Report:

The bird migration monitoring in the AES Geo Power Wind Park territory, Kaliakra region in autumn 2008

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Contents

Summary

This report comments on the results of one month study and studies performed earlier with the scope on the impact of a proposed wind farm on migrating birds. In addition, the available data were used to set up a priority list for the species involved. The reports on the field studies 2003 – 2007 are not sufficient, mainly with respect to the spatial and temporal aspects of migration. There is a mismatch in the overall numbers of species passing through the territory offered by the scientist from Bulgarian Academy of Sciences (Nikolay Karaivanov) and BSPB (Bulgarian BirdLife partner). Taking all preliminary available information into account, a standardized systematic monitoring has been planned and performed in autumn 2008.
Simultaneous observations in 8 locations through the planned AES Geo Power wind park provided full coverage of the territory. The data collected allowed special and temporal analyses of the soaring bird migration as well as the usage of the territory by the feeding migrants and local birds. The simultaneous observations through the territory allow to test different mitigation schemes in order to reduce the collision risk for the birds during the exploitation period of the wind park.

INTRODUCTION

The birds are known to be one of the most movable groups of animals. This characteristic of the birds determines the whole evolution of the group. In this relation all studies related with the birds including the present one must concern the fact of the large-scale processes underlain in the base of the bird life. Bird migration is an adaptation for the leaving in a larger area where at least during the part of the time environmental conditions are not suitable for the certain species.

Relation of the birds to thye space is a source for many fundamental questions in the Evolutionary Ecology and in the Ornithology. In particular the distribution of the migrants through the certain territory of the Bulgarian Black See Coast and their altitudinal distribution known as VIA PONTICA are of primery interest for the development of wind power industry in the region.

Seasonal migration of birds is an adaptation of the species to the changing environment. This is a solution for the increase if the breeding ranges into the territories with harm conditions. By definition it is a permanent process of adaptation to the changing environment. In the process of adaptation birds developed morphological and physiological structures enabling long distance flights between breeding ranges in the temperate zone and wintering areas in the tropics and subtropics. This adaptation exist over 100 mln years and enabled the birds to survive the global climatic changes.

There are over 400 species of birds in Bulgarian fauna. Out of 80% of all these species are Passeriformes. Passerine birds fly at night mainly, at altetudes over 500m in average in a wide front with no visible concentrations. These birds are majority of the birds in the studied territory of the AES GeoPower Wind Park. The rest 20 % of birds are soaring birds. These birds use the lifting warm air currents for a special kind of flight – soaring. This is an energy saving way of flying, in which the birds rise without moving their wings allowing the air currents to lift them high up, after which they undertake a direct flight straight ahead, covering a great distance and gradually loosing height until they reach another thermal. The conditional group of soaring birds includes the pelicans, storks, diurnal raptors and cranes, although some raptor species and the cranes fly mainly in an active manner (waving their wings). There are data, pointing to the guiding role of the Black Sea coast known as *Via Pontica* (Zalles & Bildstein, 2000). All these species also fly through the territory of the whole country and can be observed at the fields everywere during the seasonal migrations in spring and autumn. It is crutial that at the border between the ground and woter bodyes, Black See Coast, in the particular, there is an difference in the air temperature. This difference limit the flight abilityes of the soaring migrants and lead the birds along the coastal lines. These guiding lines are known as migratory fly ways.

In NE–Bulgaria close to the Black Sea coast AES Geo Energy OOD plans to set up a wind farm consisting of 60 turbines. The designated area is within the general flyway of many migratory bird species, called the "Via Pontica Flyway". In the last 3 years, several field studies have investigated the spatial and temporal distribution of the migratory and the breeding birds within this area (see below).

With a view to providing the most objective possible data for evaluation of the risk for the birds this study aim at qualitative and quantitative information about the characteristics of the autumn migration of birds through the territory of planned wind park.

2. The study area

The proposed area for the wind farm is located in NE Bulgaria, close to the Black Sea coast near the cape of Kaliakra. The designated area lies between the road from the village of Bulgarevo to St. Nikola (municipality of Kavarna), and the 1st class road E 87 Kavarna – Shabla (Map 1).

The territory of the proposed construction site consists mainly of arable land with different crops (wheat, sunflower, flax), intercepted with roads and shelter belts. The area including are outside 2000 site Kaliakra.

METHODS

Duration, methods and equipment

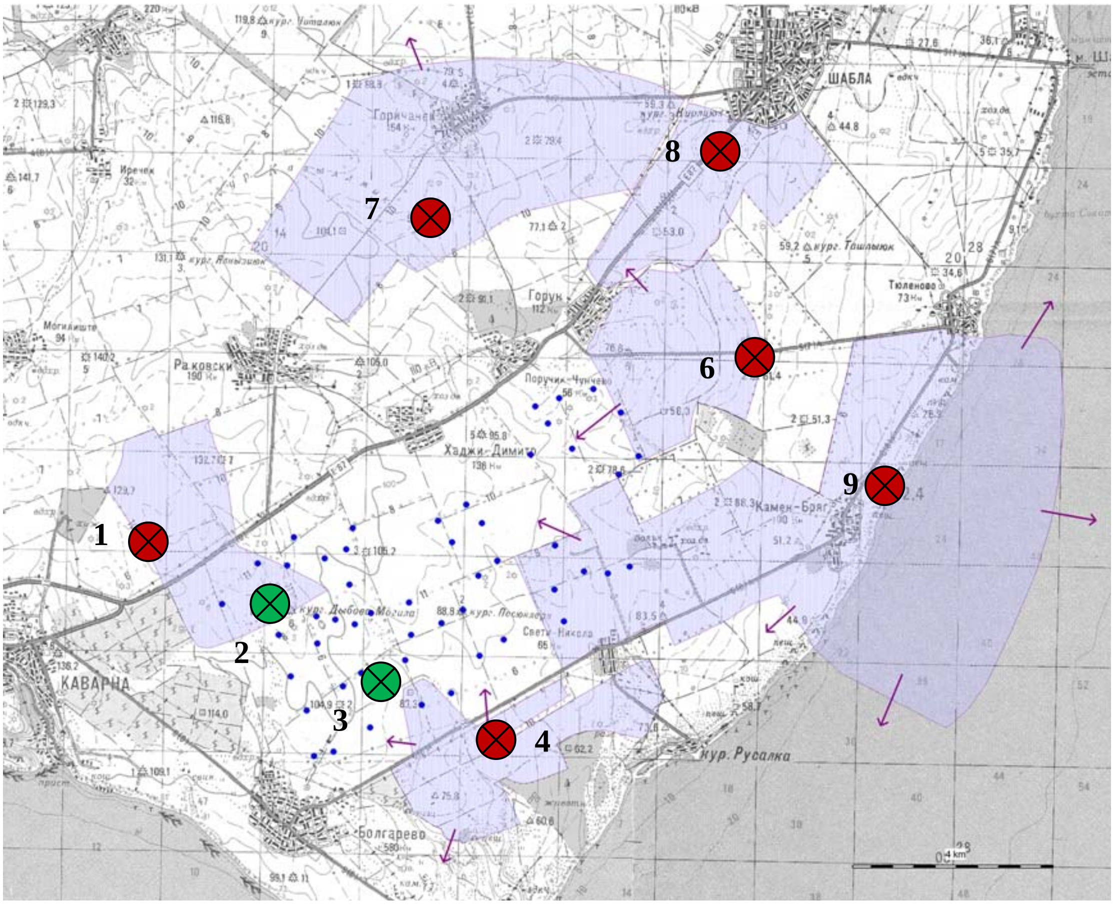
The study was carried out in the period 15 August – 15 September 2008, covering a total of 30 days, the period of the most intensive migration according to the preliminary information (5 years regular monitoring of the site). Therefore our study provide representative sample with the needed for the our goal significance.

The surveys were made during the day, in standard interval of time between 8 AM and 6 PM Astronomic time.

For the purpose of this study the birds were conditionally grouped in "soaring" and "non-soaring" ones. The first group, according to the generally acknowledged practice, included pelicans, storks, cranes and all the diurnal raptors, although some of them fly mainly in the active manner. The second group of the non-soaring birds included all the other species.

