OÜ UTILITAS WIND

SAARE-LIIVI
OFFSHORE WIND FARM
ENVIRONMENTAL IMPACT ASSESSMENT

EIA report, to be published on 03 March 2025

ROHE plaan

Client: Utilitas Wind OÜ

EIA conducted by: Roheplaan OÜ

EIA leading expert: Riin Kutsar (EIA licence No KMH00131)

1. Introduction

Utilitas Wind OÜ wants to build the **Saare-Liivi offshore wind farm** in a marine area of the Gulf of Riga. The proposed activity is located in an area of the county-wide spatial plan for the marine area bordering Pärnu County identified as suitable for wind energy development.

Utilitas OÜ (registration code 12205523) submitted an application for a superficies licence to the Consumer Protection and Technical Regulatory Authority on 18 February 2021 and an amended application on 5 July 2021 for encumbering the public body of water to construct the Saare-Liivi offshore wind farm in the Gulf of Riga. On 23 December 2021, the Consumer Protection and Technical Regulatory Authority initiated the superficies licence proceedings with environmental impact assessment by decision No 1-7/21-521. By Decision No 1-7/23-063 of Consumer Protection and Technical Regulatory Authority dated 9 March 2023, Decision No 1-7/21-521 of Consumer Protection and Technical Regulatory Authority dated 23 December 2021 was amended, and the encumbered area of the public body of water in the superficies licence proceedings initiated by Decision No 1-7/21-52 of 23 December 2021 was adjusted.

The Consumer Protection and Technical Regulatory Authority is the body conducting the proceedings concerning the development permit and the Government of the Republic is the decision-maker. The authority overseeing the environmental impact assessment is the Ministry of Climate. The environmental impact assessment is carried out by OÜ Roheplaan and the lead expert for the EIA is Riin Kutsar (EIA licence No. KMH0131).

Possible negative transboundary impacts relate to the effects of the offshore wind farm during its operation on birds which are discussed in Chapter 3.5 of the report. The significance of these impacts will need to be further clarified in future monitoring during the period of operation of the wind farm. Theoretically, there could also be transboundary impacts on fish fauna, bats and seals.

This summary does not delve into the specific topics assessed in the EIA, which primarily focus on local impacts that are limited to the wind farm and its immediate vicinity. These topics include hydrodynamics, water quality, construction geology, seabed biota and habitats, protected natural objects in Estonia, noise levels, visual impact, underwater cultural heritage and socio-economic effects.

This summary of the EIA report on the Saare-Liivi offshore wind farm focuses in particular on the issues where transboundary effects may occur, such as birds, fish fauna, bats and seals, as well as fishing, shipping and air traffic.

As the connecting cables of the offshore wind farm are not planned to be connected to any other country, no transboundary impacts are foreseen in this respect.

2. Proposed activity

The location of the offshore wind farm is situated in the internal sea, or coastal sea area, to the west of Kihnu island in the marine area bordering Pärnu County. According to the county-wide spatial plan for the marine area bordering Pärnu County, the proposed offshore wind is located in a potential wind energy development area[1] (see Figure 2-1).

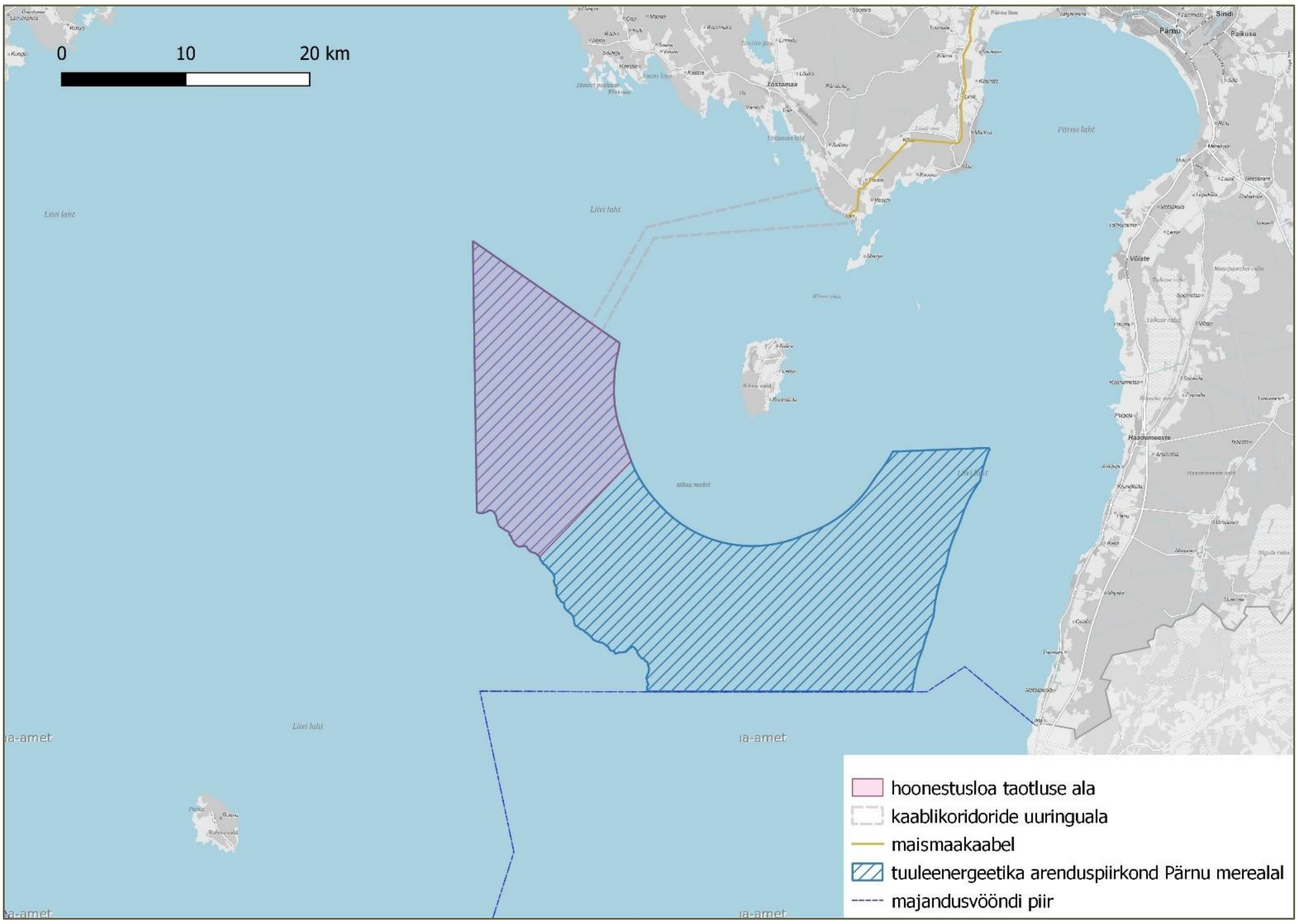

Figure 2-1. *The location of the proposed offshore wind farm in the county-wide spatial plan area for the marine area bordering Pärnu County. Source: Base drawing of the county-wide spatial plan for the marine area bordering Pärnu County.*

According to the superficies licence application (18 February 2021), Utilitas Wind desired to design an offshore wind farm consisting of a maximum 299 turbines and the spacing between the turbines was put tentatively at 1 km (main alternative 1). The approved EIA programme (Consumer Protection and Technical Regulatory Authority decision of 22 December 2022 No 16-7/21-02502-095) encompasses the full spatial scope initiated by the superficies licence proceedings. This includes the main alternative 2, which pertains to the area designated for an offshore wind farm with up to 160 wind turbines. **Based on studies of structural geology, birdlife, and seabed habitats** conducted from 2022 to 2024**, a spatial alternative featuring up to 80 wind turbines (Figure 2-2), ie main alternative 3, was developed by the end of 2024, coinciding with the preparation of the EIA report.**

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1 https://maakonnaplaneering.ee/maakonna-planeeringud/parnumaa/parnu-mereala-maakonnaplaneering/

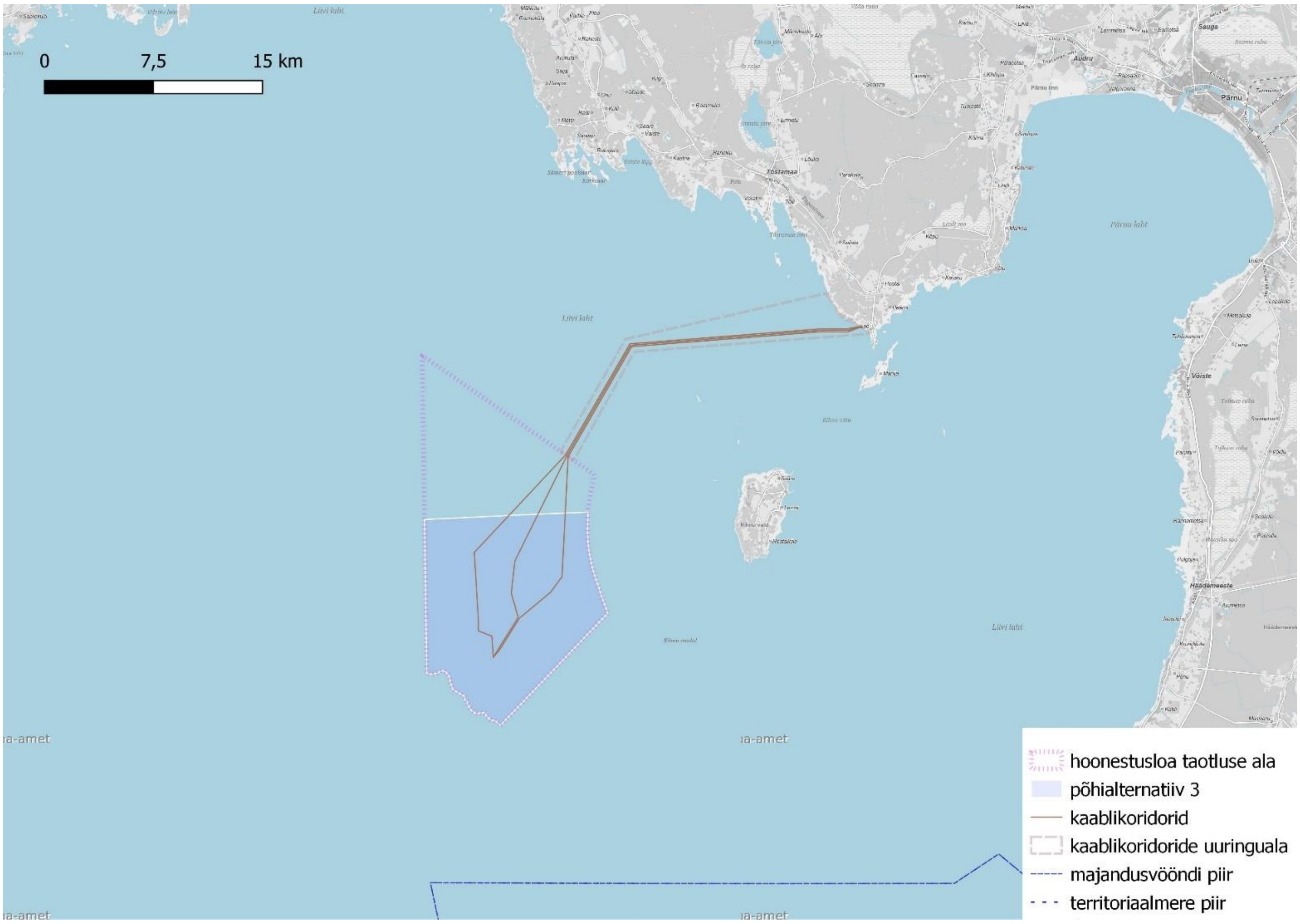

Figure 2-2. *Main alternative 3 for the Saare-Liivi offshore wind farm*

The EIA report consistently assessed this main alternative 3, which proposes up to 80 wind turbines, as the only feasible spatial option. During the EIA, the impacts and changes in the marine area associated with the proposed activity were evaluated in relation to the existing environmental status identified through the studies. As a result, the report did not include a comparison of alternative spatial placements.

The technical alternatives examined involved various types of wind turbine foundations, different turbine heights (including rotor diameters) and potential layouts for the offshore wind farm (Table 2-1).

Table 2-1. *Technical parameters of the proposed offshore wind farm and the technical alternatives considered*

PARAMETERS	***ASSESSED INDICATORS***	
	TECHNICAL ALTERNATIVE 1 – 15 MW	***TECHNICAL ALTERNATIVE 2 – 20 MW***
Main alternatives for the wind farm	As a result of the assessment, the only feasible alternative is main alternative 3.	
Number of wind turbines	80	80
Total capacity of the wind farm	Up to 1200 MW	Up to 1600 MW
Rated power of wind turbines	15 MW	20 MW
Annual productivity of the offshore wind farm	Approximately up to 5.4 TWh	Approximately up to 7 TWh

PARAMETERS	ASSESSED INDICATORS	
	TECHNICAL ALTERNATIVE 1 – 15 MW	TECHNICAL ALTERNATIVE 2 – 20 MW
Wind turbine rotor diameter	236 m (of the models actually in production today, a turbine with a rotor diameter of 236 m is likely)	280 m
Turbine mast height	Up to 157 m	Up to 170 m
Maximum wind turbine peak height	Up to 275 m	Up to 310 m
The clearance between the blade tip and the water surface	Approximately 30–40 m	Approximately 30–40 m
Distance between turbines	At least 4–6 times the rotor diameter, at least 1 km	
Foundation type(s)	Monopile foundation, gravity foundation and for substations, a third solution, the jacket foundation, is also being considered.	
Gravity foundation sole diameter, m	Up to 50 m	Up to 50 m
Monopile foundation pile diameter / thickness	12 m / 83 mm	18 m /100 mm
Foundation installation methodology	Installation on prepared seabed (gravity foundation), drilling or ramming into sandstone (monopile foundation and jacket foundation)	
Network connection to mainland / cable location	See Figure 2-2.	
Connecting cable, km	Approximate total length 31 km. Up to 3 cables, each with a transmission capacity of 400 MW. Presumably 220 kV (or 330 kV) alternating current.	
Offshore wind farm internal network cable, km	Approximate total length 240 km, expected 66 kV alternating current.	

The cumulative[2] impact may appear if due to the spatial plan(s) and its proposed activities, a territorial or temporal overlap between impacts take place, resources are repeatedly removed or added, or the landscape is altered repeatedly[34].

In assessing cumulative impacts, it is possible to consider similar projects or other proposed projects that will lead to accumulation of similar impacts from multiple activities, which have by the time of the preparation of the EIA report have reached at least the same assessment stage – in other words, it is possible to consider the study data gathered and published regarding the other project.

2 Cumulative impacts refer to the combined effect of one or more activities that may manifest through an accumulation of similar impacts, where there may be many different activities and where a change occurring as a consequence of addition of activities is an important aspect.

3 Cooper, L. M. 2004. Guidelines for Cumulative Effects Assessment in SEA of Plans. EPMG Occasional Paper 04/LMC/CEA. imperial College London.

4 Peterson, K., Kutsar, R., Metspalu, P., Vahtrus, S. ja Kalle, H. 2017. Strategic Environmental Assessment Handbook. Ministry of Environment, 137 pp.

As of the preparation of this EIA report, one superficies licence for an offshore wind farm in the Estonian marine area has been approved (10 June 2024). This approval pertains to the environmental impact assessment of the Saare Wind Energy offshore wind farm[5]. The minimum distance between the proposed offshore wind farm of Saare Wind Energy and the initial site of the Saare-Liivi offshore wind farm is 87 km. As a result, any impacts are unlikely to accumulate due to this distance. The potential for cumulative impact mainly relates to the risk of bird collisions; therefore, the cumulative impact of Saare Wind Energy is only evaluated in conjunction with the Saare-Liivi development area concerning birds.

To the southeast of the proposed Saare-Liivi offshore wind farm, the Gulf of Livonia offshore wind farm is being developed by Liivi Offshore OÜ. The superficies licence proceedings for this project were initiated in 2019[6] (Figure 2–3), and it is currently in a similar stage of development.

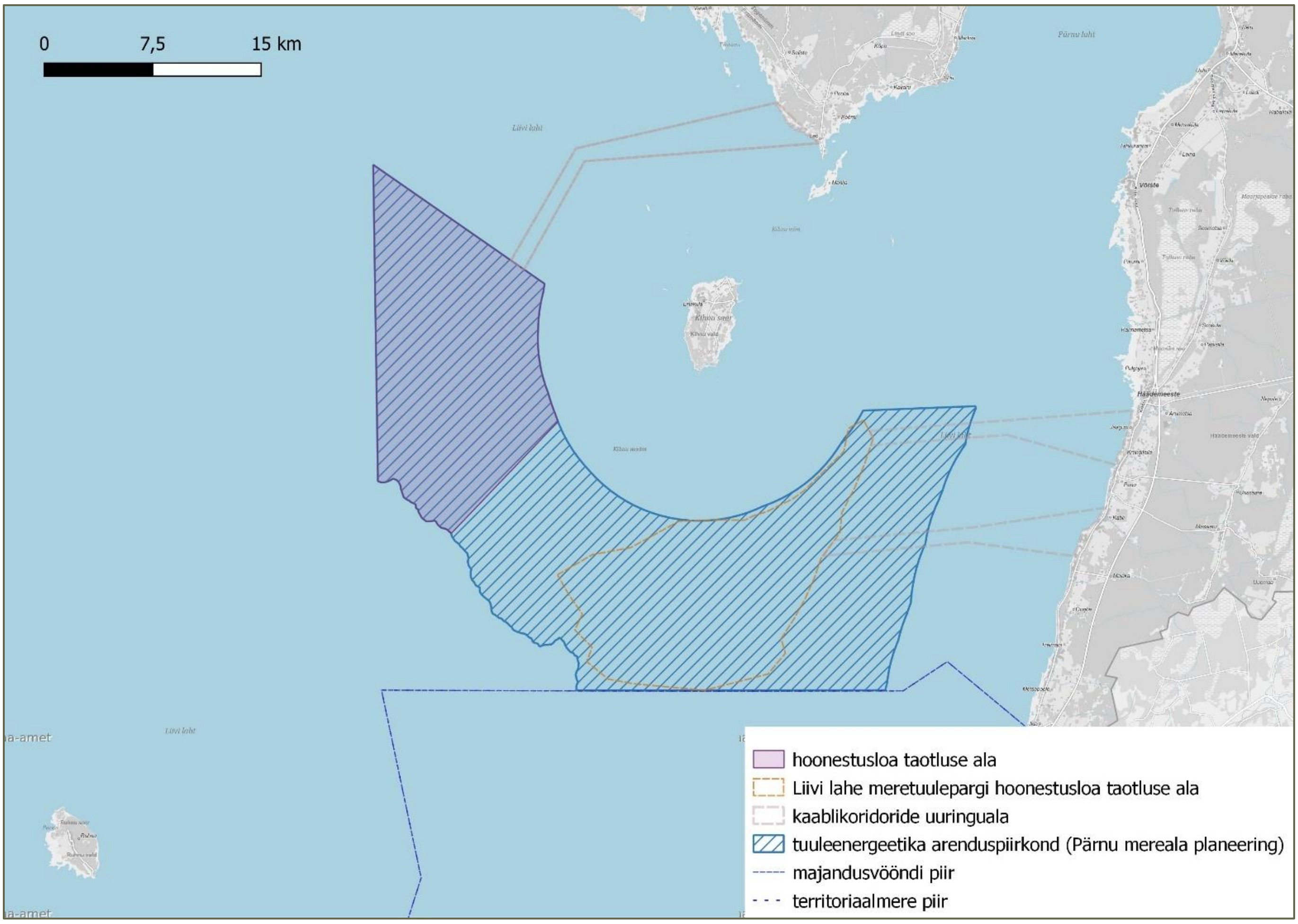

Figure 2-3. *The area covered by the Saare-Liivi offshore wind farm's superficies licence application together with the area covered by the Gulf of Riga offshore wind farm's superficies licence application.*

The Gulf of Riga offshore wind farm in the Gulf of Riga is in a similar development phase, meaning a draft EIA report has been completed. The Gulf of Riga offshore wind farm was included in this EIA report for

5 *https://www.ametlikudteadaanded.ee/avalik/teadaanne?teate_number=2271195*

6 *Order No 311 of the Government of the Republic of 19 December 2019 on the superficies licence proceedings and initiation of the EIA can be found at:*
www.riigiteataja.ee/akt/323122019010

the assessment of cumulative impacts. This assessment took into account the EIA report for the Gulf of Riga offshore wind farm, which was submitted for review on 19 December 2024, where relevant.

3. Results of the environmental impact assessment

3.1. Birds

Studies conducted:

- Avifauna studies for the Utilitas Wind Saare-Liivi offshore wind farm; Estonian Ornithological Society, the 2024 aerial censuses were conducted by Leho Luigujõe, an ornithologist from the Estonian University of Life Sciences, in collaboration with members of the Estonian Ornithological Society. Ship-based censuses were conducted and their data analysed by BioConsult SH in collaboration with the Estonian Ornithological Society. The telemetry study of birds nesting on the small islands was carried out by the Estonian Ornithological Society in cooperation with BioConsult SH.
- Habitat displacement of sea ducks in relation to Saare-Liivi OWF, Estonia. Jacobsen, E. M. & Tjørnløv, R. S. 2024.
- Monitoring plan for sea ducks in relation to Saare-Liivi OWF, Estonia. Tjørnløv, R. S. 2024; Jacobsen, E. M. & Lyngsgaard, M.M. 2025
- Saare-Liivi Offshore Windfarm – Estonia. Impact Assessment Velvet Scoter and Long-tailed Duck – Displacement. Ramboll Polska, 2024.

STOPOVER WATERBIRDS

The survey of stopover waterbirds was conducted as a visual areal census using the internationally recommended standard (Pihl & Frikke 1992[7], Camphuysen *et al* 2004[8]) and its later modification (Fox *et al* 2006[9]). To conduct the census, a flight route covering the entire initial Saare-Liivi development area (main option 1 ie boundary option 1) and its surroundings was prepared (Figure 3.1-1). The route sections were located 3 km apart, which is the minimum distance for the methodology used in this work (Petersen & Fox, 2005[10]). With this distance, 2/3 of the initial study area is covered by surveys.

20 censuses were conducted over two years during the most important bird occurrence periods (Annex 3.8 to the EIA report, Table 2).

7 Pihl, S. & Frikke, J. 1992. Counting birds from aeroplane. – In: Komdeur, J., Bertelsen, J. & Cracknell, G (eds.) Manual for Aeroplane and Ship Surveys of Waterfowl and Seabirds. IWRB Special Publ. No. 19, p 24-37.

8 Camphuysen, K., Fox, T, Leopold, M. & Petersen, I. (2004). Towards standardized seabirds at sea census techniques in connection with environmental impact assessments for offshore wind farms in the U.K. Royal Netherlands Institute for Sea Research. 39 pp. www.offshorewind.co.uk/Downloads/1352_bird_survey_phase1_final_04_05_06.pdf

9 Fox, A. D., Desholm, M., Kahlert, J., Christensen, T. K. and Krag Petersen, I. B. 2006. Information needs to support environmental impact assessment of the effects of European marine offshore wind farms on birds. Ibis, 148: 129-144. Information needs to support environmental impact assessment of the effects of European marine offshore wind farms on birds - FOX - 2006 - Ibis - Wiley Online Library

10 Petersen, I.K, Fox, A.D. 2005. An aerial survey technique for sampling and mapping distributions of waterbirds at sea.

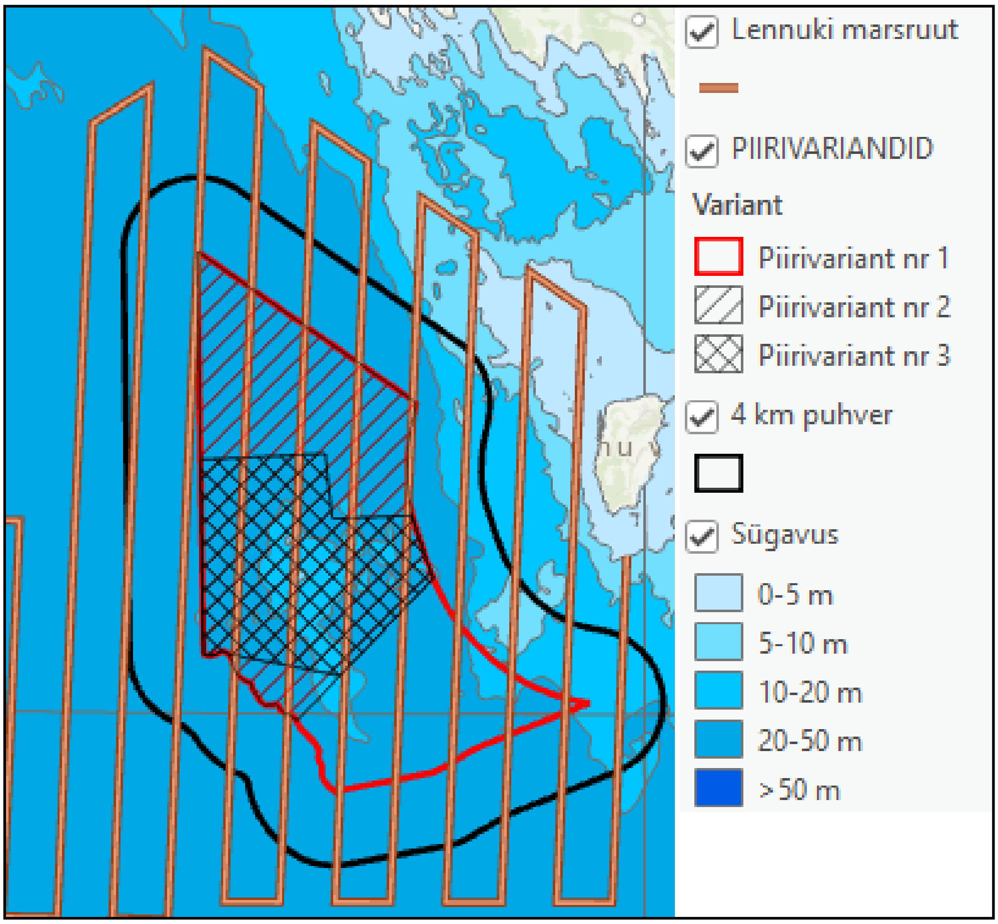

Figure 3.1-1. *Census route of stopover waterbirds*

The total number and population density of birds in the survey area depends, in addition to the ratio of the survey area to the area covered by observations, also on the detectability of birds in the area covered by observations. Detectability of birds usually decreases as their distance from the route increases. Distance sampling is a widely used method for detecting and estimating abundance (Buckland *et al* 2001[11]).

A total of 35 species of waterbirds were spotted during the aerial censuses. The following species were noteworthy: of the diving species, the long-tailed duck (*Clangula hyemalis*), the velvet scoter (*Melanitta fusca*) and the black scoter (*Melanitta nigra*); of the species feeding in pelagic layers, the loons (*Gavia sp.*) and the great cormorant (*Phalacrocorax carbo*); of the surface feeding species, the European herring gull (*Larus argentatus*), the common gull (*Larus canus*), the black-headed gull (*Chroicocephalus ridibundus*) and the little gull (*Hydrocoloeus minutus*), and the common tern (*Sterna hirundo*) and the Arctic tern (*Sterna paradisaea*). The loons, terns and the common gull were treated as a group because they were difficult to identify. All loons identified at the species level were red-throated loons (*Gavia stellata*). The remaining species were present in very small numbers or were concentrated outside the development area and its buffer in the shallow marine area surrounding Kihnu.

