Consultation document

SGU's marine seismic surveys and marine geological investigations in the Central, Southeastern and Southern Baltic Sea.

July 2024

SGU:s diarie-nr: 316-1614/2024

SGU Sveriges geologiska undersökning

Cover picture: SGU:s survey vessel Ocean Surveyor
in Skåne 2023.
Photo: Björn Bergman, SGU

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1 Introduction

The Geological Survey of Sweden (SGU) is seeking to apply for a permit in accordance with Chapter 7. Section 28 a and b §§ of the Environmental Code to carry out surveys of the seabed in the Central Baltic, the South-Eastern Baltic and the Southern Baltic Sea and within the Natura 2000 area SE0330308 Hoburgs Bank and the Midsjö Banks using various marine survey methods including multibeam echo sounder, sub-bottom profiler and seismic surveys. The investigations are part of a government assignment that SGU shall assess the possibilities for Sweden to store carbon dioxide under the sea floor.

This document forms the basis for a consultation under the Environmental Code. The purpose of the consultation is to ensure that the environmental impact assessment that SGU is to produce will have an appropriate scope and level of detail. The environmental impact assessment will only be prepared for an assessment in accordance with Chapter 7. 28 b § of the Environmental Code and the content can therefore be limited to the information needed for that assessment.

In conclusion, SGU judges that the investigations will not produce any permanent environmental effects, but that there will only be shorter-term and transitory environmental effects.

The consultation period runs between July 5 and August 9, 2025, and measurements are planned for autumn 2025.

1.1 The consultation process

For the examination of permits referred to in Chapter 7. Section 28 a of the Environmental Code, a specific environmental assessment must always be made. This means that the person who intends to conduct the activity must carry out a delimitation consultation, produce an environmental impact assessment and submit this to the person who examines the permit issue. According to chapter 6 § 30 of the Environmental Code, scope of works consultations must take place with the county administrative board, the supervisory authority and the individuals who can be assumed to be particularly affected by the investigations, as well as the other government authorities, the municipalities and the public who can be assumed to be affected by the investigations.

Regarding activities in Sweden's exclusive economic zone, what is said about the County Administrative Board in Chapter 6. The Environmental Code means the County Administrative Board of the county where Sweden's territorial waters are closest to the area in which the activity is intended to be conducted. SGU assesses that the territorial sea belonging to Gotland County is closest to the area where the activities are to be conducted.

A step before the consultation process is that a consultation document is drawn up as a framework. According to Section 8 of the Environmental Assessment Ordinance (2017:966), this consultation document must contain information on:

- The design and scope of the work
- The location of the work
- The sensitivity of the environment in the areas that can be assumed to be affected
- What in the environment can be assumed to be significantly affected
- The environmental effects that the activity can be assumed to entail or as a result of external events, to the extent that such information is available

• Actions planned to prevent, counteract or remedy negative environmental effects, to the extent that such information is available

• The assessment that the person who intends to conduct an activity makes regarding the question of whether a significant environmental impact can be assumed.

This consultation has not been preceded by any exploratory consultation.

According to chapter 6 § 32, the county administrative board must work during the consultation process to ensure that the content of the EIA has the scope and level of detail needed for the Natura 2000 permit review. During the consultation process, there is an opportunity to submit views to SGU. SGU proposes that the consultation group consists of the following parties:

Government agencies

• The Housing Authority

• The Swedish Environmental Protection Agency

• The Armed Forces

• The National Antiquities Office

• Gotland County Administrative Board

• Blekinge County Administrative Board

• Kalmar County Administrative Board

• Chamber college

• The Coast Guard

• Maritime Administration

• The Swedish Transport Administration

• The Swedish Energy Agency

• The Energy Market Inspectorate

• The Swedish Civil Contingencies Agency (MSB)

• The Norwegian Sea and Water Authority

• National Museum of Natural History

• SLU Species databank

• The Swedish Board of Agriculture

• Post and Telecom Agency (PTS)

Municipalities and regions

• Ronneby municipality

• Karlskrona municipality

• Torsås municipality

• Borgholm municipality

• Mörbylånga municipality

• Region Gotland

Organisations

• The Nature Conservation Society

• World Wildlife Fund (WWF)

• Sweden's ports

• The Swedish Boating Union

• The Swedish Cruise Club

• The Swedish Shipping Association

• Producer organisation of marine and coastal fishermen

• Swedish Pelagic Federation producentorganisation (SPFPO)

• The Swedish Fishermen's Producer Organisation (SPFO)

Others

• Baltic Sea Centre

• Maritime school

• The Marine Environment Institute

• World Maritime University

• Lund University

• Ørsted AB

• Landinfra Energy

• OX2

• RWE

• Eolus/SimplyBlue

1. 2 Scope

This consultation concerns the application for a permit to carry out surveys within the Central, Southeastern and Southern Baltic Sea including the Natura 2000 area SE0330308 Hoburgs Bank and Midsjö Banks. SGU holds a sea survey permit and since the surveys are carried out by SGU, no further permit is required according to the Continental Shelf Act.

1.3 Administrative information

Applicant: Geological Survey of Sweden

Geological Survey of Sweden

Box 670

Villavägen 18, 751 28 Uppsala

Permit authority: County Administrative Board of Gotland (see Chapter 7, Section 32 of the Environmental Code)

2 Background and aim

In 2023, the European Commission presented a proposal for a regulation on net-zero industry (Net-Zero Industry Act, NZIA), which, together with the proposal for a regulation on critical raw materials, constitute the first parts of the Industrial Plan for the Green Deal (Green Deal Industrial Plan). According to the European Commission, the proposal should contribute to creating favourable conditions for scaling up the production of green technologies within the EU. The proposal will further strengthen the EU's competitiveness and contribute to reaching the EU's climate and energy goals by 2030 and create greater energy independence within the EU. The regulation includes several measures to stimulate investments in technology with net zero emissions. A specific measure mentioned is the capacity to store carbon dioxide, where the EU will support projects for the capture and storage of carbon dioxide, including by improving access to storage sites for carbon dioxide.

With several targeted measures, the European Commission wants to simplify the regulatory framework for the manufacture of net-zero technology 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 of "Carbon Capture and Storage" and stands for separation and storage of carbon dioxide. The method is promoted - both nationally and internationally - as an important tool to reduce the large-scale emissions of carbon dioxide into the atmosphere and reach climate goals. Initial assessments show that in Sweden there are mainly two sea areas, in the southeastern Baltic Sea and next to south-west Skåne, which may be suitable for geological storage of carbon dioxide.

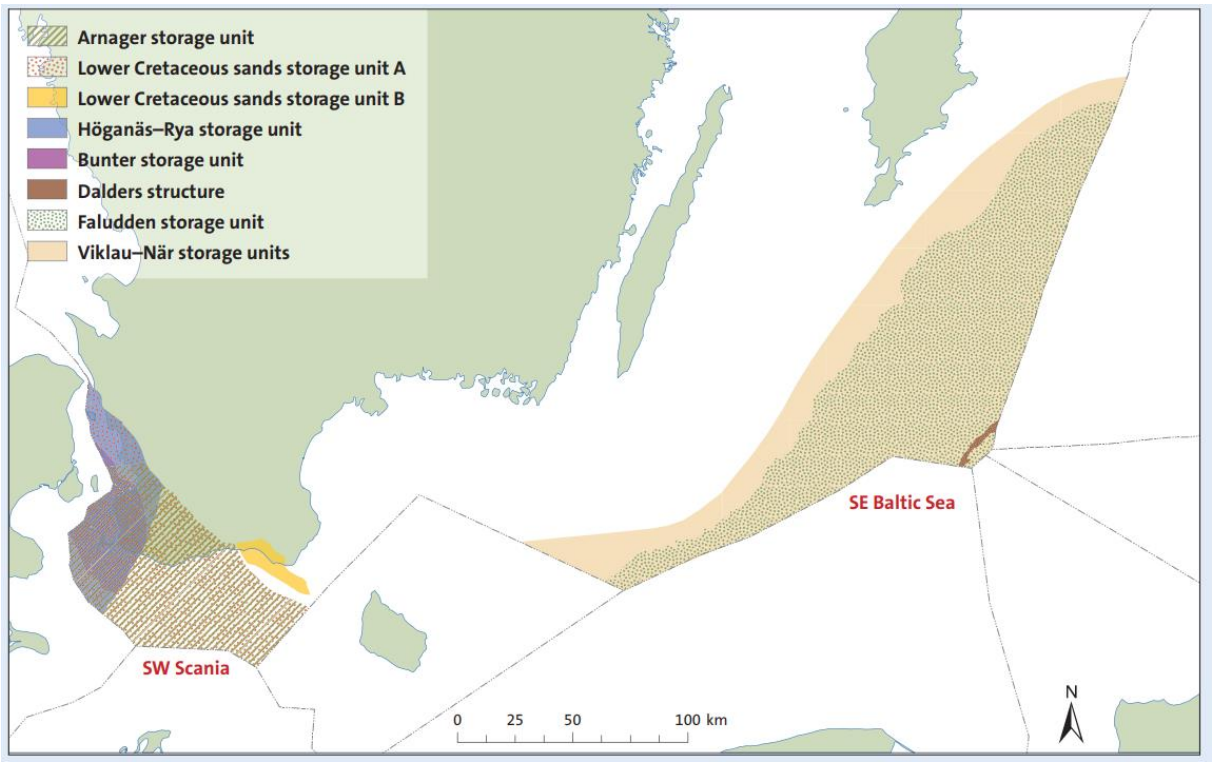


Figure 2. Potentially suitable locations for the storage of carbon dioxide in Sweden.

In 2022, SGU received an assignment (prop. 2022/23:1 expenditure area 24, bet. 2022/23:NU1, rskr. 2022/23:99) from the government with the following task:

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

SGU must actively participate in national and international cooperation, and in particular monitor CCS activities in order to maintain and develop Swedish capability regarding geological storage of carbon dioxide. When carrying out the assignment, SGU must conduct a dialogue with the Norwegian Energy Authority. SGU must submit an interim report on the implementation and progress of the assignment to the Government Office (future Ministry of Climate and Business) no later than 15 December 2023 and 15 September 2024. SGU must submit a final report on the results of the assignment no later than 15 March 2026."

In agreement with the government, SGU must make a statement as to whether the areas under investigation are suitable for geological storage of carbon dioxide, including geographical location of potential geological layers for storage, potential storage capacity, risk assessment and implications for national ocean planning. n order to be able to issue a statement regarding the area under the seabed in the south-eastern Baltic Sea, SGU needs to carry out marine-geological and marine-geophysical investigations in the area.

3 Planned survey area

The survey area extends from the northern tip of Gotland down to the coast of Blekinge, within Sweden's territorial sea and economic zone. In the Southeastern Baltic Sea lies the Natura 2000 area: SE0330308 Hoburgs Bank and Midsjö Banks, which is located centrally in the main part of the Baltic Sea, mostly within Sweden's economic zone. It is approximately 8 km south of Gotland and 20 km east of Öland and extends about 90 km south of Öland, where it borders the Polish economic zone in the southern part.

