Report:

The monitoring of the wintering geese in the AES Geo Energy Wind Park "Sveti Nikola" territory and the Kaliakra region in winter 2008/2009

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EXECUTIVE SUMMARY

During the summer of 2008, AGE OOD (AGE), developer of the proposed St. Nikola Kavarna Wind Farm (the Project), was made aware that winter bird survey records for the region, during 2007/2008, had shown what appeared to be potentially significant winter flight activity in the general area of the proposed development. Of particular interest were the reported presence of the Red-breasted Goose within those records. Recognising the importance of the Red-breasted Goose in particular, as part of the ongoing works and environmental commitments associated with the Project, AGE undertook to carry out surveys during the 2008-2009 winter bird season prior to operation of the Project. The aim of the surveys was to:

1. record winter bird activity specific to the Project area (Whilst the 2007-2008 survey highlighted potential activity in the region the data was not sufficient with respect to the spatial and temporal distribution of geese in the development envelope of the Project);

2. ascertain whether there was potential for the Project to have a significant adverse affect on the wintering birds (with a particular focus on Red-breasted Goose); and

3. in the event that an significant adverse affect were predicted, what mitigation measures would be required to reduce the affect to an acceptable level.

As set out in the EMMP, therefore, surveys for goose activity including the IUCN Endangered Red-breasted Goose, were completed in the winter season 2008/09.

The surveys focused on goose activity within the Project area, however, some surveys were completed in the main winter roosting locations at Durankulak and Shabla lakes.

There was a strong correlation seen between the number of geese and the proximity to the two fresh water lakes used as night-time roosting locations. These lakes are the only large areas of fresh water in north-east Bulgaria and the presence of this fresh water is the main attractant to large winter populations of geese.

Daily movements to and from these lakes were recorded as birds left these sites in the morning to move to feeding grounds and returned in the evening to drink and ultimately to roost. Geese were recorded feeding in fields within the Project area; however, this activity was significantly less than that recorded closer to the lakes.

Goose movements through the Project area were recorded daily throughout the winter period; however, there was a peak of activity over a 10 day period (11-20 January 2009). Geese were recorded using a combination of fixed Vantage Points and random itinery counts across the Project area. Observers recorded a standard data set per registration that was later to be incorporated in to a Collision Risk Model. Due to some limitations in the survey, a set of assumptions were made to allow a robust ‘worse case’ assessment of the collision risk to be made.

Based on the data set and assumptions for additional parameters the Collision Risk Model predicted that, in the absence of mitigation measures, a total of 22 Red-breasted Geese could collide with turbines over the winter periods. This would equate to an increase in baseline mortality of 0.7%. This would fall just below the threshold number of collisions that would need to occur to result in a significant impact (i.e. to exceed a negligible magnitude effect, defined as a 1% increase over the existing baseline mortality, as per SNH/BWEA, 2002, assessment methodology).

A mitigation package similar to that to be employed during the autumn migration is therefore recommended for over the winter period. This will be completed in the first year post construction followed by a re-run of the CRM with the mitigation strategy being revised accordingly depending on the outcome of the results.

The mitigation package to be completed includes visual observers and a radar system. All recorded information will be used to inform a turbine shut down system should birds be recorded flying in the direction of the Project area. The extent of shut down (single turbine, cluster of turbines or whole wind park) will be determined by the Project Independent Ornithological Expert (IOE) or Senior Field Ornithologist (SFO) (as defined within the Project EMMP) depending on the number and activity of observed flocks of geese.

This mitigation package was determined to reduce the potential impact of the wind farm on migration birds by a factor of 10. Assuming the same parameters the impact of the wind farm with the proposed mitigation on wintering Red-breasted Geese is calculated as an increase of 0.07% in the baseline mortality or a predicted 3.5 collisions per year. This does not exceed the threshold number of collisions that would need to occur to result in a significant impact (i.e. to exceed a negligible magnitude effect, defined as a 1% increase over the existing baseline mortality, as per SNH/BWEA, 2002, assessment methodology).

INTRODUCTION

Background

AES Geo Energy OOD (AGE) is currently constructing the St.Nikola Kavarna Wind Farm (the Project) consisting of 52 turbines (at 105m hub height and 150m tip height) in north-east Bulgaria, approximately 3-5 km inland from the Black Sea coast. The Project area is close to the two main roosting places of four goose species during the winter period (December – February). This report presents the results of the first years monitoring of winter bird (goose) activity as detailed in the AGE's Environmental Monitoring and Management Plan (EMMP) for the Project. The protocol for the study aimed at recording qualitative and quantitative information about the characteristics of the wintering goose activity in the Project area and wider neighbouring territories. This information was recorded to provide accurate, robust and objective data to inform a Collision Risk Assessment to assess the possible impacts of the wind farm on wintering goose species. Where required mitigation has been recommended in order to counter act any significant impacts reported.

The study area

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

The Project area consists mainly of arable land of various crops, crossed by roads and shelter belts. The area is outside of the Kaliakra NATURA 2000 site.

In order to collect information on the large scale movements of the wintering geese and their habits within the Project area, the survey monitoring was set up to cover an area (study area) wider than but including the Project area (footprint of the wind park) and adjacent agricultural fields (see Figure 1).

Figure 1. Study area the monitoring (red dashed line) and the location of the main roosting sites of the geese: Durankulak, Shabla and Tuzla Lakes. The Project Area is shown in blue.

Species Information

The **Red-breasted Goose** is one of the species to which the *Agreement on the Conservation of African-Eurasian Migratory Waterbirds* (AEWA) applies. It was considered a Vulnerable species by the IUCN. Over 80% of the population roost at just five sites worldwide during the winter, typically with nearby feeding areas threatened by changes in land-use. There has been a strong decline in numbers over the last few decades. As it is not clear to what extent the known population of this species fluctuates - as in other Arctic geese - and given the worsening outlook for the species as a whole, the Red-breasted Goose was upgraded from a species of Least Concern to Endangered status in the 2007 IUCN Red List.

In the middle of the 20 century, a dramatic change in the winter distribution and migratory habits of the species was registered. Red-breasted Geese were recorded for the first time in Southern Dobrudja in the Srebarna Nature Reserve (Michev, 1968) on December 8, 1961 and in the region of Shabla Lake – on February 6-8, 1964 (Donchev, 1967). During the 1950's the Bulgarian territory of Dobrudja was thoroughly studied by Petrov and Zlatanov (1955) but they did not present any information about this species. The two authors did observe, however, that the Greater White-fronted Goose, which is usually found together with the Red-breasted Goose, was often wintering in Dobrudja. Later, Ivanov and Pomakov (1983) provided information about in excess of 20 winter locations of the Red-breasted Goose for the period of 1950-1980. Since 1977 (except in 1986), Bulgarian ornithologists have carried out regular midwinter countings 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 Michev et al. (1981), 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). Research was carried out on the ecology of wintering and the dynamics of the populations of this species (a Bulgarian-Swiss program for protecting biological diversity) but the results were never published. Between 1995 and 1999, red-breasted geese were counted at their roost sites in Bulgaria and Romania (Dereliev et al.2000). It was observed that the birds arrived in Romania in the second part of October, while in Bulgaria they started to arrive in the second part of November. Peak numbers of between 40,000 and 55,000 were usually recorded in Romania in November and December. However, almost the whole population moved into Bulgaria by 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.

For the last three years simultaneous counts have been organised by BirdLife partners in Bulgaria, Ukraine and Romania at the main winter roosting sites for Red-breasted Geese; these counts are planned to continue in the future. In Bulgaria the counts take place once a week during the winter around the Shabla and Durankulak lakes. The preliminary results of these counts indicate methodological gaps in the monitoring schemes that have been applied and are still not published in peer reviewed journals. Some data is available, however, from internet sites of the local BirdLife partners: www.brantaruficollis.org

The **Lesser White-fronted Goose** (*Anser erythropus*) is closely related to the larger Greater White-fronted Goose. It breeds in northernmost Asia, but it is a scarce breeder in Europe with a re-introduction scheme taking place in Fennoscandia. The Lesser White-fronted Goose winters further south in Europe. These two 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 are readily distinguished from the Greylag Goose by their bright orange legs and their mouse-coloured upper wing-coverts. The Greylag Goose has a 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, has an obvious yellow eye-ring, and the white facial blaze goes up to the crown.

The Lesser White-fronted Goose is considered an endangered species, but there are programmes to reintroduce the birds into the wild to strengthen the population. The *Agreement on the Conservation of African-Eurasian Migratory Waterbirds* (AEWA) also applies to this species. There is no information about the number of the species in Bulgaia. It has been sporadically recorded in mixed flocks in north-east 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 with flocks of approximately 50 birds being recorded with White fronted geese (Mitchev et al. 1983).

The **Greylag Goose** (also spelled **Graylag** in the United States), is a bird with a wide range in the Old World. It is the type species of the genus *Anser*. 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-footed Goose (*Anser brachyrhynchus*). 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 *Agreement on the Conservation of African-Eurasian Migratory Waterbirds* (AEWA) also applies to this species. In Bulgaria it is a red data species and its breeding population is endangered. During the winter this species often appears in mixed goose flocks in the territory of the Shabla and Durankulak lakes.

The **Greater White-fronted Goose** is closely related to the smaller Lesser White-fronted Goose (*A. erythropus*). In Europe it has become known as simply **”White-fronted Goose**". Greater White-fronted Geese 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 White-fronted Goose lacks the yellow eye-ring of that species, and the white facial blaze does not extend upwards so far as in the Lesser.

The Greater White-fronted Goose is divided into five subspecies. The nominate subspecies *A. a. albifrons* breeds in the far north of Europe and Asia, and winters further south and west in Europe. *A. 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 hunting. The concentration of the species around the Shaba and Durankulak lakes reaches, in some years, over 250,000 birds. The species form mixed flocks with previously listed species and use the same food resourses during the winter period.

Behavioral Characteristics of the Geese
Flocking behaviour whilst foraging is characteristic of all Geese wintering in Bulgaria and particularly in the region of Northern Black Sea coast. Usually, geese form large flocks with more than 90% of individuals recorded staying in groups of more than 500 birds. 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 birds instead of looking for feeding sites on their own. Flock size is limited by both population size as well as field size and bird density together with field size are likely to be the main factors determining and constraining flock size on agricultural fields (Ekkehard et al. 1999).

Objective of the Study
Geese are dependent on fresh water and this is the main limitation on the winter distribution of these birds. The reliance on fresh water is due to the physiology of waterfowl species. Whilst geese can be to some extent flexible, they remain dependent on fresh water in the feeding process to assimilate their food and maintain normal metabolism. The literature data and BirdLife monitoring results indicate the lakes in the region as the main roosting sites. It is determined by the fresh water lakes at Durankulak and Shabla, where the goose must roost at night to function normally during the wintering period.

