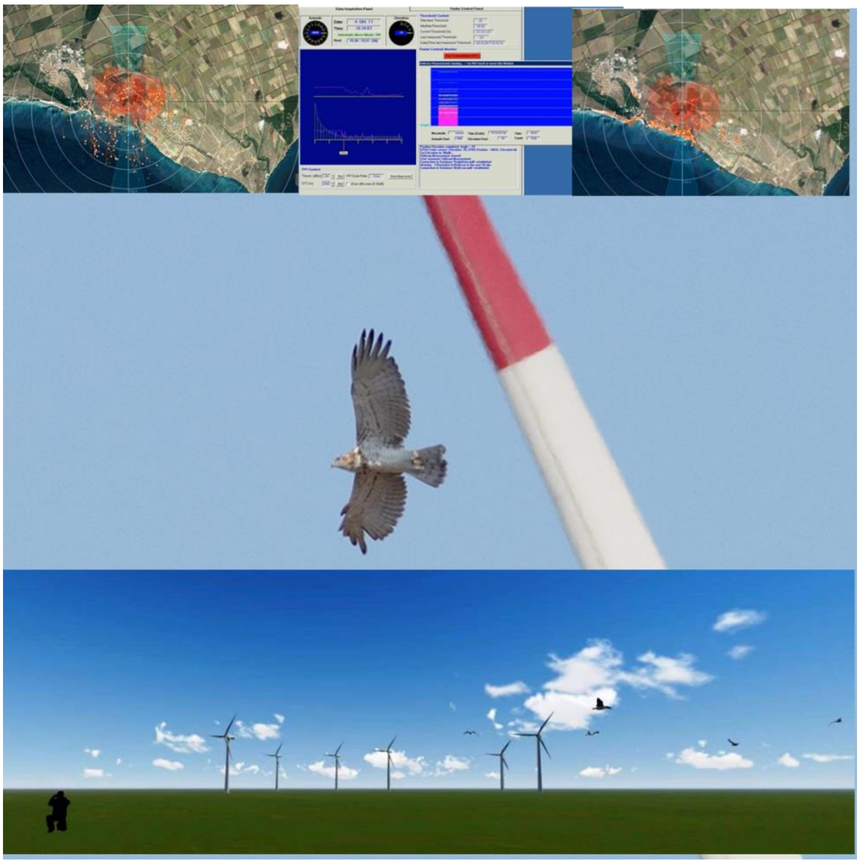
INTEGRATED SYSTEM FOR PROTECTION OF BIRDS

REPORT

Monitoring of the migration of birds through the territory of the Integrated System for Protection of Birds, Autumn 2020



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

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

November 2020

CONTENTS

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/ as well as in two previous reports on autumn migration in 2018 and 2019 respectively.

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

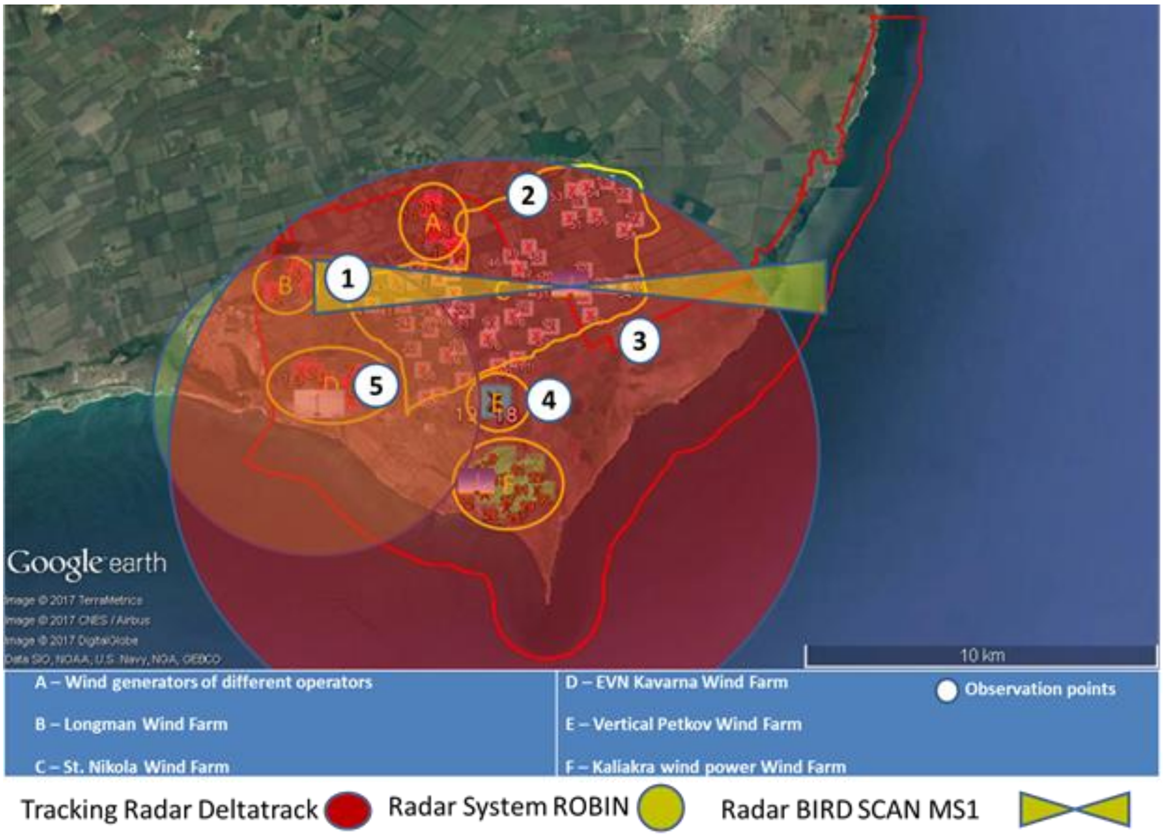


Figure 1. *A satellite photo with the location of the wind turbines covered by the ISPB and the boundaries of Kaliakra SPA (shown by the red line), together with the scope of three radar systems.*

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 migraton along the core axis of Via Ponticaaccording to data from* Michev et al. (2012)

Over the past ten 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 and 2019 on the above-mentioned territory and reports are published at https://kaliakrabirdmonitoring.eu/.

This report covers the thirth autumn migration season (01.08 - 31.10 2020) in ISPB territory. The collected information was used to assess the effectiveness of the application of ISPB in Kaliakra in the Autumn of 2020.

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 http://natura2000.moew.government.bg/PublicDownloads/Auto/OtherDoc/276296/276296_Birds_120.pdf of migration, we consider the period covered in our study as optimal and representative for autumn bird migration of all target for ISPB species.

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 the report.

2. OBJECTIVES AND TASKS OF THE STUDY

The main objective of this monitoring study is to determine the quantitative characteristics of migratory birds in the area of ISPB during autun migration, to assess the effectiveness of the TSS applied here, in order to reduce the risk for 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:

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.
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. 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.
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.