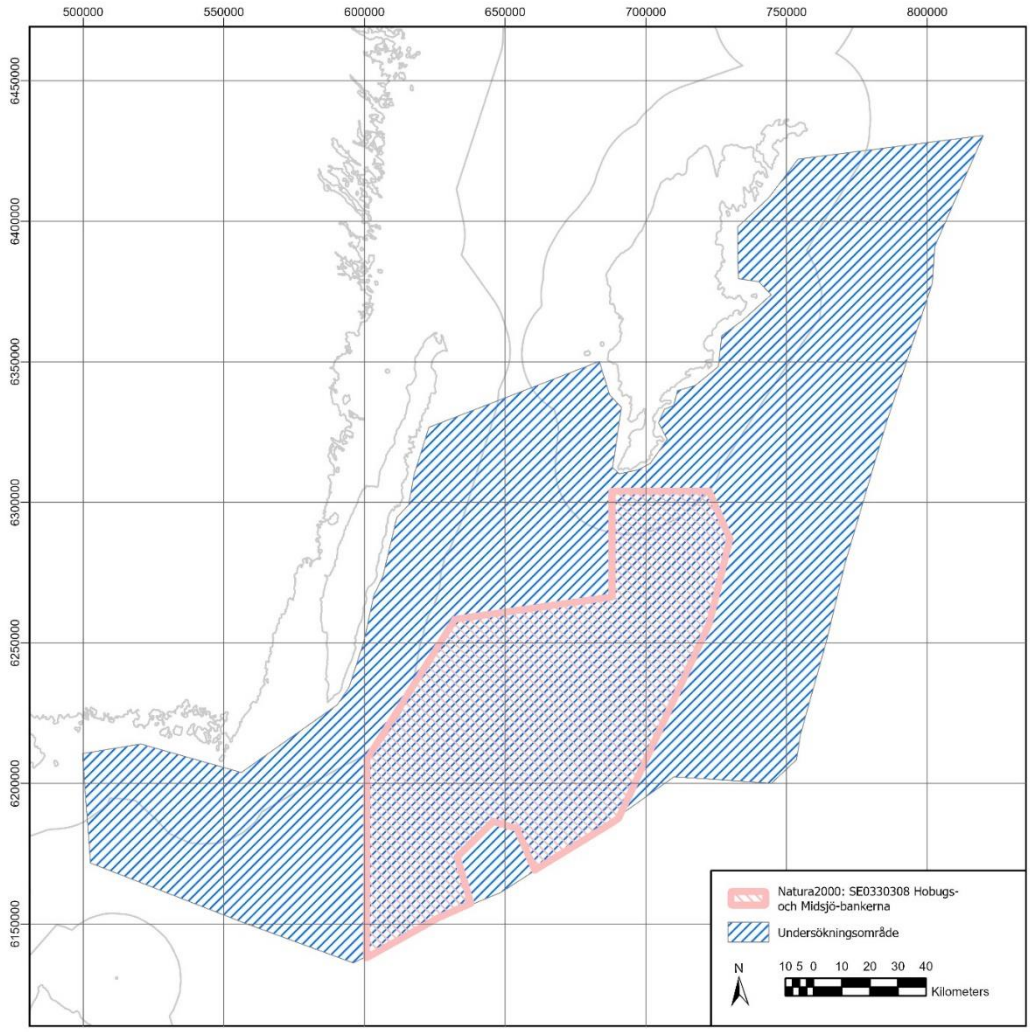


Figure 3. The pink polygon shows the Natura 2000 area in the Southern Baltic Sea and the large blue polygon shows the entire survey area.

SGU has mapped Hoburg Bank and Northern Midsjö Bank south of Gotland, providing open geographical information on geology, depth conditions, and marine life on the seabed over an area of approximately 2,350 square kilometres. The mapping is uniquely high-resolution, capturing new details compared to older maps of the area. SGU has measured sediment profiles and conducted comprehensive depth and seabed reflection surveys with a resolution of 50 cm, and modeled sand thickness, substrate, and species occurrences with a resolution of 5 m. The surveys reveal that the area's varied geology and wave energy have created complex and species-rich seabed environments. These environments are species-rich both in the shallower parts of the banks (10–30 m) and deeper down (30–65 m). A notable discovery is that small reef

environments (ranging from 25 to 1,000 square metres) consisting of gravel and stones on hard clay are significant for marine life. These environments serve as spawning grounds for herring and hiding places for cod and other bottom-dwelling fish.

From Gotland, an area with shallow seabed extends southward to the central and southwestern parts of the Baltic proper. In the case of the Baltic Sea, shallow seabed is defined as shallower than the average depth of the Baltic Sea, which is approximately 55 metres. On Northern Midsjö Bank and Hoburg Bank, depths vary from about 9 metres down to 36 metres. Between Northern and Southern Midsjö Banks, the average depth is less than 40 metres. Northern Midsjö Bank's elevation stretches eastward to Hoburg Bank, westward to the southern shallows of Öland, and finally southward to Southern Midsjö Bank. East of Hoburg Bank, the seabed slopes steeply down to a depth of 150 metres. The shallower parts of the offshore banks consist of sand, gravel, stones, and larger boulders. In some places, bedrock is exposed, and on deeper slopes, very hard-packed glacial clay forms reef structures. Hard bottom substrates are a rare type in the Baltic Sea. Strong currents and wave movements cause the bottom substrate to be unstable and mobile on the banks. Wave marks on sandy surfaces, for example, can be found down to a depth of 25 metres. In deeper areas outside the banks, soft bottoms of sand and loose sediment dominate.

From a conservation perspective, offshore areas often serve as refuges for organisms that were once common in shallower, more coastal areas but have disappeared or diminished there due to increased disturbances and pollution. They typically harbour species and habitats characteristic of less impacted aquatic environments (Hammar & Mattsson 2017). Hoburg Bank and Northern Midsjö Bank are offshore banks that provide very favourable conditions for many animal and plant species.

The water exchange is significant, and pollutants, eutrophication, and human impacts that have affected much of the Baltic Sea's coasts have less effect far from land. Offshore banks can be described as a "source" for life in the Baltic Sea, contributing to the preservation and improvement of plant and animal life and the environment throughout the region. The central location of the Natura 2000 area in the Baltic Sea means that almost all maritime traffic to Finland, Russia, the Baltic States, and northern Sweden passes through the area. Up to 35,000 ship passages occur annually through the area. The intense shipping traffic is expected to increase with the growing need for sea transport as a result of, for example, climate change. Discharges into the sea from ships in the Baltic Sea have had a very negative impact on species and habitats in the area. (Conservation Plan for the Natura 2000 area SE0330308 Hoburgs Bank and Midsjö Banks)

4 Area conditions

The Marine Plans guide national authorities, municipalities, and courts in future decisions, planning, and permit evaluations. Businesses also receive guidance from the plan. The Marine Plans aim to contribute to sustainable development in the long term. They are designed to reconcile economic, social, and environmental goals. The plans specify uses of the sea for different geographical areas. These specified uses are considered the most appropriate based on the areas' characteristics, location, and needs, aligned with the plans' overarching purpose. The geographical delineations of uses in the Marine Plans are based on one of the following types of public interests:

• National interests according to Chapter 4 Section 8 of the Environmental Code, i.e. Natura 2000 areas

• National interest claims according to Chapter 3 of the Environmental Code

The Marine Plans look ahead to 2050 and are based on a vision of how the ocean is used, provided that the planning goals are met. The vision represents the state that marine planning aims to help achieve. During the marine planning process, ten planning objectives have been formulated based on societal goals, existing legislation, and national strategies.

The planning objectives consist of an overarching goal supported by nine other goals. These nine are divided into two groups under the headings "create conditions for" and "create readiness for." Claims that are clear and extensive in the near term are grouped under conditions, while issues that are expected to have extensive claims on the sea mainly in a longer-term perspective are grouped under readiness. The objectives related to readiness signal that marine planning should account for future needs and activities. The overarching goal is to contribute to a good marine environment and sustainable growth. Additionally, conditions and readiness should be created for:

• Regional development, recreation and preservation of cultural values

• Marine green infrastructure and promotion of ecosystem services

• Sustainable shipping

• Good accessibility

• Developed energy transmission and renewable electricity production at sea

• Sustainable commercial fishing

• Defence and security

• Future extraction of minerals and carbon dioxide storage

• Future establishment of sustainable aquaculture.

The area affected by SGU's investigations for carbon dioxide storage is located in the Central, Southeastern, and Southern Baltic Sea and includes the Natura 2000 site SE0330308 Hoburgs Bank and the Midsjö Banks. The following section is text directly taken from the Marine Plans in parts 4 and 7. A chapter from the Conservation Plan concerning the Natura 2000, Hoburgs Bank, and Midsjö Banks areas is incorporated in the section that deals with the marine plans for the Southeastern Baltic Sea.

4.1 Marine Plan Central Baltic Sea

In part 4 of the Marine Plan that describes the Middle Baltic Sea, the following parts are discussed and analyzed (text taken directly from the Marine Plan):

4.1.1 Energy recovery

In the Central Baltic Sea, there are favourable conditions for energy extraction. However, the Marine Plan does not designate any areas for energy extraction. In the archipelago of Östergötland, there is a part of national interest claims for wind power (Ö220), which is not considered compatible with the interests of national defence. National interest claims for national defence take precedence over national interest claims for wind power.

4.1.2 Defence

There are several areas in the Central Baltic Sea designated for defence use in the plan. Along the mainland coast, there are the maritime training areas of Sandsänkan (Ö221) and Urban, extending through the territorial waters into the Swedish economic zone off the municipalities of Valdemarsvik, Västervik, and Oskarshamn (Ö222–Ö224). South of Visby, extending into the territorial waters, defence use is indicated because the area is an influence area for the Tofta firing range (Ö228). Further north lies the maritime training area of Fårö (Ö230). Maritime training area Martin is primarily located in the Southeastern Baltic Sea, but a small part is included in the Central Baltic Sea and designated for defence use (Ö234, Ö241). Maritime training area Sankt Olof (Ö239) is located east of Gotland and Fårö. The specifically considers the interests of national defence for parts of the western coast of Gotland due to airspace closure areas for high objects around Visby Airport (Ö227, Ö229).

4.1.3 Culture

Areas with national interest claims for cultural heritage preservation are located along the coasts outside the marine planning area and on Gotska Sandön. Cultural-historical core values identified by the National Heritage Board are mainly situated outside the marine planning area. However, smaller areas extend into the planning area at Stora Karlsö (Ö238) and outside the northern tip of Öland (Ö225) and are covered in the Marine Plan with special consideration for high cultural heritage values. Buffer distances to these core values need to be assessed from a local perspective. Outside the marine planning area, there is national interest in the uninterrupted coast covering both sides of Öland and running along the coast from Västervik to Arkösund in the north. The coasts around Gotland, outside the marine planning area, are subject to national interest for highly exploited coast.

4.1.4 Nature

The Marine Plan specifies nature use for several areas, particularly along the mainland coast and north of Gotland. Areas along the coasts of Östergötland and Kalmar counties are covered by national interest claims for nature conservation (Ö220, Ö222, Ö224–Ö225, Ö234). The area at Gotska Sandön and Salvorev is covered by Natura 2000 and several other nature reserves and reserves and Helcom MPA (Marine Protected Area) (Ö231). There are national interest claims for nature conservation mainly located in the adjacent coastal zone but extending just into the marine planning area, including in Västervik municipality (Ö223). The national interest claims are met, but depending on the overall scale of the Marine Plan, they are not marked as nature use in the Marine Plan. At the naval exercise area Sandsänkan in the Östergötland archipelago (Ö221), there are national interest claims for defence, and in the western part of the area, there is a small part of national interest claims for nature conservation. The area where the national interest claims overlap is small in scale relative to the geographical scale of the plan map and is therefore not marked in the plan map with use FN. Defence operations should be conducted so that

negative impact is avoided on the nature values that underlie national interest claims for nature conservation. East of Gotland, the Marine Plan specifies special consideration for high nature values for three areas. The areas north and south of Slite (Ö236–Ö237) are characterized by reef environments and spawning areas for fish with low environmental impact. Klint's Bank (Ö233) constitutes a potential climate refuge for blue mussels. Also, west of Gotland, around Stora Karlsö (Ö238), the Marine Plan specifies special consideration for high nature values as the area is important for bird species such as guillemots and razorbills.