In colder weather conditions, geese change their diet but do not fly greater distances as this requires extra energy. The Red-breasted Goose, as with all goose species wintering in the region (Greater White- fronted, Lesser White-fronted, Graylags and even Greater Canada Geese (*Branta canadensis*) (escaped from zoological collections) must adjust their whole circadian rhythm due to a reduction in winter day length. The distance for their feeding is a function of the time budgeted and energy consumed. The balance of energy is crucial for the decision where to look for the food and which food to use. In colder weather geese switch to maize left on the ground and look for it in the fields around the lakes which reduces the distances of the diurnal feeding movements. It is quite a successful strategy if there is no additional disturbance.

Due to the increased numbers of geese around the lakes, hunters are naturally drawn there in increasing numbers. Hunting pressure around the main roosting sites has been increasing in recent years. The geese attempt to roost on the lakes in the evening. If access to the lake is unavailable some may also roost in the nearby Black Sea with some geese drifting further off shore depending of the wind conditions.

After a week or so of such an environment, a number of the weaker birds suffer and become easy prey for raptors and hunters. As a result, the number of raptors increases in the region during this time. From the ecological perspective, the situation becomes unbalanced and external environmental factors become potentially limiting and crucial for survival of the birds.

Current research shows the change in the wintering sites for the last century from Kazakhstan to the Black Sea coast and an ongoing expansion to the west and south during the winter. This shift of the wintering grounds may cause significant changes in the wintering numbers and the spatio-temporal distribution of Red-breasted Goose in current winter areas as well.

Acknowledging this potential change in behaviour, and in response to data provided to AGE during the summer of 2008, the objectives of this study are as follows:

1. to record winter bird activity specific to the Project area (Whilst the 2007-2008 survey highlighted potential activity in the region the data was not sufficient with respect to the spatial and temporal distribution of geese in the development envelope of the Project);

2. ascertain whether there is potential for the Project to have a significant adverse affect on the wintering birds (with a particular focus on Red-breasted Goose); and

3. in the event that a significant adverse affect is predicted, what mitigation measures would be required to reduce the affect to an acceptable level.

In the course of satisfying these objectives, the validity of the following hypotheses will be also be tested in order to ascertain whether the activity observed corroborates the observations in trends described above.

Hypothesis 1:

The Red-breasted Goose can reach Kaliakra in numbers. The appearance of the geese is sporadic and no pattern can be derived concerning their number and distribution through the Project area.

Hypothesis 2:

The numbers of geese observed in the Project area are a simple function of the density in the main roosting sites at the Durankulak and Shabla lakes. The temporal dynamics are a normal distribution. The spatial distribution is random or flocking behavior based. No significant increase in the number of wintering geese is registered during the season.

METHODS

Duration, methods and equipment

The study was carried out from the 10th of December 2008 to 28th of February 2009, covering a total of 78 days. This 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 during the early mornings at take-offs from the roosting sites. The teams were separated in pairs at predetermined Vantage Points giving comprehensive coverage of the Project area and neighbouring fields.

Targeted separate counts were made around the Shabla, Durankulak and Tuzla lakes in order to record the total number of geese wintering in the region (see Figures 1 and 2). The surveys at these locations were made during the morning, with observers on site prior to the first birds leaving the roosting sites and also during the evening return of the birds to the lakes.

The geese were observed taking off from their roosting sites towards the feeding grounds as this was determined the most efficient and objective way to determine the exact numbers of the wintering geese in the region. Their distribution, feeding and flight pattern was recorded during the peak period of activity over the winter season.. Additional data was 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 within the fields.

Daily counts were made throughout the winter period at the main feeding sites throughout the Project area. Detailed recording of flight lines were made as birds passed through or in the vicinity of the Project area. Temporal itinerary counts were applied once a week for quantitative estimates of the feeding birds within the Project area.

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 and Lesser White-fronted Goose. Data about the Greater White-fronted Goose was collected as a second priority.

Figure 2. Location of Project area in Relation to the fixed Vantage Points (red and green dots).

The study involved direct visual surveys of all passing birds from 9 Vantage Points (red dots - Figure 2) focussed on the Project area (denoted by the area marked as AES Geo Energy in Figure 2) and a point at the Lake Durankulak Vantage Point (green dot – Figure 2). Point counts have been used in both the tropics and temperate areas to monitor wintering migrants before (Hutto and others 1986; Blake 1992). Although effective in terms of results, the visual observations at each counting point on its own cannot encompass the whole region. That is why the results of the visual surveys were accompanied by itinerary counts throughout the

Project area and surrounding agricultural fields. Intinery counts were completed at feeding locations by counting birds on the ground. These were done to ascertain the population of wintering geese in both the Project and Study areas. The overall number of birds per species was obtained by summarizing the counts simultaneously at least three observation points. The number of birds per species counted for each single day and additional periods 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 but focussed on the Project Area.

Height estimates and distances to the birds were verified against nearby land marks, the position of which were measured and calibrated by GPS.

All observers were qualified specialists carrying out the surveys of bird migration for many years. All observers are active members of BSPB (BirdLife Bulgaria). Also participating in the observations was Tristan Evans, a consultant and representative of RSK Carter Ecological Ltd, UK.

Survey participants

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

Victor Metodiev Vasilev
Senior researcher in the faculty 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
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PhD student,
Member of BSPB since 1999

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

Nurel Metinov Nuriev
Member of the BSPB since 2000

Tristan Evans

In order to achieve high accuracy of in-field recording, a three day field seminar was conducted before the observations to discuss and agree a standard recording methodology; this included counting and estimation of flight heights, distances and direction.

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 an expert from RSK Carter Ecological Ltd, Tristan Evans, during the survey period.

Types of data

During the surveys the following of data were recorded:

- Species of the birds
- Number of birds
- Distance of the flying birds from the observer
- Altitude of the birds
- Direction of the flight
- Behaviour of the birds in relation to other existing wind farms in the region
- Other behavioural observations
- Physical factors of the environment, influencing the the survey's objectivity

Species

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

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. If there was the possibility of single Red-breasted Geese in a large flock of Greater White-fronted Geese this was still recorded as an *Anser/Brant* flock. The proportions of Red-breasted Geese in these flocks were calculated using accurate counts of mixed flocks on the ground.

Number of the geese

The surveyors counted all the geese, flying in their scope of view, regardless of the possibility to distinguish their species or higher taxonomic category (as described in the previous paragraph). When the data was 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, when the counting of every single individual was impossible, groups of 10 birds were counted for the bulk of the flock.

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

Along with establishing the quantitative character of the wintering geese, defining the relative distance of the flying birds or flocks' trajectories was among the 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 recorded individually for each bird or flock.

The flight altitude of every single bird or flock was defined and recorded in increasing bands of height. Height bands were used to allow more accurate recording of flight heights, to reduce the subjectivity of the observers, and to provide data that could be usefully analysed for the purposes of assessment.

Flight direction

The direction of the flights observed was captured by recording the geographic direction to which the birds were headed with respect to the observation point. In defining the geographic direction, 16 possible designations of the relative geographic directions were used (every designation being limited to 22,5 degrees). The accepted 16 designations 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). The flight direction was recorded individually for every single bird or flock. However, for the purposes of analysis, in the database, the direction of the birds was captured in degrees.

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Figure 3. A view of one of the observation points and land mark used as reference when defining the birds' flight altitude.

Physical factors of the environment, influencing objectivity

The physical factors influencing the behaviour of the geese and thus potentially the objectivity of the surveys were taken into account and recorded, primarily:

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

The direction and strength of the wind as well as temperature were precisely measured by AGE and kindly offered for the analysis of data.

Visibility was defined as the maximum distance at which permanent geographic markers could be seen. Visibility was defined and recorded in metres. The data was recorded at the start of the surveys as well as any time a considerable change in the visibility occurred. The occurence of episodes, like fog, mist and other phenomena leading to deterioration of visibility was also taken into account.

Behavior of the birds in relation to other existing wind farms in the region and other behavioral observations

In addition to surveys of the Project site and the roosting and feeding areas further afield, observations were also made, where possible, in relation to bird behaviour at existing wind farms/turbines 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.

Recording of the data

All the data was captured in a diary. The data were processed daily and entered onto a *database* designed in an excel workbook. 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).

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 values of the physical factors of the environment (as described above) and the names of the surveyors.

2. When observing a bird or flock, first the exact hour and minute was recorded, followed by the species, Latin name, then the numbers, the vertical and horizontal distance from the watch point and the flight direction. After these obligatory data were

recorded, additional information such as formation of flocks, landing birds with the exact location of landing, etc., was also recorded. If any changes in the values of the physical factors of the environment 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 closing the surveys, the exact time, the values of the physical factors of the environment and the names of the surveyors were recorded again.

RESULTS

The 78 days of the study covered the whole wintering period of the of geese in the region as previously defined by literature, from 15 December 2008 up until the 28 February 2009. The study started before the geese appeared in the region and finished after the last goose was observed. The study encompassed 640 astronomic hours of observations at 10 observation points.

Table 1. **Timetable and location of the observations during the monitoring period**

	Observation points									
Dates	1	2	3	4	5	6	7	8	9	10
17.12.2008 - 21.12.2008	X	X	X		X	X	X		X	X
22.12.2008 - 26.12.2008								X		
27.12.2008 - 31.12.2008	X	X	X	X	X	X	X	X	X	X
06.1.2009 - 10.1.2009	X	X			X	X		X		
11.1.2009 - 15.1.2009	X	X	X	X	X	X	X	X	X	
16.1.2009 - 20.1.2009	X	X	X	X	X		X			
21.1.2009 - 25.1.2009	X	X		X		X			X	X
26.1.2009 - 30.1.2009	X							X	X	X
01.2.2009-05.2.2009		X								X
06.2.2009-11.2.2009								X	X	
12.2.2009-17.2.2009		X								X
18.2.2009-23.2.2009								X	X	
24.2.2009-28.2.2009		X								X

Total number of observed goose species and their numbers

Over one million individual bird observations were recorded during the surveys (Table 2). Of these, 228,571 of the registered geese were identified to the species level. In total, three species of goose were observed: Red-breasted Goose; Greater White-fronted Goose and Greylag goose. Additionally, data concerning two species of Swan were observed and analysed as part of the study.

The proportion of registered geese using the Project area is much lower than the overall stated figure above, however, data from the main roosting sites of Durankulak and Shabla has been included in order to test if the fluctuations of the geese feeding at the Project area correlate with the general number of birds in the region or whether separate patterns are present in the temporal dynamics of the studied species.

Table 2. The number of observed geese from different species

Species	Total	Percent
A. albifrons	191,206	18%
A. anser	152	0.1%
Anser sp.	718	0.6%

Anser/Branta	823,874	78%
B. ruficollis	37,213	3.4%
Grand Total	1,053,163	100%

Table 3. Average proportion and standard deviation of the two most numerous geese species registered during the study.

