NATUR VÅRDS VERKET

SWEDISH ENVIRONMENTAL PROTECTION AGENCY

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Case number:
NV-05552-24

To point of contact in:
Lituania
Poland

Consultation in accordance with Articles 4 and 5 of the Espoo Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention) regarding marine seismic surveys and marine geological investigations throughout the Baltic Sea

The Swedish Environmental Protection Agency (SEPA) notified your states on the 9th of July 2024 of the Geological Survey of Sweden (SGU) plans to apply for a Natura-2000 permit for geophysical surveys in Swedish waters throughout the Baltic Sea. In response to the notification, Lithuania and Poland replied to the Swedish Environmental Protection Agency that they request to participate in consultations in accordance with the Espoo Conventions article 4-5.

In accordance with Articles 4 and 5 of the Espoo Convention, the SEPA hereby invites your states to submit comments on SGU:s permit application and environmental impact assesment (EIA) for the plans for geophysical surveys in the Baltic Sea.

The planned project
SGU has been commissioned by the government to investigate the possibilities for carbon dioxide storage in the southern Baltic Sea. The investigations will be carried out within, and in the vicinity of, Natura 2000 areas. As impacts may arise on designated species within the Natura 2000 area Hoburgs bank and Midsjöbankarna (SE0330308), SGU is applying for a permit in accordance with 7 kap. 28 a § of the Swedish Environmental Code. The Natura 2000 areas Hoburgs Bank and Midsjöbankarna are a core area for the Baltic Sea population of harbour porpoises in the summer and an important foraging and wintering area for seabirds. The area is designated for the protection of harbour porpoises, long-tailed duck, black guillemot and eider, as well as the habitat types of sandbanks and reefs and their typical species.The overall assessment is that harbour porpoises are at risk of being moderately negatively affected within the Natura 2000 area and that cod and Herring is assessed to have small negative consequences from the surveys. No other species or habitat types are assessed to be affected more than negligibly. Since the effects and consequences from the surveys are assessed to be local, temporary and reversible, they are not assessed to affect the

conservation status of individual species, or the Natura 2000 area. The surveys will not be carried out within, or affect, any other Natura 2000 area.

Upcoming process
SGU has now submitted an application and environmental impact assessment to the County Administrative board of Gotland in accordance with chapter 7, 28 b § of the Swedish Environmental Code.

Sweden kindly asks you to submit your comments **no later than 30th of June 2025** and to:

- provide comments concerning the assessment of the environmental impacts of the project affecting your country.
- submit any comments you might receive from the public and the authorities in your country.

Kindly send the answer to this consultation by e-mail to: registrator@naturvardsverket.se. Please indicate Case number NV-05552-24 in your answer.

This decision has been made digitally and therefore lacks signatures.

For the Swedish Environmental Protection Agency

Nanna Wikholm
Head of Unit

Richard Kristoffersson
Point of Contact, Espoo Convention

Attachments
Natura 2000-application 20241220 (English)
Appendix C EIA (English)
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Appendix B Technical description SGU_eng
Appendix C1 Consultation report SGU_eng
Appendix C2 Siting investigation SGU_eng
Appendix C3 Noise investigation SGU_eng
Cc.
The Ministry of Climate and Enterprise, Sandra Jalalian and Elenora Rönström

FØYEN

County Administrative Board of Gotland County

Sent only via email to: gotland@lansstyrelsen.se

Stockholm, December 20, 2024

Application for a permit according to 7 kap. 28 a § of the Swedish Environmental Code

Applicant:	Geological Survey of Sweden ("SGU" or "the Authority"), 202100 -2528 Box 670 Villavägen 18, 751 28 Uppsala
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The matter:	Application for a permit according to 7 kap. 28 a § of the Swedish Environmental Code for geophysical surveys in the Baltic Sea (registration number at SGU: 316-3015 /2024)

FOYEN LAW FIRM KB
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1. THE REQUEST

SGU requests that the County Administrative Board of Gotland County (the "County Administrative Board"), with respect to Hoburgs Bank and Midsjöbankarna (SE0330308) (the "Natura 2000 area"), grant the Authority permission in accordance with 7 kap. 28 a § of the Swedish Environmental Code ("MB") to conduct geophysical surveys within the area set out in Appendix A , all in accordance with what is stated below in this permit application and appendices.

SGU further demands that the County Administrative Board

a) announces the conditions proposed in section 2.1 below,

b) approves the environmental impact assessment associated with the application ("EIA") in Annex C and complete the specific environmental assessment together with

c) issues an enforcement order in accordance with 19 kap. 5 § p. 12 MB and 22 kap. 28 § MB, i.e. that the permit may be used even if it is appealed.

2. TERMS

2.1 Terms and conditions proposal

General conditions

1. Unless otherwise provided by other conditions, the activities shall be designed and conducted essentially in accordance with what the applicant has stated in the application documents and otherwise undertaken in the matter.

Restrictions on the implementation of activities to protect porpoises

2. Surveys with equipment emitting frequencies below 200 kHz must not be carried out within 14 km of the Natura 2000 area during the period May-October to protect harbour porpoises (Baltic population). Surveys with equipment emitting frequencies below 200 kHz must begin with a soft start lasting at least 20 minutes. If it takes longer than 40 minutes to transport between transects, a new sequence of soft starts must be initiated.

3. Before starting up equipment emitting frequencies below 200 kHz within the *Natura 2000 investigation area*, visual and acoustic monitoring of harbour porpoises shall be carried out in a zone of 500 meters ("surveillance zone") around the vessel for at least 30 minutes. In the investigation areas *Northwest* and *Northeast,* visual or acoustic monitoring shall be carried out depending on the conditions that visibility conditions allow. When observing harbour porpoises within the surveillance zone, start-up of equipment must be delayed at least 20 minutes after the harbour porpoises have left the surveillance zone.

4. If there is a break in work longer than 10 minutes in a survey with equipment that emits frequencies below 200 kHz, a new sequence with surveillance and soft start must be started.

Cumulative effects and contact with organizations and authorities

5. When planning the surveys, cumulative effects must be taken into account, for example, that the surveys are not carried out at the same time as other geophysical surveys from nearby projects within the same sea basin as SGU's operations in the sea basins of the West Gotland Sea, the East Gotland Sea, as well as the Bornholm Sea and Hanö Bay.

6. The Swedish Fishermen's Producers' Organisation (SFPO), the Swedish Pelagic Federation Producers' Organisation (SPF) and the Sea and Coastal Fishermen's Producers' Organisation (HKPO) shall be informed of when and where the surveys will be carried out so that potential impact on fishing is minimised.

7. The operator shall inform the Armed Forces, the Swedish Maritime Administration and the Coast Guard of estimated working hours, position for the investigations and contact details for the unit carrying out the investigations no later than six (6) weeks before the investigations commence.

8. The operator shall, no later than three (3) weeks before the commencement of the investigations, consult with the Swedish Maritime Administration and the Swedish Transport Agency about the measures required to protect against disruptions to shipping, and consult with the Armed Forces about the authority's efforts and exercise activities.

9. When the investigations are completed, the results of the investigations, in those parts where there is data from multibeam echo sounder that meets the FSIS 44 hydrographic survey standard, and which is not subject to confidentiality, must be reported to the Swedish Maritime Administration via e-mail ufs@sjofartsverket.se .

Control program

10. A control program for the surveys shall be in place for the entire period during which the surveys are carried out. The control program shall be established in consultation with the County Administrative Board of Gotland County and the Swedish Agency for Marine and Water Management. The control program shall state how the activities shall be controlled, specifying the measurement method, measurement frequency and evaluation method. Proposals for control programs shall be submitted to the said County Administrative Board no later than three (3) months before the start of each stage.

2.2 Conditional justification

The applied-for surveys are planned within an area where harbour porpoises from the Baltic Sea population may occur. The Baltic Sea population is critically endangered and it is of great importance that the surveys do not further impair the conditions for the species to achieve a favourable conservation status. Through SGU's proposed conditions 2, 3 and 4 above – with measures such as time restrictions and protective measures regarding underwater noise – the negative impact on harbour porpoises is minimised. Furthermore, by avoiding the period that is most sensitive for harbour porpoises, the risk of impermissible impact on harbour porpoises can be minimised. These conditions constitute a central tool to ensure that no impact on harbour porpoises that could lead to temporary hearing damage (“TTS” temporary threshold shift), permanent hearing damage (“PTS” permanent threshold shift) or other unauthorized disturbance occurs as a result of the conduct of the surveys. Protective measures regarding

underwater noise, such as soft start, also protect other species such as seals and fish that may be disturbed by noise from geophysical surveys.

With the proposed condition 5 above, regarding consideration of cumulative effects with a particular focus on underwater noise, the impact on porpoises of the applied activity is reduced. In addition, SGU is bound by the commitments that otherwise appear in this permit application and appendices in accordance with the proposed condition 1 above.

3. BACKGROUND

3.1 The need to investigate the possibility of storing carbon dioxide under the seabed

On March 16, 2023, the European Commission presented a proposal for a Net-Zero Industry Act (NZIA) , which, together with the proposal for a Regulation on Critical Raw Materials, constitutes the first parts of the Green Deal Industrial Plan.
The regulation entered into force and shall apply from 29 June 2024.

According to the European Commission, the regulation will help create favourable conditions for scaling up the production of green technologies in the EU, strengthen the EU's competitiveness and contribute to achieving the EU's climate and energy targets for 2030, as well as creating greater energy independence within the EU. The regulation includes a number of measures to stimulate investment in net-zero emission technologies. One specific measure mentioned is carbon dioxide storage capacity, where the EU will support projects for carbon capture and storage, including by improving access to carbon dioxide storage sites.

The European Commission wants to simplify the regulatory framework for the production of net-zero technologies with several targeted measures to make the EU's net-zero industry more competitive and increase the capacity for carbon dioxide storage and CCS technology in the Member States. CCS is an abbreviation for the English " Carbon Capture and Storage ” and stands for the capture and storage of carbon dioxide. The method is highlighted – both nationally and internationally – as an important tool for reducing large-scale emissions of carbon dioxide into the atmosphere and achieving climate goals. General assessments show that in Sweden there are mainly two sea areas, in the southeastern Baltic Sea and adjacent to southwestern Scania, which may be suitable for geological storage of carbon dioxide.

3.2 SGU's government mission

For 2022, SGU has received an appropriation letter (prop. 2022/23:1 expenditure area 24, bet. 2022/23:NU1, rskr. 2022/23:99) from the government with a mission that states:

" *SGU shall investigate and investigate suitable sites for permanent storage of carbon dioxide in Sweden and analyze the conditions for the operation of the storage sites. The agency shall annually during 2023–2025, within its area of responsibility, continue the work with external monitoring and internal competence-raising efforts for the handling, processing and interpretation of deep seismic data regarding carbon dioxide storage, taking into account relevant parts of the Climate Policy Path Choice Investigation (SOU 2020:4) and SGU's publications: Reports and Announcements 131 (M2011/01361), Reports and Announcements 142 (N2017/06161) and Reporting of Government Assignments RR 2021:04 (N2022/02208).*

SGU shall actively participate in national and international collaboration and in particular monitor CCS activities to maintain and develop Swedish capabilities regarding geological storage of carbon dioxide. When implementing the assignment, SGU shall engage in a dialogue with the Swedish Energy Agency. SGU shall submit interim reports on the implementation and progress of the assignment to the Government Offices (future Ministry of Climate and Enterprise) no later than 15 December 2023 and 15 September 2024, respectively. SGU shall submit a final report on the results of the assignment no later than 15 March 2026. "

In agreement with the government, SGU shall issue a statement on whether the areas being investigated are suitable for geological storage of carbon dioxide, including geographical location of potential geological reserves of carbon dioxide, possible storage capacity, risk assessment and implications for national marine planning. In order to issue a statement regarding the area under the seabed in the southeastern Baltic Sea, SGU needs to carry out geophysical surveys in the area.

3.3 Information about the applicant

SGU is the authority for matters concerning rocks, soil and groundwater in Sweden. It is the authority in Sweden that is tasked with providing geological information for society's needs in both the short and long term. SGU collects and provides basic geological information to support industrial development and community planning. Through its own research, support for universities and participation in networks, SGU promotes geological research in Sweden. The authority works to achieve Sweden's environmental goals, particularly in the areas of "Good quality groundwater" and "Toxin-free environment", by managing contaminated areas. SGU's environmental monitoring focuses on groundwater and marine sediments. SGU carries out commissioned activities, linked to authority tasks, to promote collaboration with other authorities. In addition, SGU carries out socio-economic analyses and impact assessments to evaluate the consequences of new projects.

SGU has extensive experience in investigating and collecting knowledge about the seabed and its underlying structure. SGU is a highly competent player in marine surveying and has its own shipping company, S/V Ocean Surveyor. S/V Ocean Surveyor is staffed with permanent, experienced and competent seamen and instrument technicians. In addition, the vessel is staffed with geologists, geophysicists, biologists and environmental chemists to carry out various types of assignments.

4. SCOPE AND DELIMITATION OF THE APPLICATION

4.1 Application

A permit is required under 7 kap. 28 a § MB (so-called Natura 2000 permit) if there is a risk that an activity may significantly affect the environment in an area protected under 7 kap. 27 § p. 1 and 2 MB (so-called Natura 2000 area). According to 7 kap. 32 § MB, the provisions of the Swedish Environmental Code on the protection of Natura 2000 areas also apply within Sweden's exclusive economic zone ("EEZ"). According to the aforementioned legal provision, the county administrative board in the county closest to the Natura 2000 area concerned shall examine the application for a Natura 2000 permit. In the present case, it is thus the County Administrative Board of Gotland County which shall examine the permit application.

The present application and its appendices contain the information required under 19 kap. 6 § MB in an application for a Natura 2000 permit. A technical description (“TB”), prepared by SGU, is attached to the application, see Appendix B. An EIA has also been prepared by the consulting firm Sweco , see Appendix C to this application. Project and site-specific investigations, expert opinions, etc. , which form the basis for the assessment of the environmental effects of the applied investigations, are found as sub-appendices to the EIA. For a non-technical summary, reference is made to the EIA.

The current permit application only concerns geophysical surveys to investigate whether the area is geologically suitable for storing carbon dioxide. The impact on the environment and consequences of any future storage of carbon dioxide are therefore not covered by the current application.

In the consultation document, SGU has used the terminology “marine seismic and marine geological investigations” and “marine mapping” as an overall collective term for the planned investigations included in the Natura 2000 assessment. In subsequent documents, the term “geophysical investigations” is used instead, which is a clearer way of expressing the acoustic methods that SGU plans to use, which are presented below in section 6. SGU would like to clarify that this is only a change in terminology

and that it does not affect the assessment or change the meaning of the investigations that the application includes.

4.2 Examination under other legislation

Since SGU is part of the state, no permit is required to carry out the surveys according to the Act (1966:314) on the Continental Shelf ("KSL"), see Sections 2-3 of the KSL. With regard to nautical survey permits, it is clear from Section 2 of the Ordinance (2016:320) on the Protection of Geographic Information that certain authorities, including SGU, may carry out nautical surveys according to Section 3 of the Act (2016:319) on the Protection of Geographic Information. A permit for nautical surveys is therefore not required.

In accordance with the Convention (SÖ 1992:1) on Environmental Impact Assessment in a Transboundary Context (Espo Convention), international consultation has been carried out prior to the preparation of the EIA. Comments were received from Estonia, Latvia, Lithuania and Poland. Estonia, Latvia and Lithuania had nothing to recall. Estonia highlighted the importance of investigating risks in seismic surveys of dumping sites for chemical weapons from the Second World War. Lithuania requested an assessment of the impact on sensitive species in Lithuania's EEZ.

Poland raised the issue of the impact on exploitation interests in the event of possible carbon dioxide storage and the importance of describing the impact of the studies on wintering birds, porpoises and spawning fish. Furthermore, Poland wanted an analysis of the connection between porpoise and bird populations in Hoburgs Bank and Midsjöbankarna, as well as two Polish Natura 2000 areas. Poland also emphasized that they want SGU to use the latest data on porpoises and describe the behavioral impact and the impact at the individual level and take into account the latest EIA requirements from the EU. The views expressed in the international consultation have been considered in the preparation of the EIA. For information on the Swedish consultation, see section 11.

5. AREA DESCRIPTION

5.1 Natura 2000 area Hoburgs bank and Midsjöbankarna

The seabed surveys will be carried out in the Central, South-Eastern and Southern Baltic Seas and within the Natura 2000 area Hoburgs Bank and Midsjöbankarna. The Natura 2000 area is located centrally in the Baltic Sea Proper, mostly in the Swedish EEZ, approximately 8 km south of Gotland and 20 km east of Öland, and extends approximately 90 km south of Öland, where it borders the Polish EEZ in the southern part, see Figure 1 below. The area was designated by the government on 14 December 2016 as a special conservation area for the species long-tailed duck, black guillemot and common eider according to the Birds Directive (Council Directive 2009/147/EC) and harbour porpoises

(Baltic Sea population) according to the Species and Habitats Directive (Council Directive 92/43/EC) and the habitat types sandbanks and reefs according to the Species and Habitats Directive.

According to the conservation plan for the area, established by the County Administrative Boards of Kalmar and Gotland on December 20, 2021, the prioritized conservation values are the species harbour porpoise, long-tailed duck and black guillemot that utilize all or parts of the area, as well as the habitat types reefs and sandbanks and the species and biodiversity that are typical of these two habitat types.

Within, or in the vicinity of, the survey area there are six (6) other Natura 2000 areas; Gotska Sandön- Salvorev , Stora Karlsö , Lilla Karlsö , Näsrevet, Ottenby NR and Sydöstra Ölands sjömarker . These Natura 2000 areas have been impact assessed in the EIA, see sections 7.1.5 and 7.3.5. Since neither designated species nor habitat types in the above-mentioned Natura 2000 areas are considered to be affected by the applied surveys, SGU considers that no permit according to Chapter 7, Section 28 MB needs to be applied for for these areas.

5.2 Localization

The area in question (the “survey area”) partially overlaps with the Natura 2000 area and extends, within Sweden's territorial waters and Sweden's EEZ, approximately from the eastern side of Gotland outside Slite in the northeast to the southern tip of Öland in the southwest and from there southeast to Sweden's EEZ at approximately the same latitude as Simrishamn in Scania then along the border to the east, see Figure 1. The total area of the survey area amounts to approximately 23,832 km ^{2} .

The survey area has been divided into three investigation areas called *Natura 2000* , *Northwest* and *Northeast* . The survey area, including the three investigation areas, is shown in Figure 1 below and in Appendix A , where points with coordinates are also reported.

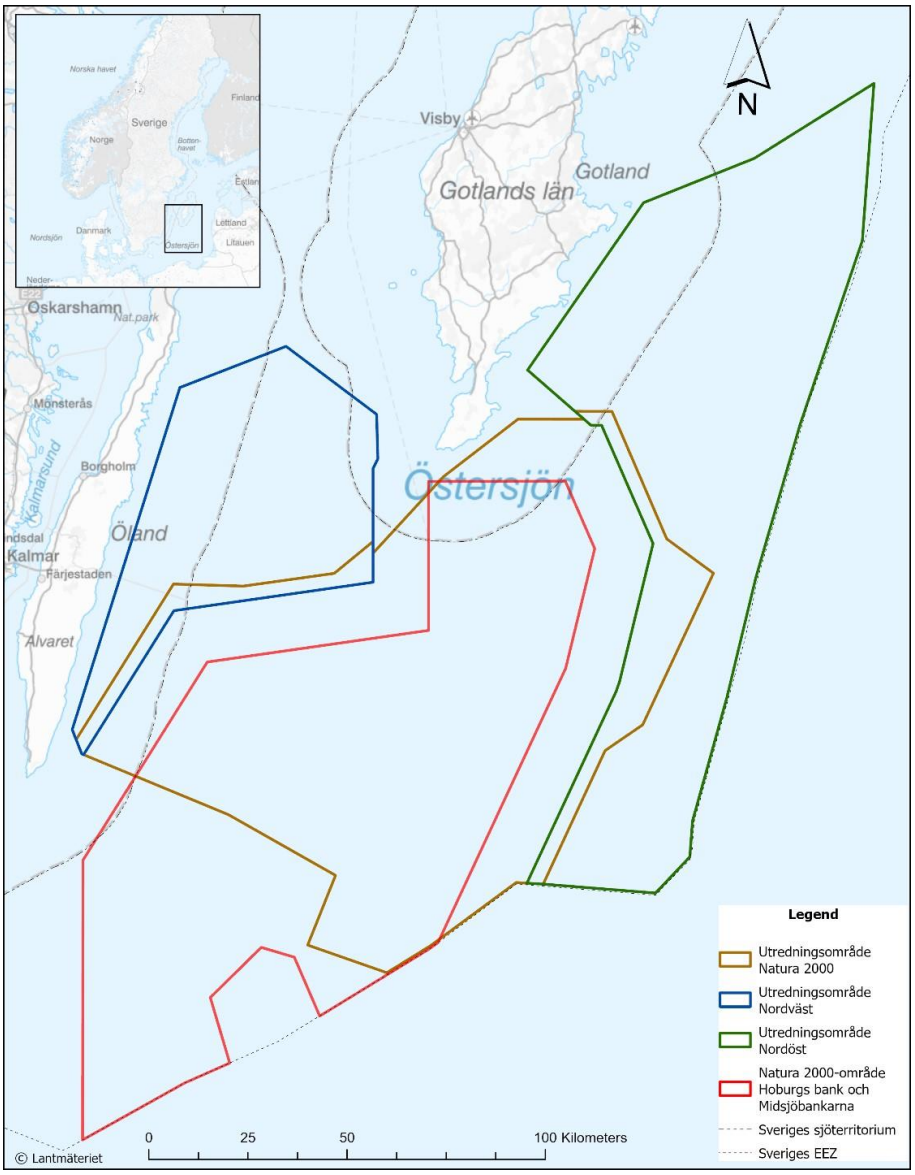


Figure 1. The survey area, including the three investigation areas (Natura 2000, Northwest and Northeast) and turning radius. The figure also shows the Natura 2000 area.

5.3 Marine plans and national interests

The survey area overlaps with the three sea areas of the Central, Southeastern and Southern Baltic Seas. The primary uses for these areas are commercial fishing, shipping, nature and general use.

New marine spatial plans are being developed to meet the need for increased offshore energy extraction. The plans are in a consultation phase and are planned to be submitted to the government for decision no later than 21 January 2025. In the new marine spatial plans, the survey area also overlaps with the area of use for energy extraction.

The survey area overlaps with several different types of national interests according to Chapters 3 and 4 of the Swedish Environmental Protection Act. The investigation area *Northeast* overlaps with national interests for shipping, naval exercise areas, fishing, areas of influence for weather radar, wind power and outdoor recreation. The investigation area *Natura 2000* overlaps with shipping, fishing, outdoor recreation, wind power and areas of

influence for weather radar. The investigation area *Northwest* overlaps with shipping, fishing, areas of influence for weather radar and outdoor recreation.

For a more detailed description of the marine plans and identified national interests, please refer to section 6.1 of the EIA. For an assessment of the admissibility of the application in relation to national interests, please refer to section 10.2 below in this application.

6. BUSINESS DESCRIPTION

6.1 General information about the surveys

SGU's offshore surveys are conducted using various geophysical methods. During the summer (May-October), the surveys will be conducted aboard SGU's own vessel S/V Ocean Surveyor and during the winter (November-April), the surveys will be conducted on a chartered vessel.

The surveys have been divided into these two periods to minimise the impact on the Baltic Sea population of harbour porpoises. During the summer months, harbour porpoises are concentrated in their core area at the Natura 2000 area, which is why surveys will not be carried out in that area during the summer. A protection zone of 14 km has been established around the Natura 2000 area to ensure that noise, or other disturbing aspects, from the surveys do not reach the area during the summer. During this period, other parts where harbour porpoise density is assessed to be lower are surveyed. The area in and around the Natura 2000 area is surveyed in the winter when harbour porpoises are more spread out over other parts of the Baltic Sea. For a more detailed description of the surveys, please refer to section 4 of the EIA and to the TB.

6.2 Geophysical surveys

Geophysical surveys are used to create images that show what the seabed, sediments and underlying bedrock look like. The geophysical survey methods that will be used will be carried out simultaneously with each other and are as follows: sediment echo sounder (Sub Bottom Profiler, SBP), multibeam echo sounder (Multibeam Echo Sounder , MBES) and seismic surveys with air guns (reflection seismics).

Sediment echosounder provides high-resolution data in the shallow subsurface, up to a maximum of 50 meters below the seabed. The sediment echosounder planned to be used is a hull-mounted model, which is a parametric echosounder that means that the sound beam is concentrated into a narrow beam directly below the ship. The system operates at a frequency of 2–30 kHz with a dominant frequency range of 5–24 kHz and a ping rate of up to 40 per second.

Multibeam echo sounder is used to map bathymetry and seabed topography, including the possible presence of gas. The system operates at a frequency of 300 kHz. Since the high-frequency sound is above 200 kHz, it is not audible to harbour porpoises and other marine mammals, so no impact is expected.

In a seismic survey, sound waves (seismic signal) are used to create detailed sections (two-dimensional images) of the bedrock structure. At sea, the powerful sound pulses can be created by, for example, a compressed air gun, a water gun or a sparker towed by a ship. In this case, the seismic measurements are planned to be made with air guns (airguns) as the sound source. Two synchronized GI air guns (generator/injector air guns) will be used and activated at 4–15 second intervals. The equipment operates at a frequency of 1–1000 Hz.

6.3 Timetable

In order for SGU to be able to report the results to the Government Offices according to the timetable in the government assignment (March 15, 2026), the surveys need to be carried out during the summer (May-October) of 2025 and during the winter (November-April) of 2025/2026. This period depends on when the permit decision from the County Administrative Board is announced and may therefore be subject to change.

The working time is estimated to amount to, in the worst case, approximately 122 days distributed per investigation area as follows; *Natura 2000* approximately 51 days, *Northeast* approximately 59 days and *Northwest* approximately 12 days. The working time is calculated based on a worst-case scenario and includes so-called " weather standby " of 25% in the summer, i.e. during surveys in the *Northeast* and *Northwest investigation areas* and 33% in the winter, i.e. during investigations in the *Natura 2000 investigation area* (including the 14 km protection zone).

7. IMPACT ASSESSMENT

In preparation for the permit application, SGU has investigated and assessed the environmental effects of planned investigations. A comprehensive and project-specific knowledge base has been developed by external experts and SGU has had a number of investigations carried out. Impact factors, such as noise dispersion, have been investigated and analysed. A summary of the impact assessment is presented below. For the complete documentation, reference is made to the EIA in Appendix C with its sub-appendices, in particular the noise investigation in Appendix C3 which contains modelling and calculations based on a worst-case scenario.

7.1 Starting point for the assessment

The assessment of environmental impacts has been based on the impact on the conservation objectives and conservation status of the designated species and habitats. Furthermore, the assessment has been based on whether the activity, alone or together with other activities, makes it more difficult to achieve or maintain a favourable conservation status for the species in question. The extent of the environmental impact varies depending on the type of impact factor and which receptor or interest is affected and in some cases extends beyond the area.

The impact factors that have been assessed are described in section 3.4 of the EIA. The assessment is based on the concepts of *effect* and *consequence* . An *effect* is a change in the environment that occurs as a result of the planned activity. A *consequence* is how a receptor/interest is affected by the effects that occur as a result of the activity. The assessment of the consequence is based on the value or sensitivity of the interest and the size of the effect; the higher the value and the greater the effect, the greater the consequence. Section 3.4 of the EIA describes the assessment scale that has been used to describe the size of the environmental consequences. A worst-case scenario has been used in the assessment of the environmental consequences of the applied activity in order not to underestimate the environmental impact.

7.2 Protected species under Natura 2000

7.2.1 Harbour porpoise

Harbour porpoise *(Phocoena phocoena*) occur within the project area from both the Baltic Sea population and the Belt Sea population. The Baltic Sea population is assessed as critically endangered (“CR”), while the Belt Sea population is assessed as viable (“LC”) according to the Swedish Red List. The Natura 2000 area Hoburgs bank and Midsjöbankarna is one of the most important areas for Baltic harbour porpoises. Despite the importance of the area, harbour porpoise density is relatively low, with most harbour porpoise activity during the summer months and least activity during the winter months. During the most intensive reproductive period, May to October, when the majority of harbour porpoises calve, nurse and mate, the density of harbour porpoises is significantly higher around the Natura 2000 area. Harbour porpoises rely on their hearing for communication, navigation and hunting and are thus sensitive to noise. The negative impact that may occur is attributable to sound and vibration and can cause temporary or permanent hearing damage to the harbour porpoise or temporary behavioural changes (including avoidance of areas and interrupted hunting).

SGU has undertaken a series of protective measures to protect and minimize the impact on the harbour porpoise, see proposed conditions in section 2.1,

and other commitments in section 8. The surveys to be carried out within the harbour porpoise core area will take place during the winter months (November-April) in order not to disturb the harbour porpoises during their reproductive period. SGU has also undertaken to follow the Swedish Agency for Marine and Water Management *Vägledning för att förhindra att seismiska undersökningar orsakar skadligt impulsivt buller med negativa effekter på marina däggdjur* (Report 2023:4).

Furthermore, geophysical surveys emitting frequencies below 200 kHz will not be carried out within 14 km of the Natura 2000 area during summer when harbour porpoises congregate in this area. When starting up equipment emitting frequencies below 200 kHz, the vessel will use a so-called soft start to give individual harbour porpoises an opportunity to move away from the immediate area. The vessel will also surveil the area around the vessel for harbour porpoises prior to starting up equipment emitting frequencies below 200 kHz. Given the low density of animals estimated to be present in the survey area during summer (approximately 2.5 individuals per 1,000 km ^{2}) and that the area is being surveyed for a short period of time with protective measures to mitigate the impact, the number of individuals at risk of being affected is assessed to be very limited. The possibility of recovery for any affected individuals is assessed to be high and the survey is assessed not to have any population effects. The consequences for harbour porpoises are therefore assessed to be negligible.

In summary, the applied activity is not assessed to have any impact that would significantly hinder the conservation of harbour porpoises within the Natura 2000 area Hoburgs bank and Midsjöbankarna.

For a more detailed description of the impact of the investigations on porpoises, please refer to sections 7.1.2, 7.2.2 and 7.3.2 of the EIA.

7.2.2 Long-tailed duck

The wintering population of the long-tailed duck (*Clangula hyemalis*) is classified as critically endangered (“EN”) according to the Swedish Red List. The Natura 2000 area is one of the most important wintering areas for the population, but wintering also occurs to a relatively large extent along the east coast of Gotland. The long-tailed duck arrives at the wintering area from October and stays until April-May. The conservation status of the long-tailed duck has deteriorated sharply since the 1990s, which is due, among other things, to illegal oil spills and bycatch in nets. The number of long-tailed ducks wintering within the Natura 2000 area has also declined sharply in recent decades.

The long-tailed duck feeds primarily on mussels, crustaceans and insects and can dive to a depth of about 30 metres. The blue mussels in the Natura 2000 area are an important food source for the long-tailed duck in winter and the

long-tailed duck gather in large numbers on the shallow banks. In the area there is a wide spread of blue mussel banks at not too great depths.

If the long-tailed duck were to be temporarily disturbed in its foraging by the planned surveys, there is plenty of space within the Natura 2000 area to which the long-tailed duck could move. The assessment is that the long-tailed duck will not be affected in its wintering strategy due to the planned surveys and the consequences for the long-tailed duck are therefore considered to be negligible.

In summary, the applied activity is not assessed to have any impact that would significantly hinder the conservation of the long-tailed duck within the Natura 2000 area Hoburgs bank and Midsjöbankarna.

For a more detailed description of the impact of the investigations on the alfalfa bird, please refer to sections 7.1.4, 7.2.4 and 7.3.4 of the EIA.

7.2.3 Black guillemot

The population of Black guillemot(*Cepphus grylle*) is classified as Near Threatened (“NT”) according to the Swedish Red List and the Natura 2000 area is an important wintering site for the Baltic Sea population of black guillemots. The bird is normally found in the area during the period October to May. The mink is seen as the greatest threat to the species, but oil spills and bycatch in fishing nets have also contributed to a declining population in Sweden.

The black guillemots dives to a maximum depth of 30 meters to catch food and feeds primarily on the viviparous eelpout, but also eats crayfish and mussels to a lesser extent. If the black guillemot were to be temporarily disturbed by the planned surveys, it is assessed that the birds will be able to sense and avoid any disturbing noises from long distances and the risk of a direct negative impact is assessed to be unlikely.

In summary, the applied activity is not assessed to have any impact that would significantly hinder the conservation of black guillemot within the Natura 2000 area Hoburgs bank and Midsjöbankarna.

For a more detailed description of the impact of the investigations on black guillemot, please refer to sections 7.1.4, 7.2.4 and 7.3.4 of the EIA.

7.2.4 Common eider

Common eider (*Somateria mollissima*) occurs within the Natura 2000 area and the species is classified as critically endangered (“EN”). The common eider feeds mainly on molluscs (mostly blue mussels), isopods , insects and vegetation which is retrieved from the seabed at depths of up to 20 metres.

The ongoing population decline is believed to be due to, among other things, reduced food availability and predation of brooding females by predators.

Most of the Swedish common eiders winter in the Danish parts of the Kattegat east of Jutland and along the eastern coast of Jutland. Common eiders move to their breeding grounds in early April and are then coast-bound during the breeding season, breeding along the entire Swedish coast and in archipelago environments. Common eiders have been observed in smaller numbers on the shallower banks within the Natura 2000 area mainly during late winter and spring.

The assessment of how the common eider may be affected by the planned surveys is considered to be equivalent to the impact on the long-tailed duck. The common eider occurs only in small numbers in the Natura 2000 area during late winter and the bird has many other suitable places to forage in both the Natura 2000 area and along the southern Gotland coast. The birds are considered to be able to sense and avoid potentially disturbing noises from long distances and the risk of a direct negative impact is considered unlikely.

In summary, the applied activity is not assessed to have any impact that would significantly hinder the conservation of eiders within the Natura 2000 area Hoburgs bank and Midsjöbankarna.

For a more detailed description of the impact of the surveys on common eiders, please refer to sections 7.1.4, 7.2.4 and 7.3.4 of the EIA.

7.2.5 Fish

Four fish species have been included in the environmental impact assessment; herring, sprat, cod and viviparous eelpout. The selection has been based on the fact that these fish species are typical of the habitat types of reefs and sandbanks designated in the Natura 2000 area (see section 7.3 below). Furthermore, the selection is based on the fact that most of the species constitute food for designated species such as harbour porpoises and black guillemots and/or that they are auditory specialists (fish species with a wide hearing range that are more sensitive to sound). The impact that may arise is attributable to noise and vibrations that can negatively affect fish by causing temporary or permanent hearing damage or temporary behavioral changes. Behavioral changes include avoidance of areas, absence/interruption of play or general stress which in turn can lead to reduced food intake or interrupted foraging .

As for herring, the species is a hearing specialist and a typical species for the Natura 2000 area's designated habitat types of sandbanks and reefs. The herring is classified as viable (“LC”) in both the Swedish Red List and the HELCOM Red List of Baltic Sea species that are at risk of extinction (HELCOM

stands for Helsinki Commission which aims to protect the marine environment of the Baltic Sea). The current study area is not considered to have a high probability of being a spawning area for herring, which spawns both in autumn and spring when the water temperature is between 4–13 °C. However, herring may occur to a lesser extent on the outskirts of the survey area and to some extent in the shallow areas within the Natura 2000 area.

Sprat is also a hearing specialist and a typical species for the designated sandbank habitat type. Sprat is classified as viable ("LC") in both the Swedish Red List and the HELCOM Red List. Sprat spawns between January and August and spawning may occur within the survey area. Sprat may also use the survey area for foraging .

Cod is a typical species for the designated habitat types sandbanks and reefs and occurs throughout the Baltic Sea. Cod is classified as vulnerable ("VU") in both the Swedish Red List and the HELCOM Red List. Cod spawns most intensively from April to August and the survey area is not located within any area with a high probability of cod spawning.

Viviparous eelpout is a designated species for reef and sandbank habitats and is the main food source for black guillemot. Viviparous eelpout is classified as viable ("LC") in the Swedish Red List and near threatened ("NT") in the HELCOM Red List. Viviparous eelpout spawns in August and September and the survey area is probably not a primary spawning area for the species, although some spawning on shallow reef areas cannot be completely ruled out.

The noise modelling that has been carried out shows that the area where fish are at risk of temporary or permanent hearing damage is less than 50 metres from the sound source. Depending on local conditions, behavioural changes are estimated to occur at most five to eight kilometres from the sound source.

With protective measures such as soft start, the risk of temporary and permanent hearing damage to all fish species is assessed as negligible as it is unlikely that more than a few individuals would be within 50 metres of the sound source when these sound levels are reached. However, certain behavioural changes cannot be ruled out as it is not certain that the species will leave the area exposed to these sound levels. Spawning of sprat is assessed to be negligibly affected and reduced foraging and general stress could arise for all species within the impact area. However, these effects are assessed as negligible and overall the consequences for herring, sprat and viviparous eelpout are assessed to be negligible while the consequences for cod are assessed to be slightly negative based on the species' natural value and status classification as vulnerable.

In summary, the applied activity is not assessed to have any impact that would significantly impair the conservation of the above-mentioned species within the Natura 2000 area Hoburgs bank and The Midsjö banks. For a more detailed description of the impact of the investigations on the above-mentioned species, please refer to sections 7.1.3, 7.2.3 and 7.3.3 of the EIA.

7.3 Protected habitats according to Natura 2000

Designated habitat types for the Natura 2000 area are sandbanks and reefs, both of which occur within the survey area.

Sandbanks usually occur in relatively shallow water, consist mainly of sandy sediments and can be either free of vegetation or covered with seaweed and/or microalgae. The habitat type has a number of typical species that can occur there, including viviparous eelpout, cod, herring, sprat, common eider and long-tailed duck.

Reefs are biogenic and/or geological formations of hard substrate that occur on hard or soft bottoms. Among other things, blue mussel beds are included in the reef habitat type, if these have a coverage rate exceeding 10%. The reef habitat type also has a number of typical species that can occur there, including viviparous eelpout, cod, herring, common eider and long-tailed duck.

Prior to the preparation of the EIA, SGU has had investigations carried out to investigate how the planned investigations could affect the habitat types. In the case of sandbanks, sound waves, when they reach the bottom of the sandbank, may possibly cause a minor spread of sediment to the sides of the sandbank. However, both the sandbanks and their benthic flora and fauna are considered to be accustomed to temporary increases in turbidity and sedimentation, which is why a weaker form of pressure wave from a sound wave from geophysical investigation methods is not considered to pose a risk to the short-term and long-term habitat of the habitat type.

As regards the reef habitat type, specifically blue mussels, blue mussels can only be affected by noise in the form of particle acceleration and then within relatively short distances. This means that the current survey will only affect blue mussels for short periods of time when the ship in principle passes directly over them. Such short-term exposure should not affect the health of blue mussels more than negligible. An impact on the conservation status of blue mussels as a result of the geophysical surveys is therefore considered unlikely.

Overall, the consequences for the sandbank and reef habitat types (both extensive geogenic reefs and biogenic reefs in the form of mussel banks) within the study area are assessed to be negligible.

For a detailed description of the impact of the investigations on designated habitat types, please refer to section 7.2.5 of the EIA.

7.4 Cumulative effects

Cumulative effects have been assessed in the EIA primarily in relation to other projects, such as ongoing offshore wind projects, and shipping. SGU has undertaken to contact the companies and projects concerned in advance of its planned investigations that may contribute cumulatively and not to carry out investigations at the same time as any other actor within the same sea basin as SGU's operations. These commitments mean that no cumulative effects from noise will arise and the cumulative effects from increased shipping are assessed to be negligible.

Regarding nearby offshore wind farms, the majority of these had their permit applications rejected by the government on 4 November 2024. However, they have continued to be included in the assessment of cumulative effects as they have survey permits for the respective park area, even though it is less likely that the surveys will be carried out.

Section 9 of the EIA provides a more detailed account of the assessment of cumulative effects. In summary, no cumulative effects from noise are assessed to arise and the cumulative effects from increased shipping are assessed to be negligible. Since no cumulative effects that are more than negligible are assessed to arise, cumulative effects are also not assessed to be able to lead to the conservation status of designated species and habitat types for any of the nearby Natura 2000 areas (Gotska Sandön- Salvorev , Stora Karlsö , Lilla Karlsö , Näsrevet, Ottenby NR and Sydöstra Ölands sjömarker) being affected to the extent that they affect the possibilities of achieving or maintaining favourable conservation status.

7.5 Transboundary effects

Transboundary effects have been assessed in the EIA. The impacts have been assessed separately for each value or interest that may be affected by the surveys. However, no transboundary effects have been identified.

7.6 Overall assessment

The overall assessment is that the applied activity, neither individually nor taking into account cumulative effects, is considered to damage any habitat intended to be protected or to affect a species in such a way that the conditions for achieving the conservation objectives of the habitat type or species or the possibility of achieving favourable conservation status are affected. Thus, the conditions for granting a permit pursuant to 7 kap. 28 a § MB are met.

8. APPLICANT'S COMMITMENTS

In addition to the specific conditions prescribed, the general conditions in section
2.1 that SGU is bound by what the Authority has stated in the application documents and otherwise undertaken in the matter. In the planning stage, SGU decided to carry out the surveys within the harbour porpoise core area (*Natura 2000 investigation area*) only during the winter months (November-April) in order not to disturb them during their reproductive period. The vessel will also have harbour porpoise surveillance in the form of PAM and/or MMO (Marine Mammal Observer) that will look for harbour porpoises in the area around the vessel prior to the start-up of equipment that emits frequencies below 200 kHz. Furthermore, all observations of harbour porpoises from the vessel will be recorded and reported with information on approximate position and number. The protective measures in conditions 2, 3 and 4 above are primarily designed for harbour porpoises but also have a positive impact on both fish and seals.

SGU has also committed to following the Swedish Agency for Marine and Water Management's *Vägledning för att förhindra att seismiska undersökningar orsakar skadligt impulsivt buller med negativa effekter på marina däggdjur* (Report 2023:4).

9. CONTROL PROGRAM

A monitoring programme for the activities with regard to the values of the Natura 2000 area will be developed for the entire period during which the surveys are carried out. The monitoring programme will be established in consultation with the County Administrative Board of Gotland County and the Swedish Agency for Marine and Water Management.

Proposals for control programs must be submitted to the County Administrative Board of Gotland County no later than three (3) months before the start of each stage. The control program must state how the operation will be controlled, specifying the measurement method, measurement frequency and evaluation method. The control program may be coordinated with other control programs for the operation.

10. PERMISSIBILITY

10.1 General rules of consideration in 2 kap. MB

SGU will observe the general rules of consideration in 2 kap. MB for the applied activity.

10.1.1 The knowledge requirement in 2 kap. 2 § MB

In its role as the central authority for geology and mineral issues, SGU has broad knowledge and experience of conducting surveys similar to those in the current permit application. The authority also has extensive knowledge and understanding of the risks, challenges, costs and benefits of using different survey techniques and the impact on the environment that the different survey methods can have. Through its role as an expert authority, SGU has extensive internal knowledge and many years of experience of complex issues relating to survey work regarding geological conditions on the seabed. Furthermore, the data on which the application is based has largely been produced by both internal and external experts with solid knowledge of relevance to carrying out the geophysical surveys covered by the application. The knowledge requirement can therefore be considered fulfilled.

10.1.2 The precautionary principle and best available technology in 2 kap. 3 § MB

SGU will apply the precautionary principle throughout the work on the investigations. This is reflected in the protective measures and precautionary measures that have been proposed, which in turn are based on the solid knowledge base in the form of investigations that have been produced and which forms the basis for the present permit application. The precautionary principle is also taken into account in that worst-case scenarios have been used in the assessment of the environmental consequences of the applied for activity.

Furthermore, the precautionary principle is guiding when choosing and using the best possible technology. Thus, the precautionary principle can be considered to be fulfilled.

10.1.3 The product selection, economy and cycle principle in 2 kap. 4-5 § MB

As mentioned above, SGU has extensive experience with investigations similar to the current one and thus has both knowledge of and access to equipment that is designed to have as little environmental impact as possible. The agency will ensure that the principles of product selection and resource management are followed with regard to survey equipment, products, any handling of chemicals, transport, material use, etc. The product selection and the economy and cycle principles are thereby considered to be fulfilled.

10.1.4 The localization principle in 2 kap. 6 § MB

SGU has carried out an investigation into the location of the current investigations, see Appendix C2 to the EIA. Possible areas for carbon dioxide storage in Sweden are considered to be limited according to SGU's basic research in the area, whereby there are no suitable alternative locations for

the investigations. SGU has also revised the areas that will be investigated during the consultation phase, particularly with regard to the natural environment and protected species. Overall, the location principle is considered to be met.

10.1.5 The polluter pays principle in 2 kap. 8 § MB

As the operator, SGU is responsible at all stages of the investigations.

10.2 National interests according to 3 and 4 kap. MB.

The area of investigation overlaps with most national interests, see section 5.3 above. In light of the fact that the investigations are being conducted for a limited time and that protective measures regarding cumulative effects and contact with organizations and authorities in prescribed conditions 5-8 are being taken, the investigations are not considered to significantly harm or otherwise affect the relevant national interests in a way that is not compatible with 3 and 4 kap. MB.

11. CONSULTATION

SGU has conducted a delimitation consultation in accordance with 6 kap. MB prior to the preparation of this permit application. Since the applied activity may give rise to transboundary effects, consultations in accordance with the Espoo Convention have also been conducted, see section 4.2 above. Views from the consultations have been considered in the work on the EIA. A consultation report is attached to this application, see Appendix C1 to the EIA.

12. GROUNDS FOR ENFORCEMENT ORDER

SGU demands that the County Administrative Board issue an enforcement order in accordance with 19 kap. 5 § p. 12 MB and 22 kap. 28 § MB, i.e. that the permit may be used even if it is appealed.

The claim is based on the fact that a possible appeal process can take a very long time and it is of great importance to SGU that the permit can be used before it has become legally binding so that SGU can report on the results of the government assignment within the specified time. It is also of great importance that the County Administrative Board issues an enforcement order so that SGU can determine whether the applied area is suitable for geological storage of carbon dioxide, which in turn is a step towards achieving the set climate goals. It is therefore important that SGU, despite any appeals, is allowed to use the permit. Finally, SGU has carried out very thorough investigations in preparation for the current permit application and it is therefore unlikely that a higher authority would reject the permit application.

13. REQUEST FOR EXPEDITED PROCESSING

In the present case, SGU has been commissioned by the government to investigate whether the areas covered by the application are suitable for geological storage of carbon dioxide. This assignment is in turn part of an overall goal within Sweden and the EU to reduce large-scale emissions of carbon dioxide into the atmosphere and achieve climate goals. It is of great importance that the matter is handled urgently, partly taking into account global climate change and the set climate goals where carbon dioxide storage can be an effective way to reduce carbon dioxide emissions, and partly taking into account that SGU has a deadline from the government to comply with regarding the implementation of the investigations.

SGU hemställer därvid om att Länsstyrelsen påskyndar handläggningen av denna tillståndsansökan. SGU får även meddela att för det fall att Länsstyrelsen finner det lämpligt accepterar SGU att delbeslut meddelas gällande del av det ansökta undersökningsområdet.

14. ÖVRIGT

Fullmakt för ombuden bifogas.

Som ovan

Pia Pehrson Tomas Fjordevik Johanna Lenell

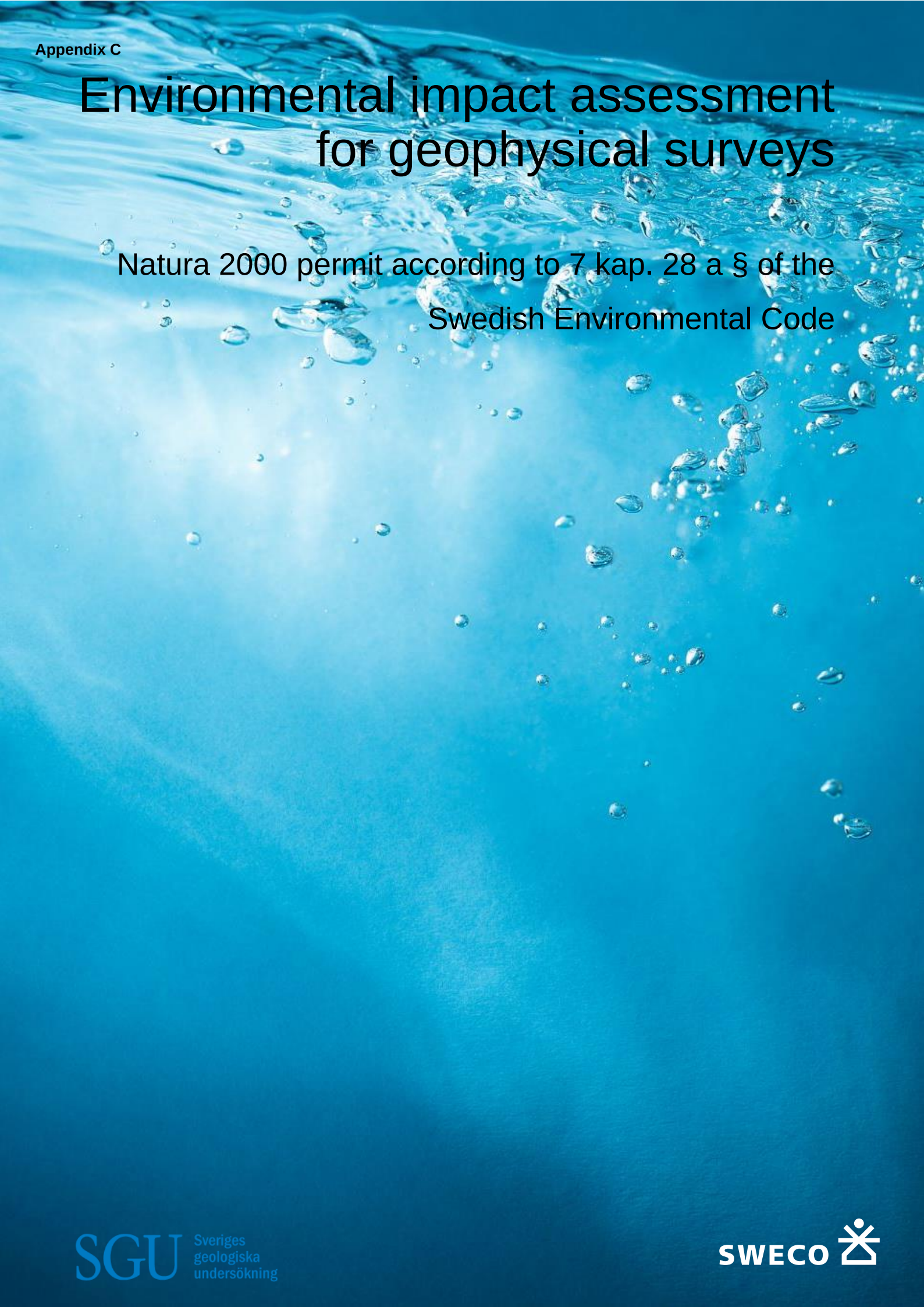
BILAGOR

A. Karta
B. Teknisk beskrivning
C. Miljökonsekvensbeskrivning

Appendix C

Environmental impact assessment for geophysical surveys

Natura 2000 permit according to 7 kap. 28 a § of the Swedish Environmental Code



SGU Sveriges geologiska undersökning

SWECO

List of amendments

Ver	Date	Change description	Reviewed	Approved by
1	2024-10-21		Lina Sultan	Gabriella Hammarskjöld
2	2024-10-30		Gabriella Hammarskjöld	Gabriella Hammarskjöld
3	2024-11-20		Gabriella Hammarskjöld	Gabriella Hammarskjöld
4	2024-12-12		Gabriella Hammarskjöld	Gabriella Hammarskjöld

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Non-technical summary

Introduction
The Geological Survey of Sweden (SGU) has been commissioned by the government to investigate the possibilities for carbon dioxide storage in the southern Baltic Sea. The investigations will be carried out within, and in the vicinity of, Natura 2000 areas. As impacts may arise on designated species within the Natura 2000 area Hoburgs bank and Midsjöbankarna (SE0330308), SGU is applying for a permit in accordance with 7 kap. 28 a § of the Swedish Environmental Code (a so-called Natura 2000 permit).

Planned investigations
To evaluate whether the investigation area is suitable for carbon dioxide storage, SGU needs to carry out geophysical investigations in the form of seismic surveys and surveys with sub-bottom profile and multibeam echo sounders. Geophysical surveys are used to create images of the seabed, the sediments and the underlying bedrock. These images are created using acoustic methods, where instruments send sound down towards the seabed which then bounces off the different geological layers. The echoes of the sound waves are captured by sensors and translated into images.

Environmental consequences for Natura 2000 areas and their designated values
The Natura 2000 area Hoburgs Bank and Midsjöbankarna is a core area for the Baltic Sea population of harbour porpoises in the summer and an important foraging and wintering area for seabirds. The area is designated for the protection of harbour porpoises, long-tailed duck, black guillemot and eider, as well as the habitat types sandbanks and reefs and their typical species.

The overall assessment is that harbour porpoises are at risk of being moderately negatively affected within the Natura 2000 area and that cod and herring are assessed to have small negative consequences from the surveys. No other species or habitat types are assessed to be affected more than negligibly. Since the effects and consequences from the surveys are assessed to be local, temporary and reversible, they are not assessed to affect the conservation status of individual species, or the Natura 2000 area. The surveys will not be carried out within, or affect, any other Natura 2000 area.

Environmental impacts outside Natura 2000 areas
Negative effects outside Natura 2000 areas are assessed to be negligible for all species of fish as well as for harbour porpoises and seals.

No transboundary effects have been identified.

1 Administrative information

Applicant	Geological Survey of Sweden
Organization number	202100-2528
Address	Geological Survey of Sweden, Box 670, 751 28 Uppsala
Project manager, contact person	Finn Baumgartner
The applicant's legal representative	Foyen Advokatfirma KB Attorney Pia Pehrson Attorney Tomas Fjordevik Attorney Johanna Lenell
Affected sea area	Central, Southeastern and Southern Baltic Sea
Nearest county in Swedish territory	Gotland

2 Introduction

In the consultation document, SGU has used the terminology “marine seismic and marine geological surveys” and “marine mapping” as an overall collective term for the planned surveys that are part of the Natura 2000 assessment. In subsequent documents, the term “geophysical surveys” is used instead, which is a clearer way of expressing the acoustic methods that SGU plans to use. These refer, more specifically, to multibeam echo sounder (MBES), sediment echo sounder (sub-bottom profiler; SBP), and seismic surveys with air guns (reflection seismic). SGU would like to clarify that this is only a change in terminology and that it does not affect the assessment or change the meaning of the surveys that the application covers.

2.1 Background and purpose

CCS is an abbreviation for "Carbon Capture and Storage" and stands for the capture and storage of carbon dioxide. The method is being highlighted – both nationally and internationally – as an important tool for reducing large-scale emissions of carbon dioxide into the atmosphere and achieving climate goals. SGU has been commissioned by the government to map the possibilities for carbon dioxide storage under the seabed (prop. 2022/23:1 expenditure area 24, bet. 2022/23:NU1, rskr. 2022/23:99).

General assessments show that in Sweden there are mainly two sea areas, in the southeastern Baltic Sea and adjacent to southwestern Scania, that may be suitable for geological storage of carbon dioxide. Investigations in southwestern Scania were carried out in 2023 and 2024. To be able to issue a statement regarding the area under the seabed in the southeastern Baltic Sea, SGU needs to carry out geophysical investigations there as well.

The purpose of this environmental impact assessment (EIA) is to provide information that enables an assessment in accordance with 7 kap. 28 a § of the Swedish Environmental Code, a so-called Natura 2000 assessment.

2.2 Consultation report

SGU has carried out consultations in accordance with 6 kap. 24 § of the Swedish Environmental Code. A digital consultation meeting was held with the Gotland County Administrative Board and written consultations were held with particularly affected stakeholders, see Table 2-1.

Table 2-1Consultation group

Government agencies	Borgholm Municipality
National Board of Housing, Building and Urban Development	Mörbylånga Municipality
Swedish Environmental Protection Agency	Gotland Region
The Armed Forces	**Organizations**
The Swedish National Heritage Board	Nature Conservation Society
County Administrative Board Gotland County	World Wildlife Fund WWF
County Administrative Board Blekinge County	Sweden's ports
County Administrative Board Kalmar County	Swedish Boat Union
Chamber of Commerce	Swedish Cruiser Club
Coast Guard	Swedish Shipping Association
The Swedish Maritime Administration	Sea and Coastal Fishermen's Producers' Organization
Swedish Transport Administration	Swedish Pelagic Federation producer organization
The Energy Agency	Swedish Fishermen's Producers' Organization
Energy Market Inspectorate	**Other**
The Swedish Civil Contingencies Agency	Baltic Sea Center
Swedish Maritime and Water Authority	Maritime School
National Museum of Natural History	Marine Environment Institute
Swedish University of Agricultural Sciences Species Data Bank	World Maritime University
Swedish Board of Agriculture	Lund University
The National Post and Telecom Agency	Ørsted AB
Municipalities and Regions	Landinfra Energy
Ronneby Municipality	OX2
Karlskrona Municipality	RWE
Torsås Municipality	Eolus/SimplyBlue

The consultation report can be seen in Appendix C1.

2.3 Natura 2000 provisions

In order not to damage natural values, a permit is required for activities or measures that may significantly affect the environment in a Natura 2000 area. According to 7 kap. 28 b § of the Swedish Environmental Code, a permit shall only be granted if the activity or measure alone, or together with other ongoing or planned activities or measures, cannot damage the habitat(s) in the area intended to be protected, and does not result in the species intended to be protected being exposed to a disturbance that may significantly impair the conservation of the species or species in the area. This may also apply to measures outside the Natura 2000 area, if they may affect the environment in the area.

Natura 2000 sites are designated throughout the EU to conserve, promote and prevent the extinction of important habitats, natural areas and animal and plant species. Sites can be designated for birds under the Birds Directive (SPA) or for habitats or species under the Species and Habitats Directive (SCI). The conservation status of these sites must be maintained or restored. For a species to be considered to have a favourable conservation status, population trends must show that the species will remain part of its habitat in the long term, its natural range must not be reduced, and it must have sufficient habitat to maintain itself in the long term. For a habitat type, its natural range and the areas it covers must be stable or increasing, the structures and functions required to maintain the habitat must remain in place for the foreseeable future and the conservation status of the species typical of the habitat type must be favourable.

3 Methodology and delimitation

3.1 Geographical delimitation

The final geographical delimitation of the investigation areas is based on several different criteria, which are described below. The investigation areas, after geographical delimitation, can be seen in Figure 3-1.

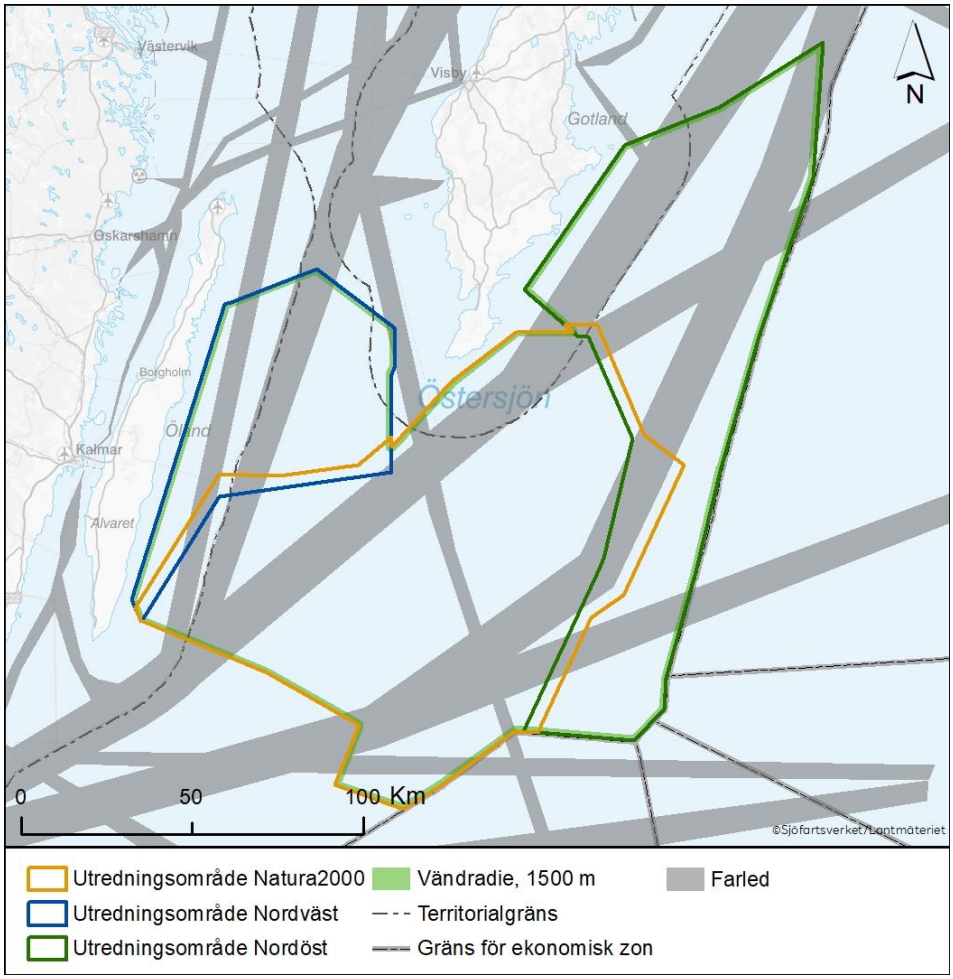

Figure 3-1The extent of the investigation areas after the geographical delimitation has been made.

3.1.1 Carbon dioxide storage survey method

A fundamental criterion has been what geophysical investigations SGU deems are needed to assess the conditions and basic functions of a future carbon dioxide storage with sufficient quality. This has been developed by planning proposals for investigation transects based on the basic requirements and investigation methods presented in Appendix C2. Siting investigation.

It has been identified that the most important area to investigate in more detail is an area east and northeast of the Midsjöbankarna where the probability of good conditions for a carbon dioxide storage is the greatest. In addition to this, the transects have been planned based on the importance of creating in-depth knowledge by collecting data using a so-called borehole correlation across many of the previously conducted borehole surveys that are in and around the Midsjöbankarna south and east of Gotland and adjacent to Öland.

3.1.2 The possibility of using the authority's own survey vessel

In the work, one criterion has also been that SGU should, to the extent possible, be able to use its own survey vessel to carry out the surveys. However, this criterion has not been allowed to be the governing criterion. Instead, the most governing criterion has been the protection needs that the Natura 2000 area Hoburgs bank and Midsjöbankarna (SE0330308) and its protected species, with a focus on the Baltic harbour porpoise, are assessed to have when surveys are carried out within and with a good margin of protection outside the Natura 2000 area.

3.1.3 The Natura 2000 area Hoburgs bank and Midsjöbankarna is very sensitive in the summer.

Early in the work, the need to not carry out the geophysical surveys in the summer within the Natura 2000 area was identified. The geographical design was consequently planned so that the geographical area that is then called the “Natura 2000 investigation area” in the EIA will be carried out with a larger and more winter-adapted vessel and during the winter season months of November - April. This is because the Baltic harbour porpoise has its absolute most sensitive period in this Natura 2000 area during the summer months from May - October when it gives birth to its young and when, according to previous harbour porpoise studies, this area has clearly been identified as the Baltic harbour porpoise’s most important summer habitat.

The remaining data *collection* areas, the investigation areas Northeast and Northwest, whose transects, with an assumed safety margin, lie outside this designated protection area, have been assessed to be able to be carried out during the summer season from May to October. For these areas, SGU can use its own survey vessel, which is particularly suitable for use in the summer for this type of seismic data collection survey.

3.1.4 Introduction of a voluntary protection zone

A protection zone is proposed around the Natura 2000 area. This is due to the Baltic harbour porpoises' need not to be disturbed during the summer, which is why the Natura 2000 area should instead be surveyed during the winter. The protection zone aims to ensure that the surveys proposed during the summer outside the Natura 2000 area should not disturb the harbour porpoises when they are most sensitive.

The protection zone around the Natura 2000 area Hoburgs Bank and Midsjöbankarna has been an important issue for SGU because the government mandate that forms the basis for the surveys is time limited. Obtaining permits for the surveys is therefore urgent to complete the government mandate within the specified time frame. However, the importance of taking sufficient account of the needs of the harbour porpoises has been central to the geographical design of the investigation areas.