- **Janko Jankov - Field ornithologist**

Graduated ecologyst and conservation biology expert. Over seven years of experience in impact monitoring of birds in Wind Park projects in NE Bulgaria. Member of BSPB.

- **Nikolay Velichkov - Field ornithologist**

Field studies of the distribution and number of breeding bird species ENVEKO, Inspection of use of pesticides and pedigrees in the framework of the project "Urgent measures for the protection of the Egyptian Vulture (*Neophron percnopterus*) BSPB”.
Monitoring the migration of birds species composition and the number of nesting fauna 2007-2012 "Ecotan" EOOD. 10 years of experience in impact monitoring study of wind turbines in the study area

- **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. 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.

- **Milen Rusev Chanev**

Master in Biology Diploma in Landscape |Ecology from Sofia University ST Kliment Ochridski. Participants in following projects: Operational Program of EU Environment 2014-2020 г. № BG16M1OP002-3.003-0001.

Maping of habitats and species subject of conservation in Natura 2000 in the period 2011-2013;

Volunteer in number of conservation projects for bird migration counting in the period 2009 - 2020

- **Boyan Michev - Field ornitologist**

PhD student at the Institute of Biodiversity and Ecosystem Research - BAS. He works in Risk Assessment and Conservation Biology department. Expert in the use of radars to study bird migration. Member of the European Migration Tracking Network through meteorological radars.

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 followed Bibby et al. (1992) and Michev et al. (2010 and 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 each of the field ornithologists. The range of the radar systems is presented in Figure 1.

The assessment of the effectiveness of the TSS utilizes the methodology developed in the USA (Morrison 1998) for monitoring bird collision with the turbines (and see methods described in http://www.aesgeoenergy.com/site/Studies.html).

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 previous reports dedicated to spring and autumn migration 2018 and available from the web site of ISPB (https://kaliakrabirdmonitoring.eu/).

5. RESULTS

5.1. Species composition and number of birds

The monitoring from 1 August to 31 October 2020 recorded 12079 individual birds, assigned to 40 bird species. Comparisons of the observed monthly number of birds in three consecutive migratory seasons are presented in Figure 3.

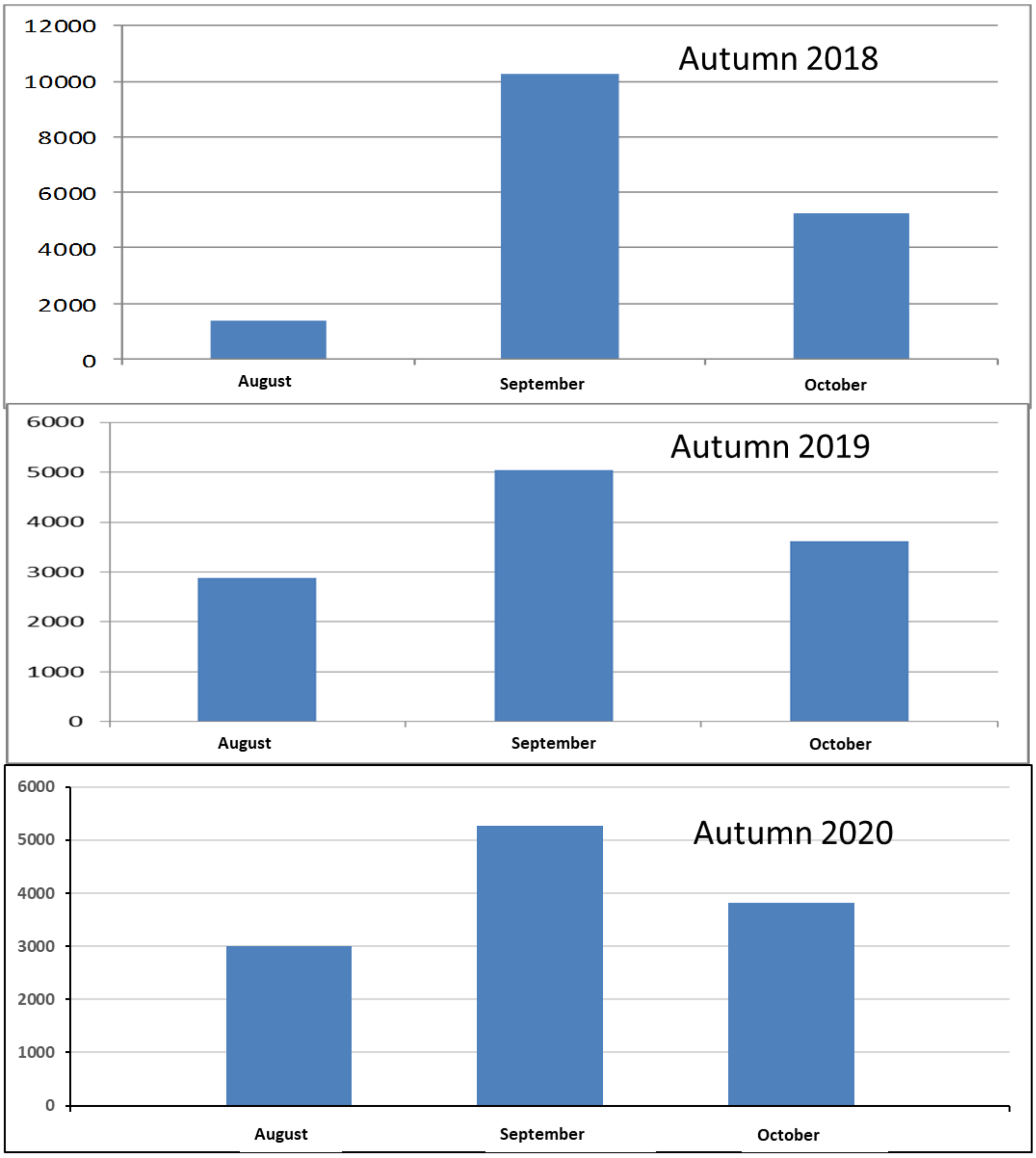


Figure 3. *Number of registered birds by months during the autumn migration period in the territory of ISPB in 2018, 2019 and 2020.*

