Nord Stream
The new gas supply route for Europe

Nord Stream Environmental Impact Assessment Documentation for Consultation under the Espoo Convention

Nord Stream Espoo Report: Key Issue Paper
Fish and Fishery

February 2009

English version | Key Issue Paper
Fish and Fishery

ENG

Please note:

The “Nord Stream environmental impact assessment documentation for consultation under the Espoo Convention” will, hereinafter and throughout the entire documentation as submitted hereunder, be referred to as the “Nord Stream Espoo Report” or the “Espoo Report”.

The English version of the Nord Stream Espoo Report has been translated into 9 relevant languages (hereinafter referred to as the "Translations") . In the event that any of the Translations and the English version conflict, the English version shall prevail.

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Abbreviations and definitions

CFP	Common Fisheries Policy
DNV	Det Norske Veritas
DPV	Dynamically Positioned Vessel
EEZ	Exclusive Economic Zone
ESR	Ecological Subregionx
FOGA	Fishermen’s Information of Oil and Gas Activities
IBSFC	International Baltic Sea Fishery Commission
ICES	International Council for the Exploration of the Sea
MAC	Minimum Allowable Concentration
PAH	Poly Aromatic Hydrocarbons
PNEC	Predicted No-Effect Concentration
ROV	Remotely Operated Vehicle
SINTEF	Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology
TAC	Total Allowable Catch
ToP	Top of Pipeline

Annex:

FOGA communications sheet

1 Introduction

Nord Stream is a natural gas pipeline that will link Russia and the European Union through the Baltic Sea.

To implement the Nord Stream Project in accordance with the high environmental standards and to minimise the pipeline's impact, Nord Stream AG has undertaken comprehensive studies of the Baltic Sea environment.

It is recognised that commercial fisheries are under great pressure as catches (e.g. for cod) are becoming increasingly limited. In cooperation with the responsible authorities, fishery associations and fishermen in the Baltic Sea countries, Nord Stream is working to minimise potential impacts on fishery/trawling activities in the vicinity of the pipeline.

To find the best solutions possible, Nord Stream have conducted the following studies:

- Mapping of spawning areas and identification of seasonal sensitivity in order to avoid impacts in these areas/seasons
- Studies of actual catches in the Baltic Sea for various commercially significant fish species in order to assess the importance of fishery activities
- Studies on the type, size and use of fishing equipment in the Baltic Sea and the potential impacts on fishing gear (e.g. risk of hooking)
- Studies on trawling frequencies
- Field studies on fishing methods in each country

Nord Stream also entered into dialogue with the fishing community. Meetings with fishermen were held in the countries of origin in 2008 in:

- Finland Helsinki: 10 Sept, 12 Sept, 3 Oct, 7 Nov, 9 Dec
- Sweden Öregrund: 3.Sept, Simrishamn: 14 Nov, Gotland: 28 Nov
- Denmark Bornholm: 25 Nov
- Germany Sassnitz: 19 Nov
- Russia October: 08

2 The Challenge

The Nord Stream Project may potentially affect both the fish in the Project area and commercial fishing interests. The gas pipelines run through areas that are important for the commercial fisheries of several countries. Under international agreements the member states of the EU and Russia have fishing rights, broadly speaking, throughout the entire area.

Many species of fish have populations with geographical distributions that extend over the borders of the Exclusive Economic Zones (EEZs). Hence the influence of the Nord Stream Project on fish and fishing throughout the Project area and in the different countries' coastal zones is of common interest to all Baltic Sea States.

Potential impacts include:

- Construction Phase
  - Munitions clearance (noise/pressure, spreading of sediments, navigation restrictions)
  - Seabed intervention works (noise, spreading of sediments, navigation restrictions)
  - Pipeline installation (noise, spreading of sediments and anchor scars, navigation restrictions)
  - Pre-commissioning and water discharge (noise, water emissions)
- Operational Phase
  - Operation of pipeline (noise, emissions)
  - Pipeline presence (over-trawlability)

This paper explains on what basis these impacts have been assessed and what the results of the assessment were. It also provides information on the mitigation measures that will be taken where necessary.

3 Current Situation

3.1 Fish in the Baltic Sea

The Baltic Sea hosts around 70 saltwater fish species and another 30 to 40 brackish or freshwater species, which inhabit the central regions of the Baltic Sea and the coastal areas.

Cod, herring and sprat dominate the fish community in biomass, as well as number. These species are also commercially most important.

In order to reflect the ecological diversity and environmental characteristics along the Nord Stream pipelines' route at a more specific level, IfAÖ (Institut für Angewandte Ökologie GmbH) was tasked by Nord Stream to develop a classification of Ecological Sub-Regions (ESRs) in the Baltic Sea. This is based on three principal characteristics, namely salinity, dissolved oxygen and substrate type. These are the factors which mainly influence the flora and fauna in the Baltic Sea. Based on these factors, five main ESRs have been defined along the pipelines' route by the Nord Stream environmental assessment team as follows:

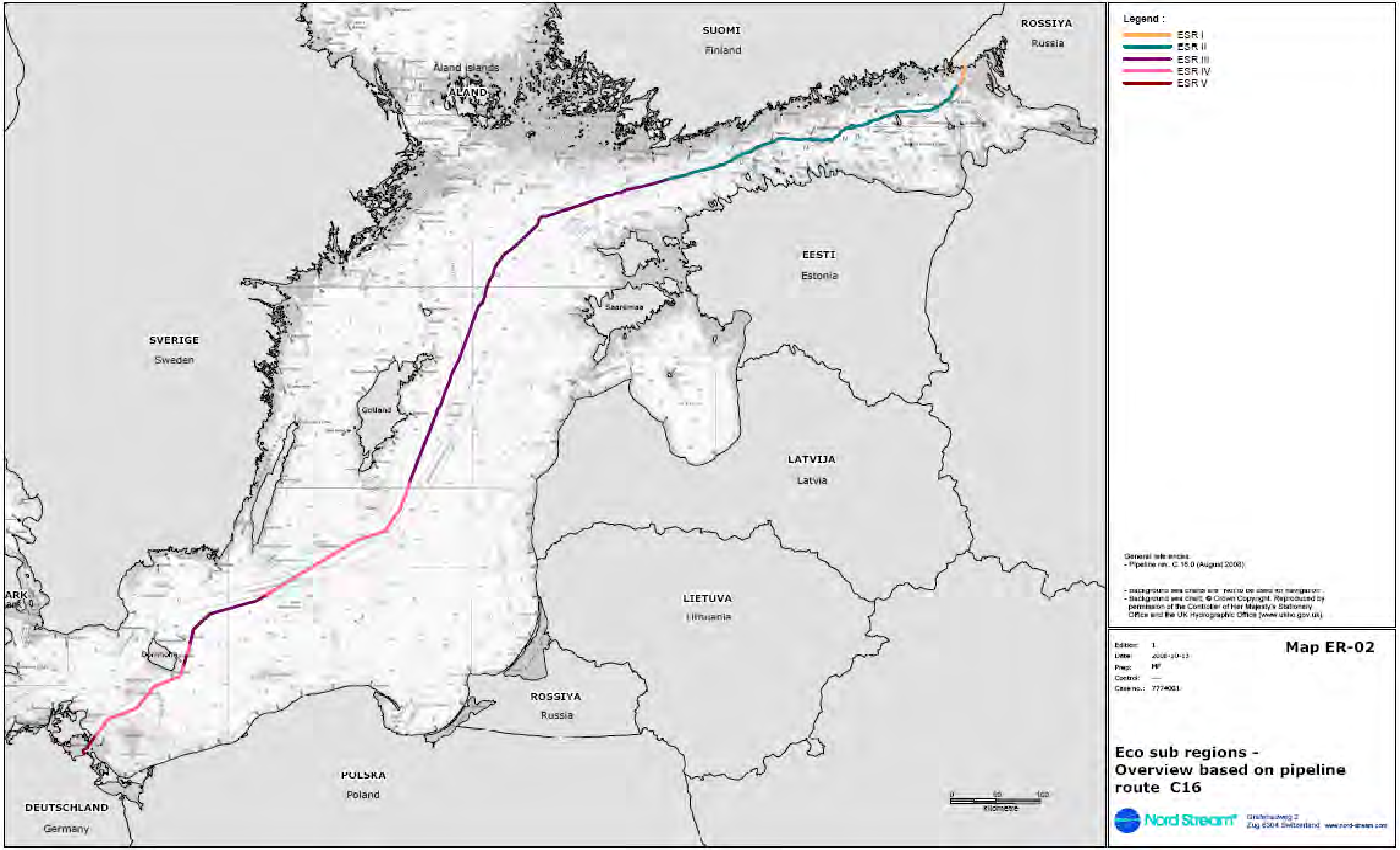

Figure 3.1 Eco Sub-Regions I-V

Table 3.1 Ecological sub-regions that form the basis of this assessment[1]

Ecological Sub-Regions		Bottom Salinity	Dissolved Oxygen	Depth	Substrate
ESR I	Portovaya Bay	0-3 psu	Enough for biological activity	Shallow water	Less exposed beds
ESR II	Gulf of Finland	3-9 psu	Variable oxic conditions	Shallow to deep water	Mixed beds
ESR III	Baltic Proper	9-16 psu	Predominant anoxia	Deep water	Mud
ESR IV	The southern sandbanks	7-16 psu	Enough for biological activity	Shallow water	Exposed mineral bed
ESR V	Greifswalder Bodden	8-18 psu	Enough for biological activity	Shallow water	Less exposed bed

The fish community in ESR I is dominated by pelagic freshwater species. Marine species such as cod and sprat do not tend to occur in these waters as they are intolerant to the low salinity, which also prevents successful development of their eggs. Some important fish of commercial value such as common bream (*Abramis brama*), perch (*Perca fluviatilis*) and Baltic herring (*Clupea harengus*) use the shallow waters of ESR I as spawning and feeding grounds. Fish species of conservation value found in ESR I include three-spined stickleback (*Gasterosteus aculeatus*), nine-spined stickleback (*Pungitius pungitius*), Atlantic salmon (*Salmo salar*), river lamprey (*Lampetra fluviatilis*) and sea trout (*Salmo trutta*).

