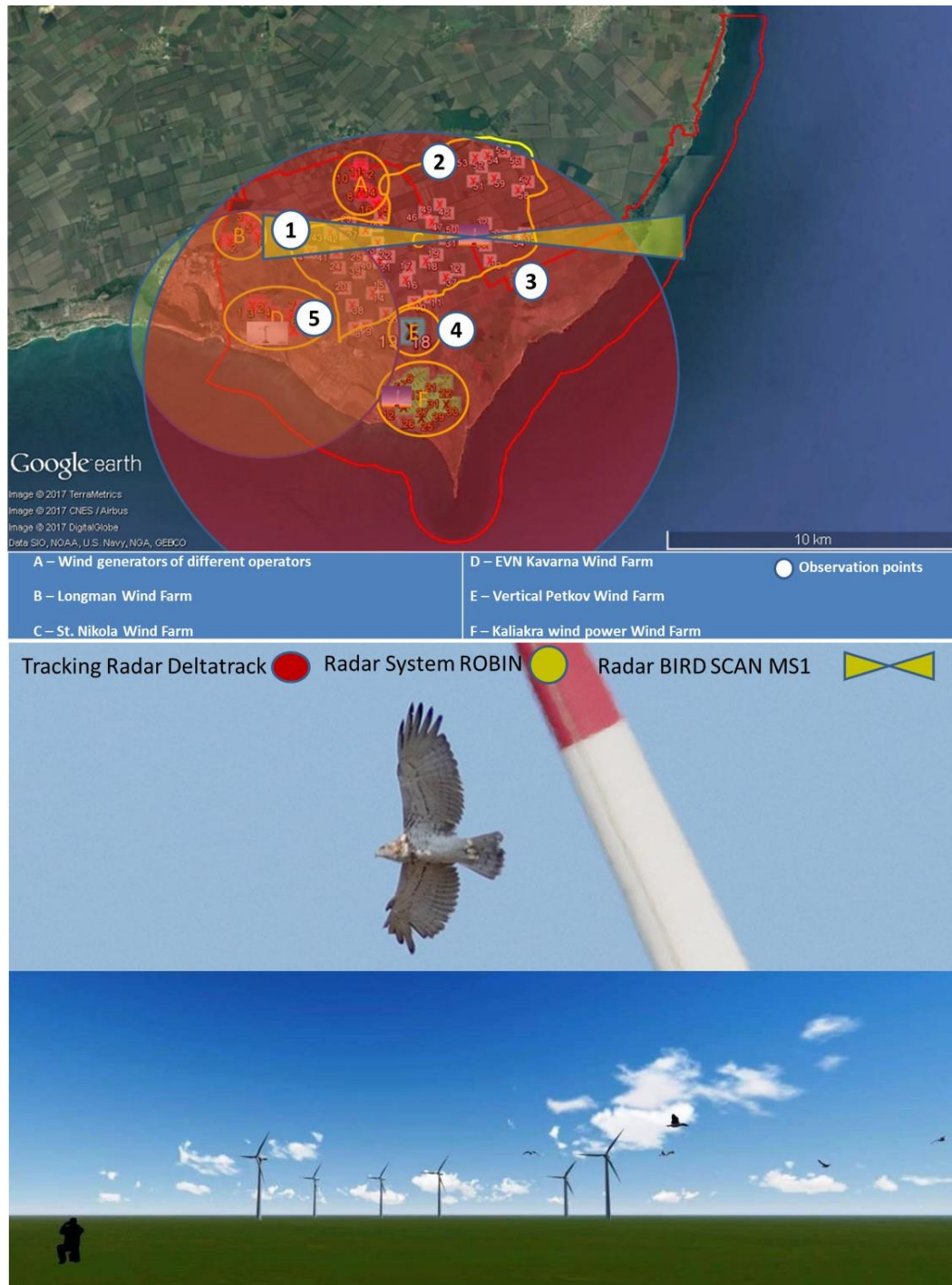


Summary of Activities and the Results of Ornithological Monitoring in 2022



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Introduction

The monitoring of SNWF in 2022 was a part of a more complex and widespread study assigned by the Wind farms, located in Kaliakra SPA BG0002051 - AES Geo Energy Ltd., Kaliakra Wind Power, 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, Millennium Group OOD. Effective of March 2018 the wind farms entered into agreement to implement and operate an 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.

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 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/>.