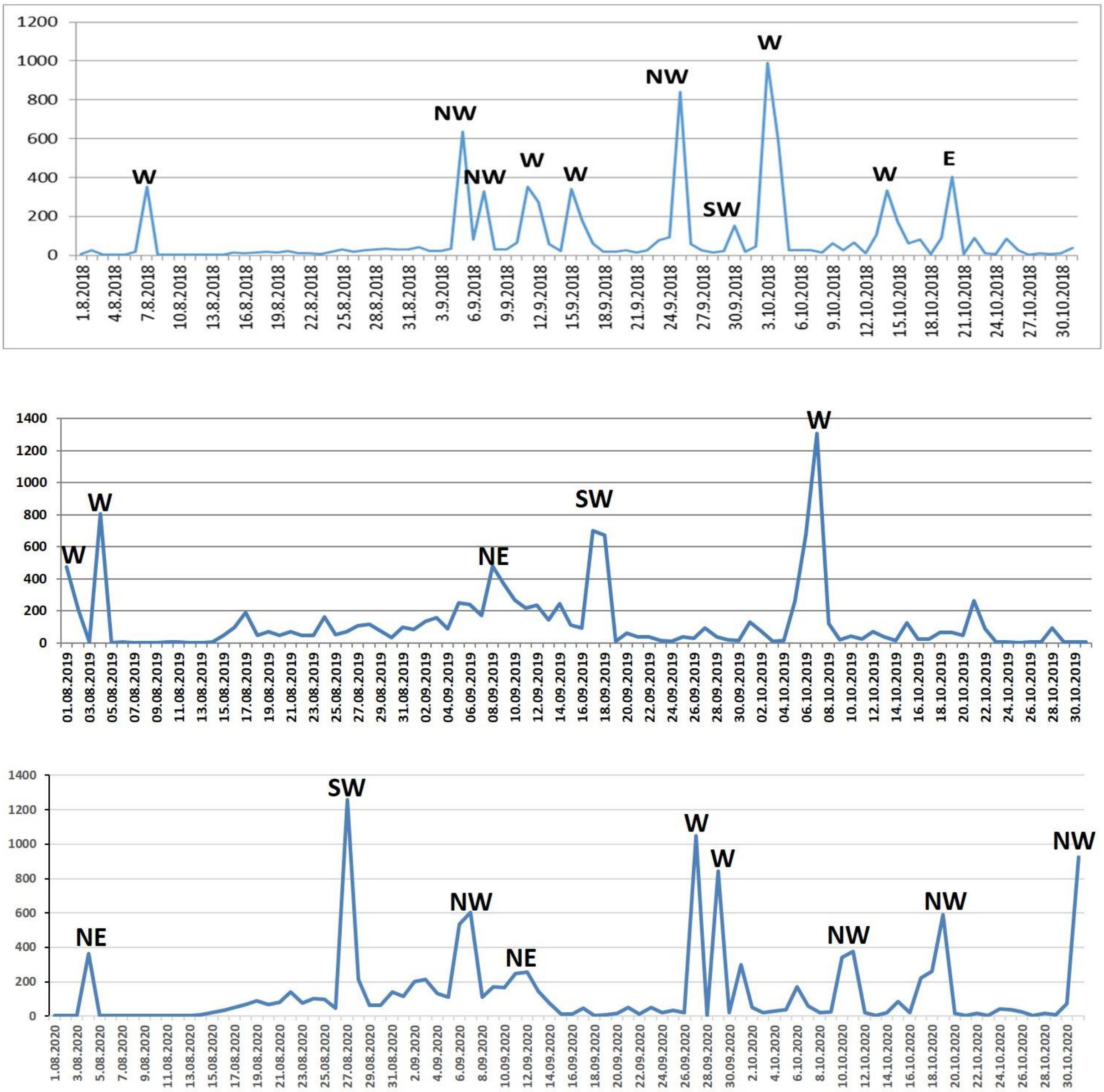


Figure 4. *Dynamics of the autumn migration of soaring bird species in the ISPB territory according to visual observations during the autumn migration in 2018, 2019 and 2020. Letters above spikes indicate the direction of wind in days with increased numbers of migrating birds.*

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 three consecutive years 2018, 2019 and 2020 (Figure 4).

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 three 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 and 2020 in the ISPB territory*

Species name	*Autumn 2018*	*Autumn 2019*	*Autumn 2020*
A. brevipes	309	123	110
A. gentilis	1	5	8
A. nisus	242	185	244
A. cinerea	21	8	37
A. clanga	0	1	0
A. purpurea	2	0	0
A. pennata	30	15	40
A. pomarina	232	29	22
A. nipalensis	0	0	1
A. heliaca	0	0	2
A. melba	0	35	0
A. apus	0	100	0
B. buteo	2642	1980	2965
B. rufinus	58	13	45
B. lagopus	3	1	15
C. albus	0	8	3
C. aeruginosus	442	180	264
C. cyaneus	37	15	16
C. pygargus	88	28	60
C. macrourus	8	5	13
C. gallicus	94	50	59
C. ciconia	451	1557	1137
C. nigra	54	7	13
C. garrulus	1	37	3
C. corax	15	27	21
C. cornix	6	8	0
C. monedula	35	0	0
C. frugilegus	14	0	0
C. oenas	44	14	0
C. crex	0	1	0
C. palumbus	1200	2	0
F. vespertinus	472	149	1215
F. subbuteo	48	46	38
F. peregrinus	4	0	1
F. tinnunculus	272	161	176
F. cherrug	2	0	0
F. columbarius	2	2	1
F. eleonorae	3	1	0
M. migrans	71	19	20
M. milvus	2	0	2
M. alba	414	0	0
M. apiaster	2963	4314	3737
M. calandra	1430	0	0
G. grus	100	4	0
G. virgo	13	0	0
G. fulvus	0	0	1
L. michahellis	234	62	0
L. cachinnans	0	0	1
L. excubitor	0	1	0
L. fuscus	1	0	0
N. nycticorax	0	12	0
H. albicilla	1	1	1
H. rustica	1000	86	1000
P. carbo	576	512	332
P. onocrotalus	2021	1243	0
P. crispus	0	1	8

Species name	***Autumn 2018***	***Autumn 2019***	***Autumn 2020***
P. apivorus	*801*	*9*	*96*
P. haliaetus	*17*	*12*	*3*
P. leucorodia	*5*	*1*	*6*
P. roseus	*1*	*0*	*0*
P. perdix	*10*	*25*	*0*
R. riparia	*76*	*0*	*0*
St. vulgaris	*400*	*0*	*360*
V. vanellus	*4*	*0*	*2*
E. garzetta	*1*	*0*	*0*
T. ferruginea	*0*	*8*	*0*

The most numerous migrating birds recorded in autumn 2020 were bee-eaters (*Merops apiaster*) with over 3,700 individuals registered. Within the soaring birds the most numerous birds recorded involved common buzzards (*Buteo buteo*), white storks (*C. ciconia*) with over 1000 individuals of each species (Table 2). One species with a marked increase in recorded numbers in 2020 was the red-footed falcon (*Falco vespertinus*). Three new species were recorded in autumn 2020. The griffon vulture (*Gyps fulvus*) is previously observed in autumn but since 2018 when the ISPB was started it is the first observation in autumn migration period. Another two species of interest observed in autumn 2020 for the first time are the steppe eagle (*Aquila nipalensis*) and imperial eagle (*Aquila heliaca*) The white pelican (*Pelecanus onocrotalus*) which usually appears in the ISPB territory in short time periods in autumn was not observed in autumn 2020.

In autumn 2018, 2019 and 2020, 451, 1557 and 1137 white storks (*Ciconia ciconia*) were recorded during ISPB studies, respectively. 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 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 0.06 % 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 fly way.