3.1.5 Additional voluntary commitments

Once the various criteria described above and the proposed 14 km protection zone had been established into a final plan with three different investigation areas, two additional criteria were finally identified that also needed to be considered and proved to be important.

3.1.5.1 Additional maritime safety considerations at the major shipping lanes

One additional criterion was that the proposed transects had not been planned sufficiently so that the survey vessel had to be adjusted during its passages in the Northeast investigation area on it transect routes across the largest shipping lane. This adjustment was based on finding a new solution so that the summer vessel did not risk having to turn into the Natura 2000 area's protection zone due to maritime safety when passing through the shipping lane. It was therefore decided to further expand the Natura 2000 investigation area in this smaller sub-area outside the 14 km protection zone in winter so that the surveys across the shipping lane can be carried out safely. This is so that the adaptation of the surveys to maritime safety needs does not risk negatively affecting the habour porpoises. This is reported in more detail in Figure 3-2in the red circle where you can see the route of the shipping lanes through the investigation areas and in relation to both the planned survey transects and the outer boundary of the Natura 2000 area worthy of protection in connection with the large and most heavily trafficked shipping lane.

Two minor adjustments with extended investigation areas in winter outside the 14 km protection zone have also been detailed for the Northwest investigation area. This has been done with the same purpose as described above, that the ship should cross the shipping lanes safely without risking having to turn into the protection zone in summer. The two minor adjustments to expand the Natura 2000 investigation area in winter outside the protection zone are also visible in Figure 3-2in the blue circles.

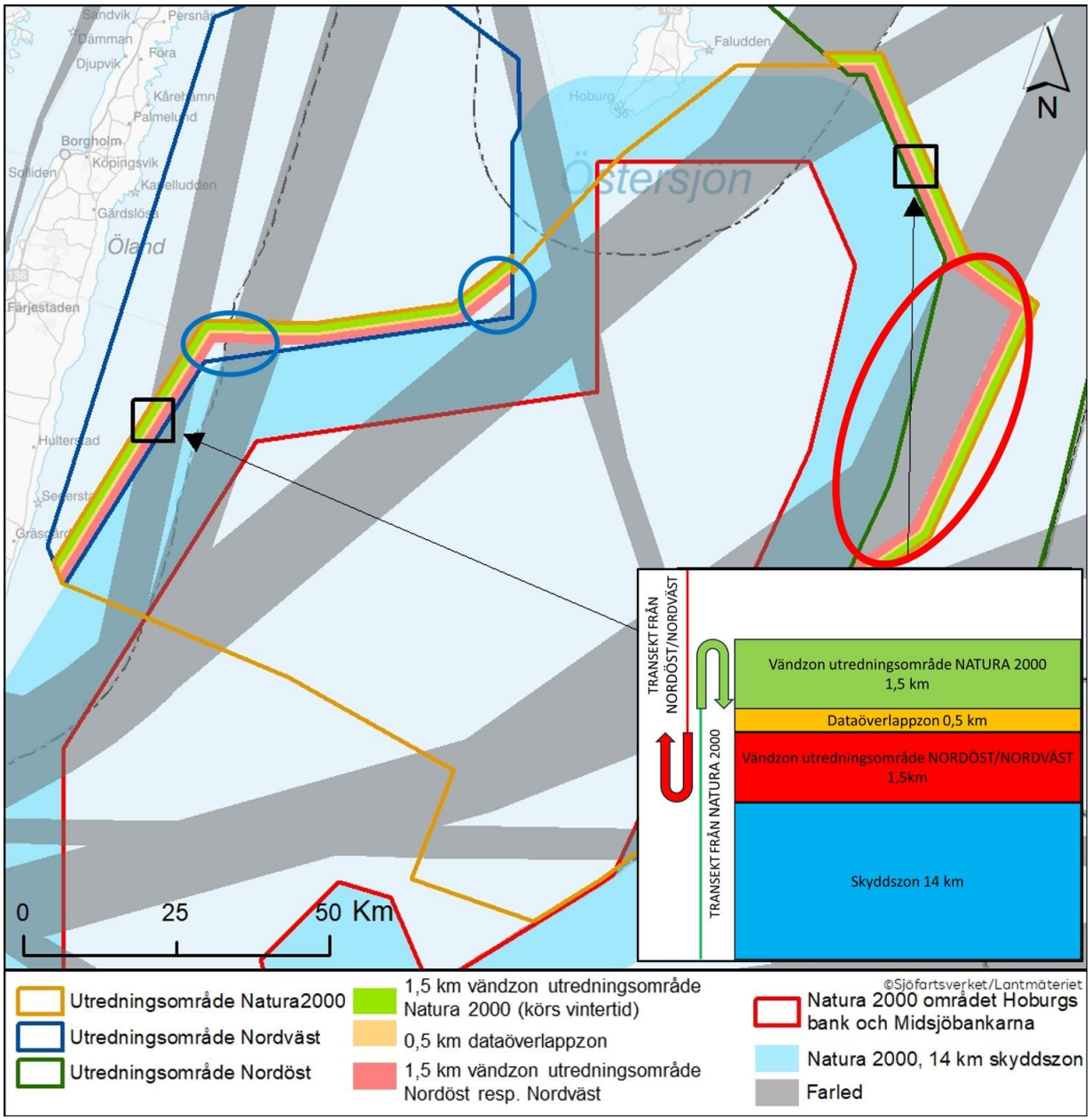

Figure 3-2. The survey vessel's transects when passing over the main shipping lane and its physical location in relation to the protected Natura 2000 area. The red ring shows how the Natura 2000 investigation area has been extended for the main shipping lane east of the Natura 2000 area. The smaller blue rings show smaller extensions of the Natura 2000 investigation area northwest of the Natura 2000 area.

3.1.5.2 The need for an overlap zone for SGU's data collection

The second additional criterion that needed to be considered was SGU's need to find a workable solution to obtain continuous data for transects that extend between the different investigation areas but are collected in different seasons due to considerations for the harbour porpoises in the Natura 2000 area. For the areas bordering the Natura 2000 investigation area and the Northwest and

Northeast investigation areas, a solution was created that prevents data loss within the different investigation areas through overlapping zones.

The solution is because the geographical delimitation allows for a so-called overlap zone between the geographical areas. The principle behind the proposed data overlap zone is that surveys that take place in winter must be allowed to overlap with surveys that take place in summer by at least 0.5 km.

To achieve a 0.5 km data overlap, the overlap zone is designed so that the Natura 2000 investigation area overlaps with the Northwest or Northeast investigation areas, where they are adjacent, by at least 3.5 km. Note that 3.5 km is needed for a 0.5 km overlap between a survey transect extending between the investigation areas due to the 1.5 km required to turn the vessel in both directions.

A visualization of the overlap zone design is seen in the inset figure in Figure 3-2which explains the solution that the smallest possible data overlap zone is 0.5 km where data for the same area is collected twice.

Having an overlap zone between the different investigation areas is considered important for the government mission's data collection to assess the carbon dioxide storage function in the area. However, with a well-proportioned protection zone of 14 km inside the overlap zones, this solution is not considered to have any negative impact on the harbour porpoises. As reported in Chapter 7, the sound propagation in the in-depth underwater models will clearly show that the protection zone of 14 km is by a very good margin sufficient to avoid that negative noise from the summer surveys from the investigation areas Northwest and Northeast risks penetrating the Natura 2000 area and affecting its species.

3.1.6 Maritime safety when operating the survey vessel in summer

An additional criterion included in the planning of the final geographical delimitation is the importance of taking maritime safety issues into account when designing the investigation areas.

3.1.7 Final balance and prioritization between the criteria for designing the geographical delimitation

The criteria that formed the basis for the geographical delimitation are summarized in Table 3-1and it is also reported in which ranking the different criteria have been weighed against each other. This summary description of the basis for the development of the geographical delimitation has been careful and well thought out. Sweco assesses that the design takes sufficient account of the Natura 2000 area Hoburgs bank and Midsjöbankarna and its protected wildlife in accordance with SGU's proposal for data collection needs for its government assignment.

The geographical delimitation is also considered to constitute an important basis for the alternative location within the original investigation area that was reported in the consultation, see Appendix C2, Siting Investigation and Chapter 5This is summarized in Table 3-1

Table 3-1Summary table of the criteria that have been considered when designing the geographical delimitation and how these criteria have been prioritized against each other. The table shows that the consideration of having a very high Natura 2000 protection has been given the highest priority.

Criterion	Order of priority	Regard
1. Very high Natura 2000 protection considerations	Highest priority	Highest consideration
2. Data collection for government missions on carbon storage	Second highest priority	The consideration is equivalent to criteria 3 and 4
3. Maritime safety when operating survey vessels	Second highest priority	The consideration is equivalent to criteria 2 and 4
4. Data overlap considerations	Second highest priority	The consideration is equivalent to criteria 2 and 3

3.2 Factual demarcation

The planned activities consist of various geophysical surveys as described in Chapter 4However, only the seismic surveys and sediment echo sounding techniques are considered to have an impact on fish, birds and marine mammals. The survey technique involving multibeam echo sounding on the other hand, is outside the animals' hearing range.

Effects and consequences are described and assessed in Chapter 7Natura 2000 areas in the vicinity of the investigation areas have been studied to see if they include designated species or habitats that could be affected by the investigations. The areas that have aquatic values that have been assessed to be affected are Gotska Sandön-Salvorev (SE0340097), Hoburgs bank and Midsjöbankarna, Näsrevet (SE0340010), Stora Karlsö (SE0340023), Lilla Karlsö (SE0340025), Ottenby NR (SE0330108) and Sydöstra Ölands sjömarker areas (SE0330174).
Values that have not been assessed to be affected, for example terrestrial species and habitats, have been delimited. Following this delimitation, it has been assessed that there is a risk of impact for the designated species harbour porpoise, seal, long-tailed duck, eider and black guillemot as well as the aquatic habitat types sandbanks and reefs. For the typical species of the habitat types, it has been assessed that there is a risk of impact on cod, herring, sprat, viviparous eelpout, common murre and razorbill.

The assessments in Chapter 7 are based solely on the results of the underwater noise investigation. Additional indirect impact of the survey vessel's possible extremely marginal impact on additional underwater noise in the sea has not been included. The noise impact from the technical survey methods' impact in the form of noise to air has also been disregarded since SGU's field staff investigated the sound by recording and the impact is assessed to be minimal. The basis for this is that the impact of underwater noise is assessed to be the dominant impact and is also assessed to constitute a clear worst-case scenario in terms of impact for all of the above-affected and assessed animal groups and habitat types. This assessment also includes an expert assessment

of the possible physical impact of the survey methods on protected habitat types. However, any additional extremely marginal impact of the survey vessel is assessed not to be significant for either the overall impact assessment for underwater noise or the proposals for final protective measures, which is why this impact factor has been disregarded in Chapter 7.

3.3 Temporal delimitation

The surveys have been divided into two different seasonal periods at an early stage of the project; summer (May-October) and winter (November-April). The reason for this division is to minimize the impact on the critically endangered Baltic Sea population of harbour porpoises. During the summer months, harbour porpoises are concentrated in their core area at Hoburgs bank and the Midsjö banks, which is why surveys will not be conducted in that area during the summer. A protection zone of 14 km has been established around the Natura 2000 area to ensure that noise, or other disturbances, from the surveys do not reach the area during the summer. During this period, other areas where harbour porpoise density is assessed to be lower are surveyed. The area in and around Hoburgs bank and Södra Midsjö bank is surveyed during the winter when harbour porpoises are more widely spread across other parts of the Baltic Sea. See Figure 3-3for an overview of which survey areas are surveyed when.

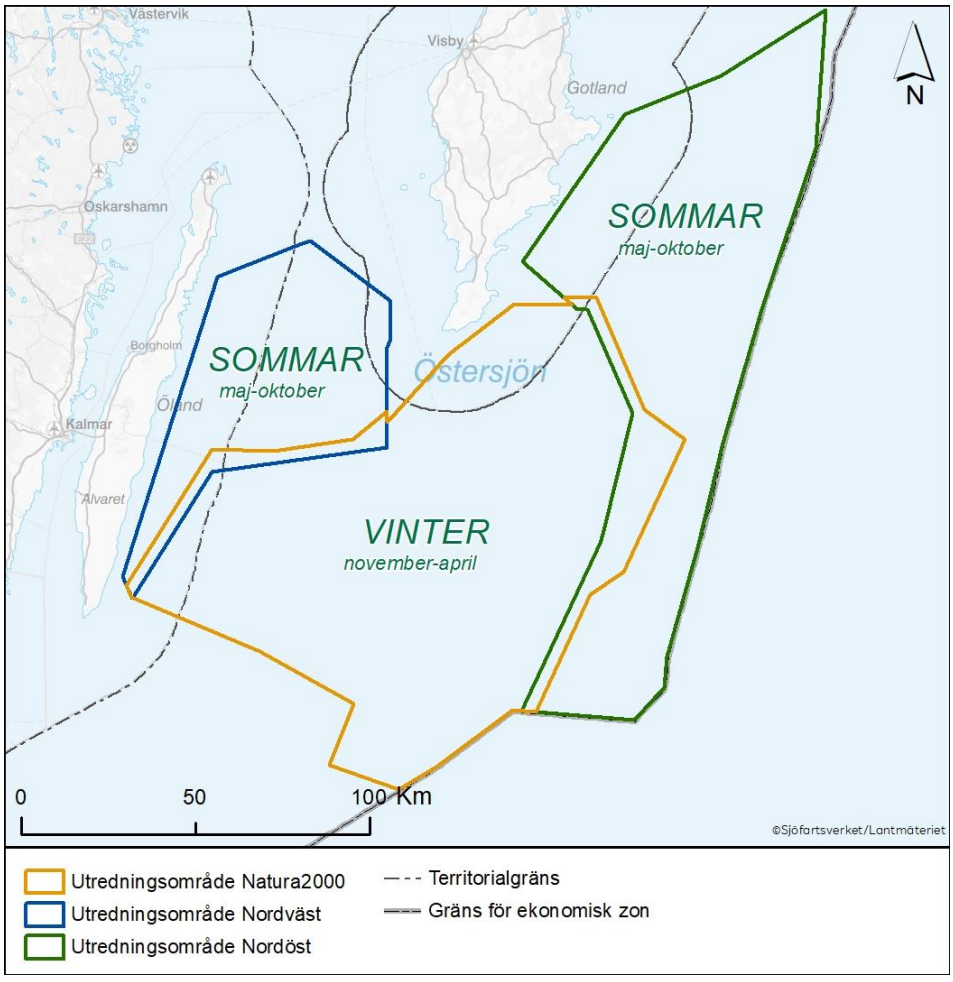

Figure 3-3Survey periods of the Northwest, Natura 2000 and Northeast investigation areas.

3.4 Method for impact and consequence assessments

Chapter 6describes the conditions and environmental values, the effects and environmental consequences of the activities are assessed in Chapter 7and cumulative effects in Chapter 9Assessments of values and effects are based on publicly available information and the underwater noise modelling that has been developed specifically for the project, see Appendix C3.

To determine what environmental consequences are likely to arise, the effect on a certain value is assessed, the higher the value and the greater the effect, the greater the consequence.

Impacts are defined as a change in the environment that results from the planned activity. For example, it could be avoidance behaviour of a certain fish species due to loud noises in an investigation area.
Impacts can be direct or indirect, positive or negative, temporary or permanent, cumulative and occur in the short, medium or long term. To assist in the impact assessments, the matrix in Table 3-2 below has been used.
Positive impacts are not valued on a scale.

Table 3- 2Assessment matrix

	Small value	**Moderate value**	**Great value**	**Very great value**
Large negative impact	**Small-moderate consequences**	**Moderate consequences**	**Major consequences**	**Very big consequences**
Moderate negative effect	**Small consequences**	**Small-moderate consequences**	**Moderate consequences**	**Major consequences**
Small negative effect	**No/negligible consequences**	**Small consequences**	**Small-moderate consequences**	**Moderate consequences**
No/insignificant effect	**No/negligible consequences**			
Positive effect	**Positive consequences**			

The assessments in Chapter 7have been made based on a so-called “worst *case scenario”*. This means that the largest areas of impact for sound modelling have been used and, where different data have been available on the impact of

species on sound, the assessments have been based on the lowest decibel levels found.
The overall assessment presents the impact on the conservation status of species and habitats.

4 Planned surveys

SGU's offshore surveys are planned to be carried out using various acoustic methods. Acoustic methods involve sending sound from instruments down to the seabed where it bounces off the various geological layers. The echoes of these sound waves are captured by sensors and then translated into images that show what the seabed, sediments and underlying bedrock look like. In the planned offshore surveys, echo sounders (sediment echo sounders and multibeam echo sounders) will be used to map the seabed and sediments above the bedrock. Potential carbon dioxide storage should ideally take place at least 800 m below the seabed, and seismic surveys will also be carried out to find out what the bedrock looks like at that depth.

In the summer, SGU's own vessel, S/V Ocean Surveyor, is used, see Figure 4-1, and in the winter, a vessel adapted for the purpose is hired.
For technical specifications of survey techniques, please refer to the technical description, Appendix B of the application – Technical description.

Figure 4-1The picture shows SGU's vessel S/V Ocean Surveyor during seismic measurements south of Scania in 2023. The picture uses an air cannon that is visible just over two boat lengths behind the vessel.

4.1 Geophysical surveys

Geophysical surveys are used to create images that show what the seabed, sediments and underlying bedrock look like. The geophysical survey methods that will be used will be carried out simultaneously with each other and the vessel will maintain a speed of between 4–4.5 knots when collecting data.

4.1.1 Seismic surveys

In a seismic survey, sound waves (seismic signals) are used to create detailed sections (two-dimensional images) of the bedrock structure. At sea, the powerful sound pulses can be created by, for example, a compressed air gun, a water gun or a sparker towed by a ship. In this case, the seismic measurements are planned to be carried out with air guns as the sound source. Two synchronized GI air guns (generator/injector air guns) will be used and activated at 4–15 second intervals.
The frequency at which the equipment operates is 1–1000 Hz.

4.1.2 Sub Bottom Profiler (SBP)

Sub Bottom Profiler (SBP) provides high-resolution data in the shallow subsurface, up to a maximum of 50 m, below the seabed.
The sediment echo sounder that is planned to be used is a hull-mounted model. It is a parametric echo sounder that means that the sound beam is concentrated into a narrow beam directly below the ship.
The system operates at a frequency of 2–30 kHz with a dominant frequency range of 5–24 kHz and a ping rate of up to 40 per second.

4.1.3 Multi-beam echo sounder (MBES)

A Multibeam Echo Sounder (MBES) is used to map bathymetry and seabed topography, including the possible presence of gas. The system operates at a frequency of 300 kHz. The high-frequency sound from the MBES is above 200 kHz and is therefore not audible to harbour porpoises and other marine mammals, see section 6.4.3.1, so no impact is expected. Therefore, the MBES has not been modelled in the noise investigation that formed the basis for the impact assessments.

4.2 Scope of planned surveys

As described in section 3.3the surveys will be conducted either in summer or winter depending on the investigation area.

To obtain a comprehensive picture of the seabed, a grid pattern of transects is required. Planned transects for the different investigation areas are shown in Figure 4-2.

The maximum length of surveyed transects is approximately 640 km for the Northwest investigation area, which is planned to take 12 days. For the Natura 2000 investigation area, the vessel will survey approximately 2600 km over 51 days and for the Northeast investigation area approximately 3140 km and 59 days. The total surveyed transect length will therefore be approximately 6380 km and is estimated to take approximately 122 days.

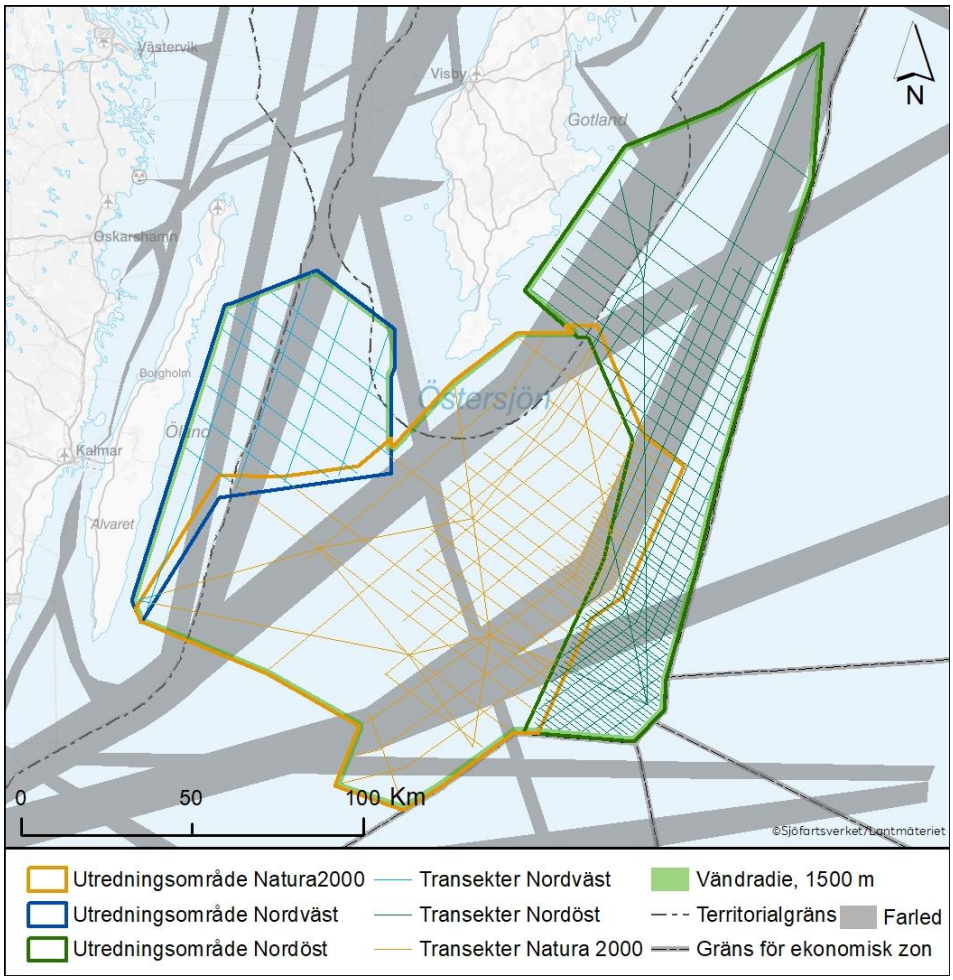

Figure 4-2.The investigation areas including transects.

Table Table 4-1summarizes which techniques will be used, what frequency they operate within, which investigation areas will be surveyed, when and how long the surveys will last within each investigation area.

Table 4-1Compilation of survey methods planned to be carried out for the project, within which investigation areas, which routes and for how long they will last.

Method	**Investigation area**	**Frequency range**
Seismic survey method	Natura 2000, Northeast and Northwest	1–1000 Hz
Sediment borehole (SBP)	Natura 2000, Northeast and Northwest	5–24 kHz
Multi-beam echo sounder (MBES)	Natura 2000, Northeast and Northwest	300 kHz
Timetable	**Investigation area**	**Number of days**
	Natura 2000	51 days
	Northeast	59 days
	Northwest	12 days
Total area	**Investigation area**	**Area (km ^{2})**
	Natura 2000	11,964 km2
	Northeast	8242 km ^{2}
	Northwest	3626 km ^{2}
Transect length	**Investigation area**	**Length (km)**
	Natura 2000	2552 km
	Northeast	3135 km
	Northwest	638 km

4.3 Sound from planned examinations

Surveys create sounds that can be disturbing or harmful to aquatic animals. Animals can suffer from temporary threshold shift (TTS), permanent threshold shift (PTS) and behavioural disturbances depending on how close they are to the sound source. Different instruments operate at different frequencies which can be perceived differently by different species. This means that the effects of an instrument can be different depending on the species being assessed.

An underwater noise model has been developed specifically for SGU's surveys, which shows how much impact the surveys have on harbour porpoises, seals and fish. Since the conditions differ in the different investigation areas linked to, for example, depth, bottom substrate and season, these have been modelled separately.
Table 4-2 to Table 4-4 show Table 4-2impact areas, regardless of technology, for different species and the threshold values that exist for each animal type. Impact distance means within how far the sound can be higher than the threshold values and thus can lead to PTS, TTS or behavioural disturbance.

Table 4-2Impact distance divided by impact type and animal type for the Northeast investigation area.

Investigation area Northeast			
Animal	**Type of injury**	**Threshold weighted dB**	**Maximum impact distance**
Porpoise			
	TTS	196	<200m
	PTS	202	<50m
	Behavioural disturbance	103	<2.7km
	TTS (cumulative 24h)	140	<600m
	PTS (cumulative 24h)	155	-
Seal			
	TTS	212	<50m
	PTS	218	-
	Behavioural disturbance	165	<300m
	Potential behavioural disturbance	160	<2.6km
	TTS (cumulative 24h)	170	<400m
	PTS (cumulative 24h)	185	-
Fish			
	TTS	206	<50m
	PTS	207	<50m
	Behavioural disturbance	150	<8 km
	TTS (cumulative 24h)	186	-
	PTS (cumulative 24h)	203	-

Table 4-3. Impact distance divided by impact type and animal type for the Natura 2000 investigation area.

Investigation area Natura 2000			
Animal	**Type of injury**	**Threshold weighted dB**	**Maximum impact distance**
Porpoise			
	TTS	196	<150m
	PTS	202	<50m
	Behavioural disturbance	103	<2km
	TTS (cumulative 24h)	140	<600m
	PTS (cumulative 24h)	155	-
Seal			
	TTS	212	<50m
	PTS	218	-
	Behavioural disturbance	165	<200m
	Potential behavioural disturbance	160	<3.3km
	TTS (cumulative 24h)	170	<300m
	PTS (cumulative 24h)	185	-
Fish			
	TTS	206	<50m
	PTS	207	<50m
	Behavioural disturbance	150	<9 km
	TTS (cumulative 24h)	186	<50m
	PTS (cumulative 24h)	203	-

Table 4-4Impact distance divided by impact type and animal type for the Northwest investigation area.

Investigation Area Northwest			
Animal	**Type of injury**	**Threshold weighted dB**	**Maximum impact distance**
Porpoise			
	TTS	196	<160m
	PTS	202	<80m
	Behavioural disturbance	103	<2.7km
	TTS (cumulative 24h)	140	<700m
	PTS (cumulative 24h)	155	-
Seal			
	TTS	212	<50m
	PTS	218	-
	Behavioural disturbance	165	<300m
	Potential behavioural disturbance	160	<2.5km
	TTS (cumulative 24h)	170	<500m
	PTS (cumulative 24h)	185	-
Fish			
	TTS	206	<50m
	PTS	207	<50m
	Behavioural disturbance	150	<7.5km
	TTS (cumulative 24h)	186	<50m
	PTS (cumulative 24h)	203	-

The impact distances reported in the tables above are those that have been used to assess the consequences in Chapter 7.

For more technical specifications on areas of influence for different technologies, the assumptions of the underwater noise model etc., please refer to the noise investigation, Appendix C3.

5 Alternative

5.1 Alternative localization

A siting investigation has been prepared by SGU, which is summarized below and can be seen in its entirety in Appendix C2.

As previously reported, the planned surveys are part of a government mission to find suitable sites for carbon dioxide storage. This means that alternative locations for the surveys are limited to sites with the right geological conditions, as carbon dioxide storage is considered to have the greatest potential in deep saline aquifers. The storage potential is primarily dependent on the size of the aquifer and the porosity and permeability of the aquifer rock. Several studies show the potential for geological storage of carbon dioxide in deep saline aquifers in Sweden and point to eight aquifers. These aquifers are in the southeastern Baltic Sea and southwestern Scania. The area in southwestern Scania has already been investigated for carbon dioxide storage by SGU in 2023 and 2024. In 2023, ground drilling was carried out on southern Gotland, which verified that Faludden is highly suitable as an aquifer for carbon dioxide storage and the only suitable aquifer of the three identified in the southeastern Baltic Sea.

After the consultation phase, SGU has revised the areas that will be investigated, primarily regarding the natural environment and protected species, but also in light of the new information from the drill core analyses that point to Faludden as a suitable aquifer. Figure 5-1shows the areas that were relevant for investigation during the consultation phase and the areas that are currently relevant. The initial survey area has been significantly reduced to minimize the effects on the environment without losing the benefit of the surveys, which resulted in the three investigation areas Northwest, Northeast and Natura 2000.

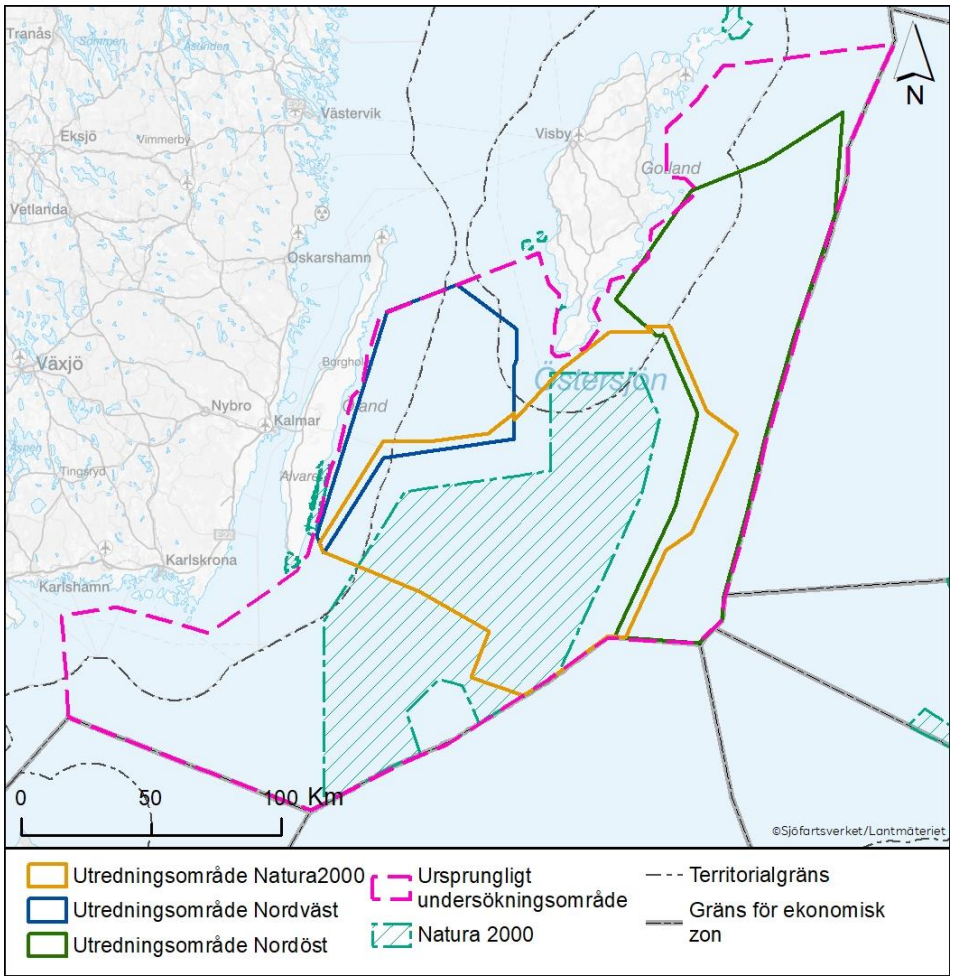

Figure 5-1The survey area that was out for consultation is seen in pink on the map and the investigation areas that are now relevant are seen in blue, yellow and green.

5.2 Alternative technology

At present, there is no alternative to the type of surveys that are planned, if the same information is to be obtained. Planned investigations are necessary to assess the suitability of storing carbon dioxide in the rock under the southern Baltic Sea, and there is therefore a lack of alternative techniques.

However, to reduce the environmental impact of the surveys, SGU has taken into account sensitive periods, especially for harbour porpoises, and has chosen not to conduct surveys in the harbour porpoise core area during the summer when the species is most sensitive to disturbance. Surveys in this area will instead be conducted during the winter. This will require the use of an external vessel, as SGU's own vessel, the S/V Ocean Surveyor, is not considered sufficiently seaworthy to conduct surveys of this type during the winter.

5.3 Zero alternative

The zero alternative means that no geophysical surveys are carried out within the investigation areas. The absence of the applied activity is not considered to affect the environmental conditions of the Natura 2000 area and thus its conservation status.

Since the planned partial surveys that are proposed will only last for a short period (days-months), with a number of protective measures, the present EIA also does not assess that the conservation status of the Natura 2000 area will be negatively affected by the planned surveys.

How the area will change in the future, for example in connection with climate change, cannot be fully predicted at present. Here, everything from increased sea temperatures, decreasing oxygen levels and pH levels in the sea could have a negative impact on the area and its natural values and wildlife. These major climatological impact factors need to be put in relation to the fact that the investigations assessed in this Natura 2000 EIA are ongoing for a short period and are local and temporary.

6 Prerequisites

6.1 Location

The investigation areas are in the Baltic Sea, primarily south and east of Gotland and are divided into three investigation areas: Northeast, Natura 2000 and Northwest, see Figure 6-1.

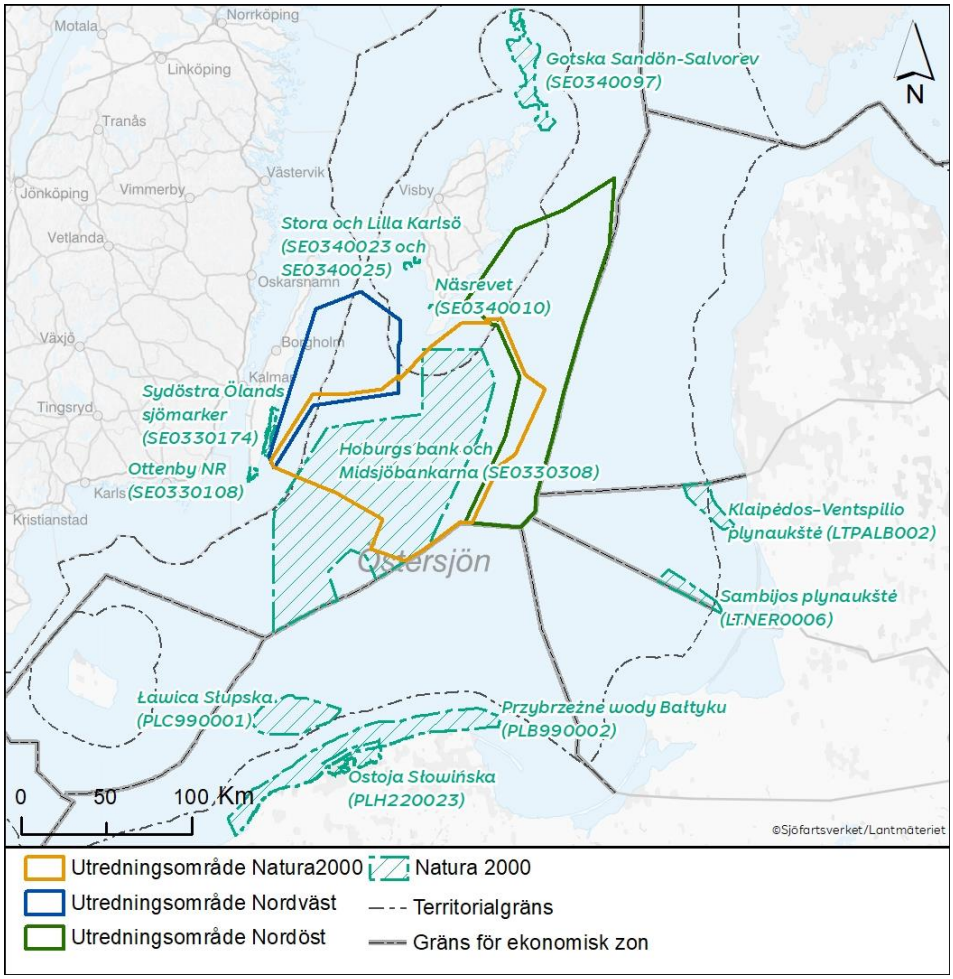

Figure 6-1The three investigation areas and the closest Natura 2000 areas in Sweden, Poland and Lithuania.

Marine plans exist for the Gulf of Bothnia, the Baltic Sea and the North Sea. The purpose of the marine plans is to provide guidance on the use of different

areas. The areas of use covered by the marine plans are electricity transmission, energy extraction, energy extraction investigation area, defence, general use, culture, nature, recreation, sand extraction, sand extraction investigation area, shipping, shipping investigation area and commercial fishing. The Baltic Sea is divided into five sea areas: North Baltic/Southern Kvarken, Central Baltic, Southeastern Baltic, Southern Baltic and Southwestern Baltic/Öresund. The investigation areas overlap with three of the sea areas (Central Baltic, Southeastern Baltic and Southern Baltic) and the primary areas of use for these areas are commercial fishing, shipping, nature and general use.

New marine plans are being developed to meet the need for increased offshore energy extraction. The plans are in a consultation phase and are planned to be submitted to the government for decision no later than 31 December 2024. (Havs- och vattenmyndigheten, 2024a). In the new marine plans, the areas of investigation also overlap with the area of use for energy extraction.

National interests are identified over geographical areas because they contain nationally important values and qualities. There are two types of national interests, partly larger areas decided by the Swedish parliament as stated in Chapter 4 of the Environmental Code, and partly areas that are national interests according to Chapter 3 of the Environmental Code which are decided by national authorities. The investigation areas overlap with several different types of national interests. Investigation area Northeast overlaps with national interests for shipping, naval exercise area, fishing, impact area for weather radar, wind power and outdoor recreation. Investigation area Natura 2000 overlaps with shipping, fishing, outdoor recreation, wind power and impact area for weather radar. Investigation area Northwest overlaps with shipping, fishing, the area of influence for weather radar and outdoor recreation.

6.2 Natura 2000 areas

Within, or close to, the investigation areas there are seven Natura 2000 areas that could potentially be affected; Hoburgs bank and Midsjöbankarna Gotska Sandön-Salvorev, Stora Karlsö, Lilla Karlsö, Näsrevet, Ottenby NR and the Sydöstra Ölands sjömarker, see Figure 6-1. These areas, as well as their designated species and habitat types, are described in the following sections. The impact on foreign Natura 2000 areas in Poland and Lithuania has been investigated but is not considered to be affected. The Polish and Lithuanian Natura 2000 areas investigated are Ławica Słupska (PLC990001), Przybrzeżne wody Bałtyku (PLB990002), Sambijos plynaukštė (LTNER0006) and Klaipėdos-Ventspilio plynaukštė (LTPALB002). All are located far from the investigation areas (between 80 and 95 km), see Figure 6-2. The maximum impact areas have been assessed through underwater noise modelling to extend nine km from the sound source. These Natura 2000 areas are therefore not assessed to be affected by noise, or in any other way, from the survey and are not dealt with further in this EIA. For specific noise levels within the above-mentioned foreign Natura 2000 areas, reference is made to the noise investigation, Appendix C3.

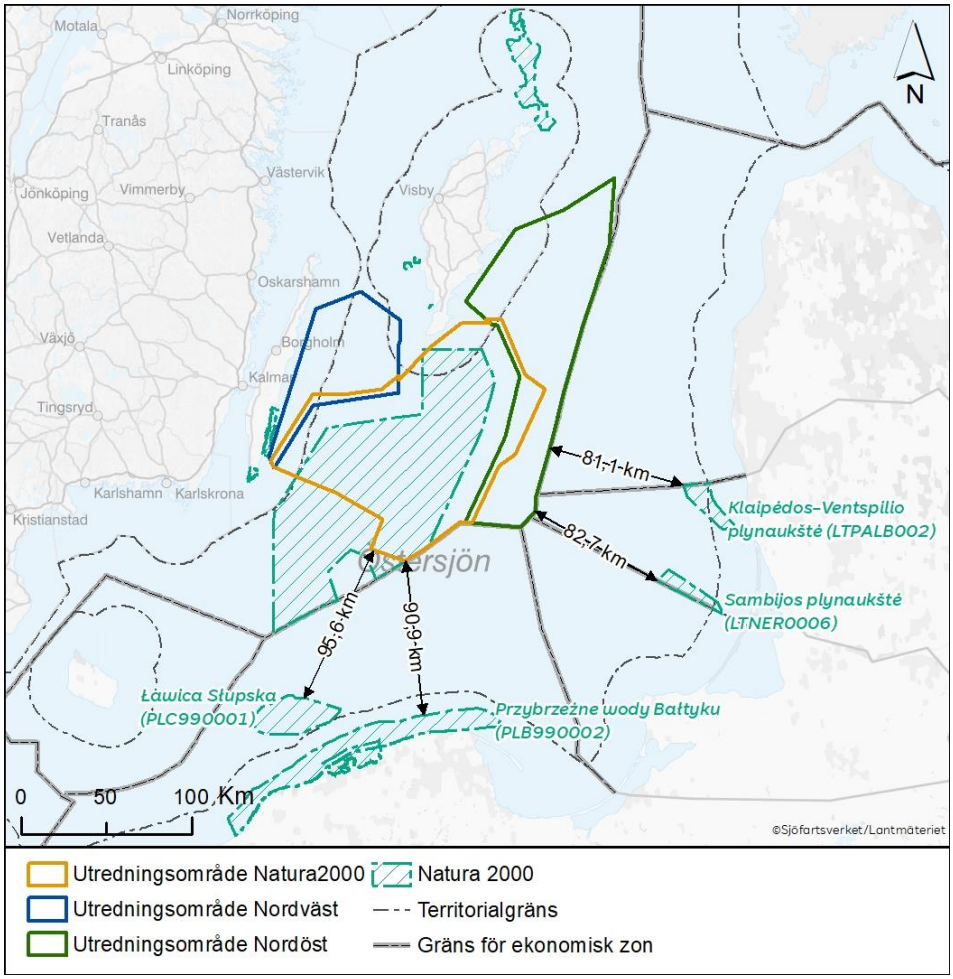

Figure 6-2Distance to Polish and Lithuanian Natura 2000 areas.

6.2.1 Investigation area Northeast

The Northeast investigation area does not overlap with any Natura 2000 area. The Natura 2000 area included in the assessments for the Northeast investigation area is Gotska Sandön – Salvorev, located north of Gotland and the study area. The investigation area in relation to the Natura 2000 area is shown in Figure 6-3.

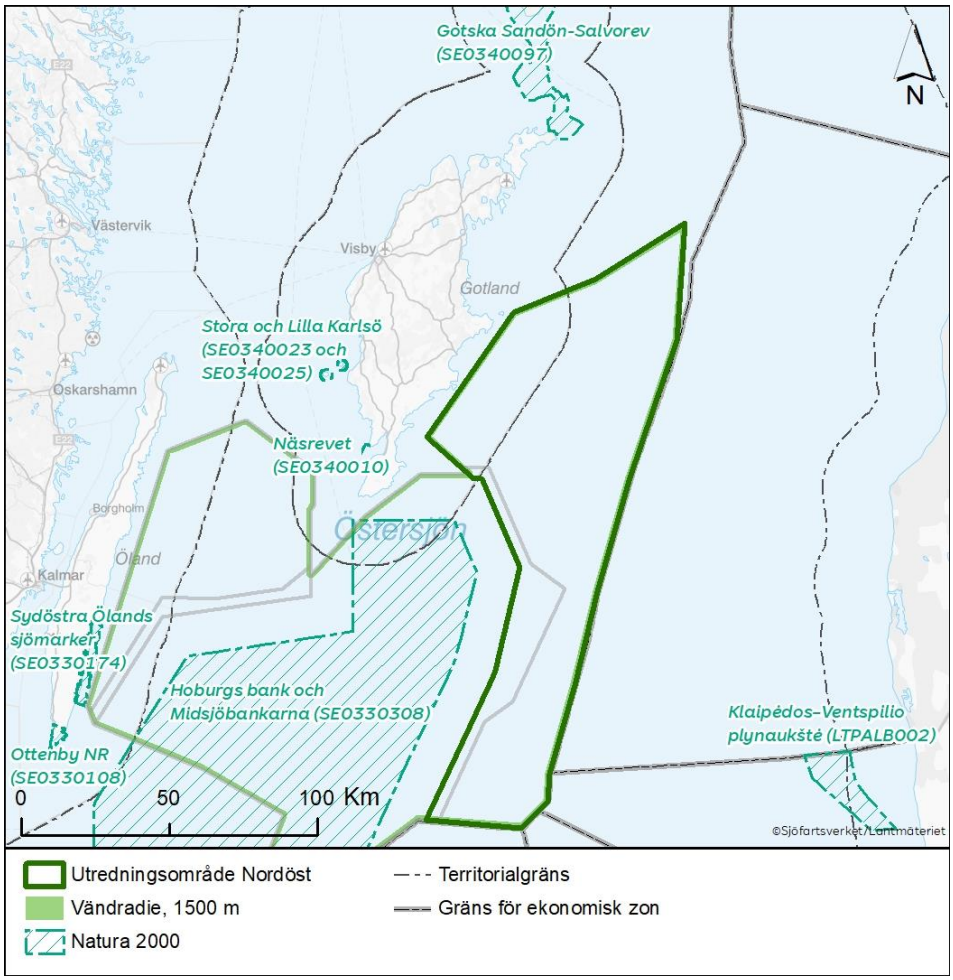

Figure 6-3Map of the investigation area Northeast with Gotska Sandön-Salvorev north of the investigation area.

6.2.1.1 Gotska Sandön – Salvorev

The Natura 2000 area Gotska Sandön-Salvorev is over 60,000 ha in size and is located approximately 38 km north of Fårö. Gotska Sandön is the most isolated island in the Baltic Sea and is interesting from both a historical and biological perspective. The island is almost entirely covered in sand and there are several valuable sand environments as well as flora and fauna associated with them. A large part of the species associated with these environments consist of insects. In spring, when the birds migrate, the bird fauna can also be very varied. Hay meadows and deciduous meadows are important to preserve on the island from both a cultural-historical and biological perspective as they are disappearing to a large extent despite the fact that they contain great values for cultural heritage and have a number of species associated with them (Länsstyrelsen Gotlands län, 2018a).

Table Table 6-1

Table 6-1Designated habitat types and species for the Natura 2000 area Gotska Sandön-Salvorev according to the conservation plan.

Habitat types	Species
Sandbanks	Grey seal, *Halichoerus grypus*
Reef	Narrow shadow beetle, *Boros schneideri*
Sandy beaches on the Baltic Sea	
Cushions	
White dunes	
Grey dunes	
Tree-covered dunes	
Dune wetlands	
Lowland hay meadows	
Leaf meadows	

6.2.2 Investigation area Natura 2000

The Natura 2000 investigation area includes the Natura 2000 area Hoburgs bank and Midsjöbankarna. The area is a core area for the Baltic Sea population of harbour porpoises that gather here during the summer, which is why the studies will take place in the winter, see more about this in section 3.3. The investigation area, in relation to the Natura 2000 area, can be seen in Figure 6-4.

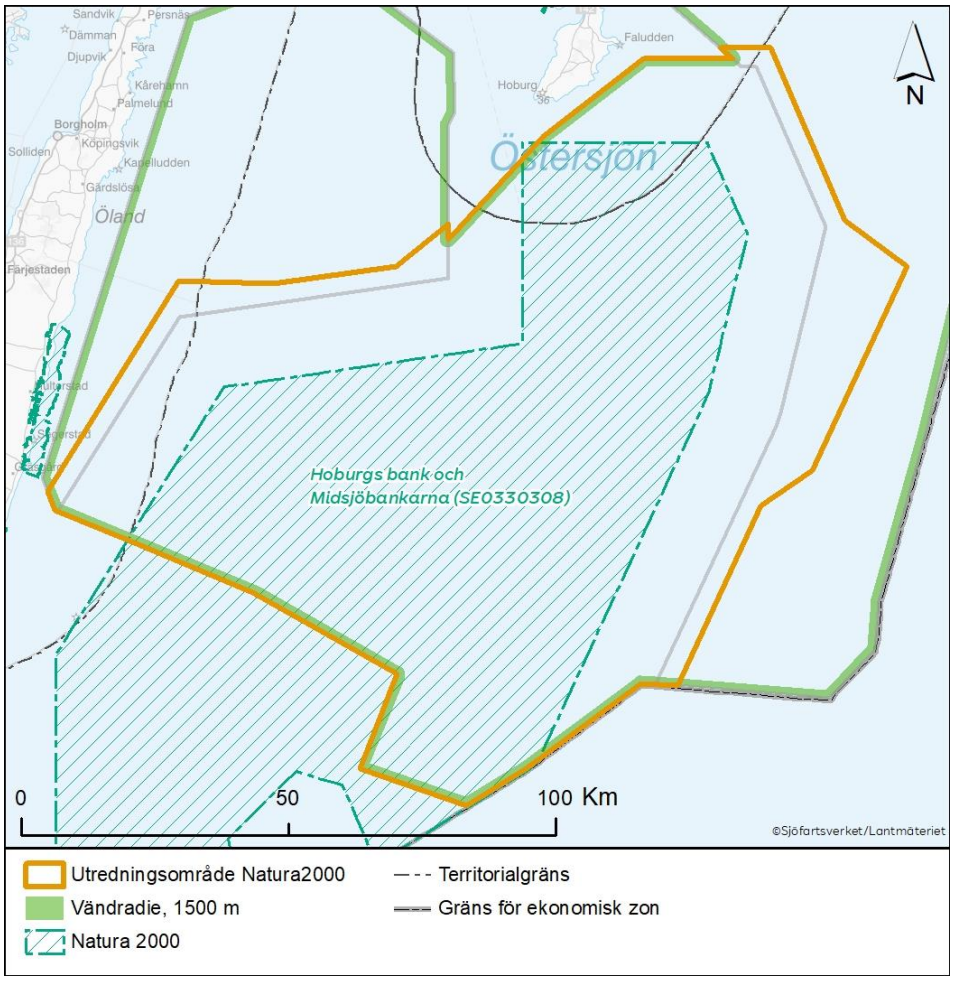

Figure 6-4Natura 2000 investigation area that can be seen to overlap with the Natura 2000 area Hoburgs bank and Midsjöbankarna.

6.2.2.1 *Hoburgs Bank and Midsjöbankarna*

Hoburgs Bank and Midsjöbanken include two offshore banks, North Midsjöbanken and Hoburgs Bank. South Midsjöbanken is located outside the area but has a strong connection to the area and the conservation status of the designated species. Offshore banks are important recruitment and foraging areas for several species of both birds, fish and mammals. This habitat is particularly important in the Baltic Sea because similar coastal areas are exposed to major environmental problems in the form of, for example, eutrophication and environmental toxins that make them less productive (Länsstyrelsen Gotlands län & Länsstyrelsen Kalmar län, 2021).

Table Table 6-2

Table 6-2Designated habitat types and species for the Natura 2000 area Hoburgs bank and Midsjöbankarna.

Habitat types	**Species**
Sandbanks	Harbour porpoise (Baltic population), *Phocoena phocoena*
Reef	Long-tailed duck, *Clangula hyemalis*
	Black guillemot, *Cepphus grylle*
	Common eider, *Somateria mollissima*

6.2.3 Investigation area Northwest

The Northwest investigation area does not overlap with any Natura 2000 areas. However, five Natura 2000 areas have been assessed for noise impacts; Näsrevet, Stora Karlsö, Lilla Karlsö, Ottenby NR and Sydöstra Ölands sjömarker. The Northwest investigation area, including the Natura 2000 areas, is shown in Figure 6-5.

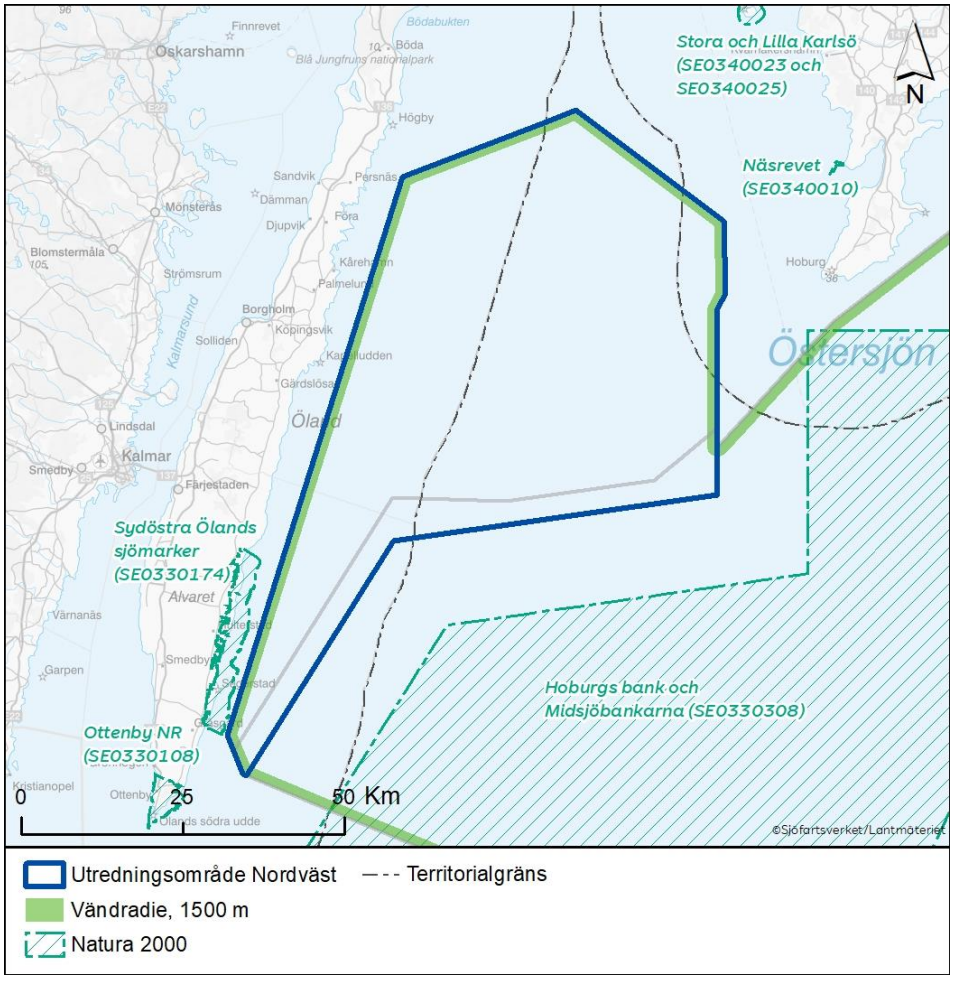

Figure 6-5Northwest investigation area with the Natura 2000 areas Ottenby NR and Sydöstra Ölands sjömarker southwest and west of the investigation area, as well as Näsrevet and Stora and Lilla Karlsö northeast of the area.

6.2.3.1 Näsrevet

The Natura 2000 area Näsrevet is primarily designated to protect resting and breeding birds. Many species of birds are known to breed in the area, such as mute swan, common eider, lesser black-backed gull, European herring gull, great black-backed gull, Caspian tern, common tern, arctic tern, oyster catcher and pied avocet. The islands off Näsrevet are important molting areas for, among other things, greylag geese.
There is also a large grey seal colony with several hundred individuals and the number has increased significantly since the beginning of the 2000s when it only consisted of about ten individuals.

Other values are terrestrial in the form of various botanical values (Länsstyrelsen Gotlands län, 2017).

Table Table 6-3the designated habitat types and species for Näsrevet.

Table 6-3Designated habitat types and species for the Natura 2000 area Näsrevet.

Habitat types	Species
Reef	Grey seal, *Halichoerus grypus*
Stone and gravel embankments	Caspian tern, *Sterna caspia*
Glasswort beaches	Arctic tern, *Sterna paradisaea*
Coastal meadows on the Baltic Sea	Pied avocet, *Recurvirostra avosetta*
Lime grasslands	Cormorant, *Phalacrocorax carbo*

6.2.3.2 Stora Karlsö

The Natura 2000 area Stora Karlsö has a very rich birdlife with large breeding colonies of, above all, common murre and razorbill. There are also values in the form of botany, entomology, geology and cultural environment. Stora Karlsö is one of the world's oldest nature conservation areas. The island consists of calcareous soils, alvar lands and open grazed meadows. The island itself is 346 ha and the Natura 2000 area extends 1000 m into the water around the entire island, giving a total area of 930 ha. The water area consists of hard bottom in the form of rocks, ledges, blocks and stones (Länsstyrelsen Gotlands län, 2018b).

Table Table 6-4designated habitat types and species for Stora Karlsö.

Table 6-4Designated habitat types and species for the Natura 2000 area Stora Karlsö.

Habitat types	Species
Reef	Vertigo *angustior*
Stone and gravel embankments	Gotland nunwort, *Corydalis gotlandica*
Vegetated sea cliffs	Barnacle goose, *Branta leucopsis*
Lime grasslands	Arctic tern, *Sterna paradisaea*
Alvar	Barred Warbler, *Sylvia nisoria*
Wet pliers	Red-backed Shrike, *Lanius collurio*
Limestone cliffs	Cormorant, *Phalacrocorax carbo*
Limestone cliffs	
Caves	
Northern hardwood forest	
Deciduous forest on steep slopes	

6.2.3.3 *Lilla Karlsö*

The Natura 2000 area Lilla Karlsö consists partly of the island itself, which has an area of approximately 158 ha, and partly of its surrounding water. The total area of the area is approximately 767 ha. The water area consists mostly of rocky reefs but also of the sea cave habitat type. On the south side of the island there is a grey seal colony with around 200 individuals. Lilla Karlsö has a varied nature with ravines, shore dikes, marshland, dry meadows, alvars and pastures. The island has been grazed for several thousand years, and the flora has been clearly characterised by this, and the species variation is rich. There are over 260 butterfly species on the island and over 420 beetle species. The island is also rich in fossils in its limestone. There are smooth snakes, smooth newts and common toads on the island in reproducing populations. The island has a rich birdlife with almost 60 different regularly breeding species and several species that can temporarily breed on the island. Among other things, the largest nesting site on Gotland for black-headed gulls and thousands of breeding pairs of common murre and razorbills (Länsstyrelsen Gotlands län, 2018c).

Table Table 6-5the designated habitat types and species for Lilla Karlsö.

Table 6-5. Designated habitat types and species for the Natura 2000 area Lilla Karlsö.

Habitat types	**Species**
Reef	Grey seal, *Halichoerus grypus*
Stone and gravel embankments	Gotland nunwort, *Corydalis gotlandica*
Vegetated sea cliffs	Barnacle goose, *Branta leucopsis*
Lime grasslands	Peregrine falcon, *Falco peregrinus*
Wet pliers	Common tern, *Sterna hirundo*
Limestone cliffs	Arctic tern, *Sterna paradisaea*
Limestone cliffs	Little Tern, *Sternula albifrons*
Caves	Cormorant, *Phalacrocorax carbo*
Sea caves	

6.2.3.4 *Ottenby NR*

The Natura 2000 area Ottenby NR is located on the southern tip of Öland and includes both land and water areas. The area is protected on the basis that the southern tip of Öland has a unique coastal landscape with claimed lands, rich deciduous forests and important marine habitats with a rich flora and fauna. The area is very varied with extensive lakelands, lake meadows and lagoons as well as meadows, wetlands, shrublands and deciduous forests. The area is important for a variety of nesting birds and off the land there are many skerries and small islands that are well suited as resting places for seals (Länsstyrelsen Kalmar län, 2016a).

Table Table 6-6designated habitat types and species for Ottenby NR.

Table 6-6Designated habitat types and species for the Natura 2000 area Ottenby NR.

Habitat types	**Species**
Sandbanks	Greater crested newt, *Triturus cristatus*
Reef	Grey seal, *Halichoerus grypus*
Coastal meadows on the Baltic Sea	Harbour seal, *Phoca vitulina*
Exposed clay and sand bottoms	Kalkkrassing, *Susymbrium supinum*
Large bays and straits	
Drifting dikes	
Dry heaths	
Basic rock outcrops	
Lime grasslands	
Stagg Grasslands	
Silicate grasslands	
Alvar	
Wet pliers	
Leaf meadows	
Lowland hay meadows	
Rich marsh	
Tree-covered pasture	
Lagoons	

6.2.3.5 *Sydöstra Ölands sjömarker*

The Natura 2000 area Sydöstra Ölands sjömarker is located on the southern east coast of Öland. The area covers both land and water areas and is protected primarily to preserve the open grazing landscape, nurture unique land and water environments that provide nesting sites for birds and regeneration sites for fish.
The land areas within the Natura 2000 area constitute a very important core of value for birds and have a long history of grazing and haying. The area is home to around 60 red-listed species and in the water area there are eelgrass meadows that are important spawning grounds and reproduction sites for fish (Länsstyrelsen Kalmar län, 2016b).

Table Table 6-7shows designated habitat types and species for the seashores of Southeastern Öland .

Table 6-7. Designated habitat types and species for the Natura 2000 area of Southeastern Öland's seashores.

Habitat types	**Species**
Exposed clay and sand bottoms	Grey seal, *Halichoerus grypus*
Lagoons	Harbour seal, *Phoca vitulina*
Reef	Kalkkrassing, *Sisymbrium supinum*
Drifting dikes	Wormwood *, Artemisia oelandica*
Glasswort beaches	Barnacle goose, *Branta leucopsis*
Skerries and small islands in the Baltic Sea	Merganser, *Mergus albellus*
Coastal meadows on the Baltic Sea	Common hawk, *Circus pygargus*
Sandy beaches on the Baltic Sea	Corncrake, Crex crex
Grey dunes	Pied avocet*, Recurvirostra avosetta*
Basic rock outcrops	Heath Pipit, *Pluvialis apricaria*
Lime grasslands	Brush-shane, *Philomachus pugnax*
Silicate grasslands	Anteater, *Limosa lapponica*
Alvar	Greenshank, *Tringa glareola*
Wet pliers	Caspian tern, *Sterna caspia*
Lowland hay meadows	Kentish tern, *Sterna sandvicensis*
Rich marsh	Common tern, *Sterna hirundo*
	Arctic tern, *Sterna paradisaea*
	Southern Marsh Sandpiper, *Calidris alpina schinzii*
	Little Tern, *Sterna albifrons* (new name *Sternula albifrons*)
	Short-eared owl, *Asio flammeus*
	Red-backed Shrike, *Lanius collurio*

6.3 Designated habitats

Of the designated habitat types that occur in Natura 2000 areas, only sandbanks (1110) and reefs (1170), including subcategories, may occur within the investigation areas. Other habitat types are either terrestrial or only located near the coast outside the impact areas and are therefore assessed not to be affected and have been demarcated.

See Figure 6-6for the distribution of the sandbank and reef habitat types according to the Gotland County Administrative Board's mapping.

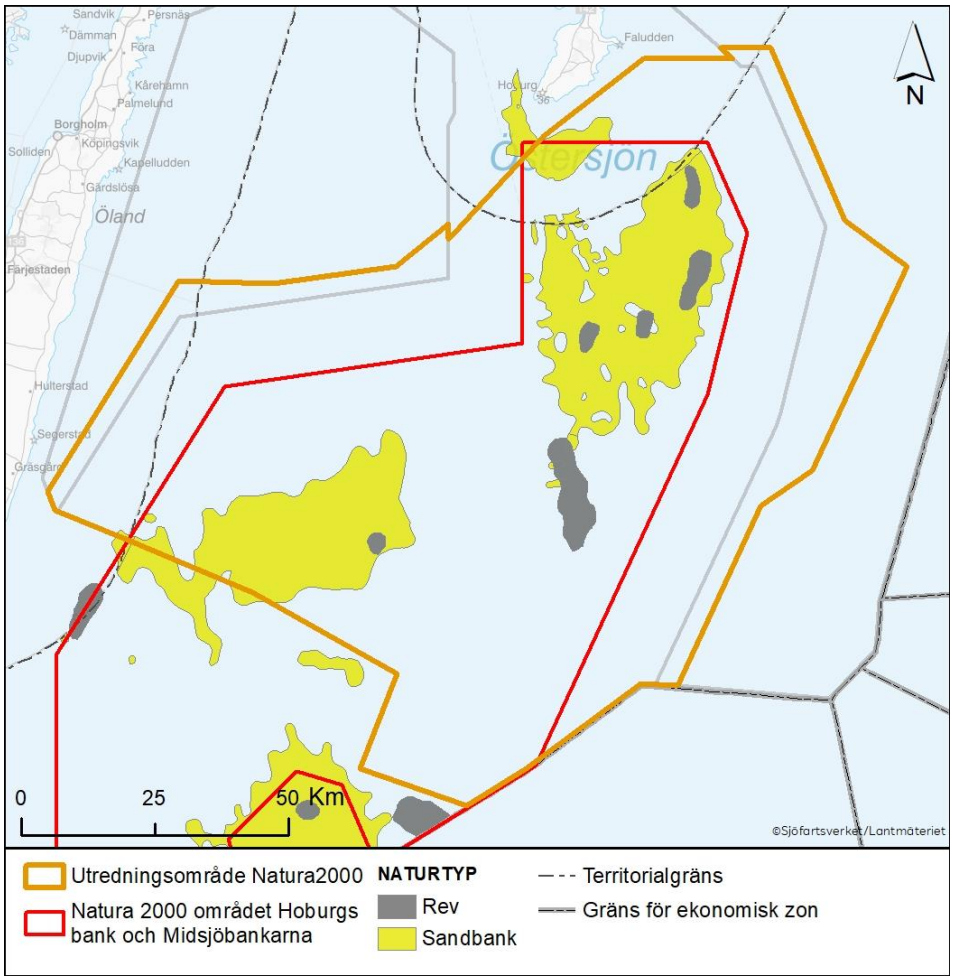

Figure 6-6Distribution of the habitat types sandbank (1110) and reef (1170). Data is taken from the Gotland County Administrative Board.