4.1.5 Recreation

The Marine Plan specifies recreational use outside parts of the Östergötland archipelago (Ö220–Ö222). The guidance on recreational use is based on national interest claims for outdoor life. Outdoor life and recreational boating are extensive, and valuable areas can be found along the entire coast from Gryt and Sankt Anna archipelagos to Northern Öland and around Gotland. The coast from the municipality of Västervik and southward, as well as the coast around Gotland outside the marine planning area, is covered by national interest outdoor life. The possibility of coexistence with other uses and buffer distances needs to be assessed from a local perspective.

4.1.6 Shipping

The Marine Plan specifies maritime use in several shipping lanes within the Central Baltic Sea (Ö220–Ö230, Ö232–Ö235, Ö238–Ö239). Several important ports are located along the coast. Maritime traffic is significant with traffic to both the mainland coast, to Gotland and further north or south, as well as to Swedish and foreign ports around the Baltic Sea. A shipping lane extending from the Gulf of Riga and connecting to the fairway east of Gotland in the Swedish economic zone is of significant national interest. The stretch is marked as maritime use (Ö232). The map shows the main shipping lanes, not the total needs of maritime traffic.

In the shipping investigation area Over Salvorev, between Fårö and Gotska Sandön, there are currently two passages for maritime traffic through an area with very high nature values: including the red-listed species Long-tailed duck. A study by the Swedish Maritime and Water Authority (2017f) shows that Long-tailed ducks are negatively affected by operational oil spills from ships. The need to investigate the impact of maritime traffic in the Salvorev area and what measures may be appropriate to reduce the negative impact of maritime traffic is closely linked to the need for investigation in the more heavily trafficked area around Hoburgs Bank south of Gotland.

In addition to the Long-tailed duck, the impact of maritime traffic on porpoises should also be investigated there. The porpoise is a red-listed species that is negatively affected by noise from maritime traffic. The overall effect of this needs further investigation, and for the shipping lanes over Salvorev, the plan therefore specifies a maritime investigation area. Also, a shipping lane east of Gotland and the fairway into Slite, as well as two lanes from Nynäshamn to the Gulf of Riga and Poland, are part of the maritime investigation area that may affect maritime traffic in the Central Baltic Sea. Read more about this in the section on the direction of use in the Southeastern Baltic Sea

4.1.7 Commercial fishing

The plan specifies commercial fishing use up to the inner marine planning boundary (Ö221, Ö223, Ö226) and east of Gotland (Ö231–Ö233, Ö235–Ö237, Ö239). The use corresponds to national interest claims for commercial fishing. Commercial fishing is widespread in the Central Baltic Sea. Most fishing in the Central Baltic Sea is pelagic fishing targeting herring and sprat, and is conducted throughout the open sea. Some fishing with passive gear occurs closer to the coast.

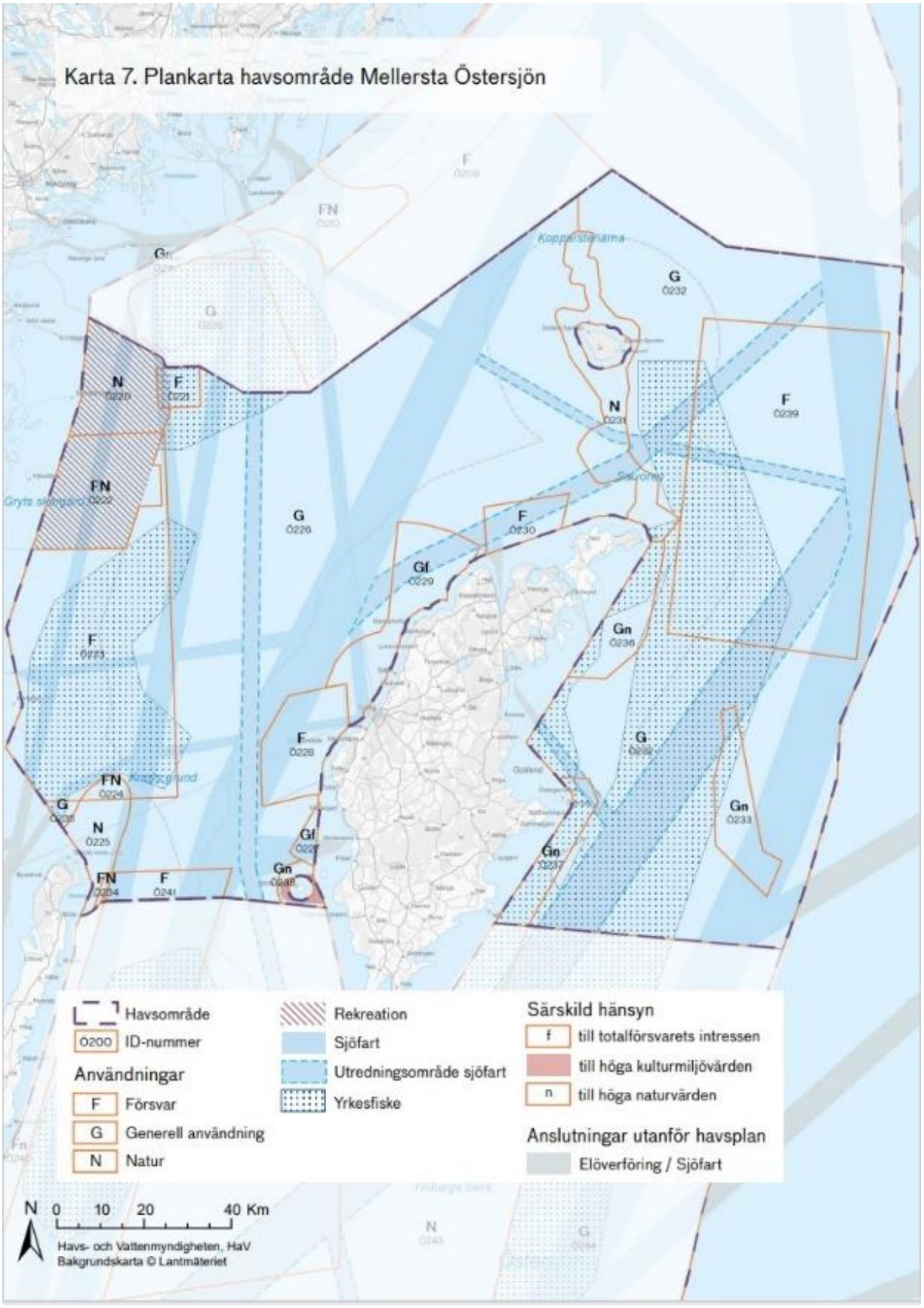


Figure 4. Map of the marine area Central Baltic Sea, Marine Plans part 4 page 97.

4.2 Marine plan Southeastern Baltic Sea

In part 4 of the Marine Plan that describes the Southeastern Baltic Sea, the following aspects are discussed and analyzed (text taken directly from the Marine Plan):

4.2.1 Energy extraction

In the Southeastern Baltic Sea, there are favourable conditions for energy extraction, and the demand for electricity is high due to the high consumption in southern Sweden. The many offshore banks have both favourable wind conditions and suitable depths for offshore wind turbines. At the same time, there are very high natural values. The extreme eastern and western parts of the Norra Midsjöbanken and part of the Södra Midsjöbanken are covered by national interest claims for wind farms. Both banks, except for part of the Södra Midsjöbanken, are covered by Natura 2000. The marine plan does not specify energy extraction for the North Midsjöbanken (Ö245). It is covered by Natura 2000 and area protection according to Helcom (MPA). The total impact on the natural values in the area is considered to be too high if wind power is installed on or adjacent to the Södra Midsjöbanken. At Kårehamn (Ö240–Ö241) there are national interest claims for both wind farms and total defence. In part of the area there is an existing wind power plant. The plant is limited in extent and due to the overall scale of the marine plan, energy extraction is not indicated on the plan map, but the interest is satisfied. Future expansion of the area is judged in the marine plan not to be compatible with the interests of total defence, and therefore the marine plan does not satisfy the national interest claim that lies outside the already existing facility.

4.2.2 Nature

The marine plan specifies natural use in a large area that stretches from Gotland's southern tip at Hoburgen via Hoburg's bank to Norra Midsjöbanken and Södra Midsjöbanken (Ö245) and in a smaller adjacent area (Ö250). They are covered by Natura 2000 and have valuable nature. In large parts, the environmental impact is low and the marine environment can be considered relatively pristine (Havs- och vattenmyndigheten 2018h). The natural values consist of valuable bottom habitats, reproduction area for the endangered Baltic porpoise and the most important wintering areas for the alfalfa. Both species are red-listed according to the Species Data Bank's assessment. There are also foraging areas for alfalfa and other birds, as well as spawning areas for fish in the area. The banks of the sea area are indicated as potential climate refuges for several species, which indicates that the ecological importance of the area may be very high in the future (Havs- och vattenmyndigheten 2017c). A conservation plan with conservation goals for the Natura 2000 area is being drawn up (Ö245). (SGU's comment; Conservation plan for the area has been established but the Marine Plan has not been updated based on this information.)

The marine plan indicates the use of nature at the southern tip of Öland (Ö252–Ö253) where there is a planned marine nature reserve. The marine plan gives special consideration to high natural values in several areas along the coasts and in connection with areas with nature protection where there are also important natural values (Ö240, Ö243, Ö248, Ö251).

4.2.3 Shipping

Maritime use is indicated for several shipping routes within the sea area (Ö240–Ö242, Ö244–Ö247, Ö250, Ö253). Sea traffic is important in the Southeast Baltic Sea, with extensive traffic to both foreign and Swedish ports. To the west of Gotland there is mainly traffic with Swedish destinations, while international traffic to and from the Gulf of Finland and the Baltics dominates to the south and east of Gotland (Havs- och vattenmyndigheten 2017d). Three shipping lanes, which extend from ports in the Baltics (Ventspils, Liepaja and Klaipeda respectively) and connect to the deep seaway southeast of Gotland in the Swedish economic zone, constitute public interests of significant importance. The routes are listed as shipping use (Ö244–Ö245).

4.2.4 Commercial fishing

The use of commercial fishing is indicated in several larger areas (Ö241–Ö246, Ö251). Commercial fishing is widespread in the South-Eastern Baltic Sea, but is rarely carried out on the offshore banks. Fishing for cod is mostly carried out in the south-western parts of the sea area with trawl fishing in the open sea and passive fishing closer to the coast. Pelagic fishing, which refers to fishing for herring/flounder and sprat, is conducted in large parts of the lake but not on the banks. Certain fishing with passive gear takes place off the coast of Öland.

