INTEGRATED SYSTEM FOR PROTECTION OF BIRDS

REPORT

Monitoring of geese in the territory of Integrated System for Protection of Birds, Winter 2018-2019

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April 2019

Contents

1. INTRODUCTION

The present study was commissioned by AES Geo Energy Ltd., Kaliakra Wind Power, EVN Kavarna, Degrets OOD, Disib OOD, Windex OOD, Long Man Invest OOD, Long Man Energy OOD, Zevs Bonus OOD, Vertikal-Petkov & Sie SD, Wind Park Kavarna East EOOD, Wind Park Kavarna West EOOD, and Millennium Group OOD in order to collect and summarize the information about the performance of the Integrated System for Protection of Birds (ISPB) that includes 114 wind turbines, 95 of which are within the Kaliakra SPA BG0002051 and 19 are in the areas adjacent to the protected zone. Considering the potentially adverse effects on environmental features, notably birds (T-PVS/Inf (2013) 15 https://tethys.pnnl.gov/publications/wind-farms-and-birds-updated-analysis-effects-wind-farms-birds-and-best-practice), the ISPB was implemented in 2018 aiming systematic monitoring primarily including fatalities through collision with rotating turbine blades, disturbance leading to the displacement of birds from feeding, drinking, roosting or breeding sites (effectively a form of habitat loss), and turbines presenting a barrier to flight movements, thereby preventing access to areas via those movements or increasing energy expenditure to fly around the turbine locations (Hötker et al. 2006, Madders & Whitfield 2006, Drewitt & Langston 2008, Masden et al. 2009, 2010, de Lucas et al. 2004, 2008, Ferrer et al. 2012, Grünkorn et al. 2016).

The ISPB consists of a combination of existing high-tech radar observations and meteorological data, integrated with field visual observations, which jointly used are essential for the accurate risk assessment and ensures that appropriate action is taken immediately. So far as potential adverse impacts of turbine collisions on birds, a Turbine Shutdown System (facilitated by an Early Warning System: EWS) is deployed.

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 (https://www.seo.org/wp-content/uploads/2014/10/Guidelines_for_Assessing_the_Impact_of_Wind_Farms_on_Birds_and_Bats.pdf). Detailed information about the scope, technical rules and monitoring procedure are publicly available at a dedicated website https://kaliakrabirdmonitoring.eu/. A detailed review of the scientific information published in scientific journals and in technical reports was also carried out for the studied area.

This report presents results of the ornithological survey and monitoring at the ISPB (Figure1) in the period 01 December 2018 to 28 February 2019, including carcass searches and Turbine Shutdown System application. The primary objective of the 2018-2019 wintering bird study at ISPB territory was to investigate the possible effects of the wind farms (114 wind generators) on geese populations, notably the Red-breasted Goose (RBG) (*Branta ruficollis)* due to its conservation status (https://www.iucnredlist.org/species/22679954/59955354).

To date, there have been no indications that wind turbines in Kalaikara region has had any adverse impact on wintering geese, including RBG (http://www.acta-zoologica-bulgarica.eu/downloads/acta-zoologica-bulgarica/2017/69-2-215-228.pdf). This report presents the latest results, from the 2018-2019 winter monitoring in the ISPB territory.

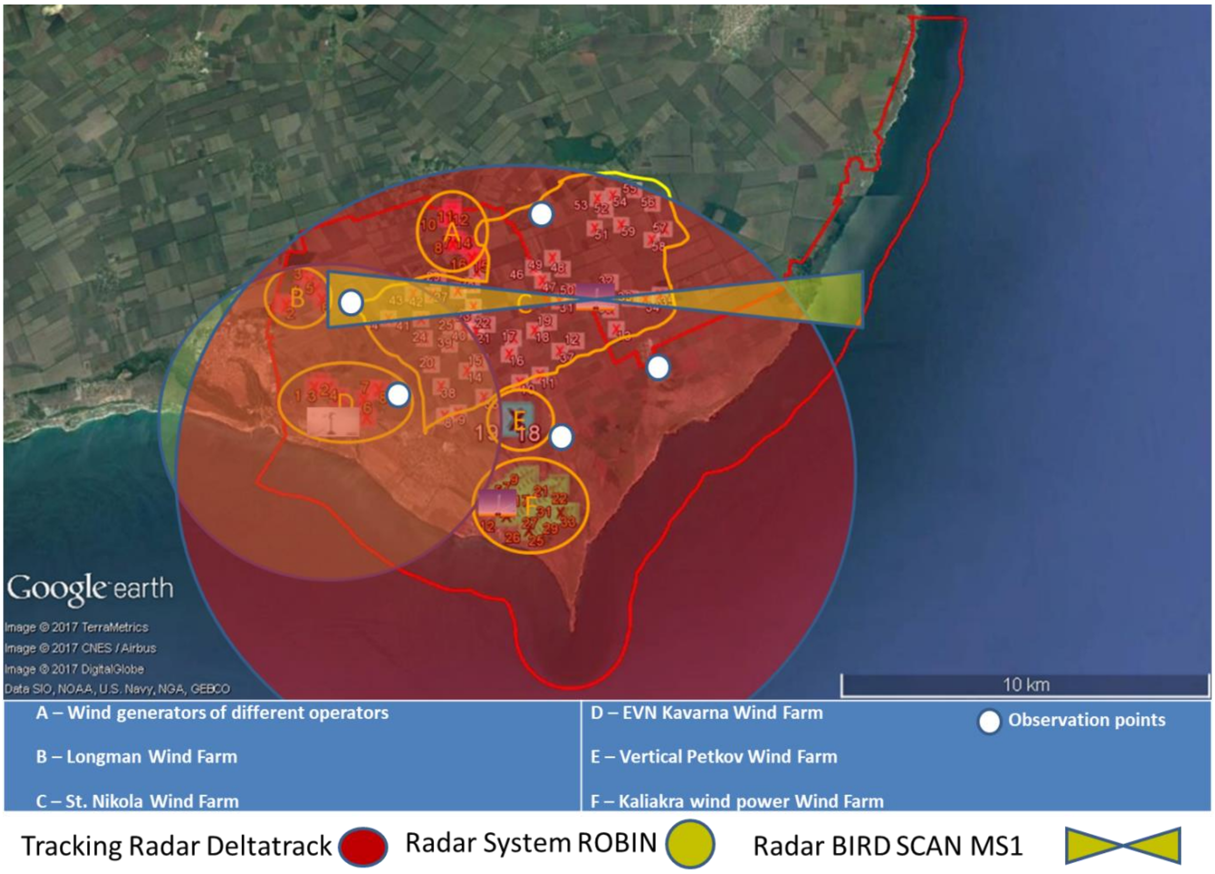

Figure 1. *A satellite photo with the location of the wind turbines covered by the ISPB and the boundaries of Kaliakra SPA.*

1.1. THE GEESE SPECIES OBSERVED IN THE TERRITORY

The **Red-breasted Goose** is one of the species to which the *Agreement on the Conservation of African-Eurasian Migratory Waterbirds* (AEWA) applies. Over 80 % of the population roost during the winter at just five sites, with nearby feeding areas threatened by changes in land-use. In addition, there has been a strong decline in numbers in the last decades. The role of the known population fluctuations in this species - as in other Arctic geese – is unclear but given the worsening outlook for the species as a whole, the Red-breasted Goose was uplisted from a species of Vulnerable in 2006 to Endangered status in the 2007 IUCN Red List.