Date	A. albifrons	B. ruficollis
17.12.2008 - 21.12.2008	100%	0%
22.12.2008 - 26.12.2008	100%	0%
27.12.2008 - 31.12.2008	89%	11%
06.1.2009 - 10.1.2009	90%	10%
11.1.2009 - 15.1.2009	82%	18%
16.1.2009 - 20.1.2009	74%	26%
21.1.2009 - 25.1.2009	90%	10%
26.1.2009 - 30.1.2009	91%	9%
31.01.2009 – 05.02.2009	88%	12%
06.02.2009 -11.02.2009	97%	3%
12.02.2009-17.02.2009	87%	13%
18.02.2009-28.02.2009	87%	13%
Average proportion (STDEV = 7%)	89%	11%

The proportion of the two most numerous species Greater White-fronted Goose and Red-breasted Goose varied during the study period. In Table 3 above the proportion of these two species is presented in 5 day periods. Greylag Geese are comparatively low in number (152 birds), which equates to a proportion from 0 to 0.3% (in average 0.09%) of all observed geese.

Spatial distribution of the geese in relation to the Project area

In 18 out of 78 days of observations, geese were registered in the Project area. However, the proportion of the registered geese in the Project area as compared with the total number of geese at the main roosting sites Durankulak and Shabla Lakes number was between 0 and 1% during the winter season. Strong positive correlation exists between the northern latitudes and number of Red-breasted and Greater White-fronted Geese (Figures 3,4,5). This correlation was reflected in the spatial distribution of geese within the wider studied territory.

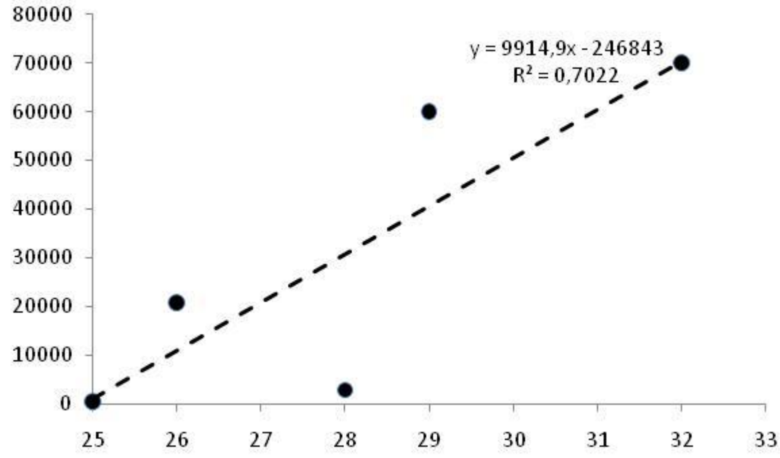


Figure 4. Correlation of the number of Greater White-fronted Geese (*A. albifrons*) observed and the Northern altitude component

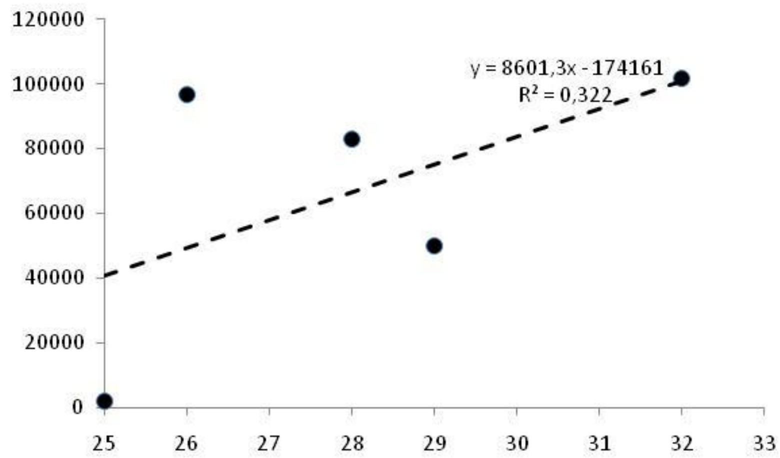


Figure 5. Correlation of geese in mixed flocks (A. albifrons/ B. ruficollis) observed and the Northern latitude component.

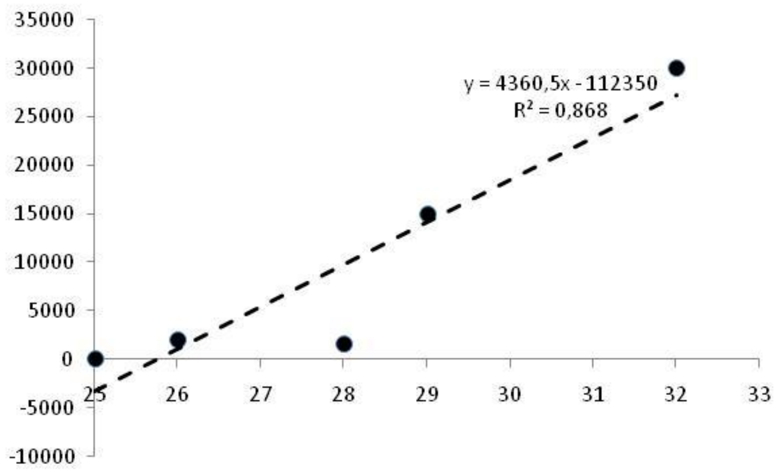


Figure 6. Correlation of Red-breasted geese (*B. ruficollis*) observed and the Northern latitude component.

Notwithstanding this latitudinal correlation, within the Project area two types of goose activities were registered: feeding and flying across the site. A summary of the spacial distribution of the geese and swans in the Project area and the wider region of the study is presented in Figures 7 and 8.

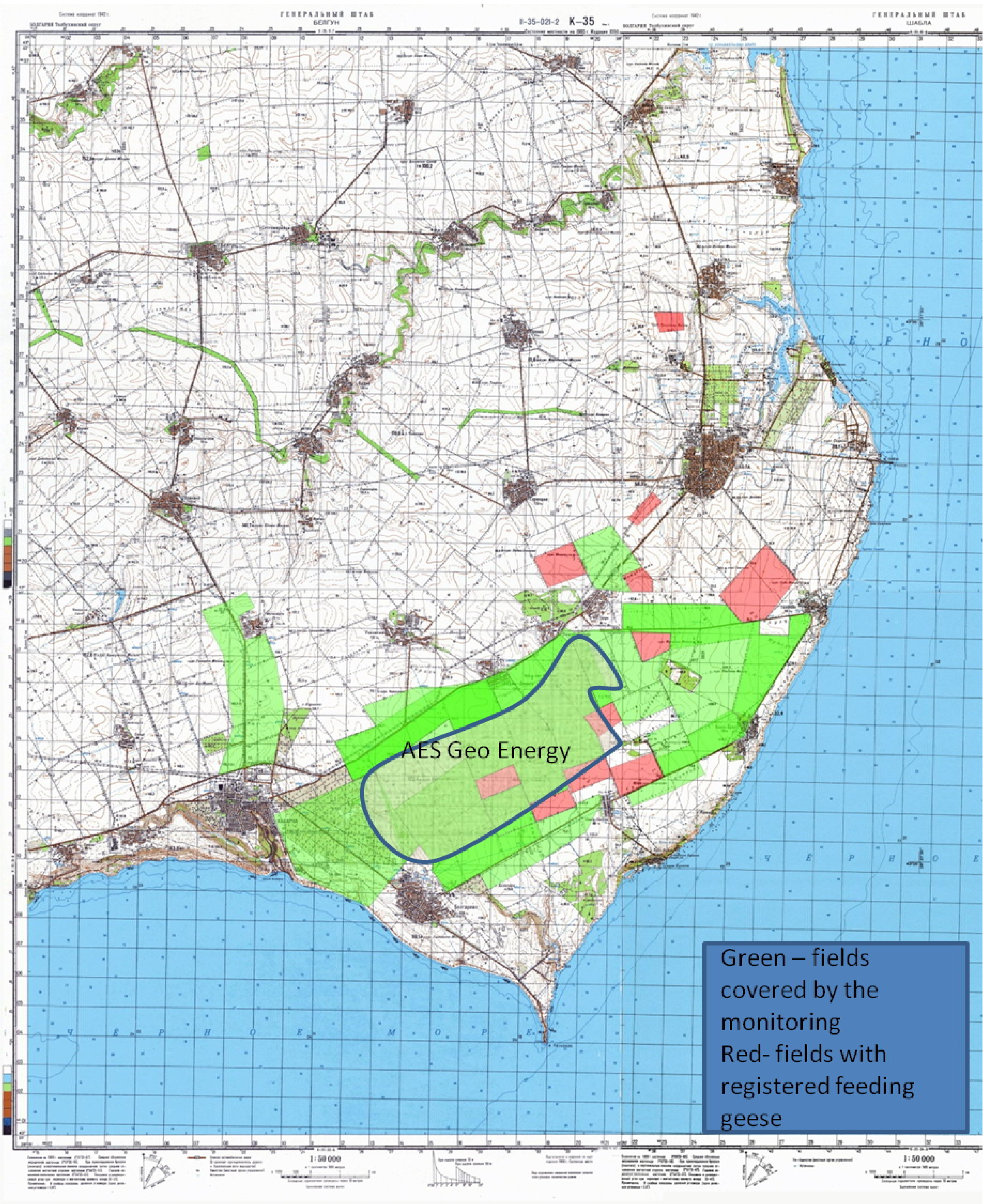


Figure 7. The distribution of the feeding geese in mixed flocks (Red-breasted and White-fronted) in relation to the Project area. The fields are given in red if a single flock of geese was registered during the period November 2008 – March 2009.

