Appendix no. 4

The assessment of the Baltica OWF's impact on migratory birds in relation to barrier effect and collision risk based on the model calculations

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Gdańsk, November 2017

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1 The list of migratory bird species and assessed value of individual species

The migratory flows of individual species have been calculated based on data from the inventory survey (The Inventory Report). This information accompanied by the abundance of biogeographic populations and the assessment of the significance of the resource were presented in table (Table 1). This information was used as a basis to assess the significance of impact of the OWF Baltica on migratory birds.

Table 1. The list of migratory bird species/groups of species included in the Environmental Impact Assessment with an indications as to the size of the biogeographic population, estimated percentage of biogeographic population flying above the area, the protection status and significance of the species

Name of the species	**Binomial nomenclature**	**Abundance of the biogeographic population**	**Abundance of the Baltic Sea population**	**Migration season**	**Migration stream in a season**	**% of the bio-geographic population**	**% of the Baltic Sea population**	**Species protection in Poland[1]**	**Annex 1 to the EU Birds Directive**	**IUCN[2]**	**SPEC[3]**	**Species signific-ance**
Long-tailed duck	*Clangula hyemalis*	1,600,000	350,000	Spring	76,589	4.8%	21.9%	Strict	Not	VU	Non-SPEC	High
				Autumn	44,982	2.8%	12.9%					
Common scoter	*Melanitta nigra*	550,000	500,000	Spring	53,917	9.8%	10.8%	Strict	Not	LC	Non-SPEC	High
				Autumn	24,407	4.4%	4.9%					
Velvet scoter	*Melanitta fusca*	450,000	170,000	Spring	9242	2.1%	5.4%	Strict	Not	VU	SPEC 3	High
				Autumn	8330	1.9%	4.9%					
Eurasian wigeon	*Anas penelope*	1,500,000	N/D	Spring	1984	0.1%	N/D	Strict	Not	LC	Non-SPEC	Low
				Autumn	3010	0.2%	N/D					
Common teal	*Anas crecca*	>1,000,000	>500,000	Spring	2480	0.2%	0.5%	G	Not	LC	Non-SPEC	Low
				Autumn	2066	0.2%	0.4%					
Mallard	*Anas platyrhynchos*	>4,000,000	>1,000,000	Spring	1462	<0.1%	0.1%	G	Not	LC	Non-SPEC	Low
				Autumn	5651	0.1%	0.6%					
Greater scaup	*Aythya marila*	310,000	>12,000	Spring	1230	0.4%	10.3%	Strict	Not	LC	SPEC 3	Medium
				Autumn	1000	0.3%	8.3%					
Geese	*Anserini*	>3,500,000	N/D	Spring	3167	0.1%	N/D	Not applicable				
				Autumn	10,444	0.3%	N/D					
Greater white-fronted goose	*Anser albifrons*	Not applicable						G	Not	LC	Non-SPEC	Low
Greylag goose	*Anser anser*							G	Not	LC	Non-SPEC	Low

Name of the species	Binomial nomenclature	Abundance of the biogeographic population	Abundance of the Baltic Sea population	Migration season	Migration stream in a season	% of the bio-geographic population	% of the Baltic Sea population	Species protection in Poland[1]	Annex 1 to the EU Birds Directive	IUCN[2]	SPEC[3]	Species signific-ance
Bean goose	*Anser fabalis*							G	Not	LC	Non-SPEC	Low
Swans	*Cygnidae*	300,000	100,000	Spring	528	0.2%	0.5%	Not applicable				
				Autumn	4777	1.6%	4.8%					
Tundra swan	*Cygnus columbianus*	Not applicable						Strict	Yes	LC	SPEC 3	High
Whooper swan	*Cygnus cygnus*							Strict	Yes	LC	Non-SPEC	Medium
Mute swan	*Cygnus olor*							Strict	Not	LC	Non-SPEC	Low
Gaviiformes	*Gaviiformes*	>400,000	8600	Spring	3140	0.8%	36.5%	Not applicable				
				Autumn	2893	0.7%	33.6%					
Black-throated loon	*Gavia arctica*	Not applicable						Strict	Yes	LC	SPEC 3	Medium
Red-throated loon	*Gavia stellata*							Strict	Yes	LC	SPEC 3	Medium
Auks	*Alcidae*	Not applicable		Spring	19,077	Not applicable						
				Autumn	36,778							
Razorbill	*Alca torda*	>1,000,000	23,000	Spring	13,366	1.3%	58.1%	Strict	Not	NT	Non-SPEC	Low
				Autumn	22,060	2.2%	95.9%					
Common murre	*Uria aalge*	>4,000,000	19,000	Spring	4751	0.1%	25.0%	Strict	Not	LC	Non-SPEC	Low
				Autumn	15,159	0.4%	79.8%					
Great black	*Phalacrocorax*	405,000	100,000	Spring	2496	0.6%	2.5%	Partial	No	LC	Non-	Low

Name of the species	Binomial nomenclature	Abundance of the biogeographic population	Abundance of the Baltic Sea population	Migration season	Migration stream in a season	% of the bio-geographic population	% of the Baltic Sea population	Species protection in Poland[1]	Annex 1 to the EU Birds Directive	IUCN[2]	SPEC[3]	Species signific-ance
cormorant	*carbo*			Autumn	3456	0.9%	3.5%				SPEC	
Little gull	*Larus minutus*	>72,000	50,000	Spring	8762	12.2%	17.5%	Strict	Yes	LC	SPEC 3	High
				Autumn	7383	10.3%	14.8%					
Black-headed gull	*Larus ridibundus*	>4,770,000	1,350,000	Spring	4191	0.1%	0.3%	Strict	Not	LC	Non-SPEC	Low
				Autumn	3115	0.1%	0.2%					
Lesser black-backed gull	*Larus fuscus*	>1,200,000	56,000	Spring	2861	0.2%	5.1%	Strict	Not	LC	Non-SPEC	Low
				Autumn	3892	0.3%	7.0%					
Common gull	*Larus canus*	1,000,000	>75,000	Spring	3229	0.3%	4.3%	Strict	Not	LC	SPEC 2	Low
				Autumn	2668	0.3%	3.6%					
Terns	*Sternidae*	>1,800,000	>440,000	Spring	6940	0.4%	1.6%	Not applicable				
				Autumn	7539	0.4%	1.7%					
Black tern	*Chlidonias niger*	Not applicable						Strict	Yes	LC	SPEC 3	Medium
Sandwich tern	*Sterna sandvicensis*							Strict	Yes	LC	SPEC 2	Medium
Arctic tern	*Sterna paradisaea*							Strict	Yes	LC	Non-SPEC	Low
Common tern	*Sterna hirundo*							Strict	Yes	LC	Non-SPEC	Medium
Caspian tern	*Hydroprogne caspia*							Strict	Yes	LC	SPEC 3	Low
Parasitic jaeger	*Stercorarius parasiticus*	>100,000	>2000	Spring	335	0.3%	16.8%	Strict	Not	LC	Non-SPEC	Low
				Autumn	368	0.4%	18.4%					
Eurasian curlew	*Numenius*	>700,000	>200,000	Spring	9876	1.4%	4.9%	Strict	Not	NT	SPEC 2	Medium

Name of the species	Binomial nomenclature	Abundance of the biogeographic population	Abundance of the Baltic Sea population	Migration season	Migration stream in a season	% of the bio-geographic population	% of the Baltic Sea population	Species protection in Poland[1]	Annex 1 to the EU Birds Directive	IUCN[2]	SPEC[3]	Species signific-ance
	arquata			Autumn	1833	0.3%	0.9%					
Plovers	*Pluvialis sp.*	>820,000	>150,000	Spring	1385	0.2%	0.9%	Not applicable				
				Autumn	1010	0.1%	0.7%					
European golden plover	*Pluvialis apricaria*	Not applicable						Strict	Yes	LC	Non-SPEC	Low
European sand martin	*Pluvialis squatarola*							Strict	Not	LC	Non-SPEC	Low
Common crane	*Grus grus*	410,000	40,000	Spring	559	0.1%	1.4%	Strict	Yes	LC	SPEC 2	Low

[1] Pursuant to the Regulation of the Minister of Environment of 16 December 2016 on protection of animal species (Journal of Laws 2016, item 2183): Strict – strictly protected species; Partial – partially protected species; pursuant to the Regulation of the Minister of the Environment of 11 March 2005 on establishment of a list of game species (Journal of Laws 2005 no. 45, Item 433). G – game species

[2] IUCN – classification created by the International Union for the Conservation of Nature and Natural Resources, global list, version 2017-2: EN – endangered species; VU – vulnerable species; NT – near threatened species; LC – species of the least concern

[3] SPEC (Species of European Conservation Concern) category of special concern, specified by the BirdLife International federation: Non-SPEC - categories the European population of which does not exceed 50% of the world populations and the conservation status of which is regarded favourable, SPEC 2 – species the European population of which exceeds more than 50% of the world population, and the conservation status of which is classified as unfavourable; SPEC 3 – species the European population of which does not exceed 50% of the world population and the conservation status of which is classified as unfavourable;

N/D – no data

Source: internal data

2 Barrier effect

Sample possible flight paths of migratory birds through the survey area, taking into account the barrier effect and lack thereof were presented in figures (Figure 1 and Figure 2). Forced change of route in order to avoid the OWF is longer by an average of 12.3 km, which increases the energetic cost in less than 1% of the majority of species for which the bioenergetic modelling was carried out (for crane it increases by 1.2%) (Table 2). For the remaining species the increase in energetic cost will maintain a similar level.

