

PESTERA

WIND

FARM

ANALYSIS REGARDING THE RISK OF COLLISION OF BIRDS WITH THE WIND TURBINES

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1. GENERAL DATA

1.1. Introduction

EDP Renewables has developed in the area of Pestera, Constanta county, a wind farm with a total power of 90 MW, currently operated by S.C. EDP RENEWABLES ROMANIA S.R.L.

The development of the wind farm was done in accordance with the specific legislation in force, in compliance with European and national regulations regarding the development of this kind of projects.

In terms of compliance with the environmental legislation, for the building of the wind farm was obtained the Environmental Agreement no. 10/2008 issued by the EPA Constanta, based on the assessment study of the environmental impact, prepared by specialists in the field.

Later, after building the objective, regulating the operation conditions for the wind farm was done by issuing the environmental permit no. 463/18.10.2010.

Both the Environmental Agreement and the Environmental Permit required the monitoring of biodiversity in the area of the wind farm both during its construction and at least during the first year of operation of the wind farm.

S.C. EDP RENEWABLES ROMANIA S.R.L. has achieved this monitoring by means of S.C. Blue Terra Consulting SRL, which has prepared regular reports that were submitted to the beneficiary and the environmental authorities according to the regulatory documents mentioned above.

1.2. General data regarding the analyzed objective

The wind farm developed by EDP in the area of the administrative territory of the Pestera village, Constanta county, has a total power of 90 MW and comprises of a total of 30 Vestas V90 turbines with a power of 3 MW each.

Regarding the location of the farm in relation to Natura 2000 sites, the following table indicates the distances to the nearest Natura 2000 sites and their position towards the wind farm.

| | Table no. 1 |
|--|--|
| Natura 2000 Site | Location of the farm in relation to Natura |
| | 2000 Site |
| ROSPA 0001 ALIMAN ADAMCLISI | 200m North (turbine 24) |
| ROSCI 000353 PESTERA-DELENI | 1 km West (turbine 26) |
| ROSPA 0001 ALIMAN ADAMCLISI ROSCI 000353 PESTERA-DELENI | 2000 Site200m North (turbine 24)1 km West (turbine 26) |

Regarding the migration routes, as indicated in the impact study, the wind farm is not located on a main migration route, but given the distance of about 6-7 km between the farm and the Danube, it is possible that specimens of birds flying along the Danube River also

reach the farm area during their migration.

2. GENERAL DATA REGARDING THE RISK ANALYSIS

2.1. Data and methodologies used for the calculation of the risk analysis

This material represents an analysis of the risk of collision of birds with wind turbines that make up the wind farm from Pestera, Constanta county.

The data used in the analysis are those obtained as a result of the monitoring of the area for 12 months (November 2010-October 2011).

The methodology used is based on the pattern developed by Scottish Natural Heritage, that takes into account that, in practice, most birds in their flight are able to detect a wind turbine or an entire farm of turbines and to modify their flight so they can avoid such obstacles.

2.2. Description of the calculation method

The method used for the analyzed wind farm, developed by SNH, aims to estimate the number of collisions of birds with the wind turbines over a period of time. In this case, the period taken into account in this analysis is of one year.

The method is mainly based on the following equation:

Number of birds that can collide with the turbines = number of birds that fly in the action area of the turbine rotor x the likelihood that the birds that fly in the action area of the rotors be hit by these

Regarding the number of birds that can collide with the wind turbines, there are two approaches:

- A. <u>Birds with regular flights in the area of the wind farm</u>. For the analyzed objective, in this category were included only species observed in migration in the area of the wind farm. These species are shown in Table. 5 of the Report on the monitoring of biodiversity in the wind farm area, prepared for the entire year 2011. The above mentioned report also describes the methods of monitoring the avifauna used during monitoring.
- B. <u>Birds frequently using the wind farm area.</u> This category only took into account, from the species of birds identified in the wind farm area, those species whose flights are frequent in the action area of the wind turbine rotor.

In each of the two cases was calculated the likelihood of collision of birds with the wind turbines, according to the methodology described by SNH.

The calculation of the collision risk is presented in further detail for each of the two

cases mentioned above.

CASE 1: MIGRATING BIRDS

For this case were considered the species listed in Table 5 of the annual monitoring report, presented in the Table 4 of this material.

