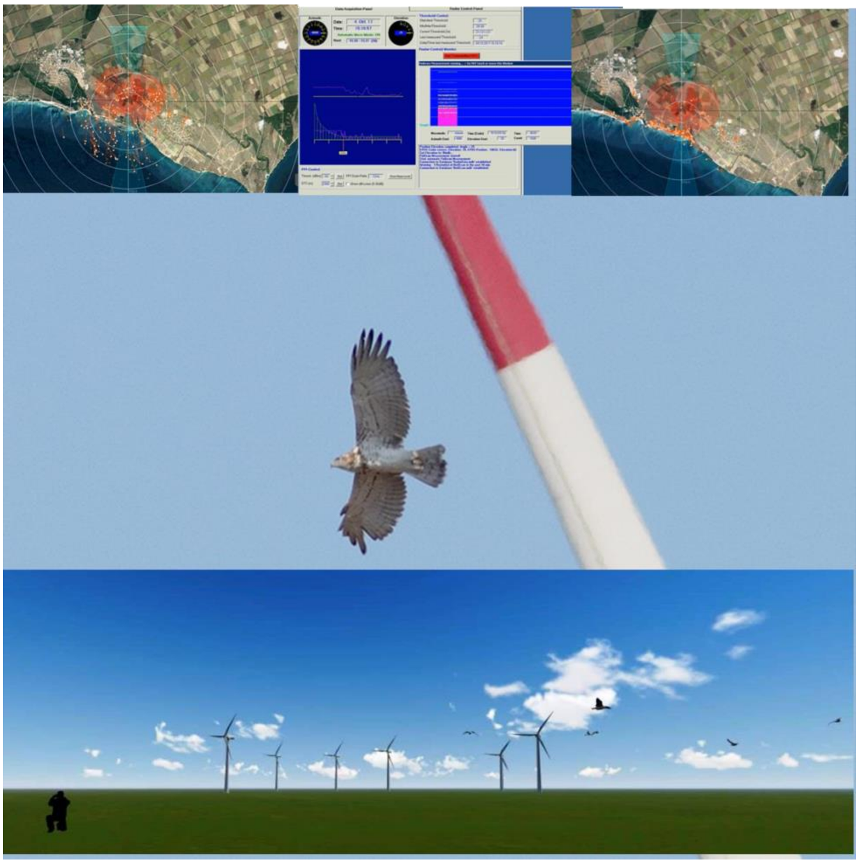
INTEGRATED SYSTEM FOR PROTECTION OF BIRDS

REPORT

Monitoring of the migration of birds through the territory of the Integrated System for Protection of Birds, Autumn 2022



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1. INTRODUCTION

The present study was commissioned by AES Geo Energy Ltd., Kaliakra Wind Power, EVN Kavarna, Degrets OOD, Disib OOD, Windex OOD, Long Man Invest OOD, Long Man Energy OOD, Zevs Bonus OOD, Vertikal-Petkov & Sie SD, Wind Park Kavarna East EOOD, Wind Park Kavarna West EOOD, and Millennium Group OOD in order to collect and summarize the information about the performance of the Integrated System for Protection of Birds (ISPB) that includes 114 wind turbines, 95 of which are within the Kaliakra SPA BG0002051 and 19 are in the areas adjacent to the protected zone (Figure 1).

Detailed information on the scope, technical rules and monitoring procedures are publicly available at a dedicated website (https://kaliakrabirdmonitoring.eu/Methodology of ISPB) as well as in four previous reports on autumn migration in 2018, 2019, 2020 and 2021 respectively (https://kaliakrabirdmonitoring.eu/Report Autumn Bird Migration, 2018; https://kaliakrabirdmonitoring.eu/Report Autumn Bird Migration, 2019; https://kaliakrabirdmonitoring.eu/Report Autumn Bird Migration, 2020; https://kaliakrabirdmonitoring.eu/Report Autumn Bird Migration, 2021).

Figure 1 presents the locations of all 114 wind turbines within the study area covered by the ISPB.

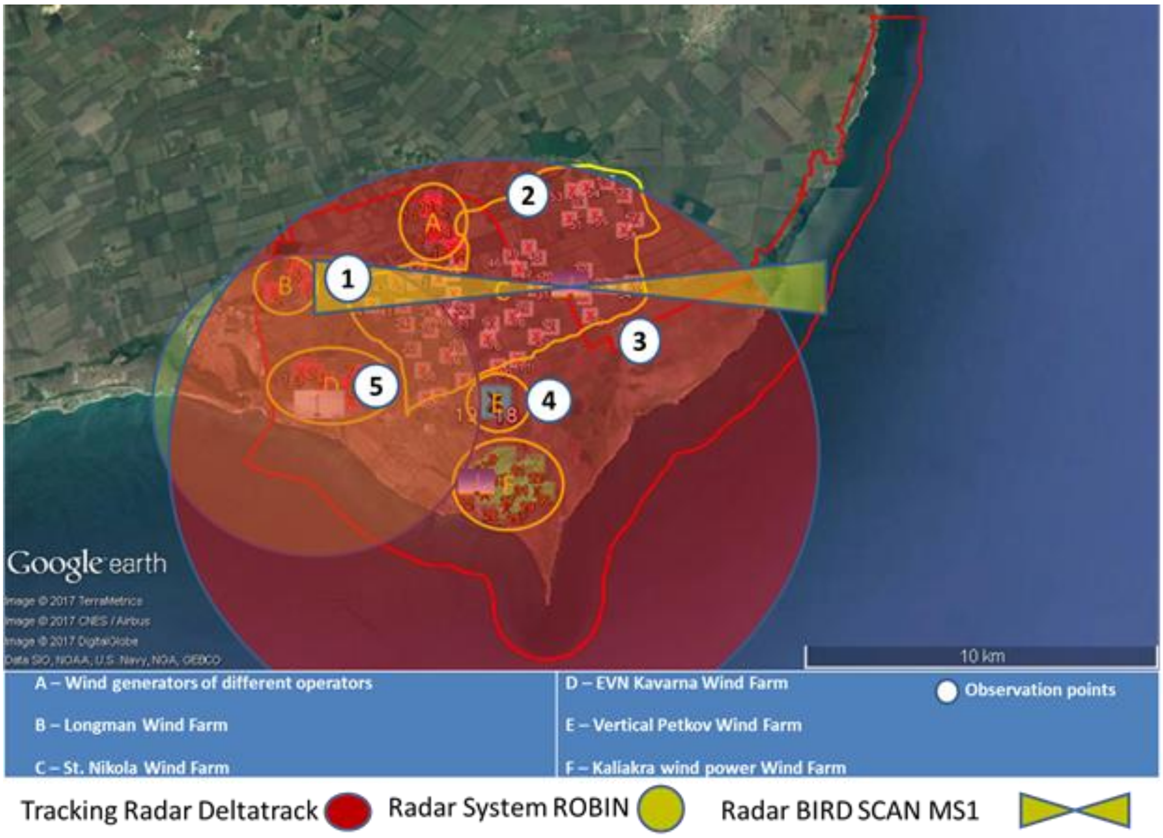

Figure 1. *A satellite photo with the location of the wind turbines covered by the ISPB and the boundaries of Kaliakra SPA (shown by the red line), together with the scope of three radar systems.*

The recent surveys of bird migration in Bulgaria show that SPA Kaliakra is in the region of the country to the east of a defined migratory route -Via Pontica: *"… relatively big number of studied sites in the last years allows drawing a line, which connects the sites with most numerous soaring migrants along Via Pontica: VP20 Slaveevo, VP8 Izvorsko, VP4 Bryastovets and Burgas".* (Michev et al., 2012 http://acta-zoologica-bulgarica.eu/downloads/acta-zoologica-bulgarica/2012/64-1-033-041.pdf) (Figure 2).

Figure 2. Orientation of vantage points with strongest aggregations of birds during autumn migration along the core axis of Via Pontica according to data from Michev et al. (2012)

Over the past therteen years, a series of studies have been carried out to study migratory, wintering and breeding birds in this area and specifically on the impact of a wind farm on birds: http://www.aesgeoenergy.com/site/Studies.html. These intensive surveys over several years have confirmed further that the study area on the Kailakra Cape is, indeed, away from the main migratory Via Pontica migration corridor. To date, moreover, these surveys found no evidence of significant impacts due to wind turbines on the populations of recorded species.

Under an agreement to establish and operate the ISPB, the ornithofauna was monitored during autumn migration in 2018, 2019, 2020, 2021 on the above-mentioned territory and reports are published at https://kaliakrabirdmonitoring.eu/.

This report covers the fifth autumn migration season (01.08 - 31.10.2022) in ISPB territory. The collected information was used to assess the effectiveness of the application of ISPB in Kaliakra in the Autumn of 2022.

Taking into account the geographical location of the site and previous research (monitoring reports from the Saint Nikola Wind Farm, http://www.aesgeoenergy.com/site/Studies.html), as well as a report published by the MoEW on Nature of the Migration of 42 Birds from the Bulgarian fauna according to the level of modern knowledge of migration http://natura2000.moew.government.bg/PublicDownloads/Auto/OtherDoc/276296/276296_Birds_120.pdf, we consider the period covered in our study as optimal and representative for autumn bird migration of all target for ISPB species (page1 point 2.2.Target Bird Species https://kaliakrabirdmonitoring.eu/Methodology of ISPB).

The study is specifically focused on target species for ISPB which are diurnal migrants. The data for all bird species flying over the territory, deemed as vulnerable to direct collision with wind facilities are presented in this report.