Both marine and freshwater species are present in the Gulf of Finland including local pike (*Esox lucius*), roach (*Rutilus rutilus*), ruffe (*Gymnocephalus cernuus*), burbot (*Lota lota*) and white bream (*Abramis bjoerkna*). The coastal waters are also inhabited by sticklebacks (*Gasterosteus aculeatus*, *Pungitius pungitius*), minnow (*Phoxinus phoxinus*), Baltic herring (*Clupea harengus*

(1) See Atlas Map ER-02 for a larger version.

membras), turbot (*Psetta maxima*) and flounder (*Platichtus flesus*). Cod *(Gadus morhua*) are not common in ESR II. Herring use the shallow coastal waters of the Gulf of Finland for spawning. Diadromous species present include the Atlantic salmon (*Salmo salar*), the smelt (*Osmerus eperlanus*) and the river lamprey (*Lampetra fluviatilis*).

Due to the ambient conditions and impoverished benthic community throughout most of ESR III, the majority of the ESR is not an important habitat for demersal and benthic fish species. However, several economically important pelagic species are common in ESR III and economically important pelagic and demersal species including cod and sprat (*Sprattus sprattus balticus*) use the basins of ESR III as spawning grounds.

ESR IV has a particularly rich benthic community in comparison to other parts of the Baltic Sea and is therefore an important habitat for demersal and benthic fish, as well as pelagic fish species. In ESR IV, pelagic fish common in Pomeranian Bay and around Bornholm include Atlantic salmon, sprat and sea trout. The pelagic fish community to the north east of Bornholm is dominated by herring, sprat and salmon.

The fish community in ESR V is composed of freshwater, marine and euryhaline species. The community is dominated by perch, flounder, eelpout (*Zoarces viviparous*), pike and herring, most of which are species of commercial importance in the Greifswalder Bodden. There are several species which inhabit ESR V that are listed as Annex II species in the Habitats Directive. These include river lamprey, sea lamprey, salmon and asp (*Aspius aspius*). The average depth of the Greifswalder Bodden is 5.8 m and this lagoon is an important habitat for fish feeding and spawning.

3.2 Fishing Activities in the Baltic Sea

Fishing is a culturally important activity for many of the Baltic Sea states. It is seen as a part of community identities and an important source of food and income. The industry is shaped by a number of factors including the species caught, fluctuations in stock size, seabed morphology, demographic and socio-economic patterns, technological innovations and the management regime.

The legislative framework that governs the Baltic enables all European Union (EU) member states and Russia to fish in the EEZ according to allocated catch limits. The access in the 12-nautical mile (21.224 km) coastal band is regulated by national jurisdiction. Consequently, it is not uncommon to find for instance Finnish or Latvian fishermen fishing in the Danish EEZ around Bornholm. Therefore those impacts that affect fisheries along the pipeline route may be felt more widely and are considered as ‘transboundary’.

3.2.1 Management and Legislation of Fisheries in the Baltic

Fishing in most parts of the Baltic Sea is subject to a management regime that aims to secure sustainable utilisation of fish and other aquatic species. The management of Baltic fish stocks is almost entirely under the mandate of the EU countries (Russia is the only country bordering the Baltic Sea that is outside of the EU). In earlier times, the fisheries in the Baltic were managed by the International Baltic Sea Fishery Commission (IBSFC) which had six members; Russia, Estonia, Latvia, Lithuania, Poland and the EU. In 2007(1), the European Community and Russia agreed to cooperate on fisheries and the conservation of marine resources. The agreement, which is initially valid for a period of 6 years, allows Russian fishermen to take a fixed portion of the shared stocks of the Baltic Sea and replaces earlier bilateral agreements in existence prior to the accession of the new EU Member States.

The Baltic Sea is managed in line with the EU's Common Fisheries Policy (CFP)(2) . Each year, total allowable catch (TAC) quota for different fish species are agreed upon by the countries permitted to fish in the Baltic Sea. Each country is then allotted a predefined percentage of the TAC, according to the available stocks and the nation's historical rights. The annual TAC quota are determined following the scientific advice by the International Council for the Exploration of the Sea (ICES) based on an analysis of the current status of the stocks in terms of biomass and fishing mortality rates of that year for different areas delineated according to the ICES sub-square division of fishery areas in the Baltic Sea. Difficult political negotiations on the TAC quota often implies that the agreed upon TAC quota for a given year exceed the actual quota recommended by ICES.

(1) Agreement between the European Community and the Government of the Russian Federation on cooperation in fisheries and the conservation of the living marine resources in the Baltic Sea (COM(2006)0868–6-0052/2007–2006/0309(CNS)). IBSFC was dissolved 1 January 2007.

(2) EC Council Regulation no. 2371/2002, relating to sustainable utilisation of fish resources within the European Community.

Table 3.2 Comparison of Total Allowable Catch 2007-2008[1]

Fish Species	Location (ICES Squares)	TAC Quota 2008 (tonnes)	TAC Quota 2007 (tonnes)	Swedish Quota 2008 (tonnes)	Swedish Quota 2007 (tonnes)
Cod	East (25-32)	38765	40805	9022	9497
	West (22-24)	19221	26696	2989	4152
Herring	Area 25-29 + 32	152630	132718	51047	44389
	Area 22-24	44550	49500	7929	8806
	MU – 3	87440	91600	15676	16501
	Bay of Riga	36094	37500		0
Sprat	All areas	454492	454492	86670	86670
Salmon	All areas	364392 (pieces)	428607 (pieces)	102068 (pieces)	120080 (pieces)
Plaice	All areas	3201	3766	173	203

Within the framework laid out by the CFP, national governments may determine their own policy with respect to their Territorial Waters up to 12 nautical miles. Many countries have, for instance, banned trawling from coastal waters. Fishery regulation is also exercised through minimum mesh size, minimum landing size, closed areas/seasons and gear-specific measures to enhance the selectivity in the fisheries. Harvest control rules based on fishing days (specifying the number of days allowed at sea) have also been introduced[2].

3.2.2 Fish Stocks

Around 30 species of fish are caught in the Baltic, but commercial fisheries are dominated by just three species - cod (*Gadus morhua*), herring (*Clupea harengus membras*) and sprat (*Clupea sprattus*) - which make up about 90-95 per cent of total weight of commercial catches in the Baltic Sea[3].

Changes in water temperature, salinity and heavy fishing during the last 10-15 years have led to a shift in the fish population from cod to herring and sprat.

(1) Fisheries report on field visit to Sweden. Fishing in the Baltic Sea: Fishermen's Information of Oil and Gas Activities (FOGA) 2008.

(2) Delaney, A.E. 2008. Profiling of small-scale fishing communities in the Baltic Sea. Study prepared for the European Commission. Innovative Fisheries Management. Aalborg. 130pp.

(3) ICES. 2007. Report of the Baltic Fisheries Assessment Working Group (WGBFAS), 17 – 26 April 2007, ICES Headquarters. ICES CM 2007/ACFM:15. 727 pp.

Box 3.1 Cod in the Baltic Sea

Cod

The Baltic cod is economically the most important species in the Baltic Sea. The abundance and distribution of cod has varied considerably over time due to biological as well as anthropogenic causes. The availability of suitable habitats for cod varies between areas and years, depending on the prevailing environmental conditions, in particular the level of oxygen and salinity near the bottom. The stock size further depends on fishing pressure, the abundance of particular prey species, notably the copepod *Pseudocalanus* spp. and the level of predation of cod eggs and fry by sprat, herring and cod itself.

There are two populations of cod inhabiting the Baltic Sea: eastern and western Baltic cod. The eastern cod occurs in the central, eastern and northern part of the Baltic but not in significant amounts in the Bothnian Sea and Gulf of Finland. Areas west of Bornholm including the Danish Straits are inhabited by the western cod population.

Spawning in the eastern Baltic is confined to areas at least 60 to 90 m deep, e.g. the deep waters off the Bornholm Deep, the Gdansk Deep and the Gotland Deep, although the latter two areas have diminished in importance over the last decade.

The spawning stock declined from the historically highest level during 1982-1983 to the lowest level on record in the most recent years. A decline in the landings of cod in the Baltic Sea started in 1985 – the present catch is only half of the 1991 catch[(1)].

(1) Ibid.

Box 3.2 Herring in the Baltic Sea

Herring

Herring may be regarded as equal to cod in terms of their importance to commercial fisheries. Herring occur in large shoals throughout the Baltic Sea with clearly differentiated stocks in different areas. Herring is a pelagic species feeding primarily on zooplankton in the water column, but to a lesser extent also on fish eggs and fry. For spawning, herring depend on coastal areas, where they shed their eggs that become attached to suitable substrate. Populations of spring spawners and autumn spawners can be distinguished. Most pelagic fisheries in the Baltic take a mixture of herring and sprat, and this contributes to uncertainties in the actual catch levels. The decline of the spawning stock of central Baltic herring until the end of the 1990s was partly caused by a reduction of mean weight-at-age(1). This has likely been caused by a change in zooplankton (prey) species composition and by an increased competition for food between herring and sprat. Mean weights have stabilised in recent years, and there are even indications of an increase. A decline in the landings of herring in the Baltic Sea started around 1990 – the present catch is only half of the 1991 catch(2).

(1) Mean weight at age is a term used to describe the average size of different year-classes of commercial fish stocks. A reduction in mean weight at age implies that fewer eggs are produced during a single reproductive cycle per fish of a commercial stock.

(2) ICES. 2007. Report of the ICES Advisory Committee on Fishery Management, Advisory Committee on the Marine Environment and Advisory Committee on Ecosystem. ICES Advice, Book 8. The Baltic Sea. 2007.

Box 3.3 Sprat in the Baltic Sea

Sprat

Sprat live in shoals throughout the Baltic Sea. The sprat is an open-sea species and rarely found along the coast. Sprat migrate in open water areas, seeking out warmer water layers during different seasons. They eat zooplankton, with a preference for the copepod *Acartia* spp., as well as cod fry. In contrast to herring, they spawn in the open water column, but often near the slopes of basins. The basins are in deep areas of the Baltic Sea which include the Bornholm Deep, the Gdansk Deep and the southern part of the Gotland Deep.