It was considered a Near Threatened species in Europe by the IUCN in 2015 which substantially reflects our knowledge on the real number of the population wintering in Europe (https://www.iucnredlist.org/species/22679954/59955354).

In the middle of the 20th century, a dramatic change in the wintering distribution and migratory habits of the species have been registered. For the first time the Red-breasted Goose was registered in Southern Dobrudzha on December 8, 1961 in the Srebarna Nature Reserve, and in the region of Shabla Lake - on February 6-8, 1964 (Ivanov and Pomakov 1983). During the 1950s the Bulgarian territory of Dobrudzha was thoroughly studied by Petrov and Zlatanov (1955) and they do not present any information about this species. The two authors write, though, that the Greater White-fronted Goose (*Anser albifrons*), which is usually found together with the Red-breasted Goose, was often wintering in Dobrudzha. Later Ivanov and Pomakov (1983) provided information on over 20 winter locations of the Red-breasted Goose for the 1950-1980 period. Since 1977 (except in 1986), Bulgarian ornithologists carried out regular midwinter counts of waterfowl in the most important wetland regions of Bulgaria. The results from the period of 1977-1989 (Red-breasted Goose included) have been published by Ivanov, Pomakov (1983), Michev et al. (1983), Michev et al. (1991). Comprehensive analysis of the winter status of this species is made by Vangeluwe and Stassin (1991). There was research on the wintering ecology and population dynamics of this species (a Bulgarian-Swiss program for protecting of biological diversity) but the results were not published. Red-breasted Geese were counted at their roost sites in Bulgaria and Romania between 1995 and 1999 (Dereliev et al.2000). They arrived in Romania in the second part of October, while in Bulgaria they started to arrive in the second part of November. The peak numbers (40,000 – 55,000) were usually recorded in Romania in November and December. Almost the whole population moved into Bulgaria during January-February when up to 62,600 were counted. Return migration started in February and by the end of March almost all had left the region.

According to Rozenfeld (2011, 2016) the total number of world population of Red-breasted (*Branta ruficollis*) counted in the bottleneck of spring migration is around 100000 individuals. This is much more above the considered total number of world population of the species until now. Currently and over the last 10 years simultaneous counts of wintering Red-breasted Geese are organized by BirdLife partners in Bulgaria, Ukraine and Romania at the known main roosting sites. In Bulgaria the counts are once a week at the Shabla and Durankulak lakes. The results of these counts indicate methodological gaps in the monitoring schemes applied and are still not published in peer reviewed journals. Some data are available from internet sites of the local BirdLife partners: www.brantaruficollis.org.

According to IUCN the minimum European population in winter is estimated at 10,800 - 81,600 individuals, which equates to 7,200 - 54,400 mature individuals. There is also a marginal breeding population in Europe estimated at 5 - 10 pairs, which equates to 10 - 20 mature individuals. The species occurs in the EU27 only in winter and the minimum population is estimated at 9,900 - 74,900 individuals, which equates to 6,600 - 49,900 mature individuals.

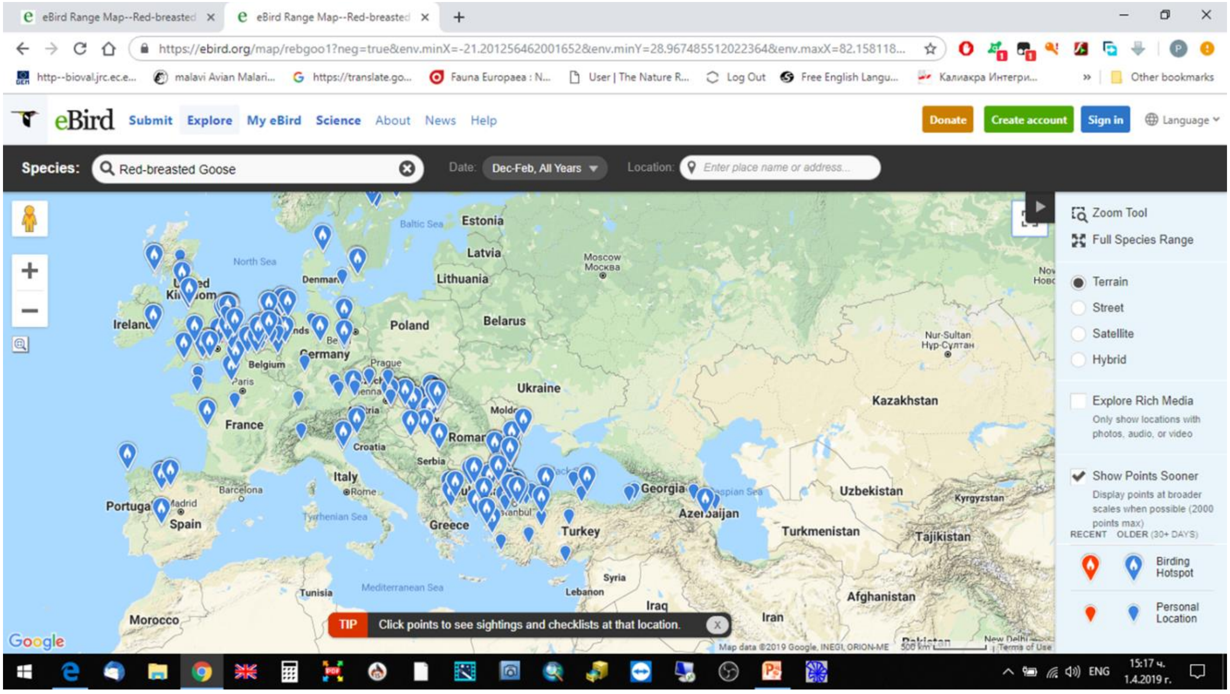

Figure 2. Winter obsevations of Red-breasted geese in last 5 years according to e-bird portal (The Cornel lab of Ornithology [https://ebird.org/species/rebgoo1)](https://ebird.org/species/rebgoo1)

The Lesser White-fronted Goose (*Anser erythropus*) is closely related to the larger Greater White-fronted Goose (*A. albifrons*). It breeds in northernmost Asia, but it is a scarce breeder in Europe. There is a re-introduction scheme in Fennoscandia.The Lesser White-fronted Goose winters further south in Europe and is a very rare winter visitor to Great Britain. The two white-fronted goose species differ little other than in size (the Lesser, at 53–66 cm length and with a 120–135 cm wingspan, is not much bigger than a Mallard (*Anas platyrhynchos*) but both may be readily distinguished from the Greylag Goose (*Anser anser*) by their bright orange legs and their mouse-coloured upper wing-coverts. The Greylag Goose has flesh-coloured bill and legs and the upper wing-coverts of a bluish-grey. Both white-front species have a very conspicuous white face and broad black bars which cross the belly. Adult Lesser White-fronted Geese, as well as being smaller than Greater White-fronted Geese, have an obvious yellow eye-ring, and the white facial blaze goes up to the crown.

Lesser White-fronted Goose is considered an endangered species, but there are programmes to reintroduce animals into the wild to strengthen the population. Additionally it is one of the species to which the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) applies.   There is no information about the number of the species in Bulgaria. It has been sporadically recorded in mixed flocks in NE Bulgaria many times. There are several studies indicating Fenoscandian and Siberian origin of the birds registered in Bulgaria during the winter. The number of wintering Lesser White-fronted geese in Bulgaria is small, in flocks of around 50 birds in mixed flocks with Greater White-fronted geese (Michev et al. 1983).

