



INTEGRATED SYSTEM FOR PROTECTION OF BIRDS

REPORT

Monitoring of spring bird migration in the Integrated System for Protection of Birds 2021



Dr. Pavel Zehindjiev
Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Sofia,
Bulgaria
e-mail: pavel.zehindjiev@gmail.com

Dr. D. Philip Whitfield
Natural Research Ltd, Banchory, UK

Sofia
July 2021

Contents

1. INTRODUCTION	3
2. RESULTS	5
2.1. DYNAMICS OF SPRING MIGRATION AND DIRECTION OF MIGRATING BIRDS.....	5
2.2. SPECIES COMPOSITION AND NUMBER OF BIRDS	6
2.3. FREQUENCY OF APPEARANCE.....	9
2.4. ALTITUDE OF FLIGHTS.....	10
2.5. ORDERED AND AUTOMATIC WIND TURBINE STOPS DURING THE SPRING MIGRATION PERIOD	11
2.6. FLOCKS OF TARGET BIRD SPECIES FOR ISPB AS OBSERVED IN SPRING MIGRATION 11	
2.7. RESULTS OF SEARCHES FOR COLLISION VICTIMS	11
3. CONCLUSIONS	14
REFERENCES	14

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.

Considering the potentially adverse effects of wind farms on environmental features, notably birds (Abbasi et al. 2014), the Integrated System for Protection of Birds (ISPB) was implemented in 2018 aiming towards systematic monitoring of any potential adverse effects, and their mitigation: primarily including fatalities through collision with rotating turbine blades, disturbance leading to the displacement of birds from feeding, drinking, roosting or breeding sites (effectively a form of habitat loss), and turbines presenting a barrier to flight movements, thereby preventing access to areas via those movements or increasing energy expenditure to fly around the turbine locations (Hötker et al. 2006, Madders & Whitfield 2006, Drewitt & Langston 2008, Masden et al. 2009, 2010, de Lucas et al. 2004, 2008, Ferrer et al. 2012).

The ISPB consists of a combination of radar observations and meteorological data, integrated with field visual observations, which jointly used are essential for the accurate risk assessment and ensure that appropriate action is taken immediately to avoid collision risk. So far as potential adverse impacts of turbine collisions on birds, a Turbine Shutdown System (TSS) is deployed, supported by an Early Warning System.

The monitoring studies are based on the requirements of basic normative and methodological documents as follows: Environmental Protection Act, Biological Diversity Act, Bulgarian Red Data Book, Directive 92/43/EEC for habitats and species, and Directive 2009/147/EC on the conservation of wild birds, Protected Areas Act and Order RD-94 of 15.02.2018 of the Minister of Environment and Waters. Best international practices are also incorporated (T-PVS/Inf (2013) 15: <https://rm.coe.int/1680746245>). Detailed information on the scope, technical rules and monitoring procedures are publicly available at a dedicated website <https://kaliakrabirdmonitoring.eu/>.

It should be noted that this is the fourth report dedicated to the spring migration period and the ISPB is a subject of continuous improvement based on the observations and any challenges revealed by the several inherent monitoring protocols.

