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Report on the environmental impact of the project involving a change in the number and parameters of the wind power plants at the planned Banie III wind farm

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1. Introduction

As a party to the United Nations Framework Convention on Climate Change, Poland is obliged to reduce emissions of greenhouse gases and other gases resulting from combustion, primarily coal. From the 19th century until today, the average global temperature has risen by 0.7° C, and exceeding the limit by 2° C could cause Greenland's glaciers to melt. Greenhouse gases, mainly carbon dioxide, are believed to be the main culprit of these changes. According to WWF, as much as 37% of these emissions come from fossil fuel energy production.

The International Energy Agency (IEA), estimates that global electricity consumption will double by 2020. Globally, it is estimated that 20% of electricity will be generated from renewable energy sources. The energy obtained from wind turbines is called an environmentally clean form of energy. A 1 kWh of electricity generated during the operation of a wind turbine can replace a 1kWh of energy generated by coal-fired power plants. Thus, it eliminates the emission of pollutants associated with this process.

It can be assumed that the annual emission of compounds to the atmosphere during the production of 1MWh of electricity in conventional power plants amounts to (Soliński and Solińska 2001): 7.8 kg of SO2; 3.2 kg of NO2; 937 kg of CO2; 0.2 kg of CO; 1.1 kg of dust.

Despite their advantages, wind turbines can pose a threat to natural resources, especially birds and bats. Under adverse conditions, birds and bats may collide with structural elements of windmills. Bats additionally experience barotrauma, which is damage to the alveoli of the respiratory epithelium due to the rapid change in pressure when they fly between rotating blades.

2. Qualification of the project

Pursuant to Article 59 sec. 1 of the Act dated October 3, 2008 on making available of information on environment and its protection, public participation in environmental protection and environmental impact assessments (Journal of Laws 2018, item 2081), an environmental impact assessment is required for the implementation of a planned project that may always have a significant impact on the environment.

The present project involving the construction of wind power plants with a capacity of up to 115 MW, according to §2 sec. 1 item 5 of the Regulation of the Council of Ministers dated November 9, 2010 on projects likely to have significant impact on the environment (Journal of Laws 2016, item 71), is classified as a project that may always have a significant impact on the environment and concerns installations using wind energy for electricity generation with a total nominal capacity of the power plant of not less than 100 MW. The project is consistent with the amendment to the Study of Conditions and Directions for Spatial Development of the Banie commune, sanctioned by the resolution NR XXV/22/05 of the Banie commune council of April 20, 2005.

The undertaking is in line with the valid spatial development plans of the Banie commune: resolutions from 2005; XXVI/224/05, XXVI/225/05, XXVI/226/05, XXVI/227/05, XXVI/228/05, XXVI/229/05 and XXVI/230/05 and amending resolutions from 2014; XXX/275/2014, XXX/276/2014, XXX/277/2014, XXX/278/2014, XXX/279/2014, XXX/280/2014 and XXX/281/2014.

3. Subject, scope and aim of the study

The purpose of this study is to analyze the environmental impact of the updated project involving the construction of 34 wind power plants with changed parameters, towers height and rotor blades length, with particular emphasis on the impact on the avifauna.

This analysis concerns the initially planned construction of the “Banie Wind Power Plant Complex” consisting of 46 wind power plants with a total capacity of up to 115 MW, along with the necessary technical infrastructure, i.e. access roads, assembly yards, medium voltage power lines and fiber optic cable lines. The project is to be located in agricultural crop areas.

On August 18, 2009, the Banie Commune Voyt issued a decision on environmental conditions of approval for the execution of a project consisting in the construction of the “Banie Wind Power Plant Complex” (GK- 7627/2/2008).
The decision was based on the conducted proceedings for the environmental impact assessment of the project, as a result of the analysis of evidence constituting the study “Environmental impact assessment of design solutions for the construction of the Banie Wind Power Plant Complex" (Zyska et al. 2008), including nature monitoring from the years 2006-2007.
The investor obtained building permits for the wind power plant complex in 2013 and obtained temporary building permits in 2014.

Due to the passage of time, during which technological progress has been made in terms of increasing the efficiency and reliability of wind turbine operation and the withdrawal from production of older models of wind turbines, which were taken into account in the earlier environmental impact analysis, the investor decided to change the parameters of wind turbines, adapting the project to the current technological capabilities.
Changes to the project include the number of wind power plants (reduction to 34 units), the height of the wind power plant tower, and the length of the rotor blade. The total capacity of the wind farm of up to 115 MW (according to the environmental decision of August 18, 2009) will be maintained.

Location of the project, on plots in 10 geodesic precincts of the Banie commune: Babinek, Banie, Baniewice, Dłużyna, Kunowo, Lubanowo, Piaseczno, Sosnowo, Swobnica, Tywica (app. *[missing appendix number in the original version – translator’s note]*). Construction of wind turbines is planned on the following plots:
- Banie 3 precinct, plots no. 835/1, 848/1, 848/2, 853/1,
- Piaseczno precinct, plot no. 591/1,
- Swobnica precinct, plots no: 174/2, 791/1, 810/1, 817/1, 822/1, 822/2,
- Baniewice precinct, plots no: 409/3, 409/4, 417/2, 417/3, 435/1,
- Lubanowo precinct, plots no: 88/7, 92/2, 95/1, 97/5, 216/2, 314/8, 314/6, 314/12, 330/2, 330/4, 330/6,
- Sosnowo precinct, plots no: 23/2, 33/1, 42/1, 127/5, 127/7, 129/1, 132/3.

The scope of the report includes issues contained in Article 66 of the Act of October 3, 2008 on the provision of information on the environment and its protection, public participation in environmental protection and environmental impact assessments (Journal of Laws of 2018, item 2081), with particular attention to the analysis of:
- the impact of the change of parameters of wind turbines on the acoustic climate,
- the impact of the change of parameters of wind turbines on avifauna, taking into account primarily the materials from pre-investment monitoring,
- the option proposed by the applicant and the justification for the rational environmentally preferable option,
- the anticipated actions aimed at avoiding, preventing and limiting negative impacts on the environment.

4. Description of the planned project

4.1. Terms of land use in the execution and operation phase

Currently, the area of the proposed project is entirely occupied by agricultural land, interspersed with field and communal roads. The area is monotonous in landscape with a small number of mid-field ponds that often dry out in the summer. No major concentrations of shrubs or mid-field trees. Small clusters of these are found along communal and field roads crossing the project area.

During implementation, some agricultural crops will be taken out of agricultural production and used for assembly yards where the wind power plants will be built, and for access/service roads. The construction area of a single wind power plant with an assembly yard will be approximately 1200 m^2. Access/service roads will have a minimum width of approximately 4.5 m.
During operation, the assembly yards and access roads will be used to service the constructed wind power plants.

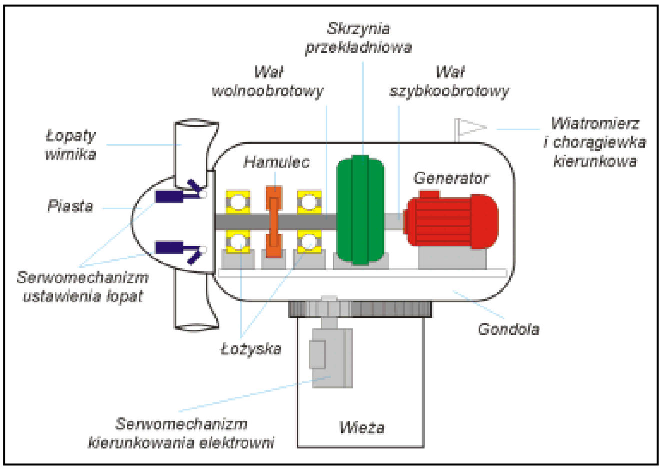
4.2. Features of the technological process

Parameters of the foundation elements of the wind power plant towers and all the necessary accompanying technical infrastructure (assembly yards, access roads, cable lines, etc.) remain the same as in the earlier report and environmental decision (GK-7627/2/2008). Only the number, tower height, and rotor blade length are changed, which are the basis of the analysis in this paper. Two brand new wind power plant models were considered: Nordex N117 and Vestas V110.

Prior output parameters of the wind power plants:
- hub (tower) height – 100 m,
- rotor diameter – 100 m,
- total wind power plant height – 150 m.

Wind power plant target parameters:
- hub (tower) height – up to 120 m,
- rotor diameter – up to 120 m,
- total wind power plant height – up to 180 m,
- increase in the total wind power plant height – 20%.

A wind turbine is used to convert the kinetic energy of the blowing wind into electrical energy. The main components of a modern wind power plant are the rotor and nacelle located on the tower. The most important part of a wind power plant is the rotor, which converts wind energy into mechanical energy. It is mounted on a shaft through which the generator is driven. The rotor usually rotates at 7.8 to 14.8 rpm, while a typical asynchronous generator produces electricity at over 1,500 rpm. Therefore, it is necessary to use a gearbox in which the speed increase takes place. Some machines use a gearless mechanism consisting of a ring generator. The most common are tri-blade rotors, constructed of fiberglass reinforced with polyester. A servo motor is located in the rotor hub allowing the blade angle (pitch) to be set. The nacelle must be able to rotate 360 degrees so that it can always be positioned against the wind. Therefore, a motor is installed at the top of the tower to rotate it through a gear transmission. In low power plants, where the mass of the nacelle is relatively small, upwind positioning of the nacelle is provided by a directional rudder integrated into the nacelle. The operation of the blade setting and the power plant direction mechanism is managed by a microprocessor system on the basis of input data (e.g. wind speed and direction). In addition, the nacelle contains a transformer, bearings, lubrication systems, and a brake to stop the rotor in emergency situations.



Key:
Skrzynia przekładniowa – gearbox
Wał wolnoobrotowy – low-speed shaft
Wał szybkoobrotowy – high-speed shaft
Łpaty wirnika – rotor blades
Piasta – hub
Serwomechanizm ustawienia łopat – blade pitch control
Wiatromierz i chorągiewka kierunkowa – anemometer and wind vane
Hamulec – brake
Generator – generator
Łożyska – bearings
Wieża – tower
Gondola – nacelle
Serwomechanizm kierunkowania elektrowni – yaw control

Source: Tomasz Boczar: Energetyka Wiatrowa

Figure 1. Simplified schematic of a typical power industry wind power plant.

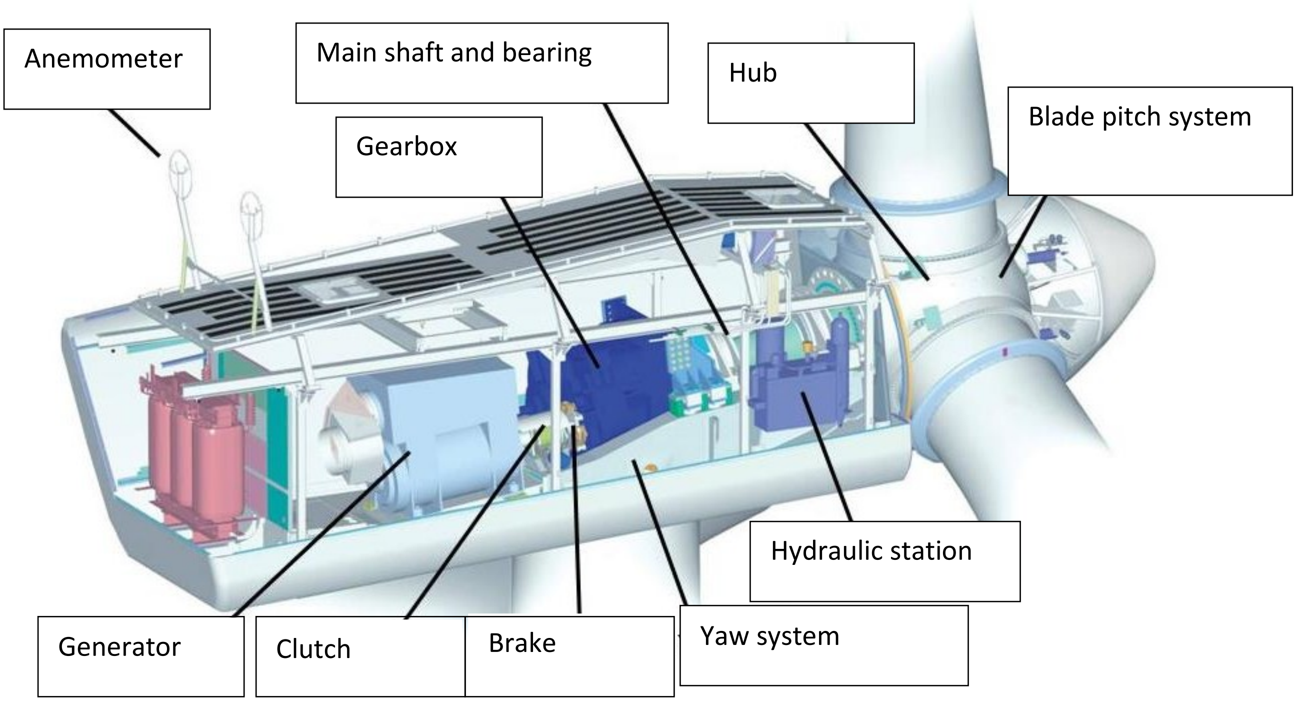
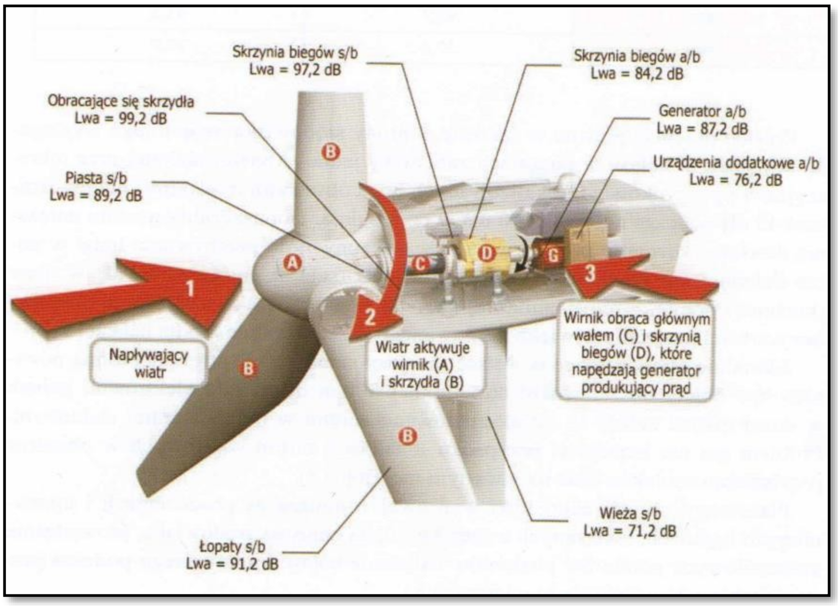


Figure 2. Wind turbine components (V110).

4.3. Expected emissions from the operation of the planned project

During the operation of the project, it is expected that mainly the following emissions will occur: noise. Other emissions: electromagnetic field, infrasound, and vibration will be largely suppressed by the wind power plant structure and screened by the external walls of the plant; therefore, their impact will not occur or will be negligible in the impact assessment.

Noise emissions will result from the mechanical devices located in the nacelle and the swirling motion of the rotor blades. The measured sound intensity levels for each component of the 2.2 MW wind turbine are shown in the figure below.



Key:
Skrzynia biegów – gearbox
Obracające się skrzydła – rotating blades
Piasta – hub
Generator – generator
Urządzenia dodatkowe – auxiliaries
Napływający wiatr – wind direction
Wiatr aktywuje wirnik (A) i skrzydła (B) – wind activates the rotor (A) and blades (B)
Wirnik obraca głównym wałem (C) i skrzynią biegów (D), które napędzają generator produkujący prąd – The rotor drives the main shaft (C) and the gearbox (D), which drive the power generator
Łopaty – blades
Wieża – tower

Source: Tomasz Boczar – Energetyka Wiatrowa, Aktualne możliwości wykorzystania
Figure 3. Noise generated by individual components of a wind turbine

The noise level is related to the wind speed at which the power plant operates and is partially attenuated through isolation of the mechanical devices in the nacelle. The perception of noise levels is mainly influenced by aerodynamic noise propagating through space.

The modern wind power plant structural components that will be used in this project have damping elements in the nacelles and towers. Hence, transmission of perceptible vibrations to the environment is not expected.

The resulting electromagnetic fields occur at the nacelle, which contains mechanical equipment and a power generator. Due to their low value, their impact will be on the space immediately around the nacelle. At ground level, their impact will not be felt.

Infrasound generated during the operation of the wind power plant will be partially attenuated by the structure itself. Only a portion of the emission will propagate through space, undergoing rapid attenuation in space.

5. Methodology used for the study

The text of the study consists of a general and analytical section. The following forecasting methods were used in developing the report:
- determination of the state of the environment on the basis of field observations (nature monitoring),
- mathematical modeling (acoustic analysis),
- cartographic analysis in the field and based on archival and contemporary maps,
- selection of studies and results of research work on particular issues occurring in the project area,
- publicly available materials from the Commune, the Ministry of Environment (www.mos.gov.pl) and others,
- published and unpublished naturalist data,
- supplemental field surveys.

The applicable values of permissible noise levels in the environment result from the provisions of the ordinance of the Minister of Environment of June 14, 2007 on permissible noise levels in the environment [consolidated text Journal of Laws of 2014 item 112]. The limit values contained in the aforementioned regulation are shown in the table below.

Permissible environmental noise levels caused by specific groups of noise sources, excluding noise generated by power lines and by take-offs, landings and flights of aircraft

No.	Terrain type	Acceptable levels of noise in [dB]			
		Roads or railways[1)]		Other facilities and activities being the source of noise	
		LAeq D reference time interval of 16 hours	**LAeq N** reference time interval of 8 hours	**LAeq D** reference time interval of the 8 least favorable consecutive hours of a day	**LAeq N** reference time interval of the 1 least favorable hour of the night
1	a) Protected zone "A" of the health resort b) Hospital areas outside the city	50	45	45	40
2	a) Areas of single-family residential development b) Areas of development connected to permanent or temporary stay of children and youth[2)] c) Areas of nursing homes d) Areas of hospitals in cities	55	50	**50**	**40**
3	a) Areas of multi-family residential development and collective residence b) Farm building areas c) Recreational areas[2)] d) Residential and service areas	60	50	**55**	**45**
4	Areas in the city-center zone of cities above 100 thousand inhabitants[3)]	65	55	55	45

Day 6:00am–10:00pm
Night 10:00pm–6:00am

Based on the data, the areas around the wind turbines can be classified into several groups:

1) Agricultural areas – no acoustic protection

2) Areas of farm development, areas of multi-family residential development and collective residence
   - L_{AeqD} – equivalent sound level for the daytime – **55 dB**
   - L_{AeqN} – equivalent sound level for the nighttime – **45 dB**

Farm development represents an entire group of areas (residential development with services, farm development, individual recreation and recreation areas) for which acoustic protection is 55dBA during daytime and 45dBA during nighttime.
Based on the inventory and planning documents, control points located on the boundaries of plots with appropriate land use were selected.
The control points were adopted in such a way that for a given group of acoustically protected areas the first building line was controlled, which is the closest to the location of the wind turbines and thus the most exposed to noise from the turbines. Thus, the first development line meeting the standards for the 55dBA/45dBA terrain group ensures that the noise limits are met on the remaining land along the subsequent development lines.
Therefore, not all acoustically protected area types have control points assigned, but only those in the first line of development closest to the proposed wind turbines.
A table with selected control points and their coordinates as well as assigned noise limits is presented below.

Control points in sensitive areas of the Banie commune

Number	Number of the plot	Description	Coordinates			
			X (m)	Y (m)	Day dB (A)	Night dB (A)
Sosnowo						
P1		Farm development	5476294.16	5890220.63	55	45
P2		Farm development	5476661.7	5890280.02	55	45
P3		Farm development	5476642.25	5890007.28	55	45
P4		Farm development	5476737.74	5890048.91	55	45
P5		Farm development	5476842.26	5890072.79	55	45
P6		Farm development	5476906.03	5890113.56	55	45
P7		Farm development	5477016.29	5890186.25	55	45
P8		Farm development	5476859.54	5890422.26	55	45
Lubanowo						
P9		Farm development	5472997.78	5888447.39	55	45
P10		Farm development	5473793.57	5888629.74	55	45
P11		Farm development	5473998.29	5889115.53	55	45
Tywica						
P12		Farm development	5474536.48	5887182.95	55	45
P13		Farm development	5475144.87	5886744.75	55	45
P14		Farm development	5475305.8	5886208.65	55	45
Banie 3						
P15		Farm development	5477461.93	5886457.42	55	45
Piaskowo						
P16		Farm development	5478552.66	5882406.43	55	45
P17		Farm development	5479131.61	5882967.29	55	45
Piaseczno						
P18		Farm development	5479463.39	5881453.97	55	45
P19		Farm development	5479696.28	5881286.13	55	45
Baniewice						
P20		Farm development	5473537.5	5882698.93	55	45
P21		Farm development	5473913.21	5882950.56	55	45
P22		Farm development	5474354.23	5882979.5	55	45
P23		Farm development	5474377.89	5882626.07	55	45

Swobodnica						
P24		Farm development	5474552.35	5878628.22	55	45
P25		Farm development	5474804.98	5879277.44	55	45
Kunowo						
P26		Farm development	5479490.18	5889382.64	55	45

Approximate location of control points (marked in red)

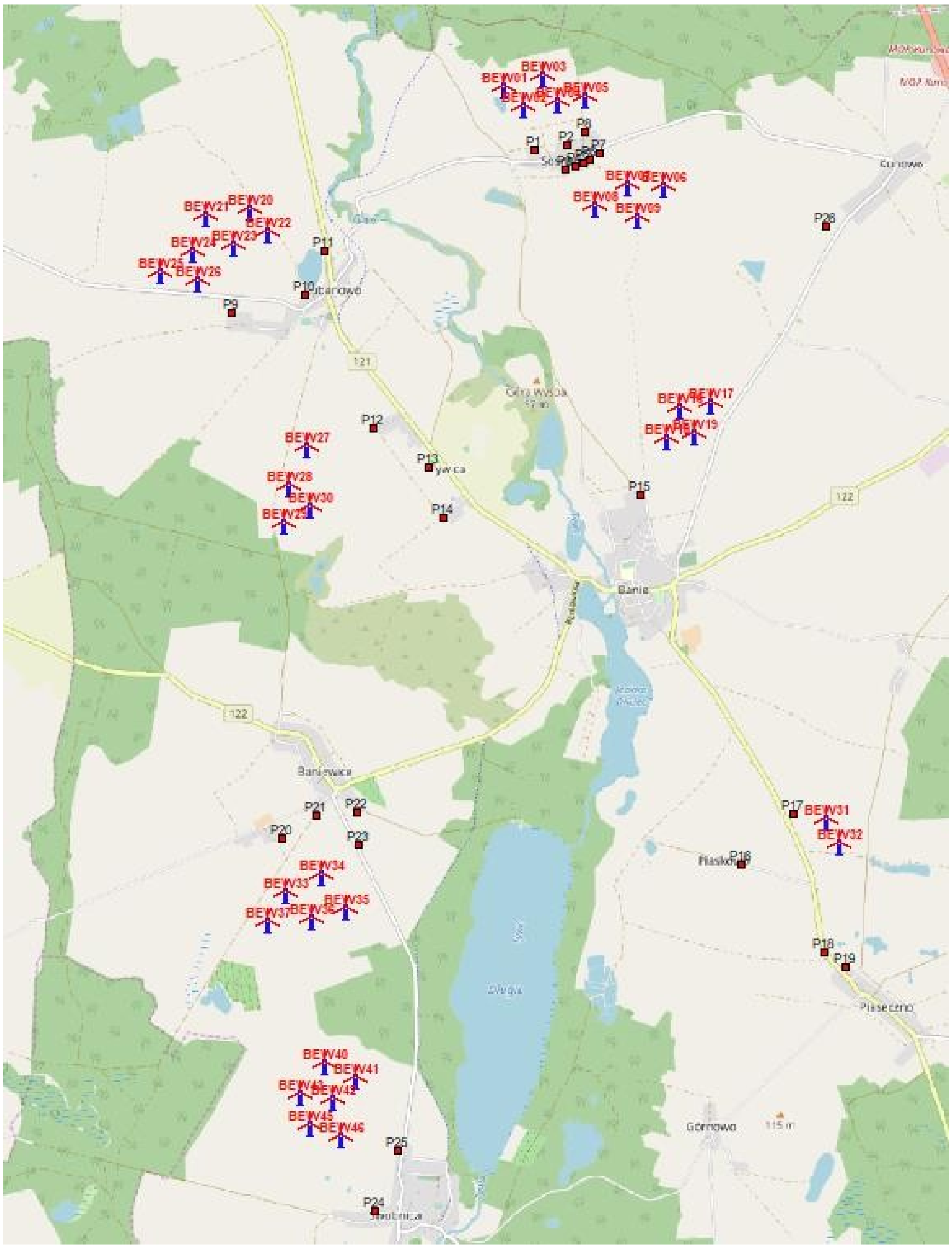


Figure 1. Approximate location of control points.

It was assumed in the analysis of wind turbine noise that wind turbines are a point source of sound, that is, one for which each linear dimension is less than half the distance between the geometric center of the source and the nearest point of observation.

For this analysis, the lowest tower height of 120m was adopted due to the largest acoustic impact range.

Another assumption is that the turbine emits acoustic energy uniformly in all directions – an omnidirectional source located at the height of the nacelle assembly, i.e., the minimum height of 120m for this study (maximum tower height is 180m)

For the purpose of performing this analysis, some simplifications were also made, which may result in slightly inflated isophone ranges of a given level. In the performed calculations it was assumed, among others, that the wind turbines will operate continuously at nominal power, which is not encountered in practice, since such an assumption would require the occurrence of winds above 12 m/s at the height of the nacelle throughout the entire period of the wind farm operation (according to meteorological data, average annual wind speed in the area of the investment is about 4-5 m/s at 10m height, which translates into approximately 7-9 m/s at the height of the nacelle)

Acoustic calculations were performed using IMMI software utilizing sound propagation modeling according to ISO 9613-2.

Calculations were performed taking into account ground effects and including attenuation associated with shielding.

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To analyze impacts on the natural environment, data from the most recent 2018 pre-investment monitoring and data from the pre-investment monitoring performed from 2004 to 2019 for the discussed project were primarily used.

The area monitored was larger than the area of the proposed wind farm. The purpose of enlarging the area is to analyze the impact of the farm not only in the area of the power plant location, but to take extra precautions, also in the directly adjacent areas (for key species within the distance of about 2 km).

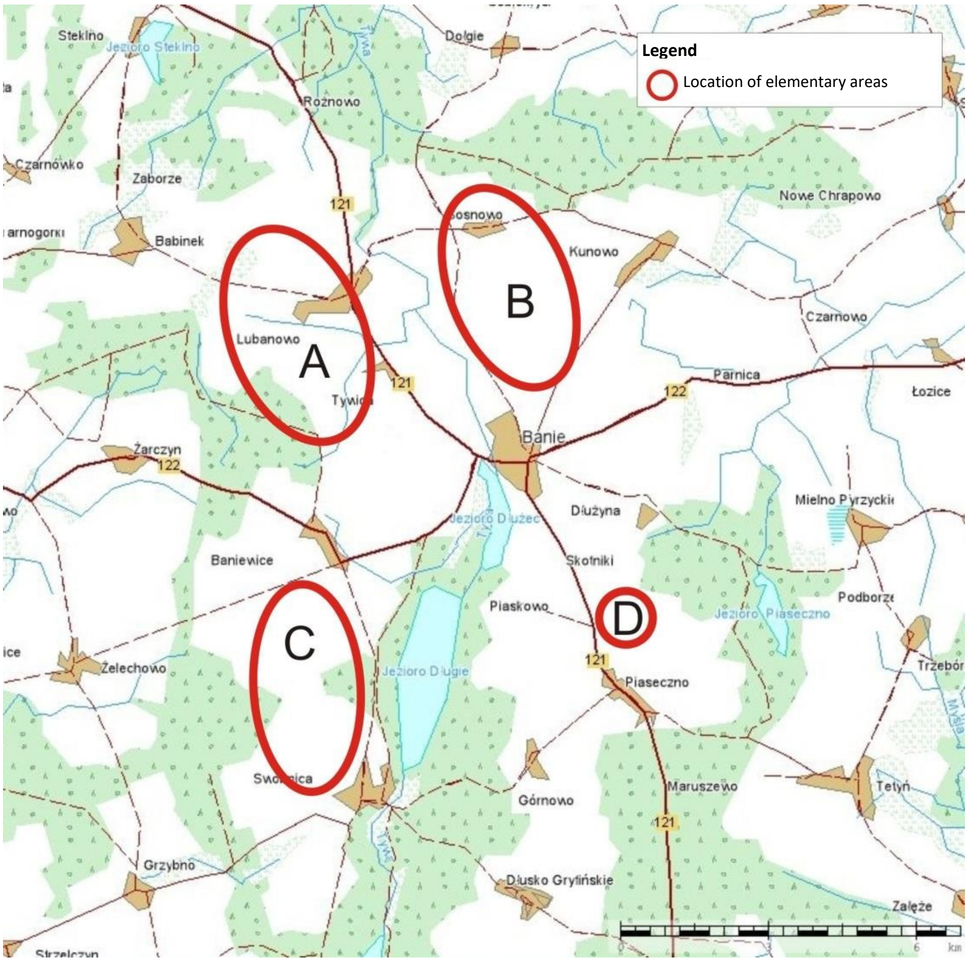


Figure 2. Location of the monitoring area broken down into elementary areas.

During the work in the monitoring area, different observation methods were used tailored to specific groups of animals, focusing on groups that are particularly vulnerable to the impact of wind turbines, namely birds and bats. Data were collected in each year, during all phenological periods (I to XII).

Bird observations were carried out based on methods commonly used in ornithology, descriptions of which are included in the literature on the subject (Tomiałojć 1980, 1997; Chylarecki et al. 2006; Chylarecki and Jawińska 2007; Morrisom et. al 2007; Chylarecki and Pasławska 2008, Chylarecki et al. 2011). In the field works, the transect study method, fixed observation points and the methods used in the MPPL program (monitoring of common breeding birds) were applied.

Observations were made using 8x42 binoculars, a 100x25-60 spotting scope, and night vision during night works. Bird taxonomic affiliation, count, flight direction and altitude, and observation sites were recorded during observations in the monitoring area. Some of the birds flying at higher altitudes and distances were not identified; where possible, the genus or higher taxonomic unit was determined. At least 36 baseline observations were made in a decade layout during the fieldworks:
- winter period – 9,
- spring migration period – 6,
- breeding and roosting season – 12,
- fall migration period – 9.

Additionally, the following were performed: 6 night inspections, 8 census inspections, 4 MPPL investigations, and an additional 6 in EA-C, during the white-tailed eagle breeding season.
Data from follow-up observations were also included.

The following tasks were conducted during the works:
1. transect studies, according to monitoring path B,
2. surveys at fixed observation points – airspace use intensity,
3. MPPL protocol studies – squares were established– sample plots,
4. key species census survey,
5. identification of groupings and concentrations of flocks.

The monitoring area was divided into 4 elementary areas: A-D; a transect and observation points were designated on each of these. The length of each transect was: T1 – approx. 3.7 km; T2 – approx. 4.3 km; T3 – approx. 4.8 km; T4 – 1.6 km. The total length of the transects was – approx. 14.4 km. Approximately 1 h was spent at each observation point.
According to the draft methodology of Chylarecki et al. (2011), the survey of the breeding census of directive species (Bird Directive) covered an area with a buffer of about 2 km in an open area and about 0.5 km in a forested area from the proposed wind power plant site. The scope of the area is shown in the figure below.

Observations of bat activity were conducted from III to XI. It was based on the methodology recommended by EUROBATS and widely used in field works (e.g., Kepel et al. 2009, Kowalski et al. 2000, Szkudlarek & Paszkiewicz 2000, Szkudlarek & Paszkiewicz 2001, Sachanowicz & Ciechanowski 2005, Rodrigues et al. 2006).

Data were obtained using night vision and ultrasonic detectors. Signals were recorded using AnaBat SD2 detectors. Analysis of the ultrasound recordings was performed using the bioacoustic software AnalookW. In addition, I+ and II generation night vision device observations were conducted to assess the use of space beyond the range of the detectors. Observations of flying bats and sound analyses were made from approximately 2.5 h before dusk to approximately 4-5 h after dusk, and overnight. Data were collected from transects and listening posts. Spotted flying bats were also recorded during the work, but being out of range of the detectors they were not marked and placed in the tables. Using a night vision device, an attempt was made to determine the approximate use of the space above the detector range. One should bear in mind that this is an estimation method because not all bats can be spotted. However, the data obtained provide some approximation of space utilization at higher levels within the range of the rotor blades.
The length of each transect was: T1 – approx. 7.3 km; T2 – approx. 5.2 km; T3 – approx. 4.5 km; T4 – approx. 1.7 km. The total length of the transects covered was approximately 18.7 km. On most transects, listening was conducted from a car, using a special external microphone together with a dedicated Titley Scientific roof mount, while driving at approximately 15-20 km/h. This was made possible by a well-developed network of field roads. Each time, the listening was started from opposite points.
Some of the signals were not identified due to the inability to accurately distinguish between similar signals of noctules and serotines (“NEV” – *Nyctalus/Eptesicus/Vespertilio*). Some of the mouse-eared bats’ signals were also not marked. Signals that could not be analyzed due to lack of: taxonomic designation, poor signal, or damage were marked as “not identified” in the tables.

To initially assess the activity and nature of bat interactions, a proposed scale by Kepel ed. (2011) was used. One should bear in mind that there are several different scales in “circulation”, each with advantages and disadvantages. Due to environmental, biogeographic, or physiographic differences, there is no standardized scale that can be used. Currently, there are several scales from different authors in use in the country. Therefore, assessments using the proposed scale should only be considered as signaling a possible impact, without a definitive assessment of the bat – wind power plant interaction. A new model for assessing bat activity is under development, but it is a complex problem and it is not clear when a model that is recognized throughout the scientific community will be developed. This problem has been signaled in both previous guidelines (Kepel et al. 2009, 2011, 2014).

Larger hibernation sites (>20 individuals) were sought during winter, and larger breeding colonies (>30 individuals) were sought during the active season.

Works were conducted in accordance with 3 tasks:

1. recording of bat voices and their analysis,
2. inspections of potential breeding colonies,
3. inspections of potential hibernation sites.

For the WPP impact analyses, 3 zones were distinguished:
- safe zone 1 – below the lower range of the rotor blades (0 – 50 m above sea level),
- potential collision zone 2 – within range of rotor blades (50 – 160),
- safe zone 3 – above the upper range of the rotor blades (> 160 m).

The potential collision zone was increased by 10 m above the upper reach of the rotor blades, relative to the total height of the wind turbine.

The following abbreviations and acronyms are used in the text:
- study area – the entire area under observation,
- monitoring area – the area covered by basic field observations, defined by a line passing through the extreme horizontal points of the blade lengths of all power plants,
- investment area – places where wind power plants and the accompanying infrastructure are designed to be located,
- adjacent area – lands immediately adjacent to the study area up to approximately 100 m from the monitoring area boundary,
- neighboring area – land located at varying distances from the adjacent area,
- WF – wind farm,
- WPP – wind power plant(s),
- EA-A – elementary area A (Lubanowo),
- EA-B – elementary area B (Sosnowo),
- EA-C – elementary area C (Swobnica),
- EA-D – elementary area D (Piaseczno),
- BD – Birds Directive,
- HD – Habitats Directive,
- MPPL – monitoring of common breeding birds coordinated by the National Society for the Protection of Birds (OTOP),
- ooś – Environmental Impact Assessment.

During data analysis, the wildlife value of individual animal taxa was determined using primarily the following selected legal acts:

- Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) Journal of Laws 1996, no. 58, item 263),
- Regulation of the Minister of Environment dated January 12, 2011 on special protection areas for birds (Journal of Laws 2011, No. 25, item 133),
- Regulation of the Minister of Environment dated March 29, 2012 amending the regulation on special protection areas for birds (Journal of Laws 2012 item 358),
- Regulation of the Minister of Environment of November 8, 2013 amending the Regulation on natural habitats and species being of Community interest, as well as the criteria for selecting areas eligible for recognition or designation as Natura 2000 areas (Journal of Laws 2013, item 1302),
- Regulation of the Minister of Environment dated Wednesday, December 28, 2016 on the protection of animal species (Journal of Laws 2016, item 2183),
- Act dated August 31, 1995 on the ratification of the Convention on Biological Diversity (Journal of Laws no. 118 item 565).

- Act dated October 3, 2008 on making available of information on environment and its protection, public participation in environmental protection and environmental impact assessments (Journal of Laws No. 199, item 1227, as amended),
- Act dated August 18, 2011 amending the act on nature conservation (Journal of Laws No. 224 item 1337 as amended).

6. Description of the natural environment elements covered by the scope of the foreseen impact of the planned project
6.1. Location of the project area

The project area is located in the Banie commune, in the south of the Zachodniopomorskie Voivodeship, between the villages: Lubanowo, Sosnowo, Kunowo, Banie, Baniewice, Swobnica and Piaseczno (Fig. 3). The work area is divided into 4 elementary areas (patches) A-D (fig. 4).

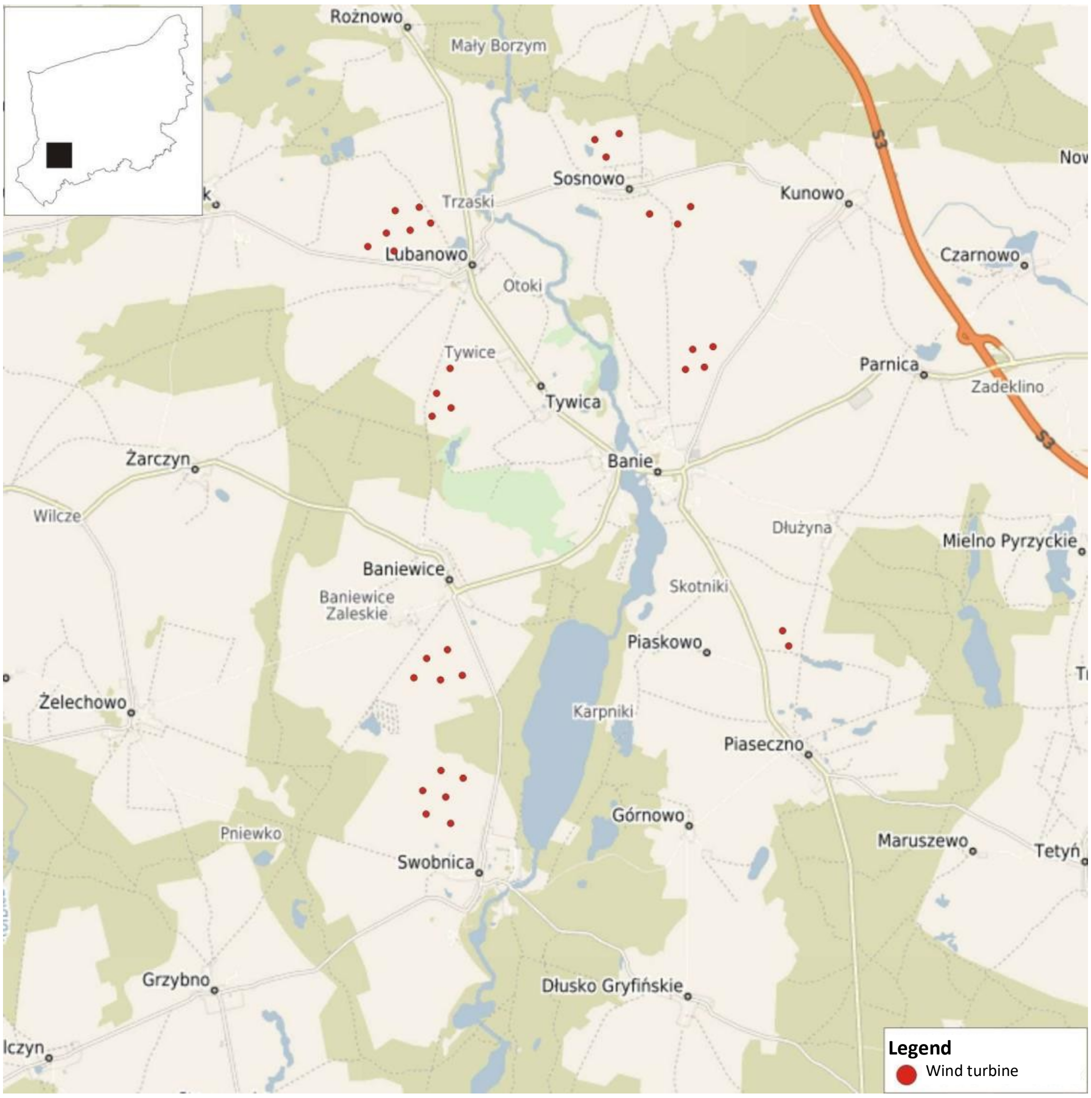


Figure 3. Location of the planned wind power plants in the Banie commune.

Elementary area A – located near the Lubanowo locality. Most of the area is occupied by farmland, interspersed with communal and field roads. Some of the roads have lines of roadside trees. Area with a small number of mid-field ponds, some partially drained. One larger reservoir is located near the village of Lubanowo.

Figure 4a. Physiography of elementary area A.

Elementary area B – it extends southward from the village of Sosnowo to the village of Banie. One of the largest by area. Virtually all of the land is farmland, with a few field roads and sparsely developed rows of roadside trees. A small number of mid-field ponds. A system of kettle ponds stretches near the western boundary. The area is of a monoculture agricultural nature.

Figure 4b. Physiography of elementary area B.

Elementary area C – it extends from the village of Baniewice to Swobnica. In the southern part it is surrounded by forest complexes. Interspersed with dirt roads with well-developed rows of tree canopies. There are a large number of mid-field ponds and a varied surface area. The terrain is slightly undulating. Most of the area is occupied by agricultural land.

Figure 4c. Physiography of elementary area C.

Elementary area D – it is the smallest area. It is an agricultural monoculture overall with a predominance of cereals. It lacks mid-field ponds. It neighbors the district road from Banie to Piaseczno with a developed line of tree canopies. The terrain is almost flat, with a slight elevation.

Figure 4d. Physiography of elementary area D.

6.2. Abiotic elements

According to the physicogeographical classification, the project is located at the junction of two mesoregions:
31. Province – Great European Plain,
313. Subprovince – South Baltic Coast
314–316. Subprovince – South Baltic Lake District,
313.2–3. Macroregion – Pobrzeże Szczecińskie,
314.4. Macroregion – West Pomeranian Lake District,
313.28. Mesoregion – Wełtyń Plain
314.41. Mesoregion – Myślibórz Lake District.

Wełtyń Plain.
An undulating moraine plateau, between the Wzgórza Bukowe in the north and the Myślibórz Lake District in the south. There are 35 small lakes, of which only 10 are larger than 10 ha. Its elevation varies between 50 and 70 m above sea level. Agricultural region. More significant patches of forest occur in the southwestern part (Kondracki 2001).

Myślibórz Lake District.
It presents a complex of glacial forms connected with the southernmost reach of the Pomeranian phase of the Vistulian glaciation. It covers an area of approx. 1810 km^2. Only in few places moraine

hills exceed 100 m above sea level, with relative heights of 20 to 40 m. Many small lakes, 200 of which are larger than 1 ha. The largest is the Myslibórz Lake with an area of approx. 6 km^2. The most extensive forests occur in the western part of the region (Kondracki 2001).

6.2.1. Geomorphology

The area of the Banie commune, including the area of the plan, lies entirely within the West European Paleozoic platform which formed at the end of the Carboniferous period. The foundation of this platform is corrugated sedimentary rocks formed during the Paleozoic era. The modern landscape of the commune area began to form during the Quaternary period. The Quaternary surface is characterized by a varied relief. Its genesis is related to erosion and denudation processes that lasted throughout the Tertiary and part of the Quaternary period. Finally, the existing relief of the area was shaped during the North Polish Glaciation, especially in its last Pomeranian phase and the period of receding glacier. Transgression occurred during this period, which was marked by the accumulation of fluvio-glacial sands and gravels. The municipality is dominated by early post-glacial landscape characteristic for the ground moraine uplands. A significant part of the area is occupied by sand plains and ground moraine uplands. The area is mostly open, slightly hilly with few rises. Most of the area is farmland with small mid-field ponds. There are also forest complexes and lakes of various sizes, concentrated in the Tywa valley. It is a part of a ground moraine upland, slightly undulating. The area under study is mainly agricultural land with dominance of cereal monocultures. A small part of the area is located in the vicinity of the Tywa valley. The Tywa is a right tributary of the Oder.