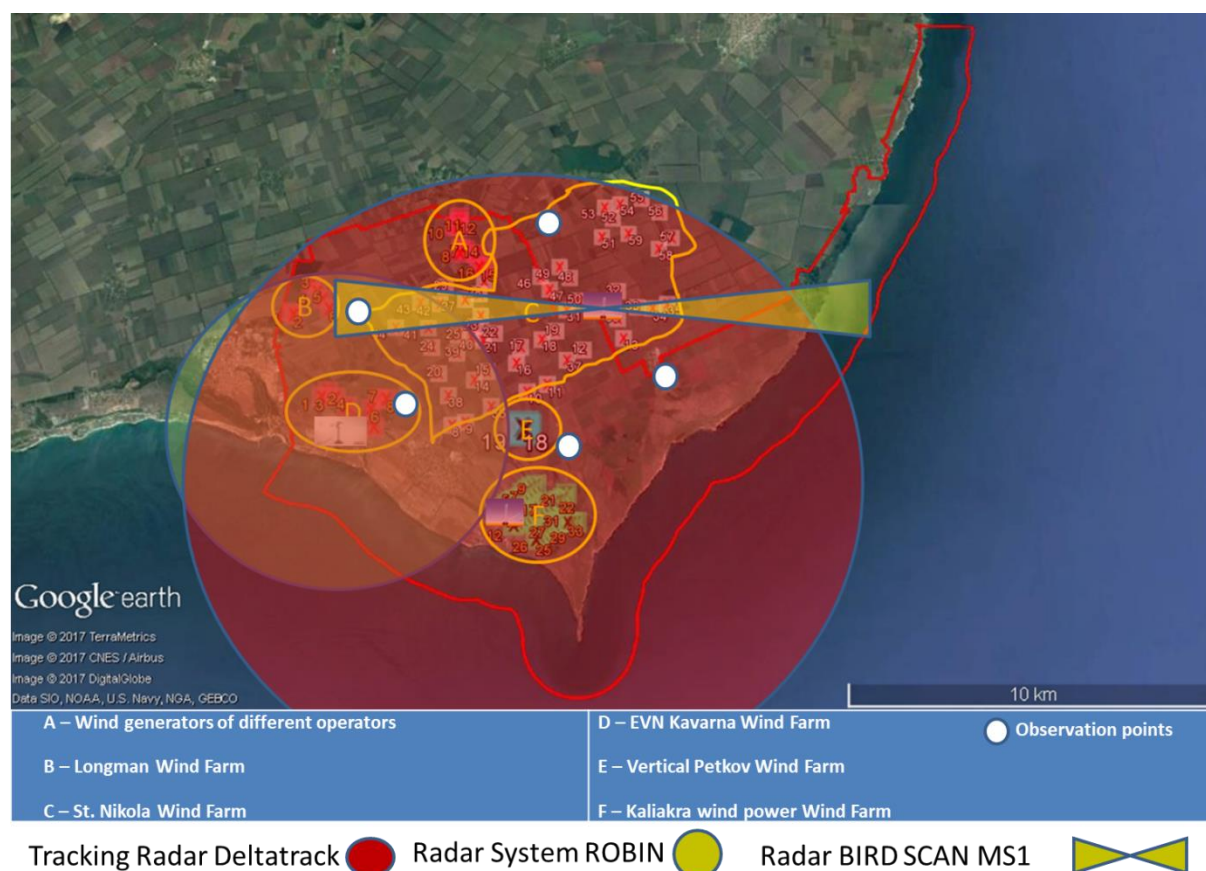


Figure 1. A satellite photo with the location of the wind turbines covered by the ISPB and the boundaries of Kaliakra SPA (shown by the red line), together with the scope of three radar systems.

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

In order to provide objective data for the bird risk assessment, this summary presents activities and results of the monitoring in 2022 with main focus on the territory of SNWF.

The activities were supervised and coordinated by Prof. Dr. Pavel Zehtindjiev - Senior Field Ornithologist with over 25 years of research in ornithology. Over 85 scientific publications in international ornithological journals. Member of European Ornithologists Union and several other conservation organisations. Winner of the Revolutionary Discovery Award for Ornithology of an American Ornithological Society in 2016 – The Cooper Ornithological Society. More than 10 years of experience in impact monitoring of wind turbines on breeding, migrating and wintering bird species in the region of Kaliakra.

Three types of radars integrated into the ISPB were used for monitoring and prevention of bird collisions:

Bird Scan MS1

The radar collects quantitative data and provides information about Migration Traffic Rate of birds through a specific sector where the fixed beam of the radar is directed (Figure 1). The quality of the data deepens on the distance to the birds and to the size of the migrating birds. In the case of ISPB the maximum distance we have used the Bird Scan MS1 radar is 10 km beam directed from west to east across the main migratory front of seasonal migrations. The data obtained by this radar system allow crude identification of ecological types of birds: for example, passerines, swifts, waders and large birds. The radar data do not allow quantification of bird migration for every bird species observed in the ISPB territory and therefore do not allow any comparison with visual observations.

These data are not used for quantification and analysis of the characteristics of migration.

Deltatrack Radar System

This radar is a tracking radar system which allows detection of a single target or group of targets and tracking of their movements in a range of around 5 km (Figure 1). It is used in the monitoring as a real time tool for the tracking of already (visually) identified bird targets in the ISPB territory. The radar is not applicable for quantitative analysis of bird migration.

Radar System Robin

This is a 3 D radar system constructed for detection and tracking of moving targets in air volume of around 10 km³ ([Robin Radar in EVN Kavarna](#)) (Figure 1). It is a real time tool for tracking of moving targets and in combination with visual observations in the field provides highly reliable data on the distance as well altitudes of birds already detected and identified by the field ornithologists. This radar does not provide quantitative data of migration at a species level because it does not allow species identification.

All three radar systems have been used as tools to assist field observations, detection of potential ingresses into the wind farms, and real time tracking of birds after visual observation through the ISPB during the period of monitoring.

All quantitative data and analysis of recorded bird numbers are based on the only possible quantification of bird migration of different bird species – the visual observations in the field. Locations of field observation points are presented in Figure 1.