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

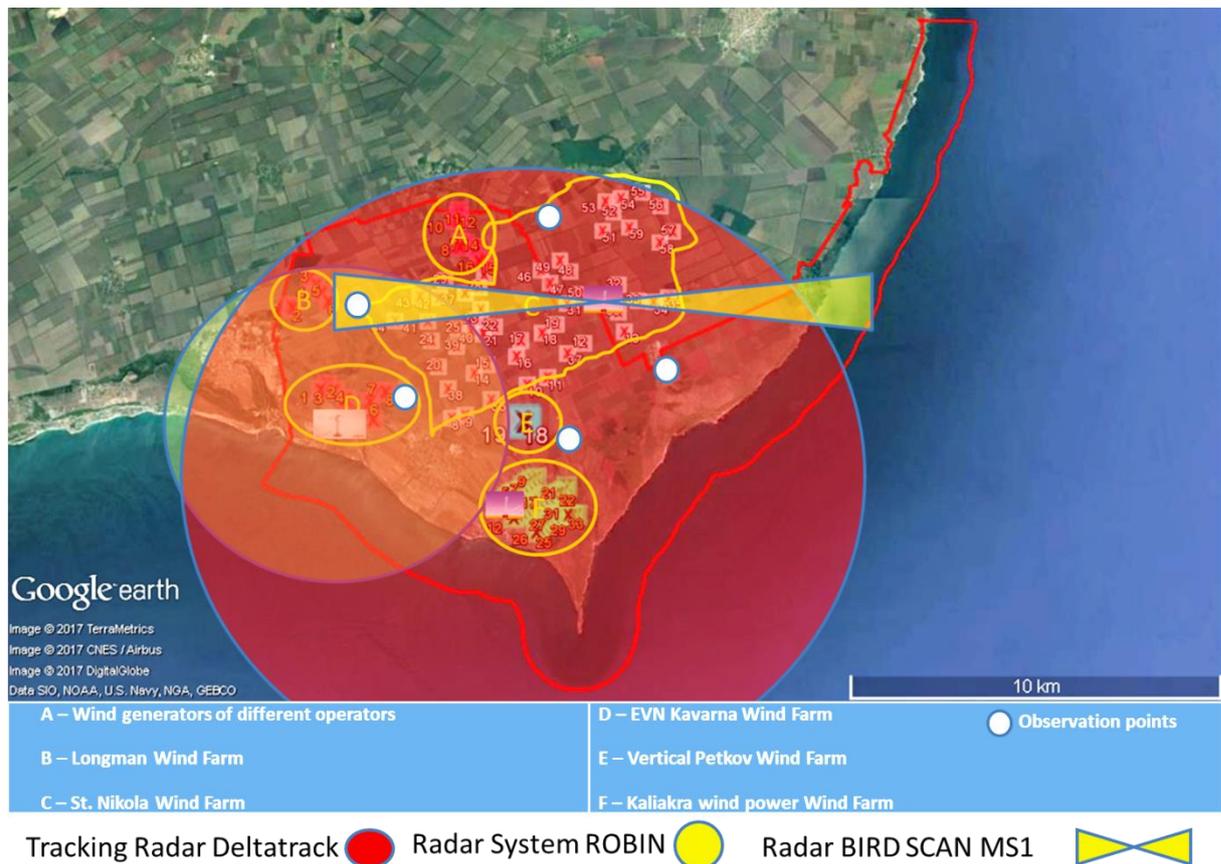


Figure 1. A satellite photo with the location of the wind turbines covered by the ISPB and the boundaries of Kaliakra SPA (shown by the red line), together with the scope of three radar systems.

The current report present results of monitoring of the territory described above in spring 2021. The objectives and tasks of the study are the same as presented before in the report for spring 2018, 2019 and 2020 available at the web site of ISPB (<https://kaliakrabirdmonitoring.eu/>). In order to collect comparative data on spring migration in 2018, 2019, 2020 and 2021 the same methods were applied in the study by the same team of ornithologists as described in detail in the report for spring migration 2018 (<https://kaliakrabirdmonitoring.eu/>)

2. Results

2.1. Dynamics of spring migration and direction of migrating birds

During the spring monitoring, observations were made during all 61 days of the season (15 March -15 May), with registered migratory, soaring birds being detected over 70 % of the time both in spring 2018, 2019, 2020 and 2021. For the survey period, a total of 1560 migratory and resident birds were registered in 2018, 3578 in 2019, 1252 in 2020 and 1012 in 2021 (Table 1).

Table 1. Number of registered birds of all taxa by day during the spring migration period in the territory covered by ISPB.

Period	Number of birds in Spring 2018	Number of birds in Spring 2019	Number of birds in Spring 2020	Number of birds in Spring 2021
15-31 March	882	1900	738	590
1-30 April	445	1203	397	354
1-15 May	233	476	117	68
Total for the period	1560	3578	1252	1012

