detectors, we succeeded in describing the situation with distribution and activity of bats.

These basic characteristics are required for further processing of field material, which will enable to reveal species composition of bats of the north-western Azov Sea region, to define places of the highest and lowest activity, to show the role of the wind park territories in comparison with the adjacent ones (human settlements, water areas and so on).

2.2. Description of species composition, dynamics of autumn migration and zoning of the territory of investigations

2.2.1. Species composition of bats

The possibility of real-time recording of bat sounds is a peculiarity of ultrasonic detectors, later these sounds shall be processed in BatSound program based on WAV- files in the form of sonograms. Mechanism of species determination is stated in methodological part of the report.

We succeeded in decoding about 70 percent of bat sounds out of the whole array of collected data, which enable to define their species composition. Species composition of bats for individual field visit is given in Tables 13 - 21. 941 sounds in all have been processed. Some discrepancies between the number of recorded files for individual field visits and quantity of identified sounds occurred owing to recording of sounds of two, or even three, bat species in one file (Fig. 31).

132	Kuhl's pipistrelle *Pipistrellus kuhlii* Kuhl, 1817				
	112.1	5.68	79.1	41.8	38.7
	Pygmy pipistrelle *Pipistrellus pygmaeus* Leach, 1825				
	103.5	6.44	75.0	52.8	50.6

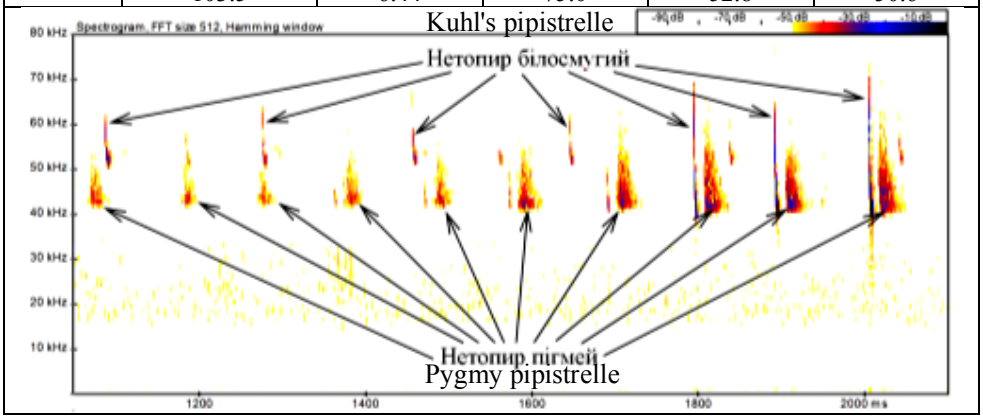


Fig. 31. Sonogram of sounds of two bat species recorded in one file

Table 13. Species Composition of Bats Registered by Means of Pettersson D240x Ultrasonic Detector on the 6 of August 2016 (EuroCape Wind Park)

No.	Species	Quantity	Part, %
1	Kuhl's pipistrelle *Pipistrellus kuhlii* Kuhl, 1817	27	57.4
2	Nathusius' pipistrelle *Pipistrellus nathusii* Keyserling et Blasius, 1839	8	17.0
3	Common pipistrelle *Pipistrellus pipistrellus* Schreber, 1774	6	12.8
4	Serotine bat *Eptesicus serotinus* Schreber, 1774	2	4.3
	Undetermined	4	8.5
	Total	**47**	**100**

Table 14. Species Composition of Bats Registered by Means of Pettersson D500x Ultrasonic Detector on the 6 – 7 of August 2016 (Melitopol City)

No.	Species	Quantity	Part, %
1	Common noctule *Nyctalus noctula* Schreber, 1774	49	28.3
2	Kuhl's pipistrelle *Pipistrellus kuhlii* Kuhl, 1817	55	31.8
3	Nathusius' pipistrelle *Pipistrellus nathusii* Keyserling et Blasius, 1839	24	13.9
4	Common pipistrelle *Pipistrellus pipistrellus* Schreber, 1774	5	2.9
5	Pygmy pipistrelle *Pipistrellus pygmaeus* Leach, 1825	8	4.6
6	Parti-coloured bat *Vespertilio murinus* Linnaeus, 1758	14	8.1
7	Serotine bat *Eptesicus serotinus* Schreber, 1774	9	5.2
	Undetermined	9	5.2
	Total	**173**	**100**

Table 15. Species Composition of Bats Registered by Means of Pettersson D240x Ultrasonic Detector on the 7 of August 2016 (EuroCape Wind Park)

No.	Species	Quantity	Part, %
1	Myotis *Myotis sp.*	1	1.8
2	Long-eared bat *Plecotus sp.*	1	1.8
3	Common noctule *Nyctalus noctula* Schreber, 1774	4	7.3
4	Kuhl's pipistrelle *Pipistrellus kuhlii* Kuhl, 1817	26	47.3
5	Nathusius' pipistrelle *Pipistrellus nathusii* Keyserling et Blasius, 1839	7	12.7
6	Pygmy pipistrelle *Pipistrellus pygmaeus* Leach, 1825	2	3.6
7	Parti-coloured bat *Vespertilio murinus* Linnaeus, 1758	3	5.5
8	Serotine bat *Eptesicus serotinus* Schreber, 1774	9	16.4
	Undetermined	2	3.6
	Total	**55**	**100**

Table 16. Species Composition of Bats Registered by Means of Pettersson D240x Ultrasonic Detector on the 23 – 24 of August 2016 (EuroCape Wind Park)

No.	Species	Quantity	Part, %
1	Common noctule *Nyctalus noctula* Schreber, 1774	2	3.4
2	Kuhl's pipistrelle *Pipistrellus kuhlii* Kuhl, 1817	15	25.4
3	Nathusius' pipistrelle *Pipistrellus nathusii* Keyserling et Blasius, 1839	13	22
4	Pipistrelle *Pipistrellus sp.*	11	18.6
5	Parti-coloured bat *Vespertilio murinus* Linnaeus, 1758	5	8.5
6	Serotine bat *Eptesicus serotinus* Schreber, 1774	2	3.5
	Undetermined	11	18.6
	Total	**59**	**100**

Table 17. Species Composition of Bats Registered by Means of Pettersson D500x Ultrasonic Detector on the 23 – 24 of August 2016 (Stepanivka Persha Village)

No.	Species	Quantity	Part, %
1	Long-eared bat *Plecotus sp.*	4	0.9
2	Common noctule *Nyctalus noctula* Schreber, 1774	82	18.4
3	Kuhl's pipistrelle *Pipistrellus kuhlii* Kuhl, 1817	195	43.7
4	Nathusius' pipistrelle *Pipistrellus nathusii* Keyserling et Blasius, 1839	47	10.5
5	Common pipistrelle *Pipistrellus pipistrellus* Schreber, 1774	12	2.7
6	Pygmy pipistrelle *Pipistrellus pygmaeus* Leach, 1825	32	7.2
7	Parti-coloured bat *Vespertilio murinus* Linnaeus, 1758	36	8.1
8	Serotine bat *Eptesicus serotinus* Schreber, 1774	26	5.8
	Undetermined	12	2.7
	Total	**446**	

Table 18. Species Composition of Bats Registered by Means of Pettersson D240x Ultrasonic Detector on the 15 - 16 of September 2016 (EuroCape Wind Park)

No.	Species	Quantity	Part, %
1	Common noctule *Nyctalus noctula* Schreber, 1774	7	18.9
2	Kuhl's pipistrelle *Pipistrellus kuhlii* Kuhl, 1817	17	46.0
3	Nathusius' pipistrelle *Pipistrellus nathusii* Keyserling et Blasius, 1839	9	24.3
4	Parti-coloured bat *Vespertilio murinus* Linnaeus, 1758	3	8.1
5	Serotine bat *Eptesicus serotinus* Schreber, 1774	1	2.7
	Total	**37**	**100**

Table 19. Species Composition of Bats Registered by Means of Pettersson D240x Ultrasonic Detector on the 20 - 21 of September 2016 (EuroCape Wind Park)

No.	Species	Quantity	Part, %
1	Kuhl's pipistrelle *Pipistrellus kuhlii* Kuhl, 1817	21	55.3
2	Nathusius' pipistrelle *Pipistrellus nathusii* Keyserling et Blasius, 1839	7	18.4
3	Common pipistrelle *Pipistrellus pipistrellus* Schreber, 1774	2	5.3
4	Myotis *Myotis sp.*	8	21
	Total	**38**	

Table 20. Species Composition of Bats Registered by Means of Pettersson D240x Ultrasonic Detector on the 6 – 7 of October 2016 (EuroCape Wind Park)

No.	Species	Quantity	Part, %
1	Kuhl's pipistrelle *Pipistrellus kuhlii* Kuhl, 1817	30	73.2
2	Nathusius' pipistrelle *Pipistrellus nathusii* Keyserling et Blasius, 1839	9	21.9
3	Common pipistrelle *Pipistrellus pipistrellus* Schreber, 1774	2	4.9
	Total	**41**	

Table 21. Species Composition of Bats Registered by Means of Pettersson D500x Ultrasonic Detector on the 6 – 7 of October 2016 (Botieve Village)

No.	Species	Quantity	Part, %
1	Common noctule *Nyctalus noctula* Schreber, 1774	3	11.1
2	Kuhl's pipistrelle *Pipistrellus kuhlii* Kuhl, 1817	18	66.7
3	Nathusius' pipistrelle *Pipistrellus nathusii* Keyserling et Blasius, 1839	1	3.7
4	Parti-coloured bat *Vespertilio murinus* Linnaeus, 1758	1	3.7
	Undetermined	4	14.8
	Total	**27**	

The results of species determination of bats, which are reflected in Tables 13 - 21, enable to create a summary table, in which all species are presented (Table 22).

When analysing summary Table 22, we can see the domination of Kuhl's pipistrelle (*Pipistrellus kuhlii* Kuhl, 1817) in the region, the part of which (415 voices) varied from 25.4% to 78.6% over the whole period of observations, on the average equal to 44.1% of all identified voices (n = 941). Subdominants were following: common noctule (*Nyctalus noctula* Schreber, 1774) and Nathusius' pipistrelle (*Pipistrellus nathusii* Keyserling et Blasius, 1839) with indices of 149 sounds (15.8%) and 130 sounds (13.8%) respectively. So, only these three species of bats made up 73.7% of all identified ones.

Other 4 bat species had the part from 2.9% for common pipistrelle (*Pipistrellus pipistrellus* Schreber, 1774) to 6.6% for parti-coloured bat (*Vespertilio murinus* Linnaeus, 1758).

Representatives of genera: Myotis (*Myotis*) – 9 voices and Long-eared bat (*Plecotus*) – 5 voices, undetermined till species, made up 0.9% and 0.5% respectively.

More detailed description of species diversity of bats is presented in Fig. 32 and Table 22.

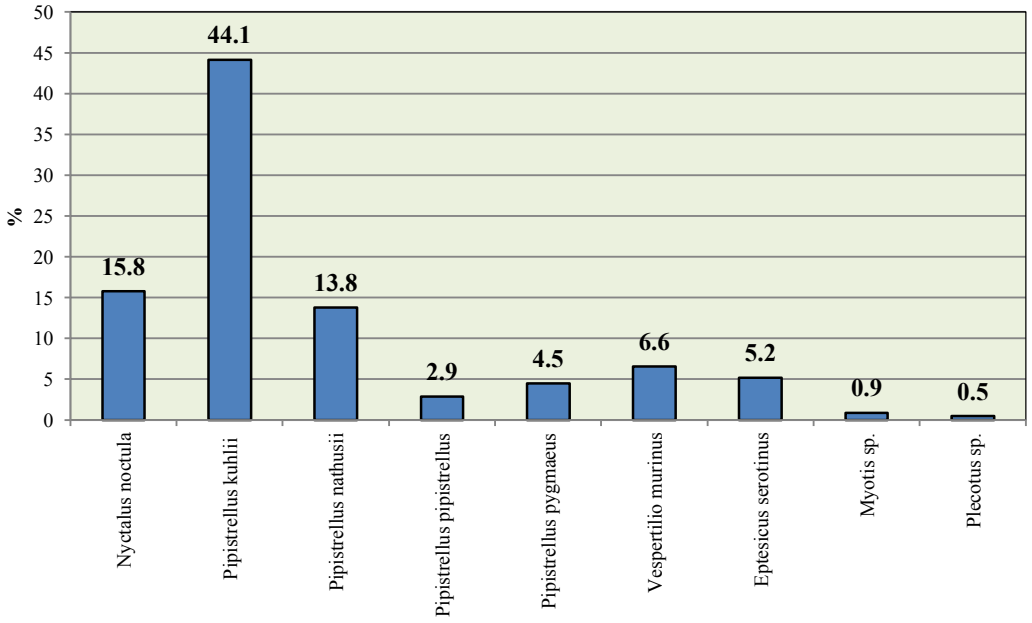


Fig. 32. Species representation of bats in the materials of researches

Table 22. Species Diversity of Bats in the Region of Researches in August - October of 2016