This conditional division was made to allow for focusing the study mainly on the birds of conservation importance like pelicans, storks and diurnal raptors. Data about the other (non-soaring) species were collected as a second priority, as specified in the text below.

Map 1. *Location of the plot of the planned wind energy generators (blue dots) and the observation points (red andgreen dots). The arrows indicate the observation directions available from the certain point. The gray surface of the map indicates the coverage of the certain observation point.*



The study involved direct simultaneous visual surveys of the all passing birds from 6 constant stationary points (red dots Map 1) and 2 temporal points (green dots Map 1). Although effective in terms of results and expenses, the visual method on its own cannot encompass the whole migration over a certain region (Kerlinger, 1989). That is why the results where extrapolated according to the maximal distance in which the species have been recorded during the period of the observations. The overall number of birds per species was obtained by multiplying the number of individuals to the

number of points theoretically needed, for certain species, to cover the whole territory. Obtained density of migrants was used in the further analysis.
Field observations followed the census techniques according to Bibby et al. (1992). Point counts were performed by scanning the sky in all directions. Height estimates and distances to the birds were verified with land mark constructions nearby the observation points preliminary measured and calibrated by GPS.
All observers are qualified specialists carrying out the surveys of bird migration for many years. All observers are active members of the BSPB (BirdLife Bulgaria). In the observations took part an Austrian volunteer, Martin Rossler whose advises and practical help in the observations we highly appreciate.
List of participants in the observations:

Dimitar Vladimirov Dimitrov
PhD student in Institute of Zoology , BAS,
Member of the BSPB since 2000

Victor Metodiev Vasilev
Senjor researcher in the facultity of Biology
University of Shumen, Bulgaria
Member of BSPB since 1992

Dr. Mihaela Nikolova Ilievaна
Junior Resercher in Institute of Zoology, BAS
Member of BSPB since 1999

Ivailo Antonov Raykov
Museum of Natural History, Varna
PhD student,
Member of BSPB since 1999

Veselina Ivanova Raykova
Museum of Natural History, Varna
Researcher
Member of BSPB since 1999

Svetla Yordanova Zehtindjieva
Geologists, many years ringing experience

DI Martin Rossler
Work for the winfd parks in Austria
Sargfabrich, Vienna, Austria

In order of higher standardization in the evaluation of the altitude and distance of flying birds a three day seminar in the field was carried on before the observations.
The surveys were carried out by means of optics, every surveyor having a pair of binoculars with magnification 10x. Observation points were permanently equipped with standard Admiral telescopes with magnification 20 – 60x, compass, GPS and digital camera.

All preconditions, location of the observation points, methods and experience of the observers were inspected by two experts from RSK Ecological in prior of the observation period.

Types of data and recording

During the surveys special attention was paid to recording the following types of data:

- Species of the birds;
- Number of birds;
- Distance of the flying birds;
- Altitude of the birds;
- Direction of the flight;
- Behavior of the birds concerning existing wind farm constructions;
- Other behavioral observations;
- Physical factors of the environment, influencing the migration of soaring birds and the surveys' objectivity.

Species of the birds

All the soaring birds, flying in the surveyors' scope of view were identified to the level of species, if possible, and recorded.

The characteristics of gender (male or female) and age (ad., subad., imm., juv.) were also identified and recorded for certain species when the conditions allowed this.

Because of the difficult distinguishing between similar species in harsh conditions (ex. bad visibility, great distance, etc.), if exact identification was not possible both possible species were written down (ex. *Aquila pomarina / clanga* or *Aquila clanga / pomarina*, depending on which of the two species was more probable).

In certain cases when it was not possible to identify the bird of prey species, the bird was referred to the lowest possible taxonomic category (genus, ex. *Circus sp*.). When the conditions did not allow any further identification of the bird of prey it was written down as a NBP (non-identified bird of prey).

Additional data concerning species composition of non-soaring birds we collected by mist nets located during the study in one of the observation points. All birds were ringed and measured according to the SEEN standards (Busse 2000).

Quantity of the birds

The surveyors counted all the migrating soaring birds, flying in their scope of view, regardless of the possibility to distinguish their species or higher taxonomic category (as described in the previous point). When the data were recorded single birds (or pairs), as well as formed flocks, were recorded with their size (number of birds) and species composition. In the cases of more numerous flocks (ex. of the White Stork *Ciconia ciconia*), when the counting of every single individual was impossible, groups of 5 or 10 birds were counted at a bulk after the flock starts planning to the next thermal.

Extrapolation of the small passerine birds and soaring birds wich are visible in a maximal distance less then distance between the observation points (2500m) was done by the following formula:

$$N= (Nt/Np) * (10000/Dmax)$$

Where N is extrapolated total number, Nt is registered total number of birds, Np – number of observation points (in the case of our study it is 6), Dmax – maximal distance the species is registered, 10000m – is the front of planned wind park territory witch birds should theoretically cross following the main migratory direction.

Distance (horizontal and vertical) of the flying flocks and single birds' trajectories

Along with establishing the quantitative character of the migration of soaring birds, defining the relative distance of the flying birds or flocks' trajectories was among the most important tasks of the study.

Preliminarily chosen field marks were used for identifying the relative horizontal distance of the flying birds from the watch point. The distances to the field marks were measured in advance in the field or by applying the topographic map. The distance from the observation point was taken down individually for each bird or flock.

The flight altitude from the level of the plateau of every single bird or flock was defined and recorded.

Flight direction

The direction was designated by pointing out the geographic direction to witch bird is going with respect to the watch point. In defining the geographic direction 16 possible designations of the relative geographic directions have been used (every designation being limited to 22,5 degrees). The accepted 16 designations are as follows: N (north), NNE (north-northeast), NE (northeast), ENE (east – northeast), E (east), NSE (east – southeast), SE (southeast), SSE (south – southeast), S (south), SSW (south – southwest), SW (southwest), WSW (west – southwest), W (west), WNW (west – northwest), NW (northwest), NNW (north – northwest). The flight direction was recorded individually for every single bird or flock. In the data base direction of the bird is given in degrees.

The mean angles as well as its significance level, for every species and group of species were calculated according to standard circular statistics (Batschelet 1981).

Photo 1. *A view of one of the observation points and land marks used as reference when defining the birds' flight altitude*.

To facilitate the defining of the flight direction a geographic compass and GPS device vas provided for every observation point.

Physical factors of the environment, influencing bird migration and the surveys' objectivity

Some of the physical factors, definitely influencing the migration of birds and the surveys' objectivity were taken into account:

- Wind direction;
- Wind strength;
- Air temperature;
- Cloudiness;

- Rainfalls;
- Visibility.

The direction and strength of the wind as well as temperature were precisely measured by the AES Geo Energy and kindly offered for the further analysis.
The cloudiness was recorded as a relative part (in %) of the visible part of the sky.

Visibility should be understood as the maximum distance at which lasting geographic markers can be seen. It was defined and recorded in meters. The data were taken down every morning with the start of the surveys, at every full hour, in the evening, as well as any time a more considerable change in the visibility occurred. The presence of factors, like fog, mist and other phenomena deteriorating the visibility was also taken into account.

Behavior of the birds concerning existing wind farm constrictions and other behavioral observations
This category of data includes surveys on the birds or the environment, relevant to the potential impact of the wind turbines on the birds. Such are, for instance, the avoidance behavior. These were recorded and described in details. Additional notices concerning feeding and resting activities of birds were recorded.

Recording of the data
All the data of the surveys were entered in a diary. The data were processed daily and entered in a *database* designed in a excel workbook. The protocol of primary data processing is an modified version of the Protocol of risk and bird mortality, used by the National Laboratory for Renewable Energy Sources of the USA (Morrison, 1998).

The diary was kept in the following manner:

1. In the morning, with the start of the surveys, the date and the exact hour were entered (the data were recorded by the astronomic hour, which is 1 hour behind the summer hour schedule, during the whole period of the study), as well as the values of the physical factors of the environment (as described above) and the names of the surveyors.
2. When observing a migrating bird or flock, first the exact hour and minute was taken down, the species, genus or family Latin name, (gender and age, if possible), then the numbers, the vertical and horizontal distance from the watch point, the flight direction. After these obligatory data additional ones, like soaring, “chimney” formation of flocks, landing birds with the exact location of landing, etc., were also recorded.