6.2.2. Soils

The soils of the Banie commune are inseparably connected with its geological structure. Soils in the area of the commune, similarly to the soil cover of Western Pomerania, are relatively young formations. The parent rocks of the soils in this area are Quaternary formations of glacial and fluvio-glacial genesis of Pleistocene age and formations connected with later (Holocene), still continuing, processes of accumulation of organic and river sediments. These include sands and sands with gravels, tills, river silts and sands, and peats. They are dominated by tills and sands and gravels of various origin, which have developed mainly rusty podzolic soils and grey-brown podzolic soils. They are mostly included in quality classes III and IV, which constitute the majority of soils in the study area. There are few soils of classes V and VI. On the other hand, silts, river sands and peats are mainly found in the Tywa valley.

6.2.3. Hydrology

The area of location of the WPP and accompanying infrastructure is devoid of major watercourses and water reservoirs. There are few remnants of a drainage system. Mid-field ponds of varying size occur in the vicinity of the WPP site.

Mid-field ponds have a variably developed littoral zone. Some of them get dried up or desiccated during the summer.

The project area is located outside the boundaries of major groundwater reservoirs. The area is located in the Odra river basin, in the Lower Odra and West Coast water region.

The Tywa, a tributary of the Oder River, flows through the middle of the study area. And in its valley there are flow-through lakes of various sizes. The largest of these are the Długie Lake and the Dłużec Lake.

The proposed project lies within the boundaries of two uniform groundwater bodies: 23 and 24. Most of the area can be found in the Groundwater Bodies Information Sheet 23.

The project site is located within 3 uniform river surface water bodies:

- Tywa from the source to the tributary from Tywica RW600025193275,

- Tributary from Tywica RW600016193276,
- Tywa from the tributary from Tywica to the mouth RW600016193299.

It should be noted that, as in previous years, a large proportion of mid-field ponds showed a tendency for water levels to drop or dry up during the summer. This has resulted in the reduction or disappearance of wetland and water table habitats suitable for amphibians and wetland bird species. Partial drying up or desiccation of ponds, wetlands, and ditches resulted in a reduction of favorable foraging habitats, primarily for birds and bats.

6.2.4 Landscape

Natural Landscape.

The landscape of this area was shaped by the impact of the last glaciation, and then, after it receded, by erosive processes and plant activity. The part of the commune covered by this study is varied in terms of terrain relief, which in geomorphological terms is a slightly undulating surface of moraine upland (ground moraine), rising at heights from about 43 to over 100 m above sea level. The terrain in the central part slopes gently towards the Tywa valley, which flows through the central part of the WPP site area in the direction from south to north. In the Tywa valley there is a complex of flow-through reservoirs, the largest of which are: the Długie and Dłużec lakes. The landscape of the study area is complemented by small mid-field ponds, often of an astatic nature, with a shore zone overgrown to various degrees with clusters of shrubs and trees. An important component of the landscape composition are clusters of shrubs and trees around the surrounding localities and rows of trees located along district and commune roads. An important element of the natural landscape are the forest complexes surrounding the project area and centrally located around the Długie Lake.

Anthropogenic landscape

In the Banie commune there are no large industrial plants having significant impact on the environment. There are no industrial plants in the area covered by this paper or areas immediately adjacent to it. The planned development is located entirely in an agricultural landscape. Virtually the entire area of the wind turbines' location and accompanying infrastructure is covered by agricultural land. The agrarian structure is dominated by arable land, with a small area of wasteland. The main elements of anthropization of the wind turbine location area are:

- villages located around the area covered by this paper: Banie, Lubanowo, Sosnowo, Parnica, Tywica, Baniewice, Piaseczno and Swobnica,
- a system of district, communal and dirt roads connecting individual villages and providing access to fields,
- high-, medium- and low-voltage power lines.

An important element of the anthropogenic landscape are cell towers or religious buildings located outside the area covered by this paper. Villages around the investment area are mainly developed in the form of the so-called linear settlements, in which buildings are arranged along the road.

Sources of noise

Human activities emit noise into the surrounding environment. There are no industrial plants in the area of the project that are noise nuisance objects. The main sources of noise are:

- vehicle traffic on surrounding poviat, communal and dirt roads,
- high-voltage power line,
- field work using heavy agricultural equipment (up to 80 dB).

6.2.5. Climate

The study area is located in climate region R-VI — West Pomeranian climate region. The specific feature of the region is the relatively frequent occurrence of days with moderately cold weather with frost, low cloudiness and no precipitation, type 600 weather, and rare occurrence of days with moderately cold weather with frost, cloudiness and precipitation, type 601 weather. The least frequent in the region are days of moderately cold weather with precipitation, there are only 10 such days on average per year, and few days of moderately frosty weather with precipitation — approx. 7 days on average per year (Woś 1999).

In terms of climate, it belongs to the Baltic District, the Myśliborski Lakes Region (Prawdzic). It encompasses an area with considerable topographic variation, and as a result, there is quite a bit of variation in local climatic conditions. There is a significant range of average annual temperatures, ranging from -7.0 to 8.0 °C. Precipitation ranges from 500 to 600 mm per year. The length of the vegetation period averages between 215 and 224 days. The number of days with snow cover varies from 28 to 50.

6.3. Biotic components

The area in which the wind turbines are located consists mainly of agricultural monocultures of cereals and rapeseed. They form a weak anthropogenic ecosystem. It is of low physiographic diversity, with a small number of microhabitats. The biodiversity in the area is low.

6.3.1. Vegetation

The vegetation of the area intended for the location of wind turbines and associated infrastructure is poor and of low diversity. Virtually the entire area is occupied by agricultural lands, dominated by cereals and rapeseed. Crops are accompanied to a small extent by segetal species, which form a group of weeds on the agricultural lands. These are mainly: melde (*Chenopodium album*), forking larkspur (*Consolida regalis*), cornflower (*Centaurea cyanus*), shepherd's purse (*Capsella bursa pastoris*), chamomile (*Matricaria chamomilla*), common knotgrass (*Polygonum aviculare)*, field pansy (*Viola arvensis*). Along the field roads, the following additional species occurred: scarlet pimpernel (*Anagalis arvensis*), chickweed (*Stellaria media*), common bent (*Agrostis capillaris*), common meadow-grass (*Poa pratensis*), and common cocksfoot (*Dactylis glomerata*).
The project area is practically devoid of mid-field shrub or tree buffers. Small concentrations of them can be found near mid-field reservoirs and along communal and dirt roads, located in the vicinity of the project.
Only anthropogenic habitats of agricultural crops are present in the vegetation.
The flora is dominated by cereal species and rapeseed, with a small admixture of ruderal plant species.
None of the following were found in the project area:
- sites of species protected by law,
- habitats protected by law,
- species or habitats of Community interest (Habitats Directive).

6.3.2. Fauna in the last year of observation — 2018.

The animal species found during the field work in 2018 that may be affected by the proposed project are presented in the tables in the following section. During the work 111 animal species were found and analyzed, including 105 birds and 6 bats. Species that may be directly or indirectly affected by wind farm during migration were used to determine the impact of the wind turbines on migration. Animal species from other systematic groups were also observed to detect species listed in Annex II of the Habitats Directive, but were not found in the wind turbine location area.

Birds.

The area of the planned “Banie” wind farm is characterized by a dominant landscape of agrocenosis. It is formed by a complex of arable land, sown with cereals and rapeseed. Small areas are occupied by grasslands and wastelands, e.g. in the form of fallows, hollows and mid-field ponds. Most of the area is devoid of forest lands, but elementary areas B and C are adjacent to forest complexes near the villages: Sosnowo and Swobnica. The surveyed area is interspersed with poviat, communal and dirt roads that delimit the area into smaller units. A small number of roads, running adjacent to the boundary of the wind farm site, feature developed rows of roadside tree buffers. The dirt roads crossing the wind farm site are devoid of shrub and tree buffers. The landscape in the vicinity is complemented by numerous clusters of shrub and tree buffers in fields and around villages. The sparsely diverse agricultural landscape of the wind farm location provides few ecological niches that are used by birds. Some species were observed in the vicinity of tree buffers and water bodies located at the edge of the wind farm site. A total of 105 bird species were found in the monitored area.

Abundance of the taxa varied with the phenological period. The lowest occurred during the winter, the highest during the breeding season and breeding dispersal.

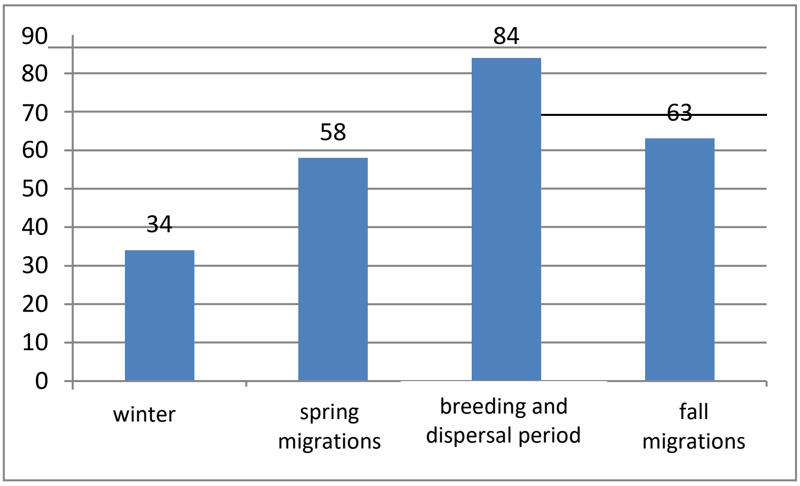


Figure 5. Taxa abundance by phenological season.

Some of the species, despite residing in adjacent areas, flew into the surveyed area to feed or rest during migration. Three main groups of birds can be distinguished: those preferring open fields and mid-field tree buffers, species associated with waters and wetlands, and those preferring forest complexes and their ecotones. The species composition was distinguished by the proportion of 3 groups of birds: those associated with agricultural lands, aquatic environments and forests. This was due to the presence in the monitored area and its immediate vicinity of: agricultural monocultures, small lakes and mid-field ponds, and extensive forest complexes. The following tables list the bird species observed in the monitored area. The altitude of flight and the importance of the site for birds are specified further in this paper. Table 1 below lists all bird species observed in the monitored area.

Table 1. List of bird species found in the monitored area.

No.	English name	Latin name	Protection status	BD	RDBoA	RLTS	Presence				Presence status
							A	B	C	D	

1	Great crested grebe	*Podiceps cristatus*	PS				+		+		IB, OB
2	Great cormorant	*Phalacrocorax carbo*	PPS				+		+		IB, OB
3	Eurasian bittern	*Botaurus stellaris*	PS	+	LC	LC					B
4	Grey heron	*Ardea cinerea*	PPS				+	+	+		IB, OB
5	White stork	*Ciconia ciconia*	PS	+			+	+			IB
6	Mute swan	*Cygnus olor*	PS				+		+		IB, OF
7	Whooper swan	*Cygnus cygnus*	PS	+				+	+		OF
8	Bean goose	*Anser fabalis*	GS				+	+	+	+	OB, OF
9	Greater white-fronted goose	*Anser albifrons*	GS								OB, OF
10	Greylag goose	*Anser anser*	GS				+	+	+		OB, OF
11	Gadwall	*Anas strepera*	PS						+		OB
12	Eurasian teal	*Anas crecca*	GS						+		IB
13	Mallard	*Anas platyrhynchos*	GS				+	+	+		IB, OF
14	Common pochard	*Aythya ferina*	GS								IB
15	Common goldeneye	*Bucephala clangula*	PS						+		IB, OB
16	Red kite	*Milvus milvus*	PS	+	NT	NT	+	+	+		IB, OF
17	White-tailed eagle	*Haliaeetus albicilla*	PS	+	LC	LC	+		+		IB, OF
18	Western marsh harrier	*Circus aeruginosus*	PS	+			+	+	+	+	IB, OF
19	Hen harrier	*Circus cyaneus*	PS	+	VU	VU		+			OB
20	Northern goshawk	*Accipiter gentilis*	PS				+	+	+		IB, OF
21	Eurasian sparrowhawk	*Accipiter nisus*	PS				+	+			IB, OF
22	Common buzzard	*Buteo buteo*	PS				+	+	+	+	IB, OF
23	Rough-legged buzzard	*Buteo lagopus*	PS				+	+	+	+	OF
24	Common kestrel	*Falco tinnunculus*	PS				+	+	+	+	IB, OF
25	Eurasian hobby	*Falco subbuteo*	PS				+	+			IB
26	Grey partridge	*Perdix perdix*	GS				+	+	+	+	IB, OF
27	Common pheasant	*Phasianus colchicus*	GS				+	+	+	+	IB, OF
28	Eurasian coot	*Fulica atra*	GS				+	+			IB
29	Common crane	*Grus grus*	PS	+			+	+	+	+	IB, OF
30	Little ringed plover	*Charadrius dubius*	PS				+	+			IB
31	European golden plover	*Pluvialis apricaria*	PS	+	EXP	EX		+	+		OB
32	Northern lapwing	*Vanellus vanellus*	PS				+	+	+	+	IB,OF
33	Eurasian curlew	*Numenius arquata*	PS		VU	VU			+		OF
34	Green sandpiper	*Tringa ochropus*	PS								IB, OB
35	Black-headed gull	*Larus ridibundus*	PS				+	+	+	+	IB, OB
36	Common gull	*Larus canus*	PS								OB
37	European herring gull	*Larus argentatus*	PPS				+	+			IB, OB
38	Common wood pigeon	*Columba palumbus*	GS				+	+	+	+	IB, OB
39	Eurasian collared dove	*Streptopelia decaocto*	PS				+	+	+		IB, OB
40	Common cuckoo	*Cuculus canorus*	PS				+	+	+	+	IB
41	Barn owl	*Tyto alba*	PS					+			IB
42	Tawny owl	*Strix aluco*	PS					+			IB
43	Common swift	*Apus apus*	PS				+	+	+		IB, OB
44	European green woodpecker	*Picus viridis*	PS								IB, OB
45	Black woodpecker	*Dryocopus martius*	PS	+					+		IB
46	Great spotted woodpecker	*Dendrocopos major*	PS				+		+		IB, OB
47	Lesser spotted woodpecker	*Dendrocopos minor*	PS					+			IB, OB

48	Eurasian skylark	*Alauda arvensis*	PS				+	+	+	+	B, OF
49	Barn swallow	*Hirundo rustica*	PS				+	+	+	+	IB, OF
50	Common house martin	*Delichon urbicum*	PS				+	+	+	+	IB, OB
51	Tree pipit	*Anthus trivialis*	PS					+			IB, OB
52	Meadow pipit	*Anthus pratensis*	PS				+	+			IB
53	Western yellow wagtail	*Motacilla flava*	PS				+	+	+	+	IB, OF
54	White wagtail	*Motacilla alba*	PS				+	+	+		IB, OF
55	Bohemian waxwing	*Bombycilla garrulus*	PS				+	+	+		OF
56	Eurasian wren	*Troglodytes troglodytes*	PS				+	+			IB
57	European robin	*Erithacus rubecula*	PS				+	+	+	+	IB, OB
58	Common nightingale	*Luscinia megarhynchos*	PS					+	+	+	IB
59	Black redstart	*Phoenicurus ochruros*	PS					+		+	OB
60	Common redstart	*Phoenicurus phoenicurus*	PS				+	+			IB
61	Whinchat	*Saxicola rubetra*	PS				+	+	+		IB
62	European stonechat	*Saxicola rubicola*	PS				+		+		IB
63	Northern wheatear	*Oenanthe oenanthe*	PS				+				IB
64	Common blackbird	*Turdus merula*	PS				+	+	+	+	IB, OB
65	Fieldfare	*Turdus pilaris*	PS				+	+	+	+	IB, OF
66	Song thrush	*Turdus philomelos*	PS				+	+	+		IB
67	Mistle thrush	*Turdus viscivorus*	PS								IB
68	River warbler	*Locustella fluviatilis*	PS					+			IB
69	Marsh warbler	*Acrocephalus palustris*	PS				+	+	+	+	IB
70	Great reed warbler	*Acrocephalus arundinaceus*	PS						+		IB
71	Lesser whitethroat	*Sylvia curruca*	PS				+				IB
72	Common whitethroat	*Sylvia communis*	PS				+	+	+	+	IB,OB
73	Garden warbler	*Sylvia borin*	PS				+	+			OB
74	Eurasian blackcap	*Sylvia atricapilla*	PS				+	+			OB
75	Willow warbler	*Phylloscopus trochilus*	PS				+	+	+		OB
76	Spotted flycatcher	*Muscicapa striata*	PS					+			IB
77	Marsh tit	*Poecile palustris*	PS				+	+	+		IB, OF
78	Willow tit	*Poecile montanus*	PS					+			OB
79	Great tit	*Parus major*	PS				+	+	+	+	IB, OF
80	Eurasian blue tit	*Cyanistes caeruleus*	PS				+	+	+	+	IB, OF
81	Eurasian nuthatch	*Sitta europaea*	PS				+	+	+	+	IB, OF
82	Eurasian treecreeper	*Certhia familiaris*	PS				+	+			IB
83	Short-toed treecreeper	*Certhia brachydactyla*	PS				+				IB, OF
84	Eurasian golden oriole	*Oriolus oriolus*	PS					+			IB, OB
85	Red-backed shrike	*Lanius collurio*	PS	+			+	+	+	+	IB, OF
86	Great grey shrike	*Lanius excubitor*	PS					+	+		IB, OF
87	Eurasian jay	*Garrulus glandarius*	PS				+	+	+	+	IB, OF
88	Eurasian magpie	*Pica pica*	PPS				+	+	+	+	IB, OF

89	Western jackdaw	*Corvus monedula*	PS					+		+	IB
90	Rook	*Corvus frugilegus*	PPS				+	+	+	+	IB
91	Hooded crow	*Corvus cornix*	PPS				+	+			IB, OF
92	Common raven	*Corvus corax*	PPS				+	+	+	+	IB, OF
93	Common starling	*Sturnus vulgaris*	PS				+	+	+	+	IB, OF
94	House sparrow	*Passer domesticus*	PS				+	+		+	IB, OF
95	Eurasian tree sparrow	*Passer montanus*	PS				+	+	+	+	IB, OF
96	Common chaffinch	*Fringilla coelebs*	PS				+	+	+	+	IB, OF
97	European greenfinch	*Carduelis chloris*	PS				+	+	+	+	IB, OF
98	European goldfinch	*Carduelis carduelis*	PS				+	+	+	+	IB, OF
99	Eurasian siskin	*Carduelis spinus*	PS								IB, OF
100	Common linnet	*Carduelis cannabina*	PS				+	+			IB, OF
101	Eurasian bullfinch	*Pyrrhula pyrrhula*	PS				+	+	+	+	OF
102	Hawfinch	*Coccothraustes coccothraustes*	PS				+				OF
103	Yellowhammer	*Emberiza citrinella*	PS				+	+	+	+	IB, OF
104	Common reed bunting	*Emberiza schoeniclus*	PS				+		+		IB
105	Corn bunting	*Emberiza calandra*	PS				+	+	+	+	B, OF

Legend: BD — Annex I of the Birds Directive; PS — protected species; PPS — partially protected species; GS — game species; "+" — present on the list of species or found in the area; RDBoA (Red Data Book of Animals) — EXP — extinct or probably extinct species, VU — vulnerable species; LC — low risk species; RLTS (Red List of Threatened Species) — EX — extinct species, VU — vulnerable species; NT — near–threatened species; B — breeding, IB — occurring during the breeding season, OB — occurring outside the breeding season, OF — occurring during the non-breeding season, using the area as a feeding ground, roosting site.

Of the 105 bird species, 88 were under strict protection, 7 were partially protected, 10 were unprotected game species, and 11 species were of Community interest and are listed on Annex I of the Birds Directive (Tab. 1). The vast majority are under strict protection, a few are under partial protection, and some are game species (Tab. 1). Although most of the birds are protected by law, it should be noted that the vast majority of are cosmopolitan species, common, numerous or very numerous in the region and Western Pomerania.

Species abundance and composition varied with the phenological period. The differences were mainly due to physiography and changing weather conditions. In recent years, the winter period is different from that in the 1980s or 1990s. In recent years, the onset of the winter season has been milder, without snowfall and low temperatures. Frosts occur in late December and January, followed by a rise in temperatures. Colder weather returns in mid-February and early March. Some occasional frosts and snowfall were recorded in April. The indicated changes alter the intensity of migratory flights. Some of the birds during migration stop over at the area covered by this paper or adjacent areas, the Odra River Valley in particular. Changes in migration translate into fluctuations in the number of species and their abundance from year to year. 1,685 individuals were found during winter, 4,538 individuals during spring migration, 7,732 individuals during breeding period and breeding dispersal, and 15,586 individuals during fall migration. This is reflected in the Tables and Figures included in the text.

Wintering period.

This is a special period in birds' life. As weather conditions deteriorate, living conditions deteriorate as well. Food availability decreases dramatically along with the decrease in temperatures. This increases the consumption of the birds' energy reserves. During this period, some birds remain in their breeding areas, while others migrate to warmer parts of the continent or to Africa. The intensity of migratory flights over the monitored area was low and decreased as weather conditions deteriorated. During the initial period, late November – early December, birds flew over the monitored area frequently as the weather was quite good and temperatures were above 0 °C. With the onset of frost and adverse weather, the number of flights decreased, and during snowstorms they practically reduced to zero. During this period the birds grouped in small flocks protecting themselves in the mid-field tree and shrub buffers. Synanthropic species or those tolerating the presence of man used the man-made structures to wait out poor weather conditions, in the nearby villages and around the surrounding areas. Some of the birds stayed close to humans for most of the winter. This strategy increased the chances of getting food and shelter. A mix of sedentary species as well as those migrating north and northeast were observed wintering in the country during this period.

34 species were found, of which 2 species were of Community Interest (included in Annex I — BD) (Tab. 2). Despite the large number of legally protected species, the avifauna is characterized by a predominance of species common in the area covered by this paper, the commune and Western Pomerania. Some of them have a close connection with man-made structures. Most belong to cosmopolitan taxa.

Table 2. Inventory of species found.

No.	English name	Latin name	Protection status	BD	RDBoA	RLTS	Presence			
							A	B	C	D
1	Grey heron	*Ardea cinerea*	PPS					+		
2	Mute swan	*Cygnus olor*	PS				+	+	+	
3	Whooper swan	*Cygnus cygnus*	PS	+				+	+	+
4	Bean goose	*Anser fabalis*	GS				+	+	+	+
5	Greylag goose	*Anser anser*	GS					+	+	
6	Mallard	*Anas platyrhynchos*	GS				+	+	+	+
7	White-tailed eagle	*Haliaeetus albicilla*	PS	+	LC	LC	+	+	+	
8	Northern goshawk	*Accipiter gentilis*	PS				+	+	+	
9	Common buzzard	*Buteo buteo*	PS				+	+	+	+
10	Rough-legged buzzard	*Buteo lagopus*	PS					+	+	+
11	Grey partridge	*Perdix perdix*	GS				+	+		
12	Northern lapwing	*Vanellus vanellus*	PS				+	+	+	
13	Black-headed gull	*Larus ridibundus*	PS				+	+	+	+
14	Common wood pigeon	*Columba palumbus*	GS				+	+	+	+
15	Eurasian collared dove	*Streptopelia decaocto*	PS						+	
16	European green woodpecker	*Picus viridis*	PS						+	
17	Bohemian waxwing	*Bombycilla garrulus*	PS				+	+	+	
18	Marsh tit	*Bombycilla garrulus*	PS				+	+	+	
19	Great tit	*Parus major*	PS				+	+	+	+
20	Eurasian blue tit	*Cyanistes caeruleus*	PS				+	+	+	+
21	Eurasian nuthatch	*Sitta europaea*	PS				+	+		
22	Short-toed treecreeper	*Certhia brachydactyla*	PS				+	+		
23	Great grey shrike	*Lanius excubitor*	PS					+		
24	Eurasian magpie	*Pica pica*	PPS				+	+	+	+
25	Common raven	*Corvus corax*	PPS				+	+	+	+
26	House sparrow	*Passer domesticus*	PS				+	+	+	+
27	Eurasian tree sparrow	*Passer montanus*	PS				+	+	+	
28	Common chaffinch	*Fringilla coelebs*	PS				+	+	+	

29	European goldfinch	*Carduelis carduelis*	PS				+	+	+	
30	Common linnet	*Carduelis cannabina*	PS				+	+	+	+
31	Eurasian bullfinch	*Pyrrhula pyrrhula*	PS				+		+	
32	Hawfinch	*Coccothraustes coccothraustes*	PS						+	
33	Yellowhammer	*Emberiza citrinella*	PS				+	+	+	
34	Corn bunting	*Emberiza calandra*	PS				+	+	+	+

Legend: as in Tab. 1.

The abundance of individual species was variable. Migratory and nomadic species predominated, some of which remained in the monitored area. Some were sedentary species wintering in or adjacent to the monitored area. There was a large share of species that prefer human proximity. Species composition and abundances were influenced by weather conditions. The beginning of winter, in December, was characterized by the absence of frost and snow cover, with temperatures usually being above 0 °C. Late December and January brought about a much colder weather which resulted in little bird activity in the winter period. In the second half of winter (February), the temperature during the day rose to positive values (even up to about 8 °C), this caused an increase in bird activity. The colder weather returned in the first half of March.

Table 3. Species abundance (N) on transects in the monitored area.

No.	**English name**	**N**					**N/km of transect**			
		A	**B**	**C**	**D**	**ΣN**	**A**	**B**	**C**	**D**
1	Grey heron	0	2	0	0	2	0.0	0.0	0.0	0.0
2	Mute swan	6	16	8	0	30	0.1	0.3	0.2	0.0
3	Whooper swan	4	89	18	0	111	0.1	1.9	0.4	0.0
4	Bean goose	6	36	9	0	51	0.1	0.8	0.2	0.0
5	Greylag goose	0	6	4	0	10	0.0	0.1	0.1	0.0
6	Mallard	22	42	14	2	80	0.5	0.9	0.3	0.0
7	White-tailed eagle	1	1	3	0	5	0.0	0.0	0.1	0.0
8	Northern goshawk	0	1	1	0	2	0.0	0.0	0.0	0.0
9	Common buzzard	2	6	4	1	13	0.0	0.1	0.1	0.0
10	Rough-legged buzzard	0	1	0	1	2	0.0	0.0	0.0	0.0
11	Grey partridge	1	2	0	0	3	0.0	0.0	0.0	0.0
12	Northern lapwing	2	4	0	0	6	0.0	0.1	0.0	0.0
13	Black-headed gull	2	8	2	1	13	0.0	0.2	0.0	0.0
14	Common wood pigeon	5	8	8	3	24	0.1	0.2	0.2	0.1
15	Eurasian collared dove	0	0	1	0	1	0.0	0.0	0.0	0.0
16	European green woodpecker	0	0	1	0	1	0.0	0.0	0.0	0.0
17	Bohemian waxwing	6	66	12	0	84	0.1	1.4	0.3	0.0
18	Marsh tit	2	1	2	0	5	0.0	0.0	0.0	0.0
19	Great tit	18	72	36	8	134	0.4	1.5	0.8	0.2
20	Eurasian blue tit	2	2	4	1	9	0.0	0.0	0.1	0.0
21	Eurasian nuthatch	0	1	1	0	2	0.0	0.0	0.0	0.0
22	Short-toed treecreeper	6	22	0	0	28	0.1	0.5	0.0	0.0
23	Great grey shrike	0	1	0	0	1	0.0	0.0	0.0	0.0
24	Eurasian magpie	4	6	5	2	17	0.1	0.1	0.1	0.0
25	Common raven	6	39	31	11	87	0.1	0.8	0.7	0.2

26	House sparrow	18	8	6	6	38	0.4	0.2	0.1	0.1
27	Eurasian tree sparrow	11	21	24	4	60	0.2	0.4	0.5	0.1
28	Common chaffinch	2	14	6	0	22	0.0	0.3	0.1	0.0
29	European goldfinch	12	8	1	0	21	0.3	0.2	0.0	0.0
30	Common linnet	4	9	4	1	18	0.1	0.2	0.1	0.0
31	Eurasian bullfinch	1	0	1	0	2	0.0	0.0	0.0	0.0
32	Hawfinch	0	0	1	0	1	0.0	0.0	0.0	0.0
33	Yellowhammer	8	8	4	0	20	0.2	0.2	0.1	0.0
34	Corn bunting	6	37	21	2	66	0.1	0.8	0.4	0.0
35	NI	22	48	61	10	141	0.5	1.0	1.3	0.2

A total of 1462 individual birds were recorded. The most numerous were: great tits (134 individuals), whooper swans (111 individuals) and common ravens (87 individuals). The remaining species were found in the range between 1 and 84 individuals (Tab. 3).

The use of space by each species is presented in Table 4 below. Individual taxa migrated in varying total numbers from 1 to 206 individuals. Table 4. Species abundance (N) at specific points in monitored area.

No.	English name	N					N/h of observation			
		A	B	C	D	ΣN	A	B	C	D
1	Grey heron	0	1	0	0	1	0.00	0.04	0.00	0.00
2	Mute swan	0	14	8	0	22	0.00	0.58	0.33	0.00
3	Whooper swan	8	12	6	2	28	0.33	0.50	0.25	0.08
4	Bean goose	0	142	52	12	206	0.00	5.92	2.17	0.50
5	Greylag goose	0	2	0	0	2	0.00	0.08	0.00	0.00
6	Mallard	8	11	18	4	41	0.33	0.46	0.75	0.17
7	White-tailed eagle	1	1	4	0	6	0.04	0.04	0.17	0.00
8	Northern goshawk	1	1	1	0	3	0.04	0.04	0.04	0.00
9	Common buzzard	2	8	3	0	13	0.08	0.33	0.13	0.00
10	Rough-legged buzzard	0	1	1	0	2	0.00	0.04	0.04	0.00
11	Northern lapwing	6	14	2	0	22	0.25	0.58	0.08	0.00
12	Black-headed gull	0	2	2	1	5	0.00	0.08	0.08	0.04
13	Common wood pigeon	3	11	8	2	24	0.13	0.46	0.33	0.08
14	Great tit	3	8	4	0	15	0.13	0.33	0.17	0.00
15	Short-toed treecreeper	0	4	0	0	4	0.00	0.17	0.00	0.00
16	Eurasian magpie	5	6	3	3	17	0.21	0.25	0.13	0.13
17	Common raven	4	34	18	4	60	0.17	1.42	0.75	0.17
18	Eurasian tree sparrow	0	0	4	0	4	0.00	0.00	0.17	0.00
19	Common chaffinch	0	0	3	0	3	0.00	0.00	0.13	0.00
20	European goldfinch	0	2	0	0	2	0.00	0.08	0.00	0.00
21	Common linnet	1	2	0	0	3	0.04	0.08	0.00	0.00
22	Yellowhammer	0	0	1	0	1	0.00	0.00	0.04	0.00
23	Corn bunting	0	6	6	0	12	0.00	0.25	0.25	0.00
24	NI	38	22	12	10	82	1.58	0.92	0.50	0.42

A total of 577 individual birds were recorded. The most numerous were: bean geese (206 individuals) and common ravens (60 individuals). The remaining species were found in the range between 1 and 41 individuals (Tab. 4).

The table below shows the percentage share of each bird species, thus the dominance structure in each elementary area. The eudominant species were: mallards, great tits, and house sparrows (A); swans, great tits, and bohemian waxwings (B); great tits, common ravens, and Eurasian tree sparrows (C); common ravens, great tits, and house sparrows (D) (Tab. 5). Most of the species shown belonged to subdominant and recendent species.

Table 5. Dominance structure (D) of species in elementary areas (>0.1).

No.	English name	A	English name	B	English name	C	English name	D
1	Mallard	14.0	Whooper swan	16.6	Great tit	15.5	Common raven	25.6
2	Great tit	11.5	Great tit	13.4	Common raven	13.4	Great tit	18.6
3	House sparrow	11.5	Bohemian waxwing	12.3	Eurasian tree sparrow	10.3	House sparrow	14.0
4	European goldfinch	7.6	Mallard	7.8	Corn bunting	9.1	Eurasian tree sparrow	9.3
5	Eurasian tree sparrow	7.0	Common raven	7.3	Whooper swan	7.8	Common wood pigeon	7.0
6	Yellowhammer	5.1	Corn bunting	6.9	Mallard	6.0	Mallard	4.7
7	Mute swan	3.8	Bean goose	6.7	Bohemian waxwing	5.2	Eurasian magpie	4.7
8	Bean goose	3.8	Short-toed treecreeper	4.1	Bean goose	3.9	Corn bunting	4.7
9	Bohemian waxwing	3.8	Eurasian tree sparrow	3.9	Mute swan	3.4	Common buzzard	2.3
10	Short-toed treecreeper	3.8	Mute swan	3.0	Common wood pigeon	3.4	Rough-legged buzzard	2.3
11	Common raven	3.8	Common chaffinch	2.6	House sparrow	2.6	Black-headed gull	2.3
12	Corn bunting	3.8	Common linnet	1.7	Common chaffinch	2.6	Eurasian blue tit	2.3
13	Common wood pigeon	3.2	Black-headed gull	1.5	Eurasian magpie	2.2	Common linnet	2.3
14	Whooper swan	2.5	Common wood pigeon	1.5	Greylag goose	1.7		
15	Eurasian magpie	2.5	House sparrow	1.5	Common buzzard	1.7		
16	Common linnet	2.5	European goldfinch	1.5	Eurasian blue tit	1.7		
17	Common buzzard	1.3	Yellowhammer	1.5	Common linnet	1.7		
18	Northern lapwing	1.3	Greylag goose	1.1	Yellowhammer	1.7		
19	Black-headed gull	1.3	Common buzzard	1.1	White-tailed eagle	1.3		
20	Marsh tit	1.3	Eurasian magpie	1.1	Black-headed gull	0.9		
21	Eurasian blue tit	1.3	Northern lapwing	0.7	Marsh tit	0.9		
22	Common chaffinch	1.3	Grey partridge	0.4	Northern goshawk	0.4		
23	Grey partridge	0.6	Grey heron	0.4	Eurasian collared dove	0.4		
24	White-tailed eagle	0.6	Eurasian blue tit	0.4	European green woodpecker	0.4		
25	Eurasian bullfinch	0.6	White-tailed eagle	0.2	Eurasian nuthatch	0.4		
26			Northern goshawk	0.2	European goldfinch	0.4		
27			Rough-legged buzzard	0.2	Eurasian bullfinch	0.4		
28			Marsh tit	0.2	Hawfinch	0.4		
29			Eurasian nuthatch	0.2				
30			Great grey shrike	0.2				

When considering the entire monitored area, it can be seen that the eudominant species were: passerines (50.6%), and anseriformes (39.9%). The remaining taxa were characterized by low or minor percentage share (Fig. 6).

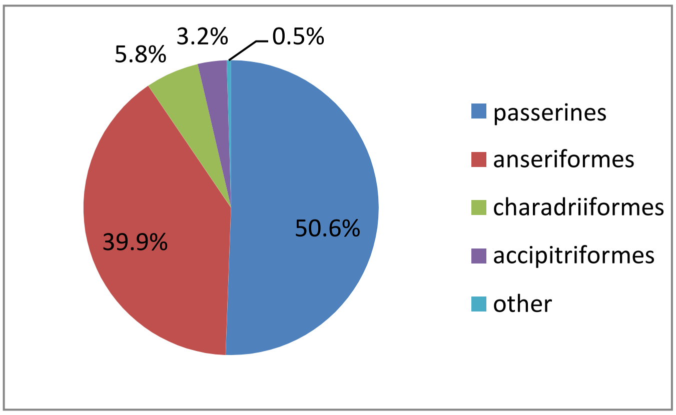


Figure 6. Percentages of individual taxa for the entire monitored area.

The data collected indicate that the monitored area is not of importance for birds during the winter, especially for species migrating over long-distances that appeared in small flocks. However, when considering the abundance of individual species, it should be noted that it was small compared to the Baltic coast, Miedwie Lake, Dąbie Lake or the Odra River Valley.

Based on the data collected, it can be predicted that the monitored area did not represent a significant habitat for birds especially the species migrating over long-distances or the accipitriformes during the analyzed period.

Spring migration period.

The period of bird migration, spring migration in particular, is one of the most interesting processes occurring in nature. It is related to a change in location as a result of improved weather conditions, and thus the ability to find food and to raise offspring. This is why the birds undertake return migrations from warmer wintering areas to Poland, heading mainly east and north-northeast. Most birds, including many domestic birds, are migratory. The best known example of this phenomenon is the migration of the white stork. It takes place via two routes from Africa. Through the Bosphorus or the Strait of Gibraltar. The flyway is determined by the breeding site. Polish storks migrate mainly from Africa via the Bosphorus.

Once the adverse winter conditions are over, a massive return migration to former breeding grounds occurs. A large proportion of the birds return to their regions in which they were born, some stay in other convenient habitats. Spring migration is shorter than fall migration and occurs over a shorter period. It is also related to the desire to occupy the best possible breeding grounds and nesting sites, which forces the birds to return quickly. Some birds, e.g. accipitriformes, arrive as early as the end of winter, in February and early March. Then, as weather conditions improve, the other species arrive as well. Some nomadic species, both sedentary individuals and early examples of migrating species, can also be observed during this period. It should be noted that some native species stay in the country for winter or only migrate over short distances. Thus, the species composition from this phenological period is a mix of spring migrants and locally wintering birds.

Table 6. Inventory of species found.

No.	English name	Latin name	Protection status	BD	RDBoA	RLTS	Presence			
							A	B	C	D
1	Great cormorant	*Phalacrocorax*	PPS				+	+	+	

		carbo								
2	Grey heron	*Ardea cinerea*	PPS				+	+	+	
3	Mute swan	*Cygnus olor*	PS				+	+	+	
4	Whooper swan	*Cygnus cygnus*	PS	*+*			+	+		
5	Bean goose	*Anser fabalis*	GS				+	+	+	+
6	Greylag goose	*Anser anser*	GS				+	+	+	+
7	Eurasian teal	*Anas crecca*	GS					+	+	
8	Mallard	*Anas platyrhynchos*	GS				+	+	+	+
9	Common goldeneye	*Bucephala clangula*	PS				+		+	
10	White-tailed eagle	*Haliaeetus albicilla*	PS	*+*	LC	LC	+	+	+	
11	Western marsh harrier	*Circus aeruginosus*	PS	*+*			+	+	+	+
12	Hen harrier	*Circus cyaneus*	PS	*+*	VU	VU		+	+	
13	Northern goshawk	*Accipiter gentilis*	PS				+	+	+	
14	Eurasian sparrowhawk	*Accipiter nisus*	PS					+		
15	Common buzzard	*Buteo buteo*	PS				+	+	+	+
16	Grey partridge	*Perdix perdix*	GS					+	+	
17	Common pheasant	*Phasianus colchicus*	GS				+			
18	Eurasian coot	*Fulica atra*	GS					+	+	
19	Common crane	*Grus grus*	PS	*+*			+	+	+	+
20	Little ringed plover	*Charadrius dubius*	PS					+		
21	Northern lapwing	*Vanellus vanellus*	PS				+	+	+	+
22	Green sandpiper	*Tringa ochropus*	PS				+		+	
23	Black-headed gull	*Larus ridibundus*	PS				+	+	+	+
24	European herring gull	*Larus argentatus*	PPS					+	+	
25	Common wood pigeon	*Columba palumbus*	GS				+	+	+	+
26	Eurasian collared dove	*Streptopelia decaocto*	PS				+	+	+	
27	Tawny owl	*Strix aluco*	PS				+		+	
28	European green woodpecker	*Picus viridis*	PS						+	+
29	Great spotted woodpecker	*Dendrocopos major*	PS						+	
30	Eurasian skylark	*Alauda arvensis*	PS				+	+	+	+
31	Barn swallow	*Hirundo rustica*	PS				+	+		
32	Western yellow wagtail	*Motacilla flava*	PS				+		+	
33	European robin	*Erithacus rubecula*	PS				+	+		
34	Black redstart	*Phoenicurus ochruros*	PS				+		+	
35	Common blackbird	*Turdus merula*	PS				+			
36	Fieldfare	*Turdus pilaris*	PS				+	+	+	+
37	Common whitethroat	*Sylvia communis*	PS				+	+	+	
38	Garden warbler	*Sylvia borin*	PS					+		
39	Willow warbler	*Phylloscopus trochilus*	PS				+	+	+	

40	Marsh tit	*Poecile palustris*	PS						+	
41	Great tit	*Parus major*	PS				+	+	+	+
42	Eurasian blue tit	*Cyanistes caeruleus*	PS				+	+	+	
43	Eurasian nuthatch	*Sitta europaea*	PS				+	+	+	
44	Short-toed treecreeper	*Certhia brachydactyla*	PS				+	+	+	
45	Great grey shrike	*Lanius excubitor*	PS				+	+		
46	Eurasian jay	*Garrulus glandarius*	PS				+	+		
47	Eurasian magpie	*Pica pica*	PPS				+	+	+	+
48	Hooded crow	*Corvus cornix*	PPS				+	+	+	+
49	Common raven	*Corvus corax*	PPS				+	+	+	+
50	Common starling	*Sturnus vulgaris*	PS				+	+	+	+
51	House sparrow	*Passer domesticus*	PS				+	+	+	+
52	Eurasian tree sparrow	*Passer montanus*	PS				+	+	+	+
53	Common chaffinch	*Fringilla coelebs*	PS				+	+	+	+
54	European greenfinch	*Carduelis chloris*	PS				+	+	+	+
55	European goldfinch	*Carduelis carduelis*	PS				+	+	+	+
56	Common linnet	*Carduelis cannabina*	PS				+	+	+	
57	Yellowhammer	*Emberiza citrinella*	PS				+	+	+	+
58	Corn bunting	*Emberiza calandra*	PS				+	+	+	+

Legend: as in Tab. 1.

58 species were found in the monitored area (Tab. 6). Most were common and cosmopolitan species associated with arable land and forest habitats. However, wetland species such as swans, geese, ducks, and grey herons were also found. However, birds associated with aquatic environments were in the minority.

58 species were recorded, including: 45 species strictly protected by law, 5 species under partial protection, 8 game species (Tab. 6), 5 species of Community interest — the Birds Directive.

Table 7. Species abundance (N) on transects in the monitored area.

No.	English name	N					N/km of transect			
		A	B	C	D	ΣN	A	B	C	D
1	Great cormorant	1	0	1	0	2	0.04	0.00	0.04	0.00
2	Grey heron	1	2	1	0	4	0.04	0.08	0.04	0.00
3	Mute swan	12	5	4	0	21	0.50	0.21	0.17	0.00
4	Whooper swan	14	24	0	0	38	0.58	1.00	0.00	0.00
5	Bean goose	62	121	8	14	205	2.58	5.04	0.33	0.58
6	Greylag goose	0	36	14	0	50	0.00	1.50	0.58	0.00
7	Eurasian teal	0	1	2	0	3	0.00	0.04	0.08	0.00
8	Mallard	28	64	29	4	125	1.17	2.67	1.21	0.17
9	Common goldeneye	0	0	2	0	2	0.00	0.00	0.08	0.00

10	White-tailed eagle	3	2	6	1	12	0.13	0.08	0.25	0.04
11	Western marsh harrier	2	4	3	1	10	0.08	0.17	0.13	0.04
12	Hen harrier	0	1	1	0	2	0.00	0.04	0.04	0.00
13	Northern goshawk	0	1	1	0	2	0.00	0.04	0.04	0.00
14	Eurasian sparrowhawk	0	1	0	0	1	0.00	0.04	0.00	0.00
15	Common buzzard	3	2	2	1	8	0.13	0.08	0.08	0.04
16	Grey partridge	0	2	1	0	3	0.00	0.08	0.04	0.00
17	Common pheasant	1	0	0	0	1	0.04	0.00	0.00	0.00
18	Eurasian coot	0	2	1	0	3	0.00	0.08	0.04	0.00
19	Common crane	12	62	36	6	116	0.50	2.58	1.50	0.25
20	Little ringed plover	0	1	0	0	1	0.00	0.04	0.00	0.00
21	Northern lapwing	122	266	68	74	530	5.08	11.08	2.83	3.08
22	Green sandpiper	1	0	2	0	3	0.04	0.00	0.08	0.00
23	Black-headed gull	12	6	4	0	22	0.50	0.25	0.17	0.00
24	European herring gull	0	1	1	0	2	0.00	0.04	0.04	0.00
25	Common wood pigeon	12	26	16	6	60	0.50	1.08	0.67	0.25
26	Eurasian collared dove	1	4	2	6	13	0.04	0.17	0.08	0.25
27	Tawny owl	1	0	1	0	2	0.04	0.00	0.04	0.00
28	European green woodpecker	0	0	1	1	2	0.00	0.00	0.04	0.04
29	Great spotted woodpecker	0	0	1	0	1	0.00	0.00	0.04	0.00
30	Eurasian skylark	8	36	15	4	63	0.33	1.50	0.63	0.17
31	Barn swallow	1	0	0	0	1	0.04	0.00	0.00	0.00
32	Western yellow wagtail	1	0	1	0	2	0.04	0.00	0.04	0.00
33	European robin	1	1	0	0	2	0.04	0.04	0.00	0.00
34	Black redstart	1	0	1	0	2	0.04	0.00	0.04	0.00
35	Common blackbird	2	0	0	0	2	0.08	0.00	0.00	0.00
36	Fieldfare	17	31	2	8	58	0.71	1.29	0.08	0.33
37	Common whitethroat	1	1	1	0	3	0.04	0.04	0.04	0.00
38	Garden warbler	0	1	0	0	1	0.00	0.04	0.00	0.00
39	Willow warbler	1	1	1	0	3	0.04	0.04	0.04	0.00
40	Marsh tit	0	0	1	0	1	0.00	0.00	0.04	0.00
41	Great tit	22	18	24	3	67	0.92	0.75	1.00	0.13
42	Eurasian blue tit	8	1	2	0	11	0.33	0.04	0.08	0.00
43	Eurasian nuthatch	1	4	1	0	6	0.04	0.17	0.04	0.00
44	Short-toed treecreeper	8	36	2	0	46	0.33	1.50	0.08	0.00
45	Great grey shrike	1	1	0	0	2	0.04	0.04	0.00	0.00
46	Eurasian jay	1	1	0	0	2	0.04	0.04	0.00	0.00
47	Eurasian magpie	4	7	6	2	19	0.17	0.29	0.25	0.08
48	Hooded crow	6	8	3	2	19	0.25	0.33	0.13	0.08
49	Common raven	4	14	11	3	32	0.17	0.58	0.46	0.13
50	Common starling	14	22	28	1	65	0.58	0.92	1.17	0.04
51	House sparrow	12	18	4	2	36	0.50	0.75	0.17	0.08
52	Eurasian tree sparrow	6	11	8	0	25	0.25	0.46	0.33	0.00
53	Common chaffinch	14	21	8	2	45	0.58	0.88	0.33	0.08
54	European greenfinch	23	14	29	6	72	0.96	0.58	1.21	0.25
55	European goldfinch	41	11	8	2	62	1.71	0.46	0.33	0.08
56	Common linnet	16	2	8	0	26	0.67	0.08	0.33	0.00
57	Yellowhammer	6	3	4	2	15	0.25	0.13	0.17	0.08
58	Corn bunting	14	66	18	6	104	0.58	2.75	0.75	0.25

59	NI	16	68	11	14	109	0.67	2.83	0.46	0.58

A total of 2145 individual birds were recorded. Northern lapwings were the most numerous (530 individuals). Bean geese (205 individuals), mallards (125 individuals) and common cranes (116 individuals) were also abundant. Other species appeared in numbers ranging from 1 to 104 individuals. (Tab. 7).