The spawning stock biomass of sprat was low in the first half of the 1980s. In the beginning of the 1990s, the stock started to increase rapidly, and in 1996-1997 it reached the maximum observed spawning stock biomass of 1.8 million tonnes. The stock size increased due to the combination of strong recruitment and declining natural mortality (the effect of declining stocks of cod biomass). Since 1998, the stock has continued to fluctuate at a high level. The stock is considered to be exploited sustainably[(1)].

Box 3.4 Other fisheries stocks in the Baltic

Other fisheries stocks

Other species of commercial interest are eel (*Anguilla anguilla*), salmon, trout (*Salmo trutta*), flounder (*Platichthys flesus*), plaice (*Pleuronectus platessa*), pike (*Esox lucius*), perch (*Perca fluviatilis*), pike-perch (*Stizostedion lucioperca*), smelt (*Osmerus eperlanus*), and whitefish (*Coregonus lavaretus*). Most of these species are predominantly caught in coastal waters. Flounder which is caught further offshore accounts for the highest landings in weight. Salmon is still seen as a valuable species even though it only accounts for 1% of all catches[(2)].

3.2.3 Fishing Gear and Type

Different types of fishing gear are used in the Baltic. The main types of gear deployed are demersal and pelagic trawls, gill nets, pound nets and to a lesser extent Danish seine and long line fishing.

(1) Ibid.

(2) http://www.greenpeace.org/raw/content/denmark/press/rapporter-og-dokumenter/baltic-recovery.pdf (accessed on 29 January 2009).

Gill nets and demersal trawls are the dominant fishing methods in cod fisheries. Increasingly, long lines are used at the expense of gillnet fishing. Mid-water trawls are sometimes used for catching cod when low oxygen conditions prevent the fish species from living near the bottom. Gill nets are set nets, measuring approximately 50 metres in length and 2 metres high, positioned on the seabed along a straight line:

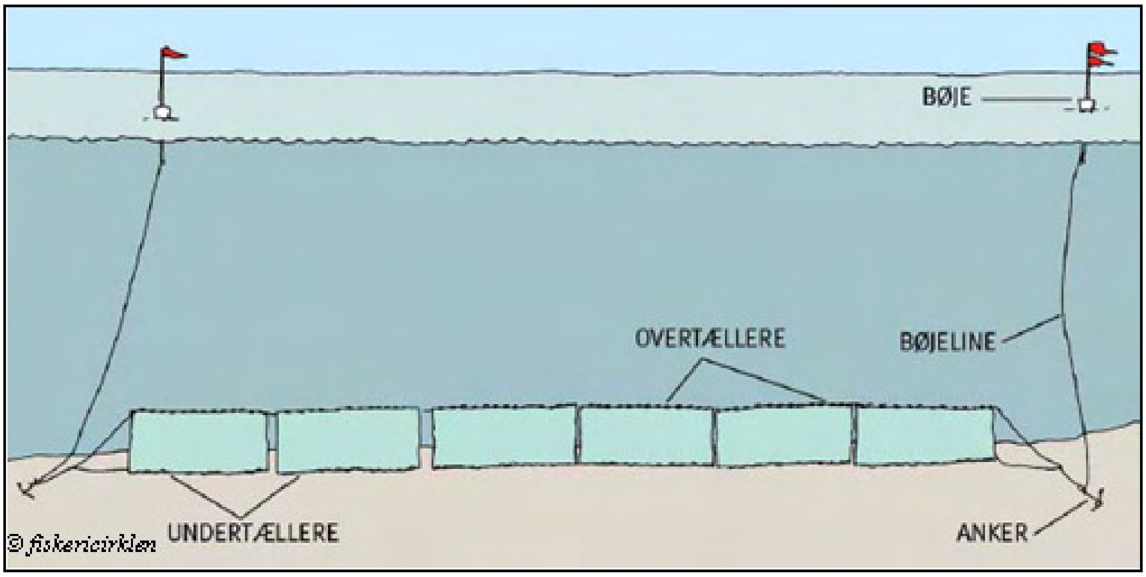

Figure 3.2 Illustration of typical gill net used in cod fisheries(1)

Legend: Bøje = buoy; Bøjeline = buoy line; Anker = anchor; overtællere = floatline; undertællere = weighted groundline

Bottom trawling or demersal trawling is done by towing a cone-shaped net over the bottom. The most common trawl net used in the Baltic are so-called otter trawls, which take their name from the rectangular trawl ‘doors’ or ‘otter boards’ that pull the wings of the net apart and keep the mouth of the net open horizontally during towing. A ground-rope at the mouth of the trawl, often fitted with wheel-like 20-50 cm ‘bobbins’ and/or rubber discs in the central part to aid rolling, provides good contact with the bottom(2). Some trawlers use a twin trawl system, where two nets are towed behind a ship with a heavy clump weight in the middle(3). There are some vessels

(1) FOGA. 2008. Fisheries report on field visit to Sweden. Fishing in the Baltic Sea: Fishermen’s Information of Oil and Gas Activities.

(2) C.C.E. Hopkins. 2003. The dangers of bottom trawling in the Baltic Sea. Coalition Clean Baltic.

(3) FOGA. 2008. Fisheries report on field visit to Denmark. Fishing in the Baltic Sea: Fishermen's Information of Oil and Gas Activities.

using heavy ground trawling gear for operating on rough seabed but these have declined in numbers, and represent only a small part of the fleet(1).

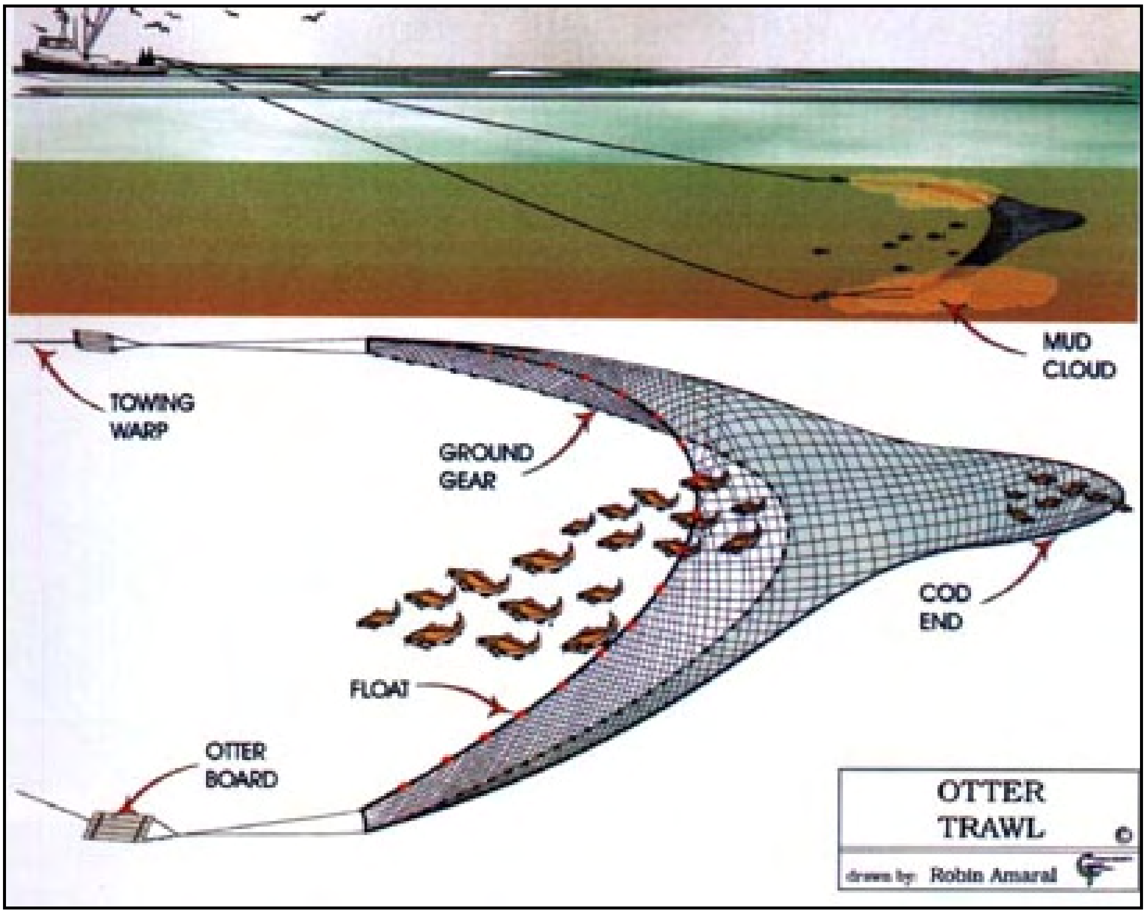

Figure 3.3 An "otter trawl" showing some of the main components in its design(2)

Pelagic or mid-water trawling in the Baltic mainly targets herring and sprat. Both species can be caught depending on the area and season. In pelagic trawling a trawl net is towed by one or a pair of vessels. The net is maintained at a certain depth in the water column by using different net weights, “otter boards” and echo sounding.

(1) FOGA. 2008. Fisheries report on field visit to Finland. Fishing in the Baltic Sea: Fishermen's Information of Oil and Gas Activities.

(2) http://www.fishingnj.org/diaotter.htm (accessed on 7 January 2009).