No.	Species	Dates, a type of detector and results of observations																						Total	
		6 - 7.08				7 - 8.08		23 - 24.08				15 - 16.09		20 - 21.09		6 - 7.10				11 - 12.10					
		500x		240x		240x		500x		240x		240x		240x		500x		240x		500x		240x			
		abs.	%	abs.	%	abs.	%	abs.	%	abs.	%	abs.	%	abs.	%	abs.	%	abs.	%	abs.	%	abs.	%	abs.	%
1	Common noctule *Nyctalus noctula* Schreber, 1774	49	28.3	-	-	4	7.3	82	18.4	2	3.4	7	18.9	-	-	3	11.1	-	-	2	14.3	-	-	**149**	**15.8**
2	Kuhl's pipistrelle *Pipistrellus kuhlii* Kuhl, 1817	55	31.8	27	57.4	26	47.3	195	43.7	15	25.4	17	46.0	21	55.3	18	66.7	30	73.2	11	78.6	-	-	**415**	**44.1**
3	Nathusius' pipistrelle *Pipistrellus nathusii* Keyserling et Blasius, 1839	24	13.9	8	17.0	7	12.7	47	10.5	13	22.0	9	24.3	7	18.4	1	3.7	9	21.9	1	7.1	4	100	**130**	**13.8**
4	Common pipistrelle *Pipistrellus pipistrellus* Schreber, 1774	5	2.9	6	12.8	-	-	12	2.7	-	-	-	-	2	5.3			2	4.9	-	-	-	-	**27**	**2.9**
5	Pygmy pipistrelle *Pipistrellus pygmaeus* Leach, 1825	8	4.6	-	-	2	3.6	32	7.2	-	-	-	-	-	-			-	-	-	-	-	-	**42**	**4.5**
6	Parti-coloured bat *Vespertilio murinus* Linnaeus, 1758	14	8.1	-	-	3	5.5	36	8.1	5	8.5	3	8.1	-	-	1	3.7	-	-	-	-	-	-	**62**	**6.6**
7	Serotine bat *Eptesicus serotinus* Schreber, 1774	9	5.2	2	4.3	9	16.4	26	5.8	2	3.5	1	2.7	-	-			-	-	-	-	-	-	**49**	**5.2**
8	Myotis *Myotis sp.*	-	-	-	-	1	1.8			-	-	-	-	8	21									**9**	**0.9**
9	Long-eared bat *Plecotus sp.*	-	-	-	-	1	1.8	4	0.9	-	-	-	-	-	-			-	-	-	-	-	-	**5**	**0.5**
	Pipistrelle *Pipistrellus sp.*	-	-	-	-					11	18.6	-	-	-	-			-	-	-	-	-	-	**11**	**1.2**
	Undetermined	9	5.2	4	8.5	2	3.6	12	2.7	11	18.6	-	-	-	-	4	14.8	-	-	-	-	-	-	**42**	**4.5**
	Total	**173**	**100**	**47**	**100**	**55**	**100**	**446**	**100**	**59**	**100**	**37**	**100**	**38**	**100**	**27**	**100**	**41**	**100**	**14**	**100**	**4**	**100**	**941**	**100**

Notes: data obtained by means of Pettersson D500x ultrasonic detector in the adjacent territories are marked by toning.

Taxonomic description of chiropterous complex in the region of investigations indicates domination of 4 species of pipistrelles (*Pipistrellus*) here, which had the part of 66.5% in the total count. The only representative of noctule genus (*Nyctalus*) is a subdominant with the part of 15.8%. Part of other species does not exceed 10% (Fig. 33).

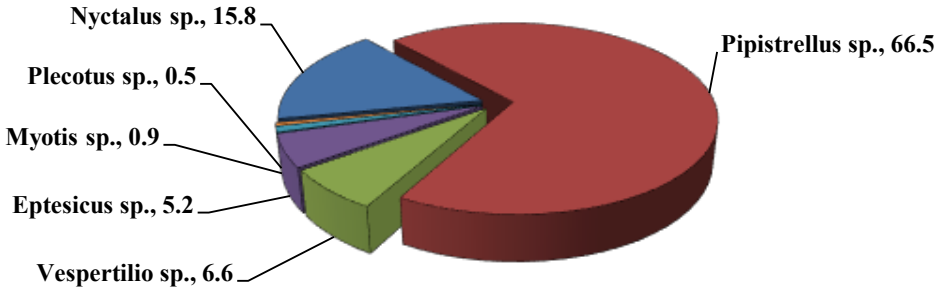


Fig. 33. Taxonomic description of chiropterous fauna in the region of investigations in August - October of 2016

So, we shall state stay of at least 9 bat species within the region being investigated.

2.2.2. Dynamics of bats' autumn migration

Space scanning by means of ultrasonic detectors, during which bats' voice activity shall be recorded, may serve as a basis for study of the dynamics of this process in terms of a certain time interval. So, the 6 of August through the 29 of October 2016, 9 field visits have been carried out to the wind park sites, results of which are given in Table 23.

Table 23. Dynamics of Bats' Voice Activity within EuroCape Wind Park and Adjacent Territories during the Period of August - October 2016 (sounds within 10 minutes)

Place (accord. to Fig. XX)	Dates of observations									Total	
	6 - 7.08	7 - 8.08	23 - 24.08	15 - 16.09	20 - 21.09	6 - 7.10	11 - 12.10	12 - 13.10	28 - 29.10	abs.	%
No. 2	3	14	6	5	2	4	1	0	3	**38**	9.1
No. 3	4	4	1	2	1	2	0	0	1	**15**	3.6
No. 4	6	3	13	5	7	4	0	0	1	**39**	9.4
No. 5	4	7	4	5	5	6	1	0	4	**36**	8.6
No. 6	9	6	3	2	2	2	0	0	1	**25**	6.0
No. 1	11	5	6	5	4	3	1	0	3	**38**	9.1
No. 7	3	10	4	4	4	2	1	0	1	**29**	7.0
No. 8	6	7	3	1	2	1	0	0	0	**20**	4.8
No. 9	9	4	1	2	2	2	0	0	1	**21**	5.0
No. 10	4	18	5	3	4	2	0	0	1	**37**	8.9
No. 11	7	6	14	6	5	6	0	0	2	**46**	11.0
No. 12	12	9	21	9	8	7	2	0	5	**73**	17.5
Total	**78**	**93**	**81**	**49**	**46**	**41**	**6**	**0**	**23**	**417**	**100**

Notes: (2, 3, 5, 7 - 10) – points of space listening within the wind park; (1, 11, 12) – at the coast of the Molochnyi Estuary and the Sea of Azov; (4, 6) – in human settlements.

Analysis of these data indicates the maximum voice activity in August, which decreases almost in half in September, and is characterized by the minimum indices in October (Fig. 34; on the left). The same tendency has been revealed also for data array obtained by means of Pettersson D500x device in the adjacent territories. The end of August and the middle of September had the maximum indices, and activity became 20 times less in October (Fig. 34; on the right).

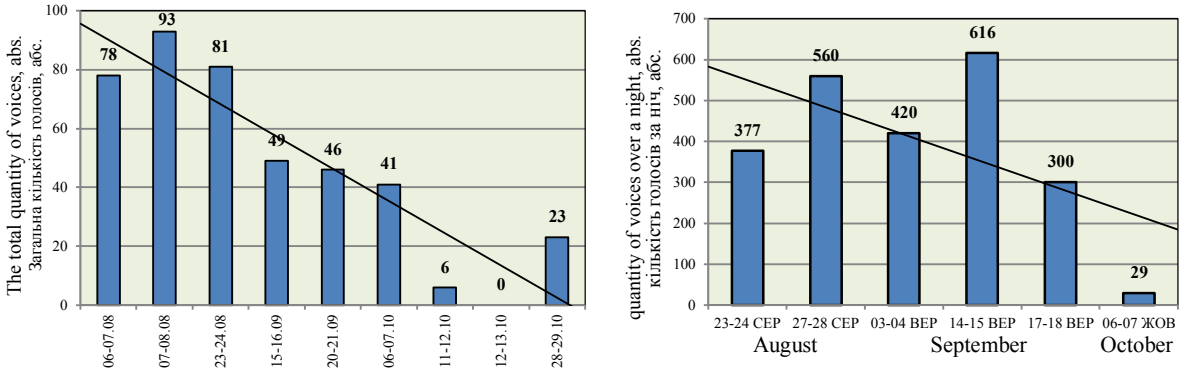


Fig. 34. Dynamics of bats' voice activity
according to data of Pettersson D240x (on the left) and Pettersson D500x (on the right) detectors

Data on registration of individual bat species during the period of observations have been analysed for description of phenological phenomena. Only data obtained by means of Pettersson D240x ultrasonic detector within the sites of EuroCape Wind Park have been selected. It turned out that only Nathusius' pipistrelle (*Pipistrellus nathusii* Keyserling et Blasius, 1839) was registered in the course of each field visit[1]. Kuhl's pipistrelle (*Pipistrellus kuhlii* Kuhl, 1817) was observed during the first 6 visits, and Serotine bat (*Eptesicus serotinus* Schreber, 1774) during the first 4 visits. Common pipistrelle (*Pipistrellus pipistrellus* Schreber, 1774) was counted each month (August - October), but its occurrences were extremely occasional. The voice of pygmy pipistrelle (*Pipistrellus pygmaeus* Leach, 1825) has been recorded only once.

Differences of bats' species composition by the months of observations indicate the highest species diversity (7 species) in August, little decrease in September (6 species) and abrupt decrease of species quantity in October (3 species).

So, we can see that constancy level of chiropterous complex within the sites of EuroCape Wind Park has wide fluctuation, which may indicate lack of factors here that would retain bats just in this very territory (Table 24).

Table 24. Phenology of Occurrences and Dynamics of Bats' Species Diversity within EuroCape Wind Park

No.	Species		Phenology of occurrences*							quantity of registrations (days)	Total	
			6 - 7. 08	7 - 8. 08	23 - 24. 08	15 - 16. 09	20 - 21. 09	6 - 7. 10	11 - 12. 10		abs.	%
1	Common noctule *Nyctalus noctula* Schreber, 1774			4	2	7				3	**149**	**15.8**
2	Kuhl's pipistrelle *Pipistrellus kuhlii* Kuhl, 1817		27	26	15	17	21	30		6	**415**	**44.1**
3	Nathusius' pipistrelle *Pipistrellus nathusii* Keyserling et Blasius, 1839		8	7	13	9	7	9	4	7	**130**	**13.8**
4	Common pipistrelle *Pipistrellus pipistrellus* Schreber, 1774		6				2	2		3	**27**	**2.9**
5	Pygmy pipistrelle *Pipistrellus pygmaeus* Leach, 1825			2						1	**42**	**4.5**
6	Parti-coloured bat *Vespertilio murinus* Linnaeus, 1758			3	5	3				3	**62**	**6.6**
7	Serotine bat *Eptesicus serotinus* Schreber, 1774		2	9	2	1				4	**49**	**5.2**
Total		**voices**	**47**	**55**	**59**	**37**	**38**	**41**	**4**		**941**	**100**
		species	**4**	**6**	**5**	**5**	**3**	**3**	**1**			

Notes: * - lack of data for the 12 - 13 of October owing to zero effectiveness, as well as for the 28 - 29 of October owing to indeterminacy of species (materials are in processing).

[1] Those results of field visits, for which species composition has been analyzed, are considered in calculation.

2.2.3. Zoning of the territory of investigations

Preliminary results show that species diversity in the course of a season, frequency of individual species occurrences and their voice activity are very variable indices. In order to ascertain individual inclinations of bats to one or another territory, we have analysed the role of certain observation points.

Data collected within two sites of EuroCape Wind Park (Points No. 2, 3, 5, 7, 8, 9, 10), human settlements (No. 4, 6) and at the coast of the Molochnyi Estuary (No. 1, 11) and the Sea of Azov (No. 12) have been considered in calculations.

General description of bats' voice activity at each observation point is presented in Table 23 (absolute indices) and in Fig. 35 (% of the total quantity of registered sounds).

Fig. 35. Activity of bats at individual listening points
(% of the total quantity; – the wind park, – water areas, – human settlements)

We can see that the most data in materials of researches are collected within EuroCape Wind Park (47% of the total quantity of voices), after which water areas (37.6%) and human settlements (15.4%) follow. But absolute indices do not estimate voice activity of bats without consideration of the quantity of observation points and calculation of the mean value for each of them. Just such index indicates the highest activity of animals within three points located at the coasts of the Molochnyi Estuary and the Sea of Azov (5.8 sounds/ point). Slightly lesser activity in human settlements (2 points; 4.9 sounds/ point). The wind park sites showed approximately half activity of that in previous zones and reached 2.7 sounds/ point. More detailed description of these phenomena is presented in Fig. 36 and 37.