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 observed in typical bottleneck sites – Burgas Bay (Michev et al. 2018). For example, black storks (*C. nigra*) in Kaliakra vary between 7 and 54 in contrast to Burgas where over 5,000 black storks were observed in autumn 2017. Marsh harriers (*Circus aeruginosus*) counts varied from 180 to 442 in Kaliakra compared to 1,468 in Burgas. Lesser-spotted eagles (*Aquila pomarina*) in Kaliakra varied between 22 and 232 in contrast to over 22,000 in Burgas. Red-footed falcons (*Falco verspertinus*) counted in Burgas reached over 15,000 in contrast to totals between 149 and 1,215 in Kaliakra. The differing proportions of the most numerous birds of prey using the ISPB area during autumn migration is shown in Figure 9.

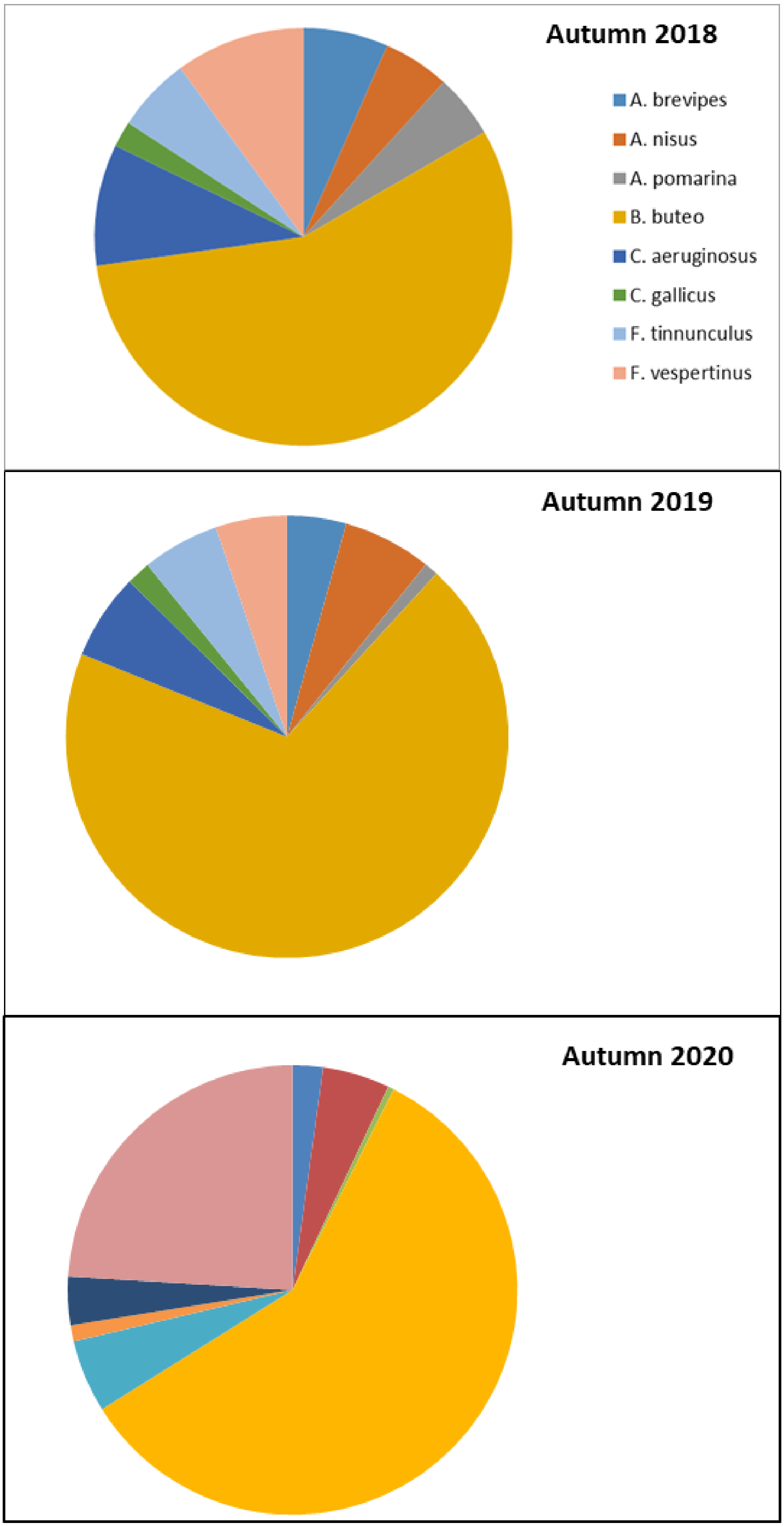


Figure 5. *Proportional representations of the eight most numerous birds of prey recorded during autumn migration in 2018, 2019 and 2020.*

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, 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 and 2020.*

Species	OP1			OP2			OP3			OP4			OP5		
	2019	2018	2020	2019	2018	2020	2019	2018	2020	2019	2018	2020	2019	2018	2020
A. brevipes	13	11	16	5		20	21	10	9	4	13	4	3	16	61
A. nisus	21	34	10	11		107	39	36	7	7	95	23	39	28	97
A. pomarina	8	18	8	1		10	2	9	1		21		5	17	3
B. buteo	80	80	37	22	4	2313	72	75	37	23	78	188	87	80	384
B. lagopus						15	1	1			1			1	
B. rufinus		15	5		1	14	10	15		1	9	1	1	10	25
C. aeruginosus	20	83	43	14	4	112	27	70	31	31	99	4	32	116	67
C. ciconia	1	1	21	1	4	1	10	10			2	1		3	1114
C. cyaneus	4	15				8	7	1			9		2	8	8
C. gallicus	4	10	5	4	3	7	11	17	5	11	16	7	6	24	35
C. garrulus		1					2					2			1
C. macrourus		3		3		5	1	1	1		2	4		2	3
C. nigra	3	5	1			7	1	3			5			3	5
F. columbarius						1	2				1			1	
F. eleonore	1										2			1	
F. subbuteo	11	13	14	1		11	9	21	6	11	4	1	3	6	6
F. tinnunculus	41	44	31	17	5	68	14	45	23	9	51	6	15	29	42
F. vespertinus	6	44	5	29		96	9	18	103	3	54	20	12	21	991
P. apivorus		15	5			84		27	1	4	17		3	17	6
P. onocrotalus	1	7					2	12			9		3	2	0

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 is shown in Figure 6.