The most numerous species in the Saare-Liivi development area was the long-tailed duck, whose maximum population estimate for boundary option 2 reached up to 92789 (see Annex 3.8 to the EIA report, Table 7) and for option 3 up to 45558 individuals. The maximum numbers of the most important waterbird species are presented in Tables 3.1-1 and 3.1-2. The maximum population estimates for the

11 Buckland ST, DR Anderson, KP Burnham, JL Laake, DL Borchers and L Thomas. 2001. Introduction to Distance Sampling: Estimating Abundance of Biological Populations.

velvet scoter were 43986 and 4139 individuals, respectively, while the population estimates for the black scoter were 8048 and 8048 individuals for both. The diving species were followed in abundance by surface feeding species, among them the common gull and mew gull (maximum 1604 individuals in the case of boundary option 2). Of the species feeding in the pelagic layers, the most abundant were loons (maximum 464 individuals in boundary option 2). The abundance estimates for the remaining species were moderate or low based on the impact assessments.

Table 3.1-1. *Maximum population estimates of key waterbird species for boundary option 2 (boundary option 2 with a 4 km buffer). (The orange background indicates abundance estimates that exceed 1% of the species' biogeographical population abundance). A longer list and table can be found in Annex 3.8 to the EIA report, Table 7.*

Species	***Season***	***Year***	***Abundance estimate***
long-tailed duck *(Clangula hyemalis)*	Winter	2022/2023	74,881
long-tailed duck *(Clangula hyemalis)*	Winter	2023/2024	92789
velvet scoter *(Melanitta fusca)*	Spring	2022	43986
black scoter *(Melanitta nigra)*	Summer	2022	8048

Table 3.1-2. *Maximum population estimates of key waterbird species for option 3 (boundary option 3 with a 4 km buffer for scoters and with a 2 km buffer for long-tailed ducks). (The orange background indicates abundance estimates that exceed 1% of the species' biogeographical population abundance).*

Species	***Season***	***Year***	***Abundance estimate***
long-tailed duck *(Clangula hyemalis)*	Winter	2022/2023	45558
long-tailed duck *(Clangula hyemalis)*	Winter	2023/2024	17778
velvet scoter *(Melanitta fusca)*	Spring	2022	4139
black scoter *(Melanitta nigra)*	Summer	2022	8048

Waterbirds are migrant birds, with different species using the area in question in different seasons. Gulls were present in the area year-round. The long-tailed duck used the area in spring, autumn and winter. As an Arctic species, the long-tailed duck does not occur in our waters in summer. Scoters and the great cormorant were more common in spring and summer, and less common in autumn and especially in winter. Terns clearly preferred the area in spring and summer. Wintering birds are absent in the area if the Gulf of Riga is frozen during harsh winters. In addition to the differences between seasons, the abundance of stopover waterbirds in the area varied significantly both within seasons and between years.

BIRDS FLYING ACROSS

Species composition

A total of 147624 birds were counted during visual observations (see tables 10–11 in Annex 3.8 to the EIA report). The total number of species by year (2022 and 2023) ranged from 82 to 104 species in spring, and from 89 to 100 species in autumn (Table 3.1-3).

The proportion of different species groups varied by year and season (Figure 3.1-4). The most numerous species group were ducks, which accounted for approximately 38% (autumn 2022) to 67% (spring 2023) of the birds counted. Depending on the year and season, the most numerous species groups also included the Eurasian crane (approximately 30% of the birds counted in autumn 2022), geese and brant geese (21% in autumn 2023, 18% in spring 2023), terns (18% in spring 2022) and passeriformes (16% in autumn 2023).

Table 3.1-3. *Number of species and individuals in visual observations*

Year	**2022**	**2022**	**2023**	**2023**
Season	**Autumn**	**Spring**	**Autumn**	**Spring**
Number of census days	26	20	27	20
Number of birds, individuals	37148	27226	29299	53951
Number of species	89	82	100	104

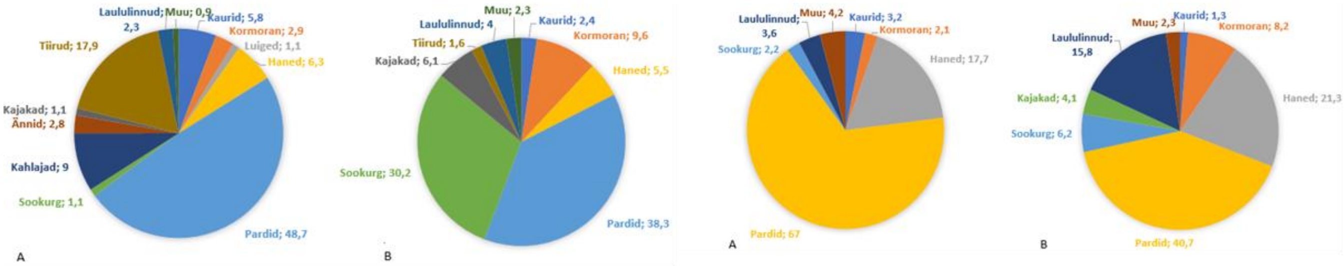

Figure 3.1-4. *Proportion of species groups (%) in visual observations in 2022 (A – spring, n = 27226; B – autumn, n = 37148) and 2023 (A – spring, n = 53951; B – autumn, n = 29299)*

Data on nocturnal species composition is provided by voice recordings. A total of 1931 contacts were recorded, belonging to at least 49 bird species (Annex 3.8 to the EIA report, tables 12 and 13). The most abundant bird group was the passeriformes, especially in autumn, when they accounted for 91% (2023) to 96% (2022) of contacts (Annex 3.8 to the EIA report, figures 38–41). In the spring, contacts with passeriformes accounted for approximately 55%. The most numerous species were the European robin, song thrush and redwing.

Flight altitude

Birds preferred to fly in lower air layers during the day. The specific altitude distribution depended on both the year and the season (Annex 3.8 to the EIA report, figures 54–59). Of the vertical radar contacts, 49% (spring 2022) – 72% (autumn 2023) were recorded in the lower 100 metre air layer, Figure 3.1-5. According to visual observations, birds preferred to fly in the lowest air layer, at a height of 0–5 metres. Birds flying in the lower 5 metre air layer accounted for up to 72% (spring 2023) of all birds recorded in visual observations.

Only radar observation data is available for nighttime flight altitude. At night, the highest number of contacts was also recorded in the lower 100 metre air layer (Annex 3.8 to the EIA report, Figures 56–59). When comparing vertical radar data on flight altitude during the day and night, it was noted that the proportion of birds flying within the lower 100 metres of air was significantly smaller at night.

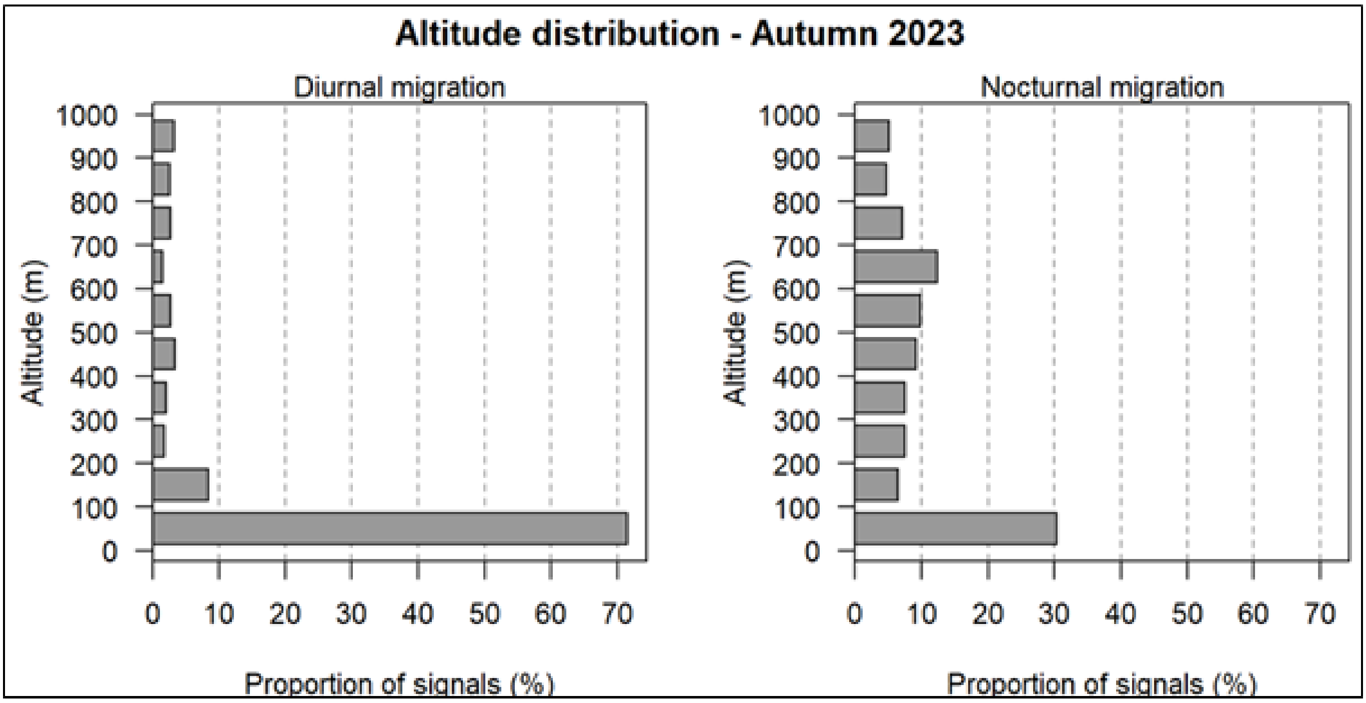

Figure 3.1-5. *The altitude distribution of birds, based on vertical radar data collected in the autumn of 2023 (the horizontal axis represents the proportion of contacts in percentage, the vertical axis indicates altitude in metres. The results are divided into day (on the left) and night (on the right))*

By species groups, the Eurasian crane, geese, brant geese and waders stood out from other birds in terms of their higher daytime flight altitude. Other species groups predominantly favoured the lowest air layers during the day, with the highest number of birds recorded in the lower 10 metres. Very few were observed above 100 metres (Annex 3.8 of the EIA report, figures 60–73). Notably, the concentration of long-tailed ducks and scoters was exceptionally high just above the water's surface, with over 90% of the counted birds recorded in the lower 10-metre air layer.

Given the impact of wind farms, it is important to consider the proportion of birds flying at potential rotor operating heights (Table 3.1-4). The lower limits for rotor operating heights have been set as high as possible, with 40–275 m (option A) and 30–310 m (option B). Since many birds prefer to fly in the lowest air layers, leaving these areas free can help reduce the risk of collisions. The relationship is straightforward: the higher birds prefer to fly, the larger the rotor radius becomes and the lower the rotor's operating zone starts, the higher the proportion of birds that may be at risk of collision. For the Eurasian crane, 76–81% of daily flights occur within the rotor operating zone. For waders, this figure is 73–79%, for geese and brant geese, it is 65–75%. At nighttime, this figure is 50–60% for nocturnal migrants. There are virtually no long-tailed ducks flying at risk altitudes, and the proportion of scoters and terns flying at these altitudes is also very low.

Table 3.1-4. *Proportion of birds flying at the rotor operating height, % (Castillo, Liedtke & Welcker 2024)*

Species	***Turbine A***	***Turbine B***
Loons (*Gavia sp.)*	11	18
Great cormorant (*Phalacrocorax carbo*)	8	14
Geese and brant geese (*Anser sp., Branta sp.*)	65	75
Eurasian wigeon (*Mareca penelope*)	41	52
Greater scaup (*Aythya marila*)	6	14
Black scoter *(Melanitta nigra*)	1	1
Velvet scoter *(Melanitta fusca*)	3	5
Long-tailed duck *(Clangula hyemalis*)	0	0

Species	*Turbine A*	*Turbine B*
Eurasian crane (*Grus grus*)	76	81
Waders	73	79
Skuas (*Stercorarius sp*)	34	44
Mew gull (*Larus canus*)	12	19
Little gull (*Hydrocoloeus minutus*)	15	23
Terns (*Sterna sp*)	1	2
Nocturnal migrants	50	60

Flight directions

The primary migration direction was northeast in spring and southwest in autumn. During the day, visual observations in the lower air layers indicated a high proportion of birds flying north in the spring and a high proportion flying south in the autumn (Annex 3.8 to the EIA report, figures 74–79).

Number of birds passing through the wind farm

However, these observations do not encompass the entire migration period. To estimate the number of birds that may pass through the wind farm, we predicted the total contacts for the entire migration period using the bootstrap method (Table 3.1-5, Figure 3.1-6). The point estimate for the number of birds passing through the wind farm during the migration period is 445193–1486296 contacts per day for rotor option A and 566311–1889757 contacts for rotor option B. At night, there are 285893–2629039 estimated contacts for rotor option A and 363034–3192456 contacts for rotor option B. There were significant differences between years; the predicted number of contacts in 2022 was higher than in 2023, both during the day and at night.

It is likely that the number of birds passing through the wind farm at night is higher than indicated in the table, as estimates are based on radar-recorded contacts rather than the number of individual birds. A single contact may also represent a group of birds rather than just one individual. Both underestimation and overestimation are possible in the daily forecast, as the radar also records the back-and-forth movements of local gulls, which cannot be distinguished from migrating bird contacts.

Table 3.1-5. *Forecast of the total number of birds passing through the wind farm, contacts during the migration period*

Season	***Day/night***	***Altitude range 0–1000 m***		***Altitude range 40–275 m (rotor A)***		***Altitude range 30–310 m (rotor B)***	
		Point estimate	95% confidence interval	Point estimate	95% confidence interval	Point estimate	95% confidence interval
2022							
Spring	Day	1856501	1629696–2099379	612888	524811–707302	787303	691938–887007
Spring	Night	3952845	3017317–4936901	1192549	879089–1548009	1362652	1025848–1735698
Autumn	Day	3451876	3053572–3858318	1486296	1300377–1681852	1889757	1667652–2120767
Autumn	Night	8416642	7296622–9567729	2629039	2255972–3021714	3192456	2740832–3681780
2023							

Season	Day/night	Altitude range 0–1000 m		Altitude range 40–275 m (rotor A)		Altitude range 30–310 m (rotor B)	
		Point estimate	95% confidence interval	Point estimate	95% confidence interval	Point estimate	95% confidence interval
Spring	Day	1638118	1418779–1865361	445193	386596–505856	566311	495012–638946
Spring	Night	1826469	1386674–2309270	464902	367391–575317	548023	432080–672500
Autumn	Day	1803430	1605602–1999868	772299	669654–876732	941377	819257–1066232
Autumn	Night	1284531	897250–1737188	285893	222218–360473	363034	282326–458446

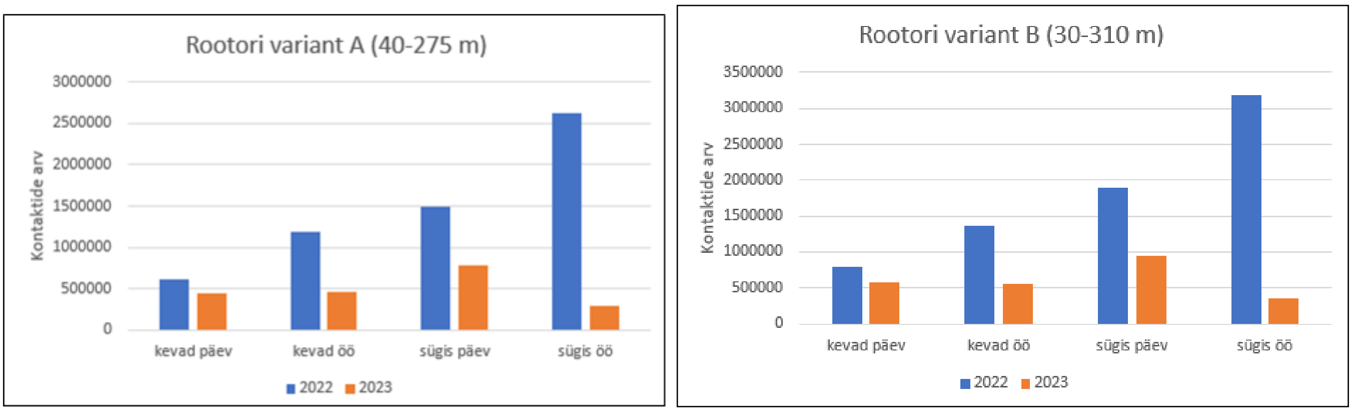

Figure 3.1-6. *Total number of predicted contacts of birds flying across at rotor height, rotor options A and B*

TELEMETRY STUDY OF BREEDING BIRDS

Near the eastern border of the development area is the Pärnu Bay special protection area for birds of international importance, which also contains bird nesting islands. To study the spatial use of birds nesting on islets, 4 important species were selected: the mew gull, the Arctic tern, the common tern and the sandwich tern (Burger *et al* 2024[12]). On Umalaiu, one of the islets closest to the initial site of the Saare-Liivi offshore wind farm, 15 mew gulls (*Larus canus*), 13 Arctic terns (*Sterna paradisaea*), 12 common terns (*Sterna hirundo*) and 12 sandwich terns (*Thalasseus sandvicensis*) were equipped with transmitters.

The spatial distribution of feeding flights of nesting birds, as well as the proportion of these flights that remain within the planned wind farm area, is determined by the length and direction of the flights. The maximum flight distance of the mew gull reached 61.1 kilometres. The average maximum flight distance (the average of the maximum distances of all feeding flights, calculated separately for each individual equipped with a transmitter) was significantly smaller, 3.02–12.26 km. For the Arctic tern, the maximum flight distance reached 126.47 km; the average maximum flight distance was 1.82–10.01 km. For the common tern, the corresponding figures were 129.21 km and 2.12–6.81 km; for the sandwich tern, 541.42 and 7.29–44.47 km.

IMPACTS DURING THE CONSTRUCTION AND DISMANTLING PHASE

12 Burger, C., Osterberg, J., Castillo, R., Welcker, J. 2024 Analysis of spatial use and collision risk of breeding seabirds based on GPS telemetry data Saare-Liivi 1 and Saare-Liivi 2 offshore wind farm planning areas.

Disturbance

Disturbance and displacement will affect waterbirds that stop in the area. When assessing these impacts, the wind farm development area must be considered together with the buffer (ie the extent of the potential significant impact area).

The impact assessment considered a significant number of bird species that stop in the area. Their frequency of occurrence allowed for abundance estimates to be made using the distance sampling method. The maximum abundance estimate of the species was used as the basis. The results of the estimate for the realistic main alternative 3 are provided in Table 3.1-6.

For boundary option 2, the development area serves as an important stopover site for long-tailed ducks, velvet scoters and black scoters, having international significance. All key stopover species are also sensitive to disturbances, and the cumulative impact of construction disturbance on these stopover waterbirds is notably negative. In option 3, proposed as a mitigation measure, there will still be potential negative cumulative impacts from disturbances during construction.

The disruption caused by construction and dismantling will be short-term, limited to the duration of these phases. However, while the original environment may not be fully restored after construction, some species, like the black scoter, are likely to partially return to the area if larger wind turbines are used and placed farther apart.

Table 3.1-6. *Significance of the disturbance risk in the development area for boundary option 3 (excluding mitigation measures)*

Species	***Importance of the area***	***Risk of disturbance (Garthe & Hüppop 2004[13], Maclean et al. 2009[14], Furness et al. 2012[15]).***	***Significance of the risk of disturbance***
loons (*Gavia sp.*)	low	very high	average
great cormorant (*Phalacrocorax carbo*)	low	high	low
long-tailed duck *(Clangula hyemalis*)	very high	medium-high	strong
velvet scoter *(Melanitta fusca*)	high	very high	strong
black scoter *(Melanitta nigra*)	high	very high	strong
little gull (*Hydrocoloeus minutus*)	low	very low	insignificant
black-headed gull (*Chroicocephalus ridibundus*)	low	low	insignificant
European herring gull and mew gull (*Larus argentatus et canus*)	low	low	insignificant
common and Arctic tern *(Sterna hirundo/paradisaea)*	low	low	insignificant

13 Garthe, S., Hüppop, O. 2004. Scaling possible adverse effects of marine wind farms on seabirds: developing and applying a vulnerability index. Journal of Applied Ecology 41: 724–734. (PDF) Scaling possible adverse effects of marine wind farms on seabirds: Developing and applying a vulnerability index (researchgate.net)

14 Maclean, I. M. D., Wright, L. J., Showler, D. A. and Rehfisch, M. M. 2009. A Review of Assessment Methodologies for Offshore Windfarms. British Trust for Ornithology Report Commissioned by Cowrie Ltd. (PDF) A Review of Assessment Methodologies for Offshore Wind Farms (researchgate.net)

15 Furness, R. W., Wade, H. M., Robbins, A. M. C., and Masden, E. A. 2012. Assessing the sensitivity of seabird populations to adverse effects from tidal stream turbines and wave energy devices. ICES Journal of Marine Science, 69(8): 1466–1479.

Disturbance during the construction and dismantling phases may have a significant negative impact on stopover waterbirds (long-tailed ducks, scoters) regardless of the boundary option used. However, disturbance during construction is not the most important risk factor for birds in this case. The impact of disturbance during construction is temporary and will be replaced by a more significant concern: the risk of displacement during the operational phase. To mitigate disturbance during construction, careful scheduling of work can be employed. While maintenance activities of the wind turbines may still cause disturbances that could lead to displacement, it is essential to note that activities like shipping and fishing are prohibited in the wind farm area, which can help balance the disturbance from maintenance vessels.

IMPACTS DURING THE OPERATION PHASE OF THE WIND FARM

Displacement

The results of the aerial census conducted in the wind farm area and their analysis show that the initial area of the Saare-Liivi offshore wind farm has great value as a stopover area for waterbirds. In the case of boundary option 2, the maximum population estimates of three species, the long-tailed duck, the velvet scoter and the black scoter, exceed the numerical thresholds of the criteria for a special protection area for birds of international importance (see Table 3.1-7). All of these species are vulnerable to the risk of displacement.

The abundance of stopover waterbirds (long-tailed duck, velvet scoter and black scoter) varies both within seasons (between different censuses), between seasons and between different years. Waterbirds are migratory birds. They arrive at an area, spend a certain amount of time there and move on. Censuses record the state of certain moments during this change. Using the maximum census result is, in practice, the most realistic way to assess the importance of an area during a season. Tables 3.1-7 and 3.1-8 show the maximum number of important species in boundary option 2 and boundary option 3, together with the applicable buffer zones.

Table 3.1-7. *Estimated number of displaced birds for boundary option 2 (Boundary option 2 with a 4 km wide buffer. The orange background indicates abundance estimates that exceed 1% of the species' biogeographical population abundance).*

Species	***Maximum abundance estimate in the area***	***Number of individuals displaced, conservative displacement rate (Jacobsen & Tjørnløv 2024[16]).***	***Number of individuals displaced, displacement rate recommended by experts (Jacobsen & Tjørnløv 2024[17]).***
Long-tailed duck *(Clangula hyemalis)*	92789	64952 (70% of abundance estimate)	27837 (30% of abundance estimate)
Velvet scoter *(Melanitta fusca)*	43986	39587 (90% of the abundance estimate)	30790 (70% of abundance estimate)
Black scoter *(Melanitta nigra)*	8048	7243 (90% of abundance estimate)	5634 (70% of abundance estimate)

16 Jacobsen, E. M. & Tjørnløv, R. S. 2024. Habitat displacement of sea ducks in relation to Saare-Liivi OWF, Estonia

17 See previous

Table 3.1-8. *Estimated number of displaced birds for boundary option 3 (Boundary option 3 with a 2 km wide buffer for long-tailed ducks and 4 km buffer for scoters. The orange background indicates abundance estimates that exceed 1% of the species' biogeographical population abundance).*

Species	***Maximum abundance estimate in the area***	***Number of individuals displaced, conservative displacement rate (Jacobsen & Tjørnløv 2024*[18]).**	***Number of individuals displaced, displacement rate recommended by experts (Jacobsen & Tjørnløv 2024*[19]).**
Long-tailed duck *(Clangula hyemalis*)	45558	31891 (90% of abundance estimate)	13667 (30% of abundance estimate)
Velvet scoter (*Melanitta fusca*)	4139	3725 (90% of abundance estimate)	2897 (70% of abundance estimate)
Black scoter *(Melanitta nigra*)	8048	7243 (70% of abundance estimate)	5634 (70% of abundance estimate)

Studies on seabird habitat displacement have shown mixed evidence regarding the impact, specifically in terms of buffer zones and displacement rates for different species. Several factors may influence the displacement rate, including the physical characteristics of the project area and its surroundings, food availability, the stopover and resting times of bird populations and the layout and design parameters of the wind farm. As a result, the impact ranges and species-specific displacement levels used in environmental impact assessments can vary significantly (Jacobsen & Tjørnløv 2024[20]).

For diving ducks, the most important bird group in this context, previous studies suggest that a buffer of 4 kilometres is necessary (JNCC 2022[21]). Additional information collected from follow-up monitoring of established offshore wind farms indicates that different buffer widths are applied for various species and areas (Jacobsen & Tjørnløv 2024).[22]). In analysing the knowledge and data accumulated over the past years, the research referred to (Jacobsen & Tjørnløv 2024) concluded that in a conservative approach, a 4-kilometre-wide buffer should be applied for diving ducks. For certain species, such as the long-tailed duck, a 2-kilometre-wide buffer is appropriate. Ongoing research continues to enhance our understanding, leading to regular updates of recommendations and guidelines as new information becomes available.

Behavioural responses to wind farms differ among various waterbird species. For example, scoters, long-tailed ducks and loons may experience some displacement from their previous stopover areas, while common eiders and terns may respond neutrally. In contrast, great cormorants and gulls might be attracted to wind farms (Dierschke *et al* 2016). In the case of diving ducks, their populations may significantly decline within the wind farm area, although not all individuals may be displaced from the region (Petersen 2024; Jacobsen & Tjørnløv 2024[23]). Among the species affected by displacement, loons are the most impacted, while the long-tailed duck experiences a lesser displacement effect.

18 See previous

19 See previous

20 See previous

21 JNCC 2022. Joint SNCB Interim Displacement Advice Note. joint-sncb-interim-displacement-advice-note-2022.pdf (jncc.gov.uk)

22 Jacobsen, E. M. & Tjørnløv, R. S. 2024. Habitat displacement of sea ducks in relation to Saare-Liivi OWF, Estonia

23 See previous

Practical advice for assessing applicable buffer zones, displacement levels and mortality is provided in Table 3.1-9.