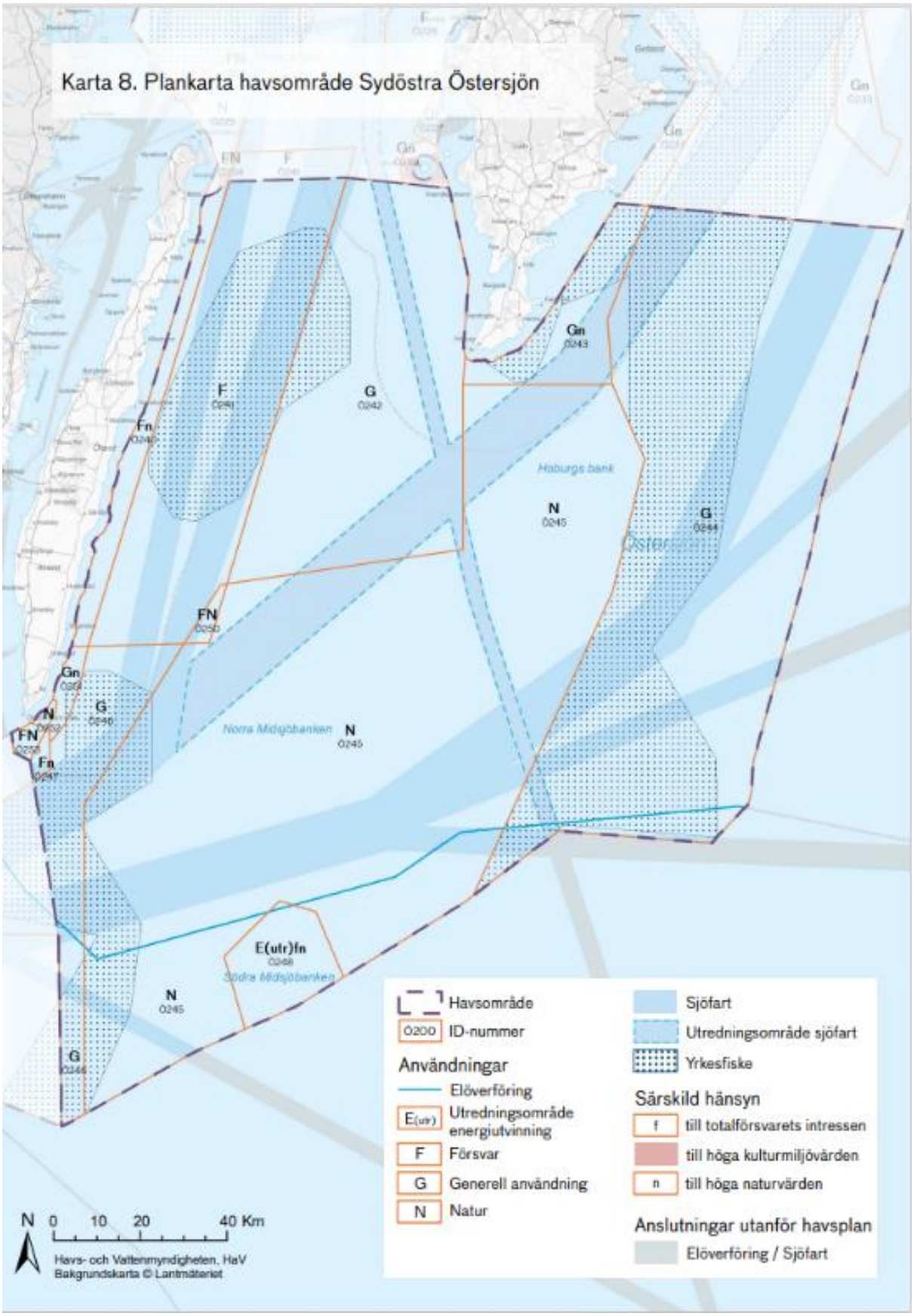
4.2.5 Investigation area energy extraction

The sea plan indicates the use of the investigation area energy extraction on the Södra Midsjöbanken (Ö248). Within the area there are some national interest claims for wind farms. The plan gives special consideration to high natural values in the area because it is very important for porpoises and as a wintering area for seabirds. The area connects to the Natura 2000 area Hoburgs bank and Midsjöbankarna (Ö245), which includes the same species.

The assessment is that this means that there is a requirement for a special permit review according to Chapter 4 Section 8 of the Environmental Code, a so-called Natura 2000 review. For this reason, the area is designated as an investigation area. By adapting, for example, the time period for construction work, noise levels during wind power construction and the closer location, wind power is deemed to be able to coexist with natural values. However, the coexistence must be tested in a so-called Natura 2000 trial. The marine plan's environmental impact description (Havs- och vattenmyndigheten 2019c) indicates that there may be places outside area Ö248 where the risk of environmental impact is less than in area Ö248. Adaptation of location to reduce negative environmental impact may therefore mean location outside area Ö248. Poland is also planning for wind power in the Polish economic zone on the Southern Mediterranean Bank, which may lead to the need for coordination to prevent extensive environmental impact. Good coordination can also promote efficient use of infrastructure. During expansion, special consideration must be given to the interests of the total defence.

4.2.6 Defense

Defense use is indicated for naval training areas Hanö and Martin which are outside Öland (Ö240–Ö241, Ö250, Ö253). Maritime training area Martin stretches from the coast through the territorial sea out into the Swedish economic zone outside Borgholm and Mörbylånga municipalities. The northernmost part of the naval exercise area Hanö lies within the territorial sea south of Öland. The sea plan indicates special consideration for the interests of the total defense for the Södra Midsjöbanken (Ö248).



Figur 5. Map of the marine area of the Southeastern Baltic sea , page 104 Marine Plans.

4.3 Marine plan Southern Baltic Sea

In part 4 of the marine plan that describes the Southern Baltic Sea, the following parts are discussed and analyzed (text taken directly from the marine plan):

4.3.1 Electricity transmission

Use electricity transmission corresponds to two transmission cables that connect Sweden with the rest of the world. The NordBalt cable runs between Sweden and Lithuania. It connects to Nybro in Sweden and to Klaipeda in Lithuania. SwePolLink is the second transmission cable in the sea area and it connects Karlshamn with Slupsk in Poland.

4.3.2 Energy extraction

In the southern Baltic Sea there are good conditions for energy extraction and the need is great due to the high electricity consumption in southern Sweden. Offshore banks and coasts have both good wind conditions and suitable depths for offshore wind turbines. There is a national interest claim for wind farms near the coast in the municipalities of Kristianstad and Sölvesborg. In the area (Ö262, Ö264) there is a permit to build a wind farm, but the development of the project has been interrupted. The permit to build a wind farm expires in 2021. The area also has national interest claims for total defence. The maritime plan gives priority to the defense interest. In the northern part of the sea area, there is part of another national interest claim for wind farms. Within the area there are also national interest claims for total defence. The government has rejected an application for wind power in the area, citing that national interest claims for total defense take precedence over national interest claims for wind farms. The sea plan gives priority to the defense interest (Ö262).

4.3.3 Defense

Defense is indicated as use in large parts of the sea area (Ö247, Ö260, Ö262, Ö264–Ö265). Karlskrona Naval Harbor is one of Sweden's largest and most important naval bases. The Ravlunda and Rinkaby ranges have areas of influence in the sea outside the municipalities of Simrishamn, Kristianstad and Sölvesborg. Naval training area Hanö is located in the territorial sea and Swedish economic zone in the Gulf of Hanö and south of Öland. At Utklippan (Ö260), coexistence between defence, nature, recreation, shipping and commercial fishing is indicated. In the northern part of the area there are national interest claims for total defence. Within the area there are also national interest claims for nature conservation and a marine nature reserve. Defense operations should be conducted in such a way that negative impact is avoided on the natural values that form the basis of the marine nature reserve.

4.3.4 Culture

The entire stretch of coast is covered by highly exploited coastline of national interest. Areas with national interest claims for cultural environment protection are found along the coast outside the sea plan area. Cultural-historical value cores identified by the National Antiquities Authority are mainly located outside the havsplane area. However, smaller parts extend into the planning area at Hanö Bay (Ö262, 4 Havsplaner | Part 4 – Baltic Sea 108 Ö264) and are there covered by special consideration for high cultural environmental values. Consideration distance to the core values needs to be assessed in a local perspective. In the planning area in Hanö Bay and at additional locations off the coast in Skåne and Blekinge, there are preserved Stone Age landscapes on the seabed. Outside the mouth of the Verkeån in Haväng, marine archaeologists

have in recent years documented and sampled an area with Stone Age remains. In the continued marine planning process, additional data may form the basis for future guidance on cultural use in the area.

4.3.5 Nature

The marine plan indicates the use of nature in several places in the Southern Baltic Sea. The outcrop (Ö260) is covered by a marine nature reserve, national interest claims for nature conservation and an existing Helcom MPA area. The Kiviksbredan outside Kristianstad (Ö265) has been proposed by the County Administrative Board in Skåne County via the Swedish Environmental Protection Agency as an area to be included in the marine Baltic region in the Natura 2000 network. The area is proposed with regard to the species of porpoise, gray seal and harbor seal as well as the habitat types sandbanks and reefs. The case is currently being prepared in the Government Office. South of Simrishamn municipality (Ö268) runs a coastal stretch of high natural values that is covered by national interest claims for nature conservation. There are relatively small areas of protected nature in the Southern Baltic Sea. In order to promote and ensure ecosystem services, special consideration is therefore given to high natural values for several areas. Outside Karlskrona (Ö247), special consideration must be given to reef environments and mammal areas, and further out into the lake to fish spawning and mammal areas with a particularly high environmental impact (Ö249). In the Bay of Hanö, there are among other things red-listed porpoises of the highly threatened Baltic Sea population, also in the Swedish Armed Forces' sea training area (Ö262). In the same area, the plan specifies special consideration for high natural values for the reef environment, play area, mammals and birds, as well as climate refuge for the three species of blue mussel, bluefish and herring. In the north-western corner of Hanö Bay (Ö265) there are additional areas that can constitute climate refuges for these three species (Havs- och vattenmyndigheten 2017c).

4.3.6 Recreation

Recreational use is indicated outside Karlskrona (Ö260) where there are national interest claims for outdoor life. Outdoor life, which also includes recreational boating, is important in the Southern Baltic Sea. Along the coast, outside the sea plan area, there are several areas that are covered by national interest claims for outdoor life. The coast in the western parts of the Bay of Hanö is covered by mobile outdoor life of national interest. Along the coast outside Simrishamn there is a national interest for mobile outdoor life that borders the plan area. Possibility of coexistence with other uses and consideration distance need to be assessed in a local perspective. Sand extraction The sea plan indicates the use of sand extraction outside Utklippan (Ö262). The area is located in a regional environment with expansive residential development and municipal interests in beach nourishment as a climate adaptation measure. 4 Sea Plans | Part 4 – The Baltic Sea 109 There are also high natural values that must be taken into account, which places high demands on coexistence. The area is an important habitat for cod, and future extraction must, among other things, take into account the cod's spawning periods in order not to risk a negative impact.