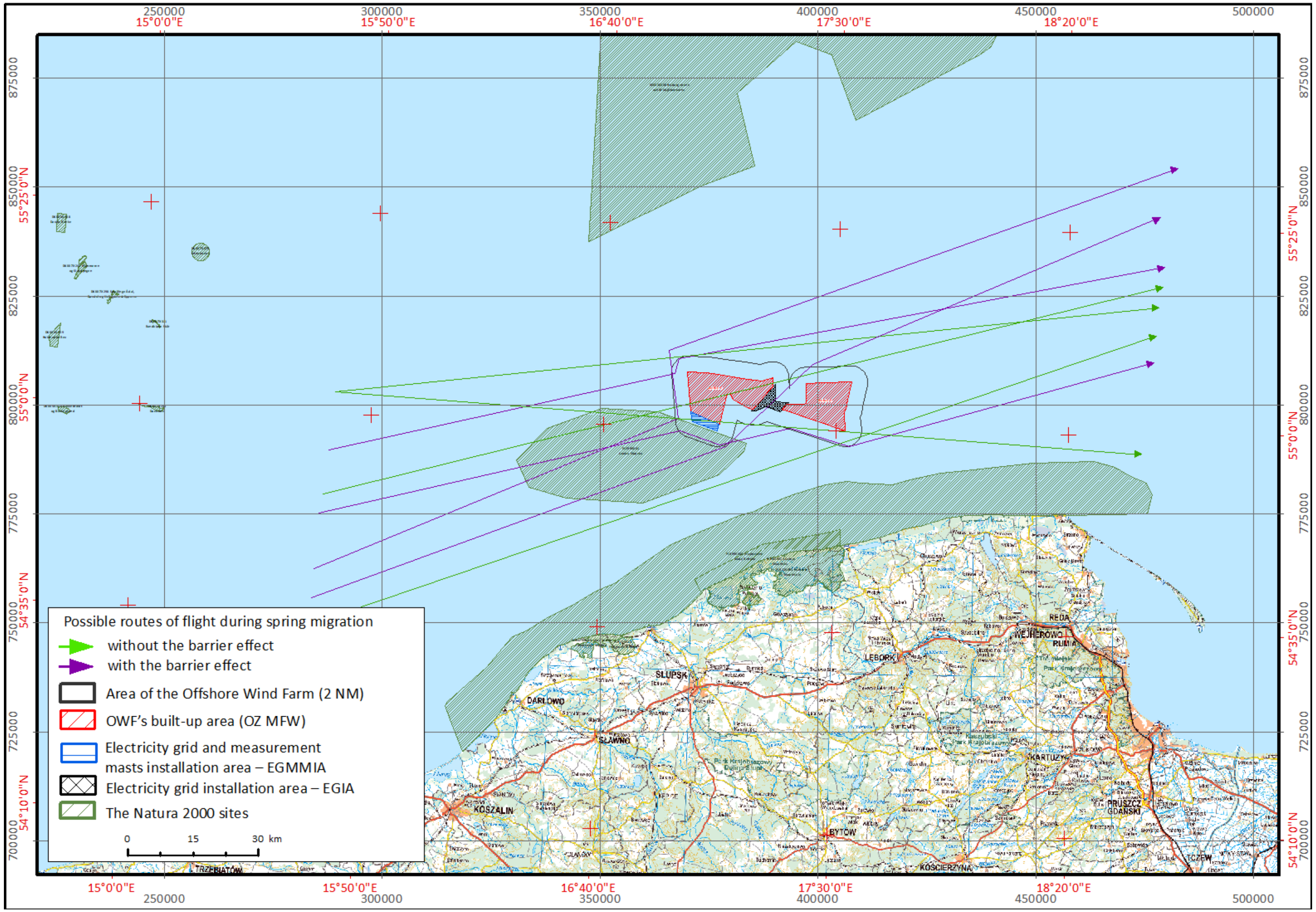

Figure 1. Sample possible routes of flight through the OWF Baltica area taking into account the barrier effect (violet lines) and without the barrier effect (green lines) during spring migration

Source: internal data

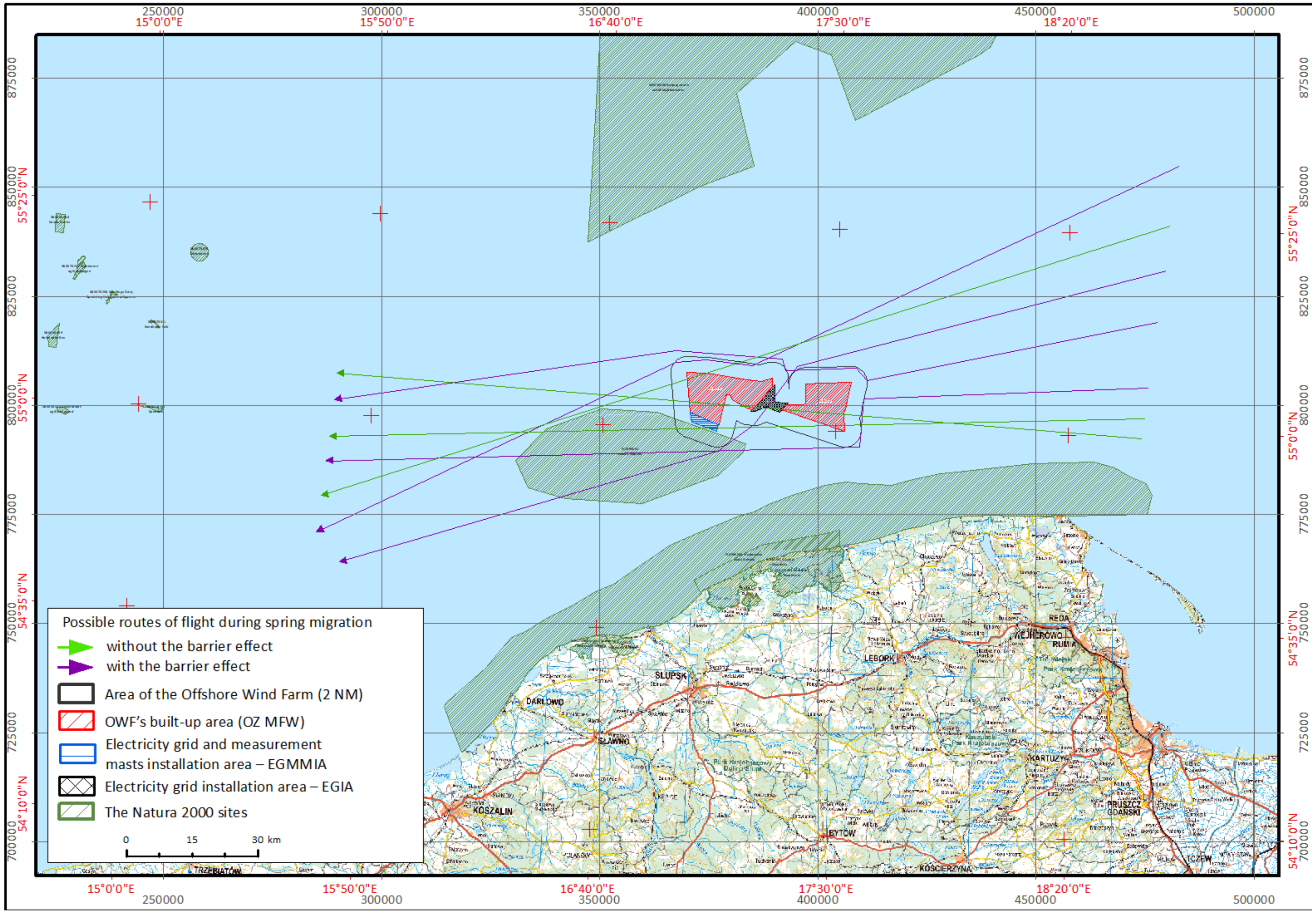

Figure 2. Sample possible routes of flight through the OWF Baltica area taking into account the barrier effect (violet lines) and without the barrier effect (green lines) during autumn migration

Source: internal data

Table 2. Estimated energetic cost accounting for the barrier effect generated by the OWF Baltica during migration

Species	**Binomial nomenclature**	**Distance to cross during migrations**	**Energetic cost to cross the migration route [kJ]**	**% of elongation for the distance in the case of a barrier effect (by 12.3 km)**	**% of increase in the energetic cost in the case of a barrier effect**
Long-tailed duck	*Clangula hyemalis*	3258	8250	0.4%	0.4%
Common scoter	*Melanitta nigra*	2863	9760	0.4%	0.4%
Geese (illustrated by the case of greater white-fronted goose)	*Anserini (Anser albifrons)*	3369	20,500	0.4%	0.4%
Common crane	*Grus grus*	984	16,200	1.2%	1.2%
Whooper swan	*Cygnus cygnus*	3080	88,000	0.4%	0.2%
Eurasian wigeon	*Anas penelope*	2890	6040	0.4%	0.5%
Common teal	*Anas crecca*	4100	2480	0.3%	0.4%

Source: internal data

Long-tailed ducks migration takes place across the entire width of the Baltic Sea. Therefore, only a small percentage of birds will be forced to change their flight path due to a barrier in the form of MFW Baltica. The elongation of a migration route by 0.4% (12.3 km) will take place compared to a route without the barrier. The energetic cost related to it has a negligible significance for long-tailed ducks due to the fact that migration routes within a population differ from one another depending on the selected route (along the southern coast of Sweden, through the Southern Baltic Sea etc.) and on the weather conditions in the time of the trip. Despite a large significance of long-tailed duck as a species (Table 1), the significance of the impact was considered of no importance (Table 6). The proposed corridor between the Baltica 2 and Baltica 3 areas may decrease the barrier effect in the case of birds which decide to fly through the corridor. As for now, there are no examples of existing OWF as large as the series of MFW BŚII, Baltica and BŚIII. Therefore the significance of the impact of such a large barrier is not known, as well as the effectiveness of corridors similar to the one designed there.

Migration of common scoters takes place across the entire width of the Baltic Sea. The elongation of a migration route by 0.4% (12.3 km) will take place compared to a route without the barrier. The energetic cost related to it has a negligible significance for long-tailed ducks due to the fact that migration routes within a population differ from one another depending on the selected route (along the southern coast of Sweden, through the Southern Baltic Sea etc.) and on the weather conditions in the time of the trip. Despite large numbers of common scoters observed in the OWF Baltica area and a high significance of common scoter as a species (Table 1), the significance of the impact was considered of no importance (Table 6).

Migration of velvet scoters takes place across the entire width of the Baltic Sea. The assessment of the barrier effect impact on this species will be similar as in the case of long-tailed duck and common scoter, species with similar behaviour, morphology and ecology as velvet scoter. Due to the scale of impact of the barrier effect on sea ducks (negligible), despite a large significance of the species (Table 1), the significance of the impact was considered of no importance (Table 6).

Migrating common teal, due to elongation of the route by 12.3 km would need 0.3% more energy to cross the survey route. Common teal is smaller than the sea ducks described above, therefore its energetic demand is relatively lower. The significance of the barrier effect impact on common teal was considered of no importance, taking into account the scale of impact and the fact that it belongs to game species in Poland.

Loons will probably avoid flying into the OWF area and it may be expected that they will avoid the OWF Baltica Area, which will make the route longer. The related consequences in the form of increased energetic cost will be small, comparable to the impact on sea ducks. The migration route is similar to the long-tailed duck, from wintering grounds in the Baltic Sea in the directions of the Kara Sea and the Arctic, therefore the change of route will constitute an equally low percentage of the total length of the migration route. Therefore, this impact on both loon species was considered of no importance (Table 6).

Great black cormorant, similarly to other waterbirds, travels across the Southern Baltic Sea with a wide front and the differences between the lengths of the trips of individual species may be greater than the added route distance resulting from the barrier effect. It was considered that the barrier effect has a significance of no importance on the great black cormorant if the birds will avoid the OWF Baltica Area. However, in many cases it was observed that OWF are not considered as barriers for the great black cormorants (Kahlert et al. 2011).

Migration of swans will also take place through a wide front and the differences between the lengths of trips of individual species may be greater than the additional route length resulting from the barrier effect. With regard to various statuses of species, this impact will have impact of no importance for mute swan and whooper swan, and of little importance for tundra swan (Table 6).

The change of route related with the barrier effect will increase the energetic cost in geese by 0.4%, which means 75 kJ, and will have a negligible significance on the condition of these birds. Taking into account assumptions made in impact assessment, its negligible scale, very abundant biogeographic populations, it was considered that the significance of the barrier effect will be of no importance for all goose species taken into account greater white-fronted goose, bean goose and greylag goose) (Table 6).

Migration of Eurasian wigeons, similarly to other waterbirds, takes place through a wide front across the Baltic Sea waters. The significance of the impact was considered insignificant, taking into account its scale and the fact that in this case the increase of the energetic cost will be negligible (0.4%).