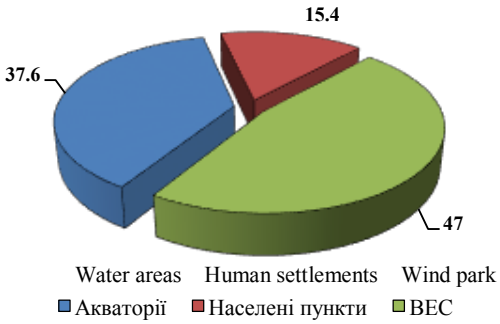


Fig. 36. Voice activity of bats in different functional zones (% of the total quantity)

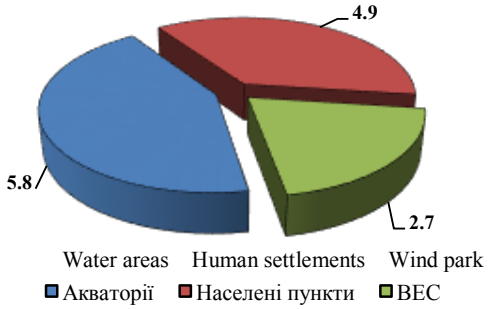


Fig. 37. Voice activity of bats in different functional zones (average number of voices per each point within individual zones)

In addition, bats' voice activity has been analysed not only at individual points and in individual functional zones, but also in terms of dynamics in the course of the whole observation period. Detailed description of obtained field material is given in Table 25.

Table 25. Seasonal Activity of Bats within EuroCape Wind Park, Adjacent Water Areas and Human Settlements during the Period of August - October 2016

Date	The wind park (7 points)			Water area (3 points)			Human settlements (2 points)			Total (12 points)		
	abs.	%	sounds/ point	abs.	%	sounds/ point	abs.	%	sounds/ point	abs.	%	sounds/ point
August 06 - 07, 2016	33	42.3	4.7	30	38.5	10	15	19.2	7.5	78	100	**6.5**
August 07 - 08, 2016	40	43.0	5.7	28	30.1	9.3	25	26.9	12.5	93	100	**7.8**
August 23 - 24, 2016	24	29.6	3.4	41	50.6	13.7	16	19.8	8.0	81	100	**6.8**
September 15 - 16, 2016	22	44.9	3.1	20	40.8	6.7	7	14.3	3.5	49	100	**4.1**
September 20 - 21, 2016	20	43.5	2.9	17	37.0	5.7	9	19.5	4.5	46	100	**3.8**
October 06 - 07, 2016	19	46.3	2.7	16	39.1	5.3	6	14.6	3.0	41	100	**3.4**
October 11 - 12, 2016	3	50.0	0.4	3	50.0	1	0	0	0	6	100	**0.5**
October 12 - 13, 2016	0	0	0	0	0	0	0	0	0	0	100	**0**
October 28 - 29, 2016	11	47.8	1.6	2	8.7	0.7	10	43.5	5.0	23	100	**1.9**
Total	**172**	**41.3**	**24.6**	**157**	**37.6**	**52.3**	**88**	**21.1**	**44.0**	**417**	100	**34.75**

Analysis of Table 25 has revealed some regularities. So, general trend of activity in the course of observation period had nonlinear decrease of indices for all three functional zones (Fig. 38). Voice activity within the sites of EuroCape Wind Park had never exceeded indices for other two zones and was always less (by the average number of sounds per one listening point). However, between listening points located in human settlements and at the coasts change of voice activity domination took place at the beginning of August. So, animals' activity within human settlements was somewhat less during observations on the 6 - 7 of August, but next night (August 7 - 8) - somewhat higher than the level of bats' activity along water areas. Since the end of August, during the whole September and till the end of October, points at the coast were dominating, but data obtained for the 28 - 29 of October 2016 indicate abrupt rise of the role of human settlements for stay of bats. It is caused by the terms of seasonal autumn migration, when at the beginning of August it had not yet enter its active phase, and toward the end of October already came to an end. Just at these very periods human settlements were more attractive for bats' feeding than other territories.

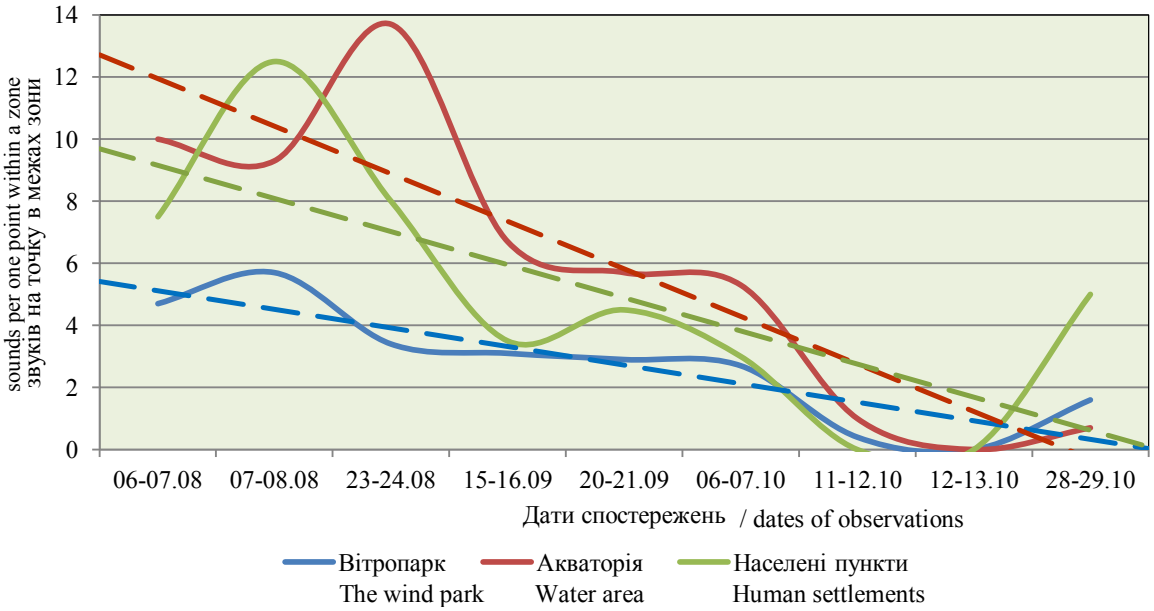


Fig. 38. Dynamics of bats' voice activity in different functional zones during the period of August - October 2016

Thus, collected information enables to appraise a role of different functional zones using numerical score system of several calculation parameters, given in Table 26. We can see that listening points near the water areas of the Molochnyi Estuary and the Sea of Azov have got the highest score (score 11), but human settlements and the wind park sites hold the second and the third rank (score 7 and 6 respectively).

Table 26. Ranking of Functional Zones According to Calculation Parameters

Functional zone	Calculation parameter								Total (score)
	Number of sounds		Sounds per visit		Sounds per point		Number of species		
	abs.	score	average	score	average	score	abs.	score	
EuroCape Wind Park	172	3	24.6	1	2.7	1	4 - 7	1	**6**
Human settlements	88	1	44.0	2	4.9	2	5 - 7	2	**7**
Water areas	157	2	52.3	3	5.8	3	6 - 7 (8)	3	**11**

Analysis data for the whole obtained field material over the period of August - October 2016 enable to state the absence of unique living conditions for bats within the whole region of investigations in the course of summer feeding, autumn migrations and search of winter hiding places, and existing distinctions between different functional zones indicate water areas as more attractive for animals against the background of the least attractivity of the wind park sites.

2.2.4. Conservation status of bats of the north-western Azov Sea region

Low individual fertility of females, in comparison with other mammals, and exactingness for hiding places rank bats among the most vulnerable representatives of theriofauna. Assessment of anthropic influence on chiropterans is ambiguous. For example, dendrophilous group losses its positions in natural conditions due to removal of hollow trees in woodlands, and gets them in urban landscapes. Troglophils, due to free access of people to caves and stone quarries, suffer from anxiety factors, but stone quarries are artificial formations, which favoured distribution of animals of this group to uncharacteristic habitats. In steppe zone, which is lacking in natural tree vegetation of proper quality of locality in its major territory, favourable conditions for habitation of chiropterans have been created due to just economic activity. They spread deep into open space due to sprawl of human settlements, building of irrigation channels and afforestation, got the possibility to stay here and breed.

Negative impact of technogenic environment has got its reflection in the regular edition of the Red Data Book of Ukraine [8], where the whole species composition of chiropterans is represented. Out of this list 1species has endangered status, 7 species - vulnerable, 2 - rare and 2 more – unrated owing to lack of information (Table 27).

12 bat species, which may occur within the sites of EuroCape Wind Park, buffer zones and in the adjacent territories according to results of preliminary researches, observations in August - September 2016, as well as according to literature data, are included in Table 27. Seven species out of twelve ones were identified by the voices and had been found in the course of investigations in 2016.

Only giant noctule (*Nyctalus lasiopterus*) out of the list of the species of the north-western Azov Sea region is listed in the international Red Lists, which has not been registered according to results of researches in August - September 2016. In accordance with the European Red List there is not enough information about distribution and biology of this species (DD category – data deficient).

All 12 species are listed in the Bern Convention (on the Conservation of European Wild Flora and Fauna and Natural Habitats) and in the Bonn Convention (on the Conservation of Migratory Species of Wild Animals). Almost all of them, according to Annex 2 of the Bern Convention are subject to special protection, and in accordance with Annex 2 of the Bonn Convention their state is estimated as unfavourable, preservation and regulation of using which needs international agreements.

Among 7 bat species, which have been registered in August - October 2016, 5 species pertain to vulnerable category, and status of Nathusius' pipistrelle and pygmy pipistrelle is unrated owing to lack of information (Table 27).

Table 27. Bats of the North-Western Azov Sea Region in the Conservation Lists of National and International Level*

No.	Species	Categories					
		RDBU	IUCN	ERL	BC	BO	WA
1	Whiskered bat *Myotis mystacinus* Kuhl, 1817	VU	–	–	2	2	–
2	Common long-eared bat *Plecotus auritus* Linnaeus, 1758	VU	–	–	2	2	–
3	Grey long-eared bat *Plecotus austriacus* Fischer, 1829	RARE	–	–	2	2	–
4	Lesser noctule *Nyctalus leisleri* Kuhl, 1817	RARE	–	–	2	2	–
5	Giant noctule *Nyctalus lasiopterus* Schreber, 1780	EN	NT	DD	2	2	–
6	Common noctule *Nyctalus noctula* Schreber, 1774	VU	–	–	2	2	–
7	Kuhl's pipistrelle *Pipistrellus kuhlii* Kuhl, 1817	VU	–	–	2	2	–
8	Nathusius' pipistrelle *Pipistrellus nathusii* Keyserling et Blasius, 1839	UR	–	–	2	2	–
9	Pygmy pipistrelle *Pipistrellus pygmaeus* Leach, 1825	UR			2	2	–
10	Common pipistrelle *Pipistrellus pipistrellus* Schreber, 1774	VU	–	–	3	2	–
11	Parti-coloured bat *Vespertilio murinus* Linnaeus, 1758	VU	–	–	2	2	–
12	Serotine bat *Eptesicus serotinus* Schreber, 1774	VU	–	–	2	2	–

Notes: ▭ – potential species that may be found in the region; ▭ – species identified in the course of researches; **RDBU** – the Red Data Book of Ukraine [8]: **VU** – vulnerable; **EN** – endangered; **RARE** – rare; **UR** – unrated; **IUCN** – the Red List of the International Union for Conservation of Nature [9]: **NT** – near threatened; **ERL** – the European Red List: **DD** – data deficient [10]; **BC** – the Bern Convention 1979 [11]; Annex 2 includes species that are subject to special protection, 3 – subject to protection; **BO** – the Bonn Convention on the Conservation of Migratory Species of Wild Animals 1979 [12]: Annex 2 includes species, state of which is unfavourable, preservation and regulation of using which needs international agreements, as well as that species, state of which might be considerably improved as a result of international cooperation on the basis of international agreements; **WA** – the Washington Convention, **CITES** [13]; " – " – a species is not listed in the list.

There were representatives of long-eared bat (*Plecotus*) and Myotis (*Myotis*) genera, unassigned till species, among identified sounds. Analysis of literature and investigations in the Azov Sea region and the Syvash region enable to assume species pertaining of these sounds to whiskered bat (*Myotis mystacinus* Kuhl, 1817) with vulnerable category and common long-eared bat (*Plecotus auritus* Linnaeus, 1758) with rare category. But additional researches in spring 2017 may be more demonstrative.