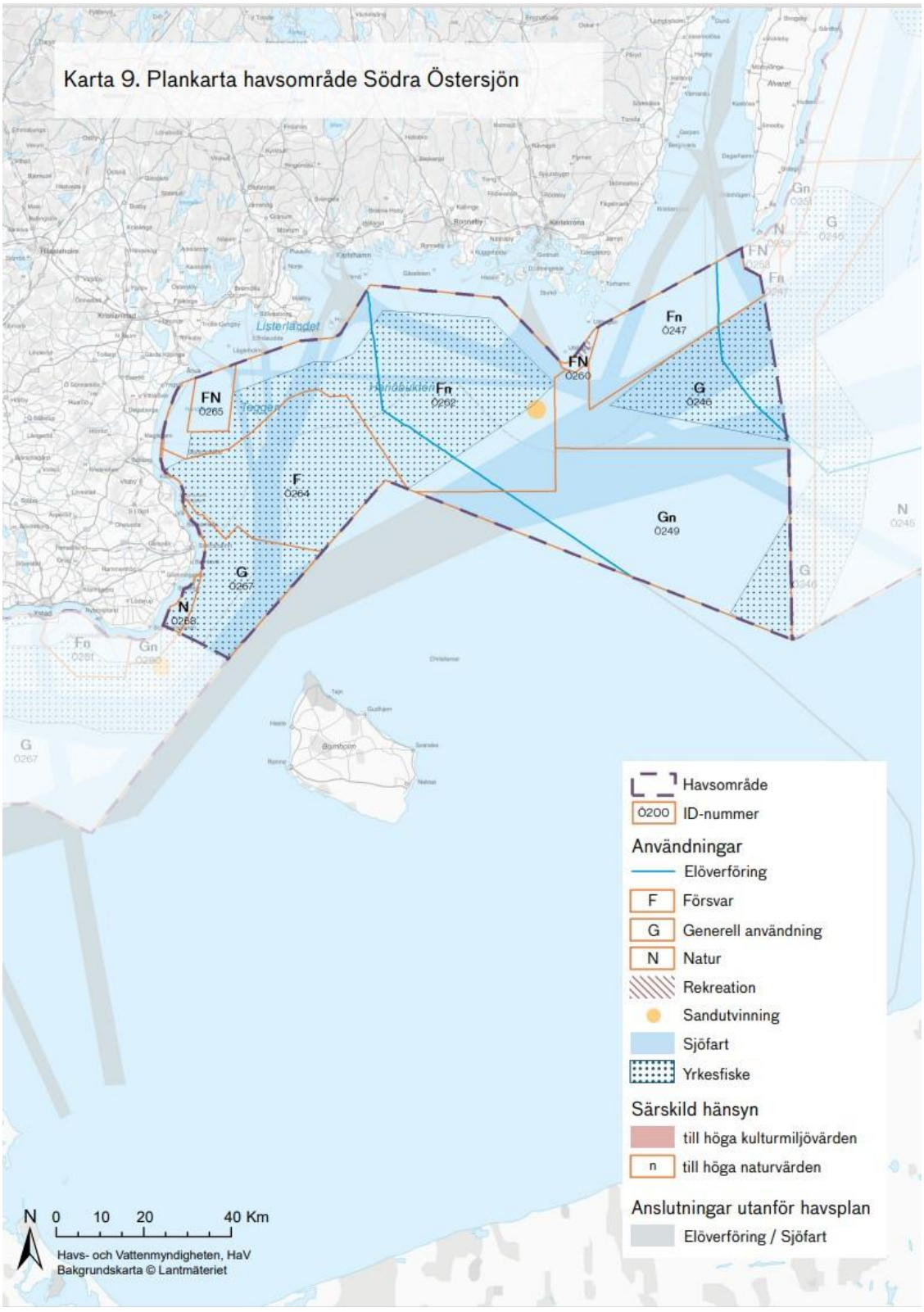
4.3.7 Shipping

Shipping use is indicated in ship lanes through the area (Ö246-Ö247, Ö249, Ö260, Ö262, Ö264, Ö265, Ö267). The busiest shipping route in the Baltic Sea runs through the Southern Baltic Sea in a system of traffic separations along the southern coast of Sweden from Öresund or from Gedser between Denmark and Germany, via the Bornholmsgattet towards southern Öland. Here also begins a depth passage for some ships when passing east through the Baltic Sea. Sea traffic

goes partly to the coast, but mainly further towards both Swedish and foreign ports. The plan map shows the most important shipping lanes, not shipping's total need for space.

4.3.8 Commercial fishing

Use commercial fishing is indicated in most areas because commercial fishing is widespread in the Southern Baltic Sea (Ö246, Ö249, Ö262, Ö264, Ö267-Ö268). The use corresponds to national interest claims for commercial fishing. Commercial fishing for cod is mostly carried out with trawl fishing in the open sea, but also with passive gear closer to the coast. Commercial pelagic fishing for herring and sprat is carried out in the lake. Other fishing with passive gear is carried out to varying extents along the coast and in Hanö Bay. Fishermen from other EU countries also fish in the area.



Figur 6. Map of the marine area of the Southern Baltic sea , page 110 Marine Plans.

4.4 Maritime spatial plans part 7 Planning conditions

4.4.1 Storage of carbon dioxide

Text taken directly from the maritime spatial plans pages 193-195.

Carbon dioxide storage involves the separation and storage of carbon dioxide from air emissions in geological formations deep beneath the seafloor. Currently, there is no carbon dioxide storage in Sweden, and no proposed installations exist. The local geology determines the conditions for carbon dioxide storage. Large parts of the Swedish bedrock are unsuitable for carbon dioxide storage due to low porosity and storage capacity, but some areas in Sweden have porous bedrock that could be suitable for carbon dioxide storage.

The technology for carbon dioxide storage is referred to as CCS, Carbon Capture and Storage. The process involves the capture and separation of carbon dioxide at industrial or combustion processes for further transport to the storage site, where it is then stored in the form of a liquid that is almost as heavy as water. The transport is carried out either through pipelines to a well facility on the seafloor or by ship to an injection platform that pumps down the liquid. The well facilities on the seafloor, together with pipelines, occupy a maximum of a few hundred square metres of the seabed. The platform resembles a small oil platform, either standing on legs anchored in the seabed or floating on pontoons.

In Sweden, it is most suitable to store carbon dioxide in deep geological formations, known as aquifers, with high porosity and permeability. The technology in question is well-known and tested and is used, among other places, in Norway, where carbon dioxide has been stored deep beneath the seabed in the Norwegian North Sea since 1996 and later also in the Norwegian and Barents Seas. The Geological Survey of Sweden, SGU, judges that better knowledge of aquifers is necessary to investigate storage capacity. The authority sees that a cost-effective strategy today is to conduct new surveys on existing collected drill cores (Geological Survey of Sweden 2017b).

- The planning goal related to carbon dioxide storage is:
- Prepare for possible future extraction of minerals and for carbon dioxide storage.

Carbon dioxide storage can be a way to reduce large-scale emissions of carbon dioxide into the atmosphere by capturing and storing it in the bedrock. Through international agreements, Sweden has committed to reducing greenhouse gas emissions and has also adopted its own climate goals, including that Sweden should have no net greenhouse gas emissions to the atmosphere by 2045. Environmentally safe geological storage of carbon dioxide is therefore considered to contribute to achieving the set climate goals. Initial geological assessments indicate that two marine areas in Sweden have good potential for geological storage of carbon dioxide:

- The Faludden storage unit within parts of the Borgholm Formation in the Southeastern Baltic Sea
- The Arnager storage unit within parts of the Arnager Greensand off the southwest coast of Skåne.

There is a need to identify the most suitable storage units before further planning can be carried out. More detailed data from surveys and mapping need to include environmental conditions and the bedrock and geotechnical properties of the seafloor.

Technological advancement will be crucial in determining the role carbon dioxide storage will play in the future.

4.4.2 International Interaction

The Nordic countries together have a high theoretical storage capacity for carbon dioxide, equivalent to storing more than 500 years of emissions at current levels (Geological Survey of Sweden 2016b). Research and data collection on carbon dioxide storage are largely carried out through international collaborations. Most carbon dioxide storage sites are found in Norway, but Sweden and Denmark also have potential in and around the North Sea.

4.4.3 Legal Conditions

According to Regulation (2014:21) on geological storage of carbon dioxide, geological storage of more than 100,000 tons of carbon dioxide may only take place in Sweden's economic zone and in areas that are not part of properties in the Swedish territorial sea from one nautical mile outside the baseline. This is the same geographical delineation as for the state maritime spatial plans. To obtain permission, an environmental permit assessment is required by the Land and Environment Court, as well as permission from the government under the Continental Shelf Act.

The legislation is based on the EU Directive on the geological storage of carbon dioxide and ultimately on the Law of the Sea Convention. However, the Swedish Environmental Protection Agency notes that there are some uncertainties in Swedish legislation in relation to Sweden's commitments under the Helsinki Convention (Helcom), which may affect feasibility.

4.4.4 Environment and climate

Safe handling and assessment of environmental and health risks are key issues in the introduction of large-scale carbon dioxide storage.

The greatest environmental and health impact associated with carbon dioxide storage is leakage of carbon dioxide, which can lead to ocean acidification and release of carbon dioxide into the atmosphere. According to the EU Directive on geological storage of carbon dioxide, a geological formation may only be chosen as a storage site if there is no significant risk of leakage and if there is no significant risk to the environment or human health. Carbon dioxide storage can have a positive effect on the climate because a reduced concentration of carbon dioxide in the atmosphere can counteract ongoing global warming.

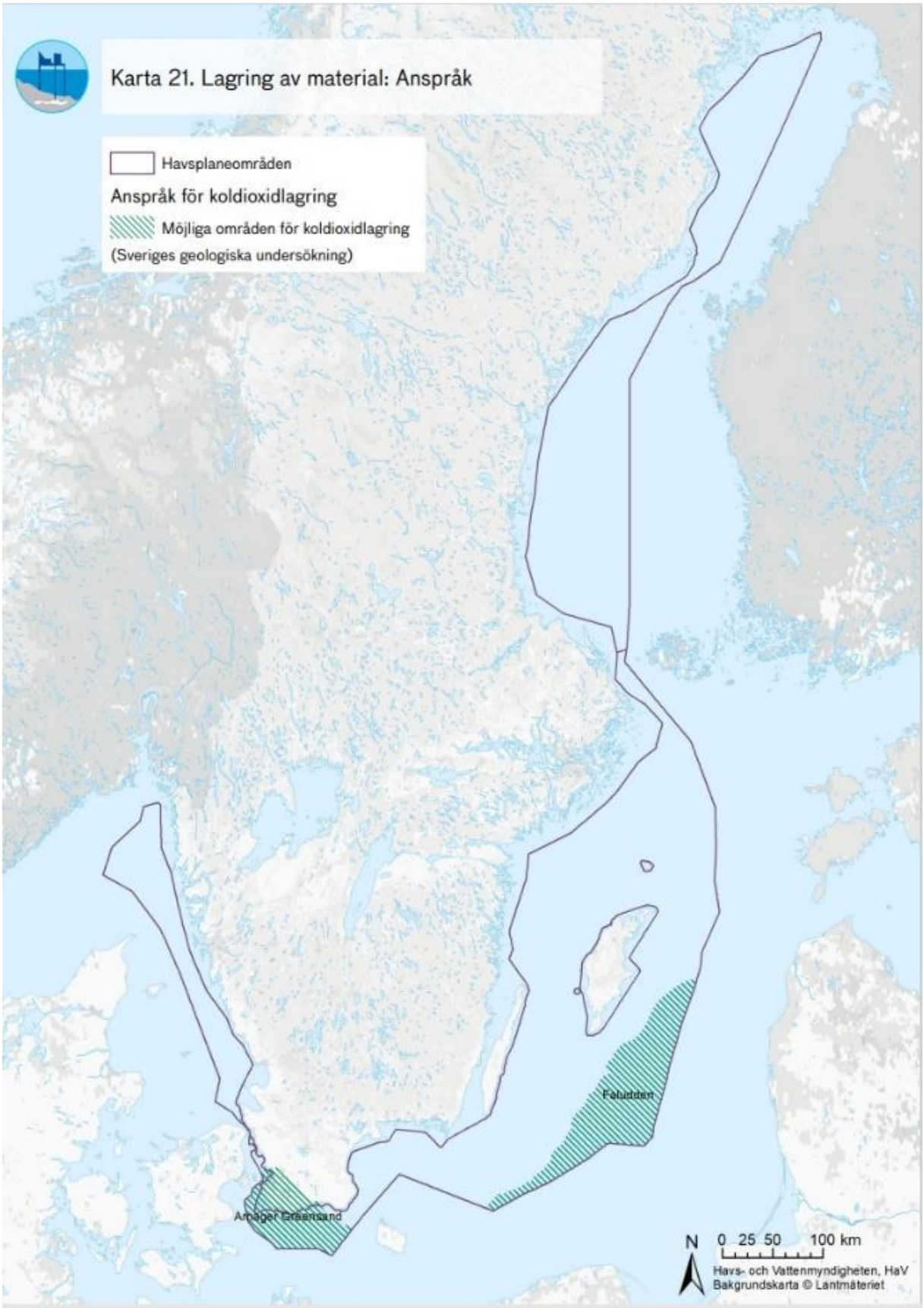


Figure 7. Storage areas shown on the map from the Marine Plans, page 194.