For the calculation of the risk of collision were considered all species listed in Table no. 4, though, as the table also emphasizes, not all were observed flying high in the action area of the wind turbine rotor, so in the area with risk of collision. But considering that these species are migratory and have been observed during migration, it has been considered that such specimens can also reach heights that would pose a risk of collision with the turbines.

Regarding the number of birds of each species considered in this case it was considered that it is n x 2, where "n" is the number of birds of each species observed during the monitoring period and 2 represents the number of regular flights of these birds in the wind farm area (spring migration and fall migration).

In order to calculate the risk of collision of birds in this category with the turbines of the wind farm, according to SNH methodology, the following technical data were also used:

| | | | | Ta | ble no. 2 | | | | |
|----------------------------------|---|-------------|--------------|-------------------|-----------|--|--|--|--|
| Input data | | Output data | | | | | | | |
| Farm width (largest width of the | 1 | 6.64 | Risk | W = l x H | 996000 mp | | | | |
| farm considered perpendicularly | | km | window | | | | | | |
| to the predominant flight | | | | | | | | | |
| direction | | | | | | | | | |
| Wind turbine height | Н | 150m | Risk section | $A = N x \pi R^2$ | 190755 mp | | | | |
| No. of turbines that make up the | Ν | 30 | | A/W | 0.19 | | | | |
| farm | | | | | | | | | |
| Radius of the turbine rotor | R | 45m | | | | | | | |

The risk window (W) is a "window", actually a vertical section through the farm whose dimensions are defined as follows:

- Length of the risk window is the largest width of the farm, perpendicularly to the predominant flight direction of birds
- Width of the risk window is the height of the highest turbine of the farm. In our case all turbines have a height of 150m.

Risk section (A) is the plan area occupied by the action radius of all turbine rotors that make up the wind farm.

Table no. 3: Technical features of the turbines

Analysis regarding the risk of collision of birds with the wind turbines S.C. EDP RENEWABLES ROMANIA S.R.L. - Wind Farm Pestera

| No. of blades | 3 |
|-------------------------------|-----------|
| Tower height | 105m |
| Blade length | 45m |
| Maximum blade width | 3.5m |
| Maximum angle of slope of the | 30^{0} |
| blade | |
| Rotor diameter | 90m |
| Rotation period | 3.72 sec. |
| Rotor depth | 4.4 m |

| Run No. | Scientific name | Common name | Observation period | Number of specimens | Phenology | Observations |
|------------|---------------------|----------------------------|---|-----------------------------|---|---|
| 1. | Ciconia ciconia | White stork | April 2011 | 27 spec. | Summer Guest (SG) | bird groups (27 spec.); flying height 150-200 m; flying direction: S-N, W |
| 2. | Hieraaetus pennatus | The Booted Eagle | April 2011 | 1 spec. Summer Gues (SG) | | single specimens flying; flying height 70-120 m; flying direction: S-E, N. |
| 3. | Buteo buteo | The Common Buzzard | October 2010 March, April 2011 | 2 spec. 7 spec. | Partially migrating (PM) | single specimens flying; flying height 120-150 m; flying direction: S-E,N |
| 4. | Buteo rufinus | The Long-legged Buzzard | April 2011 | 2 spec. | Passing by (P), Summer Guest (SG) | single specimens flying; flying height 90-150 m; flying direction: S-E,N |
| 5. | Merops apiaster | The European Bee-eater | April, May 2011 | 18 spec. | SUMMER GUEST (SG), P | single specimens flying; flying height 150-200 m; flying direction: S-V,N. |
| 6. | Coracias garrulus | The European Roller | May 2011 | 8 spec. | Summer Guest (SG) | single specimens flying; flying height 50-60m; flying direction: S-E, N. |
| 7. | Upupa epops | The Hoopoe | April, May | 10 spec. | Summer Guest (SG) | single specimens, groups of birds flying; flying height 30-40 m; flying direction: S-N-V. |
| 8. | Alauda arvensis | The Skylark | March, April, May 2011 Sept., Oct. 2011 | 51 spec. 28 spec. | Partially migrating (PM) | single specimens flying; flying height 40-60 m; flying direction: S-E, N. |
| 9. | Lullula arborea | The Woodlark | May 2011 | 4 spec. | Summer Guest | single specimens flying; |

Table no. 4: birds in migration observed in the wind farm area in the period November 2010 - October 2011