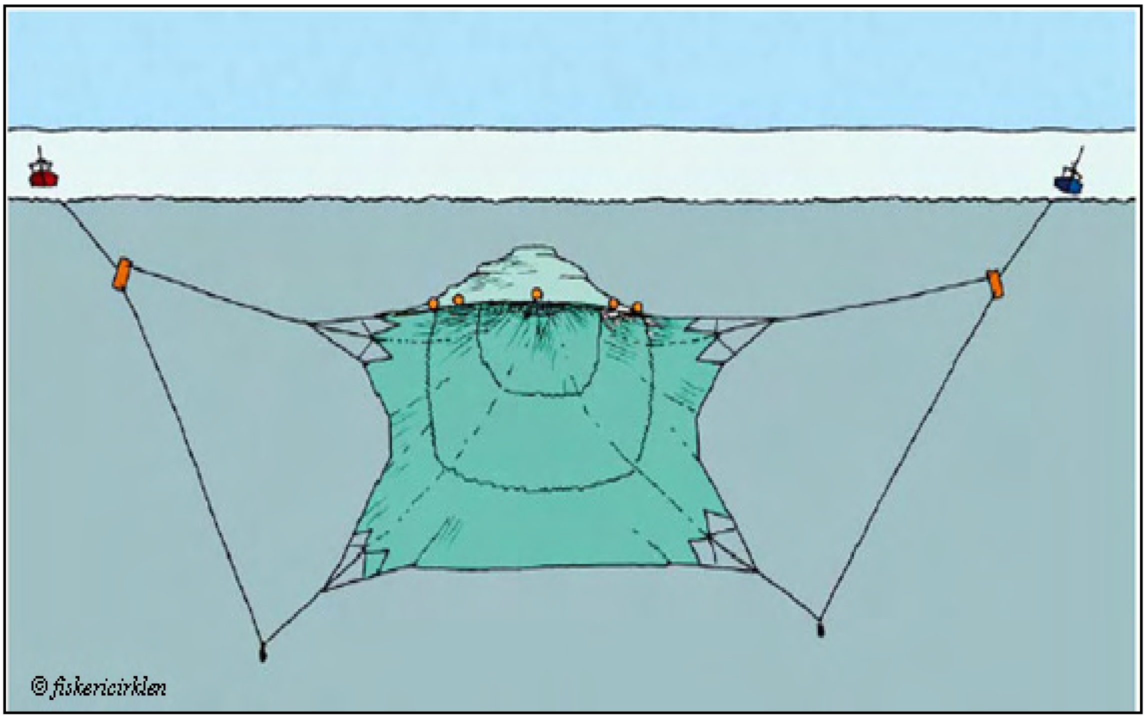

Figure 3.4 Front view of a pelagic trawl[1]

In pelagic trawling and demersal trawling, the fishing vessels overlap. Many of the vessels use both pelagic trawl and demersal trawl or the same gear is used in both fisheries. There are no restrictions on the size of commercial fishing vessels in the Baltic Sea; however, at present the largest are about 300 Gross Register Tonnage[2], with a maximum bollard pull of approximately 25 tonnes. The trawl-board size of fishing vessels in the Baltic Sea is generally in the range of 300-500 kg; at present the maximum size is three tonnes. The clump weight[3] used in twin trawling in Baltic Sea fishing vessels weighs up to three tonnes.

In the Baltic herring fishery, pelagic trawling fishing exploits the younger part of the Baltic herring stock and demersal trawling is focused on the more adult part of the stock[4]. Mid-water trawls are used throughout the Baltic Sea, whereas demersal trawls are used mainly in the Baltic Proper and the south-western Baltic.

(1) FOGA. 2008. Fisheries report on field visit to Finland. Fishing in the Baltic Sea: Fishermen's Information of Oil and Gas Activities.

(2) Gross Register Tonnage is a measure of the total internal volume of a vessel. Maximum Bollard pull is an indication of the maximum pulling force that a ship can exert on an object (eg. trawling net or another ship).

(3) Clump weight is a weight added to bottom line of the trawl net to keep net correctly positioned in the water column or at the bottom.

(4) ICES. 2007. Report of the Baltic Fisheries Assessment Working Group (WGBFAS), 17 – 26 April 2007, ICES Headquarters. ICES CM 2007/ACFM:15. 727 pp.

In coastal areas, fishing is carried out with trap-nets/pound-nets and gill nets as well as with bottom trawls.

In offshore waters, salmon are caught by drift nets and long lines and during the spawning run they are caught along the coast, mainly in trap nets and fixed gillnets. Where fisheries are allowed in the river mouths, set gill nets and traps nets are used.

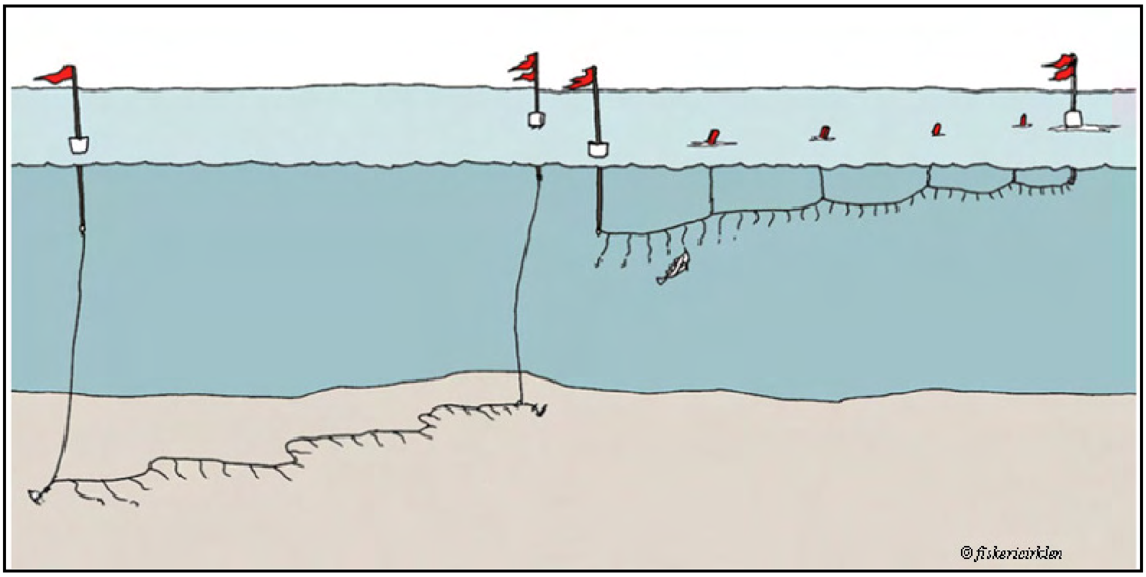

Figure 3.5 Illustration of longline fishery[1]

The coastal fishery targets a variety of species with a mixture of equipment including fixed gears (e.g. gill, pound and trap nets, and weirs) and Danish seines. The main species exploited are herring, salmon, sea trout, flounder, turbot, cod and freshwater and migratory species (e.g. whitefish, perch, pikeperch, pike, smelt, vendace, eel and turbot).

3.2.4 Overview of Baltic Sea Fisheries along the pipelines' route

For the purposes of this impact assessment study, it is important to focus on those fisheries that are potentially affected by the Project. In essence, this corresponds primarily to the trawl and gill net fisheries taking place adjacent to or across the pipelines' route, including near the landfall

(1) FOGA: 2008. Fisheries report on field visit to Finland. Fishing in the Baltic Sea: fishermen's Information of Oil and Gas Activities.

areas. To this end, Ramboll has compiled fisheries data on each of the ICES sub-squares near or overlaying the pipelines' route[(1)].

The total catch in weight and value by species in fishing areas along the pipelines' route are illustrated below. The graphs are compiled on the basis of data obtained from the national offices for fisheries management in the various countries around the Baltic[(2)]. The bulk of the catch comes from trawling. Regrettably, no data could be obtained from Germany and Russia. Nonetheless, the picture shows the importance of the three main species in the overall catch of the Baltic in ICES squares along the pipelines' route. The highest catches are reported around Bornholm and to a lesser extent east of Gotland and at the mouth of the Gulf of Finland.

(1) The area of an ICES sub-square covers 0.5° N-S and approximately the same distance E-W, representing about 55 km x 55 km = 3,025 km².

(2) Catch data refer to the sum of officially reported catches for boats of 10 m or more and to estimates of the catches by respective fishery authorities for vessels smaller than 10 m.

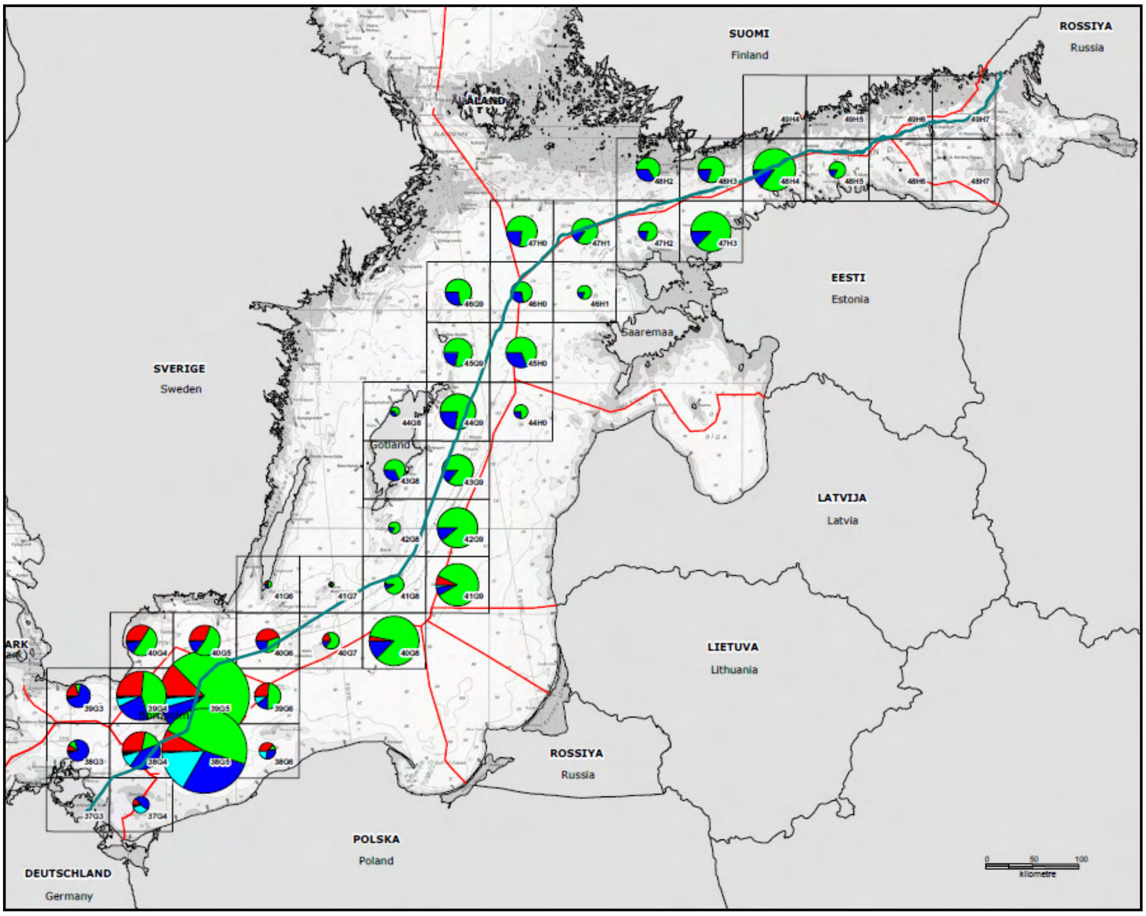

Figure 3.6 **Total catches (in weight) by species in the ICES sub-squares in 2005 (see also Atlas Map FC-6)**

Legend: Green = sprat; red = cod; blue = herring; light blue = flounder; and black = all other species

This figure shows that in 2005 the most important areas of fisheries were in the western parts of the Baltic Sea in particular to the north and east of Bornholm; in the Baltic Proper south and east of Gotland; and to some extent also at the entrance to the Gulf of Finland. The country reports prepared by FOGA[1], corroborate this finding. In general, the most important species in terms of weight is sprat and in terms of value, cod. In addition to the three most important species – sprat, cod and herring **–** flounder and salmon are also important in the southern parts of the Baltic Proper and in the western Baltic Sea.