During flight above open waters, cranes fly in a wide front because there are no elements in the landscape which would focus them in a selected flight corridor. The significance of the barrier effect was considered of no importance. The increase of energetic cost at the level of 1.2% is negligible and will have no significance for the condition of crane, taking into account the diversity of specific routes for individuals and the fact that in the cases of bad weather the route may be even longer.

All migrating seagull species (little gull, black-headed gull, lesser black-backed gull, common gull) avoid the Southern Baltic Sea on a route between the nesting grounds in the Eastern Europe and the wintering grounds at the Atlantic Ocean shores. Similarly as the case of other seabirds, there is no specific migration corridor above the Baltic Sea waters and this sea area is crossed with a broad front. For all these species, the significance of the barrier effect was considered of no importance (except for the little gull, for which the significance is of no importance, due to the high significance of the species), due to the fact that energetic demand of these birds are lower than, for instance for sea ducks, therefore the increase of energetic costs in relation to route elongation will be negligible for the condition of these birds.

The significance of the barrier effect for terns was also considered of no importance, as they are characterised by a similar manner of crossing the Baltic Sea as seagulls. The significance of energetic cost will have no impact on the terns' condition. Additionally, terns have one of the lowest energetic costs among the assessed birds.

Migrating auks also move with a broad front and natural differences in the length of the trip route may be greater than the additional route length due to the presence of the planned OWF in the flight route of part of them. For both species (razorbill, common murre the significance of the impact was considered of no importance (Table 6).

The significance of the barrier effect for plovers was considered insignificant due to the fact that these birds migrate via the Baltic sea with a broad front and the final length of the trip may differ for specific individuals, taking into account for instance the influence of bad weather. These differences may be greater than 12.3 km of the additional route length due to the fact that the OWF is avoided.

The significance of the barrier effect for parasitic jaeger was considered of no importance, taking into account the same assumptions as the ones for seagulls and terns. It is a relatively small species with a smaller energetic demand, its significance is low, which influences the of no importance significance of the impact.

The impact of the barrier effect on passerines is of no importance. The majority of passerines are nigh migrants that fly at very large heights, as shown in the Abiotic and Biotic Resources of the OWF Area Inventory Report. Energetic cost made in order to avoid the OWF will concern only a small fraction of passerines which fly lower than the majority of these birds.

A table with a collective list of significances of impacts of the OWF Baltica on individual bird species were presented in chapter 4.

3 Collision risk

In order to determine the collision risk of individual stationary and migratory bird species in the survey area, a widely used collision risk model by Band was used (Band 2012). The "Basic" Band model was created for the purposes of onshore wind farms and was modified in 2012 to adjust better to the analyses of seabirds' collisions with offshore wind farms. The updated model was named the "extended Band model". In this study the extended version of the model was applied for three sea duck species (long-tailed duck, common scoter and velvet scoter) where there is enough data to determine the frequency distribution of the flight height in 1 m intervals. For the remaining species the “basic Band model” was used and both models were calibrated in accordance with guidelines (Band 2012) and spreadsheets available in the website: http://www.bto.org/science/wetland-and-marine/soss/projects.

Estimate of the bird collision risks requires that quantitative data are obtained about stationary and migrating birds, as well as information about single wind power stations and offshore wind farms parameters. Then the collision risk estimation involves determination of a series of assumptions. Firstly, it is assumed that the probability of collision with a rotor depends only on the bird size (wing span and surface), range and blade inclination angle, rotor speed and bird flight direction. In order to facilitate calculations it was assumed that a bird has a simplified shape of a cross, with wings in the middle of the distance between the beak and the tail, a rotor blade has a width and inclination angle of a blade, but has no width, and the bird flight will not be influenced on potentially dangerous events, despite a stream of air that flows around the rotor blades. Further it was assumed that birds ply through the offshore wind power station at an angle of 90 degrees, even if they approach the rotor diagonally. It is justified by the fact that the decrease of the area cut through and elongation of the time needed for the bird to cross the rotor plane during diagonal flight probably even out (Band 2012).

Band (2012) describes the model in six stages:

- Stage a – gathering data on number of bird flights which did not move from the farm area, do not avoid it or they were drawn to the wind farm area by curiosity and are potentially vulnerable to collision risk;
- Stage B – the use of data on bird activity to estimate potential lumber of bird flights through the rotor surface of a wind farm;
- Stage C – calculating the risk of collision for a single individual rotor surface passage;
- Stage D – multiplication of the above in order to obtain the potential mortality rate as a result of collision for bird species, taking into account proportionally the time when the wind power stations do not operate, assuming the current use and lack of avoidance;
- Stage E – taking into account the share of birds which most probably will avoid the wind farm of wind power stations because they moved from an area or will avoid it; taking into account that farm might attract birds e.g. due to change of habitat;
- Stage F – expressing uncertainty of the collision risk analysis obtained this way.

Estimation of collision risk results from connection of the first 5 stages and their verification by uncertainty from the last stage (F). Stage a defines bird flights, which makes it possible to estimate the stream of birds flying through the surface of the rotor based on density (stationary birds) or the flight index (migratory birds). In the C stage the probability of collision for a single flight based on the characteristics of an offshore wind power station and a bird. Stages B and C are then connected by multiplication of the number of flights by the collision risk for a single flight and operation time of the wind farm, which results in the number of collisions in a month, assuming there is no avoidance. The extended model used for three sea ducks species allows diversity of bird stream and probability of collision within the rotor cross-section therefore these results must be summed for the entire surface of the rotor cross-section surface. The extended model is based on an assumption that the densification of bird flights increases at lower heights, and the risk of collision is lower at the ends of rotor blades and higher closer to the nacelle. For the remaining species the basic model was used, which is based on the proportional number of birds in the rotor rotation zone. At stage E the reaction of avoidance is added in order to obtain the final estimate of the number of collisions per month. The avoidance coefficients closest to the values known from the literature for individual species were selected from the list: 95%, 98%, 99% and 99.5% (Band 2012). For cranes other coefficients mentioned above were selected.

In the case of cranes, three hypothetical reaction scenarios were introduced, similarly for birds of prey, in order to increase the number of probable collision indices. It results from insufficient knowledge available on the behaviour of migratory cranes regarding offshore wind farms. Behaviour scenarios assumed for birds of prey are based on an assumption that large gliding terrestrial birds consider the offshore Wind Farm as attractive, safe object. In this scenario, bird interest of 35% is assumed, which means that more birds enter the farm area than follow the previous flight route. The bird attraction coefficient was calculated based on data for European honey buzzard *Pernis apivorus* and red kite *Milvus milvus* that migrate in the direction of Rødsand-2 wind farm in Denmark (based on Kahlert et al. 2011, Skov et al. 2012, after DHI 2014). Then, in conjunction with large-scale attraction, three indices of avoidance were assumed for the small scale, when the birds already fly into the wind farm area: 0%, 50% and 95% respectively. These scenarios are also considered due to lack of knowledge on the behaviour of large gliding terrestrial birds when encountering offshore wind farms during migration, especially as the recent surveys on attraction of birds of prey by offshore wind farms complicate the assumptions regarding small-scale avoidance inside the wind farm. When joining 35% large-scale attraction at a large scale and three versions of results were obtained as for birds of prey: avoidance by 35% attraction (or -35% avoidance), 32.5% avoidance and 93.25% avoidance.

At the last stage (F) uncertainties related with subsequent stages will be expressed. Each stage of calculating the collision risk involves uncertainties (e.g. bird density/flights indices; nocturnal activity, share of height, size and operation time of offshore wind power station and simplification of collision model). Uncertainty for individual stages was in this study based on expert assessment and therefore it should be used as the indicated uncertainty scope. Due to lack of more accurate data, the same uncertainty value was applied for all species. Errors result from the intention to reach 95% confidence interval. Uncertainty of density/flights indices equals are least 50% (e_1=0.50). Due to a small amount of information about nocturnal activity, uncertainty of 25% was assumed (e_2=0.25). Uncertainty concerning birds that fly at the rotor height equals at least 25% (e_3=0.25, Band et al. 2012), and in the operation time at least 10% (e_4=0.10). Eventually, the uncertainty resulting from the simplification of the model equals 25% (e_5=0.25, Band et al. 2012). Individual uncertainty components were summarised with the formula below (Band et al. 2012):

$$E=(e_1^2+e_2^2+e_3^2+e_4^2+e_5^2)^{0.5} \ (\pm 67\%)$$

The taken uncertainty assumption, ±67%, should be connected with collision risk estimated for all species.

3.1 Modelling collision risk

Collision calculations were carried out for 10 various OWF versions. Each of the two OWF variants (Applicant's variant and a rational alternative variant) was presented in 5 versions that differed in the height of the clearance between the water surface and the bottom scope of the rotor – 15, 20, 25, 30 and 35 metres. Details for each version for both OWF variants area presented in table (Table 3).

Migration streams of birds (based on modelling data from observations) used for calculations of collision risk for stationing birds and flight indices (number of birds/month) was described in a report with the survey results (Inventory Report). Estimated density of migratory birds was carried out for a 27 km wide belt, which corresponds to the longest cross-section in the NW-SE axis through the area of the farm, which is rectangular, to the main migration direction.

In the Inventory Report, migration streams were presented for each of the three survey stations individually. Because impact on migratory birds is assessed for the Baltica 2 and Baltica 3 areas jointly, the following steps were taken in order to obtain average migration streams representative of the entire area: average monthly migration streams were calculated for the Baltica 2 Area, using data collected from the Baltica_2-1 and Baltica_2-2 stations. Then, averaged migration streams were calculated using estimates for the Baltica 2 and Baltica 3 areas. At the end, average migration streams obtained for individual species (number of birds/km/month) was calculated by 27 km in order to obtain migration streams that correspond to the width of the OWF Baltica.

In order to determine the distribution of frequency for sea ducks flights at specific heights (used in an extended model for calculation of the entire collision) in 1 m intervals, visual observations were used. Data was divided into two parts and then processed using a generalised model with a height frequency as a dependent variable and the flight height as a predictor. Models were calibrated from a “thin plate regression spline” and the Poisson distribution (Wood 2006). For the remaining species the ration of birds flying above the rotor height.

Table 3. Technical parameters of variants and versions of wind power stations which were used in modelling collision risk using the Band 2012 model

Parameter	**Applicant’s variant**					**Rational alternative variant**				
	Clearance 15 m	**Clearance 20 m**	**Clearance 25 m**	**Clearance 30 m**	**Clearance 35 m**	**Clearance 15 m**	**Clearance 20 m**	**Clearance 25 m**	**Clearance 30 m**	**Clearance 35 m**
Number of blades	3	3	3	3	3	3	3	3	3	3
Rotational speed (rpm)	8	8	8	8	8	10	10	10	10	10
Radius of the rotor (m)	110	110	110	110	110	90	90	90	90	90
The height of the tower (m)	125	130	135	140	145	105	110	115	120	125
Uptime (%)	90	90	90	90	90	90	90	90	90	90
Maximum blade width (m)	5.2	5.2	5.2	5.2	5.2	4.6	4.6	4.6	4.6	4.6
Blade inclination angle (degrees)	30	30	30	30	30	30	30	30	30	30
The number of offshore wind power stations	209	209	209	209	209	319	319	319	319	319

Parameter	Applicant's variant					Rational alternative variant				
	Clearance 15 m	Clearance 20 m	Clearance 25 m	Clearance 30 m	Clearance 35 m	Clearance 15 m	Clearance 20 m	Clearance 25 m	Clearance 30 m	Clearance 35 m
Latitude (degrees)	55.08	55.08	55.08	55.08	55.08	55.08	55.08	55.08	55.08	55.08
Wind farm width (km)	27	27	27	27	27	27	27	27	27	27

Data on migration streams, vertical distribution of species that fly through were analysed in the Inventory Report, data on the wing span scope, body length from the DOF Internet base and the literature: Alerstam 2007 (flight speed), Furness et al. 2013, King et al. 2009 (activity of nocturnal migrants).