Table 8. Species abundance at specific points in the monitored area.

No.	English name	N					N/h of observation			
		A	B	C	D	ΣN	A	B	C	D
1	Great cormorant	1	1	1	0	3	0.17	0.17	0.17	0.00
2	Grey heron	0	1	2	0	3	0.00	0.17	0.33	0.00
3	Mute swan	8	6	6	0	20	1.33	1.00	1.00	0.00
4	Whooper swan	6	4	0	0	10	1.00	0.67	0.00	0.00
5	Bean goose	84	218	67	104	473	14.00	36.33	11.17	####
6	Greylag goose	8	28	22	14	72	1.33	4.67	3.67	2.33
7	Eurasian teal	0	0	1	0	1	0.00	0.00	0.17	0.00
8	Mallard	14	22	36	2	74	2.33	3.67	6.00	0.33
9	Common goldeneye	1	0	2	0	3	0.17	0.00	0.33	0.00
10	White-tailed eagle	2	1	8	1	12	0.33	0.17	1.33	0.17
11	Western marsh harrier	2	2	3	1	8	0.33	0.33	0.50	0.17
12	Hen harrier	0	1	0	0	1	0.00	0.17	0.00	0.00
13	Northern goshawk	1	1	1	0	3	0.17	0.17	0.17	0.00
14	Common buzzard	1	2	1	1	5	0.17	0.33	0.17	0.17
15	Eurasian coot	0	1	0	0	1	0.00	0.17	0.00	0.00
16	Common crane	8	48	16	14	86	1.33	8.00	2.67	2.33
17	Northern lapwing	82	504	180	36	802	13.67	84.00	30.00	6.00
18	Black-headed gull	5	6	2	1	14	0.83	1.00	0.33	0.17
19	European herring gull	0	1	0	0	1	0.00	0.17	0.00	0.00
20	Common wood pigeon	9	18	14	11	52	1.50	3.00	2.33	1.83
21	Eurasian collared dove	2	3	1	1	7	0.33	0.50	0.17	0.17
22	European green woodpecker	0	0	1	0	1	0.00	0.00	0.17	0.00
23	Eurasian skylark	6	23	18	6	53	1.00	3.83	3.00	1.00
24	Barn swallow	2	1	0	0	3	0.33	0.17	0.00	0.00
25	European robin	1	0	0	0	1	0.17	0.00	0.00	0.00
26	Fieldfare	4	6	0	1	11	0.67	1.00	0.00	0.17
27	Marsh tit	0	0	1	0	1	0.00	0.00	0.17	0.00
28	Great tit	13	10	16	1	40	2.17	1.67	2.67	0.17
29	Eurasian blue tit	1	0	2	0	3	0.17	0.00	0.33	0.00
30	Short-toed treecreeper	1	14	2	0	17	0.17	2.33	0.33	0.00
31	Eurasian jay	1	0	0	0	1	0.17	0.00	0.00	0.00
32	Eurasian magpie	5	6	8	1	20	0.83	1.00	1.33	0.17
33	Hooded crow	11	6	6	2	25	1.83	1.00	1.00	0.33
34	Common raven	6	8	8	3	25	1.00	1.33	1.33	0.50
35	Common starling	12	41	21	8	82	2.00	6.83	3.50	1.33
36	House sparrow	18	7	4	6	35	3.00	1.17	0.67	1.00
37	Eurasian tree sparrow	6	8	4	4	22	1.00	1.33	0.67	0.67
38	Common chaffinch	6	2	0	1	9	1.00	0.33	0.00	0.17
39	European greenfinch	8	24	14	2	48	1.33	4.00	2.33	0.33
40	European goldfinch	21	16	2	0	39	3.50	2.67	0.33	0.00

41	Common linnet	4	0	1	0	5	0.67	0.00	0.17	0.00
42	Yellowhammer	2	1	1	1	5	0.33	0.17	0.17	0.17
43	Corn bunting	47	82	11	8	148	7.83	13.67	1.83	1.33
44	NI	11	84	41	14	150	1.83	14.00	6.83	2.33

A total of 2395 individual birds were recorded. The points were dominated by northern lapwings (802 individuals) and bean geese (473 individuals). Other taxa appeared in numbers ranging from 1 to 148 individuals (Tab. 8).

Some of the first birds to appear were geese, swans, buzzards, common cranes and northern lapwings, which began to appear as early as late February and early March. This was due to increasing daytime temperatures above zero and nighttime temperatures remaining near freezing. They were followed by other species, with an increasing proportion of passerines. Other species appeared gradually, with increased flights occurring in late March to mid-April.

In general, it can be concluded that flights during the migration period took place, as in previous years, mainly around the borders of the wind power plant foundation areas. The area of fields was used by birds to a small extent. The birds were moving along forest complexes, ponds of the Tywa River Valley and rows of trees.

Observations indicate that the area of the proposed wind farm was not a particularly important place for migrating birds. The number of flying birds was lower than e.g. in the Oder River Valley or Warta River Valley.

The table below shows the percentage share of each bird species, thus the dominance structure in each elementary area. The eudominant species were: northern lapwings and geese (A, B); northern lapwings (C, D) (Tab. 9). Most of the species shown belonged to subdominant and recendent species.

Table 9. Dominance structure (D) of species in elementary areas

No.	English name	A	English name	B	English name	C	English name	D
1	Northern lapwing	23.4	Northern lapwing	27.6	Northern lapwing	17.3	Northern lapwing	47.1
2	Bean goose	11.9	Bean goose	12.6	Common crane	9.1	Bean goose	8.9
3	European goldfinch	7.9	Corn bunting	6.9	Mallard	7.4	Fieldfare	5.1
4	Mallard	5.4	Mallard	6.6	European greenfinch	7.4	Common crane	3.8
5	European greenfinch	4.4	Common crane	6.4	Common starling	7.1	Common wood pigeon	3.8
6	Great tit	4.2	Greylag goose	3.7	Great tit	6.1	Eurasian collared dove	3.8
7	Fieldfare	3.3	Eurasian skylark	3.7	Corn bunting	4.6	European greenfinch	3.8
8	Common linnet	3.1	Short-toed treecreeper	3.7	Common wood pigeon	4.1	Corn bunting	3.8
9	Whooper swan	2.7	Fieldfare	3.2	Eurasian skylark	3.8	Mallard	2.5
10	Common starling	2.7	Common wood pigeon	2.7	Greylag goose	3.6	Eurasian skylark	2.5
11	Common chaffinch	2.7	Whooper swan	2.5	Common raven	2.8	Great tit	1.9
12	Corn bunting	2.7	Common starling	2.3	Bean goose	2.0	Common raven	1.9
13	Mute swan	2.3	Common chaffinch	2.2	Eurasian tree sparrow	2.0	Eurasian magpie	1.3
14	Common crane	2.3	Great tit	1.9	Common chaffinch	2.0	Hooded crow	1.3
15	Black-headed gull	2.3	House sparrow	1.9	European goldfinch	2.0	House sparrow	1.3
16	Common wood pigeon	2.3	Common raven	1.5	Common linnet	2.0	Common chaffinch	1.3
17	House sparrow	2.3	European greenfinch	1.5	White-tailed eagle	1.5	European goldfinch	1.3
18	Eurasian skylark	1.5	Eurasian tree sparrow	1.1	Eurasian magpie	1.5	Yellowhammer	1.3

19	Eurasian blue tit	1.5	European goldfinch	1.1	Mute swan	1.0	White-tailed eagle	0.6
20	Short-toed treecreeper	1.5	Hooded crow	0.8	Black-headed gull	1.0	Western marsh harrier	0.6
21	Hooded crow	1.1	Eurasian magpie	0.7	House sparrow	1.0	Common buzzard	0.6
22	Eurasian tree sparrow	1.1	Black-headed gull	0.6	Yellowhammer	1.0	European green woodpecker	0.6
23	Yellowhammer	1.1	Mute swan	0.5	Western marsh harrier	0.8	Common starling	0.6
24	Eurasian magpie	0.8	Western marsh harrier	0.4	Hooded crow	0.8		
25	Common raven	0.8	Eurasian collared dove	0.4	Eurasian teal	0.5		
26	White-tailed eagle	0.6	Eurasian nuthatch	0.4	Common goldeneye	0.5		
27	Common buzzard	0.6	Yellowhammer	0.3	Common buzzard	0.5		
28	Western marsh harrier	0.4	Grey heron	0.2	Green sandpiper	0.5		
29	Common blackbird	0.4	White-tailed eagle	0.2	Eurasian collared dove	0.5		
30	Great cormorant	0.2	Common buzzard	0.2	Fieldfare	0.5		
31	Grey heron	0.2	Grey partridge	0.2	Eurasian blue tit	0.5		
32	Common pheasant	0.2	Eurasian coot	0.2	Short-toed treecreeper	0.5		
33	Green sandpiper	0.2	Common linnet	0.2	Great cormorant	0.3		
34	Eurasian collared dove	0.2	Eurasian teal	0.1	Grey heron	0.3		
35	Tawny owl	0.2	Hen harrier	0.1	Hen harrier	0.3		
36	Barn swallow	0.2	Northern goshawk	0.1	Northern goshawk	0.3		
37	Western yellow wagtail	0.2	Eurasian sparrowhawk	0.1	Grey partridge	0.3		
38	European robin	0.2	Little ringed plover	0.1	Eurasian coot	0.3		
39	Black redstart	0.2	European herring gull	0.1	European herring gull	0.3		
40	Common whitethroat	0.2	European robin	0.1	Tawny owl	0.3		
41	Willow warbler	0.2	Common whitethroat	0.1	European green woodpecker	0.3		
42	Eurasian nuthatch	0.2	Garden warbler	0.1	Great spotted woodpecker	0.3		
43	Great grey shrike	0.2	Willow warbler	0.1	Western yellow wagtail	0.3		
44	Eurasian jay	0.2	Eurasian blue tit	0.1	Black redstart	0.3		
45			Great grey shrike	0.1	Common whitethroat	0.3		
46			Eurasian jay	0.1	Willow warbler	0.3		
47					Marsh tit	0.3		
48					Eurasian nuthatch	0.3		

When considering the entire monitored area, it can be seen that the eudominant species were: charadriiformes (35%), passerines (32%) and anseriformes (26%). In total, they accounted for 93% of the total avifauna. The remaining taxa were characterized by minor percentage share (Fig. 7).

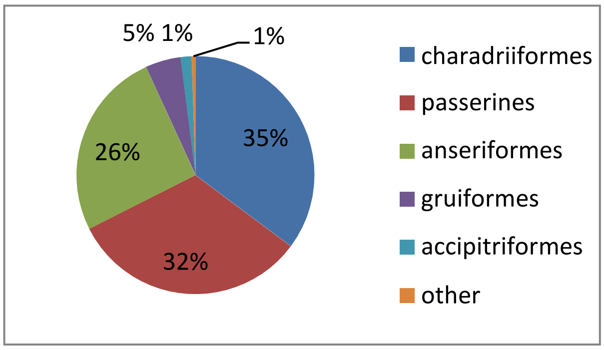


Figure 7. Percentages of individual taxa for the entire monitored area.

Based on the collected data it can be predicted that the investment site is not attractive for migrating species, especially long-distance ones, and the investment should not significantly affect migratory birds on a regional and national scale.

Breeding season and breeding dispersal period.

During this period, species nesting in the monitoring area as well as moving from neighboring areas to feed or flying over the monitoring area to neighboring areas were observed. There were 84 species found, among which small birds, belonging to passerines, dominated. The most numerous were common species related to agricultural landscapes. The following species listed in the Directive are worth mentioning: Eurasian bittern, white stork, red kite, white-tailed eagle, western marsh harrier, common crane and red-backed shrike (these species are discussed in the following chapter). No nesting of key species, which would be directly affected by operating rotors, has been observed within the agroecosystems where the turbines are planned to be located. In the vicinity of EA-C, nesting sites of the following were found: Eurasian bittern, white stork, white-tailed eagle, western marsh harrier, red-backed shrike. Most of birds listed in the Directive, especially accipitriformes, were flying in the vicinity of the proposed location of the wind turbine, but the probability of collision situations is low due to the generally low altitude of flights, below the lower range of the rotor blades. To date, few collisions of accipitriformes have been reported in the national literature. There is also no information on white stork collisions with wind turbines. The same is true for the common crane and the other species found, there are no reports of their collisions in the national literature.

Most of the species found were not breeding in the monitoring area, they were flying over or using it for feeding.

Table 10. Inventory of species found.

No.	English name	Latin name	Protection status	BD	RDBoA	RLTS	Presence			
							A	B	C	D
1	Great crested grebe	*Podiceps cristatus*	PS					+	+	
2	Great cormorant	*Phalacrocorax carbo*	PPS				+	+		
3	Eurasian bittern	*Botaurus stellaris*	PS	+	LC	LC		+		
4	Grey heron	*Ardea cinerea*	PPS				+	+	+	
5	White stork	*Ciconia ciconia*	PS	+			+	+		
6	Mute swan	*Cygnus olor*	PS				+	+	+	+
7	Gadwall	*Anas strepera*	PS						+	
8	Eurasian teal	*Anas crecca*	GS					+	+	
9	Mallard	*Anas platyrhynchos*	GS				+	+	+	+
10	Common pochard	*Aythya ferina*	GS				+	+	+	
11	Common goldeneye	*Bucephala clangula*	PS					+	+	
12	Red kite	*Milvus milvus*	PS	+	NT	NT	+	+	+	
13	White-tailed eagle	*Haliaeetus albicilla*	PS	+	LC	LC	+	+	+	+

14	Western marsh harrier	*Circus aeruginosus*	PS	+			+	+	+	+
15	Northern goshawk	*Accipiter gentilis*	PS					+	+	+
16	Eurasian sparrowhawk	*Accipiter nisus*	PS				+	+		
17	Common buzzard	*Buteo buteo*	PS				+	+	+	+
18	Common kestrel	*Falco tinnunculus*	PS				+		+	
19	Eurasian hobby	*Falco subbuteo*	PS					+		
20	Grey partridge	*Perdix perdix*	GS				+	+	+	+
21	Common pheasant	*Phasianus colchicus*	GS				+	+		
22	Eurasian coot	*Fulica atra*	GS					+	+	
23	Common crane	*Grus grus*	PS	+			+	+	+	+
24	Little ringed plover	*Charadrius dubius*	PS				+	+		
25	Northern lapwing	*Vanellus vanellus*	PS				+	+	+	+
26	Green sandpiper	*Tringa ochropus*	PS						+	
27	Black-headed gull	*Larus ridibundus*	PS				+	+	+	+
28	European herring gull	*Larus argentatus*	PPS				+	+		+
29	Common wood pigeon	*Columba palumbus*	GS				+	+	+	+
30	Eurasian collared dove	*Streptopelia decaocto*	PS				+	+	+	+
31	Common cuckoo	*Cuculus canorus*	PS				+	+	+	+
32	Barn owl	*Tyto alba*	PS				+		+	
33	Common swift	*Apus apus*	PS				+	+	+	
34	European green woodpecker	*Picus viridis*	PS						+	
35	Black woodpecker	*Dryocopus martius*	PS	+				+		
36	Great spotted woodpecker	*Dendrocopos major*	PS					+	+	
37	Eurasian skylark	*Alauda arvensis*	PS				+	+	+	+
38	Barn swallow	*Hirundo rustica*	PS				+	+	+	+
39	Tree pipit	*Anthus trivialis*	PS				+		+	
40	Western yellow wagtail	*Motacilla flava*	PS				+	+	+	+
41	White wagtail	*Motacilla alba*	PS				+	+		+
42	Eurasian wren	*Troglodytes troglodytes*	PS				+	+		
43	European robin	*Erithacus rubecula*	PS				+	+	+	+
44	Common nightingale	*Luscinia megarhynchos*	PS				+	+	+	
45	Common redstart	*Phoenicurus phoenicurus*	PS				+		+	
46	Whinchat	*Saxicola rubetra*	PS				+	+	+	
47	European stonechat	*Saxicola rubicola*	PS				+			
48	Northern wheatear	*Oenanthe oenanthe*	PS					+		
49	Common blackbird	*Turdus merula*	PS				+	+		+
50	Fieldfare	*Turdus pilaris*	PS				+	+	+	+
51	Song thrush	*Turdus philomelos*	PS				+	+	+	
52	Mistle thrush	*Turdus viscivorus*	PS				+		+	
53	River warbler	*Locustella fluviatilis*	PS					+	+	
54	Marsh warbler	*Acrocephalus palustris*	PS				+	+		
55	Great reed warbler	*Acrocephalus arundinaceus*	PS				+	+	+	
56	Lesser whitethroat	*Sylvia curruca*	PS				+			
57	Common whitethroat	*Sylvia communis*	PS				+	+	+	
58	Spotted flycatcher	*Muscicapa striata*	PS						+	

59	Marsh tit	*Poecile palustris*	PS				+	+	+	
60	Great tit	*Parus major*	PS				+	+	+	+
61	Eurasian blue tit	*Cyanistes caeruleus*	PS				+	+	+	
62	Eurasian nuthatch	*Sitta europaea*	PS					+		
63	Eurasian treecreeper	*Certhia familiaris*	PS					+		
64	Short-toed treecreeper	*Certhia brachydactyla*	PS					+		+
65	Eurasian golden oriole	*Oriolus oriolus*	PS						+	
66	Red-backed shrike	*Lanius collurio*	PS	+			+	+	+	
67	Great grey shrike	*Lanius excubitor*	PS				+			
68	Eurasian jay	*Garrulus glandarius*	PS				+	+	+	
69	Eurasian magpie	*Pica pica*	PPS				+	+	+	+
70	Western jackdaw	*Corvus monedula*	PS				+			
71	Rook	*Corvus frugilegus*	PPS				+	+	+	+
72	Hooded crow	*Corvus cornix*	PPS				+	+		
73	Common raven	*Corvus corax*	PPS				+	+	+	+
74	Common starling	*Sturnus vulgaris*	PS				+	+	+	+
75	House sparrow	*Passer domesticus*	PS				+	+		+
76	Eurasian tree sparrow	*Passer montanus*	PS				+	+	+	+
77	Common chaffinch	*Fringilla coelebs*	PS				+	+	+	+
78	European greenfinch	*Carduelis chloris*	PS				+	+	+	+
79	European goldfinch	*Carduelis carduelis*	PS				+	+	+	
80	Eurasian siskin	*Carduelis spinus*	PS				+		+	
81	Common linnet	*Carduelis cannabina*	PS				+	+	+	+
82	Yellowhammer	*Emberiza citrinella*	PS				+	+	+	+
83	Common reed bunting	*Emberiza schoeniclus*	PS				+	+	+	
84	Corn bunting	*Emberiza calandra*	PS				+	+	+	+

Legend: as in Tab. 1.

84 species were recorded, including: 70 species strictly protected by law, 7 species under partial protection, 7 game species (Tab. 10), 8 species of Community interest — the Birds Directive.

Table 11. Species abundance (N) on transects in the monitored area.

No.	**English name**	**N**					**N/km of transect**			
		A	**B**	**C**	**D**	**ΣN**	**A**	**B**	**C**	**D**
1	Great crested grebe	0	1	2	0	3	0.00	0.05	0.04	0.00
2	Great cormorant	1	1	0	0	2	0.04	0.05	0.00	0.00
3	Eurasian bittern	0	1	0	0	1	0.00	0.05	0.00	0.00
4	Grey heron	1	2	2	0	5	0.04	0.10	0.04	0.00
5	White stork	2	3	0	0	5	0.08	0.15	0.00	0.00
6	Mute swan	3	14	9	2	28	0.13	0.70	0.19	0.17
7	Gadwall	0	0	1	0	1	0.00	0.00	0.02	0.00
8	Eurasian teal	0	1	1	0	2	0.00	0.05	0.02	0.00
9	Mallard	19	64	24	3	110	0.79	3.20	0.50	0.25
10	Common pochard	1	6	4	0	11	0.04	0.30	0.08	0.00
11	Common goldeneye	0	1	5	0	6	0.00	0.05	0.10	0.00
12	Red kite	1	3	2	0	6	0.04	0.15	0.04	0.00
13	White-tailed eagle	2	3	14	1	20	0.08	0.15	0.29	0.08
14	Western marsh harrier	9	15	11	3	38	0.38	0.75	0.23	0.25
15	Northern goshawk	0	2	1	1	4	0.00	0.10	0.02	0.08

16	Eurasian sparrowhawk	1	1	0	0	2	0.04	0.05	0.00	0.00
17	Common buzzard	6	13	5	1	25	0.25	0.65	0.10	0.08
18	Common kestrel	1	0	1	0	2	0.04	0.00	0.02	0.00
19	Eurasian hobby	0	1	0	0	1	0.00	0.05	0.00	0.00
20	Grey partridge	4	5	1	2	12	0.17	0.25	0.02	0.17
21	Common pheasant	2	1	0	0	3	0.08	0.05	0.00	0.00
22	Eurasian coot	0	1	1	0	2	0.00	0.05	0.02	0.00
23	Common crane	23	78	36	8	145	0.96	3.90	0.75	0.67
24	Little ringed plover	1	1	0	0	2	0.04	0.05	0.00	0.00
25	Northern lapwing	88	121	41	8	258	3.67	6.05	0.85	0.67
26	Green sandpiper	0	0	1	0	1	0.00	0.00	0.02	0.00
27	Black-headed gull	5	26	3	0	34	0.21	1.30	0.06	0.00
28	European herring gull	2	5	0	1	8	0.08	0.25	0.00	0.08
29	Common wood pigeon	31	106	22	9	168	1.29	5.30	0.46	0.75
30	Eurasian collared dove	4	8	4	1	17	0.17	0.40	0.08	0.08
31	Common cuckoo	3	4	2	2	11	0.13	0.20	0.04	0.17
32	Barn owl	1	0	1	0	2	0.04	0.00	0.02	0.00
33	Common swift	4	6	4	0	14	0.17	0.30	0.08	0.00
34	European green woodpecker	0	0	1	0	1	0.00	0.00	0.02	0.00
35	Black woodpecker	0	0	2	0	2	0.00	0.00	0.04	0.00
36	Great spotted woodpecker	0	1	1	0	2	0.00	0.05	0.02	0.00
37	Eurasian skylark	122	214	78	24	438	5.08	10.70	1.63	2.00
38	Barn swallow	23	74	28	4	129	0.96	3.70	0.58	0.33
39	Tree pipit	3	0	1	0	4	0.13	0.00	0.02	0.00
40	Western yellow wagtail	3	4	1	1	9	0.13	0.20	0.02	0.08
41	White wagtail	2	2	0	1	5	0.08	0.10	0.00	0.08
42	Eurasian wren	2	1	0	0	3	0.08	0.05	0.00	0.00
43	European robin	4	5	2	1	12	0.17	0.25	0.04	0.08
44	Common nightingale	2	1	1	0	4	0.08	0.05	0.02	0.00
45	Common redstart	1	0	1	0	2	0.04	0.00	0.02	0.00
46	Whinchat	2	1	1	0	4	0.08	0.05	0.02	0.00
47	European stonechat	1	0	0	0	1	0.04	0.00	0.00	0.00
48	Northern wheatear	0	1	0	0	1	0.00	0.05	0.00	0.00
49	Common blackbird	11	23	0	6	40	0.46	1.15	0.00	0.50
50	Fieldfare	4	8	3	1	16	0.17	0.40	0.06	0.08
51	Song thrush	2	1	0	0	3	0.08	0.05	0.00	0.00
52	Mistle thrush	1	0	1	0	2	0.04	0.00	0.02	0.00
53	River warbler	2	0	1	0	3	0.08	0.00	0.02	0.00
54	Marsh warbler	1	1	0	0	2	0.04	0.05	0.00	0.00
55	Great reed warbler	2	1	2	0	5	0.08	0.05	0.04	0.00
56	Lesser whitethroat	1	0	0	0	1	0.04	0.00	0.00	0.00
57	Common whitethroat	1	1	1	0	3	0.04	0.05	0.02	0.00
58	Spotted flycatcher	0	0	1	0	1	0.00	0.00	0.02	0.00
59	Marsh tit	2	1	2	0	5	0.08	0.05	0.04	0.00
60	Great tit	48	102	28	11	189	2.00	5.10	0.58	0.92
61	Eurasian blue tit	4	1	3	0	8	0.17	0.05	0.06	0.00
62	Eurasian nuthatch	0	0	1	0	1	0.00	0.00	0.02	0.00
63	Eurasian treecreeper	0	3	0	1	4	0.00	0.15	0.00	0.08
64	Short-toed treecreeper	14	21	0	0	35	0.58	1.05	0.00	0.00

65	Eurasian golden oriole	0	0	1	0	1	0.00	0.00	0.02	0.00
66	Red-backed shrike	4	3	2	0	9	0.17	0.15	0.04	0.00
67	Great grey shrike	1	0	0	0	1	0.04	0.00	0.00	0.00
68	Eurasian jay	4	1	1	0	6	0.17	0.05	0.02	0.00
69	Eurasian magpie	8	12	5	6	31	0.33	0.60	0.10	0.50
70	Western jackdaw	4	0	0	0	4	0.17	0.00	0.00	0.00
71	Rook	11	8	2	2	23	0.46	0.40	0.04	0.17
72	Hooded crow	21	18	11	2	52	0.88	0.90	0.23	0.17
73	Common raven	31	72	21	8	132	1.29	3.60	0.44	0.67
74	Common starling	180	560	486	68	1294	7.50	28.00	10.13	5.67
75	House sparrow	6	2	0	0	8	0.25	0.10	0.00	0.00
76	Eurasian tree sparrow	21	81	13	8	123	0.88	4.05	0.27	0.67
77	Common chaffinch	5	14	4	2	25	0.21	0.70	0.08	0.17
78	European greenfinch	22	18	2	2	44	0.92	0.90	0.04	0.17
79	European goldfinch	6	2	5	0	13	0.25	0.10	0.10	0.00
80	Eurasian siskin	3	0	1	0	4	0.13	0.00	0.02	0.00
81	Common linnet	9	6	12	2	29	0.38	0.30	0.25	0.17
82	Yellowhammer	12	8	6	2	28	0.50	0.40	0.13	0.17
83	Common reed bunting	2	2	3	0	7	0.08	0.10	0.06	0.00
84	Corn bunting	14	8	5	2	29	0.58	0.40	0.10	0.17
85	NI	41	59	22	8	130	1.71	2.95	0.46	0.67

A total of 3875 individual birds were recorded. Common starlings were the most numerous (1294 individuals). During this period, 83 bird species were recorded, of which 7 species were from Annex 1 of the Birds Directive (Tab. 11). The vast majority of recorded species belong to common and cosmopolitan taxa at the regional and Pomeranian scale. During this period, the majority of species moved within zone 1 (<50 m) below the theoretically working rotor blades (Fig. 10, 11).

Table 12. Species abundance (N) at specific points in monitored area.

No.	English name	N					N/h of observation			
		A	B	C	D	ΣN	A	B	C	D
1	Great crested grebe	0	1	1	0	2	0.00	0.08	0.08	0.00
2	Great cormorant	0	2	0	0	2	0.00	0.17	0.00	0.00
3	Grey heron	2	6	3	0	11	0.17	0.50	0.25	0.00
4	White stork	3	4	0	0	7	0.25	0.33	0.00	0.00
5	Mute swan	6	16	6	2	30	0.50	1.33	0.50	0.17
6	Mallard	10	24	7	4	45	0.83	2.00	0.58	0.33
7	Common pochard	0	2	0	0	2	0.00	0.17	0.00	0.00
8	Common goldeneye	0	0	1	0	1	0.00	0.00	0.08	0.00
9	Red kite	1	2	1	0	4	0.08	0.17	0.08	0.00
10	White-tailed eagle	2	2	26	1	31	0.17	0.17	2.17	0.08
11	Western marsh harrier	8	23	10	2	43	0.67	1.92	0.83	0.17
12	Northern goshawk	0	1	1	0	2	0.00	0.08	0.08	0.00
13	Eurasian sparrowhawk	0	1	0	0	1	0.00	0.08	0.00	0.00
14	Common buzzard	4	18	7	2	31	0.33	1.50	0.58	0.17
15	Eurasian hobby	0	1	0	0	1	0.00	0.08	0.00	0.00
16	Common crane	18	52	14	2	86	1.50	4.33	1.17	0.17
17	Northern lapwing	87	214	23	6	330	7.25	17.83	1.92	0.50
18	Green sandpiper	0	0	1	0	1	0.00	0.00	0.08	0.00

19	Black-headed gull	4	18	8	1	31	0.33	1.50	0.67	0.08
20	European herring gull	0	4	0	0	4	0.00	0.33	0.00	0.00
22	Common wood pigeon	36	86	17	4	143	3.00	7.17	1.42	0.33
23	Eurasian collared dove	0	1	1	1	3	0.00	0.08	0.08	0.08
24	Common swift	14	16	4	0	34	1.17	1.33	0.33	0.00
25	Great spotted woodpecker	0	0	1	0	1	0.00	0.00	0.08	0.00
26	Eurasian skylark	87	150	62	34	333	7.25	12.50	5.17	2.83
27	Barn swallow	22	41	94	2	159	1.83	3.42	7.83	0.17
29	Western yellow wagtail	1	1	0	0	2	0.08	0.08	0.00	0.00
30	White wagtail	0	1	0	0	1	0.00	0.08	0.00	0.00
31	European robin	1	1	2	1	5	0.08	0.08	0.17	0.08
32	Common blackbird	4	4	0	0	8	0.33	0.33	0.00	0.00
33	Fieldfare	1	1	0	1	3	0.08	0.08	0.00	0.08
34	Marsh tit	1	0	0	0	1	0.08	0.00	0.00	0.00
35	Great tit	5	22	4	2	33	0.42	1.83	0.33	0.17
36	Eurasian blue tit	0	0	1	0	1	0.00	0.00	0.08	0.00
37	Short-toed treecreeper	0	11	0	0	11	0.00	0.92	0.00	0.00
38	Red-backed shrike	0	0	1	0	1	0.00	0.00	0.08	0.00
39	Eurasian jay	1	0	0	0	1	0.08	0.00	0.00	0.00
40	Eurasian magpie	4	7	8	3	22	0.33	0.58	0.67	0.25
41	Rook	6	4	0	1	11	0.50	0.33	0.00	0.08
42	Hooded crow	8	12	4	2	26	0.67	1.00	0.33	0.17
43	Common raven	14	21	11	4	50	1.17	1.75	0.92	0.33
44	Common starling	280	1260	560	62	2162	23.33	105.00	46.67	5.17
45	Eurasian tree sparrow	12	12	8	4	36	1.00	1.00	0.67	0.33
46	Common chaffinch	1	2	6	1	10	0.08	0.17	0.50	0.08
47	European greenfinch	1	2	0	0	3	0.08	0.17	0.00	0.00
48	European goldfinch	0	0	1	0	1	0.00	0.00	0.08	0.00
49	Common linnet	2	0	7	1	10	0.17	0.00	0.58	0.08
50	Yellowhammer	2	1	1	0	4	0.17	0.08	0.08	0.00
51	Corn bunting	8	1	14	4	27	0.67	0.08	1.17	0.33
52	NI	12	64	20	14	110	1.00	5.33	1.67	1.17

A total of 3857 individuals were recorded. Common starlings were the most abundant species at the observation points with a total number of 2162 individuals. Another was the Eurasian skylark, with a number of 333 individuals, and the Northern lapwing with 330 individuals. Other taxa appeared in numbers ranging from 1 to 143 individuals.

The table below shows the percentage share of each bird species, thus the dominance structure in each elementary area. The eudominant species were: common starling, Eurasian skylark, Northern lapwing (A); common starling and Eurasian skylark (B); common starling (C); common starling and Eurasian skylark (D) (Tab. 13). Most of the species shown belonged to subdominant and recendent species.

Table 13. Dominance structure (D) of species in elementary areas (>0.1).

No.	English name	A	English name	B	English name	C	English name	D
1	Common starling	21.5	Common starling	31.5	Common starling	51.9	Common starling	34.7
2	Eurasian skylark	14.6	Eurasian skylark	12.0	Eurasian skylark	8.3	Eurasian skylark	12.2
3	Northern lapwing	10.5	Northern lapwing	6.8	Northern lapwing	4.4	Great tit	5.6
4	Great tit	5.7	Common wood pigeon	6.0	Common crane	3.8	Common wood pigeon	4.6
5	Common wood pigeon	3.7	Great tit	5.7	Barn swallow	3.0	Common crane	4.1
6	Common raven	3.7	Eurasian tree sparrow	4.6	Great tit	3.0	Northern lapwing	4.1

7	Common crane	2.7	Common crane	4.4	Mallard	2.6	Common raven	4.1
8	Barn swallow	2.7	Barn swallow	4.2	Common wood pigeon	2.4	Eurasian tree sparrow	4.1
9	European greenfinch	2.6	Common raven	4.1	Common raven	2.2	Common blackbird	3.1
10	Hooded crow	2.5	Mallard	3.6	White-tailed eagle	1.5	Eurasian magpie	3.1
11	Eurasian tree sparrow	2.5	Black-headed gull	1.5	Eurasian tree sparrow	1.4	Barn swallow	2.0
12	Mallard	2.3	Common blackbird	1.3	Common linnet	1.3	Mallard	1.5
13	Short-toed treecreeper	1.7	Short-toed treecreeper	1.2	Western marsh harrier	1.2	Western marsh harrier	1.5
14	Corn bunting	1.7	Hooded crow	1.0	Hooded crow	1.2	Mute swan	1.0
15	Yellowhammer	1.4	European greenfinch	1.0	Mute swan	1.0	Grey partridge	1.0
16	Common blackbird	1.3	Western marsh harrier	0.8	Yellowhammer	0.6	Common cuckoo	1.0
17	Rook	1.3	Mute swan	0.8	Common goldeneye	0.5	Rook	1.0
18	Western marsh harrier	1.1	Common chaffinch	0.8	Common buzzard	0.5	Hooded crow	1.0
19	Common linnet	1.1	Common buzzard	0.7	Eurasian magpie	0.5	Common chaffinch	1.0
20	Eurasian magpie	1.0	Eurasian magpie	0.7	European goldfinch	0.5	European greenfinch	1.0
21	Common buzzard	0.7	Eurasian collared dove	0.5	Corn bunting	0.5	Common linnet	1.0
22	House sparrow	0.7	Fieldfare	0.5	Common pochard	0.4	Yellowhammer	1.0
23	European goldfinch	0.7	Rook	0.5	Eurasian collared dove	0.4	Corn bunting	1.0
24	Black-headed gull	0.6	Yellowhammer	0.5	Common swift	0.4	White-tailed eagle	0.5
25	Common chaffinch	0.6	Corn bunting	0.5	Common chaffinch	0.4	Northern goshawk	0.5
26	Grey partridge	0.5	Common pochard	0.3	Black-headed gull	0.3	Common buzzard	0.5
27	Eurasian collared dove	0.5	Common swift	0.3	Fieldfare	0.3	European herring gull	0.5
28	Common swift	0.5	Common linnet	0.3	Eurasian blue tit	0.3	Eurasian collared dove	0.5
29	European robin	0.5	Grey partridge	0.3	Common reed bunting	0.3	Western yellow wagtail	0.5
30	Fieldfare	0.5	European herring gull	0.3	Great crested grebe	0.2	White wagtail	0.5
31	Eurasian blue tit	0.5	European robin	0.3	Grey heron	0.2	European robin	0.5
32	Red-backed shrike	0.5	Common cuckoo	0.2	Red kite	0.2	Fieldfare	0.5
33	Eurasian jay	0.5	Western yellow wagtail	0.2	Common cuckoo	0.2	Eurasian treecreeper	0.5
34	Western jackdaw	0.5	White stork	0.2	European robin	0.2		
35	Mute swan	0.4	Red kite	0.2	Great reed warbler	0.2		
36	Common cuckoo	0.4	White-tailed eagle	0.2	Marsh tit	0.2		
37	Tree pipit	0.4	Eurasian treecreeper	0.2	Red-backed shrike	0.2		
38	Western yellow wagtail	0.4	Red-backed shrike	0.2	Rook	0.2		
39	Eurasian siskin	0.4	Grey heron	0.1	European greenfinch	0.2		
40	White stork	0.2	Northern goshawk	0.1	Gadwall	0.1		
41	White-tailed eagle	0.2	White wagtail	0.1	Eurasian teal	0.1		
42	Common pheasant	0.2	House sparrow	0.1	Northern goshawk	0.1		
43	European herring gull	0.2	European goldfinch	0.1	Common kestrel	0.1		
44	White wagtail	0.2	Common reed bunting	0.1	Grey partridge	0.1		
45	Eurasian wren	0.2	Great crested grebe	0.1	Eurasian coot	0.1		

46	Common nightingale	0.2	Great cormorant	0.1	Green sandpiper	0.1		
47	Whinchat	0.2	Eurasian bittern	0.1	Barn owl	0.1		
48	Song thrush	0.2	Eurasian teal	0.1	European green woodpecker	0.1		
49	River warbler	0.2	Common goldeneye	0.1	Great spotted woodpecker	0.1		
50	Great reed warbler	0.2	Eurasian sparrowhawk	0.1	Tree pipit	0.1		
51	Marsh tit	0.2	Eurasian hobby	0.1	Western yellow wagtail	0.1		
52	Common reed bunting	0.2	Common pheasant	0.1	Common nightingale	0.1		
53	Great cormorant	0.1	Eurasian coot	0.1	Common redstart	0.1		
54	Grey heron	0.1	Little ringed plover	0.1	Whinchat	0.1		
55	Common pochard	0.1	Great spotted woodpecker	0.1	Mistle thrush	0.1		
56	Red kite	0.1	Eurasian wren	0.1	River warbler	0.1		
57	Eurasian sparrowhawk	0.1	Common nightingale	0.1	Common whitethroat	0.1		
58	Common kestrel	0.1	Whinchat	0.1	Spotted flycatcher	0.1		
59	Little ringed plover	0.1	Northern wheatear	0.1	Eurasian nuthatch	0.1		
60	Barn owl	0.1	Song thrush	0.1	Eurasian golden oriole	0.1		
61	Common redstart	0.1	Marsh warbler	0.1	Eurasian jay	0.1		
62	European stonechat	0.1	Great reed warbler	0.1	Eurasian siskin	0.1		
63	Mistle thrush	0.1	Common whitethroat	0.1				
64	Marsh warbler	0.1	Marsh tit	0.1				
65	Lesser whitethroat	0.1	Eurasian blue tit	0.1				
66	Common whitethroat	0.1	Eurasian jay	0.1				
67	Great grey shrike	0.1						

When considering the entire monitored area, it can be seen that the eudominant species were passerines and charadriiformes, which together accounted for 89.6% of the total avifauna. Both taxa strongly outnumbered the other taxa (Fig. 8). Other taxa were characterized by minor or even incidental percentage share (Fig. 8).

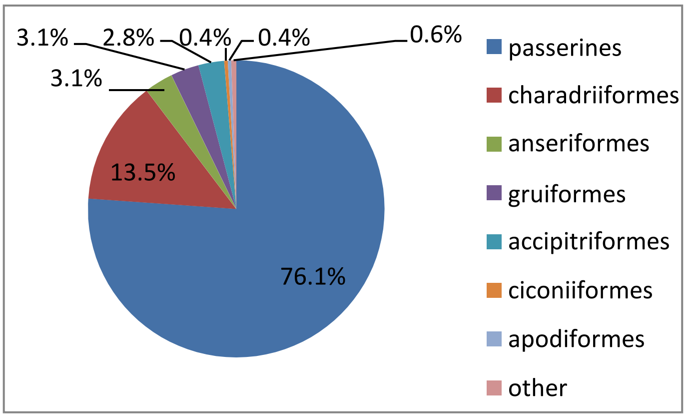


Figure 8. Percentages of individual taxa for the entire monitored area.

During the field work, 30 species were found in MPPL squares. Species abundance varied depending on the square. The lowest was found in square K4 (10 species) and the highest in square K2 (28 species) (Tab. 14).

Table 14. Density of species in MPPL squares.

No.	English name	Latin name	K1	K2	K3	K4
1	Grey heron	*Ardea cinerea*	1	1	0	0
2	Mute swan	*Cygnus olor*	0	2	2	0
3	Mallard	*Anas platyrhynchos*	0	4	2	0
4	White-tailed eagle	*Haliaeetus albicilla*	0	1	3	0
5	Western marsh harrier	*Circus aeruginosus*	2	4	3	1
6	Common buzzard	*Buteo buteo*	1	1	1	1
7	Common crane	*Grus grus*	2	2	3	0
8	Black-headed gull	*Larus ridibundus*	0	1	1	0
9	Common wood pigeon	*Columba palumbus*	2	8	4	2
10	Eurasian collared dove	*Streptopelia decaocto*	1	1	1	0
11	Common swift	*Apus apus*	4	2	0	0
12	Eurasian skylark	*Alauda arvensis*	14	26	18	8
13	Barn swallow	*Hirundo rustica*	4	5	2	0
14	Western yellow wagtail	*Motacilla flava*	1	3	1	0
15	White wagtail	*Motacilla alba*	0	1	1	1
16	European robin	*Erithacus rubecula*	2	1	1	0
17	Whinchat	*Saxicola rubetra*	1	0	1	0
18	Fieldfare	*Turdus pilaris*	1	1	0	0
19	Common whitethroat	*Sylvia communis*	1	0	1	0
20	Great tit	*Parus major*	6	5	4	2
21	Eurasian blue tit	*Cyanistes caeruleus*	1	1	1	0
22	Red-backed shrike	*Lanius collurio*	1	1	0	0
23	Common raven	*Corvus corax*	4	2	4	1
24	Eurasian tree sparrow	*Passer montanus*	4	10	2	2
25	Common chaffinch	*Fringilla coelebs*	1	2	1	0
26	European greenfinch	*Carduelis chloris*	2	1	2	1
27	European goldfinch	*Carduelis carduelis*	2	1	1	0
28	Common linnet	*Carduelis cannabina*	3	4	2	0
29	Yellowhammer	*Emberiza citrinella*	1	2	2	0
30	Corn bunting	*Emberiza calandra*	2	2	1	1

The most abundant species were Eurasian skylarks, which were recorded in all squares, in numbers ranging from 8 in K4 to 26 in K2. 6 species were observed rarely: grey heron, black-headed gull, whinchat, fieldfare, common whitethroat and red-backed shrike – 2 individuals in each of them.