(1) FOGA. 2008. Fisheries reports on field visits to countries fishing in the Baltic Sea: fishermen's Information of Oil and Gas Activities. Studies commissioned by Nord Stream.

From the information collected from the ICES sub-squares along the pipeline, the most important nations in relation to catches in the various squares can be identified. A comparison of the fisheries by nationality, excluding German and Russia, suggests that Sweden, Denmark and Poland represent the “biggest fishery nations” of the Baltic Sea.

In **Atlas Maps FC-10** to **FC-16** total catches by weight of the individual nations – Estonia, Latvia, Lithuania, Finland, Sweden, Poland and Denmark are presented. These show that in 2005 the majority of fishing vessels fished close to their national borders, although vessels from all nations frequent the area around Bornholm. This underlines the transboundary nature of fishing in the Baltic Sea.

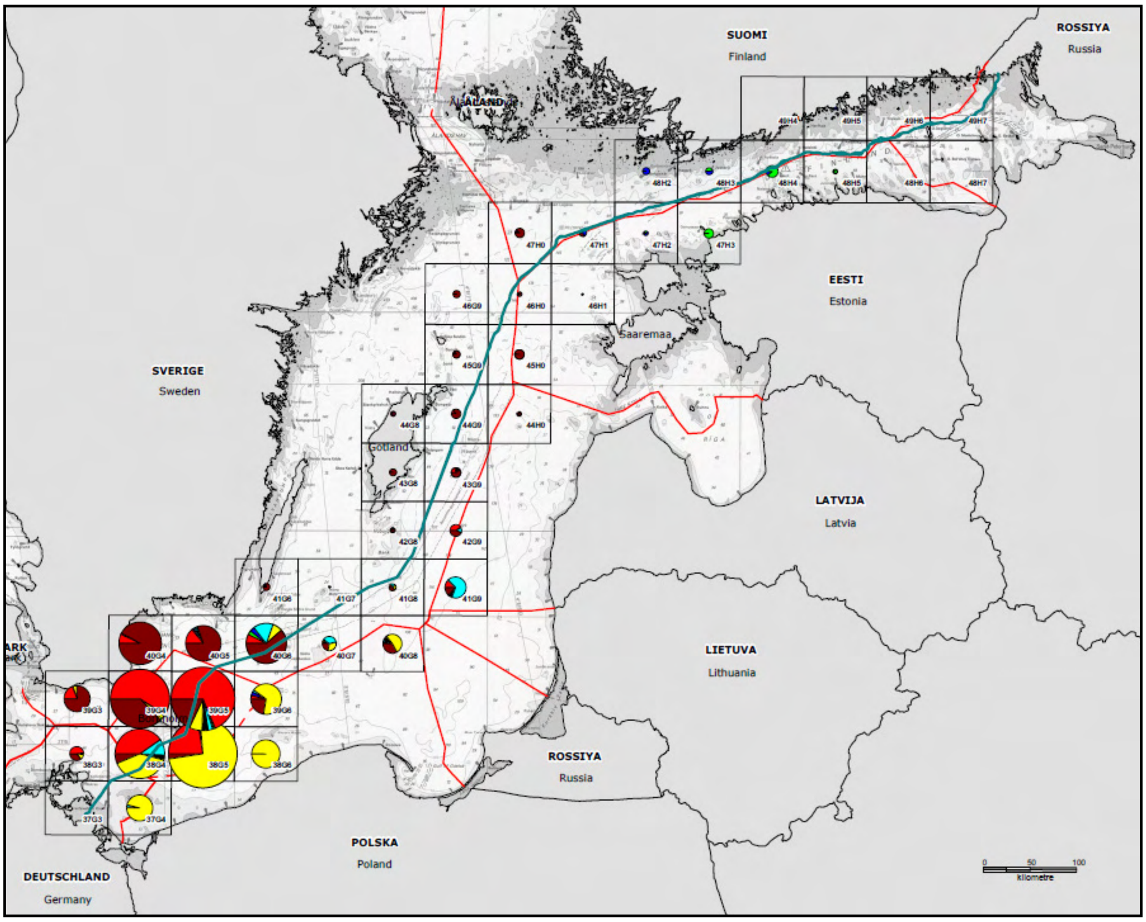

Figure 3.7 **Fisheries by nationality/value 2005**

Legend: red = Denmark; brown = Sweden; dark blue = Finland; green = Estonia; light blue = Latvia; black = Lithuania; yellow = Poland

In essence, these data show where the main fishing grounds are for the trawlers along the pipelines' route.

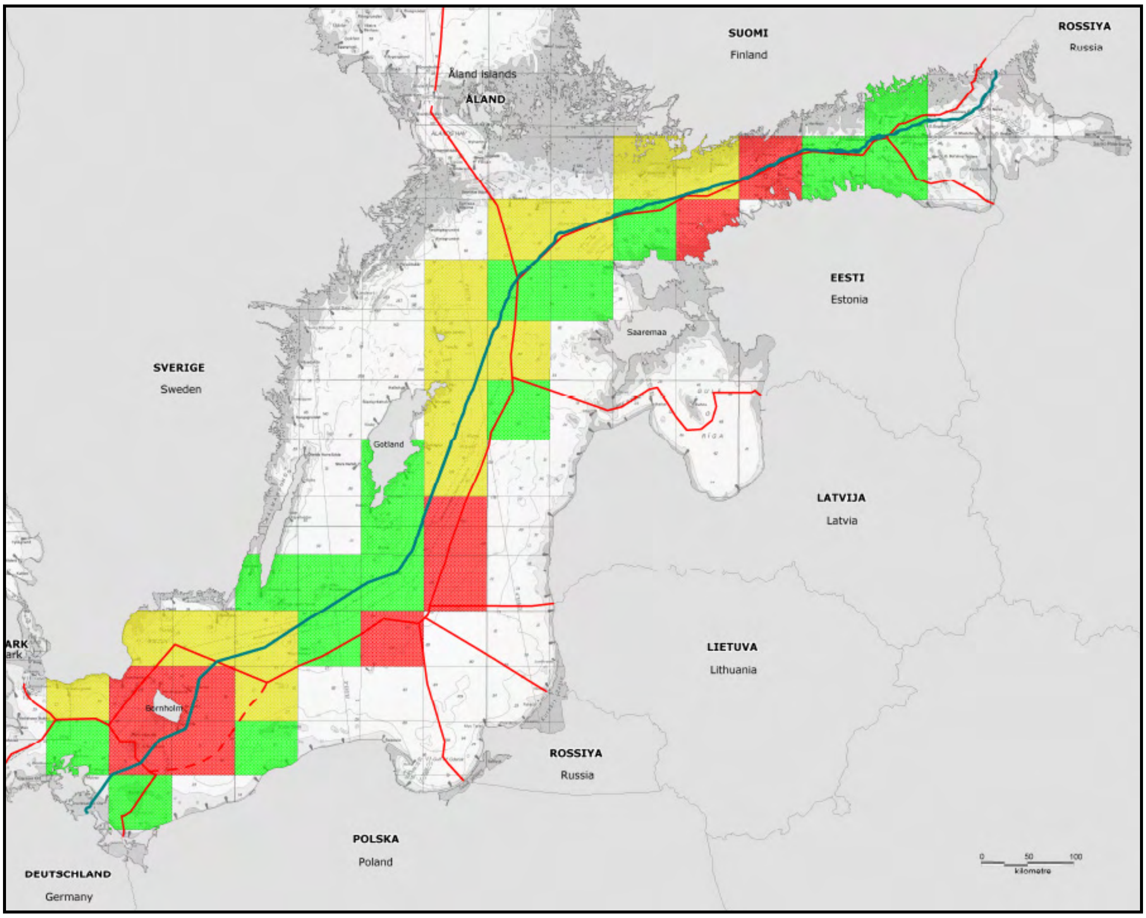

Figure 3.8 Trawl areas along the pipeline (see also Atlas Map FC-2)

Red areas are of very high importance to trawling; yellow areas are of importance to trawling; and green areas are of lesser importance to trawling.

In order to protect the Baltic fish stocks, specific management measures have been taken. Three specific areas in the Baltic Sea are currently closed to all fishing from 1 May to 31 October. The areas are: Bornholm Deep, Gdansk Deep and Gotlands Deep (although there is an exemption for salmon caught on hooks or in nets with a mesh width of 157 mm or more). Furthermore, a total ban on fishery at a distance of 4 nautical miles around the island of Gotska Sandön is in place. The areas can be seen in figure below (which also depicts the areas that are close to fishing during the spawning period of the Baltic herring in Portovaya Bay and the Greifswalder Bodden respectively) and on **Atlas Map FC-1**.