Detailed descriptions of the technical characteristics of the three radar systems integrated within the ISPB are presented on the web site: <https://kaliakrabirdmonitoring.eu/Methodology>

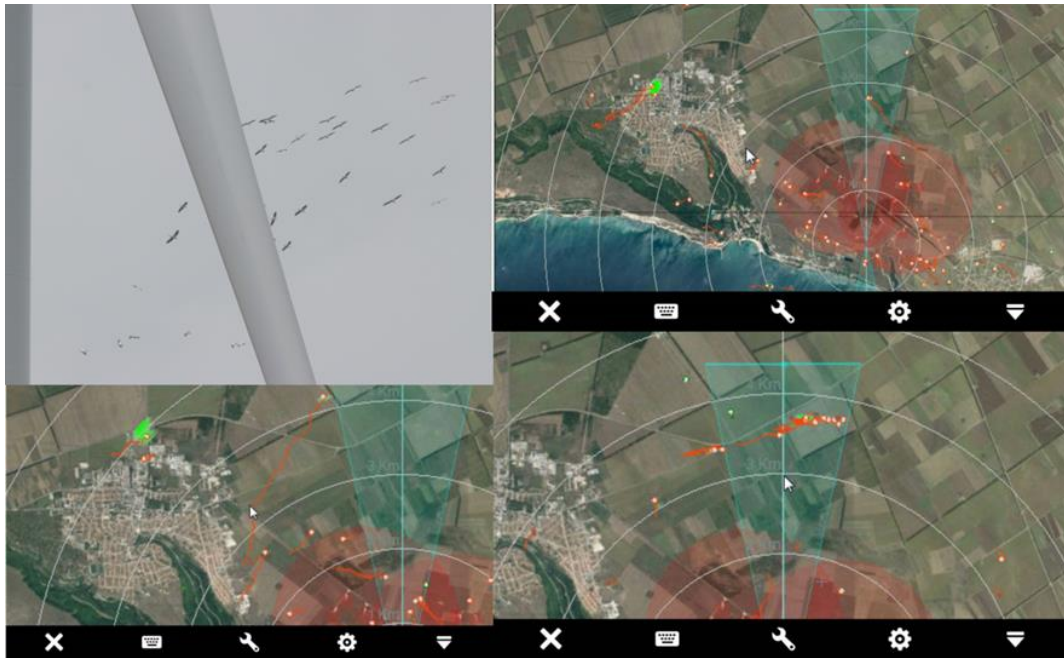


Figure 2. A flock of White pelicans: an illustration of the simultaneous records obtained by every ornithologist in real time information from Robin Radar System and visual observations. Every single bird and flock of birds from the target bird species were tracked by visual observations and the Robin radar simultaneously.

Results

Wintering geese monitoring 2021/2022

In total very low numbers of geese of all observed species were present in the ISPB territory during the winter 2021-2022. According to the coordinated counting of the wintering geese in Ukraine, southeastern Romania and Bulgaria, the numbers of the wintering geese is lowest in Bulgaria. (<https://bspb.org/en/over-500-000-greater-white-fronted-geese-counted-in-february/>)

No flocks of geese were observed in December 2021 and February 2022.

The reason for the relatively low number of wintering geese in Bulgaria in general was likely due to the exceptionally mild winter of 2021-2022. Detailed analyses of correlation between ambient temperature and number of geese in SNWF, and discussion of the role of temperature, are presented in a previous report for the same territory:

(www.aesgeoenergy.com/Winter_Report_2016-2017.pdf)

Spatial distribution of feeding geese

The flock of geese tracked and confirmed visually are presented in a map below (Figure 3). Due to the low number of wintering geese in this winter spatial analysis was not possible. In general, only one flock was observed in WNW part of the ISPB territory in winter 2021-2022. More detailed analysis of the feeding preferences of wintering geese in ISPB and SNWF as apt of the same territory are presented in previous reports available at the web site of ISPB (<https://kaliakrabirdmonitoring.eu/>).



Figure 3. Mixed flock of GWFG (*Anser albifrons*) and RBG (*Branta ruficollis*) (Green) observed during the monitoring period in winter 2021-2022 in ISPB territory (SNWF turbines are presented in purple).

Carcass monitoring results

All turbines of SNWF were searched every seventh day (if the areas under turbines were accessible) for carcasses during the whole winter survey period (01 December 2021 – 28 February 2022) when more birds were at risk of collision. The weather condition (ambient temperature, rain and snow coverage) which may have an impact on the frequency and results of the searches has been previously discussed in several winter monitoring reports available at: <http://www.aesgeoenergy.com/site/Studies.html>. The last wintering geese in SNWF are typically observed at the beginning of March; therefore, for surety of adequate coverage, the searches continued until the end of March. The actual frequencies of searches are presented in Table 1.

Table 1. Number of searches per turbine in the period 01 December 2021 – 31 March 2022.

Turbine	December	January	February	March	Total
AE10	3	4	4	2	13
AE11	3	4	4	2	13
AE12	2	3	4	4	13
AE13	2	4	4	3	13
AE14	2	5	4	2	13
AE15	2	5	4	2	13
AE16	3	4	4	2	13
AE17	3	4	4	2	13
AE18	2	3	4	4	13
AE19	2	3	4	4	13

Turbine	December	January	February	March	Total
AE20	2	5	4	2	13
AE21	3	4	4	2	13
AE22	3	4	4	2	13
AE23	3	4	4	2	13
AE24	2	5	4	3	14
AE25	2	5	4	3	14
AE26	3	4	4	2	13
AE27	3	4	4	4	15
AE28	3	4	4	4	15
AE29	2	5	4	3	14

Turbine	December	January	February	March	Total
AE31	2	4	4	3	13
AE32	2	4	4	3	13
AE33	2	4	4	3	13
AE34	2	4	4	3	13
AE35	2	4	4	3	13
AE36	2	5	4	2	13
AE37	2	3	4	4	13
AE38	2	5	4	2	13
AE39	2	5	4	2	13
AE40	2	5	4	3	14
AE41	2	5	4	3	14
AE42	2	5	4	3	14
AE43	2	5	4	3	14
AE44	2	5	4	3	14
AE45	3	4	4	4	15
AE46	2	3	4	4	13
AE47	2	3	4	4	13