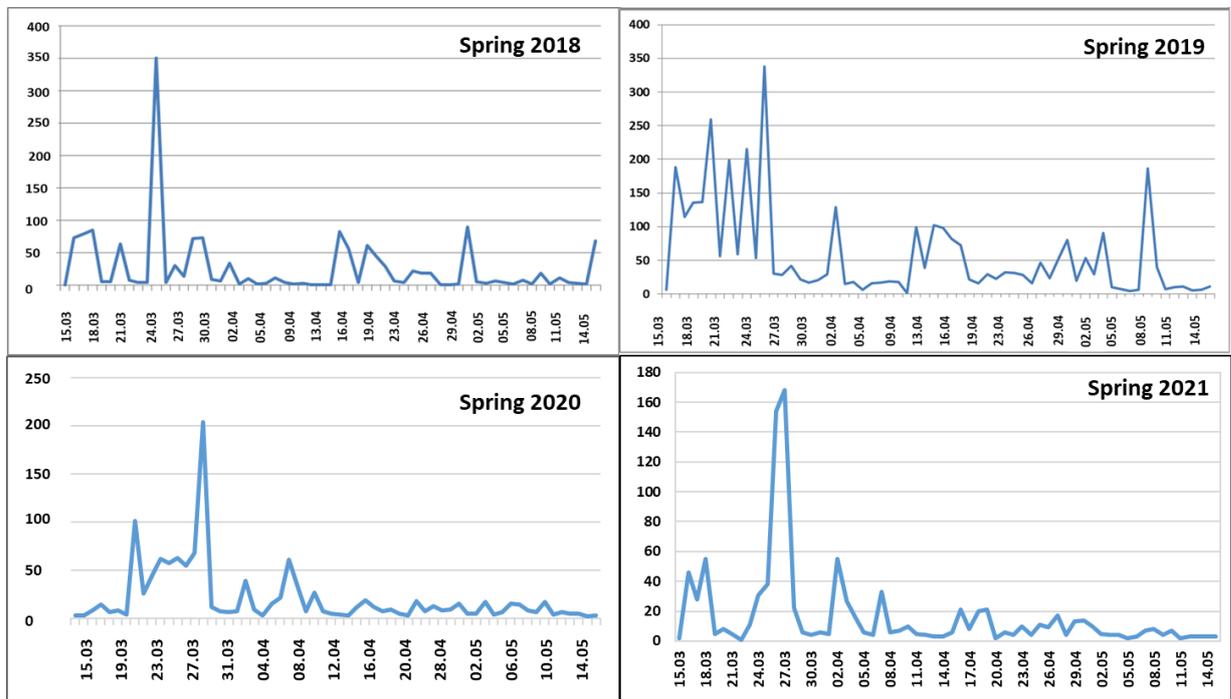


Figure 2. Dynamics of the spring migration of birds in the ISPB territory based on visual observations during the period 15 March - 15 May in 2018, 2019, 2020 and 2021.

The variations in bird numbers were substantial within the spring seasons of migration covered by the current monitoring study (Figure 2). The dynamics in numbers of birds in four spring

seasons remained relatively similar, including an identical date for the peak of migration on 26 March in 2018 and 2019, 29 March in 2020 and 27 March in 2021. The total number of observed birds in the ISPB territory in spring 2019, was over double that observed in spring 2018, 2020 and 2021.

An important parameter for determining the impact of wind turbines on birds is whether or not the general direction of the migration was changed by the presence of the turbines. For birds with registered flight directions, the distribution of directions in spring 2018, 2019, 2020 and 2021 is presented in Table 2.

Table 2. Proportion of registered birds by direction during spring migration on the territory of ISPB for the period 15 March - 15 May 2018, 2019, 2020 and 2021. In grey are the expected directions for the prevailing spring migration.

Direction	Percent of birds 2018	Percent of birds 2019	Percent of birds 2020	Percent of birds 2021
N	28,88%	19,73%	23,76%	13,34%
NE	41,91%	34,51%	56,16%	56,52%
NW	5,98%	7,15%	1,08%	3,36%
NNW	0,34%	8,83%	0	0
NNE	2,82%	0,06%	0	0
ENE	0	1,93%	0	0
WNW	0,13%	0	0	0
WSW	0	0,50%	0	0
S	1,75%	3,63%	4,54%	2,27%
SE	0,54%	3,27%	2,38%	2,47%
E	9%	4,81%	6,59%	10,28%
ESE	0	0,14%	0	0
SW	2,8%	5,76%	1,30%	1,09%
SSW	0	0,08%	0	
W	1,68%	3,80%	4,21%	2,57%

The main direction of flight in the migratory birds during the spring migration in four years 2018, 2019, 2020 and 2021 was N-NE. There was no observed deviation from the seasonal expectation of migratory flight directions which were centred towards the N-NE (Table 2). No changes were identified in the migratory directions of the birds due to the proximity to wind turbines under surveillance.

2.2. Species composition and number of birds

The species and number of birds recorded during spring migration in 2018, 2019, 2020 and 2021 are shown in Table 3.

Table 3. Composition and number of registered bird species during the period 15 March - 15 May 2018, 2019, 2020 and 2021 in the ISPB territory.