CHAPTER 3. Conclusion on the Impact of EuroCape Wind Park Construction on Vital Activity of Bats

Species composition of bats of the north-western Azov Sea region, in comparison with other natural zones, is the poorest one. Analysis of literature data and identification of sounds by means of ultrasonic detectors enables to assume that pipistrelles dominate in species composition of migrants, in particular, Kuhl's pipistrelles.

Species range is represented by taxons widely distributed in Ukraine. Lack of natural and artificial hiding places for troglophil group eliminates potential negative impact of construction and operation of the wind park on species of endangered category.

Spatial distribution of migrants over the wind park is uneven. Bats fly sparsely in a wide front. The highest intensity of passage has been recorded since the middle of August and till the middle of September. We have revealed migration corridor, which pass over the water area of the Molochnyi Estuary and along the coast of the Sea of Azov.

We have not observed mass seasonal migrations, when bats fly in flock, like birds.

Assessment of impacts on bats caused by the wind park construction and operation

1. Impacts caused by the construction.

1 a – emissions of hazardous substances. Emissions of hazardous substances will not exceed the permissible rates during the construction, owing to absence of stationary sources of pollution and short period of construction works. Concentration of pollutants in open space will hardly be higher than in industrial centres with high level of air pollution, where bats live permanently. There is no negative impact on migrating bats.

1 b – deterring by visual effects and noise. Periods of diurnal activity of builders and bats may be not coinciding. People and bats coexist in big cities, where vehicular traffic does not stop round the clock. There are greater sources of noise in the adjacent zones (human settlements, agricultural engineering, and motor roads). Deterring by visual effects is not threatening; therefore impact of these factors on bats is absent.

1 c – occupying the territory by working platforms and equipment. There is quite enough space at the site to fly past obstacles. Besides, designed density of the placement of working platforms and equipment will not obstruct feeding flights of bats, due to large area of the wind park sites and considerable distances between the wind turbines. Negative impact on migrating bats is absent.

1 d – loss of breeding places. There are no mass habitats of bats in the territories of the wind park site and in the buffer zones (with the exception of human settlements where quantity is also low). Bats occur in the designed territory only in the course of feeding migrations and in small quantity during transit migrations. Negative impact on migrating bats is absent.

1 e – loss of individual specimens of certain species. There is quite enough space at the sites for animals that possess echolocation to fly past obstacles. As a rule, feeding migrations have been registered at the altitudes not more than 20 m and this altitude interval is safe for bats. Negative impact on migrating bats shall be characterized as low.

2. Impacts caused by equipment.

2 a – long-time territory occupation and change of territory characteristics. Laying of the wind park site in the middle of agrocenosis will not change feeding biotopes of bats. As the wind park sites are represented mainly by agricultural lands, then the creation of small (by the area) infrastructure is not threatening for feeding movements of bats, as the major part of the territory remains without changes. Machinery and personnel, which will work at the construction for a small period, create an inessential anthropogenic load on bats (technological works at the site do not coincide with bats' activity in terms of diurnal rhythm). Negative impact on migrating bats is low, and during the major part of their reproductive cycle it is absent.

2 b – deterring by mast vertical structures. High-voltage lines of electric networks pass in the north and northern east of the wind park sites and buffer zones. Special observations have not revealed the negative impact on migrating bats of both vertical structures (towers) and horizontal ones (electric wires). Impact of dense electric network lines also has not been noted in human settlements, which are the

main habitats of bats. There is quite enough space at the wind park sites and in the buffer zones for animals to fly past obstacles. Negative impact on migrating bats is absent.

2 c – barrier impact and obstacles for flight. Bats do not have established narrow feeding migratory corridor. Routes of intensive transit migrations do not pass in the territory of the wind park sites. Migratory corridor passes over the water area of the Molochnyi Estuary and along the coast of the Sea of Azov. Negative impact on migrating bats shall be characterized as low.

3. Impacts caused by the wind park operation.

3 a – deterring caused by rotor motion. Technical characteristics of the wind turbines may potentially create a threat for transit migratory bats owing to rotor motion, but they have not been recorded in the territory of the wind park sites. Analysis of visual researches indicates that altitude interval within the wind park site in the course of feeding migrations does not exceed 20 m. According to our short-term observations at already operating wind parks in Kherson and Zaporizhia Regions, deterring of bats caused by rotor motion, shadows flicker, light gleams has not been revealed. So, negative impacts of these factors shall be estimated as low.

3 b – additional territory development. Potentially, bats may use different niches in structures of the wind park infrastructure elements (wind turbine generators, substations, utility buildings) as day hiding places. Negative impact on migrating bats shall be estimated as low.

3 c – disturbing owing to night-time illumination. On the one hand, bats are photophobic, but on the other hand – hunt near lamps, which attract insects. Illumination of the wind park site is characterized by considerably lesser indices than in human settlements – their main habitats. Negative impact on migrating bats is low.

3 d – collisions with the wind turbine generators. Small quantity of bats of local aggregation, slight (by quantity and intensity) feeding movements in the territory of the wind park sites, lack of intensive transit migration routes give grounds for estimation of the impact of this factor as low. But monitoring observations at already operating wind park site are necessary for confirmation of the estimation of this factor effect.

Thus, preliminary studies of living conditions of chiropterans within EuroCape Wind Park do not give grounds for conclusion that placement of wind turbine generators here will have negative influence on their populations. Negative impact on migrating bats is low.

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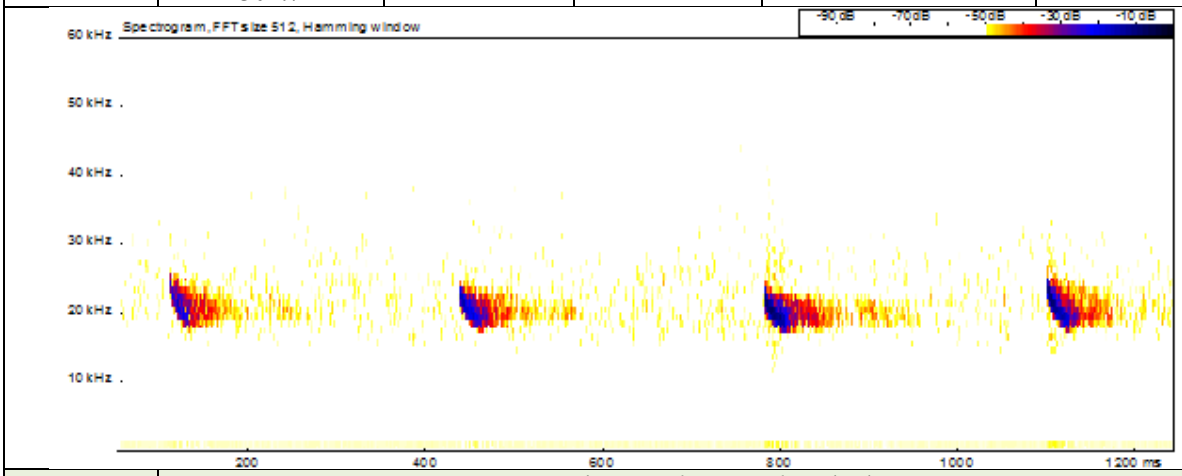
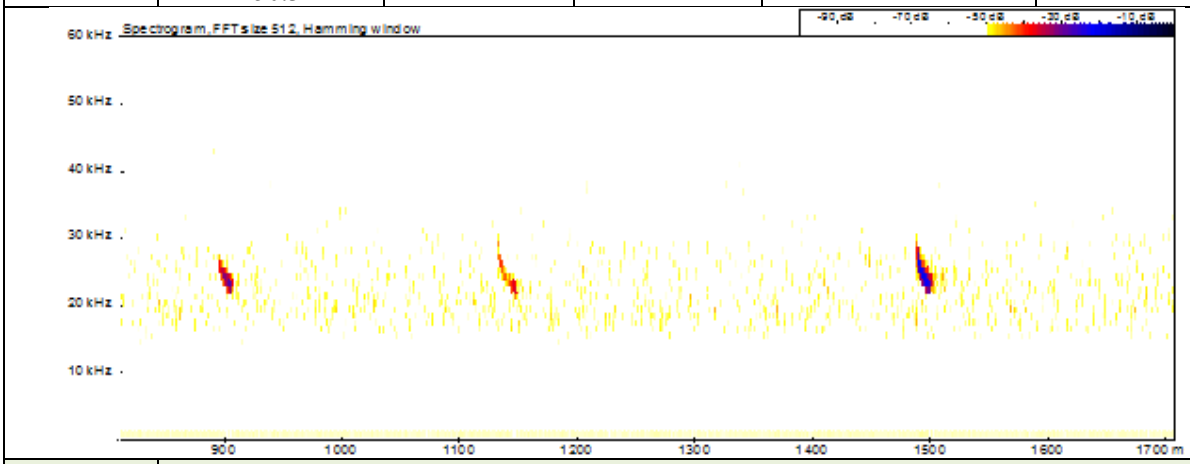
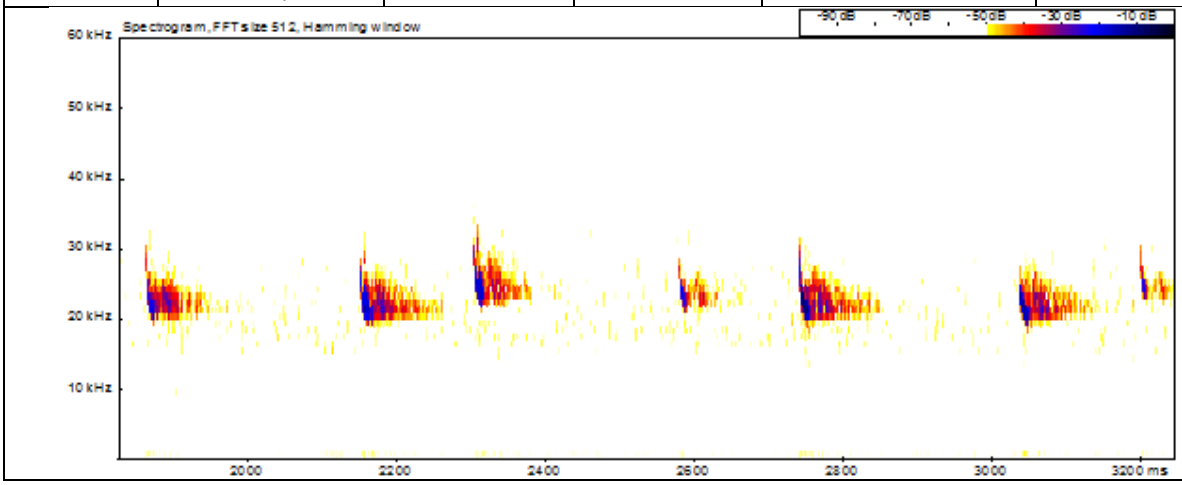
Annex