2. OBJECTIVES AND TASKS OF THE STUDY

The main objectives of this monitoring study are to determine the quantitative characteristics of migratory birds in the area of ISPB during autumn migration, to assess the effectiveness of the Turbine Shutdown System (TSS) applied here, in order to reduce the risk of collision mortality for target birds, and to evaluate the impact of the wind farms on birds during autumn migration.

During the monitoring, the following characteristics of bird migration were identified for study:

1. Migration periods, species composition, changes in the number of birds during the season, daily activity, flight heights, as well as feeding, resting and roosting places of migrant birds passing through the area and observation points.

2. The significance of the study territory for feeding birds of prey.

3. Proportion of migrating birds in respect to the Western Black Sea migratory flyway - Via Pontica.

3. ORNITHOLOGISTS WHO CARRIED OUT THE SURVEY

- **Prof. Dr Pavel Zehtindjiev – Senior field ornithologist**

More than 25 years of research experience in ornithology. Author of more than 85 scientific publications in international journals with an impact on the scientific field of bird biology, ecology and ecosystem conservation. Member of the European Ornithological Union and many nature conservation organizations. Winner of the Revolutionary Discovery Award for the Ornithology of the American Ornithological Society for 2016 - The Cooper Ornithological Society.
Over 10 years of experience in impact monitoring study of wind turbines in the study area.

- **Dr Viktor Vasilev – Field ornithologist**

Senior researcher in the Faculty of Biology, University of Shumen.
Member of BSPB and participant in number of conservation projects in Bulgaria.
Author of over 20 scientific publications in international journals. Member of BSPB.

- **Veselina Raikova - Field ornithologist**

Natural History Museum of Varna. Member of BSPB. Author of more than 10 publications in international scientific journals. Over 10 years of experience in impact monitoring study of wind turbines in the study area.

- **Ivaylo Raykov - Field ornithologist**

Museum of Natural History, Varna. Member of BSPB. Author of over 20 scientific publications in international journals.
Over Five years of experience in impact monitoring in the region of Kaliakra.

- **Kiril Bedev - Field ornithologist**

Researcher in Institute of Biodiversity and Ecosystem Research at the Bulgarian Academy of Sciences.
Active member of conservation organization Green Balkans. Long term study on migrating birds and biodiversity of Burgas lakes. Author of three articles in Bulgarian Red Data Book. Expertise in biotechnology, conservation biology and environmental monitoring. Over seven years of experience in impact monitoring of wind parks in Bulgaria. Member of Balkani NGO for conservation of birds and nature.

- **Hristo Gardov – Field ornithologists**

Experiences biologist, participant in number of field studies of birds as part of many conservation projects. BSPB active member. Member of The Wildlife Conservation Society (WCS) and member of the management of the organization.

- **Svetoslav Stoianov - Field ornithologist**

Bachelor in Biology diploma from Shumen University. Participant in numerouse conservation projects of BSPB – BirdLife Bulgaria. Midwinter counts of waterfowl birds in Bulgaria nad white stork census expert. Monitoring the migration of birds species composition and the number of nesting fauna 2007-2012 "Ecotan" EOOD. Over 10 years of experience in impact monitoring study of wind turbines in the study area

- **Jelyazko Dimitrov Dimitrov - Field ornitologist**

Member of BSPB from 31.12.2006 to 31.12.2010. Trained to monitor the severity of collisions of birds with wind turbines.

- **Vasil Panayotov Dimitrov - Field ornithologist**

Trained to monitor the severity of collisions of birds with wind turbines. Representative of local conservation organization in Balgarevo, Kavrna.

- **Aleksandar Nedialkov Petkov - Field ornitologist**

Student at the University of Forestry (UF) – Sofia and active member of Bulgarian Society for Protection of Birds (BirdLife Bulgaria).

4. MATERIAL AND METHODS

The methodology for ornithological monitoring has been developed in accordance with the methodological guidelines adopted by the National Council on Biological Diversity at the MOEW with Protocol No. 11 of 8 June 2010 and the Order of the Minister of Environment and Water of 15.02.2018 https://www.moew.government.bg/static/media/ups/tiny/filebase/Nature/Biodiversity/Preporyki%20Rykowodstwa%20Dokladi/Metodika_VEP.pdf) for the implementation of TSS in the Protected territories of Natura 2000 network of Bulgaria. Field observation protocols being part of the technical rules followed Bibby et al. (1992) and Michev et al. (2010, 2011) and were used to study the autumn migration of birds in the territory covered by ISPB.

In addition, three radar systems were used in conjunction with real time observations by all field ornithologists. The range of the radar systems is presented in Figure 1.

The assessment of the effectiveness of the Turbine Shutdown System (TSS) utilizes the methodology developed in the USA (Morrison 1998) for monitoring bird collision with the turbines (and see methods described in https://kaliakrabirdmonitoring.eu/Methodology of ISPB).

All details about the application of the radar systems in the ISPB, ornithological methods, generic protocol for visual observations, site-specific protocol for visual observations, bird data recording collation, and physical characteristics of the environment recorded are given already in the Methodology of ISPB as well as in previous reports dedicated to spring and autumn migration 2018, 2019, 2020 and 2021 are available from the web site of ISPB https://kaliakrabirdmonitoring.eu/Reports.

5. RESULTS

5.1. Species composition and number of birds

The monitoring from 1 August to 31 October 2022 recorded 26437 individual birds, assigned to 48 bird species. For comparison, the total number of observed birds of all species in 2018, 2019, 2020, 2021 were 16973, 11105, 12079 and 22983 respectively. Comparisons of the observed monthly number of birds in five consecutive migratory seasons are presented in Figure 3.

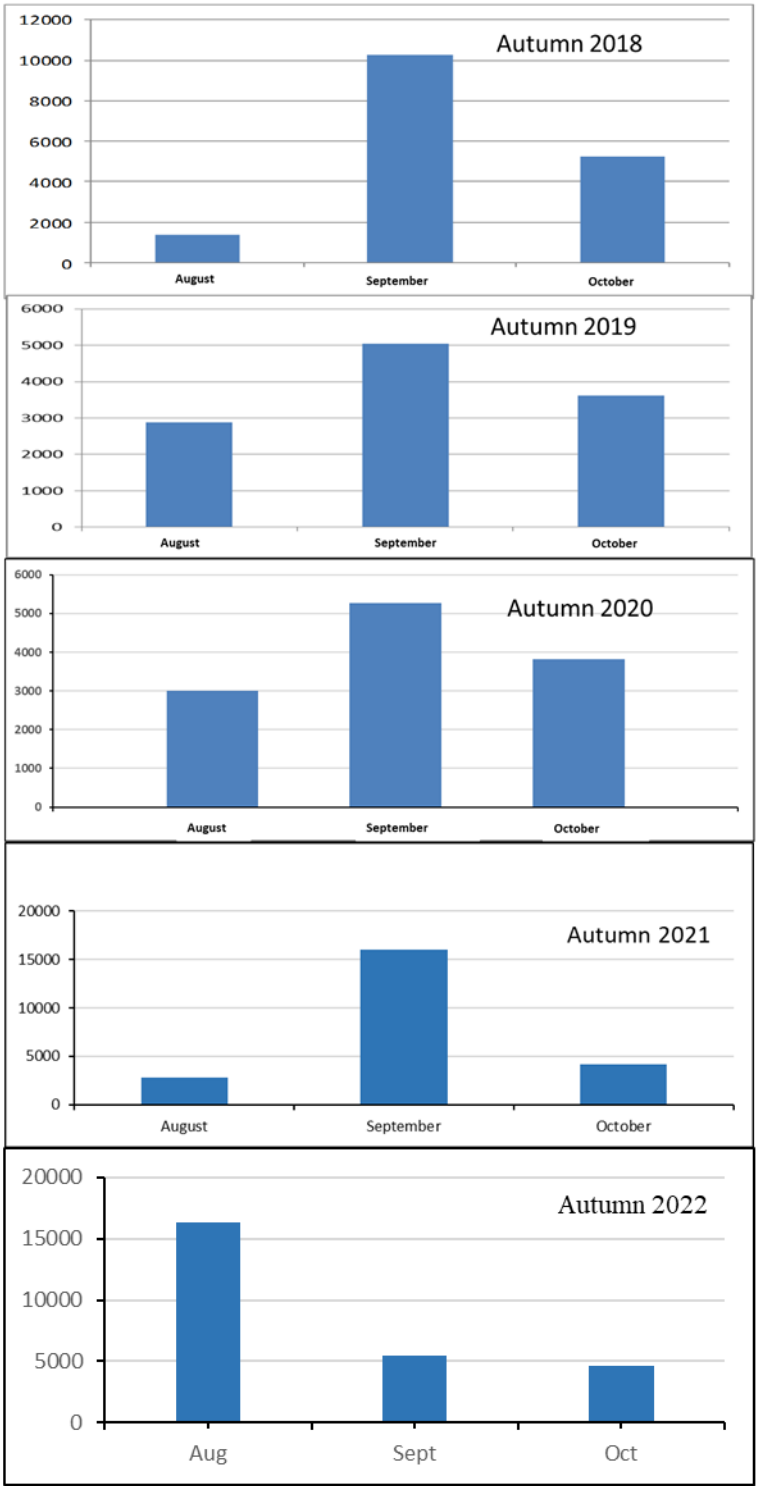

Figure 3. *Number of registered birds by months during the autumn migration period in the territory of ISPB in 2018, 2019, 2020, 2021 and 2022.*

The number of birds in the ISPB study area apparently depended on the direction of the wind in autumn. The strong correlation of wind direction in the region and number of birds observed in the ISPB territory (Kalikara area) is supported by the direct comparison of days with westerly winds and number of birds registered for the whole season, in five consecutive years 2018, 2019, 2020, 2021 and 2022 (Figure 4).