Collision index calculations were performed for individual species and the indices were presented in table (Table 4) and described in subsequent chapters. For collision index calculations, the number of assessed wind power stations placed in a 27 km wide cross-section equalled 209 for the Applicant's variant and 319 for a rational alternative variant (Figure 3).

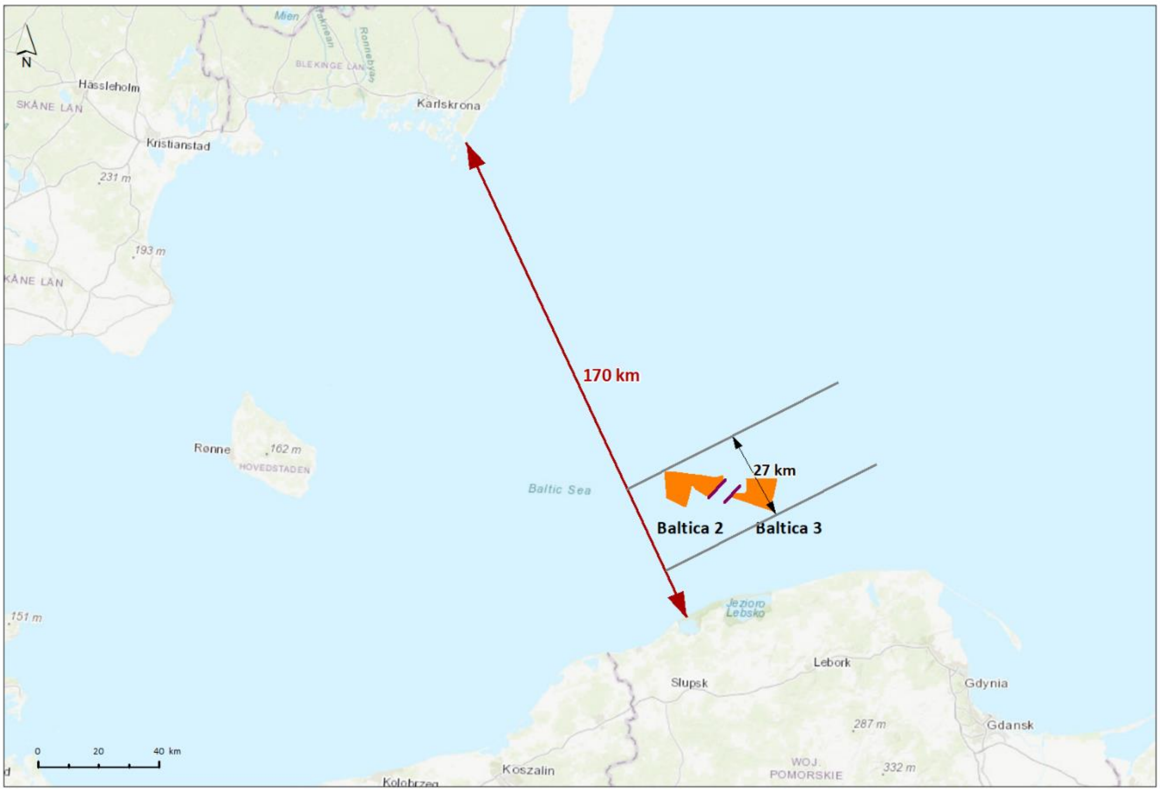

Figure 3. The map of the Baltic Sea width and the OWF Baltica along the northwest-southeast axis

Source: internal data

Table 4. The modelled number of collisions from the OWF Baltica for individual bird species

Species	**Binomial nomenclature**	**Season**	**Probability of avoiding a collision**	**Applicant's variant**					**Rational alternative variant**				
				Clearance [m]									
				15	**20**	**25**	**30**	**35**	**15**	**20**	**25**	**30**	**35**
Common teal	*Anas crecca*	Spring (N=2480 migrants)	98%	0	0	0	0	0	0	0	0	0	0
			99%	0	0	0	0	0	0	0	0	0	0
		Autumn (N=2066 migrants)	98%	0	0	0	0	0	0	0	0	0	0
			99%	0	0	0	0	0	0	0	0	0	0
Geese	*Anserini*	Spring (N=3167 migrants)	99%	2	1	1	1	1	2	2	2	2	1
			99.5%	1	1	1	1	0	1	1	1	1	1
		Autumn (N=10444 migrants)	99%	6	5	4	4	3	8	7	6	5	5
			99.5%	3	2	2	2	2	4	3	3	3	2
Great black cormorant	*Phalacrocorax carbo*	Spring (N=2496 migrants)	98%	2	1	1	1	1	2	2	2	2	1
			99%	1	1	1	1	0	1	1	1	1	1
		Autumn (N=3456 migrants)	98%	2	2	2	2	1	3	3	3	2	2
			99%	1	1	1	1	1	2	2	1	1	1
Mallard	*Anas platyrhynchos*	Spring (N=1462 migrants)	98%	1	0	0	0	0	1	1	0	0	0
			99%	0	0	0	0	0	1	0	0	0	0
		Autumn (N=5651 migrants)	98%	3	2	1	1	0	4	3	1	1	1
			99%	1	1	0	0	0	2	1	1	0	0
Eurasian curlew	*Numenius arquata*	Spring (N=9876 migrants)	98%	4	4	3	3	3	5	5	5	4	4
			99%	2	2	2	2	1	3	3	3	2	2
		Autumn (N=1833 migrants)	98%	1	1	1	1	0	1	1	1	1	1
			99%	0	0	0	0	0	0	0	0	0	0
Long-tailed duck	*Clangula hyemalis*	Spring (N=76589 migrants)	99%	1	1	0	0	0	2	1	1	0	0
			99.5%	1	0	0	0	0	1	1	0	0	0
		Autumn (N=44982 migrants)	99%	1	0	0	0	0	1	1	0	0	0
			99.5%	0	0	0	0	0	1	0	0	0	0
Swans	*Cygnidae*	Spring (N=528 migrants)	99%	0	0	0	0	0	0	0	0	0	0
			99.5%	0	0	0	0	0	0	0	0	0	0
		Autumn	99%	1	1	1	0	0	1	1	1	1	0

Species	**Binomial nomenclature**	**Season**	**Probability of avoiding a collision**	**Applicant's variant**					**Rational alternative variant**				
				Clearance [m]									
				15	**20**	**25**	**30**	**35**	**15**	**20**	**25**	**30**	**35**
		(N=4777 migrants)	99.5%	0	0	0	0	0	1	1	0	0	0
Common scoter	*Melanitta nigra*	Spring (N=53917 migrants)	99%	2	1	1	1	0	3	2	1	1	1
			99.5%	1	1	0	0	0	1	1	1	0	0
		Autumn (N=24407 migrants)	99%	1	0	0	0	0	1	1	1	0	0
			99.5%	0	0	0	0	0	1	0	0	0	0
Little gull	*Larus minutus*	Spring (N=8762 migrants)	98%	3	2	1	1	1	5	3	2	1	1
			99%	2	1	1	1	0	2	2	1	1	0
		Autumn (N=7383 migrants)	98%	3	2	1	1	1	4	3	2	1	1
			99%	1	1	1	0	0	2	1	1	1	0
Common gull	*Larus canus*	Spring (N=3229 migrants)	98%	2	1	1	1	1	3	2	1	1	1
			99%	1	1	0	0	0	1	1	1	1	0
		Autumn (N=2668 migrants)	98%	2	1	1	1	0	2	2	1	1	1
			99%	1	1	0	0	0	1	1	1	0	0
Black-headed gull	*Larus ridibundus*	Spring (N=4191 migrants)	98%	6	4	3	3	3	8	6	5	4	4
			99%	3	2	2	1	1	4	3	2	2	2
		Autumn (N=3115 migrants)	98%	4	3	2	2	2	6	5	4	3	3
			99%	2	2	1	1	1	3	2	2	2	1
Lesser black-backed gull	*Larus fuscus*	Spring (N=2861 migrants)	98%	2	2	1	1	1	4	3	2	1	1
			99%	1	1	1	1	0	2	1	1	1	1
		Autumn (N=3892 migrants)	98%	3	3	2	1	1	5	4	3	2	1
			99%	2	1	1	1	1	2	2	1	1	1
Gaviiformes	*Gavia*	Spring (N=3140 migrants)	98%	2	1	1	0	0	2	2	1	1	0
			99%	1	1	0	0	0	1	1	0	0	0
		Autumn (N=2893 migrants)	98%	1	1	1	0	0	2	1	1	1	0
			99%	1	0	0	0	0	1	1	0	0	0
Greater scaup	*Aythya marila*	Spring (N=1230 migrants)	99%	0	0	0	0	0	0	0	0	0	0
			99.5%	0	0	0	0	0	0	0	0	0	0

Species	**Binomial nomenclature**	**Season**	**Probability of avoiding a collision**	**Applicant's variant**					**Rational alternative variant**				
				Clearance [m]									
				15	**20**	**25**	**30**	**35**	**15**	**20**	**25**	**30**	**35**
		Autumn (N=1000 migrants)	99%	0	0	0	0	0	0	0	0	0	0
			99.5%	0	0	0	0	0	0	0	0	0	0
Terns	*Sternidae*	Spring (N=6940 migrants)	98%	2	1	1	1	0	3	2	1	1	1
			99%	1	1	0	0	0	1	1	1	0	0
		Autumn (N=7539 migrants)	98%	2	2	1	1	0	3	2	1	1	1
			99%	1	1	0	0	0	2	1	1	1	0
Plovers	*Pluvialis sp.*	Spring (N=1385 migrants)	98%	1	1	1	1	1	2	2	2	1	1
			99%	1	1	1	1	0	1	1	1	1	1
		Autumn (N=1010 migrants)	98%	1	1	1	1	1	1	1	1	1	1
			99%	0	0	0	0	0	1	1	1	1	1
Eurasian wigeon	*Anas penelope*	Spring (N=1984 migrants)	98%	1	1	1	0	0	1	1	1	1	0
			99%	0	0	0	0	0	1	1	0	0	0
		Autumn (N=3010 migrants)	98%	1	1	1	1	0	2	2	1	1	1
			99%	1	1	0	0	0	1	1	1	0	0
Velvet scoter	*Melanitta fusca*	Spring (N=9242 migrants)	99%	1	1	1	1	0	2	1	1	1	1
			99.5%	0	0	0	0	0	1	1	1	0	0
		Autumn (N=8330 migrants)	99%	1	1	1	0	0	1	1	1	1	1
			99.5%	0	0	0	0	0	1	1	0	0	0
Parasitic jaeger	*Stercorarius parasiticus*	Spring (N=335 migrants)	98%	0	0	0	0	0	0	0	0	0	0
			99%	0	0	0	0	0	0	0	0	0	0
		Autumn (N=368 migrants)	98%	0	0	0	0	0	0	0	0	0	0
			99%	0	0	0	0	0	0	0	0	0	0
Common crane	*Grus grus*	Spring (N=559 migrants)	-35%	52	48	45	45	45	75	70	65	65	65
			32.5%	27	25	23	23	23	39	36	34	34	34
			93.25%	3	3	2	2	2	4	4	4	4	4
			95%	2	2	2	2	2	3	3	3	3	3
			98%	1	1	1	1	1	1	1	1	1	1
			99%	0	0	0	0	0	1	1	1	1	1
			100%	0	0	0	0	0	0	0	0	0	0