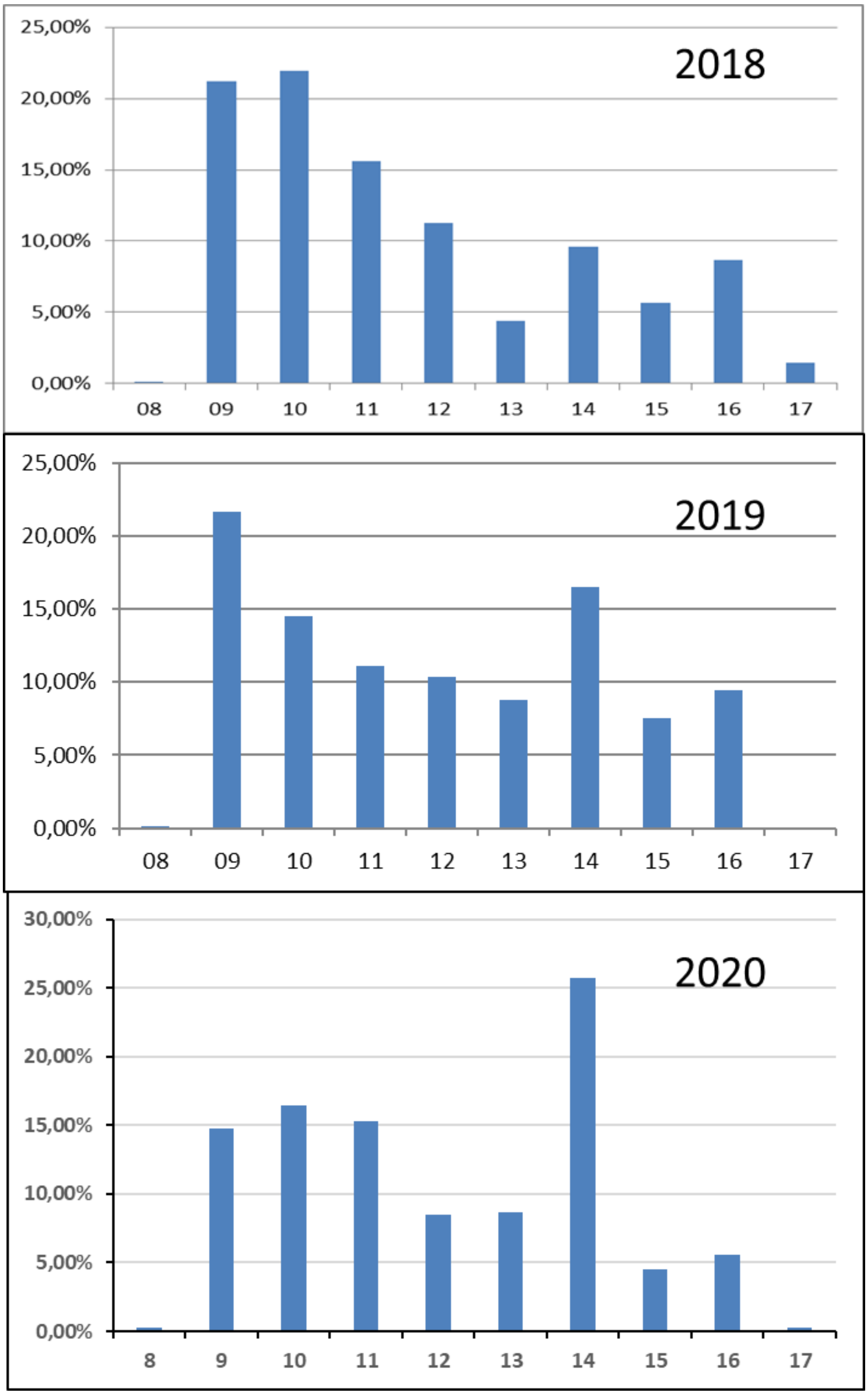


Figure 6. *The dynamics of the presence of birds by hour of the day in the ISPB territory in the autumns of 2018, 2019 and 2020.*

5.3. Direction of migrating birds

In order to test for 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 of recorded birds by direction during autumn migration, in and approaching the territory of ISPB for the period 01 August – 31 October 2018, 2019 and 2020. 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
N	3,49%	1,51%	0,56%
NE	8,73%	1,02%	1,40%
NNE	0,02%		0,03%
NNW	0,01%	0,02%	0,12%
NW	4,76%	1,77%	3,21%
E	1,75%	5,83%	2,14%
SEE	0,09%		0,05%
SE	5,64%	7,01%	4,38%
SSE	0,01%		
S	41,52%	49,57%	35,58%
SSW	0,12%		0,03%
SW	20,43%	19,35%	43,06%
WSW	0,71%	0,01%	0,04%
W	12,70%	13,91%	9,24%
WNW	0,02%		0,08%

The main direction of birds during autumn migration was towards the south to southwest, with over 70 % of observations in all three autumn seasons of 2018, 2019 and 2020 (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 three 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 two autumn seasons of 2018, 2019 and 2020. 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.