Species name	Number in Spring 2018	Number in Spring 2019	Number in Spring 2020	Number in Spring 2021
<i>A. alba</i>		22		
<i>A. apus</i>	2	18		
<i>A. cinerea</i>	6	136	78	58
<i>A. gentilis</i>	1	1		
<i>A. heliaca</i>		1		1
<i>A. melba</i>	5	9		
<i>A. nisus</i>	1	12	11	13
<i>A. pennata</i>	2			1
<i>A. pomarina</i>	1	3	1	3
<i>A. purpurea</i>		1	31	22
<i>A. querquedula</i>		240		
<i>A. ralloides</i>	1			
<i>A. heliaca</i>			1	
<i>B. buteo</i>	75	137	61	56
<i>B. oedicnemus</i>		6		
<i>B. rufinus</i>	1	27	33	30
<i>C. aeruginosus</i>	23	70	45	92
<i>C. canorus</i>		3		
<i>C. ciconia</i>	81	205	81	24
<i>C. corax</i>	2	31	4	16
<i>C. cornix</i>	6	13		
<i>C. coturnix</i>		1		
<i>C. cyaneus</i>	8	38	3	4
<i>C. frugilegus</i>		2		
<i>C. gallicus</i>	6	17	3	10
<i>C. garrulus</i>	4			
<i>C. macrourus</i>	1	6	3	3
<i>C. nigra</i>	4	1		
<i>C. olor</i>	9	12	6	
<i>C. pygargus</i>	8	41	20	7
<i>C. ridibundus</i>		26		
<i>E. alba</i>			9	12
<i>E. garzetta</i>		1		
<i>F. cherrug</i>	1			
<i>F. coelebs</i>		305		
<i>F. columbarius</i>		1		
<i>F. peregrinus</i>	1	1	1	
<i>F. subbuteo</i>	8	18	12	5
<i>F. tinnunculus</i>	37	61	30	32
<i>F. vespertinus</i>	21	11	13	17
<i>G. grus</i>	62		182	
<i>G. virgo</i>	25		63	
<i>H. albicilla</i>	1			
<i>H. caspia</i>			5	
<i>H. himantopus</i>				1
<i>H. pennatus</i>				1
<i>L. fuscus</i>		1	12	
<i>L. melanocephalus</i>		120		
<i>L. limosa</i>			29	
<i>L. michahellis</i>	43	56		
<i>L. ridibundus</i>				21
<i>M. alba</i>		1		
<i>M. apiaster</i>	85	130	10	

<i>Species name</i>	<i>Number in Spring 2018</i>	<i>Number in Spring 2019</i>	<i>Number in Spring 2020</i>	<i>Number in Spring 2021</i>
<i>M. flava</i>		2		
<i>M. migrans</i>	1	1	5	2
<i>N. nicticorax</i>			3	6
<i>O. oriolus</i>	2			
<i>P. apivorus</i>	2	1	1	
<i>P. apricaria</i>		4		41
<i>P. carbo</i>	601	1452	434	469
<i>P. falcinellus</i>		37		
<i>P. haliaetus</i>		1		1
<i>P. onocrotalus</i>	259	201		1
<i>P. pugnax</i>			61	
<i>P. perdix</i>	2			
<i>S. melanocephala</i>		2		
<i>S. rusticola</i>		1		
<i>S. turtur</i>	1			
<i>S. hirundo</i>	1			
<i>St. Vulgaris</i>	80			
<i>T. tadorna</i>	35	3		63
<i>T. ochropus</i>			1	
<i>T. torquatus</i>		1		
<i>U. epops</i>	3	12		
<i>V. vanellus</i>	2	2		
<i>Number of species</i>	43	53	32	29

In total 75 bird species are observed in ISPB territory in fourth spring season. The most numerous birds in spring in the region for four migratory seasons were Common cormorants (*Phalacrocorax carbo*) and some birds of prey – Common buzzards (*Buteo buteo*), Red-footed falcon (*Falco vespertinus*), Common kestrels (*Falco tinnunculus*) and Marsh harriers (*Circus aeruginosus*) (Table 3). One of the most numerous in previous two spring seasons 2018 and 2019 the White pelicans (*Pelecanus onocrotalus*) were not observed in the period of spring migration monitoring in 2020, but a flock of 120 white pelicans are observed 29th May 2020 in the ISPB territory and is not presented in table 3. Only one White pelican is observed in 2021 during the period of spring migration monitoring in ISPB.

Between 24 and 205 White storks (*Ciconia ciconia*) passed over the surveyed territory in the four spring seasons. The European nesting population of the White stork is estimated to be between 180,000 and 220,000 pairs, with about 80 % of the species migrating along the wider western Black Sea region, which also covers a part of north-eastern Bulgaria. According to these values, White storks flying over the Kaliakra area, substantially east of the main migratory path of White storks along the western Black Sea migration corridor, were an insignificant proportion (0.02 %) of the Via Pontica population. According to Shurulinkov et al. (2011), an estimate of the total population of White stork in SE Bulgaria flying along Via Pontica in spring was 23,358 individuals in their study period. In this respect our observations confirm the low

significance of the territory of Kaliakra as part of the migratory corridor for spring migrating White storks along the Via Pontica component of the larger flyway.

Common buzzards, Marsh harriers, Eurasian hobby (*Falco subbuteo*) Common kestrels and Red-footed falcon were the most numerous birds of prey recorded during spring migration. The proportional contribution to records of raptors from the five most commonly recorded species during spring migration 2018, 2019, 2020 and 2021 is shown in Figure 3.