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| | | | | | (SG) | flying height 40-50m; flying direction: S-V,E. |
|-----|----------------------------|-----------------------------|-------------------------------------|----------------------|-----------------------------|---|
| 10. | Hirundo rustica | The Barn Swallow | April, May 2011 September 2011 | 36 spec. 12 spec. | Summer Guest (SG) | Groups of birds/ single specimens flying (3-5 spec.); flying height 35-40 m; flying direction: S-V E |
| 11. | Anthus campestris | The Tawny Pipit | April, May 2011 | 8 spec. | Summer Guest (SG) | single specimens; flying height 25-30 m; flying direction: E, S-E,W. |
| 12. | Motacilla flava feldegg | Black- headed Wagtail | May 2011 | 7 spec. | Summer Guest (SG) | single specimens; flying height 30-40 m; flying direction: S-E, N. |
| 13. | Motacilla alba | The White Wagtail | April, May 2011 Sept., Oct. 2011 | 32 spec. 12 spec. | Summer Guest (SG) | single specimens; flying height 20-30m; flying direction: S-W N |
| 14. | Lanius collurio | The Red-backed Shrike | May 2011 September 2011 | 6 spec. 4 spec. | Summer Guest (SG) | single specimens flying; flying height 40-50m; flying direction: S-V.E. |
| 15. | Sylvia communis | The Whitethroat | April, May 2011 | 5 spec. | Partially migrating (PM) | single specimens flying; flying height 35-40 m; flying direction: S-E, N. |
| 16. | Coturnix coturnix | The Common Quail | April, May 2011 | 14 spec. | Summer Guest (SG) | Groups of birds/ single specimens; flying height 40-50 m; flying direction: S-N-W |
| 17. | Fringilla coelebs | The Chaffinch | March, April, May 2011 | 90 spec. | Partially migrating (PM) | Groups of birds/ single specimens (2- 3 spec.); flying height 40-50 m; flying direction: S-W,E. |



The following table presents the results on the risk of collision with the farm turbines of birds in migration observed in the wind farm area during monitoring.

| bird species | number of birds | number of birds through the risk window | Length of bird cm | Wingspan cm | way of flying hovering (0) flapping (1) | flying speed m/s | collision likelihood* | no. of birds with risk of collision without any avoidance activities | avoidance rate** | real risk no. of birds/ year |
|----------------------------|-----------------------|---|-------------------------|----------------|--|------------------------|--------------------------|---|---------------------|---------------------------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| | Ν | nxA/W | L | А | | | | Col. 3 x 8 | | (1-col.10)xcol.9 |
| Ciconia ciconia | 54 | 10.26 | 110 | 200 | 1 | 12 | 14.50% | 1.4877 | 95% | 0.074385 |
| Buteo buteo | 18 | 3.42 | 46 | 112 | 0 | 17 | 8.20% | 0.28044 | 98% | 0.0056088 |
| Buteo rufinus | 4 | 0.76 | 58 | 142 | 0 | 17 | 8.90% | 0.06764 | 98% | 0.0013528 |
| Merops apiaster | 36 | 6.84 | 28 | 40 | 1 | 17 | 9.00% | 0.6156 | 98% | 0.012312 |
| Coracias garrulus | 16 | 3.04 | 30 | 57 | 1 | 12 | 9.10% | 0.27664 | 98% | 0.0055328 |
| Upupa epops | 20 | 3.8 | 28 | 46 | 1 | 12 | 9.00% | 0.342 | 98% | 0.00684 |
| Alauda arvensis | 158 | 30.02 | 18 | 33 | 1 | 9 | 10.70% | 3.21214 | 98% | 0.0642428 |
| Lanius collurio | 20 | 3.8 | 18 | 26 | 1 | 9 | 10.70% | 0.4066 | 98% | 0.008132 |
| Lullula arborea | 8 | 1.52 | 15 | 26 | 1 | 17 | 6.20% | 0.09424 | 98% | 0.0018848 |
| Anthus campestris | 16 | 3.04 | 16 | 27 | 1 | 9 | 10.50% | 0.3192 | 98% | 0.006384 |
| Motacilla alba | 88 | 16.72 | 18 | 28 | 1 | 9 | 10.70% | 1.78904 | 98% | 0.0357808 |
| Motacilla flava feldegg | 14 | 2.66 | 16 | 27 | 1 | 9 | 10.50% | 0.2793 | 98% | 0.005586 |
| Sylvia communis | 10 | 1.9 | 14 | 25 | 1 | 9 | 10.40% | 0.1976 | 98% | 0.003952 |
| Coturnix coturnix | 28 | 5.32 | 18 | 27 | 1 | 9 | 10.70% | 0.56924 | 95% | 0.028462 |