6.3.1 Sandbanks

According to the definition of the Species and Habitats Directive (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora), sandbanks (1110) are banks that are permanently covered by sea water. They usually occur in relatively shallow water. The European Commission states that the sea depth over a sandbank is rarely more

than 20 metres (European Commission DG-ENV, 2013). The Swedish Environmental Protection Agency's interpretation of the EU definition is that sublittoral sandbanks are usually located in relatively shallow water, with a maximum depth of about 30 metres below sea level (Naturvårdsverket, 2011a).

Sandbanks consist mainly of sandy sediments, but other grain sizes can also occur, such as clay, gravel (including shell gravel), stone and boulders. Subtypes of the sandbank habitat type that may occur in the area are sandy bottoms that lack vegetation and have high sediment mobility, as well as mussel banks with a coverage rate of less than 10%. Mussel beds with a coverage rate of over 10% are classified as reefs (1170), see section 6.3.2.

Sandbanks are topographically distinct from the surrounding bottom areas and may be free of vegetation or covered with seaweed and/or macroalgae. Banks that are further from the coast have good water exchange and often act as refuges for marine species that have been displaced from more coastal areas. The bottoms of the banks provide habitats for both soft- and hard-bottom species.

Table Table 6-8shows typical species for the sandbank habitat type .

Table 6-8. Typical species for the sublittoral sandbank habitat type (1110). Only typical species that can occur in the brackish waters of the Baltic Sea are included in the table. Red listing: LC = Viable, NT = Near Threatened, VU = Vulnerable, EN = Critically Endangered, CR = Critically Endangered.

Swedish name	**Scientific name**	**Red listing 2020**
Crustacea		
Hästräka	Crangon crangon	LC
Långfingrad tångräka	Palaemon adspersus	LC
Kortfingrad tångräka	Palaemon elegans	LC
Fish		
Ål	Anguilla anguilla	CR
Tångspigg	Spinachia spinachia	LC
Sandstubb	Pomatoschistus minutus	LC
Abborre	Perca fluviatilis	LC
Tånglake	Zoarces viviparus	LC
Skrubbskädda	Platichthys flesus	LC
Rödspätta	Pleuronectes platessa	LC
Piggvar	Scophthalmus maximus	LC
Sjurygg	Cyclopterus lumpus	LC
Torsk	Gadus morhua	VU
Sill	Clupea harengus	LC
Skarpsill	Sprattus sprattus	LC
Birds		
Ejder	Somateria mollissima	EN

Svärta	Melanitta fusca	VU
Sjöorre	Melanitta nigra	LC
Alfågel	Clangula hyemalis	NT
Storlom	Gavia arctica	LC
Smålom	Gavia stellata	NT
Bottom flora		
Sudare	Chorda filum	LC
Borststräfse	Chara aspera	LC
Grönsträfse	Chara baltica	LC
Hårsträfse	Chara canescens	LC
Skörsträfse	Chara globularis	LC
Rödsträfse	Chara tomentosa	LC
Havsrufse	Tolypella nidifica	LC
Ålgräs	Zostera marina	VU
Trådnate	Stuckenia filiformis	LC
Borstnate	Stuckenia pectinata	LC
Storsärv	Zannichellia major	LC
Hårsärv	Zannichellia palustris	LC
Hårnating	Ruppia maritima	LC
Skruvnating	Ruppia spiralis	LC
Östersjösallat	Monostroma balticum	LC

6.3.2 Reef

Reefs are biogenic and/or geological formations of hard substrate that occur on hard or soft bottoms. The reef environment is often characterized by a zonation of benthic (bottom-dwelling) communities of algae and animal species including concretions (hard compact mineral lumps), crust formations and coral formations.

Biogenic reefs are a subtype (code 1174) of the Natura 2000 habitat type reefs (1170). Biogenic reefs occur where the physical structure of the bottom is mainly built up by living sessile organisms, which in the Baltic Sea are most often blue mussels (Mytilus *edulis*). Blue mussels can form mat-like structures (blue mussel beds), in which there is often a rich diversity of both soft- and hard-bottom species (Naturvårdsverket, 2014). Blue mussel beds are included in the reef habitat type if these have a coverage rate exceeding 10% (Naturvårdsverket, 2011b).

Reefs are delimited by the surrounding bottom where reef formation transitions by more than 50% into soft bottom surfaces and/or where biogenic formations are less than 10% of the coverage (compare with the definition of sandbanks).

Table Table 6-9shows typical species for the reef habitat type.

Table 6-9. Typical species for the reef habitat type (1170). Only typical species that can occur in the brackish waters of the Baltic Sea are included in the table. Red listing: LC = Viable, NT = Near Threatened, VU = Vulnerable, EN = Critically Endangered, CR = Critically Endangered.

Swedish name	**Scientific name**	**Red listing 2020**
Fish		
Ål	*Anguilla anguilla*	CR
Mindre havsnål	*Nerophis ophidion*	LC
Tångsnälla	*Syngnathus typhle*	LC
Sjuströlig smörbult	*Gobiusculus flavescens*	LC
Stensnultra	*Ctenolabrus rupestris*	LC
Abborre	*Perca fluviatilis*	LC
Tejstefisk	*Pholis gunnellus*	LC
Tånglake	*Zoarces viviparus*	LC
Torsk	*Gadus morhua*	VU
Sik	*Coregonus maraena*	LC
Öring	*Salmo trutta*	LC
Sill	*Clupea harengus*	LC
Birds		
Ejder	*Somateria mollissima*	EN
Svärta	*Melanitta fusca*	VU
Sjöorre	*Melanitta nigra*	LC
Alfågel	*Clangula hyemalis*	NT
Bivalve		
Blåmussla	*Mytilus edulis*	LC
Bottom flora		
Sudare	*Chorda filum*	LC
Smalskägg	*Dictyosiphon foeniculaceus*	LC
Krulltrassel	*Stictyosiphon tortilis*	LC
Sågtång	*Fucus serratus*	LC
Blåstång	*Fucus vesiculosus*	LC
Ishavstofs	*Battersia arctica*	LC
Bergborsting	*Cladophora rupestris*	LC
Grovsläke	*Ceramium virgatum*	LC
Rödris	*Rhodomela confervoides*	LC
Fjäderslick	*Vertebrata fucoides*	LC

Kräkel	*Furcellaria lumbricalis*	LC
Kilrödblad	*Coccotylus truncatus*	LC
Blåtonat rödblad	*Phyllophora pseudoceranoïdes*	LC

6.4 Designated species

There are many species identified for the Natura 2000 areas that are potentially assessed to be affected by the surveys. The vast majority are terrestrial or live only very close to the coast. Therefore, only the species that are assessed to be affected are described below, the others have been delimited and will not be addressed in this EIS.

6.4.1 Grey seal

The grey seal (Halichoerus *grypus*) is the largest seal species in Sweden, where males can grow to over two metres in length and weigh up to 300 kg. The species occurs in the North Atlantic and throughout the Baltic Sea. The Baltic Sea population was previously threatened after a sharp population decline due to environmental toxins but has now recovered and is viable. The population is centred around the Stockholm archipelago and Åland, and the species is more common northwards in the Bothnian Sea and the Gulf of Bothnia than in the southern parts of the Baltic Sea (Sveriges lantbruksuniversitet Artdatabanken, 2024a). However, there are a few grey seal localities also further south, but the only place in the southern Baltic Sea where grey seal pups is regularly born is in Rødsand in Denmark (Galatius, o.a., 2020). Grey seals feed mainly on fish, but younger individuals can also eat crustaceans, mussels and snails. The species is currently threatened mainly by bycatch and drowning in fishing gear, but also environmental toxins and intestinal ulcers from parasites (Sveriges lantbruksuniversitet Artdatabanken, 2024a).

Grey seals become sexually mature at the age of between three and seven years and females give birth to a maximum of one pup per year, which in the Baltic Sea occurs in late February to early March. After the pups are born, they suckle for about two to three weeks, and at the end of the suckling period the seals also mate. Grey seals exchange fur during May and June when they gather in large packs on land. The reproductive period and fur exchange are both sensitive periods for grey seals, where large parts of the population gather in packs on drift ice, rocks and islands. These gathering places for the seals are called haunts (Havs- och vattenmyndigheten, 2019).

6.4.1.1 Grey seals and noise

Grey seals can perceive sounds within a range of approximately 1 to 100 kHz, with the highest sound sensitivity within approximately 11 - 12 kHz. This means a slightly lower sensitivity to sounds within low frequencies compared to other seal species in the Baltic Sea but should be interpreted with caution as the data is based on only one study (Helsinki Commission, 2019). Studies on the seals' reaction to noise, in this case from piling in connection with the construction of a wind farm in Denmark, show that grey seals avoid areas where they are disturbed, but that the avoidance is temporary and that the seal densities return to normal after the noise ceases (Edrén, o.a., 2010).

6.4.2 Harbour seal

The harbour seal is a smaller seal than the grey seal, with a length of about 1.5 meters and a weight of 70 to 100 kg. It is a well-spread species that is found in both the Atlantic and Pacific Oceans. In Sweden, harbour seals are mainly found in the Skagerrak and Kattegat. In the Baltic Sea, however, there is a smaller, genetically distinct population in and around Kalmarsund. This population consists of about 2000 individuals and is classified as vulnerable (VU) (Sveriges lantbruksuniversitet Artdatabanken, 2024b). This Baltic Sea population of harbour seals can occur in a somewhat wider area outside Kalmarsund, but that is where the main distribution area is located. It is also only in Kalmarsund and around Öland that the population's breeding grounds are found. (Helsinki Commission, 2017). Harbor seals mainly hunt in shallow and coastal areas and feed mainly on fish, but also shellfish. The threats to the species consist of several factors such as overfishing, bottom mortality, disturbances to breeding grounds, bycatch and drowning in fishing gear, and environmental toxins (Sveriges lantbruksuniversitet Artdatabanken, 2024b).

Harbour seal pups are born from late May to early July and are nursed for about three to four weeks after birth. Mating occurs at the end of the nursing period. Nursing takes place on land, although harbour seal pups can swim soon after birth. Harbour seals are also dependent on access to land-based roosting sites during the molting period. Female harbour seals exchange fur from late July to early August, while males exchange fur during the last two weeks of August. Both the reproductive period and the fur exchange period are sensitive times for harbour seals (Havs- och vattenmyndigheten, 2012a).

6.4.2.1 Harbour seals and noise

Harbour seals have good hearing both above and below the water surface, they can perceive frequencies between about 100 Hz and 100 kHz, but they hear best at frequencies around 10 kHz (Helsinki Commission, 2019). As with grey seals, studies in connection with piling foundations for offshore wind turbines have shown that the species avoids noise disturbances, but only temporarily and returns when the noise ceases (Edrén, o.a., 2010).

6.4.3 Harbour porpoise

Harbour porpoises are a very small whale species, one of the smallest toothed whales, and grow to a maximum of about 2 meters long and weigh about 70 kg. The species occurs in the Northern Hemisphere in cold and temperate waters. In Sweden, the harbour porpoises can be divided into three populations: the North Sea population, the Belt Sea population and the Baltic Sea population. The border between the Baltic Sea population and the Belt Sea population is usually stated to be between Listerlandet in Skåne and Jarosławiec in Poland during the summer months. During the winter months, the harbour porpoises move over larger areas and there is no clear population boundary (Havs- och vattenmyndigheten, 2021). The Baltic Sea population of harbour porpoises is very small and currently consists of an estimated 500 animals (Amundin, o.a., 2022). The species is assessed as critically endangered (CR) (Sveriges lantbruksuniversitet Artdatabanken, 2020). Harbour porpoises usually live alone or in small groups. They mainly eat fish and most often herring, sprat or young cod. The greatest threats to the Baltic Sea population of harbour porpoises are assessed to be environmental toxins, bycatch in fishing and increased noise disturbance (Sveriges lantbruksuniversitet Artdatabanken, 2024c).

Female harbour porpoises reach sexual maturity at around 3-4 years of age. Mating takes place from July to August and the young are born from May to July of the following year. After birth, the calf follows its mother and nurses for around eight to ten months (Havs- och vattenmyndigheten, 2021). During the reproductive period from May to August, the Baltic harbour porpoises gather and are mainly found around the offshore banks within Stora Middelgrund and Hoburgs bank, south of Gotland and east of Öland (Static Acoustic Monitoring of the Baltic Sea Harbour Porpoise, 2016). Studies conducted on harbour porpoises in the Baltic Sea otherwise show the highest harbour porpoise density south of Scania, most of these individuals probably belong to the Belt Sea population. During the winter, harbour porpoises in the Baltic Sea are more spread out and can occur all the way to Åland (Carlén, o.a., 2018)(Figure 6-7and Figure 6-8). Four areas of particular importance for the Baltic harbour porpoise have been identified based on modelling; these are generally large areas that are used by many individuals all year round. These are Hanöbukten, Midsjöbankarna and Hoburgs bank, south of Öland and north of Öland. However, it should be noted that the modelled important areas north of Öland are only assessed to be used during November to April (Carlström & Carlén, 2016).

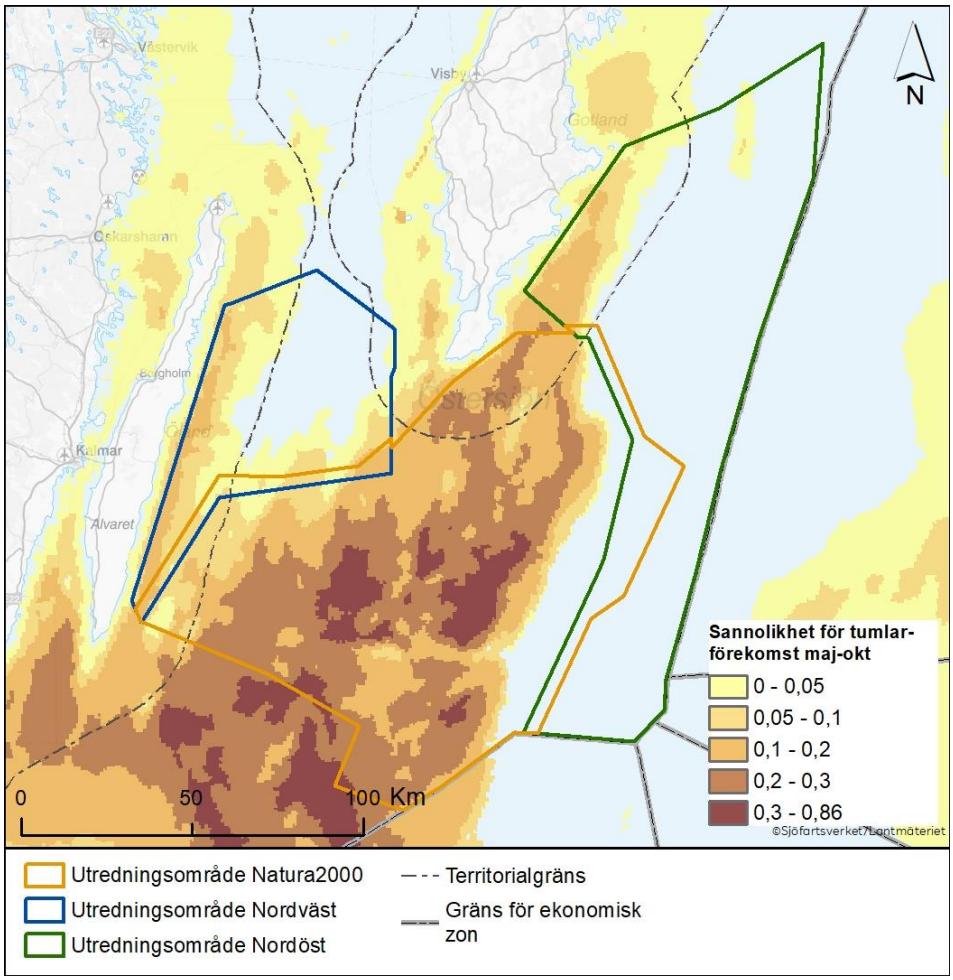

Figure 6-7. Probability of occurrence of Baltic harbour porpoises according to data from the Helsinki Commission (HELCOM), based on studies carried out within the LIFE+ project Static Acoustic

Monitoring of the Baltic Sea Harbour Porpoise (SAMBAH) from 2011 to 2013. The figure shows densities during the summer months of May to October.

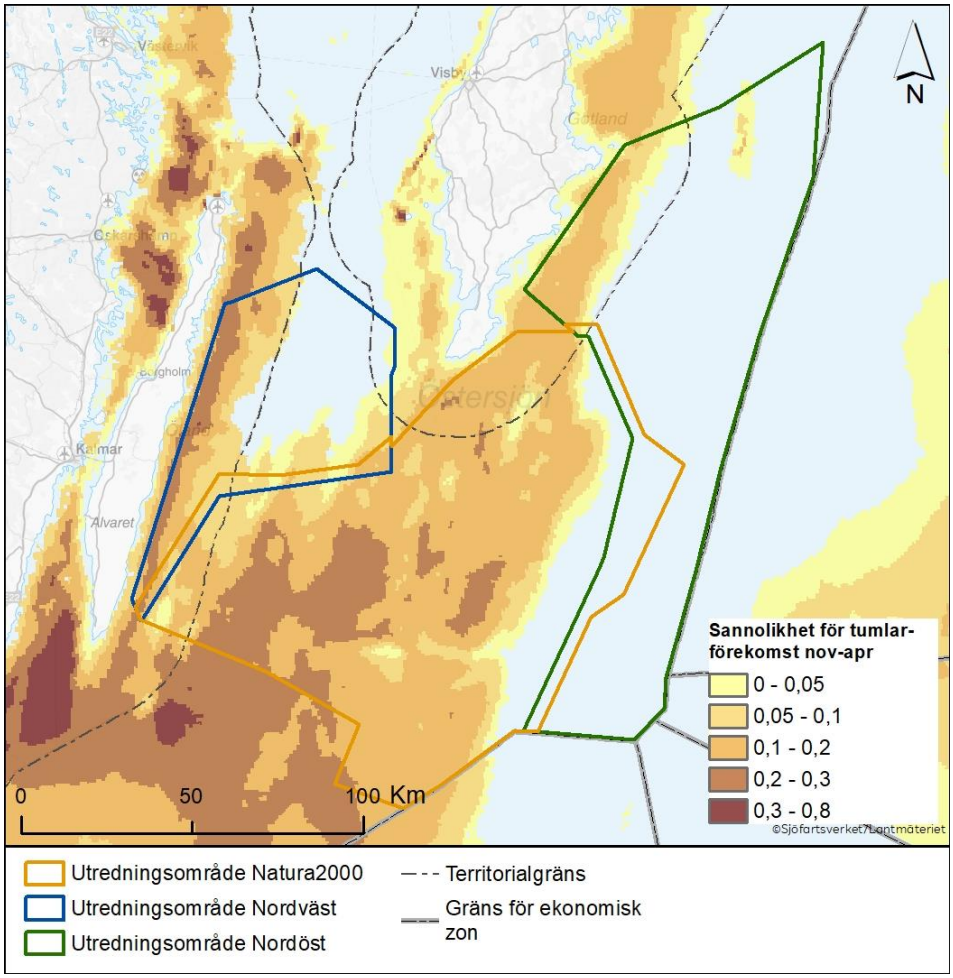

Figure 6-8Probability of occurrence of Baltic harbour porpoises according to data from HELCOM, based on studies conducted by SAMBAH from 2011 to 2013. The figure shows densities during the winter months of November to April.

6.4.3.1 Harbour porpoises and noise

Harbour porpoises use sound in the form of echolocation clicks for communication, navigation and hunting. They are therefore dependent on their hearing and can perceive sounds within a large frequency range, between approximately 0.3 and 160 kHz (Southall, o.a., 2019). However, they hear best within the higher frequencies (Havs- och vattenmyndigheten, 2021). This coincides well with the frequencies within which their echolocation occurs, also those above 100 kHz (Tougaard & Michaelsen, 2018). In addition to the risk of injury, noise can lead to avoidance behaviour and masking of porpoises' echolocation (Andersson, o.a., 2016). Behavioural disturbances can take many different forms and can range from a change in behaviour, an interrupted hunt, an avoidance of a certain area, or in more serious cases panicked flight. Panicked flight involves the risk of separation between mother and calf and an

increased risk of bycatch in nets and is an obviously negative effect. However, even minor effects on behaviour, such as interrupted hunting, can have a cumulative negative effect in the event of repeated disturbances that result in reduced food intake. These effects are, however, difficult to quantify (Tougaard & Michaelsen, 2018). In studies of the avoidance behaviour of porpoises during the piling of wind farms, avoidance has been observed for a few hours to a maximum of a day after the noise has ceased (Brandt, o.a., 2018; Dähne, o.a., 2013).

6.4.4 Long-tailed duck

The long-tailed duck is a small diving duck that feeds primarily on mussels, crustaceans and insects. The population of long-tailed duck (*Clangula hyemalis*) that winters around Hoburgs Bank and Midsjöbankarna breeds in the high Arctic areas around tundra areas in Russia but also to a lesser extent in the Swedish mountain areas (Sveriges lantbruksuniversitet Artdatabanken, 2024d). The population is classified as critically endangered (Rödlistade arter i Sverige 2020, 2020). Hoburgs Bank and Midsjöbankarna are the largest wintering site for the population, but wintering also occurs to a relatively large extent along the east coast of Gotland. The long-tailed duck arrives at these wintering sites from October and stays until April-May. The inventories that in 1992–1993 showed a wintering population of approximately 1.4 million individuals were followed up in 2007–2009 and the population had then decreased by almost 70% and only approximately 0.4 million wintering individuals were found. One of the biggest threats to the long-tailed duck is illegal oil spills, along with being caught in fishing nets as bycatch. However, this cannot fully explain why populations have declined sharply in recent years, as this was also happening before the 1990s. One explanation is believed to be the deterioration of the quality and nutritional content of Baltic Sea mussels and the deterioration of breeding areas on the Arctic tundra (Sveriges lantbruksuniversitet Artdatabanken, 2024d).

6.4.5 Black guillemot

The black guillemot is a small alka that in Sweden breeds on the coasts and remote islands in the outer archipelago. It occurs in two different populations in Sweden, the East Atlantic that breeds around the west coast and the North Atlantic, and the Baltic Sea population (Larsson, 2016). It is important that the breeding sites are completely free of predatory mammals, which is why the breeding sites have become fewer and fewer with the spread of the mink. The mink is seen as the greatest threat to the species and has exterminated several smaller local populations. Oil spills and bycatch in fishing nets have also contributed to a decreasing population in Sweden (Sveriges lantbruksuniversitet Artdatabanken, 2024e). The species is classified as near threatened (Sveriges lantbruksuniversitet Artdatabanken, 2020). The black guillemot dives to a maximum depth of 30 meters to catch food and the majority of its food in the Baltic Sea comes from viviparous eelpout (*Zoarces viviparus*), but it also eats crayfish and mussels to a lesser extent (Sveriges lantbruksuniversitet Artdatabanken, 2024e). The Baltic Sea population moves from the outer archipelago to the Midsjöbankarna and the east coast of Gotland to overwinter, approximately 90% of the Baltic Sea population overwinters here. The black guillemot is normally found on Hoburgs Bank and the Midsjöbankarna during the period October to May (Durinck, Skov, Jensen, & Pihl, 1994).

6.4.6 Common eider

Common eider (*Somateria mollissima*) is a designated species for the habitat type sandbanks and reefs that occur within the Natura 2000 area Hoburgs bank and Midsjöbankarna. The species is classified as critically endangered (Swedish University of Agricultural Sciences Species Data Bank, 2020) . The Eider bird mainly feeds on mollusks (mostly blue mussels), isopods, insects and plants, which are retrieved from the seabed at depths of up to 20 m. The ongoing population decline of the species is believed to be due to several factors. The Eider previously had good population growth until the mid-1990s, which is related to increased nutrient levels along Sweden's coasts. This was in turn considered to contribute to a strong increase in the biomass of blue mussels. When nutrient levels have decreased since the mid-1990s, this has in turn led to a deterioration in the quality and/or reduced availability of the main food, blue mussels, which are important for the eider. The decline in the eider is also believed to be due to predation of brooding females by white-tailed eagles and mink, which has led to a skewed sex ratio with a deficit of females; several other theories also exist (Sveriges lantbruksuniversitet Artdatabanken, 2024f) .

Most Swedish common eiders do not overwinter in the Baltic Sea but in the shallower areas in the Danish parts of the Kattegat east of Jutland and along the eastern coast of Jutland and around the islands existing in the area. In somewhat smaller numbers, the common eider is also found during its wintering in the southern Baltic Sea and along the Norrland coast. The common eider then moves to its breeding grounds during a concentrated period in early April. The common eider is then coast-bound during the breeding season and breeds along the entire coast of Sweden and in archipelago environments (Sveriges lantbruksuniversitet Artdatabanken, 2024f) . It is mainly during inventories during late winter periods and spring, that is, during the common eider's migration period, that a small number of common eiders have been observed on the shallower banks within the Natura 2000 area. The common eider then moves on to its breeding grounds, including along the south coast of Gotland (Länstyrelsen Gotlands län, 2018) .

6.5 Typical species

Each Natura 2000 site has designated habitat types which in themselves have typical species that represent that particular type of habitat. Typical species should be indicators of the conservation status of the habitat type, be easy to monitor, identify and quickly indicate changes in the habitat. They should also have a geographical distribution within their designated habitat type and not be too specialized.

Within a Natura 2000 area, the species are protected under Natura 2000 legislation, but outside the area they are subject to the same legislation as other species (for example, the Species Protection Regulation or the Birds Directive) but have no specific protection because they are typical species for a Natura 2000 habitat type.

6.5.1 Fish

Four fish species have been included in the assessments based on their being typical of the designated habitat types of reefs and sandbanks, food for designated species and/or hearing specialists; herring, sprat, cod and viviparous eelpout.

Sound and vibration can negatively affect fish by causing temporary or permanent hearing damage or temporary behavioural changes. Behavioural changes include avoidance of areas, absence/interruption of play, or general stress which in turn can lead to reduced food intake or interrupted foraging. Sufficiently high sound levels can even have direct lethal consequences (Isæus, Beltrán, Stensland Isæus, Öhman, & Andersson-Li, 2022; Hawkins & Picciulin, 2019).

Hearing is a very important sense for fish, which can generally detect a wide range of sounds and distinguish between different types of sounds, filter out relevant sounds from background noise and distinguish from which direction a sound is coming. The majority of fish species have a hearing range between 30 Hz to 1000 Hz, most commonly 50 Hz to 500 Hz, but there are species that can hear down to 20 Hz and up to 20 kHz (Thomsen, Lüdemann, Kafemann, & Piper, 2006; Popper & Hastings, 2009).
Fish with a narrower frequency range in hearing are often called “auditory generalists” while fish with broader hearing ranges are called “auditory specialists”. The difference between these is related to specialized anatomical structures that enhance hearing sensitivity and bandwidth (Popper & Hastings, 2009). Fish with a swim bladder are generally more sensitive to sounds/hear a wider spectrum than fish without a swim bladder but are not classified as hearing specialists for this reason alone. Species that are considered hearing specialists (for example, herring and sprat) also have a connection between the swim bladder and the inner ear, which makes them even more sensitive to sound (Isæus, Beltrán, Stensland Isæus, Öhman, & Andersson-Li, 2022; Thomsen, Lüdemann, Kafemann, & Piper, 2006).

NOAA (National Oceanic and Atmospheric Administration) in the USA made a compilation of acoustic limit values for different aquatic species in 2023. (National Oceanic and Atmospheric Administration, 2023). This compilation does not differentiate between different fish species, only in some cases the size of the fish. This means that many fish species, especially those that are not considered hearing specialists, can generally be exposed to higher sounds than stated in the report without showing the same effects. The report presents different sound levels, weighted for fish, and shows that fish are at risk of physical damage from direct sounds of 206 dB. If they are exposed to the sound continuously for 12 hours, sound levels of 187 or 183 dB are sufficient depending on whether the fish weighs more or less than 2 grams. Direct mortality for fish occurs at 229 dB with immediate exposure.
The value for behavioural changes is set at 150 dB. 150 dB is considered a very low set value, many species will not be affected at such low sound levels, but it is at this level that one can potentially start discussing behavioural changes in some species. Therefore, 150 dB should be seen as an extreme worst-case scenario in the EIA impact assessment for fish.

6.5.1.1 Herring

Herring is a so-called hearing specialist and a typical species for the Natura 2000 habitat types of sandbanks and reefs. Herring is classified as viable (LC) in both the Swedish and HELCOM red lists (Sveriges lantbruksuniversitet Artdatabanken, 2020; Helsinki Commission, 2013). Herring spawn in both autumn and spring when the water temperature is between 4–13 degrees. Spawning occurs in shallower water than 40 meters for autumn-spawning herring and only to 15 meters for spring-spawning herring, and above all close to the coast, regardless of season (Havs- och vattenmyndigheten, 2024b).

According to HELCOM, the investigation area is not considered to have a high probability of being a spawning area for herring. To a lesser extent, spawning herring can potentially occur on the edges of the investigation areas and to some extent in the shallow areas within the Natura 2000 investigation area. Herring can, however, occur throughout the Baltic Sea, including all SGU's investigation areas, see Figure 6-9.

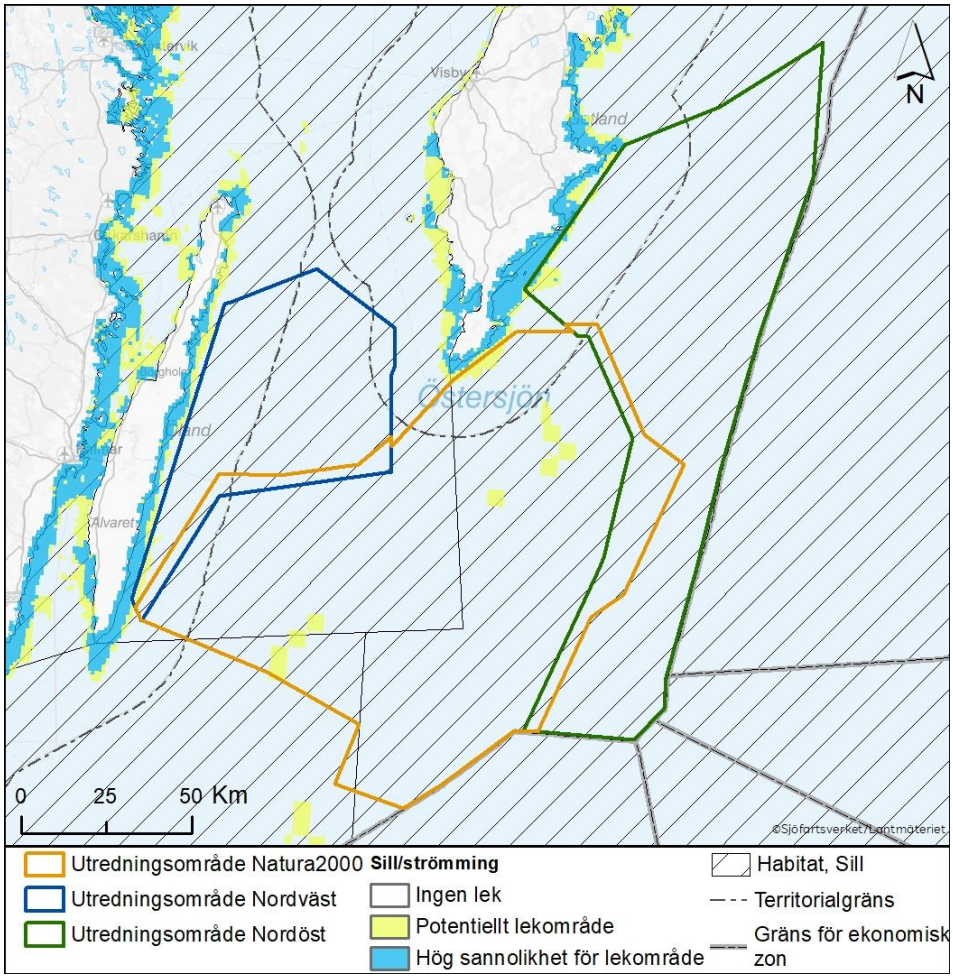

Figure 6-9. Spawning areas for herring, distributed across potential areas and areas with high probability. Herring can occur in all investigation areas.

6.5.1.2 Sprat

The sprat is a so-called hearing specialist and one of the fish species that has the best hearing and is therefore most sensitive to the impact of loud noises (Bergström, o.a., 2022). The sprat is a typical species for the Natura 2000 habitat type sandbank. The sprat is classified as viable (LC) in both the Swedish and HELCOM red lists (Sveriges lantbruksuniversitet Artdatabanken, 2020; Helsinki Commission, 2013). The sprat spawns between January and August, primarily from March in the Baltic Sea, with its most sensitive period between June and August (Havs- och vattenmyndigheten, 2024b; Havs- och vattenmyndigheten, 2024c). The spawning takes place down to 40 meters, however in the open water mass, which is why spawning can occur in large

parts of the Baltic Sea regardless of bottom depth, including investigation areas, see Figure 6-10. The sprat can also use the area for other purposes, such as foraging, during other parts of the year.

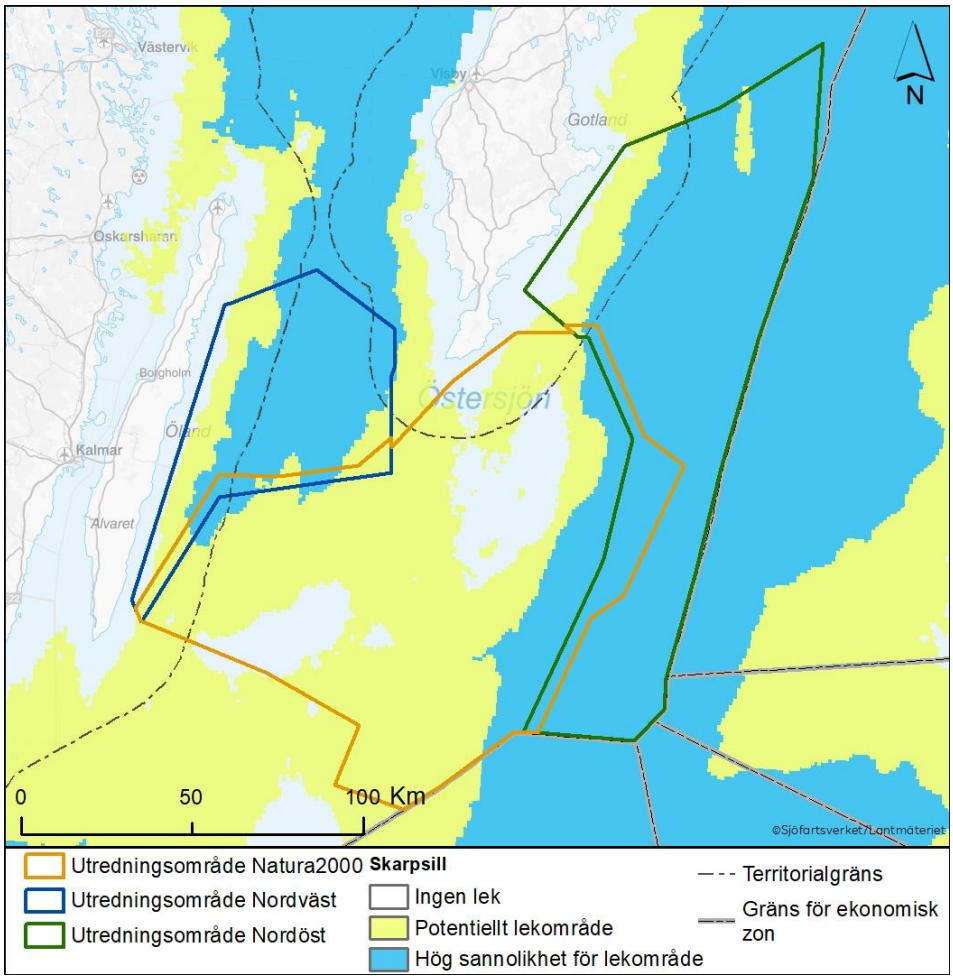

Figure 6-10Spawning areas for sprat, distributed across potential areas and areas with high probability.

6.5.1.3 Cod

Cod, unlike herring and sprat, is a hearing generalist. This means that it lacks a connection between the inner ear and the swim bladder, but it has a swim bladder, which makes it more sensitive to sound than species that lack this organ. In cod, the swim bladder is also located close to the ear, which gives the species more sensitive hearing than several other species with a swim bladder (Thomsen, Lüdemann, Kafemann, & Piper, 2006; Andersson, o.a., 2016). Cod is a typical species for the Natura 2000 habitat types of sandbanks and reefs and occurs throughout the Baltic Sea, see Figure 6-11. Cod is classified as vulnerable (VU) in both the Swedish and HELCOM red lists, the status has been improved from highly endangered (2010 for the Swedish red list and 2007 for HELCOM) (Sveriges lantbruksuniversitet Artdatabanken, 2020; Helsinki Commission, 2013). Cod spawning can occur all year round in the Baltic Sea and the cod then seek out deep burrows, preferably deeper than 100 meters, but then fertilization takes place at the surface and the eggs are pelagic. Although spawning in the Baltic Sea can occur all year round, it is most intense from April to August (Havs- och vattenmyndigheten, 2024b; Havs- och vattenmyndigheten, 2024d). Spawning areas for cod in the Baltic Sea are shown in Figure 6-11, the investigation areas are not located within an area with a high probability of cod spawning. Potentially, cod could spawn in a very small part of the southeastern part of the investigation area Northeast. However, this part of the investigation area is classified as anoxic, which means that the oxygen levels at the bottom are ≤ 2 mg/l and thus not sufficient for cod eggs to develop (Sveriges meteorologiska och hydrologiska institut, 2023). This means that even if cod spawn in the area (which occurs in the open water mass), it is unlikely that the cod eggs will develop further and contribute to the cod population in the Baltic Sea.

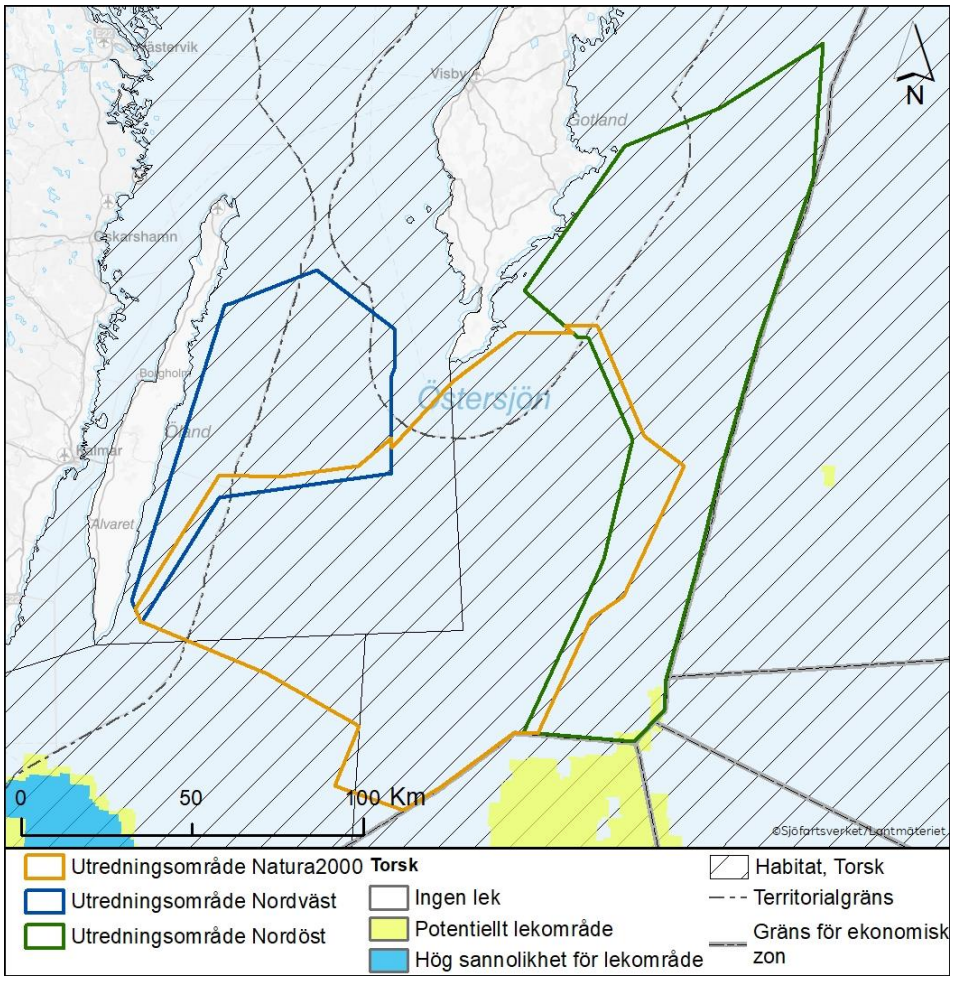

Figure 6-11Spawning areas for cod, distributed across potential areas and areas with high probability. Cod can occur in all investigation areas.

6.5.1.4 *Viviparous eelpout*

Viviparous eelpout is a designated species for reef and sandbank habitats and the main food for black guillemot. Viviparous eelpout is common throughout the Baltic Sea down to about 40 meters, see Figure 6-12.

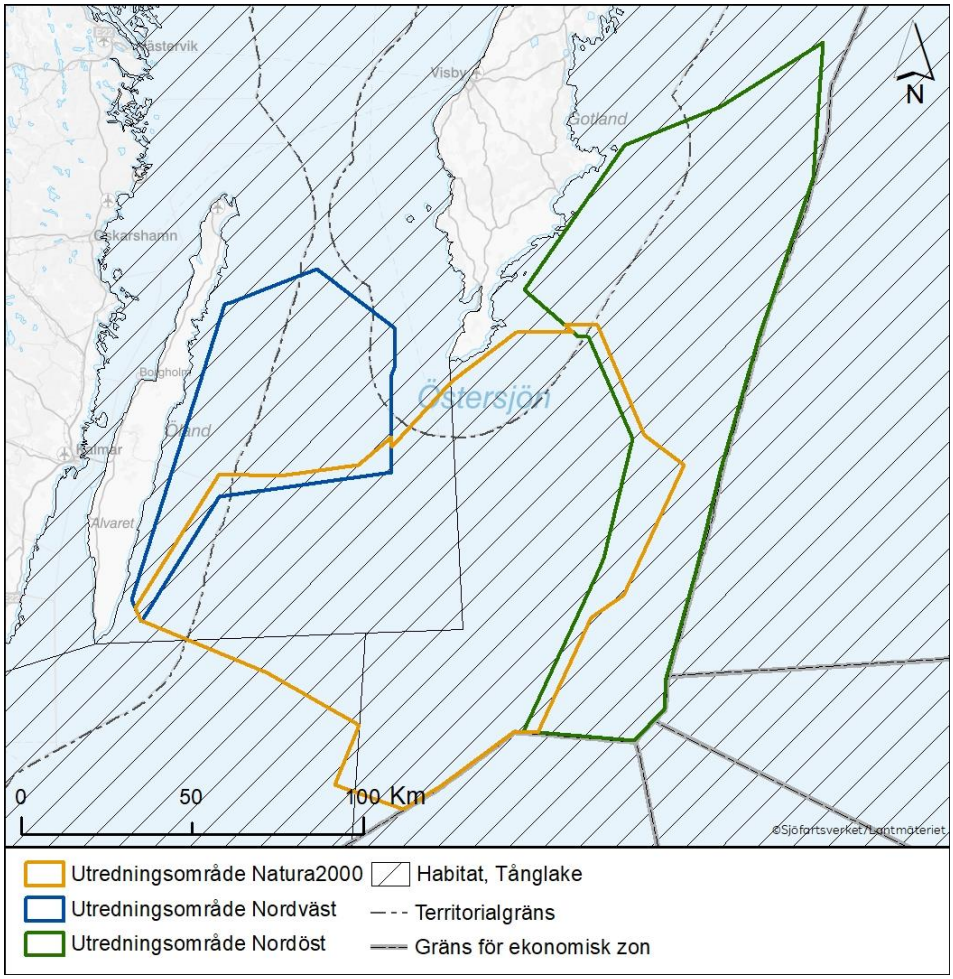

Figure 6-12All investigation areas can be utilized by viviparous eelpout.

The viviparous eelpout is classified as viable (LC) in the Swedish Red List and near threatened (NT) in HELCOM. The species was also classified as near threatened in the Swedish Red List in 2010 but has been classified as viable since 2015. (Sveriges lantbruksuniversitet Artdatabanken, 2020; Helsinki Commission, 2013). It lives mainly on hard bottoms and reefs where it eats snails, mussels and crustaceans but also smaller fish and eggs. The viviparous eelpout in the Baltic Sea shows a declining population but the reasons are unclear. The viviparous eelpout spawns in August and September (Sveriges lantbruksuniversitet Artdatabanken, 2024g). The viviparous eelpout spawns on shallow hard bottoms down to about 20 meters for a relatively short period in August and September (Havs- och vattenmyndigheten, 2024b), it is therefore unlikely that the investigation areas constitute a primary spawning area for the species, although some spawning on shallow reef areas cannot be completely ruled out.

Although the viviparous eelpout is not classified as a hearing specialist, it has a swim bladder, which makes it more sensitive to loud sounds than species that lack this organ (Isæus, Beltrán, Stensland Isæus, Öhman, & Andersson-Li, 2022).

6.5.2 Birds

6.5.2.1 Common mure

The common murre (*Uria aalge*) is a typical species for the habitat type Sea cliffs which is designated for Stora and Lilla Karlsö where the species also breeds on the cliffs. The common murre breeds on the Baltic coast up to Ångermanland but also on the west coast. However, the Karlsöarna constitute some of the largest colonies for the species and are considered very important. The species is a diving bird that feeds on pelagic fish and can dive relatively deep, which is why they do not need to stay around shallow banks. The common mure is classified as viable (LC) and has had an increasing population for the last 30 years but has stopped and is now at a stable level (Sveriges lantbruksuniversitet Artdatabanken, 2020; Sveriges lantbruksuniversitet Artdatabanken, 2024h; Larsson, 2016).

6.5.2.2 Razorbill

Razorbill (*Alca torda*) is a typical species for the habitat types Sea cliffs and rocks in the Baltic Sea which are designated for Lilla and Stora Karlsö and the sea areas of South-Eastern Öland . The species breeds both at the Karlsöarna and the Småland coast, breeding can occur as far north as Ångermanland and also in larger colonies on the west coast. Although the species occurs along most of the Swedish Baltic coast, the density is greatest around Stora and Lilla Karlsö and the tip of southern Gotland. Just like the common murre, the razorbill is a diving bird that feeds on pelagic fish and can dive relatively deeply, which is why they do not need to stay around shallow banks. The species is classified as viable (LC) with an increasing population (Larsson, 2016; Sveriges lantbruksuniversitet Artdatabanken, 2020; Sveriges lantbruksuniversitet Artdatabanken, 2024i).

7 Environmental effects and consequences

Noise modelling shows that the geophysical surveys will emit noise that could cause behavioural disturbances to fish within a maximum distance of 9 km. For other animals, the distances are smaller, so this is the largest modelled impact distance. This means that noise from the surveys is not likely to cause disturbing noise levels in other Natura 2000 areas than those presented in section 6.1, nor in the majority of these.

The assessments regarding noise below assume that the protective measures specified in Chapter 10are applied.

7.1 Investigation area Northeast

In the Northeast investigation area, assessments are based on the Natura 2000 area Gotska Sandön- Salvorev.

Below is an account of, and impact assessment of, the species that are assessed to be affected by the surveys within, and to some extent outside, this area. No impact on habitats is assessed as the investigation area does not include any Natura 2000 area and habitats are only assessed to be affected if the survey vessel is within the habitat.

7.1.1 Seal

There are a few grey seal rookeries along the eastern coast of Gotland, mainly around Östergarnsholm where between 0 and 65 grey seals have been observed during fur sewing in recent years. However, the most important areas for seals are mainly further north at Fårö and Gotska sandön, where the Natura 2000 area Gotska Sandön- Salvorev (SE0340097) with grey seals as a constituent species is also found.

Sound modelling for the area shows that the risk of permanent threshold shift (PTS) in seals occurs within less than 20 m from the sound source. The risk of temporary threshold shift (TTS) occurs within a maximum of 400 m from the sound source. However, when using the proposed protective measures in the form of a soft start, any seals in the vicinity will have time to move away from the vicinity before the noise reaches full volume. The risk of hearing damage to seals is therefore assessed as negligible.

Noise that could have a behavioural impact on seals occurs at most approximately 2.6 km from the sound source in a worst-case scenario. The distance to the Natura 2000 area Gotska Sandön- Salvorev is approximately 45

km, whereby no disturbance of seals is expected within this area. This assessment that the seals at the Natura 2000 area are not considered to be affected is based on a worst-case assessment from the closest point in the investigation area Northeast to the Natura 2000 area at Gotska Sandön. Disturbance of possible seals on and around Östergarnsholm (which is a smaller island east of Östergarnslandet along the south-east coast of Gotland) cannot be completely ruled out during the investigation period. This area is estimated to be approximately 2 – 3 km from the investigation area depending on how SGU's final survey transects are designed. However, if the seals are on land, as they tend to do during their moulting period, they will not perceive the sound from the geophysical surveys. Overall, some behavioural impact on individual seals along the Gotland coast cannot be ruled out, however, this impact is short-term and is not expected to have any population effects. Disturbance is also not expected in areas that are protected with respect to seals. Overall, the impact on grey seals from the geophysical surveys in the Northeast investigation area is therefore assessed to be small with small to negligible consequences.

7.1.2 Harbour porpoise

Within large parts of the Northeast investigation area, there is limited data on the distribution of harbour porpoises (Figure 6-7). However, there are tendencies that harbour porpoise density is somewhat lower in the deeper areas of the Baltic Sea, and it is possible that this also applies within the Northeast investigation area as it covers areas with great depths. During the summer months when the area is planned to be investigated, the core area for harbour porpoises is in and around the southern Midsjöbanken and across the Northern Midsjöbankarna up to Hoburgs bank, that is, within the Natura 2000 area Hoburgs bank and Midsjöbankarna (SE0330308) where harbour porpoises are an included species. Therefore, the most suitable time of year to investigate other parts of the Baltic Sea is precisely during the summer when the Baltic harbour porpoises are concentrated in their core area (Havs- och vattenmyndigheten, 2024e). In SAMBAH's survey in 2011 – 2013, which to date constitutes the only large-scale monitoring of harbour porpoises in the Baltic Sea, very few or no detections of harbour porpoises were seen along the east coast of Gotland during May to October (Amundin, o.a., 2022).

The survey vessel will not pass directly adjacent to the Natura 2000 area Hoburgs bank and Midsjöbankarna, but one of the precautionary measures to protect harbour porpoises is a protection zone of 14 km to the Natura 2000 area to reduce noise impact. Therefore, the sound reaching the Natura 2000 area is expected to be at most approximately SPL $_{RMS}$ 75 dB or SEL 102 dB weighted for harbour porpoises when the vessel is closest. These noise levels are not associated with a risk of hearing damage to harbour porpoises. The expected noise levels are also not associated with behavioural disturbances (Danish Energy Agency, 2022). Therefore, no disturbances to harbour porpoises within Hoburgs bank and Midsjöbankarna are expected because of the geophysical surveys in the investigation area Northeast. The consequence of the geophysical surveys in the investigation area Northeast for porpoises within the Natura 2000 area will be negligible.

The noise from the seismic surveys poses a risk of permanent threshold shift (PTS) to harbour porpoises only within less than 50 meters from the sound source. The risk of temporary threshold shift (TTS) occurs at most 600 meters from the sound source. When the proposed protective measures of monitoring

of harbour porpoises and soft start are used, it is ensured that harbour porpoises are not too close to the ship, and they are also given time to move away from the vicinity before harmful noise levels are reached. With these measures, the risk of hearing damage to porpoises in connection with the geophysical surveys is assessed to be negligible.

Noise that can cause behavioural disturbances in harbour porpoises can occur up to 2.7 km from the sound source in a worst-case scenario. The proposed protective measures involve monitoring of harbour porpoises before take-off coupled with soft start of noise-generating equipment. This should reduce the shielding effect as harbour porpoises are not expected to be in direct proximity to the sound source at take-off and the noise increases gradually. When encountering the vessel during operation, this also means a gradual approach to the sound source and a gradual increase in noise levels. Therefore, panic-like reactions and flight in harbour porpoises are not expected. Behavioural impact is therefore likely to occur in the form of interrupted hunting and avoidance behaviour.

It is difficult to quantify the impact of interrupted hunting behaviour or avoidance on an individual harbour porpoise. In the case of several interrupted hunts over a shorter period of time, the fitness of the animals, i.e. the general condition of the animals, may be negatively affected as it makes foraging more difficult the current case of geophysical surveys in the investigation area Northeast, the core area of the harbour porpoises is not affected. However, there may be harbour porpoises in the area and individual individuals may experience noise that disrupts their natural behaviour. The density of harbour porpoises in the area is likely low based on the data available. It is therefore likely that no or only a few individuals will be affected during the survey. As the area is being surveyed for a relatively short period of time with protective measures to mitigate the impact, the possibility of recovery for any affected individuals is assessed to be high and the survey is assessed not to have any population effects. The impact on both individual harbour porpoises and the Baltic Sea population is assessed, provided that protective measures are taken, to be negligible with negligible consequences.

7.1.3 Fish

For the two designated habitat types, sandbanks and reefs, which occur in nearby Natura 2000 areas to the Northeast investigation area, all four assessed fish species are typical; herring, sprat, cod and viviparous eelpout The surveys in the area will take place in the summer when all species can potentially spawn, although herring spawning is probably limited as it mainly spawns in spring and autumn and outside the investigation area. Cod only spawns possibly in a very limited area of the southeastern part of the area. ling spawning probably does not occur within the area, while sprat spawning may occur in almost the entire investigation area. For spawning areas, see Figure 6-9to Figure 6-11.

The modelling of the expected noise from the geophysical surveys shows that the area where fish are at risk of temporary threshold (TTS) or permanent threshold shift (PTS) is both less than 50 metres from the sound source. Depending on local conditions, behavioural changes are estimated to occur at most 5 to 8 km from the sound source. The surveys within the Northeast investigation area are not estimated to contribute noise that exceeds levels of behavioural change (150 dB) in any Natura 2000 site.

With protective measures such as soft start, the risk of temporary and permanent hearing damage to all fish species is assessed to be negligible as it is unlikely that more than a few individuals would be within 50 metres of the sound source when these sound levels are reached. However, behavioural changes for the species are assessed to be possible as it is not certain that the species will leave the area exposed to these sound levels and if they do leave the area, it could mean interrupted spawning.

The spawning of the sprat could be negatively affected during the time that the surveys are ongoing by being interrupted within the sound-affected area. The same applies to cod, although its spawning area within the sound-affected area is very limited, only classified as potential and any fertilized eggs have a low probability of contributing to the population due to the oxygen-poor conditions in the area. The area affected by sound is constantly moving, which is why it is unlikely that individuals will be affected for any longer period and spawning can therefore be resumed relatively quickly. Both sprat and cod have long spawning periods, so even if some spawning stops for a shorter period, it is not considered to affect the populations and the impact from the surveys is therefore considered to have only a negligible impact.

Reduced foraging and general stress could occur within the impact area with elevated noise levels. The ship is constantly moving and thus the impact area with it, the surveys are taking place over a shorter period and not all day in the same place. The assessment is that fish may be affected for a limited period and during this experience stress and have a reduced food intake. However, this is not considered to threaten the species at the population level and individuals are considered to recover relatively quickly after the surveys have been completed. The effects on general stress and reduced food intake are therefore considered to be negligible.

The consequences for all fish species taken together are assessed to be negligible.

None of the species are affected within any Natura 2000 area.

7.1.4 Birds

No bird species are assessed to be directly or indirectly affected within any of the Natura 2000 areas around the Northeast investigation area.

This impact assessment is based on the assessment that fish are not affected in the surrounding Natura 2000 areas in section 7.1.3. This assessment therefore contributes to ensuring that there is no indirect impact on the birds' foraging for fish in the Natura 2000 areas.

Furthermore, it is not considered that birds in surrounding Natura 2000 areas could be disturbed by the underwater noise of the geophysical surveys. The survey vessel is also not considered to disturb birds in surrounding Natura 2000 areas because the vessel is located so far from the geographical boundary of the Natura 2000 areas.

There are plans at the Swedish Environmental Protection Agency for Sweden to possibly designate additional Natura 2000 areas along the east coast of Gotland. The assessment for this area is equivalent to the above conclusion for the currently designated Natura 2000 areas where there are birds with designated Natura 2000 protection.

Overall, the consequences for birds in the Northeast investigation area and protected birds in the closest surrounding Natura 2000 areas are assessed to be negligible.

7.1.5 Overall assessment of the Natura 2000 site conservation status

No species are assessed to be affected within the Natura 2000 area Gotska Sandön- Salvorev or the Natura 2000 area Hoburgs bank and Midsjöbankarna. Since the surveys in the investigation area Northeast are not carried out within any Natura 2000 area, no habitat types are affected either.
Based on this, the conservation status of any of the above Natura 2000 areas is not assessed to be affected.

7.2 Investigation area Natura 2000

The Natura 2000 investigation area includes approximately 6700 km^2 of the Natura 2000 area Hoburgs bank and Midsjöbankarna, which is approximately 65% of the area. According to the area's conservation plan, seismic surveys and the use of sonars and echo sounders may negatively affect the area's conservation values. Ship traffic in and between the shallow area has previously led to oil and chemical spills, which have affected the long-tailed duck and black guillemot as well as other high nature values. Ships in the area may also lead to increased sediment turbidity.

Below is an account of, and impact assessment of, the species and habitat types that are considered to be affected by the surveys within, and to some extent outside, the Natura 2000 area Hoburgs bank and Midsjöbankarna.

7.2.1 Seal

The area in question is located at a great distance from the nearest protected area with seals as a species. At the southern tip of Gotland there are a couple of grey seal rookeries, Raude Hund and Hoburgen. At these rookeries, between about 10 and 60 individuals are usually observed at the fur sewing, although in some years there have been fewer or more. The current investigation area has about 3.5 km from the coast at the southern tip of Gotland.

Modelling of the expected noise from the surveys shows that they do not pose a risk of permanent threshold shift (PTS) in seals. Temporary threshold shift can, depending on the circumstances, occur within approximately 50 to 300 meters from the sound source, and behavioural disturbances at most 3.3 km depending on the conditions of the area.

This means that the seal rookeries at the southwestern tip of Gotland are not at risk of being exposed to noise levels associated with injury or behavioural disturbances in seals. This excludes any impact on seals when they are on or around these rookeries during the sensitive reproductive period. The noise levels are also not expected to cause any disturbance to seals in any nearby Natura 2000 area with grey seals or harbour seals as designated species.

For seals that are in the investigation area during the geophysical survey, the risk of injury is not expected to arise if protective measures in the form of soft start are observed. This gives seals the opportunity to leave the immediate area before the noise level reaches harmful levels. The impact will therefore be at most a behavioural impact in the form of temporary avoidance of the immediate

area around the survey vessel. Since seals mainly hunt in water shallower than 50 meters, (Sjöberg & Ball, 2000; Tollit, o.a., 2006) no significant disturbance to their hunting behaviour is expected as the investigations mainly take place in deeper water.

The impact is assessed to be negligible with negligible consequences on seals from geophysical surveys within the Natura 2000 investigation area.

7.2.2 Harbour porpoise

The Natura 2000 investigation area will be surveyed during the winter months when the harbour porpoises are more dispersed than during the summer months when they are mainly concentrated in the current Natura 2000 area (Figure 6-7). Although Hoburgs Bank and the Midsjöbankarna are one of the most important areas for the Baltic harbour porpoises, the density of harbour porpoises is relatively low, especially compared to areas in the Belt and Kattegat where other harbour porpoise populations occur. During a transect survey for porpoises in the area carried out over nine days in August 2022, no porpoises were seen, while 12 were detected using acoustic methods. Based on this, the area was estimated to have a density of 2.5 porpoises per 1000 km^2 , which is like the estimates made by SAMBAH (Länsstyrelserna Gotland och Kalmar län, 2022). This is during the summer months when the densities of porpoises in the area are expected to be highest. During the survey period for the Natura 2000 investigation area, which takes place in winter, harbour porpoise densities in the area are expected to be lower than this.

Modelling of noise dispersion within the area from the geophysical equipment shows that the risk of PTS to harbour porpoises occurs within less than 50 meters from the sound source. The risk of TTS occurs within less than 600 meters from the sound source. Noise associated with behavioural disturbances occurs at most 3.2 km from the sound source in a worst-case scenario.

When using proposed protective measures such as pre-start monitoring and soft start, the risk of direct harm to harbour porpoises is assessed to be negligible as they are given ample time to avoid the area before harmful noise levels are reached. The impact will therefore be of a behavioural nature.

The soft start and monitoring of harbour porpoises before take-off means that panicked flight is unlikely, as harbour porpoises will be exposed to the sound gradually, either from a distance during take-off or as the vessel approaches during operation and have plenty of time to leave the area. Behavioural impact should therefore be mostly of the type of avoidance and interrupted hunting. When the vessel is in motion, avoidance does not mean a long-term exclusion of certain areas, but the affected areas will move. It is difficult to quantify the impact of interrupted hunting behaviour or avoidance on a harbour porpoise. In the case of several interrupted hunts over a shorter period, the fitness of the animals may be negatively affected. As the survey takes place over a relatively short period of time over a large area with relatively low harbour porpoise densities (at most a single individual per 1000 km^2), the risk of the same individuals repeatedly needing to interrupt their hunt or move from an area is reduced. The likelihood that behavioural impacts will have a significant impact on the fitness of individual harbour porpoises is therefore assessed as low. The impact on harbour porpoises is therefore assessed to occur primarily at the individual level and the negative effect is assessed to be small. In this context, this means a moderate negative consequence given the very high natural value of the Baltic harbour porpoise population.

7.2.3 Fish

In the Natura 2000 area Hoburgs bank and Midsjöbankarna, which is the Natura 2000 area included in the Natura 2000 investigation area, there are two designated habitat types: sandbanks and reefs. For these habitat types, all of the assessed fish species; herring, sprat, cod and viviparous eelpout are typical species. The surveys in the area will take place in winter when herring, sprat and to some extent cod have their spawning period. Cod has no spawning areas within the investigation area and herring spawning is very limited, see Figure 6-11and Figure 6-9. Sprat could spawn within the investigation area since the species has a very large spawning area, see Figure 6-10. Sprat spawning occurs from January to August but its primary spawning period does not begin until May-June.

The modelling of the expected noise from the seismic surveys shows that the area where fish are at risk of TTS or PTS is both less than 50 metres from the sound source. Depending on local conditions, behavioural changes are estimated to occur 5 to 9 km from the sound source. Surveys within the Natura 2000 investigation area are not estimated to contribute noise that exceeds behavioural change levels (150 dB) in any other Natura 2000 area than Hoburgs bank and Midsjöbankarna.

With protective measures such as soft start, the risk of temporary and permanent hearing damage to all fish species is assessed to be negligible as it is unlikely that more than a few individuals would be within 50 metres of the sound source when these sound levels are reached. However, behavioural changes for the species are assessed to be possible as it is not certain that the species will leave the area exposed to these sound levels. Only the spawning of sprats could be affected, but since the surveys are carried out in winter, outside the sprat's primary spawning period, and in combination with the fact that the sprat's spawning area is very large, the effects of this are assessed to be negligible. The spawning of no other species is assessed to be noticeably affected as it is only herring that could potentially also spawn within the affected area and this is to a very small extent compared to the total spawning area of the species.