   Meanwhile, if changes in the values of the physical factors of the environment or other interesting and/or important phenomena should be registered, they were also entered in the diary with the exact hour of the observation.

3. In the evening, when closing the surveys, the exact hour, the values of the physical factors of the environment and the names of the surveyors were taken down again.

RESULTS

The 30 days of the study covered the main period of the autumn migration of soaring birds and part of the non-soaring bird migration. The study encompassed 270 astronomic hours of observations in 8 observation points.

Total number of observed birds species and their numbers

A total of 54866 birds were registered through the territory. 52910 of the registered birds were identified to the species level. In total 84 species of birds were established. The overall number of passing through the territory birds or birds using the territory during the autumnal migration is larger as many species we registered are visible on a distance smaller then the distance between the observation points. To obtain at least raw numbers for the bird species we were not able to count directly we have extrapolated the available data on the whole front of the studied territory i.e. approximately 10000m (Table 1).

Table 1. The number of birds

N	Species	registered bird	maximal distance of registration	Extrapolated number of passing through the territory number of birds
1	*A. apus*	108	400	450
2	*A. brevipes*	95	1000	158
3	*A. cinerea*	120	2000	100
4	*A. gentilis*	10	800	21
5	*A. heliaca*	2	2500	2
6	*A. melba*	620	700	1476
7	*A. nisus*	44	800	92
8	*A. pomarina*	44	2000	44
9	*A. trivialis*	5	50	167
10	*B. buteo*	146	2000	146
11	*B. rufinus*	163	2500	109
12	*C. aeruginosus*	327	2500	327
13	*C. carduelis*	38	30	2111
14	*C. chloris*	7	50	233
15	*C. ciconia*	2648	3500	2648
16	*C. coccothraustes*	10	50	333
17	*C. corax*	2	700	5
18	*C. cornix*	3	700	7
19	*C. coturnix*	3	400	13
20	*C. cyaneus*	5	400	21
21	*C. frugilegus*	3	40	125
22	*C. gallicus*	29	1500	32
23	*C. livia f.d.*	17	600	47
24	*C. macrourus*	8	1000	13
25	*C. monedula*	14	200	117
26	*C. nigra*	8	2500	8

27	*C. palumbus*	10	350	48
28	*C. pygargus*	32	800	67
29	*D. major*	7	30	389
30	*D. urbica*	1635	300	9083
31	*E. hortulana*	1	50	33
32	*F. coelebs*	8	30	444
33	*F. eleonorae*	7	800	15
34	*F. naumanni*	1	500	3
35	*F. parva*	2	50	67
36	*F. subbuteo*	48	1600	50
37	*F. tinnunculus*	138	1500	153
38	*F. vespertinus*	11	800	23
39	*G. glandarius*	42	1000	70
40	*H. daurica*	13	50	433
41	*H. icterina*	1	50	33
42	*H. pallida*	3	30	167
43	*H. pennatus*	4	1500	4
44	*H. rustica*	14378	500	47927
45	*J. torquila*	1	50	33
46	*L. argentatus*	10	150	111
47	*L. cachinnans*	681	1500	757
48	*L. collurio*	58	30	3222
49	*L. minor*	12	120	167
50	*M. alba*	16	100	267
51	*M. apiaster*	11079	700	26379
52	*M. cinerea*	3	50	100
53	*M. flava*	2182	200	18183
54	*M. migrans*	18	800	38
55	*M. striata*	24	30	1333
56	*Mel. calandra*	7	140	83
57	*Num. arquata*	1	100	17
58	*O. isabellina*	8	50	267
59	*O. oenanthe*	4	30	222
60	*O. oriolus*	68	50	2267
61	*O. pleschanka*	2	50	67
62	*P. apivorus*	58	2500	58
63	*P. caeruleus*	5	30	278
64	*P. crispus*	4	2500	4
65	*P. onocrotalus*	120	2500	120
66	*P. haliaetus*	15	1200	21
67	*P. leucorodia*	74	2500	74
68	*P. major*	24	30	1333
69	*P. perdix*	8	50	267
70	*P. pica*	25	600	69

71	*P. viridis*	3	50	100
72	*Ph. carbo*	417	7000	99
73	*Ph. collybita*	8	30	444
74	*Ph. trochilus*	18	30	1000
75	*Pl. falcinellus*	5	2000	5
76	*R. riparia*	9614	300	53411
77	*S. communis*	8	30	444
78	*S. curruca*	1	50	33
79	*S. vulgaris*	7333	5000	7333
80	*Sax. rubetra*	7	160	73
81	*Str. decaocto*	4	250	27
82	*Str. turtur*	152	500	507
83	*T. merula*	2	50	67
84	*U. epops*	11	60	306
In total		52910		187400

Total number of the observed soaring birds

The established number of individual soaring birds was 4156. This number reflected in a amount of 6071 extrapolated bird/10 km front of the park, belonging to 2 pelican species, 5 stork, heron and ibis species, 20 diurnal raptor species – a total of 27 species. The most numerous of them are the White Storks (*Ciconia ciconia*) 2648. The second numerous group is the pelicans – 124 individuals, of them 120 White Pelicans (*Pelecanus onocrotalus*) and 4 Dalmatian Pelicans (*Pelecanus crispus*). The established diurnal raptors amount to 1185 birds reflected in extrapolation of total 1421 raptors through the territory. The proportions of the systematic groups of birds through the soaring migrants are presented in figure 2.

3% Pelicaniformes (Pelicans)

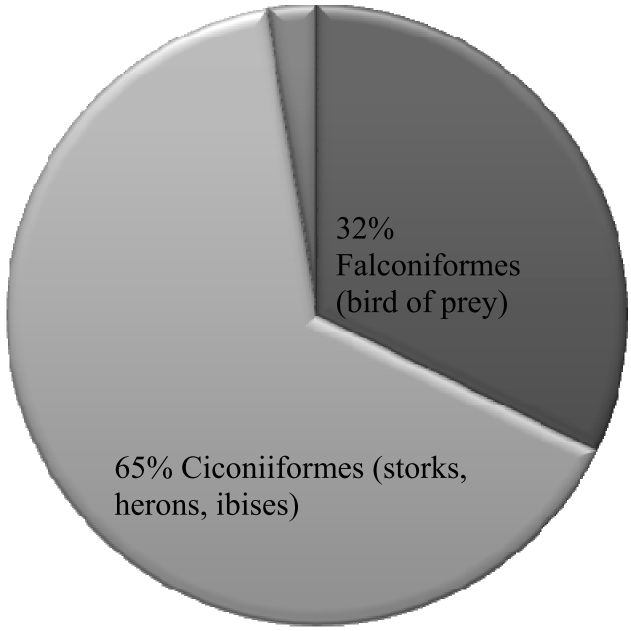


Figure 2. *Proportion of the different groups of registered soaring birds*

Spatial distribution of the birds regarding the planned wind park

Soaring birds

Despite of the fact that the soaring birds comprise only 3,2% of birds using the territory of the wind park, the significance of their altitudinal distribution is of primary importance for the collision risk assessment.

Concerning the vertical distribution 23% have passed through the risk zone between 0 and 150 m and 77% – above 150 m (*Table 2*).

Table 2. Vertical distribution of the soaring bird species

Species	Proportion of birds below 150 m above the ground	Proportion of birds above 150 m above the ground
A. brevipes	52%	48%
A. cinerea	17%	83%
A. gentilis	50%	50%
A. heliaca	0%	100%
A. nisus	72%	28%
A. pomarina	49%	51%
Accipiter sp.	43%	57%
Ardea sp.	0%	100%
B. buteo	62%	38%
B. rufinus	76%	24%

Buteo sp.	78%	22%
C. aeruginosus	68%	32%
C. ciconia	8%	92%
C. cyaneus	80%	20%
C. gallicus	45%	55%
C. macrourus	50%	50%
C. nigra	13%	88%
C. pygargus	59%	41%
F. eleonorae	100%	0%
F. naumanni	100%	0%
F. subbuteo	81%	19%
F. tinnunculus	95%	5%
F. vespertinus	73%	27%
H. pennatus	75%	25%
M. migrans	28%	72%
P. apivorus	41%	59%
P. crispus	0%	100%
P. haliaetus	40%	60%
P. leucorodia	0%	100%
Pl. falcinellus	0%	100%
P. onocrotalus	0%	100%
Grand Total	**23%**	**77%**

Of all the observed white and black storks only 8% and 13% respectively were registered at the level below the height of the turbines (150m). In vertical respect 92 and 88% of the white and black storks respectively passed in the safety zone much higher than the turbines range (*Table 2*).