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| Fringilla coellebs | 180 | 34.2 | 15 | 28 | 1 | 17 | 6.20% | 2.1204 | 98% | 0.042408 |
|--------------------|-----|-------|----|----|---|----|-------|---------|-----|-----------|
| Hirundo rustica | 96 | 18.24 | 19 | 33 | 1 | 17 | 6.40% | 1.16736 | 98% | 0.0233472 |

* calculated according to the SNH methodology

** according to the specialized literature

CASE 2: BIRDS FREQUENTLY USING THE WIND FARM AREA

In the wind farm area, as a result of the avifauna monitoring for one year a total of 57 species of birds were highlighted, which were presented in Table no. 2 of the monitoring report and in Table no. 7 of this material. But among these species only some have been taken into account when calculating the risk of collision, given that many of the species observed fly at heights much lower than the height of the action area of the turbine rotor, where the risk of collision of birds with wind turbines is particularly present.

Thus, the species that were included in the calculation in this case are shown in Table no. 8.

For the calculations the technical characteristics of the turbines, listed in Table no. 3 and the data in the following table were taken into account.

| | | | | Tabl | le no. 6 | | | | | |
|----------------------------------|---|-------|-------------|--------------------------|-----------|--|--|--|--|--|
| Input data | | | Output data | | | | | | | |
| Surface of the wind farm | Α | 11686 | Volume | $V_w = A \times H$ | 175298340 | | | | | |
| (farm area)- see fig.1 | | 556 | of the farm | | 0 mp | | | | | |
| | | mp | | | - | | | | | |
| Wind turbine height | Η | 150m | Volume | $V_r = N \times \pi R^2$ | See table | | | | | |
| No. of turbines that make up the | Ν | 30 | scanned by | x(d+l) | no. 8 | | | | | |
| farm | | | the turbine | | | | | | | |
| Radius of the turbine rotor | R | 45m | rotor | | | | | | | |
| Length of the turbine rotor | d | 4.4 m | | | | | | | | |
| Length of the bird | 1 | See | | | | | | | | |
| | | table | | | | | | | | |
| | | no. 8 | | | | | | | | |

The wind farm area (A) was thus considered: area strictly delimited by the wind turbines (cross-hatched area in Fig. 1), plus surface in the close vicinity with a width of 50m, considering that it also enters the range of action of the rotor (area in red, not cross-hatched on the sketch in Fig. 1)

The volume of the farm (V_w) , where there is some risk that birds collide with turbines, is the area bounded as described above - A, multiplied by the height of wind turbines -H.

Table no. 7: Data on the monitoring of the avifauna in the wind farm area in the period November 2010 - October 2011

| Run | Scientific name | Common name | Numbe | er of spo | ecimen | | | | | | | | | | |
|-----|------------------------|-----------------------------|-------|-----------|--------|------|-----|-----|-----|------|------|------|------|------|---|
| No. | | | Nov. | Dec | Jan. | Feb. | Mar | Apr | May | June | July | Aug. | Sep. | Oct. | Observations |
| 1. | Ciconia ciconia | White stork | - | - | - | - | - | 27 | - | - | 20 | - | - | - | groups of birds flying |
| 2. | Accipiter nisus | The Eurasian Sparrowhawk | 2 | - | 2 | - | - | 3 | - | - | - | - | 3 | - | single specimens /flying |
| 3. | Circus cyaneus | The Hen Harrier | - | 1 | 2 | - | - | 1 | - | - | - | - | - | - | single specimens /flying |
| 4. | Hieraaetus pennatus | The Booted Eagle | - | - | - | - | - | 2 | - | - | - | 2 | - | - | single specimens /flying |
| 5. | Buteo buteo | The Common Buzzard | 2 | - | - | 2 | 3 | 4 | 2 | 3 | 2 | - | 4 | 2 | single specimens, groups of birds / flying |
| 6. | Buteo rufinus | The Long-legged Buzzard | - | - | - | - | - | 2 | - | - | - | - | 2 | - | single specimens flying |
| 7. | Falco tinnunculus | The Common Kestrel | 7 | - | - | 2 | - | 2 | 3 | 2 | 2 | - | 2 | - | single specimens, groups of birds /flying |
| 8. | Perdix perdix | The Grey Partridge | 8 | 5 | 6 | - | - | - | - | - | - | - | 25 | - | single specimens /flying |
| 9. | Phasianus colchicus | The Common Pheasant | 3 | 1 | 1 | - | - | 3 | - | - | - | - | - | - | single specimens /flying |
| 10. | Coturnix coturnix | The Common Quail | | | | | - | 8 | 6 | - | - | - | - | - | single specimens |
| 11. | Larus ridibundus | The Black-headed Gull | 10 | 4 | 6 | 8 | 56 | 25 | 48 | - | - | - | - | - | single specimens |