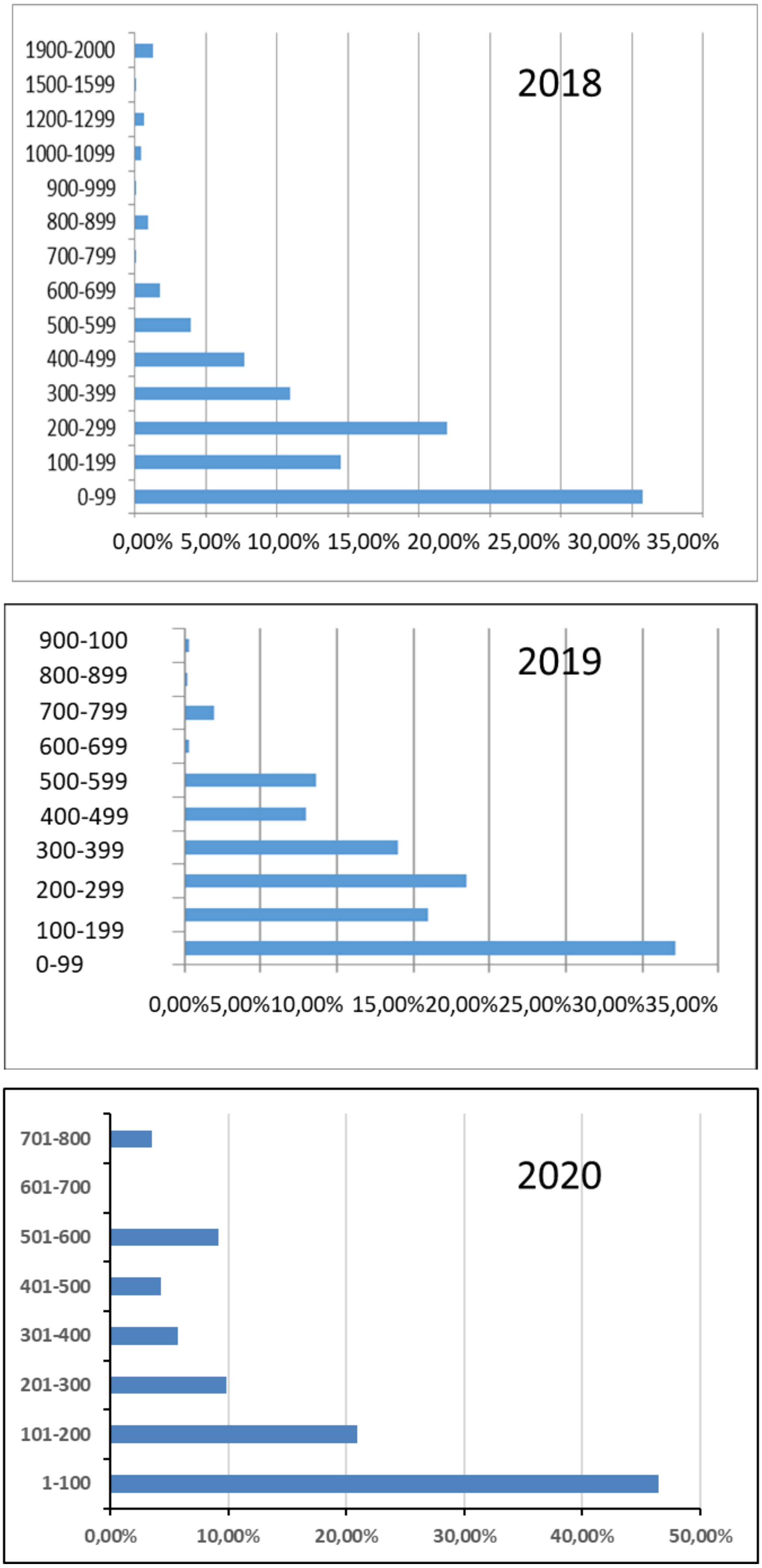


Figure 7. *Proportional (%) distributions of passing birds by altitude (metres) in ISBP as observed in autumn 2018, 2019 and 2020 monitoring periods.*

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 2020 autumn migration, there was one stop of two groups of turbines in the territory of the Kaliakra SPA and adjacent territories. The stop order 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 stop is given in Table 4.

***Table 4**. Data for stops of wind turbines ordered by field observers during the autumn migration of birds 2020.*

Date	*Wind Farm*	*Turbine code №/ Group*	*Species*	*Number of birds*	*Time stop*	*Time restart*
1.10.2020	*AES*	*F, E zones*	*Gyps fulvus*	*1*	*14:38:00*	*15:09:00*

5.6. Observed flocks of target bird species for ISPB as documented in autumn migration 2020

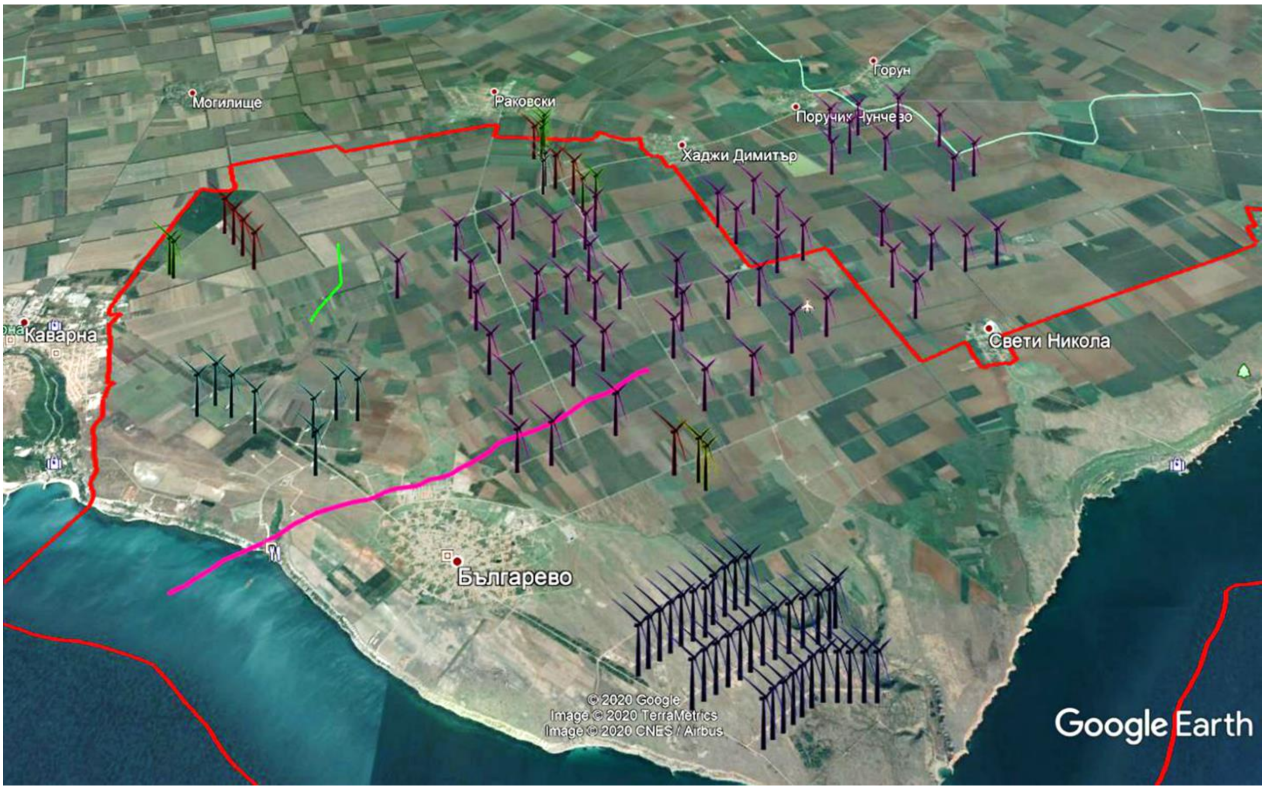


***Figure 8.** Registered flocks of white storks in August 2020: 1100 birds (pink) observed 27.08.2020 and 17 birds (green) observed 28.08.2020.*