The all registered pelicans (even in such low number) passed through the territory much higher than the critical 150m. The only registered flock of white pelicans was at 250 m above the ground. The 4 individuals of dalmatian pelicans were at 200 m above the ground.

Compared to the storks and pelicans, the percentage of diurnal raptors that have crossed the vertical zone of high risk is the highest – 66%. The main reason for the higher risk in raptors is the feeding behavior registered in high percent of the birds.

In respect of the horizontal distribution of the birds we have tested general linear model (ANOVA) in order to find any relations between the observation points. The results show a random distribution of the registered soaring birds i.e. there is no special concentrations of migrants through the territory of the wind park.

Non-soaring birds

Non- soaring birds represent majority of the registered (and extrapolated also) birds at the studied territory (96.7%). The spatial distribution of these species is highly dependent on the habitats available in the territory. Most of these bird species migrate at the night at high altitudes in a large front. The term “migratory way” is not applicable concerning these bird species.

Majority of passerine birds use vegetation in the shelter-belts and are not exposed to the collision risk.

The most common birds in the space of the wind park are migrating bee-eaters, swifts and swallows (Table 1). Most numerous is barn swellow with extrapolated number of 47927 individuals using the studied territory. The second most numerous species non-soaring migrant is bee-eater with 26379 individuals in the studied territory. Sand martin is in the third place with over 9000 birds inhabiting the territory during autumn migration of the species (Table1).

Altitudinal distribution of swallows, bee-eaters and swifts is presented in Table 2. The maximal distances at which the bee-eaters, swallows and swifts are able to be registered are respectively 700, 500 and 400 meters respectively. This limit of the direct observations influences the results concerning these species. It is known from the literature that they can fly much higher than our registration method can reach. In this sense the present result is not reliable concerning altitudinal distribution of these species.

Despite of the high numbers of these species, mainly feeding in the territory, the observations of the behavior show 100% avoidance concerning already existing wind turbines.

Table 2. Altitudinal distribution of non-soaring birds

Species	**Proportion of birds below 150 m above the ground**	**Proportion of birds above 150 m above the ground**
A. apus	85%	15%
A. melba	96%	4%
D. urbica	100%	0%
H. daurica	54%	46%
H. rustica	94%	6%
M. apiaster	82%	18%
R. riparia	100%	0%
Grand Total	93%	7%

Direction of the migration

We analyzed the main direction of migrating birds in order to understand the spatial and temporal distribution of the birds during the outumn migration as well as the way they use the territory. This information is obligatoryf for an efficient exploitation monitoring and mitigation plan.

The main direction of single species and its statistical significance (Reylegh test, Batchelet 1981) are given in table 3.

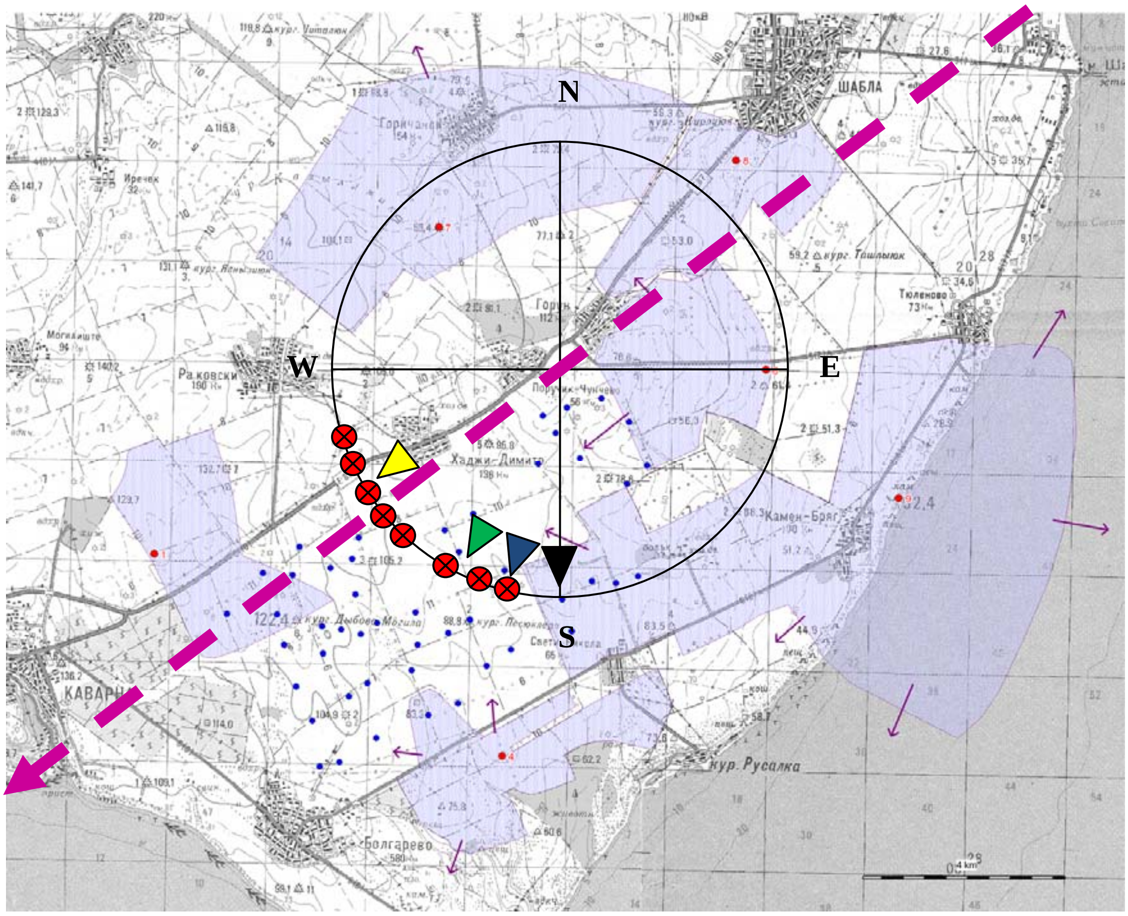
Table 3. The main migratory directions of different species. * - significant, ** - strong statistical significance.

Species	R (length of the mean vector)	N of birds	Direction, in º
A. apus	0,49	73	224
A. brevipes	0,16	92	78
A. cinerea	0,77**	120	214
A. gentilis	0,82**	10	184
A. melba	0,47	494	80
A. nisus	0,51*	44	236
A. pomarina	0,55*	40	204
Accipiter sp.	0,72**	30	291
B. buteo	0,30	91	225
B. rufinus	0,13	108	200
Buteo sp.	0,09	21	184
C. aeruginosus	0,36	290	223
C. ciconia	0,51*	2989	245
C. cyaneus	0,33	3	90
C. gallicus	0,27	24	243
C. macrourus	0,35	8	216
C. nigra	0,81**	8	277
C. pygargus	0,55*	31	249
Circus sp.	0,84**	85	227
D. urbica	0,01	1348	149
F. eleonorae	0,45	7	310
F. subbuteo	0,30	46	205
F. tinnunculus	0,13	60	119
F. vespertinus	0,39	11	231
G. glandarius	0,45	26	108
H. daurica	0,92	11	155
H. pennatus	0,54*	4	352
H. rustica	0,55*	13860	203
Hirundinidae	0,74**	1180	180
L. cachinnans	0,45	504	217
Larus sp.	0,38	51	263
M. apiaster	0,63*	10752	194
M. flava	0,27	1963	111
M. migrans	0,25	18	65
P. apivorus	0,77**	58	245
P. crispus	1,00	4	45
P. haliaetus	0,27	13	231
P. leucorodia	1,00	117	180
Ph. carbo	0,73**	265	264
R. riparia	0,29	9315	264
S. vulgaris	0,20	5223	199
Str. turtur	0,18	136	85
P. onocrotalus	1,00	120	180
Grand Total	0,17	49655	242