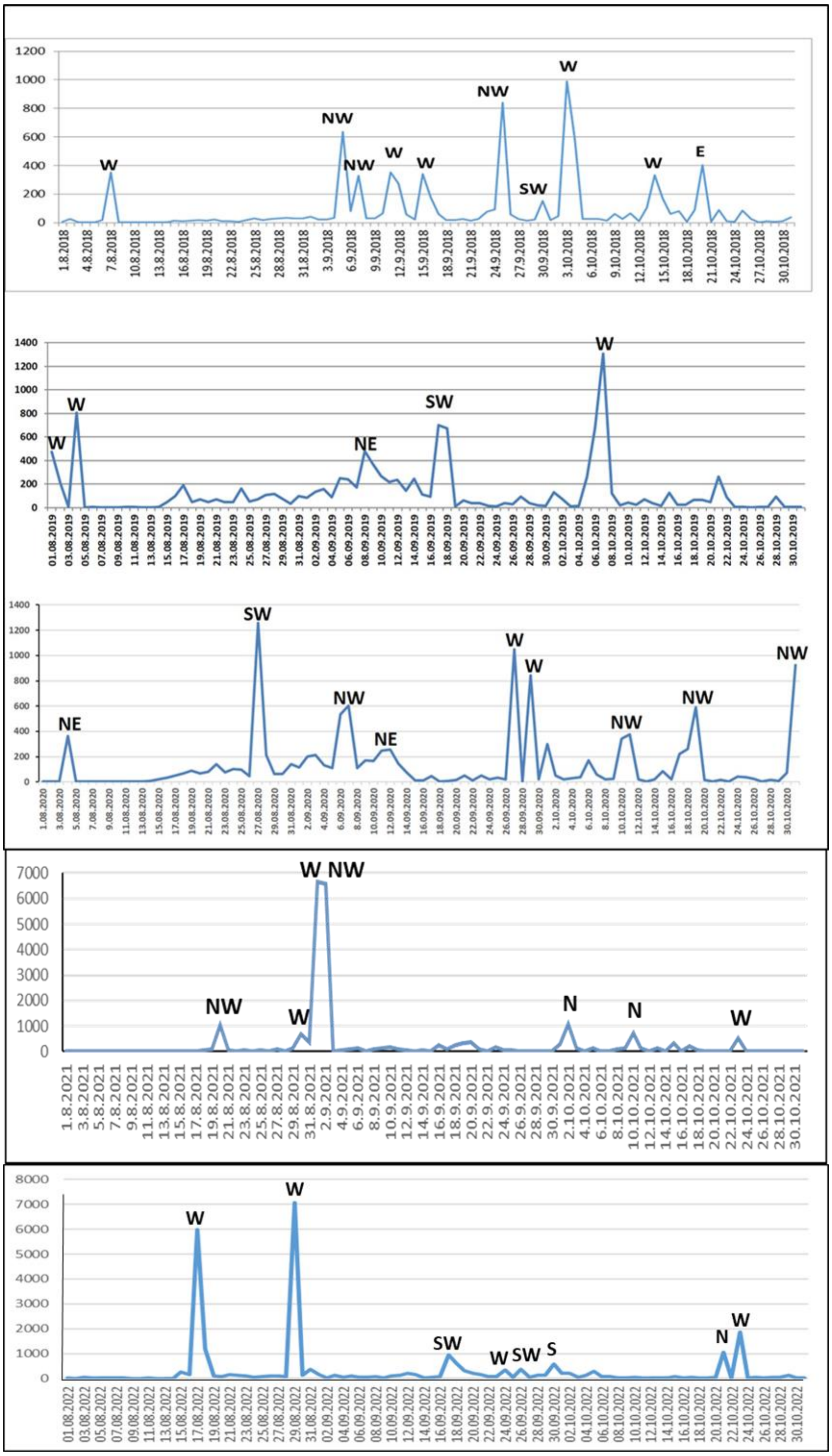

Figure 4. Dynamics of the autumn migration of soaring bird species in the ISPB territory according to visual observations during the autumn migration in 2018, 2019, 2020, 2021, 2022. Letters above spikes indicate the direction of wind in days with increased numbers of migrating birds.

This pattern in the number of birds recorded in Kaliakra in respect to westerly wind directions in autumn is confirmed in many previous studies at the St. Nikola Wind Farm (SNWF) which forms a major part of the ISPB territory (see reports http://www.aesgeoenergy.com/site/Studies.html).

The numbers of individuals recorded by species during autumn migration in five autumn seasons are shown in Table 1.

Table 1. *Composition of species and number of registered birds over the period 01 August to 31 October 2018, 2019, 2020, 2021 and 2022 in the ISPB territory*

Species name	*Autumn 2018*	*Autumn 2019*	*Autumn 2020*	*Autumn 2021*	*Autumn 2022*
A. alba	0	0	0	5	0
A. brevipes	309	123	110	194	175
A. gentilis	1	5	8	1	9
A. nisus	242	185	244	150	144
A. cinerea	21	8	37	49	3
A. clanga	0	1	0	0	0
A. otus	0	0	0	0	1
A. purpurea	2	0	0	1	0
A. pennata	30	15	40	17	31
A. nipalensis	0	0	1	0	0
A. heliaca	0	0	2	1	1
A. melba	0	35	0	0	0
A. apus	0	100	0	0	88
B. buteo	2642	1980	2965	615	720
B. rufinus	58	13	45	8	35
B. lagopus	3	1	15	0	2
C. albus	0	8	3	0	0
C. aeruginosus	442	180	264	202	321
C. cyaneus	37	15	16	18	11
C. pygargus	88	28	60	27	53
C. pomarine	232	29	22	27	124
C. macrourus	8	5	13	6	9
C. gallicus	94	50	59	63	67
C. ciconia	451	1557	1137	12859	14249
C. clanga	0	0	0	0	2
C. nigra	54	7	13	17	39
C. garrulus	1	37	3	14	8
C. corax	15	27	21	13	15
C. cornix	6	8	0	0	21
C. coturnix	0	0	0	1	0
C. monedula	35	0	0	0	37
C. frugilegus	14	0	0	0	119
C. olor	0	0	0	5	0
C. oenas	44	14	0	0	48
C. crex	0	1	0	0	0
C. palumbus	1200	2	0	500	1002
E. calandra	0	0	0	0	57
E. garzetta	1	0	0	0	0
F. vespertinus	472	149	1215	397	19
F. subbuteo	48	46	38	34	55
F. peregrinus	4	0	1	3	1
F. tinnunculus	272	161	176	94	311
F. cherrug	2	0	0	0	0
F. columbarius	2	2	1	0	0
F. eleonorae	3	1	0	0	0
M. migrans	71	19	20	28	30
M. milvus	2	0	2	1	0
M. alba	414	0	0	0	0

Species name	*Autumn 2018*	*Autumn 2019*	*Autumn 2020*	*Autumn 2021*	*Autumn 2022*
M. apiaster	*2963*	*4314*	*3737*	*2374*	*4375*
M. calandra	*1430*	*0*	*0*	*0*	*0*
G. grus	*100*	*4*	*0*	*251*	*18*
G. gallinago	*0*	*0*	*0*	*0*	*4*
G. virgo	*13*	*0*	*0*	*1*	*0*
G. fulvus	*0*	*0*	*1*	*1*	*2*
L. michahellis	*234*	*62*	*0*	*626*	*1119*
L. melanocephalus	*0*	*0*	*0*	*450*	*1800*
L. cachinnans	*0*	*0*	*1*	*0*	*0*
L. excubitor	*0*	*1*	*0*	*0*	*0*
L. fuscus	*1*	*0*	*0*	*1*	*0*
L. ridibundus	*0*	*0*	*0*	*35*	*0*
N. nycticorax	*0*	*12*	*0*	*0*	*0*
H. minutus	*0*	*0*	*0*	*45*	*0*
H. albicilla	*1*	*1*	*1*	*0*	*0*
H. rustica	*1000*	*86*	*1000*	*200*	*0*
P. carbo	*576*	*512*	*332*	*319*	*114*
P. onocrotalus	*2021*	*1243*	*0*	*1449*	*695*
P. crispus	*0*	*1*	*8*	*2*	*5*
P. apivorus	*801*	*9*	*96*	*1852*	*371*
P. haliaetus	*17*	*12*	*3*	*8*	*7*
P. leucorodia	*5*	*1*	*6*	*0*	*10*
P. roseus	*1*	*0*	*0*	*0*	*102*
P. perdix	*10*	*25*	*0*	*0*	*0*
R. riparia	*76*	*0*	*0*	*17*	*0*
S. decaocto	*0*	*0*	*0*	*0*	*5*
S. turtur	*0*	*0*	*0*	*0*	*3*
St. vulgaris	*400*	*0*	*360*	*0*	*0*
V. vanellus	*4*	*0*	*2*	*0*	*0*
U. epops	*0*	*0*	*0*	*2*	*0*
T. ferruginea	*0*	*8*	*0*	*0*	*0*

The most numerous migrating birds recorded in autumn 2022 were white storks (*Ciconia ciconia*) with over 14,000 individuals registered, but this includes a single flock of 7000 registered 3000 m away from the wind farm area (Figure 9). This relatively big flock of white storks passed near by the ISPB on 20th August 11:30 AM under a westerly wind. In the second part of the same day the wind direction changed to S and intensity of bird migration decreased suddenly. Among the other soaring birds, the most numerous recorded birds were common buzzards (*B. buteo*) and great white pelicans (*P. onocrotalus*) with around 700 individuals of each species (Table 2). Six new species were recorded in autumn 2022. The newly observed species were long-eared owl (*Asio otus*), greater spotted eagle (*Clanga clanga*), corn bunting (*Emberiza calandra*), turtle dove (*Streptopelia turtur*), Eurasian collared dove (*Streptopelia decaocto*) and common snipe *(Gallinago gallinago).* Three of the new species, turtle dove, Eurasian collared dove and corn bunting are common species usually observed in villages throughout the country. The fact they appeared in the observations this autumn is probably due to some changes in the crops near by the observation point visited by the species in the period of our study.