Species	Binomial nomenclature	Season	Probability of avoiding a collision	Applicant's variant					Rational alternative variant				
				Clearance [m]									
				15	20	25	30	35	15	20	25	30	35
		Autumn (N=0 migrants)	-35%	0	0	0	0	0	0	0	0	0	0
			32.5%	0	0	0	0	0	0	0	0	0	0
			93.25%	0	0	0	0	0	0	0	0	0	0
			95%	0	0	0	0	0	0	0	0	0	0
			98%	0	0	0	0	0	0	0	0	0	0
			99%	0	0	0	0	0	0	0	0	0	0
			99.5%	0	0	0	0	0	0	0	0	0	0

The scenarios of collision avoidance probability assessed as the most appropriate based on the literature are marked in grey
Source: internal data

3.2 Collision risk in the case of OWF Baltica impacts

3.2.1 Long-tailed duck *Clangula hyemalis*

Monitoring showed that long-tailed duck is a relatively abundant observed species in the OWF Baltica area, both in the spring and in the autumn. It was shown that sea ducks are characterised by high collision avoidance index, 99.3% acc. to Krijgsveld et al. (2011) or even higher – 99.9% – in accordance to Smartwind (2013). A scenario with the collision avoidance index at the level of 99.5% is the most appropriate and in accordance with the collision risk model used for this scenario, 0–1 bird will undergo collision in the spring and in the autumn in each considered variant (Table 4). Despite estimated collisions at the level of 0–1 bird for the migration season, occasional collisions may not be ruled out. Long-tailed duck is a species of high significance and despite negligible collision values, the significance of the impact is considered of no importance for all versions of both analysed variants (Table 6).

3.2.2 Common scoter *Melanitta nigra*

Monitoring showed that common scoter is a relatively abundant observed species in the OWF Baltica area, both in the spring and in the autumn. It was shown that sea ducks are characterised by high collision avoidance index, 99.3% acc. to Krijgsveld et al. (2011) or even higher – 99.9% – in accordance to Smartwind (2013). A scenario with the collision avoidance index at the level of 99.5% is the most appropriate and in accordance with the collision risk model used for this scenario, 0–1 bird depends on the considered OWF variant and the clearance size. Despite estimated collisions at the level of 0–1 bird for the migration season, occasional collisions may not be ruled out. Considering large significance of common scoter and negligible collision values, the significance of the impact is considered of no importance for all versions of both analysed variants (Table 6).

3.2.3 Velvet scoter *Melanitta fusca*

Monitoring showed that velvet scoter is a relatively abundant observed species in the OWF Baltica area, both in the spring and in the autumn. It was shown that sea ducks are characterised by high collision avoidance index, 99.3% acc. to Krijgsveld et al. (2011) or even higher – 99.9% – in accordance to Smartwind (2013). A scenario with the collision avoidance index at the level of 99.5%

is the most appropriate and in accordance with the collision risk model used for this scenario, 0–1 individuals will undergo collision in the spring and in the autumn (Table 4). The significance of the impact was considered to be of no importance for all versions of both analysed variants given the significance of the velvet scoter (big) (Table 6).

3.2.4 Eurasian wigeon *Anas penelope*

Monitoring showed that the Eurasian wigeon is a relatively abundant observed species in the OWF Baltica area, both in the spring and in the autumn. Estimated numbers of in-flight individuals amounted to 1984 individuals in the spring, and 3010 in the autumn. Modelling demonstrated that the number of collisions is from 0 to 2 depending on the OWF variant. Krijgsveld et al. (2011) reported that the collision avoidance risk was at the level of 98.3% for sea ducks, which is why it was assumed that the most appropriate scenario for the Eurasian wigeon is the one with the collision avoidance risk of 98%. The number of collisions in the chosen scenario is 0–1 birds in the spring and 0–2 individuals in the autumn, depending on the variant (Table 4). The highest number of collisions was calculated for the alternative variant with the smallest clearance, and the lowest one – for both variants in versions with the highest clearance (Table 4).

The estimated number of collisions is low and constitutes less than 0.01% of the biogeographic population of the Eurasian wigeon (1,500,000 individuals, Wetlands International 2014). Therefore, the significance of the impact exerted on that species was regarded of no importance for all versions of both of the analysed variants (Table 6).

3.2.5 Common teal *Anas crecca*

The monitoring demonstrated that the common teal is a relatively abundant observed species in the OWF Baltica area, in both the spring and the autumn. It was estimated that 2480 common teals fly over the survey area in the spring, and 2066 – in the autumn. The analysis of the collision risk indicated that less than 1 bird per migratory season will undergo collision. According to Krijgsveld et al. (2011), the collision avoidance risk of ducks is 98.3%. That is why the scenario with the collision avoidance risk of 98% was adopted for the common teal, with not even a single common teal undergoing collision with offshore wind power stations (Table 4).

Even in the worst scenarios, the estimated number of collisions is low and constitutes less than 0.01% of the large population of this species (1,000,000 individuals, Wetlands International 2015). Therefore, the significance of the impact exerted on that species was regarded of no importance for all versions of both of the analysed variants (Table 6).

3.2.6 Mallard *Anas platyrhynchos*

The monitoring demonstrated that the mallard is a quite abundant observed species in the OWF Baltica area, in both the spring and the autumn. The analysis showed that the number of mallards migrating over the OWF area was 5651 in the autumn and 1462 in the spring. The results of collision modelling demonstrated that the number of collisions is from 0 to 4 depending on the OWF variant. According to Krijgsveld et al. (2011), the collision avoidance risk of ducks is 98.3%. That is why the scenario with the avoidance risk at the level of 98% was adopted for the mallard, with 0–4 mallards undergoing collision with offshore wind power stations (Table 4).

The estimated number of collisions is low and constitute less than 0.01% of the biogeographic population of this species (4,000,000 individuals, Wetlands International 2015). Therefore, the significance of the impact was regarded of no importance for all versions of both of the analysed variants (Table 6).

3.2.7 Greater scaup *Aythya marila*

The monitoring demonstrated that the greater scaup is a relatively abundant observed species in the OWF Baltica area, in both the spring and the autumn. It was shown that sea ducks are characterised by high collision avoidance index, 99.3% acc. to Krijgsveld et al. (2011) or even higher – 99.9% – in accordance to Smartwind (2013). A scenario with the collision avoidance index at the level of 99.5% is the most appropriate and in accordance with the collision risk model used for this scenario, 0 individuals will undergo collision in both the spring and the autumn (Table 4).

The estimated collisions are negligible and constitute less than 0.01% of the European population (12,000 individuals), but given the protection status and the significance of the species, the importance of the impact was regarded of no importance for all versions of both of the analysed variants (Table 6).

3.2.8 Geese *Anserinae*

The monitoring demonstrated that geese are relatively high observed in the OWF Baltica area in both the spring (estimated 3167 individuals), and in the autumn (estimated 10,444 individuals). If the same collision avoidance index calculated by Krijgsveld et al. (2011) is to be accepted, the adequate scenario to be assumed is the one of 99%. In such a case, the number of collisions amounts to 1–2 collisions in the spring and 3–8 in the autumn, depending on the OWF variant (Table 4). In the report prepared by Smartwind (2013), it is suggested to avoid the collision avoidance index at the level of 99.8%. The highest collision numbers were calculated for the rational alternative variant with the lowest considered clearance. The lowest collision number was given both for the Applicant’s variant, as well as the alternative one for the wind power station with the highest clearance (35 m) (Table 4).

The estimated collision numbers are low, given the abundance of biogeographic populations of the species included in this evaluation – birds that will undergo collision constitute less than 0.01% of the whole population. Given the above and the low importance of the species, the significance of the impact for the greater white-fronted goose, the bean goose and the greylag goose was regarded of no importance.

It should be noted that the collision values presented in the Table (Table 4) may be underestimated for the spring period. In comparison with the autumn period, especially if taking into the account the observations conducted within other projects in the neighbourhood of the planned OWF Baltica area (BŚII and BŚIII Final reports along with the result, DHI 2014, 2015), a relatively small abundance of geese was observed. If to assume that the observed number of geese is equal to the number of observations from the BŚII and BŚIII areas, the number of collisions could be from 3 to 46 birds per season, depending on the season. Even if to assume such values, the significance of the impact will still concern a per cent of the biogeographic population of the considered species.

3.2.9 Swans *Cygnidae*

The monitoring demonstrated that swans are relatively abundant as observed in the OWF Baltica area in both the spring and the autumn. According to the estimates, over 528 swans migrate over the OWF area in the spring and 4777 – in the autumn (Table 4). The estimated numbers of collisions amount to 0–1 birds depending on the scenario (collision avoidance index) and the OWF variant. Krijgsveld et al. (2011) calculated that the avoidance index is 99.2%, and the scenario with the index of 99% was assumed in the present report, according to which no collision will take place in the spring and 0–1 collision will take place in the autumn (Table 4).

Occasional collisions cannot be ruled out, which is why the significance of the collision risk was evaluated as of no importance for the tundra swan and as of little importance for the mute swan and the whooper swan for all versions of both of the analysed variants (Table 6).

3.2.10 Red-throated loon *Gavia stellata* and black-throated loon *G. arctica*

The sum of all loons that may migrate over the OWF Baltica area is 3140 in the spring, and 2893 in the autumn. Both species are well-known for the fact that they strongly avoid flying into the OWF area and that solely single individuals decide to fly through OWF. According to the results obtained by Smartwind (2013), the index of collision avoidance for loons is 98% and in such a case, 1–2 individuals undergo collision in the spring and the autumn, depending on the considered OWF variant and the clearance height (Table 4). Krijgsveld et al. (2011) reported a higher index of avoidance – at the level of 99.2%, but for safety reasons the collision avoidance of 98% reported by Smartwind (2013) was assumed in the present report. Taking into account the number of collisions (less than 0.1% loon population), the significance of collision risk was considered of no importance for all versions of both analysed variants (Table 6).

3.2.11 Auks *Alcidae*

The monitoring demonstrated that auks are relatively high abundant as observed in the OWF Baltica area in both the spring and the autumn. On the basis of analysis of the results obtained from pre-investment monitoring it was concluded that all auks were always flying below the rotor's range, therefore no collision risk modelling was carried out. It cannot, however be excluded that single birds will undergo collision. The significance of the impact on auks was considered of no importance.