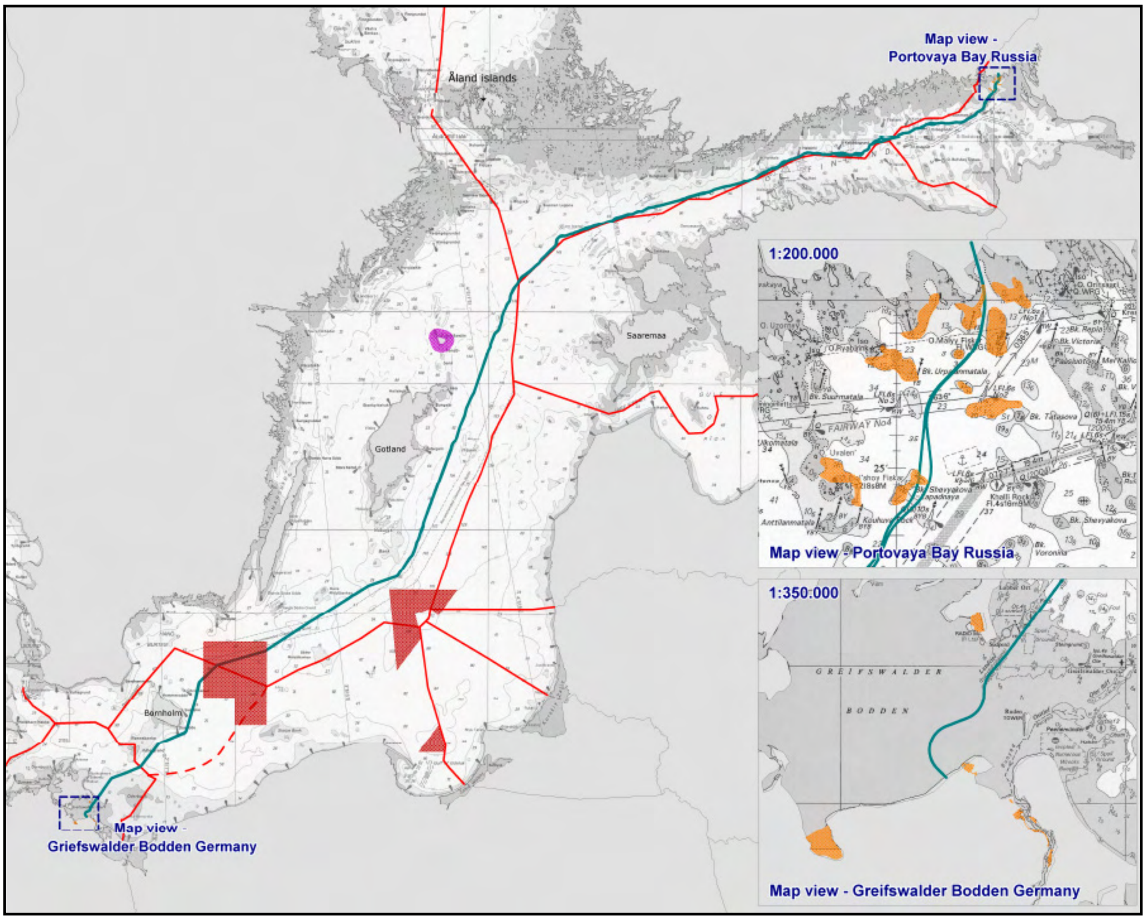

Figure 3.9 Protected areas where fishing is restricted

Areas closed to fishery from May to 31 October are marked with red and the area where fishing is prohibited at all times is marked with purple. Orange areas at the landfall sites are closed to fishing during spawning period of the Baltic herring (see also **Atlas Map FC-1**).

The different fishing nations around the Baltic support a widely varying fleet. A description of the type of fishing in each country is provided in **Chapter 8** of the Espoo Report (**8.12.2**). It is based on fleet statistics maintained by the EC Directorate General of Fisheries(1) and ICES(2).

(1) http://ec.europa.eu/fisheries/fleetstatistics/index.cfm?lng=en (accessed on 29 January 2009).

(2) ICES. 2007. Report of the Baltic Fisheries Assessment Working Group (WGBFAS), 17 – 26 April 2007, ICES Headquarters. ICES CM 2007/ACFM:15. 727 pp.

3.2.5 Summary

Fishing is important to a number of coastal communities in the countries around the Baltic. Outside coastal areas, trawls are the main type of gear used in the Baltic Sea. Pelagic trawls are used mainly to capture herring and sprat, and bottom trawls are used mainly for cod and flatfish. The intensity of trawling varies from area to area. The area around Bornholm is by far the most important bottom trawling area attracting fishermen from nearly all of the countries around the Baltic. It is particularly important in terms of cod. Other important areas comprise the area southeast of Gotland and to a lesser extent the area at the mouth of the Gulf of Finland, although this area tends to be fished by pelagic trawlers targeting herring and sprat.

The landfall area in Germany, Greifswalder Bodden, constitutes an important fishing area for herring and to a lesser extent for a variety of freshwater species too. Fishing in this area is largely carried out by passive gear. Herring are also caught in the eastern part of the Gulf of Finland outside Portovaya Bay while freshwater species are caught closer inshore.

The type of gear used, the target species and the fishing area determine to a large extent whether fisheries are potentially affected by the Project. In general, it can be assumed that fishermen deploying bottom trawls near the pipelines' route or those fishing near the landfall area will be most critical of the Project in view of the perceived risk of entanglement or damage to the trawl gear by the pipelines and possible environmental impacts on the fish stocks. Pelagic trawls, longline fishing, gillnets or other passive gear on the other hand are more compatible with the proposed Project, unless it would appear that the stock of particular target species may be directly affected (i.e. during spawning) or that favoured fishing zones need to be avoided. In view of the uncertainty involved and the fact that fisheries are important to both livelihoods and regional revenues in many coastal areas, fisheries are considered of medium sensitivity.

4 Possible Impacts on Fish and Fisheries during Construction, Pre-commissioning and Commissioning

It is considered that the possible effect on fish and fishing during the laying phase of Nord Stream is caused by the following:

- Movement of pipelay and support vessels during munitions clearance, seabed intervention works, pipelaying and anchor handling hyperbaric tie-in activities, resulting in:
    - Restriction on navigation for fishing vessels
    - Disruption of current fishing patterns
- Re-suspension and spreading of sediments from seabed intervention works, pipelaying, hyperbaric tie-in activities and anchor handling resulting in:
    - Increase in turbidity
    - Release of contaminants
- Construction and support vessel movement, munitions-clearance, seabed intervention works and construction and support vessel movement resulting in:
    - Noise and vibration
    - Visual / physical disturbance
- Pipeline flooding, pressure testing and pressure-test water discharge resulting in:
    - Noise and vibration
- Pressure-test water discharge resulting in:
    - Noise and vibration
    - Change in water quality

4.1 Impact on Fish during the Construction Phase

4.1.1 Munitions Clearance

Thirty one conventional munitions will be cleared by detonation in Finland, while one will be cleared in Sweden. Predictions exist regarding fish mortality due to the detonation of munitions during clearance operations. These published regressions lines for "probability of mortality"(1) show that, for example, the probability of mortality is 25%-35% at a horizontal distance of approximately 200 m for a charge weight of 150 kg. These impacts will be restricted to a discrete number of detonations in Finland and Sweden and restricted to the location of the mine and its immediate surroundings.

This has resulted in impacts to fish from munitions clearance events being assessed to be of minor to moderate significance. Fish are expected to return once munitions clearance has completed. The overall impact of munitions clearance on fishing patterns is therefore assessed to be **minor**.

4.1.2 Seabed Intervention Works, Pipelaying, Anchor Handling and Hyperbaric Tie-In Activities

Seabed interventions works, pipe-laying, anchor handling and tie-in activities will lead to avoidance reactions in fish in the immediate vicinity of the pipelines' corridors during the short period of construction activity. Among the impacts they cause are noise and vibration from construction and support vessels as well as the release of contaminants and increased turbidity from disturbance to the sediment. Fish will return to the area once the disturbance has ceased and turbidity has returned to normal (a matter of one or two days). The area affected will be limited to the pipeline corridor and the duration of the disturbance at any single location will be short. Impacts to fish spawning will be limited because of the precautionary measures that will be taken to avoid such areas during the spawning seasons. Fishermen will therefore be able to avoid construction activity areas without significant disruption to their normal fishing patterns.

Increase in turbidity

Re-suspension of sediments and consequent increases in turbidity will result from anchor handling, seabed intervention works, hyperbaric and above water tie-in activities. These are considered as the main impacts likely to affect fish. The greatest impact from these activities is expected to be caused by dredging which is conducted only in the shore approach areas in Russia and Germany. Dredging will lead to concentrations of suspended sediment exceeding 1 mg/l for over 72 hour in places at a distance of 1 km from the pipelines due partly to the muddy

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(1) Baxter, I., Hays, E., Hampson, G. and Backus, R., 1982, "Mortality of fish subjected to explosive shock as applied to oil well severance on Georges Bank", Woods Hole Oceanographic Institution, Ch. WHOI-82-54.

nature of the sediment, and for up to 12 hours at a distance of 7 km from the pipelines. This may potentially cause physiological damage to any fish species, eggs or larvae that are present in the areas of increased turbidity.

The reproductive success of certain species will be affected by elevated turbidity as a result of construction works at the sea bottom and will impact spawning in the following ways:

- Re-settling sediment may smother eggs and larvae, as well as prey items
- High suspended sediment concentrations may displace adults away from their natural spawning areas

Construction works are scheduled to avoid spawning areas during the spawning season in order to reduce or eliminate potential impacts on flora and fauna including fish. Therefore, herring spawning will not be impacted. However, as a result of increased turbidity, eggs that are spawned late in the season and their larvae may be affected. The overall population size in the area along the pipeline route is not likely to be affected as a result of eggs and larvae being disturbed due to immigration of fry from adjacent areas, which remain unaffected by the works. Impacts on these species due to munitions clearance, seabed intervention works and pipe-laying will therefore be **insignificant**.

Anchor Handling

Throughout the construction phase, anchors from the construction vessels will have to be lifted and repositioned as the vessel progresses along the pipeline route. The repositioning of the barge with anchors will lead to sections of anchor wires slowly sweeping the seabed. An additional impact is the action of ship propeller wash in shallow water which will also give rise to increased turbidity.