The Greater White-fronted Goose is closely related to the smaller Lesser White-fronted Goose. In Europe it has been known as simply "White-fronted Goose". Greater Whitefronts are 65-78 cm in length and have a 130-165 cm wingspan. They have bright orange legs and mouse-coloured upper wing-coverts. They are smaller than Greylag Geese. As well as being larger than the Lesser White-fronted Goose, the Greater Whitefront lacks the yellow eye-ring of that species, and the white facial blaze does not extend upwards so far as in Lesser.

The Greater White-fronted Goose is divided into five subspecies. The nominate subspecies *A. albifrons* breeds in the far north of Europe and Asia, and winters further south and west in Europe. *A.albifrons* is among the taxa to which the *Agreement on the Conservation of African-Eurasian Migratory Waterbirds* (AEWA) applies.

In Bulgaria, it is a common wintering bird. It is a game species and favorite target for hunters. The concentration of the species around the Shabla and Durankulak lakes reaches, in some years, over 250,000 birds. The species forms mixed flocks with previously listed species and uses the same food resourses during the winter period.

The Greylag Goose (also spelled Graylag in the United States) has a wide range in the Old World. It was in pre-Linnean times known as the Wild Goose ("Anser ferus"). This species is the ancestor of domesticated geese in Europe and North America. Flocks of feral birds derived from domesticated birds are widespread. In the wild the big deep-based bill, pink or orange is always diagnostic and the pink legs would rule out any species other than Pink-foot. Greylags are also bigger, bulkier and paler than other grey geese. The head, neck, chest, belly, upperwing, underwing and rump can all look conspicuously pale grey, making flight identification relatively easy.The Greylag Goose is one of the species to which the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) applies. In Bulgaria it is a red data species and its breeding population is endangered. During the winter it often appears in mixed flocks at the territory of the Shabla and Durankulak lakes.

1.2. BEHAVIORAL CHARACTERISTICS OF THE GEESE

Flocking behaviour when foraging is characteristic of all geese wintering in Bulgaria and particularly in the region of northern Black Sea coast. Usually, geese form large flocks. More than 90 % of individuals recorded stayed in groups of more than 500 birds. In large flocks (several thousand geese), observations indicate severe competition between individuals. Flight distances are lower in small flocks, but did not increase further with flocks becoming larger than 150 birds (Ekkehard et al. 1999). As shown in many studies, the benefit of flocking in terms of predator avoidance is unlikely to increase any further with groups exceeding a few hundred birds. One possible explanation of the observed flocking behaviour could be that most individuals in the population follow an opportunistic strategy when foraging. They join their foraging conspecifics instead of looking for feeding sites on their own. Flock size is limited by population size on the one hand, and by field size on the other. Bird density together with field size is likely to be the main factors determining and constraining flock size on agricultural fields.

Geese in Bulgarian Dobrudzha feed almost exclusively on winter cereals and select strongly for fields close to large roosts which are two lakes: Durankulak and Shabla. This is unsurprising, because short commuting flights result in lower flight energy expenditure. A meso-scale analysis i.e. field selection indicates a strong influence of foraging profitability and avoidance of human disturbance (Harrison et al 2017). Both Shabla and Durankulak lakes which concentrate all wintering geese are far from the ISPB territory and therefore outside the scope of the current monitoring report.

2. DURATION, METHODS AND EQUIPMENT

The study was carried out in the period of 01 December 2018 to 28 February 2019, covering a total of 90 days, which included the period of the most intensive movements of wintering geese in the region of northern Bulgarian Black Sea coast (Dereliev et al. 2000).

The counts of the geese were performed in early mornings at take-offs from the roosting sites. The teams were separated in couples on predetermined counting points at the plots including the ISPB territory and surrounding fields.

The teams registered on data forms the geese that took off from the roosting sites towards the crop fields. This was deemed the most efficient and objective way to determine the exact numbers of the wintering geese distribution and the feeding patterns preferred during the winter on the territory.

Additional data were collected in the same manner in the evening when the geese returned to the roosting sites. The estimated directions from the morning and evening observations were used for the location of the feeding sites at the fields. Detailed observations on the feeding behavior and counting of the birds at the main feeding sites in the wind park territory were made daily. Temporal itinerary counts were applied once a week for quantitative estimates of the feeding birds at the whole wind park territory.

For the purpose of this study the geese were grouped by species. This conditional division was made to allow a focused study of the birds of conservation importance, such as the Red-breasted Goose (RBG) and Lesser White-fronted Goose. Data on the Greater White-fronted Goose were collected as a second priority.

The study involved direct visual surveys of all passing birds from five stationary points (white dots: Figure 1). Point counts have been used previously in both the tropics and temperate areas to monitor wintering migrants (Hutto et al. 1986; Blake 1992). Although effective in terms of results, the visual observations at the counting point on its own cannot encompass the whole certain region. That is why the results were accompanied by itinerary counts throughout the ISPB territory and surrounding agricultural fields. The overall number of birds per species was obtained by summarizing the counts simultaneously from at least three observation points. The number of birds per species for single days and certain periods counted was used in the further analysis.

Field observations followed the census techniques according to Latta et al. (2005). 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 and by the three radar systems integrated in ISPB as described at the dedicated to the system web site (https://kaliakrabirdmonitoring.eu/).

All observers were qualified specialists carrying out the surveys of bird migration for many years.

Ornithologists who carried out the survey

- **Prof. Dr. Pavel Zehtindjiev - Senior Field Ornithologist**

Over 25 years of research in ornithology. Over 85 scientific publications in international ornithological journals. Member of European Ornithologists Union and number of conservation organisations. Winner of the Revolutionary Discovery Award for the Ornithology of the American Ornithological Society in 2016 – The Cooper Ornithological Society.
10 years of experience in impact monitoring of wind turbines on breeding, migrating and wintering bird species in the region of Kaliakra. Former and longtime member of BSPB.

- **Dr. Victor 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.

- **Dr. Dimitar Dimitrov - Field ornithologist**

Institute of Biodiversity and Ecosystem Research – Bulgarian Academy of Sciences
Author of over 20 scientific publications in international ornithological journals. Member of BSPB.
5 years of experience in impact monitoring in the region of Kaliakra.

- **Ivaylo Antonov Raykov - Field ornithologist**

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

- **Kiril Ivanov 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 7 years of experience in impact monitoring of wind parks in Bulgaria. Member of Balkani NGO for conservation of birds and nature.

- **Yanko Yankov - Field ornithologist**

Student in Biology, University of Shumen. 7 years of experience in impact monitoring of birds in Wind Park projects in NE Bulgaria. Member of BSPB.

- **Boyan Michev – Field ornithologist**

PhD Student in Institute of Biodiversity and Ecosystem Research at the Bulgarian Academy of Sciences, Department of Ecosystem Research, Environmental Risk Assessment and Conservation Biology.
Expert in radar ornithology and analysis of the radar data for bird monitoring. Member of the European Network for Weather radar application in ornithology.

- **Nikolai Velichkov - Field ornithologist**

Qualification and experience in many conservation programs of BirdLife Bulgaria over last 15 years.