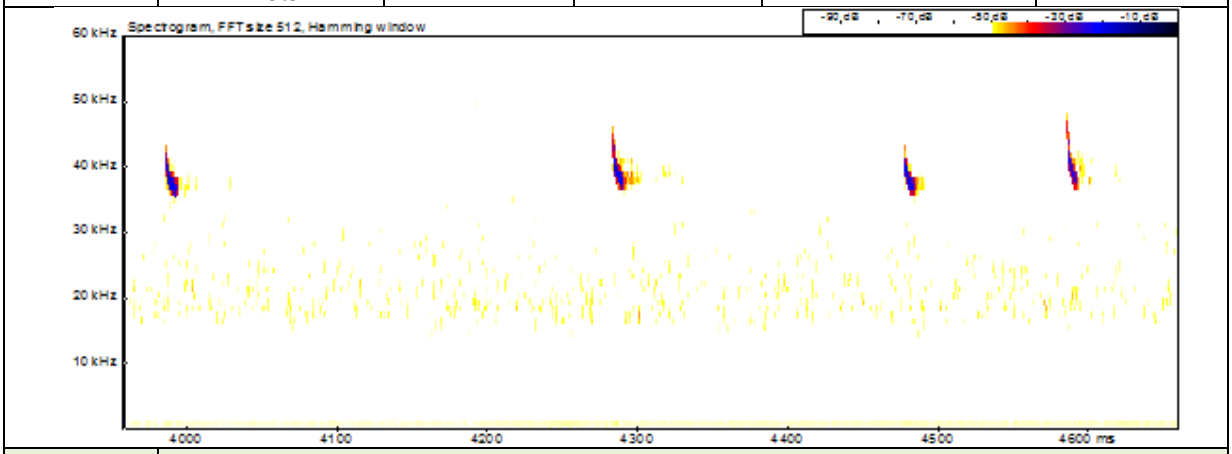
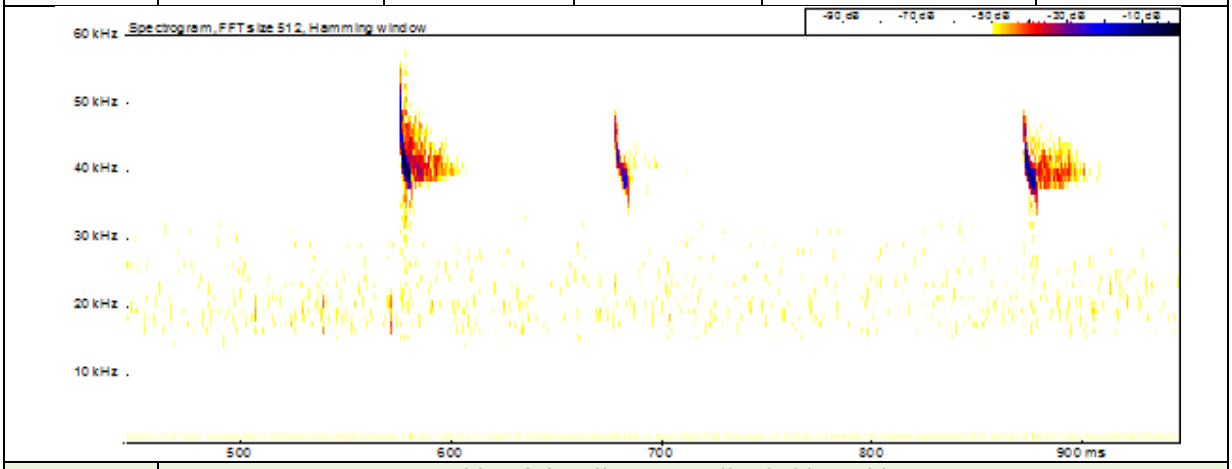
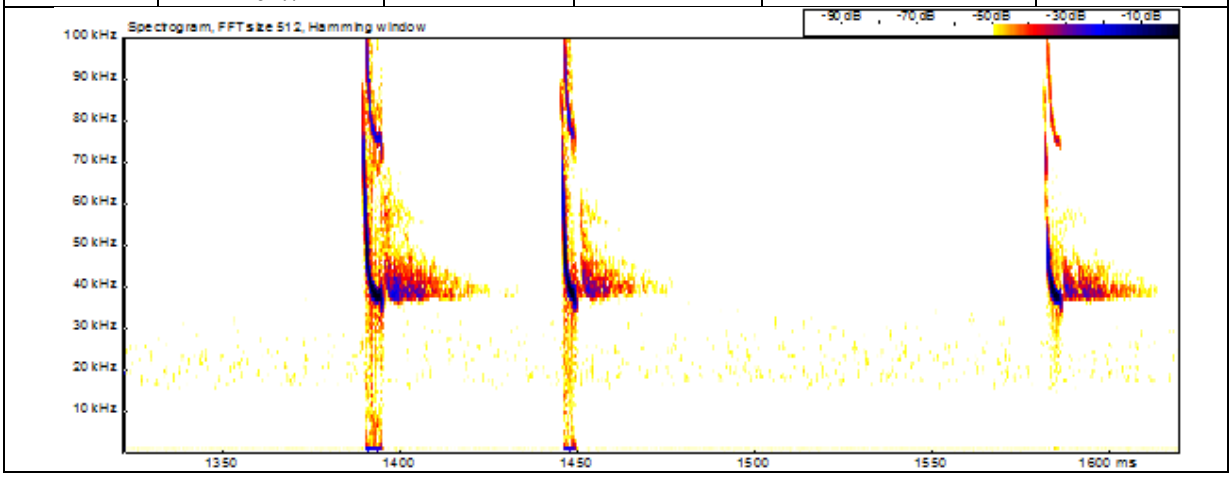
Basic Sound Parameters and Sonograms of Bats that have been Registered by means of Pettersson D 240x and Pettersson D 500x Ultrasonic Detectors within the Site of EuroCape Wind Park, in the Buffer Zones and Adjacent Territories in 2016

(typical examples of sonograms)

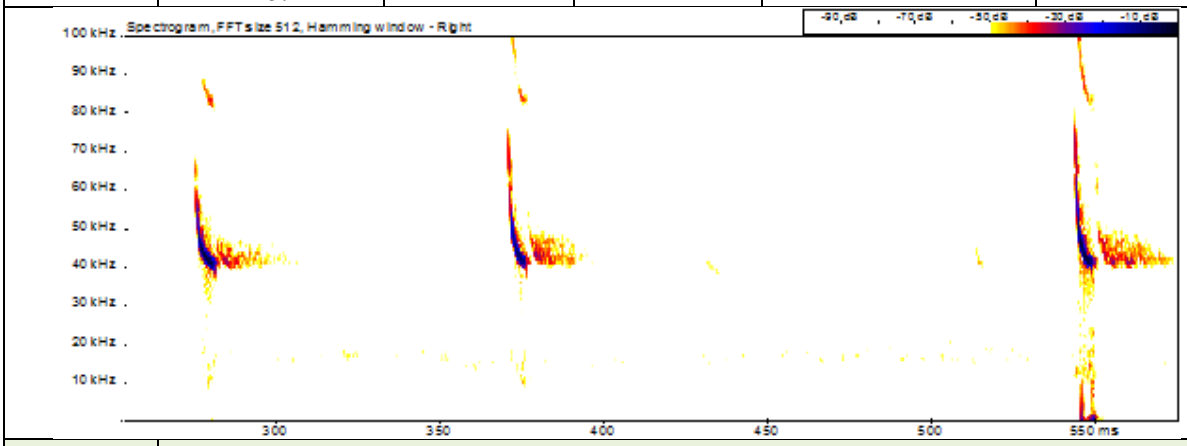
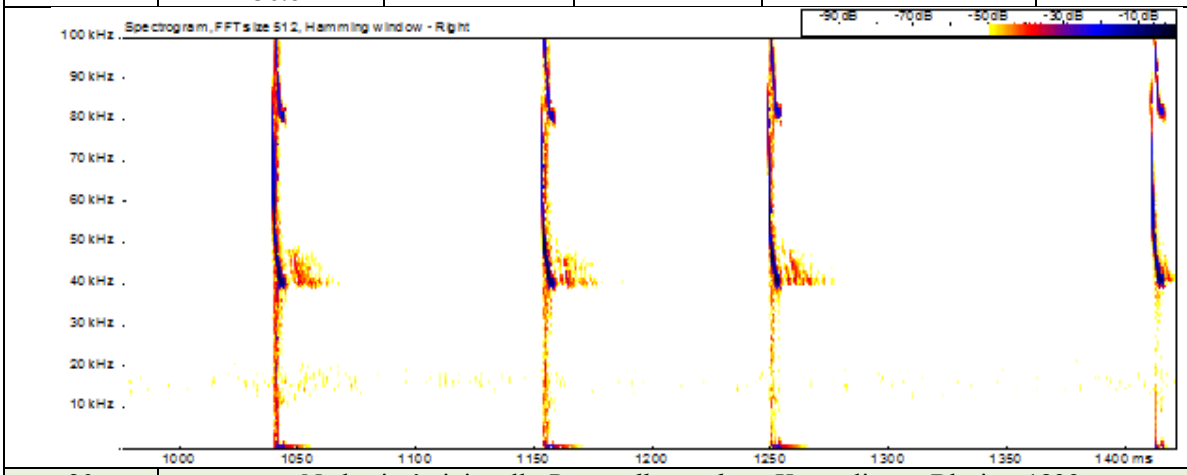
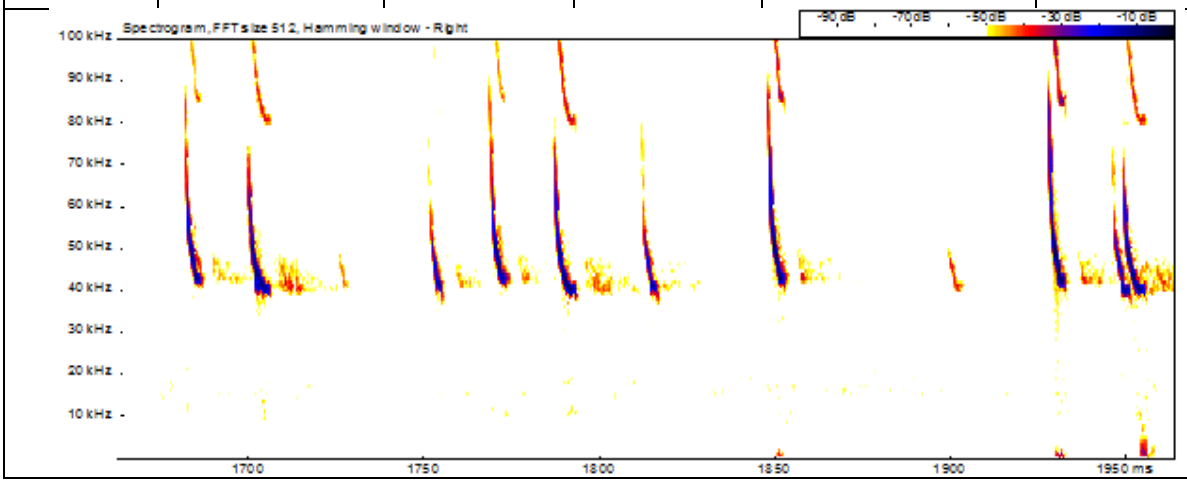
COMMON NOCTULE *NYCTALUS NOCTULA* SCHREBER, 1774

File	Average interpulse interval, ms	Pulse duration, ms	Upper limit, kHz	During the maximum sound power, kHz	Lower limit, kHz
76.0	Common noctule *Nyctalus noctula* Schreber, 1774				
	301.7	23.14	26.2	21.8	17.8
					
77	Common noctule *Nyctalus noctula* Schreber, 1774				
	450.3	13.39	30.8	24.8	21.5
					
235	Common noctule *Nyctalus noctula* Schreber, 1774				
	224.1	14.23	31.6	22.2	19.5
					

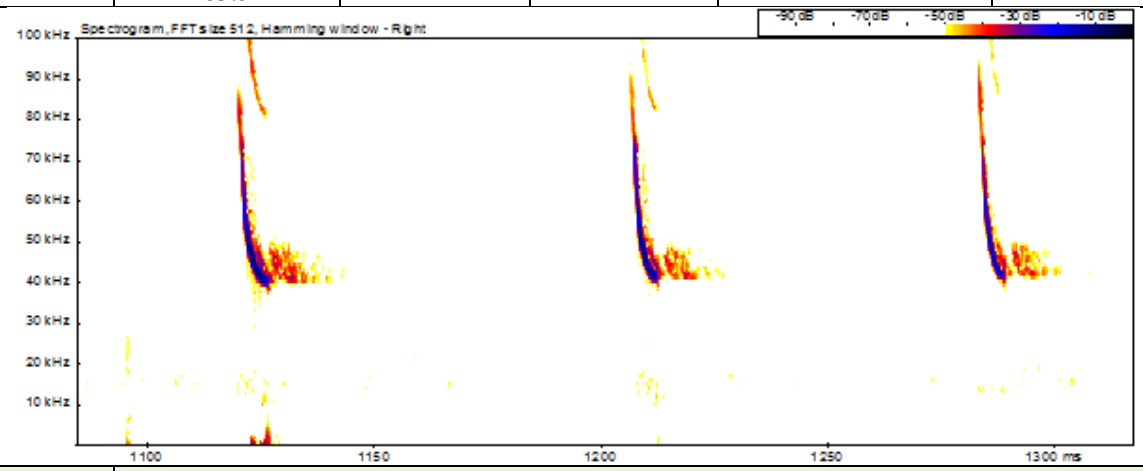
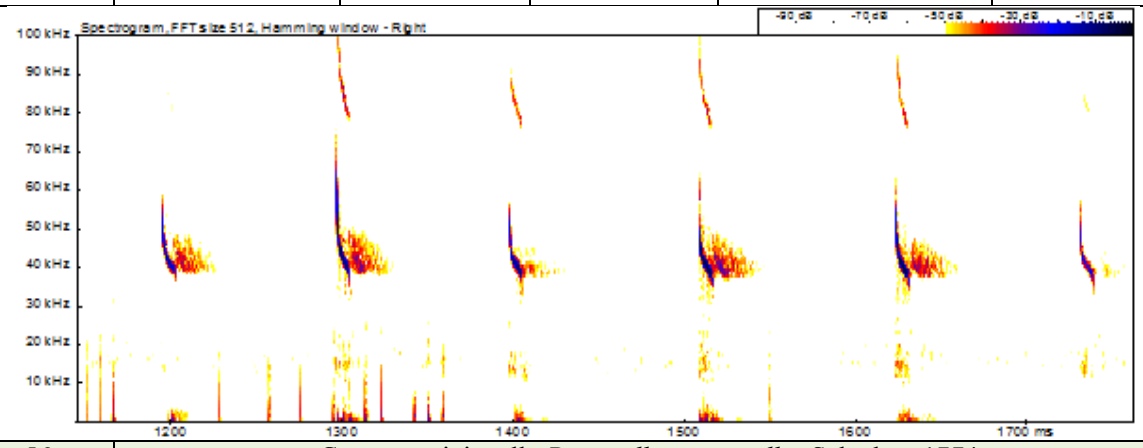
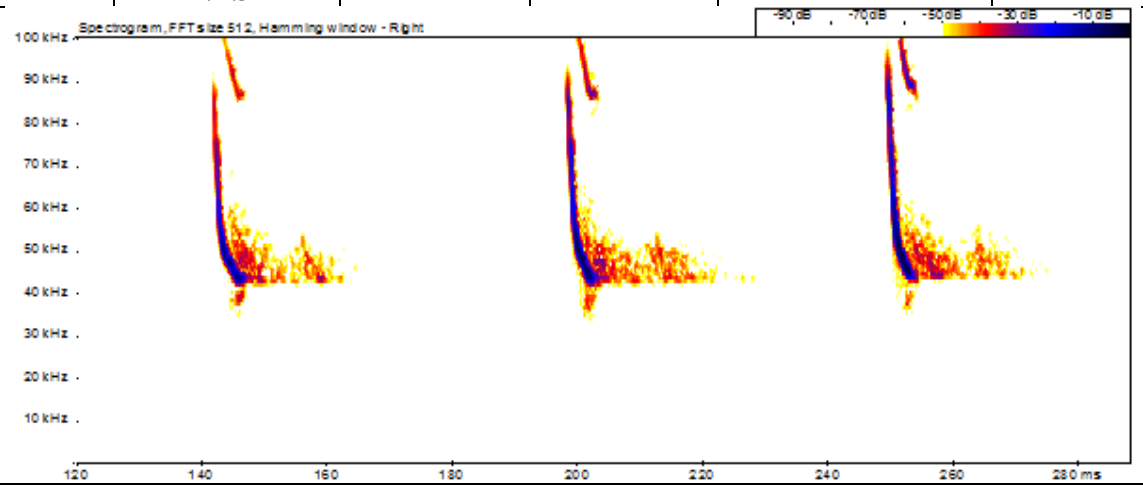
KUHL'S PIPISTRELLE *PIPISTRELLUS KUHLII* KUHL, 1817