Reduced foraging and general stress could occur within the impact area with elevated noise levels. The ship is constantly moving and thus the impact area with it, the surveys are taking place over a shorter period and not all day in the same place. The assessment is therefore that fish are unlikely to be affected for a longer period. While they are within the impact area, they may however experience stress and have a reduced food intake. However, this is not considered to threaten the species at the population level and individuals are considered to recover relatively quickly after the surveys have been completed. The effects on general stress and reduced food intake are therefore considered to be negligible.

The consequences for herring, sprat and viviparous eelpout are assessed to be negligible overall, while the consequences for cod are assessed to be slightly negative based on the species' natural value and status classification as vulnerable.

7.2.4 Birds

The long-tailed duck winters in the area around Hoburgs Bank and Midsjöbankarna from October to April-May. When they arrive there is

determined by the time of year and other foraging opportunities, including along the coasts of Scania and other parts of southern Sweden.

The long-tailed duck is a skilled diver down to a depth of about 30 meters and feeds primarily on mussels, crustaceans and insects. The blue mussels on Hoburgs Bank and Midsjöbankarna constitute an important food source for them in winter and are probably also why the long-tailed duck gather in such large numbers on these shallow banks. In this area there is a large spread of blue mussel banks at not too great depths.

In 2016, a report was published on the distribution of the long-tailed duck along the Swedish coast and shallow banks south of Scania and in the southern Baltic Sea. (Nilsson, 2016) In this report, Hoburgs Bank and the Midsjöbankarna were identified as one of the most important wintering areas for the long-tailed duck. The long-tailed duck is also considered to primarily fly from the south coast of Sweden and further up to Hoburgs Bank and the Midsjöbankarna, which is why no connectivity is considered to exist between the long-tailed duck at the Natura 2000 area at Hoburgs Bank and the Midsjöbankarna and long-tailed duck that can winter along the Polish coast. This is based on Leif Nilsson's previous long-tailed duck report, which clearly shows the long-tailed ducks' strategy of wintering along the south coast of Sweden with an extra strong concentration on the shallow banks south of Gotland (Nilsson, 2016).

Regular inventories of long-tailed ducks are carried out using aircraft. During these inventories, monitoring is carried out according to line transects. Therefore, this type of inventory does not provide an overall picture of exactly how the birds are distributed across the banks. However, what we know from many years of studies is that each inventory is a snapshot and that the variation over time in how the long-tailed ducks move across the banks is likely to be large. If the long-tailed ducks were temporarily disturbed in their foraging, it can therefore be concluded that there is plenty of space within Hoburgs Bank and the Midsjöbankarna that the long-tailed ducks could move to. The risk of the long-tailed ducks moving from the shallow banks is therefore not likely. This is because these large shallow bank areas constitute a very good wintering site with a collective important access to food sources. The impact assessment is that the long-tailed duck are not considered to be affected in their wintering strategy due to the geophysical survey (Haas, 2024).

The common eider is assessed to have a similar foraging intake as the common eider, although the common eider is not assessed to be as strongly concentrated in the Natura 2000 area during its wintering period but rather has only been found in smaller numbers during the late winter period. The assessment of how the common eider may be affected by SGU's planned geophysical surveys is therefore assessed to be equivalent to the impact on the common eider in all its parts. This means that the common eider may be temporarily affected in connection with their foraging, which they do by diving and searching for blue mussels and other food on the seabed of the shallow banks. The fact that the common eider would be affected by the ship's propulsion is not assessed to pose any risk. The common eider bird only occurs in small numbers in the Natura 2000 area during late winter and the bird has many other suitable places to forage within and outside the Natura 2000 area and along the southern Gotland coast.

The black guillemot, on the other hand, moves from the coasts of southern Sweden and is found in the area at Hoburgs Bank and Midsjöbankarna during the same time during the winter as the long-tailed duck, i.e. around October-

May. Therefore, it is not considered that there is any known connectivity here between the black guillemot that winters at the Natura 2000 area at Hoburgs Bank and Midsjöbankarna and the black guillemot that can winter along the coast of Poland. During the winter, the black guillemot is mainly found in the same areas as the long-tailed duck, i.e. on banks shallower than 30 meters. The black guillemot mainly catches fish and crustaceans on the bottom (unlike the common murre and the razorbill, which catch fish in the open water mass, and which are thus not tied to shallow banks). The black guillemot is not particularly numerous, and the species rarely occurs in larger groups during the winter.

If the geophysical surveys in the Natura 2000 area at Hoburgs Bank and Midsjöbankarna are carried out in winter, the surveys are assessed to coincide with the long-tailed duck and black guillemot populations, whose individuals overwinter in the Natura 2000 area.

There are no known scientific studies on how diving seabirds perceive geophysical survey sounds. However, it is known that seabirds can hear underwater. They hear at a very low frequency. The frequency range that seems most relevant for diving birds is 1–5 kHz (McGrew, o.a., 2022).

What one can therefore imagine is that when using so-called soft start in geophysical surveys, it could also theoretically work for hearing seabirds, that is, both the long-tailed duck, common eider and black guillemot. This could mean that diving birds are gradually exposed to the sound and choose to flee before the seismic sound increases in strength.

What is likely to happen during ongoing surveys is that the long-tailed duck, common eider and black guillemot may primarily react negatively to the underwater noise when they dive to search for food. What is then assessed to happen is that the birds push themselves out of the sea and move away from the survey vessel. However, the birds are assessed to be able to sense and avoid any disturbing noise at long distances and the risk of a direct negative impact is assessed to be unlikely.

Theoretically, the long-tailed ducks, common eiders and black guillemots could also react to the survey vessel at closer range than they can detect at significantly longer distances due to the underwater noise impact of the geophysical surveys. However, the underwater noise from the survey vessel is assessed to be so low compared to the geophysical surveys that the impact of the survey vessel can be assessed as less disruptive and not a worst-case scenario.

There are also no loud disturbing sounds from the ship's deck that can be spread in the air or underwater that are able to disturb the birds. This is according to information from SGU's own field staff who have regularly carried out corresponding geophysical surveys in Scania in 2023 and 2024 (Baumgartner, 2024).

The geophysical the studies are not considered to affect fish to such an extent that there could be an indirect impact on the black guillemot. Fish may, during the conduct of the surveys, avoid certain areas, which would mean that the black guillemot needs to change its foraging pattern. However, this is assessed to have only negligible consequences because the effect, in the form of increased energy availability for foraging, is negligible. Similarly, the blue mussels in the Natura 2000 area are not assessed to be affected by the short-

term impact of the geophysical surveys. Thus, the long-tailed or the common eider are not assessed to be indirectly affected by the geophysical surveys through their food intake of blue mussels.

No significant damage is assessed to occur to the designated sandbank and reef habitat types that could indirectly affect the three bird species' ability to feed on fish that live in the designated Natura 2000 habitat types and the mussel beds widespread on the sandbanks.

Overall, the consequences for birds within the Natura 2000 investigation area are assessed to be negligible.

7.2.5 Habitat types

According to the conservation plan for the Natura 2000 area Hoburgs bank and Midsjöbankarna, the designated habitat types are sandbank (1110) and reef (1170). Therefore, an expert assessment has also been made as to whether the geophysical surveys within the planned Natura 2000 investigation area that are carried out in winter may affect the protected habitat types. The distribution of the habitat types is shown in Figure 6-6and the most dominant habitat type is sandbank. The elements of both sandbanks and reefs, including biogenic reefs, are important for the biodiversity of the Natura 2000 area. These habitat types constitute important habitats and, above all, foraging opportunities for important species such as various fish but also the seabird’s common eider, long-tailed duck and black guillemot that winter in the area.

To assess whether sound waves from the planned geophysical surveys could physically affect the sandbanks, Sweco has made a purely theoretical assumption that a physical shock wave that propagates through the water with high force and is sent down over a sandbank surface could give rise to temporary local sedimentation in the area.

When the sound wave reaches the bottom of the sandbank, it could cause a minor sediment spread to the sides of the sandbank, which can be more likened to a kind of lateral swirling of sand like a sediment cloud. A theoretical assumption of a local sediment cloud from a sound wave should not, however, be confused with what could theoretically occur in an explosion using, for example, a sinking boom with powerful ammunition that explodes near the bottom where a kind of larger crater can be created.

Theoretically, the sound wave could at most cause a kind of limited local temporary sediment spreading effect laterally. This is primarily considered to be possible in the sandbank habitat type, whose material is fine-grained and porous. However, sand, due to its coarse grain size, does not have a long-term effect and quickly sediments again. For geogenic reefs and biogenic reefs, this is not considered to be a likely theory as the sound wave does not have sufficient power to be able to move stones or mussels, for example. The same assessment also applies to known dumping sites with chemical weapons from the Second World War. The sound waves are not considered to have sufficient power to be able to affect dumped materials on the seabed and are therefore not considered to constitute a potential risk.

This assessment of the possible effect of the sound wave in the form of locally and temporarily stirred up sand material needs to be put in proportion to the fact that the sandbanks during severe sea storms, which occur abundantly over the current Natura 2000 area, are exposed to great impact from the ocean's wave

movements. The sandbanks at the Natura 2000 area at Hoburgs bank and Midsjöbankarna are located at shallow depths and therefore have a great impact from severe storms during storms. The pressure waves of severe storm wave movements also contribute to physical swirling and sediment dispersion of the sandbanks. In a study in the Sound, for example, the background level of turbidity increased from 1 – 4 mg/l to 5 – 15 mg/l with local levels of up to 40 mg/l during storms (Valeur & Jensen, 2001).

Both the sandbanks and their benthic flora and fauna are considered to be accustomed to this temporary wave impact with accompanying temporary increases in turbidity and sedimentation, which is why a weaker form of pressure wave from a sound wave from geophysical survey methods with a sufficient seawater column in between and its temporary lateral swirling of material is therefore not considered to pose a risk to the short-term and long-term habitat of the habitat type.

As for the actual impact of the geophysical survey on blue mussels, there is research showing that they can be affected by sound, in the form of particle accelerations. Since blue mussels do not have hearing organs, they cannot suffer from hearing loss. However, noise similar to that from ships has been shown to cause increased stress, increased oxygen uptake and reduced filtration in blue mussels within distances of approximately 200 to 300 meters (Wale, Briers, Hartl, Bryson, & Diele, 2019). Blue mussels can therefore be affected by sound, but only in the form of particle acceleration and within relatively short distances. This means that the current survey will only affect blue mussels for short periods of time when the ship essentially passes directly over them. Such a short-term increase in stress or temporary reduction in filtration should not affect the animals' health more than negligible. An impact on the conservation status of blue mussels as a result of the seismic surveys is considered unlikely.

Overall, the consequences for the habitat types sandbank (1110) and reef (1170) (both extensive geogenic reefs and biogenic reefs in the form of mussel banks) within the Natura 2000 investigation area are assessed to be negligible.

7.2.6 Overall assessment of the conservation status of the Natura 2000 area

In this context, it is assessed that there will be a moderate negative impact on the Natura 2000 protected species of harbour porpoise, given the very high natural value of the Baltic harbour porpoise population.

The consequences for the typical species herring, sprat and viviparous eelpout are assessed to be negligible overall, while the consequences for the typical species cod are assessed to be slightly negative based on the species' natural value and status classification as vulnerable.

The consequences for the Natura 2000 protected birds, the long-tailed duck, the common eider and the black guillemot, as well as the Natura 2000 protected habitat types sandbank (1110) and reef (1170) within the Natura 2000 area are assessed to be negligible.

The overall impact assessment of the Natura 2000 area is assessed to be at most a moderate negative impact. The overall Natura 2000 assessment with proposed protection measures and seasonal considerations for the most

sensitive species, the Baltic harbour porpoise is not assessed to affect the conservation status of the Natura 2000 area, the designated or typical species.

Overall, the activity, alone or together with other ongoing and planned activities and measures, is not assessed to damage the habitats that the Natura 2000 area intends to protect. Nor is the activity assessed to cause the species intended to be protected to be subjected to a disturbance that significantly impairs the conservation of the species in the area.

7.3 Investigation area Northwest

The Northwest investigation area includes assessments based on the Natura 2000 areas Näsrevet, Stora and Lilla Karlsö , Ottenby NR and Sydöstra Ölands sjömarker.

Below is an account of, and impact assessment of , the species that are assessed to be affected by the surveys within, and to some extent outside, these areas. No impact on habitats is assessed as the investigation area does not include any Natura 2000 area and habitats are only assessed to be affected if the survey vessel is within the habitat.

7.3.1 Seal

Surveys in the Northwest investigation area mean that the survey vessels pass within relative proximity to four Natura 2000 areas where seals are found as a designated species. In Ottenby NR, both grey seals and harbour seals are designated species, this is also the case in Sydöstra Ölands sjömarker. Within Lilla Karlsö and Näsrevet, grey seals are a designated species.

The noise from the seismic surveys poses a risk of PTS to seals only within distances shorter than 20 meters from the sound source, while TTS can occur within a maximum of 500 meters from the sound source. However, when using the proposed protective measures with soft start of the equipment, seals should have time to move away 500 meters from the sound source, and thus the risk of hearing damage becomes negligible.

The surveys will involve noise levels of around 75 – 80 dB SPL $_{RMS}$ weighted for seals at the border of the Natura 2000 areas Lilla Karlsö and Ottenby NR. Both these noise levels and the estimated cumulative noise levels at these areas are well below those that can be expected to cause hearing damage and also below the levels within which impacts on behaviour are expected. Within Ottenby NR and Lilla Karlsö, the surveys are therefore expected to have only negligible consequences for seals. According to the modelling, noise that has a behavioural impact on seals can occur within a maximum of 2.5 km from the sound source. As Näsrevet is located at a distance of approximately 18 km from the investigation area, the survey is expected to have only negligible consequences there as well.

At Sydöstra Ölands sjömarker, the surveys at the end of the transects that run absolutely closest to the Natura 2000 area will be located at a distance of 2.7 km from the outer boundary of the protected area. As mentioned, behavioural impacts on seals can, in a worst-case scenario, occur within 2.5 km of the sound source, which means that behavioural impacts on seals will not be relevant within the Natura 2000 area. There is also no risk of either permanent or temporary hearing damage. Impacts on seals within Sydöstra Ölands

sjömarker Natura 2000 area are therefore not relevant because of the planned geophysical surveys.

Any behavioural impact on seals outside Natura 2000 areas is expected to be short-term. The three seal rookeries along the south-eastern coast of Öland are surveyed annually as part of the national environmental monitoring of seals. The number of seals there is usually between around 20 and 70, but the highest number counted was around 200 harbour seals at the Össby rookery. However, there are only a few grey seal individuals and no registered births of pups (Bergström & Fredriksson, 2022). The rookeries are located within the Natura 2000 area closer to the coast and will not be affected. The seals that may be affected are those that hunt further out from the coast or seals that migrate between areas. As seals mainly hunt in shallower areas, repeated disturbances of hunting behaviour that affect individuals in the long term are considered unlikely. These are likely to be limited and short-term disturbances on a small number of individuals without population effects.
The impact is therefore assessed to be negligible with negligible consequences for both harbour seals and grey seals.

7.3.2 Harbour porpoise

The survey vessel will not pass directly adjacent to the Natura 2000 area Hoburgs bank and Midsjöbankarna with harbour porpoises as a designated species, but one of the precautionary measures to protect harbour porpoises is a protection zone of 14 km to the Natura 2000 area to reduce noise impact. Therefore, the sound reaching the Natura 2000 area is expected to be at most approximately 75 dB SPL_{RMS} or 101 dB SEL weighted for harbour porpoises when the vessel is closest. These noise levels are not associated with a risk of hearing damage to harbour porpoises. The expected noise levels are also not associated with behavioural disturbance (Danish Energy Agency, 2022). Therefore, no disturbances to harbour porpoises within Hoburgs bank and Midsjöbankarna are expected because of the seismic surveys in the Northwest investigation area. The consequence of the geophysical surveys in the Northwest investigation area for harbour porpoises within the Natura 2000 area will be negligible.

Hoburgs Bank and the Midsjöbanks constitute the core area for the Baltic harbour porpoise during the summer months. However, harbour porpoises outside the Natura 2000 area may be affected. The risk of PTS occurs within less than 80 metres from the sound source, while the risk of TTS occurs within a maximum of 700 m from the sound source. Sounds that can have an impact on harbour porpoise behaviour occur within approximately 2.7 km from the worst-case modelled sound sources. When using soft start when starting the geophysical equipment together with monitoring harbour porpoises in the area, it should be possible to ensure that the animals have time to leave the area around the ship and thus avoid damage. This should also prevent the severe startle that can occur if the sound starts suddenly. Behavioural impact should therefore, when using such protective measures, probably be of the types of interrupted hunting behaviour and avoidance.

Within the investigation area, harbour porpoises occur regularly, but the probability of detection is lower than in the core area around Hoburgs bank and the Midsjö banks (Figure 6-7and Figure 6-8). Although the area in question is not investigated in the regional or national environmental monitoring, a similar trend can be seen in recent years' monitoring around Öland and Blekinge with

the highest number of detections around the Northern Midsjö bank and lower detections near the coast. In this monitoring, harbour porpoises were recorded on approximately 3% of the survey days in stations located closest to the southern tip of Öland. A tendency towards higher detections near the coast during the winter than during the summer could also be observed, which is consistent with detections from the SAMBAH project (Owen & Carlström, 2020). The occurrence of harbour porpoises can therefore be assumed to be relatively low within the investigation area during the summer.

It is difficult to quantify the impact of interrupted hunting or avoidance behaviour on a harbour porpoise. In the case of several interrupted hunts over a shorter period, the animals' fitness, i.e. their general health, may be negatively affected due to reduced food intake. In this case, the most important areas of the harbour porpoises are not affected, but a small number of individuals may experience noise that disrupts their natural behaviour. Given the low density of animals that are assessed to be present in the investigation area during the summer and the fact that the area is being investigated for a relatively short period of time with protective measures to mitigate the impact, the number of individuals at risk of being affected is assessed to be very limited and the possibility of recovery for any affected individuals to be high and the investigation is assessed not to have any population effects. The impact on harbour porpoises is assessed, provided that protective measures are taken, to be negligible with negligible consequences.

7.3.3 Fish

For the two designated habitat types, sandbanks and reefs, which are designated for nearby Natura 2000 areas, all four assessed fish species are typical: herring, sprat, cod and viviparous eelpout.

The surveys in the area will take place in the summer when sprat, cod and viviparous eelpout have their spawning periods. Cod spawning does not occur in the area, see Figure 6-11. It cannot be ruled out that herring can spawn in the investigation area, although to a very small extent in the southwestern part of the area, see Figure 6-9. Viviparous eelpout spawning close to the coast/on shallow hard bottoms and is not considered to spawn in the area, while sprat can use most of the area for spawning, see Figure 6-10.

Modelling of the expected noise from the planned geophysical surveys shows that the area where fish are at risk of TTS or PTS is both less than 50 metres from the sound source. Depending on local conditions, behavioural changes are estimated to occur 4 to 7.5 km from the sound source. Surveys within the Northwest investigation area are not expected to contribute noise that exceeds behavioural change levels (150 dB) in any of the surrounding Natura 2000 areas.

With protective measures such as soft start, the risk of TTS and PTS for all fish species is assessed to be negligible as it is unlikely that more than a few individuals would be within 50 meters of the sound source when these sound levels are reached. However, behavioural changes for the species are assessed to be possible as it is not certain that the species will leave the area exposed to these sound levels and if they do leave the area it could mean interrupted spawning.

Spawning of sprat could be negatively affected during the time the surveys are in progress by being interrupted within the noise-affected area. The same

applies to herring, although their spawning area within the noise-affected area is much more limited. Herring spawn on the east coast of Öland. In certain areas close to the coast, levels above 150 dB may occur even though the sound from the surveys decreases quickly in shallow areas, which is why very small spawning areas for herring are assessed to have levels that exceed behavioural change. Sound levels above 150 dB only occur for a very limited time as the transects closest to the east coast of Öland are those that run in an east-west direction and not along the Öland coast. The effect on herring spawning is therefore assessed to be negligible. The effects on sprat spawning, which is affected in a significantly larger area, are also assessed to be negligible since the survey period is very short (12 days in total) and the entire area is not affected at the same time, and the sprat spawning period extends over many months.
Reduced foraging and general stress could occur within the area with elevated noise levels for all species. The ship is constantly moving and thus the area of impact moves with it and the surveys are taking place over a shorter period and not all day in the same place. The assessment is that fish, of all assessed species, may be affected for a limited period and during this experience stress and have a reduced food intake. However, this is not considered to threaten the species at the population level and individuals are considered to recover relatively quickly after the surveys have been completed. The effects on general stress and reduced food intake are therefore considered to be negligible.

The consequences for all species are assessed to be negligible based on the short period of the investigations.

None of the species are affected within any of the surrounding Natura 2000 areas.

7.3.4 Birds

North of the Northwest investigation area are the Natura 2000 areas Lilla and Stora Karlsö, which are home to the typical species of common murre and razorbill. These birds forage for fish in the sea around Lilla and Stora Karlsö in the summer. The designated Natura 2000 areas are located at a very long distance from the planned investigation area.

Since the overall impacts on fish are assessed to be negligible for the Northwest investigation area even at long distances from the Natura 2000 area at Lilla and Stora Karlsö, the risks of affecting the typical species of common murre and razorbill are therefore assessed to be negligible. This is based on the assessment that the birds will not be indirectly affected by being inhibited in their foraging by pelagic fish during their breeding period which takes place in the summer at both Karlsöarna. This assessment is based on the assessments made in the chapter on impact assessment of fish in section 7.3.3.

No other direct or indirect impact is assessed to occur on the affected birds due to the underwater sound of the geophysical surveys or due to the movements of the survey vessel in the sea.

No bird species are assessed to be directly or indirectly affected within any of the Natura 2000 areas around the Northwest investigation area.

Sweco has assessed a proposed Natura 2000 area along the west coast of Öland that may be designated. The assessment for these areas is equivalent to the above conclusion for the currently designated Natura 2000 areas where

there are birds with designated Natura 2000 protection.
Overall, the consequences for birds within the Northwest investigation area and protected birds in the closest surrounding Natura 2000 areas are negligible.

7.3.5 Overall assessment of the conservation status of Natura 2000 sites

No species are affected within any Natura 2000 area (Näsrevet, Ottenby NR, Sydöstra Ölands sjömarker, Stora and Lilla Karlsö) that have been impact assessed for the Northwest investigation area. Since the surveys are not carried out within any Natura 2000 area, no habitat types are affected.
Based on this, it is assessed that the conservation status of the Natura 2000 areas is not affected.

7.4 Risks and preparedness

The surveys require ships to move slowly within the investigation areas and to and from the areas before and after the surveys. This leads to increased traffic in the area and thus increased risks in the form of accidents, leakage of oil products and chemicals.

SGU follows the procedures in place regarding the rules and regulations concerning trafficked waters and shipping lanes. SGU's shipping company Ocean Surveyor follows the ISM code (International Safety Management code) for the safe operation of ships and the prevention of pollution and has an established safety management system (Safety Management System; SMS) as described in SGU's Safety Manual.

SGU's safety manual states that SGU is responsible for ensuring that oil spills or leaks of harmful substances that are directly related to the investigations are handled in dialogue with the Coast Guard, the Civil Protection and Emergency Management Agency/Civil Defense Agency and the Swedish Environmental Protection Agency. Clean-up equipment in the form of booms will be on board the ship to minimize the spread in cases where, for example, oil products should leak. There is a so-called "Ship oil pollutant emergency plan” (SOPEP) for SGU's vessels and clear procedures for contacting and cooperating with relevant authorities as above in the event of environmental accidents and the risk of oil spills (Sveriges geologiska undersökning, 2024).

SGU will ensure that corresponding procedures are in place on a chartered vessel that can conduct surveys in winter. The risk of accidents and leaks is assessed as small, although it can never be completely prevented. However, with the proposed protective measures, the risk is assessed as acceptable.

The sound waves are not considered to have sufficient power to affect dumped chemical warfare agent materials on the seabed and are therefore not considered to constitute a potential risk. For how sound waves affect physical substrates and materials, see section 7.2.5.

8 The Swedish Agency for Marine and Water Management's underwater indicator for good marine environmental status

To assess the impact of marine surveys on marine mammal habitats, the Swedish Agency for Marine and Water Management (HaV) has developed the regulation HVMFS 2012:18 descriptor 11 which defines indicators for good environmental status with regard to underwater noise and indicator 11.1A deals specifically with impulsive underwater noise (Havs- och vattenmyndigheten, 2012b; Havs- och vattenmyndigheten, 2024f). The regulation divides the Swedish sea into different sea basins which are used to monitor the indicators, see Figure 8-1.

For indicator 11.1A, the following threshold values apply with regard to mammals:

1. **Short-term value:** A noise level considered to lead to behavioural change is not exceeded in more than 20% of any of the basins on any single day during the assessment period.
2. **Long-term value:** A noise level considered to lead to a change in behaviour is not exceeded in more than 10% of the assessment area as an annual average in any year during the assessment period.

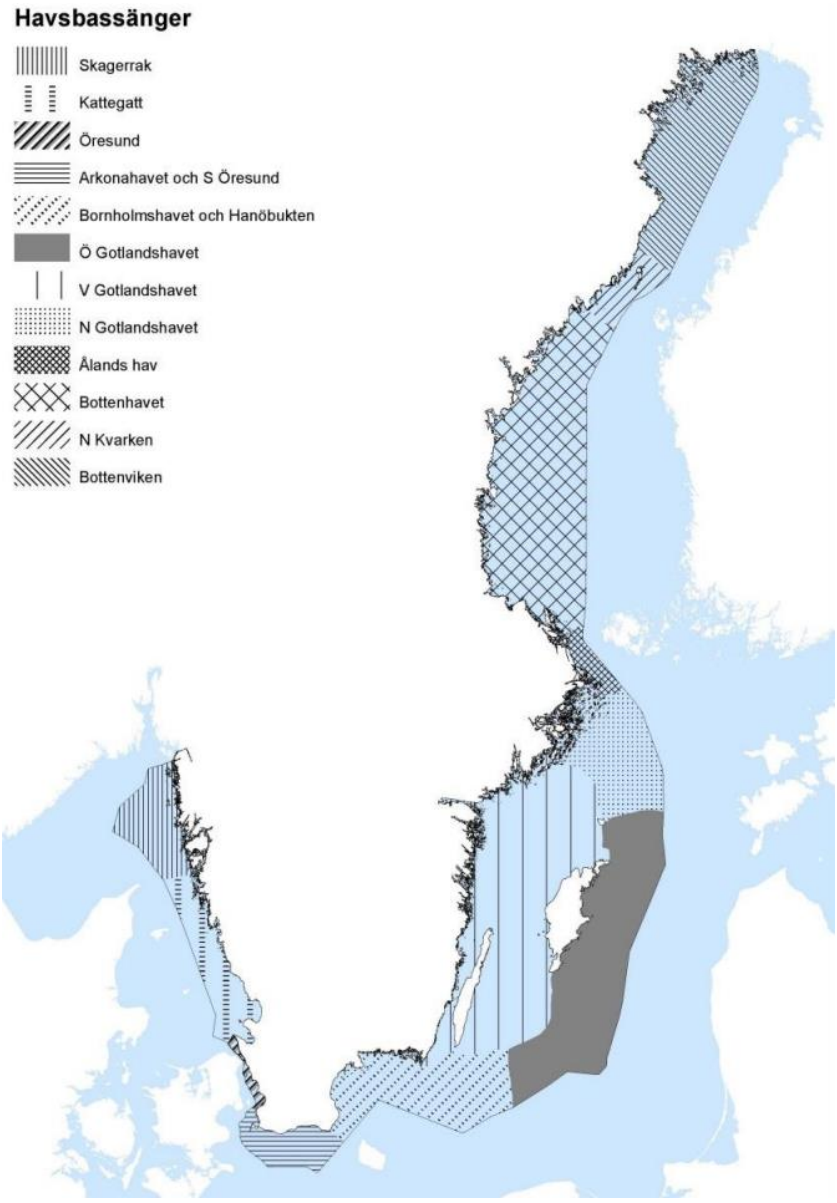

Figure 8-1Ocean basins defined in HVMFS 2012:18.

In addition, the following thresholds apply from May to October with regard to harbour porpoises:

3. **Short-term value:** A noise level considered to lead to behavioural change is not exceeded in more than 10% of the distribution area of the Baltic harbour porpoise
(illustrated in Figure 8-2) during any single day during the assessment period.
4. **Long-term value:** A noise level considered to lead to behavioural change is not exceeded in more than 5% of the distribution area of the

Baltic harbour porpoises as an annual average in any year during the assessment period.

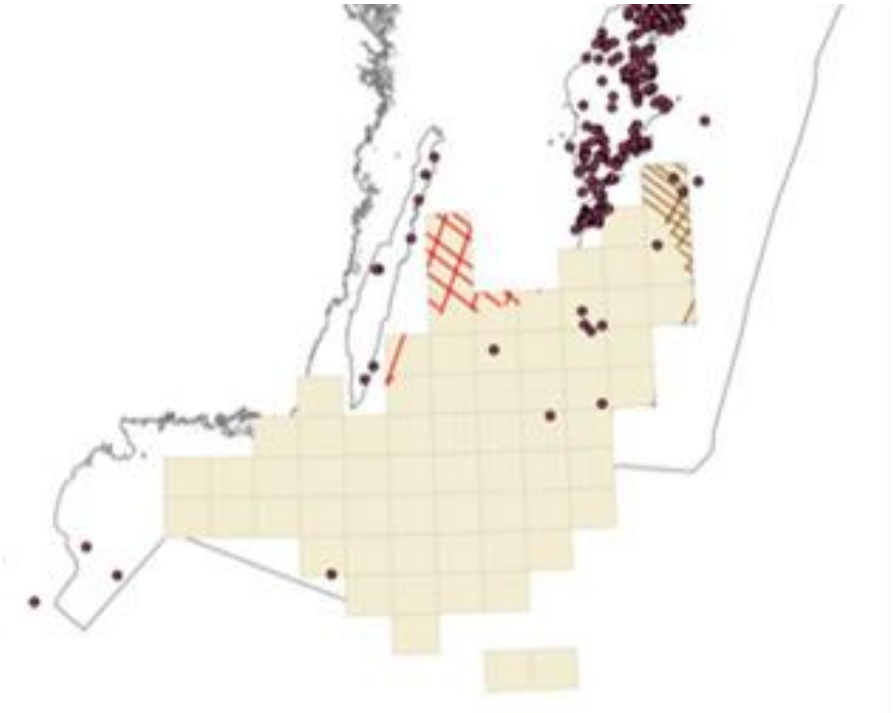

Figure 8-2. Harbour porpoise range, as used in HVMFS 2012:18, with overlapping transects from SGU's surveys plotted.

The regulation includes a fact sheet providing guidance on how the assessment should be carried out in accordance with the regulation. The fact sheet specifies a standard impact area/protection distance of 12 km for calculations for air guns and other impulsive sound sources. In the modelling that Sweco has developed specifically for the equipment to be used by SGU (Appendix C3), the impact area/protection distance is 3.2 km for porpoises and 3.3 km at most for seals. If the standard assumption of 12 km is used, the limit for the time that noisy activities can be carried out is 12 hours per day in the harbour porpoise range and in the Bornholm Sea and Hanö Bay Sea basins, which are the smallest sea basins. In the East Gotland Sea and the West Gotland Sea, the vessel can be active all day without exceeding 20% of the area. If you instead use the impact areas/protective distances that are developed for the specific equipment, but as an extra safety measure more than double this to 7 km, you can investigate around the clock without exceeding 20% of the area.

In neither case, regardless of whether the default value or modelled values are used, is the average value at risk of exceeding 10% as an annual average for sea basins or 5% as an average value from May to October for the porpoise range.

For precise calculations of the percentage of each ocean basin that is affected in the different scenarios, please refer to Appendix C3.

9 Cumulative effects

9.1 Cumulative effects of sound from other projects

Noise from various geophysical and geotechnical surveys from nearby projects is able to give rise to cumulative effects that negatively affect wildlife.

To assess the cumulative effect of SGU's investigations, SGU has contacted all ongoing offshore wind projects located within, and in the vicinity of, SGU's planned investigation areas. Information has also been received about a Polish sand mining project, however, there is currently no information on the exact location.
Table Table 9-1below summarizes these contacts and which projects are affected. The table also states which survey methods the various projects have survey permits for or which they consider they may receive permits to carry out. The table shows that there are only a few companies and projects that could theoretically take place at the same time. Several of these projects had their applications to build wind farms rejected by the Government on 4 November 2024, marked in Table 9-1with an *. However, they are still included in the cumulative assessment because they have permits to survey the respective park area even though it is less likely that the surveys will be carried out.

Table 9-1Other actors, their relevant projects in relation to investigation areas and any planned surveys

Offshore wind companies	General answer	Relevant projects	Survey method
Freja Offshore	Nothing planned	NA [1]	NA [1]
Orsted	Nothing planned	NA [1]	NA [1]
RWE	Nothing planned	NA [1]	NA [1]
Aeolus	Nothing planned	NA [1]	NA [1]
OX2	Planned but subject to conditions	Aurora*, Pleione *, Neptune*	MBES, SSS, SBP, sparker , mini airgun , VC, CPT, drilling, bottoming2
Landinfra-energy	Planned but subject to conditions	Baltic Edge, Slite , Öland - Hoburg	MBES, SSS, SBP, VC, CPT, film, bottom chop [2]
Wind Power AS (Equinor)	Nothing planned in SEZ, but maybe in Poland	Baltic I	Investigation is ongoing regarding survey but MBES, SSS, SBP, UHRS (probably sparking), drilling may be relevant [2]
Statkraft	Nothing planned after April 2025, subject to change but not likely	Alpha (March-April 2025), Beta*, Delta North (Oct-Dec 2024)	MBES, SSS, SBP, MAG [2]
Poland ESBO	Near the PEZ/SEZ border	Project for geological works for exploration and evaluation of sand and gravel deposits in the South Midsjöbanken in the Baltic Sea (next 18 months)	MBES, SBES, SSS, SBP, boomer, VC, bottom chop [2]

[1] NA stands for “Not- Applicable ” which means no surveys are planned to be conducted during the summer of 2025 or winter of 2026

[2] Abbreviations: MBES- Multibeam echo sounder (multibeam sonar), SSS- Side scan sonar (Side scanning sonar), SBP- Sub-bottom profiler (Sediment sounder), VC- Vibrocorer , CPT- Cone-penetration test, MAG- Magnetometer, SBES- Single beam echo sounder (Single-beam sonar)

*Application to build a wind farm rejected by the Government 20241104

Of the Swedish offshore wind companies, only OX2's Aurora, Pleione and Neptunus projects and Landinfra-energy's Baltic Edge, Slite and Öland- Hoburg projects are theoretically considered to be able to take place at the same time as SGU's planned investigations during the summer season 2025 and 2026 and the winter season 2026. The Polish sand extraction project cannot be ruled out either, since the location is unknown.

To create a good understanding of how different projects are affected by SGU's three investigation areas, this is presented in a comprehensive map, see Figure 9-1

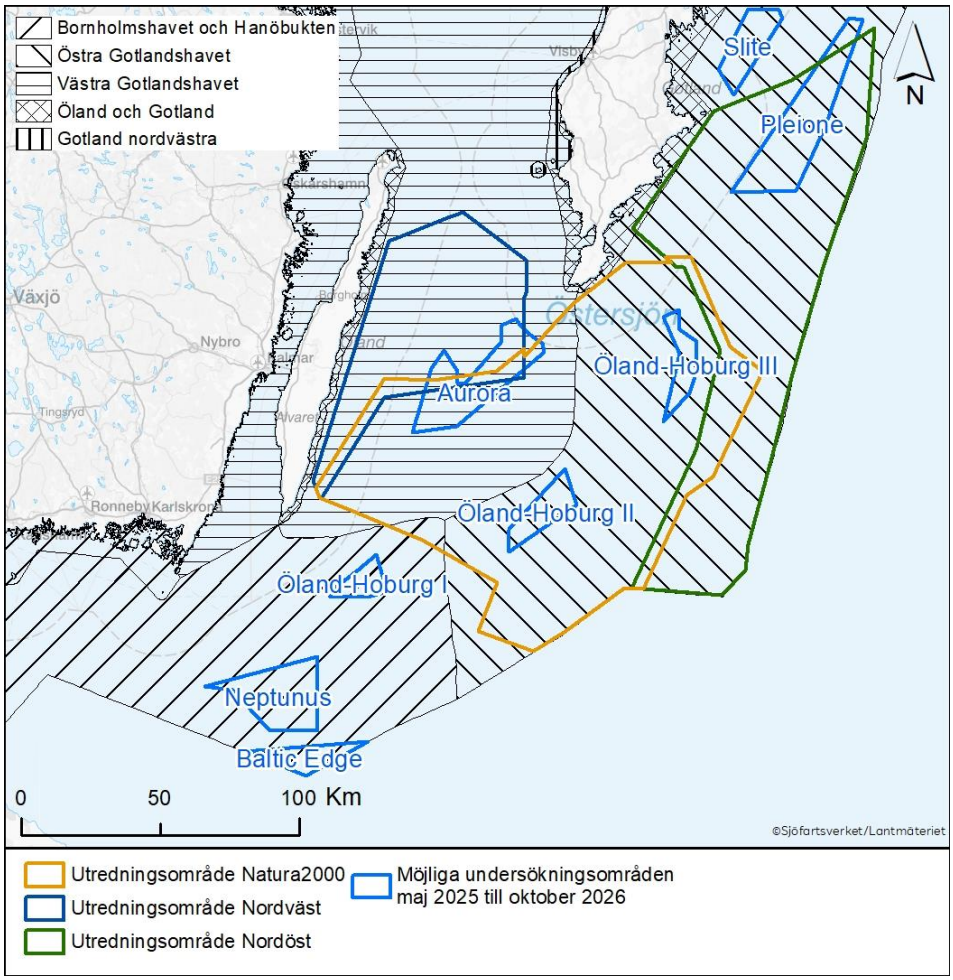

Figure 9-1The map shows SGU's investigation areas, the planned wind projects and their names, and how these both relate to the sea basins in the Swedish Agency for Marine and Water Management regulation HVFMS 2012:18.

In Figure 9-1it can be seen that there is only one survey area for offshore wind power that is located within the same sea basin as the investigation area Northwest and parts of the investigation area Natura 2000 (West Gotland Sea). The investigation area Natura 2000 is also located within the sea basin East Gotland Sea where there are four possible survey areas for offshore wind power. A very small part of the investigation area Natura 2000 is also located within the sea basin Bornholm Sea and Hanö Bay which have three possible survey areas for offshore wind power. The investigation area Northeast is located within the sea basin East Gotland Sea where, as mentioned earlier, there are four possible survey areas for offshore wind power.

SGU has voluntarily undertaken to contact the few companies and projects concerned in advance of its planned surveys that may contribute cumulatively. In agreement with the respective projects, an survey plan shall be agreed upon so that SGU's geophysical surveys do not take place at the same time as someone else's planned surveys. In this way, it is assessed that no cumulative effects will arise in connection with sound and noise.

9.2 Cumulative effects from ship traffic

SGU's surveys contribute to additional ship traffic to the investigation areas, which can have a disruptive effect on wildlife and lead to increased risks of accidents and emissions of environmentally harmful substances.

The surveys are being conducted in a heavily trafficked area with several major shipping lanes and the contribution of increased traffic that SGU's surveys contribute is assessed to be so small that it does not contribute cumulatively to more than a negligible extent and that this does not lead to any cumulative effects.

Increased risks in the form of maritime safety and emissions of harmful substances into the environment are also not considered to be more than negligible with the proposed protective measures.

9.3 Overall assessment of cumulative effects

As explained in Chapter 8, SGU's geophysical surveys will not affect the underwater indicator for good marine environmental status, either for the short-term or long-term value of the regulation. SGU has committed not to carry out surveys at the same time as any other actor within the same sea basin. These assumptions mean that no cumulative effects from noise arise and the cumulative effects from increased shipping are assessed to be negligible.

Since no cumulative effects are assessed to arise that are more than negligible, cumulative effects are also not assessed to be able to lead to the conservation status of any of the assessed Natura 2000 areas (Gotska Sandön- Salvorev , Hoburgs bank and Midsjöbankarna, Näsrevet, Ottenby NR, Sydöstra Ölands sjömarker, Stora and Lilla Karlsö) being affected to the extent that they affect the possibilities of achieving or maintaining favourable conservation status.

10 Protective measures

SGU has undertaken several protective measures, most of which are designed to protect the harbour porpoise. Already in the planning stage, it was decided to carry out the surveys within the harbour porpoise's core area during the winter months so as not to disturb them during their reproductive period. During the consultation phase, SGU has also undertaken to follow HaV's *Vägledning för att förhindra att seismiska undersökningar orsakar skadligt impulsivt buller med negativa effekter på marina däggdjur* (Havs- och vattenmyndigheten, 2024e). Examples of protective measures that will be taken are:

- Seismic surveys will not be carried out within 14 km of the Natura 2000 area Hoburgs bank and Midsjöbankarna during summer when harbour porpoises gather in this area.
- When starting up the seismic equipment, when technically possible, the vessel will use a soft start to give animals an opportunity to move away from the immediate area. The soft start period will be for at least 20 minutes to give harbour porpoises an opportunity to avoid harmful impacts.
- The vessel will have a harbour porpoise monitoring system that observes the area around the vessel for porpoises prior to the start-up of seismic equipment.
- Before starting the seismic equipment, the area in a zone of at least 500 meters around the ship will be monitored for at least 30 minutes for harbour porpoises. If harbour porpoises are observed within the monitoring zone, the equipment will be delayed until at least 20 minutes after the harbour porpoises have left the protection zone.
- If there is a break in work of more than 10 minutes, a new sequence with monitoring and soft start must be started.
- The vessel will only initiate the start-up of seismic equipment when the 500-meter zone can be reliably monitored for harbour porpoises. If for any reason it is not possible to reliably monitor harbour porpoises within this zone, the vessel should not start work with noise-generating equipment emitting frequencies below 200 kHz. This also applies after breaks in work of longer than 10 minutes as above.

In addition, all observations of harbour porpoises from the vessel will be recorded and reported with information on approximate position and number.

The protective measures above, such as soft-starting equipment, which are designed primarily for harbour porpoises, also have a positive impact on fish and seals.

11 Overall assessment

SGU's surveys are not considered to affect the conservation status of any species or Natura 2000 areas. Impacts, which are more than negligible, are considered to only arise for individual species and are considered in all cases to be local, temporary and transient. Table 11-1below summarises the impact assessments made in Chapter 7.

Table 11-1Overall assessment of the consequences that are considered to be likely to arise on the species and habitat types assessed in the EIA, divided into investigation areas.

Investigation area	Seal	Harbour Porpoise	Fish	Bird	Habitat type	Conservation status
Northeast	No consequences are expected to arise for seals within any Natura 2000 area. However, it is assessed that colonies outside Natura 2000 areas could be affected and lead to negligible-small negative consequences.	No-negligible impacts are assessed to arise for Harbour porpoises, both in and outside Natura 2000 areas.	No consequences are expected to arise for fish within any Natura 2000 area. Outside Natura 2000 areas, the consequences for all fish species are assessed to be negligible.	No-negligible impacts are assessed to arise for birds.	No consequences are assessed to arise for any habitat type because the surveys are located outside Natura 2000 areas.	The conservation status of Natura 2000 areas is assessed not to be affected.
Natura 2000	No-negligible impacts are assessed to arise for seals.	Moderate negative consequences are assessed to arise for porpoises in the investigation area.	None-negligible impacts are assessed for herring, sprat and seaweed. For cod, the impacts are assessed to be small negative.	No-negligible impacts are assessed to arise for birds.	No-negligible impacts are assessed to arise for the habitat types reefs and sandbanks.	The conservation status of Hoburgs Bank and Midsjöbankarn a is assessed not to be affected.
Northwest	No consequences are assessed to arise for seals within any Natura 2000 area. However, seals outside Natura 2000 areas are assessed to be affected in the short term, but only	No-negligible impacts are assessed to arise for porpoises, both in and outside Natura 2000 areas.	No consequences are expected to arise for fish within any Natura 2000 area. Outside Natura 2000 areas, the consequences for all fish species are assessed to be negligible.	No-negligible impacts are assessed to arise for birds, both in and outside Natura 2000 areas.	No consequences arise for any habitat type because the surveys are located outside Natura 2000 areas.	The conservation status of Natura 2000 areas is assessed not to be affected.

	with negligible consequences.

12 Competence

The people who have contributed to the development of this EIA are described below.

Name / Role	Description
Gabriella Hammarskjöld Mission leader / Reviewer and administrator – Fokus fågel	Gabriella is a previously experienced environmental manager and senior permit review manager who has led several large complex environmental permit review projects in onshore wind, metro projects, mining and minerals, offshore wind, electricity concessions, hydrogen concessions and in Swedish final disposal. Gabriella is basically a soil/plant agronomist with 23 years of professional experience. Initially with approximately 9 years of international environmental negotiations in seeds, climate and emissions to air as well as in environment and energy at the Government Offices, the Swedish Environmental Protection Agency and Sida. The last 13 years as environmental manager and senior permit review manager at Nordkalk and Vattenfall Offshore and most recently at SKB in the Vattenfall Group. Gabriella has solid experience of running large Natura 2000 permit reviews in marine environments from early start-up phase to full-scale implementation and implementation. Trained to work closely with corporate lawyers, lawyers, EIA experts, technical experts and a wide range of subject specialists. Very extensive experience in conducting dialogue and negotiating with most Swedish review authorities, supervisory authorities, environmental authorities such as NV and HaV, and other relevant authorities .
Johanna Lindberg Administrator – Focus on marine mammals	Johanna is a project manager and project manager with a bachelor's degree in both marine biology and biology and a master's degree in aquatic ecology. She has previously worked at, among others, the Swedish Transport Administration and Medins Havs och Vattenkonsulter and has approximately 7 years of experience working with assessments, permit issues and inventories of natural environments. Johanna has extensive experience in investigating and impact assessing the marine environment, including marine mammals, primarily from work with offshore wind power where she has to date participated in investigations for approximately 15 different wind farms for various actors.
Kimberly Melkersson Administrator – Focus Fish	Kimberly has a bachelor's degree in marine biology, a master's degree in aquatic ecology and a vocational education in fish and shellfish farming. Kimberly works on various assignments related to water, including a lot of permitting issues in water operations, aquaculture and offshore wind power. Kimberly has previously worked at a county administrative board with the assessment of coastal protection dispensers and water operations according to the Environmental Code.
Lina Sultan Examiner	Lina Sultan is an experienced project manager and senior environmental consultant at Sweco in Nyköping. Lina is a geologist with approximately 20 years of experience in environmental assessments, EIAs and environmental legislation. She works primarily with permit assessments and EIAs for water activities and environmentally hazardous activities, in recent years with a focus on offshore wind power.
Emil Steuch GIS expert	Emil is a geographer with a focus on GIS systems and has worked in various GIS-related roles at Sweco since 2007. Since 2014, he has primarily focused on projects within offshore wind power, where Emil has worked as GIS manager in the German project Arkona and the Danish Thor. He has also had GIS responsibility for development projects in Swedish waters, including Södra Victoria (formerly Södra Midsjöbanken) and Neptuni .

	In addition to daily GIS work, these projects have also included planning and handling data from seabed surveys.
Johan Portstrom Civil Engineer and Acoustician	Johan Portström is a civil engineer. He is an acoustician with experience working in room acoustics, building acoustics, industrial noise and noise measurements. Johan has previous experience in underwater sound investigations and assessing these types of issues in a thorough manner.
Sebastian Larsson Acoustician	Sebastian has good competence in various engineering software such as Soundplan, ArcGIS , QGIS, FME and also basic system development knowledge. In acoustics, Sebastian has specialized in community noise, construction noise, road and railway plans, wind turbine noise, aircraft noise, power electronics noise, underwater acoustics and industrial acoustics.

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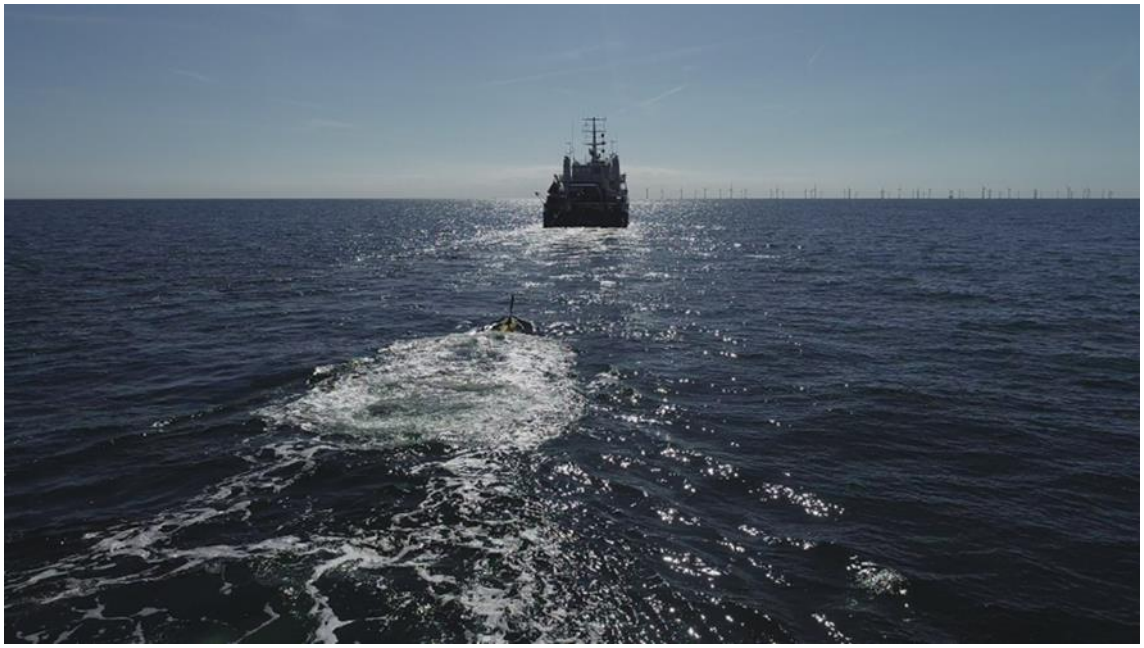
Technical Description

GEOPHYSICAL SURVEYS SOUTH EASTERN BALTIC SEA

december 2024

SGU:s diarienummer: 316-3015/2024



SGU Sveriges geologiska undersökning

Omslagsbild: S/V Ocean Surveyor utför geofysiska undersökningar söder om Skåne 2023
Fotograf: Björn Bergman, SGU

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Appendix B1. Technical Information

1 INTRODUCTION

In the consultation document, SGU has used the terminology "marine seismic and marine geological surveys" and "marine mapping" as an overall collective term for the planned surveys that are part of the Natura 2000 assessment. In subsequent documents, the term "geophysical surveys" is used instead, which is a clearer way of expressing the acoustic methods that SGU plans to use. These refer, more specifically, to multibeam echo sounders (multibeam echo sounder; MBES), sediment echo sounder (sub-bottom profiler; SBP), and seismic surveys with air guns (reflection seismic). SGU would like to clarify that this is only a change in terminology and that it does not affect the examination or change the meaning of the surveys that the application covers.

1.1 Project description

SGU has been commissioned by the government to map the possibilities for Sweden to store carbon dioxide under the seabed with geophysical surveys. The surveys are planned in three different investigation areas, which are called Natura 2000, Northeast and Northwest (Figure 1). The Natura 2000 investigation area includes the Natura 2000 area Hoburgs bank and Midsjöbankarna (SE0330308). In order to map the geological properties of the area, geophysical surveys are planned to be carried out with three instruments, which are described in detail in chapter 1.2, which simultaneously collect geophysical data:

- Reflection seismic system (air guns) that collects data on the geological sequence from the seabed surface to deep below the seabed.
- Sediment echosounders (so-called sub-bottom profilers; SBP) that collect data on the near-surface layer sequence beneath the seabed and have a large variation in penetration ability, depending on the geology, among other things.
- Multibeam echo sounder (so-called multibeam echo sounder; MBES) that collects data on the bathymetry and surface roughness of the seabed using sound beams in a fan shape beneath the ship.

To fulfill the government mandate, SGU will map the geological properties of the area using geophysical methods. The purpose is a comprehensive mapping to locate possible injection sites and reservoirs for carbon dioxide. The surveys will also investigate the reservoir's leakage risk, to ensure that carbon dioxide does not leak during injection or dispersion within the reservoir.

Reflection seismic is the most important geophysical method for the government mission because seismic reflection data provides information about the thickness, depth, distribution and lithology of the geological formations at the depths relevant for carbon dioxide storage, which is further described in Appendix C.2 *Siting investigation*. Seismic reflection data is usually collected along long transects and allows one to create a 2D image or section of the bedrock**.** Seismic reflection data is also important for investigating faults (large-scale fractures) in the bedrock which are associated with an increased risk of leakage of stored carbon dioxide. Furthermore, reflection seismic methods allow one to map reservoirs and cap rocks over large areas and are important for being able to correlate with reference boreholes. No drilling has been planned offshore in connection with the government mission, but supplementary drilling has been carried out on land in southern Scania and southern Gotland.

Sediment echosounder and multibeam echosounder are used to investigate the geometry and structure of near-surface sediments and the topography of the seabed. Furthermore, the methods are important within the framework of carbon capture and storage, often referred to as CCS (Carbon , Capture and Storage). This is to gain an understanding of how structures in the underlying bedrock can affect seabed sediments. With this type of data, it is possible to map

indications of gas and liquid in the sediment that come from fractures or zones of weakness in the bedrock. This gives an indication of whether there is an increased risk of leakage from carbon dioxide storage.

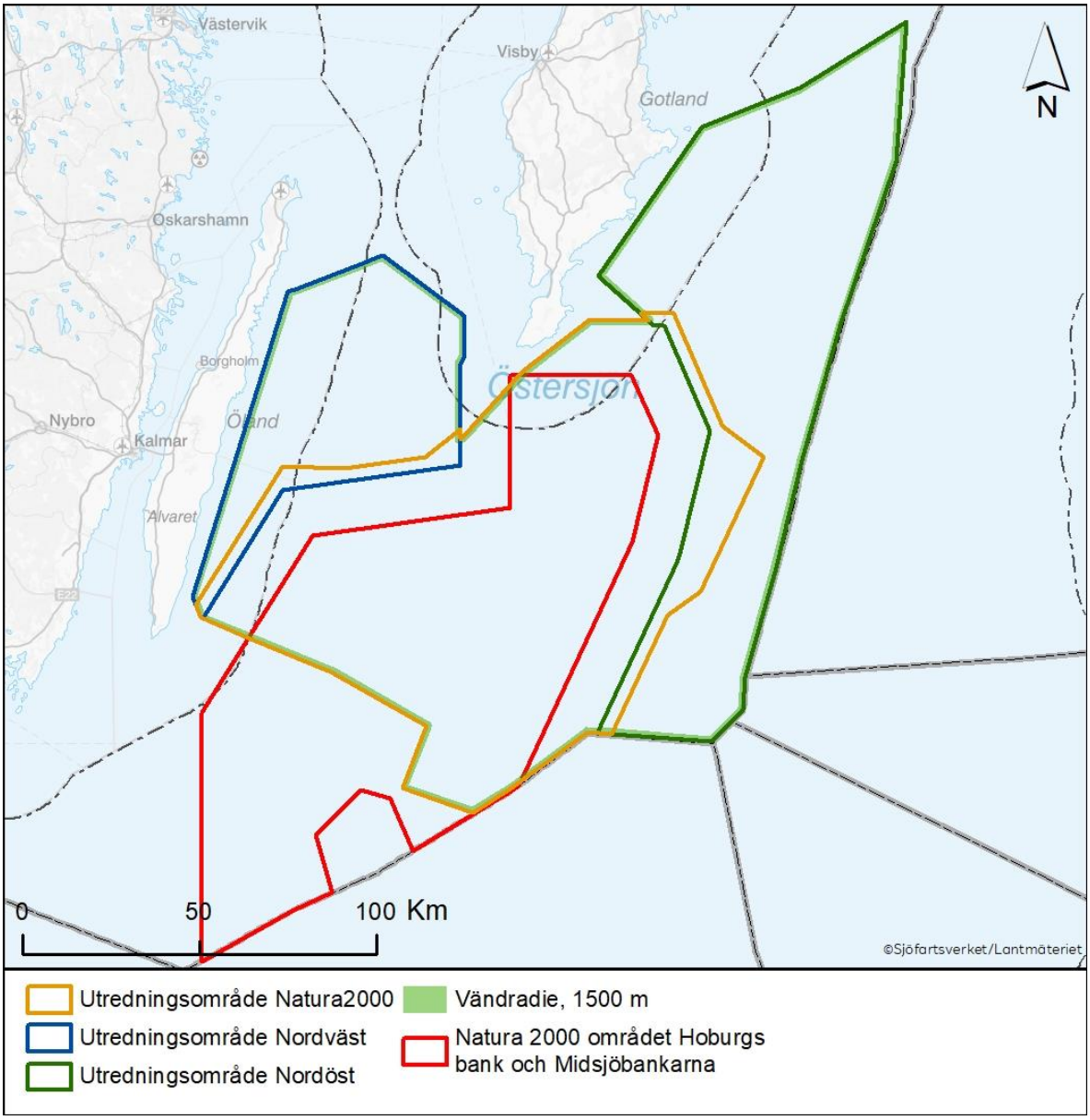

Figure 1 Overview of the three investigation areas for the surveys. Map from Sweco .

The following section describes the typical scope of the surveys. The survey methods may deviate slightly from the description, for example due to technological advances or site-specific requirements.

1.2 Geophysical surveys

Geophysical surveys are used to create images that show what the seabed, sediments and underlying bedrock look like. The images are created using acoustic methods, where instruments send sound down towards the seabed which then bounces off the different geological layers. The echoes of the sound waves are captured by sensors and then translated into images. To create images of, i.e. map, the seabed and sediments above the bedrock, the instruments sediment echo sounder and multibeam echo sounder are used. To find out what the bedrock looks like at the depths that are optimal for carbon dioxide storage (at least 800 m below the seabed), reflection seismic surveys are required.

The geophysical survey methods that will be used during the survey will be conducted simultaneously. The vessel plans to maintain a speed of between 4–4.5 knots during data collection.

1.2.1 Seismic surveys

Description of the equipment

In a seismic survey, sound waves (seismic signal) are used to create detailed sections (two-dimensional images) of the bedrock structure. At sea, the powerful sound pulses can be created by, for example, a compressed air cannon, a water cannon or a sparker (electrical signal) towed by a ship. The aim is to have a signal that is as short and impulsive as possible. Some of the sound energy goes down to the bottom and is reflected to the surface from the different layers of the bottom and bedrock. The reflected sound waves are captured and recorded by pressure gauges (hydrophones) mounted in a hose (streamer) towed by the ship. Depending on the depth to be investigated, the streamer can be between 100 m and 3000 m long and the sound source can be of varying power (see illustration of the concept in Figure 2).

Description of the implementation of the survey

SGU's marine seismic measurements are planned with airguns as the sound source. Two synchronized Sercel GI-SOURCE 210 airguns (generator/injector-airgun) will be used and activated at 4-15 second intervals. The specified airguns will have a generator volume of 45 cubic inches and an injector volume of 105 cubic inches each, giving a total of 150 cubic inches per airgun. The generator is the most impulsive and its valve opens first. Approximately 50 milliseconds (ms) later, the injector opens, releasing compressed air to counteract the bubble pulse that occurs when the bubble from the generator oscillates. This method is at the forefront of technological development in the field and developed to provide the best possible seismic signal with the least possible environmental impact. Figure 3shows what the survey setup looked like when conducting seismic surveys off the south coast of Scania in 2023.

Description of the impact of seismic surveys

The sound frequency and amplitude in the water layer from the sound source will depend on several factors (for example, the air pressure used in the air cannon, the depth of the sound source below the water surface, the depth to the seabed and to some extent the type of bottom substrate). The assessments of the seismic survey method's origin of underwater noise and its impact are described in more detail in the environmental impact assessment (EIA) with the associated underwater noise investigation (see Appendix C and C.3).

The frequency content will also vary with distance from the sound source, with higher frequencies being attenuated and decaying more rapidly than lower frequencies. Near the sound

source, sound frequencies between 1 and 1000 Hz will be generated in the water layer, with the majority of the energy being in the frequency range of approximately 5–250 Hz.

With increasing distance from the air gun, the signal strength decreases due to Transmission Loss (TL), which is a combination of several effects. Near the air gun, TL is dominated by spherical scattering. This is called geometric attenuation and is because the surface area of the wavefront increases with increasing distance. As the distance increases to be significantly greater than the bottom depth, the geometric part of TL gradually changes to cylindrical scattering. In addition to geometric attenuation, TL is affected by several other attenuation processes. Some of the energy is absorbed by the water and converted to heat, which has the greatest effect on high frequencies. Energy with low frequencies disappears into the seabed, especially in shallow areas such as the Baltic Sea.

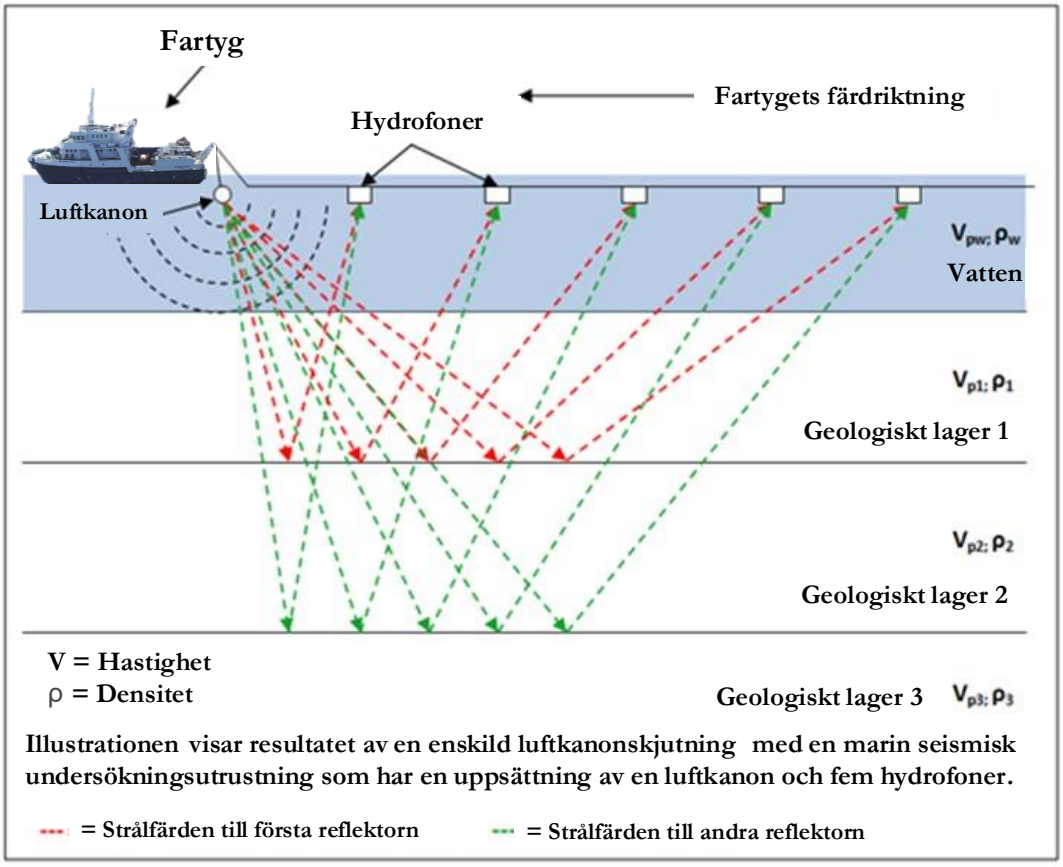

Figure 2 Schematic image of measurement with marine reflection seismic system. Modified image from Nwhit (2012).

Figure 3S/V Ocean Surveyor during seismic measurements south of Scania in 2023. The air cannon is visible just over two boat lengths behind the ship. Photo: Björn Bergman, SGU.

1.2.2 Sediment echo sounder

Description of the equipment

The type of sediment echo sounder, or sub-bottom profiler (SBP), planned to be used is a hull-mounted Kongberg Topas PS120. It is a parametric echo sounder that concentrates the sound beam into a narrow beam directly below the vessel. The system provides high-resolution sediment echo data in the shallow subsurface, up to a maximum of 50 m below the seabed depending on the geology and the instrument settings.