Turbine	December	January	February	March	Total
AE48	2	3	4	4	13
AE49	2	3	4	4	13
AE50	2	4	4	3	13
AE51	2	4	4	2	12
AE52	2	4	4	2	12
AE53	2	4	4	2	12
AE54	2	4	4	2	12
AE55	2	4	4	2	12
AE56	2	4	4	2	12
AE57	2	4	4	2	12
AE58	2	4	4	2	12
AE59	2	4	4	2	12
AE60	2	4	4	3	13
AE8	2	5	4	2	13
AE9	2	5	4	2	13
Total	115	216	208	142	681

Systematic searches under 52 turbines in the period of 1 December 2021 – 31 March 2022 resulted in three intact carcasses which can be associated with collision with wind turbines. Details of the collision victims recorded in the SNWF during winter 2021-2022 are presented in Table 2.

Table 2. Collision victims in SNWF in winter 2021-2022.

Date	Latin name	Number of birds	Red Data book	IUCN
13.12.2021	<i>Sturnus vulgaris</i>	1	Not Listed	Least Concern
02.01.2022	<i>Accipiter nisus</i>	1	Endangered	Least Concern
23.01.2022	<i>Perdix perdix</i>	1	Not Listed	Least Concern

No body parts or intact remains of geese which could be considered as collision victims were detected after an accumulation of 681 searches under 52 turbines in the period December 2021 – March 2022. Therefore, no evidence for collision of any goose species, including RBG, has been found in the winter 2021 – 2022 when geese were potentially present, and turbines were operating.

There were no circumstances in the 2021-2022 winter which required the Turbine Shutdown System (TSS).

Experiment on the carcass removal rate: winter 2021-2022.

Such a winter trial at SNWF was first conducted in February 2010 using 25 domestic duck carcasses placed around five turbines. The results of the 2010 trial were confirmed in 2016 trial, despite the difference in the carcass species.

The new trial in winter 2021-2022 was performed in much larger territory and with larger number of habitats covered by ISPB. This study includes 2 plots of SNWF which is exclusively located in agrarian habitats where all the tested plots in current experiment are located too.

The test in winter 2021-2022 also confirmed that carcasses were apparently removed quicker in winter than in autumn: see several trial results reported in previous autumn monitoring reports: <http://www.aesgeoenergy.com/site/Studies.html>.

Table 3. Periodicities for scavenging or removal of carcasses in winter 2021-2022

Day after corpses disposal	AE39	AE41	E02	E04	M5	M6	Total number of chickens
0th day	5	5	5	5	5	5	30
1st day	4	1	5	4	3	5	22
2nd day	0	0	0	1	2	0	3
3rd day	0	0	0	0	0	0	0
4th day	0	4	0	0	0	0	4
5th day	0	0	0	0	0	0	0

The winter 2021-2022 experiment showed higher scavenging (or otherwise removal) rate of carcasses in the ISPB and SNWF respectively in comparison to those previously estimated in experiments conducted. It could be explained by the increased number of scavengers in the variable habitats which are included in the ISPB and SNWF as a part of this territory.

Taking into account the results of the searchers' efficiency which varied between 80 and 93 percent of the experimentally allocated dead chickens and a relatively higher scavenging rate, we have maintained a searching frequency of once per week on each of 114 turbines protected in the territory of ISPB in which significant part consist of SNWF. This frequency is the same as applied in previous monitoring periods in a part of the territory (SNWF) and allows comparison of the results in the long-term. Despite the higher scavenging rate discovered by the 2022 experiment we decided to keep the frequency of the searches at seven days. Practically, this allows coverage with the available resources of experienced ornithologists across all the 114 turbines included in ISPB and SNWF respectively. Even with increased scavenging rate, this frequency of seven days is also sufficient to allow the estimation of the 'real' mortality, via analyses noted later.

Additionally, to date there has been no indication of any target species' population being remotely affected by collision mortality, as revealed by the numerous weekly searches under all the turbines in last 4 years within the ISPB study area. An increased frequency of search effort may be suggested superficially by the winter 2022 trials with 30 chickens. That superficial indication, however, would only be valid if there was any substantive data from collision fatality data on which any potential search biases should or could apply.

To date, there are no indications of any substantive collision fatality estimates to which corrective factors through searcher efficiency or carcass removal could reasonably apply. In other words, correcting fatality-zeroes is analytically fraught, and will not contribute towards or much-alter the basic finding – undertaken with a relatively frequent search regime of 7 d under every turbine, with no individual of a target species being found as a collision casualty, to date.

Some may argue that there is some circularity in this view, such that if the basic search regime is insufficiently frequent to record collision fatalities of target species, then they will not be recorded. However, this argument can be dismissed in this programme because of the basic necessity for the number of fatalities which would have to be recorded to create an adverse population impact for the target species. The recording of such a fatality level is well within the

realms of the search programme to detect potentially adverse levels, and any potential biases (even if detection of fatalities may be lowered by the winter 2022 searcher/removal trial).

Conclusions: wintering geese 2021-2022

A relatively mild 2021 – 2022 winter is likely the main reason for the low number of observed only one flock of geese in close vicinity of SNWF territory. Daily observations from December 2021 to February 2022 (inclusive) revealed no records of geese in SNFW territory.

52 wind turbines of SNWF were not a source of collision mortality for wintering geese, even though they may frequently fly through or feed within wind farm territory. The evidence for this is that no remains of geese that could be attributed to collision with turbines were found during systematic searches under operational turbines not only in the 2021-2022 winter but also in any of the twelve winters when 52 turbines at SNWF (part of ISPB) have been operational and searched systematically every winter season.