File	Average interpulse interval, ms	Pulse duration, ms	Upper limit, kHz	During the maximum sound power, kHz	Lower limit, kHz
19	Kuhl's pipistrelle *Pipistrellus kuhlii* Kuhl, 1817				
	245.5	7.77	48.0	39.9	36.2
					
38	Kuhl's pipistrelle *Pipistrellus kuhlii* Kuhl, 1817				
	182.4	5.98	56.1	41.8	37.4
					
45	Kuhl's pipistrelle *Pipistrellus kuhlii* Kuhl, 1817				
	161.7	5.62	89.7	38.3	35.0
					

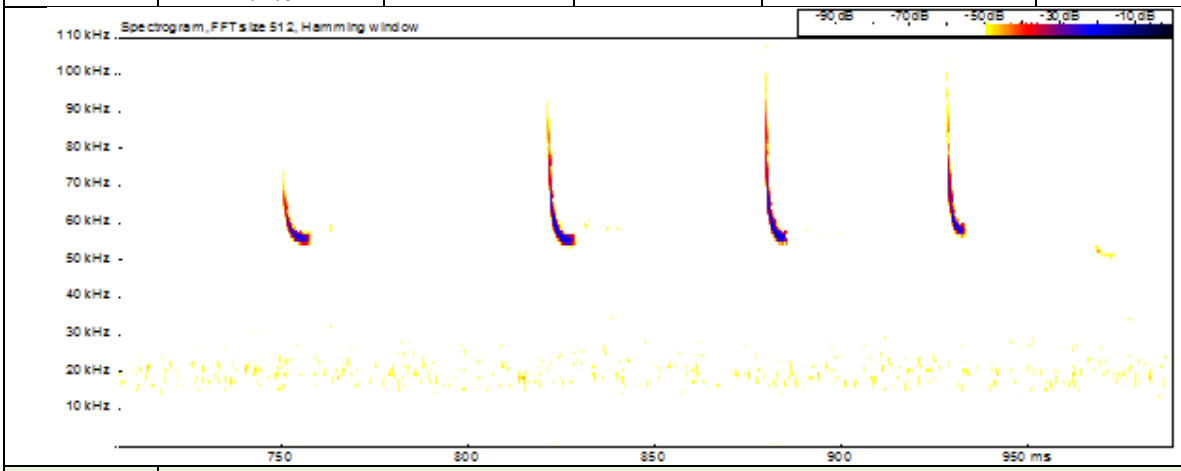
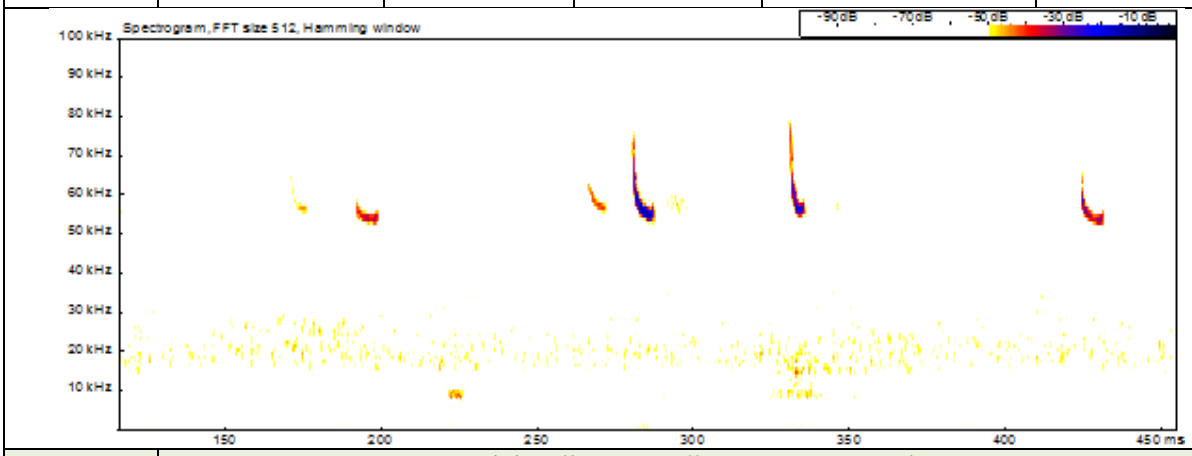
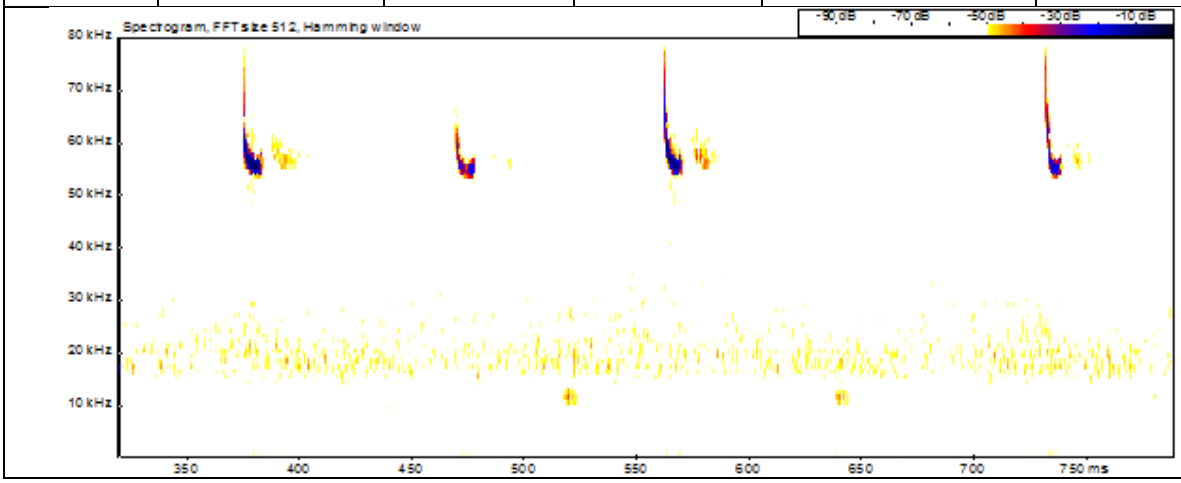
NATHUSIUS' PIPISTRELLE *PIPISTRELLUS NATHUSII* KEYSERLING ET BLASIUS, 1839

File	Average interpulse interval, ms	Pulse duration, ms	Upper limit, kHz	During the maximum sound power, kHz	Lower limit, kHz
16	Nathusius' pipistrelle *Pipistrellus nathusii* Keyserling et Blasius, 1839				
	145.1	5.0	80.7	42.0	39.2
					
19	Nathusius' pipistrelle *Pipistrellus nathusii* Keyserling et Blasius, 1839				
	136.8	5.54	89.7	42.4	38.5
					
20	Nathusius' pipistrelle *Pipistrellus nathusii* Keyserling et Blasius, 1839				
	–	4.38	92.6	43.8	40.5
					

COMMON PIPISTRELLE *PIPISTRELLUS PIPISTRELLUS* SCHREBER, 1774

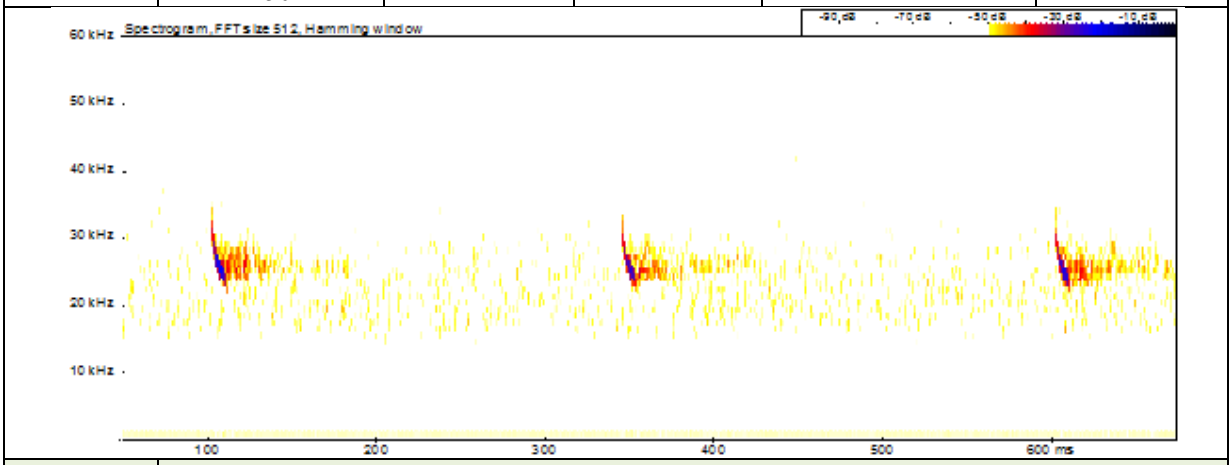
File	Average interpulse interval, ms	Pulse duration, ms	Upper limit, kHz	During the maximum sound power, kHz	Lower limit, kHz
27	Common pipistrelle *Pipistrellus pipistrellus* Schreber, 1774				
	83.5	6.03	94.3	46.2	40.2
					