Analyses of directions rewealed no statistically significant direction of all registered migrants at the territory. Only 14 (17%) species out of 83 registerd have directed migratory flight through the territory. The rest of the species were disoriented concerning the expected seasonal migratory direction and can be considered as feeding migrants or local birds. At figure 1 all significant migratory directions are presented. The most numerous birds with a significant direction are Swallows (Hirundinidae) flighing in S (A^o=180, R= 0.74 n = 1180) direction (Table 3). The barn swallows in SSW direction (A^o=203, R= 0.55 n = 13860). The bee-eaters, one of the most numerous migrants at the site also fly in SSW (A^o=194, R= 0.63 n = 10752). Surprisingly the cormorants have significant direction indicating intensive migratory movements through the territory in SW direction (A^o=264, R= 0.73 n = 265).
The storks and herons fly to SW and SSW respectively with hight significance of the directions (A^o=245, R= 0.51 n = 2989 and A^o=214, R= 0.77 n = 120 respectively).
The birds of prey are generally not directed while fly above the territory of the park. It is in support of the general use of the territory as a feeding ground for most of the species registered. The only flying in significant direction throught the territory migrating raptors are Honey buzzards (A^o=245, R= 0.77 n = 58), Lesser Spotted Eagles (A^o=204, R= 0.55 n = 40), Goshawks (A^o=184, R= 0.82 n = 10) and Harriers (A^o=227, R= 0.84 n = 85). The Harrier species identified (i.e. low flying birds) are not directed because they are hunting through the territory (Table 3).
There are is one general migratory direction throught the territory (Figure 1). The main direction of the soaring birds flying at high altitude in SW direction (A^o=253, R= 0.51 n = 3375) indicated in purple at the figure 1. The rest of the species having significant directiona throught the territory can not be grouped and must be considered as single migratory directions (Table 3).

Figure 1. Directions of registered bird species.

Red dots – mean directions of the soaring bird species: starting from 180^{o} A. pomarina, A. cinerea, Circus sp. A. nisus, P. apivorus, C. ciconia, C. nigra, C. pygargus (see details in Table2). Triangles are mean directions of the Swellows (Hirundinidae) (black), Barn swallows (blue) and Bee-eaters (green). Dashed errows indicate main migratory direction of soaring birds (purple)



Temporal distribution of the registered birds

Seasonal dynamics

Bird migration over the territory of the park was concentrated in one single day with over 55% of all migrants registered during the study period (the main migratory period of soaring birds) (Figure 2). Such non random and non normal distribution of the migrants in a single day indicates an external influence and none biologically determined process. The migration through the park territory is obviously highly correlated with the western wind componend when the number of migrants sharply increases. The rest of the time the number of migrants fluctuates in the limt of 5% with no notable peaks. The number of migrants is extremely low for the season and do not reflect known from the literature phenology of autumn migration.

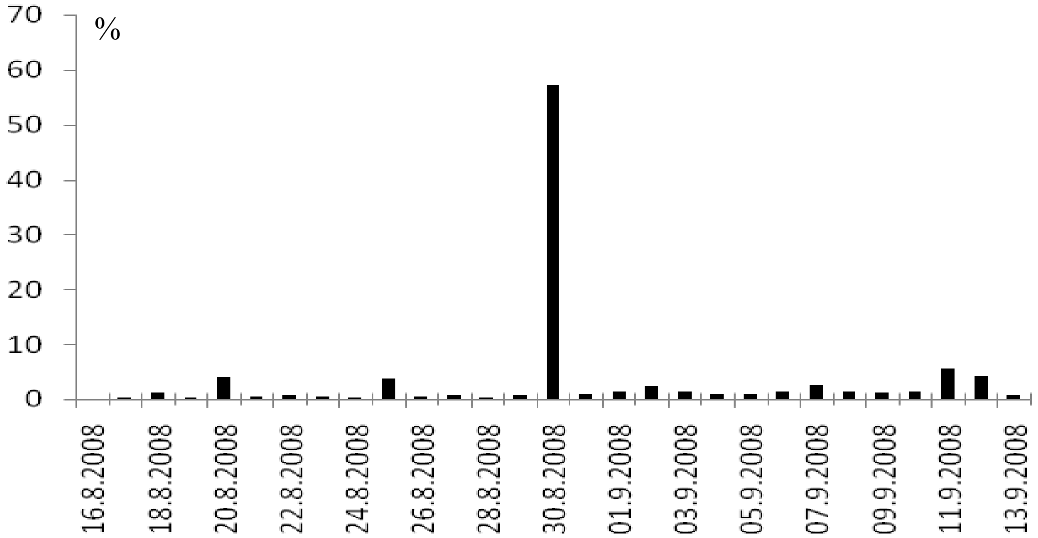


Figure 2. Dinamics of soaring bird migration in percent of all registered at the territory soaring migrants.

Dinamics of non-soaring birds is closer to the seasonal dynamic of autumn migration in general, but is concentrated also in single days with extremely high concentrations indicating external factors ruling theyr migration at the territory (Figure 3). Around 70% of swallows and beee-eaters pass through the territory in 2 days.

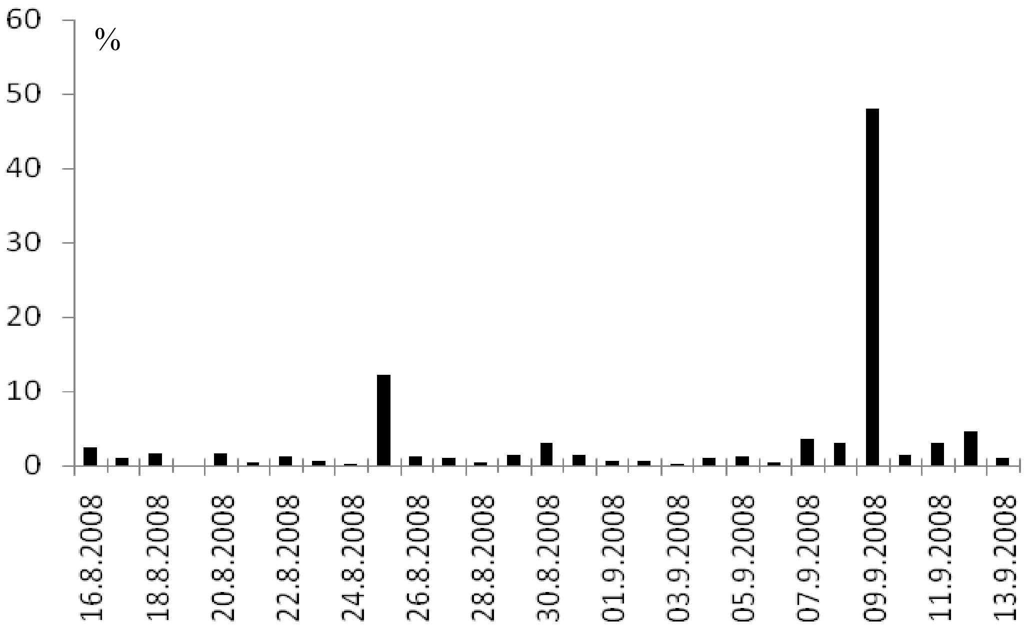


Figure 3. Dinamics of non-soaring birds (swellows and bee-eaters) in the wind park territory.

In general every species has its own peaks of migration when its number reach maximum. The charachteristic of the wind park territory and probably the whole region of Kaliakra cape is the sporadic increase of the dencity of different species (Table 4). The reason for such sporadic increase in contrast to the migratory pattern of the seasonal dynamics must be complex of meorological conditions and theyr interaction with the species flight abilities, genetic program and orientation behavior. In general may be concludet that the majority of the migrants pass in the first 10 days of September. The passerine migrants flight at night and use the habitats for refilling the enbergetic reservs at day time. These birds are less exposed at the risk concerning wind turbines and are not included in the present analisis of the temporal dynamics of migration.