Over several years, this evidence from SNWF consists of records of hundreds of thousands of geese flying through or feeding in SNWF (even though it is apparently not preferred habitat), and several thousands of searches under turbines to detect any strike casualties: no casualties have been found. It is beyond dispute that even the risk of collision mortality to wintering geese, of any species, presented by SNWF is remote in the extreme. Prospects of any possible adverse effect on geese populations through collision mortality are effectively zero.

No displacement (disturbance) reaction from geese has been observed for the period 2008-2022 as a result of construction and operation of wind turbines in the SNWF territory. Observed numbers of geese of all species as well as observed spatial distribution of flying and feeding geese does not indicate gross displacement from the operational turbines or its immediate environs. Wintering geese at SNWF do not apparently show mega-avoidance or even meso-avoidance (whole wind farm avoidance or turbine avoidance, respectively: May 2015: Biological Conservation 190, 179-187). Despite this lack of avoidance at such scales, they are clearly extremely capable of not being at risk of collision with turbine blades.

From research described in the present report and earlier SNWF surveys (see previous SNWF winter reports on <https://www.aesgeoenergy.com/site/Studies.html>) the area continues to be a feeding ground for RBG as well as GWFG, but it also remains an unimportant area for both species, as indicated in pre-construction studies. Consequently, and based on other studies, SNWF presents no material threat through preventing use of food supplies: especially in light of other agricultural practices such as crop type and field size of the preferred crop of feeding geese. Harrison et al. (2017) http://bspb-redbreasts.org/files/docs/1505998995_639.pdf documented avoidance of habitat by feeding geese with a small-scale loss around turbine bases. This “avoidance” could be due in part to the concrete bases of turbines and farmers’ reluctance to cultivate areas in their immediate vicinity, to reduce potential damage to their machinery. Hence, the avoidance could have been the shortage of anything to eat, rather than the turbines *per se*. Whatever the reason, these potential losses (which would be zero if the crop is not preferred by geese; and crop choice is under the farmers’ discretion) are dwarfed by the more serious consequences of agricultural crop practices, such as crop type, field size, field boundaries’ habitat, and losses to farmers’ decisions (Harrison et al. 2017, Petkov et al. 2017: European Journal of Wildlife Research DOI 10.1007/s10344-017-1119-0). The impacts of hunting through direct and indirect pressures are also probably more severe than any consequence of wind farms in the region.

Spring migration

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 days in spring 2022. For the survey period, a total of 3779 migratory and resident birds were registered in spring 2022 (Table 3).

Table 4. Number of registered birds of all ecological groups by day during the spring migration in the territory covered by ISPB

Period	Number of birds in Spring 2022
15-31 March	1490
1-30 April	996
1-15 May	1293
Total for the period	3779

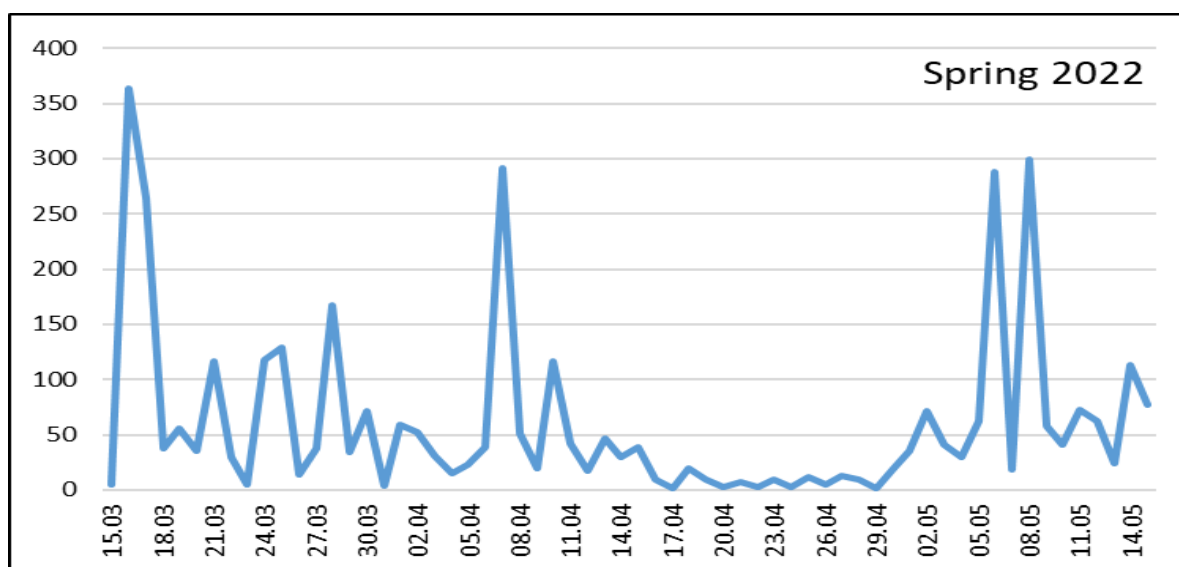


Figure 5. Dynamics of the spring migration of birds in the ISPB territory based on visual observations during the period 15 March - 15 May 2022

The variations in bird numbers were substantial within the spring seasons of migration covered by the current monitoring study (Figure 5). 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. In spring 2022 season the peak of migration was observed 10 days earlier on 16 March. The total number of observed birds in the ISPB territory in spring 2022, was over twice that observed in spring 2018, 2020 and 2021 and almost equal to the number of birds observed in spring 2019.