33	Common pipistrelle *Pipistrellus pipistrellus* Schreber, 1774				
	117.4	7.87	75.1	45.9	38.1
					
56	Common pipistrelle *Pipistrellus pipistrellus* Schreber, 1774				
	71.3	–	98.8	46.5	42.7
					

PYGMY PIPISTRELLE *PIPISTRELLUS PYGMAEUS* LEACH, 1825

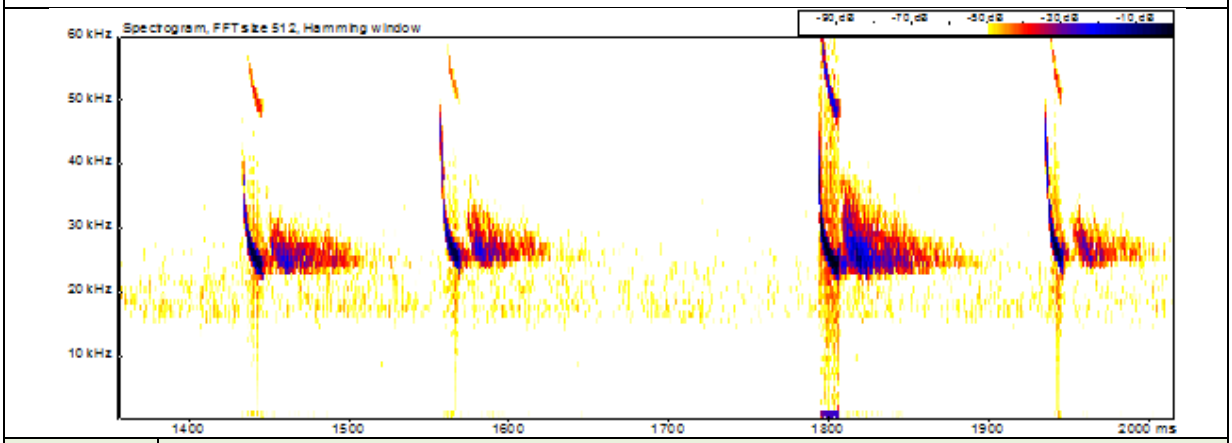
File	Average interpulse interval, ms	Pulse duration, ms	Upper limit, kHz	During the maximum sound power, kHz	Lower limit, kHz
207	Pygmy pipistrelle *Pipistrellus pygmaeus* Leach, 1825				
	72.6	5.85	101.2	57.2	54.5
					
238	Pygmy pipistrelle *Pipistrellus pygmaeus* Leach, 1825				
	–	4.78	78.9	56.7	53.6
					
248	Pygmy pipistrelle *Pipistrellus pygmaeus* Leach, 1825				
	–	6.91	–	56.2	–
					

PARTI-COLOURED BAT *VESPERTILIO MURINUS* LINNAEUS, 1758

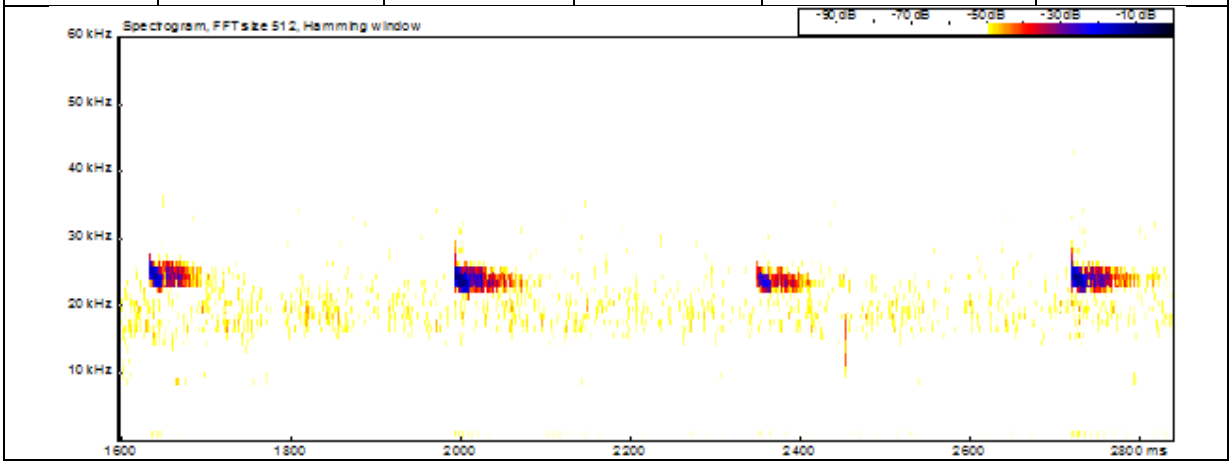
File	Average interpulse interval, ms	Pulse duration, ms	Upper limit, kHz	During the maximum sound power, kHz	Lower limit, kHz
73	Parti-coloured bat *Vespertilio murinus* Linnaeus, 1758				
	250	8.51	34.0	25.9	22.6



205	Parti-coloured bat *Vespertilio murinus* Linnaeus, 1758				
	188.4	10.87	49.4	26.5	23.6

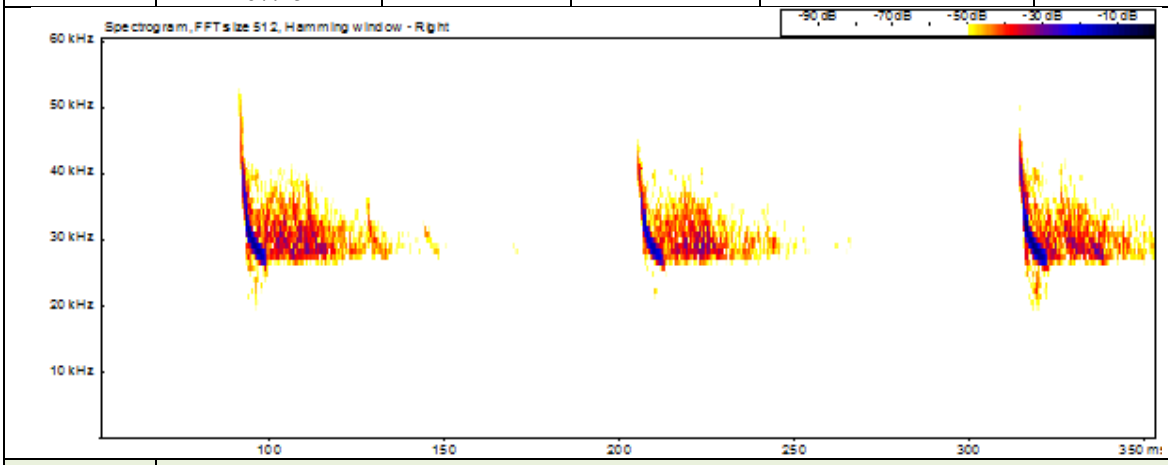


227	Parti-coloured bat *Vespertilio murinus* Linnaeus, 1758				
	386.6	15.91	29.7	24.8	21.7

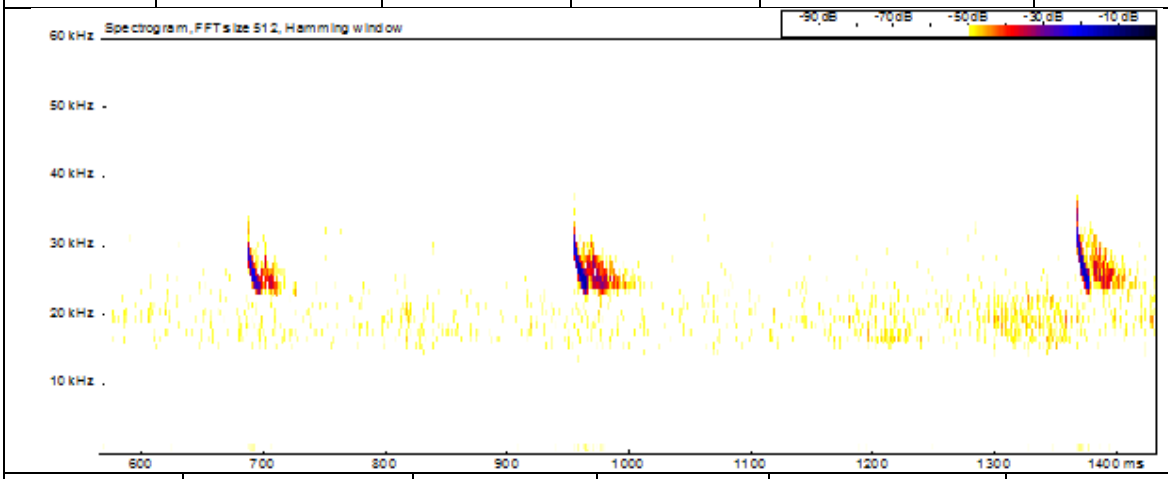


SEROTINE BAT *EPTESICUS SEROTINUS* SCHREBER, 1774

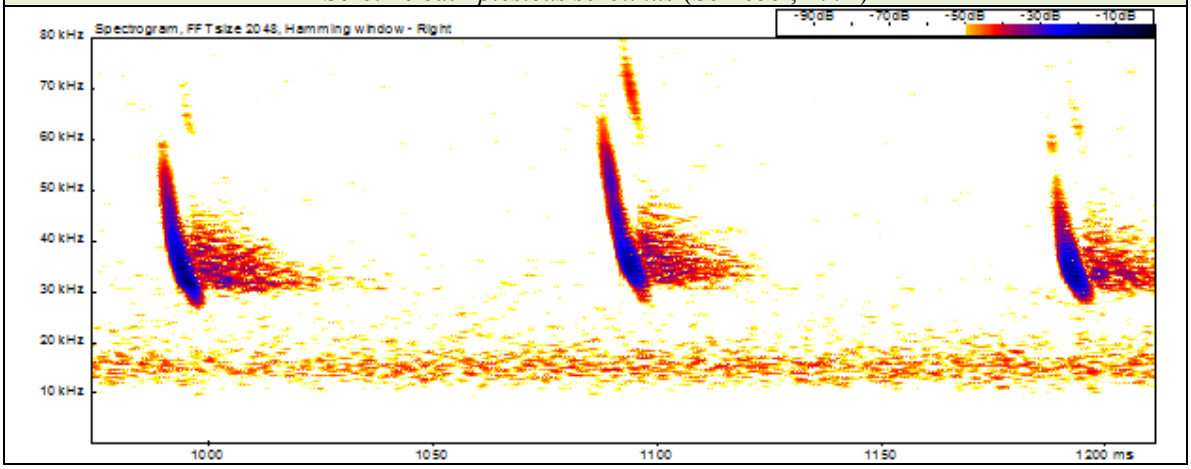
File	Average interpulse interval, ms	Pulse duration, ms	Upper limit, kHz	During the maximum sound power, kHz	Lower limit, kHz
73	Serotine bat *Eptesicus serotinus* Schreber, 1774				
	167.25	7.51	52.3	29.5	25.9



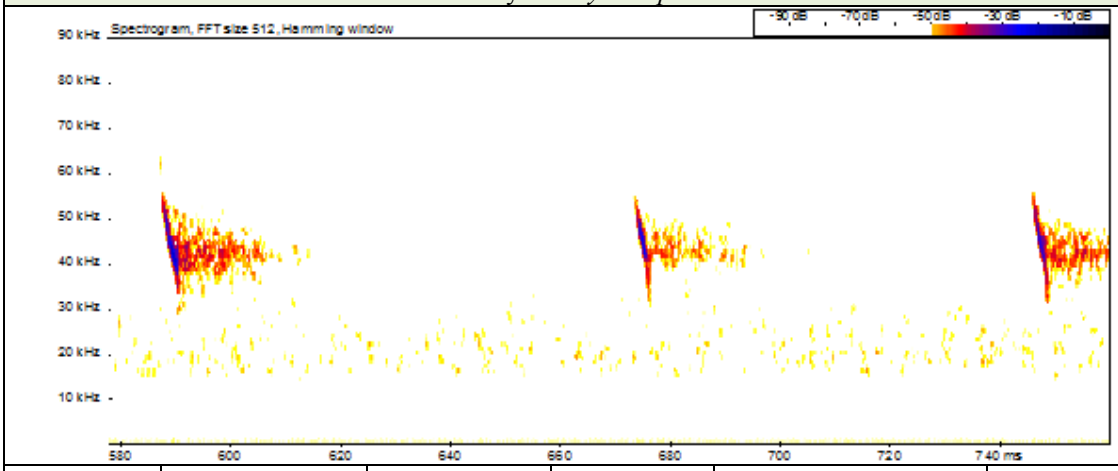
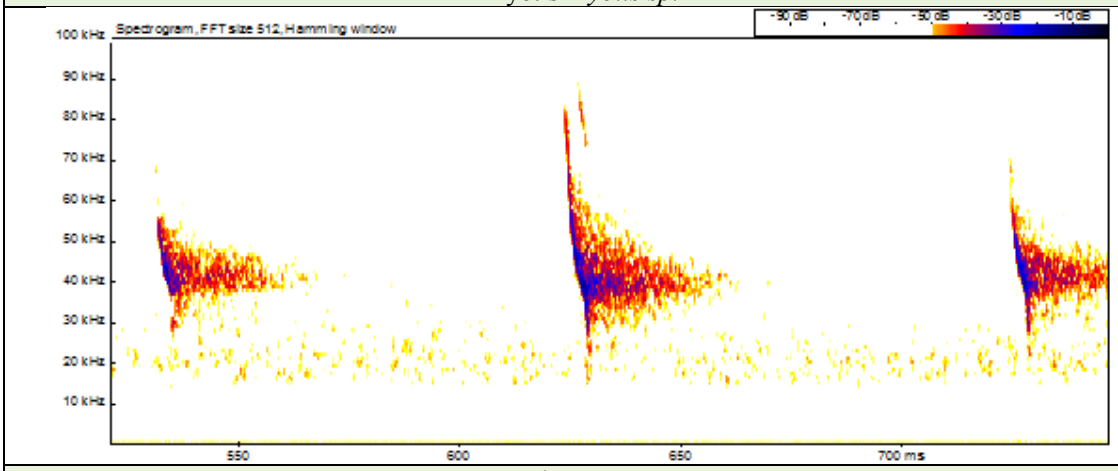
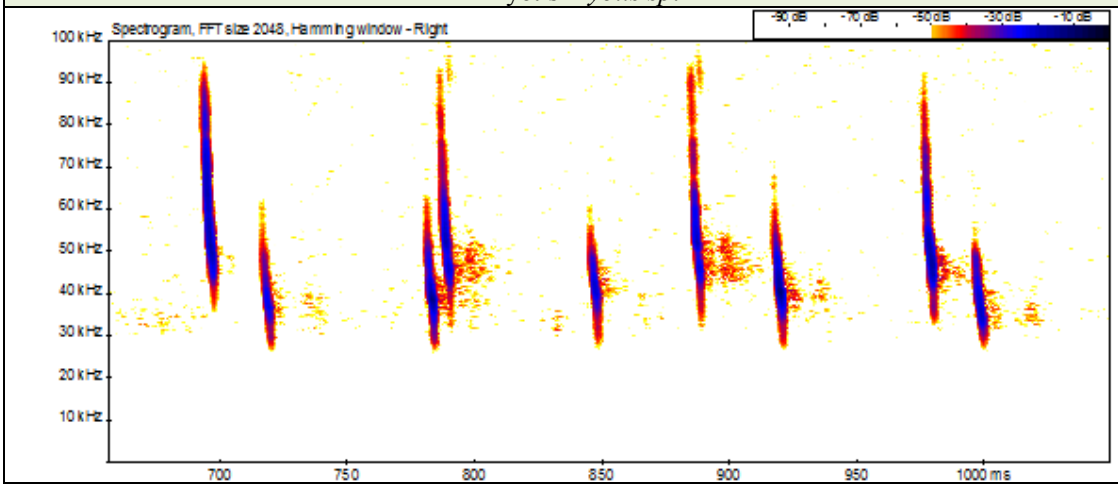
320	Serotine bat *Eptesicus serotinus* Schreber, 1774				
		10.1	37.4	26.2	23.4