Nationally, the average species abundance was 34-35 species, with variability in squares ranging from 7 to 71 species. This was probably related to the physiography of the individual squares. In squares located in the vicinity of large forest complexes and mid-field tree buffers, the number of species was higher, which was associated with a greater number of habitats. In contrast, in areas of monocultures of agroecosystems, the number of species was low, which was related to the dominance of a single habitat, used by a small number of species, and subjected to intensive farming.

The number of species in the surveyed squares was average, near medium or low values (K4). This was associated with a low diversity of habitats. The lowest number of 10 species occurred in square K4, which included basically cereal crops, devoid of mid-field ponds and refuge. The highest was recorded in squares K2 and K3 (respectively: 28 and 26), which, in addition to agricultural land, included mid-field tree buffers and shrub buffers, mid-field ponds, espaliers and shrubs along watercourses. The most numerous species were: Eurasian skylarks, Eurasian tree sparrows, common wood pigeons.

The results of the survey when compared to the rest of the country should be considered average, both in terms of species composition, abundance of individual species and distribution.

During the key species census, the presence of 34 species from 9 taxa was found (Tab. 15): pelecaniformes, ciconiiformes, anseriformes, accipitriformes, gruiformes, charadriiformes, strigiformes, apodiformes, piciformes, passerines.

Table 15. The presence of key species in the areas covered by the census.

No.	English name	Latin name	A	B
1	Great cormorant	*Phalacrocorax carbo*	+	+
2	Eurasian bittern	*Botaurus stellaris*	+	+
3	Grey heron	*Ardea cinerea*	+	+
4	White stork	*Ciconia ciconia*	+	+
5	Whooper swan	*Cygnus cygnus*	+	+
6	Mallard	*Anas platyrhynchos*	+	
7	Red kite	*Milvus milvus*	+	+
8	White-tailed eagle	*Haliaeetus albicilla*	+	+
9	Western marsh harrier	*Circus aeruginosus*	+	+
10	Hen harrier	*Circus cyaneus*	+	+
11	Northern goshawk	*Accipiter gentilis*	+	+
12	Eurasian sparrowhawk	*Accipiter nisus*	+	+
13	Common buzzard	*Buteo buteo*	+	+
14	Rough-legged buzzard	*Buteo lagopus*	+	+
15	Common kestrel	*Falco tinnunculus*	+	+
16	Eurasian hobby	*Falco subbuteo*	+	+
17	Corncrake	*Crex crex*		+
18	Common crane	*Grus grus*	+	+
19	Little ringed plover	*Charadrius dubius*	+	+
20	European golden plover	*Pluvialis apricaria*	+	+
21	Northern lapwing	*Vanellus vanellus*	+	
22	Eurasian curlew	*Numenius arquata*	+	
23	Green sandpiper	*Tringa ochropus*	+	+
24	Black-headed gull	*Larus ridibundus*	+	+
25	Common gull	*Larus canus*	+	+
26	European herring gull	*Larus argentatus*	+	+
27	Barn owl	*Tyto alba*	+	+
28	Tawny owl	*Strix aluco*	+	+
29	Common swift	*Apus apus*	+	
30	Black woodpecker	*Dryocopus martius*	+	+
31	Red-backed shrike	*Lanius collurio*	P, POD	
32	Rook	*Corvus frugilegus*	+	+
33	Common raven	*Corvus corax*	+	+
34	Corn bunting	*Emberiza calandra*	TE, POD	

Legend: P – a pair of birds in breeding habitat; TE – singing male; POD – birds with food for the young or droppings of the nestling.

In area A (wind farm area), 33 species were found, of which only 2 were classified as breeding species. Among these, only corn buntings nested in agricultural land where wind turbines are planned to be constructed. The red-backed shrike nested in the woodlands outside the location of wind turbines. In area B (outside the wind farm area), 31 species were found.

Based on the collected data, it can be concluded that the area of the designed investment should not have a significant negative impact on breeding avifauna.

Fall migration period.

This phenological period, in addition to the breeding period, is the most important period to study the impact of power plants on avifauna. It is related to a change in location as a result of deteriorating weather conditions, and thus reducing the availability of food, the inability to raise offspring, and the need to search for sites suitable for surviving the winter period in breeding grounds. Hence the birds migrate to warmer regions of the globe, from Poland they head mainly west and south as well as south-west. Most birds, including many domestic birds, are migratory. The best known example of this phenomenon is the migration of the white stork. It takes place via two routes to Africa. Through the Bosphorus or the Strait of Gibraltar. The flyway is determined by the breeding site. Polish storks migrate to Africa via the Bosphorus. During fall migration, birds typically move in broad fronts. At the same time, migrations of most species are extended over time. Therefore they are less intense than spring migrations, but they last longer. This is caused, among others, by the lack of competition in occupying wintering grounds and the slowly decreasing availability of food. Birds have time to build up energy reserves for migration. During this period, flocks of nomadic birds, often reaching several thousand birds, and gatherings of long-distance species such as common cranes or storks, can be often observed. It is also an interesting period, because as some species fly away to warmer areas, species from colder regions of the globe, such as the Siberian tundra or northern Europe, come to us. There is a kind of species exchange, but it is limited to a few species, e.g., rough-legged buzzard, bean geese and some smaller passerine species.

The tables below list the species observed, on transects and at observation points, during the fall migration period. The first small flights were observed as early as the end of August, when the first Northern lapwings appeared and when some small passerines like common starlings started to form larger flocks. Thereafter, flight intensity and flock size gradually increased, reaching a maximum in late September and mid-October. It then declined, and the last major flights were observed in late October. Single overflights were still observed in early November.

Table 16. Inventory of species found.

No.	English name	Latin name	Protection status	BD	RDB oA	RLTS	Presence			
							A	B	C	D
1	Great crested grebe	*Podiceps cristatus*	PS				+	+	+	
2	Great cormorant	*Phalacrocorax carbo*	PPS				+	+	+	
3	Grey heron	*Ardea cinerea*	PPS				+	+	+	
4	Mute swan	*Cygnus olor*	PS				+	+	+	+
5	Whooper swan	*Cygnus cygnus*	PS	+			+	+	+	
6	Bean goose	*Anser fabalis*	GS				+	+	+	+
7	Greater white-fronted goose	*Anser albifrons*	GS				+	+		
8	Greylag goose	*Anser anser*	GS					+	+	
9	Eurasian teal	*Anas crecca*	GS				+	+	+	
10	Mallard	*Anas platyrhynchos*	GS				+	+	+	
11	Common pochard	*Aythya ferina*	GS					+	+	

12	Red kite	*Milvus milvus*	PS	+	NT	NT	+	+		
13	White-tailed eagle	*Haliaeetus albicilla*	PS	+	LC	LC	+	+	+	
14	Hen harrier	*Circus cyaneus*	PS	+	VU	VU		+		
15	Northern goshawk	*Accipiter gentilis*	PS				+	+	+	
16	Eurasian sparrowhawk	*Accipiter nisus*	PS					+	+	+
17	Common buzzard	*Buteo buteo*	PS				+	+	+	+
18	Rough-legged buzzard	*Buteo lagopus*	PS				+	+	+	
19	Common pheasant	*Phasianus colchicus*	GS				+		+	
20	Common crane	*Grus grus*	PS	+			+	+	+	+
21	European golden plover	*Pluvialis apricaria*	PS	+	EXP	EX	+	+		
22	Northern lapwing	*Vanellus vanellus*	PS				+	+	+	+
23	Eurasian curlew	*Numenius arquata*	PS		VU	VU	+	+	+	
24	Black-headed gull	*Larus ridibundus*	PS				+	+	+	+
25	Common gull	*Larus canus*	*PS*					+		
26	European herring gull	*Larus argentatus*	PPS				+	+	+	
27	Common wood pigeon	*Columba palumbus*	GS				+	+	+	+
28	Eurasian collared dove	*Streptopelia decaocto*	PS				+	+	+	
29	European green woodpecker	*Picus viridis*	PS				+		+	
30	Great spotted woodpecker	*Dendrocopos major*	PS				+	+	+	+
31	Eurasian skylark	*Alauda arvensis*	PS				+	+	+	+
32	Barn swallow	*Hirundo rustica*	PS					+	+	+
33	Tree pipit	*Anthus trivialis*	PS				+		+	
34	Meadow pipit	*Anthus pratensis*	PS				+			
35	Western yellow wagtail	*Motacilla flava*	PS				+	+	+	+
36	White wagtail	*Motacilla alba*	PS				+	+	+	+
37	Bohemian waxwing	*Bombycilla garrulus*	PS				+	+	+	
38	European robin	*Erithacus rubecula*	PS				+		+	
39	Fieldfare	*Turdus pilaris*	PS				+	+	+	+
40	Eurasian blackcap	*Sylvia atricapilla*	PS				+			
41	Marsh tit	*Poecile palustris*	PS				+	+	+	
42	Willow tit	*Poecile montanus*	PS				+			
43	Great tit	*Parus major*	PS				+	+	+	+
44	Eurasian blue tit	*Cyanistes caeruleus*	PS				+	+	+	+
45	Short-toed treecreeper	*Certhia brachydactyla*	PS				+	+	+	
46	Eurasian golden oriole	*Oriolus oriolus*	PS						+	
47	Great grey shrike	*Lanius excubitor*	PS				+	+	+	
48	Eurasian jay	*Garrulus glandarius*	PS					+	+	+
49	Eurasian magpie	*Pica pica*	PPS				+	+	+	+
50	Hooded crow	*Corvus cornix*	PPS				+	+	+	+
51	Common raven	*Corvus corax*	PPS				+	+	+	+
52	Common starling	*Sturnus vulgaris*	PS				+	+	+	+
53	House sparrow	*Passer domesticus*	PS				+	+		+
54	Eurasian tree sparrow	*Passer montanus*	PS				+	+	+	+
55	Common chaffinch	*Fringilla coelebs*	PS				+	+	+	+
56	European greenfinch	*Carduelis chloris*	PS				+	+	+	+
57	European goldfinch	*Carduelis carduelis*	PS				+	+	+	+
58	Eurasian siskin	*Carduelis spinus*	PS				+	+	+	+
59	Common linnet	*Carduelis cannabina*	PS				+	+	+	
60	Eurasian bullfinch	*Pyrrhula pyrrhula*	PS				+		+	

61	Hawfinch	*Coccothraustes coccothraustes*	PS					+	+	
62	Yellowhammer	*Emberiza citrinella*	PS				+	+	+	+
63	Corn bunting	*Emberiza calandra*	PS				+	+	+	+

Legend: as in Tab. 1.

63 species were recorded, including: 49 species strictly protected by law, 6 species under partial protection, 8 game species (Tab. 16), 6 species of Community interest — the Birds Directive.

Table 17. Species abundance (N) on transects in the monitored area.

No.	English name	N					N/km of transect			
		A	B	C	D	ΣN	A	B	C	D
1	Great crested grebe	0	1	1	0	2	0.00	0.08	0.03	0.00
2	Great cormorant	8	2	1	0	11	0.50	0.17	0.03	0.00
3	Grey heron	2	4	2	0	8	0.13	0.33	0.06	0.00
4	Mute swan	14	34	8	2	58	0.88	2.83	0.25	0.10
5	Whooper swan	0	6	0	0	6	0.00	0.50	0.00	0.00
6	Bean goose	46	210	28	46	330	2.88	17.50	0.88	2.30
7	Greater white-fronted goose	0	22	0	0	22	0.00	1.83	0.00	0.00
8	Greylag goose	0	12	8	0	20	0.00	1.00	0.25	0.00
9	Eurasian teal	2	1	1	0	4	0.13	0.08	0.03	0.00
10	Mallard	13	182	24	6	225	0.81	15.17	0.75	0.30
11	Common pochard	0	1	2	0	3	0.00	0.08	0.06	0.00
12	Red kite	1	1	0	0	2	0.06	0.08	0.00	0.00
13	White-tailed eagle	2	1	7	0	10	0.13	0.08	0.22	0.00
14	Hen harrier	0	1	0	0	1	0.00	0.08	0.00	0.00
15	Northern goshawk	0	2	0	1	3	0.00	0.17	0.00	0.05
16	Eurasian sparrowhawk	0	1	1	0	2	0.00	0.08	0.03	0.00
17	Common buzzard	2	4	2	1	9	0.13	0.33	0.06	0.05
18	Rough-legged buzzard	2	1	1	0	4	0.13	0.08	0.03	0.00
19	Common pheasant	1	0	2	0	3	0.06	0.00	0.06	0.00
20	Common crane	42	28	58	11	139	2.63	2.33	1.81	0.55
21	European golden plover	6	21	0	0	27	0.38	1.75	0.00	0.00
22	Northern lapwing	660	1280	186	42	2168	41.25	106.67	5.81	2.10
23	Eurasian curlew	1	3	0	0	4	0.06	0.25	0.00	0.00
24	Black-headed gull	51	40	8	4	103	3.19	3.33	0.25	0.20
25	Common gull	0	6	0	0	6	0.00	0.50	0.00	0.00
26	European herring gull	4	11	8	1	24	0.25	0.92	0.25	0.05
27	Common wood pigeon	24	182	52	9	267	1.50	15.17	1.63	0.45
28	Eurasian collared dove	3	6	2	0	11	0.19	0.50	0.06	0.00
29	European green woodpecker	1	0	1	0	2	0.06	0.00	0.03	0.00
30	Great spotted woodpecker	2	1	1	1	5	0.13	0.08	0.03	0.05
31	Eurasian skylark	41	154	112	8	315	2.56	12.83	3.50	0.40
32	Barn swallow	86	34	66	12	198	5.38	2.83	2.06	0.60
33	Tree pipit	1	0	1	0	2	0.06	0.00	0.03	0.00
34	Meadow	1	0	0	0	1	0.06	0.00	0.00	0.00

	pipit									
35	Western yellow wagtail	2	1	1	1	5	0.13	0.08	0.03	0.05
36	White wagtail	1	6	0	1	8	0.06	0.50	0.00	0.05
37	Bohemian waxwing	36	4	12	0	52	2.25	0.33	0.38	0.00
38	European robin	2	0	1	0	3	0.13	0.00	0.03	0.00
39	Fieldfare	8	164	23	2	197	0.50	13.67	0.72	0.10
40	Eurasian blackcap	1	0	0	0	1	0.06	0.00	0.00	0.00
41	Marsh tit	2	2	1	0	5	0.13	0.17	0.03	0.00
42	Willow tit	1	0	0	0	1	0.06	0.00	0.00	0.00
43	Great tit	36	42	51	7	136	2.25	3.50	1.59	0.35
44	Eurasian blue tit	8	3	6	2	19	0.50	0.25	0.19	0.10
45	Short-toed treecreeper	38	0	6	0	44	2.38	0.00	0.19	0.00
46	Eurasian golden oriole	0	0	1	0	1	0.00	0.00	0.03	0.00
47	Great grey shrike	1	1	2	0	4	0.06	0.08	0.06	0.00
48	Eurasian jay	0	2	4	1	7	0.00	0.17	0.13	0.05
49	Eurasian magpie	7	6	3	4	20	0.44	0.50	0.09	0.20
50	Hooded crow	18	21	8	2	49	1.13	1.75	0.25	0.10
51	Common raven	22	61	42	11	136	1.38	5.08	1.31	0.55
52	Common starling	680	2164	220	610	3674	42.50	180.33	6.88	30.50
53	House sparrow	14	11	0	6	31	0.88	0.92	0.00	0.30
54	Eurasian tree sparrow	16	38	8	2	64	1.00	3.17	0.25	0.10
55	Common chaffinch	61	36	48	3	148	3.81	3.00	1.50	0.15
56	European greenfinch	6	48	61	14	129	0.38	4.00	1.91	0.70
57	European goldfinch	20	166	48	16	250	1.25	13.83	1.50	0.80
58	Eurasian siskin	6	8	14	2	30	0.38	0.67	0.44	0.10
59	Common linnet	31	12	8	0	51	1.94	1.00	0.25	0.00
60	Eurasian bullfinch	1	0	1	0	2	0.06	0.00	0.03	0.00
61	Hawfinch	0	1	1	0	2	0.00	0.08	0.03	0.00
62	Yellowhammer	22	31	24	8	85	1.38	2.58	0.75	0.40
63	Corn bunting	51	26	6	8	91	3.19	2.17	0.19	0.40
64	NI	22	56	31	32	141	1.38	4.67	0.97	1.60

A total of 9381 individual birds were recorded (Tab. 17). The most abundant species were common starlings and northern lapwings, with numbers of 3674 individuals for common starlings and 2168 individuals for northern lapwings (Tab. 17). Starlings traveled in flocks of up to several hundred individuals, usually above ground in zone 1 or roosted on the ground. Northern lapwings traveled similarly.

Table 18. Species abundance (N) at specific points in monitored area.

No.	**English name**	**N**					**N/h of observation**			
		A	**B**	**C**	**D**	**ΣN**	**A**	**B**	**C**	**D**
1	Great crested grebe	2	1	0	0	3	0.22	0.11	0.00	0.00
2	Great cormorant	21	12	4	0	37	2.33	1.33	0.44	0.00
3	Grey heron	1	3	1	0	5	0.11	0.33	0.11	0.00
4	Mute swan	24	18	16	2	60	2.67	2.00	1.78	0.22
5	Whooper swan	6	0	8	0	14	0.67	0.00	0.89	0.00
6	Bean goose	54	84	36	38	212	6.00	9.33	4.00	4.22
7	Greater white-fronted goose	12	8	0	0	20	1.33	0.89	0.00	0.00
8	Greylag goose	0	4	0	0	4	0.00	0.44	0.00	0.00
9	Mallard	14	34	16	6	70	1.56	3.78	1.78	0.67

10	Common pochard	0	0	1	0	1	0.00	0.00	0.11	0.00
11	Red kite	0	1	0	0	1	0.00	0.11	0.00	0.00
12	White-tailed eagle	1	1	4	0	6	0.11	0.11	0.44	0.00
13	Northern goshawk	0	1	1	0	2	0.00	0.11	0.11	0.00
14	Eurasian sparrowhawk	0	2	1	1	4	0.00	0.22	0.11	0.11
15	Common buzzard	2	6	3	1	12	0.22	0.67	0.33	0.11
16	Rough-legged buzzard	1	0	1	0	2	0.11	0.00	0.11	0.00
17	Common crane	28	148	22	9	207	3.11	16.44	2.44	1.00
18	Northern lapwing	228	940	310	14	1492	25.33	104.44	34.44	1.56
19	Black-headed gull	21	24	8	1	54	2.33	2.67	0.89	0.11
20	European herring gull	2	2	0	0	4	0.22	0.22	0.00	0.00
21	Common wood pigeon	11	61	8	6	86	1.22	6.78	0.89	0.67
22	Eurasian collared dove	2	1	1	0	4	0.22	0.11	0.11	0.00
23	European green woodpecker	0	0	1	0	1	0.00	0.00	0.11	0.00
24	Great spotted woodpecker	1	0	1	0	2	0.11	0.00	0.11	0.00
25	Eurasian skylark	26	240	68	31	365	2.89	26.67	7.56	3.44
26	Barn swallow	22	41	8	8	79	2.44	4.56	0.89	0.89
27	Western yellow wagtail	0	1	1	0	2	0.00	0.11	0.11	0.00
28	White wagtail	0	0	2	0	2	0.00	0.00	0.22	0.00
29	Fieldfare	31	62	12	6	111	3.44	6.89	1.33	0.67
30	Marsh tit	1	0	0	0	1	0.11	0.00	0.00	0.00
31	Great tit	8	22	14	6	50	0.89	2.44	1.56	0.67
32	Eurasian blue tit	1	0	1	0	2	0.11	0.00	0.11	0.00
33	Short-toed treecreeper	0	22	0	0	22	0.00	2.44	0.00	0.00
34	Great grey shrike	1	0	1	0	2	0.11	0.00	0.11	0.00
35	Eurasian magpie	4	6	5	3	18	0.44	0.67	0.56	0.33
36	Hooded crow	6	14	8	1	29	0.67	1.56	0.89	0.11
37	Common raven	9	22	12	4	47	1.00	2.44	1.33	0.44
38	Common starling	262	1840	190	422	2714	29.11	204.44	21.11	46.89
39	Eurasian tree sparrow	0	0	2	0	2	0.00	0.00	0.22	0.00
40	Common chaffinch	4	22	6	1	33	0.44	2.44	0.67	0.11
41	European greenfinch	4	31	6	4	45	0.44	3.44	0.67	0.44
42	European goldfinch	4	46	14	5	69	0.44	5.11	1.56	0.56
43	Eurasian siskin	0	0	32	0	32	0.00	0.00	3.56	0.00
44	Common linnet	2	4	2	0	8	0.22	0.44	0.22	0.00
45	Yellowhammer	6	6	18	0	30	0.67	0.67	2.00	0.00
46	Corn bunting	16	9	18	0	43	1.78	1.00	2.00	0.00
47	NI	31	102	42	22	197	3.44	11.33	4.67	2.44

A total of 6206 individuals were recorded during flights (Tab. 18). At the observation points the most numerous was the common starling with a total number of 2714 individuals, and the northern lapwing with 1492 individuals. Larks (365 individuals) and bean geese (212 individuals) were the next abundant taxa.

Considering the percentage of each bird species, the dominance structure in each elementary area is evident. The eudominant species were: common starlings and lapwings (A, B, C); common starlings (D). The remaining species belonged to subdominant and recendent species (Tab. 19).

Table 19. Dominance structure (D) of species in elementary areas

No.	English name	A	English name	B	English name	C	English name	D
1	Common starling	32.3	Common starling	42.4	Common starling	18.6	Common starling	72.3
2	Northern lapwing	31.3	Northern lapwing	25.1	Northern lapwing	15.7	Bean goose	5.5
3	Barn swallow	4.1	Bean goose	4.1	Eurasian skylark	9.5	Northern lapwing	5.0
4	Common chaffinch	2.9	Mallard	3.6	Barn swallow	5.6	European goldfinch	1.9
5	Black-headed gull	2.4	Common wood pigeon	3.6	European greenfinch	5.2	European greenfinch	1.7
6	Corn bunting	2.4	European goldfinch	3.3	Common crane	4.9	Barn swallow	1.4
7	Bean goose	2.2	Fieldfare	3.2	Common wood pigeon	4.4	Common crane	1.3
8	Common crane	2.0	Eurasian skylark	3.0	Great tit	4.3	Common raven	1.3
9	Eurasian skylark	1.9	Common raven	1.2	Common chaffinch	4.1	Common wood pigeon	1.1
10	Short-toed treecreeper	1.8	European greenfinch	0.9	European goldfinch	4.1	Eurasian skylark	0.9
11	Bohemian waxwing	1.7	Great tit	0.8	Common raven	3.6	Yellowhammer	0.9
12	Great tit	1.7	Black-headed gull	0.8	Bean goose	2.4	Corn bunting	0.9
13	Common linnet	1.5	Eurasian tree sparrow	0.7	Mallard	2.0	Great tit	0.8
14	Common wood pigeon	1.1	Common chaffinch	0.7	Yellowhammer	2.0	Mallard	0.7
15	Common raven	1.0	Mute swan	0.7	Fieldfare	1.9	House sparrow	0.7
16	Yellowhammer	1.0	Barn swallow	0.7	Eurasian siskin	1.2	Black-headed gull	0.5
17	European goldfinch	0.9	Yellowhammer	0.6	Bohemian waxwing	1.0	Eurasian magpie	0.5
18	Hooded crow	0.9	Common crane	0.5	Mute swan	0.7	Common chaffinch	0.4
19	Eurasian tree sparrow	0.8	Corn bunting	0.5	Greylag goose	0.7	Mute swan	0.2
20	Mute swan	0.7	Greater white-fronted goose	0.4	Black-headed gull	0.7	Fieldfare	0.2
21	House sparrow	0.7	European golden plover	0.4	European herring gull	0.7	Eurasian blue tit	0.2
22	Mallard	0.6	Hooded crow	0.4	Hooded crow	0.7	Hooded crow	0.2
23	Great cormorant	0.4	Greylag goose	0.2	Eurasian tree sparrow	0.7	Eurasian tree sparrow	0.2
24	Fieldfare	0.4	Common linnet	0.2	Common linnet	0.7	Eurasian siskin	0.2
25	Eurasian blue tit	0.4	European herring gull	0.2	White-tailed eagle	0.6	Northern goshawk	0.1
26	Eurasian magpie	0.3	House sparrow	0.2	Eurasian blue tit	0.5	Common buzzard	0.1
27	European golden plover	0.3	Eurasian siskin	0.2	Short-toed treecreeper	0.5	European herring gull	0.1
28	European greenfinch	0.3	Whooper swan	0.1	Corn bunting	0.5	Great spotted woodpecker	0.1
29	Eurasian siskin	0.3	Common gull	0.1	Eurasian jay	0.3	Western yellow wagtail	0.1
30	European herring gull	0.2	Eurasian collared dove	0.1	Eurasian magpie	0.3	White wagtail	0.1
31	Eurasian collared dove	0.1	White wagtail	0.1	Grey heron	0.2	Eurasian jay	0.1
32	Grey heron	0.1	Eurasian magpie	0.1	Common pochard	0.2	Great crested grebe	0.0
33	Eurasian teal	0.1	Grey heron	0.1	Common buzzard	0.2	Great cormorant	0.0
34	White-tailed eagle	0.1	Common buzzard	0.1	Common pheasant	0.2	Grey heron	0.0
35	Common buzzard	0.1	Bohemian waxwing	0.1	Eurasian collared dove	0.2	Whooper swan	0.0
36	Rough-legged buzzard	0.1	Eurasian curlew	0.1	Great grey shrike	0.2	Greater white-fronted goose	0.0

37	Great spotted woodpecker	0.1	Eurasian blue tit	0.1	Great crested grebe	0.1	Greylag goose	0.0
38	Western yellow wagtail	0.1			Great cormorant	0.1	Eurasian teal	0.0
39	European robin	0.1			Eurasian teal	0.1	Common pochard	0.0
40	Marsh tit	0.1			Eurasian sparrowhawk	0.1	Red kite	0.0
41					Rough-legged buzzard	0.1	White-tailed eagle	0.0
42					European green woodpecker	0.1	Hen harrier	0.0
43					Great spotted woodpecker	0.1	Eurasian sparrowhawk	0.0
44					Tree pipit	0.1	Rough-legged buzzard	0.0
45					Western yellow wagtail	0.1	Common pheasant	0.0
46					European robin	0.1	European golden plover	0.0
47					Marsh tit	0.1	Eurasian curlew	0.0
48					Eurasian golden oriole	0.1	Common gull	0.0
49					Eurasian bullfinch	0.1	Eurasian collared dove	0.0
50					Hawfinch	0.1	European green woodpecker	0.0

When considering the entire monitored area, it can be seen that the eudominant species were passerines and charadriiformes, which together accounted for 90% of the total avifauna during this period. The dominant taxa was anseriformes, which made up 6.9% of the avifauna. The remaining taxa were characterized by minor percentage share (Fig. 9).

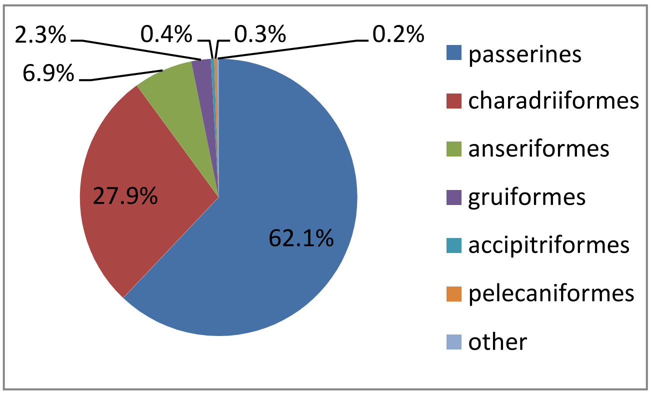


Figure 9. Percentages of individual taxa for the entire monitored area.

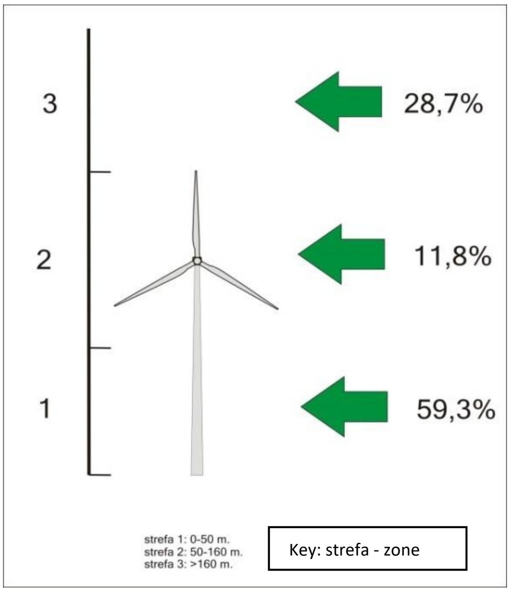
The collected data indicate that this area is not an important site for bird migrations, especially long-distance ones. Especially, if one compares the numbers of swans and geese in the Odra River Valley or in the Słońsk reserve in the Warta River Valley, located several dozen kilometers to the south, where their flocks reach several thousand individuals.

<u>Based on the collected data, it can be predicted that the area of the designed investment is not an important location on migration routes. Therefore, it can be concluded that the designed investment will not have a significant adverse impact on migrating avifauna.</u>

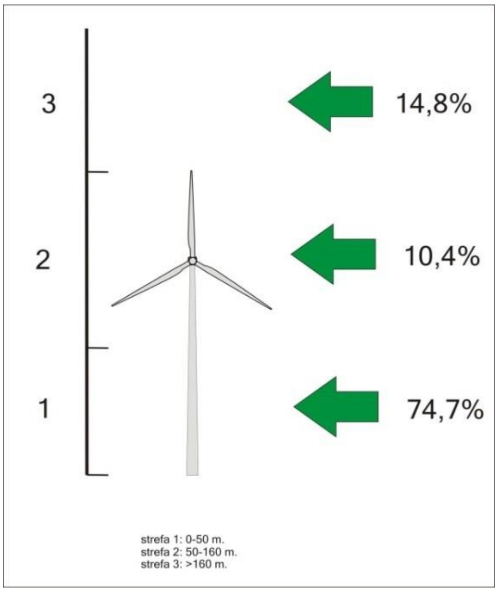
Characteristics of bird flights.

The direction and altitude of flights of individual bird species was variable and depended mainly on the phenological period, the location of their destination nesting sites, topographic conditions along the flight route, and the strength and direction of the winds. The flight directions during the period of horizontal migration were consistent with the general trend in the country and Europe. During the spring migration period birds traveled mainly in northern and northeastern directions. This was a period of quick return of birds from wintering to breeding and feeding grounds. In the fall migration period, the flight directions were opposite. Birds were flying in southern and southwestern direction. At that time, birds were departing for their wintering grounds in warmer regions of Europe and Africa.

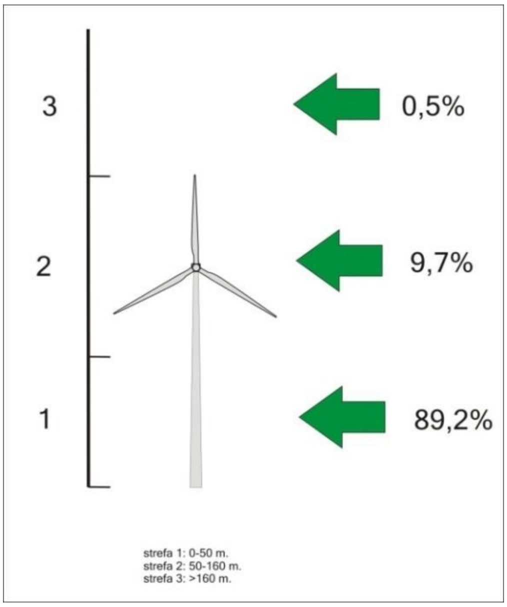
The use of space varied and depended on the phenological period. Flights were recorded in all zones. In winter most flights were within zone 1 (<50 m) (Fig. 10). This was due to unfavorable weather conditions and low numbers of birds. The intensive use of zone 3 was linked to warming at the end of the winter period and the beginning of spring migration. A similar situation continued during the spring migration period, which is shorter and often more intense. In this period the use of zone 1 increased, presumably as a result of the increased number of birds in the investment area that completed their migrations here, as well as their intensive movement when searching for nesting sites, building them and feeding. During the rest of the phenological periods flight gradation also occurred. During the breeding season and breeding dispersal the use of space in zone 1 increased and was the highest of the year (Fig. 10). The reason was probably the movement of nesting birds for feeding and, during the dispersal, the concentration of young birds after flying off the nest. The higher number of birds resulted in an increase in flights in zone 1. Low number of flights in zone 3 resulted from the lack of migratory flights. The use of space in zone 3 increased again during the fall migration period.



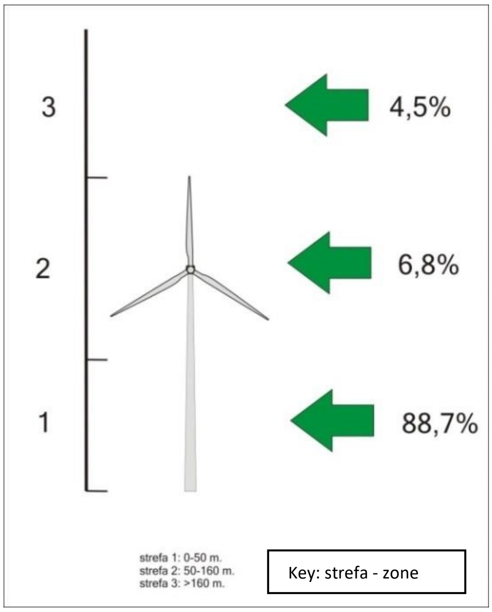
Winter period



Spring migrations



Breeding season and breeding dispersal period



Fall migrations

Figure 10. Frequency of bird flights by phenological period, for the entire monitored area.

Most taxa moved at or below the range of the blades of the designed wind turbines (Fig. 10). As shown in Figure 10, the use of zone 2 was low in each period and ranged from 6.8% to 11.8%. Observed in zone 2 were mainly representatives of anseriformes, accipitriformes, common cranes, pigeons and gulls from charadriiformes and mainly corvids from passerines. Herons and swifts were occasionally recorded flying into zone 2 (Fig. 10). The use of zone 2 resulted from, among other things, the fact that some migrating birds landed on the ground or lowered their flight in the area covered by this paper to feed or rest. This was the behavior of swans, geese, accipitriformes, and small passerines, among others. Most of the birds moved within zone 1. This group consisted mainly of small passerines, cormorants, anseriformes, common cranes, charadriiformes, and most accipitriformes that were flying in from surrounding areas, feeding or flying across the investment site between surrounding areas. Hence, their flights were at low altitudes. A small number of migrating species was observed in zone 2 – a potential collision zone. It mainly concerned geese and northern lapwings during migration, while during breeding and breeding dispersal periods - also buzzards, gulls, occasionally common cranes and large corvids. In zone 3 flights were recorded during all phenological periods, but were most numerous during migration periods (Fig. 10).

Most birds and taxa were observed in zone 1. A small group of species traveled within zone 2 – a potential collision zone. In contrast, at the highest altitudes in zone 3 only geese, white-tailed eagles, buzzards, and common cranes were recorded (Fig. 11).

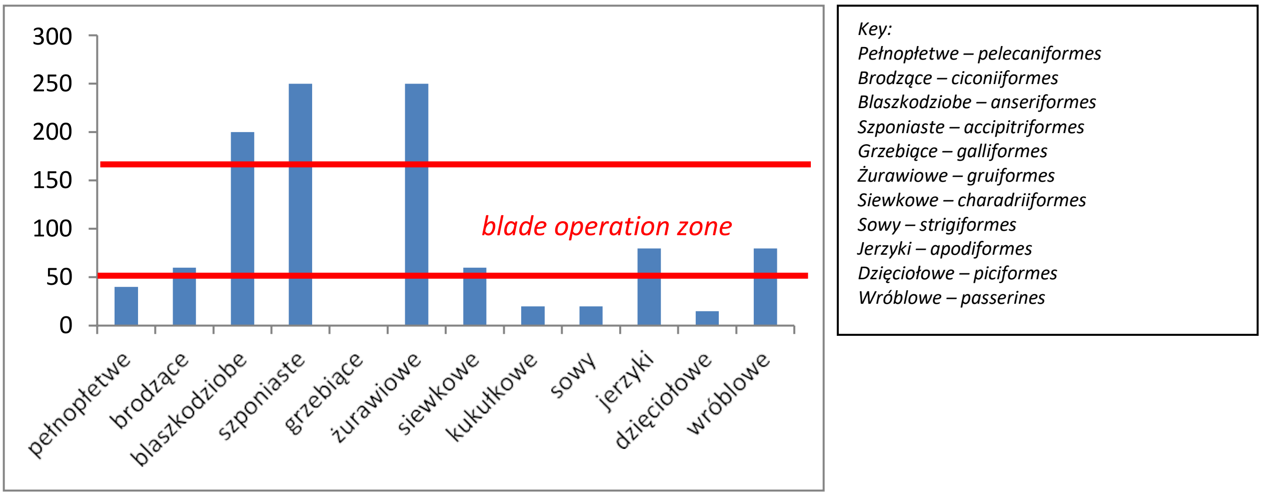


Figure 11. Maximum vertical flight altitude of individual bird taxa over the monitored area.

In the horizontal system, similarly to the previous years, the majority of birds moved along the boundaries of monitored areas, which was connected with the presence of watercourse valleys, mid-field ponds and lakes or forest complexes in their vicinity. They constituted natural migration and feeding routes. Birds use natural, permanent, linear structures as migration cues.

An important migration route was the sequence of lakes along the Tywa River, running from the north to the south, mid-field pond complexes in the vicinity of the lakes and forest complexes located longitudinally in the vicinity of the boundaries of the designed wind farm (Fig. 12).

Between the locations of individual wind turbine units there are wide undeveloped open strips of land. Additionally, there is an open strip of the Tywa River valley with lakes, mid-field ponds and a forest complex running through the area of the wind turbine location. The project site is surrounded by nearby forest complexes. Such physiography ensures that, despite the designed location of the wind turbine, there are still large areas between the turbine units that provide collision-free movement of birds both during the breeding season and during migration.

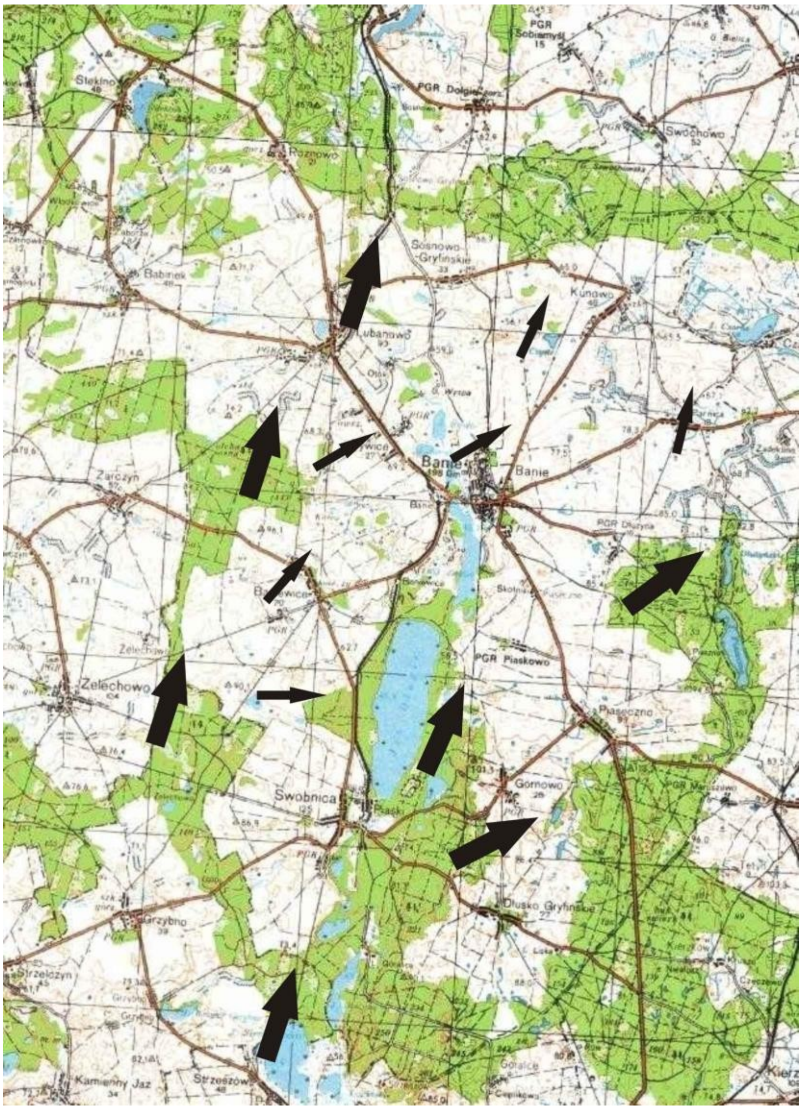


Figure 12a. Main spring flight routes.

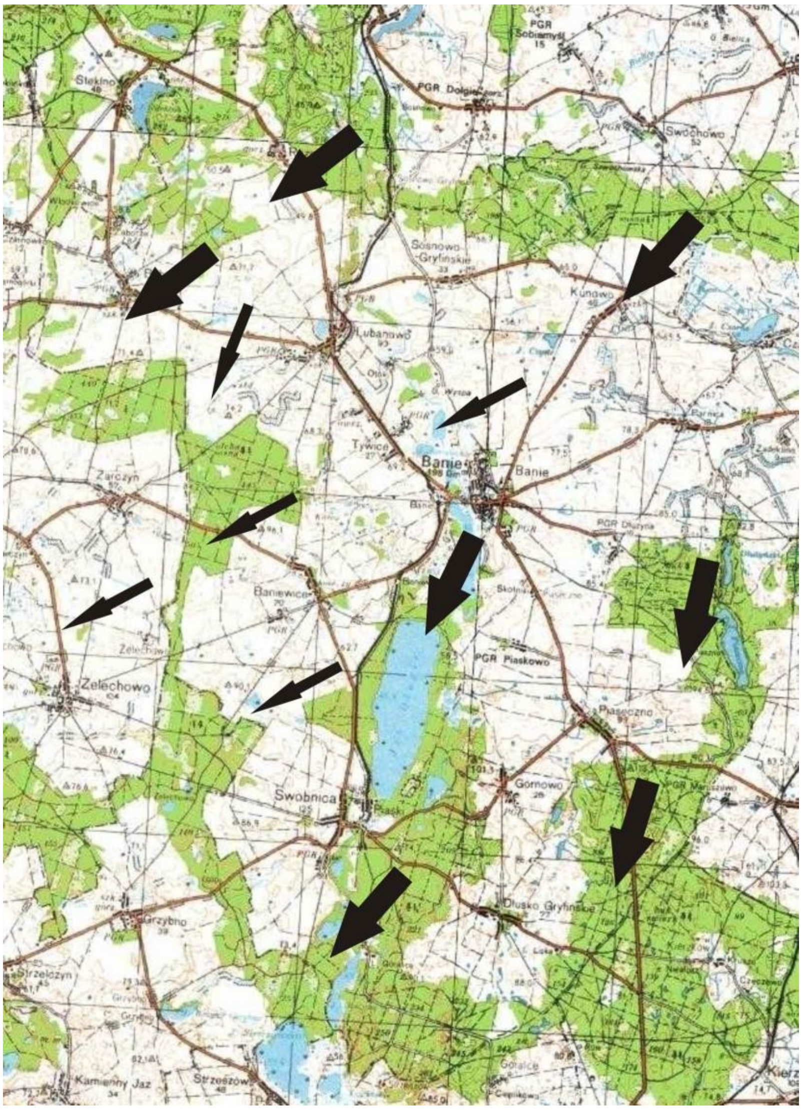


Figure 12b. Main fall flight routes.

Identification of groupings and concentrations of flocks.

Flocks are observed during migration and breeding dispersal periods, when young and adult specimens gather in nomadic flocks before migration. Flocks of particular species as well as mixed flocks were observed in the monitored area. The size of flocks was variable and dependent on the species. Nevertheless, only common starlings formed larger flocks exceeding 300 individuals. Other species moved in smaller flocks, often consisting of a dozen or a few dozen individuals.

The collected data allow to predict that the designed wind farm should not have a significant adverse impact on the avifauna migrating across the investment area, especially the species migrating over long-distances.

Characteristics of species from Annex I of the Birds Directive.

Among the birds there are species of natural value that are rare or threatened with extinction on a national and global scale (Tab. 20). These include taxa of Community interest - included in Annex I of the Birds Directive as well as in the National Red Book and the Polish Red List.

In the past year 11 species of natural value have been shown to occur over the project area.

Table 20. Species listed in the Directive observed in the monitored area.