- **Svetoslav Stoianov- Field ornithologist**

Qualification and experience in many conservation programs of BirdLife Bulgaria in last 20 years

- **Rusi Welichkov – Qualified searcher for collision victim monitoring**
- **Zeliazko Dimitrov – Qualified searcher for collision victim monitoring**
- **Teodor Antonov – Qualified searcher for collision victim monitoring**

Types of data collected

During the survey in winter 2018-2019 the same standard data were recorded in order to be comparable with previous winter monitoring studies' results:

- Species of birds
- Number of birds
- Distance of the flying birds from the observer
- Altitude of birds
- Direction of the flight
- Behaviour of the birds in relation to other existing wind farms in the region
- Other behavioural observations
- Weather conditions

Species

All geese flying in the surveyors' scope of view were identified to the level of species, if possible, and recorded. Because of the difficulty in distinguishing between similar species in harsh conditions (e.g. poor visibility, great distance, etc.), if exact identification was not possible both possible species were written down. If there was the possibility of a single RBG in a large flock of Greater White-fronted Geese, then this was still recorded as an *Anser/Branta* flock. The proportions of RBG in flocks were also calculated using observations of mixed species flocks on the ground. Due to the greater precision of ground counts gathered during itinerant surveys, analytical preference was given to data collected on species composition by this method.

Numbers of geese

Surveyors counted all geese flying in their scope of view, regardless of the possibility of identification to species or higher taxonomic order (as described in the previous paragraph). For single birds or small flocks, the number of birds and species composition were recorded according to units of individual birds. In larger flocks, when the counting of every single individual was impossible, numbers and composition were recorded according to units of 10 birds.

Distance from observer and flight height

The location of flying birds (distance from the observer) and their flight height were essential measures in order to determine whether flocks' flight lines and their height above ground would potentially make birds at risk of collision. The distance from the observation point was recorded for each bird or flock seen. The flight altitude of every single bird or flock was also recorded according to fixed bands of height.

Recording of both measures was facilitated by thorough familiarisation of the observers with the geography of the study area prior to observations starting. This familiarisation process included use of numerous land marks, their position and height relative to Vantage Points. The distance to land marks and their height were measured and calibrated in advance using GPS in the field and by reference to a topographic map on which they were notated.

Flight direction

The flight direction of birds was recorded according to 16 pre-defined geographic categories on which the birds were heading with respect to the observation point (each category corresponding to 22.5 degrees of the compass). These records were again facilitated by reference to land marks. The 16 categories were 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). For the purposes of data entry and analysis, the direction of birds' flight was described in degrees.

Behaviour of birds in relation to other existing wind farms and other behavioural observations

In addition to surveys of the ISPB area and the vicinity, observations were also made during itinerant surveys, where possible, in relation to bird behaviour at other nearby operational wind farms, such as geese displaying avoidance behaviour in the vicinity of turbines. These were recorded and described in detail. Additional observations concerning feeding and resting activities of birds were recorded during itinerant surveys.

Weather conditions

As weather likely affects the behaviour of the geese and thus potentially the objectivity of the surveys, the following measures were recorded:

- Wind direction
- Wind strength
- Air temperature
- Precipitation
- Visibility

Weather data were recorded at the start and end of each daily survey session as well as any time after the start when a considerable change in visibility occurred, such as created by episodes of fog or mist. Visibility was defined as the maximum distance (in metres) at which permanent land marks at known distance could be seen. Wind direction and strength as well as temperature were precisely measured by AGE through anemometer masts and kindly offered for analysis of data.

Recording and storage of data

The protocol adopted for the purposes of primary data processing was a modified version of the Protocol of Risk and Bird Mortality, used by the National Laboratory for Renewable Energy Sources of the USA (Morrison 1998). All the data were captured in a daily diary by each observer which were then processed and entered daily into an Excel database.

The diary was kept in the following manner:

1. At the start of each survey, 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 name of the surveyor.

2. When detecting a bird or flock, observers first recorded the exact hour and minute, followed by the species, then the number of birds by species (see above), the horizontal distance from the watch point, flight altitude and the flight direction. After these obligatory data were recorded, additional notes on formation of flocks, landing birds with the exact location of landing etc., were also recorded. If any changes in weather or other interesting and/or important phenomena were observed, they were also entered in the diary with the exact time of the observation.

3. When finishing the daily survey, the exact time, weather conditions and the name of the surveyor were recorded again.

Collision monitoring protocol

The proposed collision monitoring methodology followed that developed in the USA for bird collision monitoring at wind farms (Morrison 1998).

It is well known that searches for victims of collision with operational wind turbines fail to find all dead birds, for several reasons, with the two principal factors being searcher efficiency (searchers fail to find all dead birds) and removal/disappearance of dead birds before the searcher can potentially find them. Accounting for these two potential biases can substantially improve estimates of collision mortality at operational wind farms derived from searches around turbine bases. Staged trials are typically undertaken in order to provide for such correction.

Such trials during winter 2009-2010 at the part of the ISPB territory indicated that searches every 4 days would be appropriate during this season, in order to detect about half the numbers of any geese that may be killed. These were in contrast to comparable trials conducted during autumn 2009 and 2010 when the results suggested that searches every 7 days would detect about half of all medium to large body collision victims. All sets of trials showed that increasing search effort (i.e. increasing the interval search interval) would not generate proportionately greater confidence in documentation of mortality rates. The autumn trials were reasonably consistent across the two years as regards observer efficiency and removal of carcasses by (for example) scavengers. The winter trial showed that carcasses disappeared at a higher rate than during autumn; hence the need to search more frequently in winter to give a similar detection rate.

Searches for collision victims were undertaken in 200 x 200 m plots centred on a turbine along transects 20 m apart, scanning with binoculars areas beyond the search plot when the searcher was at the edge of the plot. Searches were scheduled to start when geese were recorded in the wind farm area, and finish later in the winter when geese had departed the area. All collision victims were to be photographed, collected with notes on finding circumstances (e.g. GPS location, distance from transect, state of carcass, any tracks around carcass).

Radar Observations

Three radar Systems operated continuously during daylight hours (06 - 21 hrs GMT) from 01 December 2018 to 28 February 2019 at a location designed to maximise coverage and minimise ground clutter confusion (Figure 1). The radar systems recorded all flights of geese in the vicinity of the wind farms during the study period and have been used for full coverage control of the ISPB territory during the winter monitoring period. The observed tracks were confirmed by visual observations in orderto quantify flocks and identify species of birds detected by radars.

Figure 3*. Examples of the observed by the radar flocks of 250 GWFG (left) and 150RBG (right) 15 of January 2019 in ISPB territory.*

A Turbine Shutdown System (TSS) was discussed and synchronised with wind farm operators in order to reduce the risk for collision for geese in the ISPB territory. This TSS followed principles and experience described in a web site dedicated to ISPB (https://img1.wsimg.com/blobby/go/1a109f6d-5fe3-4ff5-bcf3-17602b59ac27/downloads/1cjddqfou_175924.pdf?ver=1553584153032) and was applied during the 2018-2019 winter. Hence, in the 2018-2019 winter when large flocks of geese approached groups of operational turbines in conditions of low visibility, coordinated TSS actions with the wind farm operators, informed by measures described in the ISPB, were applied.

3. RESULTS

The 90 days of the study encompassed the whole period when geese were recorded in the region during 2018-2019.

Total number of observed goose species and their numbers

In total very low numbers of geese of all observed species were present in the ISPB territory during the winter 2018-2019. Unusually low numbers of wintering geese was also observed in Bulgaria and Romania in general in the winter season 2017-2018 as well as 2018-2019 (http://wildlifeconservation.bg/english/red-breasted-goose-wintering-season-2017-2018/ and https://greenbalkans.org/en/Low_numbers_of_wintering_geese_in_the_Coastal_Dobrogea-p6918).