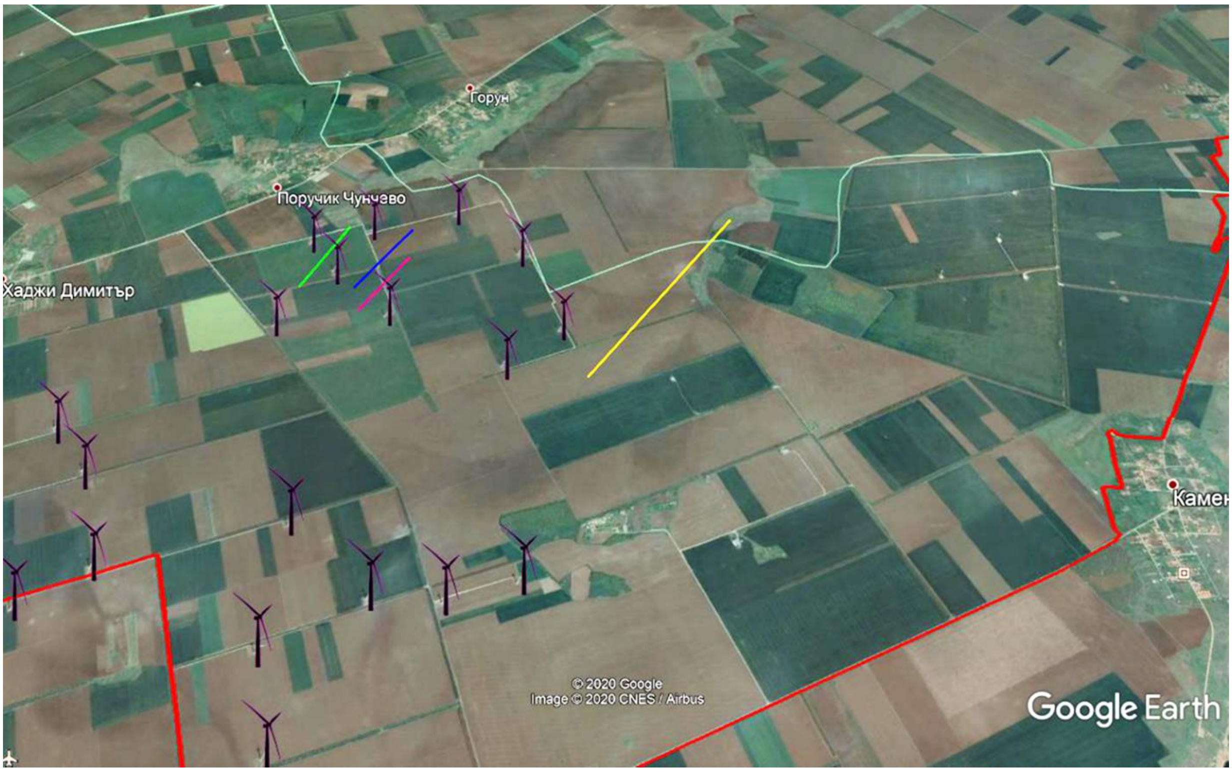


Figure 9. *Registered flocks of honey buzzards in September 202: 16 birds (green), 10 birds (blue), 18 birds (yellow), 33 birds (pink) observed 04.09. 2020.*