Table 3.1-9. *Applicable buffer zones, displacement rate levels and mortality (conservative approach and recommended approach (Jacobsen & Tjørnløv 2024)[24]* Assuming that there are no designated special protection areas for birds for the red-throated loon within 10 km of the Saare-Liivi project area.*

Conservative approach	**Loons**	**Common eider**	**Black scoter**	**Velvet scoter**	**Long-tailed duck**	**Razorbill**
Applicable buffer zone	4 km*	4 km	4 km	4 km	4 km	2 km
Displacement risk (%)	100%	70%	90%	90%	70%	70%
Mortality (% of birds displaced)	5–10%	5–10%	5–10%	5–10%	5–10%	5–10%
'Recommended' approach	**Loons**	**Common eider**	**Black scoter**	**Velvet scoter**	**Long-tailed duck**	**Razorbill**
Applicable buffer zone	4 km*	2 km	4 km	4 km	2 km	2 km
Displacement risk (%)	90%	30%	70%	70%	30%	30%
Mortality (% of birds displaced)	1–5%	1–5%	1–5%	1–5%	1–5%	1–5%

As a result of a comprehensive analysis of existing literature and implemented projects, recommendations have been reached, in which the following values of the displacement rate should be applied in terms of the risk of displacement: 90% and 70% for the scoters and 70 and 30% for the long-tailed ducks (Jacobsen & Tjørnløv 2024[25]). It was recommended to use the same proportion of displaced individuals both within the wind farm and in its buffer zone. An estimate of the number of displaced birds for the most important species is provided in tables 3.1-7 and 3.1-8. **The adoption of boundary option 3, proposed as a mitigation measure, would significantly reduce the number of displaced individuals and their share of the population along the migration route.** Considering the displacement rates recommended by experts, the number of displaced birds will remain below 1% of the biogeographic population.

In most impact assessments, it is common to estimate the impact of displacement relative to biogeographic population size, using a 1% threshold as the acceptability limit for negative impacts. However, this approach makes the assessment of cumulative impacts significantly more difficult. Assessing cumulative impacts generally means including all projects within the range of a biogeographic population in the assessments; however, this is often not feasible in practice (Jacobsen & Tjørnløv 2024[26]).

Several studies indicate that seabirds may not be permanently displaced by offshore wind farms, as some species have shown an ability to adapt and coexist with these developments. Sea ducks, in particular, seem capable of adapting to the presence of wind farms, as long as adequate food supplies are available in the area. If adaptation is overlooked in impact assessments, there is a risk of overestimating the long-term increase in mortality due to the presence of an offshore wind farm (Jacobsen & Tjørnløv 2024[27]). When developing the boundary option 3 alternative, it was taken into account that wind turbines should not be located on the identified reef habitat in the development area. This exclusion means that direct impacts on benthic communities will not occur, and the suitable food sources for long-tailed ducks will remain intact. Moreover, turbine foundations can provide additional substrate for the growth of benthic organisms, which serve as food for birds.

24See previous

25 See previous

26 Jacobsen, E. M. & Tjørnløv, R. S. 2024. Habitat displacement of sea ducks in relation to Saare-Liivi OWF, Estonia

27 See previous

The capacity to adapt to wind turbines varies by area and species. In addition to interspecies differences, there are individual variations within species (Fox & Petersen 2019[28]). Monitoring in Denmark has shown that after an initial sharp decline in long-tailed duck abundance following the construction of a wind farm, their population began to increase over time; however, it did not return to pre-wind farm levels even after 15 years. Black scoters appeared to recover better (Petersen 2024[29]; Scott-Hayward *et al* 2024[30]). Currently, specific studies on the adaptation of velvet scoters are lacking.

The displacement rate can be affected by several factors, such as the height of the wind turbines and their spacing. Several studies claim that there is no significant relationship between the size of wind turbines and their displacement effect (Lamb *et al* 2024[31]). However, research conducted in Denmark suggests that the risk of displacement for black scoters and loons is lower with large, widely spaced wind turbines compared to smaller ones (Scott-Hayward *et al* 2024[32]). As the planned size of wind turbines for our marine areas has not been previously implemented, there is limited data regarding their actual impact. Interestingly, as wind turbines increase in size, their displacement effect may diminish as they are spaced wider apart.

When evaluating the significance of the displacement risk, factors such as the importance of the area as a stopover site and published displacement risk scales were considered, along with species distribution and the proportion of displaced individuals. For the black scoter, the significance of the displacement risk was downgraded by one level for both boundary options 2 and 3, primarily because this species was observed in very large numbers during only one census and in the buffer zone of the development area. Similarly, the risk of displacement for the long-tailed duck was reduced by one level in option 3, considering the potentially lower proportion of displaced individuals (30–70%) compared to that of the scoters (70–90%) (Jacobsen & Tjørnløv 2024[33]) (Table 3.1-7).

The construction of a wind farm in the initial and boundary option 2 areas of the Saare-Liivi offshore wind farm is expected to have a significant negative impact on waterbirds, making such development undesirable. As a result, the area has been narrowed down, focusing on the alternative solution developed in the assessment of displacement risk, namely boundary option 3. The assessment of the displacement risk is presented in Table 3.1-10.

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28 Fox, A. D., Petersen, I. K. 2019. Offshore find farms and their effects on birds. Dansk Orn. Foren. Tidsskr. 113: 86-101. (PDF) Offshore wind farms and their effects on birds (researchgate.net)

29 Petersen, I.K, Fox, A.D. 2005. An aerial survey technique for sampling and mapping distributions of waterbirds at sea.

30 Scott-Hayward, L., Petersen, I. K., MacKenzie, M., Pedersen, C. L., Isojunno, S., Nielsen, R. D., Sterup, J., Thomsen, H. M., Neergaard, R. S. 2024. Changes in the distribution and abundance of common scoter and diver species in the Horns Rev I, II and III offshore windfarm areas, Denmark.

31 Lamb, J. G., Gulka, J., Adams, E., Cook, A., Williams, K. A. (2024). A synthetic analysis of post-construction displacement and attraction of marine birds at offshore wind energy installations. Environmental Impact Assessment Review 108.

32 See 114

33 Jacobsen, E. M. & Tjørnløv, R. S. 2024. Habitat displacement of sea ducks in relation to Saare-Liivi OWF, Estonia

Table 3.1-10. *Significance of the displacement risk in the development area for boundary option 3 (boundary option 3 with buffers), without taking into account the displacement risk rate*

Species	***Importance of the area***	***Displacement risk (Piggott[34], Vulcano & Mitchell 2021, Humphreys et al 2015[35])***	***Significance of the displacement risk***
loons (*Gavia sp.)*	low	high	low
great cormorant (*Phalacrocorax carbo*)	low	average	low
long-tailed duck *(Clangula hyemalis*)	very high	average	average
velvet scoter *(Melanitta fusca*)	very high	average	strong
black scoter *(Melanitta nigra*)	very high	high	average
little gull (*Hydrocoloeus minutus*)	low	very low	insignificant
black-headed gull (*Chroicocephalus ridibundus*)	low	very low	insignificant
European herring gull and mew gull (*Larus argentatus et canus*)	low	very low	insignificant
common and Arctic tern *(Sterna hirundo/paradisaea)*	low	low	insignificant

The presence of suitable stopover areas for birds in the vicinity has been taken into account as one component in the assessment of the displacement risk (Sciara Offshore Energy LTD 2006[36], Ramboll Polska 2024[37]). Ideally, if relocated birds encounter similar conditions in neighbouring areas—such as comparable food resources, competition, predation, and disturbances—displacement from their original habitat should have no adverse effects on the population. However, bird relocation typically impacts their body condition, which can lead to increased mortality or reduced reproductive capacity (Petersen 2024[38]). In this case, alternative stopover options could be provided by the shallow marine areas around Kihnu, located northeast of the development area. Additionally, for boundary option 3, stopover areas excluded from the original development area to the north and south may also serve this purpose. The exact 'capacity' of the suitable areas remains unknown, leading to the possibility that birds may experience excessive competition. Furthermore, differences in bird distribution between censuses suggest that birds may require multiple stopover areas to survive successfully.

In summary, boundary option 2 of the development area holds significant value as a stopover habitat for long-tailed ducks, black scoters and velvet scoters. The construction of a wind farm would likely have a substantial negative displacement effect on these species, making boundary option 2 unsuitable within the defined spatial scope. On the other hand, the introduction of reduced boundary option 3, developed as a mitigation measure, significantly diminishes the potential displacement impact, indicating that there are no significant negative consequences from implementing these mitigation measures.

34 Piggott, A., Vulcano, A., Mitchell, D. 2021. Impact of offshore wind development on seabirds in the North Sea and Baltic Sea: Identification of data sources and at-risk species. *(PDF) Impact of offshore wind development on seabirds in the North Sea and Baltic Sea: Identification of data sources and at-risk species. (researchgate.net)*

35 *Humphreys, E. M., Cook, A. S. C. P., & Burton, N. H. K-2015 Collision, Displacement and Barrier Effect Concept Note. 669.*

36 *Sciara Offshore Energy LTD 2006. Sheringham Shoal Wind Farm Offshore Environmental Statement.* *http://sheringhamshoal.co.uk/downloads/Offshore%20environmental%20statement.pdf*

37 *Ramboll Polska 2024. Saare-Liivi Offshore Windfarm – Estonia. Impact Assessment Velvet Scoter and Long-tailed Duck – Displacement.*

38 *Petersen, I. K. 2024. UTILITAS Saare-Liivi offshore wind farm site and diving ducks. Seaduck sensitivity to offshore wind farms.*

HABITAT DESTRUCTION

Direct habitat destruction can affect stopover waterbirds. Direct habitat destruction caused by wind turbine foundations accounts for only a small portion of the wind farm area. In addition, a certain amount of habitats may be destroyed under the narrow cable route. In this case, the primary threat factor in the development area is the significant negative displacement effect, while habitat destruction is relatively minor in comparison.

BARRIER EFFECT

Traditionally, environmental impact assessments focus on how the barrier effect impacts birds nesting nearby. This barrier effect can be significant if a wind farm is situated between breeding colonies and the feeding grounds of the birds that breed there (Speakman *et al*, 2009[39]). In this context, the Pärnu Bay special protection area for birds of international importance lies near the eastern border of the planned offshore wind farm (regardless of which wind farm boundary option is being considered). The Pärnu Bay special protection area for birds includes important bird nesting islands. Among the breeding species, four key species were selected because their flight paths extend into the wind farm areas: the mew gull, Arctic tern, common tern and sandwich tern. The abundance of all these species in the region exceeds 1% of the total Estonian abundance (Table 3.1-11), underscoring the high importance of these areas for them.

An assessment of the potential significance of the barrier effect for birds nesting nearby is provided in Table 3.1-11.

Table 3.1-11. *Abundance of breeding species in the area*

Species	***The average abundance of breeding species in the wind farm impact area, in pairs (Burger et al 2024[40])***	***Average abundance in Estonia, in pairs (Elts et al 2019[41])***	***Proportion of species breeding in the area of Estonian abundance, %***
mew gull (*Larus canus*)	244.6	8500	2.88
common tern (*Sterna hirundo*)	954.12	6000	15.9
arctic tern (*Sterna paradisaea*)	320.65	10000	3.21
Sandwich Tern (*Thalasseus sandvicensis*)	217.94	950	22.94

Different species exhibit varying behavioural responses to a wind farm as an obstacle, whether they choose to pass it by or through it. The risk posed by the barrier effect has been assessed as low for swans,

39 Speakman, J., Gray, H., Furness, L. 2009. University of Aberdeen report on effects of offshore wind farms on the energy demands on seabirds.

40 Burger, C., Osterberg, J., Castillo, R., Welcker, J. 2024 Analysis of spatial use and collision risk of breeding seabirds based on GPS telemetry data Saare-Liivi 1 and Saare-Liivi 2 offshore wind farm planning areas.

41 Elts, J., Leito, A., Leivits, M., Luigujõe, L., Nellis, R., Ots, M., Tammekänd, I. & Väli, Ü. 2019. Status, abundance during breeding and winter of Estonian birds 2013–2017. Hirundo 32 (1): 1-39. [Elts_et_al_2019-1.pdf (eoy.ee)] geese, skuas, gulls and terns and medium for diving ducks, loons, great cormorants and razorbills (Langston 2010[42]).

An important factor regarding the barrier effect is the proportion of the wind farm area relative to the feeding areas used by these birds. To study the spatial usage of key species, representatives from these species were equipped with transmitters (Burger *et al* 2024[43]). The results of the telemetry study have been taken as the basis for assessing the significance of the barrier effect (Table 3.1-12).

Table 3.1-12. *Significance of the barrier effect in boundary option 3 (as well as boundary option 2)*

Species	***Importance of the area***	***Threat from the wind farm***	***Importance of the barrier effect***
Mew gull (*Larus canus*)	high	low	low
Arctic tern *(Sterna paradisaea*)	high	low	low
Common tern *(Sterna hirundo*)	high	very low	insignificant
Sandwich tern (*Thalasseus sandvicensis*)	high	low	low

The primary areas where birds spent more than half of their time were consistently located outside boundary option 2 of the Saare-Liivi wind farm. For some individual mew gulls, Arctic terns and sandwich terns, 95% of their activity occurred within the development area. However, the intensity of use of the development area was low, with only 0.36% (sandwich tern) to 0.81% of the recorded bird locations in the development area. Overall, the impact of the barrier effect can be considered slightly negative.

COLLISION RISK

The collision risk was assessed for both migrant (Castillo, Liedtke & Welcker 2024[44]) and breeding species (Burger *et al* 2024[45]). In both cases, the upgraded Band model and the software created to implement it were used (R package '*stochLAB*', Caneco *et al* 2022[46]). The modelling was performed by the German company BioConsult SH GmbH and Co. KG (Castillo, R., Liedtke & Welcker 2023[47]).

The population estimate of birds migrating through the area was found based on average flight intensities. To estimate flight intensity (individuals per hour per kilometre), we multiplied the average flight intensity by the number of daytime hours (or nighttime hours for nocturnal migrants) and the maximum width of the wind farm in the southeast-northwest direction, which is perpendicular to the main migration route. Monthly abundance estimates were aggregated by season (spring and autumn). For nocturnal migrants, the abundance estimates were comparable to those found using the bootstrap

42 Langston, R. H. W. 2010. Offshore wind farms and birds: Round 3 zones, extensions to Round 1 & Round 2 sites & Scottish Territorial Waters. RSPB Research Report No. 39. [Offshore wind farms and birds: Round 3 zones, extensions to Round 1 & Round 2 sites & Scottish Territorial Waters (pnnl.gov)]

43 Burger, C., Osterberg, J., Castillo, R., Welcker, J. 2024 Analysis of spatial use and collision risk of breeding seabirds based on GPS telemetry data Saare-Liivi 1 and Saare-Liivi 2 offshore wind farm planning areas.

44 Castillo, R., Liedtke, J. & Welcker J. 2024. Collision risk models for Utilitas offshore wind farm – Primary area.

45 Burger, C., Osterberg, J., Castillo, R., Welcker, J. 2024 Analysis of spatial use and collision risk of breeding seabirds based on GPS telemetry data Saare-Liivi 1 and Saare-Liivi 2 offshore wind farm planning areas.

46 Caneco, B., Humphries, G., Cook, A. S. C. P. & Masden, E. 2022. Estimating bird collisions at offshore windfarms with stochLAB.

47 Castillo, R., Liedtke, J. & Welcker J. 2024. Collision risk models for Utilitas offshore wind farm – Primary area.

method, remaining within its confidence interval. The significance of the area for migratory birds was assessed based on the higher population estimate from either spring or autumn.

The modelling took into account, among other things, the following:

- bird dimensions (including body length, wingspan), flight speed, avoidance behaviour and avoidance rates;
- a low avoidance rate (98%) was used for nocturnal migrants;
- the frequency of nocturnal migration is based on radar observations;
- site-specific frequencies are based on averages from ship-based surveys conducted during spring and autumn migration;
- to obtain the abundance for the entire migration period, survey data were extrapolated, taking into account possible overestimation, as the surveys were conducted under favourable weather conditions for migration;
- mortality rates are proportional to the frequency used in the models regardless of the total number of birds;
- wind turbine dimensions according to Table 2.-1, average wind speed and wind turbine operating time by month.

The placement of the wind turbines does not influence the collision risk calculations because the Band model computes collisions for each wind turbine individually. The overall impact of the wind farm is the sum of the impacts of all the individual turbines, regardless of their specific locations.

For all observed waterbirds, the estimated abundance of birds migrating through the wind farm area exceeded 1% of the total abundance of the biogeographic population (Table 3.1-14). The development area was particularly crucial for the Eurasian crane; according to the methodology used, 59% of the individuals in the biogeographic population passed through this area. 38% of the velvet scoter population also passed through the development area.

Collision risk for migratory birds was modelled for 15 key species or species groups. Observations were recorded in groups when the number of undetermined individuals during visual observations was high. The main species in the groups are the following: among the loons, the Arctic loon and red-throated loon; among the geese and brant geese, the bean goose, the greater white-fronted goose and the barnacle goose; among the waders, the Eurasian golden plover, the grey plover, the bar-tailed godwit, the dunlin and the Eurasian curlew; among the terns, the common and Arctic tern. For skuas, the Arctic jaeger was the dominant species. Two possible options were used as operating heights for the turbines.

The estimated annual number of collisions for diurnal migratory species reached up to 296 (geese and brant geese for wind turbine option B; Table 3.1-13). The annual average number of collisions for nocturnal migrants (probably mainly passeriformes) was estimated at 3536 (turbine option A) and 4841 (turbine option B), with a range estimate of up to 6080 collisions per year. In the case of nocturnal migrants, it is important to note that the original data is measured in contacts rather than individuals (where one contact may represent a group). Consequently, the actual mortality risk for individuals may be higher than what the model suggests.

For most observed species, the estimated number of collisions was very low. Aside from nocturnal migrants, it is important to pay attention to the Eurasian crane, as well as geese and brant geese. A significant factor contributing to the increased collision risk for the Eurasian crane, geese and brant geese is their higher flight altitude, which significantly overlaps with the operating altitude of the rotors.

In all cases, the modelling results indicated a higher risk of fatalities for wind turbine option B, which considered larger wind turbines. On larger wind turbines, the rotors have larger working zones and cover a larger area. Also, for larger wind turbines, the operating zone of the rotors starts lower, increasing the risk to low-flying birds. The latter may also be the reason why the modelling results contradict the opinions expressed in the literature that larger wind turbines are safer for birds (Johnston *et al*, 2014[48]; Thaxter *et al* 2017[49]). Differences in wind turbine types are not of great practical importance; the selection of turbines for constructing a wind farm is primarily determined by the currently available production models.

Table 3.1-13. *Estimated number of collisions for migrant birds per year for boundary option 2 (Castillo, Liedtke & Welcker 2024[50])*

Species / group	***Turbine A 275 m***		***Turbine B 310 m***	
	Mean ± SD	***95% confidence interval***	***Mean ± SD***	***95% confidence interval***
Loons (*Gavia stellata/arctica, G. arctica*)	0.88 ± 0.1	0.68–1.08	1.35 ± 0.14	1.07–1.63
great cormorant (*Phalacrocorax carbo*)	2.32 ± 0.27	1.8–2.87	3.56 ± 0.4	2.78–4.34
Geese and brant geese	193.02 ± 17.93	158.19–228.28	249.81 ± 23.25	204.65–295.64
Eurasian Wigeon (*Mareca penelope*)	23.28 ± 1.94	19.49–27.1	28.23 ± 2.28	23.75–32.67
Greater scaup (*Aythya marila*)	0.9 ± 0.12	0.69–1.13	1.44 ± 0.15	1.16–1.74
Black Scoter (Melanitta nigra)	0.25 ± 0.05	0.17–0.35	0.32 ± 0.06	0.22–0.45
Velvet Scoter *(Melanitta fusca*)	0.98 ± 0.16	0.69–1.32	1.57 ± 0.23	1.15–2.04
Long-tailed duck *(Clangula hyemalis*)	0.09 ± 0.02	0.05–0.13	0.17 ± 0.03	0.11–0.24
Eurasian Crane (*Grus grus*)	76.23 ± 8.74	59.35–93.18	88.58 ± 10.14	68.94–108.24
Waders	11.14 ± 1.53	8.21–14.19	12.34 ± 1.67	9.14–15.69
Skuas (*Stercorarius parasiticus*)	0.57 ± 0.06	0.45–0.7	0.75 ± 0.08	0.59–0.9
Mew gull (*Larus canus*)	0.99 ± 0.14	0.72–1.27	1.55 ± 0.2	1.17–1.95
Little gull (*Hydrocoloeus minutus*)	0.34 ± 0.04	0.27–0.42	0.5 ± 0.05	0.4–0.59
Terns (*Sterna hirundo, S. paradisae*a)	0.11 ± 0.02	0.07–0.16	0.18 ± 0.03	0.13–0.24
Nocturnal migrants	3535.69 ± 456.24	2646.22 - 4432.27	4840.89 ± 629.52	3610.25 - 6079.88

The exact species and numerical composition of nocturnal migrants is unknown. According to nighttime audio recordings, the most abundant bird group was the passeriformes, especially in autumn, when they accounted for 90% of contacts. According to audio recordings, the most abundant species were the European robin, song thrush and redwing. In autumn (the season with the highest number of contacts with nocturnal migrants), song thrush contacts accounted for 30%, redwing contacts for 10% and European robin contacts for 27% of all registered contacts. Assuming that the percentages found based

48 Johnston, A., Cook, A. S. C. P., Wright, L. J., Humphreys, E. M., & Burton, N. H. K. 2014. Modelling flight heights of marine birds to more accurately assess collision risk with offshore wind turbines. Journal of Applied Ecology, 51(1), 31–41. https://doi.org/10.1111/1365-2664.12191

49 Thaxter, C. B., Buchanan, G. M., Carr, J., Butchart, S. H. M., Newbold, T., Green, R. E., … Pearce-Higgins, J. W. 2017. Bird and bat species' global vulnerability to collision mortality at wind farms revealed through a trait-based assessment. Proceedings of the Royal Society B: Biological Sciences, 284(1862). https://doi.org/10.1098/rspb.2017.0829

50 Castillo, R., Liedtke, J. & Welcker J. 2024. Collision risk models for Utilitas offshore wind farm – Primary area.

on audio recordings apply to all nocturnal migrants, 2.2% of European song thrushes, 2.1% of redwings and 0.9% of European robins pass through the development area in autumn. The results of this type of calculation are highly approximate; however, given the significant estimated number of nocturnal migrants, the value of the development area is considered to be very high.

Table 3.1-14. *The seasonal abundance estimates of migratory birds and their share of the biogeographical population*

Species / Group	***Season's abundance -estimate***	***Season***	***1% of biogeographical population size (Wetlands International)***	***Share of migratory birds in the size of the biogeographical population, %***
Loons (*Gavia stellata, G. arctica*)	32928	Spring	4453*	7
Great cormorant (*Phalacrocorax carbo*)	67566	Autumn	6200	11
Geese and brant geese	130469	Spring	12316	11
Eurasian Wigeon (Mareca penelope)	87993	Autumn	14000	6
Greater scaup (Aythya marila)	42733	Autumn	2600	16
Black scoter (Melanitta nigra)	102152	Spring	7500	14
Velvet scoter (Melanitta fusca)	112613	Spring	3000	38
Long-tailed duck (Clangula hyemalis)	466922	Spring	16000	29
Eurasian crane (Grus grus)	88022	Autumn	1500	59
Waders	18514	Spring	11179*	1.6
Skuas (Stercorarius parasiticus)	12868	Spring	1000**	12.8
Common gull (Larus canus)	70790	Autumn	16400	4
Little gull (Hydrocoloeus minutus)	12296	Autumn	1300	9
Terns (Sterna hirundo, S. paradisaea)	61038	Spring	16606*	4
Nocturnal migrants	4399785	Autumn	?	?

** 1% was found as a weighted average of the percentages of the key species in the group. The proportions of the respective species in visual observations were used as weights.*

*** Wetlands International does not provide abundance estimates for this species. 1% of the population abundance of the Arctic jaeger was calculated based on the European population abundance (Stercorarius parasiticus) (iucnredlist.org))*

The scale used to assess the significance of the collision risk is provided in Table 3.1-15. We established that a collision estimate of less than one individual per year indicates a very low impact. It is difficult to precisely determine the boundary between low and medium impact. We calculated the significance of collision risk for Eurasian cranes and nocturnal migrants to be average. For the Eurasian crane, we based our assessment on the relatively high number of estimated collisions and the critical importance of the area as a migratory route for this species. Some considerations regarding the cumulative impact on the Eurasian crane are presented below in the relevant chapter. In examining nocturnal migratory birds, we not only took into account the high estimated number of collisions but also the considerable uncertainty surrounding both their abundance and species composition. Additionally, we factored in the potential attracting effect of safety lighting used at wind farms and the declining trends in the populations of common species. For geese, we limited ourselves to low significance. The collision risk assessment applies to the group of species, divided between the three main species (bean goose, greater white-fronted goose and barnacle goose), which are currently in good condition.

Table 3.1-15. *Danger from collision risk*

Vulnerability	
high	The number of collisions is very high, the wind farm alone would have a significant negative impact on the population.
average	The number of collisions is considerable, given the large number of wind farms and the challenging-to-predict cumulative impacts associated with them. These impacts could negatively affect the overall bird population.
low	Individual collisions occur every year. The impact on the species population as a whole is present, but is expected to be weak.
very low	The number of collisions is negligible, there may not be a single collision every year.

Estimates of the number of collisions represent a small fraction of the size of biogeographic populations (Annex 3.8 to the EIA report, Table 36). The collision risk for different species and species groups ranges from very low to medium. The significance of the development area as a migration route is very high, and the risk of collision varies from low to high (Eurasian Crane, nocturnal migrants; Table 3.1-16). It is possible that this wind farm, along with others in the region, could negatively impact bird populations due to cumulative effects that are difficult to predict. To reduce the negative impact, mitigation measures would be necessary.

Table 3.1-16. *The significance of collision risk for migratory species in boundary option 2*

Species / Group	***Importance of the area***	***Threat from the wind farm***	***The significance of the collision risk***
Loons (Gavia stellata, G. arctica)	very high	low	average
Great cormorant (Phalacrocorax carbo)	very high	low	average
Geese and brant geese	very high	low	average
Eurasian Wigeon (Mareca penelope)	very high	low	average
Greater scaup (Aythya marila)	very high	low	average
Black scoter (Melanitta nigra)	very high	very low	low
Velvet scoter (Melanitta fusca)	very high	low	average
Long-tailed duck (Clangula hyemalis)	very high	very low	low
Eurasian crane (Grus grus)	very high	average	strong
Waders	very high	low	average
Skuas (Stercorarius parasiticus)	very high	very low	low
Common gull (Larus canus)	very high	low	average
Little gull (Hydrocoloeus minutus)	very high	very low	low
Terns (Sterna hirundo, S. paradisaea)	very high	very low	low
Nocturnal migrants	very high	average	strong

In the case of reduced boundary option 3, both the width of the wind farm and the number of turbines are reduced, which also reduces the mortality risk. Mortality risks for the reduced boundary option were found using the same software (R package '*stochLAB*', Caneco *et al* 2022[51]). Most of the parameters used in the modelling also remained the same (Castillo, Liedtke & Welcker 2024[52]), only the width of the wind

51 Caneco, B., Humphries, G., Cook, A. S. C. P. & Masden, E. 2022. Estimating bird collisions at offshore windfarms with stochLAB.
52 Castillo, R., Liedtke, J. & Welcker J. 2024. Collision risk models for Utilitas offshore wind farm – Primary area.

farm (13.67 km) and the number of turbines (80) were changed. The mortality risks of the most important bird groups in the case of boundary option 3 are presented in Table 3.1-17 and its possible impact in tables 3.1-18 and 3.1-19. The collision risks for the remaining species and species groups were very low even in the case of the larger boundary option 2.