No.	English name	Latin name	Protection status	BD	RDBoA	RLTS
1	Eurasian bittern	*Botaurus stellaris*	PS	+	LC	LC
2	White stork	*Ciconia ciconia*	PS	+		
3	Whooper swan	*Cygnus cygnus*	PS	+		
4	Red kite	*Milvus milvus*	PS	+	NT	NT
5	White-tailed eagle	*Haliaeetus albicilla*	PS	+	LC	LC
6	Western marsh harrier	*Circus aeruginosus*	PS	+		
7	Hen harrier	*Circus cyaneus*	PS	+	VU	VU
8	Common crane	*Grus grus*	PS	+		
9	European golden plover	*Pluvialis apricaria*	PS	+	EXP	EX
10	Black woodpecker	*Dryocopus martius*	PS	+		
11	Red-backed shrike	*Lanius collurio*	PS	+		

Eurasian bittern – likely breeding in a mid-field pond, southeast of Sosnowo (EA-B). Voices of a single individual were recorded twice. Afterwards, no calls were heard in the area. It is a secretive bird, reluctant to move around. Flies at low altitudes, within zone 1. There are no reports of collisions of the Eurasian bittern with wind turbines in the literature. No risk of adverse impact of the investment is forecasted.

White stork – observed sporadically, mainly in the northern part of the monitored area during the breeding season (areas A and B). It was recorded 12 times in total. Its nesting was observed in the vicinity of the wind farm, in the villages of Lubanowo and Sosnowo, among others. Reported mainly from wet meadows in the Tywa River Valley. No fall stork gatherings were observed in the monitored area. There are no reports of collisions of white storks with wind turbines in the national literature. No significant risk of adverse impact of the investment is forecasted.

Whooper swan – observed in winter and during spring and fall migrations. Most numerous in the winter period in EA-B (101 individuals). It flew rarely, in small flocks mainly over EA-A and B. Small flocks were observed roosting in the fields in the vicinity of the Tywa River Valley. The number of individuals found in the monitored area, a total of 207 during 3 phenological periods, was low compared to other regions of Poland during the migration period. In the areas of the Szczecin Lagoon and Warta River Mouth up to a few thousand of these birds were observed during migration. In the winter period over 3 thousand individuals were recorded inland and 4 thousand in the Szczecin Lagoon area (Tomiałojć and Stawarczyk 2003). An upward trend in the occurrence of this swan is also confirmed by the results of the Whooper Swan Monitoring (MLK - Pol. Monitoring Łabędzia Krzykliwego).
There are no reports of collisions of this species with wind turbines in the literature. This swan is often observed roosting in the vicinity of wind turbines. No nesting was observed in the area of the designed wind farm. No risk of adverse impact of the investment is forecasted.

Red kite – observed only during breeding, breeding dispersal and fall migration periods. It flew over the monitored area from forest complexes located in the vicinity. Usually it penetrated the northern and north-western part of the monitored area (EA-A and B). Appeared one at a time, a total of 13 flights were recorded. It was not found breeding within the monitored area and its vicinity. There are no reports of collisions of this species with wind turbines in the literature, despite its frequent observations from the wind farms operating in Poland. No significant risk of adverse impact of the investment is forecasted.

White-tailed eagle – observed throughout the entire area, primarily in areas A and C of the monitored site. However, its counts varied spatially. It was rarely observed in the northern and eastern parts of the monitored area. Most frequently observed in the southern part of the EA-C in the vicinity of Swobnica village, where the nest protection zone is located. It is situated several hundred meters from the nearest planned wind turbine (Fig. 13). In total, flights of 100 individuals were observed throughout the year of the study, with the largest number during the breeding season – half of the observations (51 flights). The number of flights was higher than in previous years, and was related to the investor increasing the frequency of observations to 5 during the breeding months. Some of the observations were of the same individuals, as they moved over forest complexes often circling, or of young individuals that landed and took to the air. Single birds were observed most often, pairs less frequently. During the breeding season young birds were spotted sporadically. Most flights were within the area of agricultural crops near the forest complex where the nest is located. This is the zone of departure and access of birds to the nest. Adult individuals moved, as in previous years, in two main directions: westwards and south-westwards towards fish ponds and lakes near Grzybno and Żelechów and further towards Trzcińsko-Zdrój; and eastwards towards Lake Długie and the Tywa River Valley (Fig. 13). They were also observed flying and stopping over in fields or on trees in an area of up to about 0.4 km from the forest wall. Mainly young birds learning to fly were observed in this strip.
The appearance of the white-tailed eagle at the edges of the wind turbine area near Swobnica may cause conflict situations in the future, because there is a likelihood of their collision with the blades of the turbine. However, it seems that such an event will not be frequent. Nevertheless, it should be taken into account. While flights westwards will not cause the white-tailed eagles to collide with the wind turbines, the routes of flights towards Lake Długie run close to the proposed location of two wind turbines (no. 39 and 41 – currently designated as 44), the closest of which will be located approximately 1.2 km from the nest (approximately 630 m from the protection zone). In order to minimize potential collisions, I recommend abandoning the plans or moving both above-mentioned wind turbines to another location, e.g. eastwards towards Swobnica or to the road from Baniewice to Swobnica. These are agricultural areas where flights of white-tailed eagles were occasional. If this is not possible, I recommend temporarily shutting down the above-mentioned wind turbines during the breeding and breeding dispersal period from April to August from dawn to dusk, i.e. during the period of increased activity of white-tailed eagles. Additionally, new wind turbines should not be located in the future between those already designed, especially in the flight corridor between the nest and Lake Długie. I also recommend continuing to conduct white-tailed eagle observations until the wind turbines are constructed and in subsequent years after their commissioning.

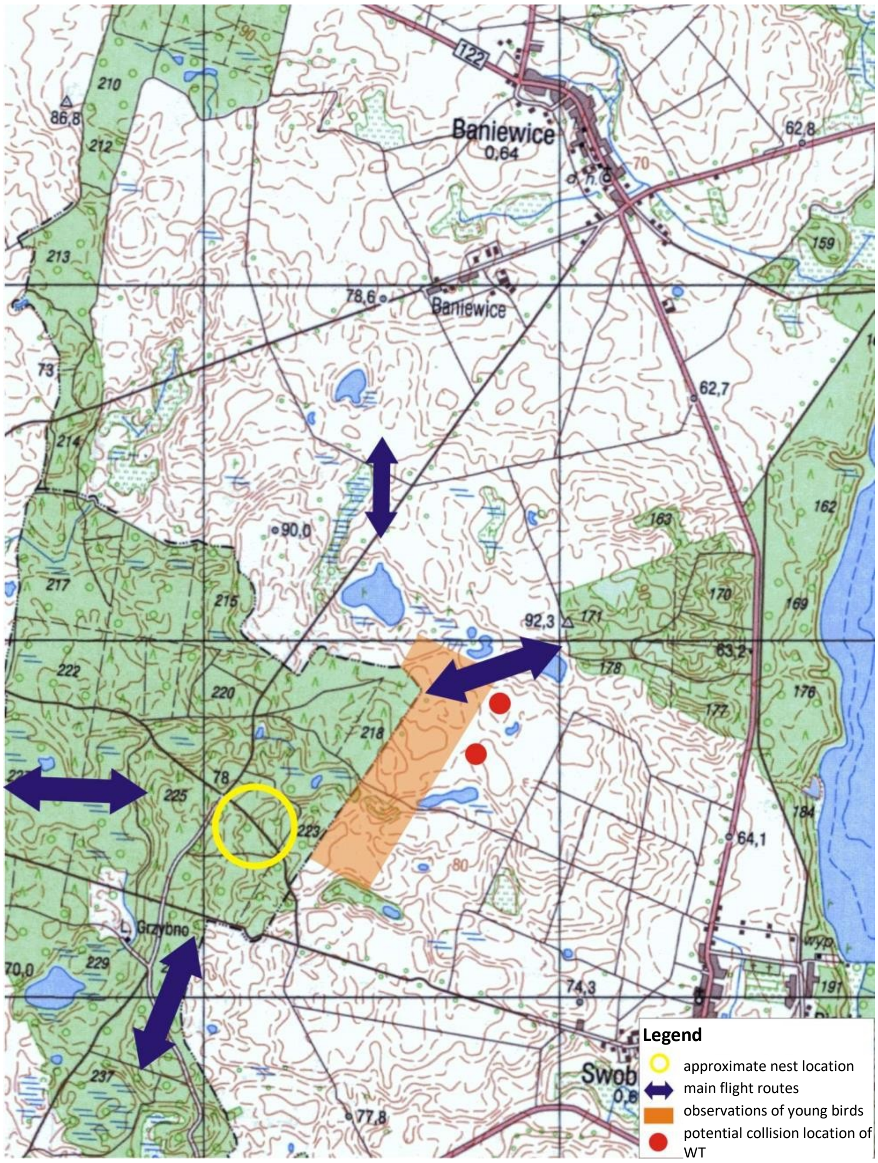


Figure 13. Main flight routes of the white-tailed eagle in the vicinity of the 2 closest wind turbine locations.

On a European scale, the white-tailed eagle is ranked 14th in terms of collisions with wind turbines (Dürr 2014). Its collisions have been reported from 8 European countries, the most numerous being in Germany, Norway and Sweden. National literature mentions 4 collisions at 3 wind farms. On a national scale, such number is small. However, it is probably lowered, as not all cases are published in scientific periodicals. According to data from Regional Directorate for Environmental Protection (RDOŚ - Pol. Regionalna Dyrekcja Ochrony Środowiska) in Szczecin, from 1992 to March 2017, 274 injured or dead white-tailed eagles were found in West Pomeranian Voivodeship, of which only 25 (9.1%) events were classified as collisions with wind turbines. The estimated number of the white-tailed eagle at the beginning of the second decade of the 21st century was up to 1,400 pairs nationwide (Eagle Conservation Committee (KOO - Pol. Komitet Chrony Orłów) 2010 data). A large part of the population is found in Western Pomerania. A small number of collisions despite more than 200 wind turbines operating in the region, most of them on the Baltic coast, in feeding and migration areas of the white-tailed eagle, indirectly proves its ability to avoid operating wind turbines. However, working turbines may threaten mainly young individuals in the period of learning to fly.

In the Swobnica area, the white-tailed eagles flew in the vicinity of the designed wind turbines, but most flights were far from the proposed location of the wind turbine.

Based on the collected data, it is possible to predict adverse impact of the investment on the white-tailed eagle, but it is difficult to determine it precisely. Therefore, measures have been proposed above to minimize the threat to the white-tailed eagle posed by the discussed project.

Western marsh harrier – observed throughout the monitoring area, in the spring migration and breeding and breeding dispersal period (EA-A-D). It appeared alone or less frequently in pairs. A total of 99 flights were reported throughout the year, of which only 1 was in zone 1. It was not found nesting within the investment area. Nested in the vicinity, in the Tywa River Valley and in a mid-field pond west of Kunów. National literature reports collisions of 2 individuals with wind turbines. In Europe its collisions have been recorded in 4 countries (Dürr 2014). Due to the distance of the breeding site from the wind turbine and movement in zone 1, it can be predicted that the investment will have no adverse impact on this harrier.

Hen harrier – observed incidentally, only 3 flights of single individuals during spring and fall migration in the EA-A and B. No collisions between this harrier and wind turbines have been reported in the national literature. In Europe, its collisions have been reported in 3 countries (Dürr 2014), for a total of 5 individuals. Due to no breeding in the vicinity of the wind farm and sporadic use of the investment area during migration, it can be predicted that the investment will have no adverse impact on this harrier.

Common crane – observed in most of the monitored area. It was also present at a considerable distance, flocks were observed flying in the vicinity of the Odra River Valley and cranes were heard calling from the neighboring areas, e.g. south and south-west of the EA-C border. It appeared as one of the first birds already in the beginning of March. Most numerously found during fall migration. Most often observed were feeding single individuals or pairs. Small flocks of 4 to 42 individuals were observed flying during migration. The literature mentions collisions of common cranes with wind turbines in 4 European countries, including 1 collision in Poland. No nesting was observed in the monitored area. No significant risk of adverse impact of the investment is forecasted.

European golden plover – observed only in the fall migration period in elementary areas A and B. A total of 27 individuals were recorded, in two flocks. It traveled within zone 1. No risk of adverse impact of the investment is forecasted.

Black woodpecker – observed during the breeding season and breeding dispersal in EA-C. A total of 2 individuals were recorded at the forest edge. Probably breeding in the adjacent forest complex, but no nest was found. No risk of adverse impact of the investment is forecasted.

Red-backed shrike – observed during the breeding season and breeding dispersal period in most of the monitored area (EA-A-C) where mid-field tree and shrub buffers were present. It usually moved one at a time at low altitudes, below the lower range of wind turbine blades. It is a breeding species in area covered by this paper and its vicinity. A total of 10 individuals were recorded. In the literature there are no reports of collisions of the red-backed shrike with wind turbines. No risk of adverse impact of the investment is forecasted.

The obtained data allow to predict that the designed wind farm investment will not cause significant threat to local and regional populations of key species.

Bats.

The monitoring activities were also focused on bats, mammals that may be affected by operating wind turbines. The adverse impact for these animals is primarily the possibility of flying bats colliding with the rotor blades and experiencing barotrauma due to pressure changes when flying between the blades.

Six species of bats were identified during the course of the works (Tab. 21). All of them are under legal protection. None are of Community interest and are not listed in Annex II of the Habitats Directive.

Table 21. Bat species found in the monitored area.

No.	English name	Latin name	Protection status	HD	PRDBoA	PRLTS	IUCN
1	Daubenton's bat	*Myotis daubentonii*	PS				LR: LC
2	Serotine bat	*Eptesicus serotinus*	PS				LR: LC
3	Common pipistrelle	*Pipistrellus pipistrellus*	PS				LR: LC
4	Soprano pipistrelle	*Pipistrellus pygmaeus*	PS				LR: LC
5	Nathusius's pipistrelle	*Pipistrellus nathusii*	PS				
6	Common noctule	*Nyctalus noctula*	PS				LR: LC

Legend: HD — Habitats Directive Annex II; PRDBoA — Polish Red Data Book of Animals; PRLTS — Polish Red List of Threatened Species; IUCN — International Union for Conservation of Nature; PS — protected species; LR: LC — lower risk: least concern.

Spotted flying bats were also recorded during the work, but being out of range of the detectors they were not marked and are listed in the tables as not identified. Using a night vision device, an attempt was made to determine the approximate use of the space above the detector range. One should bear in mind that this is an estimation method because not all bats can be spotted. However, the data obtained provide some approximation of space utilization at higher levels within the range of the rotor blades. This estimation was done to find out the approximate use of the space above the detector range. The practical range of the detectors is small. Most bats can be detected up to about 30 - 50 m from the detector. Some species such as the common noctule or the serotine bat emit signals at longer distances, even up to about 100 – 150 m. It is connected with their flight in open spaces, where there are no landmarks. Some species can only be detected at short distance of up to 5 – 10 m (horseshoe bats).

In the course of the works, the average bat activity index was determined based on the collected data, as a unit of activity per hour. The data collected allow us to approximate the value of areas to bats and the extent to which bats use the space above the monitored area.

Table 22a. Average activity indices of species on transects and points in period 1.

Species	Transect	Points	Average
Daubenton's bat	0.00	0.00	0.00
Serotine bat	0.00	0.00	0.00
Common pipistrelle	0.00	0.00	0.00
Soprano pipistrelle	0.00	0.00	0.00
Nathusius's pipistrelle	0.40	0.00	0.20
Common noctule	0.00	0.00	0.00
Not identified	0.40	0.00	0.20
Overall average	0.11	0.00	0.06

Table 22b. Average activity indices of species on transects and points in period 2.

Species	Transect	Points	Average
Daubenton's bat	0.53	0.00	0.27
Serotine bat	1.27	0.16	0.71

Common pipistrelle	0.80	0.00	0.40
Soprano pipistrelle	0.60	0.00	0.30
Nathusius's pipistrelle	2.40	0.08	1.24
Common noctule	0.40	0.16	0.28
Not identified	0.80	0.08	0.44
Overall average	0.97	0.07	0.52

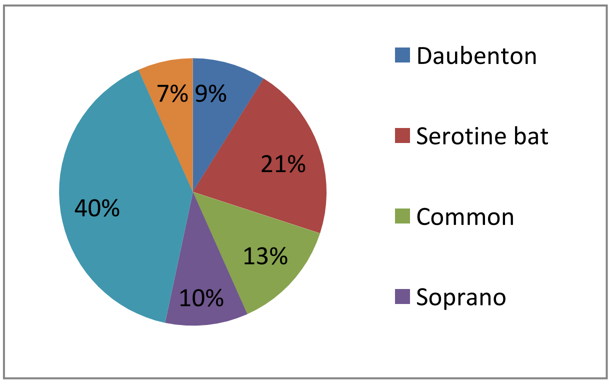


Figure 14a. The share of individual species on transects in period 2.

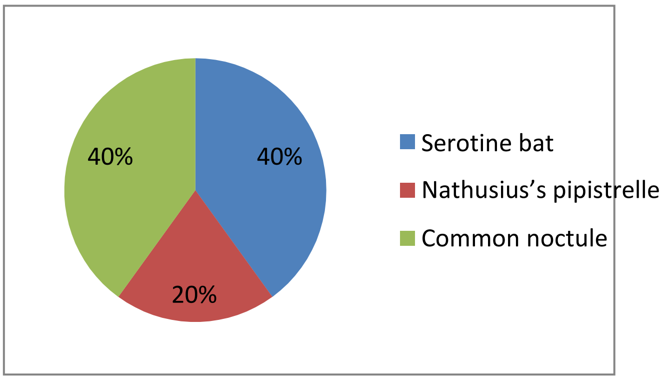


Figure 14b. The share of individual species on transects in period 2.

Table 22c. Average activity indices of species on transects and points in period 3.

Species	Transect	Points	Average
Daubenton's bat	1.40	0.03	0.72
Serotine bat	1.60	0.36	0.98
Common pipistrelle	2.20	0.00	1.10
Soprano pipistrelle	0.90	0.00	0.45
Nathusius's pipistrelle	7.20	0.12	3.66
Common noctule	2.10	0.78	1.44
Not identified	0.80	0.12	0.46
Overall average	2.31	0.20	1.26

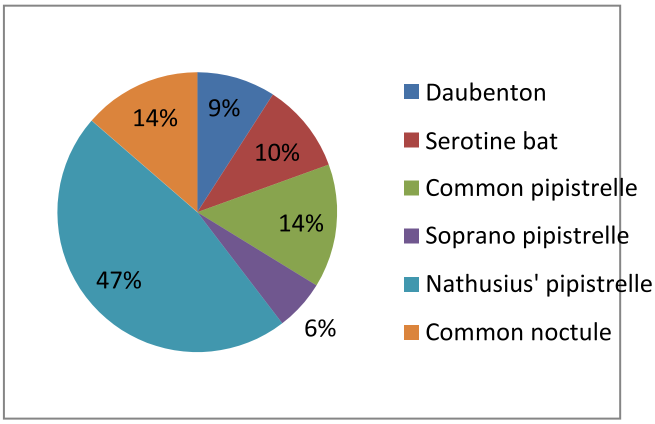


Figure 15a. The share of individual species on transects in period 3.

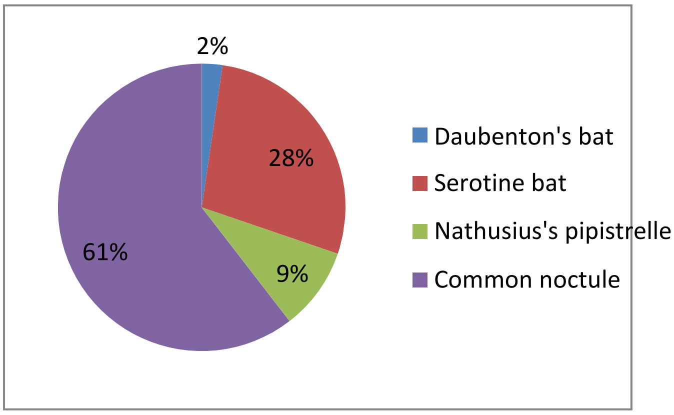


Figure 15b. The share of individual species on transects in period 3.

Table 22d. Average activity indices of species on transects and points in period 4.

Species	Transect	Points	Average
Daubenton's bat	2.65	0.05	1.35
Serotine bat	1.14	0.14	0.64
Common pipistrelle	2.02	0.00	1.01
Soprano pipistrelle	0.76	0.00	0.38
Nathusius’s pipistrelle	4.04	0.03	2.04
Common noctule	1.45	0.31	0.88
Brown long-eared bat	0.00	0.00	0.00
Not identified	0.69	0.02	0.36
Overall average	1.82	0.08	0.95

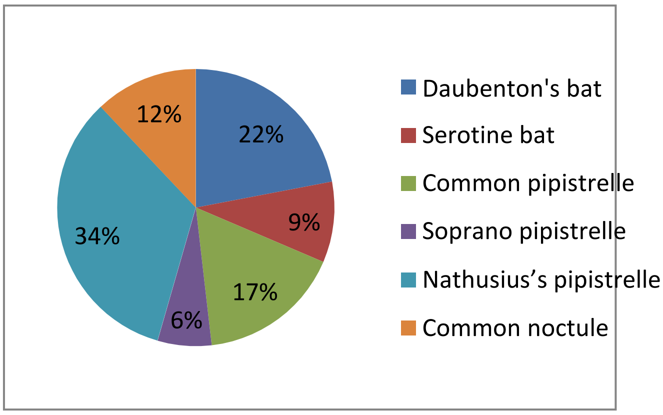


Figure 16a. The share of individual species on transects in period 4.

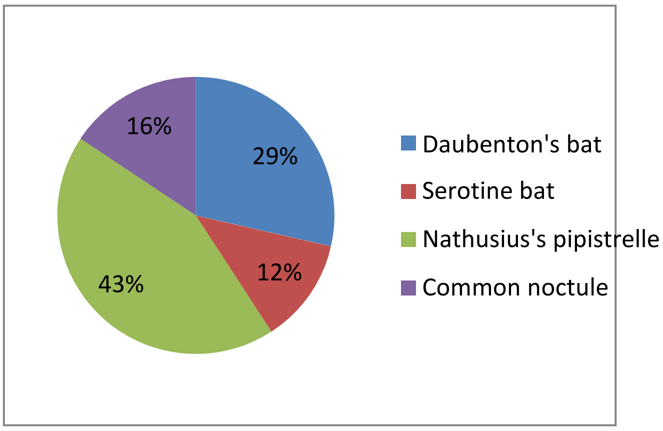


Figure 16b. The share of individual species on transects in period 4.

Table 22e. Average activity indices of species on transects and points in period 5.

Species	Transect	Points	Average
Daubenton's bat	0.76	0.03	0.40
Serotine bat	0.69	0.24	0.47
Common pipistrelle	0.88	0.00	0.44
Soprano pipistrelle	0.76	0.00	0.38
Nathusius’s pipistrelle	1.52	0.24	0.88
Common noctule	1.14	0.58	0.86
Not identified	0.25	0.07	0.16
Overall average	0.86	0.17	0.51

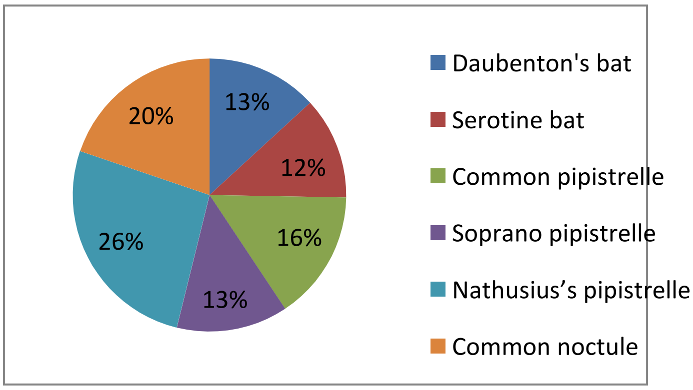


Figure 17a. The share of individual species on transects in period 5.

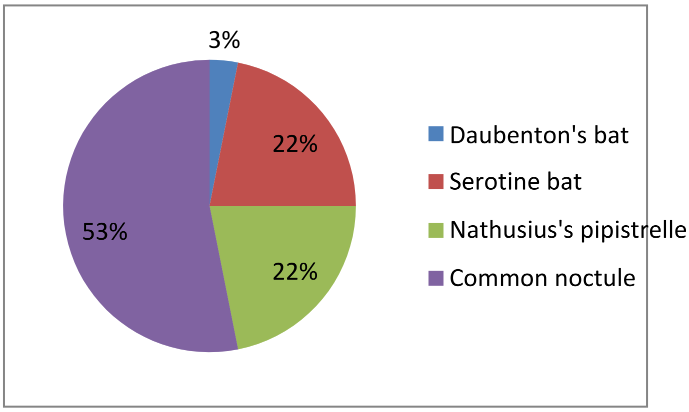


Figure 17b. The share of individual species on transects in period 5.

No bat activity was observed in period 6.

The values of the averaged activity indices varied depending on the period of bat activity and physiography. The highest indices were recorded during the periods of highest bat activity, i.e. during the formation of breeding colonies, disintegration of these colonies and dispersal of bats (periods 3-5). The highest indices were obtained in periods 3 and 4 on transects, for the Nathusius' pipistrelle, Daubenton's bat and common pipistrelle. Their highest indices reached values of respectively: 7.20, 2.65 and 2.20. The indices of the remaining taxa did not exceed the value of 2.10. The lowest values occurred in period 1, the period of awakening from hibernation and the beginning of spring migration. No bat activity was recorded during period 6 – end of fall migration and beginning of hibernation.

Significantly lower values of the indices were characteristic for listening points. The highest value of the indices was recorded in period 5 for the common noctule – 0.78. Only 4 species were recorded at the points (Tab. 22e). These were species that fly into open areas of agricultural crops or hunt near water reservoirs.

This spatial distribution of activity was probably related to the habitat preferences of the bats. They moved mainly along linear landscape structures - roadside trees, forest complexes, watercourses or around buildings. The vast majority of the monitored area consisted of agricultural crops without ponds and mid-field woodlots. In the turbine location area, for the most part, there were no mid-field ponds or larger mid-field woodlots that would increase habitat diversity and thus provide new feeding sites for bats. There were a small number of mid-field ponds and watercourses in areas adjacent to the turbine location area. This caused species to group in certain areas, mainly outside the turbine location, and hence the low value of the average activity indices. Bats were found mainly near buildings, roadside alleys, forest complexes and the Tywa River Valley. These physiographic structures provided flight routes and feeding habitats. Hence, the preponderance of signals came from areas outside the wind turbine location. As shown in tables ..., only occasional or no flights were recorded at listening points located in open areas of agricultural crops.

The collected data indicate that the planned location of the wind turbine in the agricultural crop area will not have an adverse impact on bat populations.

Pipistrelles and Daubenton's bats were recorded mainly in the vicinity of human settlements and rows of roadside trees. The common noctule and serotine bat were also registered in open areas in the vicinity of forest complexes and roadside trees. This is probably the reason for the higher number of the common noctule and serotine bat flights at the listening points located in the open spaces of arable land, where they flew in from the trees and forests adjacent to the monitored area.

Based on the monitoring data, biology of the species and night-vision observations, the approximate use of the open field areas - wind turbine locations - can be determined. Most flights were over the area at low altitudes of up to about 2 – 15 m. Night-vision observations of the area of the planned wind turbine location showed few flights up to about 30 m above ground level. No bat flights were recorded above this altitude. These values may be higher because not all flights can be observed using night vision devices.

The Daubenton's bat was observed mainly in EA-A, B and C, where there were a few ponds and remnants of a drainage system. It moves mainly in the vicinity of buildings of nearby villages, in the Tywa River Valley and along rows of trees. This species also fed by the water and in its immediate vicinity. Its flights were at the altitude of about 12-15 m. It is one of the most common species. Prefers areas with access to water reservoirs, and such areas are far from the designed wind turbine location.

The serotine bat was observed mainly in the vicinity of trees, ponds and buildings of the nearby villages usually at an altitude of 2 - 10 m. It was recorded throughout the entire monitored area, including the village-field ecotone in the area of the planned investment. This species was observed feeding around concentrations of trees along field roads and roadside alleys. It often hunted near human settlements and on roads passing through villages. It is a synanthropic species.

Pipistrelles are one of the more common bat species and were the most numerous one in the monitored area. They were recorded in all elementary areas. These bars prefer anthropogenic areas, often feed in villages or along woodlots and by water reservoirs. They were present throughout the monitored area. Fed at low altitudes up to about 20 m. The Nathusius' pipistrelle obtained the highest index values. Unlike the common and soprano pipistrelle – the Nathusius' pipistrelle prefers wooded areas, does not avoid woodlands, and feeds near water reservoirs. It is significantly less synanthropic than the previous two species. Pipistrelles avoid open spaces, which helps to reduce the potential for collisions with a wind turbine, especially since the turbines will be located away from woodlots.

The common noctule was recorded throughout the entire monitored area. It appeared frequently both on transects and at listening posts. It was the most numerous species at the listening points. It moved mainly along ecotones of forests and fields, and along roadside trees. It was the most frequently observed bat in the area of open agroecosystems, where it dominated together with the serotine bat.

No large breeding colonies (>20 individuals) or hibernation sites (>20 individuals) of bats were found in the monitored area or within 1 km from it. No significant bat migration routes were identified above the monitored area. The investment area is covered with agricultural crops, while in the vicinity there are forest complexes and settlements. No suitable habitats for wintering or breeding colonies were found. There are no caves, adits, underground structures etc. No dugouts or open wells in use. No wintering was observed in road bridge structures. No sites convenient for wintering and forming breeding colonies were found in the forest areas. There is no concentration of old growths of trees, practically the entire forest area is covered by industrial forest crops of age class not exceeding 100 years. No large hollows suitable for use during the breeding season were found there.

Alleys and rows of trees along district and communal roads as well as areas with ponds and mid-field lakes in the Tywa River Valley should be considered valuable for bats.

An analysis of bat flights and areas of their highest activity does not suggest that any fragments of the area should be excluded from the investment. The areas of the highest bat activity include village buildings, roadside trees and forest complexes. They are far from the open agroecosystem areas, where the wind turbines will be located. Considering the very average indices of activity at the listening points, it can be expected that there will be no adverse impact of the turbine on bats.

The obtained data allow to predict that the designed investment will not cause significant threat to local and regional populations of bats. It will also not have an adverse impact on their migration routes. The project in question will not cause any adverse impact on breeding colonies and hibernation sites.

Summary and conclusions of fauna observations.

This section presents findings from the pre-investment monitoring carried out in 2018. One should bear in mind that the presented conclusions are certain assumptions and may change in the future as more data is collected. The data obtained present a slice of the reality investigated, and the assumptions and conclusions made may evolve in the future.

- During the observation 111 animal species were found and analyzed, including 105 birds and 6 bats.
- 105 bird species were found, of which: 88 were under strict protection, 7 were partially protected, 10 were unprotected game species, and 11 species were of Community interest and are listed on Annex I of the Birds Directive.

- At least 34 bird species were observed during the winter period, including 2 species listed in the Birds Directive. In this period, the vast majority of birds moved at low altitudes up to 50 m. They accounted for 59.3% of total flights.
- During the spring migration period there were 58 bird species observed, including 5 species of Community Interest. Spring migration of birds took place mainly at low altitudes in zone 1 (74.7%), i.e. below the lower range of the rotor blades.
- During the breeding season 84 bird species were recorded, including 8 from Annex 1 of the Birds Directive. They predominantly flew in zone 1 (89.2%), i.e. below the reach of the turbine rotor blades.
- During the fall migration period a total of 63 bird species were found. Of these, 6 were species of Community Interest. Again, most birds moved in zone 1 (88.7%), which is below the range of the rotor blades.
- Long-distance migrants traveled at high altitude, even up to about 250 meters, which is above the upper range of the wind turbine rotor blades. Some migrants flew within the wind turbine operation zone. This mainly concerned geese, accipitriformes, northern lapwings, and common cranes, which sometimes landed within certain elementary areas.
- Among long-distance migrants the majority were geese, swans, common cranes and northern lapwings.
- Small birds - mostly passerines - usually moved at low altitudes below 50 m.
- In terms of numbers, passerines dominated in all phenological periods. Less abundant were charadriiformes and anseriformes. Woodpeckers and cuckoos were the least abundant.
- Horizontal bird migration routes are consistent with general national trends and local physiography. In fall, the main direction is western and south-western. In spring it is the opposite - northern and north-eastern.
- There were 11 bird species listed in Annex I of the Birds Directive: the Eurasian bittern, white stork, whooper swan, red kite, white-tailed eagle, western marsh harrier, hen harrier, common crane, European golden plover, black woodpecker and red-backed shrike.
- No significant threats to individual key species associated with the planned wind farm were identified.
- Potential conflict situations may occur between the white-tailed eagle and the wind turbines located in the southern part of the EA-C by the village of Swobnica. A protection zone is located nearby. The birds were observed flying in the vicinity of the nest, roosting in the area and flying to feeding grounds. There is a threat of collision between the white-tailed eagle and the turbine during its migration to Lake Długie. It is recommended to conduct permanent monitoring of the area until the turbine is built, and then at least 5 years of post-investment monitoring. A mitigation and rescue action plan should be developed prior to beginning construction.
- It is recommended to consider decommissioning or relocation of the 2 closest wind turbines eastward towards Swobnica or periodic shutdown of the turbines no. 5 to 8 during the day.
- The works revealed 6 common bat species present in the monitored area: the Daubenton's bat, serotine bat, common, soprano and Nathusius' pipistrelles, as well as the common noctule. None are of Community interest.
- The monitored area has low values of average activity indices on the national scale. The highest values of indices were recorded near rows of roadside trees, watercourses and settlements.
- Very low index values were shown at listening points, in agroecosystem areas and at the location of wind turbines.
- Bats were flying into the monitored area at a short distance, or flying between clusters of trees. All species moved at low altitudes, below the range of rotor blades.

- There were no regionally significant migration routes of bats through the area of the designed wind farm. No significant hibernation sites or breeding or summer colonies were found.
- The data collected so far allow to predict that the planned investment should not have a significant adverse impact on the avifauna and chiropterofauna.
- No habitats or plant and animal species listed in the Habitats Directive were found in the area of the proposed wind farm.
- Three species from the Birds Directive – the European bittern, western marsh harrier and red-backed shrike – were found in the monitored area. The white stork and the white-tailed eagle nest in the vicinity. Other species were observed over the investment area less frequently or occasionally in small numbers.
- The collected data indicate that the proposed wind farm will not have a significant adverse impact on the integrity and continuity of the Natura 2000 network.
- Based on the collected data, it can be predicted that the proposed Banie III wind farm should not have a significant adverse impact on the avifauna and chiropterofauna of the area under monitoring.
- The compiled study indicates that providing the proposed mitigation measures are observed, the investment area is suitable for the construction of the Banie III wind farm.

6.3 3. Diversity of avifauna in the years 2011 – 2018.

During the work 114 animal species were found and analyzed, including 107 birds and 7 bats. Species that may be directly or indirectly affected by wind farm during migration were used to determine the impact of the wind turbines on migration. Animal species from other systematic groups were also observed to detect species listed in Annex II of the Habitats Directive, but were not found in the wind turbine location area.

Table 23. Inventory of bird species found in the course of pre-investment monitoring.

No.	English name	Latin name	Protection status	BD	RDBoA	RLTS
1	Mute swan	*Cygnus olor*	PS			
2	Whooper swan	*Cygnus cygnus*	PS	+		
3	Bean goose	*Anser fabalis*	GS			
4	Greater white-fronted goose	*Anser albifrons*	GS			
5	Greylag goose	*Anser anser*	GS			
6	Gadwall	*Anas strepera*	PS			
7	Eurasian teal	*Anas crecca*	GS			
8	Mallard	*Anas platyrhynchos*	GS			
9	Common pochard	*Aythya ferina*	GS			
10	Common goldeneye	*Bucephala clangula*	PS			
11	Grey partridge	*Perdix perdix*	GS			
12	Common pheasant	*Phasianus colchicus*	GS			
13	Little grebe	*Tachybaptus ruficollis*	PS			
14	Great crested grebe	*Podiceps cristatus*	PS			
15	Great cormorant	*Phalacrocorax carbo*	PPS			
16	Eurasian bittern	*Botaurus stellaris*	PS	+	LC	LC
17	Grey heron	*Ardea cinerea*	PPS			
18	White stork	*Ciconia ciconia*	PS	+		
19	Red kite	*Milvus milvus*	PS	+	NT	NT

20	White-tailed eagle	*Haliaeetus albicilla*	PS	+	LC	LC
21	Western marsh harrier	*Circus aeruginosus*	PS	+		
22	Hen harrier	*Circus cyaneus*	PS	+	VU	VU
23	Northern goshawk	*Accipiter gentilis*	PS			
24	Eurasian sparrowhawk	*Accipiter nisus*	PS			
25	Common buzzard	*Buteo buteo*	PS			
26	Rough-legged buzzard	*Buteo lagopus*	PS			
27	Lesser spotted eagle	*Aquila pomarina*	PS	+	LC	LC
28	Common kestrel	*Falco tinnunculus*	PS			
29	Eurasian hobby	*Falco subbuteo*	PS			
30	Corncrake	*Crex crex*	PS	+		DD
31	Eurasian coot	*Fulica atra*	GS			
32	Common crane	*Grus grus*	PS	+		
33	Little ringed plover	*Charadrius dubius*	PS			
34	European golden plover	*Pluvialis apricaria*	PS	+	EXP	EX
35	Grey plover	*Pluvialis squatarola*	PS			
36	Northern lapwing	*Vanellus vanellus*	PS			
37	Common snipe	*Gallinago gallinago*	PS			
38	Eurasian curlew	*Numenius arquata*	PS		VU	VU
39	Green sandpiper	*Tringa ochropus*	PS			
40	Black-headed gull	*Larus ridibundus*	PS			
41	European herring gull	*Larus argentatus*	PPS			
42	Common tern	*Sterna hirundo*	PS	+		
43	Stock dove	*Columba oenas*	PS			
44	Common wood pigeon	*Columba palumbus*	GS			
45	Eurasian collared dove	*Streptopelia decaocto*	PS			
46	Common cuckoo	*Cuculus canorus*	PS			
47	Tawny owl	*Strix aluco*	PS			
48	Common swift	*Apus apus*	PS			
49	European green woodpecker	*Picus viridis*	PS			
50	Black woodpecker	*Dryocopus martius*	PS	+		
51	Great spotted woodpecker	*Dendrocopos major*	PS			
52	Lesser spotted woodpecker	*Dendrocopos minor*	PS			
53	Eurasian skylark	*Alauda arvensis*	PS			
54	Barn swallow	*Hirundo rustica*	PS			
55	Common house martin	*Delichon urbicum*	PS			
56	Tree pipit	*Anthus trivialis*	PS			
57	Meadow pipit	*Anthus pratensis*	PS			
58	Western yellow wagtail	*Motacilla flava*	PS			
59	White wagtail	*Motacilla alba*	PS			
60	Bohemian waxwing	*Bombycilla garrulus*	PS			
61	Eurasian wren	*Troglodytes troglodytes*	PS			
62	European robin	*Erithacus rubecula*	PS			
63	Common nightingale	*Luscinia megarhynchos*	PS			
64	Black redstart	*Phoenicurus ochruros*	PS			
65	Whinchat	*Saxicola rubetra*	PS			
66	European stonechat	*Saxicola rubicola*	PS			
67	Common blackbird	*Turdus merula*	PS			
68	Fieldfare	*Turdus pilaris*	PS			
69	Song thrush	*Turdus philomelos*	PS			

70	River warbler	*Locustella fluviatilis*	PS			
71	Marsh warbler	*Acrocephalus palustris*	PS			
72	Great reed warbler	*Acrocephalus arundinaceus*	PS			
73	Lesser whitethroat	*Sylvia curruca*	PS			
74	Common whitethroat	*Sylvia communis*	PS			
75	Garden warbler	*Sylvia borin*	PS			
76	Common chiffchaff	*Phylloscopus collybita*	PS			
77	Willow warbler	*Phylloscopus trochilus*	PS			
78	Goldcrest	*Regulus regulus*	PS			
79	Spotted flycatcher	*Muscicapa striata*	PS			
80	Marsh tit	*Poecile palustris*	PS			
81	Willow tit	*Poecile montanus*	PS			
82	Great tit	*Parus major*	PS			
83	Eurasian blue tit	*Cyanistes caeruleus*	PS			
84	Eurasian nuthatch	*Sitta europaea*	PS			
85	Eurasian treecreeper	*Certhia familiaris*	PS			
86	Short-toed treecreeper	*Certhia brachydactyla*	PS			
87	Eurasian golden oriole	*Oriolus oriolus*	PS			
88	Red-backed shrike	*Lanius collurio*	PS	+		
89	Great grey shrike	*Lanius excubitor*	PS			
90	Eurasian jay	*Garrulus glandarius*	PS			
91	Eurasian magpie	*Pica pica*	PPS			
92	Western jackdaw	*Corvus monedula*	PS			
93	Rook	*Corvus frugilegus*	PPS			
94	Hooded crow	*Corvus cornix*	PPS			
95	Common raven	*Corvus corax*	PPS			
96	Common starling	*Sturnus vulgaris*	PS			
97	House sparrow	*Passer domesticus*	PS			
98	Eurasian tree sparrow	*Passer montanus*	PS			
99	Common chaffinch	*Fringilla coelebs*	PS			
100	European greenfinch	*Carduelis chloris*	PS			
101	European goldfinch	*Carduelis carduelis*	PS			
102	Eurasian siskin	*Carduelis spinus*	PS			
103	Common linnet	*Carduelis cannabina*	PS			
104	Eurasian bullfinch	*Pyrrhula pyrrhula*	PS			
105	Yellowhammer	*Emberiza citrinella*	PS			
106	Common reed bunting	*Emberiza schoeniclus*	PS			
107	Corn bunting	*Emberiza calandra*	PS			

Legend: BD — Annex I of the Birds Directive; PS — protected species; PPS — partially protected species; GS — game species; "+" — present on the list of species or found in the area; RDBoA (Red Data Book of Animals) — EXP — extinct or probably extinct species, VU — vulnerable species; LC — low risk species; RLTS (Red List of Threatened Species) — EX — extinct species, VU — vulnerable species; NT — near–threatened species.

Of the 107 bird species found during pre-execution monitoring, 90 were under strict protection, 7 were partially protected, 10 were unprotected game species, and 14 species were of Community interest and are listed on Annex I of the Birds Directive (Tab. *[missing number in the original version – translator's note]*). The vast majority are under strict protection, a few are under partial protection, and some are game species (Tab. 1). Although most of the birds are protected by law, it should be noted that the vast majority of are cosmopolitan species, common, numerous or very numerous in the region and Western Pomerania.

Bird species diversity changed in successive years of observation (2011 – 2018). It was the highest in 2011 and the lowest in 2016 and 2017 (Fig. 18). It can be explained by natural processes responsible for fluctuations in the number of species in a particular area.

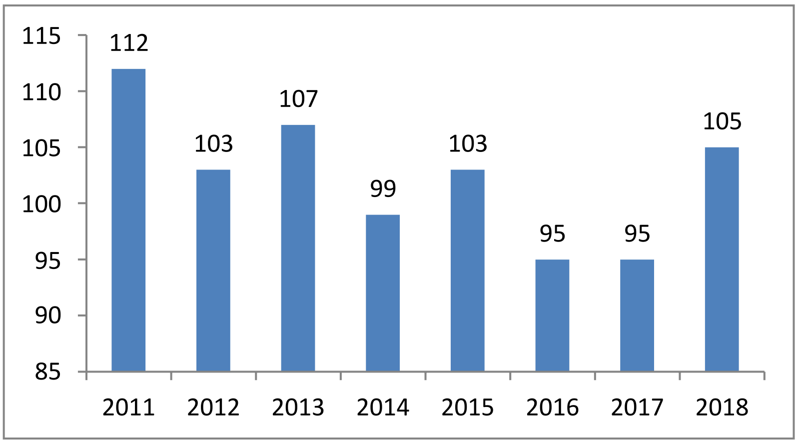


Figure 18. Species diversity in subsequent years.

This may have also been influenced by weather conditions to some extent. In the years 2011 – 2013, 2015 and 2018, winters in the monitoring area were mild, often with temperatures around 0^{o} or even slightly above. It dropped below zero for short periods. The snow cover was short-term and thin. In contrast, in 2014 and 2016, the winter period was characterized by a predominance of days with negative temperatures. The reduction in the number of taxa can be caused by, among others, the monotypization of agricultural crops and the increase of agroecosystem monocultures. Milder winter periods result in early commencement of migration and greater availability of breeding habitat, and this promotes increased species diversity.

Since the beginning of monitoring, as well as throughout the voivodeship, lowering of the groundwater level was observed. Associated with this is the gradual drying of mid-field ponds, the disappearance and reduction of their number. This results in reduced habitat diversity for animals. Particularly in the vicinity of Sosnowo and Swobnica, the number of mid-field ponds is decreasing or they are drying to varying degrees.