It is planned to use a Dynamically Positioned Vessel (DPV) to lay pipeline one (northwest pipeline) for KP 7.5 to KP 300. A DPV may also be used to lay pipeline two (southeast pipeline) from KP 7.5 to KP 300, depending on availability. Use of the DPV will minimise the increase in turbidity resulting from construction works and anchor handling in this area.

The lifting of anchors off the seabed and the repositioning back on the seabed will give rise to limited increased turbidity. However, in comparison to turbidity as a result of fishing and trawl nets, these impacts are considered to be **insignificant**.

The following mitigation measures are planned to be carried out where possible, to address or reduce the significance of the identified potential impacts associated with anchor handling on spawning fish:

- Where practical pipe lay will be scheduled to minimise impacts within the main fish spawning area

Trenching and Dredging

Trenching and dredging will result in increased turbidity and could potentially cause physiological damage to any fish. Flatfish are habituated to turbid conditions associated with living on the seabed and thus are not sensitive to increased turbidity. Studies also show that increased turbidity has little effect on the ability of juvenile cod to locate prey [(1)]. Where no halocline exists a number of sensitive pelagic species such as Atlantic salmon, European eel and herring could potentially be affected by increased turbidity. Much of the seabed along the proposed pipelines' route where trenching or dredging will be conducted is nevertheless sandy or hard bottomed and is not likely to be disturbed or remain suspended in the water column for long periods of time.

The sediment dispersion modelling carried out indicates minimal re-suspension of sediment will result from trenching activity and re-suspended sediment will settle relatively quickly. Subsequently, increases in turbidity and levels of re-settling sediment will be minimal in this important spawning and nursery grounds. Thus, it is unlikely that significant numbers of eggs and larvae will be smothered or that significant displacement of adults from spawning grounds will occur.

The following mitigation measures are planned to be carried out where possible, to address or reduce the significance of the identified potential impacts associated with seabed intervention works on spawning fish:

- In order to reduce the volume of re-suspended sediments, the pipelines' route has been optimised to reduce the extent of seabed intervention works required

- Use of a pipeline plough rather than jetting techniques to lower the pipeline in discrete offshore sections

Tie-In Activities

Both pipelines will be tied in by means of a seabed tie-in (hyperbaric) at KP 300 located in the western Gulf of Finland and at KP 675 to the east of Gotland. Both locations do not lie in or near an important spawning ground. The zone of elevated turbidity will be localised and is expected to be minimal and remain beneath the halocline. Due to the tie-in activities being of a highly

(1) Meager, J.J., Solbakken, T., Utne-Palm, A.C. and Oen, T., (1978) Effects of turbidity on the reactive distance, search time, and foraging success of juvenile Atlantic cod (Gadus morhua).

localised nature, in addition to the presence of a halocline, the vast majority of species will not be affected by an increase in turbidity and the impact is deemed to be **insignificant**.

The lifting of the pipelines off the seabed during above water tie-in activities at KP 1,195.9 and their repositioning back on the seabed will give rise to limited increased turbidity. However, in comparison to turbidity as a result of fishing and trawl nets, these impacts are considered to be minimal and therefore **insignificant**.

Release of contaminants

The re-suspension of dissolved contaminants in the water column from re-suspended contaminated sediment could, theoretically, raise the concentration of contaminants in the food chain and affect fish spawning and the fish themselves. In ESR III and IV, eggs and larvae from pelagic spawners will remain in the upper layers of the water column and will not be affected by the release of contaminants immediately above the seabed.

The sediments in ESR I, ESR II and ESR V contain elevated levels of contaminants. Contaminants of concern include heavy metals and organic compounds including polyaromatic hydrocarbons (PAHs). Fish exposed to elevated concentrations of contaminants will absorb contaminants through their gills, accumulating it within the liver, stomach, and gall bladder, which can lead to long-term, sub-lethal effects. Adult fish are mobile and generally able to detect heavily contaminated areas(1) or areas of low water quality. Pelagic species in contaminated waters will be affected by the elevated concentrations of dissolved contaminants. The duration for which PAH concentrations are expected to be greater than the Predicted No-Effect Concentration (PNEC) is 14 hours. Once fish move away from the source of contamination they can metabolise the pollutants and cleanse themselves within a few weeks of exposure (2),(3). The period of exposure is therefore short and, in addition, fish are likely to avoid areas of elevated turbidity, where suspended contaminants may occur. Some fish species such as perch and roach use turbidity as a refuge when macrophytes are not present (4) and therefore these species may be subject to higher levels of contaminants as a result. However, ongoing works will result in increased noise and vibration, therefore fish will move away from the areas of increased turbidity due to increased noise levels.

(1) IPIECA. 2000. Biological Impacts of Oil Pollution - Fisheries. IPIECA Report Series. Vol.8.

(2) GESAMP (IMO/FAO/UNESCO/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Pollution. 1993. Impact of Oil and Related Chemicals and Wastes on the Marine Environment. UNEP.

(3) Heath, A.G. 1995. Water Pollution and Fish Physiology. second ed. Lewis Publishers. Boca Raton. FL.

(4) Pekcan-Hekim, Z., (2007) Effects of turbidity on feeding and distribution of fish. Doctoral dissertation (article-based). University of Helsinki. Faculty of Biosciences. Department of Biological and Environmental Sciences, Aquatic Sciences.

In ESR V, the period of exposure could potentially be considerable. The following mitigation measures are planned to be carried out where possible, to address or reduce the significance of the identified potential impacts associated with dredging on spawning fish:

- A 3-walled cofferdam will be constructed in order to limit the extent of dredging required and minimise the spreading of sediment
- The pipelines will be installed in 'one' installation season
- A single very narrow trench will be created to limit the affected surface area

4.1.3 Noise and Vibration

A potential impact to fish will arise from increased levels of underwater noise and vibration as a result of construction. These impacts could arise from a number of activities during the construction phase, particularly seabed intervention works, pipe-laying and construction and support vessel movement and operations. Elevated underwater noise levels can affect fish by causing tissue damage (including damage to hearing apparatus) and changes in behaviour (including avoidance and attraction).

The nature and magnitude of the impacts of noise on fish vary greatly between species due to their differing hearing abilities and resultant sensitivity to noise. It has been shown that all species of fish are able to hear, but the frequencies that different fish species are able to hear vary significantly from 30 Hz to 4 kHz.

In ESR I for example, herring is one of the most sensitive species to noise impacts and can hear in an extended range of frequencies of between 30 Hz and 4 kHz with a hearing threshold of 75 decibels (dB) re 1 µPa at 100 Hz[(1)]. Herring are demersal spawners, depositing their eggs on coarse sand, gravel, stones and rock. Increased noise levels in these areas will impact spawning success rates of Baltic herring if construction is carried out during the spawning season between May and June[(2)]. Therefore, Nord Stream has set up its construction schedule so that no works will be carried out in the near shore areas, in water depths of between 3 and 17m between the 15th April and 15th June. Thus there will be no impact on herring spawning as a result of noise.

Fish may also exhibit behavioural changes in response to lower level intermittent or continuous noise sources, however, these are often hard to detect. Behavioural changes will typically involve a cessation of normal activities and the commencement of avoidance or 'startle' behaviour as a result of the detection of sound from marine construction activity. Continued

(1) Enger, P.S. 1967. Hearing in Herring. Comparative Biochemistry and Physiology. 22: 527-538.

(2) http://www.rktl.fi/english/fish/fish_atlas/herring/ (accessed on 29 January 2009).

detection of noise activity by fish often results in habituation to the sound, followed by a re-commencement of normal behaviour(1).

Vessel Movement

Fish can acclimatise to noise sources and studies have demonstrated this ability(2). The species inhabiting the pipelines' route are already likely to be habituated to vessel noise from other marine traffic and the addition of a pipe-laying vessel is unlikely to represent a significant increase in underwater noise. A study of spawning herring in Norway was carried out to investigate the effects of repeated passage (at a distance of 8 – 40 m, in 30 – 40 m of water) of a research vessel with a peak noise level of around 145 dB re 1uPa 1Hz within the range 5 – 500 Hz. This study showed that the vessel had no detectable reaction amongst the spawning herring(3). The maximum level of noise anticipated from the vessels is 162 dB. This is slightly higher than that of a fishing trawler (158 dB) and lower than that of the large tankers (177 dB) that are known to operate in the Baltic(4). Impacts on fish as a result of increased vessel noise are deemed to be **insignificant**.

Munitions Clearance

Tissue damage or death is likely to occur when fish are in the immediate vicinity of loud, sudden noises and pressure waves such as that caused by the accidental explosion of munitions (see above **4.1.1 Munitions Clearance**).

Dredging and Trenching

Dredging and trenching are expected to emit similar underwater noise levels. In terms of trenching (and therefore dredging), studies have shown that fish may be able to detect noise at peak levels of 178 dB at 1 metre from the source at 160 Hz, with an overall source level of 185 dB at 1 metre(4). These studies have shown that fish may be able to detect noise of this frequency and magnitude at distances of more than 10 km.

The hearing threshold for herring at 160Hz is approximately 76 dB re 1µPa. The peak noise levels during dredging are significantly greater than this threshold. For Clupeids (herring and sprat), injuries have been reported due to noise exposure at sound levels of 153 to 180 dB re

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(1) Knudsen, F.R., Enger, P.S. and Sand, O. 1992. Awareness reactions and avoidance responses to sound in juvenile Atlantic salmon, Salmo salar L. Journal of Fish Biology. 40: 523-534.

(2) Chapman, C.J., and Hawkins, A.D. 1969. The importance of sound in fish behaviour in relation to capture by trawls. FAO Fisheries Reports 62(3): 717-729.

(3) Skaret, G., Axelsen, B. E., Nottestad, L., Ferno, A. and Johanssen, A. 2005,"The behaviour of spawning herring in relation to a survey vessel, ICES Journal of Marine Science. 62: 1061- 1064.

(4) Thomsen, F., Lüdemann, K., Kafemann, R. & Piper, W. 2006. Effects of offshore wind farm noise on marine mammals and fish. Biola, Hamburg on behalf of Cowrie.

1µPa. Pile driving can generate noise of similar levels to dredging and this has been shown to cause severe injury or mortality of fish in the direct vicinity of the piling (10–12 m). However, due to the presence and passage of vessels in the areas where these activities take place, it is expected that fish will move out of the vicinity of the pipelines prior to noise reaching levels that could cause injury.