Table 5. Composition and number of registered bird species during the period 15 March - 15 May 2022 in the ISPB territory

Species name	Number of birds
<i>A. apus</i>	35
<i>A. arvensis</i>	52
<i>A. campestris</i>	4
<i>A. cinerea</i>	13
<i>A. gentilis</i>	4
<i>A. heliaca</i>	1
<i>A. melba</i>	20
<i>A. nisus</i>	10

Species name	Number of birds
<i>A. palustris</i>	1
<i>A. pomarina</i>	1
<i>A. purpurea</i>	2
<i>A. querquedula</i>	170
<i>B. buteo</i>	142
<i>B. oedicnemus</i>	8
<i>B. rufinus</i>	14
<i>B. stellaris</i>	2

Species name	Number of birds
<i>C. aeruginosus</i>	35
<i>C. brachidactylia</i>	9
<i>C. canorus</i>	13
<i>C. carduelis</i>	2
<i>C. ciconia</i>	39
<i>C. corax</i>	21
<i>C. cornix</i>	16
<i>C. cyaneus</i>	24
<i>C. frugilegus</i>	45
<i>C. gallicus</i>	7
<i>C. garrulus</i>	1
<i>C. hybrida</i>	12
<i>C. livia</i>	60
<i>C. macrourus</i>	2
<i>C. monedula</i>	27
<i>C. oenas</i>	56
<i>C. palumbus</i>	16
<i>C. pygargus</i>	5
<i>D. urbicum</i>	35
<i>E. calandra</i>	2
<i>E. melanocephala</i>	1
<i>F. coeleps</i>	21
<i>F. peregrinus</i>	1
<i>F. subbuteo</i>	6
<i>F. tinnunculus</i>	56
<i>F. vespertinus</i>	12
<i>G. cristata</i>	6
<i>G. grus</i>	1
<i>G. nilotica</i>	1
<i>H. rustica</i>	52
<i>L. arborea</i>	5

Species name	Number of birds
<i>L. canabina</i>	2
<i>L. colurio</i>	2
<i>L. michahellis</i>	187
<i>L. minor</i>	4
<i>L. senator</i>	1
<i>M. alba</i>	35
<i>M. apiaster</i>	223
<i>M. calandra</i>	9
<i>M. flava</i>	13
<i>M. migrans</i>	1
<i>N. arquata</i>	1
<i>O. isabellina</i>	7
<i>O. oriolus</i>	11
<i>P. apivorus</i>	2
<i>P. apricaria</i>	36
<i>P. carbo</i>	596
<i>P. colchicus</i>	2
<i>P. falcinellus</i>	2
<i>P. hispaniolensis</i>	2
<i>P. onocrotalus</i>	33
<i>P. porzana</i>	1
<i>P. pugnax</i>	3
<i>S. decapoda</i>	12
<i>S. rubetra</i>	1
<i>S. turtur</i>	6
<i>S. vulgaris</i>	1507
<i>T. erythropus</i>	1
<i>T. philomelos</i>	1
<i>U. epops</i>	10
Number of species	76

In total 76 bird species were observed in ISPB territory in the fifth spring season of study. The most numerous birds in spring migratory seasons in the region were Great cormorant (*Phalacrocorax carbo*), Common starling (*Sturnus vulgaris*) and some birds of prey – Common buzzards (*Buteo buteo*), Red-footed falcon (*Falco vespertinus*), Common kestrels (*Falco tinnunculus*) and Marsh harriers (*Circus aeruginosus*) (Table 5). During the spring migration monitoring 2022, 33 White pelicans (*Pelecanus onocrotalus*) were observed on the territory of ISBP, unlike observations in the 2020 and 2021 seasons, when only one white pelican was recorded.

Between 24 and 205 White storks (*Ciconia ciconia*) passed over the surveyed territory in the five 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 (<https://tethys.pnnl.gov/sites/default/files/publications/Shurulinkov-et-al-2012.pdf>), 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.

No stops of turbines were ordered under the Turbine Shutdown System (TSS) during the spring migration period of 2022. This was primarily because all the observed birds passing through the ISPB territory were outside the zone of the risk of collision with turbines.

In order to check the effectiveness of the ISPB to prevent collisions of spring migrating birds, each of all turbines of SNWF covered by the ISPB programme was checked at least once a week for collision victims. According to previously performed carcass removal and searcher efficiency tests during autumn migration and in winter at SNWF (and repeated in autumn 2018 and in winter 2022 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/>.

Table 6. Number of turbines searched for collision victims in SNWF during the period 15 March - 15 May 2022

Turbine	March	April	May	Total
AE10	2	5	2	9
AE11	2	5	2	9
AE12	3	4	2	9
AE13	3	4	2	9
AE14	2	4	3	9
AE15	2	4	3	9
AE16	2	5	2	9
AE17	2	5	2	9
AE18	3	4	2	9
AE19	3	4	2	9
AE20	2	4	3	9
AE21	2	5	2	9
AE22	2	5	2	9
AE23	2	5	2	9
AE24	2	5	2	9
AE25	2	5	2	9
AE26	2	5	2	9
AE27	3	4	2	9
AE28	3	4	2	9
AE29	2	5	2	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	3	9

AE37	3	4	2	9
AE38	2	4	3	9
AE39	2	4	3	9
AE40	2	5	2	9
AE41	2	5	2	9
AE42	2	5	2	9
AE43	2	5	2	9
AE44	2	5	2	9
AE45	3	4	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	2	4	2	8
AE52	2	4	2	8
AE53	2	4	2	8
AE54	2	4	2	8
AE55	2	4	2	8
AE56	2	4	2	8
AE57	2	4	2	8
AE58	2	4	2	8
AE59	2	4	2	8
AE60	3	4	2	9
AE8	2	4	3	9
AE9	2	4	3	9
Total	123	224	112	459

Two records of dead birds after collision with wind turbines were documented during the 2022 spring migration of birds in the SNWF part of ISPB territory (Table 7). No case of collision with the turbines of a target bird species for the period of TSS application in ISPB (including SNWF) was registered during the monitoring in spring 2022 (the target species are listed at [Target bird species](#)).