| 12. | Larus cachinnans | The Caspian Gull | 22 | 12 | 15 | 18 | 24 | 16 | 12 | - | - | - | - | - | single specimens /groups of birds flying |
|-----|----------------------------|-------------------------------------|----|----|----|----|----|----|----|----|----|----|----|----|--|
| 13. | Columba livia domestica | The Domestic Pigeon | 12 | 8 | 17 | 14 | - | 26 | 18 | - | - | - | - | - | single specimens /flying |
| 14. | Streptopelia decaocto | The Eurasian Collared Dove | 10 | 6 | 9 | - | - | 17 | 24 | - | - | - | - | - | groups of birds flying |
| 15. | Merops apiaster | The European Bee-eater | - | - | - | - | - | 10 | 8 | - | 9 | - | - | - | groups of birds flying |
| 16. | Coracias garrulus | The European Roller | - | - | - | - | - | - | 8 | - | 6 | - | - | - | single specimens /flying |
| 17. | Upupa epops | The Hoopoe | - | - | - | - | - | 6 | 4 | - | - | - | - | - | single specimens /flying |
| 18. | Dendrocopos medius | The Middle Spotted Woodpecker | - | - | - | - | - | - | - | - | 2 | - | - | - | single specimens |
| 19. | Melanocorypha calandra | The Calandra Lark | - | - | - | - | - | 10 | 14 | - | - | - | - | - | single specimens /flying |
| 20. | Galerida cristata | The Crested Lark | 14 | 7 | 10 | 8 | 16 | 11 | - | - | 10 | - | - | - | single specimens /flying |
| 21. | Alauda arvensis | The Skylark | - | - | - | - | 24 | 15 | 12 | 10 | 18 | 14 | 16 | 12 | single specimens /flying/ on the ground |
| 22. | Lullula arborea | The Woodlark | - | - | - | - | - | - | 4 | 4 | - | - | - | - | single specimens /flying |
| 23. | Hirundo rustica | The Barn Swallow | - | - | - | - | - | 16 | 20 | 14 | 8 | 10 | 12 | - | groups of birds flying |
| 24. | Anthus campestris | The Tawny Pipit | - | - | - | - | - | 4 | 4 | - | 2 | - | - | - | single specimens /on the ground |
| 25. | Motacilla flava feldegg | Black-headed Wagtail | - | - | - | - | - | - | 7 | - | - | - | - | - | single specimens/ flying/ on the vegetation in the |