Description of the implementation of the equipment

The Topas PS120 allows for a variety of pulse types, frequencies and ping rates to suit the hydrographic and geological conditions. The system operates between 2–30 kHz with a dominant frequency range of 5–24 kHz, has a ping rate of up to 40 Hz and has a variable pulse length of 0.1–30 ms. The focused beam emitted by the instrument has a beam width, similar to an angle, of approximately 3–4°, and rapidly decays in strength horizontally.

Description of the impact of geophysical surveys

The assessments of the impact of the geophysical survey methods on underwater acoustics are described in more detail in the EIA with the associated underwater noise investigation (see Appendix C and C3). The sound pulse emitted from the sediment echo sounder is not considered to have any significant physical impact on the seabed, such as causing turbidity or other disturbance in sediment. Flora and fauna are also not considered to be negatively affected as the duration of the sound pulse over a specific point is very short, which is further described in the EIA.

1.2.3 Multibeam echo sounder

The multibeam echo sounder, also known as Multibeam Echo Sounder (MBES), that is planned to be used is a Kongsberg EM2040 with a frequency of 300 kHz. This frequency is inaudible to porpoises, so nothing further is stated for this instrument. The instrument is used for bathymetric mapping of the seabed topography and can also be used to collect information about the water column, such as the presence of animals or the presence of gas.

2 THE SURVEY PLAN AND ITS DURATION

The geophysical surveys are planned to be divided into two different time periods; summer and winter, where surveys will be conducted in different areas regarding nature conservation. During summer, SGU's own vessel S/V Ocean Surveyor, which is described further in chapter 4.1, will carry out the surveys in areas that are considered to be less sensitive to harbour porpoises. During winter, when the activity of harbour porpoises is lowest in the investigation area within the Natura 2000 area, areas will be surveyed in accordance with recommendations that emerged during the consultation process, for example from the Swedish Maritime and Water Management Agency and the Gotland County Administrative Board (see Appendix C.1). To carry out the surveys during winter, SGU is required to charter a vessel for the purpose, which means that two vessels will be involved in the surveys.

The main survey campaign consists of towing the measuring equipment in straight transects within the investigation areas. The transects reported in this technical description are a proposal for how the implementation could look like, with reservation for changes. The scope of the transects will not be expanded as the EIA treats the investigation plan according to the worst-case principle. The transects are selected based on achieving as representative a survey result as possible within the time available for each investigation area. The scope, distribution and orientation of the transects are planned based on geology and other background data. Also, with regard primarily to the need for extra protection of the porpoise within the Natura 2000 area, and further also with regard to maritime traffic without negatively affecting porpoises. Background data includes existing boreholes (Figure 4), which are of great importance for the purpose of the survey to be able to correlate with new reflection seismic data.

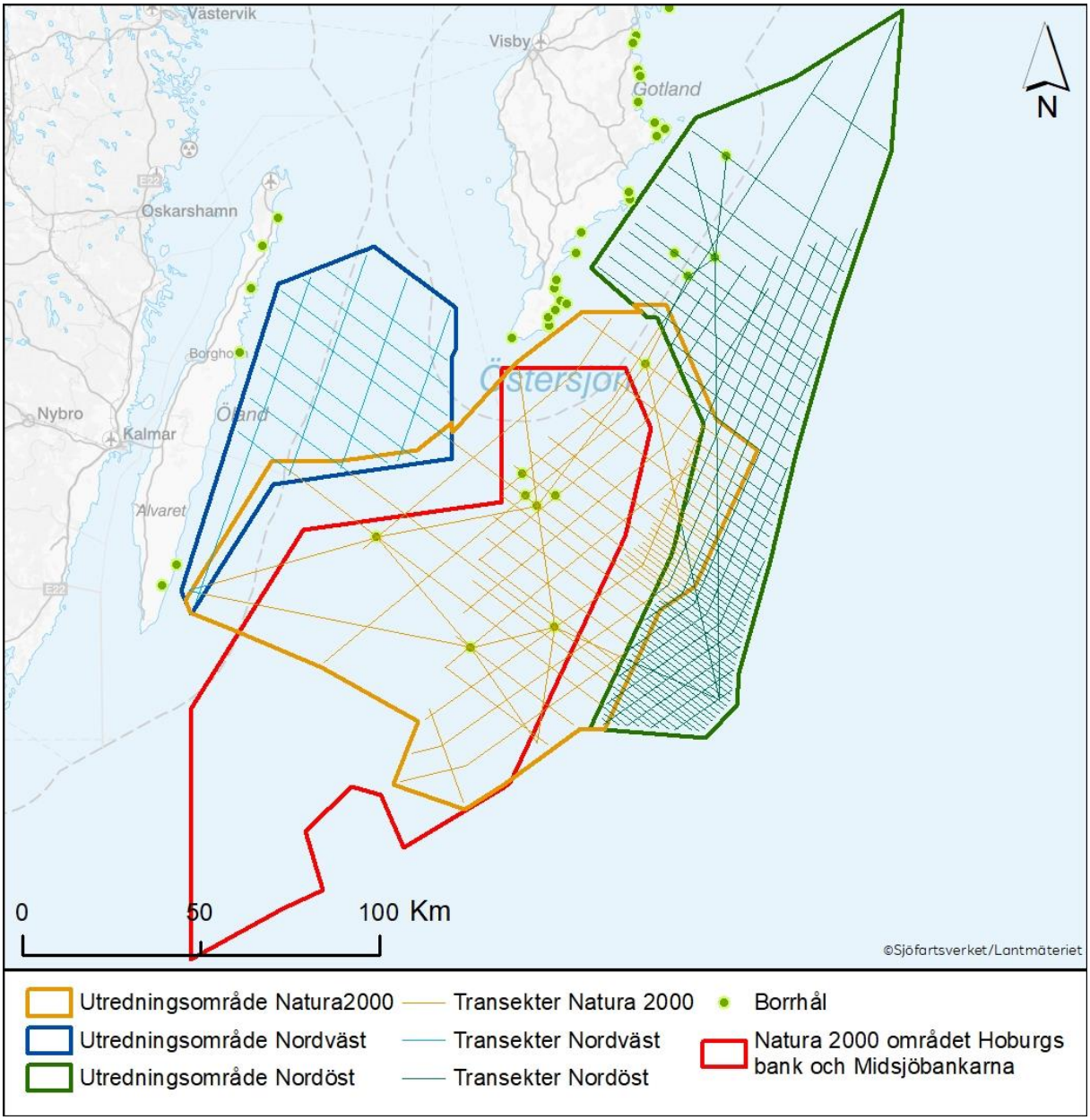

Figure 4 All investigation areas with transects shown together with the existing borehole locations which are of primary importance to correlate with reflection seismic data. Map from Sweco .

The surveys are divided into three investigation areas: Natura 2000, Northwest and Northeast (Figure 4). For the Northwest and Northeast investigation areas, a protection zone has been established against the Natura 2000 area Hoburgs bank and Midsjöbankarna of 14 km (Figure 5), which has been estimated as a reasonable safety distance regarding the propagation of sound in the water column.

The Northwest and Northeast investigation areas are planned to be investigated during the summer, and Natura 2000 during the winter. The Natura 2000 investigation area includes the Natura 2000 area Hoburgs bank and Midsjöbankarna and the safety distance of 14 km established towards the Northwest and Northeast investigation areas, as well as an overlap zone of at least 3.5 km where operations will be carried out within the same geographical area as the Northwest and Northeast investigation areas (Figure 5). The overlap zone is similar for the Northwest and Northeast investigation areas where the investigation areas border the Natura 2000 investigation area. The overlap zone includes a Natura 2000 reversal zone of 1.5 km, a data overlap zone of 0.5 km and a Northwest/Northeast reversal zone of 1.5 km. The overlap zone is

necessary to achieve continuous transects between the investigation areas without data gaps, which also includes room to turn the vessel including towing equipment.

For each investigation area and time period, protective measures will be applied based on what is proposed in the EIA and stated in the permit application.

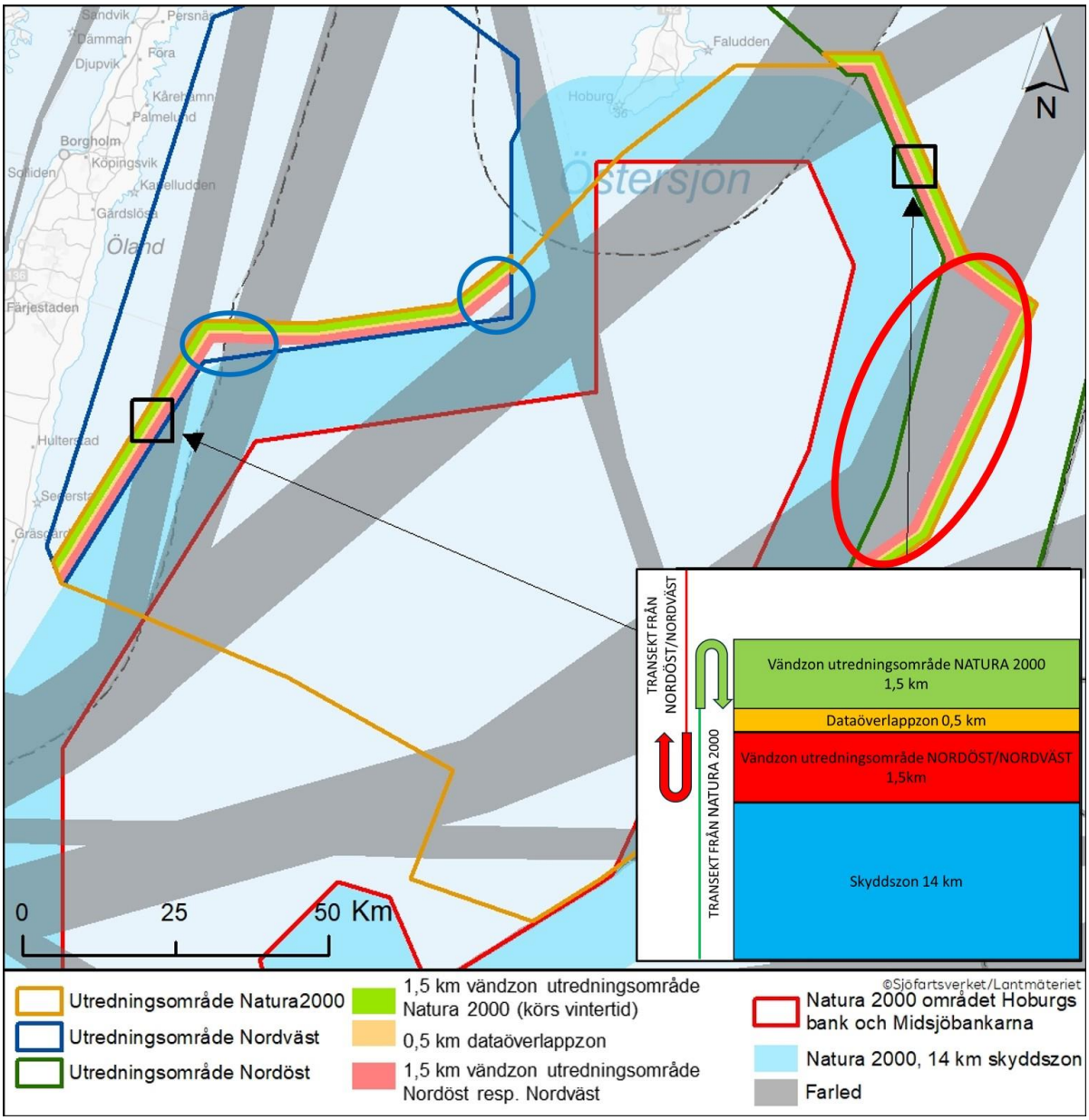

Figure 5 Schematic illustration illustrating the protection zone between the Natura 2000 area Hoburgs bank and Midsjöbankarna and the investigation areas Northwest and Northeast, and how the overlap zone between the Natura 2000 investigation area, and the investigation areas Northwest and Northeast are laid out. Map from Sweco .

2.1 Approximate time for geophysical surveys

2.1.1 Survey areas summertime

To be able to carry out geophysical surveys, one depends on good weather conditions. Wind, waves and currents are some factors that can be problematic for the implementation of the survey methods described in chapter 1.2. Therefore, it is of great importance to plan the surveys according to the seasonal patterns that exist in the Baltic Sea area, to avoid weather-related interruptions in the work. This also provides increased data quality as well as a shorter total period from the start to the end of the surveys. Summertime is the time of year when weather conditions are usually most favorable in the area, when fewer interruptions due to weather are generally expected.

SGU's vessel S/V Ocean Surveyor is a vessel that is primarily designed for field work during the summer, as the vessel is not considered to be seaworthy for research purposes during the winter period. To be able to fulfill the government mission to the greatest extent possible, it is important to be able to use the vessel during the summer to the greatest extent possible in areas that are not considered to have a negative impact on the environment.

During the period May – October, SGU plans to survey the investigation areas Northwest and Northeast with SGU's own vessel S/V Ocean Surveyor, where the specified transects in each investigation area can be seen in Figure 6and Figure 7The investigation is mainly planned to be carried out between May – September, as October is a weather-limited month for S/V Ocean Surveyor.

2.1.2 Survey areas wintertime

To fulfill the government mandate, it is necessary for SGU to investigate areas that are subject to nature conservation. To minimize the negative impact that the investigations may cause, the part of the investigation area that is subject to nature conservation for the Baltic porpoise is planned to be carried out in winter. During winter, the occurrence of protected species, such as the Baltic porpoise, is at its lowest during the year in the investigation area. Winter also does not include any of the most critical periods (mating and calving) in the life of the Baltic porpoise. During the period November – April, SGU plans to investigate the Natura 2000 investigation area with a chartered vessel (Figure 8). The investigation is planned to mainly take place between November – February.

2.2 Survey plan

The survey plan is distributed over summer in the Northwest and Northeast investigation areas and winter in Natura 2000 (Figure 9).

A summary of the survey plan for each investigation area can be found in Chapter 4, where the estimated time required for the investigations to be carried out is summarised. The summary is based on Appendix B.1.

There are several factors that affect the total time that the surveys will take. The survey periods presented in this document include the estimated time that is expected to be spent on downtime due to bad weather, but it should be noted that this is a guideline. Other types of activities that are typically part of an offshore geophysical survey may extend the stated survey periods, such as mobilisation of equipment, transport to and from investigation areas, embarkation and disembarkation of personnel and bunkering. Protective measures may also extend survey periods. During winter, weather conditions are expected to be significantly worse, which means that the risk of downtime due to bad weather is higher. It can be expected that the time to carry out the survey campaign during winter will include interruptions due to the weather to a greater extent.

The total time required for both summer and winter time combined is estimated to be approximately 122 days, with a collection of approximately 6380 km of transect data.

2.2.1 Summertime

The Northwest and Northeast investigation areas will be surveyed during the summer, with an estimated 3,780 km of transect data collected, spread over approximately 3,140 km in the Northeast (Figure 6) and approximately 640 km in the Northwest (Figure 7). Transect separation varies by area, with the Northwest study area having a general transect separation of approximately 10–15 km, while the Northeast study area has closer transect separation in the southern part of the study area (approximately 1–5 km) and a thinner one in the northern part of the study area (approximately 3–10 km). The summer survey period is estimated to last approximately 71 days, spreading over 12 days in the Northwest study area and 59 days in the Northeast study area.

2.2.2 Wintertime

The Natura 2000 investigation area (Figure 8) is planned to be surveyed during the winter with a transect data collection along approximately 2600 km, which is estimated to take around 51 days. In the Natura 2000 investigation area, the transect separation varies mainly due to the need to link the existing borehole data in the area with new reflection seismic data. Furthermore, a general densification of the transects (approximately 3–15 km transect separation) is focused on the south-eastern part of the study area with the aim of increasing the data density in the area where the depth to the carbon dioxide storage reservoir is greatest.

2.3 Investigation area Northeast

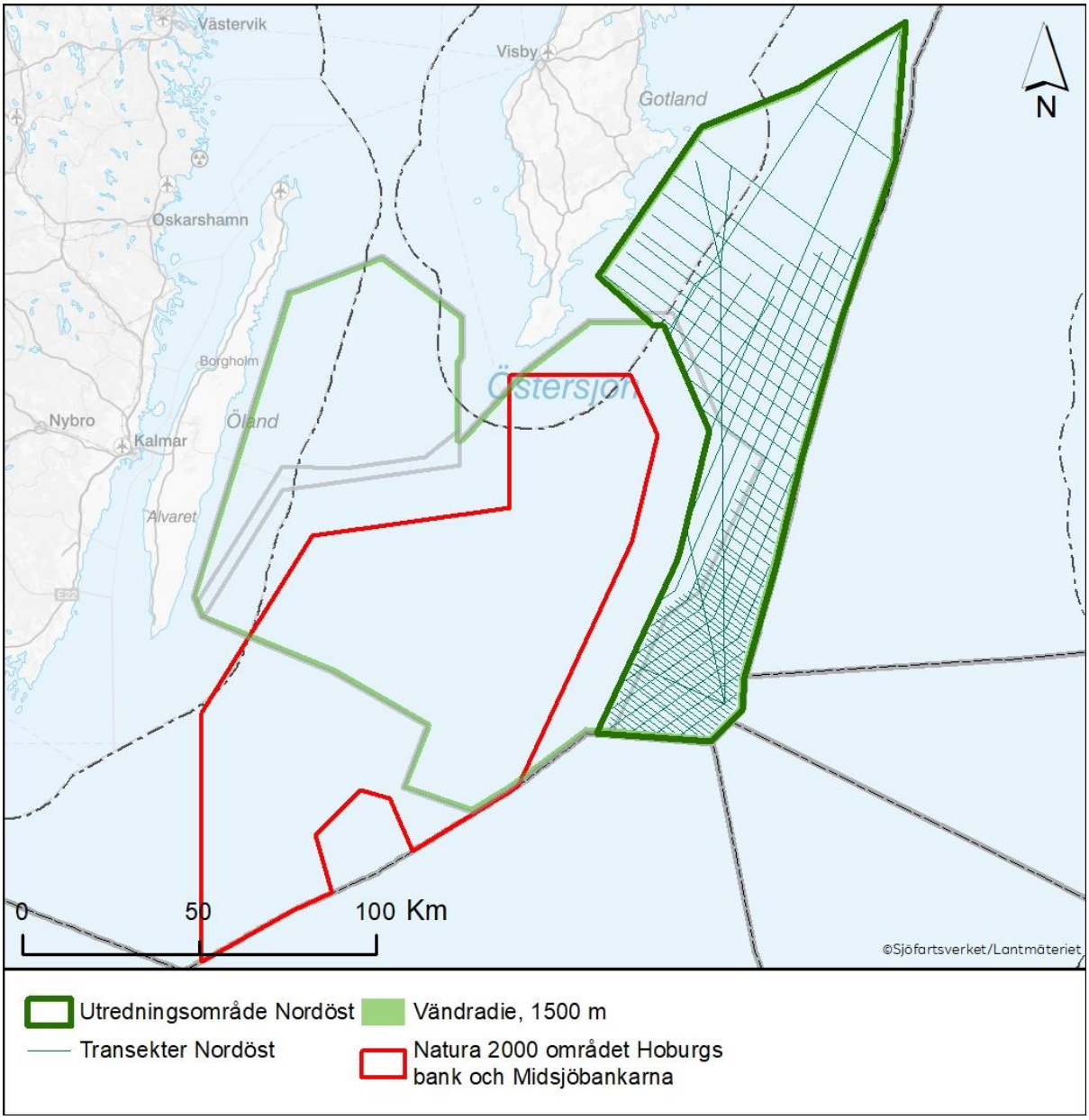

Figure 6 Overview of the Northeast investigation area with the planned transects (green lines). Turning radius shows the zone required for the vessel to turn beyond the specified overlap zones. Map from Sweco .

2.4 Investigation area Northwest

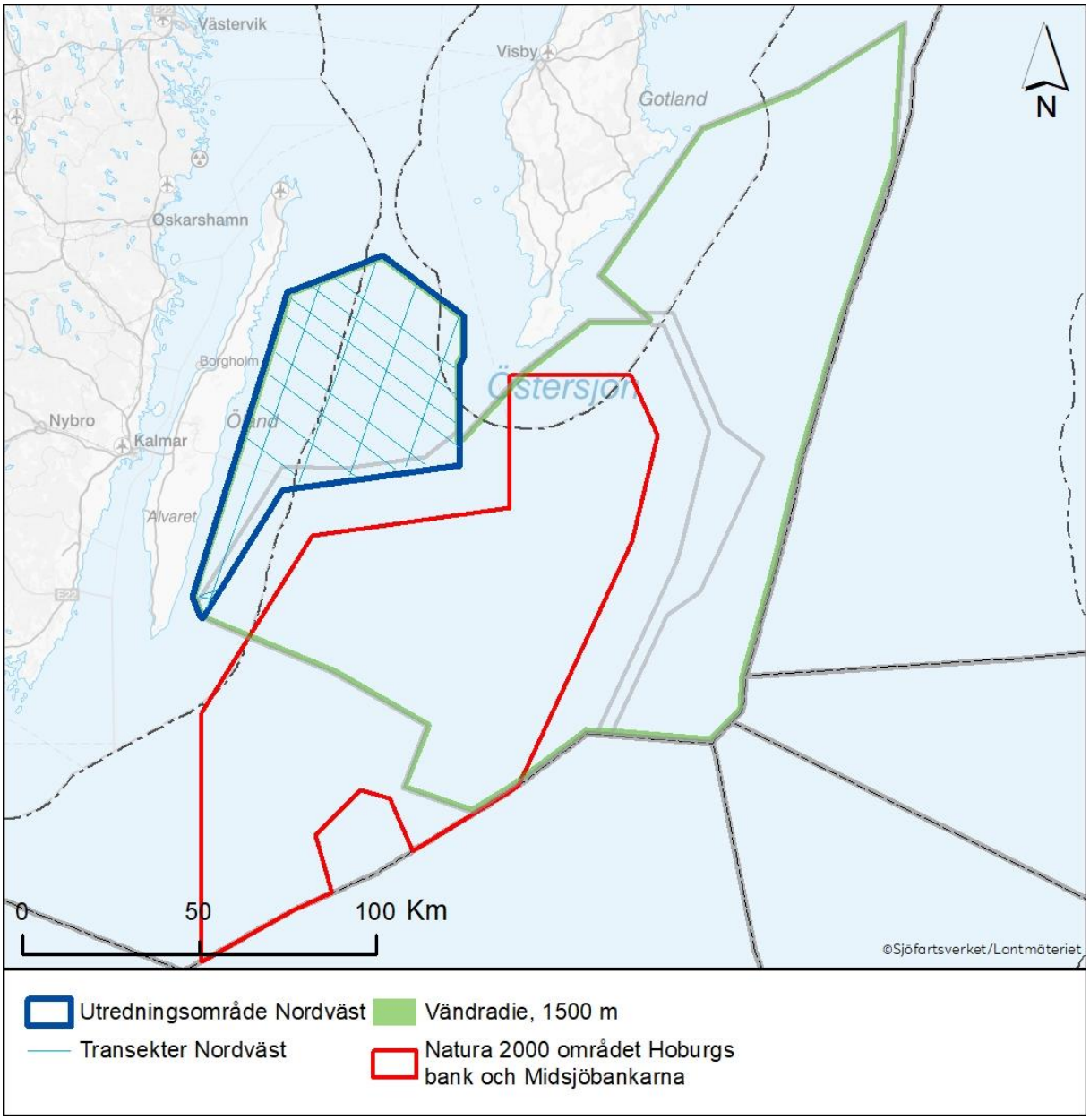

Figure 7 Overview of the Northwest investigation area with the planned transects (blue lines). Turning radius shows the zone required for the vessel to turn beyond the specified overlap zones. Map from Sweco .

2.5 Investigation are Natura 2000

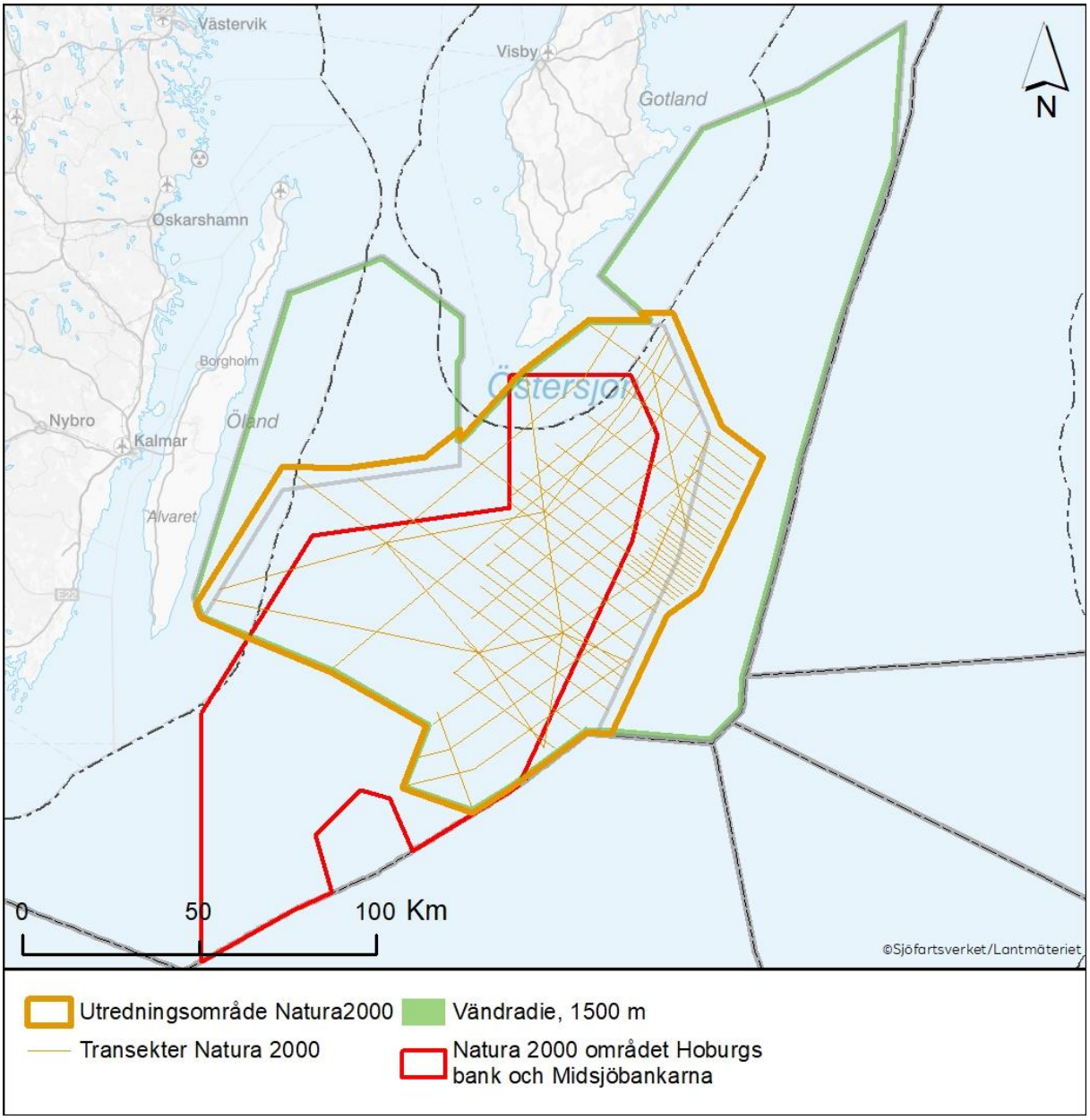

Figure 8 Overview image of the Natura 2000 investigation area with the planned transects (orange lines). Turning radius shows the zone required for the vessel to turn beyond the specified overlap zones. Map from Sweco .

3 MARITIME SAFETY AND OTHER PREPAREDNESS

3.1 Maritime safety

The survey plans in each investigation area have been carefully developed to maintain maritime safety to the greatest extent possible. The transects are oriented primarily parallel along shipping lanes and other known sea routes, and perpendicular at intersections to minimize unnecessary risks. A few exceptions have been made after careful consideration of this strategy as the results of the surveys are expected to achieve higher quality and better basis for making decisions in the future. These exceptions apply to transects that violate the grid pattern and focus on connecting existing boreholes in the area (Figure 4). The existing borehole data that is available is considered to have an important role in interpretation work as a correlation of geophysical data with borehole data enables correct interpretation.

Conditions can change quickly out in the Baltic Sea. Weather forecasts and the surrounding environment are constantly monitored. The measurement planning carried out on board the ship is carried out with continuous communication with the captain, where planning changes are made according to the circumstances.

SGU follows the procedures that exist regarding the rules and regulations concerning trafficked waters and shipping lanes. SGU's shipping company Ocean Surveyor, according to a decision from the Director General, follows the ISM code (International Safety Management code) for the safe operation of ships and the prevention of pollution and therefore has an established safety management system (Safety Management System; SMS) as described in SGU's Safety Handbook (Sveriges geologiska undersökning, 2024). Note that the government ships, which the shipping company Ocean Surveyor owns, are not allowed to be ISM code certified by the Swedish Transport Agency. However, the shipping company was certified with an ISM code until 2017, when it was permitted. Before the planned start of the survey, the Swedish Maritime Administration is contacted in good time with an announcement with information about the scope of the surveys. During the day, a daylight signal is used and during the night, lighting is used in the mast. The ships' AIS (Automatic Identification System) continuously sends out information to other ships and coastal stations in the vicinity, and there is constant monitoring of VHF radio (Very High Frequency) channel 16.

Equivalent requirements as above will be imposed on all vessels and crew involved in the survey campaign.

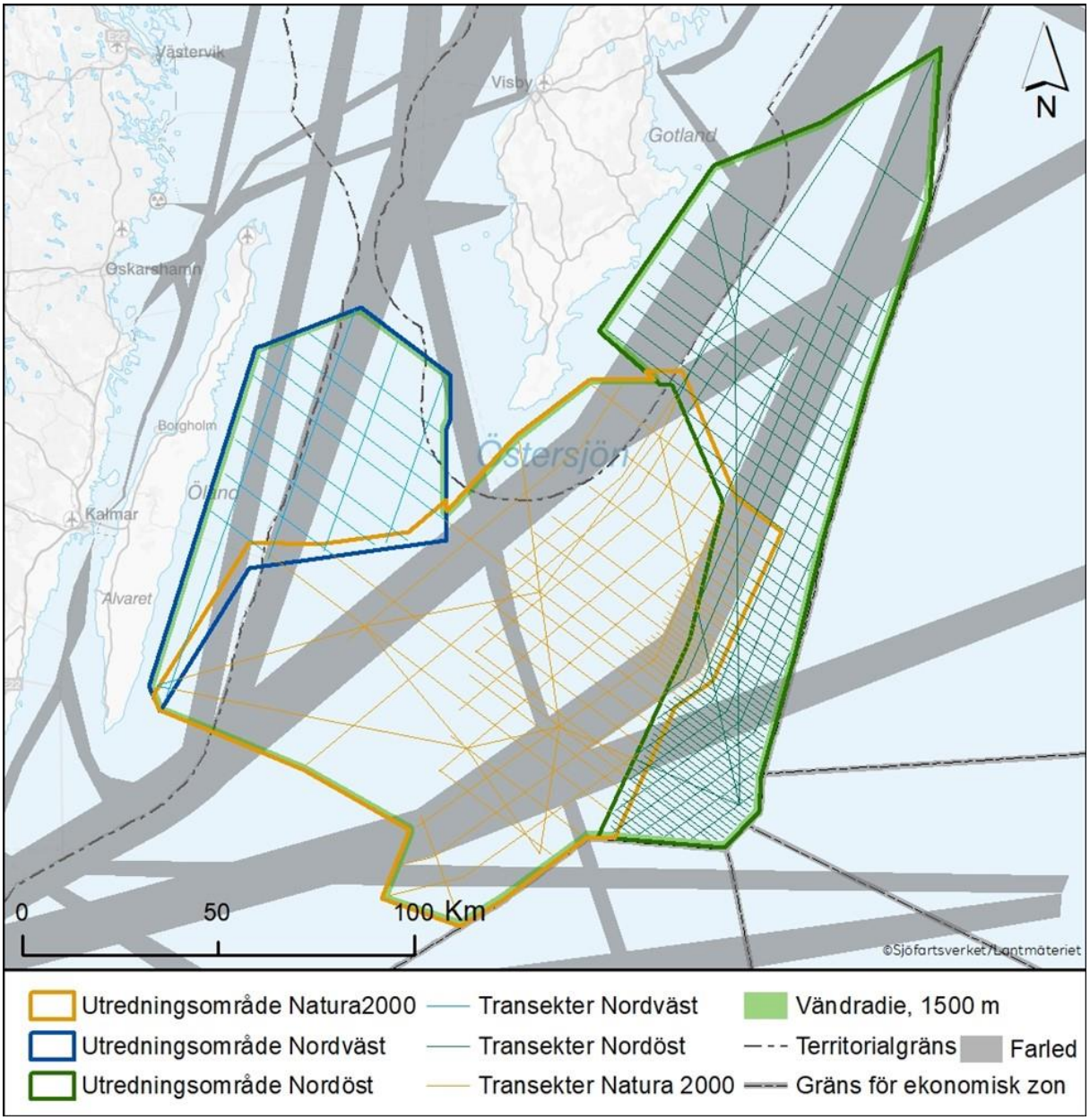

Figure 9 All investigation areas and transects together with the shipping lanes (grey). Turning radius shows the zone required for the vessel to turn beyond the specified overlap zones. Map from Sweco .

3.2 Preparedness for leakage of environmentally harmful substances around the Natura 2000 area

The ships that SGU plans to use have an appropriate routine in the event of accidents and spills. SGU's shipping company Ocean Surveyor has established a SOPEP (Shipboard Oil Pollution Emergency Plan) which is based and developed by the IMO (International Marine Organization) to combat oil spills (International Marine Organization, 1992; 2000), which is revised annually. The SOPEP plan contains all the information and practical instructions required according to the IMO guidelines. The purpose of this plan is to provide the Captain and other Officers on board with guidance on what measures should be taken when an oil spill or similar has occurred or is likely to occur. For example, the SOPEP contains an action plan for;

- What information and who to report to in the event of an accident
- Carrying out measures in the event of an accident
- National and local coordination in the event of an accident
- Information about protective clothing and equipment used when dealing with an accident

The different types of accidents covered in a SOPEP include, for example, grounding, collision and fire. The Safety Handbook (Sveriges geologiska undersökning, 2024) also serves as a basis for minimizing the risks of accidents that can damage the environment.

Equivalent requirements as mentioned above will be imposed on all vessels and crew involved in the survey campaign.

4 COMPILATION AND QUANTITY OF THE SURVEY

A summary of the geophysical surveys that may be carried out for the project, as well as the specifications for these, is provided in Table 1.

Table 1 Summary of survey methods and the scope of surveys planned to be carried out for the project.

Method	Areas of investigation	Number of survey days, other specifications
Geophysical surveys		
Seismic survey method	Natura 2000, Northeast and Northwest	1–1000 Hz
Sub bottom profiler (SBP)	Natura 2000. Northeast and Northwest	5–24 kHz
Multi-beam echo sounder (MBES)	Natura 2000, Northeast and Northwest	300 kHz
Timetable		
	Natura 2000	51 days
	Northeast	59 days
	Northwest	12 days
Total area		
	Natura 2000	11,964 km^2
	Northeast	8,242 km^2
	Northwest	3,626 km^2
Transect length		
	Natura 2000	2552 km
	Northeast	3135 km
	Northwest	638 km

4.1 The survey vessel S/V Ocean Surveyor

S/V Ocean Surveyor is a catamaran built in fibreglass and is classified for ocean-going traffic (Figure 10; Table 2). The vessel is self-sufficient in fresh water and has large tanks which, together with the well-equipped galley, enable long voyages. The vessel's life-saving equipment is designed for 25 persons.

The steering system is equipped with so-called dynamic positioning (DP). With the satellite-based positioning equipment, two side propellers on each side, and two propellers in the stern, the ship can automatically and with decimeter accuracy stand still in a position or follow a laid out course.

The vessel is equipped with several fixed measurement systems, such as single and multi-beam echo sounders, sediment echo sounders, side-scan sonar, multi-channel seismic (air guns), sound velocity profilers, current and oxygen content meters. A 50 m^2 area for controlling the measurement systems, data processing and interpretation, and data storage is located directly adjacent to the bridge.

The ship has a large main deck in the stern with several winches, cranes, a stern frame and a so-called moonpool in the main deck from which the ship's various samplers and underwater cameras can be used.

Two laboratory spaces are on board, a wet lab for sediment and environmental sample analysis and a space with a gamma spectrometer and sediment X-ray for detailed studies of samples.

Figure 10SGU's ship S/V Ocean Surveyor.

Table 2 Characteristics of S/V Ocean Surveyor and equipment relevant to the project.

Specification		
Length	38 m	
Width	12 m	
Profound	3.4m	
Maximum speed	11 knots	
Equipment		
Hydrographic echo sounder	Kongsberg ES60	Navigation aid
Positioning system	Seatex Seapath 130 including MRU 5 motion sensor	RTK positioning
Navigation system	RTK positioning	

4.2 Chartered survey vessel in winter

The vessel that SGU plans to charter during the winter can be expected to have similar specifications to two other state vessels; R/V Skagerak (University of Gothenburg; GU) and R/V Svea (Swedish University of Agricultural Sciences; SLU and the Swedish Meteorological and Hydrological Institute; SMHI) (Figure 11). The length of the vessels varies between 50 and 70 m and has a gross tonnage of approximately 900 – 3200 tons. Further information about the vessels can be found on the official websites of GU (Göteborgs universitet, 2024) and SLU (Sveriges lantbruksuniversitet, 2024a), respectively.

Figure 11R/V Svea (left) and R/V Skagerak (right). Image from Sveriges lantbruksuniversitet (2024b).

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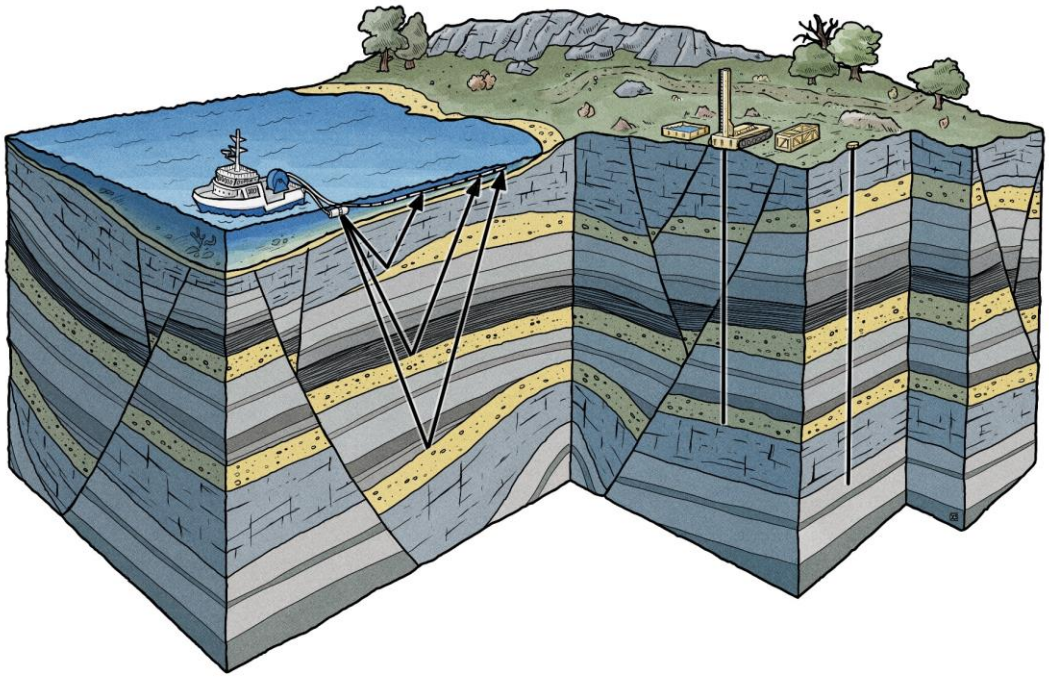
Siting investigation

december 2024

SGU:s diarienummer: 316-3015/2024



SGU Sveriges geologiska undersökning

Cover image: Schematic diagram of seismic reflection and borehole survey. Note that the image is not to scale.
Illustrator: Daniel Sopher

Author: Finn Baumgartner
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1 INTRODUCTION

The Geological Survey of Sweden's (SGU) report to the government Geologisk lagring av koldioxid i Sverige och i grannländer – status och utveckling RR 2021:04 (Mortensen & Sopher, 2021) and Geologisk lagring av koldioxid, delrapport 1 RR 2023:04 (Sveriges geologiska undersökning, 2023) have formed the basis for the descriptions in this siting investigation.

In the consultation document, SGU has used the terminology "marine seismic and marine geological surveys" and "marine mapping" as an overall collective term for the planned surveys that are part of the Natura 2000 assessment. In subsequent documents, the term "geophysical surveys" is used instead, which is a clearer way of expressing the acoustic methods that SGU plans to use. These refer, more specifically, to multibeam echo sounders (multibeam echo sounder; MBES), sediment echo sounder (sub-bottom profiler; SBP), and seismic surveys with air guns (reflection seismic). SGU would like to clarify that this is only a change in terminology and that it does not affect the examination or change the meaning of the surveys that the application covers.

2 CRITERIA FOR SELECTING SUITABLE CARBON DIOXIDE STORAGE AREAS

Carbon dioxide storage in deep saline aquifers are considered to have the greatest potential globally and are also identified as the most suitable in Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC and 2008/1/EC of the European Parliament and of the Council and Regulation (EC) No 1013/2006 (hereinafter the CCS Directive). Deep saline aquifers are defined here as aquifers that occur at sufficient depths to enable the storage of carbon dioxide in a supercritical state. The storage potential is primarily dependent on the size of the aquifer and the porosity and permeability of the aquifer rock.

Overall criteria for selecting suitable carbon dioxide storage areas in Sweden are described below and are based on, among other things, the CCS Directive, Ordinance (2014:21) om geologisk lagring av koldioxid and the report "Geologisk lagring av koldioxid i Sverige – Lägesbeskrivning avseende förutsättningar, lagstiftning och forskning samt olje- och gasverksamhet i Östersjöregionen" authored by Mortensen et al. (2017):

- If more than 100,000 tons of carbon dioxide are intended to be stored, the storage must take place offshore under the seabed, optimally at a depth of more than approximately 800 m.
- The overlying, dense bedrock that prevents carbon dioxide from seeping up to the surface should be at least 100 m thick.
- The storage unit where the carbon dioxide is to be injected and stored should be more than 20 m thick, have high permeability and a pore volume of around 20%.
- There must be no faults in the bedrock that could lead to leakage.
- It is advantageous if the storage capacity is large enough to be able to store the amount of carbon dioxide generated from industrial activities, for example 100 million tons of carbon dioxide or more.

3 BACKGROUND ON THE IMPORTANCE OF THOROUGH INVESTIGATIONS

A thorough investigation is required to assess whether an identified storage site is suitable for geological storage of carbon dioxide. What should be included in an investigation is regulated by the CCS Directive.

The initial work should include an inventory of existing data from drillings and borehole geophysical surveys on the structure of the bedrock. For description and further assessment of the regional areas, a structural mapping is carried out using existing geophysical measurements (seismic) and drillings. The aim is to develop a geological model as a basis for assessing the potential of the area and to delimit the investigation areas that are particularly suitable for further surveys. The assessment work includes initial calculations and assessments of storage capacity and safety.

4 AREA-SPECIFIC SURVEYS

Annex 1 to the CCS Directive provides instructions on how to conduct a description and assessment of a potential storage complex and is briefly described below:

- Collection of basic information.

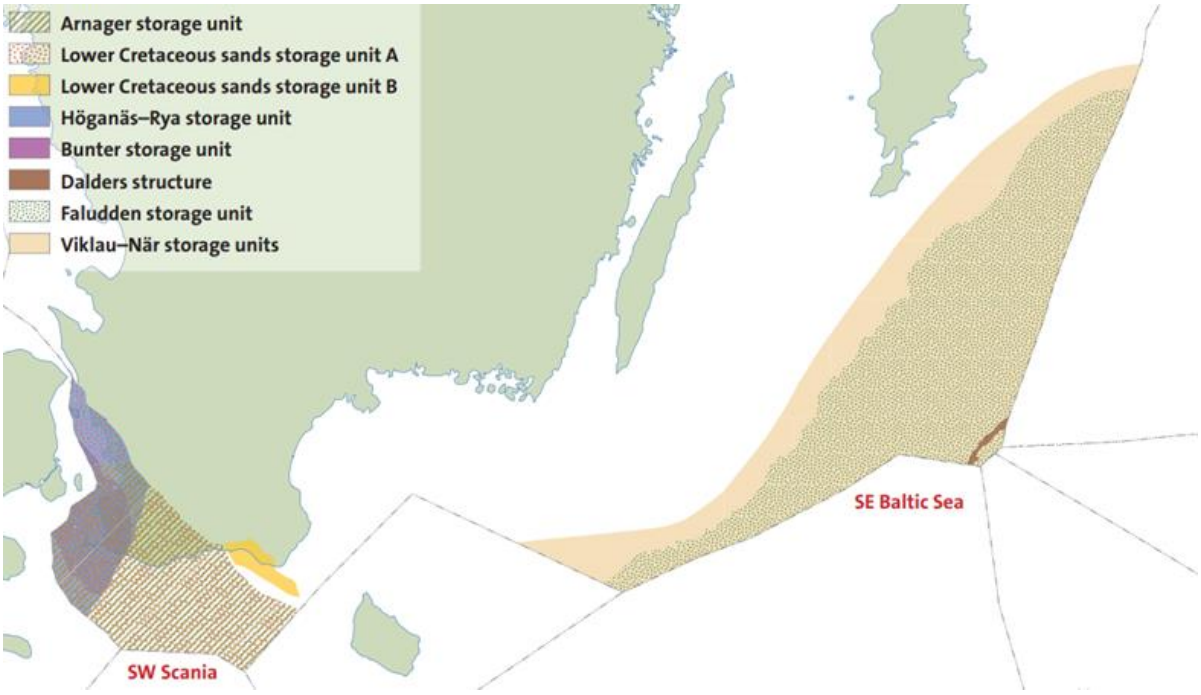
  The data to be collected is intended to clarify the geological, hydrogeological, geochemical and physical properties of the storage complex and its surroundings. The storage complex comprises the entire geological formation, or aquifer, that contains the storage unit, as well as the associated surface and injection facilities. This also includes the properties of the cap rock and hydrologically interconnected areas. Many of these properties are collected through information from new, complementary core drilling and geophysical surveys, including deep seismic measurements.

- Geological and hydrogeological modeling in space and time.

  Using input data from collected basic information, a series of three-dimensional and four-dimensional models of the storage complex are produced.

5 CONDITIONS AND LOCATION ALTERNATIVES FOR CARBON DIOXIDE STORAGE AREAS IN SWEDEN

Mortensen & Sopher (2021) describe, based on several research studies, that the potential for carbon dioxide storage in deep saline aquifers exists in Sweden and that the most suitable areas are located in the southeastern Baltic Sea and southwest Scania including adjacent sea areas (Figure 1). This therefore constitutes a first, very central starting point in the localisation process.



Figur 1. The figure describes the two known areas that have been identified as particularly suitable for geological storage of carbon dioxide, south of southwest Scania and the southeasten Baltic Sea south of Gotland, respectively. Figure from Mortensen (2014).

Within the two geographical areas, eight potential storage units in deep saline aquifers have been identified, three in the southeastern Baltic Sea (Table 1) and five in southwest Scania including sea areas (Table 2). Note that the information presented in Tables 1 and 2 is based on a limited number of samples so some figures are estimates. SGU shall, according to an assignment in its appropriation letter (prop. 2022/23:1 utg.omr . 24, bet. 2022/23:NU1, rskr. 2022/23:99), among other things, investigate and survey suitable sites for permanent storage of carbon dioxide in Sweden and analyse the conditions for the operation of the storage sites. Note that complementary geophysical surveys have already been carried out in sea areas south of Scania in 2023 and 2024. Therefore, the southeastern Baltic Sea is the only remaining area that remains to be investigated and thus the area covered by the current application.

Table 1. Physical parameters and estimated capacities for the three potential storage units in the southeastern Baltic Sea. From Table 2 in RR 2021:04 (Mortensen & Sopher, 2021).

Lagringsenhet	Djup, m	Mäktighet, m	N/G sand	Porositet, %	Permeabilitet, mD	Teoretisk kapacitet, Mt CO_2	Effektiv kapacitet, 2 %, Mt CO_2	Dynamisk simulering, Mt CO_2
Faludden	830	45	0,90	14	147	37 271	745	250
När	817	36	0,65	10	50	21 294	426	-
Viklau	865	57	0,65	8	30	27 631	553	-

Mt = miljoner ton.

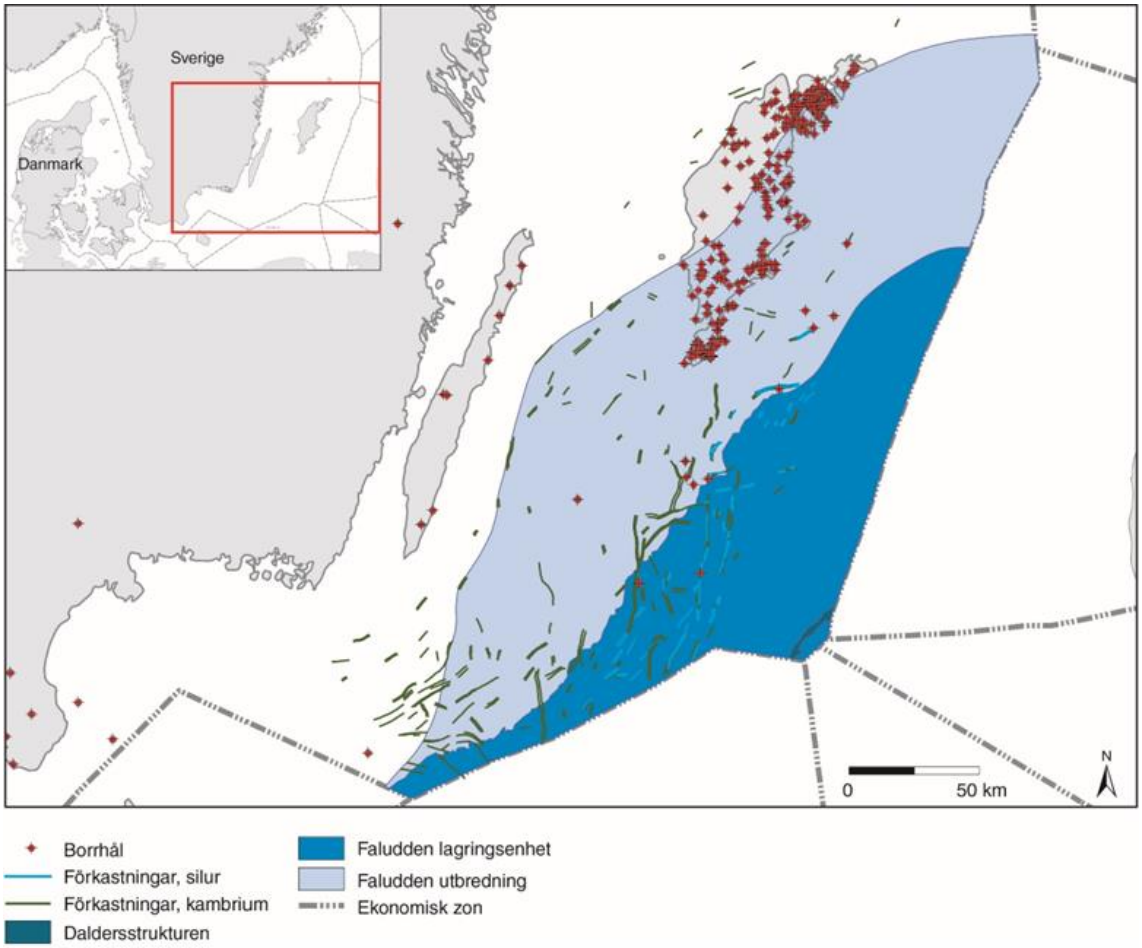
Table 2. Physical parameters and estimated capacities for the five potential storage units in southwest Scania. From Table 3 in RR 2021:04 (Mortensen & Sopher, 2021).

Lagringsenhet	Djup, m	Mäktighet, m	N/G sand	Porositet, %	Permeabilitet, mD	Teoretisk kapacitet, Mt CO_2	Effektiv kapacitet, 2 %, Mt CO_2	Dynamisk simulering, Mt CO_2
Arnagergrönsand	946	39	0,80	26	681	26 050	521	250
Undre krita A	965	29	0,65	25	200	16 523	330	-
Undre krita B	776	200	0,65	25	200	5 753	115	-
Höganäs–Rya	976	180	0,51	23	200	27 127	543	-
Bunter	1 509	137	0,67	12	300	8 268	165	-

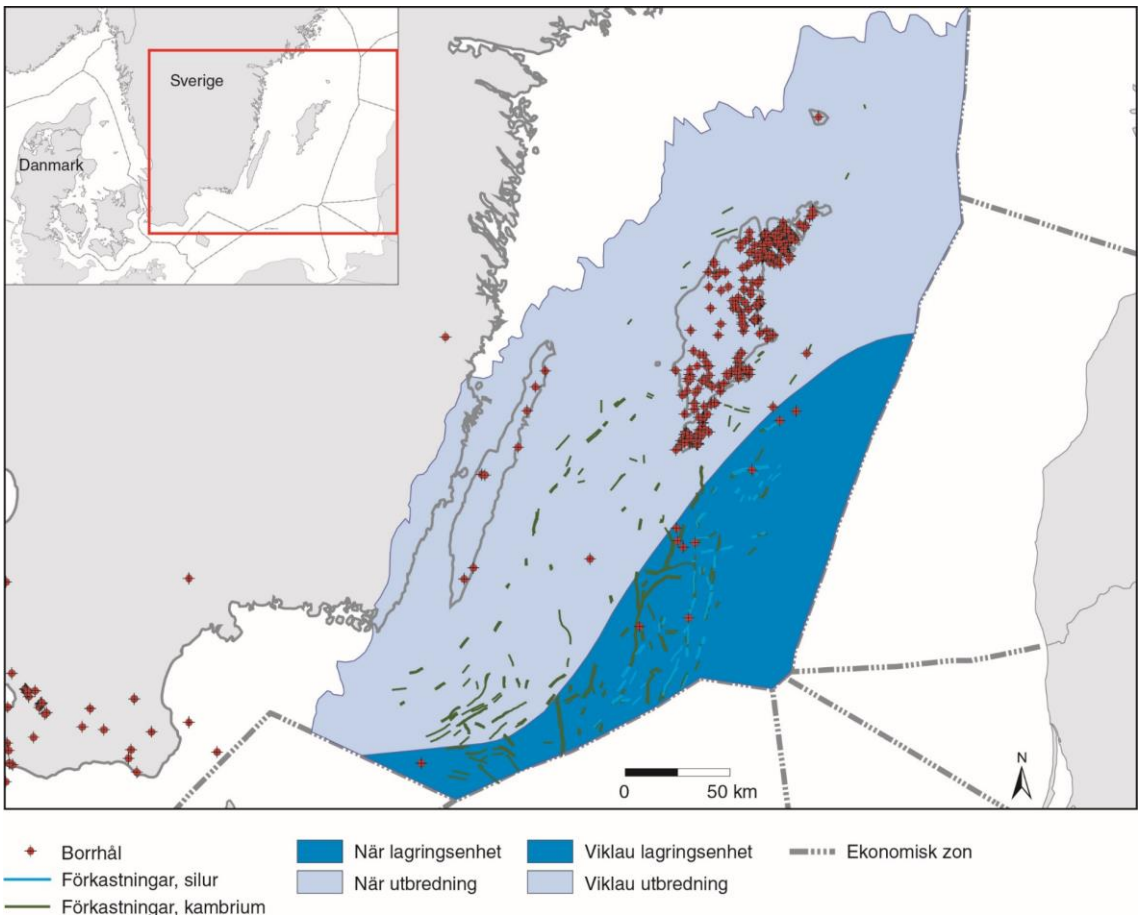
Mt = miljoner ton.

In the southeastern Baltic Sea, Faludden has previously been assessed as the most promising storage unit (Mortensen & Sopher 2021; Figure 2). The results from porosity and permeability analyses of drill cores collected on southern Gotland in 2023 (Nore-1 and Nore-2; see Figure 5) have supported this assessment and verified that Faludden is the only suitable storage aquifer in the southeastern Baltic Sea (M. Erlström, personal communication, September 27, 2024). The other two potential storage units, När and Viklau, are located in approximately the same area as Faludden but at different depths (Figure 2 compared to Figure 3; Table 1). The extent of the När and Viklau storage complexes is larger than Faludden (Figure 2 compared to Figure 3). However, porosity and permeability analysis data from När and Viklau have shown that these are not suitable for carbon dioxide storage (M. Erlström, personal communication, September 27, 2024). Therefore, the geophysical investigation will focus on the less widespread Faludden storage complex.

Figure 2 shows the estimated extent of the Faludden storage complex, where reference boreholes are available for further assessment of the carbon dioxide storage areas and where there are known occurrences of faults in the sea area. The figure also shows in the darker blue area where the estimated Faludden carbon dioxide storage unit is located.



Figur 2. The estimated extent of Faludden within the Swedish economic zone, the entire range in light blue and the storage unit in darker blue. From figure 7 in RR 2021:04 (Mortensen & Sopher, 2021).



Figur 3. När and Viklaus estimated extent within the Swedish economic zone, interpreted together. The entire range in light blue and the storage units in darker blue. From figure 8 in RR 2021:04 (Mortensen & Sopher, 2021).

6 THE DESIGN OF SGU'S PLANNED INVESTIGATIONS AT HOBURGS BANK AND MIDSJÖBANKARNA AS WELL AS EAST AND WEST OF GOTLAND

There is currently no alternative to the type of survey intended to be used in the application that has an equivalent function and has an equally small, or smaller, environmental impact. The new surveys are necessary to assess the suitability of storing carbon dioxide in the rock under the southeastern Baltic Sea with a focus on the Faludden storage complex .

This primarily concerns the occurrence, location, characterisation and risk assessment of any area-limiting faults. This information is crucial for the dynamic models that form the basis for the volume assessments, dispersion scenarios and risk assessments that need to be made according to the CCS Directive.

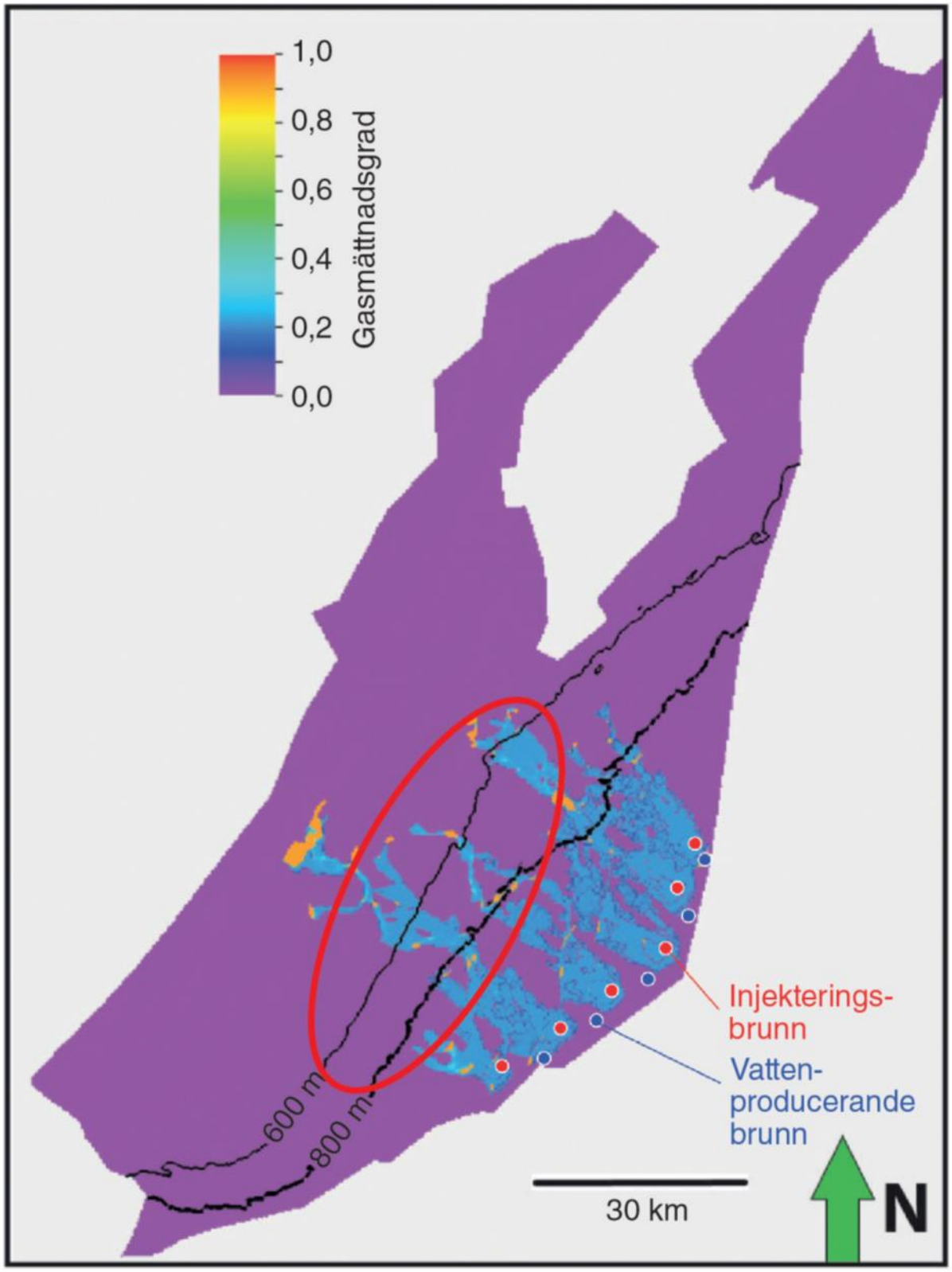
SGU's report to government commission RR2023:04 (Sveriges geologiska undersökning, 2023) clarifies in more detail why new surveys need to be carried out in the southeastern Baltic Sea:

SGU's planned geophysical surveys are crucial for assessing storage in the southeastern Baltic Sea, both regarding knowledge of the storage capacity of sandstone aquifers and the density of the cap bedrock. The size and delimitation of Faludden will depend on the availability of information on the occurrence and extent of limiting faults in the area.

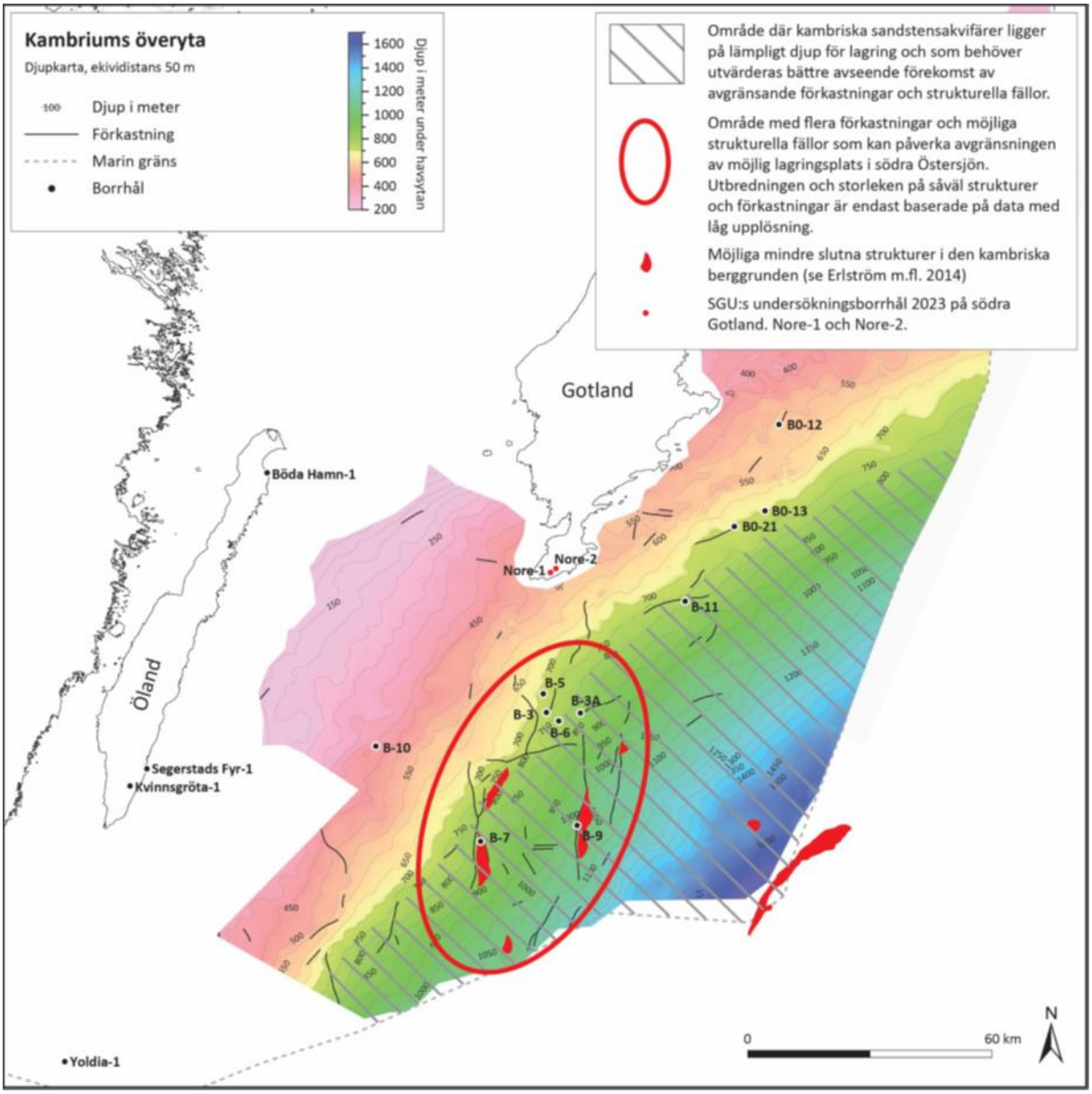
Today, knowledge of existing structures in the bedrock is largely based on seismic surveys with poorer resolution, carried out by Oljeprospektering AB (OPAB) during the 1970s and 1980s. Information on the vertical extension of faults towards shallower bedrock must be improved in order to be able to carry out a risk analysis of the density of the cap bedrock and an assessment of the risk of leakage from Faludden .