4.5 Natura 2000 area Hoburgs bank and Midsjöbankarna according to the conservation plan (SE0330308)

The Natura 2000 area SE0330308 Hoburgs Bank and Midsjö Banks were designated as a special conservation area for the species common eider and razorbill according to the Birds Directive and Baltic Sea porpoise according to the Habitats Directive as well as the habitat's sandbanks (1110) and reefs (1170) according to the Habitats Directive by the government on December 14, 2016. There were some previous decisions regarding SPA areas but these have been repealed. The Conservation Plan for the area was decided by the County Administrative Boards of Kalmar and Gotland counties on December 20, 2021.

4.5.1 Overall conservation objectives for the Natura 2000 site

The conservation plan states that Good environmental status according to Sections 17 - 19 of the Marine Environment Ordinance (2010:1341) is a prerequisite for achieving and maintaining a favourable conservation status for the designated habitat types and species in the Natura 2000 area. Preserving and promoting biodiversity is an overarching part of achieving favourable conservation status. Furthermore, it is stated that measures to achieve the goals shall be based on environmental quality standards in Appendix 3 (HVMFS 2012:18). Specified goals for each habitat type and species are stated in the conservation plan.

4.5.2 Description of the area

According to the conservation plan, the offshore banks have unique conditions for marine life in the Baltic Sea. The clear water and good water exchange of the Natura 2000 area have, for example, given rise to red algal communities down to a depth of 38 metres (Kågesten et al., 2020), which is significantly deeper than in coastal areas. The algal communities within the area are mostly composed of red algae (Rhodophyta). Algal species are primary producers, they sequester carbon dioxide and release oxygen, just like plants on land. They are a food resource and provide habitats for species such as crustaceans and fish. Today, the dominant fish species on and around the banks are the flounder (Platichthys flesus) and the turbot (Psetta maxima). The once common cod (Gadus morhua) also occurs, but only in a small, red-listed population. The shallower areas are important spawning grounds for flatfish. For example, turbot spawn on the banks at depths from 20 metres and upwards. In the deeper parts of the Northern Midsjö Bank, there are large mussel-covered reef structures and signs that the area may be important for the spawning of herring (Kågesten et al., 2020). The area also harbors large shoals of herring and sprat that move between the banks. All offshore banks host large populations of blue mussels (Mytilus edulis). The blue mussel is an important building block for the ecosystem and a food resource for fish and mussel-eating seabirds. Fish, in turn, are a food resource for the porpoise and fish-eating bird species that visit the banks. The rich abundance of mussels has made the banks very important overwintering areas for seabirds that have mussels as their main food source. Bird species that occur regularly include the Long-tailed duck, Black Guillemot, Common Guillemot, Razorbill, Common Eider, Common Scoter, Black-throated Diver, Red-throated Diver, Velvet Scoter, and gulls. Terns also occur on the banks.

4.5.3 Long-tailed duck

The Long-tailed duck is critically endangered in its wintering areas. The conservation plan mainly states the following about the species.The Natura 2000 area Hoburgs Bank and Midsjö Banks is one of the most important wintering areas for the Long-tailed duck in the world (Larsson 2018), with about 25% of the entire North European and West Siberian population wintering on Hoburgs Bank (Skov et al. 2011). The Long-tailed duck migrates from its breeding areas to the offshore banks in autumn and remains there until spring. The conservation status of the Long-

tailed duck has deteriorated significantly since the 1990s. The population has been severely impacted by illegal oil discharges and bycatch in nets. The number of wintering Long-tailed ducks in the entire Baltic Sea decreased by about 65%, from approximately 4.3 million in 1993 to about 1.5 million in 2009 (Skov et al. 2011). More recent surveys in various parts of the Baltic Sea have indicated a continued decline. The number of Long-tailed ducks wintering on Hoburgs Bank, North and South Midsjö Banks has decreased by about 74%, from about 1 million in 1993 to about 260,000 in 2016 (Nilsson 2016). Due to this rapid decline, the wintering population of Long-tailed ducks is red-listed and classified as endangered (EN) by SLU Species databank 2020.

4.5.4 Black Guillemot

The Natura 2000 area Hoburgs Bank and Midsjö Banks is an important wintering site for the Baltic population of the black guillemot (Durinck et al. 1994, Larsson & Skov 2005). The conservation plan mainly states the following about the species. Two different subspecies of the black guillemot breed in Sweden. The Baltic population, the nominate subspecies Cepphus grylle grylle, breeds along the coasts of Sweden, Finland, and Estonia from the Central Baltic Sea up to the northern Gulf of Bothnia. The Atlantic subspecies, C. g. arcticus, breeds along the Swedish west coast and the North Atlantic coast. The nominate subspecies in the Baltic Sea is classified as Near Threatened (NT) on HELCOM's red list of threatened species and the Swedish Red List (SLU Species Databank 2020). The Baltic population of the black guillemot is estimated to number just under 20,000 breeding pairs, and the population trend is declining (HELCOM 2013).

4.5.5 Baltic Sea Porpoise

The Natura 2000 area Hoburgs Bank and Midsjö Banks is a crucial core area for the critically endangered population of the Baltic porpoise (Carlström & Carlén 2016). The density of porpoises in the area is higher than in the surrounding waters year-round. During the peak reproduction period, from May to October, when most porpoises are calving, nursing, and mating, the density of porpoises is significantly higher, particularly around Hoburgs Bank, and North and South Midsjö Banks. The conservation status is very poor, and the population is near extinction. The number of individuals is estimated to be around 500 for the entire Baltic, down from an estimated 10,000 in the early 1900s. The Baltic porpoise is red-listed by SLU Species Databank 2020 and classified as Critically Endangered (CR) in the Swedish Red List and HELCOM's red list (SLU Species Databank 2020, HELCOM 2013).

A study by Carlén et al. (2018) (fig. 9) estimated the probability of porpoises being present in a certain part of the Baltic Sea during different seasons. Based on this study, there is a low probability of porpoises being present in Hoburgs Bank and Midsjö Banks between September and December.

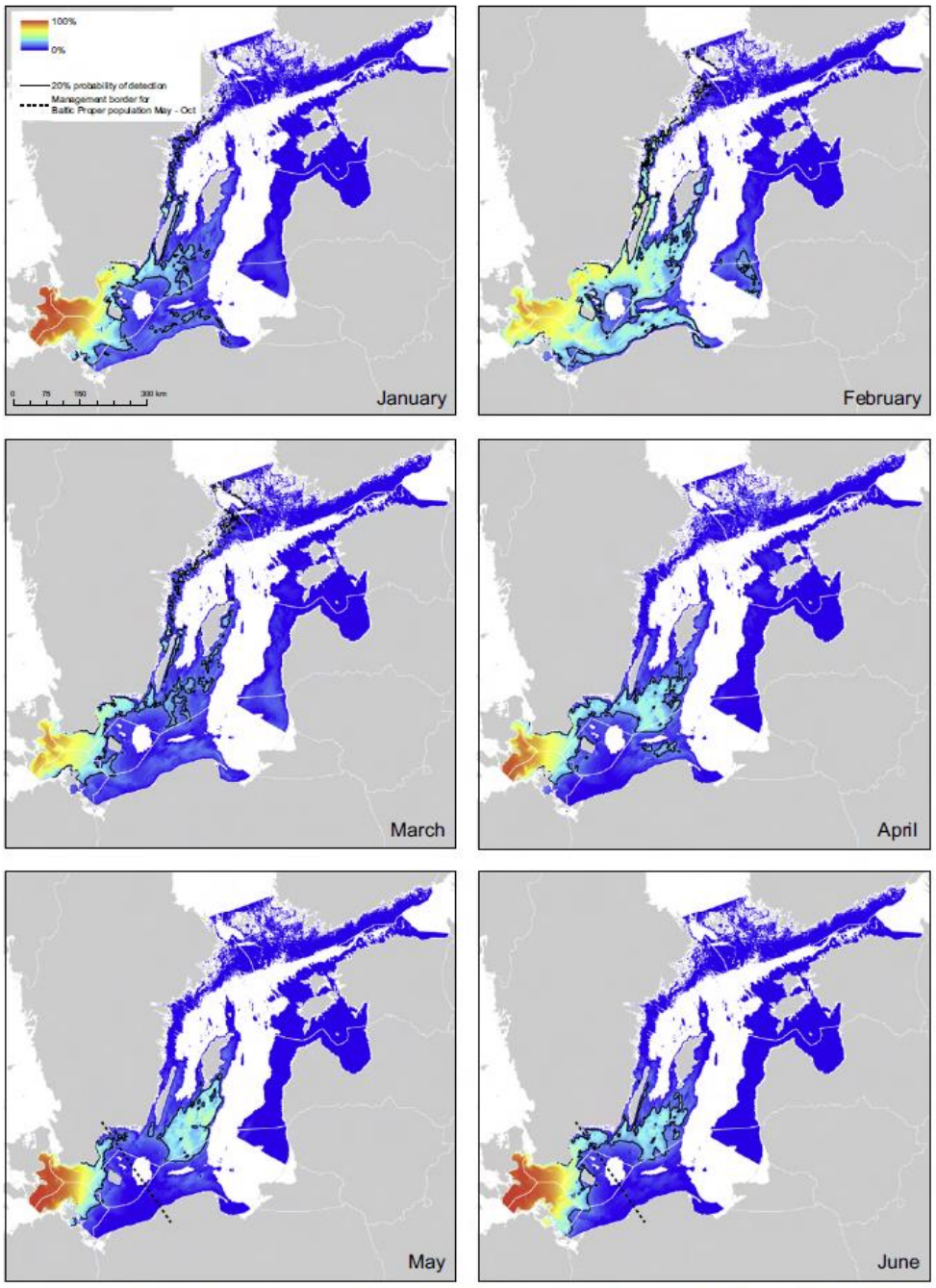


Fig. 3. Predicted monthly probability of detection of harbour porpoises in the study area, for each month January–December. The probability scale is the same in all figures. The black lines indicate the 20% probability of detection. The dotted line shown for May–October is the seasonal management border proposed here for the Baltic Proper population.

Figure 8. An estimate of the probability of finding porpoises in the Baltic Sea during different seasons; January to June. After Carlén et al. 2018.