Over 10,000 individual goose observations were recorded during the surveys (Table 1). Two species of goose were observed: RBG and Greater White-fronted Goose (GWFG) No Lesser White-fronted Goose and Greylag Goose were seen in winter 2018-2019.

Table 1. *The number of observed geese by dates of different species (data from visual observations). The dates with 0 observed birds are not included in the table.*

Date/Species	A. albifrons	Anser/Branta	B. ruficollis	Grand Total
06.12.2018	48			48
09.12.2018	180			180
31.12.2018	4			4
05.01.2019	90	30	2	122
08.01.2019	136			136
09.01.2019	376		192	568
10.01.2019	508		35	543
11.01.2019	1738	719		2457
12.01.2019	498	60		558
13.01.2019	475	30		505
14.01.2019	147			147
15.01.2019	78	250	180	508
16.01.2019	340			340
17.01.2019	1			1
18.01.2019	550			550
19.01.2019	64			64
21.01.2019	43			43
22.01.2019	206			206
24.01.2019	820	450		1270
26.01.2019	310		11	321
27.01.2019	285	22	10	317
29.01.2019	2			2
30.01.2019	28			28
07.02.2019	65			65
18.02.2019		200		200
28.02.2019	140			140
Grand Total	7132	1761	430	9323

The first GWFG were recorded by observers in the territory at the beginning of December. The last 320, 350 and 120 GWFG were observed first 3 days of March respectively.

The maximum number of geese including RBG was observed in mixed species flocks on 11 January. The proportion of RBG could not always be precisely evaluated but in all the observations available where the proportions of species could be identified it was consistent with previous winters' records and varied between 10 % and 50 %. The number of geese observed in February was much lower than the number of geese in January. No RBG were observed in February and March. The number of flights per day is presented in Table 1.

Temporal dynamics of geese number during the period when geese were observed in ISPB territory are presented in Figure 4.

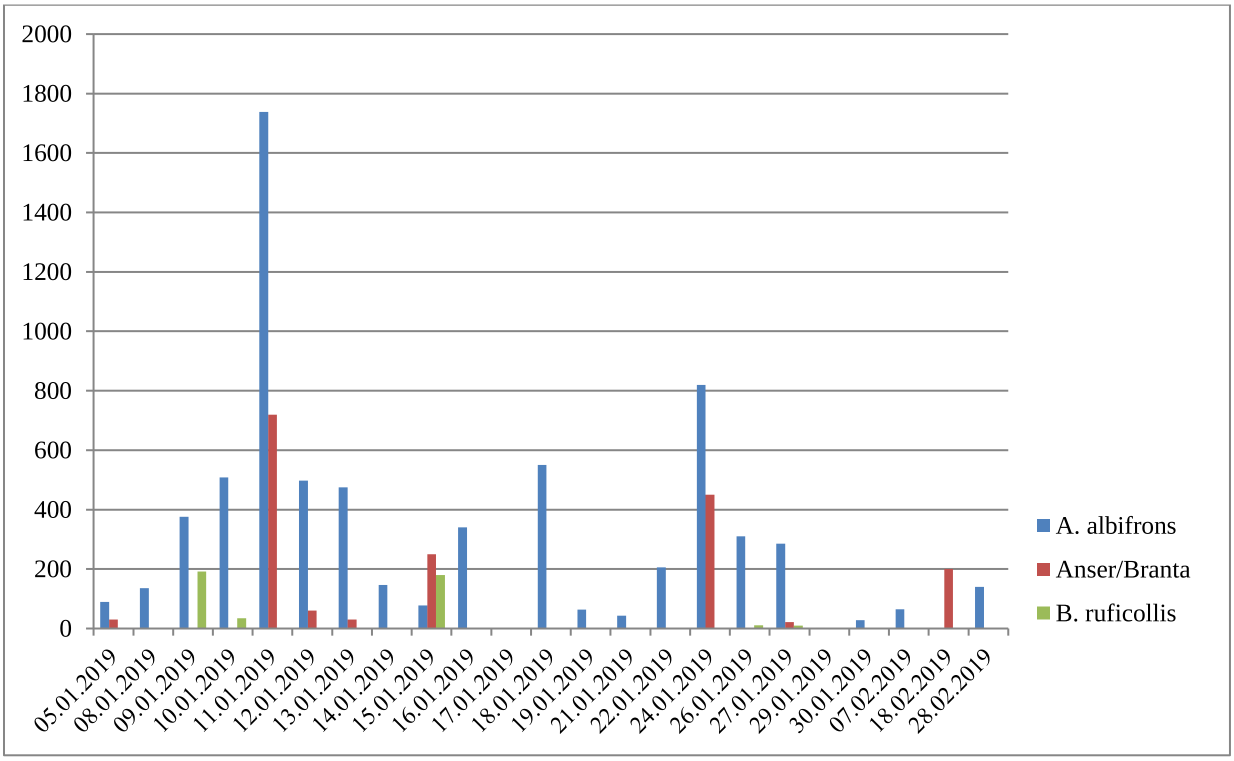

Figure 4. *Temporal dynamics of wintering geese observed in ISPB territory, season 2018-2019.*

The reason for the relatively low number of wintering geese in Bulgaria in general was likely due to the exceptionally mild winter of 2018-2019. Detailed analyses of correlation between ambient temperature and number of geese in SNWF territory in the last 10 years, and discussion of the role of temperature, are presented in a previous report for part of the same territory (http://www.aesgeoenergy.com/site/images/Winter%20Report%202016-2017.pdf).

The winter 2017-2018 as well as 2018-2019 were very mild with day temperatures reaching over 10 ^{0}C even in January. The milder winter conditions and the lack of snow, which allowed good grazing for the birds further north-east in Ukraine and Russia, resulted in a very late arrival of Red-breasted Geese in their wintering grounds along the western Black Sea coast and very low numbers compared to previous seasons.

The highest number of wintering Red-breasted Geese for the last two winter seasons were between 5000 and 6000 over the whole territory of Bulgaria (https://greenbalkans.org/en/Low_numbers_of_wintering_geese_in_the_Coastal_Dobrogea-p6918).

Just for reference: The highest total count of Red-breasted Geese from their wintering grounds came in January 2013 during the International Waterfowl Count, when around 56,000 birds were counted in Bulgaria, Romania and Ukraine. This is believed to be around the current population of the species (AEWA). The greatest number of Red-breasted Geese in 2013 was observed in the middle of the season when geese traditionally pass through the territory of ISPB. No collision with operating wind turbines was recorded in the season with the major 2013 influx of the species in the study territory.

At the same time, many observations across the European continent suggest a permanent expansion of the species to the wintering areas further north, most likely as a result of global warming. This shift of wintering ranges has been observed in various bird taxa (Estrada et al., 2016).