Since a possible storage scenario occurs east of the high-interest area and the carbon dioxide plume is estimated to move along a slightly inclined storage plane in a westerly and northwesterly direction (Figure 4), any faults in the area to the west (Figure 5) will be crucial for the delimitation of a possible storage site. An area south of Gotland towards Polish territory (Figure 4 and Figure 5) is identified as crucial for the delimitation of Faludden. The area largely coincides with the Natura 2000 area Hoburgs bank and Midsjöbankarna.

Improved knowledge of north–south trending faults and a number of smaller structural traps are of great importance for the outcome of the ongoing investigation (Figure 5). The area also contains the two most important older reference boreholes (B-7 and B-9, see Figure 5) in the Swedish marine area which, when correlated with new seismic information, enables a more secure understanding of the structure of the storage complex in the southeastern Baltic Sea.

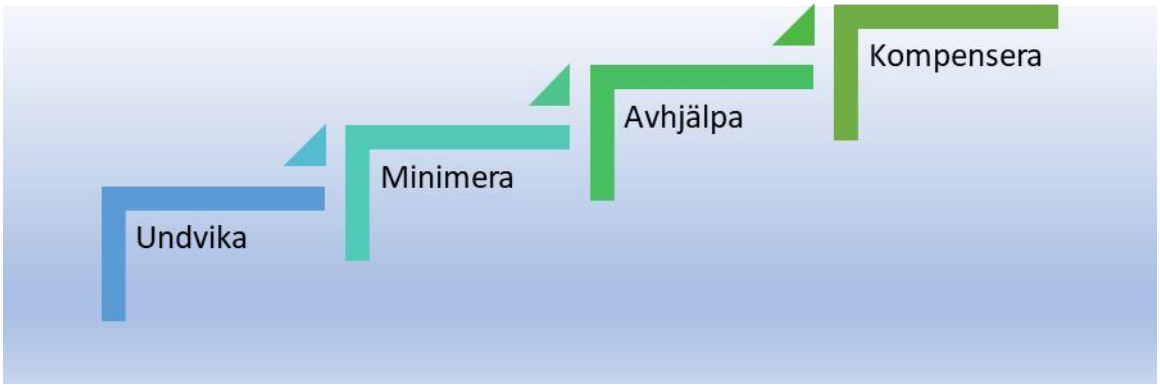


Figur 4. An example of a dynamic reservoir simulation of carbon dioxide injection in the Faludden storage unit, where the amount of capillary (within pore spaces) carbon dioxide captured after 6,000 years is shown as blue areas; 250 million tonnes of carbon dioxide injected over 50 years. Note that no consideration has been given to limiting faults here. From Figure 12 in RR2023:04 (Sveriges geologiska undersökning, 2023).



Figur 5. Illustration showing the depth to the Cambrian bedrock surface (storage aquifers) and the hatched area for possible carbon dioxide storage according to older SGU reports and the circled area of special geological interest for investigation of faults and structures. The location of SGU's investigation boreholes on southern Gotland in 2023 are marked. From Figure 13 in RR 2023:04 (Sveriges geologiska undersökning, 2023).

In order for the chosen design to also be considered acceptable from a Natura 2000 perspective, a number of consideration measures and important adaptations in accordance with the mitigation hierarchy have been applied in the EIA work. The mitigation hierarchy means that consideration is primarily taken by avoiding, minimizing and remedying negative effects of a measure. Only when reasonable consideration has been taken and negative effects still remain are compensatory measures taken (Figure 6).



Figur 6. Mitigation hierachy

The following considerations can be summarised as having been taken with the aim of adapting the surveys so that they are deemed to be feasible also within and in the vicinity of the Natura 2000 area Hoburgs bank and Midsjöbankarna:

- The Natura 2000 area's need for consideration for Baltic harbour porpoises:
    - Seasonal restrictions on surveying within the Natura 2000 area have been introduced so that the area can only be surveyed during the winter season, November – April.
    - An additional voluntary protection zone has been introduced around the Natura 2000 area which must also be surveyed in winter as an additional voluntary precautionary measure.
    - Consideration of the Baltic harbour porpoise's need for seasonal restrictions has been given priority over maritime safety issues so that maritime safety is based on the Baltic harbour porpoise's need for seasonal protection during the summer (May - October) in its most sensitive life cycle and within Natura 2000 designated habitats.
- Protective measures in the form of suggestions for how to behave with the seismic survey methods are based on the actual underwater modeled results on permanent threshold shift (PTS), temporary threshold shift (TTS), and behavioral impacts on harbour porpoises, seals, and fish.
- A clear prioritisation of which areas need to be investigated in order to obtain sufficiently good research data for the overall assessment of a future carbon dioxide store and in which seasons these investigations can be carried out with sufficient consideration for the Baltic harbour porpoise's most sensitive period in the summer.

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SGU Geophysical Surveys

Noise investigation

SWECO

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1 Nomenclature

Bathymetry The terrain under water. Corresponding topography on land.

Impulsive and continuous noise Impulsive noise is defined as a short and distinct event that is distinct from other noise. The corresponding, non-impulsive noise is referred to as continuous noise.

Source strength Sound level or Source Level (SL). Means a reference intensity or reference power generated by a plane wave with a sound pressure of 1 µPa RMS at a distance of 1 meter in a volume of water with a density of 1000 kg/m ^{3} and a sound speed of 1500 m/s.

Unweighted and weighted sound levels Unweighted sound levels are the sum of the sound levels for each frequency over the specified frequency range without filtering. For weighted sound levels, a weighting filter is used to simulate the sensitivity of the recipient's auditory system.

PCW Phocid Carnivores in Water , used to describe a sound filter that emulates the hearing range of seals.

VHF Very High-Frequency cetaceans , used to describe a sound filter that emulates the hearing range of harbour porpoises

TTS Temporary Threshold Shift . A temporary hearing loss or injury that lowers the animal's hearing ability for up to 24 hours.

PTS Permanent Threshold Shift . Involves a permanent hearing loss that reduces the animal's ability to hear certain types of sounds.

RMS RMS (Root Mean Square) also known as effective value refers to the average sound pressure over a specific unit of time.

SEL Sound Exposure Level . Represents the sound exposure level, either for a single pulse (SEL_{ss}) or cumulatively for multiple pulses (SEL_{cum}).

SPL Sound Pressure Level . Represents the sound pressure level and is given in dB relative to the reference pressure. Unless otherwise stated, it is usually the RMS value of the pressure difference that is referred to.

L_{peak} The peak value of a single sound. The highest single impulse during a single pile stroke, measured from 0 to maximum pressure. There is also the peak-to-peak value, which evaluates based on the difference between positive and negative pressure differences.

2 Summary

The Geological Survey of Sweden (SGU) plans to conduct geophysical surveys in the Baltic Sea with the aim of finding a suitable location for carbon dioxide storage. This is planned to be done using acoustic methods in the form of seismic air guns, a sediment echo sounder, and a multibeam echo sounder , the first two of which give rise to high noise levels. Sweco has investigated the consequences of the sound propagation from these.

Dimensioning impact distances have been calculated based on worst-case assumptions, from which the soft start period needed for animals to have time to get to a safe distance has been calculated. In all investigation areas for all animal types, the soft start has been calculated to be shorter than 7 minutes, which is less than the 20 minutes proposed in the Swedish Agency for Marine and Water Management's (HaV) report 2023:4 Skyddsåtgärder vid seismiska undersökningar: Vägledning för att förhindra att seismiska undersökningar orsakar skadligt impulsivt buller med negativa effekter på marina däggdjur (Havs- och vattenmyndigheten, 2024a).

Calculations of the affected area according to indicators 11A on impulsive underwater sound in the Swedish Agency for Marine and Water Management's regulations (HVMFS 2012:18) on what characterizes good environmental status and environmental quality standards with indicators for the North Sea and the Baltic Sea (Havs- och vattenmyndigheten, 2024b; Havs- och vattenmyndigheten, 2024c) show that based on the calculated impact distances with an assumption of an impact distance of 6.6 km, based on Sweco's calculations, surveys can be carried out 24 hours a day without the affected percentage exceeding 20% per day in all sea basins and 10% of the harbour porpoise's distribution area.

If instead the standard impact distance of 12 km, from Havs- och vattenmyndigheten (2024c), is adopted, surveys can be carried out 24 hours a day in the East Gotland Sea and West Gotland Sea sea basins, but only 12 hours in the Bornholm Sea and Hanö Bay sea basins and in the harbour porpoise range.

3 Background and project description

SGU plans to conduct geophysical surveys in the Baltic Sea with the aim of finding a suitable location for carbon dioxide storage. This is planned to be done using acoustic methods in the form of seismic air guns, a sediment echo sounder, and a multibeam echo sounder , the first two of which give rise to high noise levels. Sweco has investigated the consequences of the sound propagation from these.

Calculations have been made with dBsea 2.4., which is a software that enables powerful and accurate prediction of underwater sound levels for a wide range of environments and scenarios (see dBSea (2024) for more info).

In the consultation document, SGU has used the terminology “marine seismic and marine geological surveys” and “marine mapping” as an overall collective term for the planned surveys that are part of the Natura 2000 assessment. In subsequent documents, the term “geophysical surveys” is used instead, which is a clearer way of expressing the acoustic methods that SGU plans to use. These refer, more specifically, to multibeam echo sounders (multibeam echo sounder ; MBES), sediment echo sounder (sub-bottom profiler; SBP), and seismic surveys with air guns (reflection seismic). SGU would like to clarify that this is only a change in terminology and that it does not affect the examination or change the meaning of the surveys that the application covers.

3.1 Thresholds

Threshold values for behavioural disturbances, temporary damage (TTS) and permanent damage (PTS) for various animals are taken from the following sources:

- National Oceanic and Atmospheric Administration, 2023 (as also (refers to National Marine Fisheries Service, 2018)
- Danish Energy Agency, 2022
- Andersson et al., 2016 (referring to Popper et al., 2014)
- Southall et al. , 2019

Many of the proposed thresholds are fairly rough estimates and generalizations based on studies of specific animals exposed to specific types of sounds. Research is ongoing in this area and the figures are frequently revised.

The listed sources explain the reasoning behind the thresholds and the reservations that apply.

3.1.1 Threshold values for harbour porpoises

Table 1Threshold values for harbour porpoises

Damage	Unit	Sound level (dB)	Source
PTS	SEL_{cum} VHF	155	Danish Energy Agency , 2022
TTS	SEL_{cum} VHF	140	Danish Energy Agency , 2022
Behavioural disturbance	SEL_{SS} VHF	103	Danish Energy Agency , 2022
TTS	L_{peak}	196	Southall et al. , 2019
PTS	L_{peak}	202	Southall et al. , 2019

3.1.2 Thresholds for seals

Table 2Threshold values for seals

Damage	Unit	Sound level (dB)	Source
Potential behavioural disturbance	SEL_{cum} PCW	165	National Oceanic and Atmospheric Administration, 2023
TTS	SEL_{cum} PCW	170	Danish Energy Agency, 2022
PTS	SEL_{cum} PCW	185	Danish Energy Agency, 2022
TTS	L_{peak}	212	Southall et al. , 2019, also National Oceanic and Atmospheric Administration, 2023 citing National Marine Fisheries Service , 2018
PTS	L_{peak}	218	Southall et al. , 2019, also National Oceanic and Atmospheric Administration, 2023 citing National Marine Fisheries Service , 2018
Potential behavioral disturbance (all animals)	SPL_{rms}	160	National Oceanic and Atmospheric Administration, 2023

Note that since there is no clear behavioural disturbance level for a single sound for seals, the broader term " Underwater " is used here. Onset often Behavioral Disturbance Acoustic Thresholds " as defined in the National Oceanic and Atmospheric Administration (2023).

3.1.3 Thresholds for fish

Table 3Threshold values for fish

Damage	Unit	Sound level (dB)	Source
TTS	SEL_{cum}	186	Popper et al., 2014 & Andersson et al., 2016
PTS	SEL_{cum}	203	Popper et al., 2014 & Andersson et al., 2016
TTS	L_{peak}	206	National Oceanic and Atmospheric Administration, 2023
PTS	L_{peak}	207	Popper et al., 2014 & Andersson et al., 2016
Lowest sound level for reaction	SPL_{rms}	150	National Oceanic and Atmospheric Administration, 2023

3.1.4 HVMFS 2012:18

In order to assess the impact of the survey on marine mammal habitats, the Swedish Agency for Marine and Water Management has developed a set of regulations that contain guiding fact sheets for how the assessment should be carried out in accordance with the regulation. The regulation HVMFS 2012:18

descriptor 11 defines indicators for good environmental status with regard to underwater noise and indicator 11.1A deals specifically with impulsive underwater noise (Havs- och vattenmyndigheten, 2024b; Havs- och vattenmyndigheten, 2024c).

For indicator 11.1A, the following threshold values apply with regard to marine mammals:

1. **Short-term value** : A noise level considered to lead to behavioural change is not exceeded in more than 20% of any of the basins in Figure 1on any single day during the assessment period.
2. **Long-term value** : A noise level considered to lead to a change in behaviour is not exceeded in more than 10% of the assessment area as an annual average in any year during the assessment period.

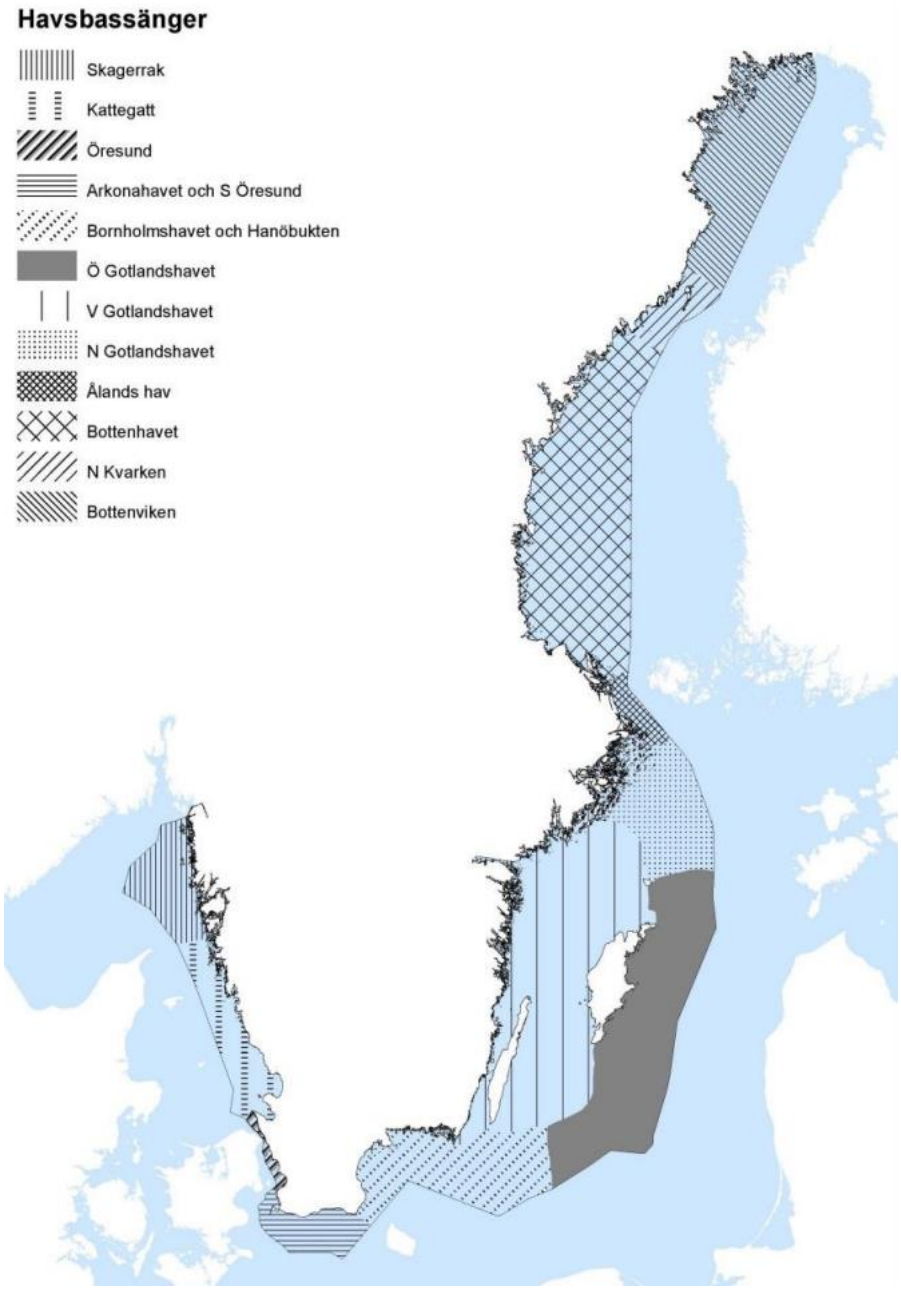

Figure 1Sea basins defined in HVMFS 2012:18 (from Havs- och vattenmyndigheten, 2024b)

In addition, the following thresholds apply with regard to harbour porpoises from May to October:

3. **Short-term value** : A noise level considered to lead to behavioural change is not exceeded in more than 10% of the Baltic harbour porpoise range (illustrated in Figure 2) on any single day during the assessment period.
4. **Long-term value** : A noise level considered to lead to behavioural change is not exceeded in more than 5% of the Baltic harbour porpoise's range as an annual average in any year during the assessment period.

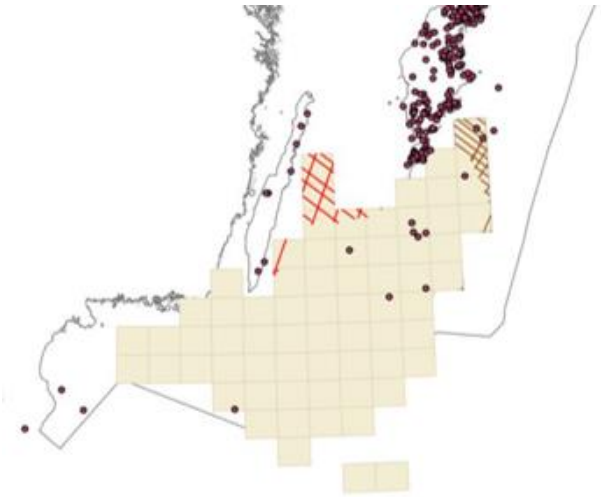

Figure 2Harbour porpoise range, with overlapping transects drawn

4 Prerequisites and assumptions

4.1 Basis

The following data has been used to develop and define the model:

- SGU's proposal for consultation, 2024-06-27
- Shape files for the investigation areas and Natura2000 areas
- Adopted input data and implementation description from meetings with SGU
- Open data from GEBCO for bathymetry model
- Assumptions about sediment succession, choice of sound sources and sound velocity profiles obtained from SGU
- Seismic airgun input data from internal Sercel report

4.2 Area

The current area is parts of the Baltic Sea Proper, from just east of the east coast of Öland to the border of Sweden's economic zone, a bit east of Gotland, see Figure 3.

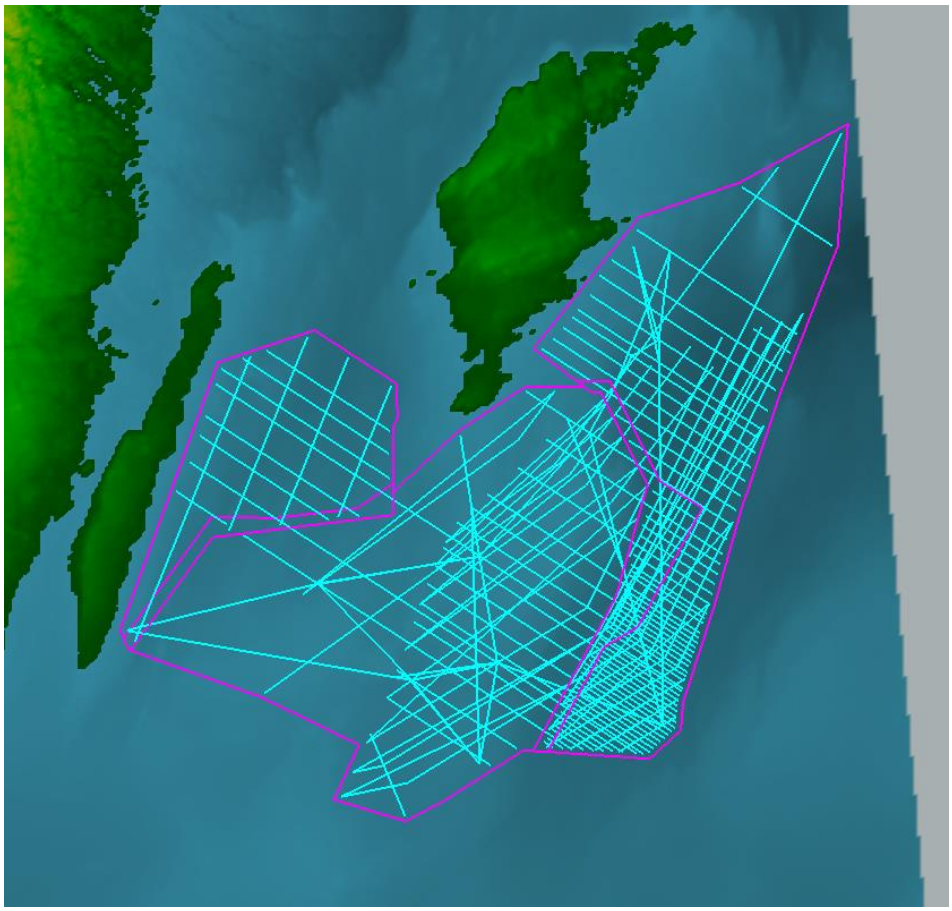

Figure 3The three planned investigation areas plotted on a map, taken from the calculation model in dBsea

Transects in the maps are shown here for illustrative purposes. For final, current and updated transects and areas, see Appendix B – Technical description. However, the modelling is done at worst-case points, so the assessments of impact distances will not exceed what is stated in this report.

Surveys are planned to take place within the Natura 2000 area Hoburgs bank and Midsjöbankarna (SE0330308), which is located in the middle of the area. The entire survey area is divided into three investigation areas: Natura 2000 (which includes the Natura 2000 area Hoburgs bank and Midsjöbankarna and a protection zone), a northwestern part called Northwest and a northeastern part called Northeast where the eastern and western borders of the areas are at least 14 km from the Natura 2000 area Hoburgs bank and Midsjöbankarna.

The depth in the area varies. It is shallower in the western part of the area and near the coasts. The deepest part is in the southern part of the investigation area Northeast, which is largely 200 m deep. Overall, the depth varies between 20 and 200 m in the investigation areas.

The sound is mostly spread over open water. It is shielded when blocked by underwater mountain ranges. Within the Natura 2000 area Hoburgs bank and Midsjöbankarna, there are a lot of shallow banks.

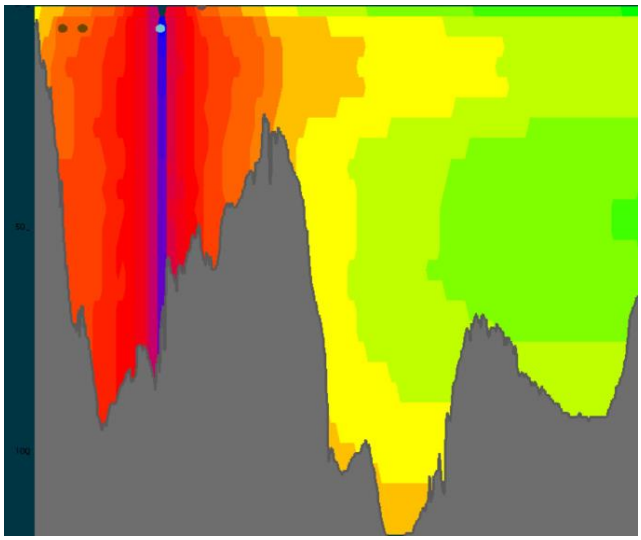

Figure 4Example of how underwater mountain ranges can shield sound, which can lead to lower calculated sound levels depending on direction. Blue shows the sound source. Sound levels are higher at red colors and farther at green.

4.3 Affected sea basins with regard to HVMFS 2012:18

Affected sea basins and estimated size:

- Eastern Gotland Sea, 23806 km ^{2}
- West Gotland Sea, 34556 km ^{2}
- Bornholm Sea and Hanö Bay, 13400 km ^{2}
- Harbour porpoise range, 26192 km ^{2}

4.4 Survey vessel

Two vessels are planned to be used. SGU's own survey vessel, S/V Ocean Surveyor, is planned to be used in the Northwest and Northeast investigation areas, which are intended to be surveyed in the summer. The second vessel, which is larger and can handle winter conditions, is planned to be rented by SGU. It is planned to be used in the middle investigation area, Natura 2000, which is to be surveyed in the winter.

S/V Ocean Surveyor has traveled at an average speed of approximately 4 knots when collecting data. Surveys are expected to be able to continue around the clock in good weather conditions. When weather conditions are poor, there may be a weather standby for days or weeks before surveys can be resumed.

4.5 Sedimentary sequences

Sediments on the seabed consist of different layers/sequences of sediment types. Table 4to Table 6show which sediment sequences have been assumed for the investigation areas.

Table 4 Northwest investigation area's assumed sediment sequences

Layer thickness (m)	Material	Speed of sound *c* (m/s)	Density ρ (kg/m^3)
0 - 7	Postglacial clay	1600	1600
7 - 17	Glacial clay	1733	1800
17 - 19	Moraine clay / muddy moraine	1725	1800
19 -	Sedimentary bedrock		

Table 5Natura 2000 investigation area's assumed sediment sequences

Layer thickness (m)	Material	Speed of sound *c* (m/s)	Density ρ (kg/m^3)
0 - 9	Glacial clay	1733	1800
9 - 16	Moraine clay / muddy moraine	1725	1800
16 -	Sedimentary bedrock		

Table 6 Northeast investigation area's assumed sediment sequences

Layer thickness (m)	Material	Speed of sound *c* (m/s)	Density ρ (kg/m^3)
0 - 2	Postglacial clay	1690	1550
2 - 9	Glacial clay	1660	1850
9 - 13	Moraine clay / muddy moraine	1800	2000
13 -	Sedimentary bedrock		

4.6 Sound speed profiles

The salinity in the current investigation areas has been modelled as 7‰. Sound velocity profiles have been obtained from SGU and are taken from the Swedish Meteorological and Hydrological Institute's (SMHI) marine environmental monitoring stations BY38 and BCS III-10. Typical summer profiles have been assumed for the investigation areas Northeast and Northwest, and furthermore a typical winter profile has been assumed for the investigation area Natura 2000.

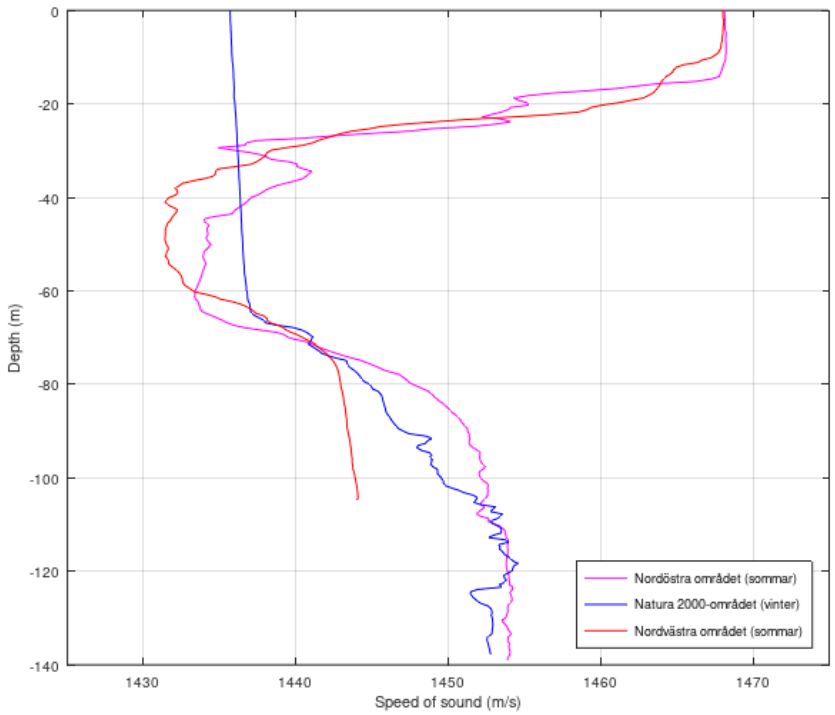

Figure 5Assumed sound speed profiles for the three investigation areas

4.7 Natura 2000 areas

SGU's three investigation areas extend over a large area and are located at longer or shorter distances from several Natura 2000 areas than just the Natura 2000 area Hoburgs bank and Midsjöbankarna. These are home to protection for different animal groups and can therefore be sensitive for several different reasons. Depending on which of the three investigation areas is being evaluated, there is a need to assess the environmental consequences for harbour porpoises, seals and fish, as these three animal groups are in different ways extra sensitive to different types of sounds at different frequencies.

Based on the geographical demarcation that has been developed for the project, which is also described in the environmental impact assessment (EIA), noise levels have been calculated from the closest distance the survey vessel will reach in relation to the nearest point of the various Natura 2000 areas affected.

4.8 Sound sources

Three types of sound sources are currently under investigation: seismic airgun, sediment echosounder and multibeam echosounder . They are used for different purposes and have different characteristics.

Sound used to scan the seabed and map depths has a high frequency and does not need to penetrate the bottom. Uneven surfaces reflect the sound diffusely and smooth surfaces reflect the sound specularly. The time and direction of the reflections are used to build a three-dimensional image of the ground. Hard surfaces reflect more sound and soft surfaces absorb some of the sound. The whole thing can be likened to a lamp that illuminates a darkness

and the reflections are interpreted as shapes and colors. The higher the frequency of the sound used, the finer the resolution can be, but the lower the range and the more sources of interference arise. The very high frequencies, several hundred kHz, are also absorbed very quickly in the water and do not reach very long distances.

Sound used to study sediments and bedrock is based on the sound being strong enough to penetrate the bottom and continue several layers down. Since different sediment types and rocks have different densities and sound speeds, each transition can give an impedance contrast where part of the sound continues down and part of the sound bounces up. This also means a change in the direction of the sound. The number of bounces, the time and the angle of these give an image of which layers are present. The further down the sediments are to be tested, the stronger the sound needs to be. Lower frequencies penetrate the bottom more easily than higher frequencies do, but higher frequencies give shorter wavelengths, which gives better detail reproduction. A trade-off between depth and detail therefore determines which methods are suitable. In this case, a seismic air gun is used in combination with a sediment echo sounder.

Table 7- Equipment and technical data of the model

Equipment	**SPL @ 1m**	**Frequency range**	**Pulse length**	**Pulse interval**	**Modeled directivity**
Sediment echo sounder Kongsberg Topas PS120	238 dB	5-24kHz	0.01 to 30ms	Down to 25 milliseconds	4ºx4º
Seismic airgun 2 x Sercel GI-Source 210	207 dB	12.5-1000Hz	Explosions	5 seconds	360ºx360º
Multibeam echo sounder Kongsberg EM2040	211-217 dB	300 kHz	19 µs to 6 ms	Down to 20 milliseconds	-

4.8.1 Seismic airgun (Seismic Airgun)

Seismic airgun is a method in which one or more containers are filled with air at high pressure. The pressure detonates in air explosions that create a powerful shock wave that will penetrate the seabed. If multiple containers are used, they are phase-matched so that multiple explosions can be added in a downward direction. In this way, the explosions can have a cleaner and stronger signal with downward directivity .

The sound is primarily low frequency, with most energy up to ~200 Hz. However, there is still significant energy content up to about 1000 Hz.

Seismic airguns are used for oil exploration in deep and shallow seas. Some types of airguns produce some of the highest sound levels in the oceans and are prone to disturbing whales, which are sensitive to low frequencies. In the oceans, depths can be as much as 5000 m, and sound propagates both downwards and upwards. The sound must therefore be very powerful to compensate for the propagation. The Baltic Sea is a shallow sea and the sound

levels that need to be used are considerably lower than those used in the oceans.

In the current case, it is planned to use two smaller seismic airguns mounted side by side. As input, Sercel's internal investigation of two Sercel GI-Source 210 airguns, which have a maximum volume of 210 cubic inches , but which are operated in true GI mode where they have a volume of 150 cubic inches , with a 45 cubic inch generator and a 105 cubic inch injector , which is considered to correspond to the sound source to be used. The spectrum may not be reproduced in this report, as it is from an internal investigation by Sercel .

The source strength has been chosen to be:

- SPL_{rms} 207 dB
- L_{peak} is assumed to be 231 dB
- SEL_{SS} is assumed to be 197 dB[1]

The sound source is modeled with spherical dispersion, placed 5 m below the surface. Larger groups of airguns have a very significant directivity which means that it can sound 10-20 dB more downward than to the sides, but with only two airguns the directivity is assumed to be limited to at most 3 dB difference between vertical and horizontal direction, so the case is simplified to spherical dispersion.

As the sound source consists of low to medium frequencies that are intended to penetrate to the bottom, it has been modeled with modal dispersion in the lowest frequencies and parabolic equation in higher frequencies. The third-order bands 12.5-200 Hz have been calculated modally and the third-order bands 250-1000 Hz have been calculated with parabolic equation.

4.8.2 Sediment echo sounder (SBP - Sub Bottom Profiler)

A sediment echo sounder of the Kongsberg Topas PS120 type is planned to be used.
The sound source is a pure signal generated downwards, for example CW signal or short sine sweeps. According to the datasheet, the maximum source strength is slightly above 238 dB re 1 µPa @1m.

According to SGU, this is a sound source with a frequency range of 5-24 kHz, the narrowest possible downward direction and adjustable sound level and with a sound level of 203 dB at 12.5 kHz. The narrowband sound level is set to 203 dB per Hz, which means that the 12.5 kHz frequency band is summed to 238 dB.

[1]The assumption that SEL_{SS} is 10 dB lower than SPL_{rms} is made because it occurs in a number of different sources. Among them ' Low -Energy Acoustic Sources ', by EIS/OEIS, 2011. In reality, $SEL = SPL_{rms} + 10*\log_{10}(T)$, where T is the time of the sound source. A 10 decibel difference would thus correspond to the sound source having 0.1 second duration. At close range, the sound from an explosion is very short, only a few milliseconds, but with increasing distance the reverberation time of the sound increases, causing $10*\log_{10}(T)$ to increase with distance, while the SPL_{rms} decreases. To make a rough assumption, it is assumed that the difference of 10 dB is at a distance of 1 kilometer. According to the article Keen , KA, Deep-Sea Research Part I, https://doi.org/10.1016/j.dsr.2018.09.003 , the SPL_{rms} decays with approximately spherical attenuation but the SEL decays more cylindrically, precisely because T increases with approximately distance* 10^{-5} s*m^{-1} . That increase in T was tested in the evaluations, but was found to have quite a small impact because the cumulative sound calculations are characterized by fast escape velocity.

Sound levels were calculated using ray path calculation. A sound source was set to a source strength of 238 dB in the 12.5 kHz and 20 kHz frequency bands, one frequency band at a time.

A number of point hits were made with calculations of sound from sediment echo sounders. The result was that the dispersion was mostly extremely narrow, since the sound source itself is narrowly directed downwards. Depending on how the bottom sloped, the sound could be reflected in one direction but have almost no dispersion at all in the opposite direction. The most dispersion occurred when there was great depth and the beam was simultaneously directed towards a rock wall in a pallet edge down in the seabed, so that maximum reflection in one direction could occur. Figure 6shows an example of this, with the sound reflected in mainly one direction.

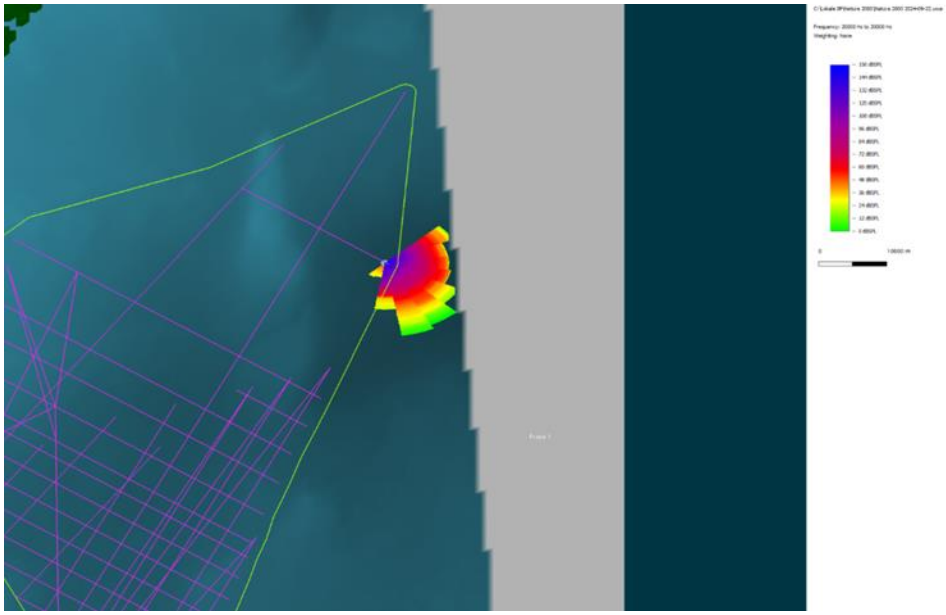

Figure 6Example of dispersion when calculating with sediment echo sounder. In this case, the sound only spreads in the east and southeast direction

In reality, the beam will not be reflected so specularly, because the bottom is less smooth in reality. A larger part will be diffused in all directions, but the distance the sound will reach is shorter. Most of the time, the sound will spread fairly short distances, but occasionally reflections will reach longer distances. For this reason, unlike the case of an airgun, it is not possible to imagine the sound spread as a protective zone with a predictably even sound level. The only thing that matters is therefore the risk of individual peak levels. It is not possible to convert the sound into cumulative sound levels in the same way.

4.8.3 Multibeam Echosounder (MBES - Multibeam Echosounder)

Multibeam echo sounders emit high-frequency signals that are used to 3D scan depth conditions in fairly high resolution.

The Kongsberg EM2040 is intended to be used and is active at 300 kHz, which is assumed to be so high frequency that neither harbour porpoises, seals nor fish can hear any sound. The sound source therefore does not need to be assessed within the framework of the underwater noise investigation.

4.9 Calculation of cumulative noise

Cumulative noise is calculated according to an equation described on page 10 of the Danish Energy Agency (2022).

It is originally based on the case of piling, which assumes a stationary sound source. When the sound source starts to make noise, the animal is assumed to start swimming away at, for example, a speed of 1.5 m/s. The sound level therefore decreases with increasing distance. The calculation can also include a soft start in piling.

To translate the equation to the case of a survey vessel moving in a straight line, it is assumed that the same stage occurs backwards, i.e. from a stationary point, the sound source comes closer with the speed of the vessel and the sound level therefore increases. When the sound source comes to its closest point, it moves further away and decreases with increasing distance, as the sound source disappears with the speed of the vessel. If the real case is assumed to be simplified to a point source, this means that the total cumulative sound the animal is exposed to can be simplified to a calculation of the Danish Energy Agency's standard equation plus three dB.

A calculation of cumulative noise as above, based on the calculated noise level at different distances, results in a sphere of a slightly overestimated impact distance around the vessel. If the animal comes closer than the impact distance to a certain threshold value, it risks being exposed to a higher cumulative noise level than permitted.

This gives an overestimation of the impact distance, as it is assumed that the animal does not move when the ship does.

5 Calculation results

5.1 Calculated impact distances

This section breaks down the calculated results by animal type studied and summarizes the impact distances needed to avoid damage and behavioral changes from the geophysical survey equipment that is planned to be used. The distances have been calculated for the different investigation areas and during the season that the surveys are planned to be carried out. The tables report the maximum impact distances for different types of damage, including behavioral impacts for harbour porpoises, seals and fish. For each animal type, the maximum impact distance per type of threshold value is given.

These results are summarized below by animal type and form the basis for assessing the need for the duration of the soft start. For comparison, Havs- och vattenmyndigheten (2024a) states that the soft start should last at least 20 minutes when this is technically possible.

The calculated distances vary greatly due to local variations and are usually shorter than the listed distance, but are applicable to approximately open waters without major depth variations. If the threshold is not exceeded even at very close distances, a dash is shown in the table.

5.1.1 Estimated impact distances, investigation area Northeast

Table 8reports the worst case, with the longest modeled impact distance to the prevailing threshold value for the assessed geophysical survey methods. The table is reported per different animal types and, where relevant, for each animal type's specific weighted threshold values.

Investigation area Northeast			
Animal	**Type of injury**	**Threshold (dB)**	**Maximum impact distance**
Porpoise			
	TTS	L_{peak} 196	<200m
	PTS	L_{peak} 202	<50m
	Behavioural disturbance	$SEL_{SS,VHF}$ 103	<2.7km
	TTS (cumulative 24h)	$SEL_{cum,VHF}$ 140	<600m
	PTS (cumulative 24h)	$SEL_{cum,VHF}$ 155	-
Seal			
	Potential behavioural disturbance	SPL_{rms} 160	<2.6km
	TTS	L_{peak} 212	<50m
	PTS	L_{peak} 218	-
	Behavioral disturbance (cumulative 24 h)	$SEL_{cum,PCW}$ 165	<300m
	TTS (cumulative 24h)	$SEL_{cum,PCW}$ 170	<400m
	PTS (cumulative 24h)	$SEL_{cum,PCW}$ 185	-
Fish			
	TTS	L_{peak} 206	<50m
	PTS	L_{peak} 207	<50m
	Behavioural disturbance	SPL_{rms} 150	<8 km
	TTS (cumulative 24h)	SEL_{cum} 186	-
	PTS (cumulative 24h)	SEL_{cum} 203	-

5.1.1.1 Harbour porpoise

The impact on harbour porpoises from the geophysical survey equipment planned to be used has been assessed. Table 8shows the impact distance for behavioural changes up to 2,700 m.

The impact distances for high sound levels that can be harmful (L_{peak} PTS or TTS) with a calculated impact distance of 200 m.

Cumulative sound levels, calculated according to assumptions described in chapter 4.9, imply an impact distance of approximately 600 m around the ship.

Given these calculated values and an estimated escape velocity of 1.5 m/s in marine mammals, a soft start period of 7 minutes (rounded up) is required to avoid harmful impacts on harbour porpoises based on the worst case scenario. The 20-minute soft start proposed in Havs- och vattenmyndigheten (2024a) is fully sufficient.

5.1.1.2 Seal

The impact on seals from the planned geophysical survey methods has been assessed. Table 8shows the impact distance for potential behavioural changes up to 2600 m.

The impact distances for high sound levels that can be harmful (L_{Peak} PTS or TTS) are highest for SBP, with a calculated impact distance of 50 m.

Cumulative sound levels, calculated according to assumptions described in chapter 4.9, imply an impact distance of approximately 400 m around the ship.

Given these calculated values, a soft start period of approximately 4 minutes (rounded up) is required to avoid harmful effects on seals. The 20-minute soft start proposed in the Havs- och vattenmyndigheten (2024a) is fully sufficient.

5.1.1.3 Fish

The impact on fish from the planned geophysical survey methods has been assessed. The impact distance for potential behavioural changes is at most 8,000 m.

See Table 8for all impact distances to the prevailing threshold value for the calculated techniques.

Soft start periods are calculated for marine mammals, but to some extent also serve as a protective measure for fish.

5.1.2 Estimated impact distances, investigation area Natura 2000

Table 9reports all impact distances to the current threshold value for the assessed geophysical survey methods. The table is reported per different animal types and, where relevant, for each animal type's specific weighted threshold values.

Investigation area Natura 2000			
Animal	**Type of injury**	**Threshold weighted dB**	**Maximum impact distance**
Porpoise			
	TTS	L_{peak} 196	<150m
	PTS	L_{peak} 202	<50m
	Behavioural disturbance	$SEL_{SS,VHF}$ 103	<2 miles
	TTS (cumulative 24h)	$SEL_{cum,VHF}$ 140	<600m
	PTS (cumulative 24h)	$SEL_{cum,VHF}$ 155	-
Seal			
	Potential behavioural disturbance	SPL_{rms} 160	<3.3km
	TTS	L_{peak} 212	<50m
	PTS	L_{peak} 218	-
	Behavioural disturbance (cumulative 24 h)	$SEL_{cum,PCW}$ 165	< 200m
	TTS (cumulative 24h)	$SEL_{cum,PCW}$ 170	<300m
	PTS (cumulative 24h)	$SEL_{cum,PCW}$ 185	-
Fish			
	TTS	L_{peak} 206	<50m
	PTS	L_{peak} 207	<50m
	Behavioural disturbance	SPL_{rms} 150	<9 km
	TTS (cumulative 24h)	SEL_{cum} 186	<50m
	PTS (cumulative 24h)	SEL_{cum} 203	-

5.1.2.1 Harbour porpoise

The impact on harbour porpoises from the geophysical survey equipment planned to be used has been assessed. Table 9shows the impact distance for behavioural changes up to 3,200 m.

The impact distances for high sound levels that can be harmful (L_{peak} PTS or TTS) with a calculated impact distance of 150 m.

Cumulative sound levels, calculated according to assumptions described in chapter 4.9, imply an impact distance of approximately 600 m around the ship.

Given these calculated values and an estimated escape velocity of 1.5 m/s in marine mammals, a soft start period of approximately 7 minutes (rounded up) is required to avoid harmful impacts on porpoises based on the worst case scenario. The 20-minute soft start proposed in the Havs- och vattenmyndigheten (2024a) is fully sufficient.

5.1.2.2 Seal

The impact on seals from the planned geophysical survey methods has been assessed. Table 9shows the impact distance for potential behavioural disturbance up to 3300 m.

The impact distances for high sound levels that can be harmful (L_{peak} PTS or TTS) are highest for SBP, with a calculated impact distance of 50 m.

Cumulative sound levels, calculated according to assumptions described in chapter 4.9, imply an impact distance of approximately 300 m around the ship.

Given these calculated values, a soft start period of approximately 2 minutes (rounded up) is required to avoid harmful effects on seals. The 20-minute soft start proposed in the Havs- och vattenmyndigheten (2024a) is fully sufficient.

5.1.2.3 Fish

The impact on fish from the planned geophysical survey methods has been assessed. Table 9shows the impact distance for behavioural changes up to 9000 m.

Soft start periods are calculated for marine mammals, but to some extent also serve as a protective measure for fish.

5.1.3 Estimated impact distances, investigation area Northwest

This section breaks down the results by animal type examined and summarizes the impact distances needed to avoid damage and behavioral changes.

The impact on harbour porpoises, seals and fish from the geophysical survey equipment that is planned to be used has been assessed based on noise modelling from underwater noise. Table 10presents the maximum impact distances for different types of damage, including behavioural impacts for harbour porpoises, seals and fish. For each animal type, the maximum impact distance per type of threshold value is given.

These results are summarized below per animal type and form the basis for assessing the need for the duration of the soft start in comparison with the Havs- och vattenmyndigheten (2024a) which recommends a soft start of at least 20 minutes.

Table 10reports all impact distances to the current threshold value for the assessed geophysical survey methods. The table is reported per different animal types and, where relevant, for the respective animal type-specific weighted threshold values.

Investigation area Northwest			
Animal	**Type of injury**	**Threshold value**	**Maximum impact distance**
Porpoise			
	TTS	L_{peak} 196	<160m
	PTS	L_{peak} 202	<80m
	Behavioural disturbance	$SEL_{SS,VHF}$ 103	<2.7km
	TTS (cumulative 24h)	$SEL_{cum,VHF}$ 140	<700m
	PTS (cumulative 24h)	$SEL_{cum,VHF}$ 155	-
Seal			
	Potential Behavioural disturbance	SPL_{rms} 160	<2.5km
	TTS	L_{peak} 212	<50m
	PTS	L_{peak} 218	-
	Behavioural disturbance (cumulative 24 h)	$SEL_{cum,PCW}$ 165	<300m
	TTS (cumulative 24h)	$SEL_{cum,PCW}$ 170	<500 m
	PTS (cumulative 24h)	$SEL_{cum,PCW}$ 185	-
Fish			
	TTS	L_{peak} 206	<50 m
	PTS	L_{peak} 207	<50 m
	Behavioural disturbance	SPL_{rms} 150	<7,5 km
	TTS (cumulative 24h)	SEL_{cum} 186	<50 m
	PTS (cumulative 24h)	SEL_{cum} 203	-

5.1.3.1 Harbour porpoise

The impact on harbour porpoises from the geophysical survey equipment planned to be used has been assessed. Table 10shows the impact distance for behavioural changes up to 2,700 m.

The impact distances for high sound levels that can be harmful (L_{Peak} PTS or TTS) with a calculated impact distance of 160 m.

Cumulative sound levels, calculated according to assumptions described in chapter 4.9, imply an impact distance of approximately 700 m around the ship.

Given these calculated values and an estimated escape velocity of 1.5 m/s in marine mammals, a soft start period of approximately 8 minutes (rounded up) is required to avoid harmful impacts on porpoises based on the worst case scenario. The 20-minute soft start proposed in the Havs- och vattenmyndigheten (2024a) is fully sufficient.

5.1.3.2 Seal

The impact on seals from the planned geophysical survey methods has been assessed. Table 10shows the impact distance for potential behavioural changes up to a maximum of 2500 m.

The impact distances for high sound levels that can be harmful (L_{Peak} PTS or TTS) are highest for SBP, with a calculated impact distance of 50 m.

Cumulative sound levels, calculated according to assumptions described in chapter 4.9, imply an impact distance of approximately 500 m around the ship.

Given these calculated values, a soft start period of approximately 6 minutes (rounded up) is required to avoid harmful effects on seals. The 20-minute soft start proposed in the Havs- och vattenmyndigheten (2024a) is fully sufficient.

5.1.3.3 Fish

The impact on fish from the planned geophysical survey methods has been assessed. Table 10shows that the maximum impact distance for behavioural changes is 7,500 m.

Soft start periods are calculated for marine mammals, but to some extent also serve as a protective measure for fish.

5.2 The Swedish Agency for Marine and Water Management's assessment of good environment

HVMFS 2012:18 mentions threshold values for the percentage of areas of sea basins in which noise levels that are considered to lead to behavioral change should not be exceeded, daily and annual averages, respectively. See 3.1.4.

Fact sheet 11.1A, to HVMFS 2012:18, (Havs- och vattenmyndigheten, 2024c) states the standard distance of 12 km for calculating seismic compressed air guns and other impulsive sound sources.

The longest calculated impact distances for behavioral impacts on mammals are 3.2 km for airguns for harbour porpoises and 3.3 km for airguns for seals.

A rough estimate of the area can be made by assuming that the ship travels a straight distance. From the distance, an imaginary area is drawn with the impact distance as a circle around the ship. If the ship starts traveling at a constant speed, the threshold value in practice means a limitation per day on how many hours the ship can travel within each basin before 20% area is met, or 10% of the harbour porpoise range.

Below are calculated percentages according to:

1) the standard assumption of 12 km impact distance and

2) based on the longest calculated impact distance of 3.3 km, but as an extra precaution doubled to 6.6 km.

The ship's assumed speed is 4 knots, which is 7.41 km/h.

Table 11Calculated percentage of affected area per sea basin/range based on SGU's planned number of survey days per area

Ocean basin/range	Speed (km/h)	Number of hours (h)	Total distance per day	Assumed impact distance (km)	Area affected (km ^{2})	Total area of the ocean basin (km ^{2})	Affected percentage one day	Number of active days per year	Affected percentage annual average
Porpoise range	7.41	12	89	12	2586	26192	9.87 %	8	0.43%
Eastern Gotland Sea	7.41	24	178	12	4719	23806	19.82 %	79	4.29%
Western Gotland Sea	7.41	24	178	12	4719	34556	13.66 %	16	0.60 %
The Bornholm Sea and the Hanö Bay	7.41	12	89	12	2586	13400	19.30%	1	0.05%
Porpoise range	7.41	24	178	6.6	2484	26192	9.48%	8	0.41%
Eastern Gotland Sea	7.41	24	178	6.6	2484	23806	10.43%	79	2.26%
Western Gotland Sea	7.41	24	178	6.6	2484	34556	7.19%	16	0.32%
The Bornholm Sea and the Hanö Bay	7.41	24	178	6.6	2484	13400	18.53%	1	0.05%

The result is that with the standard assumption of 12 km, the limit for active time is 12 hours per day in the harbour porpoise range and in the Bornholm Sea and Hanö Bay , which is the smallest basin. In the East Gotland Sea and the West Gotland Sea, the ship can be active all day without exceeding 20% of the area.

Assuming that the calculated distance is valid, with a doubling of the distance as an extra precaution, it is possible to operate the ship 24 hours a day in all sea basins without exceeding the evaluated areas.

In none of the cases is the average value at risk of exceeding 10% as an annual average for sea basins or 5% as an average value from May to October for the harbour porpoise range.

SGU will adjust its surveys so that they do not take place at the same time as another actor's surveys. If another actor will be active on other days of the same year in the same sea basin, all actors' annual average percentage of the affected area is added.

5.3 Noise levels in Natura 2000 areas

Estimated sound levels taken from representative probe points in the various Natura 2000 areas that may be affected by the surveys.

5.3.1 From the Northeast investigation area

The Northeast investigation area is the deepest area. It will be surveyed during the summer.

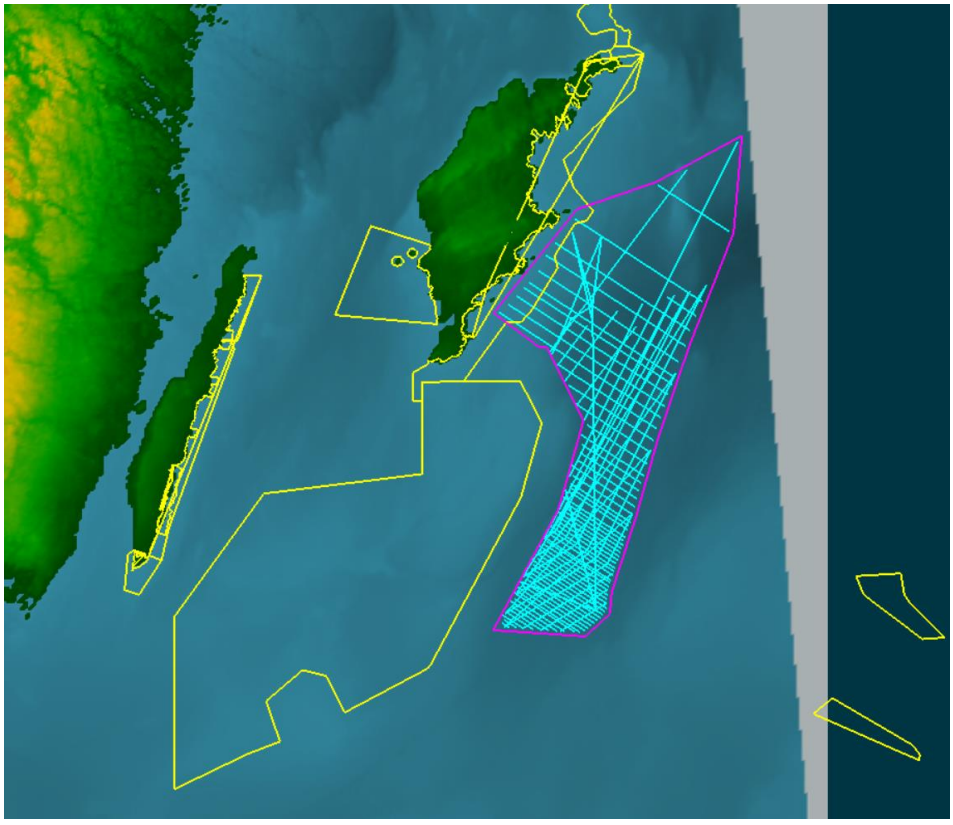

Figure 7Northeast investigation area visible in magenta , with example transects drawn in cyan and Natura 2000 areas in yellow

5.3.1.1 *From the Northeast investigation area to the Gotska Sandön Natura 2000 area*

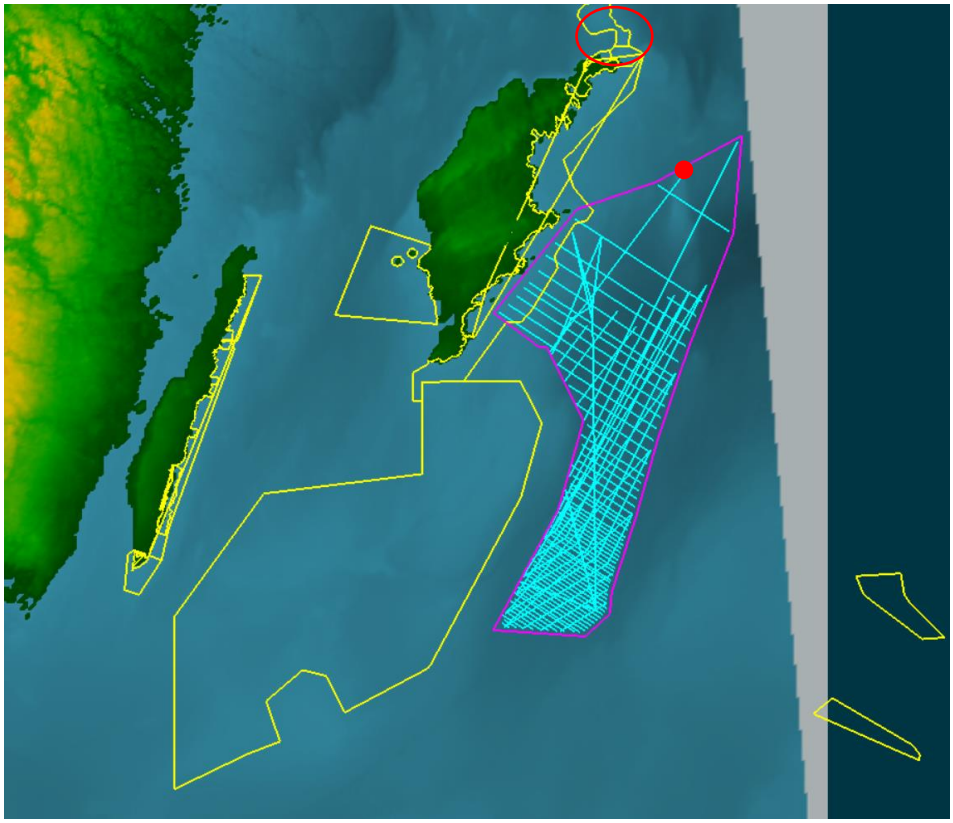

Figure 8The Gotska Sandön- Salvorev Natura 2000 area is circled in red. The sound source, from which calculations for noise levels in the Natura 2000 area are made, is placed as a red dot.

The distance from the investigation area (worst-case modeled point) to the Natura 2000 area Gotska Sandön- Salvorev is approximately 57 km.

Table 12Calculated noise levels from the closest point in the investigation area of the Northeast (indicated in red in Figure 8) to the Natura 2000 area Gotska Sandön-Salvorev.

Unit	Estimated sound level (dB)	Relevant threshold value (dB)
SEL_{cum}	120	186
SEL_{cum} PCW	109	165
SEL_{cum} VHF	68	140
SEL_{SS}	83	-
SEL_{SS} PCW	72	-
SEL_{SS} VHF	38	103
L_{peak}	116	196
SPL_{rms}	93	150
SPL_{rms} PCW	82	-
SPL_{rms} VHF	48	-

5.3.1.2 *From the Northeast investigation area to Natura 2000 areas in Lithuania*

In Lithuanian waters, there are two Natura 2000 areas potentially within range of the surveys, both >80 km from the survey areas.

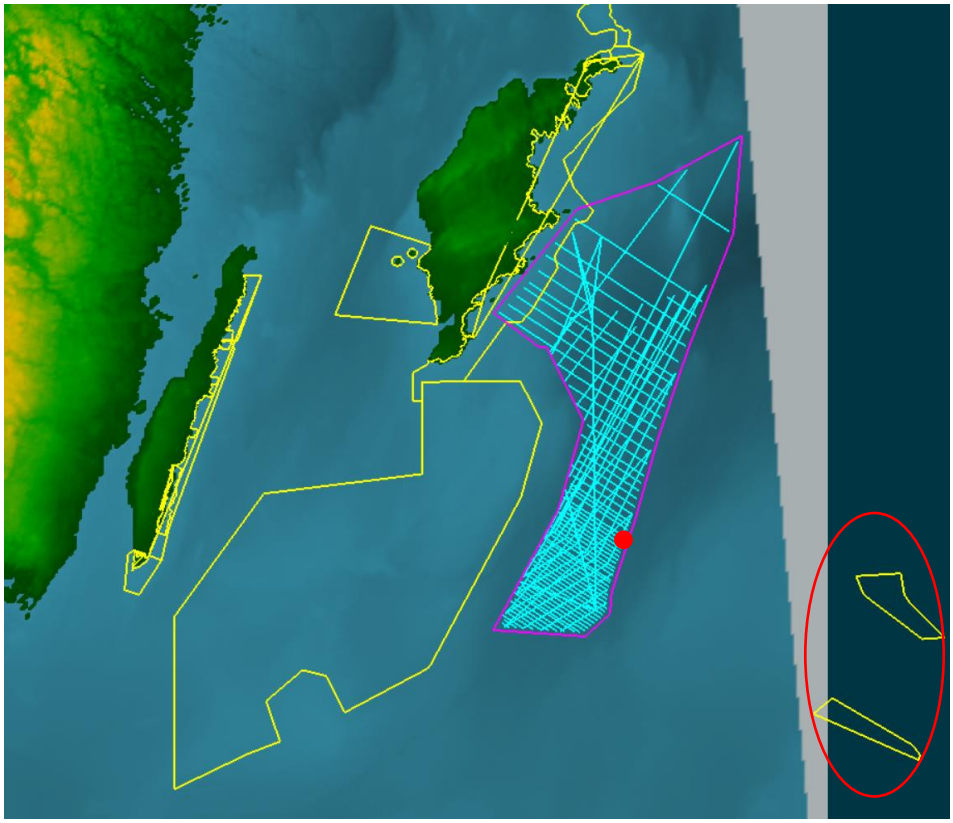

Figure 9Lithuania's two Natura 2000 areas circled in red. The sound source, from which calculations for noise levels in the Natura 2000 area are made, is placed as a red dot.