In autumn 2018 - 451, 2019 - 1557, 2020 – 1137, 2021 – 12859 and 2022 - 14249 white storks were recorded during ISPB studies, respectively. The European nesting population of the white stork is estimated to be between 180000 and 220000 pairs, with about 80 % of the species migrating along the western Black Sea flyway (Via Pontica), covering a region of northeastern Bulgaria. Our results confirm that white storks flying over the Kaliakra area have a negligible number (between 0.02 % and 6.5 % of the Via Pontica population) and the area still remains east of the main migratory route of white storks along the western Black Sea migration flyway. Strong fluctuations of white stork numbers have been observed in ISPB territory in over 10 years of our monitoring in a part of the same territory (see autumn migration reports from AES Geo Energy at at SNWF https://www.aesgeoenergy.com/Studies.html). In 2010 in two days at the end of August and beginning of September under westerly winds over 24 000 white storks were observed over the same territory. The coincidence of westerly winds in Kaliakra with the days of most intensive migration of white storks over the whole territory of Bulgaria (30 August – 2 September) was associated with an increased number of white storks over Kaliakra.

The remaining registered bird species were also observed in low numbers in respect to total numbers of these species passing along the Via Pontica flyway, as observed previously in typical bottleneck sites – e.g. Burgas Bay (Michev et al. 2018). For example, counts of black storks (*C. nigra*) in Kaliakra have varied between 7 and 54 in contrast to Burgas where over 5000 black storks were observed in autumn 2017. Marsh harriers (*Circus aeruginosus*) counts varied from 180 to 442 in Kaliakra compared to 1468 in Burgas. Lesser-spotted eagles (*Clanga pomarina*) in Kaliakra varied between 22 and 232 in contrast to over 22000 in Burgas. Red-footed falcons (*Falco verspertinus*) counted in Burgas reached over 15000 in contrast to totals between 149 and 1215 in Kaliakra. The differing proportions of the most numerous birds of prey using the ISPB area during autumn migration is shown in Figure 9.

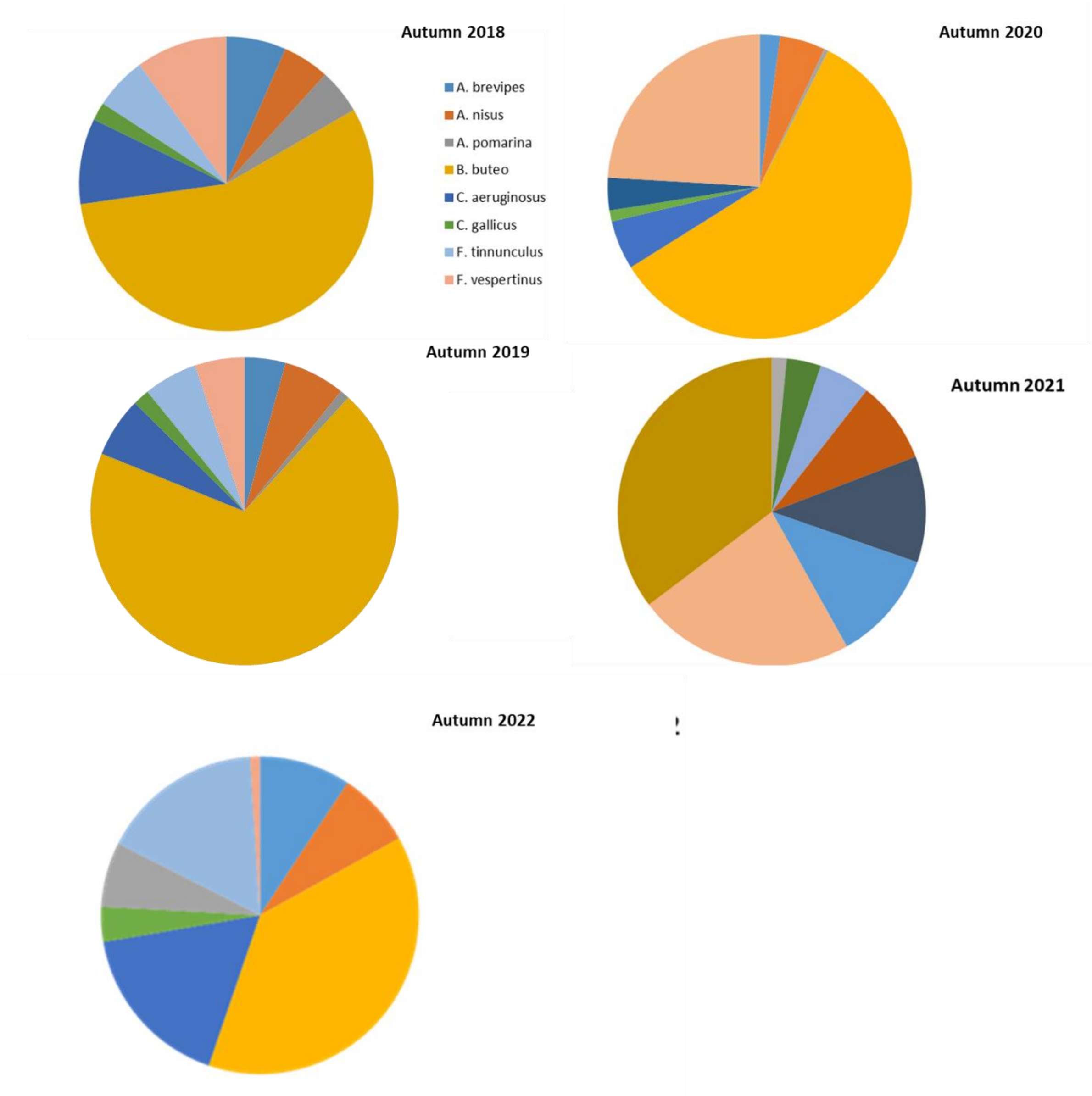

Figure 5. *Proportional representations of the eight most numerous birds of prey recorded during autumn migration in 2018, 2019, 2020, 2021 and 2022.*

5.2. Frequency of appearance

The appearance of the observed species in different parts of the ISPB study area does not obviously indicate avoidance of the locations with operating wind turbines. This supposition is reached by virtue of the observed frequency of appearance of every species by observation points (OP), indicated in location by Figure 1, and on data presented in Table 2.

Table 2. *Number of days with records of the most numerous soaring bird species, according to every observation point, during the period of monitoring in ISPB territory in autumns of 2018, 2019, 2020, 2021 and 2022.*

Species	OP1					OP2					OP3					OP4					OP5				
	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
A. brevipes	11	13	16	15	74		5	20	89	5	10	21	9	7	38	13	4	4	21	5	16	3	61	62	53
A. nisus	34	21	10	1	14		11	107	67	25	36	39	7	4	39	95	7	23	63	2	28	39	97	15	64
B. buteo	80	80	37	30	92	4	22	2313	230	281	75	72	37	17	197	78	23	188	322	4	80	87	384	16	146
B. lagopus								15			1	1				1					1				2
B. rufinus	15		5		4	1		14	1	5	15	10			9	9	1	1	4	2	10	1	25	3	15
C. aeruginosus	83	20	43	47	49	4	14	112	34	138	70	27	31	15	63	99	31	4	80	28	116	32	67	26	43
C. ciconia	1	1	21	6389	14150	4	1	1	1670	41	10	10		55		2		1	4167	3	3		1114	578	55
C. cyaneus	15	4						8	9	8	1	7				9			7		8	2	8	2	3
C. gallicus	10	4	5	15	13	3	4	7	8	23	17	11	5	11	8	16	11	7	16	9	24	6	35	13	14
C. garrulus	1											2			2			2		3			1	14	3
C. macrourus	3						3	5	2	8	1	1	1		1	2		4	2		2		3	2	
C. nigra	5	3	1	9	6			7			3	1			10	5				23	3		5	8	
C. pomarina	18	8	8	13	29		1	10	10	32	9	2	1	2	37	21			1		17	5	3	1	26
F. columbarius								1				2				1					1				
F. eleonore		1														2					1				
F. subbuteo	13	11	14	6	10		1	11	5	12	21	9	6	1	20	4	11	1	16	2	6	3	6	6	11
F. tinnunculus	44	41	31	8	61	5	17	68	26	98	45	14	23	11	82	51	9	6	34	11	29	15	42	15	59
F. vespertinus	44	6	5	1	2		29	96	16	8	18	9	103	261	9	54	3	20	49		21	12	991	70	
P. apivorus	15		5	584	65			84	2	156	27		1	7	66	17	4		1226	9	17	3	6	33	75
P. onocrotalus	7	1		95	427				568	120	12	2		1	123	9			785		2	3			25

Activity of observed soaring birds in respect to wind turbines during the autumn migratory period did not indicate any avoidance of the area with turbines. The daily activity of autumn migratory birds from records collected in the ISPB study area is shown in Figure 6.