| 26. | Motacilla alba | The White Wasteil | - | - | - | - | - | 24 | 8 | 12 | 20 | 8 | 6 | 6 | area single specimens flying/ on the |
|-----|----------------------------|--------------------------|----|----|----|----|----|----|----|----|----|----|----|----|---|
| | | wagtan | | | | | | | | | | | | | ground |
| 27. | Parus major | The Great Tit | 4 | 2 | 6 | 3 | 5 | 4 | - | - | - | - | - | - | single specimens /flying |
| 28. | Lanius collurio | The Red-backed Shrike | - | - | - | - | - | - | 6 | - | 4 | - | 4 | - | single specimens flying/ on the vegetation in the area |
| 29. | Pica pica | The European Magpie | 8 | 4 | 6 | 3 | 5 | 4 | 4 | 6 | 5 | 3 | 3 | 2 | single specimens flying/ on the ground |
| 30. | Corvus monedula | The Jackdaw | 4 | 2 | 5 | 3 | - | 14 | - | - | - | - | - | - | single specimens flying/ on the ground |
| 31. | Corvus frugilegus | The Rook | 23 | 31 | 25 | 16 | 24 | 26 | 12 | 46 | 42 | 22 | 43 | 27 | single specimens, groups of birds/ |
| 32. | Corvus corone cornix | The Hooded Crow | 10 | 8 | 4 | 7 | 9 | 8 | 12 | 14 | 6 | 10 | 8 | 4 | single specimens flying/ on the ground |
| 33. | Sylvia communis | The Whitethroat | - | - | - | - | - | 3 | 2 | - | - | - | - | - | Single specimens/ on the vegetation in the area |
| 34. | Sylvia atricapilla | The Blackcap | - | - | - | - | - | - | - | 3 | - | - | - | - | Single specimens/ on the vegetation in the area |
| 35. | Phylloscopus collybita | The Common Chiffchaff | - | - | - | - | - | - | - | 6 | 4 | 4 | 2 | - | single specimens / on the vegetation in the area |
| 36. | Phylloscopus trochillus | The Willow Warble | - | - | - | - | - | 4 | 2 | - | - | - | - | - | single specimens / on the vegetation in the area |
| 37. | Phylloscopus | The Wood | - | - | - | - | - | - | - | 4 | 2 | 2 | - | - | single specimens |

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| | sibilatrix | Warble | | | | | | | | | | | | | / on the vegetation in the area |
|-----|--------------------------|---------------------------|----|----|----|----|----|----|----|----|----|----|----|----|---|
| 38. | Muscicapa striata | The Spotted Flycatcher | - | - | - | - | - | - | - | - | 6 | 4 | - | - | single specimens / on the vegetation in the area |
| 39. | Oenanthe oenanthe | The Northern Wheatear | - | - | - | - | - | - | 8 | 6 | 6 | 4 | - | - | single specimens |
| 40. | Saxicola rubetra | The Whinchat | - | - | - | - | - | - | - | - | 4 | 2 | - | - | single specimens / on the vegetation in the area |
| 41. | Erithacus rubecula | The European Robin | - | - | - | - | - | - | - | - | 3 | - | - | - | single specimens |
| 42. | Luscinia megarhynchos | The Nightingale | - | - | - | - | - | - | - | 2 | 2 | - | - | - | single specimens / on the vegetation in the area |
| 43. | Turdus philomelos | The Song Thrush | - | - | - | - | - | - | - | 4 | 2 | 2 | - | - | single specimens / on the vegetation in the area |
| 44. | Turdus merula | The Common Blackbird | - | - | - | - | - | - | - | 4 | 2 | 3 | - | - | single specimens / on the vegetation in the area |
| 45. | Turdus pilaris | The Fieldfare | - | - | - | - | - | - | 14 | 18 | 10 | 12 | - | - | single specimens /flying |
| 46. | Oriolus oriolus | The Golden Oriole | - | - | - | - | - | 7 | 3 | 2 | 2 | 2 | - | - | single specimens / on the vegetation in the area |
| 47. | Sturnus vulgaris | The Common Starling | 14 | 10 | 16 | 19 | - | 15 | 18 | 36 | 44 | 18 | 28 | 12 | single specimens, groups of birds/ flying/ on the ground |
| 48. | Passer domesticus | The House Sparrow | 22 | 10 | 14 | 8 | 12 | 24 | 22 | 18 | 34 | 26 | 14 | 10 | single specimens, groups of birds/ flying/ on the vegetation in the area |
| 49. | Passer montanus | The Eurasian Tree | 15 | 12 | 16 | 14 | 18 | 16 | 33 | 28 | 24 | 44 | 16 | 8 | single specimens, groups of birds/ |