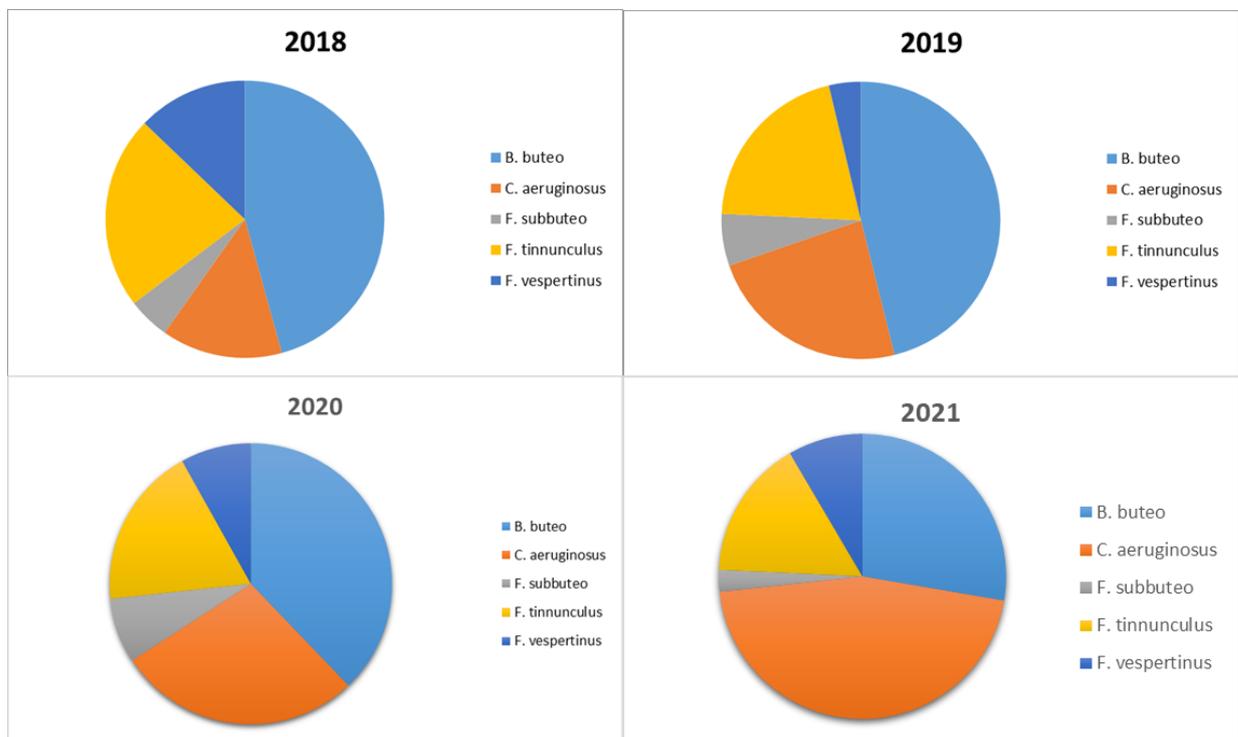


Figure 3. Proportional representations of the five most numerous birds of prey recorded during spring migration 2018, 2019, 2020 and 2021 respectively.

2.3. Frequency of appearance

During the spring migration in 2018, 2019, 2020 and 2021 over the surveyed area, migratory species of soaring birds were noted on an average of 80 % of the days covered by observations in spring migration. In the majority of days, only one bird was observed, predominantly Falconiformes, some of which are local breeding species for the area. These were mostly Common buzzard and Common kestrel. These species were regularly observed to hunt in the area covered by ISPB in all three spring seasons. Flocks of migratory birds having more than three individuals were observed in only few days. In most cases, they were flocks of

cormorants. Another more regularly observed species was Red-footed falcon. The most frequent migrant during the spring monitoring period was the Common buzzard. White storks were observed on only nine days during the monitoring in spring 2018, 28 days in spring 2019, 27 days in 2020 and 19 days in 2021. In fact, only three flocks of White storks were observed respectively in 2018 and 2019 spring migration periods and only one flock in spring 2020. The rest of White storks observed in spring migration periods were single individuals and most probably breeding individuals which were observed in different days of the monitoring.

2.4. Altitude of flights

The substantial majority of observed migrating birds in the monitoring periods of 2018, 2019, 2020 and 2021 passed through the area with wind turbines at altitudes below 300 m above the ground. Over 70 %, 60 % and 90% of birds were observed to fly at a height of less than 200 m above ground level in spring 2018, 2019, 2020 and 2021 respectively. No changes in flight height due to the proximity of wind turbines were observed. The distribution of migratory birds according to flight altitude is shown in Figure 4.