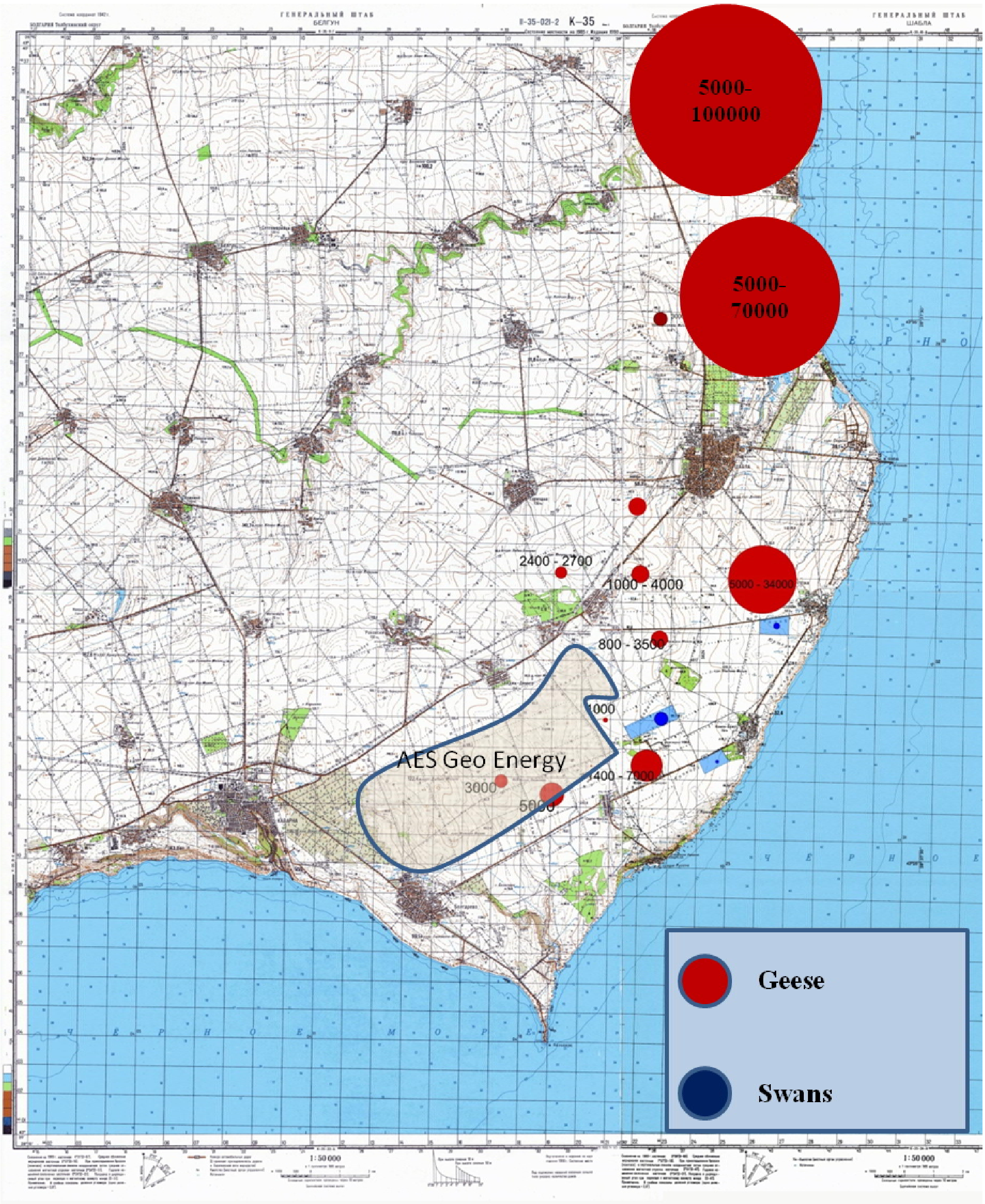


Figure 8. The distribution of the feeding geese in mixed flocks (Red-breasted and White-fronted) in relation to the Project area. The fields are given in red if a single flock of geese is registered during the period November 2008 – March 2009.

Altitudinal distribution of flying geese

298,938 individual observations were included in the analysis of the flight altitudes. The majority of the birds were observed flying at altitudes of between 100 and 300 metres above the ground level (Figure 9). The species variations in the altitudes are not statistically significant. Accounting for all registered geese, 91% of them were observed between 100 and 300 metres above the ground (Figure 10). This distribution includes birds observed during all hours of the day. Therefore, the altitudes of the bird flights represent all kinds of functional flights and represent the whole spectrum of spatial trends seen during the winter season.

The average altitudes measured in relation to activity within the Project area correspond with the identified feeding territories in the study area (Figures 11 and 7). The lower flights were more often recorded around the fields with registered feeding geese. The rest of the study area was used by geese during their transit flights to the feeding grounds.

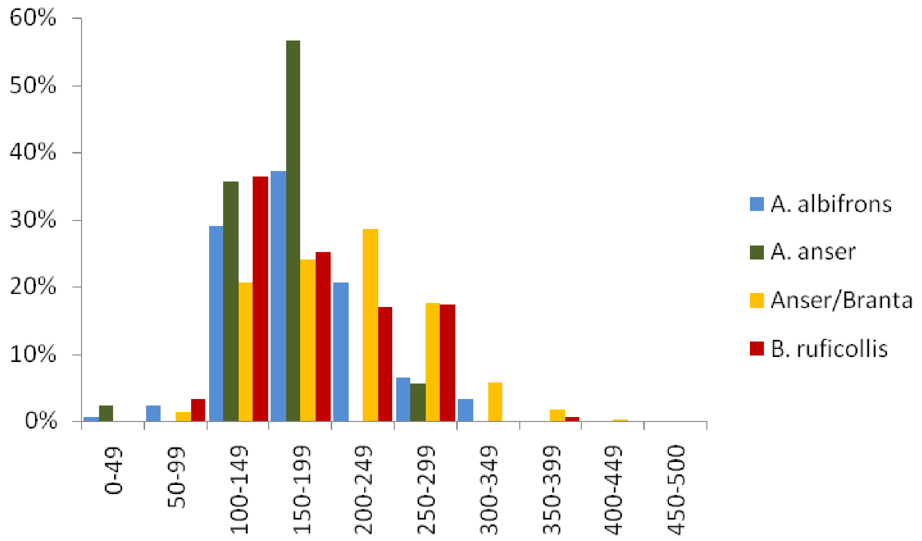


Figure 9. Comparative distribution of the flight altitudes of all geese species

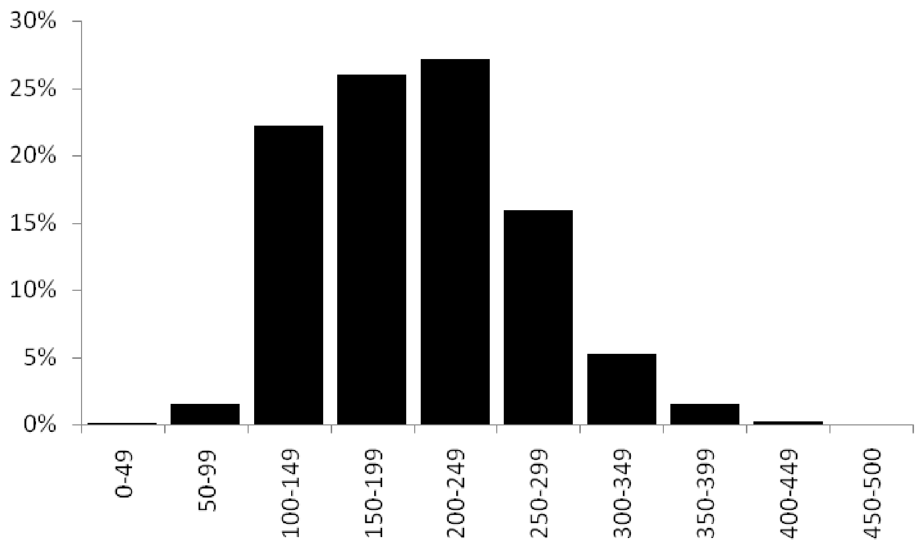


Figure 10. Flight altitudes of the geese registered during the monitoring

Figure 11. Average flight altitudes of the geese measured in 5 observation points at the border of Project area territory.

Flight directions of the geese

The main direction of flying geese of all three species was also analysed in order to understand the spatial and temporal flight distribution of the birds in relation to the Project area. The main direction of a single species and its statistical significance (Reylegh test, Batchelet 1981) are given in Table 4 and Table 5.

Table 4. The mean flight directions of different species at the morning (6:30 – 8:30). * - statistically significant

Species	**R**	**Number of birds**	**Mean direction**
A. albifrons	0,59	42558	**222***
B. ruficollis	0,55	4670	**214***
Anser/Branta	0,42	469441	**217**

Table 5. The mean flight directions of different species at the evening (16:00 – 18:00). * - statistically significant

Species	**R**	**Number of birds**	**Mean direction**
A. albifrons	0,55	8357	**53***
B. ruficollis	0,88	2545	**70****
Anser/Branta	0,40	151168	**97**

During three of the days where the maximum number of geese were observed during the winter, flocks we tracked by simultaneous observations in at least 3 points in order to locate precise movements through the Project area and neighbouring land. The results of this tracking are shown in Figures 16, 17 and 18. It is worth noting that the days when tracking of the movements occured coincided with the hunting days and thus provides an insight into the behaviorial changes of the geese during such days.

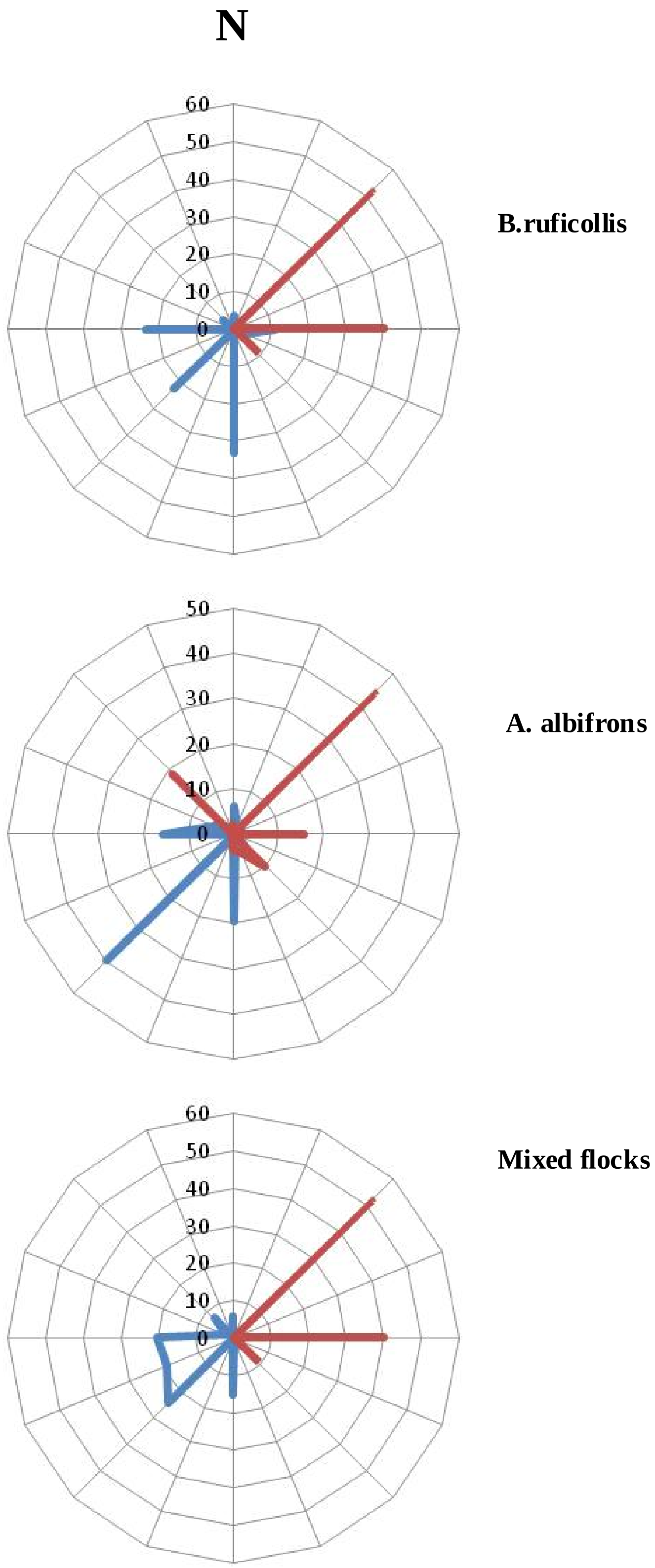


Figure 12. Circular distributions of the registered flights during the morning (blue line) and evening (red line) counts at the observation points near Lake Shabla and Tuzla. The mean direction, its significance and the number of birds included in the analysis are given in Tables 4 and 5.