Table 3.1-17. *Estimated number of key bird group collisions per year for boundary option 3*

Species / group	***Turbine A 275 m***		***Turbine B 310 m***	
	Mean ± SD	***95% confidence interval***	***Mean ± SD***	***95% confidence interval***
Geese and brant geese	144.18 ± 13.80	117.50–171.55	187.17 ± 17.99	152.45–222.71
Eurasian crane (Grus grus)	49.33 ± 5.70	38.25–60.75	58.32 ± 6.80	45.19–71.81
Nocturnal migrants	2617.4 ± 340.1	1950.5–3288.0	3635.0 ± 476.3	2705.4–4577.0

Table 3.1-18. *Proportion of the number of collisions of migratory species to the size of the biogeographic population for boundary option 3*

Species / Group	***Annual point estimate of the number of collisions***	***95% confidence interval for the annual number of collisions***	***1% of the biogeographic population size***	***Share of collisions in the size of the biogeographical population, %***
Turbine A				
Geese and brant geese	144.18	117.50–171.55	12316	0.011707
Eurasian Crane (*Grus grus*)	49.33	38.25–60.75	1500	0.032887
Nocturnal migrants	2617.4	1950.5–3288.0	?	?
Turbine B				
Geese and brant geese	187.17	152.45–222.71	12316	0.015197
Eurasian Crane (*Grus grus*)	58.32	45.19–71.81	1500	0.038880
Nocturnal migrants	3635.0	2705.4–4577.0	?	?

Table 3.1-19. *The significance of collision risk for migratory species in boundary option 3*

Species / Group	***Importance of the area***	***Threat from the wind farm***	***The significance of the collision risk***
Geese and brant geese	very high	low	average
Eurasian Crane (*Grus grus*)	very high	average	strong
Nocturnal migrants	very high	average	strong

For breeding birds, collision risk was considered for the four key species in the project area's impact zone (mew gull, Arctic tern, common tern and sandwich tern). The importance of the project area for all of the mentioned species is high, with breeding populations exceeding 1% of the estimated population in Estonia (Table 3.1-14). Collision risk estimates were low for all observed species (Table 3.1-20) and the overall significance of the collision risk for breeding birds is low (Table 3.1-21).

Table 3.1-20. *Estimated number of collisions of breeding birds per year (Burger et al 2024[53])*

Species	Turbine A 275 m		Turbine B 310 m	
	Mean ± SD	95% confidence interval	Mean ± SD	95% confidence interval
mew gull (*Larus canus*)	0.07 ± 0.03	0.01–0.14	0.09 ± 0.05	0.02–0.2
common tern (*Sterna hirundo*)	0	0	0	0
arctic tern (*Sterna paradisaea*)	1.19 ±,0.52	0.3–2.27	1.51 ± 0.66	0.39–2.89
Sandwich Tern (*Thalasseus sandvicensis*)	3.63 ± 1.81	0.94–7.85	4.5 ± 2.24	1.17–9.72

Table 3.1-21. *The significance of the collision risk for breeding birds*

Species / Group	Importance of the area	Threat from the wind farm	The significance of the collision risk
mew gull (Larus canus)	high	very low	insignificant
common tern (Sterna hirundo)	high	very low	insignificant
Arctic tern (Sterna paradisaea)	high	low	low
Sandwich tern (Thalasseus sandvicensis)	high	low	low

There are numerous nests of the white-tailed eagle (*Haliaeetus albicilla*), a species of protection category I, on the Estonian coast. To ensure safety, a maximum 6 km wide zone around the nest is considered necessary (Estonian Ornithological Society and Kotkaklubi 2022[54]). The wind farm area is situated more than 10 kilometres away from the nearest white-tailed eagle nest, making it unnecessary to assess the collision risk for these birds.

INDIRECT EFFECTS

During the operational phase, waterbirds may be impacted not only by changes in prey availability but also by the risk of pollution, similar to the effects during the construction phase. Prey availability may be affected by loss of seabed beneath wind turbine foundations, underwater noise from wind turbines and maintenance vessels, the addition of new hard substrate as an attachment point for benthic organisms, electromagnetic fields, warming of sediments above cables and restrictions on fishing (Moray West 2018[55]). Unlike many factors associated with wind turbines, the introduction of new hard substrates and restrictions on fishing can have a positive impact on birdlife.

However, there are pollution risks due to the potential release of harmful substances into the environment from accidents and leaks related to wind turbines and their maintenance equipment. The likelihood of such accidents and leaks occurring is low if the work is performed carefully. The maintenance vessels for wind turbines are generally smaller than those used during the construction phase, which means they

53 Burger, C., Osterberg, J., Castillo, R., Welcker, J. 2024 Analysis of spatial use and collision risk of breeding seabirds based on GPS telemetry data Saare-Liivi 1 and Saare-Liivi 2 offshore wind farm planning areas.
54 Estonian Ornithological Society and Kotkaklubi 2022 Nationwide analysis of terrestrial bird population [Üle-eestiline maismaalinnustiku analüüs]. Nationwide analysis of terrestrial bird population | Environmental Portal
55 Moray West 2018, Moray West Offshore Windfarm Offshore EIA Report. http://marine.gov.scot/sites/default/files/00538033.pdf

carry less fuel. Consequently, the risk of environmental contamination from fuel spills in the event of an accident is also reduced.

SUMMARY

According to the analysis of the birdlife study and the subsequent report, boundary options 1 and 2 for the Saare-Liivi initial development area are significant as stopover sites for waterbirds, both in terms of spatial extent and activity volume. The key species are the long-tailed duck (*Clangula hyemalis*) and the velvet scoter (*Melanitta fusca*).

Due to bird protection requirements, a modified version of the main alternative (alternative 3) was developed, which features a reduced northeast corner (see Figure 4.1-1). This modification represents the maximum realistic spatial extent for the wind farm's development. Considering the displacement rates, the estimated number of displaced birds in main alternative 3 will remain below 1% of the biogeographic population, based on displacement rates recommended by experts. If the main mitigation measures to address the risk of displacement are implemented, along with strategies to reduce collision risks during operation, main alternative 3 is unlikely to have a significant adverse impact on birdlife.

Table 3.1-22. *Impacts associated with wind farm design and their significance*

Consequence/impact	***Significance of impact***		***Need for mitigation measures, final significance of impact***
	15 MW (A)	***20 MW (B)***	
Wind farm construction and dismantling			
Disturbance from construction activities and vessels	-	-	Time limits for performing work. Cumulative effect: 0
indirect impacts (impact on food abundance and pollution risk)	0	0	
Laying the connection cable			
Disturbance from construction activities and vessels	0/-	0/-	
Wind farm operation			
displacement	--	--	Area reduction (occurred). Cumulative effect: -
direct destruction of habitats	-	-	
collision risk	--	--	Mitigation measures required. Cumulative effect: 0/-
barrier effect	0	0	
indirect impacts (impact on food abundance and pollution risk)	0	0	

**The scale of significant environmental impact used in the EIA report: - minor negative impact, -- significant negative impact, 0 - no impact, neutral, + minor positive impact, ++ significant positive impact*

In addition, it is important to ensure that the important stopover areas for diving ducks outside boundary option 3 (Annex 3.8 to the EIA report, Figure 89) are not affected by further development activities. In conclusion, no wind turbines are currently planned for these critical stopover areas in this procedure. To ensure the effectiveness of conservation measures, it is essential to integrate important stopover sites into the existing network of protected areas in the future. A proposal to formally protect these areas should be prepared as an independent document and handled as a separate procedure.

3.2. Bats

Conducted study:

- Pre-construction study of *Chiroptera* in the initial area of the Saare-Liivi offshore wind farm. Elustik OÜ, 2024.

All bat species in Estonia are protected by both national and several international conventions and legislation. The 12 bat species that are definitely found in Estonia belong to protection category II based on the Government of the Republic's Regulation No. 195 of 20 May 2004 'List of species placed under protection as species in the protected category I or II'.

Bat data was collected using three methods:

- ship-based censuses during the spring and autumn migration periods of bats;
- bat censuses on sea buoys during spring and autumn migration periods and in summer;
- bat censuses on the coast in Kabli and Kihnu.

Five special-purpose buoys were installed in the study area to record bats offshore. Ship-based censuses were conducted in 2022 and 2023. During the spring migration period, censuses were conducted over seven nights, all of which took place in 2023. In the autumn migration period, censuses were carried out over fourteen nights, eight of which occurred in 2022. The survey points are shown in Figure 3.2-1.

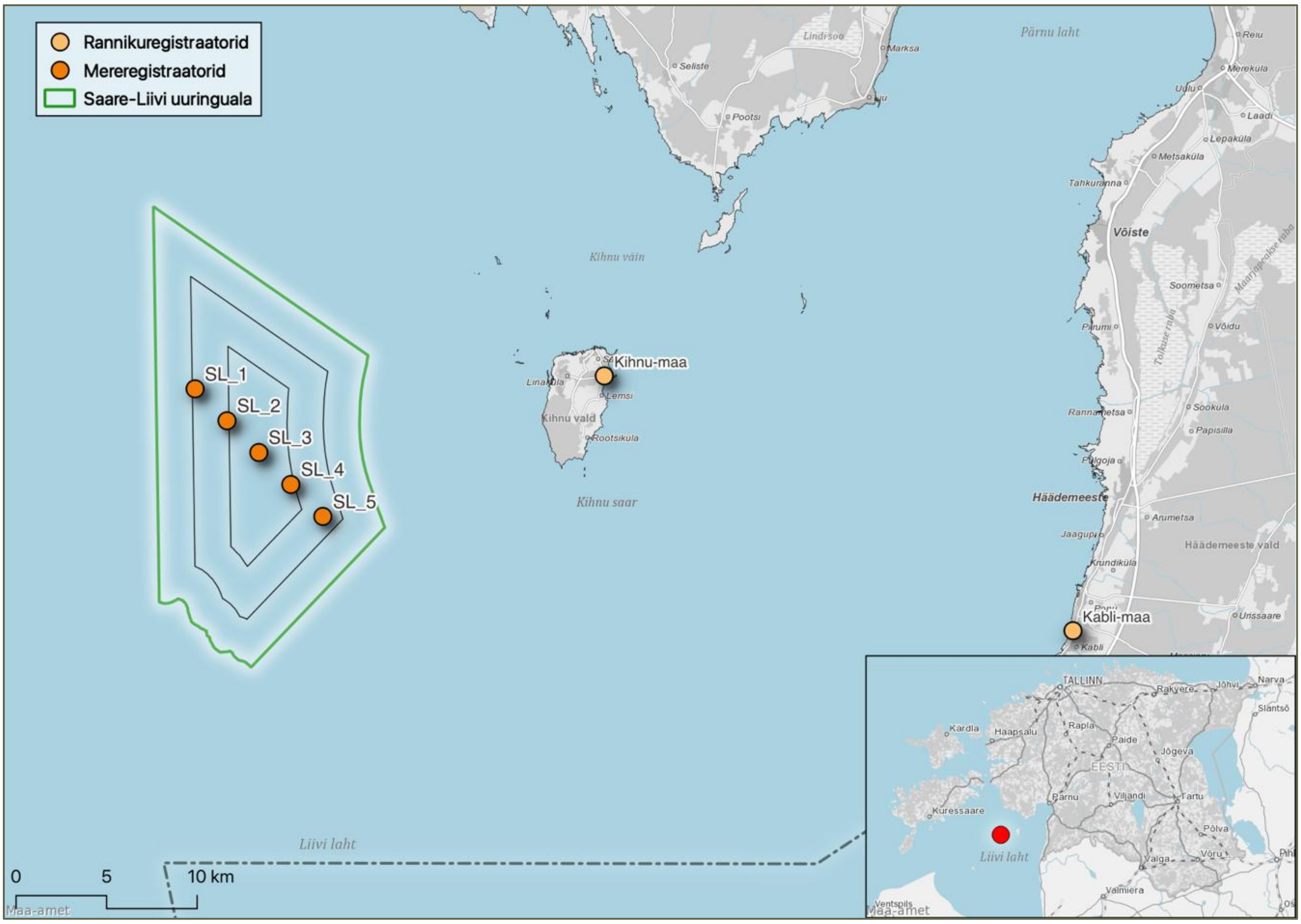

Figure 3.2-1. *Initial area of the Saare-Liivi offshore wind farm and location of bat recorders (Elustik OÜ, 2024)*

BAT MIGRATION IN KABLI AND KIHNU

During migration monitoring, a total of 30818 bat flybys from 11 taxa (Table 3.2-1) were recorded on both recorders. In some cases, recorded vocalisations were not identified on the species level and were taxonomically assigned to the most accurate level possible.

Table 3.2-1. *Bat species encountered by the recorders and number of recordings. *For Myotis, the species was determined for only a portion of the recordings. (Elustik Oü, 2024)*

Species name		***Kabli***	***Kihnu***
Nathusius's pipistrelle	*Pipistrellus nathusii*	*10797*	*1092*
Northern bat	*Eptesicus nilssonii*	*8041*	*2043*
Parti-coloured bat	*Vespertilio murinus*	*2672*	*47*
genus *Myotis*	*Myotis sp.*	*1644*	*145*
Soprano pipistrelle bat	*Pipistrellus pygmaeus*	*1572*	*8*
Noctule bat	*Nyctalus noctula*	*794*	*112*
Vesper bat	*Vespertilionidae sp.*	*462*	*13*
Common pipistrelle	*Pipistrellus pipistrellus*	*398*	*2*

Species name		***Kabli***	***Kihnu***
Brown long-eared bat	*Plecotus auritus*	*256*	*56*
Ept/Vesp/Nyc	*Ept/Vesp/Nyc*	*153*	*304*
Water bat	*Myotis daubentonii*	*88*	-
Genus pipistrellus	*Pipistrellus sp.*	*22*	*79*
Brandt's bat	*Myotis brandtii/mystacinus*	*11*	-
Natterer's bat	*Myotis nattereri*	*4*	-
Pond bat	*Myotis dasycneme*	*3*	-
Total		***26917***	***3901***

The occurrence of identified species at the Kabli and Kihnu coastal recorders varied by season (Figure 3.2-2). At the Kabli recorder, all identified species (11) were present throughout most of the observation period, while on Kihnu Island, the common pipistrelle, soprano pipistrelle bat and parti-coloured bat were absent in spring and summer. Also, the noctule bat was not recorded on the island in mid-summer. Seven bat species and the genus *Myotis* were identified at the Kihnu observation point.

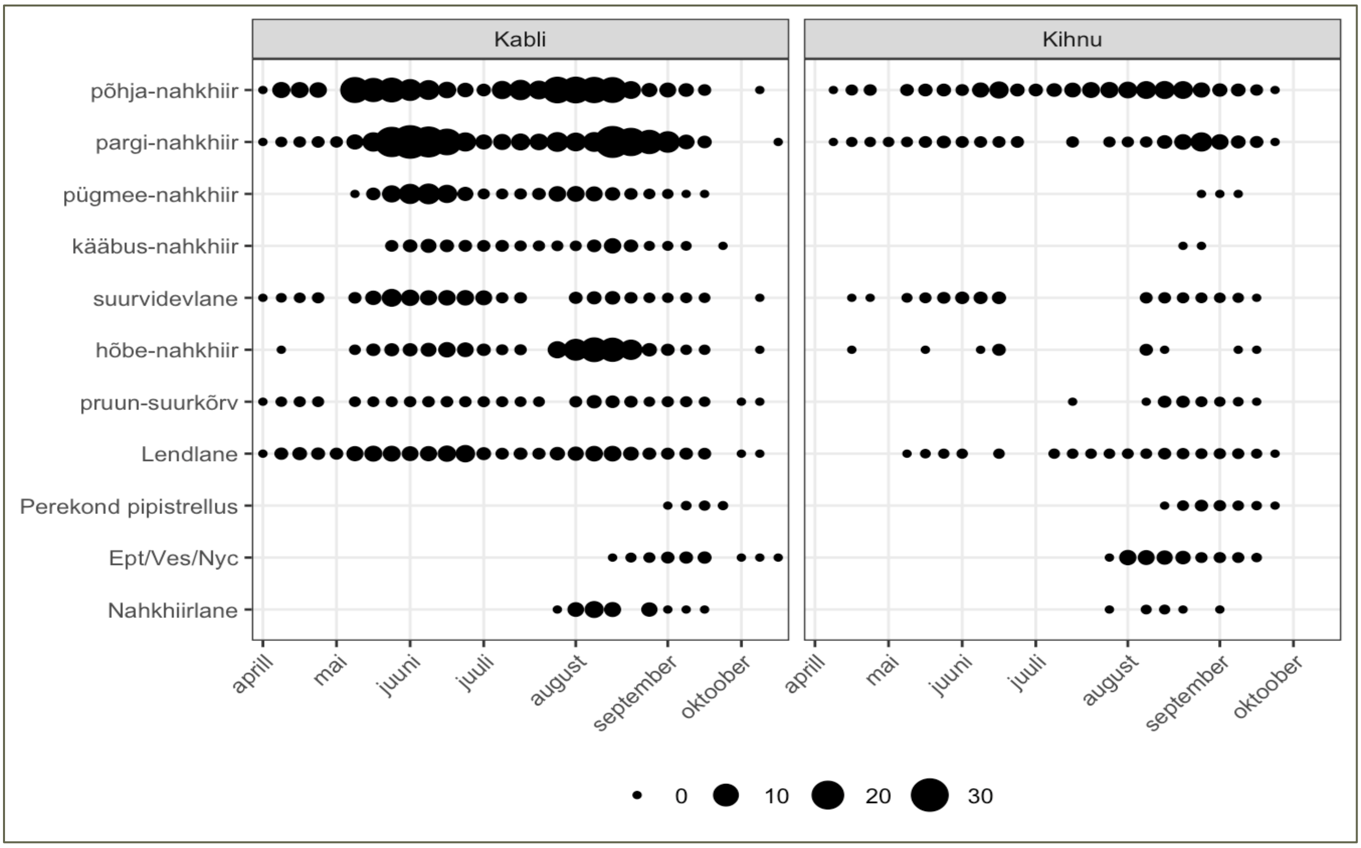

Figure 3.2-2 *Bat species identified during the study by recorders and weeks. The size of the dot indicates the moving average of recordings over a 7-day period. (Elustik OÜ, 2024)*

The study results revealed the following:

- Migratory species passed through both observation points in both spring and autumn. Both areas (Kihnu and Kabli) are passed by both the spring and autumn migration of bats.
- The number of bats passing through Kihnu during spring migration is significantly lower than the number of species passing through Kabli. Likely, bats prefer to migrate over land during spring.
- During autumn migration, the number of bats in Kabli is significantly higher, while there are several times more migratory species in Kihnu compared to spring. Autumn migration takes place both across land and the Gulf of Riga.
- The peak of spring migration occurs in both Kihnu and the Kabli coast at approximately the same time, in the middle and second half of May. The first migrants are already arriving in the region in April.
- The peak of autumn migration occurs in both Kihnu and the Kabli coast around the same time, in the second half of August. Migratory species are found in the area throughout the migration period.

SHIP-BASED CENSUSES

During the ship-based censuses (over a total of 136 hours), four bat species were identified – the northern bat (*Eptesicus nilssonii*), the nathusius's pipistrelle (*Pipistrellus nathusii*), the noctule bat (*Nyctalus noctula*) and the parti-coloured bat (*Vespertilio murinus*). In addition, in some cases, sound recordings were not identified at the species level and were identified at group level – northern bat, parti-coloured bat or noctule bat (*Ept/ Ves / Nyc*) (Figure 3.2-3). The *Ept/ Ves / Nyc* group recordings are likely to be parti-coloured bats or noctule bats.

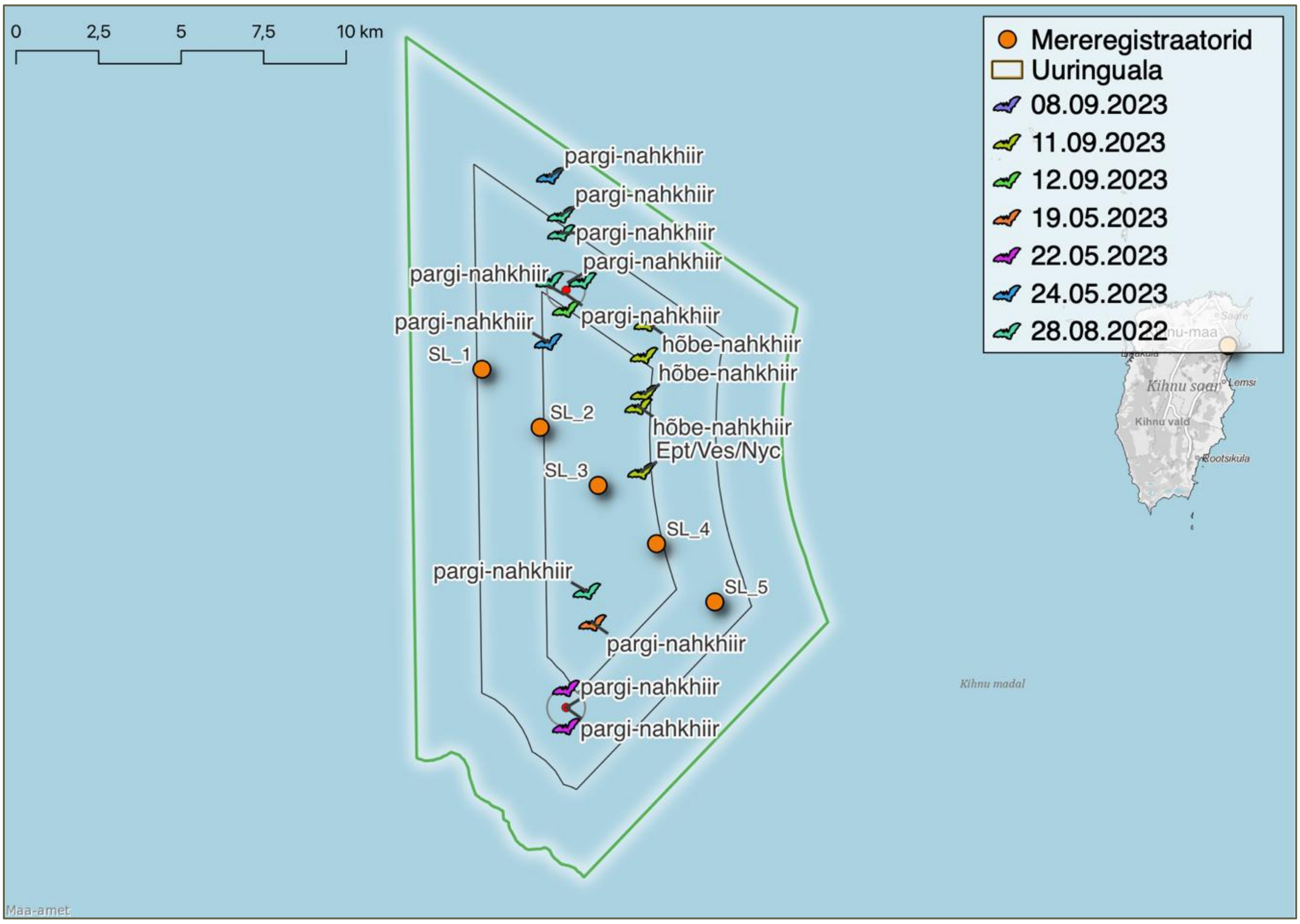

Figure 3.2-3 *Bat flybys recorded during ship-based censuses (Elustik OÜ, 2024)*

During the ship-based censuses, 18 bat flybys were identified, six of them during the spring migration period and 12 during the autumn migration period (Figure 3.2-4). The relative abundance of bat flybys (flybys per ship-based census hour) ranged from 0.12 to 1 flyby per hour on nights when bats were recorded. The average number of flybys per hour, during nights when bats were encountered offshore, was 0.4 flybys per hour.

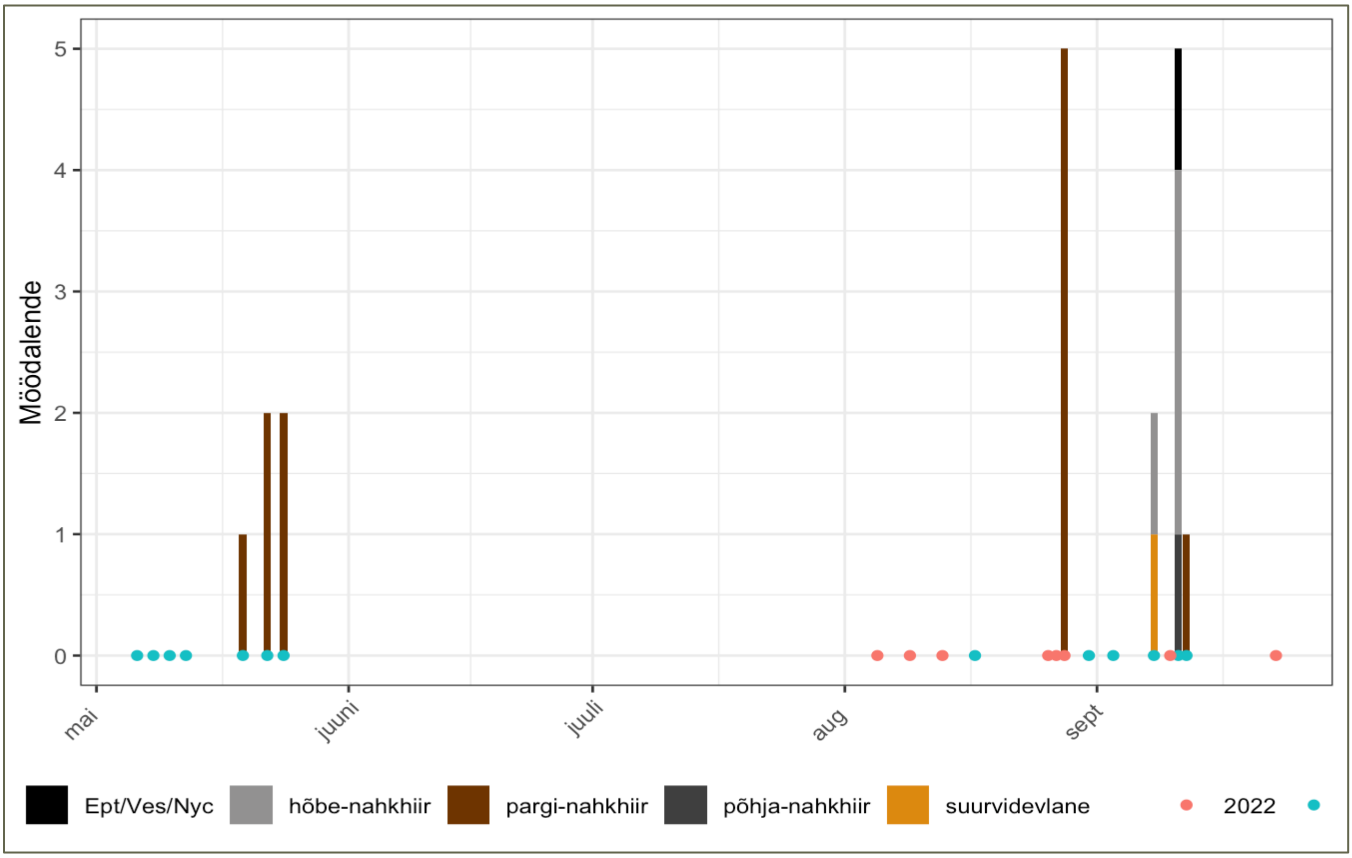

Figure 3.2-4. *Distribution of bat flybys by species and dates (Elustik OÜ, 2024)*

The most abundant species in the ship-based censuses was the nathusius's pipistrelle, which was recorded on five out of seven nights when bats were recorded. Of the 18 recorded flybys, 11 were by nathusius's pipistrelle (Figure 3.2-4).