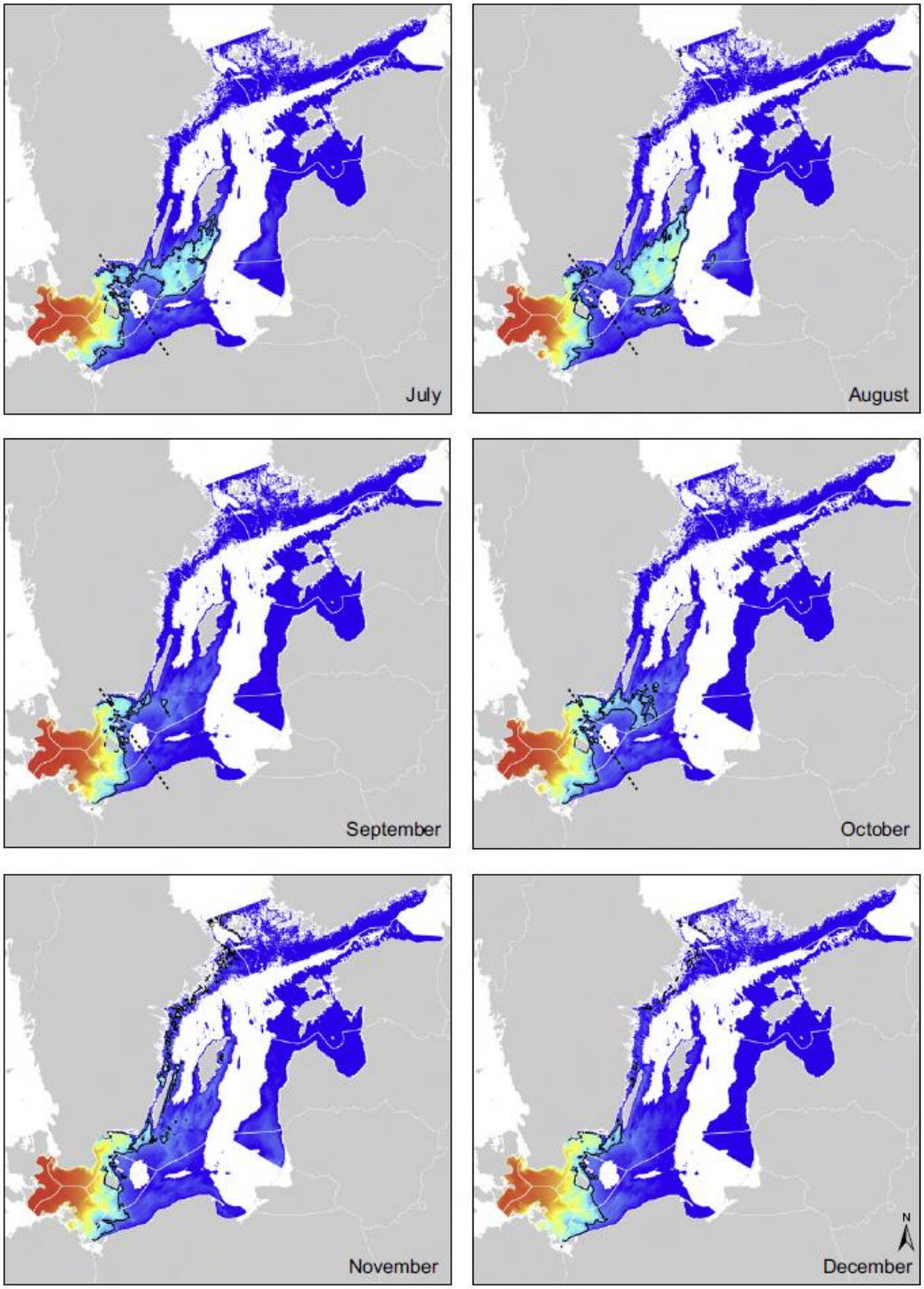


Fig. 3. (*continued*)

Figur 9. An estimate of the probability of finding porpoises in the Baltic Sea during different seasons; July to December, after Carlén et al. 2018. Continuation of Figure .8

Further described in the Conservation Plan (pages 27–30) is that the Baltic population of the porpoise should be managed as a separate population. Studies of the porpoise's genetics, morphology, and seasonal distribution patterns have led to the conclusion that the Baltic population of the porpoise is genetically distinct and has its own isolated breeding area.

The population is estimated at around 500 porpoises (Amundin et al. In press), with the number of reproductive individuals estimated at about 100 (SLU Species Databank 2020). In 2020, the population is projected to decline by more than 10% within 21 years (equivalent to 3 generations). The decline in the number of reproductive individuals has led to the assessment in the Swedish Red List that the population is critically endangered (SLU Species Databank 2020). This assessment has also been made in HELCOM's (Helsinki Commission for the Protection of the Marine Environment of the Baltic Sea) red list. The Baltic population is not assessed in the IUCN's (International Union for Conservation of Nature) red list.

The Baltic porpoise is the smallest whale species living in cold, temperate waters. It has a high metabolism and requires a good supply of food. For most of the year, females are accompanied by a calf that initially has poorer diving and swimming abilities and relies on staying within hearing range of the mother. Females therefore have a particularly high need for easily accessible food. A porpoise can reach critically low energy levels and may die within as short a time as a day if it does not obtain food (MacLeod 2014). This means that their distribution is closely linked to productive areas (Carlström et al. 2016). The pregnancy rate of porpoises is correlated with the nutrition in their diet, highlighting the importance of access to undisturbed areas with high-quality food (Ijsseldijk et al. 2021).

Adult porpoises are typically about 1.4–1.9 m long and weigh about 40–75 kg. The body is spindle-shaped, and the grey-black back has a low, slightly backward-leaning triangular dorsal fin. The sides are lighter grey, and the belly is white. The head is round, and the nose is blunt. Porpoises become sexually mature at 3–4 years of age. Females rarely become pregnant the same year they become sexually mature but subsequently give birth to an average of about 0.6–0.7 calves per year (SLU Species Databank).

The pregnancy rate, due to females giving birth to an average of about 0.6–0.7 calves per year, means that on average just under 50% of sexually mature females are pregnant and lactating at the same time. The pregnancy rate varies somewhat between populations, and data is lacking for the Baltic population.

Throughout their lives, each porpoise female contributes an estimated 3–4 individuals that reach adulthood. The calf is suckled for between 8 and 10 months but starts eating solid food from 3–4 months of age and grows from about 8 kg at birth to about 15–20 kg at three months of age. Porpoises rarely live beyond 12 years. Studies on bottlenose dolphins and porpoises have shown that the firstborn calves of mothers exposed to elevated levels of environmental toxins during pregnancy, such as PCBs, have higher mortality rates than the subsequent calves born to the same mother. This is because the accumulated toxins that the mother has been exposed to over her lifetime are transferred to the first calf, and as a result, the remaining toxin levels in the mother are lower, but the calf dies (Schwacke et al. 2002, Murphy et al. 2015). (Conservation Plan)

In porpoises in the Baltic region (most information comes from other populations in Swedish waters such as the Belt Sea population), the main reproduction occurs during the summer half-year (Börjesson & Read 2003). Calving occurs in June–July, and mating takes place around August, but the annual cycle can vary, and reproduction can occur year-round. The calf is suckled

for 8–10 months. There may also be minor shifts in life history parameters over decades, likely as an adaptation to changes in the environment.

During calving and the calf's growth period, porpoises need access to undisturbed and relatively shallow areas (The Swedish Environmental Protection Agency, 2011). Porpoises usually dive shallower than 20–30 metres but can dive to several hundred metres deep. However, they spend a significant amount of time at or near the surface. Dive frequency is often around 30–50 dives per hour. There are significant variations in porpoise diving behavior, both between individuals and for the same individual moving between different areas (The Swedish Environmental Protection Agency, 2011).

Hearing is the porpoise's primary sense. They rely on echolocation using high-frequency clicks to orient themselves, hunt, and communicate. Even though their clicks fall within a narrow frequency band, their hearing range is considerably broader. Hearing ability is crucial for porpoises to orient themselves, perceive their environment, and survive. Porpoises can be affected by underwater noise in many ways, depending on the intensity of the sound.

Noise can, for example, reduce the communication range of porpoises, cause behavioral impacts such as fleeing or interruption of feeding, induce physiological damage, or even cause death (Hermannsen et al. 2014, von Brenda-Beckman et al. 2015, Sarnocinska et al. 2020). Porpoises have a very low hearing threshold, and impulsive noise that exceeds the threshold by 40–50 dB triggers flight behavior (Tougaard et al. 2015). At the same reaction threshold, porpoises have been shown to interrupt feeding and stop echolocating when exposed to continuous noise from shipping (Wisniewska et al. 2018). Since porpoises are small mammals living in cold waters, behavioral impacts from underwater noise can impair their energy balance, leading to reduced reproductive ability and death (Gallagher et al. 2020).

Stomach content analyses of porpoises show that they eat a very large number of fish species, but herring, sprat, and cod dominate in Swedish waters. Other commonly found species are other codfish and gobies. The prey are usually less than 30 cm long, except for cod, which is typically 30–45 cm. An acoustic study of porpoise foraging behavior in Danish waters found that prey size was as small as 3–10 cm (Wisniewska et al. 2016). Dietary studies show that porpoises are opportunistic in their diet and switch to the species with the highest nutritional content for the season.

As part of the Life project SAMBAH (Static Acoustic Monitoring of the Baltic Sea Harbour Porpoise), a foundation has been laid for valuable areas for porpoises. From May to October, most of the Baltic Sea population is found in the Natura 2000 area Hoburgs Bank and Midsjö Banks. The study shows that the area is very important for the main reproductive period, that is, for calving, mating, feeding, and nursing. The Baltic Sea population overwinters in the Southern and central parts of the Baltic Sea and occupies offshore banks at depths of 10–30 metres, where Hoburgs Bank and Northern and Southern Midsjö Banks are of great significance (Durinck et al. 1994, Larsson & Skov 2005).

Conservation measures that have a specific year linked to them are related to the Marine and Water Authority's action program for porpoises 2021–2025 (ÅGP Tumlare 2021) or the action program for the marine environment in the North Sea and the Baltic Sea 2022–2027 according to the Marine Environment Code (ÅGP Havsmiljön 2022–2027, unpublished).

<u>One of the major threats to the porpoise is:</u>
Loud impulsive noise, such as from sonars, seismic surveys, underwater explosions, or pile driving for constructions, can cause physiological damage at shorter distances and has been documented to have a significant impact on porpoise behavior over long distances. Weaker

impulsive noise from sources like sonar used by both commercial shipping and recreational boats can cause behavioral changes. Noise that is 40-50 dB above the porpoise's hearing threshold can lead to flight behavior and cause the animals to stop echolocating and foraging. Continuous noise from sources such as shipping, construction work, or other noise-generating activities can cause behavioral impacts as well as mask porpoises' own signals and their echoes, as well as important environmental signals. This reduces the porpoise's ability to detect nets, threats, prey, and to communicate.

The Conservation Plan further refers to guidelines regarding impulsive and continuous noise on porpoises as follows:

- National guidance for the impact of impulsive noise on porpoises. National guidelines and threshold values for impulsive noise from activities such as offshore constructions, seismic surveys, underwater explosions, sonar searches, are to be developed by 2025 (ÅGP Tumlare 2021). Until the national guidelines are established, the CMS guidelines for environmental impact assessments for noise-generating activities are applied (https://www.ascobans.org/sites/default/files/document/ascobans_res8.11_rev.mop9_cmsfamily-guidelines-eia-noise.pdf). (Conservation Plan p. 17)
- Further information can be obtained from HELCOM's report on noise-sensitive animals in the Baltic Sea (https://helcom.fi/wp-content/uploads/2019/12/BSEP167.pdf).
- National guidance for the impact of continuous noise on porpoises. National guidelines and threshold values for continuous noise from activities such as offshore wind power and shipping are to be developed by 2025 (ÅGP Tumlare 2021). Until the national guidelines are established, the CMS guidelines for environmental impact assessments for noise-generating activities are applied (https://www.ascobans.org/sites/default/files/document/ascobans_res8.11_rev.mop9_cmsfamily-guidelines-eia-noise.pdf).
- Further information can be obtained from HELCOM's report on noise-sensitive animals in the Baltic Sea (https://helcom.fi/wp-content/uploads/2019/12/BSEP167.pdf). (Conservation Plan p. 17).

4.5.6 Fish

Fish is a food source for some of the targeted species, mainly porpoises and sand guillemots.