Figure 13. Morning (blue line) and evening (red line) flight directions of the mixed flocks observed near Lakes Shabla and Tuzla during the monitoring. The mean direction, its significance and the number of birds included in the analysis are given in Tables 4 and 5.

Figure 14. Morning (blue line) and evening (red line) flight directions of Red-breasted geese observed near Lakes Shabla and Tuzla during the monitoring. The mean direction, its significance and the number of birds included in the analysis are given in Tables 4 and 5.

Figure 15. Morning (blue line) and evening (red line) flight directions of Greater White-fronted Geese observed near Lakes Shabla and Tuzla during the monitoring. The mean direction, its significance and the number of birds included in the analysis are given in Tables 4 and 5.

Figure 16. The movements of mixed flocks registered on 10th of January 2009 simultaneously at several points of observation. Blue arrows – morning hours (6-8:30), red arrows – evening hours (16-18).

Figure 17. The movements of mixed flocks registered on 11th of January 2009 simultaneously at several points of observation. Blue arrows – morning hours (6-8:30), red arrows – evening hours (16-18).

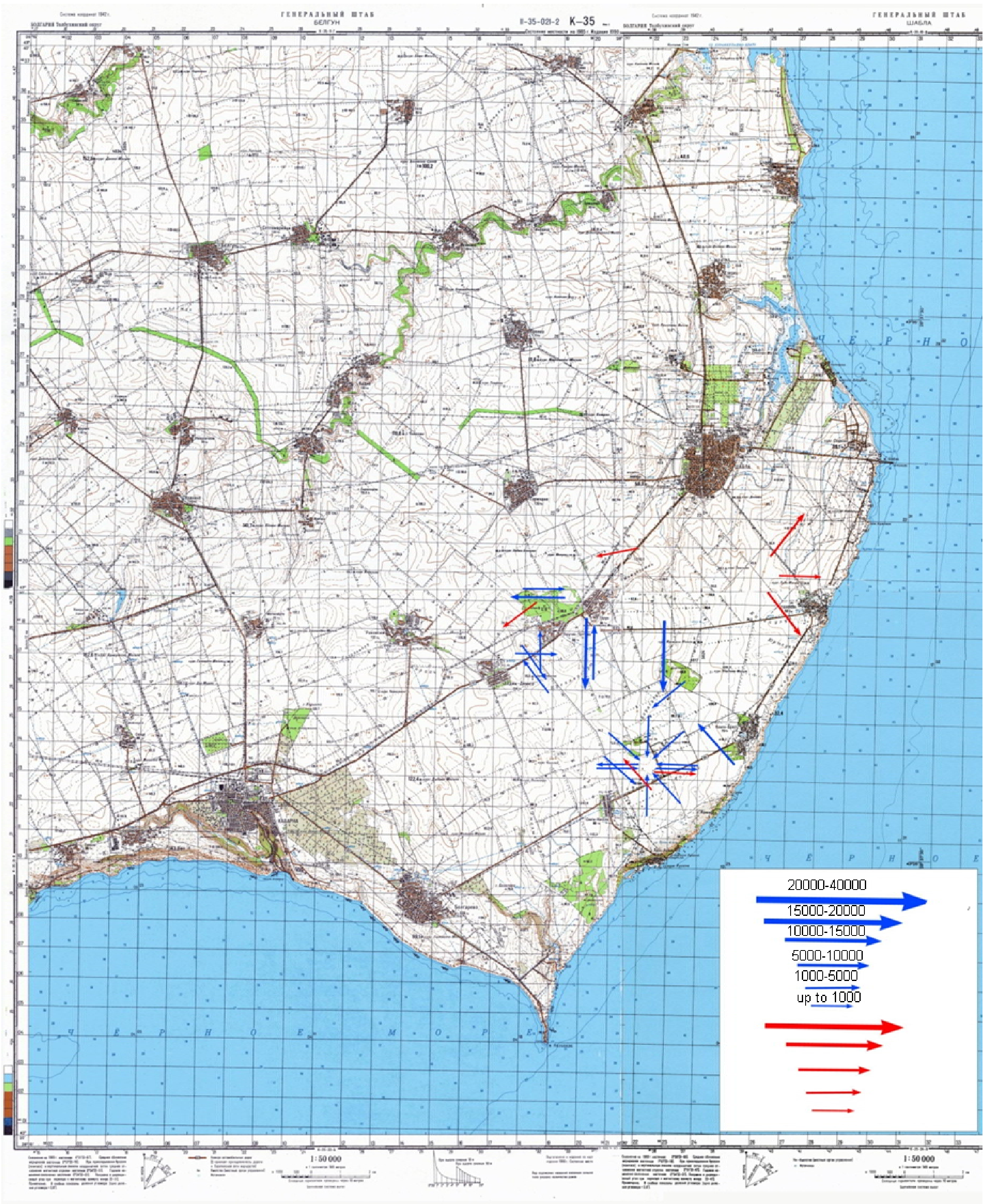


Figure 18. The movements of mixed flocks registered 12th of January 2009 simultaneously at several points of observation. Blue arrows – morning hours (6-8:30), red arrows – evening hours (16-18).

Temporal distribution of the registered birds

Dynamics of the species during the winter season

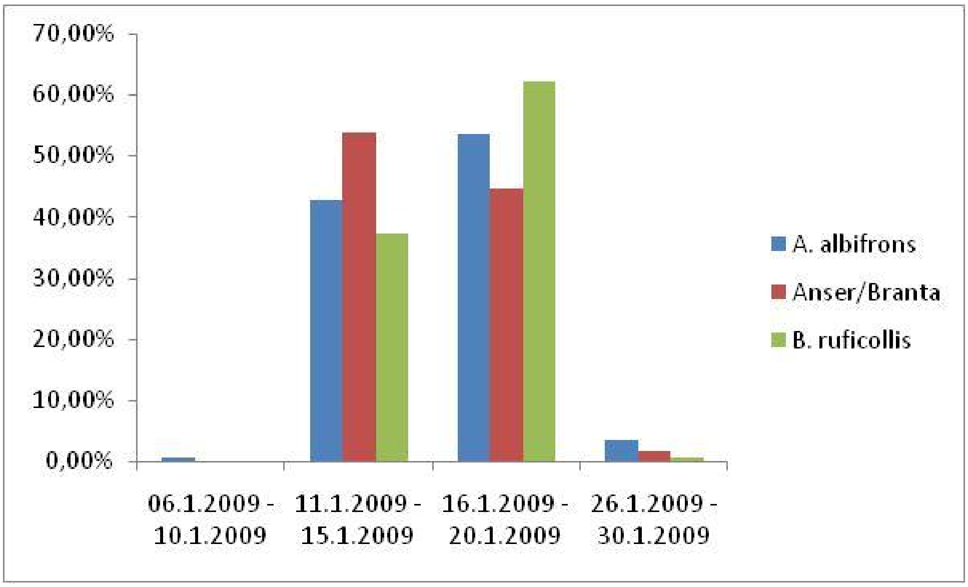
The first observations of the geese at the main roosting sites in region of the Durankulak and Shabla lakes were from the middle of December (19.12.2008) when single birds and small flocks were registered for the first time. Since the majority of the observed geese are in mixed flocks it is difficult to confirm differences in the time of appearance of single species in the studied area. The data obtained suggested simultaneous appearance of all 3 species recorded. However, it was notable that the first confirmed registration of Red-breasted Goose near the Project area (29 December) was 10 days after the first Greater White-fronted Goose and flocks of non-identified and probably mixed geese were observed in the region (18 December).

Dynamics of the geese number within the Project area

For the analysis of temporal distribution of the geese in the Project area the data from the Vantage Points around the Project area were included (1 to 7). Additional data from the road itinerary counts through the Project area were also incorporated.

The number of the three goose species using the Project area as a feeding site or just crossing this territory during the transit movement were concentrated in a 10 day period (between 11 and 20 January) (Figure 19).

This peak of activity in the Project area coincides with the peak number of geese observed in the wider study area including the lakes at Durankulak and Shabla (Figure 20).