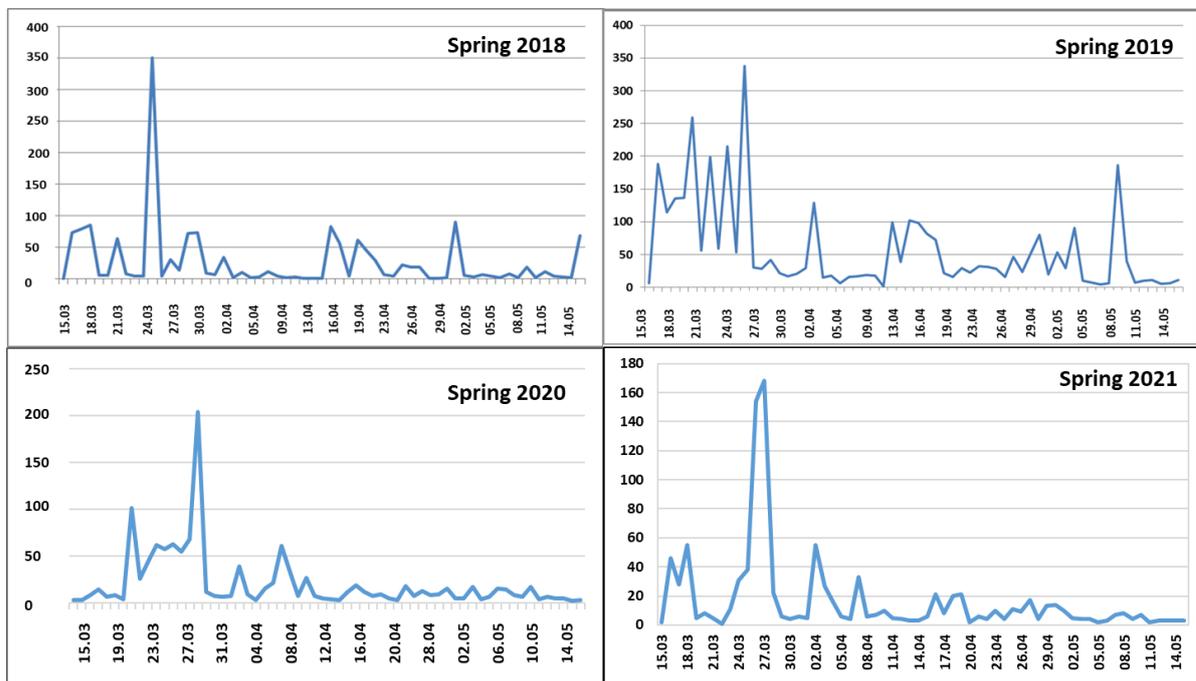


Figure 4. Distribution of passing birds in 10 % classes according to flight altitude (m) in spring 2018,2019, 2020 and 2021.

2.5. Ordered and automatic wind turbine stops during the spring migration period

No stops of turbines were ordered under the Turbine Shutdown System (TSS) during the spring migration period of 2021. This was primarily because all the observed birds passing through the ISPB territory were outside the zone of the risk of collision with turbines.

2.6. Flocks of target bird species for ISPB as observed in spring migration

Figure 5. Flock of 41 European golden plover (green) observed 16 March 2021 and in yellow flock of 47 Common shelduck observed 18 March 2021.



2.7. Results of searches for collision victims

In order to check the effectiveness of the ISPB to prevent collisions of spring migrating birds, the surroundings of each of the 114 turbines covered by the ISPB programme was searched for collision victims at least once a week. According to previously performed carcass removal and searcher efficiency tests during autumn migration and in winter at SNWF (and repeated in autumn 2018 for ISPB territory), this search regime of weekly searches provides for a cost-effective method, which can also be calibrated, to discover any bird strike fatalities which may be of concern. For details, see previous studies of: <http://www.aesgeoenergy.com/site/Studies.html> and results of previous ISPB reports at <https://kaliakrabirdmonitoring.eu/>.

The total of turbine searches per turbine is presented in Table 4.

Table 4. Number of turbines searched for collision victims in the territory of ISPB during the period 15 March 15 May 2021. The Code of every turbine includes the abbreviation of the wind farm and the number of the turbine: **AE8/60** - AES Geo Energy Ltd., **MI/35** - Kaliakra Wind Power, **EI/8** - EVN Kavarna, **DC1/2** - Degrets OOD, **DBΓ1/5** - Disib OOD, **DBΓ2MN600/DBΓ1HSW250** - Windex OOD, **ABΓ4** - Long Man Invest OOD, **ABBalgarevo** - Long Man Energy OOD, **ABZevs** - Zevs Bonus OOD, **VP1/2** – Vertikal Petkov&Sie SD, **ABΓ3** - Wind Park Kavarna East EOOD, **ABΓ1/2** - Wind Park Kavarna West EOOD, **AB Millennium Group Micon/ AB Millennium Group** - Millennium Group OOD.