Table 13Estimated noise levels in the areas of Lithuania

Unit	Estimated sound level (dB)	Relevant threshold value (dB)
SEL $_{cum}$	130	186
SEL $_{cum}$ PCW	114	165
SEL $_{cum}$ VHF	78	140
SEL $_{SS}$	92	-
SEL $_{SS}$ PCW	76	-
SEL $_{SS}$ VHF	40	103
L $_{peak}$	120	196
SPL $_{rms}$	102	150
SPL $_{rms}$ PCW	86	-
SPL $_{rms}$ VHF	50	-

5.3.1.3 *From the Northeast investigation area to the Natura 2000 area Hoburgs Bank and Midsjöbankarna*

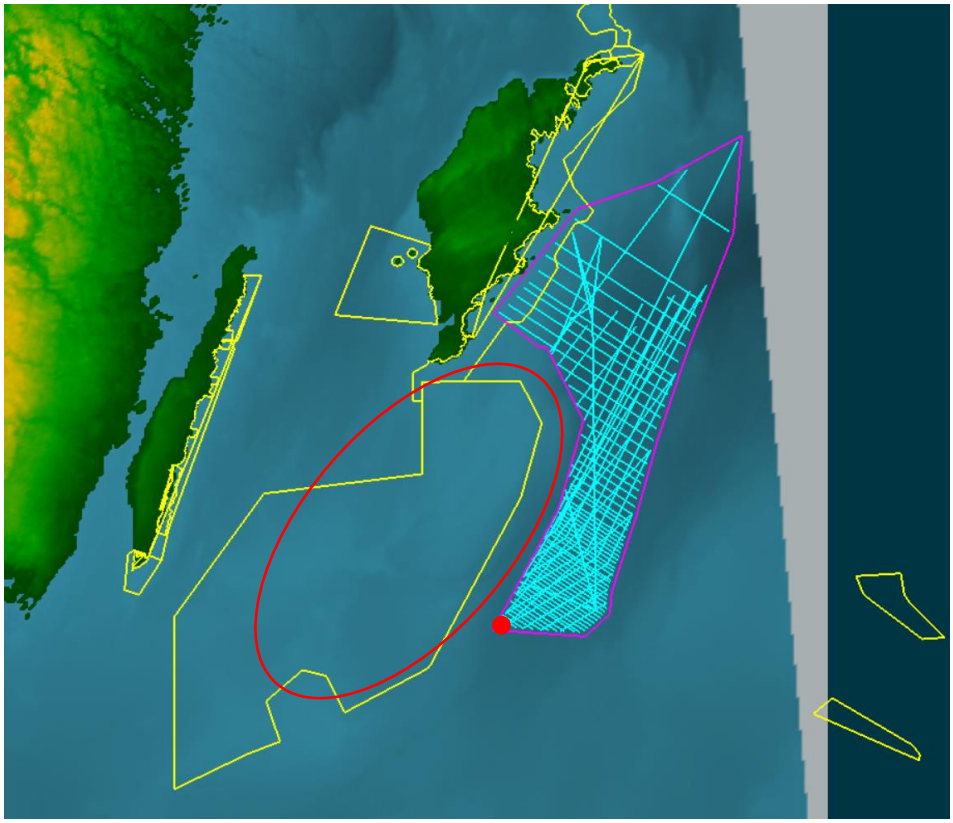

Figure 10The eastern part of the Natura 2000 area Hoburgs Bank and Midsjöbankarna circled with a red ring. The sound source, from which calculations for sound levels in the Natura 2000 area are made, is placed as a red dot.

The distance to the Natura 2000 area Hoburgs bank and Midsjöbankarna is approximately 15 km.

Table 14Estimated noise levels in the nearest parts of the Natura 2000 area Hoburgs Bank and Midsjöbankarna

Unit	Estimated sound level (dB)	Relevant threshold value (dB)
SEL_{cum}	157	186
SEL_{cum} PCW	138	165
SEL_{cum} VHF	102	140
SEL_{SS}	120	-
SEL_{SS} PCW	101	-
SEL_{SS} VHF	65	103
L_{peak}	154	196
SPL_{rms}	130	150
SPL_{rms} PCW	112	-
SPL_{rms} VHF	75	-

5.3.2 From the Natura 2000 investigation area

The middle investigation area, Natura 2000, overlaps the distribution area of the Baltic harbour porpoise. It will be investigated in winter.

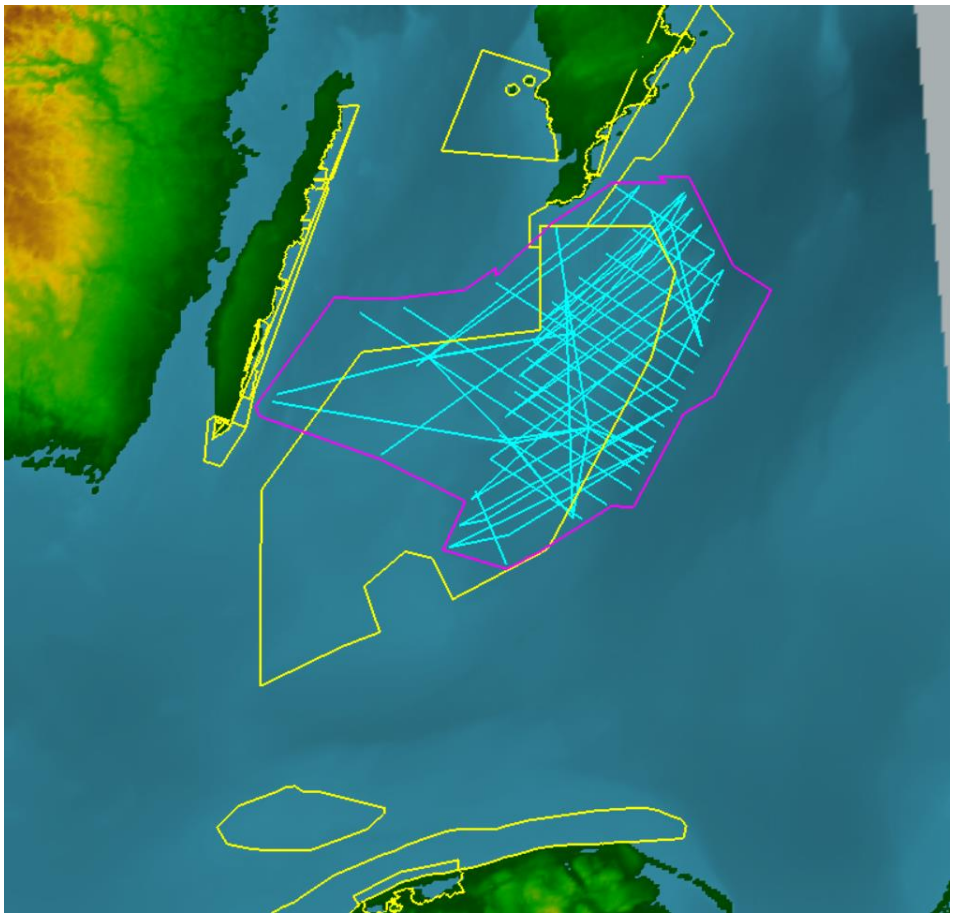

Figure 11Natura 2000 investigation area visible in magenta , with example transects drawn in cyan and Natura 2000 areas in yellow

5.3.2.1 *From Natura 2000 investigation area to Natura 2000 areas in Poland*

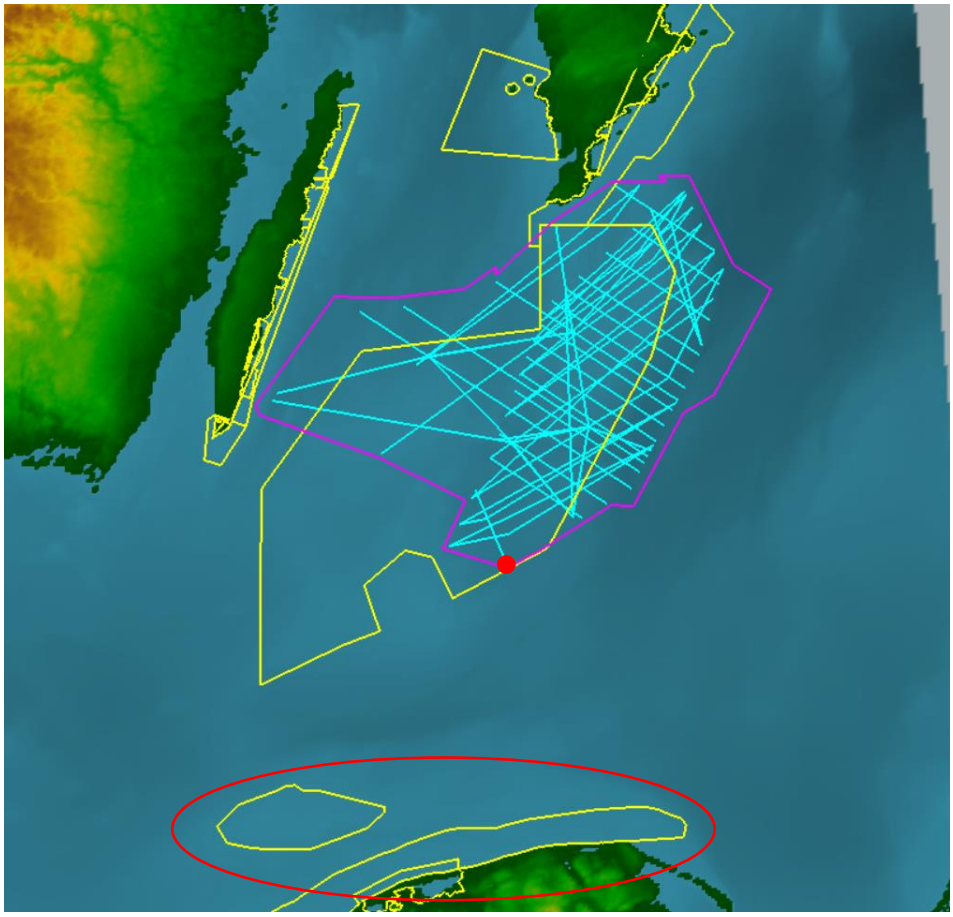

Figure 12Poland's two Natura 2000 areas circled in red. The sound source, from which calculations for noise levels in the Natura 2000 area are made, is placed as a red dot.

Distance to Natura 2000 areas in Poland is approximately 90 km.

Table 15Estimated noise levels in Polish areas

Unit	Estimated sound level (dB)	Relevant threshold value (dB)
SEL $_{cum}$	139	186
SEL $_{cum}$ PCW	120	165
SEL $_{cum}$ VHF	78	140
SEL $_{SS}$	111	-
SEL $_{SS}$ PCW	92	-
SEL $_{SS}$ VHF	50	103
L $_{peak}$	144	196
SPL $_{rms}$	121	150
SPL $_{rms}$ PCW	101	-

SPL $_{rms}$ VHF	60	-

5.3.2.2 From Natura 2000 investigation area to Natura 2000 area Ottenby NR

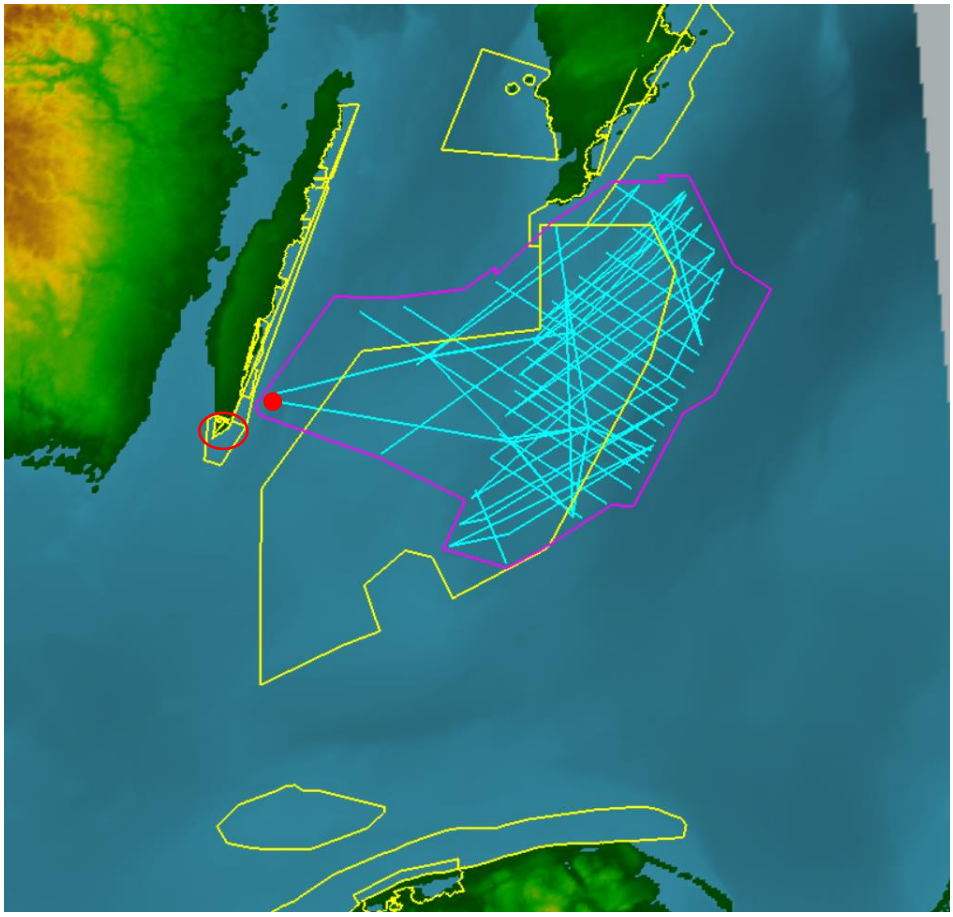

Figure 13Natura 2000 area Ottenby NR circled with a red ring. The sound source, from which calculations for noise levels in the Natura 2000 area are made, is placed as a red dot.

The distance to the Natura 2000 area Ottenby NR is approximately 15 km.

Table 16Calculated noise levels in the Natura 2000 area Ottenby NR

Unit	Estimated sound level (dB)	Relevant threshold value (dB)
SEL $_{cum}$	147	186
SEL $_{cum}$ PCW	129	165
SEL $_{cum}$ VHF	97	140
SEL $_{SS}$	121	-
SEL $_{SS}$ PCW	102	-
SEL $_{SS}$ VHF	70	103
L $_{peak}$	154	196
SPL $_{rms}$	131	150
SPL $_{rms}$ PCW	112	-

SPL $_{rms}$ VHF	80	-

5.3.2.3 From the Natura 2000 study area Sydöstra Ölands sjömarker

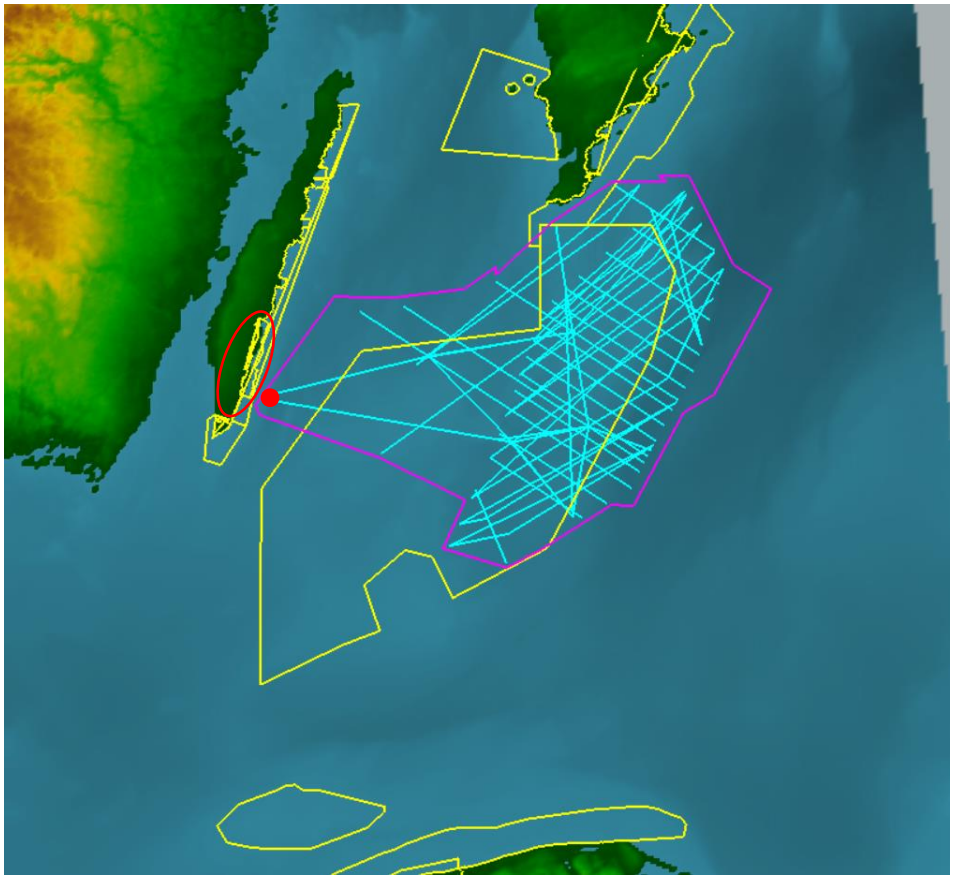

Figure 14 Sydöstra Ölands sjömarker Natura 2000 area circled with a red ring. The sound source, from which calculations for noise levels in the Natura 2000 area are made, is placed as a red dot.

The distance to the Natura 2000 area Sydöstra Ölands sjömarker is approximately 6 km.

Table 17Estimated noise levels in the Natura 2000 area Sydöstra Ölands sjömarker

Unit	Estimated sound level (dB)	Relevant threshold value (dB)
SEL $_{cum}$	151	186
SEL $_{cum}$ PCW	135	165
SEL $_{cum}$ VHF	104	140
SEL $_{SS}$	124	-
SEL $_{SS}$ PCW	108	-
SEL $_{SS}$ VHF	77	103
L $_{peak}$	157	196
SPL $_{rms}$	134	150

SPL_{rms} PCW	118	-
SPL_{rms} VHF	87	-

5.3.3 From the Northwest investigation area

The Northwest investigation area is generally the shallowest area. It will be investigated during the summer.

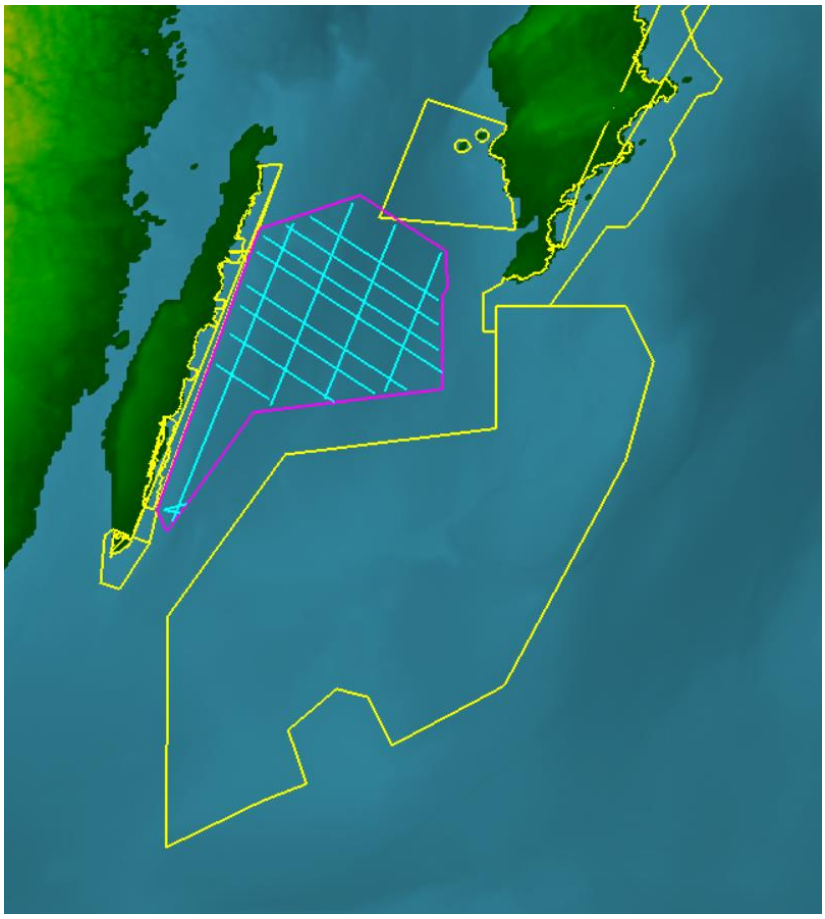

Figure 15Northwest investigation area visible in magenta , with example transects drawn in cyan and Natura 2000 areas in yellow

5.3.3.1 *From the Northwest investigation area to the Natura 2000 areas Stora and Lilla Karlsö*

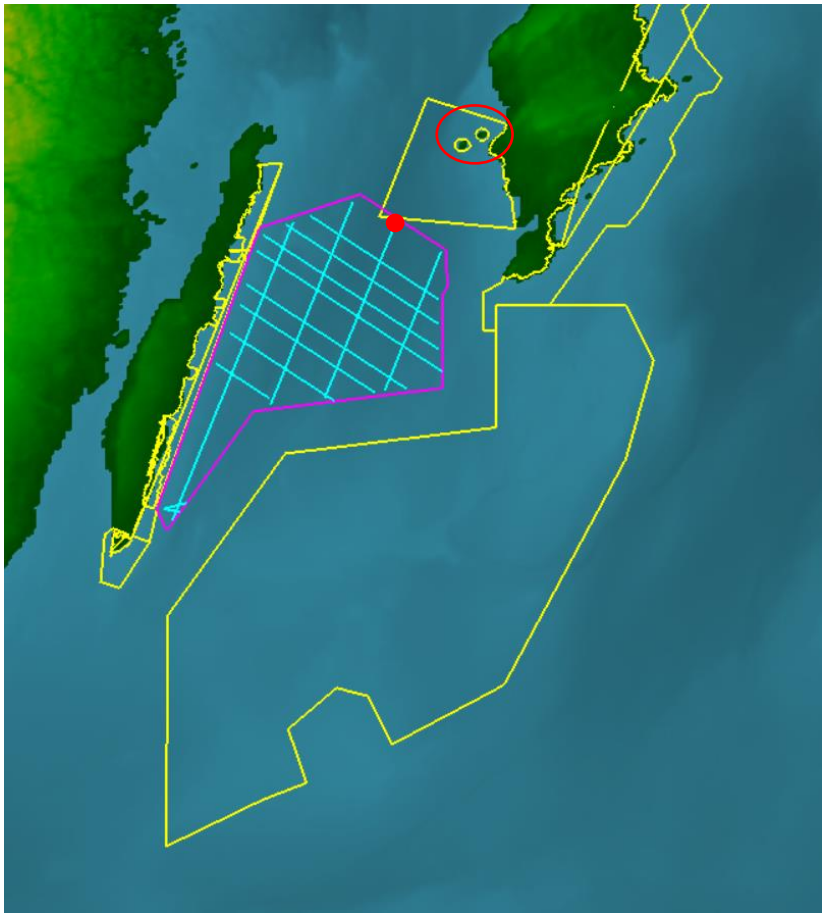

Figure 16Stora and Lilla Karlsö Natura 2000 areas circled with a red ring. The sound source, from which calculations for noise levels in the Natura 2000 area are made, is placed as a red dot.

The distance to the Natura 2000 areas Stora and Lilla Karlsö is approximately 30 km.

Table 18Calculated noise levels in the areas of Stora and Lilla Karlsö

Unit	Estimated sound level (dB)	Relevant threshold value (dB)
SEL_{cum}	132	186
SEL_{cum} PCW	119	165
SEL_{cum} VHF	85	140
SEL_{SS}	95	-
SEL_{SS} PCW	82	-
SEL_{SS} VHF	47	103
L_{peak}	128	196
SPL_{rms}	105	150
SPL_{rms} PCW	92	-
SPL_{rms} VHF	57	-

5.3.3.2 *From the Northwest investigation area to the Natura 2000 area Ottenby NR*

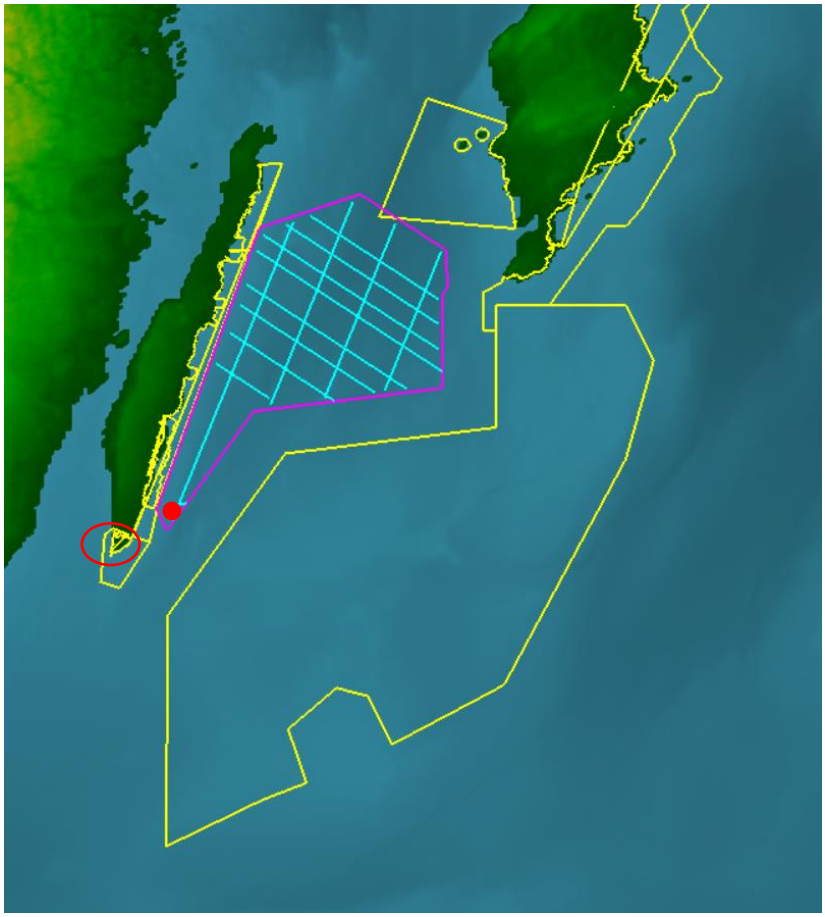

Figure 17Ottenby NR Natura 2000 area is circled in red. The sound source, from which calculations for noise levels in the Natura 2000 area are made, is placed as a red dot.

The distance to the Natura 2000 area Ottenby NR is approximately 15 km.

Table 19From the Northwest investigation area to Ottenby NR (closer to the beach)

Unit	Estimated sound level (dB)	Relevant threshold value (dB)
SEL $_{cum}$	120	186
SEL $_{cum}$ PCW	108	165
SEL $_{cum}$ VHF	72	140
SEL $_{SS}$	82	-
SEL $_{SS}$ PCW	70	-
SEL $_{SS}$ VHF	34	103
L $_{peak}$	115	196
SPL $_{rms}$	92	150

SPL $_{rms}$ PCW	80	-
SPL $_{rms}$ VHF	44	-

5.3.3.3 From the Northwest investigation area to the Natura 2000 area Hoburgs Bank and Midsjöbankarna

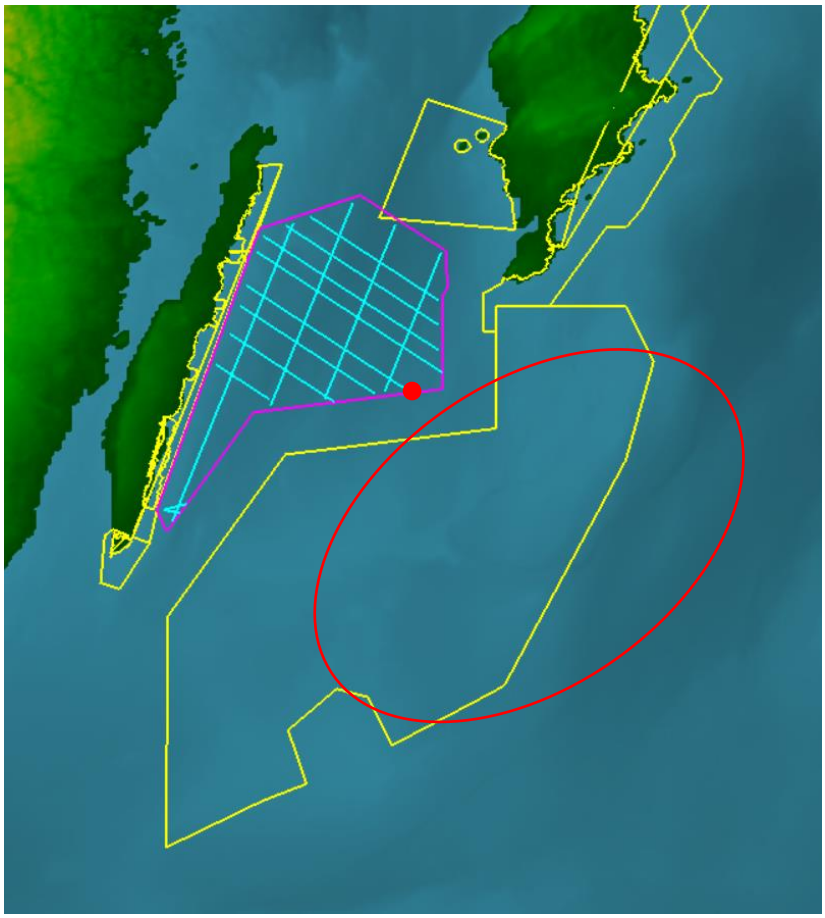

Figure 18Affected part of the Natura 2000 area Hoburgs Bank and Midsjöbankarna circled with a red ring. The sound source, from which calculations for noise levels in the Natura 2000 area are made, is placed as a red dot.

The distance to the Natura 2000 area Hoburgs bank and Midsjöbankarna is approximately 16 km.

Table 20Estimated noise levels in the Hoburgs Bank and Midsjöbankarna areas

Unit	Estimated sound level (dB)	Relevant threshold value (dB)
SEL $_{cum}$	156	186
SEL $_{cum}$ PCW	137	165
SEL $_{cum}$ VHF	101	140
SEL $_{SS}$	120	-
SEL $_{SS}$ PCW	101	-
SEL $_{SS}$ VHF	65	103

L_{peak}	154	196
SPL_{rms}	130	150
SPL_{rms} PCW	111	-
SPL_{rms} VHF	75	-

5.3.3.4 From the Northwest investigation area to the Natura 2000 area of Sydöstra Ölands sjömarker

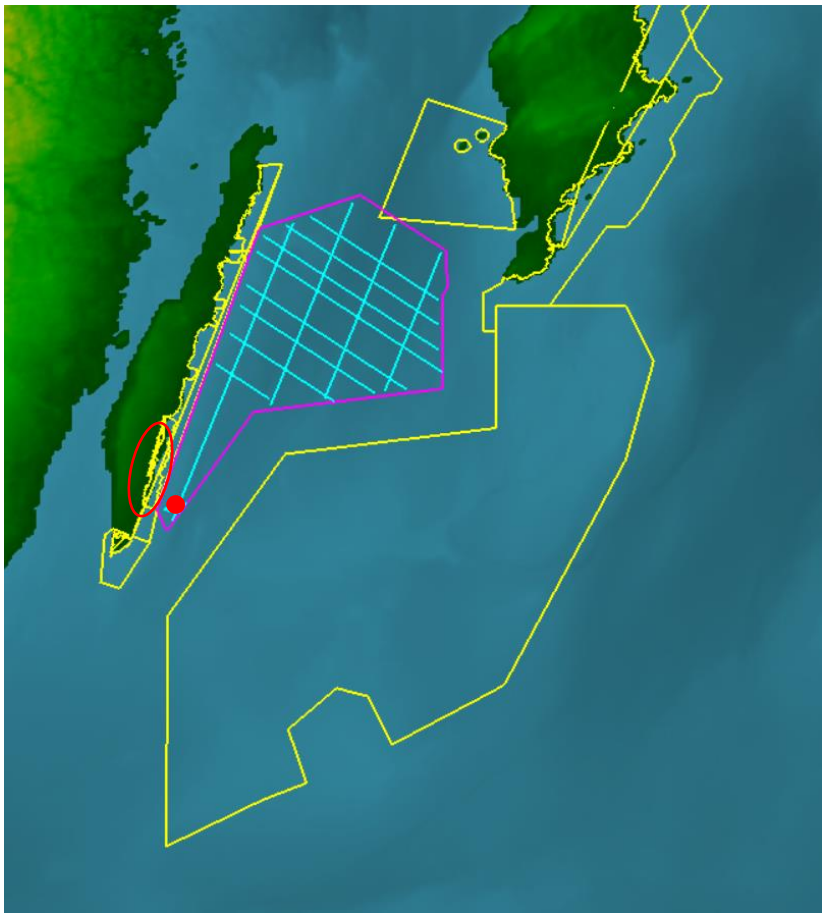

Figure 19 Sydöstra Ölands sjömarker Natura 2000 area circled with a red ring. The sound source, from which calculations for noise levels in the Natura 2000 area are made, is placed as a red dot.

The distance to the Natura 2000 area Sydöstra Ölands sjömarker is approximately 8 km.

Table 21Calculated noise levels in Sydöstra Ölands sjömarker

Unit	Estimated sound level (dB)	Relevant threshold value (dB)
SEL_{cum}	155	186
SEL_{cum} PCW	140	165
SEL_{cum} VHF	104	140

SEL_{SS}	121	-
SEL_{SS} PCW	106	-
SEL_{SS} VHF	70	103
L_{peak}	154	196
SPL_{rms}	131	150
SPL_{rms} PCW	116	-
SPL_{rms} VHF	80	-

6 Conclusions

6.1 Safety distance

Calculated dimensioning impact distances in all investigation areas for all animal types imply a shorter soft start than the 20 minutes proposed in the Havs- och vattenmyndigheten (2024a).

6.2 The Swedish Agency for Marine and Water Management's assessment of good environment

Calculations of the affected area according to HVMFS 2012:18 show that with an assumption of an impact distance of 6.6 km, based on Sweco's calculations, surveys can be carried out 24 hours a day without the affected percentage exceeding 20% per day in all sea basins and 10% of the harbour porpoise's distribution area.

If instead the standard impact distance of 12 km, from Havs- och vattenmyndigheten (2024c), is adopted, surveys can be carried out 24 hours a day in the East Gotland Sea and the West Gotland Sea, but only 12 hours in the Bornholm Sea and Hanö Bay and in the harbour porpoise range.

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CONSULTATION REPORT

Consultation for Geophysical Surveys

Natura 2000 Permit under 7 kap. 28a § of the Swedish Environmental Code

December 2024

SGU:s diarienummer: 316-3015/2024

SGU Sveriges geologiska undersökning

Cover image: S/V Ocean Surveyor conducting geophysical surveys south of Scania 2023
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Full name of the government assignment: Carbon dioxide storage in Sweden

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1 INTRODUCTION

The Geological Survey of Sweden (hereinafter referred to as "SGU" or "the authority") shall, on behalf of the Government, map the possibilities for Sweden to store carbon dioxide under the seabed. SGU plans to carry out geophysical surveys of the seabed in the Central Baltic Sea, the Southeastern Baltic Sea and the Southern Baltic Sea. As the surveys are also planned within the Natura 2000 area Hoburgs bank and Midsjöbankarna (SE0330308), SGU intends to apply for a permit in accordance with 7 kap. 28 a and b § of the Swedish Environmental Code.

This consultation report contains a report on the delimitation consultation that was carried out in accordance with 6 kap. 30 § of the Swedish Environmental Code prior to the preparation of an environmental impact assessment (EIA). The permit application concerns an assessment in accordance with 7 kap. 28 b § of the Swedish Environmental Cod, whereby the content of the EIA includes the information required for such an assessment.

As the planned investigations could potentially affect the waters of neighbouring countries, SGU has also submitted consultation documents to the Swedish Environmental Protection Agency in accordance with the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention) and the countries concerned have been given the opportunity to comment on the consultation.

The consultation report shows the opinions received and SGU's response to them.

In the consultation document, SGU has used the terminology "marine seismic and marine geological surveys" and "marine mapping" as an overall collective term for the planned surveys that are part of the Natura 2000 assessment. In subsequent documents, the term "geophysical surveys" is used instead, which is a clearer way of expressing the acoustic methods that SGU plans to use. These refer, more specifically, to multibeam echo sounders (multibeam echo sounder; MBES), sediment echo sounder (sub-bottom profiler; SBP), and seismic surveys with air guns (reflection seismic). SGU would like to clarify that this is only a change in terminology and that it does not affect the examination or change the meaning of the surveys that the application covers.

2 IMPLEMENTATION OF THE CONSULTATION

2.1 Advisory group

The consultation group was limited to several affected county administrative boards, authorities, organizations and companies, see Table 1below.

Table 1The consultation group divided into government agencies, municipalities and regions, organizations and others.

Advisory group	
Government agencies	**Organizations**
National Board of Housing, Building and Urban Development	Swedish Shipping Association (FSS)
Energy Market Inspectorate	Sea and Coastal Fishermen's Producers' Organization (HKPO)
The Energy Agency	Nature Conservation Society
The Armed Forces	Swedish boat union
Swedish Agency for Marine and Water Management (HaV)	Swedish Cruiser Club
Swedish Board of Agriculture	Swedish Fishermen's Producers' Organization (SFPO)
Chamber of Commerce	Sweden's ports
Coast Guard	Swedish Pelagic Federation producer organization (SPF)
Blekinge County Administrative Board	World Wildlife Fund (WWF)
Gotland County Administrative Board	
Kalmar County Administrative Board	**Other**
The Swedish Civil Contingencies Agency (MSB)	Eolus/SimplyBlue
National Museum of Natural History	Freja offshore
Swedish Environmental Protection Agency	Marine Environment Institute
The Swedish Post and Telecom Agency (PTS)	Landinfra Energy
National Heritage Board (RAÄ)	Lund University
The Swedish Maritime Administration	OX2
SLU Species Data Bank	RWE
Swedish Transport Administration	Maritime Academy
	World Maritime University
Municipalities and regions	Ørsted AB
Borgholm Municipality	Baltic Sea Center
Karlskrona Municipality	
Mörbylånga Municipality	
Gotland Region	
Ronneby Municipality	
Torsås Municipality	

2.2 Consultation invitation

On 3 July 2024, the invitation was sent out to the consultation group in Table 1and an announcement was published on SGU's website on 5 July 2024 (Appendix 1). The consultation period ran from 5 July 2024 to 9 August 2024. On 26 August 2024, a reminder was sent to those in the consultation group who had not responded during the consultation period to confirm that they had refrained from expressing an opinion (see Appendix 2). Some confirmed while others wished to submit comments. Those who wished to submit comments had until 9 September 2024 to submit a document.

2.3 Consultation with the Gotland County Administrative Board

Delimitation consultations were held with the Gotland County Administrative Board on August 8, 2024. Participating from SGU were unit manager Maria Khalili and state geologists Andrea Claesson and Finn Baumgartner. From Sweco, senior permit advisor Gabriella Hammarskjöld and marine biologist Johanna Lindberg participated.

Attorney Johanna Lenell participated from Foyen Advokatfirma.

From the Gotland County Administrative Board, environmental protection officer Amanda Östman, environmental assessment coordinator Lena Kulander and coastal and marine environment officers Per-Arvid Berglund and Alexandra Colbing participated.

The Gotland County Administrative Board emphasized the importance of describing in detail the conduct of the investigations in the permit application and the EIA. The seismic equipment must be described technically, with information on how the sound is propagated. Direct and indirect impacts on designated species in the Natura 2000 area must be described and the permit application must also contain proposals for conditions for the investigations. Protective measures must be described and preparedness for possible accidents or emissions must be in place.

SGU accepts the above comments and will take them into account in the permit application and the EIA. The noise modeling will be carried out from a worst-case scenario.

Memoranda and the presentation from the meeting can be found in Appendix 3.

2.4 Consultation with particularly affected stakeholders

Consultations with particularly affected stakeholders were held in writing. The mailing in section 2.2was sent to the consultation group, which can be seen in Table 1Those who chose to comment and the authority's response to the comments can be seen in Chapter 3All comments can be found in their entirety in Appendices 4 and 5.

3 COMMENTS RECEIVED AND THEIR RESPONSES

Below is a summary of the comments received, along with SGU's response to them. Complete comments can be found in Appendices 4 and 5.

The Energy Market Inspectorate, the Blekinge County Administrative Board, the Sea and Coastal Fishermen's Producers' Organization, the Swedish Boat Union, the Swedish Civil Contingency Agency, Ronneby Municipality, Torsås Municipality and Lund University announced that they would refrain from commenting. The Swedish National Board of Housing, Building and Planning, the Energy Agency and Mörbylånga Municipality had no comments. The Swedish Coast Guard, the Swedish Environmental Protection Agency and the Marine Environment Institute refrained from commenting. The National Heritage Board was granted an extended response period but did not submit any comments. Others in the consultation group did not respond when the consultation period expired.

3.1 Borgholm Municipality

Borgholm Municipality refrains from submitting a statement at this stage, as the consultation period was short and ran during the holiday season but wants to be a consulting party in the continued permit process going forward.

Treatment

SGU confirms that it will continue to have Borgholm Municipality as a consulting party in the permit process going forward.

3.2 Swedish Shipping Association (FSS)

FSS states that the work will partly be carried out in areas with frequent maritime traffic and assumes that SGU maintains continuous dialogue with maritime authorities, using internationally agreed signals.

Treatment

SGU confirms that dialogue with maritime authorities will take place according to internationally agreed signals.

3.3 The Armed Forces

The Armed Forces have nothing to say regarding the investigations.

However, the authority wishes that no later than three weeks before an investigation begins, the opportunity to influence the investigation activities is provided to minimize the impact on the authority's efforts and exercise activities.

Treatment

SGU confirms that dialogue will be held with the Armed Forces prior to the investigations.

3.4 Swedish Agency for Marine and Water Managment (HaV)

HaV would like an in-depth account of the modelling, the results of which showed that the sound intensity does not reach above the level for the escape response of harbour porpoises until the sound source is closer than 10 m from a harbour porpoise, but that a dull rumble can be perceived by half the population already at approximately 7 nautical miles (13 km).

The authority would like to see underwater noise modelling in the upcoming EIA based on knowledge of the specific survey methods that are planned to be used. The modelling should show at what distances the threshold values for hearing damage and behavioural disturbance for the harbour porpoise are reached. The total area and duration of the effects that may arise should also be reported. Furthermore, the authority would like an account of the possibilities of limiting the survey area geographically (especially within the Natura 2000 area), the possibilities of adapting the surveys in terms of time (during the mating and calving months for harbour porpoises) and the possibilities of choosing survey methods that are gentler from a noise perspective.

The authority also highlights the need to report in the EIA how the investigations can affect the assessment of good environmental status in accordance with the Marine Environment Directive and states that there are indicators for assessing good environmental status for underwater noise (descriptor 11) according to updated regulations (HVMFS 2024:11).

Treatment

SGU will take HaV's views into account. An underwater noise modelling based on planned survey equipment and methods will be described in the EIA. Adaptations and protective measures to the important areas and time periods for the harbour porpoise will be considered and described in the EIA. SGU will describe how the surveys can affect the assessment of good environmental status for descriptor 11, underwater noise, according to HVMFS 2024:11 in the EIA.

3.5 Swedish Board of Agriculture

The Swedish Board of Agriculture considers it of great importance that the Swedish Marine Agency's guidance on underwater noise "Protective measures for seismic surveys, Guidance to prevent seismic surveys from causing harmful impulsive noise with negative effects on marine mammals" (HaV Report: 2023:4; hereinafter Protective measures for seismic surveys) is applied, as the surveys proposed in the consultation document risk negatively affecting various fish species, such as herring and cod.

Treatment

SGU considers the views of the Swedish Board of Agriculture and will follow the Swedish Marine Agency's guidance on protective measures during seismic surveys (HaV Report: 2023:4) and describe these in the EIA.

3.6 Gotland County Administrative Board

The County Administrative Board asks SGU to clarify and specify which protective measures are applied and when.

The County Administrative Board believes that it can have sufficient data to assess the impact on the Baltic harbour porpoise if the Ministry of the Environment's guidance Protective measures for seismic surveys (HaV Report: 2023:4) is followed, together with the additions below.

The County Administrative Board requests that information on the duration of each investigation, consequences and cumulative effects be described in the upcoming EIA together with noise modelling and expected effects of the work. It is important that noise modelling with sound levels is clear for each type of investigation. The County Administrative Board also wishes for a better method description of how the execution will take place geographically, supplemented with a map and estimated time required for the investigations.

The County Administrative Board asks SGU to:

Propose conditions for delimitation in time and space so that work does not risk negatively impacting the Baltic harbour porpoise.

Propose conditions for demarcation, as well as protective measures for work around Hoburgs Bank and Midsjöbankarna during winter so as not to scare away designated bird species and fish during the wintering period.

Include information on preparedness for leakage of environmentally harmful substances around the Natura 2000 area to minimize the impact on designated bird species.

Describe preparedness for accidents and preventive measures for surveys in the heavily trafficked Baltic Sea.

Harbour Porpoise

The County Administrative Board views the proposal to introduce buffer zones to the Natura 2000 area for noisy work positively but would like to convey that a future assessment will include the impact on the Baltic harbour porpoise inside and outside the Natura 2000 area boundary. Furthermore, a description of how adaptations in work, geographical distribution and techniques can minimize the burden on the critically endangered Baltic harbour porpoise is desired in accordance with the conservation plan for Hoburgs bank and Midsjöbankarna (SE0330308).

Bird

The County Administrative Board would like more information about any turbidity and its extent, as well as whether blue mussels or other bottom fauna could be physically affected or damaged by the investigations, which could have an indirect impact on the wintering birds, the long-tailed duck and black guillemot, that forage in the area.

The County Administrative Board also wants a description of the direct impact on the long-tailed duck and black guillemot from the presence of ships near wintering areas, i.e. whether noise from seismic surveys can affect them above the water surface or when they are foraging below the water surface.

Fish

The Gotland County Administrative Board identifies cod, herring and sprat as particularly important species to investigate as they are red-listed and/or hearing specialists. They also want displacement effects and protective measures to be considered.

Cumulative effects

The County Administrative Board wants cumulative effects to be considered in the area with other noisy activities and coordinated so that the disturbance is as small as possible and suggests

that proposals for conditions be developed. Furthermore, the County Administrative Board wants measures to reduce the impact of cumulative effects to be described for assessment.

Other information

The County Administrative Board informs that there are more Natura 2000 areas that may be affected.

Treatment

SGU will consider the HaV's guidance on protective measures for seismic surveys (HaV report 2023:4) and describe the noise modelling based on planned survey equipment and its impact on harbour porpoises in the EIA. Delimitation and planned transects will be described together with protective measures regarding noise, geographical areas and time restrictions.

Contingency plans for accidents and leakage of environmentally hazardous substances will be described in the EIA.

Impacts on birds and fish, as well as cumulative effects in the area, will be described in the EIA. Actors who hold survey permits in nearby areas will be contacted prior to the surveys for coordination.

SGU will also describe other Natura 2000 areas, such as Ottenby (SE0330108), Stora Karlsö (SE0340023), Lilla Karlsö (SE0340025), Gotska Sandön- Salvorev (SE0340097), Sydöstra Ölands sjömarker (SE0330174) and Näsrevet (SE0340010), as well as potential impacts in the EIA.

3.7 Kalmar County Administrative Board

The County Administrative Board states that the conservation values in Hoburgs Bank and Midsjöbankarna are very sensitive to disturbance and believes that exploitation within the Natura 2000 area is problematic and that investigations to find suitable places to store carbon dioxide should be carried out outside the area.

The County Administrative Board states that impact on the conservation values of the Natura 2000 area that occur outside the boundaries of the protected area risk negatively affecting the conservation values, which is why surveys carried out outside the area may also require a permit according to 7 kap. 28 a § of the Swedish Environmental Code.

Cumulative effects

The County Administrative Board wishes to have a report on all cumulative effects with other activities, existing and planned, that affect the conservation values in the Natura 2000 area, as well as the protective measures planned to minimize cumulative impacts.

Harbour porpoise

The County Administrative Board states that the different investigation methods and their impact on the area's conservation values should be carefully described in the EIA. Sound propagation modeling should be site- and season-specific, as bottom conditions and water temperature affect how sound propagates.

The EIA must clearly state which protective measures are planned to minimize the impact on harbour porpoises.

Alternative survey methods that are not harmful to harbour porpoises, or if it is possible to avoid conducting surveys in the Natura 2000 area, shall be specifically described.

Long-tailed duck and black guillemot

The County Administrative Board emphasizes that the Natura 2000 area is an important wintering site for the Baltic Sea population of black guillemot and wants the impact on the long-tailed duck and black guillemot, as well as the protective measures planned to minimize the impact, to be described in the EIA.

Treatment

SGU thanks you for your comments and states that cumulative effects will be described in the EIA. The noise modelling will be site- and season-specific.

SGU points out that to fulfil the government mission, seismic equipment is required, and no alternative method is available. The seismic equipment that will be used, however, has less noise impact than seismic equipment that is usually used for exploration purposes, but nevertheless provides good enough results to meet the needs of the mission. The survey area consists of three sub-areas, outside and inside Natura 2000, where the Natura 2000 area is only intended to be surveyed in winter. Equipment, time restrictions and protective measures will be described in the EIA.

3.8 Nature Conservation Society

Summary

The Swedish Society for Nature Conservation does not believe that exploitation such as CCS should take place within or adjacent to protected areas due to the risk of disturbance from surveys and establishment. The society states that the proposed surveys therefore lack a clear purpose.

The association highlights that the area largely consists of a Natura 2000 area designated for endangered populations of harbour porpoises and seabirds, where the surveys risk causing disturbance at both the individual and population level and adds that disturbance at the individual level of harbour porpoises is prohibited under Article 12.1 of the Species and Habitats Directive (see European Court of Justice case C-473/19).

The association also states that Hoburgs Bank and Norra Midsjöbanken have complex and species-rich environments, including spawning grounds for fish such as herring and cod, and that shallow offshore areas often function as refuges for species and habitats that are otherwise characteristic of more undisturbed marine environments. The association believes that exploitation of these important environments is inappropriate and instead needs restoration and protection.

The association points out that there is intensive ship traffic in the area and in some parts also industrial trawl fishing and believes that cumulative effects from the surveys may be more extensive than a simple impact analysis can produce.

The association would like more detailed information about the extent of the investigations in time, i.e. for how long the area would be affected.

Treatment

SGU thanks you for the comments and will take them further in the process. SGU emphasizes that the consultation does not concern CCS being or not being, but only investigations to investigate whether the area is geologically suitable for storing carbon dioxide and therefore only addresses comments that concern the investigations themselves. SGU is aware of the sensitivity of the area and will describe the extent of the investigations in time in the EIA, together with protective measures, cumulative effects, geographical boundaries and time restrictions.

3.9 Gotland Nature Conservation Society

The Gotland Society for Nature Conservation believes that there are significant risks that the activities could lead to permanent and irreversible damage to species listed in the EU Nature Conservation Directive and in areas protected by the same directive. Furthermore, the society would like to point out that the new Restoration Regulation (2024/1991) clearly sets time frames for when the EU Nature Conservation Directives must be implemented. Measures to implement the directives include habitat types and species also outside Natura 2000 areas. Activities that risk affecting Natura 2000 areas may therefore not be carried out.

The association states that:

The design of the study area should be adapted to actual premises that may be relevant for carbon dioxide storage. Areas designated as Natura 2000 should be excluded as it is not compatible with the conservation plan or the EU Nature Conservation Directive to store carbon dioxide with associated infrastructure within these areas. The Natura 2000 area Hoburgs bank and Midsjöbankarna (SE0330308) should therefore be excluded as a study area.

Proven protective measures to reduce the spread of noise in aquatic environments and restrictive safety distances must be implemented and reported in detail. This is so that the risk becomes negligible for the critically endangered, and according to the EU's species and habitats directive strictly protected, Baltic harbour porpoise, as well as other species (e.g. fish and other marine animals).

A suitable protective measure could be a safety distance of seven nautical miles to the Natura 2000 area Hoburgs bank and Midsjöbankarna, as well as other areas worthy of protection with a rich flora and fauna.

A detailed description of the implementation of the planned surveys, i.e. methods, location (how close together the test points are), the number of sound booms (per point and in total), when in the year these surveys are planned to be carried out, and protective measures to minimize disturbance to wildlife must be presented in the EIA.

The Swedish Environmental Protection Agency's Handbook 2017:1 states that the concept of disturbance must be viewed from the perspective of the purpose of Natura 2000 protection, which means that measures that negatively affect the long-term survival conditions of a protected species must be considered a disturbance, even if the habitats in the protected area are not affected. For species that move over larger areas and are dependent on areas outside a designated Natura 2000 area (for example, the Baltic harbour porpoise, our note), this fact needs to be considered in connection with the assessment of whether an unauthorized disturbance is at risk.

That the EIA needs to be supplemented with how habitat types and species may be affected outside the Natura 2000 area in accordance with the EU's Nature Conservation and Restoration Directive.

Treatment

SGU thanks you for your comments and will take them into account in the process. According to the government's mandate, SGU will investigate suitable premises for carbon dioxide storage. This requires a comprehensive survey to locate possible injection sites and to ensure the reservoir's risk of leakage, as carbon dioxide can migrate within the reservoir after injection. SGU would like to clarify that no infrastructure will be installed on the seabed as the investigations only involve a survey of the reservoir's properties.

SGU is aware of the sensitivity of the area and will describe the extent of the investigations in time in the EIA, along with protective measures, cumulative effects, geographical delimitations and time restrictions. The technical implementation will also be described.

3.10 OX2

OX2 emphasizes the importance of carefully describing in the EIA how cumulative effects can be avoided and that future writings clarify how the investigations are planned as the investigation area overlaps with most of the company's projects.

The company would like their project areas to be well covered with geophysical surveys so that misunderstandings in later assessments of whether the activities affect each other can be avoided. The company is happy to assist with coordinates for their various project areas.

The company states that many relevant aspects are addressed regarding environmental impact, but that there is some doubt that the radius of behavioural impact on harbour porpoises is as short as 10m.

Treatment

SGU will carry out detailed noise modelling to ensure the radius of behavioural impact from the noise source and describe this in the EIA. Cumulative effects will also be described. SGU thanks for the other comments and will take them further in the process.

3.11 RWE

RWE generally views the improvement of knowledge about the seabed in the Baltic Sea positively and is therefore positive about investigations being carried out in the area.

The company provides information about ongoing or planned projects that they are running in the area, with the aim of facilitating future coordination of investigations. Final reports as well as raw data and interpretations have been submitted to SGU in accordance with applicable terms. To avoid unnecessary burden on the environment, the company believes that the need for corresponding investigations in the area should be considered.

Delimitation and content of the EIA

The company points out that in a Natura 2000 review, they were rejected by the review authority regarding seabed surveys within the Natura 2000 area Hoburgs Bank and Midsjöbankarna, and that the review authority made far-reaching demands for reporting of cumulative effects and rejected the application with reference to, among other things, the surveys' impact on harbour porpoises. The decision has been appealed and is currently before the Land and Environmental Court for a decision. The company believes it is important that all Natura 2000 permit applications for seabed surveys are handled according to the principle of equal treatment.

Coordination and information exchange

The company is requested to be contacted for coordination at least 8 months in advance of planned surveys in the areas where the company has or has applied for a permit for seabed surveys.

The company wishes that investigations within Natura 2000 areas are designed so that the results are useful for all tests, including those under the Environmental Code and the Cultural Environment Act, which may be relevant for various activities but also for technical design, which can provide the conditions for other uses of the results without the area needing to be burdened with additional investigation campaigns. The company is open to dialogue about collaboration.

Treatment

SGU thanks you for the information provided about the investigations that RWE has carried out or planned in the area. SGU would like to state that cumulative effects and the impact on harbour porpoises will be described in the EIA. However, the authority would like to point out that the current investigations differ from those required for the establishment of offshore wind power.

SGU will contact relevant stakeholders in the area before the start of the investigations, for coordination.

SGU refers to the EU Regulation on Net Zero Industry (2022/23:FPM 78) which will require EU countries to share and publish data provided regarding the few suitable carbon storage sites available. SGU will make available the information collected in the government assignment that is not subject to confidentiality.

3.12 The Swedish Maritime Administration

The Swedish Maritime Administration has nothing to complain about the planned investigations, provided that the conditions set out below are met and the views are considered.

Views

The Swedish Maritime Administration points out that the current surveys are planned to take place in the vicinity of or within areas with high levels of maritime traffic, such as nationally classified fairways, deep-water routes, traffic separation schemes and in certain coastal water areas.
The agency notes that there are risks of close-in situations between survey vessels and other maritime traffic, as well as between other ship traffic that may be affected by survey vessels. The agency therefore points out that the implementation of maritime safety-enhancing measures may need to be considered in certain areas.

The authority requires that further consultation be carried out with the Swedish Maritime Administration well in advance of the commencement of the investigations regarding the identification of any maritime safety-related risks and the need for necessary maritime safety-enhancing measures in areas that the authority considers suitable for their implementation.

The authority shall be notified no later than six (6) weeks before the investigations commence, for further information to shipping via regular contact channels.
The information shall include information on the area, scope, contact details for the responsible

unit or work management carrying out the work (with VHF calling channels to the work vessel) as well as a timetable and any other information of importance to shipping.

Other information
After completed investigations, geological data obtained during the investigations, in those parts where there is data that meets the FSIS 44 hydrographic standard, should be reported to the Swedish Maritime Administration.

Treatment

SGU confirms that a dialogue will be held with the Swedish Maritime Administration regarding maritime safety-related risks and maritime safety-enhancing needs before the start of the investigations. SGU accepts the conditions to inform the Swedish Maritime Administration and deliver marine feeding data that meets the correct quality standard.

3.13 Swedish Fishermen's Producers' Organization (SFPO)

SFPO would like to state that the organization considers it inappropriate to consider storing carbon dioxide under the seabed in the Baltic Sea.

The organization shares SGU's assessment that the investigations will likely not produce any permanent environmental effects, but that there will only be short-term, temporary and transient environmental effects.

The organization wishes that the EIA describes how the survey methods affect the fish community, e.g. Baltic cod, at all locations where surveys are conducted, and that the impact of the surveys on commercial fishing is accounted for.

The organization assumes that information about when and how the investigations will be carried out will be provided to them, together with the EIA.

Treatment

SGU thanks you for your comments and states that the impact of the investigations on fish will be described in the EIA. SGU agrees to inform SFPO about when and how the investigations are carried out and states that the EIA will be made available.

3.14 Swedish pelagic federation producer organization (SPF)

SPF has nothing to complain about the planned investigations.

The organization believes that the surveys should be adjusted in time so that disruption to fishing is minimized and that commercial fishing should be kept well informed about the times and locations of the surveys.

The organization states that it cannot be ruled out that the surveys may cause disturbances to, for example, herring, which have very good hearing and are dependent on sound signals for their communication within the shoal. The organization believes that it is very important that surveys do not take place at times and places where the herring spawn, to ensure that there is no disturbance to their reproduction.

Treatment

SGU will engage in dialogue with SPF and inform about the time and location of the investigations. The impact on and protection conditions for herring will be described in the EIA.

3.15 Swedish Transport Administration

The Swedish Transport Administration has nothing to say regarding the planned investigations. The authority notes that the documentation mentions areas that are designated as maritime investigation areas in the maritime plan. If the investigation area becomes the subject of an investigation due to the results of the investigations, the authority wishes to lead or be an active part of this together with the Swedish Maritime Administration. The designated areas in the maritime plan with the designation maritime investigation area are designated as national maritime interest and are of great importance for maritime traffic across the Baltic Sea.

Treatment

SGU thanks you for your comments and states that the current data only relates to the planned investigations and is not responsible for any subsequent investigations currently.

3.16 Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention)

As the planned investigations could potentially affect the waters of neighbouring countries, SGU submitted consultation documents to the Swedish Environmental Protection Agency in accordance with the Espoo Convention. Four statements were received by SGU and are summarised below together with SGU's responses.

3.16.1 Estonia

Estonia, through The Ministry often Climate, has nothing to recall and assesses that the activities will not have a significant impact within the territory of Estonia, but informs that the consultation document does not assess any risk from seismic surveys of dumping sites for chemical weapons from the Second World War. Furthermore, Estonia wishes to be provided with the data/results from the surveys, as well as the EIA.

Treatment

SGU will explain the possible impact of sound waves on dumping sites of chemical weapons in the EIA. SGU will make available the information collected in the government assignment that is not subject to confidentiality.

3.16.2 Latvia

Latvia, through The Environmental State Bureau, has no views on the basis and assesses that the planned investigations will not have a significant impact within the territory of Latvia. However, Latvia wishes to receive the basis/results from the investigations, as well as the EIA.

Treatment

SGU will make available the information collected in the government mission that is not subject to confidentiality.

3.16.3 Lithuania

Lithuania, through The Ministry of Environment**,** wishes to participate in the EIA process in a transboundary context, as well as an assessment of the impact on potentially sensitive species in the Lithuanian Exclusive Economic Zone (EEZ).

Treatment

SGU will describe Natura 2000 areas in Lithuania that may be affected by the investigations in the EIA and describe protective measures for, among other things, harbour porpoises.

3.16.4 Poland

Poland, through The Department often Environmental Impact Assessment, announces its participation in the EIA process in a transboundary context. They also highlight that SGU should describe the impact of the surveys, especially related to noise, on wintering birds and their food, spawning fish, and marine mammals with a focus on harbour porpoises. They request an analysis of the connection between harbour porpoise populations in Hoburgs Bank and the Polish Natura 2000 site Ostoja Sÿowiÿska , and the connection between bird populations at Hoburgs Bank and the Polish Natura 2000 site Sÿupsk Bank and Coastal Waters of the Baltic Sea. They want SGU to use the latest data on harbour porpoises and birds and describe the behavioural impact, as well as the impact on harbour porpoises at the individual level. They also want SGU to consider the latest EIA requirements from the EU.

In addition, Poland points out areas of exploitation interest in the vicinity of SGU's planned surveys and wants SGU to present its plans in more detail with geographical coordinates.

Treatment

Regarding the impact of carbon dioxide storage on exploitation interests, SGU emphasizes that the consultation does not concern the carbon dioxide storage itself, but only investigations to investigate whether the area is geologically suitable for storing carbon dioxide and therefore only addresses views that concern the investigations themselves. However, SGU undertakes to share the coordinates of the investigations to inform Poland about the distance of the investigations to exploitation interests.

SGU will describe the impact of the surveys on wintering birds such as the tern and sand eel as well as spawning fish and describe protective measures for these in the EIA. The harbour porpoises in the Baltic Sea belong to a population and reside in the Natura 2000 area during the summer and no surveys will be carried out within the protected area during that time. Protective measures and time restrictions to protect the harbour porpoises will be taken and described in the EIA. SGU will describe the geographical extent of the survey in more detail in the EIA.