Table 7. Confirmed collision victims and species' conservation status as recorded during the 2022 spring migration period in SNWF territory

English name	Species name	Number of birds	Red Data Book	IUCN
Grey Partridge	<i>Perdix perdix</i>	1	Not listed	LC
Common Buzzard	<i>Buteo buteo</i>	1	Not listed	LC

Conclusions: spring migration

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 bird migration in NE Bulgaria.

The results of the monitoring confirmed the relatively low importance of the SNWF territory for migratory birds in spring and the absence of negative influence of the operating wind farms on bird populations during their spring migration.

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 wind turbines.

The data presented in this report confirmed the absence of any adverse impact on sensitive bird species of the order Ciconiiformes, Pelecaniformes, Falconiformes, Gruiformes using migratory ascending air flows (thermals) for movement over long distances.

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.

The quantitative characteristics of bird migration in the SNWF area during spring 2022, and the absence of mortality among the target bird species allows a continued conclusion that SNWF, as well as the other 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.

Autumn migration

During the autumn monitoring, observations were made during all 92 days of the season 2022 (01.08 - 31.10.2022).

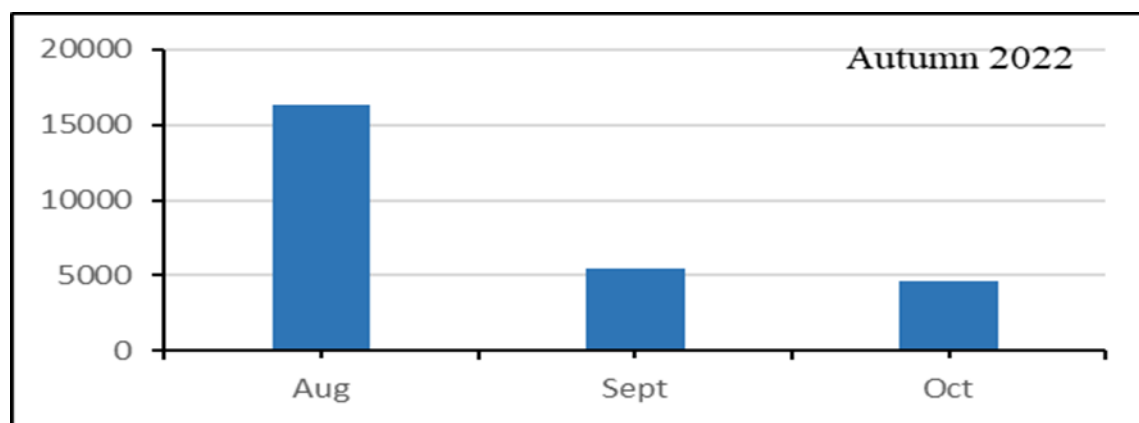


Figure 5. Number of registered birds by months during the autumn migration in the territory of ISPB.

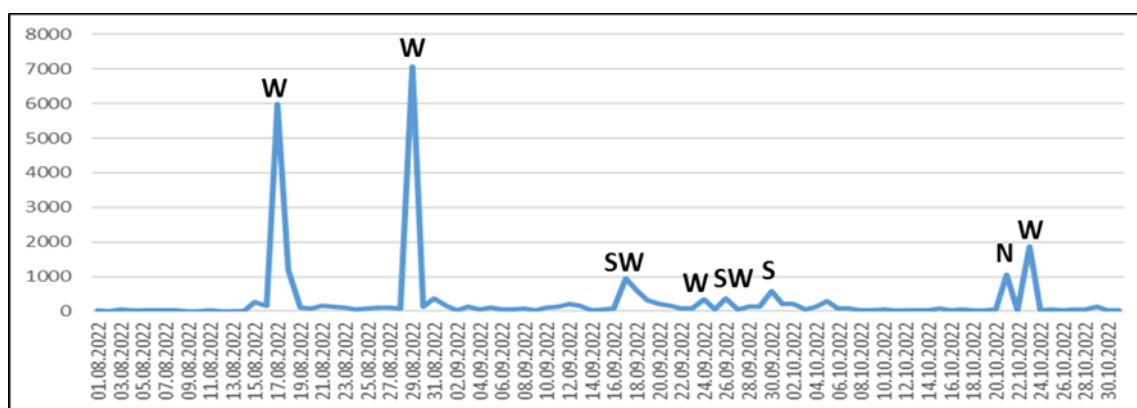


Figure 6. Dynamics of the autumn migration of the flying bird species in the ISPB territory according to visual observations during the period 01 August - 31 October 2022. Letters indicate the direction of wind in days with increased number of migrating birds.

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 SNWF which forms a major part of the ISPB territory (see reports <http://www.aesgeoenergy.com/site/Studies.html>).

The monitoring from 1 August to 31 October 2022 recorded 26437 individual birds, assigned to 48 bird species. The numbers of individuals recorded by species during autumn migration in 2022 are shown in Table 8.

Table 8. Composition of species and number of registered birds over the period 01 August to 31 October 2022 in the ISPB territory.