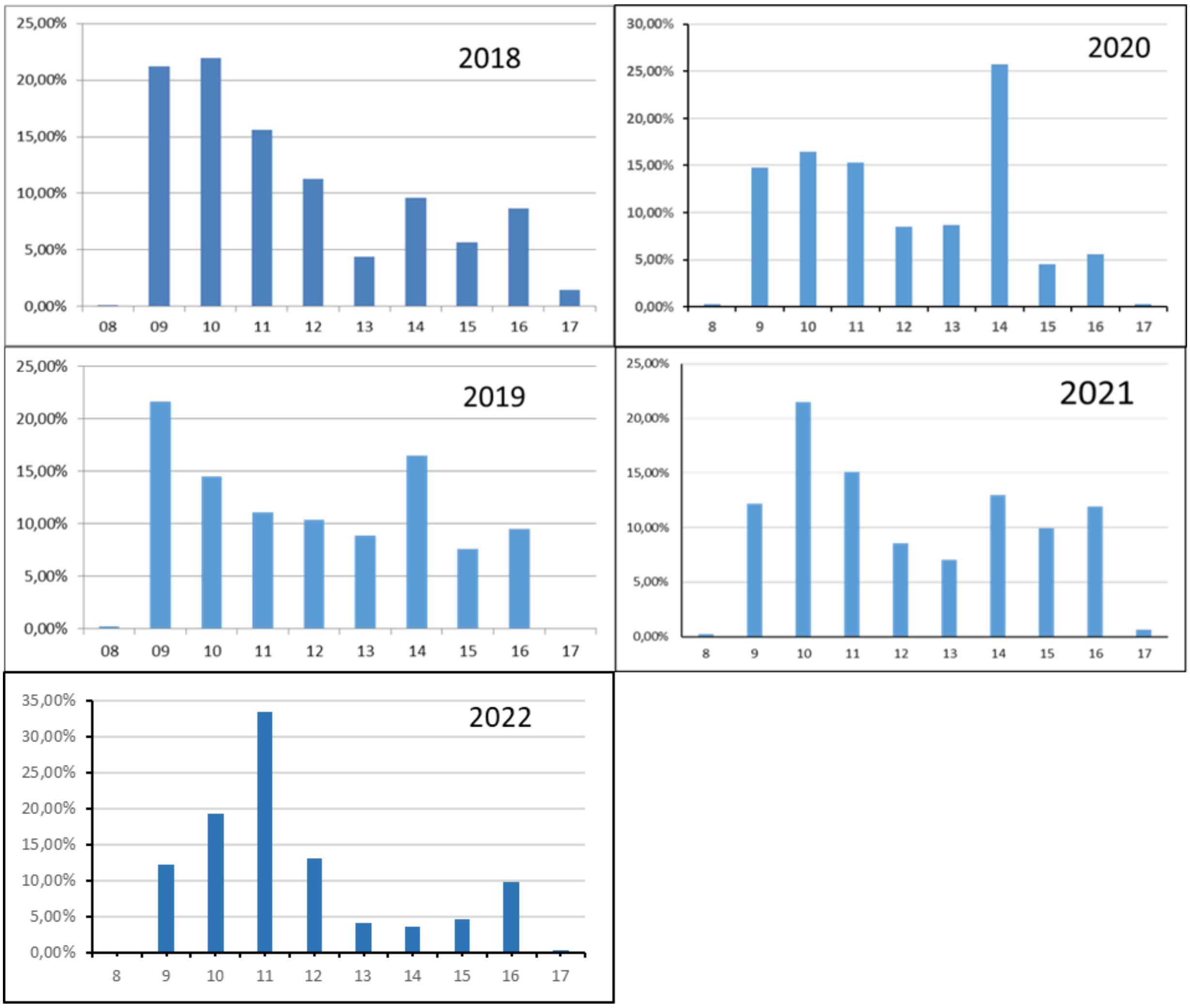

Figure 6. *The dynamics of the presence of birds by hour of the day in the ISPB territory in the autumns of 2018, 2019, 2020, 2021 and 2022.*

5.3. Direction of migrating birds

In order to examine a potential barrier effect of the study area's wind turbines on migrating birds we analysed deviation of the flight directions from the expected main migratory direction of autumn migration – southerly directions. An important parameter for determining the presence of a barrier effect is the degree of observed circumvention of the ISPB territory with its operating wind turbines. The recorded flight directions in autumn are presented in Table 3.

Table 3. *Proportions (expressed as %) of recorded birds by direction during autumn migration, in and approaching the territory of ISPB for the period 01 August – 31 October 2018, 2019, 2020, 2021 and 2022. In grey are the observed proportions (%) as expected for autumn migration migratory directions.*

Direction	Proportion of records 2018	Proportion of records 2019	Proportion of records 2020	Proportion of records 2021	Proportion of records 2022
N	3,49%	1,51%	0,56%	1,73%	4,88%
NE	8,73%	1,02%	1,40%	3,38%	8,74%
NNE	0,02%		0,03%		0,19%
NNW	0,01%	0,02%	0,12%	0,01%	0,27%
NW	4,76%	1,77%	3,21%	0,54%	1,31%
E	1,75%	5,83%	2,14%	2,05%	0,90%
ESE	0,09%		0,05%		0,03%
SE	5,64%	7,01%	4,38%	3,74%	3,65%
SSE	0,01%				1,04%

Direction	Proportion of records 2018	Proportion of records 2019	Proportion of records 2020	Proportion of records 2021	Proportion of records 2022
S	41,52%	49,57%	35,58%	12,72%	14,48%
SSW	0,12%		0,03%	0,68%	2,69%
SW	20,43%	19,35%	43,06%	38,63%	48,01%
WSW	0,71%	0,01%	0,04%	21,56%	1,02%
W	12,70%	13,91%	9,24%	14,62%	12,74%
WNW	0,02%		0,08%	0,12%	0,04%

The main direction of birds during autumn migration was towards the south to southwest, with over 70 % of observations in all four autumn seasons of 2018, 2019, 2020, 2021 and 2022 (Table 3). Within this pattern of movement, the tendency of many migratory birds (around 20 %) to be on a south/southwesterly direction is also probably an indication that when winds came from the west more birds were observed in ISPB (as noted above), having been diverted from the major Via Pontica migratory route to the west. A southwesterly flight direction is indicative of birds attempting to return to that route. A trend in that southwesterly direction, around a general southerly path, is also likely to be related to the study area's geography, in that a persistent southerly flight path across ISPB and beyond would take birds over the Black Sea which would curtail any further migration through lack of supporting winds. Therefore, there was no observed marked deviation from the seasonal expectation of migratory flight directions, which were centered around the south in four consecutive years of monitoring. No changes were apparent in the migratory directions of the birds due to the presence of wind turbines.

5.4. Altitude of birds

Over 50 % of birds observed in the ISPB flew at a height of less than 200 m above ground level in five autumn seasons of 2018, 2019, 2020, 2021 and 2022. No changes in flight height due to the proximity of wind turbines were observed. The distribution of migratory birds in height is shown in Figure 7.