Spatial distribution of feeding geese in the ISPB territory

The density of flocks of geese tracked by the radar systems and confirmed visually are presented in maps below and indicate prevalence of geese activity (flights and feeding fields) in NE part of territory (Figures 5 – 9). Our results from winter 2018-2019 support the selective behaviour of wintering geese in favour of fields that were near to major roosts – the lakes Durankulak and Shabla (Harrison et al. 2017). The same conclusion has been published after 8 years of wintering geese monitoring at one of the wind farms included in ISPB (See http://www.aesgeoenergy.com/site/Studies.html)

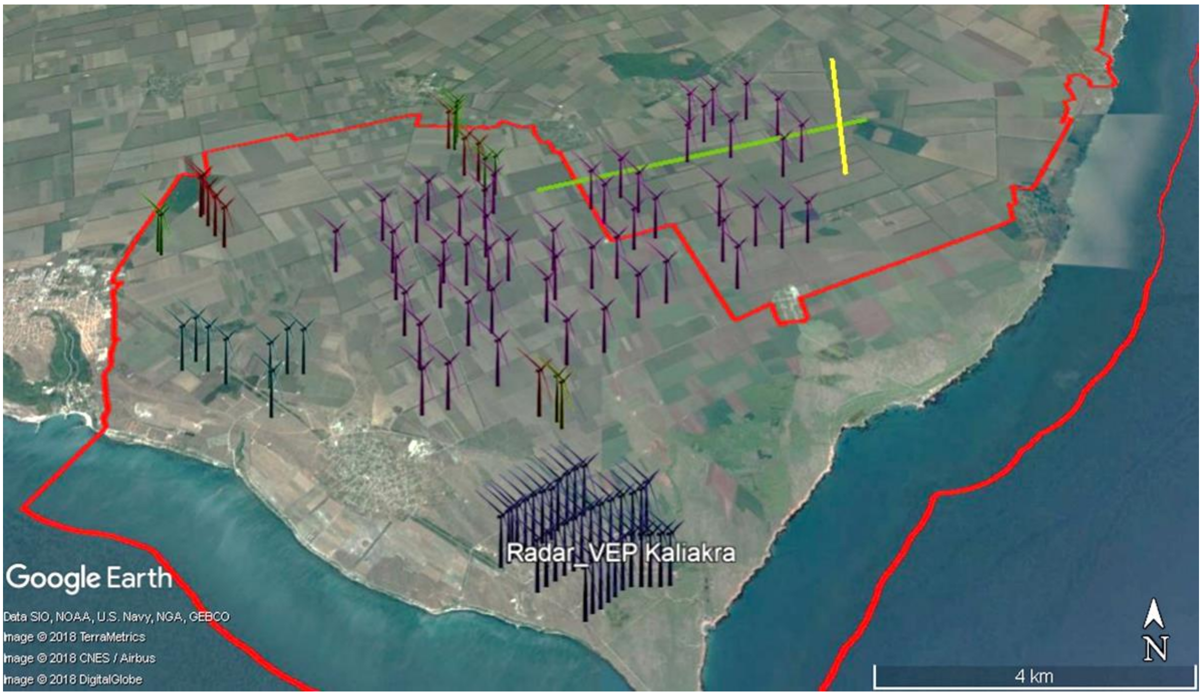

Figure 5. *Two flocks of 48 and 180 GWFG observed 06 December 2018 (yellow) and 09 December 2018 (green) respectively.*

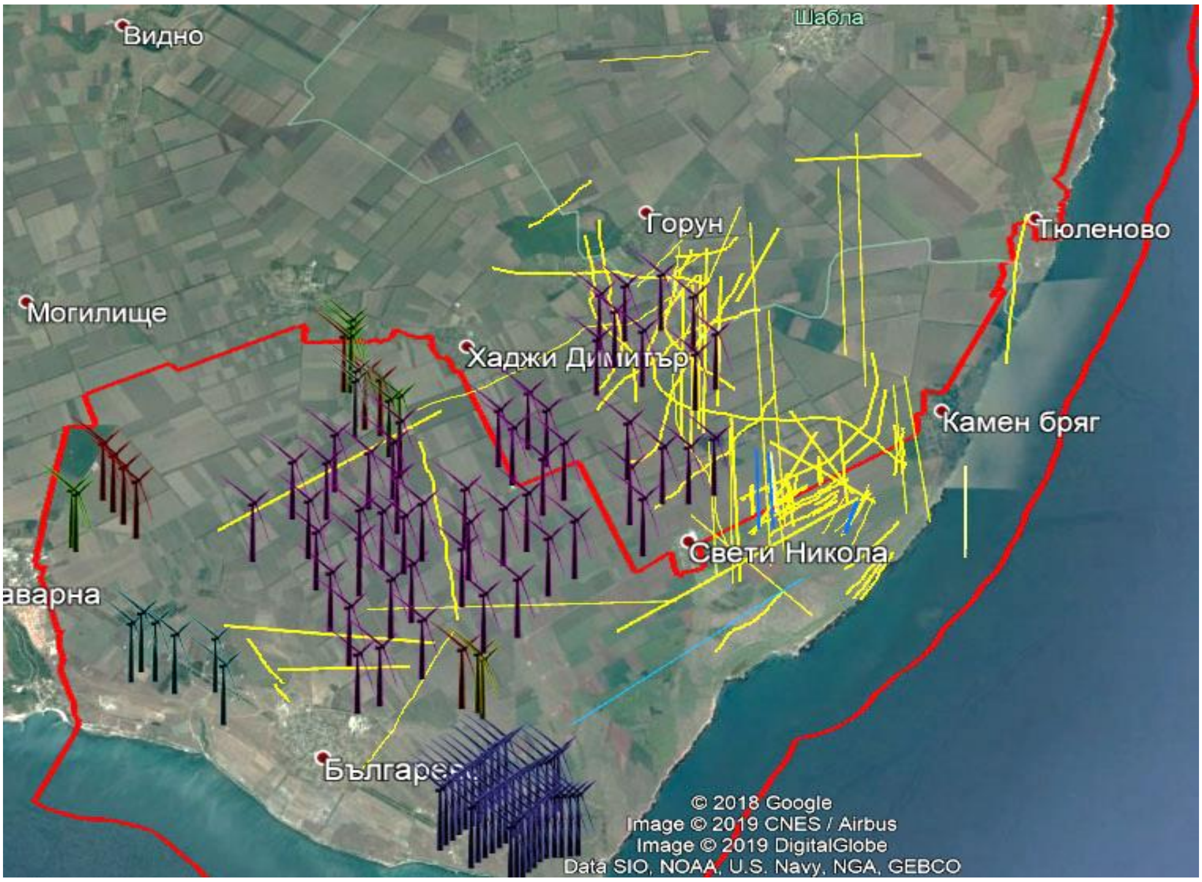

Figure 6. *Flocks of GWFG (yellow) and RBG (blue) registered in ISPB territory in January 2019*