Turbine number	March 2021	April 2021	May 2021	Total
ABBalgarevo	2	5	2	9
ABΓ1	9	11	2	22
ABΓ2	1	3	2	6
ABΓ3	1	3	2	6
ABΓ4	1	3	2	6
AB Millennium Group	2	5	2	9
AB Millennium Group Micon	2	5	2	9
AE10	2	5	2	9
AE11	2	5	2	9
AE12	3	4	2	9
AE13	3	4	2	9
AE14	2	4	2	8
AE15	2	4	2	8
AE16	2	5	2	9
AE17	2	5	2	9
AE18	3	4	2	9
AE19	3	4	2	9
AE20	2	4	2	8
AE21	2	5	2	9
AE22	2	5	2	9
AE23	2	5	2	9
AE24	2	4	3	9
AE25	2	4	3	9
AE26	2	5	2	9
AE27	2	5	2	9
AE28	2	5	2	9
AE29	2	4	3	9
AE31	3	4	2	9
AE32	3	4	2	9
AE33	3	4	2	9
AE34	3	4	2	9
AE35	3	4	2	9
AE36	2	4	2	8
AE37	3	4	2	9
AE38	2	4	2	8
AE39	2	4	2	8

Turbine number	March 2021	April 2021	May 2021	Total
AE40	2	4	3	9
AE41	2	4	3	9
AE42	2	4	3	9
AE43	2	4	3	9
AE44	2	4	3	9
AE45	2	5	2	9
AE46	3	4	2	9
AE47	3	4	2	9
AE48	3	4	2	9
AE49	3	4	2	9
AE50	3	4	2	9
AE51	3	4	2	9
AE52	3	4	2	9
AE53	3	4	2	9
AE54	3	4	2	9
AE55	3	4	2	9
AE56	3	4	2	9
AE57	3	4	2	9
AE58	3	4	2	9
AE59	3	4	2	9
AE60	3	4	2	9
AE8	2	4	2	8
AE9	2	4	2	8
DBΓ1	1	3	2	6
DBΓ1HSW250	2	4	3	9
DBΓ2	1	3	2	6
DBΓ2MN600	2	4	3	9
DBΓ3	1	3	2	6
DBΓ4	2	5	2	9
DBΓ5	2	5	2	9
DC1	2	5	2	9
DC2	2	5	2	9
E00	2	5	2	9
E01	2	4	3	9
E02	2	4	3	9
E04	2	4	3	9
E05	2	4	3	9

Turbine number	March 2021	April 2021	May 2021	Total
E07	2	4	3	9
E08	2	4	3	9
E09	2	5	2	9
M1	2	5	2	9
M10	2	5	2	9
M11	2	5	2	9
M12	3	4	2	9
M13	3	4	2	9
M14	3	4	2	9
M15	3	4	2	9
M16	3	4	2	9
M17	3	4	2	9
M18	3	4	2	9
M19	3	4	2	9
M2	2	5	2	9
M20	3	4	2	9
M21	3	4	2	9
M22	3	4	2	9
M23	3	4	2	9
M24	3	4	2	9
M25	3	4	2	9

Turbine number	March 2021	April 2021	May 2021	Total
M26	3	4	2	9
M27	3	4	2	9
M28	3	4	2	9
M29	3	4	2	9
M3	2	5	2	9
M30	3	4	2	9
M31	3	4	2	9
M32	3	4	2	9
M33	3	4	2	9
M34	3	4	2	9
M35	3	4	2	9
M4	2	5	2	9
M5	2	5	2	9
M6	2	5	2	9
M7	2	5	2	9
M8	2	5	2	9
M9	2	5	2	9
VP1	2	5	2	9
VP2	2	5	2	9
ABZevs	1	3	2	6
Grand Total	277	489	244	1010

13 records of dead birds after collision with wind turbines were documented during the 2021 spring migration of birds in ISPB territory (Table 5). Most numerous among the confirmed collision victims during the study period were Skylarks (*Alauda arvensis*) and Calandra lark (*Melanocorypha calandra*). No case of collision with the turbines of a target bird species for the period of TSS application in ISPB was registered during the monitoring in spring 2021 (the target species are listed at <https://kaliakrabirdmonitoring.eu/>).

Table 5. Confirmed collision victims and species' conservation status as recorded during the 2021 spring migration period.