Additionally, it should be taken into account that the number of migrating auks may have been overestimated due to the share of (an unknown number) of birds that stay locally in this area of the Baltic Sea. It may be indicated by lack of unambiguous flight direction (Inventory report). Migratory birds are characterized by visibly predominant flight direction. It is impossible to divide migrating auks from local ones; therefore it was assumed that migrating auks do not constitute more than 50% of the estimated number of birds for individual seasons.

3.2.12 Great black cormorant *Phalacrocorax carbo*

Monitoring showed that great black cormorant is a relatively abundant species observed in the OWF Baltica area both in the spring and in the autumn. This species was often observed flying without hesitation into the areas of operational OWFs (Kahlert et al. 2011). Depending on the source, the collision avoidance index equals 98% (Krijgsveld et al. 2011) or 99% (King et al. 2009). Therefore a more conservative scenario was assumed with collision avoidance of 98% and it was estimated that 1–2 birds will undergo collisions in the spring season and 1–3 great black cormorants in the autumn (Table 4). The above estimates are negligible, taking into account the size of the biogeographic population (380,000 individuals, Wetlands International 2014). Taking the above conclusions into account the significance of the impact was regarded of no importance for all versions of both analysed OWF variants (Table 6).

3.2.13 Little gull *Larus minutus*

The monitoring demonstrated that the little gull is a relatively abundant observed species in the OWF Baltica area, in both the spring and the autumn. High collision avoidance index was demonstrated for seagulls: 98% according to Krijgsveld et al. (2011), above 99.9% according to Forewind (2013). The scenario with a 99% collision avoidance index was considered the most appropriate, also taking into account recommendations prepared by Cook et al. (2014). Estimated numbers of birds that undergo collisions in this scenario reach 0–2 per season with zero collisions for the OWF with wind power stations with the greatest clearance between the water table and the lower range of the rotor (Table 4).

The number of collisions is negligible in both seasons, however due to high significance of the species, the significance of the impact is of no importance for all versions of both analysed variants (Table 6).

3.2.14 Black-headed gull *Larus ridibundus*

The monitoring demonstrated that the black-headed gull is a relatively abundant observed species in the OWF Baltica area, in both the spring and the autumn. High collision avoidance index was demonstrated for seagulls: 98% according to Krijgsveld et al. (2011), above 99.9% according to Forewind (2013). The scenario with a 99% collision avoidance index was considered the most appropriate, also taking into account recommendations prepared by Cook et al. (2014). Estimated number of birds that undergo collisions in this scenario equal 1–4 during both seasons (Table 4).

The number of collisions constitutes less than 0.01% of the European population of black-headed gull (3,700,000 individuals), the significance of the collision risk impact on this species is of no importance (Table 6).

3.2.15 Lesser black-backed gull *Larus fuscus*

The monitoring demonstrated that lesser black-backed gull is a relatively abundant observed species in the OWF Baltica area, in both the spring and the autumn. High collision avoidance index was demonstrated for seagulls: 98% according to Krijgsveld et al. (2011), above 99.9% according to Forewind (2013). The scenario with a 99% collision avoidance index was considered the most appropriate, also taking into account recommendations prepared by Cook et al. (2014). Estimated number of birds that undergo collisions in this scenario equal 0-2 during both seasons, depending on the variant considered (Table 4). Low collision values constitute less than 0.01% of the European population of lesser black-backed gull (1,200,000 individuals), the significance of the impact is of no importance for this species (Table 6).

3.2.16 Common gull *Larus canus*

The monitoring demonstrated that common gull is a relatively abundant observed species in the OWF Baltica area, in both the spring and the autumn. High collision avoidance index was demonstrated for seagulls: 98% according to Krijgsveld et al. (2011), above 99.9% according to Forewind (2013). The scenario with a 99% collision avoidance index was considered the most appropriate, also taking into account recommendations prepared by Cook et al. (2014). Estimated number of birds that undergo collisions in this scenario equal 0-1 during both migration seasons, depending on the variant selected (Table 4). The collision values are low and constitute less than 0.01% (1,000,000 birds), the impact significance is of no importance (Table 6).

3.2.17 Terns *Sternidae*

Terns are observed when feeding at the altitude of approx. 20 m ASL, however in the migration period they fly at greater altitudes. The collision avoidance index for terns was estimated by Krijgsveld (2011) at the level of 98.3%, based on observation of a sandwich tern. Assuming a 98% avoidance index, it was assumed that the number of collisions will equal 0–3 individuals, depending on the size of the clearance and the variant (Table 4). For terns, the significance of the impact was regarded of no importance for all versions of both of the analysed variants (Table 6).

3.2.18 Parasitic jaeger *Stercorarius parasiticus*

Jaegers are not observed often and are not regular migrants, but observations fulfilled the species selection criteria that undergo impact assessments. Estimated numbers of jaegers that fly through are 354 individuals in the spring, and 393 in the autumn (Table 4). The significance of the impact was regarded of no importance for all versions of both of the analysed variants (Table 6).

3.2.19 Eurasian curlew *Numenius arquata*

Surveys demonstrated that Eurasian curlews are observed in quite a high abundance in the OWF Baltica Area, with greater bird abundances in the spring. It should be noted that the estimated numbers of migratory curlews during the season may be overestimated due to several very numerous flocks observed in April. Eurasian curlews were not observed through the entire survey period; therefore it should be assumed that the area of the planned OWF does not lie in their main migration corridor. Flight altitude was not maintained on a single altitude (observed altitudes reached 160 m ASL). Collision avoidance index for Eurasian curlews is not known, but there were documented observations of avoidance reaction in macro scale by changing flight altitude and flight above the OWF Horns Rev (Krijgsveld et al. 2011, Krijgsveld 2014). Other waders observed in the area of the same OWF mainly flew above the OWF and slightly changed the flight direction (Christensen et al. 2003 a, b, Krijgsveld 2014). The most conservative scenario with the index of 95% indicates 9–13 collisions in the spring for both variants with the smallest possible clearance between the water table and the bottom location of blades. In accordance with the results of Krijgsveld (2011), the general avoidance index (flight above the OWF) estimated for waders equals 98.3%. With the scenario with the index of 98% the number of collisions will equal 0–5 (Table 4). However, even in the case of the most conservative scenarios and the highest number of collisions they will not constitute more than 0.01% of the biogeographic population of Eurasian curlew (70,000 individuals, Birdlife International 2015). Eurasian curlews are not regular migrants in the OWF Baltica area, but sporadic collisions may not be excluded, therefore taking into account the significance of the species, the impact significance was considered of no importance (Table 6).

3.2.20 Plovers *Pluvialis* sp.

Plovers are not too abundant migrants that cross the OWF Baltica area. Plovers usually migrate on large distances and are observed then they fly above the OWF (Krijgsveld et al. 2011, Krijgsveld 2014). Therefore, it should be noted that the numbers of plovers may be underestimated, because these birds migrate on high altitudes and mainly at night (Newton 2010). Due to the flight altitude, probability of collision is small. In reference to Krijgsveld (2011), who determined that plovers avoid collisions at the level of 98.3%, the scenario with 98% avoidance was considered to be the best. With this scenario, the number of collisions equals 1–2 individuals per season (Table 4).

Even if the estimated numbers of plovers that fly at potential collision heights were doubled, they still would not exceed 0.01% of biogeographic population of the European golden plover and grey plover. The significance of the impact was regarded of no importance for all versions of both of the analysed variants (Table 6).

3.2.21 Passerines *Passeriformes*

Data concerning passerines during monitoring do not allow for determination of the collision risk for individual species. It results for instance from the difficulties in observation of small birds at large altitudes – they can be discerned by observers to approx. 50 m ASL. In turn, vertical radar parameters do not make it possible to recognise species that fly at potential collision heights. However, this data gives a general view of the expected passerines collisions.

As indicated by acoustic data, the majority of passerines migrate by night.

The majority of them migrate at altitudes height greater than 200 m. At night or during bad weather they may be forced to fly at lower altitudes, which may increase the risk of collision. To sum up, the factors which may increase the risk of collision are:

- attraction to the OWF due to lights installed there;
- presence of bad weather during the trip.

Taking into account the abundance of passerines population which crosses the Baltic Sea during mass spring and autumn migrations, it should be assumed that collisions of passerines will surely be more numerous than collisions of all other groups of birds. However, natural mortality of passerines in their first year of life is high (in European robin it reaches 60%), therefore the added mortality caused by collisions will have a negligible significance in the scale of enormous biogeographic populations of these species. Therefore, the significance of the impact is of no importance.

3.2.22 Common crane *Grus grus*

Based on monitoring, an assessment was made that in the spring 559 cranes fly through the OWF Baltica area. As no cranes were observed earlier, based on the estimates it was assumed that in the autumn no cranes fly through the survey area.

Taking into account lack of knowledge about the reaction of crane on the OWF, several scenarios were considered below which may be considered probable which differ in the avoidance/attraction factor. Reference was made regarding the existing literature that documents behaviour of other large migrating species, such as geese and cormorants and expected reactions of predatory birds. The most appropriate scenario was presented in detail.

Calculation of a collision risk for both analysed variants of the OWF using only a basic Band model (2012) is insufficient in the case of cranes due to lack of knowledge on their reaction to wind farms that are located far from land, on open waters of the Baltic Sea and other seas. So far no post-implementation OWF monitoring results were published which would discuss the reactions of cranes. Therefore, it cannot be assumed with a total certainty which scenario presents the actual crane behaviour in the truest manner. Data from crane observations and their reactions to onshore wind farms may constitute only a cautious reference to cranes that fly above open waters and there may not be treated as analogous observations, because it cannot be assumed that crane behaviours as a reaction to OWF will be the same.

Modelling collision risk for cranes was carried out in three additional scenarios. They assumed that reactions of cranes will be similar to reactions of predatory birds (Skov et al. 2015, FEBI 2013), which according to the latest reports are to a certain extent drawn by the OWF structures when they migrate through open waters.

Predatory birds will minimise the effort put in the flight over the open sea, and OWF will probably seem a safe object on such a route. Scenarios based on the behaviour of predatory birds will be hereinafter referred to as predatory birds scenarios. Predatory birds and cranes share certain characteristics, such as wing span and large body size as well as their use of thermal columns above land that allow gliding flight. Thermal columns do not appear above open sea and both cranes and predatory birds must rely on fluttering flight which requires more energy. Results of monitoring indicate that cranes more often cross the southern Baltic Sea than predatory birds.

In cormorants, avoidance reaction is observed rarely in relation to OWF (Kahlert et al. 2011, Krijgsveld et al. 2011), but they can avoid collisions with offshore wind power stations by avoidance in a micro scale, that is within the area of the OWF, when they avoid individual wind power stations. Krijgsveld et al. (2011) shown that the collision avoidance level in the case of cormorants equals 98% and such a scenario was selected for them. It one was to assume a similar reaction of cranes, they would consider corridors between rows of offshore wind power stations as safe flight zones and thereby the collision risk would be low. In such a scenario (98%) no crane would collide with wind power stations. An argument against such a reaction of cranes is an entirely different flight type and another distribution of flight altitude of migratory cranes and cormorants.