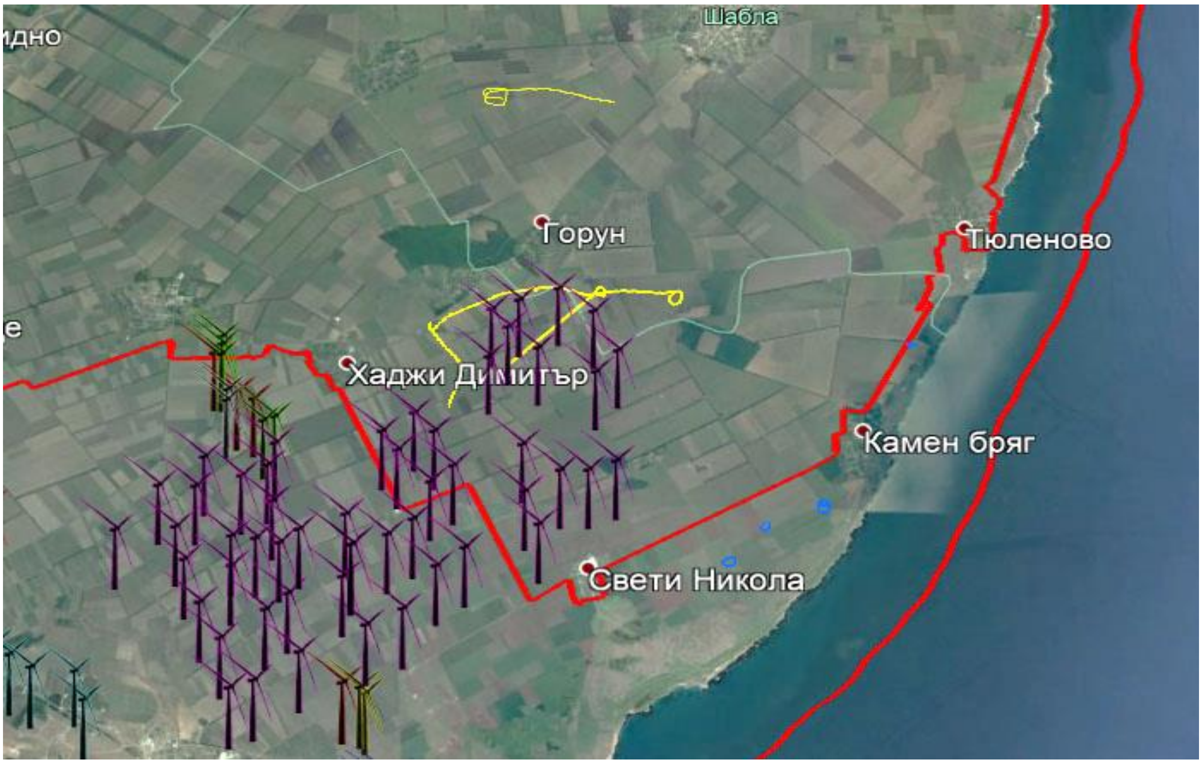

Figure 7. *Mixed flocks of GWFG and RBG feeding (blue) and flying (yellow) observed in January 2019*

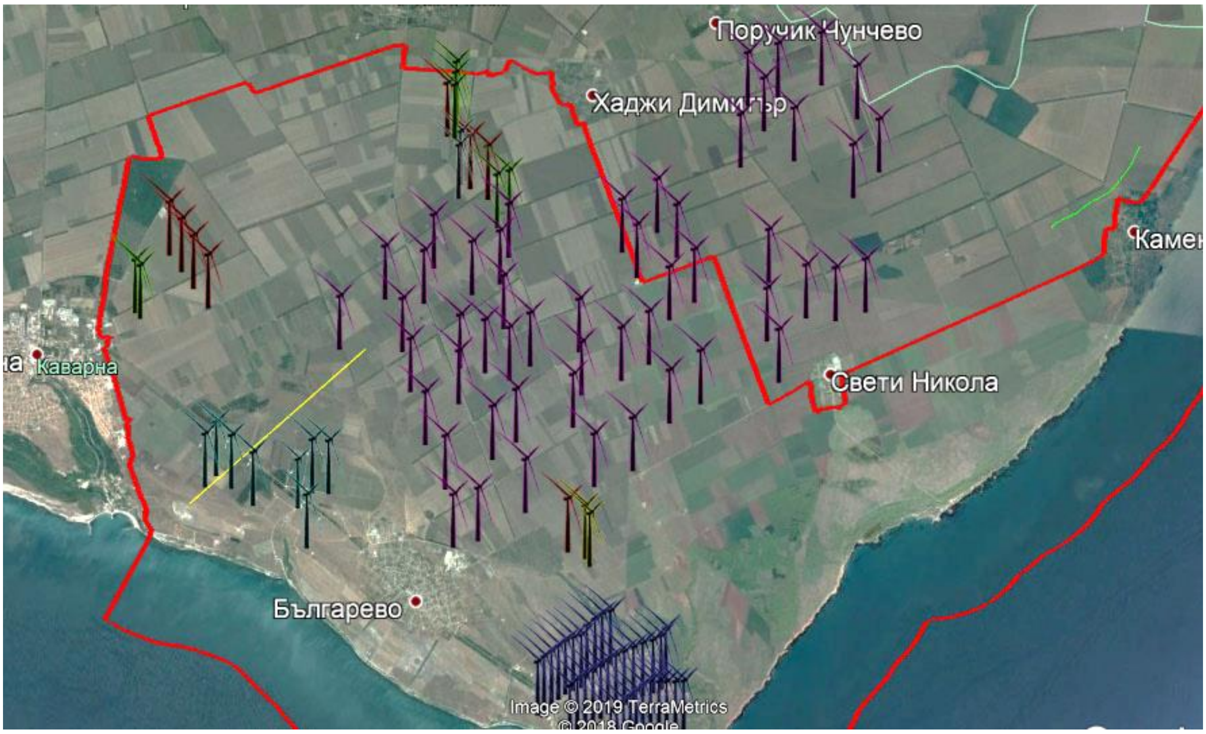

Figure 8. *Flock of GWFG (yellow) and mixed flock of RBG and GWFG (green) registered in ISPB territory in February.*

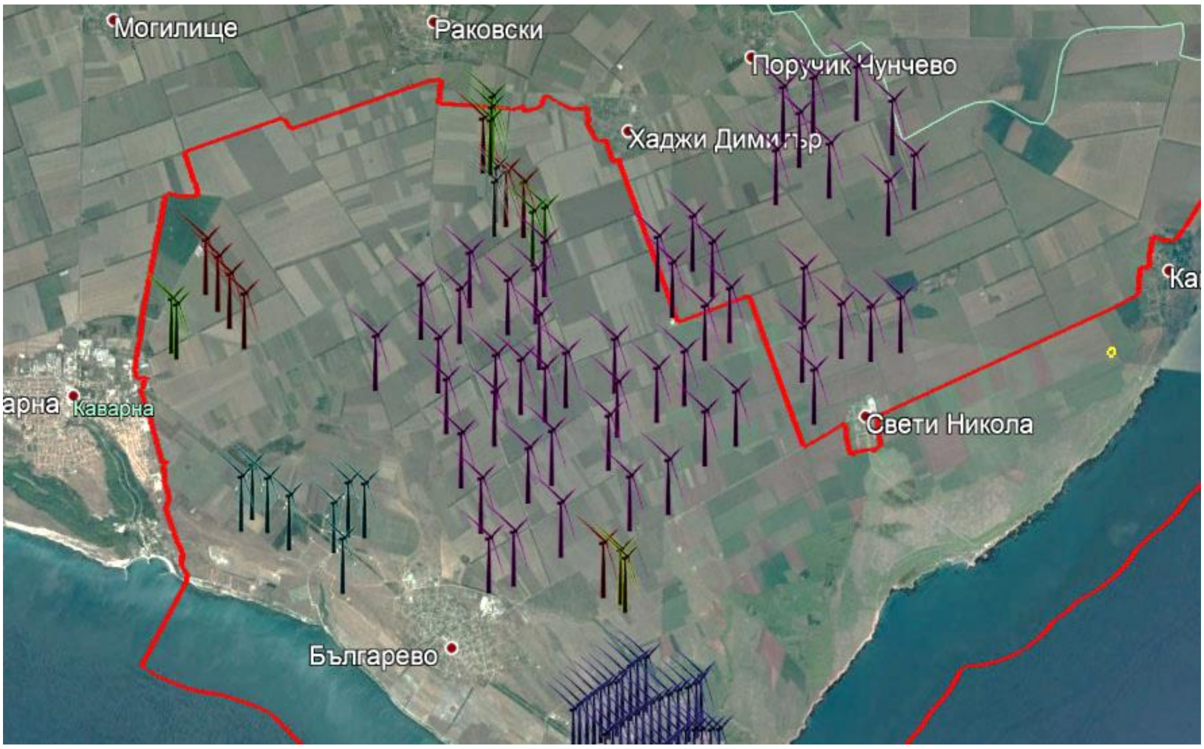

Figure 9. *The only flok of feeding GWFG (yellow) observed February 2019*

Carcass monitoring results

All 114 turbines were programmed to be searched every seventh day (if the areas under turbines were accessible) for carcasses during the whole winter survey period (1st December 2018 – 28th February 2019) when more birds are at risk of collision. The last wintering geese in ISPB territory (see previous reports from St. Nikola Wind Farm (SNWF) – a part of the territory) 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 2.