Based on the results of the study, it was revealed that the autumn migration of bats passes through the area of the Saare-Liivi offshore wind farm. The peak of the autumn migration occurs in the last third of August and the first half of September. The spring migration also passes through the area, but bat abundance in the study area is lower in spring.

PERMANENT RECORDERS

The permanent recorders identified 4 bat species – the northern bat, the nathusius's pipistrelle, the noctule bat and the pond bat (Table 3.2-2). In some cases, recordings were not identified at the species level because the bats did not make the echolocation sound typical of the species at sea. In these cases, the bats were either the northern bat, the parti-coloured bat or the noctule bat (Ept/Ves/Nyc). The smallest number of bats were recorded at buoy SL_2, where 1 flyby was recorded. At the remaining buoys, the number of recordings varied between 4 and 9.

Table 3.2-2. *Species recorded by permanent recorders by marine buoys (Elustik OÜ, 2024)*

Taxon	***SL_1***	***SL_2***	***SL_3***	***SL_4***	***SL_5***	***Total***
Northern bat	1					**1**
Pond bat	1			1		**2**
Noctule bat			1		2	**3**
Nathusius's pipistrelle	1	1	6	3	2	**13**
Ept/Ves/Nyc			1		1	**2**
Vesper bat	1		1			**2**
Total	**4**	**1**	**9**	**4**	**5**	**23**

Bats were recorded over four months – May, June, August and September (Figure 3.2-5). The data indicates that bats make minimal use of the offshore study area during the summer, likely only a few individuals pass through there. This area is probably not used as a feeding ground, and the operation of the wind farm is considered safe for bats during this period. The spring and autumn flybys of bats are related to the migration period. In spring, bat populations in the area are lower than in autumn; however, both spring and autumn migrations pass through the region. Based on the available data, it is not possible to identify any areas with significant differences in bat abundance.

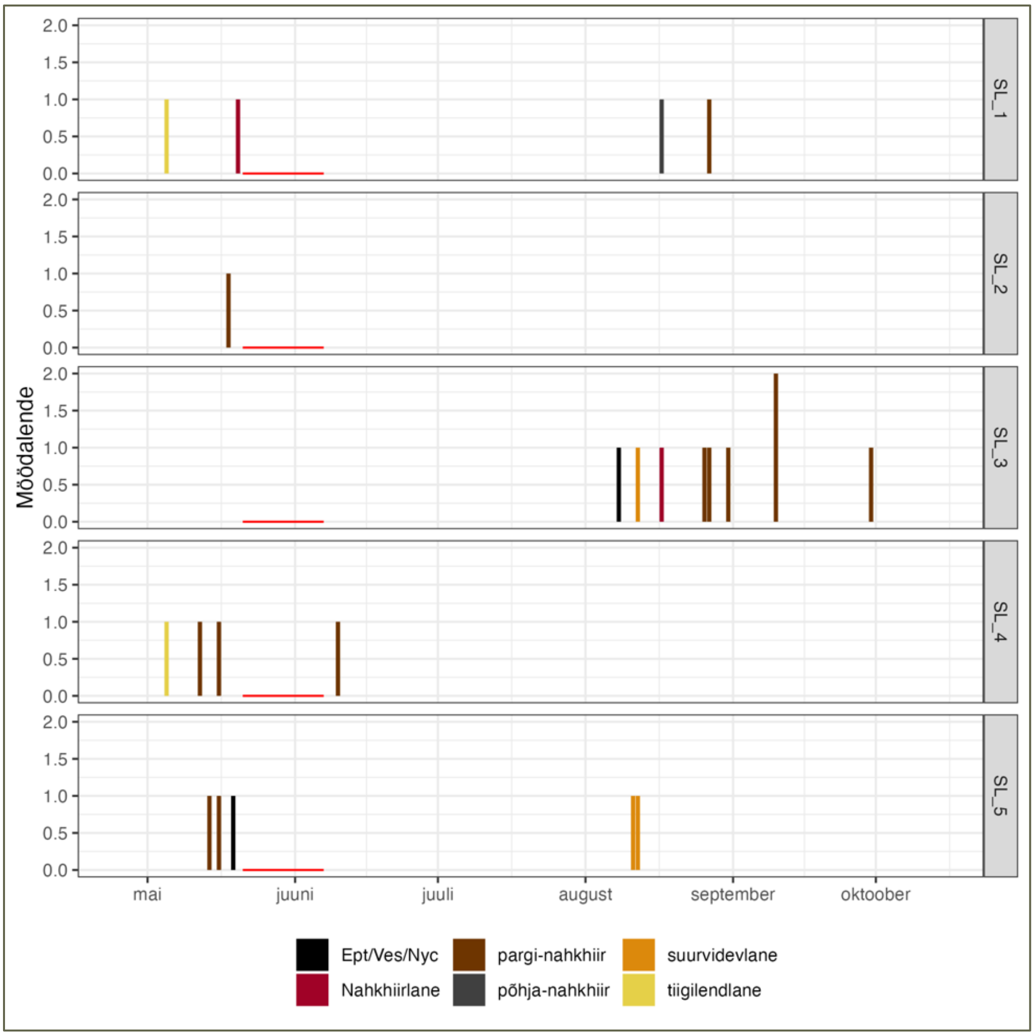

Figure 3.2-5. *Temporal distribution of bat observations recorded by permanent recorders. The red line indicates the period when the recorders were not working (Elustik OÜ, 2024).*

The conducted permanent recorder study confirmed the following:

- the Saare-Liivi offshore wind farm study area is crossed by the spring and autumn migration of bats bat abundance is higher during autumn migration
- bats do not use the study area as a feeding ground during the summer in summer, single individuals pass through the area.
- the peak of autumn migration is at the end of August and the first half of September
- bat abundance did not differ between different regions of the study area
- bats are active in the area almost all night, and no hours were identified during which they do not move around.

POSSIBLE IMPACT OF THE WIND FARM ON BATS

The biggest problem associated with wind farms is bat mortality. The risk of mortality tends to be higher in locations where wind turbines are situated near or within biotopes that are favourable for bats. These may include the home ranges of bat colonies, areas close to coastlines, internal bodies of water, forest stand edges and other linear features in the environment that bats use for navigation(Ijäs et al. 2017[56]; Ahlén, Baagøe, ja Bach 2009[57]), as well as sites where bats gather during migration(Rydell et al. 2010[58]; Arnett et al. 2016[59]).

The impact of a wind farm on bats not only depends on the placement of the turbines but also on the time of year. Three main periods are distinguished in the context of impacts – summer and the bat migration periods in autumn and spring. Research conducted in Estonia has recorded four species of bats offshore, with some classified on the genus *Myotis* level. The four identified bat species were the northern bat (*Eptesicus nilssonii*), the nathusius's pipistrelle (*Pipistrellus nathusii*), the noctule bat (*Nyctalus noctula*) and the parti-coloured bat (*Vespertilio murinus*). The latter three are considered long-distance migrants.(Hutterer et al. 2005[60]) In the case of species belonging to the genus *Myotis*, the individuals were probably the water bat (*Myotis daubentonii*) or the pond bat (*Myotis dasycneme*).

In spring, migratory species typically arrive in Estonia in May, with only a few individuals observed in April(Leivits 2013[61]). By the end of May, the bats have gathered in breeding colonies, marking the completion of their migration. The autumn migration in Europe begins at the end of July (for nathusius' pipistrelle) or early August(Dietz ja Kiefer 2016[62]). The last representatives of migratory species can be seen here in early October, but they are generally rare from the second half of September onwards (Leivits 2013[63]). It is important to note that long, warm autumns, which have been observed in recent years, may prolong the presence of migratory bat species in our area.

Bats migrate solely at night and do not form flocks during migration. However, they may gather in certain places near the coast where they await better weather for crossing the sea. Consequently, careful consideration must be given when planning a wind farm to avoid disrupting bat flight corridors and migration routes—these are narrow landscape features where bats congregate as they travel from one area to another. Such congregation places are also possible at sea, (Rodrigues et al. 2015[64]) for example, in places where crossing the sea is possible via the shortest route.

Based on the datasets collected in the Saare-Liivi study area, several general conclusions can be drawn regarding the importance of the Gulf of Riga and its coastline for bats. The data indicate that the spring migration of bats occurs over both the Gulf of Riga coast and the open sea. Migratory individuals were

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56 Ijäs, Asko, Aapo Kahilainen, Ville V. Vasko, and Thomas M. Lilley. 2017. „Evidence of the migratory bat, Pipistrellus nathusii, aggregating to the coastlines in the Northern Baltic Sea". Acta Chiropterologica 19 (1): 127–39. https://doi.org/10.3161/15081109ACC2017.19.1.010.

57 Ahlén, Ingemar, Hans J. Baagøe, and Lothar Bach. 2009. „Behavior of Scandinavian Bats during Migration and Foraging at Sea". Journal of Mammalogy 90 (6): 1318–23. https://doi.org/10.1644/09-MAMM-S-223R.1.

58 Rydell, Jens, Lothar Bach, Marie-Jo Dubourg-Savage, Martin Green, Luisa Rodrigues, ja Anders Hedenström. 2010. „Bat Mortality at Wind Turbines in Northwestern Europe", detsember, 261–74.

59 Arnett, Edward B., Erin F. Baerwald, Fiona Mathews, Luisa Rodrigues, Armando Rodríguez-Durán, Jens Rydell, Rafael Villegas-Patraca, and Christian C. Voigt. 2016. „Impacts of Wind Energy Development on Bats: A Global Perspective". Bats in the Anthropocene: Conservation of Bats in a Changing World, toimetanud Christian C. Voigt and Tigga Kingston, 295–323. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-25220-9_11.

60 Hutterer, Rainer, Teodora Ivanova, Christine Meyer-Cords, ja Luisa Rodrigues. 2005. Bat Migrations in Europe: A Review of Banding Data and Literature. Bonn: Federal Agency for Nature Conservation.

61 Leivits, Meelis. 2013. 'Eesti Riikliku Keskkonnaseire Eluslooduse mitmekesisuse ja maastike seire allprogrammi seiretöö Nahkhiired 2013 aasta koondaruanne'. Estonian Environmental Board

62 Dietz, Christian, and Andreas Kiefer. 2016 Bats of Britain and Europe. Bloomsbury USA.

63 Leivits, Meelis. 2013. 'Eesti Riikliku Keskkonnaseire Eluslooduse mitmekesisuse ja maastike seire allprogrammi seiretöö Nahkhiired 2013 aasta koondaruanne'. Estonian Environmental Board

64 Rodrigues, Luísa, Lothar Bach, Marie-Jo Dubourg-Savage, Branko Karapandža, Dina Kovač, Thierry Kervyn, Jasja Dekker, Andrzej Kepel, Petra Bach, and Jan Collins. 2015. Guidelines for consideration of bats in wind farm projects: Revision 2014. UNEP/EUROBATS.

recorded in the Saare-Liivi wind farm study area during spring through the use of both permanent recorders and ship-based censuses. The abundance of bats in spring was lower compared to autumn migration. However, the abundance of bats at the Kabli permanent observation point during spring was comparable to that observed in autumn, suggesting that bats may prefer to migrate along the coast during spring.

During the summer period, offshore observations were made only using permanent recorders. In June, two bat flybys were recorded offshore. From the last third of June to the beginning of August, no bat flybys were recorded in the study area. This indicates that bats use the study area very little during this period. It is noteworthy that offshore areas, which are located far from the coast, are too distant for bats to fly to for foraging in the summer. More favourable feeding areas are found on land and near the coastline.

During autumn migration, bats pass through both the coast and the study area. The peak of migration in both cases falls around the same period – mid and early September. Recordings captured offshore illustrated that bats fly over the sea throughout August, with the highest activity occurring towards the end of the month. Bats are also found at sea in early September. With both methods, the number of bat flybys per hour remained in the same order of magnitude. Permanent observation points showed that bat abundance did not differ between parts of the study area.

Bat migration and overall activity (relative abundance at a particular location) are largely influenced by weather conditions, specifically three parameters: wind speed, temperature and precipitation (Sander Lagerveld, Poerink, ja Geelhoed 2021[65]). Bats tend to migrate and forage during calm or low-wind nights. As wind speed increases, their flight activity decreases. Several studies have found that most bat flybys occur at wind speeds between 0 and 6 m/s (Sander Lagerveld et al. 2015[66]; Behr et al. 2017[67]). Similar results have been obtained in Estonia both on land and (Suigusaar 2022[68]; O. Kalda ja Kalda 2022[69]; 2018; R. Kalda ja Kalda 2018[70]) offshore (Lutsar 2019[71]). At higher wind speeds, only a few flybys are recorded.

Furthermore, the intensity of migration and the relative abundance of bats correlate with temperature; lower temperatures result in reduced flight activity.

Studies conducted offshore in Estonia have shown that the relative abundance of bats, expressed as the number of flybys per hour, varies greatly. On most nights, bats are not recorded, but when they are, their relative abundance ranges from 0.3 to 2 flybys per hour (Lutsar 2017; 2019[72][73]).

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65 Lagerveld, Sander, Bob Poerink, and Steve Geelhoed. 2021. „Offshore Occurrence of a Migratory Bat, Pipistrellus nathusii, Depends on Seasonality and Weather Conditions". Animals 11 (detsember): 3442. https://doi.org/10.3390/ani11123442.

66 Lagerveld, Sander, Bob Jonge Poerink, Pepijn de Vries, and Michaela Scholl. 2015. „Bat Activity at Offshore Wind Farms LUD and PAWP in 2015", 32.

67 Behr, Oliver, Robert Brinkmann, Klaus Hochradel, Jürgen Mages, Fränzi Korner-Nievergelt, Ivo Niermann, Michael Reich, Ralph Simon, Natalie Weber and Martina Nagy. 2017. „Mitigating bat mortality with turbine-specific curtailment algorithms: A model based approach". Wind Energy and Wildlife Interactions, 135–60. Springer.

68 Suigusaar, Anette. 2022. 'Nahkhiirlaste rändedünaamika ja seda mõjutavad tegurid Kablis', May. https://dspace.tktk.ee/handle/20.500.12863/4334.

69 Kalda, Oliver, and Rauno Kalda. 2022. 'Nasva Bat Survey'. Tallinn, Tartu.

70 Kalda, Rauno, and Oliver Kalda. 2018 'Nahkhiirte uuring Saarde valda kavandatavate P14, P15 ja P16 tuuleparkide mõju kohta nahkhiirtele'.

71 Lutsar, Lauri 2019. 'Nahkhiirte uuring merel Saaremaa ümbruses 2018. aasta juulist oktoobrini', 20.

72 Lutsar, Lauri 2017. 'Nahkhiirte uuring Veiserahul ja Kerjurahul 2016. aasta augustis, septembris ja oktoobris', 21.

73 See reference 187

The results from the Saare-Liivi offshore wind farm study indicate that bats do not fly over the sea in all weather conditions. Weather without precipitation and with calm winds was preferred; half of the recordings were made at times when the average wind speed of the previous hour was below 1.9 m/s, 75% of the flybys were recorded at wind speeds up to 2.5 m/s and 90% of the flybys were recorded at wind speeds up to 4.6 m/s (Figure 3.2-6).

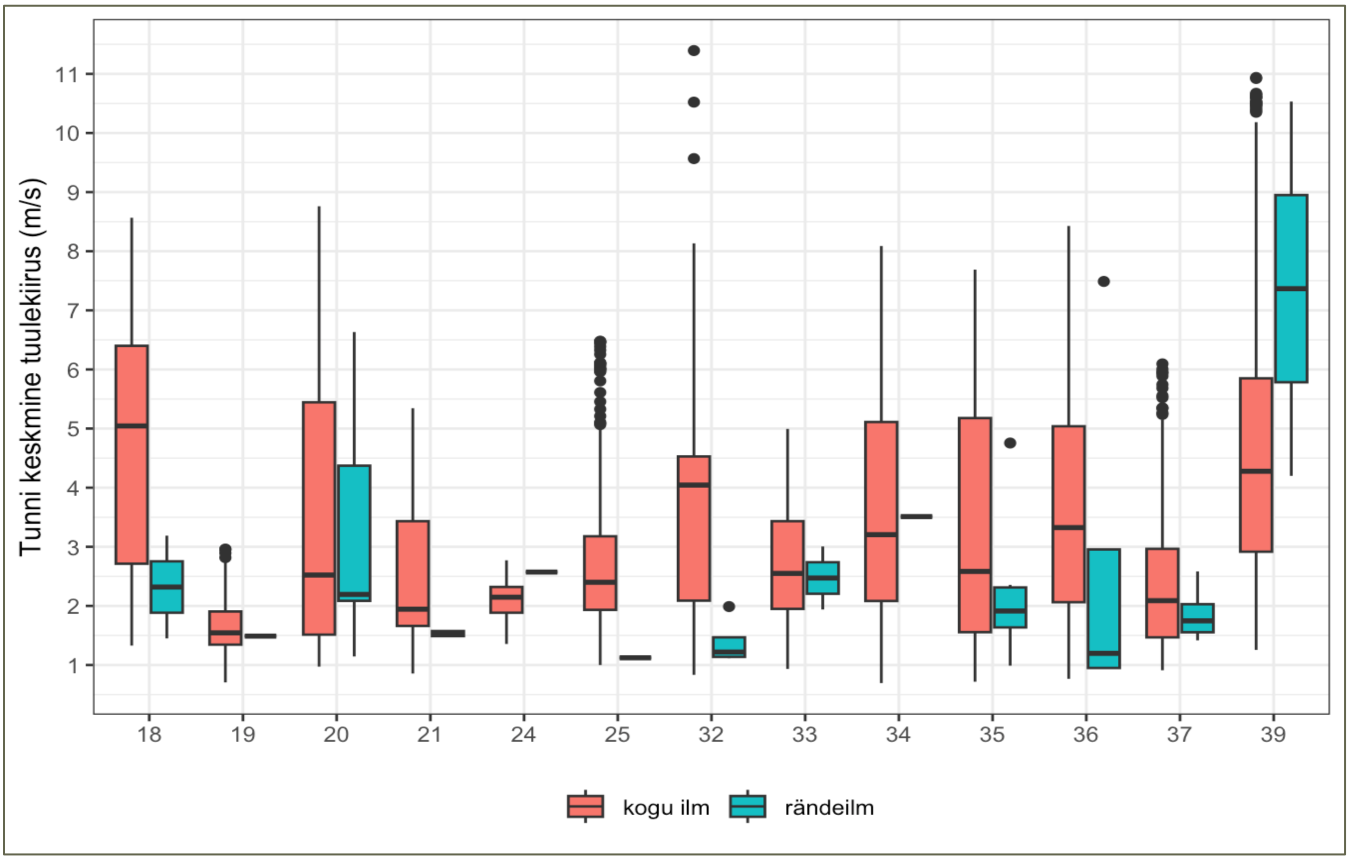

Figure 3.2-6 *Dependence of bat flybys on wind speed. The X-axis indicates the weekly number. The figure shows data collected in the Saare-Liivi and Saare-Liivi additional areas (Elustik OÜ, 2024).*

Bats primarily migrate during winds blowing from the east and south. When winds blow from the westerlies, bats do not migrate over the open sea. Nighttime temperatures do not affect migration.

In summary, the study indicates that bats inhabit the study area seasonally and only under specific weather conditions. This allows to proceed from the results of the study to take action that minimise negative impacts on bat populations. The Saare-Liivi wind farm may have potential effects during its operation. However, the impact during the construction and dismantling phases of the wind farm, including the installation of associated cables, can be considered insignificant.

To significantly reduce the risk of bat mortality, it is recommended to suspend the operation of wind turbines during the autumn migration period (from 1 August to 15 September) from sunset to sunrise, particularly at wind speeds below 5 m/s.

Table 3.6-2. *Impacts associated with wind farm design and their significance*

Consequence/impact	***Significance of impact***	***Need for mitigation measures, final significance of impact***
Construction and dismantling phase		
habitat loss	0	

Consequence/impact	***Significance of impact***	***Need for mitigation measures, final significance of impact***
disturbance	0	
collision risk	0	
Operation stage		
collision risk	-/--	The potential impact of the wind farm on bats can be mitigated; Cumulative impact: 0

The scale of significant environmental impact used in the EIA report: - minor negative impact, -- significant negative impact, 0 - no impact, neutral, + minor positive impact, ++ significant positive impact

3.3. Seals

Studies conducted:

- Saare Wind Energy wind farm seal survey report. MTÜ Pro Mare, 2024.
- Detection of the presence of the grey seal from underwater sound recordings. TalTech, 2024
- Assessment of the underwater noise impact of the Saare-Liivi wind farm. Taltech, Mechanics of Fluids and Structures Research Group, 2024

SEAL ABUNDANCE IN THE BALTIC SEA AND THE GULF OF RIGA

The Gulf of Riga is a semi-enclosed marine area populated by two seal species – the grey seal (*Halichoerus grypus*) and ringed seal (*Pusa hispida*). The gulf is home to both grey and ringed seals, which use key habitats for various biological functions.

Between 2007 and 2023, a total of 22 ringed seals—21 of which are associated with the Gulf of Riga—were tagged with telemetric devices (using ARGOS and GPS/GSM platforms) on the west coast of Estonia. Additionally, 21 grey seals were tagged (18 in Estonia and 3 in Lithuania), of which 12 are linked to the Gulf of Riga.

The grey seal

The abundance of the grey seal has increased to a minimum of 45800 (HELCOM 2023[74]) since its historic low in the 1970s, when the total abundance was estimated at about 3000 individuals (Hårding *et al* 2007). The population growth has shown signs of decline over the past five years, but the trend is positive, seals are numerous and the species is not considered endangered based on these indicators. In Estonia, the population of grey seals has increased significantly, rising from a low of 1148 individuals in 2000 to 6324 individuals in 2023 (source: Pro Mare 2023), according to the international census conducted with harmonised methodologies. Comparing averages from the last five years, Estonia is inhabited by approximately 13% of the grey seal population in the Baltic Sea during the spring molting period, which is considered a minority.

The grey seal is a common species in the Saare-Liivi wind farm area and can frequently be found at sea, although there are no large resting sites in the region where these animals congregate. <u>Anthropogenic changes related to the construction and operation of the wind farm are unlikely to have a significant</u>

74 HELCOM 2023. 2nd Informal Consultation Session of the Expert Group on Marine Mammals IC EG MAMA 2-2023 Stralsund, 12.09.2023-14.09.2023.

impact on approximately 75% of grey seals in the Gulf of Riga. The impacts on the populations in Estonia and the broader Baltic Sea are even smaller.

The ringed seal

The current abundance of ringed seals is dangerously low in three of the four subpopulations. The herd in the Gulf of Bothnia likely exceeds the critical limit of 10000 individuals. Approximately 200 ringed seals can be found in the Gulf of Finland, about 150 in the Sea of Åland and less than 1000 on the west coast of Estonia. Monitoring results from the waters off the west coast of Estonia indicate a continuing decline in the population size of ringed seals, highlighting the need for heightened attention to their status and habitats. Conditions in the Gulf of Riga have a direct impact on the population in Western Estonia, making the situation a shared responsibility for both Estonia and Latvia.

The ringed seal is also a common species in the Saare-Liivi wind farm area, as the majority of individuals tagged in the Väinameri Sea have been found to frequent this marine area. Ringed seals require sea ice to successfully raise their pups, so like grey seals, seasonal increases in their numbers are possible due to concentrations in the Saare-Liivi wind farm area or in Pärnu Bay when ice forms there.

MOVEMENT OF SEALS IN THE SEA AND USE OF THE SEA

The grey seal

Grey seals have the ability to move freely throughout the Baltic Sea, but they are attached to specific resting sites. This means they do not wander randomly in the sea; instead, they consistently return to the same areas to rest between foraging trips. The same animal can have several resting sites. In the Gulf of Riga, tagged grey seals used all the resting sites along the Saaremaa coast. However, on the Kihnu islets, tagged seals did not venture out of the water.

Adult female grey seals exhibit a certain degree of site fidelity. Research through photo-identification has shown that the likelihood of a female grey seal traveling more than 80 kilometres from her 'home range' in the Baltic Sea during the summer is less than 10%. It was also observed that animals return to the same marine area the following summer after the breeding cycle (Karlsson *et al* 2005[75]).

These seals often return to the same feeding areas, a behaviour known as central place foraging, which connects their resting sites with their feeding locations. An individual seal may repeatedly use one or more foraging sites while resting at the same site (Figure 3.3-1). For instance, the primary foraging areas are typically located about 25 kilometres from the resting sites, where seals spend the entire period from early July to early October.

75 Karlsson, O., Hiby, L., Lundberg, T., Jüssi, M., Jüssi, I. and Helander, B., 2005. Photo-identification, site fidelity, and movement of female gray seals (Halichoerus grypus) between haul-outs in the Baltic Sea. AMBIO: A Journal of the Human Environment, 34(8), pp.628-634.

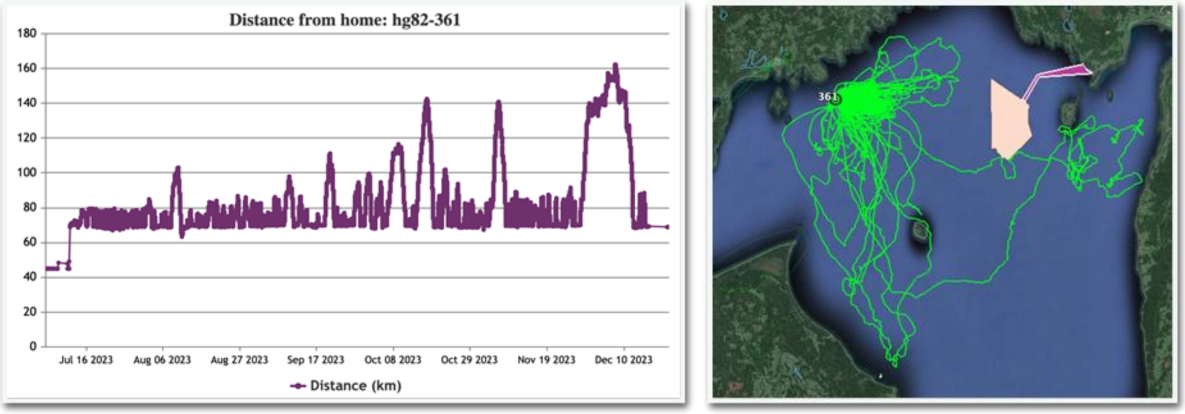

Figure 3.3-1. *Use of the sea by the grey seal hg82-361. The left shows distances from the tagging site (70 km), indicating longer search behaviours in autumn and winter, while the right illustrates the movement trajectory.*

Given that grey seals roam a vast marine area and are numerous in the Gulf of Riga, it is likely that they frequent the development areas of the Saare-Liivi wind farm during the ice-free period. **However, this area does not appear to be a particularly attractive habitat for them.**

The ringed seal

The main resting areas for ringed seals along the West Coast of Estonia are found in the Väinameri Sea, while the majority of these animals forage and give birth in the Gulf of Riga. However, due to geographical limitations, there are few suitable resting sites in the Gulf of Riga. The most commonly used areas for resting are the shallow waters around the Kihnu islets and at the mouth of the Suur Strait in the Viirelaid and Pühadekare region.