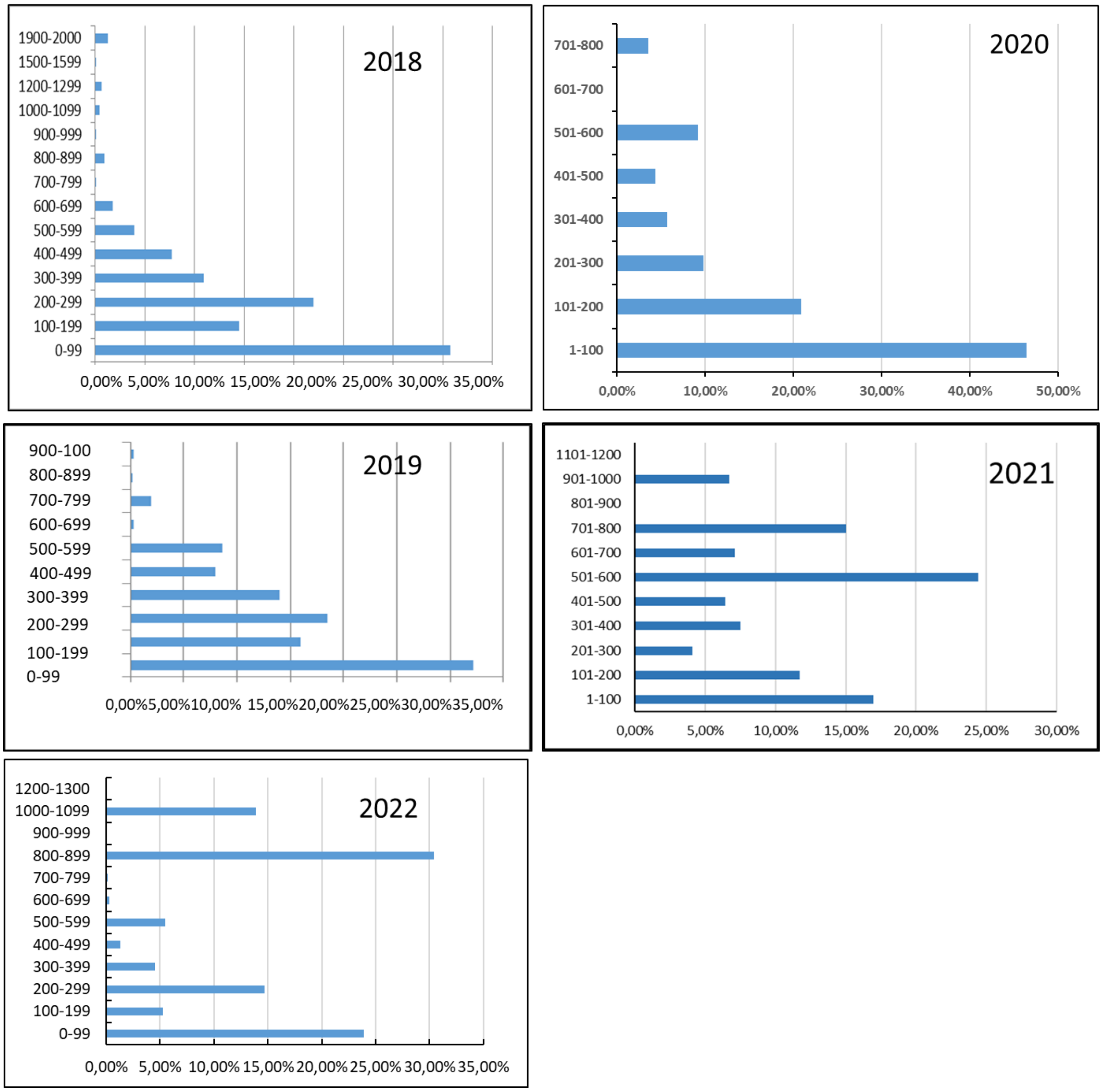

Figure 7. *Proportional (expressed as %) distributions of passing birds by altitude (metres) in ISBP as observed in autumn 2018, 2019, 2020, 2021 and 2022 monitoring periods.*

5.5. Ordered wind turbine stops during the autumn migration period

As a result of the simultaneous observations at five constant observation points and three radar systems (Figure 1) during the whole period of the 2022 autumn migration, there were one stop of two groups of turbines (SNWF) and four complete wind farms (KWP and EVN) in the territory of the Kaliakra SPA and adjacent territories. The stop orders given to the engineers on duty were executed in a timely manner, thus avoiding any collision risk of bird passing through the territory. Detailed information on the duration of the ordered stops is given in Table 4.

***Table 4**. Data for stops of wind turbines ordered by field observers during the autumn migration of birds 2022.*

Date	*Wind Farm*	*Turbine code №/ Group*	*Species*	*Number of birds*	*Time stop*	*Time restart*
17.09.2022	*SNWF*	*E and F zones*	*G. fulvus*	*1*	*10:58:00*	*11:42:00*
17.09.2022	*EVN*	-	*G. fulvus*	*1*	*11:02:00*	*11:42:00*
19.09.2022	*KWP*	-	*P. onocrotalus*	*23*	*09:34:00*	*09:43:00*
19.09.2022	*EVN*	-	*P. onocrotalus*	*23*	*09:34:00*	*09:43:00*
19.09.2022	*EVN*	-	*P. onocrotalus*	*1*	*10:24*	*10:49*
			G. fulvus	*1*		

5.6. Observed flocks of target bird species for ISPB as documented in autumn migration 2022

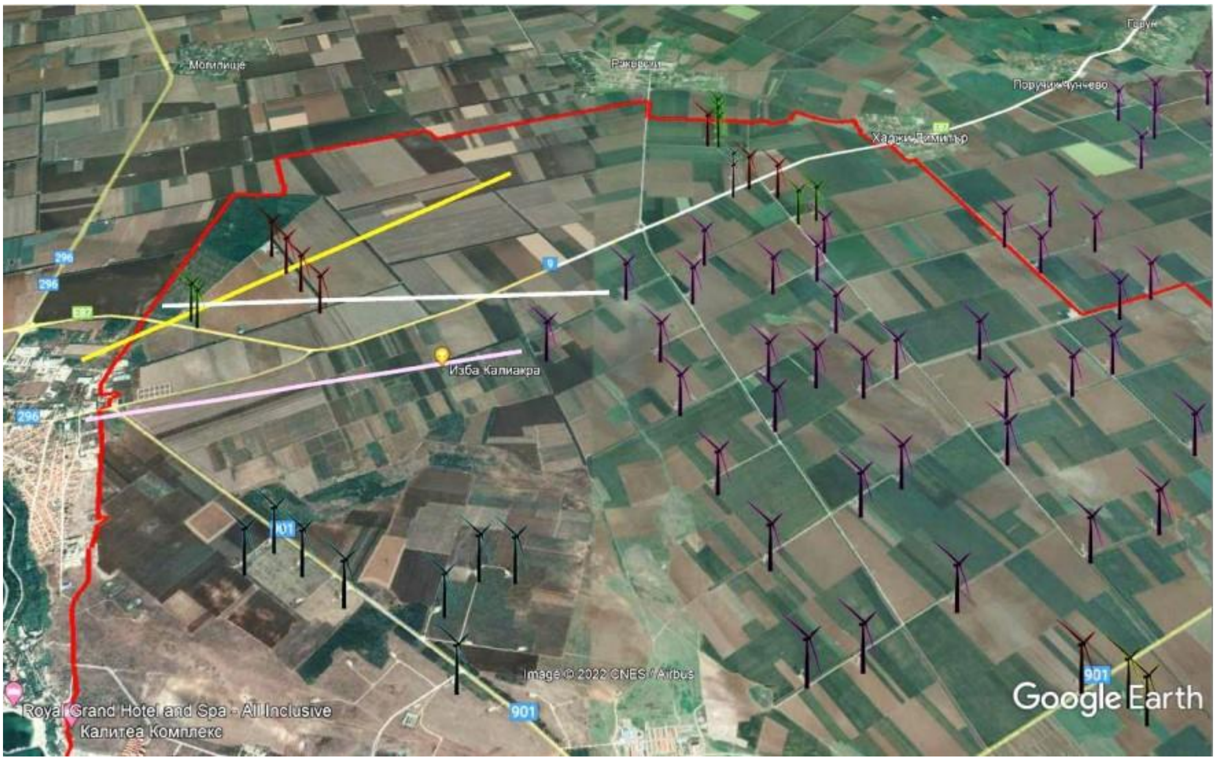

***Figure 8.** Registered flock of 90 white storks (white) observed on 15.08.2022; flock of 360 white storks (yellow) observed on 17.08.2022; flock of 110 white storks (pink) observed on 18.08.2022.*

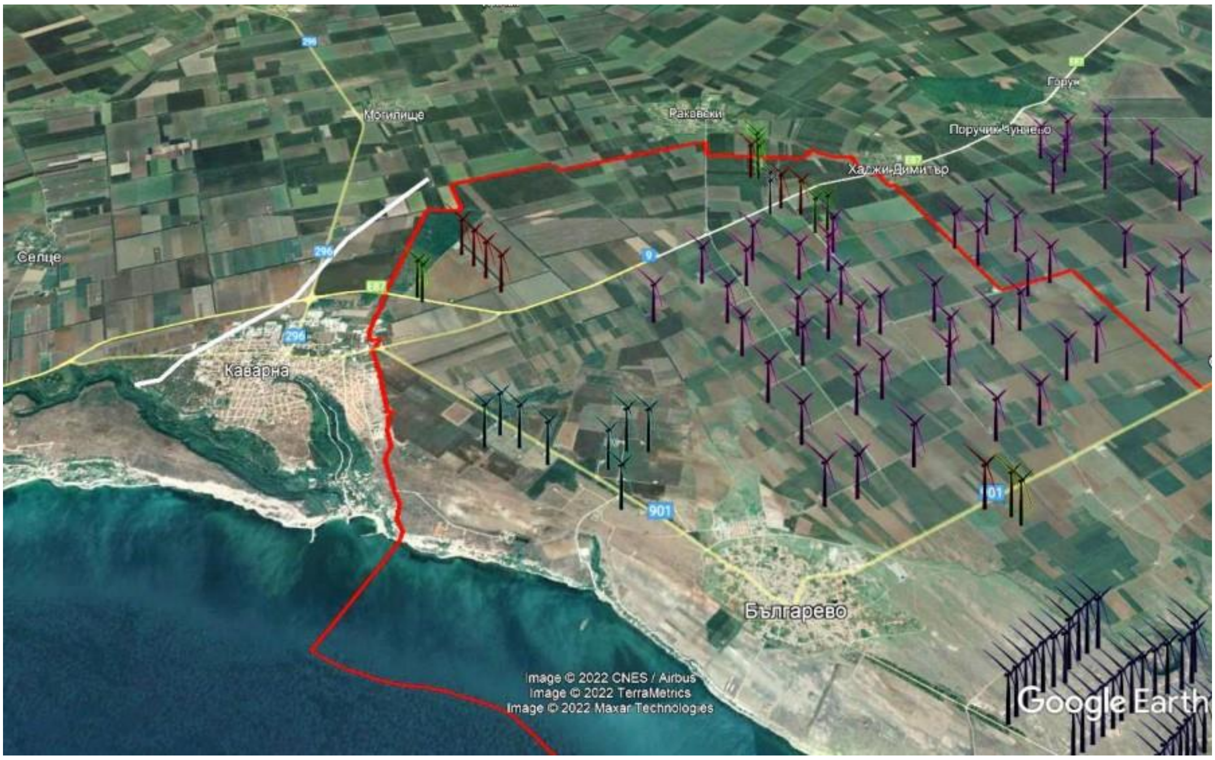

Figure 9. *Registered flock of 7000 white storks (white) observed on 29.08.2022.*