The south-eastern part of the investigation area is located within a probable, or very likely, spawning area for torks (HELCOM, 2024). Cod spawning can occur in the southern Baltic Sea all year round (HaV, 2024).

Flounder and Baltic flounder are closely related and have recently split into separate species. They have different spawning environments where the flounder spawns in large parts of the Baltic Sea at depths of between 20-40 metres, while the Baltic flounder spawns more close to the coast. It is mainly spawning of flounder that can occur in the study area, but also to some extent the Baltic flounder spawns in the area that is relevant for investigations. The flounder spawns in January-April and the Baltic flounder between April and June (HELCOM, 2024; HaV, 2024).

Herring spawns primarily close to the coast, both spring and autumn spawning can occur. Only small areas of the study area overlap with the herring spawning area (HELCOM, 2024; HaV, 2024). On the other hand, the Skaprillen spawns in large areas of the Baltic Sea, including the majority of the study area. The Skaprisillen spawns March-August at depths of between 10–40 metres (HELCOM, 2024; HaV, 2024).

The survey area overlaps with four catchment areas for commercial fishing according to ICES; 25, 26, 27 and 28–2. The investigation area includes the majority of conservation areas for different species during different seasons, including for cod, flounder and turbot (Länsstyrelsen, 2024).

5 The planned activity

SGU's investigations at sea are conducted using various acoustic methods aboard their own vessel, the Ocean Surveyor. Acoustic methods involve sending sound from instruments down towards the seafloor where it bounces off the various geological layers. The echo of these sound waves is captured by sensors and then translated into images showing the appearance of the seafloor, sediments, and the underlying bedrock.

In the upcoming sea surveys, echo sounders (sediment echo sounder and multibeam echo sounder) are used to map the seafloor and sediment over the bedrock. These methods are important within the framework of CCS to gain an understanding of how structures in the underlying bedrock can affect seabed sediments. With this type of data, one can map indications of gas and liquid in the sediment coming from fractures or weak zones in the bedrock. This gives an indication of whether there is an increased risk of leakage from carbon dioxide storage.

However, potential carbon dioxide storage must occur at least 800 metres below the seafloor, and to determine the appearance of the bedrock at that depth, reflection seismic surveys are also conducted. The seismic surveys are carried out in collaboration with the Danish Geological Survey (GEUS) and Aarhus University.

During a seismic survey, sound waves are used to create detailed sections (two-dimensional images) of the bedrock structure. At sea, the powerful sound pulses can be created, for example, by an air gun, a water gun, or a so-called sparkers system (which uses electricity). The sound waves are shot down towards the bottom and reflected back from the various layers of the seabed and bedrock. The reflected sound waves are captured and recorded by hundreds of interconnected pressure sensors (hydrophones) dragged in the water behind the vessel in a hose-like system (streamer). Depending on the depth to be investigated, the streamer can be between 100 metres and 3,000 metres long.

Reflection seismic is the most important geophysical method because it provides information on the thickness, depth, extent and lithology of the geological formations at the depths relevant for carbon dioxide storage. Seismic reflection data is also important for investigating faults (large-scale cracks) in the bedrock and associated risk of leakage of stored carbon dioxide.

5.1 Marine mapping

Within the framework of marine mapping, SGU will conduct high-resolution measurements using multibeam echo sounder (MBES) and sub-bottom profilers (SBP) and perform seismic measurements.

5.1.1 Multibeam echo sounder

The multibeam echo sounder uses a frequency of 300 kHz. This frequency is inaudible to porpoises, so no further specifications are provided for this instrument.

5.1.2 Sub-bottom profiler

The sub-bottom profiler is a parametric echo sounder that uses a frequency of about 120 Khz, meaning the sound beam is focused into a narrow beam directly beneath the vessel. The sound intensity decreases rapidly in the vertical direction, partly because it is focused and partly because the high frequencies used by the sounder are quickly attenuated in the water mass. At a distance of 3 degrees from the centerline in any direction, the sound intensity has dropped by 20 dB, rapidly falling to inaudible levels. Our assessment is that the sound only affects what is directly beneath the transmitter.

5.1.3 Seismic surveys

During a seismic survey, sound waves are used to create detailed sections (two-dimensional images) of the bedrock's structure. At sea, the powerful sound pulses can be generated, for example, by an airgun, a water gun, or a so-called sparker system (using electricity). The sound waves are emitted towards the seafloor and reflected back from the various layers of the seabed and bedrock. The reflected sound waves are captured and recorded by hundreds of interconnected pressure gauges (hydrophones) towed in the water behind the vessel in a hose-like system (streamer). Depending on the depth to be investigated, the streamer can be between 100 m and 3,000 m long.

During data collection, the sound source will be activated regularly with intervals of 4–20 seconds. The seismic sound waves propagate through the water and down beneath the seafloor. The frequency and amplitude of the sound in the water layer from the sound source will depend on several factors (such as air pressure used in the case of an airgun, depth of the sound source below the water surface, depth to the seafloor, and to some extent the type of bottom substrate).

The frequency content will also vary with distance from the sound source, with higher frequencies being attenuated and diminishing faster than lower frequencies. Near the sound source, sound frequencies between 5 and 500 Hz will be generated in the water layer, with the majority of energy in the frequency range of 5–250 Hz.

With increased distance from the sound source, the signal strength decreases due to Transmission Loss (TL), which is a combination of several effects. Near the sound source, TL is dominated by spherical spreading. This is called geometric damping and is due to the increase in wavefront area with distance. As the distance becomes significantly larger than the water depth, the geometric part of TL gradually transitions to cylindrical spreading. In addition to geometric damping, TL is affected by several other damping processes. Some of the energy is absorbed by the water and converted into heat, which has the greatest effect on high frequencies. Energy with low frequencies disappears into the seabed, especially in shallow areas like the Baltic Sea.

6 Effects and suggested protection measures

6.1 Assessed effects

Geophysical and seismic surveys above all give rise to sounds that can be disturbing or in some cases harmful to marine life. It is mainly marine mammals such as porpoises and seals that can be sensitive to underwater noise from these acoustic methods, but fish can also be affected and the most sensitive are the fish species that have a swim bladder. In the Natura 2000 area Hoburgs bank and Midsjöbankarna, porpoises are the designated species that above all could be directly

affected, while both porpoises and designated seabirds could be indirectly affected by fish, which is one of the main foods, being negatively affected.

During transport at sea, there is always a risk of emissions into the water in the form of diesel, petrol or chemicals used in the operation.

6.1.1 Marine mammals

Of the method that will be used, it is the low-frequency sound produced by the seismic equipment that probably has the greatest potential to affect marine mammals.

SGU has carried out modeling of how the sound level decreases with distance from a sound source similar to what will be used. The modeling follows accepted methodology and published assumptions about seismic wave propagation in seawater. The modeling shows what the sound level will be at different distances from the sound source. The result shows that the sound level does not reach above the level of the porpoise's escape response until the sound source is closer than 10 m from a porpoise, but a dull rumble will be perceived by half the population already at a distance of approximately 7 nautical miles (13 km).

6.1.2 Fish

As with marine mammals, fish can be affected by low-frequency sounds generated by the seismic equipment. Fish are generally less sensitive than marine mammals, but several species use sound for communication and navigation, which is why they can be both disturbing and harmful. This can lead to failure to reproduce as a result of stress or displacement from spawning areas during ongoing surveys.

The most sensitive are the species that have a swim bladder, this includes, among other things, cod, sprat and herring, all of which can be found in the investigation area and serve as food for designated Natura 2000 species for Hoburg Bank and the Midsjö Banks.

6.1.3 Other

No designated nature types according to Natura 2000 are deemed to be affected by planned surveys due to the nature of the surveys as they have no impact on the seabed. However, accidents during the investigations cannot be ruled out which could affect either nature types or designated species through leakage of fuel, propellant or chemicals.

6.2 Protective measurements

Together with the Norwegian Maritime and Water Authority, SGU has produced a guideline for underwater noise "Protective measures in seismic surveys, Guidance to prevent seismic surveys from causing harmful impulsive noise with negative effects on marine mammals" 2023:4 Publication date 1 March 2024.

Safeguards are planned to be taken to minimize disturbance and potential harm to marine life. Protection measures mainly focus on porpoises, but they also provide protection for, for example, fish and other species of marine mammals.

To minimize the risk of disturbing the animals, surveys are avoided during certain periods of the year. You can also use a so-called soft start (the sound level is raised slowly), then the animals that may still be in the immediate area are given time to move. You can also to a certain extent reduce the size of the sound source, as well as compensate for how it affects the data by using a more sensitive streamer (which contains more receivers).

Preventive measures will be taken to prevent any leakage from spreading to the water. Should a release still occur, there are contingency plans including equipment and materials (such as absorption products and visors) to limit the spread.

7 Cumulative and cross-border effects

Cumulative effects refer to effects that could arise as a result of the effects of other activities interacting with the effects of the current project. Cumulative effects could lead to effects from different activities that individually have acceptable consequences together could have unacceptable negative consequences.

In the upcoming EIA, an identification and evaluation of cumulative effects will be carried out. The activities with which the planned activity could potentially create cumulative effects include shipping and other geophysical and seismic surveys.

The surveys will be carried out in the central, south-eastern and southern Baltic Sea and near the sea border with several of the other Baltic Sea countries, such as the Baltic countries, Poland and Germany. As there is a certain potential risk that the waters of these countries may be affected by the surveys, SGU will submit documentation for a consultation in accordance with the Espoo Convention to the Environmental Protection Agency.

8 Summary

In 2022, SGU received a regulatory letter from the government with a task to investigate and investigate suitable locations for permanent storage of carbon dioxide in Sweden and to analyze the conditions for the operation of the storage locations.

The work will thus require that we work with historical data, but above all that we collect new, better data in the areas that we consider most suitable, during the duration of the mission, 2023–2025. Acquisition of data will take place both through geophysical surveys from a boat, as well as drilling on land to take samples to characterize a reservoir rock through physical tests.

Previous basic studies have shown that the regions in Sweden that are of utmost interest are located in the Östersjön - the southeastern parts south of Gotland, and the southwestern parts south of Skåne. (see figure 2).

The operations for this application will be conducted in the South-Eastern, Southern and Eastern Baltic Sea. Area includes the Natura 2000 area Hoburgs bank and Midsjöbankarna (SE0330308).

The preliminary assessments that SGU makes are that the impact from the investigations linked to the Natura 2000 area Hoburgs bank and Midsjöbankarna, and its designated species, is mainly linked to marine mammals. The planned surveys include certain survey methods that may affect marine mammals in the form of underwater noise when it coincides with the porpoise's hearing range, which is used when the porpoise orientates, communicates and hunts using echolocation through clicking sounds. Nature types and seabirds can be indirectly affected if fish are negatively affected.

8.1 Scope of the environmental impact statement

The upcoming EIA is planned to focus on effects and consequences linked to the impact on porpoises and fish, as the examination only covers 7 ch. Section 28 a of the environmental code

within Hoburgs bank and Midsjöbankarna where porpoises and seabirds are designated species. Seabirds themselves are not considered to be affected by the nature of the surveys, but some have fish as their primary prey, which is why they may be affected indirectly if the recruitment of fishers is affected.

Designated nature types are deemed not to be affected by the surveys but effects on typical species cannot be ruled out.

The EIA is tentatively proposed to have the following content and structure:

- Non-technical summary
- Administrative tasks
- Introduction
- Demarcation
- Consultation
- Location, plan conditions and area description
- Description of investigations
- Method for assessments
- Environmental effects and consequences
- Cumulative effects
- The marine environment directive and the environmental goals
- Overall assessment
- Competence in the EIA team
- References

9 References

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