Species name	Number
<i>A. apus</i>	88
<i>A. brevipes</i>	175
<i>A. cinerea</i>	3
<i>A. gentilis</i>	9
<i>A. heliaca</i>	1
<i>A. nisus</i>	144
<i>A. otus</i>	1
<i>A. pennata</i>	31
<i>B. buteo</i>	720
<i>B. lagopus</i>	2
<i>B. rufinus</i>	35
<i>C. aeruginosus</i>	321
<i>C. ciconia</i>	14249
<i>C. clanga</i>	2
<i>C. corax</i>	15
<i>C. cornix</i>	21
<i>C. cyaneus</i>	11
<i>C. frugilegus</i>	119
<i>C. gallicus</i>	67
<i>C. garrulus</i>	8
<i>C. macrourus</i>	9
<i>C. monedula</i>	37
<i>C. nigra</i>	39
<i>C. oenas</i>	48

Species name	Number
<i>C. palumbus</i>	1002
<i>C. pomarina</i>	124
<i>C. pygargus</i>	53
<i>E. calandra</i>	57
<i>F. peregrinus</i>	1
<i>F. subbuteo</i>	55
<i>F. tinnunculus</i>	311
<i>F. vespertinus</i>	19
<i>G. fulvus</i>	2
<i>G. gallinago</i>	4
<i>G. grus</i>	18
<i>L. melanocephalus</i>	1800
<i>L. michahellis</i>	1119
<i>M. apiaster</i>	4375
<i>M. migrans</i>	30
<i>P. apivorus</i>	371
<i>P. carbo</i>	114
<i>P. crispus</i>	5
<i>P. haliaetus</i>	7
<i>P. leucorodia</i>	10
<i>P. onocrotalus</i>	695
<i>P. roseus</i>	102
<i>S. decaocto</i>	5
<i>S. turtur</i>	3

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 (*Buteo buteo*) and great white pelicans (*Pelecanus 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.

As a result of the simultaneous observations of five constantly attended observation points with assistance from three radar systems (Figure 1) during the whole period of the autumn migration, only one stop of two group of turbines in the territory of SNWF was ordered.

Table 9. Number of Turbine Shutdown System applications in autumn 2022.

Date	Wind Farm	Turbine code №/ Group	Species	Number of birds	Time stop	Time restart
17.09.2022	SNWF	E and F zones	<i>G. fulvus</i>	1	10:58:00	11:42:00

According to previously performed carcass removal and searcher efficiency tests during autumn migration and in winter at SNWF, a search regime of weekly searches provided for a cost-effective method, which can also be calibrated on the potential for missed carcasses, to discover any bird strike fatalities which may be of concern. Hence a frequency of four searches per month under every turbine allowed estimation of the mortality of the birds from a collision with the turbines. For details see previous studies on the same territory: <http://www.aesgeoenergy.com/site/Studies.html>

The total number of searches per turbine in SNWF is presented in Table 10.

Table 10. Number of checks for victims of collision in the territory of SNWF during the period 01 August-31 October 2022

Turbine	Aug.	Sep.	Oct.	Total
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

Turbine	Aug.	Sep.	Oct.	Total
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

Turbine	Aug.	Sep.	Oct.	Total
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

Turbine	Aug.	Sep.	Oct.	Total
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
Total	181	219	233	633

As a result of 633 searches under 52 individual turbines between 1 August and 31 October 2022, a total of five dead birds of five species were identified. The number of identified collision victims by species are given in Table 11.

Table 11. 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
Common buzzard	<i>Buteo buteo</i>	1	not listed	LC
Eurasian skylark	<i>Alauda arvensis</i>	1	not listed	LC
Great white pelican	<i>Pelecanus onocrotalus</i>	1	extinct species in Bulgaria	LC
Grey Partridge	<i>Perdix perdix</i>	1	not listed	LC
Yellow-legged gull	<i>Larus michahellis</i>	1	not listed	LC

Four bird species identified as collision victims are not listed in the Red Data Book of Bulgaria. One species is listed in Bulgarian Red Data Book – Great white pelican. It is an extinct breeding species in Bulgaria according to Bulgarian Red Data Book. In the period of autumn bird migration any birds found during carcass searches are very likely to be 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 classifications 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 ISPB area which includes SNWF, 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 10 several previous years of monitoring undertaken at SNWF, before the ISPB has started see: <http://www.aesgeoenergy.com/site/Studies.html>.

Conclusions: autumn migration

During the monitoring, there were no apparent changes in the main characteristics of the ornithofauna typical for the autumn migration in the whole country and the specific characteristics of the species composition and phenology of bird migration in NE Bulgaria.

The results of the monitoring confirmed the relatively low importance of the SNWF territory (including SNWF) for the migratory birds in autumn and the absence of negative influence of the operating wind farms on bird populations passing through the SNWF during their autumn migration.

The migration periods, the species composition, the dynamics in number of birds, the daily activity, the elevation of 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 wind turbines in autumn migration period.

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.

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 period of autumn migration.

The quantitative characteristics of bird migration in the SNWF area during autumn 2022, 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.

List of participants in the observations

➤ 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.

➤ **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. Over 10 years of experience in impact monitoring study of wind turbines in the study area

➤ **Svetoslav Stoyanov - Field ornithologist**

Bachelor in Biology diploma from Shumen University. Participant in numerous conservation projects of BSPB – BirdLife Bulgaria. Midwinter counts of waterfowl birds in Bulgaria and 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 - Field ornithologist**

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

➤ **Boyan Michev - Field ornithologist**

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.

➤ **Vasil Panayotov Dimitrov - Field ornithologist**

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

➤ **Aleksandar Nedialkov Petkov - Field ornithologist**

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