Migratory geese avoid flying into the OWF area, they show an inclination to avoid collisions in a macro scale and avoid the entire barrier by changing the flight route. Petersen et al. (2006) demonstrated that a general avoidance level of OWF for geese and ducks regarding the OWF Nysted in Denmark equalled above 99%. Krijgsveld et al. (2011) determined avoidance at a level of 99.2% for geese regarding OWF Egmond aan Zee in the Netherlands and the results reported by Smartwind (2013) mention even higher collision avoidance level – 99.8% for OWF Hornsea in Great Britain. In this study, in order to assess the impact of the risk of collision on geese a scenario was used with avoidance index at the level of 99%. This scenario as well could be considered in the case of cranes. Based on post-implementation monitoring for OWF Yttre Stengrund in Sweden, such a scenario seems to be the most adequate. For the duration of this monitoring, two crane formations approaching OWF during the autumn migration were observed. They reacted to the OWF barrier by changing their flight path in order to avoid the OWF sideways or increased altitudes in order to fly above the wind farm. Cranes from two subsequent formations also changed their flight route in order to avoid the farm (Pettersson 2005). In the referenced study it was also indicated that the observed cranes that decide to fly above the OWF area flew much above the highest point of the OWF – at least 70 m above the highest point of blade location (Pettersson 2005).

A strong avoidance reaction of cranes regarding onshore wind farms was also indicated based on observations in Germany, where only 3 collisions involving a crane were recorded for all 1148 bird collisions in 2004–2010 (Illner 2011). The fact that the reaction of migrating cranes onshore and offshore differs drastically from the behaviour of geese during flight should be treated as an argument against the scenario applied in geese. Lack of thermal columns above water and recorded crane collisions with high voltage lines during fogy and rainy weather may indicate that even though they are rare, collisions will occur (Rioux et al. 2013). If a scenario of a reaction typical for a goose was to be assumed, then the number of collisions according to the Band model (2012) would equal 0 (Table 6).

Monitoring in OWF Rødsand 2 indicated that certain predatory bird species are attracted by OWF at a level of 35% in a macro scale when they fly out from above the land in the southern Denmark in the autumn and start their flight above the Baltic Sea (Skov et al. 2011, 2015; Kahlert et al. 2012). This attraction is interpreted as aversion to predatory birds to flights above open sea. A similar reaction could be expected from cranes which move around during migration in a manner similar to predatory birds, using gliding flight, increasing elevation and fluttering flight. Gliding in cranes and predatory birds is possible due to thermal columns which increase abundance of these birds at large altitudes in a coastal zone. Due to lack of thermal columns above the sea, these birds are forced to use fluttering flight and greater energetic costs the moment there is a need to increase altitude, for instance in order to avoid barriers, such as OWFs. Therefore, they are exposed to fatigue, which may even lead to death, as there are no possibilities of rest at the open sea. The fact that crane as a species is much less reluctant to cross open waters than predatory birds is an argument against assuming a typical reaction for predatory birds. It can be seen when comparing the number of observed cranes with sparse predatory birds which is also confirmed by observations that indicate that the majority of Scandinavian population (up to 100,000 individuals) cross a 80–100 km long section of the Arkona Sea in the southern Baltic Sea instead of flying for as long as possible along the coast in order to cross the Baltic Sea in the area of the Fehmarn strait which is 20–30 km wide. Telemetric surveys also confirm that cranes regularly cross open waters of the Baltic Sea (internal surveys “Badania telemetryczne żurawi w Szwecji” (“Telemetric surveys of cranes in Sweden”), movebank.com). It a scenario for predatory birds was to be considered the appropriate one, there would be more collisions which would reach 45–75 birds during spring migration (Table 4).

With no possibility of empirical checking which of the scenarios would correspond the best to the reaction of cranes to the OWF, the impact assessment for this species must be treated with caution. However, taking into account the considerations above and various tested scenarios, the scenario with 98% avoidance indicator seems the most appropriate, as it limits the possibility of underestimation and overestimation of the collision risk impact on cranes. The estimated collision risk according to the scenario used in the case of the great black cormorant suggests that there will be no collisions with the planned OWF. However, single cases of collisions cannot be ruled out. With regard to the above, the significance of the impact on cranes was considered of no importance (Table 6).

Moreover, single collisions may not be excluded in case migratory cranes encounter bad weather conditions during their trip – limited visibility due to fog, darkness and strong wind. Bird migrations is the most intensive when the weather conditions are favourable, but sudden weather deteriorations or fogginess above the sea cannot be ruled out, as they are pretty frequent in the spring.

Eventually, it should be noted that no observations of cranes during the autumn migration is caused by lack of calculations of collision risk for this season (values are equal to 0). During other monitoring sessions, cranes were recorded abundantly (BŚII, BŚIII, DHI 2014, 2015). If cranes migrate, crossing the area of the planned OWF Baltica also in the autumn, it will involve collisions at the level from single to ones that exceed 100 times, but when applying the scenario with avoidance at the level of 98%, approx. 10–20 birds will undergo collisions during a season and thereby the significance of the impact would still remain of no importance.

3.3 Collision risk in the case of accumulated impacts of OWF Baltica, BŚII and BŚIII

In order to calculate the accumulated impacts of OWF Baltica, BŚII and BŚIII the same model parameters were used as in table (Table 3), with a difference that the farm width was assumed at a level of 30 km (Figure 4) and 449 and 559 wind power stations were taken into consideration in the Applicant's variant and the rational alternative variant.

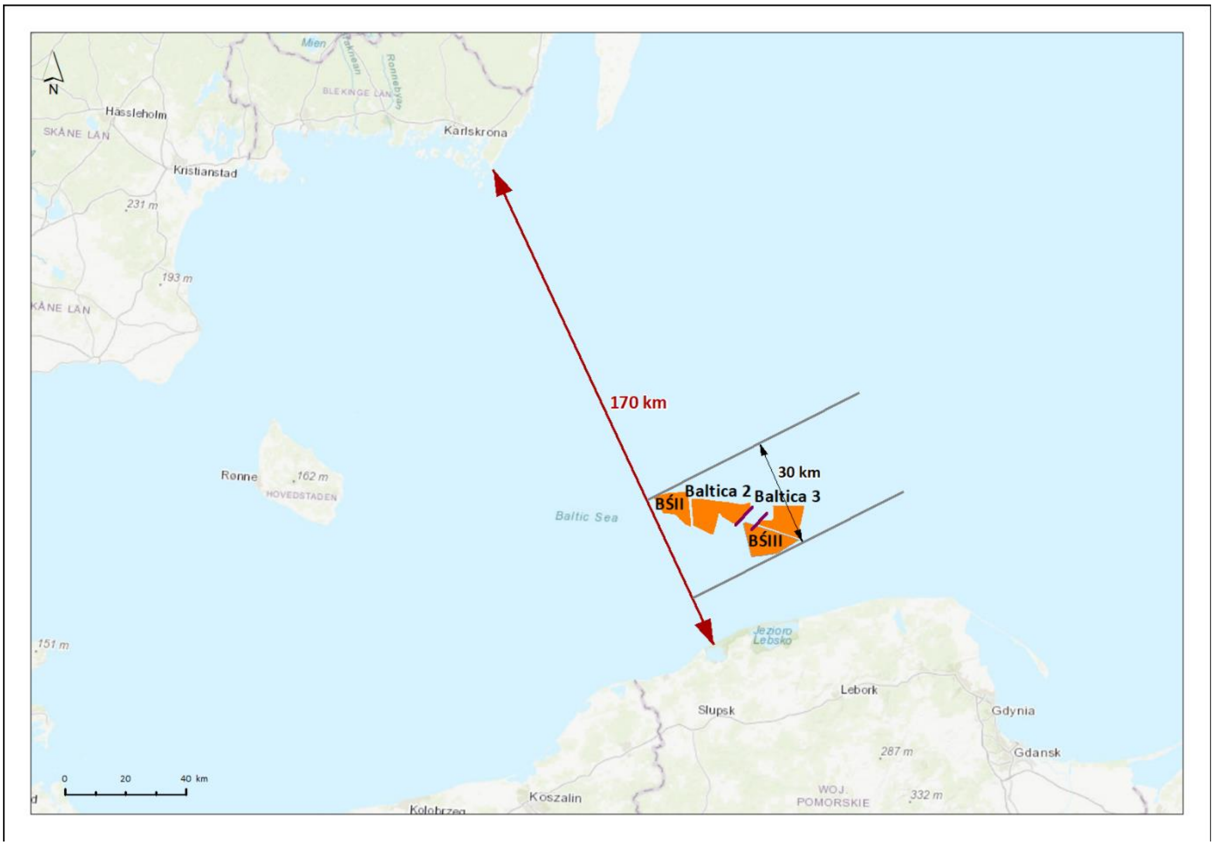

Figure 4. The width map of the Baltic Sea and the OWF Baltica, BŚII and BŚIII along the northwest–southeast axis

Source: internal data

Table 5. Modelled number of collisions with the OWF Baltica, BŚII and BŚIII for individual bird species

Species	**Binomial nomenclature**	**Season**	**Probability of avoiding a collision**	**Applicant's variant**					**Rational alternative variant**				
				Clearance [m]									
				15	**20**	**25**	**30**	**35**	**15**	**20**	**25**	**30**	**35**
Common teal	*Anas crecca*	Spring (N=2480 migrants)	98%	1	0	0	0	0	1	1	0	0	0
			99%	0	0	0	0	0	0	0	0	0	0
		Autumn (N=2066 migrants)	98%	0	0	0	0	0	0	0	0	0	0
			99%	0	0	0	0	0	0	0	0	0	0
Geese	*Anserini*	Spring	99%	3	3	2	2	2	4	3	3	2	2

Species	**Binomial nomenclature**	**Season**	**Probability of avoiding a collision**	**Applicant's variant**					**Rational alternative variant**				
				Clearance [m]									
				15	**20**	**25**	**30**	**35**	**15**	**20**	**25**	**30**	**35**
		(N=3167 migrants)	99.5%	2	1	1	1	1	2	2	1	1	1
		Autumn (N=10444 migrants)	99%	11	9	8	7	6	12	11	9	8	7
			99.5%	5	5	4	3	3	6	5	5	4	4
Great black cormorant	*Phalacrocorax carbo*	Spring (N=2496 migrants)	98%	3	3	3	2	2	4	3	3	3	2
			99%	2	1	1	1	1	2	2	2	1	1
		Autumn (N=3456 migrants)	98%	4	4	4	3	3	5	5	4	4	3
			99%	2	2	2	2	1	3	2	2	2	2
Mallard	*Anas platyrhynchos*	Spring (N=1462 migrants)	98%	1	1	0	0	0	2	1	1	0	0
			99%	1	0	0	0	0	1	1	0	0	0
		Autumn (N=5651 migrants)	98%	5	4	2	1	1	6	4	2	2	1
			99%	3	2	1	1	0	3	2	1	1	0
Eurasian curlew	*Numenius arquata*	Spring (N=9876 migrants)	98%	7	7	7	6	5	8	8	8	7	6
			99%	4	4	3	3	3	4	4	4	3	3
		Autumn (N=1833 migrants)	98%	1	1	1	1	1	1	1	1	1	1
			99%	1	1	1	1	0	1	1	1	1	1
Long-tailed duck	*Clangula hyemalis*	Spring (N=76589 migrants)	99%	2	1	1	0	0	3	2	1	0	0
			99.5%	1	1	0	0	0	1	1	0	0	0
		Autumn (N=44982 migrants)	99%	1	1	0	0	0	2	1	1	0	0
			99.5%	1	0	0	0	0	1	1	0	0	0
Swans	*Cygnidae*	Spring (N=528 migrants)	99%	0	0	0	0	0	0	0	0	0	0
			99.5%	0	0	0	0	0	0	0	0	0	0
		Autumn (N=4777 migrants)	99%	1	1	1	1	0	2	2	1	1	1
			99.5%	1	1	1	0	0	1	1	1	1	0
Common scoter	*Melanitta nigra*	Spring (N=53917 migrants)	99%	3	2	1	1	1	4	3	2	1	1
			99.5%	1	1	1	1	0	2	1	1	1	1
		Autumn (N=24407 migrants)	99%	1	1	1	0	0	2	1	1	1	0
			99.5%	1	0	0	0	0	1	1	0	0	0