Table 4. Timetable of the passage of different species soaring and non-soaring birds through the territory

	Periods of 10 days		
Species	**16.8.2008 - 25.8.2008**	**26.8.2008 - 04.9.2008**	**05.9.2008 - 14.9.2008**
A. apus	70%	24%	6%
A. brevipes	14%	32%	55%
A. cinerea	1%	72%	28%
A. gentilis	10%	10%	80%
A. heliaca	0%	0%	100%
A. melba	30%	24%	46%
A. nisus	9%	30%	61%
A. pomarina	14%	32%	55%
Accipiter sp.	10%	30%	60%
B. buteo	25%	39%	36%
B. rufinus	21%	30%	49%
C. aeruginosus	10%	26%	63%
C. ciconia	7%	92%	1%
C. cyaneus	80%	20%	0%
C. gallicus	31%	34%	34%
C. macrourus	0%	0%	100%
C. nigra	25%	63%	13%
C. pygargus	72%	19%	9%
D. urbica	52%	31%	17%
F. eleonorae	29%	57%	14%
F. naumanni	0%	100%	0%
F. subbuteo	6%	31%	63%
F. tinnunculus	21%	39%	40%
F. vespertinus	9%	9%	82%
H. daurica	0%	15%	85%
H. pennatus	0%	50%	50%
H. rustica	14%	12%	74%
M. apiaster	8%	7%	84%
M. migrans	94%	6%	0%
P. apivorus	10%	2%	88%
P. crispus	0%	0%	100%
P. haliaetus	0%	20%	80%
P. leucorodia	0%	0%	100%

Pl. falcinellus	100%	0%	0%
R. riparia	45%	11%	44%
P. onocrotalus	100%	0%	0%
Grand Total	**21%**	**18%**	**61%**

The passerine migrants flight at night and use the habitats for refilling the enbergetic reserves at day time. These birds are less exposed at the risk concerning wind turbines. We have analised the data from our observations in combination with the ringing results we obtained in some of the observation sites during the present study. The results are presented in Table 5. The main passage period for the passerine migrants throught the territory is the last 10 days of August.

Table 5. Temporal dynamics in the abundance of nocturnal migrants in different habitats at the studied territory.

	Periods of 10 days		
Species	**16.8.2008 - 25.8.2008**	**26.8.2008 - 04.9.2008**	**05.9.2008 - 14.9.2008**
A. trivialis	80%	0%	20%
C. coturnix	33%	0%	67%
E. hortulana	100%	0%	0%
F. coelebs	100%	0%	0%
F. parva	0%	100%	0%
H. icterina	100%	0%	0%
H. pallida	67%	0%	33%
J. torquila	100%	0%	0%
L. collurio	64%	21%	16%
L. minor	42%	50%	8%
M. alba	13%	13%	75%
M. cinerea	100%	0%	0%
M. flava	44%	38%	17%
M. striata	29%	33%	38%
Mel. calandra	71%	0%	29%
O. isabellina	25%	50%	25%
O. oenanthe	75%	25%	0%
O. oriolus	31%	48%	21%
O. pleschanka	0%	50%	50%
Ph. collybita	38%	63%	0%
Ph. trochilus	44%	22%	33%
S. communis	63%	0%	38%
S. curruca	0%	0%	100%
Sax. rubetra	14%	0%	86%
T. merula	0%	0%	100%
U. epops	13%	25%	63%
Grand Total	**44%**	**37%**	**19%**

Circadian dinamics

There are two main periods of durnal activity of migrants throught the territory of the park. Around 40% of the soaring migrants were registered between 8 and 10 oclock at the morning. The second peak of activity is in the middle of the day. The most intensive period of the day is between 9 and 13 when over 90% of the observed soaring migrants passed over the territory.
Non soaring birds are feeding all over the day using the spaece of the park with decreasing intensity (Figure 4).

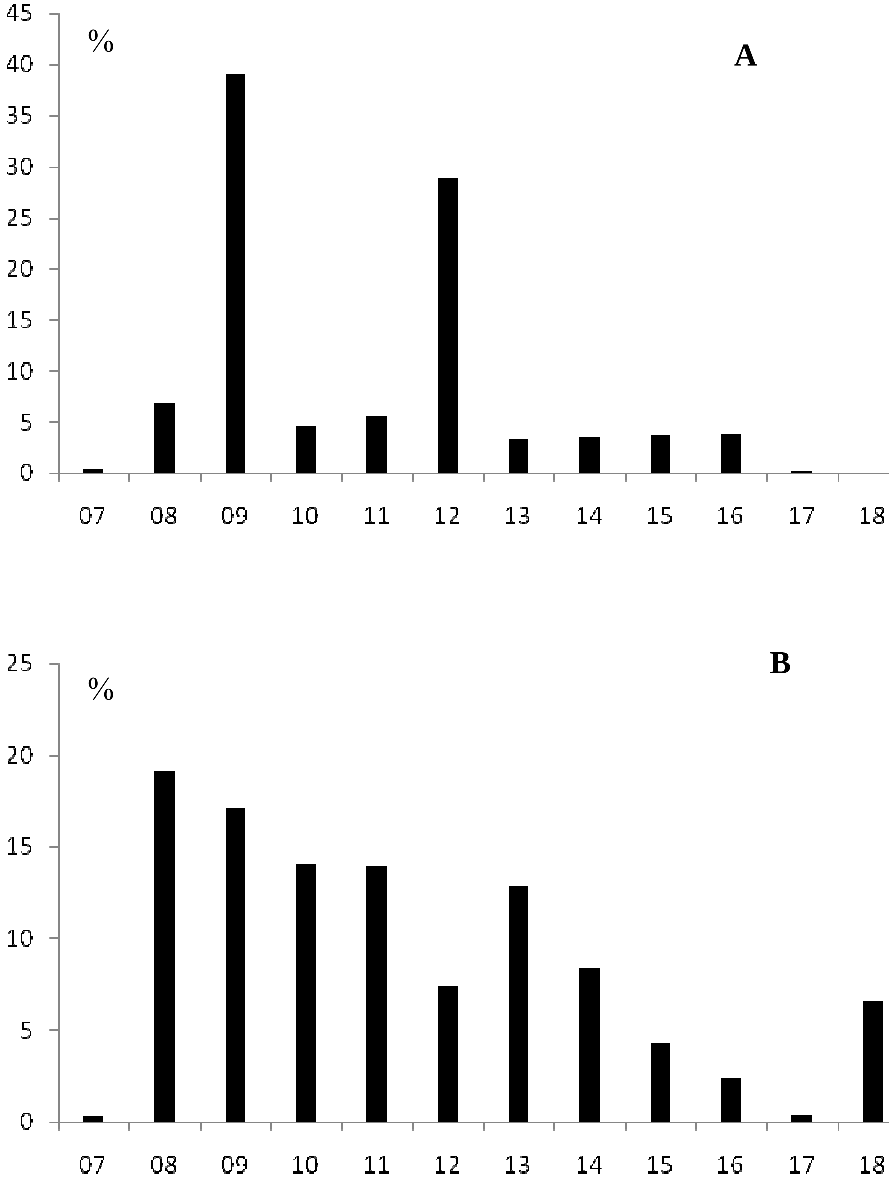


Figure 4. Diurnal activity of the soaring (A) and non soaring (B) migrants.

Ppriority list for the species involved with high conservation status exposed to the risk of collisions with wind turbines

The species established, in the territory of the wind power park, with high breeding density and low conservation status which populations can not be influenced by the additional mortality caused by wind generators are not included in the following list. According the available information (monitoring reports) even the whole passing through the wind park territories part of the population would be exposed to the risk of collision it would not have significant impact on the number of these species in the nature or its natural trends.
The focal point for the migrating along the Bulgarian Black Sea coast is Atanassovsko Lake near Bourgas. The maximum numbers of certain species per one autumn season reach as follows: White Stork (*Ciconia ciconia*) - 204 423, Black Stork (*Ciconia nigra*) – 4 574, White Pelican (*Pelecanus onocrotalus*) – 37 228, Lesser Spotted Eagle (*Aquila pomarina*) – 25 796, Common Buzzard (*Buteo buteo*) – 30 662 (Michev et al., 1999). This data were used for the comparative analysis of the data collected in our study in respect of the whole migrating through Black Sea coast populations of different species. Additional data concerning the breeding numbers of world, European and regional populations of some species where obtained from: BirdLife International (2004): Birds in Europe. Population estimates, trends and conservation status.
BirdLife conservation series No. 12. 374 p.