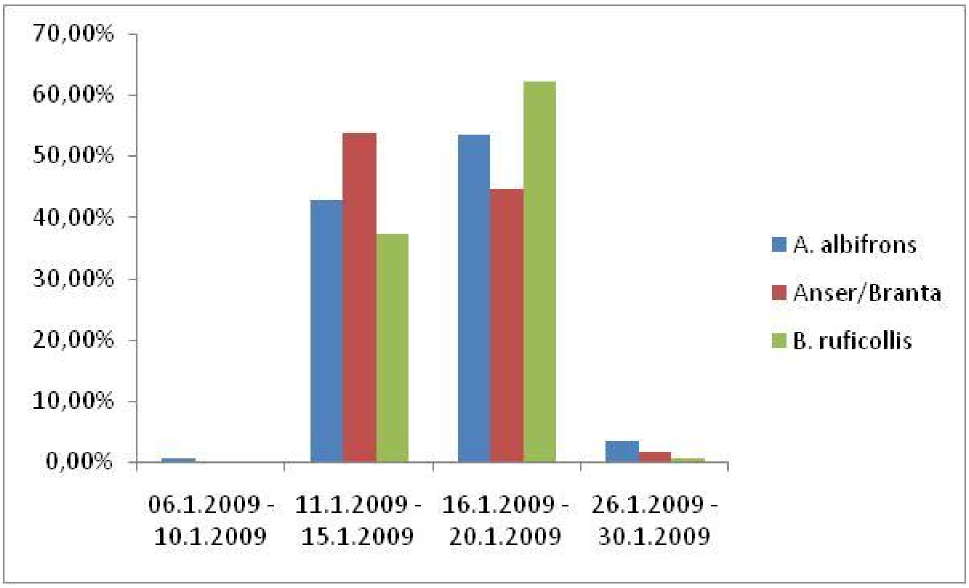


Figure 19. Temporal dynamics of the geese number in the Project area

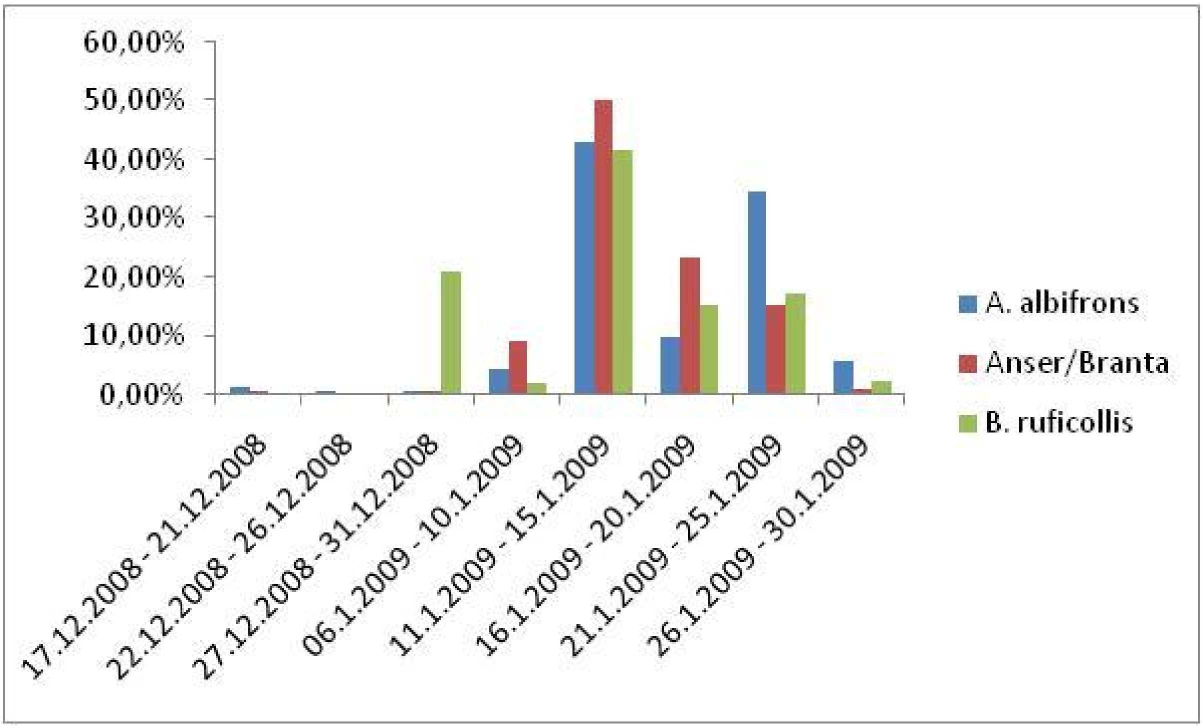


Figure 20. Temporal dynamics of the geese number in the Study area

Circadian dynamics

Data concerning all passage of geese registered from the Vantage Points around the Project area was analysed. The diurnal activity of the geese in the Project area was seen to include two peaks, one during the morning and one in the evening (Figure 21). The results of this analysis were similar to those for all species circadian dynamics over the whole Study area.

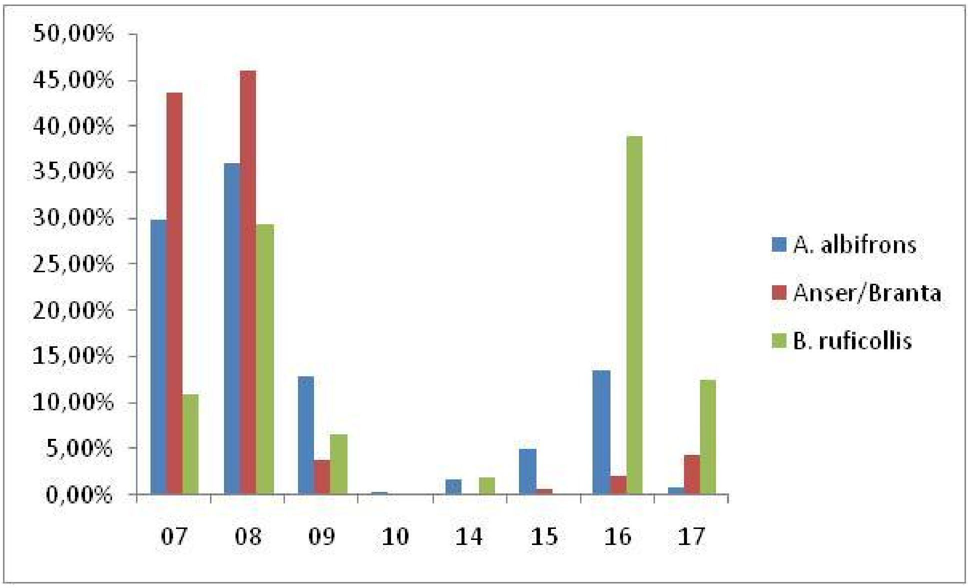


Figure 21. Circadian dynamics of the flying geese through the Project area**.**

CONCLUSIONS OF FIELD OBSERVATIONS & ANALYSIS

The methods applied to this study have provided significant information concerning the species composition of geese and their spatial and temporal distribution within the Project area and wider Studied Area. Furthermore, the number of observation points and the sample size collected is representative for the whole population of the wintering geese in the Project area and wider Studied Area.

The wintering period of the geese observed during the surveys starts in the middle of December and ceases by the end of February. From the analysis of the data, it can be seen that there is a strong positive correlation between the number of geese observed and latitude, with the number of geese increasing northwards throughout the Studied Area. In addition, the main feeding grounds of the Red-breasted and White fronted Geese were confirmed as being located outside the Project area and, again, concentrated further north. Indeed, the spatial distribution of geese observed indicates strong dependence on the fresh water resource at Durankulak and Shabla lakes. There is a gradient of the registered density of geese decreasing with the distance from these two main roosting sites.

Three goose species were registered in the Project area as well as in the neighbouring territories: Red-breasted Goose, Greater White-fronted Goose and Greylag Goose. The ratio of Red-breasted to Greater White-fronted Geese in the Project area was recorded as 1:10. The Greylag Goose was recorded sporadically and in small numbers and was not therefore considered to be at risk from the project.

The duration of the winter stay in the Studied Area was observed to be similar for both Red-breasted and Greater White-fronted Geese however there was a definite 'peak' period of activity with a concentration of over 90% of the birds within 10 days (11-20 January); which corresponds to the coldest period of the winter.

The average flight altitudes of the geese from all species observed crossing the Project area varied between 110 and 236 metres above the ground level. The flight directions of the Red-breasted and Greater White-fronted Geese observed were seen to be similar in their bearing. Overall, the main directions of flight to and from the Project area observed in the morning and the evening respectively, were shown to be heavily correlated to the fresh water at Dorankulak and Shabla lakes, thus indicating the significance of these locations as the most important roosting sites in the Study Area (and indeed region as a whole).

It was also noted during the surveys that the local movements of birds increased during the hunting days when the directional scatter of the birds increased through the Project area as a result. Notwithstanding this pressure, diurnal activity of the geese generally indicated two periods of intensive movements/flights: morning (7-9h) and evening (16-18h).

Relative to the trends observed within the wider Study Area, no significant increase of the wintering geese in the Project area was observed during the winter season. The number of geese observed in the Project area is a simple function of the density of geese at the main roosting sites of the Durankulak and Shabla lakes. The temporal trends were also observed as being normal in distribution, whereas the spatial distribution was random or flocking behavior based. Hunting pressure was seen, however, exerts a strong influence on the behavior of all geese species and increased the random movements across the Project area and wider Study Area as a whole.

The survey results have proven Hypothesis 2 (see "Objective of the Study" page 11) to be true, in that the observed movements of geese within the Project area correlate with those in the wider Study Area and region. However, turning our attention to the key objectives of the study, the numbers of geese observed, and particularly Red-breasted Goose (65,000 flights through the site during the winter season), suggest that the Project does have the potential to have an impact upon their populations. For this reason, a CRA has been run for the data collated in respect of the Red-breasted Goose within the Project area in order to ascertain the scale of impacts that could result from the development of the Project and to inform the requirement for mitigation. The results of the CRA are reported below.

It should be noted that, contrary to the 2007-2008 observation data provided to AGE during 2008, there were no observations of geese moving over the Project area to roost in the Kavarna Bay. Whilst it is considered that the data captured for the purposes of this study are an accurate account of the activity observed for the 2008-2009 winter season, it is acknowledged that the 2007-2008 data exhibited potential trends that could be experienced from time to time e.g. possibly due to extreme weather events or hunting pressure. This would, therefore, have to be accounted for in any mitigation proposed for the Project and is also discussed with respect to the CRA below.

COLLISION RISK ASSESSMENT

Introduction

This Section of the winter bird report, summarises the results of the CRA for the project. The section first describes the input data that provided the basis for the assessment and then goes on to outline the assumptions made in running the model. Finally the results of the assessment are described with conclusions and recommendation made. Appendix 2 of this report contains a detailed description of the prescribed mitigation for further reference.

Technical Input Data

The collision risk parameters factored in to the Collision Risk Model for the Red-breasted Geese include:

- *Bird size and flight speed*

Data on bird body size were taken from Cramp (1998) – wingspan 1.26m, body length 0.55m, and flight speed from Campbell and Lack (1985) – 19 m/s.

- *Wind Farm Parameters*

The Project is currently a scheme of 52 turbines, each of which would have a 90m rotor diameter and up to a 105m tower (150m to blade tip). The assessment presented in this report has used the Vestas V90 machine as one of typical dimensions of the 3MW turbines that are planned for the site (Table 6).

Table 6 Wind turbine model input parameters

Model input variable	Input value	Comments
Number of turbines	52	Current number being considered: collision modelling presented here based on that number.
Rotor diameter (m)	90	Turbine specifications based on typical 3MW machine (Vestas V90).
Rotational speed (rpm)	16.1	Variable rotational speed, dependent on wind speed. 16.1 rpm is nominal speed.
Maximum chord (m)	3.5	
Pitch	15º	From Vestas V90 brochure.
Corridor width (km)	6.9	Mean distance across wind farm site plus 200m buffer.

- *Avoidance Rate*

An important stage of the collision risk model is to incorporate an avoidance rate to take into account the fact that birds take a degree of avoiding action when approaching structures such as wind turbines. Whilst the Project lies within the jurisdiction of Bulgaria, for the purposes of assessing impacts and developing suitable mitigation, AGE has elected to pay due regard to the guidance adhered to within the United Kingdom. To this end, current recommended Scottish Natural Heritage [SNH] guidance is to apply a 95% avoidance rate as a precautionary value (Band et al. 2007) where specific values from studies at existing wind farms are not available. However, for geese, SNH accept that this is overly cautious and currently recommend applying a 99% rate (SNH 2008). Waterfowl avoidance rates that have been measured at existing wind farms are very high and usually well in excess of 99% (e.g. Desholm and Kahlert 2005; Fernley et al. 2006). The latter publication has suggested that actual goose avoidance rates are actually in the order of 99.93%. The main analysis undertaken here has used the precautionary 99% rate but has also considered the possibility of higher rates as well.