Species	Binomial nomenclature	Season	Probability of avoiding a collision	Applicant's variant					Rational alternative variant				
				Clearance [m]									
				15	20	25	30	35	15	20	25	30	35
Little gull	*Larus minutus*	Spring (N=8762 migrants)	98%	7	5	3	2	1	8	5	3	2	1
			99%	3	2	1	1	1	4	3	2	1	1
		Autumn (N=7383 migrants)	98%	6	4	2	2	1	6	5	3	2	1
			99%	3	2	1	1	1	3	2	1	1	1
Common gull	*Larus canus*	Spring (N=3229 migrants)	98%	4	3	2	2	1	4	3	2	2	1
			99%	2	1	1	1	1	2	2	1	1	1
		Autumn (N=2668 migrants)	98%	3	2	2	1	1	3	3	2	1	1
			99%	1	1	1	1	0	2	1	1	1	1
Black-headed gull	*Larus ridibundus*	Spring (N=4191 migrants)	98%	11	9	6	6	5	12	10	7	7	6
			99%	5	4	3	3	3	6	5	4	3	3
		Autumn (N=3115 migrants)	98%	8	6	5	4	4	9	7	6	5	4
			99%	4	3	2	2	2	5	4	3	2	2
Lesser black-backed gull	*Larus fuscus*	Spring (N=2861 migrants)	98%	5	4	2	2	1	6	4	3	2	2
			99%	2	2	1	1	1	3	2	1	1	1
		Autumn (N=3892 migrants)	98%	7	5	3	3	2	8	6	4	3	2
			99%	3	2	2	1	1	4	3	2	2	1
Gaviiformes	*Gavia*	Spring (N=3140 migrants)	98%	3	2	1	1	1	3	2	1	1	1
			99%	2	1	1	0	0	2	1	1	0	0
		Autumn (N=2893 migrants)	98%	3	2	1	1	1	3	2	1	1	1
			99%	1	1	1	0	0	2	1	1	0	0
Greater scaup	*Aythya marila*	Spring (N=1230 migrants)	99%	0	0	0	0	0	0	0	0	0	0
			99.5%	0	0	0	0	0	0	0	0	0	0
		Autumn (N=1000 migrants)	99%	0	0	0	0	0	0	0	0	0	0
			99.5%	0	0	0	0	0	0	0	0	0	0
Terns	*Sternidae*	Spring (N=6940 migrants)	98%	4	3	2	1	1	5	3	2	1	1
			99%	2	1	1	1	0	2	2	1	1	0
		Autumn	98%	4	3	2	1	1	5	4	2	2	1

Species	Binomial nomenclature	Season	Probability of avoiding a collision	Applicant's variant					Rational alternative variant				
				Clearance [m]									
				15	20	25	30	35	15	20	25	30	35
		(N=7539 migrants)	99%	2	1	1	1	0	2	2	1	1	1
Plovers	*Pluvialis sp.*	Spring (N=1385 migrants)	98%	2	2	2	2	2	2	2	2	2	2
			99%	1	1	1	1	1	1	1	1	1	1
		Autumn (N=1010 migrants)	98%	2	2	2	2	1	2	2	2	2	2
			99%	1	1	1	1	1	1	1	1	1	1
Eurasian wigeon	*Anas penelope*	Spring (N=1984 migrants)	98%	2	1	1	1	1	2	2	1	1	1
			99%	1	1	1	0	0	1	1	1	0	0
		Autumn (N=3010 migrants)	98%	3	2	2	1	1	3	3	2	1	1
			99%	1	1	1	1	0	2	1	1	1	1
Velvet scoter	*Melanitta fusca*	Spring (N=9242 migrants)	99%	2	1	1	1	1	2	2	2	1	1
			99.5%	1	1	1	1	0	1	1	1	1	1
		Autumn (N=8330 migrants)	99%	2	1	1	1	1	2	2	1	1	1
			99.5%	1	1	1	0	0	1	1	1	1	1
Parasitic jaeger	*Stercorarius parasiticus*	Spring (N=335 migrants)	98%	0	0	0	0	0	0	0	0	0	0
			99%	0	0	0	0	0	0	0	0	0	0
		Autumn (N=368 migrants)	98%	0	0	0	0	0	0	0	0	0	0
			99%	0	0	0	0	0	0	0	0	0	0
Common crane	*Grus grus*	Spring (N=559 migrants)	-35%	94	89	83	83	83	110	103	96	96	96
			32.5%	50	47	44	44	44	59	55	51	51	51
			93.25%	5	5	5	5	5	6	6	5	5	5
			95%	4	4	3	3	3	5	4	4	4	4
			98%	2	1	1	1	1	2	2	2	2	2
			99%	1	1	1	1	1	1	1	1	1	1
			100%	0	0	0	0	0	0	0	0	0	0
		Autumn (N=0 migrants)	-35%	0	0	0	0	0	0	0	0	0	0
			32.5%	0	0	0	0	0	0	0	0	0	0
			93.25%	0	0	0	0	0	0	0	0	0	0
			95%	0	0	0	0	0	0	0	0	0	0
			98%	0	0	0	0	0	0	0	0	0	0
			99%	0	0	0	0	0	0	0	0	0	0

Species	Binomial nomenclature	Season	Probability of avoiding a collision	Applicant's variant					Rational alternative variant				
				Clearance [m]									
				15	20	25	30	35	15	20	25	30	35
			99.5%	0	0	0	0	0	0	0	0	0	0

The scenarios of collision avoidance probability assessed as the most appropriate based on the literature are marked in grey
Source: internal data

4 Summary

The significance of the impact on individual migratory birds species (Table 6) were specified for the estimated impact of the barrier effect (Table 2) and the results of collision modelling (Table 4) on the basis of inventory results and assessment of the impact of individual bird species (Table 1). The significance of the impact in the case of accumulated impact of the OWF Baltica, BŚII and BŚIII is the same for all versions of both analysed variants.

Table 6. Summary of impacts on migratory birds at the exploitation stage of the planned OWF Baltica. The barrier effect impact and the risk of collision have been assessed with respect to all the investment variants at the same stage

Name of the species	Binomial nomenclature	Importance of the species/resource	Impact	Spatial scale of impact	Duration	Intensity	Impact reversibility	Impact scale	Importance of impact
Long-tailed duck	*Clangula hyemalis*	High	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Insignificant
			Collision risk	Local	Long-term	Small	Irreversible	Negligible	Insignificant
Common scoter	*Melanitta nigra*	High	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Insignificant
			Collision risk	Local	Long-term	Small	Irreversible	Negligible	Insignificant
Velvet scoter	*Melanitta fusca*	High	Barrier effect	National	Long-term	Small	Reversible	Negligible	Insignificant
			Collision risk	Local	Long-term	Small	Irreversible	Negligible	Insignificant
Eurasian wigeon	*Anas penelope*	Low	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Medium	Irreversible	Negligible	Negligible
Common teal	*Anas crecca*	Low	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Small	Irreversible	Of no importance	Negligible
Mallard	*Anas platyrhynchos*	Low	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Small	Irreversible	Negligible	Of no importance
Greater scaup	*Aythya marila*	Medium	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Small	Irreversible	Negligible	Of no importance
Greater white-fronted goose	*Anser albifrons*	Low	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Medium	Irreversible	Small	Of no importance
Greylag goose	*Anser anser*	Low	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Medium	Irreversible	Negligible	Of no importance
Bean goose	*Anser fabalis*	Low	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Medium	Irreversible	Negligible	Of no importance
Tundra swan	*Cygnus columbianus*	High	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Insignificant

Name of the species	**Binomial nomenclature**	**Importance of the species/resource**	**Impact**	**Spatial scale of impact**	**Duration**	**Intensity**	**Impact reversibility**	**Impact scale**	**Importance of impact**
			Collision risk	Local	Long-term	Small	Irreversible	Negligible	Insignificant
Whooper swan	*Cygnus cygnus*	Medium	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Small	Irreversible	Negligible	Of no importance
Mute swan	*Cygnus olor*	Low	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Small	Irreversible	Negligible	Of no importance
Black-throated loon	*Gavia arctica*	Medium	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Small	Irreversible	Negligible	Of no importance
Red-throated loon	*Gavia stellata*	Medium	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Small	Irreversible	Negligible	Of no importance
Razorbill	*Alca torda*	Low	Barrier effect	National	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Small	Irreversible	Negligible	Of no importance
Common murre	*Uria aalge*	Low	Barrier effect	Local	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Small	Irreversible	Negligible	Of no importance
Great black cormorant	*Phalacrocorax carbo*	Low	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Small	Irreversible	Negligible	Of no importance
Little gull	*Larus minutus*	High	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Insignificant
			Collision risk	Local	Long-term	Small	Irreversible	Of no importance	Insignificant
Black-headed gull	*Larus ridibundus*	Low	Barrier effect	Local	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Small	Irreversible	Negligible	Of no importance
Lesser black-backed gull	*Larus fuscus*	Low	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Small	Irreversible	Negligible	Of no importance
Common gull	*Larus canus*	Low	Barrier effect	Local	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Small	Irreversible	Negligible	Of no importance

Name of the species	Binomial nomenclature	Importance of the species/resource	Impact	Spatial scale of impact	Duration	Intensity	Impact reversibility	Impact scale	Importance of impact
Black tern	*Chlidonias niger*	Medium	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Small	Irreversible	Negligible	Of no importance
Sandwich tern	*Sterna sandvicensis*	Medium	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Small	Irreversible	Negligible	Of no importance
Arctic tern	*Sterna paradisaea*	Low	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Small	Irreversible	Negligible	Of no importance
Common tern	*Sterna hirundo*	Medium	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Small	Irreversible	Negligible	Of no importance
Caspian tern	*Hydroprogne caspia*	Low	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Small	Irreversible	Negligible	Of no importance
Parasitic jaeger	*Stercorarius parasiticus*	Low	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Small	Irreversible	Negligible	Of no importance
Eurasian curlew	*Numenius arquata*	Medium	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Small	Irreversible	Small	Insignificant
European golden plover	*Pluvialis apricaria*	Low	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Small	Irreversible	Low	Negligible
European sand martin	*Pluvialis squatarola*	Low	Barrier effect	Regional	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Small	Irreversible	Low	Of no importance
Common crane	*Grus grus*	Low	Barrier effect	Local	Long-term	Small	Reversible	Negligible	Of no importance
			Collision risk	Local	Long-term	Small	Irreversible	Medium	Insignificant

Source: internal data

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