There is also a decrease in the amount of mid-field shrub buffers and tree buffers due to the increase of areas intended for cultivation. The mentioned processes affect the qualitative and quantitative composition of fauna, especially avifauna.

Within each phenological period, the number of species found also varied over the years of observation (Fig. 19). During the winter period, the number of species was similar in successive years, with the lowest number in 2016. During the spring migration period, there was little difference in the years 2011 – 2015, but in 2014 the number of species was significantly higher than in previous years and amounted to 69. During the breeding season and breeding dispersal, species diversity between subsequent years ranged from 66 to 89, with the lowest in 2013 and the highest in 2011. During the fall migration period, the number of species gradually increased in the years 2011 – 2015, remained at a similar level in the years 2015 – 2016, and increased in 2017. (Fig. 19).

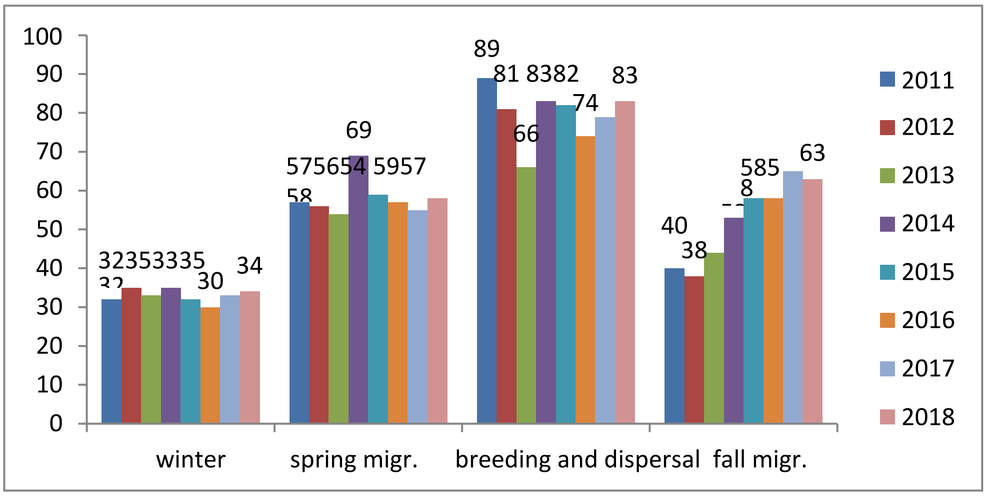


Figure 19. Species diversity by phenological periods.

The number of species listed in the Directive (Annex I of the BD), varied slightly from year to year (Fig. 20). The highest occurred in 2011 and 2016 – 12 species and the lowest in 2014 and 2017 – 8 species (Fig. 20). The differences were recorded for the following: Eurasian bittern (appeared in 2016 and 2018), hen harrier, lesser spotted eagle, corncrake, black woodpecker, and common tern – which appeared only in 2017.

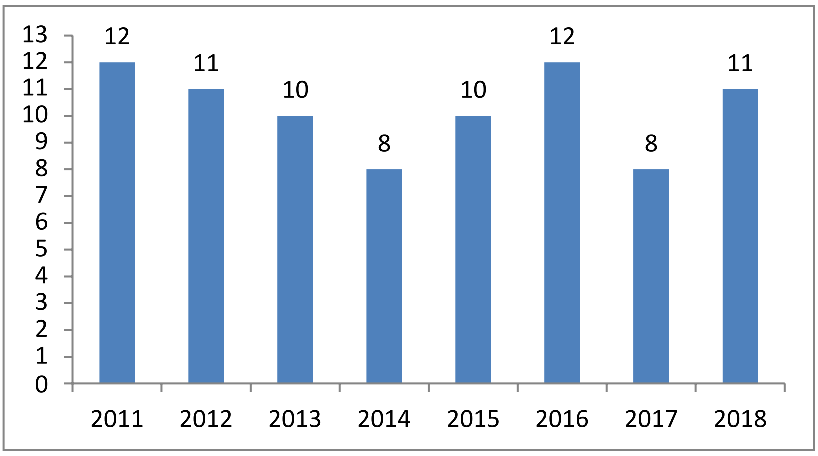


Figure 20. Number of species listed in the Directive in subsequent years.

Lesser spotted eagle appeared in 2011, 2012, and 2015. Corncrake appeared in 2011 and 2012. In 2015, contrary to previous years, the following were not observed: corncrake and black woodpecker (Tab. 24). It is interesting to note that one individual of the Eurasian bittern was found in 2016, but it did not breed. In 2017, the common tern appeared for the first time.

Table 24. The presence of species listed in the Directive by years.

No.	Name	2011	2012	2013	2014	2015	2016	2017	2018
1	Eurasian bittern						+		+
2	Whooper swan	+	+	+	+	+	+	+	+
3	White stork	+	+	+	+	+	+	+	+
4	Red kite	+	+	+	+	+	+	+	+
5	White-tailed eagle	+	+	+	+	+	+	+	+
6	Western marsh harrier	+	+	+	+	+	+	+	+
7	Hen harrier	+	+	+		+	+	+	+
8	Lesser spotted eagle	+	+			+	+		

9	Corncrake	+	+				+		
10	Common crane	+	+	+	+	+	+	+	+
11	European golden plover	+		+	+	+	+		+
12	Common tern							+	
13	Black woodpecker	+	+	+			+		+
14	Red-backed shrike	+	+	+	+	+	+	+	+

The Eurasian bittern, corncrake and common tern listed above should be considered sporadic for the monitored area. The lesser spotted eagle was observed at the northern boundary of the proposed wind farm during the breeding season and breeding dispersal. While the corncrake's voice was heard only once during the breeding season, which may mean that it was an accidental species and did not breed. The corncrake nests outside the monitoring area, voices coming from neighboring areas were recorded. The hen harrier and European golden plover occurred sporadically, only during migration. The common tern was observed adjacent to lakes on the EA-B in the Tywa River Valley.

During the migration period, flights in each zone were changeable (Fig. 20, 21).

During spring migration, the highest space utilization occurred in zone 1 (below the lower range of rotor blades) in all years and ranged from 70.2% in 2018 to 91% in 2013. (Fig. 21). In zone 3 (above the upper range of rotor blades) the fewest number of flights were observed in most years (2011-15). In the years: 2016 and 2018 the number of flights was higher than in zone 2. In zone 3, flights ranged from 15.1% in 2016 to 0% in 2014. In the potential collision zone (rotor blade range), flights were observed from 14% in 2011 to 7% in 2013.

During fall migration, as in the earlier spring period, the highest number of flights was observed in zone 1 in all years of observation. Space utilization ranged from 81% in 2011 to 92.5% in 2014. (Fig. 22). Lower, similar to the spring migration period, was recorded in zone 3, where flights ranged from 12% in 2011 to 1.5% in 2014. In zone 2, a potential collision zone, flights ranged from 6.8% in 2018 to 8.4% in 2017. (Fig. 22).

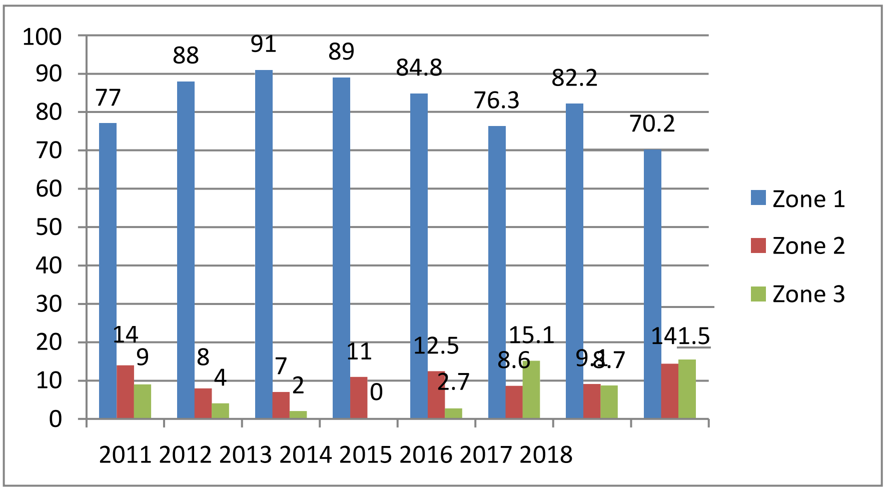


Figure 21. Space utilization during spring migration in three zones in consecutive years.

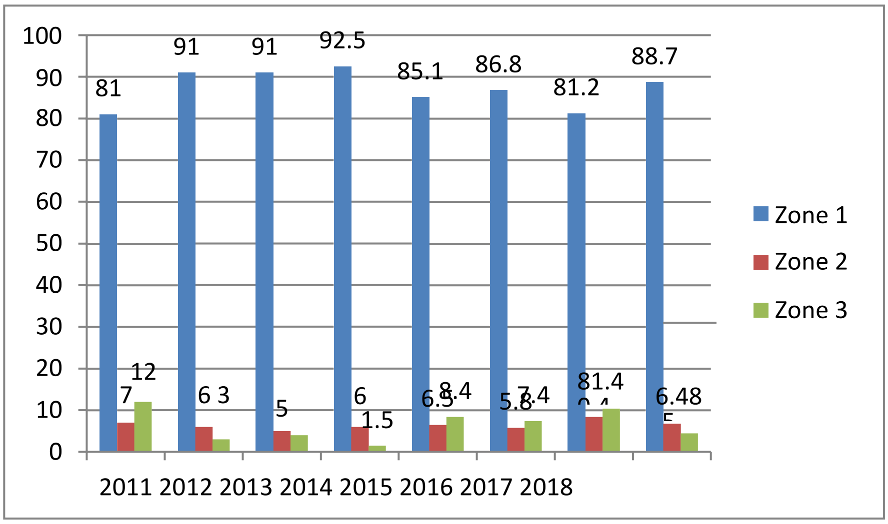


Figure 22. Space utilization during fall migration in three zones in consecutive years.

To sum up, it can be said that the wealth of species, abundance of species listed in the Directive and intensity of flights in each altitude zone were changeable in individual years. The changes shown were natural in nature, probably related to some degree to human activity. In each year, the area of wind turbines location was subject to strong human pressure associated with intensive agriculture. One of the main limiting factors could be weather conditions, which were variable over time. The years 2011 – 2013 and 2015 – 2018 showed higher winter temperatures and short periods of snow cover occurrence. Winter temperatures were lower in 2014. Changes in atmospheric conditions determine initiation of migration, its length and intensity. Due to the size of the area, and thus its susceptibility to changes in local weather conditions and the intensity of agricultural management, fluctuations in the wealth of species can be expected in subsequent years.

The presence of white-tailed eagle.

In the analyzed area, the white-tailed eagle was already recorded during the pre-investment natural monitoring carried out for the purpose of obtaining a decision on environmental conditions of the project in the years 2007-08. At that time, the presence of a white-tailed eagle nest was also recorded in the vicinity of wind turbines near Swobnica (EA-C).

During pre-execution monitoring conducted in subsequent years (2011-18), flights of mainly adult and occasionally young individuals were observed.

Based on observations of adult and young individuals, nest settlement was indirectly confirmed in most years of observation. Due to protection zones around the nest, the forest area in the immediate vicinity of the nest was not penetrated.

In particular years, the number of individuals recorded varied depending on elementary area (A-D), weather conditions, and breeding success. In 2017, the number of observations increased due to an increase in the number of observations during the breeding season at the request of the investor, but the average number of individuals per observation (average/observation) did not increase significantly (Tab. 26).

The number of individuals observed varied by elementary area (EA). In areas, in the vicinity of which there are no white-tailed eagle nests, the number of flights was low or in some seasons did not occur at all (Tab. *[missing number in the original version – translator's note]*). This applies to areas A, B, and D, where single flights of adult individuals to feeding grounds and to the nest were recorded. Significantly higher activity of white-tailed eagles was observed in EA-C in the vicinity of which the nest is located (Tab. 25).

Table 25. The number of white-tailed eagle individuals in each elementary area.

Area	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
A	4	3	4	8		3	1	6	9	8
B	3	2	3	2	1	1	2	3	6	3
C	7	21	11	21	24	16	21	28	42	44
D							2	1	2	2
Total	14	26	18	31	25	20	26	38	59	57

In EA-C, white-tailed eagle flights included adult individuals arriving to and flying off the nest, as well as young individuals making training flights and flying off the nest. The number of white-tailed eagles observed also depended on the phenological period. The fewest white-tailed eagles were observed during fall migration and wintering, and the most during the breeding season (Table 26). This is understandable, during the breeding season and breeding dispersal, increased flights of adult individuals feeding their young, as well as young individuals training flights in the vicinity of the nest were observed.

Table 26. The number of white-tailed eagle individuals in EA-C near Swobnica in particular phenological seasons, in subsequent years.

Phenological period	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
W	2		2	6	3	4	3	2	5	5
SM	3	5	4	9	7	4	3	6	6	9
B		16	5	6	9	6	11	17	28	23
FM	2				5	2	4	3	3	6
Total	7	21	11	21	24	16	21	28	42	43
Average/observation	1.2	3.5	1.8	3.5	4.0	2.7	3.5	4.7	3.5	3.6

*- number of individuals per 1 observation (1 day of observation); W – wintering period; SM – spring migration period; B – breeding and dispersal period; FM – fall migration period.

Vertical flights of white-tailed eagles within EA-C occurred at various levels. In case of adult individuals, flights at higher levels up to 200 m were predominant. They appeared in all 3 zones of impact of wind turbines. Young individuals flew at much lower altitudes, not exceeding 50 m (zone 1 – safe zone). Significant increases in recorded flights in the years 2017-18, shown in the table, were due to additional observations during the breeding period.

Table 27. Number of white-tailed eagle flights in the 3 zones of impact in EA-C by year.

Zone	2010	2011	2012	2013	2014	2015	2016	2017	2018
1	14	8	15	16	10	15	20	27	29
2	5	2	3	6	5	4	6	10	11
3	2	1	3	2	1	2	2	5	4
Total	21	11	21	24	16	21	28	42	44

Horizontal flights of adult individuals included 3 major directions (Fig. 23): in an easterly direction towards Długie Lake and Dłużec Lake, along the ponds on the eastern side of Długie Lake and over water reservoirs in the Tywa River Valley; in a northerly and north-westerly direction towards Kołbicze Lake and forest and mid-field reservoirs; in a westerly and south-westerly direction towards the Oder River Valley, towards Trzcińsko-Zdrój, Strzeszewskie and Trzcińskie Lakes and fish ponds near Grzybno, Żelechowo and Strzelczyn.

Flights of young individuals took place in the vicinity of the forest complex where the nest was located. They were observed when perching in trees near the forest wall and training flights along the forest wall up to about 300 m into the fields (Fig. 23).

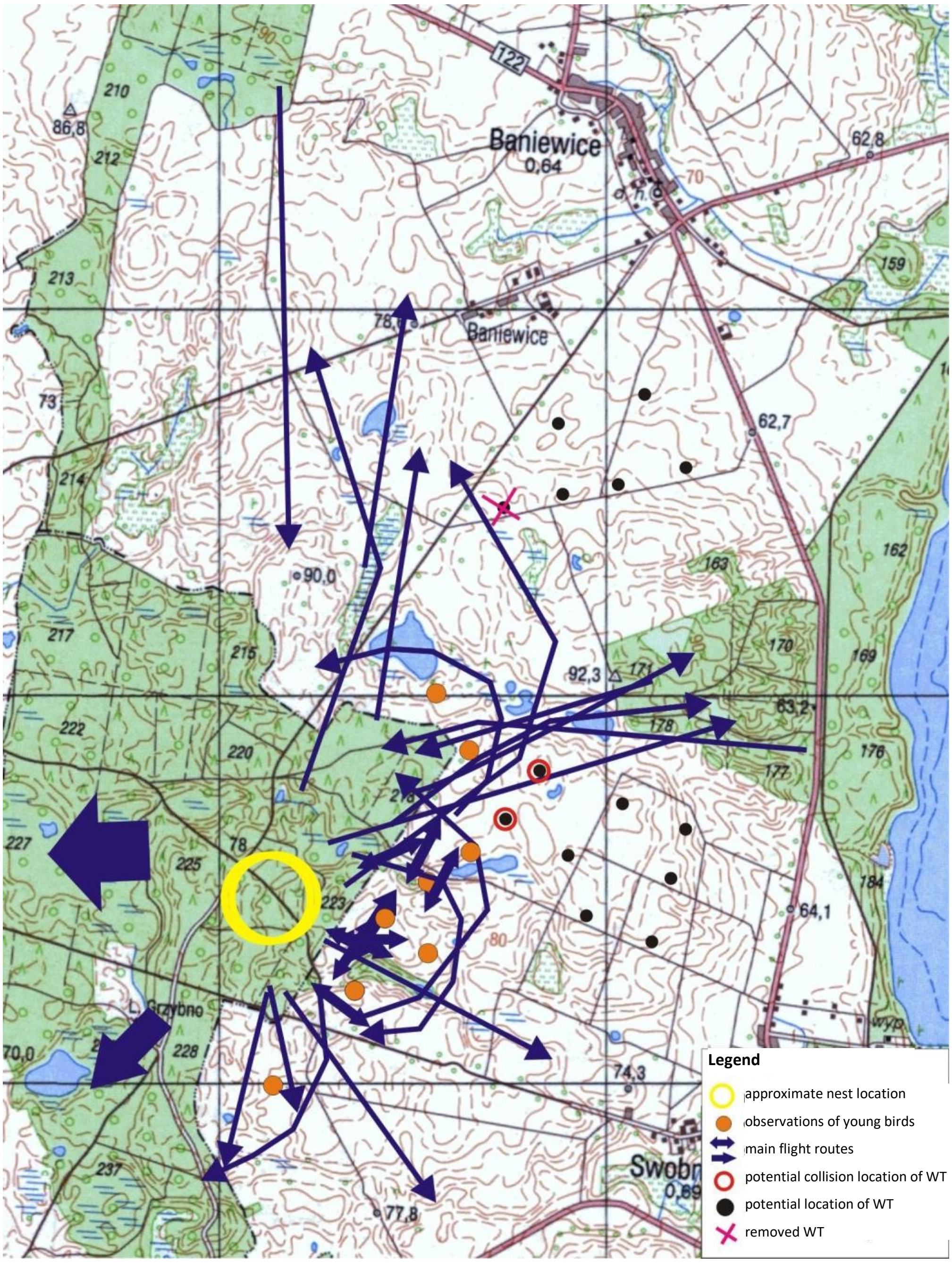


Figure 23. Major routes and directions of migration of white-tailed eagle in EA-C (2011-18).

7. Description of the form of nature conservation in the immediate range and in the vicinity of the planned project

In the area of the proposed location of wind turbines and accompanying infrastructure there are no natural objects protected by law. In the vicinity (up to 10 km) there are sites belonging to the Natura 2000 ecological network. There are habitat refuges in the immediate vicinity (up to 5 km): Las Baniewicki, Dziczy Las and Dolina Tywy (Fig. 24a). Further away (up to 10 km) there are: habitat refuges – Pojezierze Myśliborskie, Ostoja Wełtyńska; bird refuges – Dolina Dolnej Odry, Ostoja Witnicko-Dębniańska and Jeziora Wełtyńskie (Fig. 24b). The others are located at a greater distance from the monitoring area, i.e. from a dozen to several dozen kilometers.

"Las Baniewicki" refuge PLH320064.
A dense complex of fertile deciduous forests with a fairly uniform oak-hornbeam character. In local depressions, riparian forests develop on small areas, in the north-western part, there are areas which are more difficult to be included in a syntaxonomic classification and to diagnose the habitat, referring to inland acid oak forests (however, it is probably the influence of the acidification of the habitat due to the former higher share of coniferous species in the forest stand). More than 56% of the area consists of well-developed habitats of fertile deciduous forests, mostly sub-Atlantic oak-hornbeam forest – a habitat poorly represented in the N2000 network approved by the European Commission so far. The forests have good conservation prospects, they are characterized by wealth of flora species. As many as 107 ha are habitats developed in a typical way (state A). The remaining area of the site consists of similar oak-hornbeam habitats, which are, however, degraded by the breeding of mixed stands with coniferous or geographically alien species (Northern red oak, Canadian poplars). Greening of forest management, however, contributes to a gradual improvement in the composition of tree stands and with time we should rather expect an increase in the area of protected habitats. The area contributes significantly to the achievement of appropriate representativeness within the Natura 2000 network for the sub-Atlantic oak-hornbeam habitat, the resources of which are concentrated in Zachodniopomorskie Voivodeship. The nearest wind turbines will be located approximately 2.1 km from the refuge.

"Dziczy Las" Refuge PLH320060.
Almost half of the area (44.5%) is occupied by well-preserved natural habitats with good prospects for conservation, characterized by wealth of flora species. In the remaining area, there are potential habitats where, if the composition and structure of the tree stand are properly adjusted, regeneration of natural habitats is possible. The area is important because it improves the representativeness of the regional variability of beech habitats, at the regional scale concentrated in several larger forest complexes. Beech forests occur in a mosaic with ash riparian forests occupying small areas, which is reminiscent of the Bukowe Hills landscape. The presence in the area of well-developed sub-Atlantic oak-hornbeam forests and transitional peat bogs, which are underrepresented in the N2000 network on a regional scale, but are important due to the concentration of their occurrence in this part of the country, is important. Eutrophic lakes and ponds, which, due to being common in the country, are not usually treated as an important value of the Natura 2000 system. The nearest wind turbines will be located approximately 0.6 km from the refuge.

"Dolina Tywy" refuge PLH320050.
The greatest natural value of "Dolina Tywy" habitat area is its habitat diversity. Sixteen natural habitat types were found here, including 3 with priority status. They cover about 31% of the area. The greatest significance of "Dolina Tywy" refuge is the significant proportion of well-preserved habitats in Western Pomerania: 9130, 3150, 91E0*. There are also habitats, one of the westernmost in Poland, of chara-lakes (3140) and of Cretaceous vegetation (7210*) with endangered plant species (Mirek at al. 2006). The specific character of this refuge makes it also a kind of ecological corridor between the Myślibórz Lake District and the Lower Oder Valley. The Tywa River has long stretches of water preferred by fish from the *Cobitis* complex (spined loach), which are quite numerous in some places. Moreover, the above-mentioned diversity of biotopes makes this watercourse very interesting from the ichthyological point of view and worthy of protection (even though only two "Natura" species have been observed here). In addition, some places of the watercourse are ideal spawning grounds for European river lamprey, salmon or European bullhead. The nearest wind turbines will be located approximately 0.6 km from the refuge.

"Pojezierze Myśliborskie" refuge PLH320014

The area of Community importance "Pojezierze Myśliborskie" in Kondracki's classification (2002) is located in the central part of the Myślibórz Lake District mesoregion. The southern axis of the refuge is formed by numerous ribbon and flow-through lakes which are part of the hydrographic network of the Myśla River basin. Among the most important ones are: Chłop, Łubie, Sitno Wielkie, Będzin. The most important watercourses draining the Myśla River basin within the area include: the Głęboki Canal (draining Sitno Wielkie Lake), the Tarnów Canal (Tchórzyno Lake and Jezierzyca Lake to Myśliborskie Lake). It should be emphasized here that the refuge area has undergone significant interference in water relations in the past and is almost completely devoid of natural watercourses. Nevertheless, spring phenomena are frequently observed here, both within forests and non-forest ecosystems. In geomorphological terms, the area is a mosaic of glacial forms (mainly ground moraines, marginal plains, glacial channels) related to the three phases of the Pomeranian stage of the last glaciation. A varied lithology of surface sediments was found here. They are dominated by Pleistocene tills and clayey sands of moraine uplands, sands of sand plains, clays and other fractions of glacial tills (e.g. Sitno Lake), sands and gravels in river valleys, Holocene gyttjas (often calcareous) and peats. The lakeland landscape is dominated by forests (deciduous in the area of Przydarłów and Chłop Lake, managed coniferous forests in the remaining part). The largest areas of non-forest ecosystems (mainly arable fields used for agricultural purposes and grasslands) are located around the following lakes: Sitno Wielkie, Chłop, Łubie, Będzin. The most important nature reserve in the refuge is the floral reserve "Tchórzyno", with an area of 37.18 ha, created on 23 October 1965 to preserve the unique flora and wetland communities formed on the artificially exposed in the 19th century lake marl (including Schoenetum nigricantis and Cladietum marisci communities). Other fragments of the Myślibórz Lake District which are very valuable from the point of view of nature include the eastern shore of Sitno Wielkie Lake (an exposed calcareous gyttja with a unique calciphilous flora), the channel and the surroundings of Chłop and Grochacz Lakes (mesotrophic lakes surrounded by fertile forests on the slopes) and a vast forest complex in the area of Przydarłów (important for the preservation in the region of large patches of fertile beech forests, sub-Atlantic oak-hornbeam forests and elm-ash forests). 12 natural habitats were found: 3140, 3150, 6210, 6410, 6510, 7210, 7230, 9130, 9160, 91D0, 91E0, 91F0. The following animal species listed in Annex II were found: *Bombina bombina*, *Cobitis laenia*, *Cottus gobio*, *Liparis loeselii*, *Unio crassus*. In the refuge, there are only 2 species under protection: the European bullhead and the Unio crassus. The nearest wind turbines will be located approximately 6.6 km from the refuge.

“Ostoja Wełtyńska” refuge PLH320069

The area includes a complex of water reservoirs and hydrogenic habitats – riparian forests, Molinia meadows and peat bogs in the basin of a small watercourse, a tributary of the Oder River – the Omulna River, with a large lake – Wełtyń Lake (349 ha). The area surrounding the reservoirs is dominated by agricultural landscape – farmland, small meadows, pastures and tree stands; only in two places, in the southwestern and northeastern part, small forest complexes dominated by riparian forests have been preserved. More than 90% of the area overlaps with the Special Protection Area for birds and their habitats – Wełtyń Lake PLB320018. The refuge is important for the protection of six types of natural habitats from Annex I of the Habitats Directive – hard water lakes, eutrophic lakes, Molinia meadows, alkaline peat bogs, acid oak forests and alder-ash riparian forests. The largest area is occupied by habitat 3140 (hard water lakes), which includes most of the area of Wełtyń Lake. A slightly smaller area is occupied by eutrophic reservoirs (3150) and riparian forests represented mainly by well-developed alder and ash riparian forests (91E0). 9 natural habitats were distinguished: The following animal species listed in Annex II were found: *Bombina bombina*, *Leucorrhinia pectoralis, Lutra lutra, Triturus cristatus*. In the refuge, only the fire-bellied toad is under protection. The nearest wind turbines will be located approximately 8.1 km from the refuge.

“Jeziora Wełtyńskie” refuge PLB320018

The area includes, from the north, a complex of small mid-field lakes, surrounded by cultivated fields, meadows and pastures. The area is characterized by a well-preserved agricultural landscape offering favorable habitat for agricultural landscape animals especially amphibians and birds. The largest lake is Wełtyń Lake with an area of about 360 ha. This lake is characterized by relatively low trophic levels and moderate levels of anthropogenic changes. There are islands and small areas of common reed rushes on the lake. It offers good breeding conditions for water and marsh birds. Small beech forests and forest areas of wetlands occur in this area. In addition, there are 13 lakes with an area larger than 1 ha. The vast majority are located in the northern part of the Natura 2000 area. These lakes are characterized by varying trophic levels determined by anthropogenic impacts. All these reservoirs are eutrophic lakes with a well-developed strip of common reed rushes. In the case of 5 of them (Brudzno, Gardzienko, Gardyńskie, Głębokie and Krzywienko Lakes) there are particularly favorable habitats for birds and amphibians. The area of Wełtyń Lake PLB320018 belonging to Natura 2000 is one of the smallest bird refuge in Poland. It covers an area of only 2811.2 ha, but this refuge, due to its location between other bird refuges, is of key importance for the coherence of the Natura 2000 network. It is especially a link between the "OSO Jezioro Miedwie i okolice" PLB320005 and the "OSO Dolina Dolnej Odry" PLB320003. This area has been designated in a frugal way in terms of its size, but the habitats of bird species of Community importance cover almost 100% of the refuge. These habitats are well-preserved, offering very attractive conditions for birds, which in turn is evident in the extremely high density of nesting pairs. Most breeding bird species here are unable to reach the criterion of 0.5% national population. Thus, the following criteria should be applied: habitat convenience, a link between population and high density. In the refuge, the following are under protection: *Anser albifrons*, *Anser anser*, *Anser fabalis*, *Chlidonias niger*, *Cygnus cygnus*. The nearest wind turbines will be located approximately 7.7 km from the refuge.

"Dolina Dolnej Odry" refuge PLB320003

The area includes the Oder River Valley between Kostrzyn and the Szczecin Lagoon (total length of 150 km) together with Dąbie Lake. Dąbie Lake is a shallow delta reservoir (5,600 ha, depth of max. 4 m), with a diversified shoreline. It is supplied by rainwater and river water, as well as by sea water (backwater phenomenon). The lake is separated from the Oder River stream by islands: Czapli Ostrów, Sadlińskie Łąki, Mienia, Wielka Kępa, Radolin, Czarnołęka, Dębina, Kacza and Mewia. The meadows and wetlands of Rokiciny, Sadlińskie and Trzebuskie Łęgi are adjacent to the southeastern shore of the lake. Dębie Lake has rich aquatic vegetation. The banks are occupied by a wide belt of rushes (mainly reeds and bulrush), behind which riverside herb vegetation grows. Large areas are occupied by riparian forests and willow scrubs. The interiors of large islands are covered with alder and ash-alder riparian forests. The estuary of the Oder River has two main branches – the East Oder and the Regalica. The area between the main branches (channels) (Międzyodrze) is a flat plain with numerous lakes and smaller channels, it is marshy, with periodically flooded meadows and fragments of riverine riparian forests. The area below Cedynia is called the Oderbruch, within which the Kostrzynieckie Swamp is of particular importance for birds. The refuge contains the entirety of the Lower Oder River Natura 2000 habitat area. On the German side, the Lower Oder Valley National Park extends along the Oder River. In the central and southern parts of the area, fragments of forest adjacent to the valley with the highest density of birds of prey were included. A bird refuge of the European range E 06. There are at least 43 species of birds from Annex I of the Birds Directive, 14 species from Polish Red Data Book (PRDBoA). A very important area especially for water and marsh birds during breeding, migration and wintering season. During the breeding season the area is inhabited by at least 1% of the national population (C3 and C6) of the following bird species: Eurasian bittern (PRDBoA), montagu's harrier and greylag goose; the following occur in relatively high density (C7): black tern, red-backed shrike and aquatic warbler (PRDBoA). During the migration period, at least 1% of the migration route populations (C2 and C3) of the following bird species occur: bean and greater white-fronted goose; the following occur in relatively high density: whooper swan, great crested grebe, gadwall, northern lapwing and European golden plover; in the fall staging area, up to 5,000 individuals (C5) of common cranes can be recorded. In winter, the great crested grebe occurs in high density (C3). 74 species of birds of the refuge are under protection. The nearest wind turbines will be located approximately 8.6 km from the refuge.

"Witnicko-Dębniańska" refuge PLB320015

The Witnicko-Dębniańska refuge occupies a part of the forests of the Lubuskie Voivodeship, located north of the Warta River, covering the edge zone of its valley and the adjacent fairly dense forest complex occupying the central part of the refuge in Zachodniopomorskie voivodeship, as well as a mosaic of farmland, mid-field ponds and smaller lakes, tree buffers and forest fragments between Warnice and Trzcińsko-Zdrój. The area is characterized by dense forest cover (about 70% of the refuge's area), with a predominance of pine forests, lesser amounts of riparian forests, oak-hornbeam forests and beech forests, concentrated mainly along river valleys, around lakes and ponds. Within the forests there are numerous raised bogs, dystrophic ponds and larger water reservoirs – eutrophic lakes. Currently, the area of the refuge is relatively little urbanized and anthropogenically transformed, however, due to the high landscape values, the refuge is under quite strong pressure from recreation and tourism. In addition, the refuge is a place where mining industry is growing (a natural aggregate mine as well as an oil and gas mine). Within the borders of the refuge there are small localities, among which we can mention Gogolice Piaseczno, Chełm Dolny and Górny, Barnówko, Mostno, Bogusław, or Cychry.
The land around the villages is used for agriculture. The preservation and maintenance of the habitats of valuable bird species in "Witnicko-Dębniańska" refuge is favored by the varied post-glacial landscape and the associated diversity of natural habitats, dense forest cover and non-forested agricultural areas, which provide feeding grounds for the species subject to protection. The most important threats to the avifauna and its habitats in the area in question are: the development of tourism and recreational development of the lake shores as well as urban pressure on open areas, which are mainly feeding grounds for the species subject to protection, medium- and high-voltage power lines crossing the area and the areas directly adjacent to it, the existing, planned and projected wind farms concentrated around the borders of the area, in its immediate vicinity, creating an additional barrier effect. A very serious threat to the avifauna is predation and the plundering of nests by alien species of predatory mammals such as American mink, raccoon and raccoon dog. Other threats include the processes of draining the ecosystems of fens, transitional raised bogs and high peat bogs, watercourse maintenance and the associated interference with the riverbed and banks, fertilizer runoff from fields intensifying the process of eutrophication of water reservoirs and peat bogs, afforestation of open feeding grounds, sewage disposal causing the direct pollution of surface waters, the penetration of bird habitats connected with fishing, angling, hunting and poaching, the expansion of the oil and gas mine and exploitation fields located near the refuge, as well as insufficient knowledge about the species subject to protection in the area, which may lead to adverse impact on avifauna as a result of unconscious activities connected with, among other things, forest management. A bird refuge of international importance (IBA PL013).
There are at least 34 species of birds listed in Annex I of the Directive 2009/147/EC of 30 November 2009 on the conservation of wild birds (the Birds Directive) and 2 species of migrating birds, of which 30 species are classified as breeding birds, 6 as migrating birds, while 12 species are listed in the Polish Red Data Book of Animals (PRDBoA). High numbers during the breeding season (more than 1%) are reached by greylag goose, Eurasian eagle owl (PRDBoA), common goldeneye, common crane, white-tailed eagle (PRDBoA), black kite (PRDBoA), red kite (PRDBoA), osprey (PRDBoA). 74 bird species in the refuge are subject to protection. The nearest wind turbines will be located approximately 9.6 km from the refuge.

"Rozlewisko pod Mielnem Pyrzyckim" (trans. Mielno Pyrzyckie Swamp) ecological site.
Established by virtue of Resolution No. VI/69/11 of the Kozielice commune council dated September 1, 2011. The purpose of establishing the site is protection of water-muddy ecosystem, being a place of existence of protected fauna species. The site covers an area of 38.63 ha, located in Mielno Pyrzyckie district, Kozielice commune.

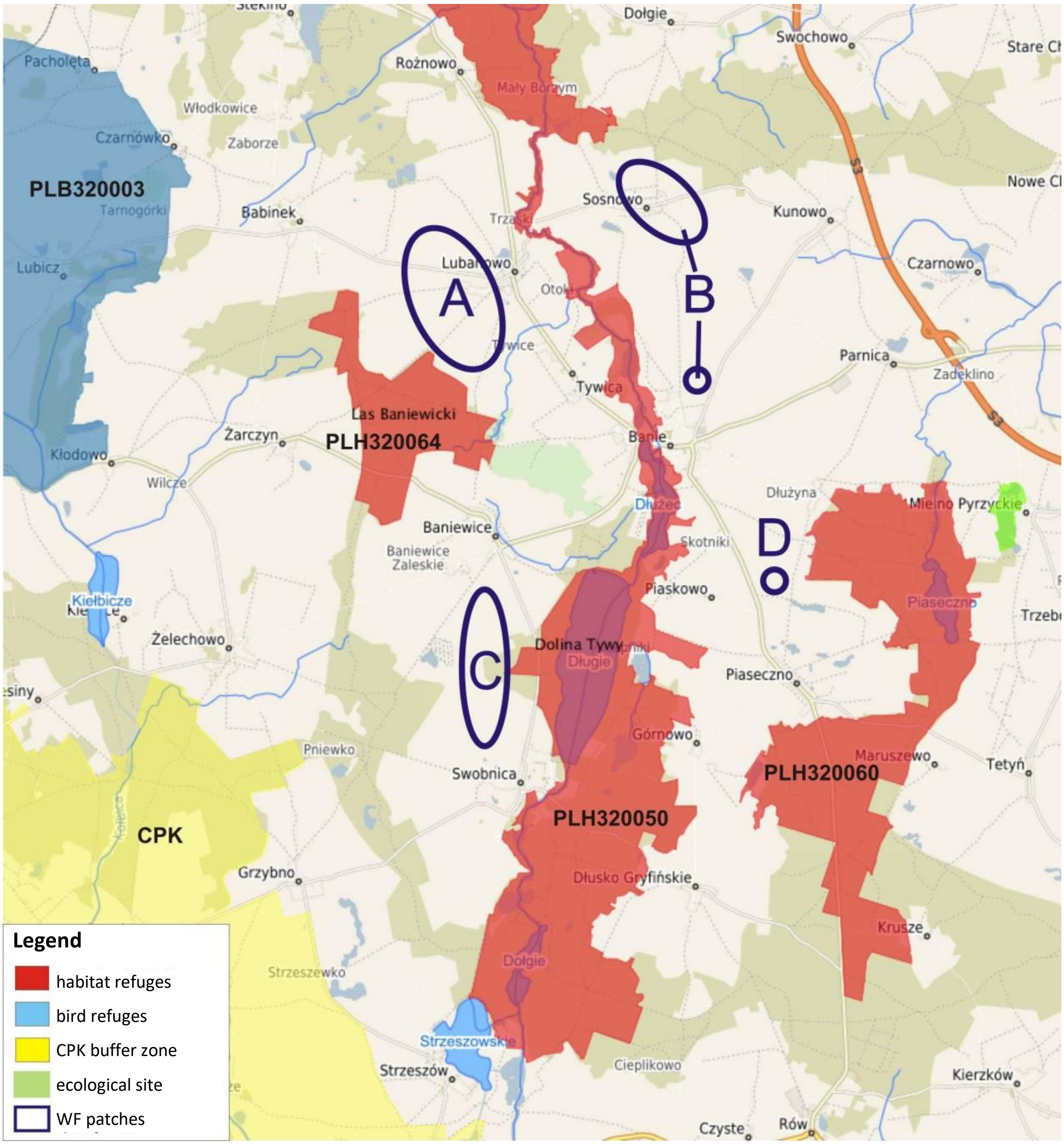


Figure 24a. Location of the project on the background of the local Natura 2000 network.

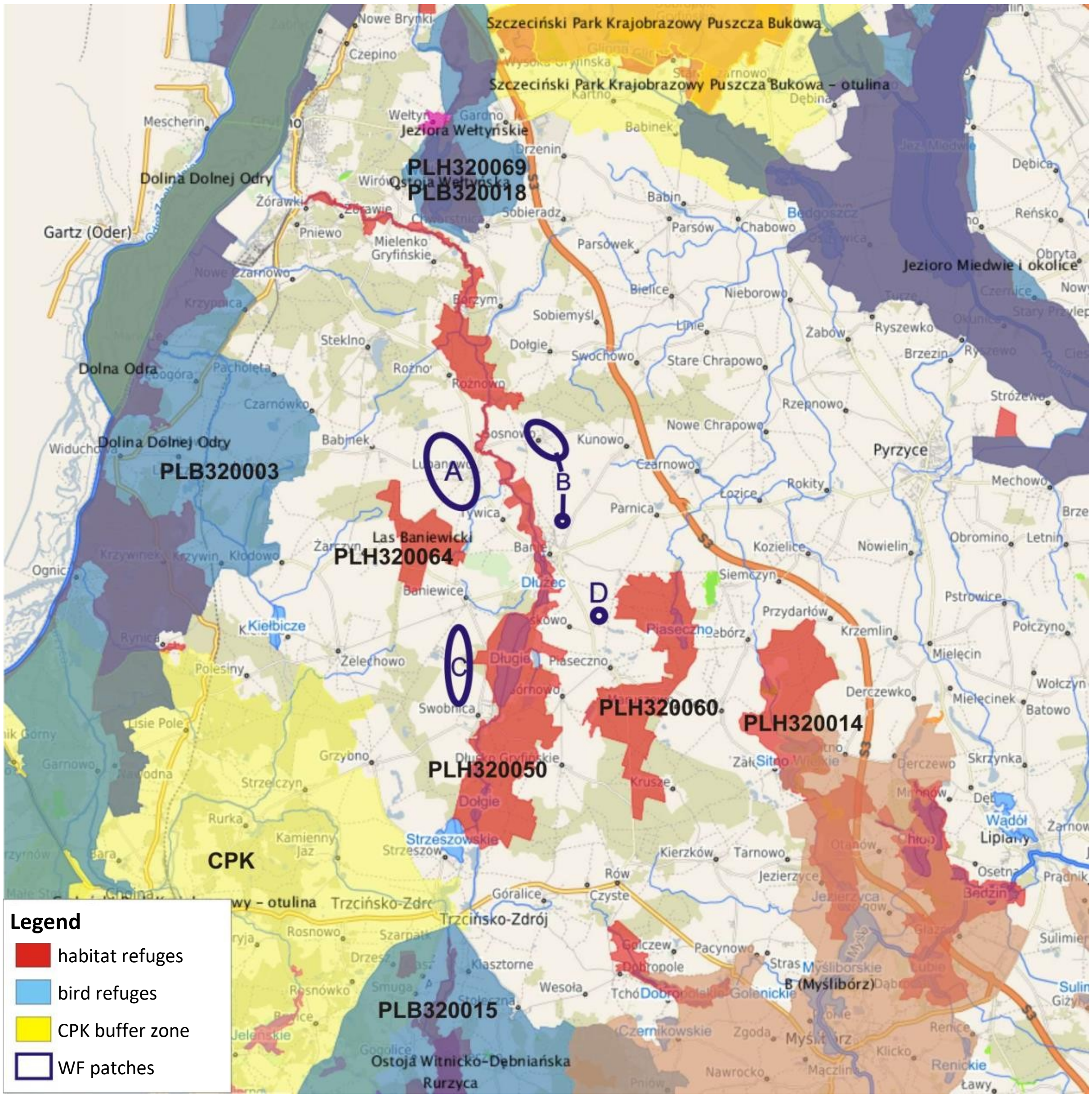


Figure 24b. Location of the project on the background of the regional Natura 2000 network.

In the vicinity of wind turbines location on the basis of the nature valorization of Banie commune (Piątkowska et al. 1998), specific objects were selected for protection of habitats as well as plant and animal sites. Some of them were maintained in the natural valorization of the Zachodniopomorskie voivodeship (Spieczyński ed. 2010). However, they were not included in the plans of Banie commune and were not created. Hence, as non-existent, they were not included in the analysis.

8. Description of monuments protected under the regulations on the protection and care over monuments in the study area

There are no monuments protected by law in the wind turbines location area.

In the vicinity of the project, in surrounding villages, there are still immovable monuments protected by law and entered in the register of the Voivodeship Office for Monument Protection in Szczecin.

Table 28. Immovable monuments in the vicinity of the investment area.

Locality	Reservoir	Register no.	Date of entry	Decision no.
Babinek	Churchyard cemetery	160	1/19/2004	DZ-4200/63/O/03/2004
Babinek	manor park	1048	12/2/1980	KL.I.5340/41/80
Babinek	Church of St. Ann [*kościół św. Anny*]	160	1/19/2004	DZ-4200/63/O/03/2004
Banie	Old Town area	70	10/29/1955	Kl-V-0/52/55
Banie	Chapel of St. George [*Kaplica św. Jerzego*]	1019	12/5/1963	Kl.20/46/63
Banie	Jewish Cemetery	946	9/12/1994	PSOZ/Sz-n/5340/128/94
Banie	Church of Our Lady of Succour to the Faithful [*kościół M.B. Wspomożenia Wiernych*]	995	7/2/1956	Kl.V.-0/97/56
Banie	Churchyard cemetery	995	6/12/2015	DZ.5130.14.2015.AR
Banie	powder tower	1023	12/5/1963	Kl.20/45/63
Baniewice	Church of the Sacred Heart of Jesus [*Kościół NSPJ*]	996	7/2/1956	Kl.V.-0/98/56
Baniewice	Churchyard cemetery	996	6/12/2015	DZ.5130.16.2015.AR
Dłusko Gryfińskie	Church of Our Lady, Queen of Poland [*Kościół MB Królowej Polski*]	952	5/30/1974	Kl.I.6801/8/74
Dłusko Gryfińskie	Churchyard cemetery	952	6/12/2015	DZ.5130.15.2015.AR
Górnowo	Church of the Sacred Heart of Jesus [*Kościół NSPJ*]	1499	1/19/2016	DZ.5130.01.2016.AR
Górnowo	Churchyard cemetery	1499	1/19/2016	DZ.5130.01.2016.AR
Kunowo	Churchyard cemetery	172	7/13/2004	DZ-4200/16/O/2004
Kunowo	Church of St. Adalbert of Prague [*Kościół Św. Wojciecha*]	172	7/13/2004	DZ-4200/16/O/2004
Lubanowo	manor park	932	12/12/1980	KL.I.5340/47/80
Lubanowo	Church of Christ the King [*Kościół Chrystusa Króla*]	1001	7/31/1956	Kl.V.-0/127/56
Lubanowo	Churchyard cemetery	1001	6/12/2015	DZ.5130.12.2015.AR
Otoki	smock mill	948	5/29/1989	Kl.3-5340/26/89
Piaseczno	Church of Our Lady of the Rosary [*kościół MB Królowej Różańca Św.*]	973	7/31/1956	Kl.V.-0/143/56
Piaseczno	Churchyard cemetery	973	6/12/2015	DZ.5130.10.2015.AR
Rożnowo	manor park	949	12/3/1980	KL.I.5340/45/80
Rożnowo	Church of Our Lady of Częstochowa [*Kościół M.B. Częstochowskiej*]	1179	10/22/1957	Kl.V.-0/283/57
Sosnowo	Church of the Immaculate Conception of the Blessed Virgin Mary [*kościół Niepokalanego Poczęcia NMP*]	981	8/1/1956	Kl.V.-0/159/56
Sosnowo	Churchyard cemetery	981	6/12/2015	DZ.5130.13.2015.AR
Swobnica	manor park	760	12/4/1980	KL.I.5340/55/80
Swobnica	Church of St. Casimir [Kościół św. Kazimierza]	1025	8/1/1956	Kl.V.-0/163/56
Swobnica	castle	760	3/31/1957	Kl.V.-0/248/57

There are also archaeological protection zones in the vicinity of the wind turbines location, however, their occurrence outside the wind turbines location and their assembly and service yards exclude any negative impacts.