White Pelican (*Pelecanus onocrotalus*)
This species has a large range, with an estimated global extent of occurrence of 100,000–1,000,000 km^2. It has a large global population estimated to be 270,000–290,000 individuals (Wetlands International 2002). Global population trends have not been quantified, but the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e., declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern. The total European breeding population is estimated at between 3000 and 3600 pairs. Up to 100 of these breed at Lake Mikri Prespa (Greece), the rest are on the Danube delta. Russian population 100-350 Turkish population 250-400.
The number passed through the wind park territory in autumn 2008 is 120 individuals. According to the previous monitoring reports 2004-2006 the number of white pelicans registered at the site vary between 79 and 335 individuals.
The number of the individuals flying along Via Pontica is 37 228 (Michev et al., 1999). The proportion of the birds using the space of the wind park during the autumn seasonal migration is less then 0.5% of the passing population of the species.

White Stork (*Ciconia ciconia*)
This species has a large range, with an estimated global extent of occurrence of 1,000,000–10,000,000 km^2. It has a large global population estimated to be 500,000–520,000 individuals (Wetlands International 2002). Global population trends have not been quantified, but the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e., declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern. The European population is estimated at about 100,000 pairs. Russian population 3500-4000. Turkish population 15000-35000.

The number of the individuals flying along Via Pontica is - 204 423 (Michev et al., 1999). In the previose monitoring reports available 2004 – 2006 the numbers counted through the territory vary between 555 and 22196 individuals in 2006 when unusual hight number is registered. Our survey in the outumn of 2008 resulted in 2648 birds. We assume the mumber of 3000 birds per season cross the wind park territory during the autumn migration.
Therefore the proportion of the passing population exposed to the risk when the park is constrocted is between 1 and 1,5% of the migratory white storks along Via Pontica.

Black Stork (*Ciconia nigra*)
This species has a large range, with an estimated global extent of occurrence of 1,000,000–10,000,000 km^2. It has a large global population estimated to be 32,000–44,000 individuals (Wetlands International 2002). Global population trends have not been quantified, but the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e., declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern European population estimated at about 6000 pairs. Russian population 1000-10000 Turkish population 500-2000
Survey in Burgas revealed 4 574 individuals flighing Via Pontica. In our survey we registered 8 Black storks. Previouse monitorings report for a variation between 4 – 15 (2004-2006) individuals.
The everage of 10 birds per year results in a proportion of 0.2% of the migrating along Bulgarian Black sea coast black stoarks.

Booted Eagle *(Hieraaetus pennatus)*
This species has a large range, with an estimated global extent of occurrence of 10,000,000 km^2. It has a large global population estimated to be 10,000–100,000 individuals (Ferguson-Lees *et al*. 2001). Global population trends have not been quantified; there is evidence of a population decline (Ferguson-Lees *et al*. 2001), but the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e., declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern. 2,800-5,000 breeding pairs in southern and eastern Europe. Largest numbers exist in France, Spain and Portugal.
In the monitoring reports 2004-2006 its number through the territory varies between 1 and 4. During the study 2008 4 birds of the species are observed over the territory. Assuming a maximum of 8 birds per autumn season we obtain a proportion of les then 0.03% of the migratory population of the species passes yearly through the wind park territory.

Bee-eater *(Merops apiaster)*
This species has a large range, with an estimated global extent of occurrence of 1,000,000–10,000,000 km^2. It has a large global population, including an estimated 950,000–2,000,000 individuals in Europe (BirdLife International in prep.). Global population trends have not been quantified, but the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e., declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern. European estimates range from 90-200,000

breeding pairs. The main strongholds include Portugal, Spain, Ukraine, Romania, Bulgaria and France.
Unfortunately there are no data concerning this species in previose monitoring reports ans there is scarce information about migratory dencity of the species along Via Pontica. On the base of our survey we have an extrapolation of over 26000 individuals using space above the wind park in autumn. It results in a raw estimate of less then 0.2% of the migrating birds. Taking into account that over 90% of the birds are registered below 150 m we should expect high number of birds to be exposed to the collision risk. Aditional data concerning avoidance behaviore are needed for precise estimate of the risk for the species.

Lesser Spotted Eagle (*Aquila pomarina*)
This species has an estimated global extent of occurrence of 1,000,000–10,000,000 km^2. It has a large global population estimated to be 100,000–1,000,000 individuals (Ferguson-Lees *et al*. 2001). Global population trends have not been quantified; there is evidence of a population decline (Ferguson-Lees *et al*. 2001), but the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e., declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern. 7-8,000 breeding pairs with a relatively restricted range covering eastern and central Europe. Largest populations are found in, Belarus 3000-3500, Poland 1000-1200. Russian population 50-200 Turkish population 30-500
In Burgas the number of migrating along Via Pontica birds is estimated on over 25 000 (Michev et al., 1999).
In our study 44 lesser spotted eagles were registered. Variations between 1 and 146 are reported in 2004-2006. Therefore the proportion of the birds using wind park territory in autumn is 0.2% of the migratory population of the species.

Honey Buzzard (*Pernis apivorus*)

This species has a large range, with an estimated global extent of occurrence of 10,000,000 km^2. It has a large global population estimated to be 100,000–1,000,000 individuals (Ferguson-Lees *et al*. 2001). Global population trends have not been quantified, but populations appear to be stable (Ferguson-Lees *et al*. 2001) so the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e., declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern. The European population is between 40,000-50,000 pairs, with a further 70,000-100 000 in Russia. Turkish population 50-500.
Reports 2004-2006 give number variations of 395 – 451 birds. In 2008 only 58 honey buzzards are registered. Concidering 400 maxumum possible number of birds per atumn using the wind park territory we come to a proportion of less then 0.1% of the migrating honey buzzards.

Common Buzzard (*Buteo buteo*)
This species has a large range, with an estimated global extent of occurrence of 10,000,000 km^2. It has a large global population estimated to be at least 4,000,000 individuals (Ferguson-Lees *et al*. 2001). Global population trends have not been quantified, but there is evidence of a population increase (Ferguson-Lees *et al*. 2001),

and so the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e., declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern. 400,000-500,000 breeding pairs spread across most of Europe apart from the very north including Iceland, Norway and Lapland with 100,000-200,000 in Germany alone. Russian population 400000-600000. Turkish population 1000-5000.
According to the study in Burgas 30 662 common buzzards fly along Via Pontica (Michev et al., 1999). The reports 2004-2006 give a numbers of 118 – 419 birds per season. In the autumn of 2008 the common buzzards are 146. Coming to an average of 170 birds per season we have an proportion of 0.5% of the birds flying by Via Pontica.

Red-footed Falcon (*Falco vespertinus*)

Red-footed Falcon breeds in eastern Europe and west, central and north-central Asia, with its main range from Belarus south to Hungary, northern Serbia and Montenegro, Romania, Moldova and east Bulgaria, eastward through Ukraine and northwest and south Russia and north Kazakhstan to extreme northwest China and the upper Lena river (Russia). It winters in southern Africa, from South Africa northwards to southern Kenya. It has a large global population estimated to be 300,000-800,000 individuals, but recent evidence suggests that it is undergoing large declines in parts of its range. The European population of 26,000-39,000 pairs (forming 25-49% of the global population) suffered a large decline during 1970-1990, and has continued to decline during 1990-2000, particularly in the key populations in Russia and Ukraine, with overall declines exceeding 30% in ten years (three generations). Declines have also been reported from eastern Siberia, where the species may have disappeared as a breeder from the Baikal region. In Hungary estimated populations have declined from 2,000-2,500 pairs in the late 1980s to 800-900 pairs based on surveys in 2003 and 2004, and in Bulgaria very few active colonies remain. However, populations in central Asia appear to be stable, with the species reported to be common in suitable habitats (especially in forest-steppe zone with Rook Corvus frugilegus colonies) in Kazakhstan, and no evidence of any population declines there. Populations in western Europe are also stable or undergoing increases. Nearly qualifies as threatened under criteria A2bc+3bc. 3 000-3,600 breeding pairs found in central and eastern Europe.
11 (extrapolated 27) red-footed falcons are registered in our study in 2008. Previouse monitoring reports give numbers of 0-52 birds. We assume an average of 25 per autumn season wich result in 0.3% of the migrating birds of the species use in some period in autumn the wind park territory.