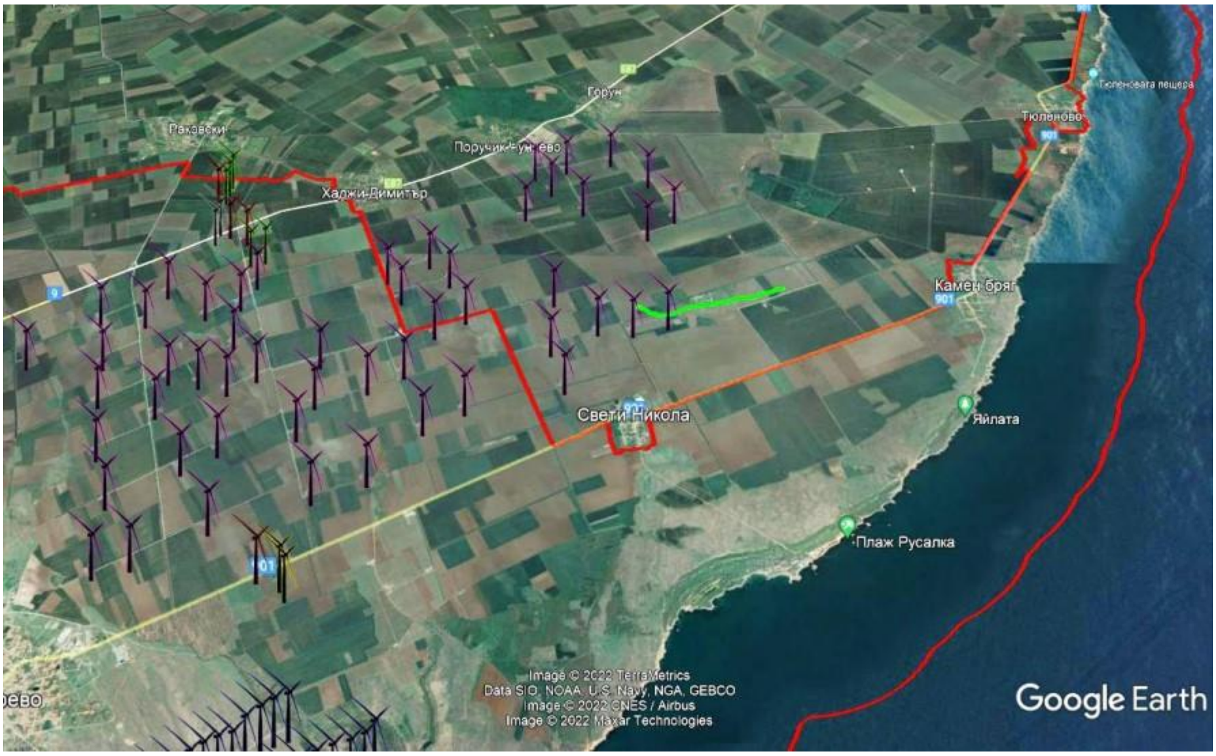

Figure 10. *Registered flock of 35 European honey buzzards (green) observed on 03.09.2022*

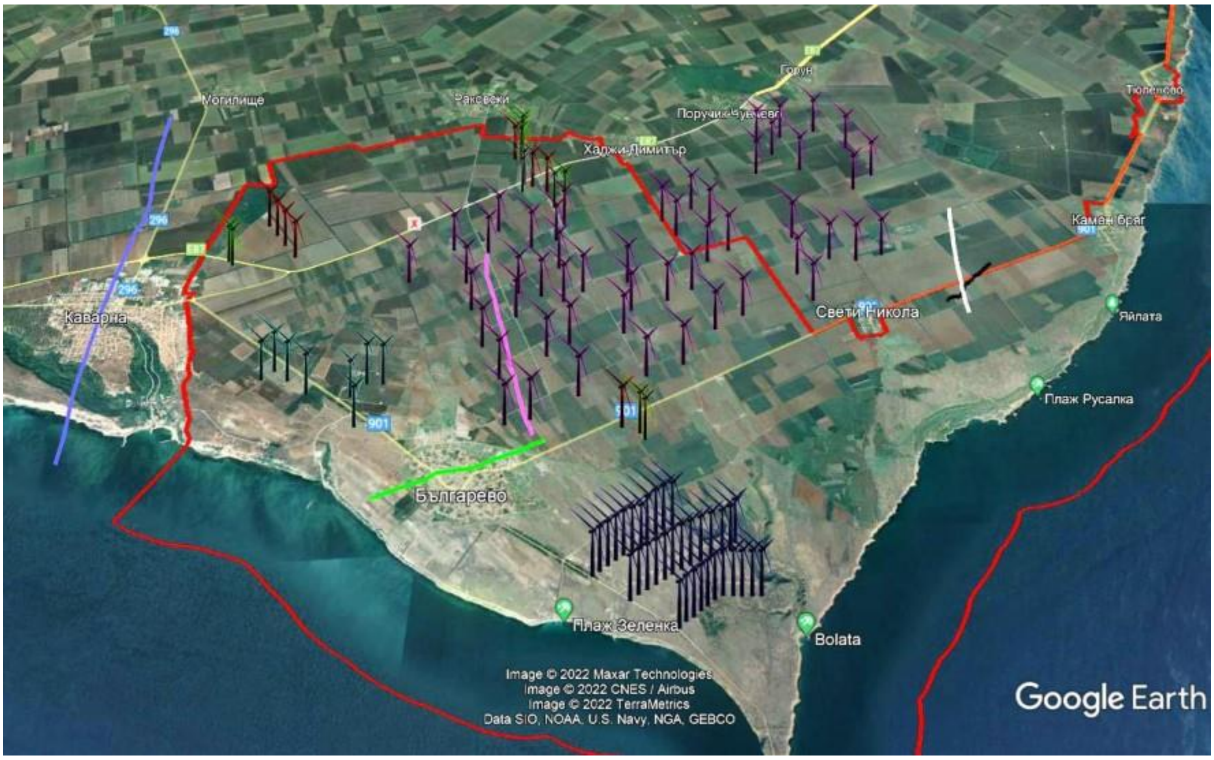

Figure 11. *Registered flock of 14 great cormorants (black) observed on 12.09.2022; flock of 32 levant sparrowhawks (white) observed on 16.09.2022; flock of 24 white storks (green) observed on 17.09.2022; 1 Eurasian griffon vulture e(pink) observed on 17.09.2022; flock of 350 great white pelicans (blue) observed on 18.09.2022.*

Figure 12. *Registered flock of 23 great white pelicans (white) observed on 19.09.2022; 1 Eurasian griffon vulture (black) observed on 19.09.2022; flock of 12 European honey buzzards (pink) observed on 19.09.2022; flock of 45 levant sparrowhawks (blue) observed on 20.09.2022; flock of 11 European honey buzzards(green) observed on 23.09.2022.*

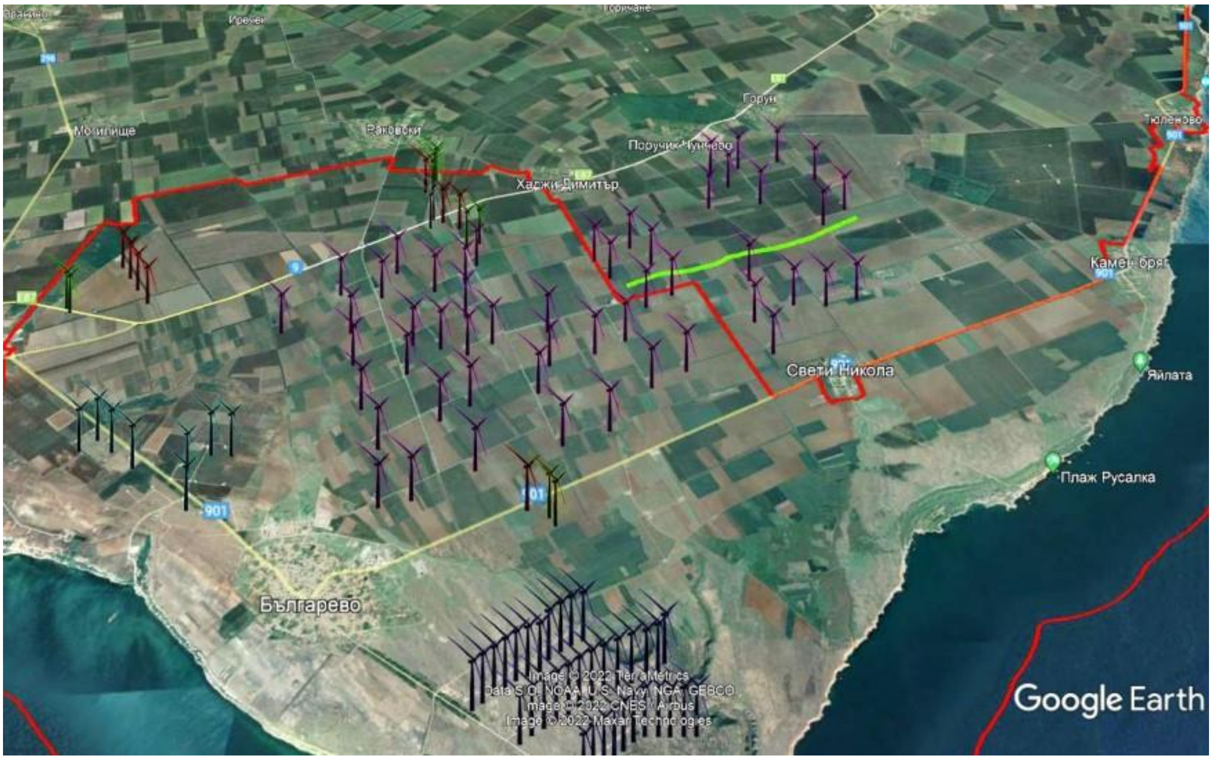

Figure 13. *Registered flock of 120 great white pelicans (green) observed on 05.10.2022.*