9. Description of the analyzed project options
9.1. No project option

This option was not analyzed due to the issued environmental decision specifying the conditions for the construction of the Banie wind power plant complex consisting of 46 wind turbines (GK-7627/2/2008) and obtaining a building permit by the Investor. This option will be implemented by the investor if the proposed "new" option is not agreed upon.

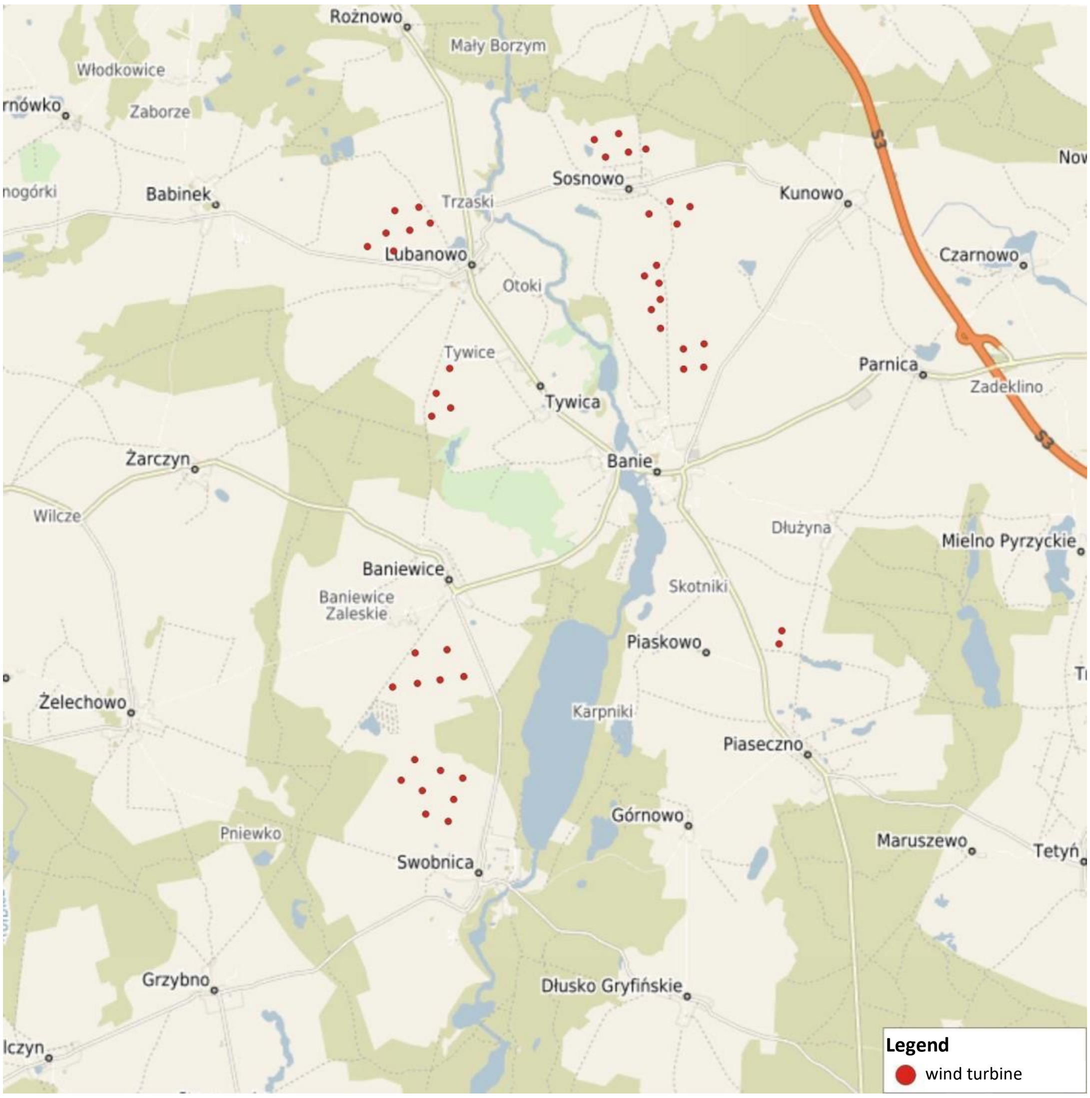


Figure 25. Wind turbines location in the "old" option.

9.2. Alternative options subject to analysis.

The analysis of the proposed project implementation alternative options was performed taking into account 2 criteria:
- impact on noise levels,
- impact on the natural environment.

9.2.1. Impact on noise levels in the environment.

Due to the development of construction technology and the operation of new wind turbine models, two state-of-the-art wind turbine models were analyzed: Nordex 1N117 and Vestas V110. Total for 39 wind turbines of both models.

The analysis of the generated noise indicated that permissible noise levels are not exceeded during the daytime. A possibility of slight exceeding of permissible noise levels at night was found in relation to 8 Nordex wind turbines (change of operation mode) and 5 Vestas V110 wind turbines (elimination of 3 units and power reduction in 2 units) (Appendix).

To eliminate noise level exceedances, mitigation measures were taken that led to wind turbine reduction or operating power reduction to optimize turbines' acoustic power. As a result, noise levels were determined with the reduced number of wind turbines and their acoustic power.

Another analysis included 37 Nordex wind turbines and 34 Vestas wind turbines (Appendix).
In case of N117 turbines, the power of 8 units had to be reduced to meet permissible nighttime noise levels.
In case of V110 turbine, the power of 2 units had to be reduced to meet permissible nighttime noise levels.

9.2.2. Cumulative impact on the natural environment.

During the preliminary analysis phase of the "new" project variant, the number of wind turbines was reduced by 7, from the original 46 units to 39.
Analyses of the natural conditions, based on many years of pre-investment monitoring, indicated that the Tywa River Valley is an important habitat for avifauna, during nesting and migration periods. Appreciating the value of the Tywa River Valley, it was decided against constructing 6 wind turbines along the eastern border of the valley along the section from Sosnów to Banie (Fig. *[missing figure number in the original version – translator's note]*).

An important part of the impact is the nesting of the white-tailed eagle in the vicinity of the wind turbines located near Swobnica (EA-C). The birds return to the nest annually, and the flights over the Tywa River Valley and northward of adult birds and training flights of young birds near the nest may result in collisions with the nearest two wind turbines. The annual pre-investment monitoring reports suggested moving or eliminating the two nearest wind turbines.
In order to protect the white-tailed eagle population and minimize the possibility of collisions, the investor decided to eliminate 3 wind turbines: 1 to the north and 2 to the east — located closest to the nest (Fig. 26).

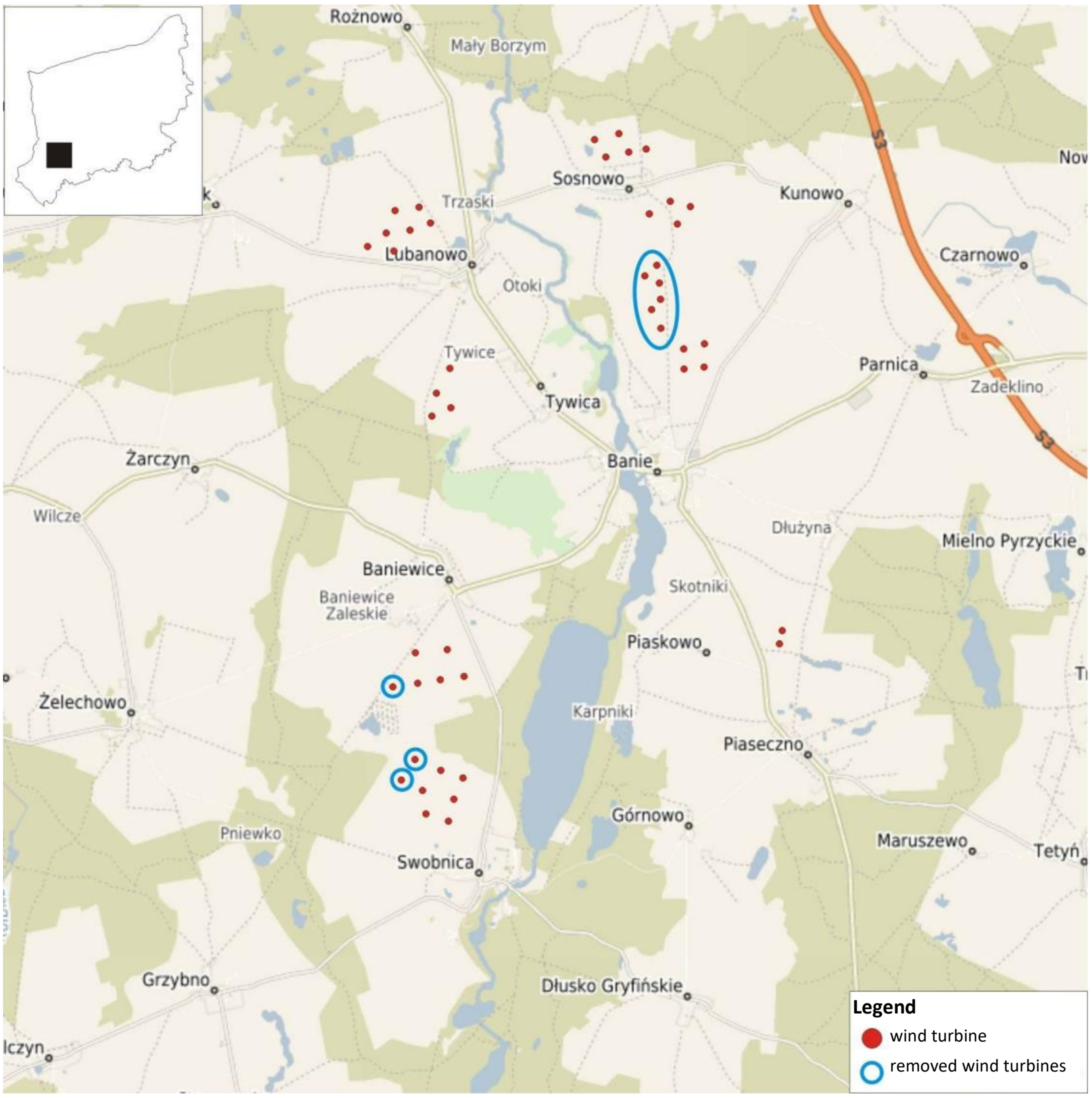


Figure 26. Location of eliminated wind turbines.

9.2. The most environmentally favorable variant

The only rational variant considered in the project is the reduction of the number of wind turbines along with the change of basic parameters: increasing the height of the tower and the length of the rotor blades.

This option is related to the technological change in wind turbines that has occurred since the "old" environmental decision was issued in 2008 and the withdrawal from production of the older types of wind turbines included in the 2008 analysis.

The presented variant with increased wind turbine parameters to 180 m total height and 120 m rotor diameter changes little compared to the earlier design. The overall height of the wind turbine increases by 30 m and the rotor diameter by 20 m, which translates into a 20% increase. The remaining construction assumptions described in the report which was the basis for issuing the decision on environmental conditions of the project in 2008 remain unchanged. During the pre-investment monitoring in the previous years (2011-18), the total height of the power plant of 160 m and the rotor of 110 m were taken into account in the analyses, due to the possibility of constructing higher wind turbines in the future. This makes the difference in possible impact amounting to only 20 m - 12%. This is a small value and as the analysis of the selected variant, discussed in further detail in chapter 10 below shows, the construction of wind turbines with changed parameters does not significantly increase the impact of the project on the natural environment, especially on avifauna. The change in parameters will have a positive impact on reducing the risk of bird collisions, as a result of increasing

the ceiling for safe bird movement from 50 to 60 m above sea level.
The presented new alternative would reduce environmental impact due to the reduction in the number of wind turbines from 46 to 34 (Fig. 27). The impact on noise generation will be reduced, so that lower number of wind turbines will not result in exceeding acceptable noise levels during both day and night periods.
Reducing the number of wind turbines will also reduce the development of agricultural land, thereby leaving large areas between clusters of wind turbines available for use by animals, especially birds. This will increase the amount of habitats available for animals and the width of corridors for collision-free movement of birds, especially during migration.
Undoubtedly, the new variant, with a reduced number of wind turbines, a slight increase in total height of the wind turbine and the diameter of rotors will contribute, in contrast to the "old" project, to a greater minimization of the impact of the project on the environment, including avifauna.

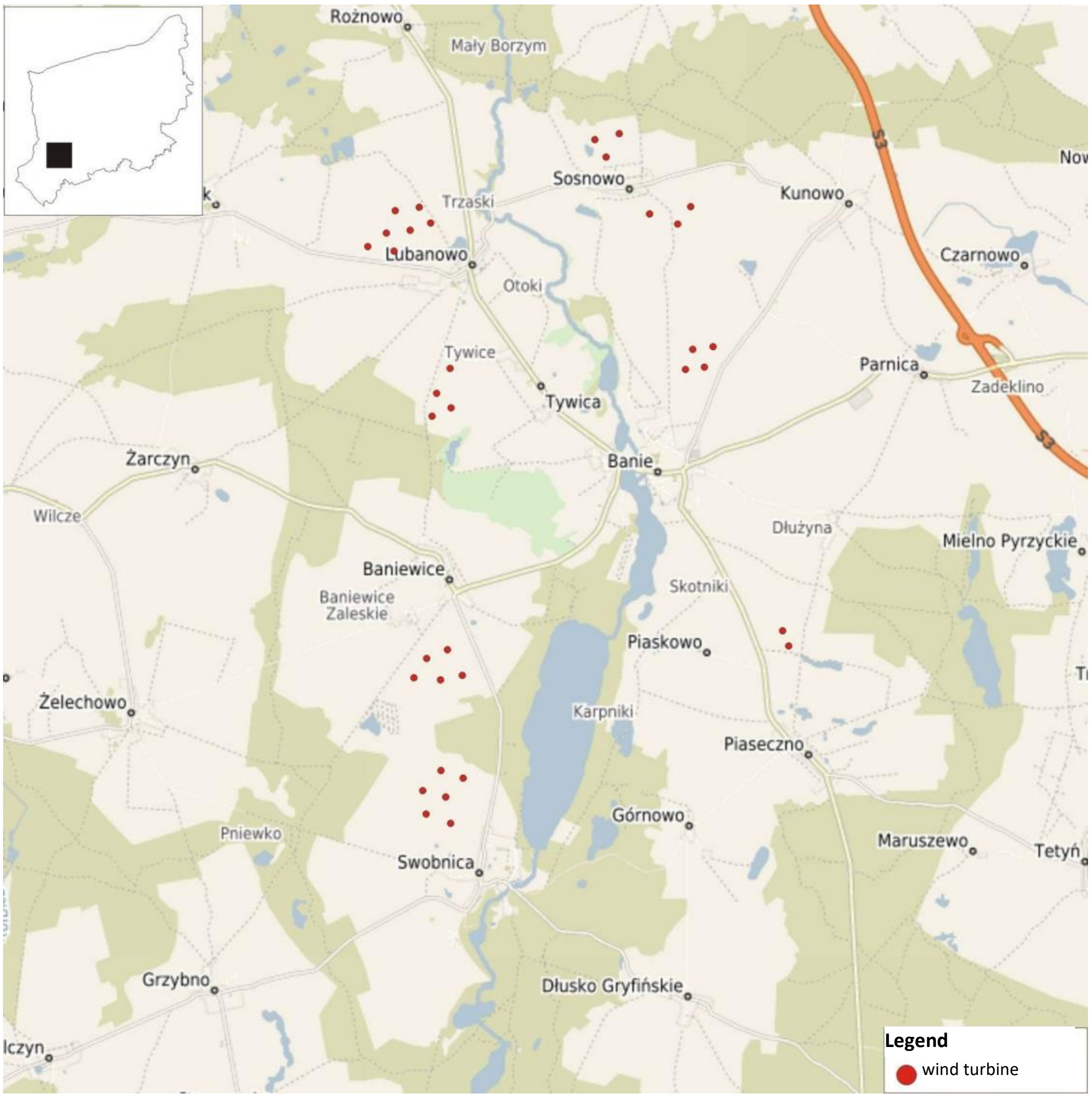


Figure 27. Localization of wind turbines in the "new", most favorable variant provided for implementation.

10. Environmental impact of the selected project variant

The analysis includes the forecast of the environmental impact of the "new" variant of the project, compared to the "old" variant for which the environmental decision was obtained in 2008. The analyzed variant differs from the "old" one only in 3 parameters: reduced number of wind turbines, increased tower height and rotor blade length. Other parameters of the project (sizes of assembly and service yards, layout of service roads, routing of cables and fiber optic lines, etc.) remain unchanged and will be consistent with the 2008 environmental decision and the 2013 and 2014 construction designs.

This section primarily analyzes the environmental impact of change in the aforementioned three parameters.

The environmental impact of the "new" variant would be primarily related to:

- reduction in the number of and change of parameters of wind turbines - change of acoustic environment,
- reduction in the number of wind turbines - decrease in the occupation of biologically active areas, decrease in the space occupied by wind turbines, change in the impact on avifauna,
- changes of wind turbines parameters - change of the impact on avifauna and occurrence of collisions of birds with wind turbines,
- changes in the number and parameters of wind turbines in EA-C - change in the impact on the population of white-tailed eagles.

The impact of the "new" variant will change, at least because the number of wind turbines will reduced by 12 units. There will be a significant reduction in adverse impact for most elements, i.e. the final effect will be positive for the environment.

10.1. Impact during the construction phase

Implementation of the project will result in impacts on the abiotic and biotic environment. In the case of abiotic elements, the impact will mainly concern noise emission and pollution of the atmosphere caused by construction works. Local dusting and fumes emission to the environment will occur. It is important to note that all of these phenomena will be intermittent, limited to the work areas, and will cease with the completion of the construction.

In the case of biotic elements, the impact will mainly concern the reduction of biologically active surfaces for the infrastructure elements of the project.

Impact on the ground surface.

Construction works will result in the need to collect topsoil and obtain soil from excavations. Soil should be stockpiled and, to the extent possible, reused after construction activities are completed. Excavation soil should be reused for road hardening, etc.

Reducing the number of wind turbines in the "new" variant will reduce the land area allocated for assembly and service yards and reduce service and access road sections. The planned area of an assembly and service yard is estimated at about 1200 $m^{2.}$ Reducing the number of wind turbines from 46 to 34 will reduce the converted area by 26.9%. This will leave nearly 27% more biologically active surface in the environment, in the form of agricultural crops. As much less soil would be converted and removed compared to the "old" variant.

With the change in the number of wind turbines, the interference with the ground surface will also decrease. The number of foundation excavations will decrease by 12, thereby reducing the amount of soil removed and converted by approximately 27%.

Soil contamination by oil derivatives leaking from machinery and technical equipment may occur. It can be effectively eliminated by collecting the contaminated soil, proper supervision of the operation of such equipment and maintaining it in a good technical condition.

During the construction phase, adverse impacts on soil and ground surfaces are projected to decrease compared to the "old" variant.

Impact on water.

Compared to the "old" variant, removal of some wind turbines will result in reduction of the impact on water, which virtually will not occur. There are no groundwater reservoirs in the project area. In the adjacent areas there are sparse mid-field ponds and watercourses which are elements of the drainage system. Despite the presence of mid-field ponds and drainage ditches in the vicinity, the remoteness of the projected locations of tower foundations and technical infrastructure will ensure that the project will not adversely affect groundwater conditions, either underground water or surface water.

The project is not expected to have an adverse impact on surface water, groundwater, or underground water.

Impact on air.

The planned project may reduce air parameters due to the necessity of work of construction equipment and traffic of transport vehicles, causing local emissions of dust and fuel combustion products. Unorganized emissions of pollutants will occur during construction works. Suspended particulates and falling dust as well as CO and NO_2 will be emitted. The impact of pollutant emissions from the project will be limited to the immediate vicinity of the area of construction and assembly works. It will not pose a threat to air quality due to the works being spread over time and space. It will be short-lived and will cease after construction and assembly works are completed. Reducing the number of wind turbines will reduce emissions to the air, thereby reducing the environmental impact of the "new" variant.

The project is not expected to have an adverse impact on the condition of the air. The proposed variant will reduce pollutant emissions, thereby reducing the threat to the air.

Impact on the climate.

As with the air, climate impacts would be imperceptible during construction. Its nature will be periodic. Since the proposed wind turbines will be constructed at a distance from each other, their cumulative impact on microclimate will be negligible. The proposed variant with a reduced number of wind turbines will further mitigate climate impacts.

No adverse impact on climate is expected from the construction of the wind farm. The proposed "new" variant will significantly reduce potential climate impacts.

Impact on natural resources.

No natural resources will be extracted at the project site or in the immediate vicinity during construction.

The project is not expected to have an adverse impact on the natural resources.

Impact on tangible property.

The project's impact on tangible property will be insignificant. There may be local damage to existing field roads or agricultural crops due to transport of construction materials and wind turbine structures. Once the works are complete, any local damage should be repaired. In the case of damage caused to agricultural crops, compensation for causing the damage is the responsibility of the investor. The implementation of the project will also have a positive impact. As part of the construction works the technical condition of existing field roads will be improved and short sections of new field roads will be built to facilitate access and movement of farm equipment in the agricultural crops area.

No significant adverse impact on tangible property is expected.

Impact on the natural and cultural landscape.

Wind turbines are new specific tall objects that change the perception of the landscape, and their location is always perceived subjectively. During construction, wind turbine impacts would be minor, primarily related to the increase in tower height during gradual, partial assembly.

By reducing the number of wind turbines the proposed "new" project variant will further reduce the visual impact of the project, despite increasing the total height of wind turbines by 30 m, up to 180 m above ground level.

There are no historical monuments or archaeological sites in the wind turbine location area. There are also no preservation maintenance areas.

The project is not expected to have a significant adverse impact on the natural landscape. The project is not expected to have an adverse impact on historical monuments and modern cultural heritage.

Impact on acoustic climate.

Implementation of the project will require the use of construction machinery and transportation of building materials and structural elements. The following construction equipment relevant to noise emissions is to be used:

- excavators and bulldozers - earthmoving and construction works,
- crane and trucks - work concerning preparation of foundations and assembly of towers and transmission cables, delivery of concrete mix or operation of concrete batching plant,
- operation of hand-operated power tools.

When assessing the potential for noise pollution, it should be borne in mind that noise sources in the analyzed case do not have a permanent, long-term location (construction of subsequent elements), so any possible adverse impacts or nuisance at a given location will be periodic and short-term, and will cease with the completion of construction and assembly works. Any nuisance associated with a construction phase will cease completely upon its completion. In the immediate vicinity of the planned works there are undeveloped areas (fields and meadows) - areas that are not acoustically protected. Noise emissions associated with the construction will be temporary in nature, typical of construction works, will only occur during project execution and will cease with the completion of the works. The periodic impact on the acoustic climate around the works will be similar to noise from other construction works.

The project is not expected to pose significant threat to the acoustic climate. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

Impact on vibrations

Implementation of the plan document will require the use of heavy construction equipment, whose operation may cause vibrations. The vibrations will have a local range and will cover the area of the construction works. They will cease as soon as they are completed. Due to the considerable distances of residential buildings from the construction site, no vibration hazards to the nearest buildings and their occupants are expected.

No vibration hazards beyond the boundaries of the areas covered by works are predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

Impact on electromagnetic field generation

The project will not emit electromagnetic fields at environmentally significant levels. Their emissions will cease with the completion of construction works.

No adverse impact from electromagnetic fields is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

Impact on infrasound emissions

The project will not emit infrasound at environmentally significant levels. Their emissions will cease with the completion of construction works.

No adverse infrasound impact is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

Impact on waste management.

The main waste product at the construction and installation work site will be topsoil: excavated soil and earth, including stones. It will be mostly reused as base layer for service yard and access road. In case of surplus, it will be stored in designated areas for reuse during reclamation or for leveling by farmers.

Due to the reduction of the number of wind turbines by 12, the amount of waste will be reduced from that projected in the "old" variant.

The generation of the following wastes is expected:

Waste type	Code
Synthetic engine oils, gear oils and and lubricating oils*	13 02 06
Ferrous metals	16 01 17
Mixed waste from concrete, brick rubble, waste ceramic materials and elements of equipment	17 01 07
Wood	17 02 01
Soil and earth including stones	17 05 04
Unsorted (mixed) municipal waste	20 03 01

* — hazardous waste.

The waste generated should be sorted and stored in designated secured areas. Municipal and hazardous waste should be stored in tightly sealed containers.

The waste generated should be managed in a manner consistent with the principles of waste management and environmental protection requirements. Waste generated for disposal should be transported to a municipal landfill by authorized entities. Supervision of the manner in which waste is sorted, stored and transported from the site should be carried out during construction and installation works.

No adverse environmental impact is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

Impact on vegetation.

During construction works a minor, temporary destruction of vegetation, including agricultural crops (cereals, rapeseed) in the area of the wind turbines installation, construction of assembly and service yards and service roads. The adverse impact on flora will be spatially limited and, due to the project covering a small area, should not cause great damage to the biocenosis. There are no natural or little transformed habitats in the area covered by the project: mid-field ponds, refuges or mid-field vegetation clusters.

The fact that the project is distanced from any such areas found in the vicinity allows to conclude that the planned project will not have a negative impact on the vegetation of the area in question.

No significant adverse impact on the vegetation is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

Impact on fauna.

The main impact on animals, including birds, will be related to high noise levels generated by heavy construction machinery. The exhaust fumes generated or the movement of the heavy construction machinery itself is of a lesser significance. The aforementioned impact will be temporary and short term. There may be temporary abandonment of areas around the wind turbine installation sites by birds. Construction works will result in the exclusion of small portions of the installation sites that are animal habitat.

The author's observations and data from wind farms already in operation indicate that this impact on birds is temporary and that some birds return to their old habitats after construction is complete and noise has ceased.

No significant adverse impact on fauna, especially birds, is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

Impact on biodiversity.

Any project implemented in the natural environment interferes directly or indirectly with local biodiversity resources. The area of the planned project is characterized by low biodiversity. Areas of agrocenosis, in particular monocultures of cereals or rapeseed, are characterized by very low species diversity. This applies to all taxa, both plants and animals.

Temporary occupation of small parts of agrocenosis for assembly and service yards and access roads will not result in a significant decrease in available habitat for breeding or feeding. Observations indicate that the areas around wind turbine become re-inhabited by animals.

The organisms most likely to be affected by wind turbines are birds and bats. Birds are the most numerous group of animals protected by law in the agrocenosis area. Observations from operating wind farms in the Zachodniopomorskie Voivodeship show that the most common breeding species in agrocenoses — the Eurasian skylark, returns to areas around wind turbines in following breeding periods. Nesting, mating flights and singing of Eurasian skylarks were observed in the space between the wind turbine and the horizontal range of the rotor blades' reach. Many other species that feed in fields also return and travel between the operating wind turbines or between rotor blades. Mammals also return to the areas around wind turbines. Examples include deer or foxes that have been observed feeding near operating wind turbines. Deer tracks were observed at a distance of about 1.2 m from the towers of operating wind turbines.

No significant adverse impact on biodiversity resources is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

Impact on protected areas.

There are no existing forms of nature conservation in the area covered by the project. There are some protected sites located in the neighboring areas.
The construction and assembly works will be carried out in a small, limited area, hence there will be no impact of the purpose and objects of protection covered by the protected areas.
Due to the distance, the proposed project will have no adverse impact on the conservation objectives of Natura 2000 areas and their continuity and integrity.
Due to the distance, the proposed project will not adversely affect the protection objectives of the Cedynia Landscape Park *(Polish name: Cedyński Park Krajobrazowy - CPK)* and its buffer zone.
Due to the distance, the project will have no adverse impact on the protection objectives of the "Rozlewisko pod Mielnem Pyrzyckim" (trans. *Mielno Pyrzyckie Swamp*) ecological site.

No adverse impact on the existing protected areas is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

Impact on living conditions and human health.

Due to the nature of the project, the wind turbines shall be built at a considerable distance from buildings and human habitation. Construction and installation works will be carried out in the open spaces between the villages. Hence, there will be no impact on the residents of nearby villages. Noise, dust and chemical fumes (paints, varnishes, anti-corrosive coatings, etc.) may be a nuisance only to the employees of companies performing construction, installation and painting work in the immediate vicinity of the construction site. They should be provided with suitable protection in accordance with applicable health and safety regulations.

Taking into account the scope and nature of the planned works and distance of the construction sites from buildings and places of permanent human habitation, there is no possibility of an adverse impact of the project on the health of the residents of local villages.

No adverse impact on human health is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

Summary of construction phase impact.

At this stage, the impact of the project will be low, and most of the above-mentioned elements will only have a temporary, short term impact on the environment and will cease upon completion of the works.
Construction works would not result in any significant impact in all aforementioned areas. Compared to the "old" variant, the reduction of the number of wind turbines in the "new" variant will reduce the environmental impact of the project in all of the above-mentioned areas.

<u>The construction phase impact analysis concludes that the proposed "new" project variant will be more favorable to the environment. Its implementation will result in reduced impact compared to the "old" variant.</u>

10.2. Impact during the operation phase

After the construction and commissioning of the wind farm the main impact will be on the biotic and to a lesser extent on the abiotic environment. In the case of abiotic components the impact will focus on acoustic climate, electromagnetic field and landscape. In the case of biotic components, the impact may affect fauna, especially birds and bats, which may move near and between the wind turbines. The reduction of the number of wind turbines alone will result in the reduction of the adverse impact.

Impact on the ground surface.

The impact of the project in this phase will not be perceptible. Operating wind turbines do not affect the ground surface.

No adverse impact on the ground surface is predicted.

Impact on water.

Wind turbines are unmanned devices. Electricity generation technology does not require supply of water. All operating devices will be monitored by a computer-based system of remote monitoring and diagnosing of wind turbines. Lack of necessity to constantly operate the devices will result in no household (sanitary) wastewater being generated. The wind turbine construction is a closed, sealed environment; any spills from operating equipment will be captured in the turbine into oil sumps and disposed of. In addition, each turbine will be located away from watercourses, water reservoirs and elements of the drainage system. The possibility of surface water and groundwater contamination is negligible.

The operating turbines will not adversely affect the chemical and ecological state and will not cause any increase in the risk of failing to meet the environmental objectives: the Groundwater Bodies Information Sheets 23 and 24 and the Surface Water Body Information Sheet.

No adverse impact on surface water and groundwater is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

Impact on air.

The operating wind turbines are unmanned installations and do not contain any sources of dust, gas or other chemical emissions. The planned wind farm will have a positive impact on air due to production of green energy, contributing to reduction of fossil fuel combustion for heating and industrial purposes. Limitation of fossil fuel combustion will result in reduction of emissions of carbon dioxide, carbon monoxide, nitrogen and sulfur oxides and harmful fractions of PM2.5 and PM10 dust in combined heat and power plants, municipal heating plants and domestic heating facilities.

Positive impact on the condition and quality of air is predicted.

Impact on the climate.

Wind turbines, due to their construction and lack of emissions, do not affect the climate on a regional scale. They may affect the microclimate of areas in the immediate vicinity. Since the planned turbines will be located at a distance from each other, their cumulative impact on the microclimate will be negligible. The proposed variant with a reduced number of wind turbines will further mitigate the impact on the local climate.

Wind turbines will contribute to the reduction of fossil fuel combustion, thereby reducing emissions of carbon dioxide, nitrogen oxide, sulfur oxide and other substances.

No adverse impact on the climate is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

Impact on natural resources.

No natural resources will be used at this stage.

No adverse impact on the natural resources is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

Impact on tangible property.

There will be no impact on tangible property at this stage.

No adverse impact on tangible property is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

Impact on the natural and cultural landscape.

Wind turbines are new specific tall objects that change the landscape, and their location is always perceived subjectively. During construction, the impact of the wind turbines will be minor, mainly related to the increase in height of the towers during their gradual, partial assembly. The impact of operating wind turbines on the surrounding landscape results from the visual specificity of the structures themselves, the physiography of the investment area and the settlement structure of the region. The specificity of the wind farm structure lies in the visual impact on the landscape values of the area, which are closely linked to the structure of the wind turbines, the terrain and the settlement structure of the region.

The impact of the turbine depends mainly on its height parameters. In the variant under analysis, the total height of the wind turbine will increase by 30 m. In case of such high structures, such an increase is unnoticeable in the spatial perception. Especially since the previous variant, with the total height of the turbine of 150 m, demonstrated no significant adverse impact on the landscape.

Such high objects constitute a strange, technical element of the natural landscape. Due to their height it is difficult to incorporate and "mask" the turbines in the landscape, as they tower over the trees. However, the presence of forest complexes, mid-field tree buffers or roadside trees contributes to the reduction of landscape disharmony. The site of the planned investment is surrounded by wooded areas.

The planned location of the wind farm should not significantly reduce the aesthetic value of the landscape. The presence of forest complexes around the wind farm location sites will partially "mask" the existence of the wind turbines. Additionally, in the middle of the area, between the wind farm patches, stretches the Tywa River Valley, surrounded by forest complexes, especially in the southern part, between Banie and Swobnica, which will also mask the wind farm to some extent. Due to the size of the wind turbines it is not possible to completely mask them in the landscape. Large areas of forests, roadside alleys and village buildings will to a large extent neutralize their presence in the landscape.

The aesthetic value of the landscape depends on how the turbine is painted. Usually it is white or the pastel color that has the least contrast to the background.

There are no archaeological sites or preservation zones in the areas of the planned location of wind turbines. The investment site is an agricultural area and there is no modern cultural assets.

No significant adverse impact on landscape, cultural heritage and historical monuments as well as on modern cultural assets is predicted. Reducing the number of wind turbines will further reduce the impact of the project.

Impact on acoustic climate.

The operation of the "new" variant of the project selected for implementation will not cause a significant adverse impact on the environment.

The increase in noise levels will occur in the immediate vicinity of the operating turbines. It will only affect the animals in the vicinity. As demonstrated by observations from operating wind farms, this impact will be short-lived and most animals become accustomed to it.
The turbines will be located in agricultural areas away from buildings and places of permanent human habitation. The isophones indicate that acceptable noise levels will not be exceeded, both during the day and at night.

No adverse impact on noise levels is predicted. Reducing the number of wind turbines will further reduce the impact of the project.

Impact on vibrations

Modern wind turbines are equipped with elements that dampen the generated vibrations in the devices and tower structures. Since the turbines will be dampened, no significant amounts of vibration will be transmitted to the environment.

No significant adverse impact on vibration generation is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

Impact on electromagnetic field emissions.

The emitted electromagnetic fields will be shielded by the construction of the nacelle and the entire turbine. Measurable fields will occur surrounding the equipment in the nacelle. They will be practically non-measurable at ground level. Therefore, there will be no impact on humans or animals.

No adverse impact from electromagnetic field emissions is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

Impact on infrasound emissions.

Infrasound will be attenuated by the wind turbine structure. Based on data from existing wind farms, it can be concluded that infrasound levels near buildings will be comparable to the background (wind noise) or lower.

No adverse impact from infrasound emissions is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

Impact on waste management.

Virtually no waste will be produced in this phase. Small amounts of operational waste will be produced during the servicing of the turbine, which is carried out as it is for any piece of equipment in operation. The waste produced will not be accumulated, but will be removed by the servicing personnel on an ongoing basis.

No adverse impact on waste management is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the amount of waste generated, thus the impact of the project.

Impact on vegetation.

During their operation the wind turbines will have no impact on the vegetation. The areas around the service yards will continue to be used for agricultural production.

No adverse impact on the vegetation is predicted.

Impact on fauna.

The analysis of the impact of the planned investment on fauna, performed for 46 turbines in the "old" variant, did not indicate a significant adverse impact (Zyska and Rychlewski 2008). It was the basis for the positive decision on environmental conditions of the project issued in 2009.

The analysis of the "new" variant of the project, which assumes changes of three parameters of the project: increase of the total height of the wind turbine, the length of rotor blades and reduction of the number of wind turbines, also demonstrates no significant adverse impact on the environment. It should be emphasized that the reduction of the number of turbines to 34 will significantly reduce the impact on fauna.

The impact was analyzed in two ways, in terms of the influence of the changed wind farm parameters on animals and their habitats and in terms of its influence on the white-tailed eagle population nesting in the vicinity of the EA-C near Swobnica.

Projected impact of the project on animals
It is planned to change the number of turbines and the total height of the turbine from 150 to 180 m. This results from the technological progress and the discontinuation of production of the previous smaller wind turbine models by the manufacturers, as well as from the use of wind energy in a more optimal way. The use of new models will result in higher efficiency with fewer wind turbines. Thus, it will increase the profitability of the investment with less impact on the natural environment.

Impact on mammals
Observations reveal that the impact of the wind farm will practically only affect birds. Mammals present on the site use the investment area for feeding. Deer, wild boars and foxes often appeared in the vicinity of the designed wind turbines. Observations of operating wind farms indicate that wind turbines do not constitute an obstacle or a deterrent for them. They were often feeding near them. The impact of habitat loss on mammals will be very small or non-existent. Deer, wild boars, and foxes appearing on agricultural crops become accustomed to wind turbines. In areas of operating wind farms deer and foxes were observed feeding near the very towers.
Therefore, no negative impact is predicted for large mammals.

No negative impact is expected for bats either. This is evidenced by the data from listening points that were located in agricultural areas in the vicinity of the proposed wind farm site. The use of this space was negligible, limited to single flights. Night-vision observations showed that bat flights occurred mostly at low altitudes of up to about 20 m, well below the lower range of the rotor blades. Increasing the total height will result in the increase of zone 1 by 10 m to an altitude of 60 m. This will additionally considerably reduce the possibility of collisions with bats, which mostly moved at up to approx. 20 m. In the areas of the wind farm location there are no mid-field refuges, roadside shrub and tree buffers, and thus they are unattractive to bats. The investment site lacks habitats attractive to bats. Even the species moving in open areas (the serotine bat and the common noctule) appeared sporadically.
No significant bat flight and migration routes were identified above the investment area.

The "new" proposed project variant would have no significant adverse impact on mammals.

Impact on birds.

Due to the number of species, their numbers and distribution, birds constitute a group particularly vulnerable to the impact of the project. The collected data indicate that the investment site was not intensively used by birds, both during breeding and post-breeding periods.

The presence of 105 taxa was recorded. Most were protected species, frequent or common on a national scale. Rare species were usually observed only occasionally.

The main impact of wind turbines is related to the limitation of availability of habitats, the possibility of collisions and the occurrence of an ecological barrier effect during flights, especially the migratory ones.

Loss of habitats.

The planned wind farm will be located in agricultural areas that are unattractive for most bird species. The investment area is intensively farmed. The area is occupied by monocultures of cereals and rapeseed, with a small share of other crops. Wastelands constitute a very small area.

The agrocenosis areas, in particular monocultures of cereals and rapeseed, are used during the breeding season by a small number of species associated with agricultural areas, mainly small passerines, dominated by the Eurasian skylark and the corn bunting. Galliformes – common pheasants and grey partridges were also observed. Occasionally moving over the crops were charadriiformes, mainly pigeons, as well as accipitriformes and corvids (crows, rooks, ravens) and other small passerines (yellowhammers, sparrows). There are no mid-field shrub and tree buffers or habitats attractive for birds at the locations of the designed wind turbines. Short, non-continuous rows of shrubs and trees (often wild fruit trees) were present in few sections of the area, along field roads. However, their numbers are declining every year, as a result of felling and dieback. The destruction of roadside shrub and tree buffers in order to increase the crop area was observed. The low mosaicism of crops resulted in low number and abundance of bird species. Thus, it had an impact on the low use of space in the wind turbine locations.

The construction of the wind farm and associated infrastructure entails a change in use of a portion of the area. There will be a temporary loss of a small portion of habitats used by birds. The reduction in the number of turbines, and thus the size of the infrastructure, will result in an approx. 20% reduction of the converted area. This will result in a 20% increase in the habitats available for birds, compared to the "old" variant of the project. Their loss to the turbine location will not be significant for most species. The areas for assembly and service yards are under cultivation, and thus unattractive for most birds. The areas of the wind turbine locations are monocultures of crops, lacking mid-field shrub, tree buffers and ponds, which makes them little attractive. The grounds intended for service roads include already existing field roads and field accesses. Only small fragments of crops will be converted.

It should be noted that the investment will not affect habitats adjacent to the planned wind farm area. Construction works will be carried out only at the sites of the designed infrastructure, in the area of agricultural crops. The project will not cause damage or degradation of habitats in the vicinity, nor will it fragment them.

The area of lost habitats in relation to the total area will be very small and will not have a significant impact on the condition of the habitats attractive to birds found in the vicinity. Thus, the loss of a marginal portion of agricultural crops will not adversely affect the condition and availability of habitats for birds.

Collisions.

Birds nesting in the area of the proposed wind farm and the birds traversing the area during migratory flights are in risk of collisions.

During the breeding season, only two species were found nesting in the area: the Eurasian skylark and the corn bunting, as well as probable breeding of the grey partridge. However, together with the pheasant, it breeds mainly in mid-field refuges and wastelands, which were practically absent from the area.

Other species, in particular the species covered by the Directive, nested in the periphery or outside of the wind farm location or even the monitored area. They appeared over the wind farm area during habitat migration or feeding.
Impacts to field species are reasonably well recognized based on data from existing wind farms that have been in operation for years now and are located primarily on agricultural lands. The Eurasian skylark, nesting in the vicinity of wind farms, is considered particularly exposed to the risk of collisions. However, observations from wind farms already in operation do not support this. Monitoring results from the West Pomeranian region show its low collision rate, e.g., 1 Eurasian skylark collision was observed at Jagniątkowo wind farm in 2007–2011; no collisions were observed at Zagórze wind farm in 2003–2009; no Eurasian skylark collisions were observed at Karściono wind farm in 2009–2010; 1 Eurasian skylark collision was observed at Resko wind farm in 2015–2017; no Eurasian skylark collisions were observed at Banie I wind farm in 2016–2018. Flocks of Eurasian skylarks have been observed flying in the vicinity of operating wind turbines and even singing in flight between rotor blades. Eurasian skylarks seem to be able to adapt to the presence of wind turbines. Despite numerous observations of the Eurasian skylarks during the breeding season and breeding dispersal, the number of collisions is insignificant compared to the population.
Corn buntings, despite their presence in wind turbine location sites, are not a species at risk of collision. In their case, this is probably related to adaptation and low-level, non-collision low-altitude flights. In the West Pomeranian region, there were no collisions with wind turbines were reported.
Monitoring and literature data suggest that no significant negative impact of the project on local and regional population status is to be expected for the 2 species mentioned above.