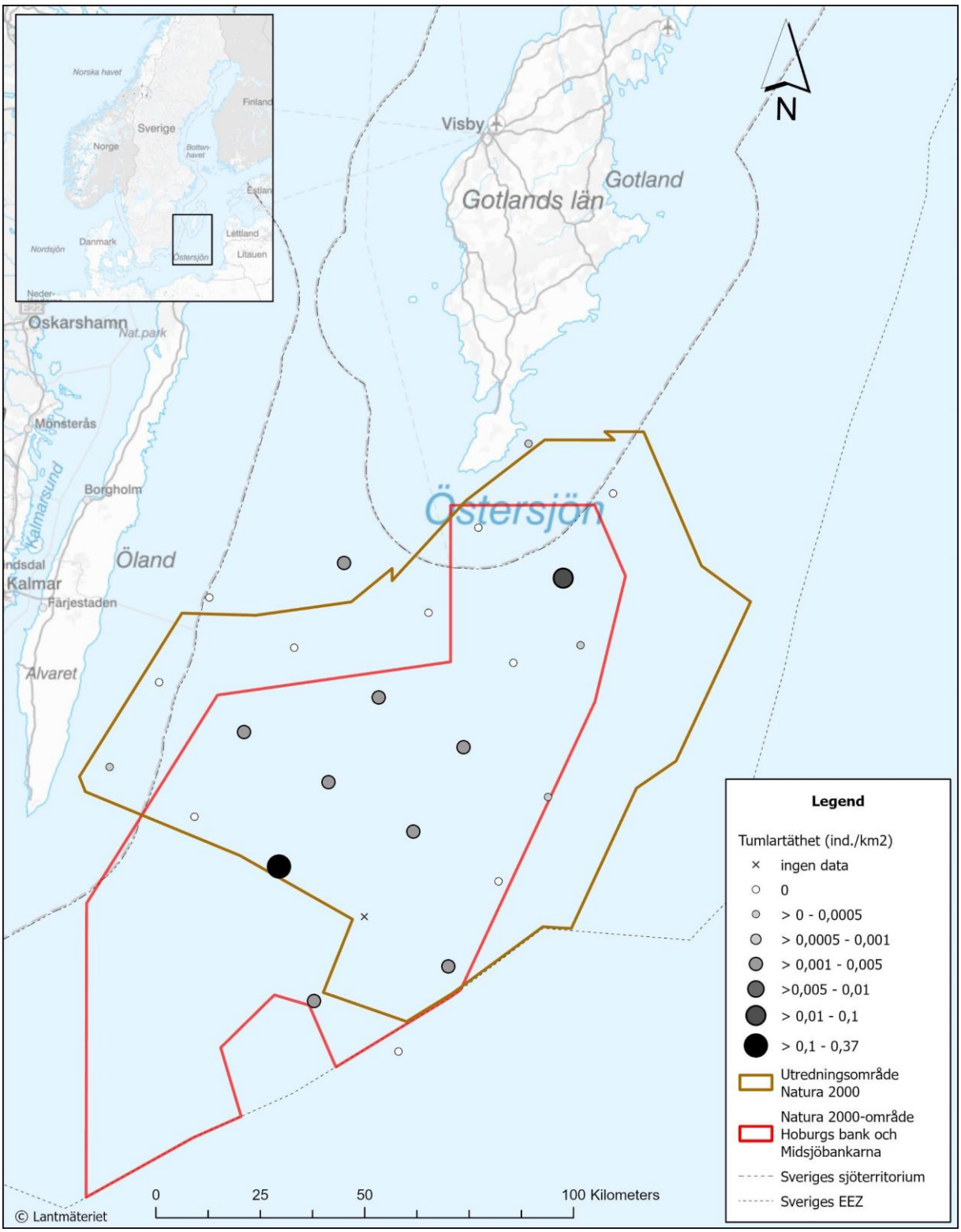

Figure 1. Map of harbour porpoise density during the winter period (November–April) from SAMBAH data relevant for the Natura 2000 investigation area.

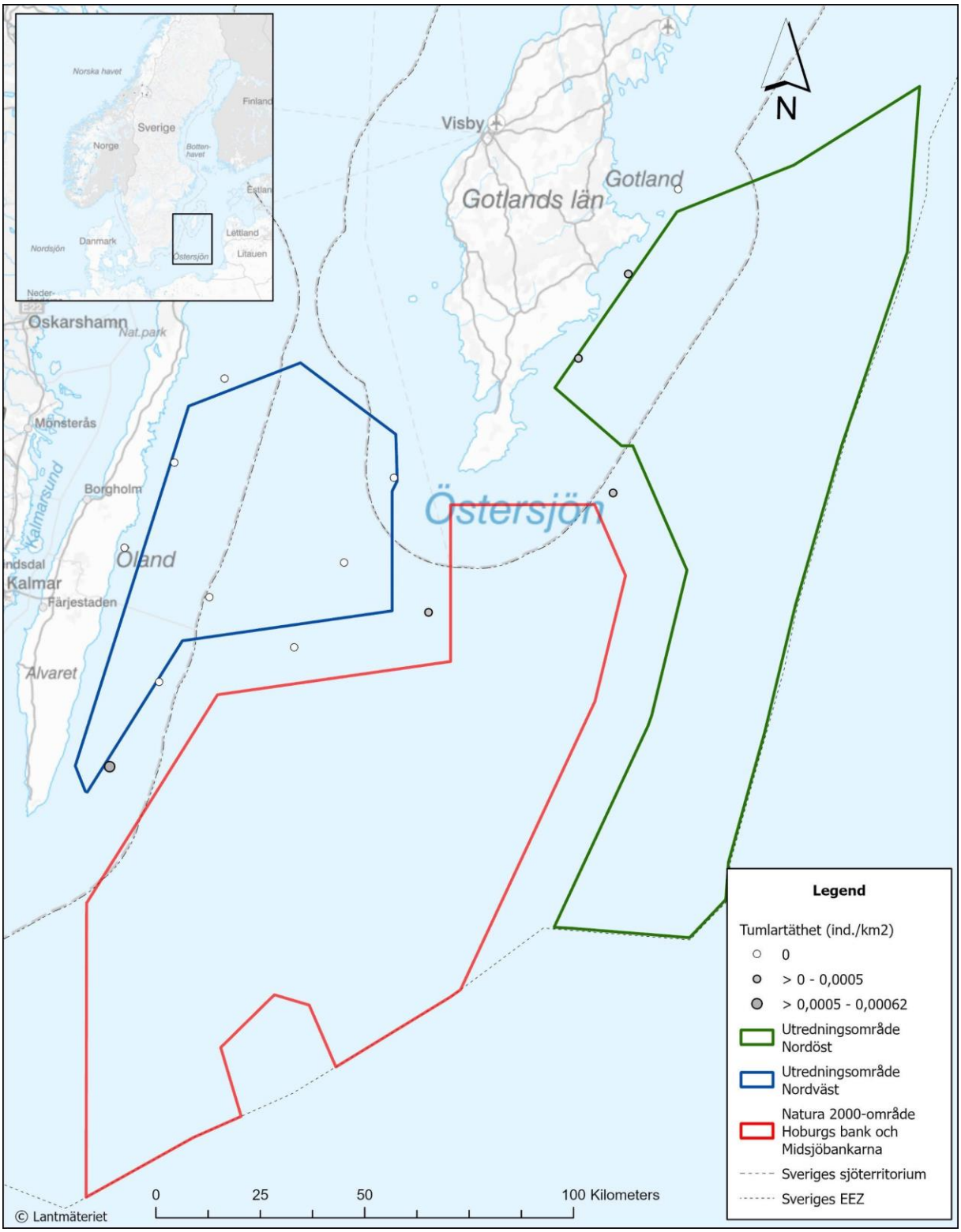

Figure 2. Map of porpoise density during the summer period (May-September) from SAMBAH data relevant to the Northeast and Northwest investigation areas.

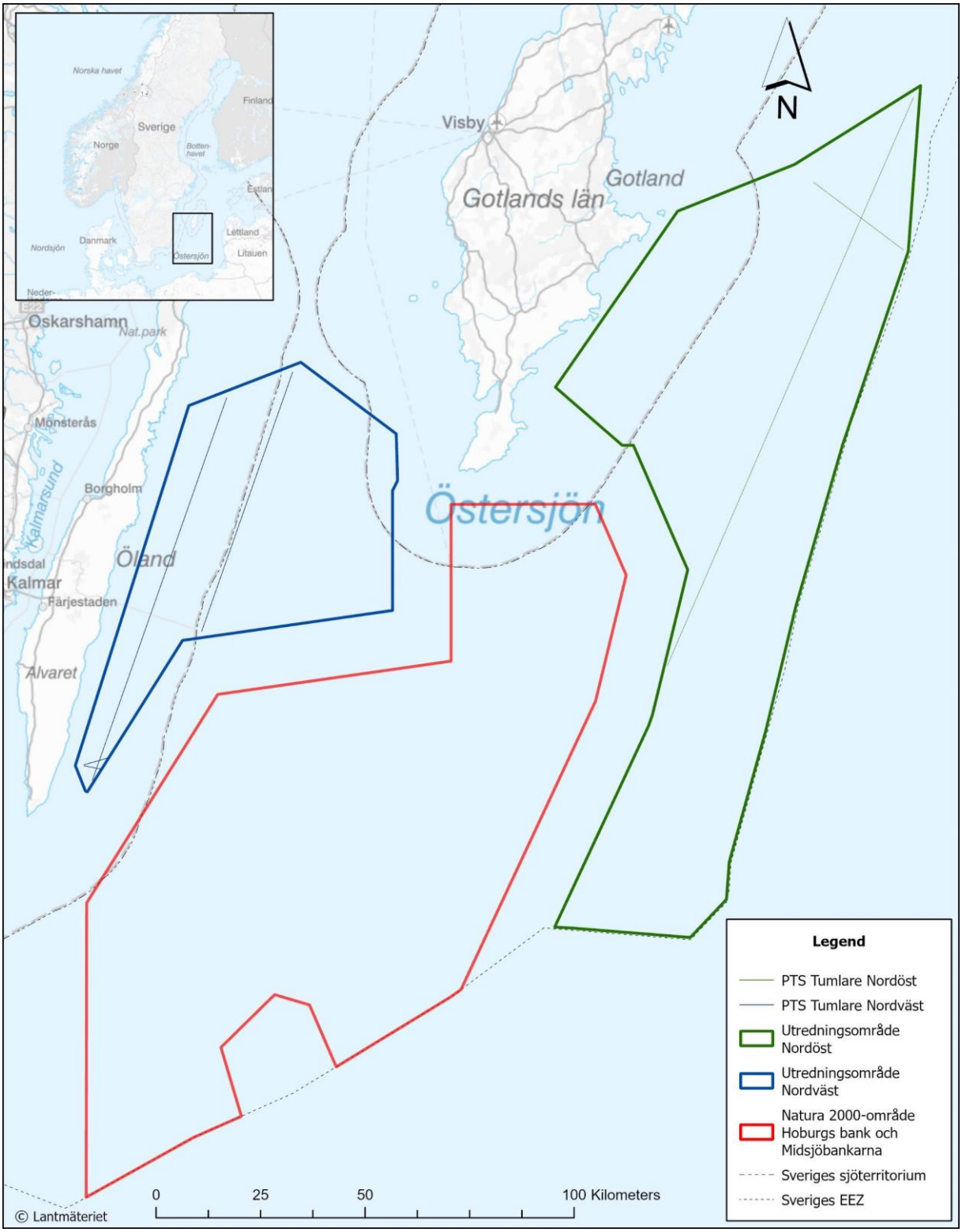

Figure 1. Example of maximum distance for PTS on harbour porpoises in relation to the transects, based on a 24-hour maximum measurement in the Northeast and Northwest investigation areas, summer period (May–October). Maximum distances for PTS on harbour porpoises in the Northeast and Northwest investigation areas are 50 m and 80 m, respectively. The total length of the transects shown in the Northeast and Northwest investigation areas are 175 km and 173 km, respectively. The reason why the PTS polygons are so weak is because the distances for the PTS are very small.

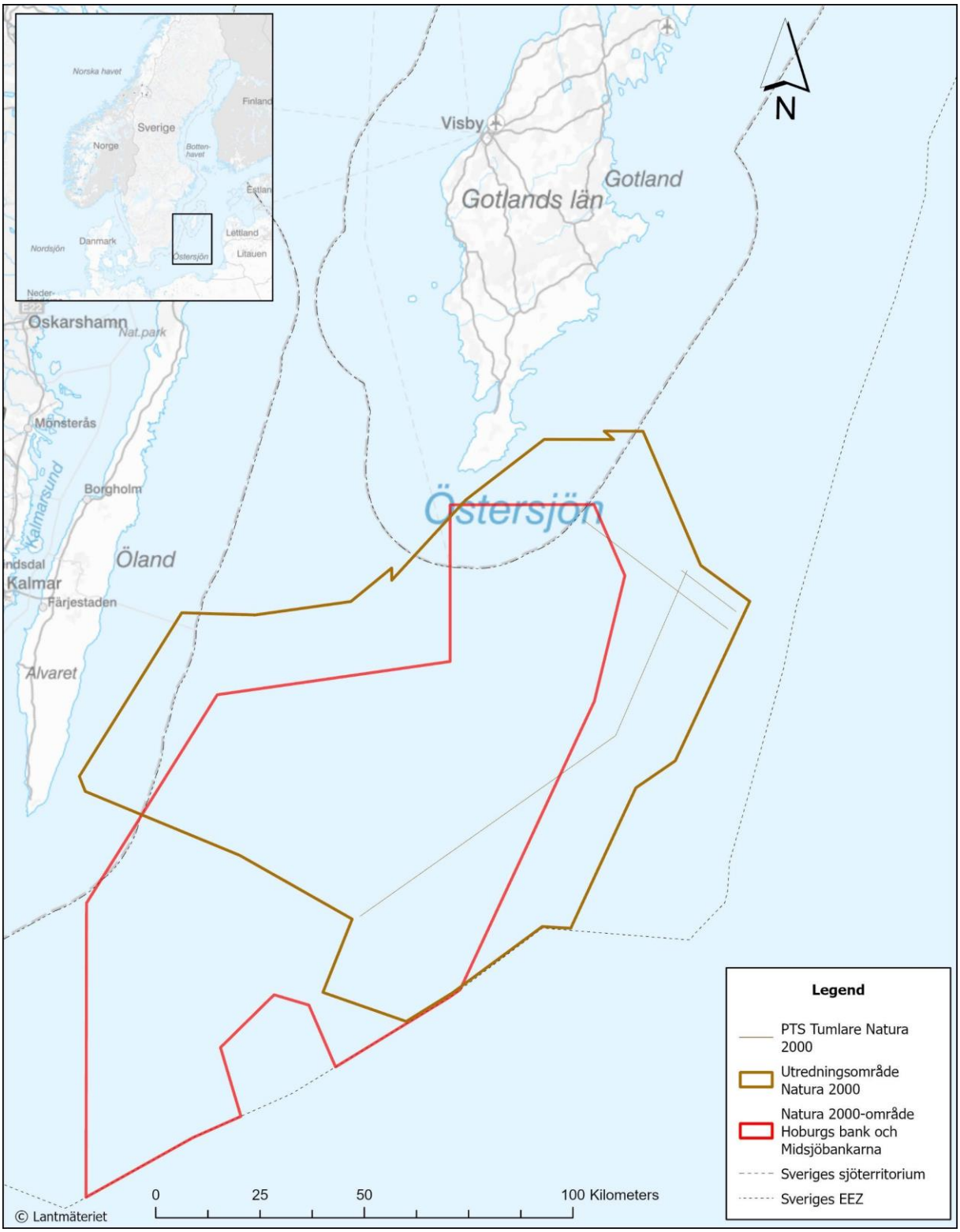

Figure 2. Example of maximum distance for PTS on harbour porpoises in relation to the transects, based on a maximum measurement of one day in the Natura 2000 investigation area, winter period (November–April). Maximum distance for PTS on harbour porpoises in the Natura 2000 investigation area is 50 m. The total length of the transects shown in the Natura 2000 investigation area is 178 km. The reason why the PTS polygons are so weak is because the distances for PTS are very small.

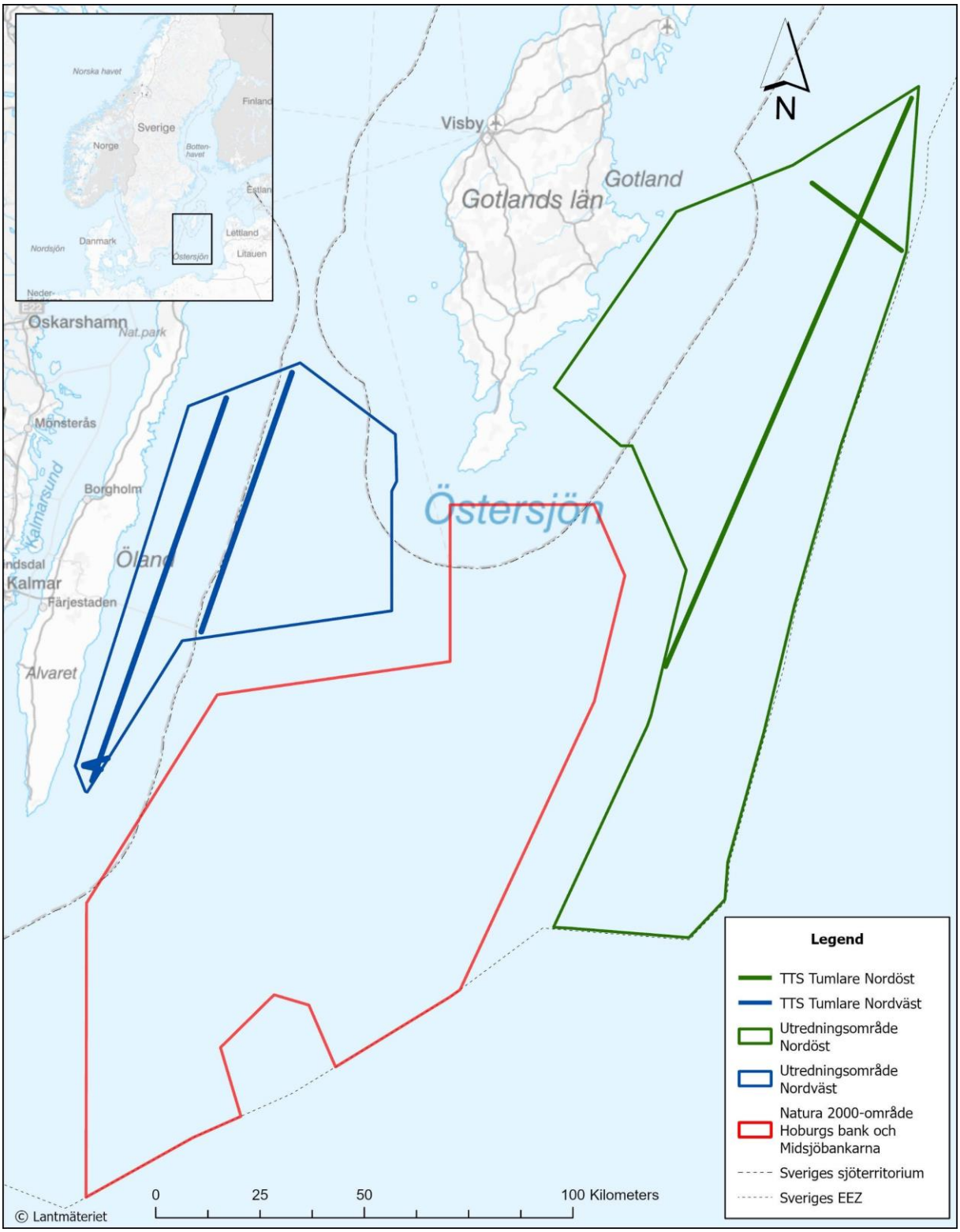

Figure 3. Example of maximum distance for TTS on harbour porpoises in relation to the transects, based on a 24-hour maximum measurement in the Northeast and Northwest investigation areas, summer period (May-October). Maximum distances for TTS on harbour porpoises in the Northeast and Northwest investigation areas are 600 m and 700 m, respectively. The total length of the transects shown in the Northeast and Northwest investigation areas are 175 km and 173 km, respectively.

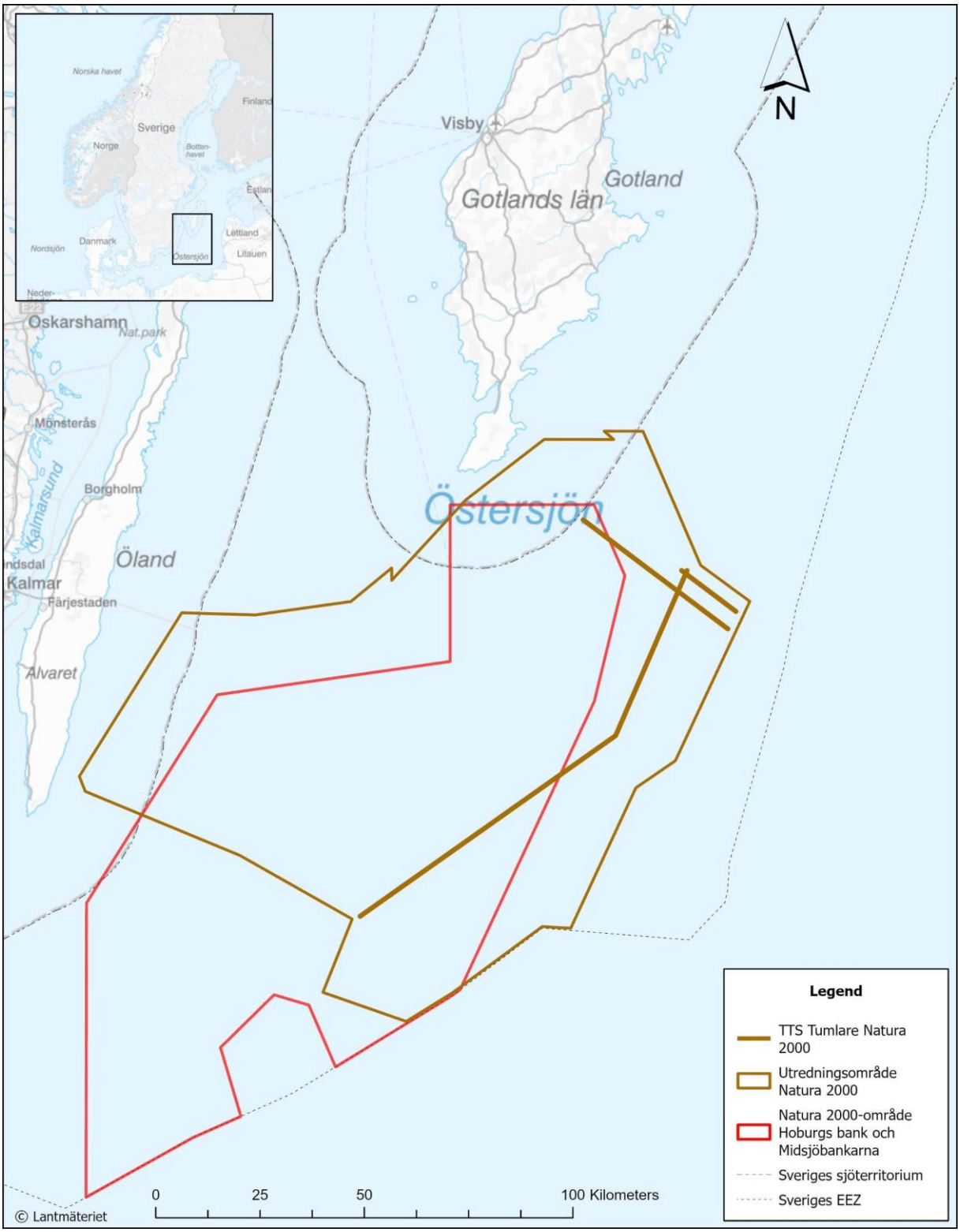

Figure 4. Example of maximum distance for TTS on harbour porpoises in relation to the transects, based on a maximum measurement of one day in the Natura 2000 investigation area, winter period (November–April). Maximum distance for TTS on harbour porpoises in the Natura 2000 investigation area is 600 m. The total length of the transects shown in the Natura 2000 investigation area is 178 km.

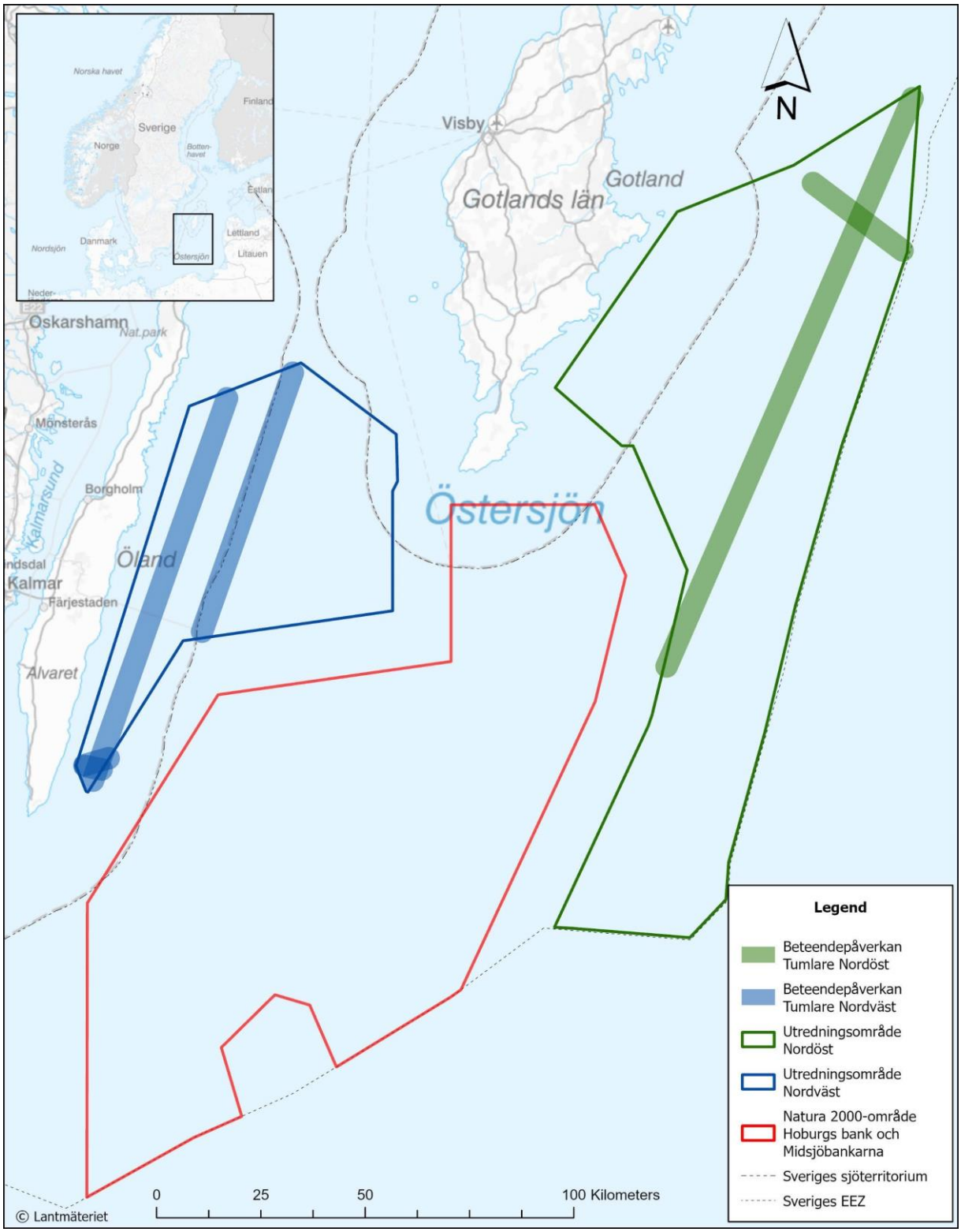

Figure 5. Example of maximum distance for behavioural impact on harbour porpoises in relation to transects, based on a 24-hour maximum measurement in the Northeast and Northwest investigation areas, summer period (May–October). Maximum distance for behavioural impact on harbour porpoises in the Northeast and Northwest investigation areas is 2.7 km. The total length of the transects shown in the Northeast and Northwest investigation areas are 175 km and 173 km, respectively.

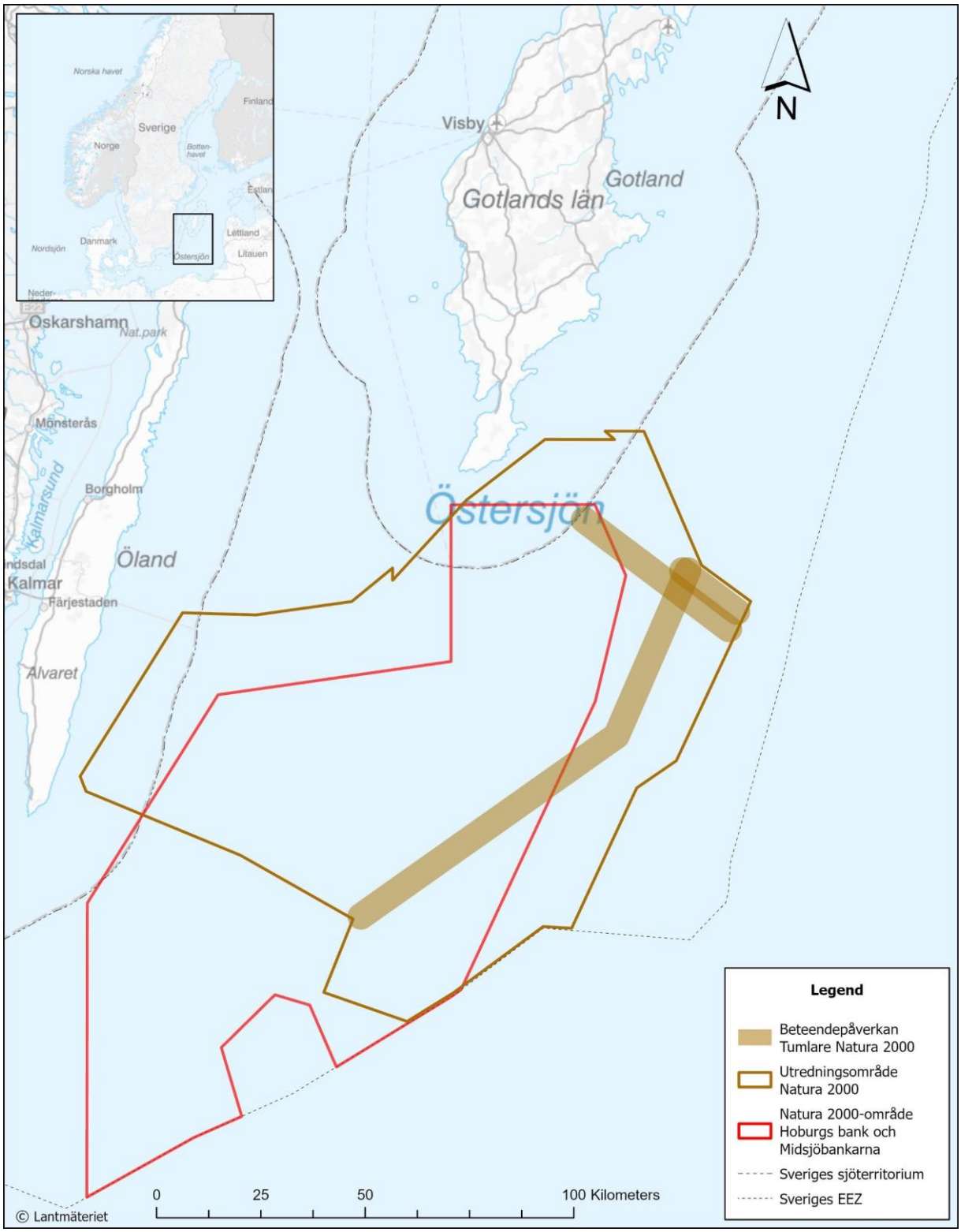

Figure 6. Example of maximum distance for behavioural impact on porpoises in relation to transects, based on a maximum daily measurement in the Natura 2000 study area, winter period (November–April). Maximum distance for behavioural impact on harbour porpoises in the Natura 2000 study area is 3.2 km. The total length of the transects shown in the Natura 2000 study area is 178 km.

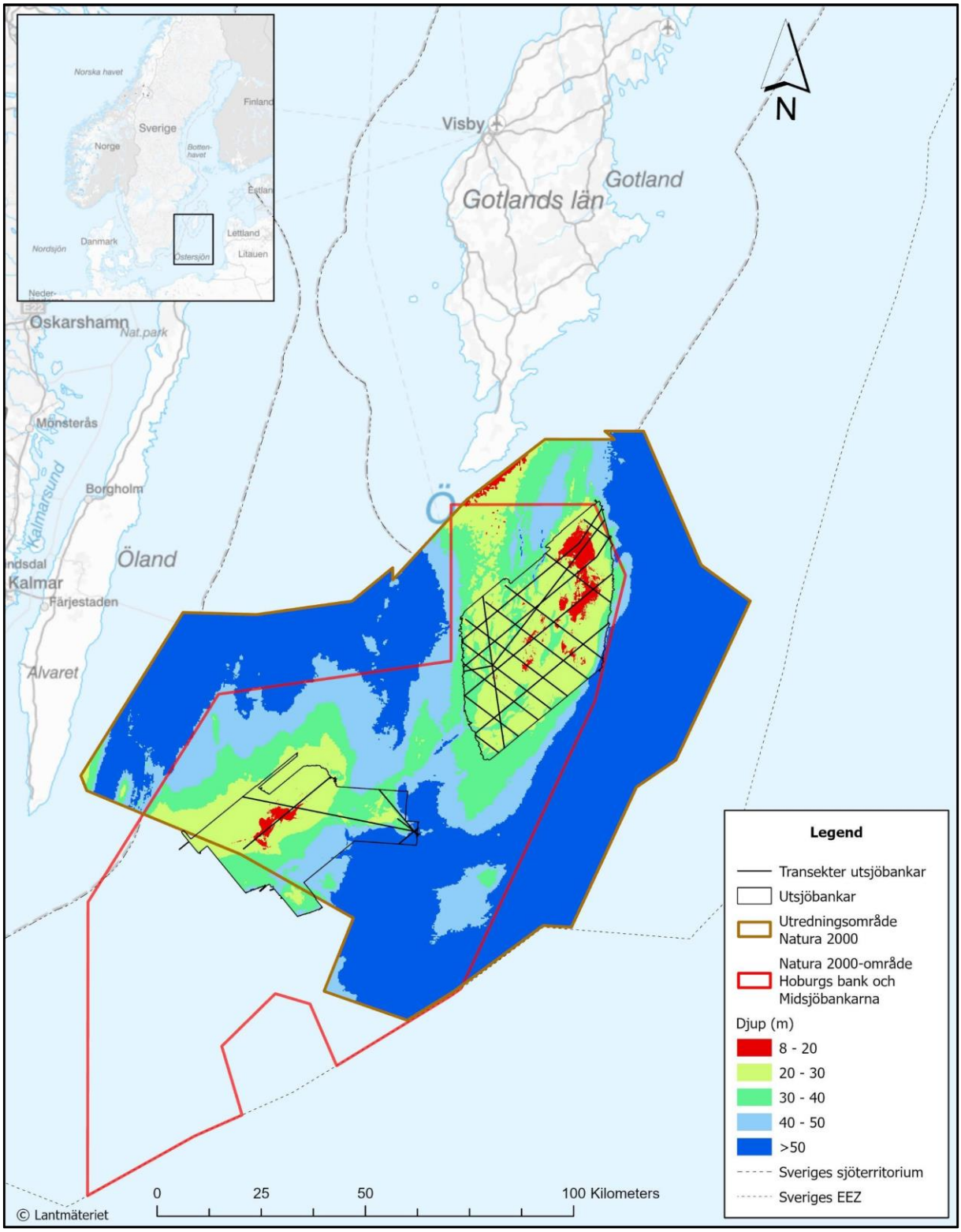

Figure 1. Bathymetry over the Natura 2000 investigation area in relation to planned transects and how they cross the offshore banks Hoburgs bank and Norra Midsjöbanken . Bathymetry data for the offshore banks are from Sveriges geologiska undersökning (2022) and Sveriges geologiska undersökning (2024) and data outside the offshore banks are from the Baltic Sea Hydrographic Commission (2013).

References

Baltic Sea Hydrographic Commission, 2013: Baltic Sea Bathymetry Database version 0.9.6. Hämtad 27 februari, 2025 från: https://www.bshc.pro/data/

Sveriges geologiska undersökning, 2022: Produkt: Habitatkartering, Hoburgs bank version 1.2., depth . Hämtad 10 mars 2025 från: https://resource.sgu.se/oppnadata/html/marin/marin.html

Sveriges geologiska undersökning, 2024: Produkt: Habitatkartering, Norra Midsjöbanken version 1.2., depth . Hämtad 10 mars 2025 från: https://resource.sgu.se/oppnadata/html/marin/marin.html

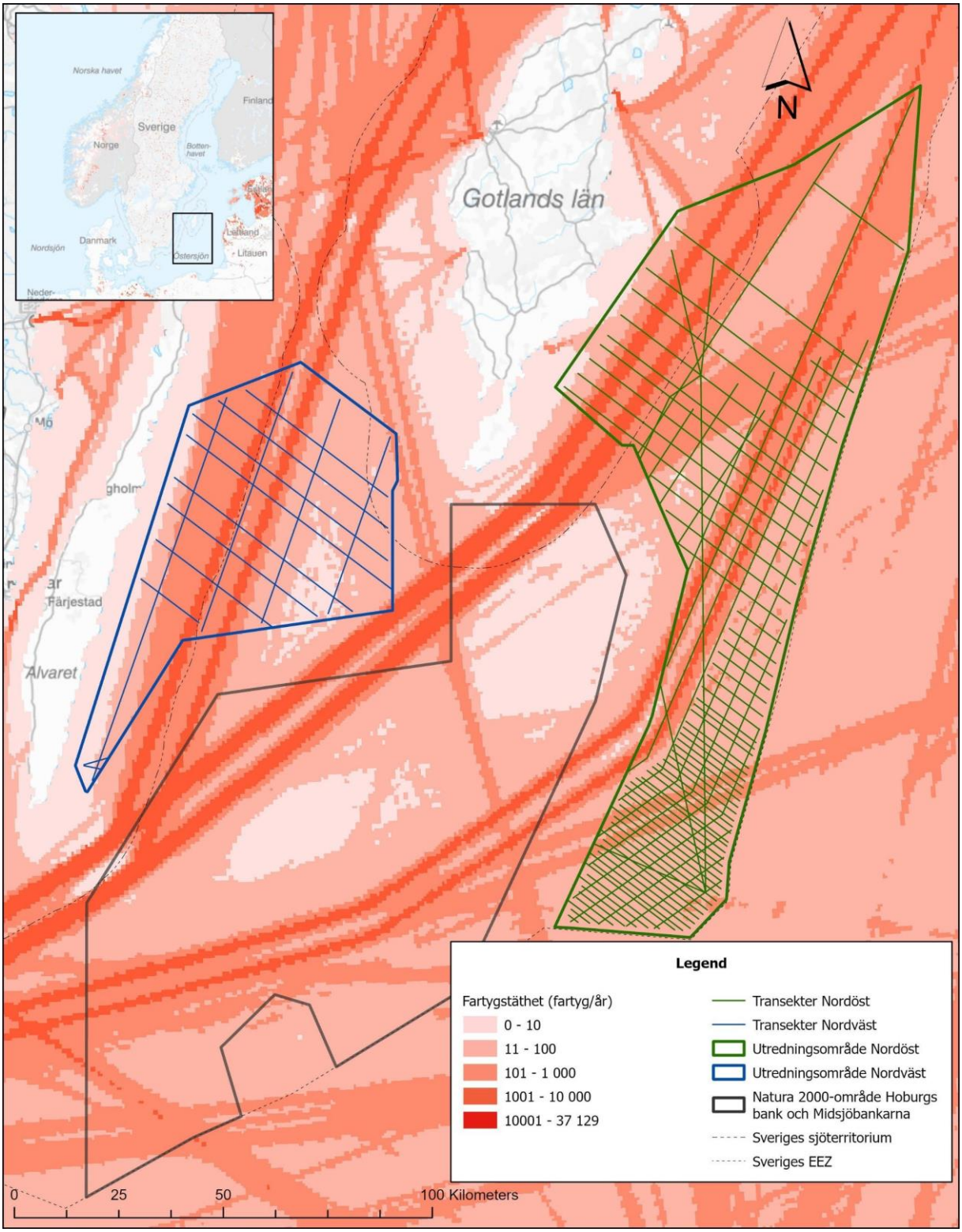

Figure 1. Vessel density for all vessel types in the year 2022 in relation to the planned transects in the Northeast and Northwest investigation areas during the summer period (May – October).

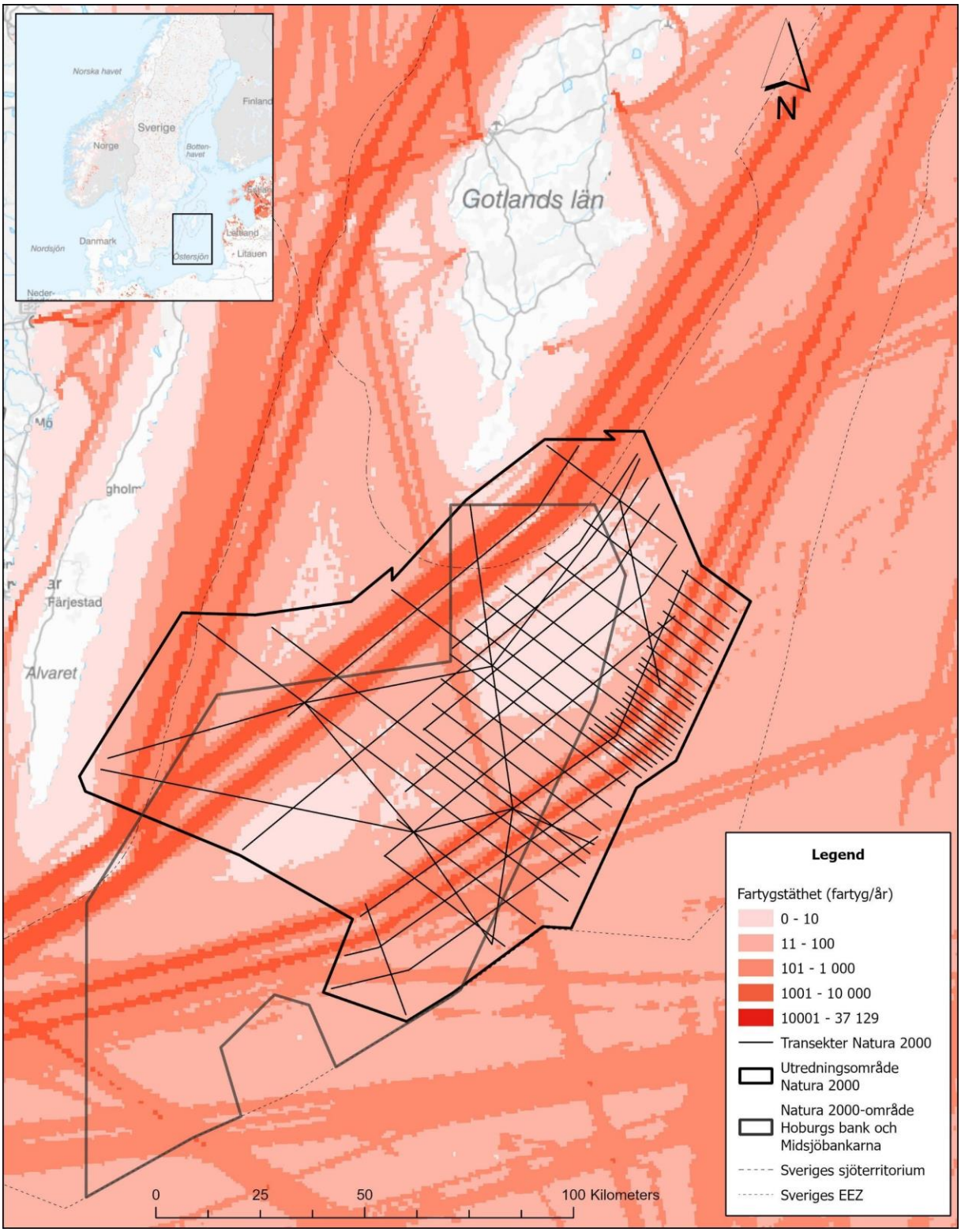

Figure 2. Vessel density for all vessel types in 2022 in relation to the planned transects in the Natura 2000 investigation area during the winter period (November – April).

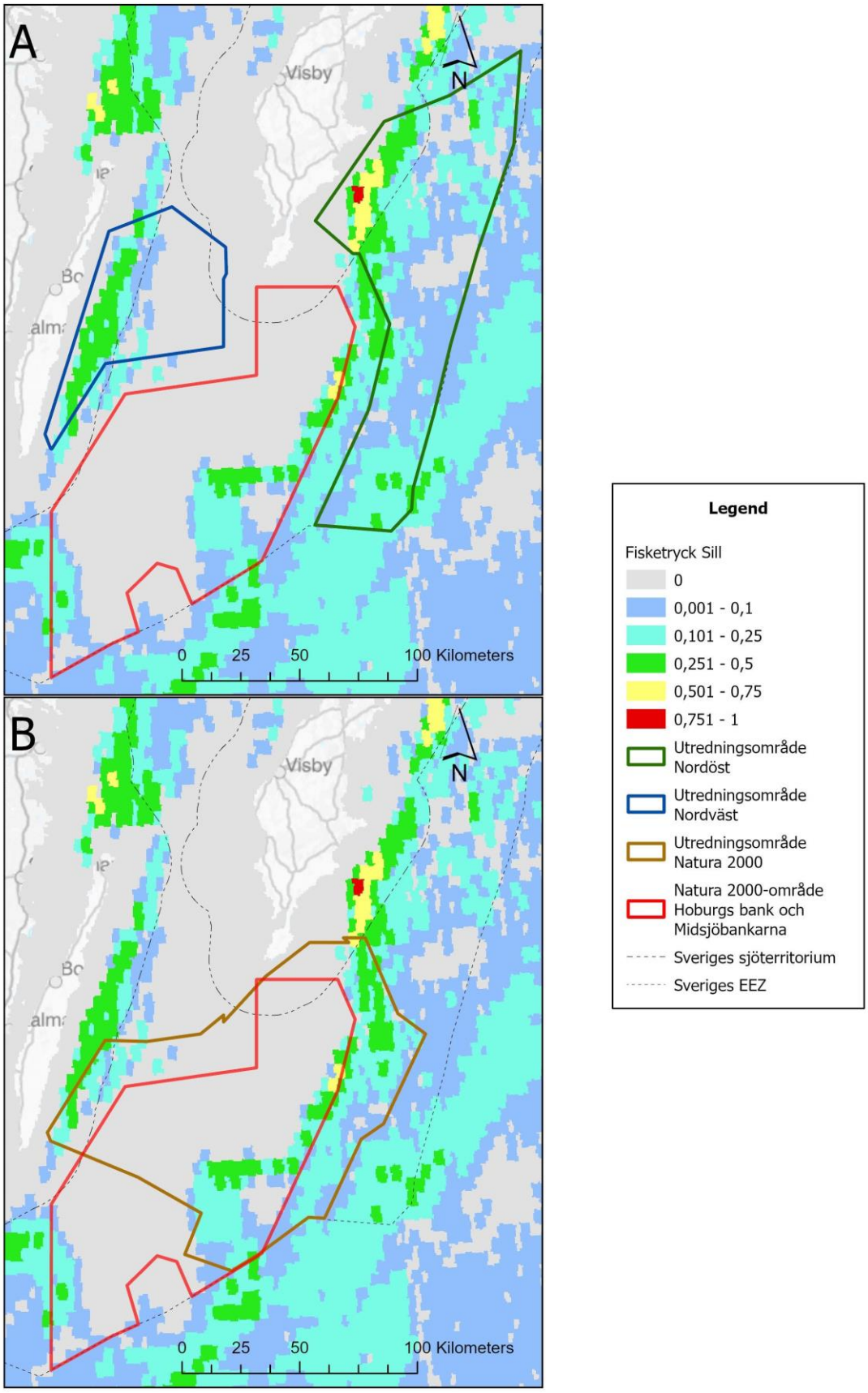

Figure 3. Fishing pressure on herring in 2016–2020 in relation to A) the Northeast and Northwest investigation areas and B) the Natura 2000 investigation area.

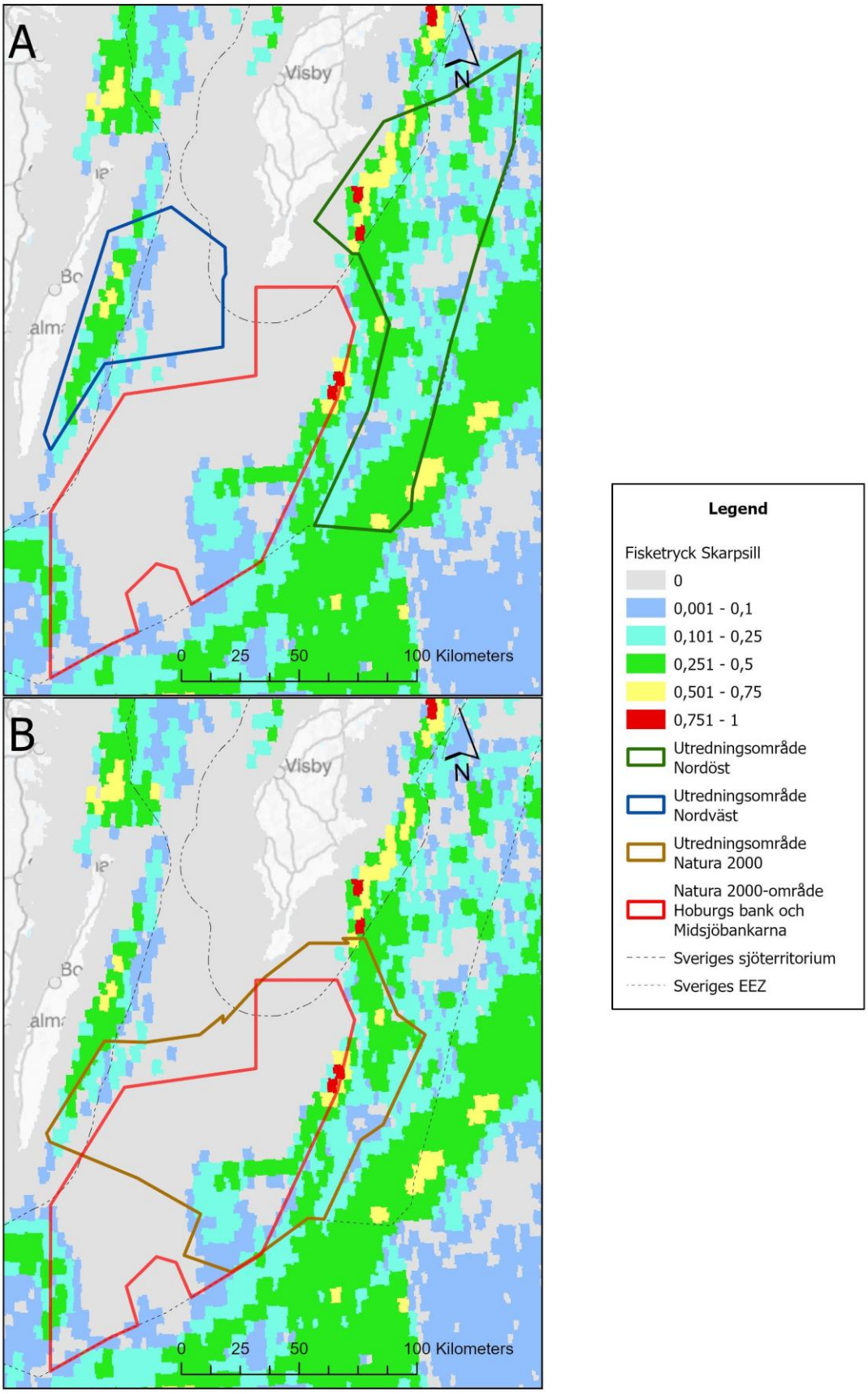

Figure 4. Fishing pressure on sprat 2016–2020 in relation to A) Northeast and Northwest investigation areas and B) Natura 2000 investigation area.

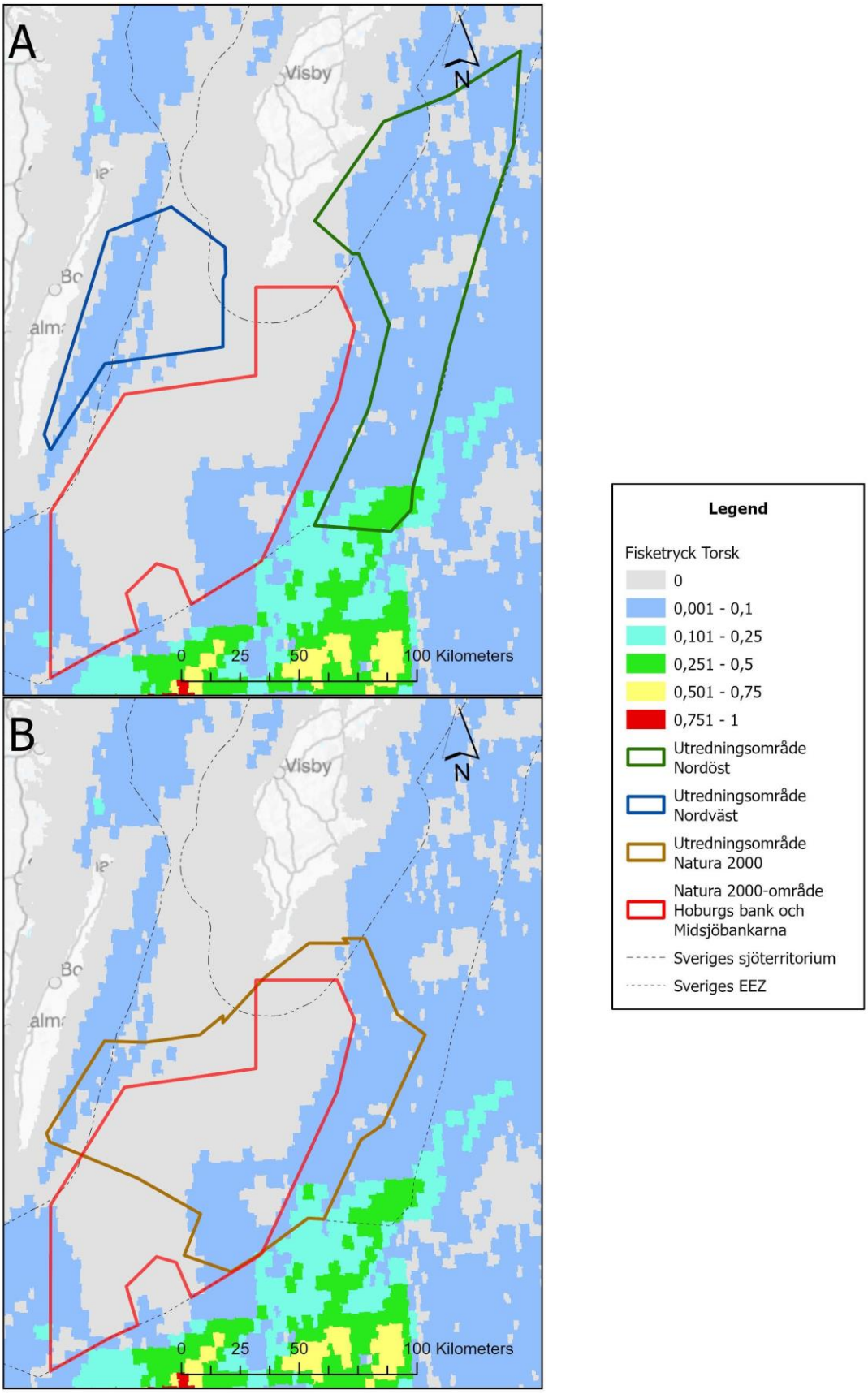

Figure 5. Fishing pressure on cod 2016–2021 in relation to A) the Northeast and Northwest investigation areas and B) the Natura 2000 investigation area.

Table. Natura 2000 areas along the southern and eastern coast of Gotland, their designated habitat types and/or species, and whether the area is designated according to the Birds Directive (SPA) and/or the Species and Habitats Directive (SCI). Data taken from the Swedish Environmental Protection Agency's map tool Protected Nature.

Natura 2000 Nature types Species SPA/SCI (all in Swedish)

Natura 2000	Nature types	Species	SPA/SCI
Flisviken SE0340162	Sten- och grusvallar Strandängar vid Östersjön Sandstränder vid Östersjön Kalkgräsmarker Alvar Fuktängar Rikkärr Taiga	Fisktärna Ljungpipare Silvertärna Skärfläcka Småtärna Vitkindad gås	SPA/SCI
Heligholmen SE0340121	Sten- och grusvallar Vegetationsklädda havsklippor Kalkgräsmarker Alvar	Fisktärna Silvertärna Vitkindad gås	SPA/SCI
Austre SE0340169	Grå dyner Trädklädda dyner	-	SCI
Yttre Stockviken SE0340104	Driftvallar Sten- och grusvallar Glasörtstränder Strandängar vid Östersjön Sandstränder vid Östersjön Kalkgräsmarker Fuktängar	Brushane Fisktärna Kalkkrassing Silvertärna Skärfläcka Småtärna Vitkindad gås	SPA/SCI
Faludden SE0340099	Driftvallar Sten- och grusvallar Strandängar vid Östersjön Kalkgräsmarker Fuktängar	Brushane Fisktärna Ljungpipare Silvertärna Skärfläcka Småtärna Vitkindad gås	SPA/SCI
Austerrum SE0340161	Glasörtstränder Strandängar vid Östersjön Sandstränder vid Östersjön Enbuskmarker Kalkgräsmarker Alvar Fuktängar Taiga Trädklädd betesmark	Brushane Fisktärna Silvertärna Skärfläcka Småtärna Sydlig kärrsnäppa Vitkindad gås	SPA/SCI
Södra Grötlingboudd SE0340105	Laguner Strandängar vid Östersjön Sandstränder vid Östersjön Kalkgräsmarker Fuktängar Trädklädd betesmark	Brushane Fisktärna Kentsk tärna Silvertärna Skärfläcka Småtärna Törnskata Vitkindad gås	SPA/SCI
Grötlingboudd-Ytterholmen SE0340098	Sandbankar Rev Sten- och grusvallar Strandängar vid Östersjön Kalkgräsmarker Fuktängar	Fisktärna Kentsk tärna Silvertärna Skräntärna Skärfläcka Småtärna Sångsvan Vitkindad gås	SPA/SCI
Sigdesholm SE0340106	Sten- och grusvallar Strandängar vid Östersjön	Fisktärna Silvertärna	SPA/SCI

Natura 2000	Nature types	Species	SPA/SCI
	Kalkgräsmarker Fuktängar	Skärfläcka Småtärna Vitkindad gås	
Ålarve SE0340114	Sandbankar Laguner Strandängar vid Östersjön Enbuskmarker Kalkgräsmarker Alvar Fuktängar Agkärr Trädklädd betesmark	Fisktärna Silvertärna Småtärna Vitkindad gås	SPA/SCI
Hummelbosholm SE0340016	Blottade ler- och sandbottnar Sten- och grusvallar Strandängar vid Östersjön Kalkgräsmarker Fuktängar Trädklädd betesmark	Brushane Silvertärna Skärfläcka Småtärna Sångsvan Vitkindad gås	SPA/SCI
Närsholmen SE0340017	Blottade ler- och sandbottnar Driftvallar Sten- och grusvallar Strandängar vid Östersjön Kalkgräsmarker Fuktängar Trädklädd betesmark	Bergand Brushane Salskrake Silvertärna Skärfläcka Småtärna Vitkindad gås	SPA/SCI
Pavals SE0340166	Kalkgräsmarker	-	SCI
Laus holmar SE0340021	Sten- och grusvallar Strandängar vid Östersjön Kalkgräsmarker Alvar Fuktängar	Kentsk tärna Mellanskarv Silvertärna Skräntärna Vitkindad gås	SPA/SCI
Lausvik SE0340167	Strandängar vid Östersjön Sandstränder vid Östersjön Mindre vattendrag Kalkgräsmarker Silikatgräsmarker Fuktängar Taiga Trädklädd betesmark	Silvertärna Skärfläcka Småtärna Vitkindad gås	SPA/SCI
Mullvalds strandskog SE0340133	Sandstränder vid Östersjön Vita dyner Grå dyner Trädklädda dyner Taiga	-	SCI
Danbo SE0340038	Sten- och grusvallar Fördyner Vita dyner Grå dyner Trädklädda dyner Kalkgräsmarker Alvar Taiga Trädklädd betesmark	-	SCI
Sandviken SE0340164	Sandbankar Fördyner Vita dyner Grå dyner Trädklädda dyner	-	SCI
Grogarnsberget SE0340152	Sten- och grusvallar Kalkgräsmarker Alvar Fuktängar Agkärr Rikkärr	Kalkkrassing	SCI

Natura 2000	Nature types	Species	SPA/SCI
	Kalkbranter Nordlig ädellövskog Trädklädd betesmark		
Liste-Hammars SE0340156	Sten- och grusvallar Strandängar vid Östersjön Vita dyner Kalkgräsmarker Silikatgräsmarker Fuktängar Trädklädd betesmark		SCI
Asunden SE0340154	Driftvallar Sten- och grusvallar Vegetationsklädda havsklippor Strandängar vid Östersjön Kalkgräsmarker Fuktängar Kalkbranter	Brushane Fisktärna Silvertärna Skärfläcka Småtärna Sydlig kärrsnäppa	SPA/SCI
Sajgs SE0340199	Sten- och grusvallar Basiska berghällar Alvar Agkärr Taiga	-	SCI
Furilden SE0340073	Sten- och grusvallar Strandängar vid Östersjön Fuktängar Trädklädd betesmark	-	SCI
Skenholmen SE0340127	Sten- och grusvallar Strandängar vid Östersjön Kalkgräsmarker Alvar Fuktängar	Brushane Fisktärna Ljungpipare Silvertärna Skräntärna Skärfläcka Småtärna Vitkindad gås	SPA/SCI
Bungenäs SE0340158	Sten- och grusvallar Kalkgräsmarker Alvar Fuktängar Agkärr Taiga Trädklädd betesmark	Gulyxne	SCI
Ryssnäs SE0340155	Sten- och grusvallar Kalkgräsmarker Alvar Fuktängar Agkärr Taiga Trädklädd betesmark	Fisktärna Silvertärna Småtärna Trädlärka	SPA/SCI
Skalahauar SE0340093	Vita dyner Trädklädda dyner	-	SCI

From: Beata Vilimaitė Šilobritienė <beata.vilimaite@am.lt>

Sent: Monday, May 19, 2025 14:10
To: Info <info@am.lt>
Cc: Vitalijus Auglys <vitalijus.auglys@am.lt>
Subject: Persiųsta: Invitation to consultation in accordance with Articles 4 and 5 of the Espoo Convention, geophysical surveys in the Baltic Sea

Laba diena,

Prašau registruoti ir nukreipti TPPG.

Ačiū,
Beata

Nuo: Richard.Kristoffersson@Naturvardsverket.se <Richard.Kristoffersson@Naturvardsverket.se>
Išsiųsta: 2025 m. gegužės 19 d., pirmadienis 14:07
Iki: Dorota.Szumanska@gdos.gov.pl <Dorota.Szumanska@gdos.gov.pl>; sekretariat.doos@gdos.gov.pl <sekretariat.doos@gdos.gov.pl>; Vitalijus Auglys <vitalijus.auglys@am.lt>; Beata Vilimaitė Šilobritienė <beata.vilimaite@am.lt>
Kopija: Nanna.Wikholm@naturvardsverket.se <Nanna.Wikholm@naturvardsverket.se>; sandra.jalalian@regeringskansliet.se <sandra.jalalian@regeringskansliet.se>; eleonora.ronstrom@regeringskansliet.se <eleonora.ronstrom@regeringskansliet.se>; Asa.Blomster@Naturvardsverket.se <Asa.Blomster@Naturvardsverket.se>
Tema: Invitation to consultation in accordance with Articles 4 and 5 of the Espoo Convention, geophysical surveys in the Baltic Sea

Case no: NV-05552-24

Invitation to consultation in accordance with Articles 4 and 5 of the Espoo Convention regarding marine seismic surveys and marine geological investigations throughout the Baltic Sea

In accordance with Articles 4 and 5 of the Espoo Convention, the SEPA hereby invites your states to submit comments on SGU:s permit application and environmental impact assessment (EIA) for the plans for geophysical surveys in the Baltic Sea.

Sweden kindly asks you to submit your comments no later than 30th of June 2025

Hälsningar, Richard

RICHARD KRISTOFFERSSON
Point of Contact, Esbokonventionen
NATURVÅRDSVERKET
Avdelningen för planering, prövning och tillsyn
Samhällsplaneringsenheten

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Läs om hur Naturvårdsverket behandlar
dina personuppgifter

DETALŪS METADUOMENYS	
Dokumento sudarytojas (-ai)	RICHARD KRISTOFFERSSON, Richard.Kristoffersson@Naturvardsverket.se
Dokumento pavadinimas (antraštė)	Invitation to consultation in accordance with Articles 4 and 5 of the Espoo Convention, geophysical surveys in the Baltic Sea
Dokumento registracijos data ir numeris	2025-05-19 Nr. b/n
Dokumento gavimo data ir dokumento gavimo registracijos numeris	2025-05-19 Nr. D13-343
Adresatas	Lietuvos Respublikos aplinkos ministerija, A. Jakšto g. 4, LT-01105 Vilnius
Registratorius	Vyriausiasis specialistas Renata Paukštienė
Veiksmo atlikimo data ir laikas	2025-05-19 14:56:20
Dokumento nuorašo atspausdinimo data ir jį atspausdinęs darbuotojas	2025-05-23 atspausdino Patarėjas Rasa Griškevičienė

Nuorašas tikras
Lietuvos Respublikos aplinkos ministerija
2025-05-23