The main limitation on programmed searches in the study period was the restricted access because of weather conditions: mostly thick mud. In such situations the plots of 200 x 200 metres under turbines were searched from the turbine base (stairs and platform around 3 metres high) by binoculars. Over 95 % of the programmed searches under the 7 day-interval protocol using walked transects in the 200 x 200 metres plots were completed.

Searcher efficiency and carcass persistence has been examined twice during winter monitoring at the part of the ISPB territory – in February 2010 and in January 2016 (see SNWF monitoring reports). The results were similar and broadly confirm the efficiency in searches and carcass removal rates under turbines for a programme of searches every seven days.

Table 2. *Number of searches per turbine during the winter monitoring 2018-2019*

Turbine code	December	January	February	March	Total
ABBalgarevo	1	4	3	3	11
ABΓ1	1	4	4	3	12
ABΓ2	1	4	4	3	12
ABΓ3	1	4	4	3	12
ABΓ4	1	4	4	2	11
ABMillenium group	1	6	6	3	16
ABMillenium group Mikon	1	2	2	1	6
AE10	1	3	4	3	11
AE11	1	3	4	3	11
AE12	1	4	4	2	11
AE13	1	4	4	2	11
AE14	1	4	4	3	12
AE15	1	4	4	3	12
AE16	1	3	4	3	11
AE17	1	3	4	3	11
AE18	1	4	4	2	11
AE19	1	4	4	2	11
AE20	1	4	4	3	12
AE21	1	3	4	3	11
AE22	1	3	4	3	11
AE23	1	3	4	3	11
AE24	1	4	4	3	12
AE25	1	4	4	3	12
AE26	1	3	4	3	11
AE27	1	4	4	2	11
AE28	1	4	4	2	11
AE29	1	4	4	3	12
AE31	1	4	3	2	10
AE32	1	4	4	2	11

Turbine code	December	January	February	March	Total
AE33	1	4	4	2	11
AE34	1	4	4	2	11
AE35	1	4	4	2	11
AE36	1	4	4	3	12
AE37	1	4	4	2	11
AE38	1	4	4	3	12
AE39	1	4	4	3	12
AE40	1	4	4	3	12
AE41	1	4	4	3	12
AE42	1	4	4	3	12
AE43	1	4	4	3	12
AE44	1	4	4	3	12
AE45	1	4	5	2	12
AE46	1	4	4	2	11
AE47	1	4	4	2	11
AE48	1	4	4	2	11
AE49	1	4	4	2	11
AE50	1	4	4	2	11
AE51	1	4	4	2	11
AE52	1	4	4	2	11
AE53	1	4	4	2	11
AE54	1	4	4	2	11
AE55	1	4	4	2	11
AE56	1	4	4	2	11
AE57	1	4	4	2	11
AE58	1	4	4	2	11
AE59	1	4	4	2	11
AE60	1	4	4	2	11
AE8	1	4	4	3	12
AE9	1	4	4	3	12

Turbine code	December	January	February	March	Total
DBГ1	1	4	4	3	12
DBГ1HSW250	1	4	4	3	12
DBГ2	1	4	4	3	12
DBГ2MN600	1	4	4	3	12
DBГ3	1	4	4	3	12
DBГ4	1	4	4	2	11
DBГ5	1	4	4	2	11
DC1	1	4	4	2	11
DC2	1	4	4	2	11
E00	1	4	3	3	11
E01	1	5	3	3	12
E02	1	5	3	3	12
E04	1	5	3	3	12
E05	1	5	3	3	12
E07	1	5	3	3	12
E08	1	5	3	3	12
E09	1	4	3	3	11
M1	1	4	3	3	11
M10	1	4	4	2	11
M11	1	4	4	2	11
M12	1	4	4	2	11
M13	1	4	4	2	11
M14	1	4	4	2	11
M15	1	4	4	2	11
M16	1	4	4	2	11
M17	1	4	4	2	11
M18	1	4	4	2	11
M19	1	4	4	2	11
M2	1	4	3	3	11
M20	1	4	4	2	11
M21	1	4	4	2	11
M22	1	4	4	2	11
M23	1	4	4	2	11
M24	1	4	4	2	11
M25	1	4	4	2	11
M26	1	4	4	2	11
M27	1	4	4	2	11
M28	1	4	4	2	11
M29	1	4	4	2	11
M3	1	4	3	3	11
M30	1	4	4	2	11
M31	1	4	4	2	11
M32	1	4	4	2	11
M33	1	4	4	2	11
M34	1	4	4	2	11
M35	1	4	4	2	11
M4	1	4	4	2	11
M5	1	4	4	2	11
M6	1	4	4	2	11
M7	1	4	4	2	11
M8	1	4	4	2	11
M9	1	4	4	2	11
VP1	1	4	3	3	11
VP2	1	4	3	3	11
ABZevs	1	4	4	3	12
Grand Total	**114**	**454**	**442**	**275**	**1285**

Figure 10. *Location of searched for collision victims turbines with the names given in table 2.*

Systematic searches under 114 turbines covered by ISPB (Table 2) in the period 01 December 2018 – 28 February 2019 resulted in no one collision victim.

No body parts or intact remains of geese which could be considered as collision victims were detected after an accumulation of 1010 searches under 114 turbines in the period 1 December 2018 – 28 February 2019. Therefore, no evidence for collision of any goose species, including RBG, has been found in the winter 2018 – 2019 when geese were present, and turbines were operating.

There were no circumstances in the 2018-2019 winter which required the Turbine Shutdown System (TSS) to be applied.

4. CONCLUSIONS

Relatively mild 2018-2019 winter is probably the main reason for low number of observed geese of two species in ISPB territory.

Daily observations from December 2018 to February 2019 (inclusive) revealed that the recorded presence of geese in ISPB territory was compressed into a short time period within the winter, which was essentially the same as already established in studies 2008 – 2018 in a part of the ISPB territory.

The number of wintering geese observed in ISPB during winter broadly corresponds to the total number of wintering geese in the larger region of coastal Dobroudzha region; but is lower, because of relatively distant roosting sites of wintering geese at the two fresh water lakes – Durankulak and Shabla.

114 wind turbines covered by ISPB were not a source of collision mortality for wintering geese, even though they fly through or feed within ISPB 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 2018-2019 winter but also in any of the nine winters when 52 turbines at SNWF (part of ISPB) has been operational and searched systematically every winter season.

No displacement (disturbance) reaction from geese has been observed for the period 2008-2019 as a result of construction and operation of wind turbines in the ISPB 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.

From research associated directly with ISPB described in the present report (and see previous SNWF winter reports on the AES website, and earlier surveys from this part of the same territory) the study 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, the investigated 114 wind turbines present 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.

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