Figure 14. *Registered flock of 14 common cranes (green) observed on 15.10.2022.*

5.7. Analysis of the recorded additive mortality caused by wind turbines on the bird populations passing through the ISPB territory

In order to check the effectiveness of the ISPB to prevent collisions of autumn migrating birds, each of the 114 turbines covered by the ISPB programme was checked at least once a week for collision victims during the autumn migration monitoring period of 2022. It is well known that in the search for victims of collision with working wind turbines do not detect all dead birds for several reasons. The two main factors behind this are the effectiveness of the searcher (the searchers fail to find all the dead birds) and the removal / disappearance of the dead birds before they can eventually be discovered by the searcher. Reporting on these two potential parameters can substantially improve the assessment of mortality due to collision in operating wind farms. To foresee such corrections, field experiments were undertaken in ISPB territory in autumn 2018. According to additional previously performed carcass removal and searcher efficiency tests during autumn migration and in winter at SNWF, a weekly search regime provides for a cost-effective method, which can also be calibrated, to discover any bird strike fatalities which may be of concern. Hence a frequency of four searches per month under every turbine allows estimation of the mortality of birds from collision with the turbines in the ISPB. This allows estimation of bird mortality from collision with the turbines in the Kaliakra SPA and others of the total 114 wind turbines included in the ISPB. For details of relevant previous studies at SNWF within the wider ISPB territory, see: http://www.aesgeoenergy.com/site/Studies.html

Table 5. *Number of checks for victims of collision in the territory of ISPB during the period 01 August - 31 October 2022.*

Turbine	Aug.	Sep.	Oct.	Total
ABBalgarevo	3	5	4	12
ABГ1	3	4	5	12
ABГ2	3	4	5	12
ABГ3	3	4	5	12
ABГ4	3	4	5	12
ABMillenium group	5	7	6	18
ABMillenium group Micon	1	3	2	6
AE10	3	5	4	12
AE11	3	5	4	12
AE12	4	4	4	12
AE13	4	4	4	12
AE14	3	4	5	12
AE15	3	4	5	12
AE16	3	5	4	12
AE17	3	5	4	12
AE18	4	4	4	12
AE19	4	4	4	12
AE20	3	4	5	12
AE21	3	5	4	12
AE22	3	5	4	12
AE23	3	5	4	12
AE24	3	4	5	12
AE25	3	4	5	12
AE26	3	5	4	12
AE27	3	5	4	12
AE28	3	5	4	12
AE29	3	4	5	12
AE31	4	4	4	12
AE32	4	4	4	12
AE33	4	4	4	12
AE34	4	4	4	12
AE35	4	4	4	12
AE36	3	4	5	12
AE37	4	4	4	12
AE38	3	4	5	12
AE39	3	4	5	12
AE40	3	4	5	12
AE41	3	4	5	12
AE42	3	4	5	12
AE43	3	4	5	12
AE44	3	4	5	12
AE45	3	5	4	12
AE46	4	4	4	12
AE47	4	4	4	12
AE48	4	4	4	12
AE49	4	4	4	12
AE50	4	4	4	12
AE51	4	4	5	13
AE52	4	4	5	13
AE53	4	4	5	13
AE54	4	4	5	13
AE55	4	4	5	13
AE56	4	4	5	13
AE57	4	4	5	13
AE58	4	4	5	13
AE59	4	4	5	13
AE60	4	4	4	12
AE8	3	4	5	12
AE9	3	4	5	12
DBГ1	3	4	5	12

Turbine	Aug.	Sep.	Oct.	Total
DBГ1HSW250	3	4	5	12
DBГ2	3	4	5	12
DBГ2MN600	3	4	5	12
DBГ3	3	4	5	12
DBГ4	3	5	4	12
DBГ5	3	5	4	12
DC1	3	5	4	12
DC2	3	5	4	12
E00	3	5	4	12
E01	3	4	5	12
E02	3	4	5	12
E04	3	4	5	12
E05	3	4	5	12
E07	3	4	5	12
E08	3	4	5	12
E09	3	5	4	12
M1	3	5	4	12
M10	3	5	4	12
M11	3	5	4	12
M12	4	4	4	12
M13	4	4	4	12
M14	4	4	4	12
M15	4	4	4	12
M16	4	4	4	12
M17	4	4	4	12
M18	4	4	4	12
M19	4	4	4	12
M2	3	5	4	12

Turbine	Aug.	Sep.	Oct.	Total
M20	4	4	4	12
M21	4	4	4	12
M22	4	4	4	12
M23	4	4	4	12
M24	4	4	4	12
M25	4	4	4	12
M26	4	4	4	12
M27	4	4	4	12
M28	4	4	5	13
M29	4	4	5	13
M3	3	5	4	12
M30	4	4	5	13
M31	4	4	5	13
M32	4	4	5	13
M33	4	4	5	13
M34	4	4	5	13
M35	4	3	5	12
M4	3	5	4	12
M5	3	5	4	12
M6	3	5	4	12
M7	3	5	4	12
M8	3	5	4	12
M9	3	5	4	12
VP1	3	5	4	12
VP2	3	5	4	12
ABZevs	3	4	5	12
Grand Total	**391**	**488**	**505**	**1384**

As a result of 1384 single inspections of 114 individual turbines between 1 August and 31 October 2022, a total of 16 dead birds of eight species were identified. The numbers of identified collision victims by species are given in Table 6.

Table 6. *Victims of collision with turbines during the autumn migration period in 2022 according to the Red Data Book for Bulgaria and IUCN conservation status classifications(LC = Least Concern).*

Species name	***Scientific name***	***Number***	***Red Data Book***	***IUCN***
Calandra lark	*Melanocorypha calandra*	*2*	*endangered*	*LC*
Common buzzard	*Buteo buteo*	*2*	*not listed*	*LC*
Corn bunting	*Emberiza calandra*	*3*	*not listed*	*LC*
Eurasian skylark	*Alauda arvensis*	*1*	*not listed*	*LC*
Great white pelican	*Pelecanus onocrotalus*	*1*	*extinct species in Bulgaria*	*LC*
Grey Partridge	*Perdix perdix*	*1*	*not listed*	*LC*
Red-backed shrike	*Lanius collurio*	*3*	*not listed*	*LC*
Yellow-legged gull	*Larus michahellis*	*3*	*not listed*	*LC*

Six of the bird species identified as victims are not listed in the Red Data Book of Bulgaria. Two of the species are listed in Bulgarian Red Book Data - great white pelican and calandra lark. Great white pelican is as extinct species in Bulgaria according to Bulgarian Red Data Book. In the period of autumn bird migration all birds found during carcass searches are very likely to be migrants and must be considered as immigrants into Bulgaria. Therefore, for the evaluation of the population level impact of the additive mortality of wind turbines included in the monitoring, the international bird species status must be applied. IUCN clasifications as Least Concern (LC) were appropriate to all species identified as collision victims. The category Least Concern indicates that the species has been evaluated against the Red List criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category. Great white pelican is a target for ISPB species in monitoring. In the case of collision mortality monitoring in the ISPB area, this is the first collision with turbines of great white pelican for all five autumn periods in 2018, 2019, 2020, 2021 and 2022. No collisions were recorded in the several previous years of monitoring undertaken only at SNWF, a major component of the ISPB study area, see: http://www.aesgeoenergy.com/site/Studies.html.

6. CONCLUSIONS

1) During the monitoring of ISPB territory, there were no substantive differences in the main characteristics of the ornithofauna typical for the autumn migration in the whole country and the specific characteristics of species' composition and phenology of bird migration in NE Bulgaria.

2) The results of the monitoring confirmed the relatively low importance of the ISPB territory for the birds flying through or over it and no apparent negative influence of the operating wind farms on bird populations during their autumn migration.

3) The migration periods, the species composition, the dynamics in number of birds, the daily activity, the height of the flights, as well as the feeding, resting and roost sites of the flying birds passing through the area and the observation points indicated the absence of a barrier effect of the 114 wind turbines covered by ISPB in autumn migration period.

4) The data presented in this report confirmed the absence of impact on sensitive bird species using migratory upward airflows (thermals) to move (soaring) over long distances in autumn migration period.

5) All these species were found during the study to cross the site using suitable habitats without the need to increase their energy losses in their daily movements and to change their migratory strategy in the autumn period.

6) The quantitative characteristics of bird migration in the ISPB area during autumn 2018, 2019, 2020, 2021 and 2022 and the low mortality among the target bird species allows a continued conclusion that the studied wind farms do not present a risk of adverse impact to migratory birds. The application of the ISPB's safeguards potentially was and can be an ongoing contributory part of the minimal risk posed to birds from wind farms in the Kaliakra region.

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