Bird migration in the wind turbine location sites fluctuated between phenological periods. The breeding and dispersal periods were dominated by low-altitude flights, below the lower range of the rotor blades' reach (Fig. 28). These were habitat flights, associated with feeding and raising young, and roosting prior to migration. Flights in the collision zone were of low intensity, limited to a small number of taxa, mainly large passerines (pigeons, crows, ravens), flocks of Eurasian skylarks and common starlings, and accipitriformes. They accounted for 6.8 – 11.8% of total avifauna flights. Accipitriformes and corvids are able to move and feed adjacent to the wind farm as well as within range of rotor blades. Flights are more intense during the migration period, with birds moving in flocks at various altitudes. Mainly anseriformes (geese and less frequently swans) and cranes were observed in the collision zone. The presence of these species was associated with some birds landing in the monitored area or lowering the altitude for landing outside the area of the project. Occasionally there were gulls, pigeons, some accipitriformes or crows and ravens. Observations from the wind farms already in operation show that the aforementioned species can react to the presence of operating wind turbines and avoid them, fly between wind turbines or increase their altitude to fly over them. It should be noted that during the migration period only a portion of the birds moved within the area of the proposed wind farm, a large portion flew over the location of the wind farm. Few cases of collisions between gulls, geese, or accipitriformes are mentioned in the literature. There are virtually no reports of collisions of swans, cranes, crows or ravens.
The analyzed new variant assumes an increase in tower height and rotor blade length. Compared to the "old" variant, this will enlarge Zone 1 — safe by 10 m and Zone 2 — potential collision hazard, by 20 m. Enlarging Zone 1 will have a positive effect by reducing the number of potential collisions. Most birds traversing during all seasons, use Zone 1 (Fig. 28). Some of the birds flew at an altitude of 50 m above ground level which was previously included in Zone 2. Increasing the ceiling of Zone 1, will increase the number of birds using the safe zone, thereby minimizing the impact of the project (Fig. 28). As the figures show , in contrast to the "old" variant, after increasing the ceiling of zone 1, the use of Zone 2 decreased in all phenological periods, vulnerable migration periods in particular. This will translate into fewer potential collisions.

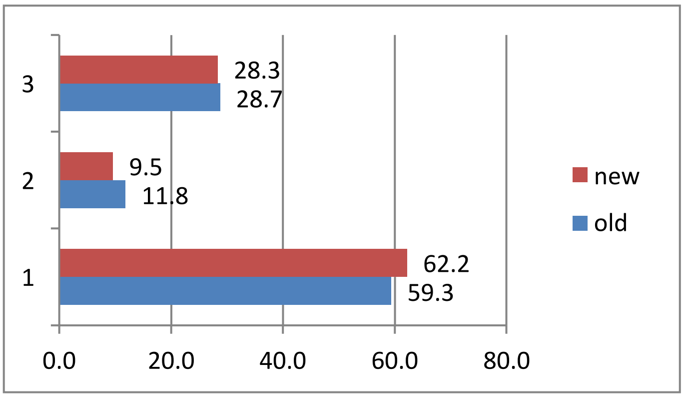


Figure 28a. Comparison of space use by birds in the old (h — 150 m) and new (h — 180 m) project variants during winter.

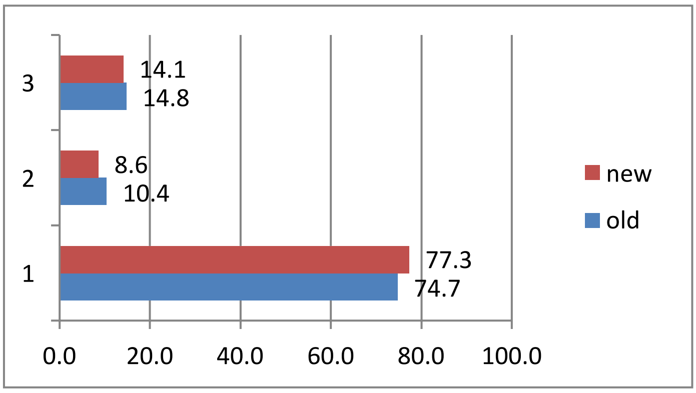


Figure 28b. Comparison of space use by birds in the old (h — 150 m) and new (h — 180 m) project variants during spring migration.

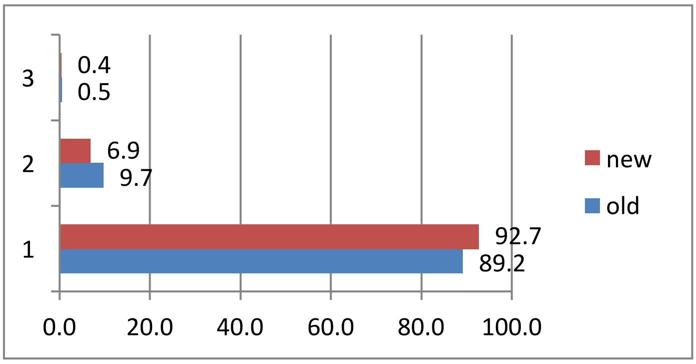


Figure 28c. Comparison of space use by birds in the old (h — 150 m) and new (h — 180 m) project variants during the breeding and breeding dispersal period.

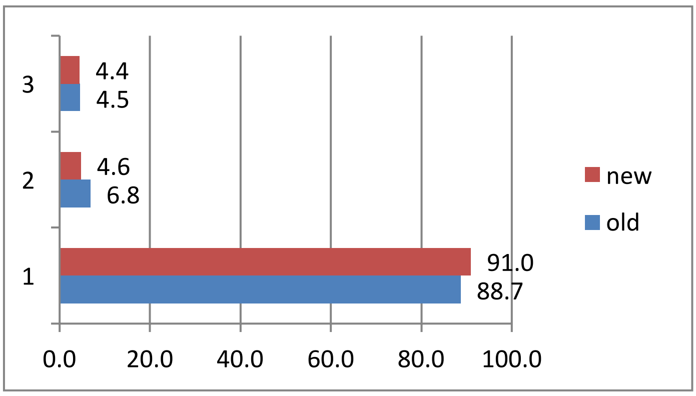


Figure 28d. Comparison of space use by birds in the old (h — 150 m) and new (h — 180 m) project variants during fall migration.

The possibility of collisions of birds with wind turbine cannot be completely ruled out. Observations from the wind farms already in operation show that collisions do happen. However, their intensity is very low and usually insignificant compared to the populations of most species.
The reduction in wind turbine and the enlargement of Zone 1, will further reduce the impact of the project.

Based on data from wind farms in Warmińsko-Mazurskie Voivodeship (Świtajski et al. 2012), the number of collisions relative to the volume of flights in Zone 2 was estimated to range 0.01 – 0.38%. Based on these assumptions, the potential minimum and maximum number of collisions for both alternatives can be estimated:

	Winter	Spring migration	Breeding and dispersal period	Fall migration
Old variant				
Min. number	0.1	0.3	0.4	0.4
Max. number	2.6	9.5	13.9	16.0
New variant				
Min. number	0.1	0.2	0.3	0.3
Max. number	2.1	7.8	9.7	10.9

The table above shows a decrease in the number of potential bird collisions under both variants. For the minimum number, values are similar to 1 bird per 2 years of farm operation. For the maximum value, differences range from 1 to 4 birds per 1 year of farm operation. It should be kept in mind that as the volume of flights in Zone 2 increases, the number of potential collisions in the "new" variant of the project will decrease. Thus, the "new" variant will have a lesser potential adverse impact.

Projected impact of the project on the white-tailed eagle.

One of the impacts of the project may white-tailed eagle collisions with the wind turbines on flight routes from the nest to the feeding grounds and back, and collisions of young birds in the vicinity of the nest.
Taking into account the flight routes and directions of white-tailed eagles, there may be collisions of birds with elements of the wind turbines, rotor blades in particular. This may be particularly true for young birds that are just practicing their flying skills in the vicinity of operating wind turbines. Taking into account that the area where the young birds were observed was approx. 300 – 400 m into the fields, the potential threat may be posed by 2 wind turbines, turbines no.: 39 and 44 (old designations 39 and 41). Although they are located at a distance of 1.2 and 1.4 km from the nest (approx. 630 m from the boundaries of the protection zone), they are closest to the nest and the flight zone of the young birds and on the flight route to Lake Długie and the Tywa River Valley (Fig. 1). Additionally, one wind turbine located north of the nest was removed (Fig. 29).
Increasing the height could potentially increase white-tailed eagle collisions with the wind turbines. However, the planned new parameters will result in the increase of Zone 1 — safe, by 10 m, from 50 to 60 m from the ground level to the lowest position of the rotor blades. Zone 2 — potentially hazardous, will be increase by 30 m, to 180 m above ground level. (60 – 180 m).
Vertically, white-tailed eagles flew most frequently in Zone 1 — safe, less frequently in Zone 2 — potentially hazardous, and occasionally in Zone 3 — safe (Fig. 29). Adult birds were observed in all zones, while young eagles were observed only in Zone 1. Thus, it can be predicted that collisions may primarily involve adult birds.

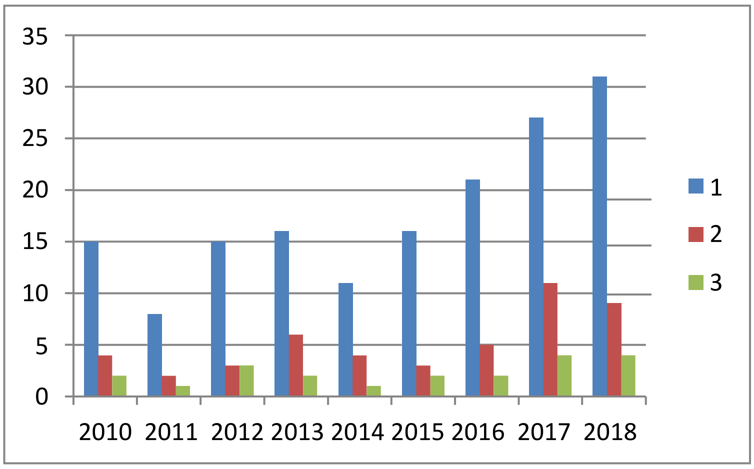
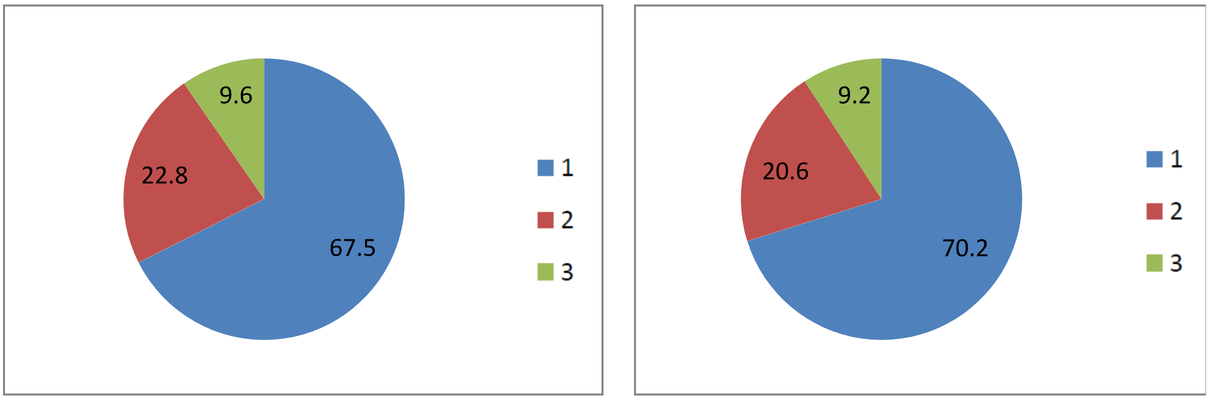


Figure 29. Number of white-tailed eagle flights in the 3 zones by year.

When flights were converted to the new flight zone ranges, the proportion of flights in each zone changed little (Fig. 30). This will have a positive impact because there will be a reduction in the number of flights in Zone 2, the hazardous one. This phenomenon will be beneficial to the protection and preservation of the white-tailed eagle population. This may indicate that the impact of enlarged wind turbines on white-tailed eagles will not have a significant negative impact.



160 m

180 m

Figure 30. The share of flights in each zone with change in total height of wind turbines.
Additionally, on the basis of analyses and postulates voiced during pre-investment monitoring regarding moving away of the two closest wind turbines, the investor made a decision to liquidate the mentioned turbines no.:
39 and 44 as well as turbine no. 38 located north of the nest (Fig. 26).

At a nearby wind farm near Kozielice, in May 2016 an adult white-tailed eagle collided with a wind turbine located approximately 350 m away from the nest. This was the first year the wind farm was in operation. Observations indicated annual nesting by white-tailed eagles, despite the wind turbine operating in the vicinity. No collisions were recorded in subsequent years. Field observations indicate the white-tailed eagle adapted to the presence of wind turbines and fly closer the nest, away from the operating wind turbines. This behavior makes it possible to predict, a similar change in the behavior of the white-tailed eagle towards the wind turbines operating in the vicinity. However, the investor, being precautions, will liquidate the two closest wind turbines, no. 39 and 44, and in order to minimize the possibility of white-tailed eagle collision during flights to the north, turbine no. 38 will be liquidated as well.

Elimination of 3 wind turbines along with increase of Zone 2, will be beneficial for protection and preservation of white-tailed eagle population, significantly minimizing the risk of collisions in-flight, of young birds in particular.

Analysis of the reduction in the number and increase in the wind turbine parameters, indicates a significant reduction in the impact of the "new" variant of the project on the population of white-tailed eagles.

Ecological barrier.

Flights during the breeding and post-breeding season occurred primarily at or adjacent to the proposed project site. This was mainly related to the physiography of the area. Varied, mosaic areas with abundant nesting or foraging habitats are preferred for flights. Therefore, forest complexes and their edges, water bodies and wetlands, and river valleys are preferred. They form linear spatial structures to aid navigation, especially during migration. They also provide safe resting places. In the vicinity of the proposed wind farm, such places are formed by forest complexes and the Tywa River Valley. These physiographic features form major migration corridors (Fig. *[missing figure number in the original version – translator's note]*). Major flyways and migration routes run in and adjacent to them. Clusters of wind turbines can create spatial barriers for migrating birds, during migration in particular. The trend is to cluster wind turbines and separate their clusters to create areas free of man-made structures to allow for bird movement.

The analyzed variant assumes reduction of the number of wind turbines from 46 to 34, the reduction concerns mainly turbines in the EA-B along the Tywa River Valley — 9 (Fig. *[missing figure number in the original version – translator's note]*). This will result in the liquidation of the row of wind turbines along the Tywa River, thus separating the turbine clusters at Sosnów and Banie 3. Locating and reducing the number of wind turbines will separate turbine clusters with wide corridors of space, free from man-made structures, at least 1.2 km wide. Wide strips of free space, several kilometers long, will contribute to free passage of birds through the monitored area, collision-free flights along forest complexes and the Tywa River Valley. They will also allow for collision-free flights around wind turbine clusters. Eliminating some wind turbine and placing them in clusters will help minimize impacts on birds and collision-free flight.

Observations of migration indicate that the project is not expected to have a significant adverse impact on migrating birds by creating a barrier.

There are wind farms operating in the vicinity. They are located at distances of more than 7 km to the east and northeast. These are Kozielice I and Kozielice II wind farms, located near Mielno Pyrzyckie, Tetyń, Kozielice, Bielice and Nowe Chrapowo. Other existing wind farms are located more than 10 km away.

The neighboring existing wind farms are located at a distance and there are wide areas of wind turbine free space between them. Therefore, the absence of negative cumulative impact and the ecological barrier effect can be predicted.

Implementation of the proposed "new" variant of the project will reduce the potential ecological barrier effect.

Impact of reducing the number and parameters of wind turbine on the natural environment.

As the content of the above section shows, the planned change in the number and parameters of wind turbines will reduce the impact of the "new" variant of the project on the natural environment. We can talk about a positive impact — an ecological benefit of sorts, in relation to the "old" variant (Tab. 29).

Table 29. Projected ecological benefit from changing the number and parameters of wind turbines in the "new" variant.

Planned actions	Ecological benefit
Reduce the number of wind turbines from 46 to 34 across the project area	Total reduction of the project's impact on the natural environment

	Enlargement of the biologically active surface without wind turbines
	Enlargement of the area of habitats available to birds
	Enlargement of the area of habitats safe for white-tailed eagles and facilitate collision-free access to feeding ground
	Enlargement of areas free of risk of collision with wind turbines,
	Elimination of a row of wind turbines along the Tywa River Valley, reduction of the barrier effect
	Increase of opportunities for collision-free movement of birds
Reduction of the number of wind turbine by 9 in the vicinity of Sosnowo and Banie 3	Reduction of the environmental impact of the project
	Enlargement of open space, free of wind turbine for bird migration
	Elimination of the ecological barrier along the Tywa River Valley
	Reduction of the risk of collisions during bird migration along the Tywa River Valley
Elimination of wind turbines no. 39 and 44 located adjacent to the white-tailed eagle nest (Fig. *[missing figure number in the original version – translator's note]*)	Reduction of the risk of collision of birds with wind turbine, young eagles in particular
	Enlargement of the safe buffer zone at the forest wall from approx. 0.4 km to approx. 0.8 – 1 km, crucial for young birds
	Reduction of the risk of collisions on flights in the eastern direction to Lake Długie and the Tywa River Valley
	Protection of young birds during their flights and hunting practice in the vicinity of the nest
	Enlargement of the safe-to-fly area in the vicinity of the nest, crucial during the birds' departures and arrivals at the nest
	Reduction of the impact on the local white-tailed eagle population
Elimination of 1 wind turbine located north of the nest, at the northern direction of migration (Fig. 3)	Reduction of the risk of white-tailed eagle collisions on northbound flights
	Enlargement of the feeding area free from risk of collision, for white-tailed eagles in particular
Increase in total height of wind turbine from 150 m to 180 m	Total reduction of the project's impact on the natural environment, by increasing Zone 1 — safe, from 50 to 60 m above ground level
	Increase of Zone 1, relevant to: - young white-tailed eagle, - other accipitriformes, - flight of birds during migration

The proposed "old" variant of the project, on the basis of analyses of the natural environment, received a positive environmental assessment decision in 2010. The impact analysis showed no significant adverse impact on the environment, including avifauna and chiropterofauna. There was also no significant negative impact on the population of white-tailed eagle nesting in the vicinity of the proposed wind turbines near Swobnica. The previous option has been approved and a building permit has been issued.

The proposed "new" project variant, based on available pre-completion monitoring data, also does not confirm a significant adverse environmental impact. Reducing the number of wind turbines and changing their overall height, will further minimize the environmental impact of the development. Compared to the "old" variant, the "new" one will have a positive impact on the environment. There will be a decrease in the area undergoing transformation, and an increase in the area of untransformed habitats that animals can use. Zone 1 — safe, will increase, and with that the risk of collisions will decrease. Negative impacts on white-tailed eagle and other accipitriformes populations will be reduced.

To sum up, it can be concluded that the proposed "new" project variant is more environmentally friendly and its implementation will significantly reduce the impact, particularly on the natural environment.

Potential impacts on fauna are projected to decrease as a result of reduced numbers of wind turbines and changes in their parameters. The new variant would not result in significant adverse impacts on fauna.

Impact on biodiversity.

The biodiversity of the project area and adjacent areas will not be significantly altered. The area will continue to be used for intensive agricultural production. Construction and operation of the wind farm will not interfere with valuable natural areas (watercourses, mid-field ponds, lakes, forest complexes and mid-field tree buffers).

No negative impact on biodiversity is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

Impact on people.

No adverse impact on human health is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

10.3. Impact during the decommissioning phase

The impact of the proposed wind turbine construction project, will have little impact on the elements of the natural environment during their decommissioning. Minor disturbance of topsoil may occur as a result of dismantling and disposal of components of wind farm structures, substations, roads, and power lines. Waste will be generated during decommissioning works. Construction elements, as waste ferrous metals (code 16 01 17) and concrete rubble (code 17 01 01), should be transported to appropriate landfills. It should be noted that reducing the number of wind turbines by 12 units will significantly reduce the amount of waste at this stage.

There will be a periodic increase in exhaust and noise emissions associated with the operation of construction and transportation equipment. No impact on flora and fauna is anticipated during decommissioning.

No adverse environmental impact is projected. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project at this stage.

10.4. Impact of the project on forms of nature conservation

Impact on existing forms of nature conservation (excluding Natura 2000 projects).

There are no existing forms of nature conservation in the area covered by the project. The closest ones are outside the impact range of the project.

The project is not expected to have adverse impact on existing forms of nature conservation. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

Impact on the ecosystem of Natura 2000 areas.

There are no existing Natura 2000 areas in the area covered by the project.
The project does not intersect with or cover the same area as any refuge located in its vicinity.
Due to its distance from the refuges, the project will not directly affect the species protected in the individual refuges.
Due to the distance from the refuge, the project will not adversely affect the continuity and coherence of the Natura 2000 network.

No adverse impact on elements of the Natura 2000 ecological network is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

10.5. Impact of the project on historical monuments and the cultural landscape

There are no existing historic or cultural heritage sites in the area were the wind turbines are to be located. The closest ones are outside the impact range of the project.

The project is not expected to have adverse impact on historical monument and the cultural landscape. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

10.6. Possible cross-border impacts

Due to the location of the wind farm at a distance of about 14 km from Polish western border, as well as due to the nature of the operation and the zero-emission technology of producing electricity, no cross-border environmental impact of the project is expected.

10.7. Cumulative Impact

In the course of developing a region's economic infrastructure, facilities are created that can affect the natural environment in a variety of ways. With a single location, the impact is usually minor. However, when multiple facilities are in close proximity, the impact can cumulate.

There are no projects significantly affecting the environment in the Resko commune. No heavy industry, no petrochemicals, and no large industrial livestock production.

The nearest existing wind farm is located approximately 5.1 km to the east and northeast, around the villages: Tetyń, Mielno Pyrzyckie. Other existing wind farms are located in the vicinity of Kozielice, Nowe Chrapowo and Linia, at a distance of about 7 km. The closest ones are: the wind farm near Parsowo — located at a distance of approx. 8.5 km, the wind farm near Schwedt — located at a distance of approx. 25 km, the wind farm near Penkun and Tantow — located at a distance of approx. 26 km, the wind farm near Wierzchowo — located at a distance of approx. 29 km, and the wind farm near Boleszkowice — located at a distance of approx. 32 km. Between them there are wide strips of

open space, several kilometers long, providing free passage for birds, during migration in particular. As the wind farms mentioned above are located at a considerable distance from the project, it can be concluded that there will be no cumulative impact.
Available information on the spatial distribution of bird migration routes, contained in various publications, unpublished data contained in environmental impact reports and results of field observations for the project in question allow the following conclusions to be made:
- the main bird migration routes are located outside the project in question,
- between individual wind farm locations there are large corridors of free space, allowing animals to move freely,
- the nearest operating wind farm is located at a distance of approximately 5.1 km,
- results of pre-investment monitoring of natural conditions indicate no significant negative impact on the natural environment,

Available information on the natural conditions from the areas of planned wind farms as well as the existing one in the vicinity of the project in question as well as the results of field observations in the area of the project result in the conclusion that the investment project in question in the Banie commune will not have a cumulative impact with other projects in the region.

10.8. The effects of a major structural integrity failure, industrial and natural disaster

Wind turbines are technologically advanced devices. Their construction must meet stringent technical and safety requirements. The construction of the tower and rotor are resistant to strong gusts of wind and weatherproof. They have anti-corrosion protection, lightning protection. They feature design elements for vibration damping, noise reduction, electromagnetic field suppression. They have internal protection against leakage of operating fluids. They are self-service devices, monitored in real time.
The possibility of an industrial or construction failure is reduced to a minimum. Cases of failure or destruction are very rare.
A failure or disaster may occur, but due to its location in open farmland, away from development and human habitation, it will not have a negative impact on the environment, plants, animals, or people.

However, should it occur, the investor will be required to remedy the failure or disaster immediately. If necessary, the investor will take appropriate minimization measures.

No adverse environmental impact resulting from a failure or disaster is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

11. Description of potentially significant impacts of the planned project on the environment
11.1. Resulting from the existence of the project

On a time scale, the planned project will have: temporary, permanent, short-, medium- and long-term impact on the environment.
The impact of the proposed "new" project variant will change partially in comparison to the "old" variant, as a result of the reduced number of wind turbines. The impact will be minimized to a greater extent. The "new" variant will result in: reduction of the area of agricultural land converted to assembly and service yards, reduction of areas occupied by service roads, reduction of biologically active surfaces excluded from biological processes, reduction of areas subject to noise and dust emissions during transport of construction elements, and reduction of landscape disharmony.

In the table below, green color indicates the reduction of the impact of an adverse parameter in the "new" variant in comparison to the "old" variant.

Table 30. Projected impact of the project on the environment.

No.	Type of Impact	Execution period	Operation period	Decommissioning period
1	2	3	4	5
1.	Positive	-	Reduction of carbon dioxide emissions to the atmosphere	Restoration of the original function of the site
2.	Adverse	Transformation of soil and topsoil, periodic emission of noise, dust and other pollutants into the atmosphere, and sound emission from machinery operation	Noise emissions, impact on fauna	Periodic emission of noise, dust and other pollutants into the atmosphere and sound emissions from the operation of machinery
3.	Direct	Transformation of soil and topsoil, reduction of biologically active surfaces	Reduction in the area of plant and animal habitat, impact on avifauna	Restoration of the original function of the site
4.	Indirect	Reduction in the area of plant and animal habitats	Reduction of carbon dioxide emissions to atmosphere, disharmony of landscape, slight reduction in the area of plant and animal habitats	Restoration of biologically active surfaces, plant and animal habitats
5.	Short-term	Periodic emission of noise, dust and other pollutants into the atmosphere and sound emissions from the operation of machinery	-	Temporary increase in sound emission
6.	Long-term	Transformation of soil and topsoil, reduction of biologically active surfaces	Transformation of part of the land surface and noise emissions	Restoration of biologically active surfaces, plant and animal habitats
7.	Reversible	Transformation of soil and topsoil, reduction of biologically active surfaces	Noise emissions, landscape disharmony, reduction in the area of plant and animal habitats, impact on avifauna	-
8.	Irreversible (cumulative)	-	-	-

9.	Permanent	-	-	Restoration of biologically active surfaces, plant and animal habitats,
10.	Periodic	Transformation of soil and topsoil, periodic emission of noise, dust and other pollutants into the atmosphere, and sound emission from machinery operation, reduction of biologically active surfaces	Noise emissions, landscape disharmony	Temporary increase in noise emissions

11.2. Resulting from the use of natural resources

During the operation of the project, non-renewable natural resources will not be used.

No adverse significant impacts are predicted.

11.3. Resulting from emissions

Reducing the number of wind turbines will reduce the area subject to noise emissions. There will be a reduction in the area impacted by exhaust and dust emissions from the transportation of construction components and building materials and a smaller network of service roads.

The designed reduction in the number of wind turbines will reduce the amount of emissions to the environment generated during construction, operation, and decommissioning of the project.
The changes in the "new" project variant will have a favorable impact on the local natural environment.

12. Description of anticipated measures to prevent, mitigate and provide natural compensation of possible adverse impact of the project on the environment

In order to minimize the possible impact of wind turbines on the environment, proposed measures to mitigate, prevent adverse impact on the environment are presented.

Mitigation and prevention measures.
Implementation phase:

- organize building sites and back-up facilities outside areas of high natural value,
- prior to works commencement, inspect construction areas for burrows, nests, or other structures used for animal breeding,
- if animal breeding sites are found, perform minimization measures developed on an ongoing basis by the naturalist,
- conduct works in an orderly manner,
- work equipment should be in good working condition,
- the possibility of leakage of lubricants, operating fluids and fuels onto the ground must be prevented,
- if spills are observed, collect the contaminated substrate and store in a sealed container,

- collect the waste in containers and hand it over for disposal to companies with appropriate authorization,
- conduct construction activities between 6 a.m. and 10 p.m. to limit temporary noise increases, outside of the period of continuous construction work on the foundations,
- limit the running time of the engines construction equipment and heavy vehicles to the necessary minimum,
- when transporting excavated soil, cover hoppers with tarps,
- power turbines will be made of ready-made elements assembled at assembly yards,
- during construction and installation works, properly stockpile the stripped soil in a designated area for reuse to restore the original condition upon completion of construction,
- the surface layer of soil obtained during the earthworks should be reused on the building sites,
- disposal of the resulting construction waste to designated disposal sites or to an operating landfill,
- protect excavations for the foundations of towers and the created infrastructure from amphibians, reptiles and small mammals falling into them, and in case they are found, allow them to leave the excavation freely,
- after completion of the construction and assembly works, the area around the towers should be restored to its original condition using the soil obtained during the earthworks,
- strictly restore any loss of vegetation.

Operation phase:

- the locations of individual towers have been moved at least 160 m away from trees,
- locate the power plant towers at an appropriate distance from residential buildings, in order to meet the conditions resulting from the acceptable noise standards,
- measure actual noise levels after commissioning,
- tower construction uses tubular structure, which has less impact on birds than lattice structure,
- the planned wind turbines will be equipped with modern technological solutions ensuring lower noise emission into the environment,
- to eliminate light reflections, the towers and rotor blades will be painted in a light pastel matte color, in addition to the markings required by air traffic regulations,
- no advertising should be placed on wind towers and nacelles, the logo of the power plant manufacturer or energy producer harmonizing with the color of the tower and nacelle itself is acceptable,
- carry out post-implementation monitoring within 3 years from the commissioning of the wind farm, with an annual report submitted to the Regional Nature Conservator,
- submit the monitoring methodology for approval to the Regional Nature Conservator,
- based on the monitoring results provided, the Regional Nature Conservator may decide to apply other necessary minimization measures,
- the investor is obliged to finance the treatment and recovery of birds injured by wind turbines,
- the investor is obliged to keep records of bird fatalities,
- if any bird mortality is observed during migration or breeding season, especially of rare bird species, immediate action should be taken to mitigate the adverse impact on birds.

Decommissioning phase:

- the works should be carried out outside the night time between 6 a.m. and 10 p.m. in order to eliminate the noise associated with the operation of construction machinery and means of transport,
- transport any waste to a designated disposal site or to an operating landfill,
- after the completion of construction works and decommissioning of the investment, the initial character of the area should be restored so as to enable agricultural use, recultivate the sites where access roads and foundations of wind turbines were located,
- in case of a possible wind turbine tower failure or collapse, the investor is obliged to repair any damage caused to the natural environment.

13. Proposals for monitoring the impact of the planned project

During construction, operation and decommissioning of the project, the Investor is obliged to monitor the works and functioning of the project as well as the impact of the investment on the environment.

13.1. Proposals for monitoring during the construction phase

The following should be inspected during the construction phase:
- the course of construction and assembly works, in terms of impact on the vegetation,
- the excavations for the foundations of wind turbines and the created infrastructure for the presence of amphibians, reptiles and small mammals that might have fallen into them,
- amount of noise emissions,
- compliance with the provisions of the environmental decision.

13.2. Proposals for monitoring during the operation phase

- Make measurements of the actual noise level after the start of operation,
- permissible noise levels must be met,
- carry out post-implementation environmental monitoring within 3 years from the date of commissioning the wind farm; monitoring should include:
  - avifauna, based on the recommendations of the General Directorate for Environmental Protection (GDOŚ - Pol. Generalna Dyrekcja Ochrony Środowiska) included in the study by Chylarecki et al. (2011) and more recent studies,
  - chiropterofauna based on recommendations included in the study by Kepel et al. (2011) and more recent studies,
- place wind turbines near Swobnica, in the vicinity of the white-tailed eagle nest, under special surveillance,
- submit annual monitoring reports to RDOŚ in Szczecin,
- the investor is obliged to conduct monitoring of the investment for the occurrence of cases of injured birds at a frequency determined by the environmental supervision,
- in the event of a collision, the investor is obliged to immediately undertake rescue measures at its own expense,
- the investor is obliged to register bird fatalities and report them to RDOŚ in Szczecin.

13.3. Proposals for monitoring during the decommissioning phase

During this phase, the investment area should be restored to its original condition, prior to the start of construction.

14. Analysis of potential social conflicts related to the planned project

A conflict analysis was performed for the earlier, "old" project variant in 2010. As indicated, potential conflicts may relate to the impact on the landscape and visual perception of the wind turbines as new dominant heights in space.
No community conflicts were identified during previous planning work.
The proposed "new" variant of the project assumes raising the total height of the wind turbines by 30 m. In the spatial visual perception of wind turbines this will be a small change, probably unnoticeable to many people.

Reduction of the area of the wind farm by eliminating 12 wind turbines will reduce landscape occupation by approximately 25%. There will be a significant reduction in the number of new dominant heights. Wide areas of undeveloped landscape will thus be created, that will in turn significantly reduce the visual impact of the investment.

The main public objection to this type of project is the increased noise level. As shown in the calculations above, the investor has selected the number and type of turbines that guarantee compliance with the legal noise levels. Maintaining appropriate noise levels should not raise public objections in this case.

15. Indication of the need to establish a limited use area

The project does not require the establishment of a limited use area.

16. Difficulties due to technical deficiencies or gaps in contemporary knowledge

The environmental impact of wind turbines have been well studied. A lot of monitoring and research has been done in the last 2 decades in the world, Europe and Poland. The spread of renewable energy sources and the rapid development of wind energy in the last decade, also in Poland and in the Zachodniopomorskie Voivodeship, have contributed to this.

Zachodniopomorskie is a region with a large number of completed wind farms, including some of the first and some of the largest in the country.
The projects were preceded by pre-implementation and post-implementation monitoring, which provided data showing the impact of wind turbines on the environment, especially on the avifauna.

Despite the abundance of data on the environmental impact of wind turbines, we still cannot determine the impact of a specific project on avifauna with 100% certainty. Although numbers of collisions for individual wind farms are lower than the predicted rates, we still do not know all possible interactions. Forecasting is based on fragmentary data and the results are abstracted to the entire lifetime of the wind turbines. Hence, the forecasts are subject to some error that is still difficult to estimate.

Therefore, following the precautionary principle, the possibility of collision situations should always be taken into account. This is why the investor, before starting the operation, should have a post-implementation monitoring program developed together with environmental supervision and consulted with RDOŚ.

17. Summary and conclusions

- As part of the study, an analysis of the potential environmental impact of changing the "old" wind farm variant to the "new" wind turbine siting variant was performed.
- For the old variant, the decision on environmental conditions of the project (GK-7627/2/2008) was obtained in 2008 and the construction permit was issued.
- In the proposed variant, the number of wind turbines was reduced from 46 to 34 and the wind turbines parameters were changed: tower height to 120 m, rotor blade length to 60 m, total wind turbine height to 180 m.

- This change stems from the passage of time, during which technological progress has been made in terms of increasing the efficiency and reliability of wind turbine operation and the withdrawal from production of older models of wind turbines, which were taken into account in the previous environmental impact analysis.
- The investor decided to change the parameters of wind turbines, adapting the project to the current technological capabilities.
- Other infrastructure elements of the "old" variant remain unchanged.
- Annual pre-investment monitoring was performed for the project, which forms the basis for the environmental impact analyses of the "new" variant.
- The analysis of the impact of the "new" variant, in alternative and investor versions, on the acoustic climate was performed.
- In the course of the analysis, the variant assuming construction of 34 Vestas V110 wind turbines was adopted for implementation. During the construction phase:
  - The impact on soil and ground surface of the "new" variant was found to be reduced in comparison to the "old" variant
  - The project is not expected to have an adverse impact on surface water, groundwater, or underground water.
  - The project is not expected to have an adverse impact on the condition of the air. The proposed variant will reduce pollutant emissions, thereby reducing the threat to the air.
  - No adverse impact on climate is expected from the construction of the wind farm. The proposed "new" variant will significantly reduce potential climate impact.
  - The project is not expected to have an adverse impact on the natural resources.
  - The project is not expected to have a significant adverse impact on tangible property,
  - The project is not expected to have a significant adverse impact on the natural landscape. The project is not expected to have adverse impact on historical monuments and modern cultural heritage,
  - The project is not expected to pose significant threat to the acoustic environment. Reducing the number of wind turbines in the proposed alternative will further reduce the impact of the project.
  - No vibration hazards beyond the boundaries of the areas covered by works are predicted. Reducing the number of wind turbines in the proposed alternative will further reduce the impact of the project.
  - No adverse impact from electromagnetic fields is predicted. Reducing the number of wind turbines in the proposed alternative will further reduce the impact of the project.
  - No adverse infrasound impact is predicted. Reducing the number of wind turbines in the proposed alternative will further reduce the impact of the project.
  - No adverse environmental impact is predicted. Reducing the number of wind turbines in the proposed alternative will further reduce the impact of the project.
  - No significant adverse impact on the vegetation is predicted. Reducing the number of wind turbines in the proposed alternative will further reduce the impact of the project.
  - No significant adverse impact on fauna, especially birds, is predicted. Reducing the number of wind turbines in the proposed alternative will further reduce the impact of the project.
  - No significant adverse impact on biodiversity resources is predicted. Reducing the number of wind turbines in the proposed alternative will further reduce the impact of the project.
  - No adverse impact on the existing protected areas is predicted. Reducing the number of wind turbines in the proposed alternative will further reduce the impact of the project.
  - No adverse impact on human health is predicted. Reducing the number of wind turbines in the proposed alternative will further reduce the impact of the project.
- The construction phase impact analysis concludes that the proposed "new" project variant will be more favorable to the environment. Its implementation will result in reduced impact compared to the "old" variant.

During the operation phase:

- No adverse impact on the ground surface is predicted.
- No adverse impact on surface and groundwater is predicted. Reducing the number of wind turbines in the proposed alternative will further reduce the impact of the project.
- Positive impact on the condition and quality of the air is predicted.
- No adverse impact on the climate is predicted. Reducing the number of wind turbines in the proposed alternative will further reduce the impact of the project.
- No adverse impact on natural resources is predicted. Reducing the number of wind turbines in the proposed alternative will further reduce the impact of the project.
- No adverse impact on tangible property is predicted. Reducing the number of wind turbines in the proposed alternative will further reduce the impact of the project.
- No significant adverse impact on landscape, cultural heritage and historical monuments as well as on modern cultural assets is predicted. Reducing the number of wind turbines will further reduce the impact of the project.
- No adverse impact on noise levels is predicted. Reducing the number of wind turbines will further reduce the impact of the project.
- No significant adverse impact on vibration generation is predicted. Reducing the number of wind turbines in the proposed alternative will further reduce the impact of the project.
- No adverse impact from electromagnetic field emissions is predicted. Reducing the number of wind turbines in the proposed alternative will further reduce the impact of the project.
- No adverse impact from infrasound emissions is predicted. Reducing the number of wind turbines in the proposed alternative will further reduce the impact of the project.
- No adverse impact on waste management is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the amount of waste generated, thus the impact of the project.
- No adverse impact on the vegetation is predicted.
- The “new” proposed project variant would have no significant adverse impact on mammals.
- No significant adverse impact of the proposed variant on avifauna in all phenological periods is predicted, the reduction of the occupied space and the number of wind turbines will reduce the impact in comparison to the "old" variant,
- The analysis of the reduction in the number and increase in the wind turbine parameters indicates a significant reduction in the impact of the “new” variant of the project on the population of white-tailed eagles.
- Implementation of the "new" variant will reduce the potential for bird collisions with wind turbines.
- Implementation of the "new" variant will result in a reduction of transformed habitats, thus increasing the areas favorable for birds.
- The potential impact on fauna is predicted to decrease as a result of reduced numbers of wind turbines and changes in their parameters. The new variant would not result in significant adverse impact on fauna,
- No adverse impact on biodiversity is predicted. Reducing the number of wind turbines in the proposed alternative will further reduce the impact of the project.
- No adverse impact on human health is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

- During the decommissioning phase, no adverse impact on the environment is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.
- No adverse impact on existing forms of nature conservation is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.
- No adverse impact on elements of the Natura 2000 ecological network is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.
- No adverse impact on historical monument and the cultural landscape is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.

- No cross-border impact is predicted.
- No significant cumulative effect is predicted.
- No adverse environmental impact resulting from a failure or disaster is predicted. Reducing the number of wind turbines in the proposed variant will further reduce the impact of the project.
- The designed reduction in the number of wind turbines will reduce the amount of emissions to the environment generated during construction, operation, and decommissioning of the project.
- The changes in the "new" project variant will have a favorable impact on the local natural environment.
- The anticipated measures aimed at minimizing the potential environmental impact of the project during the construction, operation and decommissioning phases were presented.
- The assumptions for monitoring the impact of the planned project during the construction, operation and decommissioning phases were presented.
- The collected data and performed analyses indicate that the "new" variant of the project is more environmentally friendly.
- Implementation of the "new" project variant will have a positive environmental impact compared to the "old" variant.

18. Summary in non-specialist language

The subject of the study is the construction of a wind farm consisting of 34 wind turbines in the Banie commune. The report analyses a new variant for a wind farm with 46 wind turbines, for which the environmental decision was obtained in 2009 (GK-7627/2/2008) and the construction permit was issued.

The purpose of the study is to analyze the possible environmental impact of the "new" variant of the investment, with the following change of parameters: tower height to 120 m and blade length to 60m. Other elements of the wind farm infrastructure remain unchanged.

For the purposes of the study, a noise analysis was performed for the new variants of the investment: alternative and investment ones. The most environmentally favorable variant consisting of 34 Vestas V110 wind turbines was proposed.

The proposed alternative variant will meet environmental regulatory requirements.

No adverse environmental impact is predicted during construction. In some cases, there will be a positive environmental impact.

No significant adverse environmental impact is predicted during operation. Similar to the construction phase, there will be a positive impact on the environment, especially on the avifauna.

The collected data indicate that the impact on birds will be lower compared to the "old" variant (46 wind turbines), and in some aspects even positive (collisions, habitat loss, barrier effect). The impact of the "new" variant on the white-tailed eagle population is projected to decrease compared to the "old" variant.

Also for mammals, especially bats, a reduction in impact is anticipated compared to the "old" variant.

No adverse impact on the existing forms of nature conservation located in the vicinity of the project, including the ecological integrity and continuity of the Natura 2000 network, is expected.

Analysis of available materials does not indicate the possibility of a cross-border impact or the occurrence of a cumulative impact.

The proposed "new" investment variant will result in reduced adverse impact and positive impact on the environment, especially birds.

In order to minimize the possible impact of wind turbines on the environment, proposed measures to mitigate, prevent adverse impacts on the environment are presented:

implementation phase:

- organize building sites and back-up facilities outside areas of high natural value,
- prior to works commencement, inspect construction areas for burrows, nests, or other structures used for animal breeding,
- if animal breeding sites are found, perform minimization measures developed on an ongoing basis by the naturalist,
- conduct works in an orderly manner,
- work equipment should be in good working condition,
- the possibility of leakage of lubricants, operating fluids and fuels onto the ground must be prevented,
- if spills are observed, collect the contaminated substrate and store in a sealed container,
- collect the waste in containers and hand it over for disposal to companies with appropriate authorization,
- conduct construction activities between 6 a.m. and 10 p.m. to limit temporary noise increases, outside of the period of continuous construction work on the foundations,
- limit the running time of the engines construction equipment and heavy vehicles to the necessary minimum,
- when transporting excavated soil, cover hoppers with tarps,
- power turbines will be made of ready-made elements assembled at assembly yards,
- during construction and installation works, properly stockpile the stripped soil in a designated area for reuse to restore the original condition upon completion of construction,
- the surface layer of soil obtained during the earthworks should be reused on the building sites,
- disposal of the resulting construction waste to designated disposal sites or to an operating landfill,
- protect excavations for the foundations of towers and the created infrastructure from amphibians, reptiles and small mammals falling into them, and in case they are found, allow them to leave the excavation freely,
- after completion of the construction and assembly works, the area around the towers should be restored to its original condition using the soil obtained during the earthworks,
- strictly restore any loss of vegetation.

operation phase:

- the locations of individual towers have been moved at least 160 m away from trees,
- locate the power plant towers at an appropriate distance from residential buildings, in order to meet the conditions resulting from the acceptable noise standards,
- measure actual noise levels after commissioning,
- tower construction uses tubular structure, which has less impact on birds than lattice structure,
- the planned wind turbines will be equipped with modern technological solutions ensuring lower noise emission into the environment,
- to eliminate light reflections, the towers and rotor blades will be painted in a light pastel matte color, in addition to the markings required by air traffic regulations,
- no advertising should be placed on wind towers and nacelles, the logo of the power plant manufacturer or energy producer harmonizing with the color of the tower and nacelle itself is acceptable,
- carry out post-implementation monitoring within 3 years from the commissioning of the wind farm, with an annual report submitted to the Regional Nature Conservator,

- submit the monitoring methodology for approval to the Regional
  Nature Conservator,
- based on the monitoring results provided, the Regional Nature Conservator may decide to apply other necessary minimization measures,
- the investor is obliged to finance the treatment and recovery of birds injured by wind turbines,
- the investor is obliged to keep records of bird fatalities,
- if any bird mortality is observed during migration or breeding season, especially of rare bird species, immediate action should be taken to mitigate the adverse impact on birds.

decommissioning phase:

- the works should be carried out outside the night time between 6 a.m. and 10 p.m. in order to eliminate the noise associated with the operation of construction machinery and means of transport,
- transport any waste to a designated disposal site or to an operating landfill,
- after the completion of construction works and decommissioning of the investment, the initial character of the area should be restored so as to enable agricultural use, recultivate the sites where access roads and foundations of wind turbines were located,
- in case of a possible wind turbine tower failure or collapse, the investor is obliged to repair any damage caused to the natural environment.

In summary, it can be concluded that the proposed "new" variant of the project, which consists in reducing the number of wind turbines to 34 and changing the height of the tower and rotor blade length, will not significantly affect the quality of the environment. Quite the opposite, it will positively affect the environment, compared to the "old" variant.

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