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| | | Sparrow | | | | | | | | | | | | | flying/ |
|-----|---------------------------|-----------------------------|---|---|---|---|----|----|----|---|----|---|---|----|--|
| 50. | Fringilla coelebs | The Chaffinch | 4 | 7 | 2 | 4 | 28 | 38 | 24 | - | - | - | - | - | single specimens /flying |
| 51. | Carduelis spinus | The Eurasian Siskin | - | 8 | - | 7 | - | - | - | - | - | _ | - | 14 | single specimens/ on the vegetation in the area |
| 52. | Carduelis carduelis | The European Goldfinch | - | 6 | - | 4 | 4 | 8 | 6 | - | - | - | - | - | single specimens /flying |
| 53. | Carduelis cannabina | The Linnet | 3 | 5 | 4 | 2 | - | 4 | 3 | - | - | - | - | - | single specimens/ on the vegetation in the area |
| 54. | Emberiza citrinella | The Yellowhammer | - | - | - | - | - | 10 | 8 | - | 6 | 6 | 4 | 4 | single specimens flying/ on the vegetation in the area |
| 55. | Emberiza hortulana | The Ortolan Bunting | 8 | 6 | 7 | 5 | - | - | - | - | 10 | 8 | - | - | single specimens flying/ on the vegetation in the area |
| 56. | Emberiza melanocephala | The Black-headed Bunting | - | - | - | - | - | - | - | 4 | 2 | 4 | - | - | single specimens flying/ on the vegetation in the area |
| 57. | Miliaria calandra | The Corn Bunting | - | - | - | - | - | 10 | 12 | 8 | - | - | - | - | single specimens flying/ on the vegetation in the area |

Table no. 8 summarizes the results regarding the risk of collision with the farm turbines of birds that frequently use the air space of the wind farm during the monitoring period (November 2010-October 2011).

| Bird species | Length of the bird (cm) | Wingspa n (cm) | d+1 (m) | Vr | No. of birds observe d in the farm area | No. of day s/y ear | no. of birds in Vw –N (occup ation degree) | Vr/Vw | NxVr/ Vw | v (flyi ng spee d - m/s | t=(d+ l)/v | no. Bird s betw een the rotor s | Collision likelihoo d | no. of birds with risk of collisi on witho ut any avoid ance activit ies | Avoi danc e rate | Real risk no. of birds/ year |
|------------------------|----------------------------------|----------------------|------------|---------------|--|--------------------------------|---|---------|-------------|--|---------------|--|-----------------------------|--|---------------------------|--|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| Ciconia ciconia | 110 | 200 | 5.5 | 1049152. 5 | 47 | 10 | 470 | 0.00060 | 0.28 | 12 | 0.46 | 0.61 | 0.145 | 0.09 | 0.95 | 0.004 |
| Accipiter nissus | 36 | 70 | 4.76 | 907993.8 | 10 | 20 | 200 | 0.00052 | 0.10 | 17 | 0.28 | 0.37 | 0.074 | 0.03 | 0.98 | 0.001 |
| Circus cyaneus | 48 | 112 | 5.52 | 1052967. 6 | 4 | 15 | 60 | 0.0006 | 0.04 | 15 | 0.37 | 0.10 | 0.09 | 0.01 | 0.98 | 0.000 |
| Hieraateus pennatus | 45 | 120 | 5.6 | 1068228 | 4 | 10 | 40 | 0.0006 | 0.02 | 15 | 0.37 | 0.07 | 0.09 | 0.01 | 0.98 | 0.000 |
| Buteo buteo | 46 | 112 | 4.86 | 927069.3 | 24 | 45 | 1080 | 0.0005 | 0.57 | 17 | 0.29 | 2.00 | 0.08 | 0.16 | 0.98 | 0.003 |
| Buteo rufinus | 58 | 142 | 5.82 | 1110194. 1 | 4 | 10 | 40 | 0.0006 | 0.03 | 12 | 0.39 | 0.07 | 0.10 | 0.01 | 0.98 | 0.0001 |
| Falcotinnu nculus | 30 | 68 | 5.08 | 969035.4 | 20 | 35 | 700 | 0.0006 | 0.39 | 9 | 0.34 | 1.14 | 0.08 | 0.09 | 0.98 | 0.002 |