Winter 2008-09 field studies Input Data

The two key input parameters for the collision risk model derived from field studies are (1) the numbers of birds flying through the Project site and (2) the proportion of those that are at rotor height (and hence at risk of collision).

Derivation of these parameters from the available data does require some assumptions to be made (as explained below) but it does still enable a more reasonable collision risk assessment to be undertaken that had been possible previously.

Assumptions

- *Numbers of Flights through the Project Area*

There were daily observations through the main part of the season however not all vantage points could be surveyed on each day. In spite of this, each vantage point was subject to well over the minimum recommended 'viewing hours' over the survey period. Observers were still present in the study area until the end of February, however, the vantage points at the Project area were not manned; rather observations were taken from the VPs to the north-east of the Project area where the concentration of activity was seen to occur late on in the season. Any significant goose movement from Durankulak and Shabla Lakes would have been recorded from these VPs. If any activity of Red-breasted Geese had been registered in the Project area during this period, observations at the Project area VPs would have re-started.

Some estimation was derived regarding the numbers of flights from the observed flight rate at each vantage point, the number of days observation at each vantage point, the mean flight rate from all vantage points overlooking the Project area and the proportion of identified geese that were red-breasted (12%). This data was used in the Collision Risk Model (CRM).

Flight directions were recorded and this showed which flocks were 'at risk' i.e. flying through the Project area. All of this flight data was used, with the flights that were definitely outside the Project area excluded. The latter were determined from the direction of each flock from the observer at its closest point (which was recorded in the main database).

This gave an estimate of about 90,000 red-breasted goose flights through the Project area per winter season during the dawn and dusk roost flights (the period that was sampled during the 2008-09 surveys). A worse case allowance has also been made for daytime movements of geese that may have occurred when the observers were not present at their VPs in the middle of the day. This was estimated as being an additional 15% to those movements recorded at dawn and dusk.

- Proportion of Birds Flying at Rotor Height

Flight height data from the Project area from the 2008-09 winter surveys were used to estimate the proportion flying at rotor height, but a wider range of flight heights was incorporated as potentially at rotor height to take into account the potential error in height estimates (this is the usual practice in the UK). As the data were largely recorded as broad flight height bands and there is inherently a degree of inaccuracy in flight height determination (particularly above 50m) birds recorded between the 20-30m and the 150-200m bands were included as being potentially at rotor height. This gave an overall estimate of 76% of red-breasted goose flights potentially at rotor height.

Collision Risk Modeling Results

The collision risk assessment predicted an annual number of red-breasted goose collisions, applying a precautionary 99% avoidance rate, of 22 collisions per year. This would be equivalent to an increase of approximately 0.7% over the existing baseline mortality. This would fall just below the threshold number of collisions that would need to occur to result in a significant impact (i.e. to exceed a negligible magnitude effect, defined as a 1% increase over the existing baseline mortality, as per SNH/BWEA, 2002, assessment methodology).

The main finding of the modelling was that the predicted collision risk, using the standard precautionary approach, was just below that which would be considered as significant. The modelling suggested that the magnitude of collision risk to all of these species would be of negligible magnitude in a population context. However it was very close to that which could be considered significant, and this species is an IUCN Endangered species. Whilst this analysis is probably overly pessimistic given the behaviour of geese at existing wind farms, the main conclusion is that there remains the potential for a substantial impact on this species and therefore a need to implement effective mitigation measures to ensure that the collision risk does not reach such significant levels. The 2008-09 field studies have confirmed the need for such measures.

Conclusions

It is clear that red-breasted geese do use the Project area during the winter, albeit for a relatively short period of time. The numbers within the Project area are sufficient to be considered internationally important (approximately 10% of world population, though the precise numbers counted within the Project area are not explicitly known from the data collated for the site thus far). The current best estimate of the total population of the species is only about 34,000 (source: www.brantaruficollis.org).

Using the standard worst-case modelling approach and the 2008-2009 winter field data, it is concluded that there is an impact upon the Red-breasted Goose that is just below the threshold that would be classed as significant. Experience of geese at existing wind farm does, however, suggest that the worst case may be unrealistic and that a higher avoidance rate would actually occur. Notwithstanding this, in light of the rarity of the species and population involved (and hence the high likelihood of a population impact even with relatively small levels of additional mortality), the current status of that population (declining) and the lack of information available about how red-breasted geese behave at existing wind farms, careful consideration of mitigation is required.

It is also important to note that Red-breasted Geese were not observed roosting overnight in Kavarna Bay in 2008-09, as they had been previously, in numbers up to 10,3000 (Georgiev et al. 2008). Such behaviour could increase the numbers feeding and flying within the Project area, and hence increased collision risk. However the frequency with which birds do this, and extent to which such activity would occur within the Project area is not known. If it were to occur the collision risk could be substantially greater that that calculated here based on the 2008-09 data, further increasing the requirement for effective mitigation measures to be able to deal with such a scenario.

It is clear from the results that suitable mitigation is required in order to ensure that impacts are reduced to a suitable level that are no considered significant. The mitigation measures proposed for the Project are described in the ‘recommendations’ below.

Recommendations

The collision risk modelling indicates that, in the absence of further mitigation measures, the predicted annual worst-case number of collisions of Red-breasted Geese with the turbines in the Project area would not have a significant negative impact on the species. The predicted number of collisions of 22 per year would be equivalent to an increase of approximately 0.7% over the existing baseline mortality. This figure is not significant when taking into account the high number of birds that are directly or indirectly killed annually as a result of hunting in the study area, however, this does not discharge AGE of their obligation to ensure that the Project does not adversely affect this species.

During 2008, as a result of the collision risk assessment of the Project that was run with respect to the autumn migration data, a mitigation package was developed to reduce impacts. In that instance a less than significant collision risk had been reported, however, adhering to good practice, AGE wished to reduce the potential for collisions to a practical minimum. Within the CRA for the autumn migration, it was considered that the mitigation package would reduce the collision risk by a factor of 10 and it is therefore proposed that a similar package will be employed during the winter period in order to reduce the potential impacts of the Project to a level not considered to be significant. Indeed, taking this in to consideration, the collision risk would be reduced from a predicted annual mortality of 22 birds to 2.2 birds which would equate to an increase of 0.07% in baseline mortality. This would therefore significantly reduce the number of collisions that could occur to result in a significant impact.

Appendix 2 of this report provides a detailed description of the mitigation that is recommended for the Project during the winter period. In particular a detailed protocol for turbine shut-down during periods of Red-breasted Goose activity in the area will need to be drawn up and put in place, and marking of any new overhead lines with bird deflectors should also be implemented in any areas where the geese might feed/over-fly in important numbers. As an additional measure, an observation point will be established that will provide sufficient coverage of the Kavarna Bay in to ensure that any such chance events of the birds roosting in the bay can be accounted for as part of the shut down protocol.

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Appendix 1 – Field Photography

The Red-breasted Geese were in the focus of present monitoring

The flocking behavior is characteristic of the geese

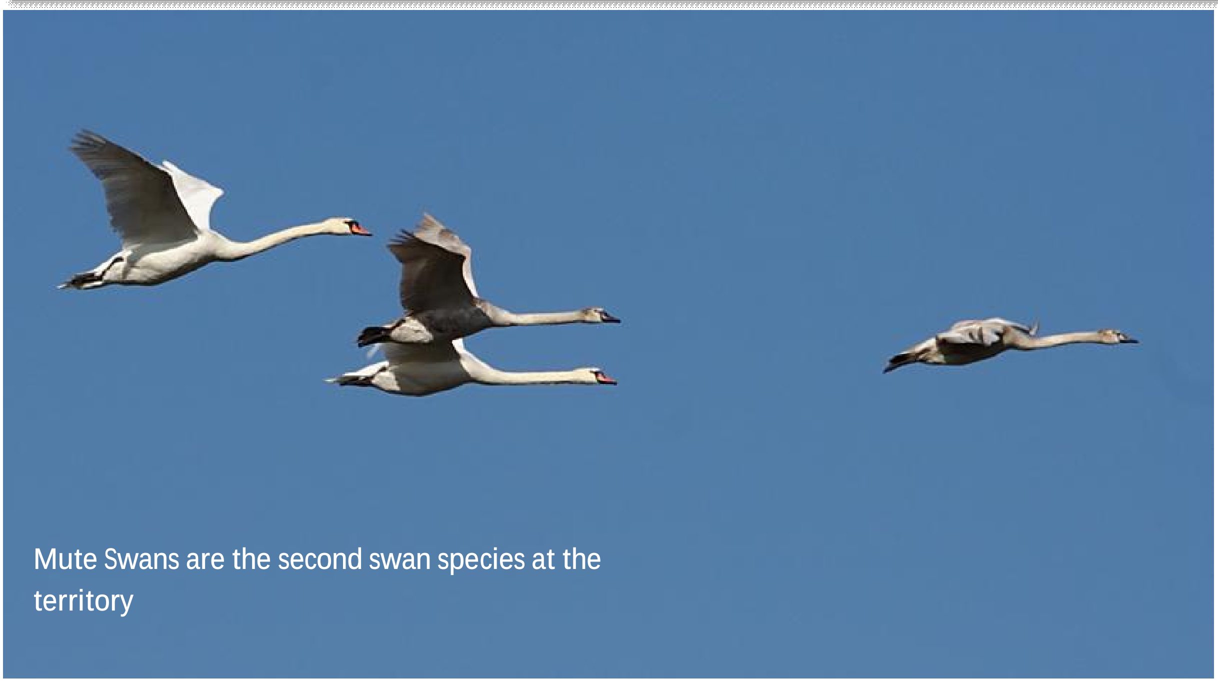
The Red breasted geese and White fronted geese form often mixed flocks

The morning and evening flights of the geese indicate lakes Durankulak and Shabla as main roosting sites.


The size of flocks change during the hunting days


The flocks usually demonstrate adaptive behavior regarding existing already wind turbines

Whooping Swans are highly conservative concerning feeding fields



Mute Swans are the second swan species at the territory

Appendix 2 - Mitigation Strategy

Mitigation – Observation, Radar and Turbine Shut Down

During the operational phase of the project, the greatest known potential ecological impact is to the local and, migratory bird populations. Due to this, a Turbine Shut Down System, detailed below, will be put in place, along with long term monitoring (described in the monitoring procedures).

The principle of the Turbine Shut Down System is that, in the event that a significant 'at risk' (within the swept path of the turbines) movement of wintering birds (in this case geese) is observed, then single turbines, groups of turbines or the entire wind farm will be shut down to minimise the potential for collision. The scale of shutdown will be dependent on the size of 'at risk' flock, direction of flight and prevailing weather conditions. The decision as to the need for and scale of shut down will be made by the IOE. Both the IOE and SFO will have the power to order the turbine shut down, however, the SFO shall only instigate the shut down in the field if this duty has been delegated by the IOE (typically this would be at time of absence of the IOE from site).