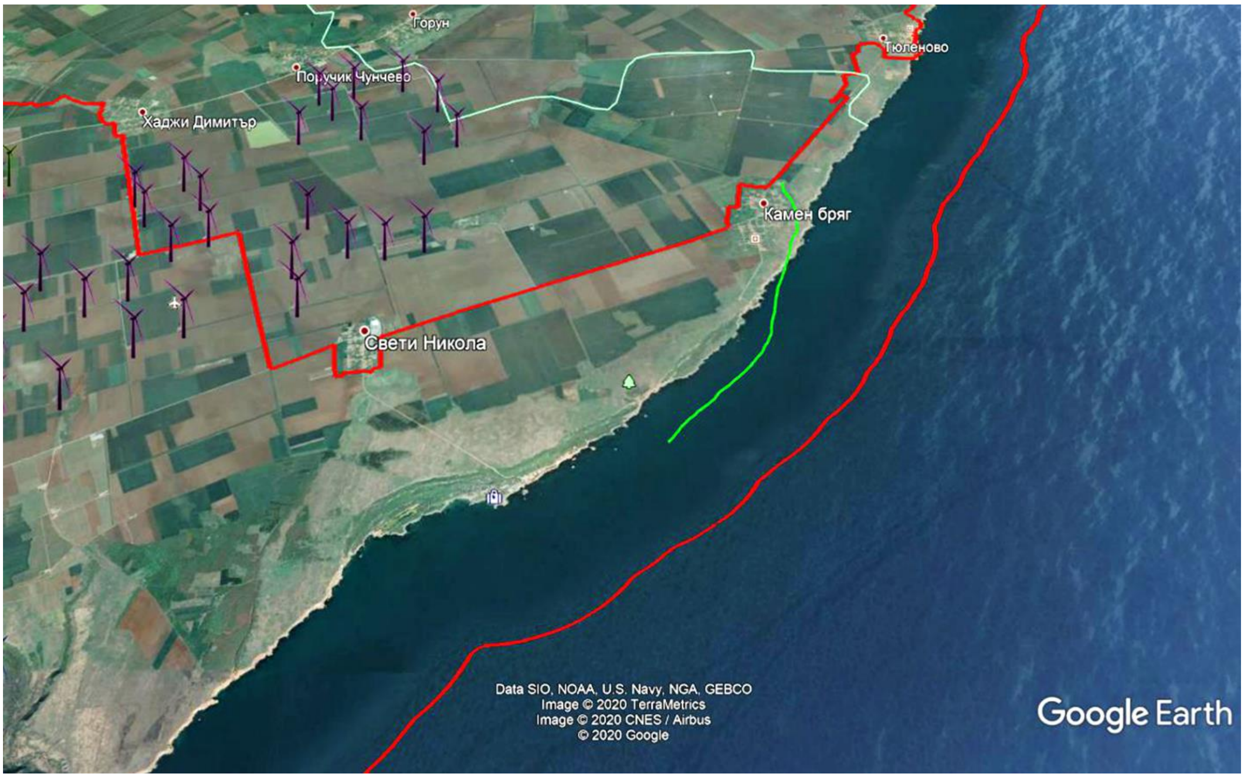


Figure 10. *A flock of grey herrons observed 21.09.2020*

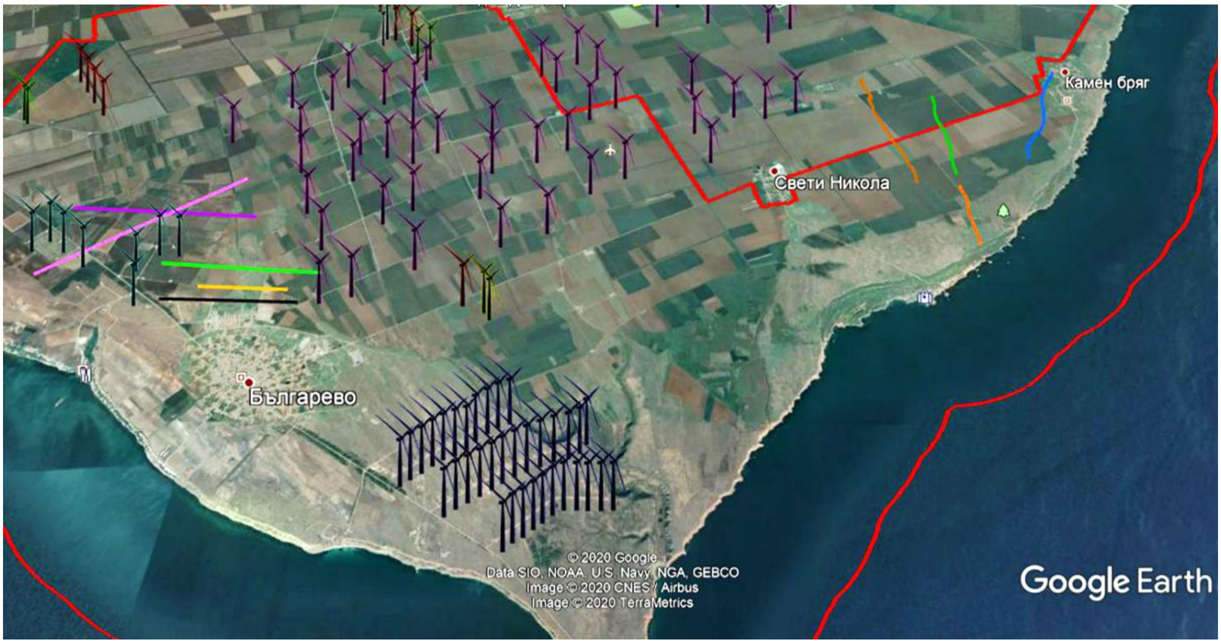


Figure 11. *Registered flocks of red footed falcons: 57 birds (orange), 115 birds (green), 260 birds (violet), 220 birds (pink), 32 birds (black), 25 birds (blue), 12 birds (braun), 10 birds (dark orange), 14 birds (dark green) observed 29.09.2020.*

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 2020. 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 significantly 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 (and repeated in spring 2018 with similar results), 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 2020.*

Turbine	Aug.	Sep.	Oct.	Total
ABBalgarevo	4	4	4	12
АВГ1	4	4	4	12
АВГ2	4	4	4	12

Turbine	Aug.	Sep.	Oct.	Total
АВГ3	4	4	4	12
АВГ4	4	4	4	12
ABMillenium group	3	4	5	12

Turbine	Aug.	Sep.	Oct.	Total
ABMillenium group Micon	3	4	5	12
AE10	4	4	5	13
AE11	4	4	5	13
AE12	2	5	4	11
AE13	3	5	4	12
AE14	4	4	4	12
AE15	4	4	4	12
AE16	4	4	5	13
AE17	4	4	5	13
AE18	2	5	4	11
AE19	2	5	4	11
AE20	4	4	4	12
AE21	4	4	5	13
AE22	4	4	5	13
AE23	4	4	5	13
AE24	4	4	5	13
AE25	4	4	5	13
AE26	4	4	5	13
AE27	3	4	5	12
AE28	3	4	5	12
AE29	4	4	5	13
AE31	3	5	4	12
AE32	3	5	4	12
AE33	3	5	4	12
AE34	3	5	4	12
AE35	3	5	4	12
AE36	4	4	4	12
AE37	2	5	4	11
AE38	4	4	4	12
AE39	4	4	4	12
AE40	4	4	5	13
AE41	4	4	5	13
AE42	4	4	5	13
AE43	4	4	5	13
AE44	4	4	5	13
AE45	3	4	5	12
AE46	2	5	4	11
AE47	2	5	4	11
AE48	2	5	4	11
AE49	2	5	4	11
AE50	3	5	4	12
AE51	4	4	4	12
AE52	4	4	4	12
AE53	4	4	4	12
AE54	4	4	4	12
AE55	5	4	4	13

Turbine	Aug.	Sep.	Oct.	Total
AE56	4	4	4	12
AE57	4	4	4	12
AE58	4	4	4	12
AE59	4	4	4	12
AE60	3	5	4	12
AE8	4	4	4	12
AE9	4	4	4	12
DBΓ1	4	4	4	12
DBΓ1HSW250	4	4	5	13
DBΓ2	4	4	4	12
DBΓ2MN600	4	4	5	13
DBΓ3	4	4	4	12
DBΓ4	3	4	5	12
DBΓ5	3	4	5	12
DC1	3	4	5	12
DC2	3	4	5	12
E00	4	4	4	12
E01	4	4	5	13
E02	4	4	5	13
E04	4	4	5	13
E05	4	4	5	13
E07	4	4	5	13
E08	4	4	5	13
E09	4	4	4	12
M1	4	4	4	12
M10	3	4	6	13
M11	3	4	6	13
M12	3	5	3	11
M13	3	5	3	11
M14	3	5	3	11
M15	3	5	3	11
M16	3	5	3	11
M17	3	5	3	11
M18	3	5	3	11
M19	3	5	2	10
M2	4	4	4	12
M20	3	5	3	11
M21	3	5	3	11
M22	3	5	3	11
M23	3	5	3	11
M24	3	5	3	11
M25	3	5	3	11
M26	3	5	3	11
M27	3	5	4	12
M28	3	4	3	10
M29	3	4	3	10
M3	4	4	4	12

Turbine	Aug.	Sep.	Oct.	Total
M30	3	4	3	10
M31	3	4	3	10
M32	3	4	3	10
M33	3	4	3	10
M34	3	4	3	10
M35	3	4	3	10
M4	3	4	5	12
M5	3	4	6	13

Turbine	Aug.	Sep.	Oct.	Total
M6	3	4	6	13
M7	3	4	6	13
M8	3	4	6	13
M9	3	4	6	13
VP1	4	4	4	12
VP2	4	4	4	12
ABZevs	4	4	4	12
Grand Total	**392**	**488**	**480**	**1360**

As a result of 1360 single inspections of 114 individual turbines between 1 August and 31 October 2020, a total of 13 dead birds of nine species were identified. The number of identified collision victims by species are given in Table 6.

Table 6 *Victims of collision with turbines during the autumn migration period in 2020 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
European skylark	*Alauda arvensis*	1	not listed	LC
House martin	*Delichon urbicum*	1	not listed	LC
Yellow-legged gull	*Larus michahellis*	3	not listed	LC
Grey partridge	*Perdix perdix*	1	not listed	LC
Marsh harrier	*Circus aeruginosus*	1	endangered	LC
Common swift	*Apus apus*	1	not listed	LC
Common kestrel	*Falco tinnunculus*	1	not listed	LC
Mediterranean gull	*Larus melanocephalus*	1	vulnerable	LC
Calandra Lark	*Melanocorypha calandra*	3	endangered	LC

Six of the bird species identified as victims are not listed in the Red Data Book of Bulgaria. Two species are endangered, and one is vulnerable in Bulgaria but in the period of autumn bird migration all birds found during carcass searches are migrants and have to 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. All recorded victims were not among the target ISPB species. In the case of collision mortality monitoring in the ISPB, no case of collision with turbines of target bird species was identified in autumn 2018, 2019 and 2020.

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, and 2020 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, V. 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.V.13, 2 395-407

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 V. 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(4):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. M., Profirov L. A., Miche B.T., Hristov L. A., Ignatov A. L, Stoynov E. H. & Chipev N. H. 2018. Long-term Changes in Autumn Migration of Selected Soaring Bird Species at Burgas Bay, Bulgaria Acta zool. bulg., 70 (1), 2018: 57-68

Michev T., L. Profirov, K. Nyagolov, M. Dimitrov. 2011. The autumn migration of soaring birds at Bourgas Bay, Bulgaria. British Birds 104(1):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 (1), 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