Historically, the Kihnu area has had a rich population of ringed seals, but recent censuses indicate that only about 20 to 40 individuals are present there now. The cause of this decline is unclear, but it is likely related to changes in the fish population, which may have made the area less appealing to the seals. In Viirelaid and Pühadekare, the number of ringed seals is also limited by the availability of suitable resting stones, typically ranging from 40 to 100. There is obviously a large rotation between animals migrating to the Gulf of Riga and the Väinameri Sea.

The foraging strategy of ringed seals is likely influenced by their main prey species, causing them to adjust their feeding areas seasonally based on the location of fish. Their diet may also vary depending on what is available within a particular marine area. Trajectory analyses reveal a considerable degree of individual specialisation in foraging strategies, which can change across seasons.

The movements of ringed seals from the Väinameri Sea to the Gulf of Riga fall into four distinct categories. More than half of the seals that forage in the gulf (15 individuals, or 68%) use the deeper areas near the Latvian coast, likely feeding on Baltic herring found in that area. If a seal travels from the Väinameri Sea and passes through the Suur Strait without stopping, the journey covers approximately 200 kilometres. Depending on the individual seal, there may be up to ten such trips during the observation period. These consistent patterns are classified as foraging migrations (Figure 3.3-2).

Based on the duration of their visits, the impact of the wind farm, as well as the associated expansion and cable corridor areas on ringed seals along Estonia's west coast, appears relatively minor in terms of the identified activities and the overall population. Despite most tagged animals using this marine area, it has a limited effect on the population.

The primary feeding areas for ringed seals inhabiting the Väinameri Sea are found in the deeper sections of the Gulf of Riga, particularly in the coastal waters of Latvia. During intense foraging periods, these animals engage in long migrations. Pärnu Bay and other coastal marine areas are used by many seals, especially as water cools and more fish are likely to appear. However, some seals specialise in foraging near the coast.

The Saare-Liivi offshore wind farm area constitutes a small part of the marine habitat for ringed seals in the Gulf of Riga. Even for seals that frequently visit this marine area, the total observed time or distribution of location points within the Gulf of Riga does not exceed 5% of their overall observed behaviour, indicating it is of minor significance.

INDIRECT DISTURBANCE AND HABITAT FRAGMENTATION

According to national and international monitoring, as well as additional censuses, it is estimated that 1.5% of the total Baltic Sea grey seal population and 90% of the ringed seals along Estonia's western coast are potentially associated with the Saare-Liivi wind farm, based on species-specific conservation management units defined at the HELCOM level. The Gulf of Riga is a crucial marine area for both seal species, especially regarding their resting, foraging and pupping areas. The Kihnu Sea and Pärnu Bay are home to both species year-round. These seals are likely the most numerous during the spring spawning and migration period of Baltic herring and other fish that migrate en masse to their spawning grounds, as well as in late autumn and winter when ice forms.

Telemetry studies indicate that despite a significant number of animals potentially visiting the Saare-Liivi offshore wind farm within the Gulf of Riga, these areas are generally peripheral in nature in terms of critical biological functions of seals—such as resting, foraging, breeding and migration. Activity analyses demonstrate that the primary activity areas for both species are located in different parts of the gulf or, in the case of ringed seals, also in the Väinameri Sea. Both species exhibit detectable long-distance foraging migrations in the autumn and winter towards Kihnu, with grey seals primarily coming from the southern coast of Saaremaa and ringed seals migrating from the Väinameri Sea. Conversely, their intense summer foraging areas are found in other sections of the sea—ringed seals along the southwestern and southern parts of the Gulf of Riga on the Latvian coast, while grey seals forage near the main resting areas on the southern and western coasts of Saaremaa or elsewhere in the Baltic Sea.

DIRECT DISTURBANCE

Disturbance on the water

Direct disturbance is predominantly related to the perception of danger or discomfort by animals, which leads to a change in behaviour: escape or avoidance. Such events are associated with sensations – sudden sounds, smells or phenomena. These activities are mainly related to the construction of wind farms, which have stronger impacts, but are short-term.

Direct disturbance has the greatest impact on the resting areas when animals are resting or feeding their young, as any escape consumes energy and can break the bond between the young and the mother during the pupping period. Generally, direct disturbance does not have a significant long-term effect, because animals determine whether the experience poses a real danger. They pay less attention to repeated stimuli over time, leading to adaptation.

Another form of direct disturbance with serious consequences is the movement of icebreakers on ice fields used by seals for pupping. This situation is not merely a disturbance; it poses a direct risk of seal pups being crushed by ships or breaking ice (Wilson *et al* 2017[76]). These impacts may intensify during the operational period of the wind farm, particularly in harsher winters when ice fields can form in the wind farm area or on the routes of maintenance vessels, which seals use for pupping. Both seal species prefer pupping on ice, with it being obligatory for the ringed seal. Since ice can form in the Saare-Liivi wind farm area during (currently) average and harsher winters, it is possible that the offspring of both species could be born in this marine region. Ringed seals tend to give birth in a scattered and hidden manner, whereas grey seals typically give birth in groups and in more visible locations. The emergence and extensive use of ice as a pupping platform by seals in the Saare-Liivi wind farm area is likely under narrow ice conditions.

In other scenarios there could either be too much ice, or the ice cover could be so extensive that a ringed seal might breed in the area. Alternatively, if there is too little ice, it may not reach the Saare-Liivi wind farm, leading ice from surrounding areas to drift in with a ringed seal or group of grey seals potentially pupping on it.

The extent and persistence of ice are unpredictable in a warming climate, but when it does form, it is crucial to account for the possibility of pupping animals during construction and maintenance work to avoid their disturbance or injury. If maintenance work is unavoidable during such harsh ice periods, a survey flight over the ice must be conducted to plan vessel movements, ensuring that they are guided past the pupping seals.

Human presence in the marine area typically results in environmental disturbances that affect seals through visible and audible disruptions, as well as odours and underwater sounds and vibrations. Above-water sensations for the seals are mostly related to the installation of wind turbines and cables during the construction phase. The presence of vessels or installation platforms in a previously uninhabited marine area can temporarily attract animals due to their curiosity about the activity. In general, seals are rather indifferent to the sight of large vessels, as the vessels pose no clear threat to them. A vessel or an erected turbine can become a so-called background object if it does not produce impulsive sounds or light, which might attract animals' attention.

However, construction-related vessels will likely operate motors, diesel generators and compressors continuously, generating noise above and below the water and emitting exhaust gases or strong artificial odours. They can make animals alert and cause behavioural changes. The impact area is typically confined to a few hundred metres downwind from the source of disturbance. In cases of strong noise or odours above the water, this distance may be greater. Should such disturbances reach a resting area, seals are more likely to leave. Generally, disturbances from vessels moving on established fairways do not reach resting seals, as these fairways are located farther offshore. The likelihood of odours spreading to resting areas is influenced by strong sea winds.

Seals must be considered in the event of exceptional disturbances, such as an oil spill. For instance, an oil spill offshore releases an odour that can spread widely downwind, impacting animals with a keen sense of smell beyond just the oil slick itself. This could lead to temporary or spatial barriers on foraging areas, along with longer travel distances (resulting in additional energy expenditure) between resting and feeding spots. Oil risk modelling has indicated that, given prevailing wind directions, an oil slick could potentially reach the coast east of the wind farm, although the probability of this occurrence is relatively low.

76 Wilson, S.C., Trukhanova, I., Dmitrieva, L., Dolgova, E., Crawford, I., Baimukanov, M., Baimukanov, T., Ismagambetov, B., Pazylbekov, M., Jüssi, M. and Goodman, S.J., 2017. Assessment of impacts and potential mitigation for icebreaking vessels transiting pupping areas of an ice-breeding seal. Biological Conservation, 214, pp.213-222.

Potential direct impacts during operation arise mainly from the placement of wind turbines in the sea and from the associated processes perceived by seals. Similar to vessels, seals tend to acclimate to the physical presence of wind turbines (including cables), unless they present a direct threat.

Underwater disturbance

Disturbance to the seabed during construction occurs both during the laying of foundations and the installation of cables. This can cause temporary suspended solids and a decrease in water transparency, though it likely does not affect seals directly, as underwater visibility is generally limited in the Baltic Sea, making seals' vision of little significance underwater. The spread of suspended solids from construction activities is also short-lived.

Current knowledge indicates that the most significant underwater sensation is noise. Strong sounds that have a significant impact are predominantly associated with the construction of monopile foundations. During the construction phase of the wind farm, pile driving and drilling generate underwater impulse noise, and during operation, wind turbines emit low-frequency continuous noise into the water. The impact of vibrations from an operating farm, which do not reach the senses of seals, is less critical.

Seals living in the Baltic Sea are sound-sensitive animals that use vocal communication both in the air and in the water. Today, marine animals are classified into hearing groups (Southall 2019[77]), so seals belong to the hearing group PCW (phocid carnivores in water). Based on the precautionary principle, we consider the response level to be 110 dB in the tertiary band of 500 Hz.

When assessing the anthropogenic impact, it is also necessary to take into account the significant time periods for seals in which mating and pupping take place (see Annex 3.1 to the EIA report, Table 2.1). During the mating period, seals make a lot of noise, and intense anthropogenic noise can disrupt the communication of animals by masking important signals. The period from February to April plays an important role in the lives of seals. It is considered that a high risk of masking occurs when the anthropogenic sound at 500 Hz in the tertiary band exceeds the natural background by 20 dB, and the moderate risk occurs at 16 dB.

In order to avoid significant environmental impacts, the criteria that must be followed is that the median sound level of continuous anthropogenic noise must not exceed the limit values (response levels) given in Table 3.3-1. in more than 20% of the animals' habitat during periods of life important to the animals, according to the recommendation of TG Noise (TG Noise 2022[78]) and secondly, that anthropogenic impulse noise is at a level that does not cause a permanent increase in the hearing threshold of seals (Table 3.3-2).

77 Southall, B.L., Finneran, J.J., Reichmuth, C., Nachtigall, P.E., Ketten, D.R., Bowles, A.E., Ellison, W.T., Nowacek, D.P. and Tyack, P.L., 2019. Marine mammal noise exposure criteria: Updated scientific recommendations for residual hearing effects. Aquatic Mammals, 45(2), pp.125–232.

78 Setting of EU Threshold Values for continuous underwater sound. Recommendations from the Technical Group on Underwater Noise (TG Noise). Deliverable 4 of the work programme of TG Noise 2022.

Table 3.3-1. *Limit values for anthropogenic sounds for sound-sensitive biota – continuous low-frequency noise.*

Sea species	***Tertiary strip***	***Response level***	***Moderate risk of masking***	***High risk of masking***	***References***
	Hz	**dB re 1µPa**			
		sound level	**Level of exceedance**		
Seals	500	110	12	20	(Kastelein et al. 2006)

Table 3.3–2. Limit values for anthropogenic sounds for sound-sensitive biota – impulse noise.

Sea species	***Response level, SEL, dB re 1µPa²s (M)***	***Peak response level, SPL, dB re 1µPa***	***Temporary increase in hearing threshold (TTS) SELcum, dB re 1µPa² s***	***Permanent increase in hearing threshold (PTS)***
Seals	171 (Southall 2008[79])	212 (Southall 2008[80])	170 dB SEL PCW weighted (Southall 2019[81]) or 165 dB SEL in the 500 Hz tertiary band	185 dB SEL PCW weighted (Southall 2019[82]) or 180 dB SEL in the 500 Hz tertiary band

The modelling results indicated that the scenario of the construction of the foundation with the lowest environmental impact in terms of the sound emitted would be the use of a gravitational foundation, followed by drilling. During vibratory and impact ramming, seals in the danger zone may temporarily or permanently experience an increase in their hearing threshold due to construction work. However, mitigation measures can significantly reduce the risk of a permanent increase in hearing thresholds, making the impact on seals insignificant.

Modelling results for the operational period indicate that, according to established criteria, seal populations are not at risk. The median value of the average sound level at 500 Hz in the assessment area remains below 110 dB. The impact on seals is expected to be noticeable only during the construction period. In conclusion, the increase in ambient noise levels caused by the operation of wind farms can be assessed as insignificant regarding its impact on seals.

Table 3.3-3. *Impacts associated with wind farm design and their significance*

Consequence/impact	***Significance of impact***	***Need for mitigation measures, final significance of impact***
Wind farm construction and dismantling		
Gravity foundation		
Noise	0	
Monopile foundation – vibratory ramming		

79 Southall, B.L., Finneran, J.J., Reichmuth, C., Nachtigall, P.E., Ketten, D.R., Bowles, A.E., Ellison, W.T., Nowacek, D.P. and Tyack, P.L., 2019. Marine mammal noise exposure criteria: Updated scientific recommendations for residual hearing effects. Aquatic Mammals, 45(2), pp.125–232.

80 See previous

81 See previous
82 See previous

Consequence/impact	***Significance of impact***	***Need for mitigation measures, final significance of impact***
Noise	--	Mitigable Cumulative effect: 0/-
Monopile foundation – drilling		
Noise	0/-	Mitigable Cumulative effect 0
Monopile foundation – ramming		
Noise	--	Mitigable Cumulative effect: 0/-
Wind farm operation		
Barrier to migration	0	
Technological option 1 – wind turbine 15 MW		
Noise	0	
Technological option 1 – wind turbine 20 MW		
Noise	0	

The scale of significant environmental impact used in the EIA report: - minor negative impact, -- significant negative impact, 0 - no impact, neutral, + minor positive impact, ++ significant positive impact

3.4. Fisheries and fishing

Studies conducted:

- The impact of the Saare-Liivi offshore wind farm and cable route on fish. Estonian Marine Institute, University of Tartu, 2024
- Assessment of the underwater noise impact of the Saare-Liivi wind farm; Mechanics of Fluids and Structures Research Group, 2024 Potential impacts of offshore wind farms planned in Estonia on fish in the Baltic Sea. University of Tartu, 2020.

The impacts associated with the construction of wind farms are divided into construction, operation and dismantling periods. The operational and physical impacts are related to the location of the wind farm and the submarine cable. During the operational phase of the wind turbines, the noise generated by the turbines and the electromagnetic fields from the submarine cables can affect fish populations. Construction work might adversely impact fish due to construction noise and suspended solids generated during earthworks.

In some cases, the construction of wind farms may actually have a positive effect on fish abundance. The foundations and towers of the wind turbines (including substations) can provide hard substrates to the seabed, which may lead to local consolidation of fish populations and an increase in production. However, the exact indirect impacts on the fish population and, consequently, on the entire marine ecosystem remain unclear.

IMPACT ON SPRING-SPAWNING BALTIC HERRING

Based on the study of the migration of spring-spawning Baltic herring conducted over two consecutive years, it can be concluded that the spring migration of herring to spawning grounds does not significantly pass through the proposed buildable area of the Saare-Liivi wind farm. Instead, this area may serve as a post-spawning feeding ground for Baltic herring.

Data collected during hydroacoustic surveys indicate that the primary migration corridors for springtime Baltic herring toward their spawning grounds do not intersect with the proposed buildable area of the Saare-Liivi offshore wind farm. Migration patterns of Baltic herring can vary depending on weather conditions. Therefore, construction activities on the western edge of the buildable area should be avoided in March and April, as construction noise and suspended solids could disrupt the Baltic herring's spawning migration.

IMPACT ON AUTUMN-SPAWNING BALTIC HERRING

Research into the distribution and abundance of autumn-spawning Baltic herring larvae and spawners, along with an assessment of environmental conditions, has confirmed that both the development area for the Saare-Liivi offshore wind farm and the reference area located at the Kihnu shoal are used by autumn-spawning Baltic herring as migration routes to spawning grounds in areas shallower than the 20 m isobath. Autumn-spawning Baltic herring typically prefer areas with a steep depth gradient, known as slope areas, for spawning. The larvae of these fish also drift passively with water currents, resulting in an evenly distributed presence throughout the development area. Given the declining status of autumn-spawning Baltic herring in the Baltic Sea ecosystem overall, it is crucial to minimise and disperse risks that could harm this species in its remaining known spawning grounds. Consequently, construction activities should be avoided in the buildable area of the wind farm during the autumn spawning season, as well as during the peak distribution of Baltic herring larvae in September and October, especially in the Mölli lowland area closer than one kilometre in the 20 m isobath.

IMPACT ON OTHER SPAWNING AREAS

During the spring period, a small number of European smelt individuals with mature reproductive products were observed in the Saare-Liivi offshore wind farm buildable area of the planned wind farm, which is located closer to Kihnu Island. Spawning grounds of European smelt are typically located in rivers or in the shallow coastal waters of strongly brackish sea bays. Therefore, these European smelt should be considered migratory spawning fish that were caught in the monitoring nets before reaching their spawning grounds. Their reproductive products were released due to mechanical pressure caused by the mesh of the nets.

The abundance of flounder in the monitoring catches within the proposed Saare-Liivi offshore wind farm development area was relatively low, accounting for 4.5% of the total number of fish caught.

During the late autumn survey conducted in the Saare-Liivi offshore wind farm study area, no spawning European whitefish were caught, and the presence of spawning grounds in the area was not confirmed.

NOISE IMPACT

Current knowledge indicates that Baltic herring are likely the most vulnerable among the fish in the Baltic Sea to the potential negative effects of noise generated by offshore wind farms. Anthropogenic noise can impact fish spawning, long-term health and development, prey-predator relationships and communication (such as camouflage). The period from May to June and August to September plays an important role in the lives of Baltic herrings.

Different values have been proposed as sound pressure levels that are harmful to fish, and there is no common methodology for determining them to date. The study of underwater noise relies on the work of (Blaxter and Hoss, 1981[83]), where the response level of an 8–11 cm long herring to a signal with a frequency of 79 Hz was 122 dB re 1 µPa.

The scenario of the construction of the foundation with the lowest environmental impact in terms of the sound emitted would be the use of a gravitational foundation. Vibratory ramming and impact ramming have a negligible negative impact on Baltic herring, while drilling has no impact. According to established criteria, the Baltic herring population is not considered at risk, as the median average sound level at 125 Hz in the assessment area is below 122 dB. In conclusion, the increase in ambient noise levels caused by the operation of wind farms can be assessed as insignificant regarding its impact on Baltic herring.

Furthermore, since the cable being installed is typically buried to a depth of 1 metre, there is minimal or no impact from electromagnetic radiation generated during the cable's operation on the local fish community.

TRAWL FISHING

In the Gulf of Riga, trawling is primarily employed for Baltic herring and to a lesser extent for European sprat. Fishing for Baltic herring is regulated by quotas. In recent years, these have ranged from 6400 tonnes to nearly 17000 tonnes (Figure 3.4-1).

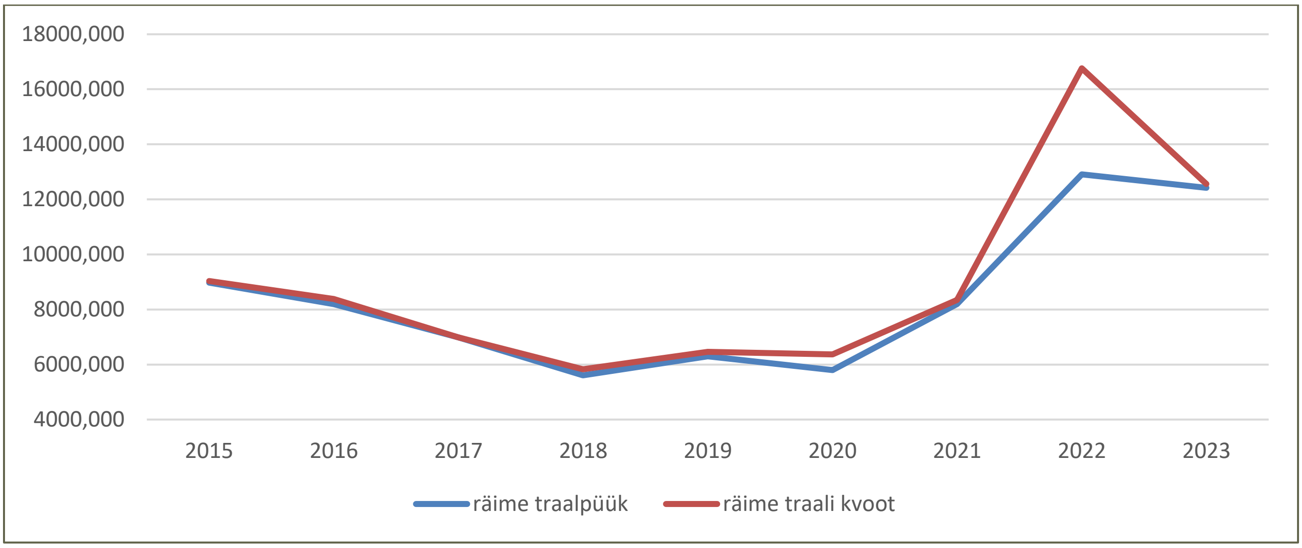

Figure 3.4-1. *Baltic herring trawling in the Gulf of Riga 2015–2023*

Figure 3.4-2 illustrates active fishing vessel movements in the area; however, the Saare-Liivi offshore wind farm area is generally not located directly along the fishing vessel routes. Therefore, it is not anticipated that the offshore wind farm will have a significant negative impact on trawl fishing.

83 Blaxter, J.H.S., Hoss, D.E., 1981. Startle response in herring: the effect of sound stimulus frequency, size of fish, and selective interference with the acoustico-lateralis system. Journal of the Marine Biology Association UK 61, 871–879.

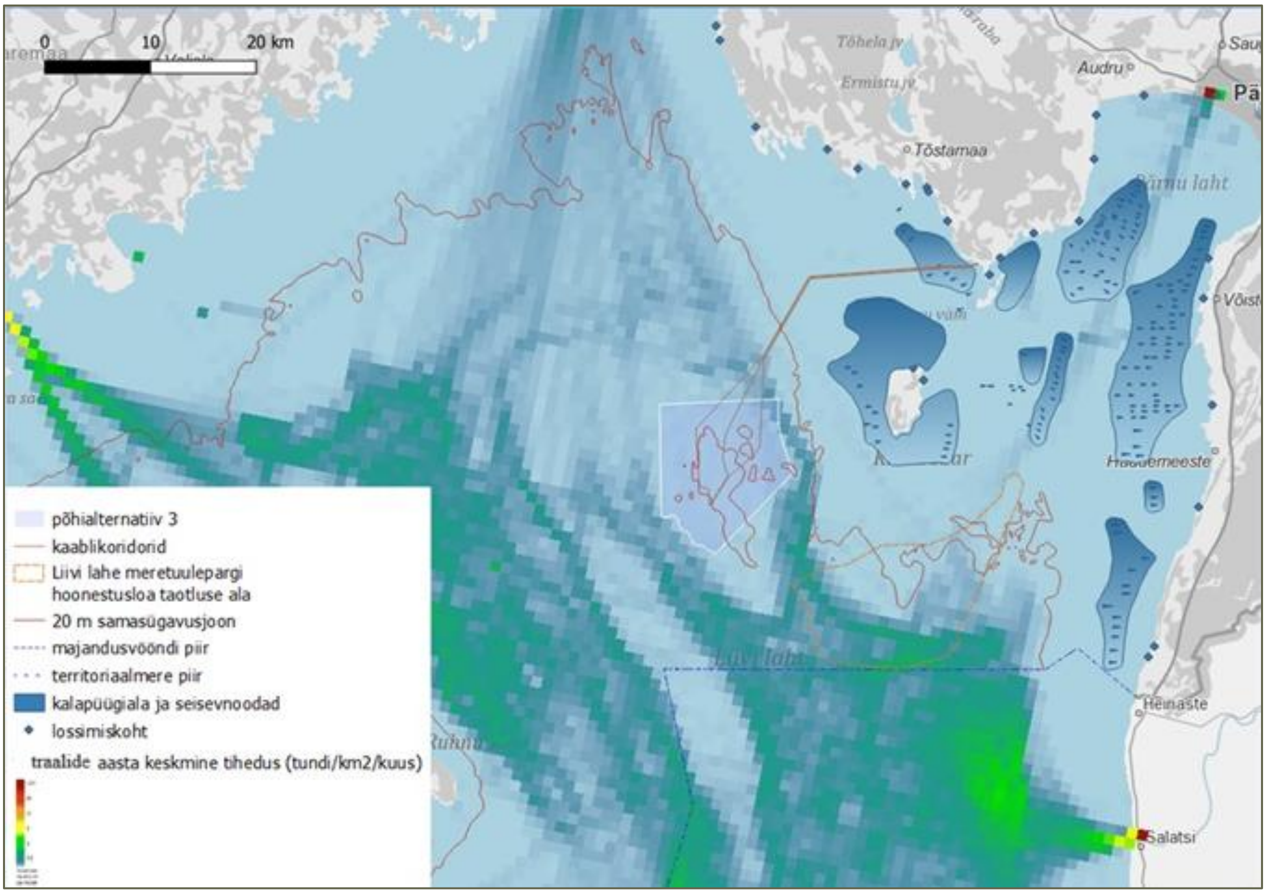

Figure 3.4-2. *Fishing in the Gulf of Riga, fishing areas and pound nets according to the Pärnu County marine area plan*

Table 3.4-1 *Impacts associated with wind farm design and their significance*

Consequence/impact	***Significance of impact***	***Need for mitigation measures, final significance of impact***
Wind farm construction and dismantling		
Indirect effects (dispersion of suspended solids)	-	Can be temporarily mitigated Cumulative effect: 0
Gravity foundation		
Noise	0	
Monopile foundation – vibratory ramming		
Noise	-/--	Can be temporarily mitigated Cumulative effect: 0
Monopile foundation – drilling		
Noise	0	
Monopile foundation – ramming		
Noise	-/--	Can be temporarily mitigated Cumulative effect: 0
Laying the connection cable		
Electromagnetic field impact	0/-	Mitigable Cumulative effect: 0
Indirect effects (dispersion of suspended solids)	-	Can be temporarily mitigated Cumulative effect: 0

Consequence/impact	*Significance of impact*	*Need for mitigation measures, final significance of impact*
Wind farm operation		
Habitat loss	0	
Barrier to migration	0	
Noise	0/-	
Impact on fishing	0	

The scale of significant environmental impact used in the EIA report: - minor negative impact, -- significant negative impact, 0 - no impact, neutral, + minor positive impact, ++ significant positive impact

3.5. Natura assessment

The Natura assessment is a procedural process carried out pursuant to Article 6 (3) and (4) of the Habitats Directive, 92/43/EEC. This work draws on European Commission guidance entitled “Assessment of plans and projects significantly affecting Natura 2000 sites. Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC”[84], to the "Instructions for carrying out a Natura assessment in regard to implementation of Article 6 (3) of the nature directive in Estonia"[85] and the guidance on “Wind energy developments and Natura 2000” (European Union, 2021)[86].