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| Merops apiaster | 28 | 40 | 4.68 | 892733.4 | 28 | 15 | 420 | 0.0005 | 0.21 | 9 | 0.28 | 0.78 | 0.09 | 0.07 | 0.98 | 0.001 |
|----------------------------|----|-----|------|---------------|-----|----|-------|--------|-------|----|------|-----------|------|------|------|-------|
| Coracias garrulus | 30 | 57 | 4.7 | 896548.5 | 14 | 10 | 140 | 0.0005 | 0.07 | 12 | 0.39 | 0.18 | 0.09 | 0.02 | 0.98 | 0.000 |
| Pica pica | 45 | 55 | 4.85 | 925161.7 5 | 53 | 60 | 3180 | 0.0005 | 1.68 | 9 | 0.54 | 3.11 | 0.13 | 0.40 | 0.95 | 0.020 |
| Corvus Monedula | 33 | 68 | 4.73 | 902271.1 5 | 28 | 25 | 700 | 0.0005 | 0.36 | 9 | 0.53 | 0.69 | 0.10 | 0.07 | 0.95 | 0.003 |
| Corvus fragilegus | 46 | 85 | 4.86 | 927069.3 | 337 | 60 | 20220 | 0.0005 | 10.69 | 12 | 0.41 | 26.4 0 | 0.10 | 2.64 | 0.98 | 0.053 |
| Corvus corone cornix | 46 | 90 | 4.86 | 927069.3 | 100 | 60 | 6000 | 0.0005 | 3.17 | 12 | 0.41 | 7.83 | 0.10 | 0.78 | 0.98 | 0.016 |
| Larus ridibundus | 38 | 91 | 4.78 | 911808.9 | 157 | 35 | 5495 | 0.0005 | 2.86 | 12 | 0.40 | 7.18 | 0.10 | 0.70 | 0.98 | 0.014 |
| Larus argentatus | 57 | 135 | 4.97 | 948052.3 5 | 119 | 35 | 4165 | 0.0005 | 2.25 | 12 | 0.41 | 5.44 | 0.11 | 0.60 | 0.98 | 0.012 |
| Alauda arvensis | 18 | 33 | 4.58 | 873657.9 | 121 | 40 | 4840 | 0.0005 | 2.41 | 17 | 0.27 | 8.95 | 0.11 | 0.96 | 0.98 | 0.019 |
| Hirundo r ustica | 19 | 33 | 4.59 | 875565.4 5 | 80 | 30 | 2400 | 0.0005 | 1.20 | 17 | 0.27 | 4.44 | 0.06 | 0.28 | 0.98 | 0.006 |
| Sturnus vulgaris | 21 | 36 | 4.61 | 879380.5 5 | 230 | 60 | 13800 | 0.0005 | 6.92 | 17 | 0.27 | 25.5 3 | 0.07 | 1.66 | 0.98 | 0.033 |

Observations:

- Column 4: d- represents the depth of the turbine rotor, 4.4m (it is highlighted in table no. 3). Column 4 represents the sum between this depth of the turbine rotor and the length of the birds (see column 2);
- Column 6: represents the number of birds of each species observed in the wind farm area, as a result of the monitoring.
- Column 7: represents an estimation of the number of days within a year when the bird species identified after the survey are considered to fly in the farm area. The number of days is estimated according to the number of months when the species was identified in the farm area, according to the data indicated in table no. 7, considering that birds spent on average 4 hours/day in the wind farm area.
- Column 8= col.6 x col.7
- Column 12: represents the time necessary for a bird to fly over the entire distance representing the depth of the rotor
- Column 14: the likelihood was calculated according to the SNH methodology

3. **RESULT INTERPRETATION AND CONCLUSIONS**

Obviously a risk of collision of birds with the wind turbines exists only when a bird is flying within the rotor sweep area or when it can be affected by the turbulences caused by the rotors.

The behavior during the flight, including the height at which birds fly, varies considerably between species. Many birds sometimes barely reach the action area of the rotor, while others perform routine flights in these areas and others fly at heights much higher than this area.

There are also various types of flights such as hovering, flying in circles in the air, flying horizontally and vertically, which is characteristic for certain species of birds or certain activities that may pose different risks of collision. The variation of the visibility conditions during the day or night, or due to weather conditions, is also likely to influence the risk of bird collision with the turbines.

For example, although few data are available, it seems that most collisions that occur are the result of the fact that birds do not notice wind turbines due to poor visibility conditions, rather than of the fact that they cannot avoid a turbine visible.

As far as the analyzed farm is concerned, as shown in tables no. 5 and no. 8, one can notice that all values that emphasize the real risk of collision of birds with the wind turbines (column 11 of Table no. 5 and column 17 of Table no. 8) are subunits, which emphasizes that over a year it is very unlikely that mortality occurs in the populations of birds that cross the wind farm area due to collision with the wind turbines.