Marsh Harrier *(Circus aeruginosus)*

This species has an estimated global extent of occurrence of 1,000,000–10,000,000 km^2. It has a large global population estimated to be 100,000–1,000,000 individuals (Ferguson-Lees *et al*. 2001). Global population trends have not been quantified, but populations appear to be stable (Ferguson-Lees *et al*. 2001) so the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e., declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern. 26,000-35,000 breeding pairs in Europe; common in eastern Europe with scattered populations in the west and south. Poland holding between 4000-9000, Germany 3000-10000. Russian population 25000 Turkish population 500-5000
In total 327 marsh harriers are registered in our study in 2008. The reports 2004-2006 give variation of 21-127 birds per autumn. The average of 200 birds per outumn result

in a proportion of 0.3% of the migrating marsh harriers is using wind park territory in autumn.

Black Kite (*Milvus migrans*)

This species has a large range, with an estimated global extent of occurrence of 10,000,000 km^2. It has a large global population, including an estimated 130,000–200,000 individuals in Europe (BirdLife International in prep.). Global population trends have not been quantified; there is evidence of a population decline (Ferguson-Lees *et al*. 2001), but the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e., declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern. The European population is between 26,000-29,000 breeding pairs. Russian population 50000-70000 Turkish population 100-1000
4-10 in the monitoring reports 2004-2006. In our study 2008 we have observed 18 (extrapolated dancity - 38 birds per 10000m) black kites in the territory.
Even in the worst case we have the maximum proportion of less then 0.01% of the migrating birds using the wind park territory.

Sparrowhawk (*Accipiter nisus*)
This species has a large range, with an estimated global extent of occurrence of 100,000–1,000,000 km^2. It has a large global population estimated to be 1,000,000–10,000,000 individuals (Ferguson-Lees *et al*. 2001). Global population trends have not been quantified, but populations appear to be stable (Ferguson-Lees *et al*. 2001) so the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e., declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern. 150,000-170,000 breeding pairs widespread throughout most of Europe. The UK is a stronghold with about 34000 pairs. Russian population 140000-180000 Turkish population 3000-10000.
Monitorins of 2004-2006 report for numbers of 42-83 birds per season. Our monitoring 2008 show a number of 44 birds (92 extrapolated per 10000m front). In all cases the proportion of the birds using the wind park territory and exposed to the risk is less then 0.001% of the migrating population of the species.

Speed of migration and mitigation plan test

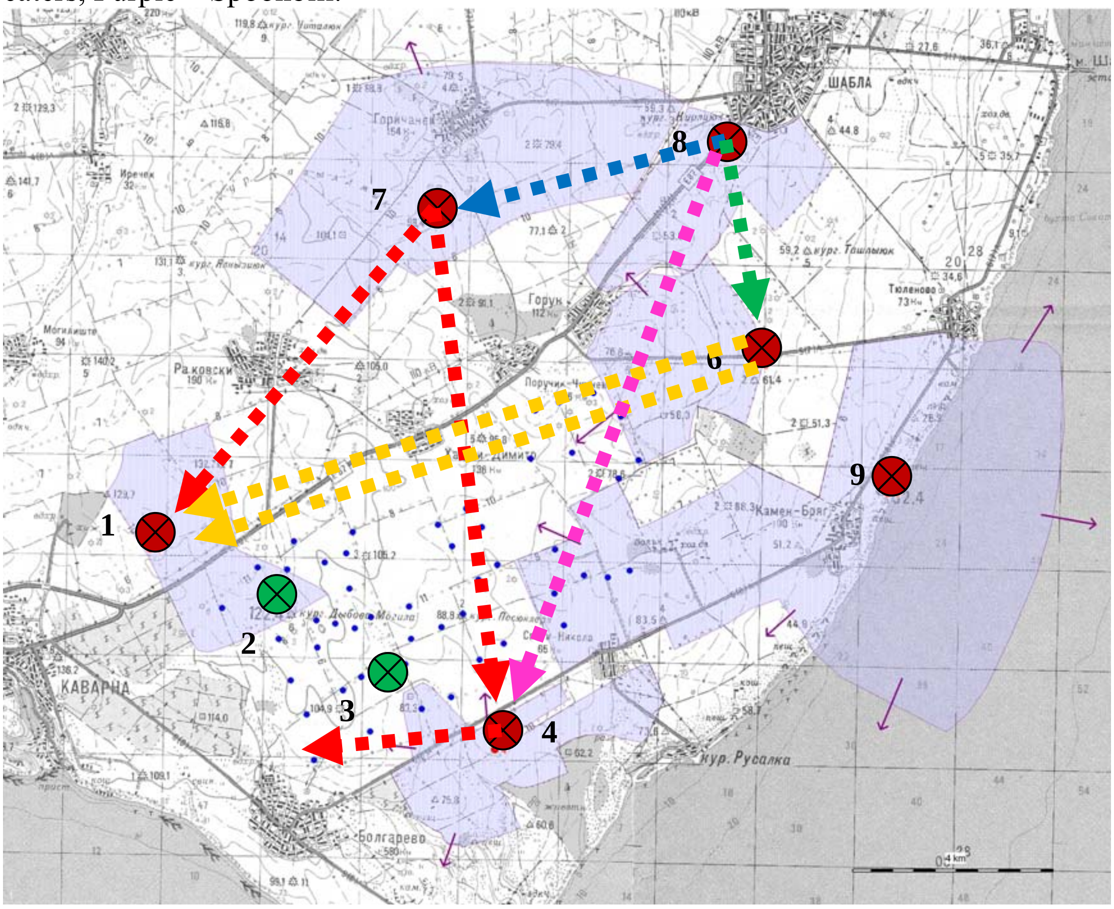
For the period of 20 days observations in the specified for test of the exploitation monitorin mitigation plam 2092 individuals were tracked in at least 2 points consequently (Table 5). Through the points passed 8 flocks in total and all of them were recorded in the one or more neighbor observation points.
Individual speed of migration is calculated for 5 species. The evarage speed of migration per species is presented in Table 5.
Based on the collected data we can confirm around 100% coverage of the footsteps around the wind park. The tested points provide reliable information 10 minutes before the average flock of migrating birds (Storks and Pelicans) can reach or avoide the territory of the park. The observation points 1, 4, 6, 7, 8, and 9 in combination with two mobile observers along main roads

Table 5. The vererage speed of migration for tracked flocks of birds

Species	Date	Number	Time	O. point	Time	O. point	Distance, km	Speed, km/h	Direction
C. ciconia	30.08.2008	500	12:06	7	12:15	1	6	40	ssw
C. ciconia	30.08.2008	500	12:34	7	12:55	4	12	34	sse
C. ciconia	30.08.2008	1500	10:20	4	10:23	4	2	40	wsw
A. cinerea	02.09.2008	8	13:18	8	13:20	7	2,5	80	wsw
A. pomarina	05.09.2008	1	10:07	8	10:50	6	5	07	sse
M. apiaster	05.09.2008	20	9:40	6	10:17	1	12	20	sw
M. apiaster	05.09.2008	20	10:20	6	10:59	1	12	20	sw
Pl. leucorodia	07.09.2008	43	11:17	8	11:27	4	12	75	ssw

The observation points 1, 4, 6, 7, 8 and 9 provide around 100% coverage of the footstep of the wind park territory (Maps 1and 2).

Map 2. Trackes of the flocks registered in more then one observation point. Red - White Storks, Blue – Gray Herrons, Green – Lesser Spotted Eagle, Yellow – Bee-eaters, Purple – Spoonbill.



*The data concerning avoidance behaviore of different species collected in the points of observations close to already constructed wind turbines can be analised under request.

*The data concerning avoidance behaviore of different species collected in the points of observations close to already constructed wind turbines can be analised under request.
** Species can be added to the Prtiority List under regquest.

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