Linkage between proposed activity and protection management

The proposed activity is not associated with the protection management of any Natura 2000 network area and does not contribute directly or indirectly to achievement of the conservation objectives of the areas.

Description of the Natura 2000 sites within the impact area of the proposed activity

The following Natura 2000 network sites are within the potential impact area of the proposed offshore wind farm: Kihnu special area of conservation, Pärnu Bay bird area, Väinameri special protection area for birds, Kahtla-Kübassaare special protection area for birds and Ainazi-Salacgriva (see figure 3.5-1). The Pärnu Bay special protection area for birds is within the impact area of the proposed submarine cable.

84 Assessment of plans and projects significantly affecting Natura 2000 sites. Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC’. Brussels, 28.9.2021

85 Kutsar, R.; Eschbaum, K. and Aunapuu, A. 2019. Instructions for carrying out Natura assessment in the implementation of Article 6(3) of the Habitats Directive in Estonia. Client: Environmental Board. https://www.envir.ee/sites/default/files/KKO/KMH/kemu_natura_hindamise_juhendi_uuendus_2020.pdf

86 https://op.europa.eu/en/publication-detail/-/publication/2b08de80-5ad4-11eb-b59f-01aa75ed71a1

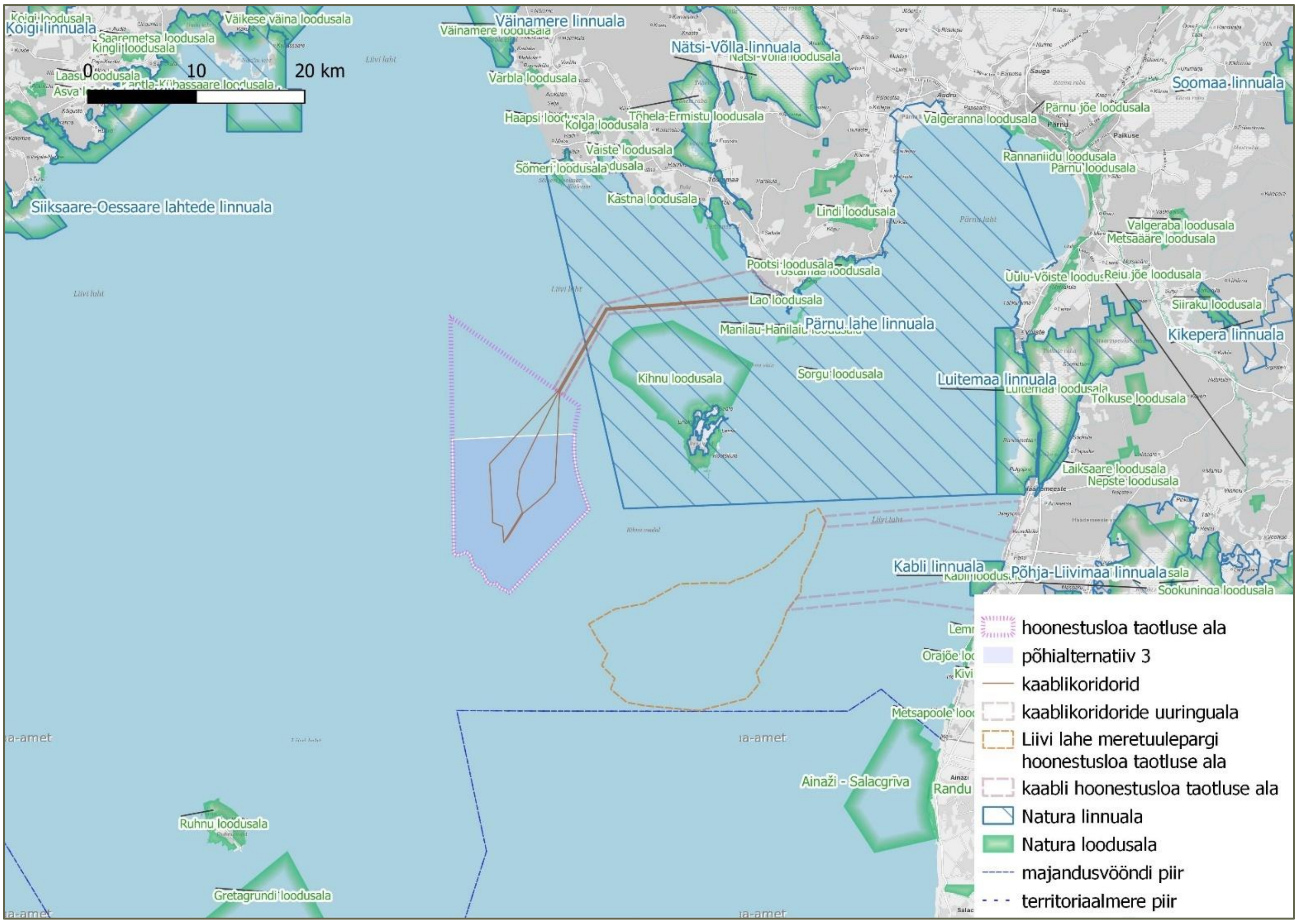

Figure 3.5-1. *Overview of Natura 2000 network areas in the impact area of the proposed wind farm area (Basis: Land Board and EELIS, 2024)*

Result of the Natura assessment and conclusions

The preliminary Natura assessment concludes that the implementation of the proposed activity will not have an adverse impact on the Lao special area of conservation and the Ainazi-Salacgriva special area of conservation, for which an appropriate assessment is not necessary.

The preliminary Natura assessment concludes that adverse impacts from the implementation of the activity cannot be excluded for the following Natura 2000 sites: Kihnu special area of conservation, Pärnu Bay special protection area for birds, Väinameri special protection area for birds, Kahtla-Kübassaare special protection area for birds. For these areas, an appropriate or full Natura assessment must be conducted.

Result of the appropriate Natura assessment and conclusions

The Natura 2000 Appropriate Assessment concludes that the **proposed activity in the marine area**—specifically, the planning of the offshore wind farm and the connection cable associated with this superficies licence—will not have an adverse impact on any of the following assessed Natura 2000 network sites or their conservation objectives: Kihnu special area of conservation, Pärnu Bay special protection area for birds, Väinameri special protection area for birds, Kahtla-Kübassaare special protection area for birds. The implementation of the proposed activity in the marine area will not harm the integrity of the Natura 2000 network sites.

3.6. Impacts on the climate

During the 21st century, climate change is expected to lead to an increase in temperature, precipitation, more frequent storms and sea level rise in Estonia.[87.] To mitigate climate change, the European Union has set a goal of reducing net greenhouse gas emissions by 55% by 2030 compared to 1990 and of making the European Union climate neutral by 2050[88].

Assuming that the annual energy production of the Saare-Liivi offshore wind farm is 5400 MWh, the estimated CO_2e savings with the 2021 specific emission factor[89] would be 3.5 million tonnes per year. This is 25% of Estonia's total CO_2e emissions in 2022 and more than the total consumption-based CO_2e emissions of the city of Pärnu in 2021. If we use the specific emission factor of 0.9–1.2 kt/GWh of oil shale electricity as a basis, the savings would be approximately 5.4 million tonnes of CO_2e.

The large-scale use of offshore wind energy will significantly reduce the use of biomass in energy production. It is also possible to significantly reduce or completely eliminate the use of fossil fuels in electricity generation.

Offshore wind farms have a significantly lower carbon footprint throughout their entire life cycle compared to fossil fuel-based electricity generation. The largest opportunities to further reduce the carbon footprint of offshore wind turbines are related to increasing the use of recyclable materials, decarbonising production processes and optimising installation and maintenance operations. Life cycle emissions vary depending on the size and production volumes of the wind turbine.

Table 3.6-1. *Impacts associated with wind farm design and their significance*

Consequence/impact	***Significance of impact***
Impacts on the climate	++

The scale of significant environmental impact used in the EIA report: - minor negative impact, -- significant negative impact, 0 - no impact, neutral, + minor positive impact, ++ significant positive impact

87 Estonia's future climate scenarios until 2100, Environmental Agency, 2015

88European Commission, 2021. COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE ONF THE REGIONS 'Fit for 55': delivering the EU's 2030 Climate Target on the way to climate neutrality

89 The specific emission factor for electricity in Estonia in 2021 was 0.648 kt CO_2e/GWh.

3.7. Impact on vessel traffic and maritime safety

Conducted study:

- .Maritime safety risk analysis of the Saare-Liivi offshore wind farm. Estonian Maritime Academy of Tallinn University of Technology, 2024.

Currently, there are no vessel traffic management measures implemented by the International Maritime Organization (IMO) in the Saare-Liivi offshore wind farm area. There are no anchorage areas near the offshore wind farm or the connection cable. Several navigation marks are located near the Saare-Liivi offshore wind farm area and the submarine cable corridor (Figure 3.7-1), but none are positioned within the Saare-Liivi offshore wind farm superficies licence area.

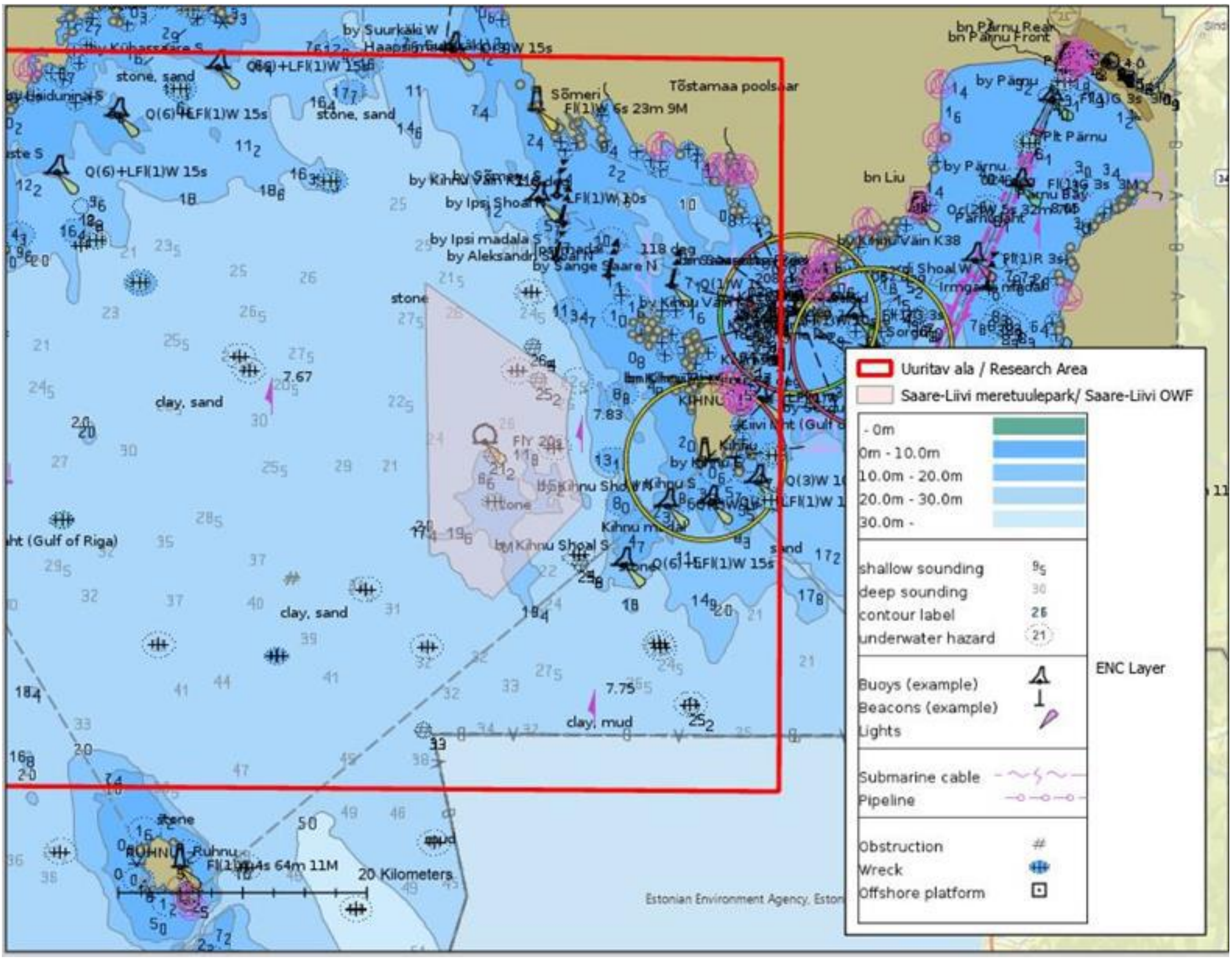

Figure 3.7-1. *Locations of navigation objects in the Saare-Liivi offshore wind farm area*

According to the traffic density map (Figure 3.7-2), Automatic Identification System (AIS) data reveals distinct vessel traffic corridors running southeast-northeast through the central part of the Gulf of Riga, to the west of the wind farm area. Additional corridors run west-east from the Port of Pärnu to the Gulf of Riga, south of the wind farm area, and northwest-southeast to the east of the wind farm area, as well as north-south along the western border. Currently, vessels navigate this area without restrictions, primarily choosing trajectories based on the fastest and safest routes. The west-east corridor (Pärnu Port to Gulf of Riga) is the busiest, primarily used by cargo vessels The maximum vessel length is 144 metres and the draft is 7.3 metres.

Fishing vessel traffic in the offshore wind farm area mainly involves movement to fishing areas outside the proposed wind farm. There is no active ancillary vessel traffic in the area. Recreational craft traffic is mainly active in the west-east corridor north of the wind farm.

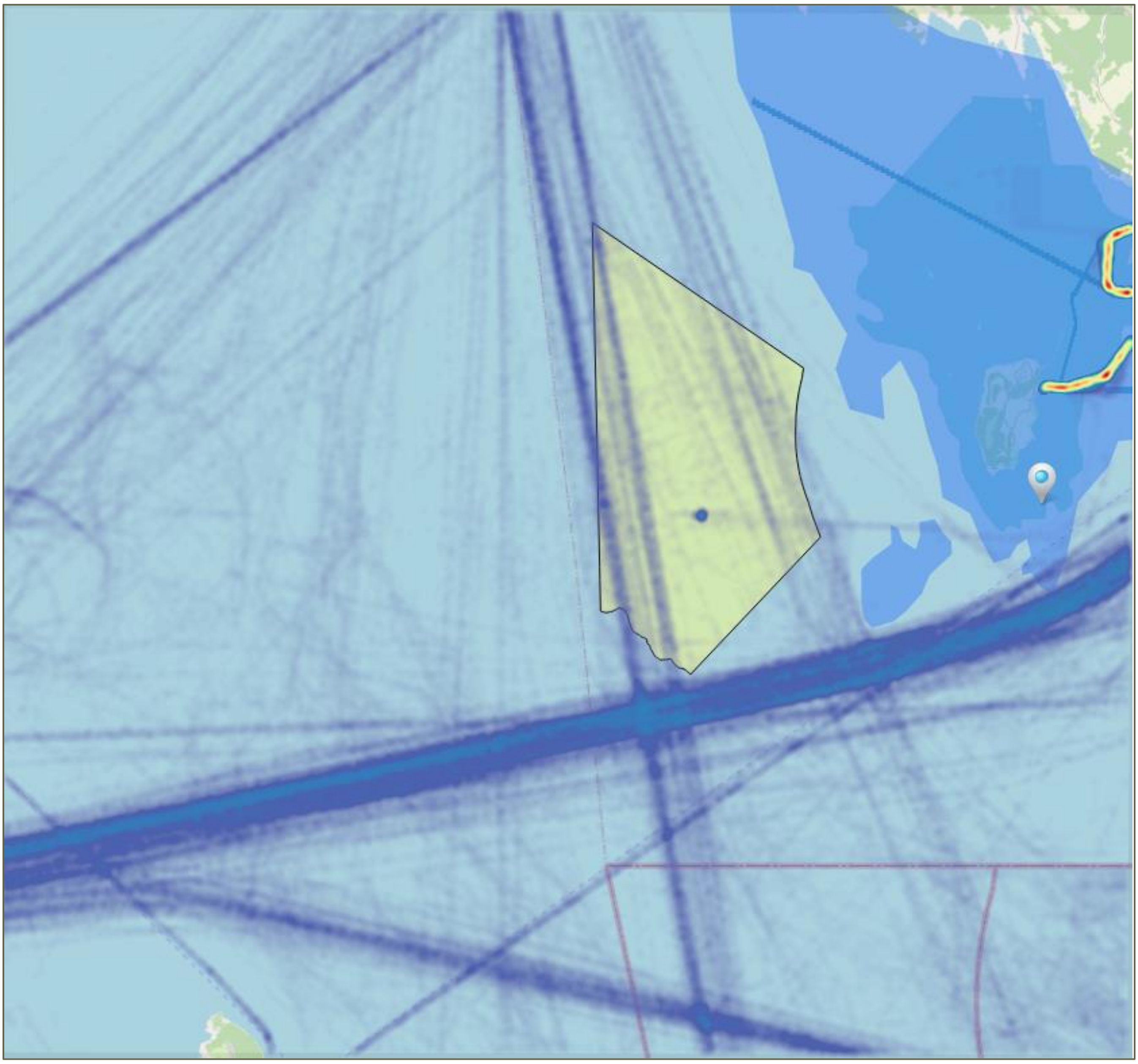

Figure 3.7-2. *Heatmap of vessel traffic based on AIS data*

Collision modelling identified various risks, including vessel collisions, stranding or collisions with facilities. However, these risks do not accurately reflect the current situation; they represent a hypothetical scenario without measures in place to ensure navigational safety during the construction and operation phases of the offshore wind farm. The analysis indicated that by implementing maritime risk control measures, identified navigational hazards can be reduced to at least the ALARP (as low as reasonably practicable) level.

During modelling and expert consultations, no increased maritime risks were identified in Latvian territorial waters. Therefore, the Saare-Liivi offshore wind farm is not expected to negatively impact vessel traffic in Latvia.

Based on the studies conducted thus far, offshore wind farms are not likely to significantly affect vessel positioning and communication systems, including VHF, NAVTEX, radio communications, GPS receivers, mobile phones, AIS systems, ship radars and sonars. However, the World Association for Waterborne Transport Infrastructure (PIANC) guideline titled 'Interaction between offshore wind farms and maritime navigation' indicates that several studies have shown the potential impact of wind farms on VHF signals. It recommends that after the wind farm is completed, measurements should be performed to determine its actual impact on radio communication systems and AIS. This will help verify that required coverage is maintained and assess the need for constructing additional coastal radio stations or AIS base stations.

Table 3.7-1. *Impacts associated with wind farm design and their significance*

Consequence/impact	***Significance of impact***	***Need for mitigation measures, final significance of impact***
Wind farm construction and dismantling		
Risk of vessel collision	0	
Laying the connection cable	0	
Wind farm operation		
Risk of vessel collision	0	
Impact on vessel positioning and communication systems, including VHF, NAVTEX, radio communications, GPS receivers, mobile phones, AIS systems, ship radars and sonars.	0	

The scale of significant environmental impact used in the EIA report: - minor negative impact, -- significant negative impact, 0 - no impact, neutral, + minor positive impact, ++ significant positive impact

3.8. Impact on air traffic

Conducted study:

- Impacts of the Saare-Liivi offshore wind farm on aviation. Estonian Aviation Academy, 2023

In the area under observation, the Tallinn flight information region has airspace class G up to flight level 95, and the Riga flight information region also has airspace class G, which is uncontrolled airspace up to FL95, where flying takes place in accordance with the common flight rules of Commission Implementing Regulation (EU) No 923/2012. Air traffic in the Tallinn flight information region is organised and managed by Lennuliiklusteeninduse AS (EANS). According to the common flight rules, when flying in a given area, the obstacle must be passed horizontally at a distance of at least 150 m and vertically at an altitude of at least 500 ft. When flying according to the instrument flight rules, an obstacle within a radius of 8 km from the estimated position of the aircraft must be passed vertically at least 1000 ft (305 m) above the obstacle.

The offshore wind farm has little impact on the area's minimum altitudes above sea level (AMA). The method used to determine the AMA is a square with a 5 NM buffer zone. The proposed offshore wind farm area will be located in three squares determined by longitudes and latitudes, of which the first square AMA 1700 ft, the second square AMA 1600 ft and the third square AMA 1400 ft. If the wind turbine peak height is up to 400 m, the AMA increases to 2400 ft in all squares, and in addition, the AMA in the fourth square, located within the 5 NM buffer zone, also increases from 1100 ft to 2400 ft. Such a change affects the instrumental flights. The altitude of 2400 ft is the new minimum flight altitude above sea level for the given areas to ensure the minimum obstacle clearance (MOC) required under instrumental flight conditions (see Figure 3.8-1). When the exact height of the turbines is determined, the AMA must also be reviewed.

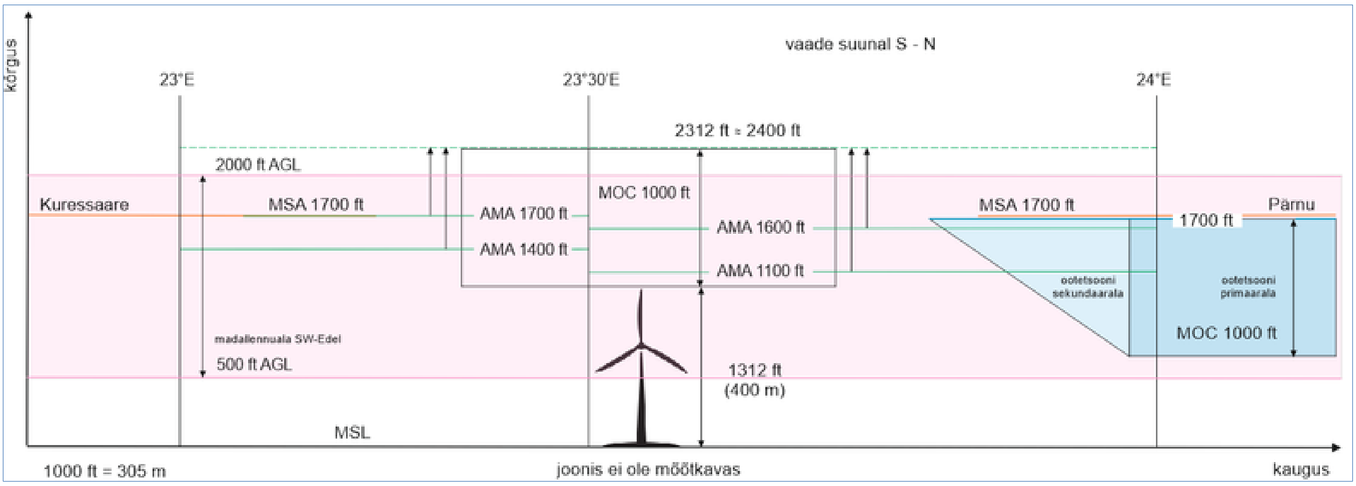

Figure 3.8-1. *Cross-section of the airspace of the Gulf of Riga, indicating AMA changes and the location of the offshore wind farm in relation to Kuressaare and Pärnu airports and the SW low-flying zone*

Overall, the proposed offshore wind farm will have a moderate impact on regional aviation for the following reasons:

- There is no impact on the prohibition, restriction and danger areas.
- The offshore wind farm is not located in the immediate vicinity of Pärnu or Kuressaare Airport, so there is no impact on the obstacle limitation surface (OLS).
- There is no impact on the approach procedures at Pärnu and Kuressaare Airport.
- There is no impact on instrumental flights.
- The performance of visual flights is influenced by a variety of factors, resulting in impacts that can be assessed as moderate to significant. Notably, there is a very significant impact on the Kuressaare-Ruhnu-Pärnu regular line. The impact will be reduced if the mitigation measures are implemented.
- The impact on unmanned aircraft cannot be estimated at this time.
- On search and rescue (SAR) and medical emergency evacuation (MEDEVAC) flights, the impact is significant. There is no significant impact if the mitigation measures are implemented.
- The impact on communications, navigation and monitoring equipment is low to moderate.
- The wake turbulence from the offshore wind farm has a moderate impact on flights.

Table 3.8-1. *Impacts associated with wind farm design and their significance*

Consequence/impact	***Significance of impact***	***Need for mitigation measures, final significance of impact***
Wind farm construction and dismantling		
Impact on the minimum altitudes above sea level (AMA) of the area	0	
Laying the connection cable	0	
Wind farm operation		
Impact on the minimum altitudes above sea level (AMA) of the area	0	

Prohibition, restriction and danger areas	0	
Impact on the obstacle limitation surfaces (OLS) of Kuressaare and Pärnu airports	0	
There is no impact on the approach procedures at Kuressaare and Pärnu airports	0	
Wake turbulence	-	
Search and rescue (SAR) and medical emergency evacuation (MEDEVAC) flights	-	
Kuressaare-Ruhnu-Pärnu regular line (until 2029)	--	The need for mitigating measures. Cumulative effect: 0

The scale of significant environmental impact used in the EIA report: - minor negative impact, -- significant negative impact, 0 - no impact, neutral, + minor positive impact, ++ significant positive impact

4. Environmental measures

4.1. Mitigation measures

Table 4.1-1 lists mitigation measures aimed at avoiding and minimising significant adverse impacts, as well as any other potential negative effects on the environment and aspects evaluated in the Environmental Impact Assessment (EIA) report. These mitigation measures are proposed for consideration during both the design phase of the wind farm and for implementation during its construction and operational stages.

The measures have been informed by the outcomes of previous studies and existing knowledge about offshore wind farms. If follow-up monitoring reveals that the projections in the EIA report have likely underestimated the associated impacts, additional mitigation measures must be implemented. This ensures that expected negative effects can be avoided or reduced based on the monitoring results.