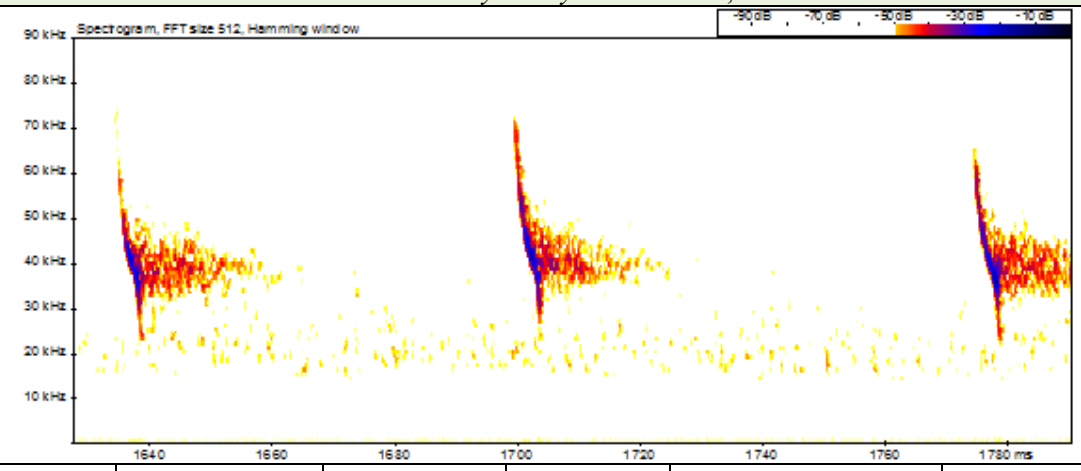
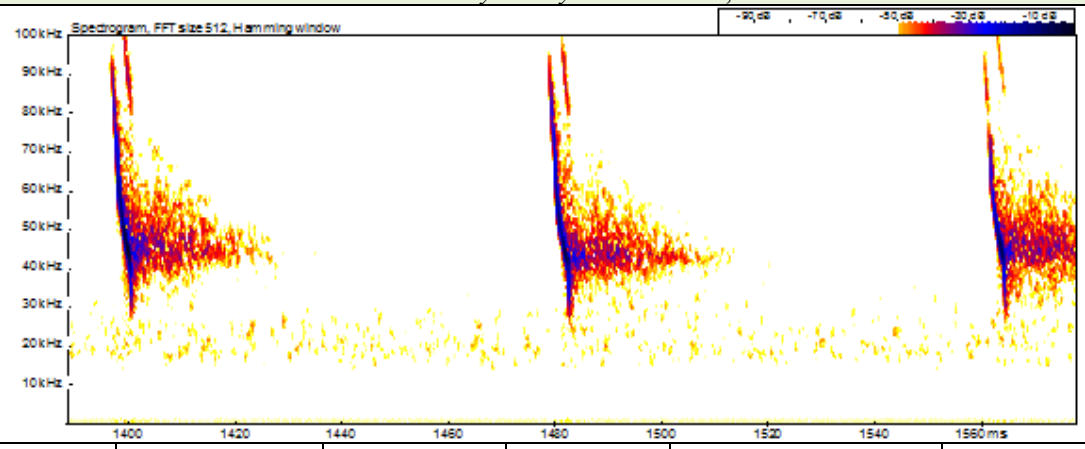
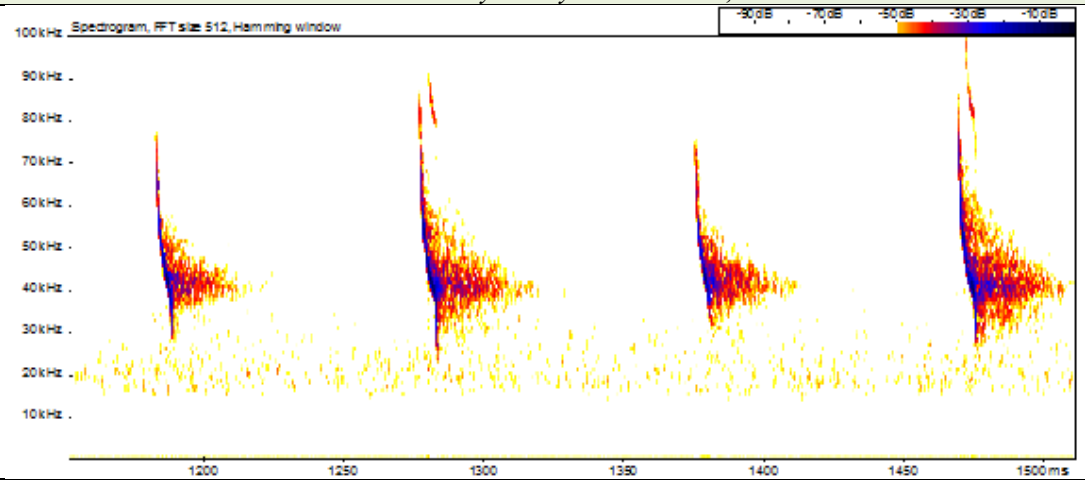
STE-004	113.7	8.94	68.4	36.2	28.0
Serotine bat *Eptesicus serotinus* (Schreber, 1774)					



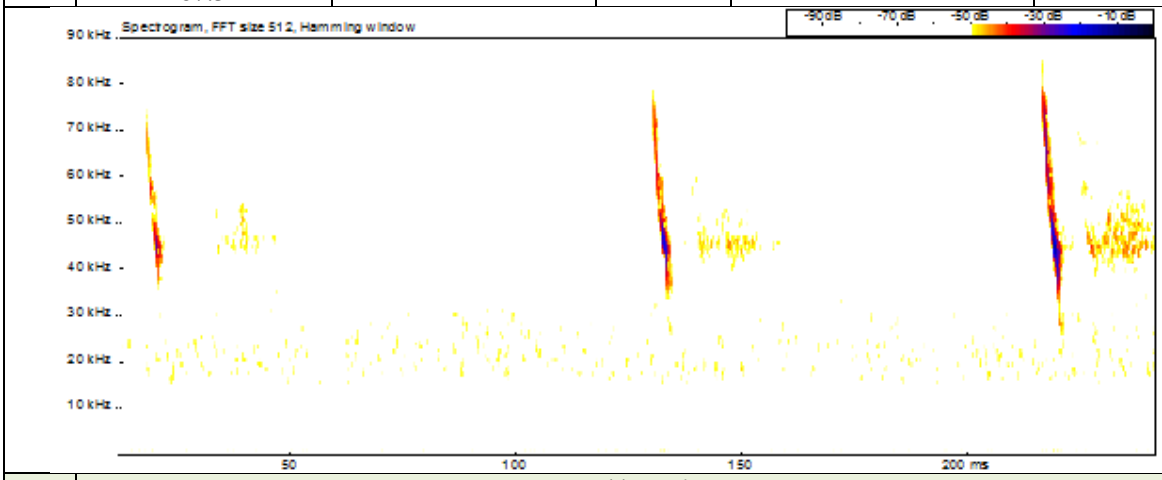
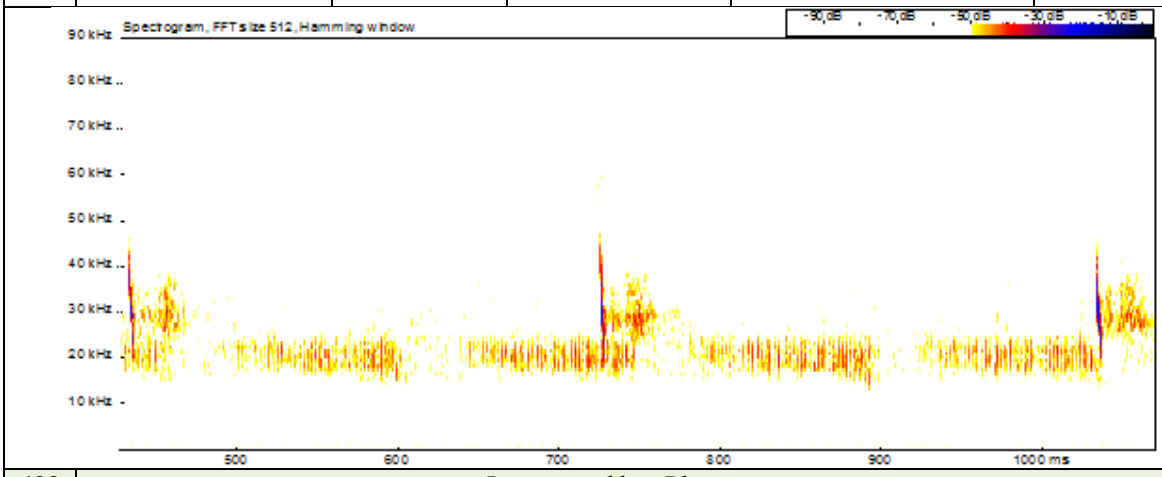
MYOTIS *MYOTIS SP.*

File	Average interpulse interval, ms	Pulse duration, ms	Upper limit, kHz	During the maximum sound power, kHz	Lower limit, kHz
M00141	96.6	2.6	56.2	45.7	31.3
Myotis *Myotis sp.*					
					
M00214	96.8	–	82.6	39.5	21.7
Myotis *Myotis sp.*					
					
Myotis *Myotis sp.*					
					

WHISKERED BAT *MYOTIS MYSTACINUS* KUHL, 1817

File	Average interpulse interval, ms	Pulse duration, ms	Upper limit, kHz	During the maximum sound power, kHz	Lower limit, kHz
M00132	80.1	4.94	72.8	42.7	26.2
Whiskered bat *Myotis mystacinus* Kuhl, 1817					
					
M00203	76.6	4.08	94.9	45.4	27.4
Whiskered bat *Myotis mystacinus* Kuhl, 1817					
					
M00206	97.6	–	84.0	42.1	23.6
Whiskered bat *Myotis mystacinus* Kuhl, 1817					
					

LONG-EARED BAT *PLECOTUS SP.*

File	Average interpulse interval, ms	Pulse duration, ms	Upper limit, kHz	During the maximum sound power, kHz	Lower limit, kHz
241	Long-eared bat *Plecotus sp.*				
	87.3	4.09	84.9	43.7	26.4
					
242	Long-eared bat *Plecotus sp.*				
	–	3.84	47.2	30.9	18.7
					
488	Long-eared bat *Plecotus sp.*				
	72.9	2.36	55.6	40.8	28.2