The shutdown system will include a combination of human observers and radar systems to give early warning of approaching migrant flocks. Using both of these will be essential to enable a full assessment of the oncoming risk and to ensure the appropriate action is taken swiftly. The main periods of concern are the autumn, winter and spring bird migration activity seasons. The Turbine Shutdown System, and thus mitigation monitoring, will therefore operate during December – February for the first year of operation

After the first year of winter mitigation monitoring the Collision Risk Model will be re-run and extent of any future mitigation will be determined. It is likely however that if there is no significant change in observed goose movement and behaviour that the Turbine Shut Down System will be operated for the lifetime of the Project during the winter season.

Human Observers

Figure 2 shows the location of the Vantage Points used in 2008/09 to inform this CRM and these vantage points will be used in the first year post construction to recorded winter movements of geese. The winter goose monitoring will only operate from one hour before dusk until one hour after sunset to ensure that all peak movements are recorded. If large flocks are recorded feeding in the proximity to the Project area these will be continually monitored to ensure that if they are disturbed or naturally move to other feeding grounds they do not come in to contact with turbines. At the end of each day observers will check the Kaliakra Bay to ensure that no geese are roosting in this location. If birds are recorded then an observer will be present at this point before first light to monitor which direction the birds fly toward their daily feeding grounds. If this is across the Project area then the shutdown system will be instigated accordingly.

The Vantage Points that have been selected were researched and agreed upon after site visits during winter period 2008. The observation points give full coverage of the main flight paths from roosting site and through the Project area and allow adequate time to make observations and activate the Turbine Shut Down System. Five of the 8 Vantage Points will be staffed permanently throughout the winter season with locations c hosen to give comprehensive coverage of the Project area. Observations will be biased toward the north-east corner of the Project area as this is where the peak feeding area was recorded. In addition monitoring along the northern edge of the Project area is equally important as this is the area where highest flight activity was registered. In addition to the five fixed points at least one mobile observer will be employed to track birds from the fixed point to the wind farm. The mobile observer would be in radio or mobile phone contact with the radar base. The SFO will be the mobile observer so that they are able to travel to the fixed points to assist with survey effort, verify the location and flight direction of mobile flocks and be able to confirm shut down and document each shut down event (the procedure for which is described under the Turbine Shut Down section below).

The location of the fixed observers will also allow for all birds that are moving through the Project area to be recorded on an annual basis thus maintaining and augmenting the data set that was collected for inclusion in this CRM. The observers at each location will record the same information to that which was taken in 2008/09.

Radar

A bird-tracking radar system will be set up at an appropriate location giving the radar a view over the Project area and beyond. The final choice of site will be decided through trials to determine the best radar visibility. The radar system will include a horizontally-mounted surveillance radar to track bird flight paths and a vertically-mounted radar to measure flight heights.

The radar location point will be manned by an observer and an assistant recorder throughout daylight hours during the winter period. The assistant observer will also be deployed to provide additional flight observation data and report to the radar base via radio or mobile phone. The radar observer through contact with the SFO will determine when to contact the wind farm operations base to advise on shut down. The IOE will also have knowledge and understanding of the radar system to be used and will be present during the initial training and installation of this facility. This training will be extended to relevant local regulators where appropriate.

Turbine Shut Down

To ensure a rapid response the shut down procedure will be incorporated into the site operating procedures. Authority for the shutdown will rest with the IOE, although the SFO will have delegate powers where the IOE directs. The fixed ornithological observers will be in contact with each other and the IOE via telecommunications should a large flock of ‘at risk’ birds be observed. Such a flock would be tracked by the fixed observers and one of the mobile observer(s) (the SFO primarily) will be deployed so that they are positioned between the flock and the wind farm. The radar operator will also be alerted by the IOE as to the location of the ‘at risk’ flock and will observe the flock using the radar. The IOE will remain in the field observing the behaviour of the flock but may, if the need arises go to the radar operating system to assist in the field analysis. The IOE will confirm with the fixed observers, mobile observer and the radar operator that the birds are still ‘at risk’ and will decide on the level of shut down required to minimise the risk of collision. The decision to shut down will primarily be based on the professional judgement of the IOE taking account of the information presented by the field ornithologists, radar, their own observations and prevailing weather conditions. In addition, the general principles as listed in Appendix B will also be taken into account (which would also be followed by the SFO when delegated to undertake these duties).

If the decision has been reached, based on the observation data and radar data, to shut down turbine(s) the IOE will contact the site’s operator via telecommunication and request a shut down making it clear to the site operator which turbines require shut down. The turbine shut down will take the form of blade feathering, whereby a gradual slow down of the turbine blades will occur. This can be achieved in under two minutes of the verbal instruction to shut down. Only in extreme circumstances where shut down is required in a shorter timeframe than the feathering can achieve will immediate shut down be employed in order to minimise wear a tear on the turbine equipment (bringing the turbine(s) to an almost immediate stop). At this point the IOE will proceed to the operations centre. Once shut down is commenced, the IOE will provide and sign a formal Notice to Shut Down by way of recording the shut down event and submit to the site operator. The fixed observers in the field will remain in place but will monitor the passage of the birds over, past, or through the site during shut down in order to observe behaviour and to relate any change in behaviour to the IOE and site operator should further action be required.

Once the ‘at risk’ bird flock has passed the wind farm, all observation points, the mobile observer and the radar operator will be contacted by the IOE to confirm that there are no more ‘at risk’ flocks approaching. If the IOE considers that the key risks have sufficiently abated then turbine operations will then re-commence. This process will be documented by the IOE in the form of Notice to Commence Operations, which he/she will complete, sign and submit to the site operator. Whilst the IOE and SFO hold the authority to request turbine shut down, it is the site operator who will perform the shut down.

The shut down system for the whole site will be reviewed annually, in conjunction with the monitoring programs; this will allow the system to evolve, based on site specific data.

Recording and logging

As described under Turbine Shut Down above, Notices to Shut Down and Notices to Commence Operation will be completed and signed off by the SFO for each event where turbine shut down is required. Copies of these notices will be submitted to the site operator who will record the shutdown on Environmental Incident and copies will be kept by the SFO. A log book of the shut down events, containing the incident forms and including details of the time shut down occurred, duration of shut down and observations of bird behaviour on site during shut down, will be kept. To tie in with the role of the IOE, the log book, which will contain the results of the recording made during the migration season, will be retained on site for last 3 years on site and up to 10 years at AES head office in Sofia. Along with the results of other site monitoring e.g. breeding bird and collision monitoring (see below), the results of the analysis of this data will be made available to relevant stakeholders on a yearly basis including but not limited to BirdLife International, the BSPB, Bulgarian Academy of Sciences, Intercreditor Agent, and relevant local inspectors.

Bird Collision Monitoring

The following methodology follows that developed in the USA for bird collision monitoring at operational wind farms (Morrison 1998). A core area of 100 m radius around each turbine will be carefully searched on foot. The 100 m distance is set conservatively as bird fatalities have rarely been documented over 70 m from turbines at other farms (Johnson *et al.* 2000). Sectors around each turbine will be slowly searched, taking particular care to search any taller clumps of vegetation, and openings of animal burrows. In addition, if ground conditions allow, a further 250 m area around each turbine will be scanned with binoculars to check for large bird carcasses. The precise location of any carcasses found will be recorded and mapped (by reference to the distance and direction to the nearest turbine and using a GPS recorder). Each turbine will be subject to a detailed carcass monitoring survey once per week, during the peak migration season. Outside of the season a check once per month will be undertaken. Site staff will complete the monthly checks outside of the migration season. It is estimated that the collision risk monitoring and carcass search should take approximately 30 minutes per turbine. All carcasses will be photographed to enable confirmation of species by either the IOE or SFO. Feather spots (e.g. a group of feathers attached to skin) and body parts will also be recorded. For all casualties the following data will be collected and reported at the end of each migration season (or each month, outside of the migration season):

- Species
- Sex and age (if known)
- Date and time collected
- Location
- Distance and direction (degrees) to the nearest turbine
- Condition
- Any other comments regarding possible cause of death e.g. distinction between those deaths caused by collision and other causes

With respect to the final bullet point above, whilst for some of the carcasses the nature of the cause of death will be obvious if they have died through collision with turbines (dismembered body parts, etc), there will be a category of lower certainty that will be given greater consideration during interpretation and the necessary precaution taken to highlight any that cannot be suitably determined. However, this is more likely for smaller birds rather than the larger key species considered at most risk with the Project and so the misinterpretation of cause of death for species of interest is considered unlikely.

The condition of each carcass will be recorded in the following manner:

- Intact – carcass completely intact, it is not badly decomposed and shows no sign of being fed upon by a scavenger or predator.
- Scavenged – entire carcass that shows sign of being fed upon by a predator or scavenger or a portion(s) of a carcass in one location (e.g. wings, skeletal remains, legs, pieces of skin etc).
- Feather spot – 10 or more feathers at one location indicating predation or scavenging.

In addition to monitoring of wild bird carcasses, a sample of 50 dead birds (e.g. feathered chickens) will be obtained in order to study the rate of carcass removal and to test observer efficiency. These will be placed in the search area at intervals through the study by someone independent of the carcass searcher. These carcasses will be marked appropriately (e.g. with coloured tape) to identify them as experimental birds. The location of these marked carcasses will be recorded in a similar way to non-experimental birds by the observer. These birds will be placed in the vicinity of each turbine by an individual who will not be completing the carcass monitoring (primarily the SFO). These will be left on site until they disappear. The purpose of the experimental carcasses being left on the site is to (i) check the effectiveness of the carcass monitor (i.e. what percentage of known carcasses are missed by this person) and (ii) to gain an understanding of the amount of predators/scavengers within the wind farm site.

With respect to the latter, as part of the survey effort, the SFO will review the locations and status of the experimental dead birds and, taking into account all those discovered by the searchers and those that have disappeared through natural decomposition, will calculate the number of experimental birds that go missing for other reasons such as animals scavenging, and removal by landowners and the public. The proportion missing due to these other circumstances will be used to factor the number of non-experimental carcasses found in order to calculate actual mortality on site (which will then be used for the purposes of CRA). If many of the sample experimental bird carcasses are being removed in this way , then an increase in the survey effort will be required in order to minimise the potential for the under-recording of actual collisions.

The bird collision monitoring will be carried out for the whole of the year to investigate real collisions and to enable the CRA undertaken during the due diligence to be updated. The CRA will be rerun after each migration season based on observation data and the result of the carcass monitoring and will take account of updates to species populations. It is anticipated that this process will be a test of the CRA to assess the relationship between predicted and actual impact based on the results of the previous years modelling and the actual recorded and observed data.

Over-Head Power Lines

Bird deflectors should be installed on all new over-head power lines constructed in the Project area. The likelhood or potential impact of striking power lines in the Project Area has not been included within this CRM; however the impacts of such an event are well documented and could potentially have a significant impact on the wintering Red-breasted Geese. Deflectors would serve to minimise any potential impact that could result from the installation of over-head power lines.