Table 4.1-1. *Measures to prevent, avoid, reduce and mitigate significant adverse environmental impacts associated with the implementation of the proposed activity*

Environmental component	***Implementation phase***	***Mitigation measures***
Seabed geology	*Design and/or pre-construction phase*	▪ Wind turbine locations in the northern part of the original site (main alternative 2) should be excluded, as the thickness of the clayey sediment exceeds 4 metres and additional hazards, such as gas pockets and paleochannels, are present.
	Construction stage	▪ -
	Operation stage	▪ -
Sea water quality	*Design and/or pre-construction phase*	▪ -
	Construction stage	▪ During the installation of the export cable route, it is essential to conduct real-time monitoring of the spread of suspended solids generated during the installation process. If the spread of suspended solids exceeds the 300-metre buffer zone and reaches a depth greater than 6 metres, work should be halted. Real-time

Environmental component	***Implementation phase***	***Mitigation measures***
		monitoring helps prevent large quantities of suspended solids from being transported and settling in sensitive areas. ▪ To minimise sedimentation in the Pärnu Bay limited-conservation area when constructing wind turbine foundations, work that generates suspended solids should be avoided during stronger south-westerly winds (greater than 10 m/s), especially when installing the eastern wind turbines. Since habitats are not listed as conservation objectives within the limited-conservation area, and the marine habitat survey did not identify a need for special measures, this is a recommended measure.
	Operation stage	▪ Additionally, a pollution control plan must be developed to ensure a rapid response in the event of an oil spill.
Seabed habitats and biota	*Design and/or pre-construction phase*	▪ Avoid building wind turbines on reef habitats.
	Construction stage	▪ Activities related to seabed dredging along the connection cable route should be conducted outside of the vegetation period. ▪ In the case of the sandbank habitat type (seagrass communities), these habitats must be restored after the cable route has been laid. This restoration can completely rehabilitate the damaged habitat. A prerequisite for restoring seagrass communities is detailed mapping of their locations prior to the commencement of work, which should occur during pre-construction monitoring. The mapping effort must encompass the entire potential impact area, which includes a depth range of 0–6 metres and extends 300 metres on both sides of the cable route. ▪ When installing a cable route in a reef habitat type, the buried cable must be covered with a material that has properties similar to the natural one.
	Operation stage	▪ -
Birds	*Design and/or pre-construction phase*	▪ Development activities are only permitted within the scope of boundary option 3 of the reduced development area, in order to avoid and minimise significant environmental impacts. ▪ When implementing boundary option 3, reef habitats must remain free of wind turbines, as these areas could serve as important stopover sites for diving ducks. ▪ In the future, follow-up monitoring will be essential to assess the extent to which diving ducks use the limited space between the wind turbines. ▪ It would also be advisable to arrange the turbines in rows aligned with the prevailing migration direction. In this case, the prevailing migration direction is northeast to southeast.
	Construction stage	▪ To mitigate the risk of disturbance during construction, careful timing of the work is crucial. Different species are present in the area during different seasons; however, under boundary option 3, the most sensitive species include the long-tailed duck in winter and the velvet scoter in spring. Therefore, construction of the wind farm in winter and spring should be avoided (to be specified later).
	Operation stage	▪ Additionally, halting wind turbine operations during periods of intense bird migration is recommended. To ensure accuracy and efficiency, advanced technology

Environmental component	Implementation phase	Mitigation measures
		should be employed to identify the optimal times for implementing this measure. ▪ Turbine layout. It would also be advisable to arrange the turbines in rows aligned with the prevailing migration direction. In this case, the prevailing migration direction is northeast to southeast. ▪ If it is technically feasible and aligns with legal regulations, turning off the lighting used for flight safety when no low-flying aircraft are present would help reduce the risk of bird collisions. ▪ Furthermore, if manufacturers have the technological capability to enhance the visibility of wind turbines, this option should be considered.
Bats	*Design and/or pre-construction phase*	▪ -
	Construction stage	▪ -
	Operation stage	▪ To significantly reduce the risk of bat mortality, it is recommended to suspend the operation of wind turbines during the autumn migration period (from 1 August to 15 September) from sunset to sunrise, particularly at wind speeds below 5 m/s if there is no precipitation. During follow-up monitoring, it is important to reassess the necessity of restricting wind turbine operations. This includes specifying the duration and spatial extent of these restrictions. It is essential to determine whether there are areas within the wind farm where the number of migrating bats is significantly lower. Additionally, it should be clarified whether mitigation measures need to be applied to all wind turbines or only to specific ones. ▪ If reliable technical solutions for alternative mitigation measures become available in the future, such as wind turbine stopping mechanisms based on radar, infrared cameras or other sensors, these can be implemented upon approval from experts.
Seals	*Design and/or pre-construction phase*	▪ -
	Construction stage	▪ -
	Operation stage	▪ To prevent potential impulse noise generated by certain types of wind turbine foundations and specific installation methods, appropriate mitigation measures must be enacted (Chapter 3.7.4). ▪ To avoid disturbing pupping seals during unavoidable maintenance work, observation flights can be conducted over the ice to plan vessel movements. Pupping grey seals are easily visible from an airplane or drone because they gather in groups on the ice. In contrast, ringed seals are more challenging to identify, as they give birth in snow caves. However, breeding areas can be located by observing older seals, breathing holes or other traces of activity. Using an observer also aids in guiding the ship past the pupping seals.
Fish	*Design and/or pre-construction phase*	▪

Environmental component	Implementation phase	Mitigation measures
	Construction stage	▪ Construction activities on the western edge of the buildable area should be avoided in March and April, as construction noise and suspended solids could disrupt the Baltic herring's spawning migration. ▪ Avoid construction activities in the buildable area of the wind farm during the autumn spawning season, as well as during the peak distribution of Baltic herring larvae in September and October, especially in the Mölli lowland area closer than one kilometre in the 20 m isobath. ▪ Construction work in the connecting cable corridor should be avoided during the spawning season for Baltic herring and other fish species, which lasts from early April to late May. ▪ To minimise the potential negative impact of electromagnetic fields emitted by submarine cables, these cables should be buried in the seabed or otherwise covered. The preferred type of cable to use should be alternating current and three-core.
	Operation stage	▪ -
Social-economic factors, fishing	*Design and/or pre-construction phase*	▪ -
	Construction stage	▪ When laying connection cables, it is advisable to schedule the work outside the coastal fishing season. Alternatively, cooperation with fishing permit holders to agree on a suitable timeframe can help minimise any disruptions to coastal fishing.
	Operation stage	▪ If a wind power plant is proven to reduce fish catch, fishing operators have the right to receive compensation from the wind energy production charge collected by the state. ▪ Under the Environmental Charges Act, a charge for compensation for environmental nuisances caused by a wind farm is paid to Kihnu rural municipality.
Protected natural objects, Natura areas	*Design and/or pre-construction phase*	▪ -
	Construction stage	▪ During the installation of the connection cable, the spread of suspended solids must be monitored in real time. If the spread of suspended solids exceeds the 300-metre buffer zone and reaches a depth greater than 6 metres, work should be halted. ▪ In line with the precautionary principle, direct cable installation work that generates noise should be excluded from the coastal zone within the special protection area for birds during the bird nesting period, which runs from April to July. The specific technology for laying the cable is detailed in the building design documentation and the work execution plan. If the work execution plan, developed in cooperation with ornithologists and the Environmental Board, concludes ▪ To prevent damage to the community, the underground cable must be installed using a closed method. In cases where an open trench is necessary, the upper meadow layer must be placed back in the correct position to avoid any unevenness in the ground.

Environmental component	***Implementation phase***	***Mitigation measures***
		▪ No work should be conducted in the coastal meadow during the main breeding season of birds using this habitat and during grazing season, which is from 15 April to 31 August.
	Operation stage	▪ A major potential cumulative effect of the two closely proposed Saare-Liivi offshore wind farms, along with the Gulf of Riga offshore wind farm, is the increased risk of bird collisions with wind turbines. Therefore, in accordance with the precautionary principle, mitigation measures must be implemented in wind farms to reduce the risk of bird collisions and minimise potential negative impacts. The necessity of implementing these mitigation measures should be consistently applied to both existing nearby wind farms and those that are proposed.
Underwater archaeological values	*Design and/or pre-construction phase*	▪ -
	Construction stage	▪ -
	Operation stage	▪ -
Vessel traffic, maritime safety	*Design and/or pre-construction phase*	▪ When designing a wind farm, after the exact turbine layout is determined, it is essential to conduct a thorough vessel traffic analysis for the offshore wind farm area, particularly to assess navigation risks for construction and maintenance vessels, as well as vessels involved in rescue and icebreaking operations. This analysis should take place throughout the year, including during the winter months.
	Construction stage	▪ -
	Operation stage	▪ Maritime safety information regarding the construction and operation of the offshore wind farm must be communicated to both commercial vessels and recreational craft. Additionally, restricted areas should be clearly marked to minimise the risk of collisions. ▪ Navigation signs should be designed and installed according to the specific project development phase (construction or operation), and a comprehensive maintenance programme should be established to ensure the signs remain effective throughout their intended service life. ▪ The Estonian Transport Administration currently mandates that turbines from mean sea level up to a height of 15 metres must be painted yellow and marked with a unique identifier, composed of letters and numbers, to ensure visibility from vessels. ▪ The wind farm array will be designated with edge structures in accordance with IALA recommendations. *In the Saare-Liivi offshore wind farm area, it is advisable to create a vessel traffic management system for effective coordination of vessel movements, in collaboration with the Estonian Transport Administration.*
Air traffic	*Design and/or pre-construction phase*	*Cooperation with the Ministry of the Interior and the Police and Border Guard Board.*

Environmental component	Implementation phase	Mitigation measures
	Construction stage	▪ During the construction phase, it is recommended to establish a restricted area for flying to the construction site. Information on the restricted area allows airspace users to avoid the area, which increases flight safety. *Cooperation with the Ministry of the Interior and the Police and Border Guard Board.*
	Operation stage	▪ Pursuant to §34 and §35 of the Aviation Act, obstacles must be marked and illuminated in accordance with Annex 14 of ICAO. As for lighting, it is recommended to use the lighting system of Aircraft Detection Lighting System (ADLS). When an aircraft approaches the offshore wind farm, the safety lights of the ADLS system light up, at other times the flight safety lights are extinguished. ▪ For SAR and MEDEVAC flights, a minimum SAR access lane width of 1 kilometre should be maintained. This must be clearly marked, and a refuge area for helicopters should be established if necessary. It is also important to implement a clear and visible wind turbine marking system for both watercraft and aircraft.
Maritime monitoring, operational communications	*Design and/or pre-construction phase*	*Cooperation with authorities concerned*
	Construction stage	
	Operation stage	

The mitigation measures outlined in Table 4.1-1 are expected to be effective in reducing or preventing significant adverse impacts, as well as minimising environmental disturbances associated with the proposed wind farm and its infrastructure. Implementing the follow-up monitoring activities specified in Table 4.1-1 will help ensure the effectiveness and enhance the efficiency of these measures.

Many of the measures listed in Table 4.1-1 have already been put into action during the EIA process to eliminate or minimise adverse impacts as much as possible. To do this, the following has been completed during the process:

1) Areas that are unsuitable for construction due to geological conditions — such as locations with clayey sediments thicker than 4 metres and additional risk factors like gas pockets and paleochannels — have been excluded from consideration.
2) The spatial extent of the wind farm development area has been reduced to protect important resting areas for diving ducks identified during the bird surveys within the designated buildable area. Main alternative 3 was developed with a reduced northeast corner to accommodate these changes.
3) In main alternative 3, reef habitats have been kept free of wind turbines, as these areas are important marine habitats and could serve as important stopover sites for diving ducks.
4) The developer has taken into account that it would also be advisable to arrange the turbines in rows aligned with the prevailing migration direction. In this case, the prevailing migration direction is northeast to southeast.
5) Following the recommendations of the birdlife study, a minimum distance of 30–40 metres will be maintained between the water surface and the wind turbine rotors, depending on the power of the wind turbines.

6) The number of wind turbines for the Saare-Liivi offshore wind farm has been reduced to 80 (main alternative 3). This reduction has led to a decrease in the area covered by the wind turbines, which consequently has reduced the field of view from 67 degrees to 50 degrees. From more distant viewpoints, the field of view occupied by wind turbines is a maximum of 24 degrees.

As a result, the area suitable for the development of the offshore wind farm has decreased, leading to the maximum realistic alternative, which is illustrated in Figure 4.1-1.

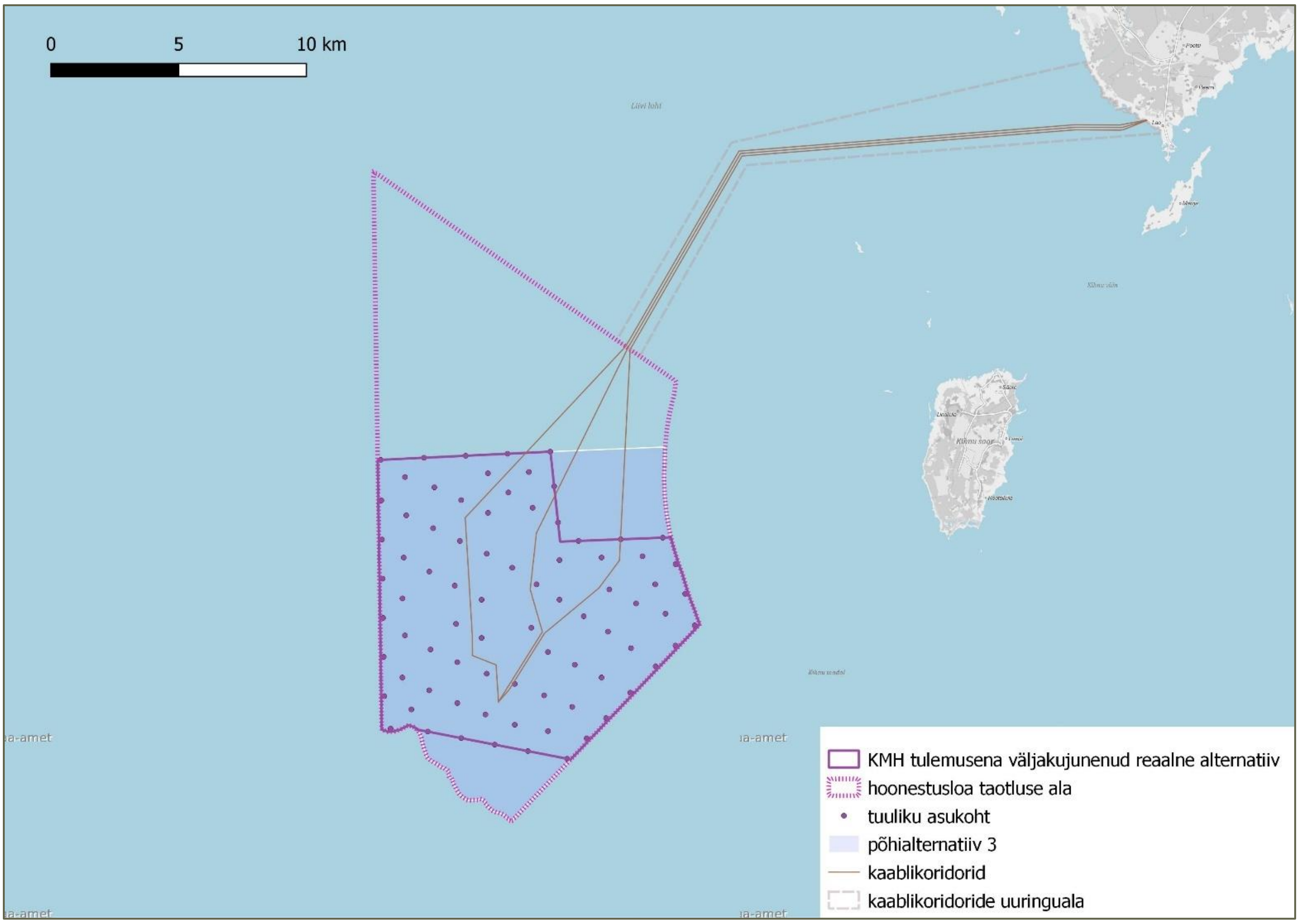

Figure 4.1-1. *The maximum possible realistic solution for the Saare-Liivi offshore wind farm developed as a result of the EIA*

The precise details of the wind farm, including the number of wind turbines, their locations and installation methods, will be determined later in the design process following the superficies licence process.

4.2. Follow-up monitoring

Table 4.2-1 presents the expert group's proposal for a follow-up monitoring plan categorised by environmental aspects. This plan is essential for the ongoing planning of the offshore wind farm to avoid environmental hazards and risks, as well as to gather additional information regarding possible environmental changes.

Table 4.2-1. *Follow-up monitoring measures*

Environmental component	***Implementation phase***	***Follow-up monitoring***
Seabed geology	*Pre-construction phase*	▪ During the construction design stage, a geological survey will be conducted at the location of each specific wind turbine, which is necessary for engineering purposes.
Sea water quality	*Construction stage* *And operation stage*	▪ Monitoring suspended solids during construction will include measuring total phosphorus, total nitrogen, phosphates, nitrates and nitrites, and chlorophyll a.

Environmental component	Implementation phase	Follow-up monitoring
		▪ Water column monitoring will be conducted during construction and the subsequent operation of the wind farm to identify the potential impacts of these activities on the marine environment, specifically focusing on changes in the concentrations of nitrogen and phosphorus compounds. During the construction phase of the wind farm, monitoring of water column parameters should occur more frequently (up to twice a month) and should have sufficient spatial separation to effectively assess the direct impacts of construction activities on the surrounding coastal waters.
Seabed habitats and biota	*Pre-construction phase*	▪ Monitoring suspended solids during construction will include measuring total phosphorus, total nitrogen, phosphates, nitrates and nitrites, and chlorophyll a. ▪ Water column monitoring will be conducted during construction and the subsequent operation of the wind farm to identify the potential impacts of these activities on the marine environment, specifically focusing on changes in the concentrations of nitrogen and phosphorus compounds. During the construction phase of the wind farm, monitoring of water column parameters should occur more frequently (up to twice a month) and should have sufficient spatial separation to effectively assess the direct impacts of construction activities on the surrounding coastal waters.
	Construction stage	▪ Monitoring suspended solids during construction will include measuring total phosphorus, total nitrogen, phosphates, nitrates and nitrites, and chlorophyll a. ▪ Water column monitoring will be conducted during construction and the subsequent operation of the wind farm to identify the potential impacts of these activities on the marine environment, specifically focusing on changes in the concentrations of nitrogen and phosphorus compounds. During the construction phase of the wind farm, monitoring of water column parameters should occur more frequently (up to twice a month) and should have sufficient spatial separation to effectively assess the direct impacts of construction activities on the surrounding coastal waters.
	Post-construction stage	▪ Monitor the colonisation of foundation structures by seabed biota (quantitative sampling or assessment once a year for five years following foundation installation, covering the entire depth range from the bottom to the surface at three foundations located in different parts of the wind farm area). ▪ Monitor the accumulation of organic matter near the foundations at the seabed (within a 0–30 metre radius around each foundation. This will involve the use of sediment traps over a five-year period at three different foundations located in various parts of the wind farm area). ▪ Monitor the condition of seabed habitats within the wind farm area (three study areas of 1000 m^2, covering the reef habitat type. The observation methods will include underwater video observations (with a minimum of 25

Environmental component	Implementation phase	Follow-up monitoring
		stations/transects) and quantitative sampling from at least 10 stations, performed once a year). ▪ Assess the extent of disruption caused by construction activities, focusing on both the export cable route and the surrounding buffer zone. Follow-up monitoring of the cable route installation should take place annually during the summer months (June to September) for a minimum of five years. Depending on the substrate, the technology used for observations and sampling may vary: **Soft sediment.** When planning the wind farm or cable route, identify three areas where cable embedment or installation has taken place. In each selected area, video observations of the seabed will be conducted using an underwater vehicle (ROV/AOV), drop camera or diver. Each observation should include 10 repetitions, with each video covering a minimum area of 5 m^2. Additionally, quantitative samples must be collected from the soft sediment near the cable in at least three replicates in each area. A reference area, at least 500 metres away and with similar seabed characteristics, should be established for each monitoring site. In the reference area, observations and sampling will follow the same methodology. It is important that the reference area is located well outside the impact area of the cable installation. **Hard substrate.** When planning the wind farm or cable route, identify five areas where cable embedment or installation has taken place. These areas should be evenly distributed across the depth gradient of the wind farm and cable route, covering both the photic and aphotic zones. The shallowest area must be between 2 and 5 metres in depth. In each selected area, video observations of the seabed will be conducted using an underwater vehicle, drop camera or diver. Each observation should include 10 repetitions, with each video covering a minimum area of 5 m^2. Additionally, quantitative samples must be collected from the hard substrate near the cable in at least three replicates in each monitored area. A reference area, at least 500 metres away and with similar seabed characteristics, should be established for each monitoring site. In the reference area, observations and sampling will follow the same methodology. It is important that the reference area is located well outside the impact area of the cable installation. If, after a five-year monitoring period, the affected communities have not shown signs of recovery (indicated by a statistical difference between the reference area and the impacted area) monitoring must be extended for another five years.
Birds	*Pre-construction phase* *Construction stage* *Operation stage*	Furthermore, monitoring of birdlife at the offshore wind farm is critical during construction, but especially in the operation stage. A comprehensive monitoring plan should be developed, ideally before the issuance of the construction permit. This plan needs to be created in collaboration with ornithologists and the Environmental Board to ensure consistent data collection on

Environmental component	Implementation phase	Follow-up monitoring
		avifauna, especially considering the planned development of several wind farms in the Gulf of Riga. An initial framework for this monitoring plan has already been established within this EIA (Annex 3.8.2).
Bats	*Post-construction stage*	▪ Follow-up monitoring will take place over the two years following the start-up of the wind farm. During this monitoring period, the relative abundance of bats must be assessed and compared with the data collected during the baseline survey. To minimise any potential bias from the placement of recording devices, these should be installed in the same areas of the wind farm as those used during the baseline survey. Instead of using temporary buoys, it is advisable to install recorders on the maintenance platforms of the wind turbines for follow-up monitoring. Monitoring must be conducted after the wind farm has been completed and commissioned. ▪ To assess the risk of bat mortality, it is essential to use devices located near the sea surface and also those installed in the area where the wind turbine blades operate. This will help evaluate bat flight activity in areas in the danger zone. ▪ At present, there is no established methodology for accurately assessing bat fatalities. However, it is anticipated that suitable solutions may emerge soon. Once the Saare-Liivi offshore wind farm is completed, existing methodologies for assessing bat fatalities should be reviewed and updated based on the best practices available at that time.
Seals	*Construction stage*	▪ Since this is a study based on the existing situation and there are no competent analogues from the Baltic Sea areas that include the proposed wind farm areas where ringed seals and grey seals coexist, observers need to be deployed during construction. Efforts must be made to study both seal species to measure and assess their responses in relation to potential long-term impacts.
	Operation stage	▪ Since there are no competent analogues from the Baltic Sea areas that include the proposed wind farm areas where ringed seals and grey seals coexist, it is important to repeat telemetry studies once the farm is operational.
Fish	*Monitoring during construction and operation*	▪ Monitoring must be carried out annually during the first five years of wind farm operation and every other year during the following ten years, after which an assessment should be made on the need to continue with monitoring, a more detailed research plan will be formulated in cooperation with the developer, the decision maker and the research institution. ▪ After this period, an assessment will be conducted to determine the necessity of continuing monitoring, and a more detailed survey plan will be developed in collaboration with the developer, decision-maker and research institutions.
Underwater noise	*Design and/or pre-construction phase*	▪ Underwater ambient noise measurements should be conducted to verify the results of the modelling at each

Environmental component	Implementation phase	Follow-up monitoring
	Construction stage *Operation stage*	stage of the wind farm's construction and during its operational period. Ambient noise levels must be measured during times when construction activities are not taking place. The chosen locations for measurements should represent the ambient noise levels in the work area as accurately as possible. ▪ To verify the accuracy of the sound propagation model, short-term measurements of sound pressure levels must be taken in the operation area. It is preferable to use an impulse noise source with controllable intensity as the sound source for these measurements. Additionally, the sound levels produced during pile driving and drilling activities must also be measured.
Navigation, radio communication	*Monitoring during operation*	▪ Once the wind farm is operational, it is essential to conduct measurements of the radio communication systems and the AIS to ensure that the required coverage is achieved. This will also help determine if there is a need to establish additional coastal radio stations or AIS base stations.

5. Cumulative impact

Cumulative impacts have been discussed in each subchapter where it has been deemed relevant.

Bird displacement is a significant concern in the development of wind farms in the Gulf of Riga. A major potential cumulative effect of the two closely proposed Saare-Liivi offshore wind farms, along with the Gulf of Riga offshore wind farm, is the increased risk of bird collisions with wind turbines.

To minimise this potential negative impact, the construction of offshore wind farms in the Gulf of Riga should avoid locations that are crucial for birds, such as important stopover areas and migration bottlenecks. Additionally, mitigation measures must be implemented in the wind farms being constructed to reduce the risk of collisions. The necessity of implementing these mitigation measures should be consistently applied to both existing nearby wind farms and those that are proposed.

6. Transboundary environmental impact

The impact assessment conducted indicates that the construction of the proposed Saare-Liivi wind farm will not result in any direct transboundary environmental impacts. Key points regarding the anticipated transboundary environmental impacts include:

- The potential negative transboundary environmental impact concerns birds, particularly migratory species, during the operational phase of the offshore wind farm, as discussed in Chapter 3.1. The significance of this impact will need to be further assessed through monitoring during the operational phase of the wind farm. The impact could become more significant due to cumulative effects if additional offshore wind farm development areas are planned or implemented nearby.
- In theory, transboundary environmental impacts could also extend to fish, bats, and seals. However, based on the conclusions drawn in chapters 3.2, 3.3 and 3.4, the proposed wind farm is not expected

to adversely affect marine life. Therefore, no significant transboundary environmental impacts are anticipated concerning these factors.

Additionally, the offshore wind farm's connecting cables will not link to any other country, which means there will be no transboundary environmental impacts in this regard.

Ultimately, the proposed Saare-Liivi offshore wind farm will contribute to climate change mitigation efforts. The large-scale use of offshore wind energy will significantly reduce the use of biomass in energy production. It is also possible to significantly reduce or completely eliminate the use of fossil fuels in electricity generation.

7. Summary

The report on the EIA carried out addresses the impacts on all the environmental aspects set out in the national law and previously specified in the EIA programme. The assessment results are presented in Chapter 3. During the EIA, at least 20 different studies and modelling efforts were conducted. The EIA did not identify any significant negative environmental impacts for the main alternative 3 concerning any of the assessed environmental aspects. Mitigation measures were suggested, along with the need for ex-post evaluation and monitoring, to prevent and reduce potential environmental impacts.

One of the primary concerns during the EIA was the potential impact on avifauna. To minimise adverse impacts on birds, during the EIA process, adjustments were made to reduce the initially requested superficies licence area from the north and south. The northeastern and southwestern corners of main alternative 3, along with the central region with a depth of less than 20 metres, were excluded as possible important stopover areas for diving ducks, which are also part of the distribution range for the important habitat type known as reefs. The wind turbines are oriented in a northeast-southwest direction, which aligns with the prevailing migratory patterns, and a minimum distance of 30–40 metres is maintained between the water surface and the rotor blades. The reduction in the spatial extent of the offshore wind farm and the number of wind turbines has also lessened the visual impact. Depending on the viewing point, the field of view occupied by the wind turbines ranges from 24 to 50 degrees.

The Natura 2000 Appropriate Assessment concludes that the proposed activity in the marine area will not have an adverse impact on any of the following assessed Natura 2000 network sites or their conservation objectives: Kihnu special area of conservation, Pärnu Bay special protection area for birds, Väinameri special protection area for birds, Kahtla-Kübassaare special protection area for birds. The implementation of the proposed activity in the marine area will not harm the integrity of the Natura 2000 network sites.

As a result of the impact assessment, no significant cumulative negative impacts were identified in conjunction with the Gulf of Riga offshore wind farm. However, it was not possible to estimate the impacts related to the risk of bird displacement or the rate of collisions because the data published in the EIA for the Gulf of Riga offshore wind farm did not include maximum population estimates for the species in the area.

The construction of the Saare-Liivi offshore wind farm will not have any transboundary environmental impact.