English name	Species name	Number of birds	Red Data Book	IUCN
Calandra lark	<i>Melanocorypha calandra</i>	4	Endangered	LC
Common Starling	<i>Sturnus vulgaris</i>	1	Not listed	LC
Common pheasant	<i>Phasianus colchicus</i>	1	Not listed	LC
Corn bunting	<i>Emberiza calandra</i>	1	Not listed	LC
Grey partridge	<i>Perdix perdix</i>	1	Not listed	LC
Skylark	<i>Alauda arvensis</i>	3	Not listed	LC
Willow warbler	<i>Phylloscopus trochilus</i>	1	Not listed	LC
Yellow legged gull	<i>Larus michahellis</i>	1	Not listed	LC

3. CONCLUSIONS

- 1) During the monitoring, there were no apparent changes in the main characteristics of the ornithofauna typical for the spring migration in the whole country and the specific characteristics of the species composition and phenology of spring bird migration in NE Bulgaria.
- 2) The results of the monitoring confirmed the relatively low importance of the ISPB territory for migratory birds in spring and the absence of negative influence of the operating wind farms on bird populations during their spring migration.
- 3) During 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 indicated the absence of a barrier effect of the 114 wind turbines.
- 4) The data presented in this report confirmed the absence of any adverse impact on sensitive bird species of the orders Ciconiiformes, Pelecaniformes, Falconiformes, Gruiformes using migratory ascending air flows (thermals) for movement over long distances.
- 5) All these species were found to occasionally cross the study site, and their observed behaviour in respect to wind turbines did not indicate major changes which would impact on the energetics of these species during daily movements.
- 6) The quantitative characteristics of bird migration in the ISPB area during spring 2021, and the absence of 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.

REFERENCES

- Abbasi M., Abbasi P.T., Abbasi S.A. 2014 Wind energy: Increasing deployment, rising environmental concerns. *Renewable and Sustainable Energy Reviews*, 31, 270-288
- Bildstein K.L. 2006. *Migrating Raptors of the World: Their Ecology and Conservation*. Comstock Pub. Associates; 1 edition (October 15, 2006)
- Batschelet E. 1981. *Circular Statistics in Biology*. Academic Press Inc., New York.
- Bibby, C. J., Burgess, N.D. & Hill, D.H. 1992. *Bird Census Techniques*. London, UK: Academic Press.
- de Lucas, M., Janss, G.F.E., Whitfield, D.P. & Ferrer, M. 2008. Collision fatality of raptors in wind farms does not depend on raptor abundance. *Journal of Applied Ecology* 45, 1695-1704.

- de Lucas, M.; Janss, G.; Ferrer, M. 2004. The Effects of a Wind Farm on Birds in a Migration Point: The Strait of Gibraltar. *Biodiversity & Conservation* 13 , 395-407
- Drewitt, A.L. and R.H.W. Langston. 2008. Collision effects of wind-power generators and other obstacles on birds. *Ann. N.Y. Acad. Sci.* 1134: 233–266.
- Ferrer, M.; Lucas, M.; Janss, G.; Casado, E.; Muñoz, A.; Bechard, M.; Calabuig, C. 2012. Weak Relationship Between Risk Assessment Studies and Recorded Mortality in Wind Farms *Journal of Applied Ecology* 49, 1 38-46
- Hahn S., Bauer S., Liechti F. The natural link between Europe and Africa – 2.1 billion birds on migration. 2009. *Oikos* 118 :624 – 626 DOI: 10.1111/j.1600-0706.2008.17309.x
- Hötker, H., Thomsen, K.-M. & Jeromin, H. 2006. Impacts on biodiversity of exploitation of renewable energy sources: the example of birds and bats - facts, gaps in knowledge, demands for further research, and ornithological guidelines for the development of renewable energy exploitation. Michael-Otto-Institut im NABU, Bergenhusen.
- Madders, M. & Whitfield, D.P. 2006. Upland raptors and the assessment of wind farm impacts. *Ibis* 148 (Suppl. 1), 43-56.
- Masden, E.A., Haydon, D.T., Fox, A.D., and Furness, R.W. 2010. Barriers to movement: modelling energetic costs of avoiding marine wind farms amongst breeding seabirds. *Marine Pollution Bulletin* 60, 1085–1091.
- Masden, E.A., Haydon, D.T., Fox, A.D., Furness, R.W., Bullman, R., and Desholm, M. 2009. Barriers to movement: impacts of wind farms on migrating birds. *ICES J. Mar. Sci.* 66, 746-753.
- Michev T., L. Profirov, K. Nyagolov, M. Dimitrov. 2011. The autumn migration of soaring birds at Bourgas Bay, Bulgaria. *British Birds* 104(:16–37
- Michev T., Profirov L.A., Karaivanov N. P., Michev B. T. 2012. Migration of Soaring Birds over Bulgaria. 2012 *Acta zool. Bulg.*, 64, 33-41
- Morrison, M. 1998. Avian Risk and Fatality Protocol. Report NREL/SR-500-24997. National Renewable Energy Laboratory. U.S. Department of Energy. 29
- Shurulinkov, P., Daskalova, G., Chakarov, N., Hristov, K., Dyulgerova, S., Gocheva, Y., Cheshmedzhiev, S., Madzharov, M., Dimchev, I., 2011. Characteristics of soaring birds' spring migration over inland SE Bulgaria. — *Acrocephalus*, 32 (148/149): 29-43.