Rock Placement

Noise generated from rock placement is not expected to exceed background noise beyond the immediate vicinity of the works and thus **no impact** on fish is anticipated as a result of this activity.

Summary

As loud noise usually initiates an avoidance response, fish will move away from the pipelines while construction is carried out and return once construction has completed. The impacts of noise generated from construction on fish will be local **temporary** and of **low** intensity and therefore of **minor** significance.

4.1.4 Visual/physical disturbance

The presence and passage of vessels may have some impact on pelagic fish present in the area such as herring, cod, sprat and Atlantic salmon during construction. The increase in vessel traffic however, is unlikely to be a significant increase over existing background levels. The presence of pipe-laying vessels at any one location along the pipelines' route will be for a short duration, as 2 to 3 km of pipeline will be laid per day. The Baltic Sea is a heavily navigated waterway and vessels associated with commercial shipping and fishing vessels will regularly pass through the Project area (see **Atlas Map SH-1**). The addition of an extra few construction vessels over these short periods will not represent a significant increase, particularly because there will be an exclusion zone imposed on other non-project vessels. Due to this, the impact of the presence and passage of vessels on fish is therefore anticipated to be **insignificant** within the context of the Baltic Sea.

4.2 Impacts on Fish during the Pre-commissioning and Commissioning Phase

During the pre-commissioning and commissioning phase potential impacts on fish may result from noise associated with the seawater intake and pressure-test water discharge in ESR I. Physical damage to fish eggs and larvae may also arise. However, as fish are known to move away from disturbances, the intake of pressure-test seawater and dewatering associated with pre-commissioning of the pipelines will result in a temporary displacement of fish present in the immediate vicinity of the intake area.

4.2.1 Noise and vibration

Impacts on fish during the pre-commissioning and commissioning phase (pipeline flooding and pressure-test water discharge), and during the commissioning phase as a result of natural gas input to the pipelines, may result as a consequence of underwater noise and vibration. However, these impacts are anticipated to be less significant than those associated with the construction phase, as pre-commissioning activities will be carried out over a much smaller area and over a shorter duration. Impacts are therefore considered to be **insignificant**.

Noise from construction and support vessel movement during pre-commissioning and commissioning may have some impact on pelagic fish present in the area, such as perch, bream, carp, sea trout, herring, and salmon. As with construction, this increase in noise due to vessel traffic in ESR I will not be a significant increase over existing background levels and therefore the impact is considered to be **insignificant**.

4.2.2 Change in Water Quality

Seawater for pressure testing is to be sourced at a depth of 10 m near the Russian landfall. This seawater will be filtered and treated with additives such as an oxygen scavenger to prevent corrosion. The additives that are planned to be used already exist in seawater and are harmless to the marine environment at natural concentrations. A screen will be used in order to minimise and where possible prevent the intake of eggs, larvae or small fish with the seawater.

According to Russian regulations the "Minimum Allowable Concentration" (MAC) of oxygen levels in water allowed to be discharged is 6 mgO_2/l of seawater(1). To comply with this standard Nord Stream will ensure, by dilution, that discharged pressure-test waters will have a minimum

(1) Peter Gaz. 2006. The north European gas pipeline; Offshore section (The Baltic Sea). Environmental Survey. Part 1. Stage 1. Book 5. Final report. Section 1 Russia's EEZ and territorial waters. Folder 1. Moscow.

oxygen concentration of 7 mg/l. Therefore, there will be **no impact** to eggs and larvae development as a result of pressure testing.

4.2.3 Summary

Fish eggs and larvae mostly occur in the upper layers of the water column and are less likely to be impacted by re-suspension of sediments and consequently increased contaminants in the water column. Any changes to the densities of eggs or larvae due to seabed intervention works will therefore have a minimal impact and is assessed to be **insignificant.**

4.3 Impacts on Fishing Activities during the Construction Phase

4.3.1 Increase in Ship Traffic

Project construction activities, including pre-lay surveys, munitions clearance, seabed interventions works, pipe-laying and hyperbaric tie-ins, will result in increased vessel movements along the pipeline corridor. These may potentially hamper the normal passage of trawlers and other fishing vessels as they travel to and from their target stocks. Construction vessels that are free to manoeuvre, such as pipe carriers and supply vessels, present no more risk than other vessels already active in the area. All vessels operate under the International Maritime Organisation's International Regulations for the Prevention of Collision at Sea, which requires vessels to take avoiding action when approaching trawlers.

Annual shipping movements along the main sailing routes through the Baltic Sea range from 53,000 north of Bornholm to 18,000 east of Gotland. In comparison the number of construction vessels is very small. Their impacts will be restricted to a discrete number of locations and will be of short duration. Fishermen will therefore be able to resume normal fishing activities in the area soon after these activities and the effect on catches are not expected to be significant.

Munitions Clearance

All identified conventional munitions that lie within 25 metres of the planned pipeline's route will be cleared by detonation. It is planned to clear 31 conventional munitions identified in the Finnish EEZ and one such munitions identified in the Swedish EEZ. It may be necessary to clear additional munitions from the anchor corridor to facilitate the safe anchoring of the pipelay barge.

Safe and proven clearance methods will be used and these methods will be similar to those previously used to dispose of munitions in the Baltic Sea. The collective navies of the Baltic

States have developed techniques that are both safe and effective for the clearance of mines and other explosive underwater ordnance (for details please refer to Key Issue Paper on Munitions).

A restriction on navigation for fishing vessels will apply during munitions clearance. An exclusion zone will be put into effect around the munitions clearance site which is expected to be in the order of 2 nautical miles from the detonation point. The munitions clearance exclusion zone is expected to have a **minor** impact on fishing vessel navigation as the duration is predicted to be short-term (a few hours) and the fishing vessels will be able to avoid the exclusion zone without significant deviation from their passage.

Disruption of current fishing patterns will be caused by shock waves associated with munitions clearance. The impact will be restricted to the discrete location of the clearance site. In each case the affected area will be dependent on the charge size, and up to a maximum of 1.5 km radius of the detonation event (150 kg charge) and fish are expected to return to the area following the event. The effect on catches is not expected to be significant. The impact of munitions clearance on fishing patterns is therefore assessed to be **insignificant**.

The clearance of munitions also has the potential to cause physical alteration of the seabed through altering the structure of the seabed. Crater size is dependent on the charge size which range between 0.8 kg to 320 kg TNT and the sediment type. Craters have been estimated to range from several decimetres for the smallest charges up to a maximum of approximately 10 – 15 m, with average radii of 4.5 metres. Due to their highly localised nature these changes in the seabed are anticipated to be insignificant.

Seabed Intervention Works

Seabed intervention works will comprise a number of discrete activities that will be carried out before and after laying the pipelines. They include activities such as trenching, rock-placement and the installation of special support structures. Typically, one to two vessels are involved in these activities, depending upon the scale of the intervention at any particular time. Given the short duration and strictly local nature of these activities no significant impact on fishing activities is expected.

Pipelaying and Anchor Handling

Pipe-laying operations will involve a lay barge which will either be anchored or dynamically positioned as it progresses along the pipelines’ route. Anchor-positioned lay barges will be supported by two to six anchor laying vessels which will operate between one and two kilometres from the pipe laying barge. In addition, the lay barges will require support of a number of surveying vessels and a single supply vessel. During pipe-laying, the barge will proceed at a speed of approximately two to three kilometres per day. To ensure minimum interference with construction operations from other sea traffic, an exclusion zone will be established around the lay vessel, typically extending 2.5–3 km from the lay barge. Unauthorised ship traffic, including fishing vessels, will not be permitted to enter this zone. This exclusion zone might therefore potentially hamper the passage of fishing vessels navigating to and from their target fish stocks. However, there will be no permanent change in passage and most fishing vessels will be able to avoid the exclusion zone without significant deviation from their passage.

Nord Stream will issue a 'Notice to Mariners' on the Project installation activities to national coast guards throughout the period of construction (see Annex – FOGA communications sheet). The maritime authorities will be kept continuously informed on the progress of installation. The coast guard will inform vessels, including fishing vessels, of ongoing activities and traffic limitations, such as exclusion zones, through various media, e.g. broadcasts on Navtext. This will enable fishing vessels to plan ahead and avoid construction activities, ensuring that any disruptions are within the range of normal navigational conditions that would typically be experienced in shipping routes.

5 Possible Impacts on Fish and Fisheries during Operation

5.1 Impact on Fish during Operations

5.1.1 Introduction

During operations there are two possible sources for impacts on fish:

- Maintenance and repair activities
- Pipeline presence

The presence of the pipeline causes not only a physical change to the seabed but could also change the water temperature, emit some noise or possibly release contaminants, which may have an impact on fish.

5.1.2 Maintenance and Repair Operations

Maintenance and repair operations will cause avoidance reactions in fish. However, as described above for the construction phase, these impacts will be temporary, reversible and localised in nature. In addition, it is likely that any repair operations will be small-scale and infrequent. This means that the impacts on fishing patterns of operational phase inspection and maintenance activities will be **insignificant**.

5.1.3 Pipeline Presence

Impacts that will arise throughout the operational phase are anticipated to result from increased noise and vibration, physical disturbance of the seabed and temperature change due to pipeline presence.

Noise and Vibration

The noise levels of natural gas movement through a pipeline are known to have frequencies between 0.030 and 0.100 kHz(1), which is at the lowest levels detectable by many fish species. It will be of a similar range to that described in the pre-commissioning and commissioning phase

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(1) Martec Limited. 2004. Effects of Pipelines/Gathering Lines on Snow crab and Lobster.

above. It is unlikely that any fish species will be adversely affected by the sounds emitted from the pipelines, in particular as fish quickly become habituated to noise as experience with shipping noise has shown. Therefore, the impact will be **short-term, local**, of **low** intensity and **minor** significance.

Routine inspections and maintenance works on the pipelines are assumed to have an **insignificant** impact in terms of noise on fish, as inspections and works will be infrequent and will be restricted to the immediate pipelines' route.

Physical Alteration of the Seabed

As the surface area of the seabed taken up by the physical presence of the pipelines will represent less than 0.001 per cent of the total seabed area of the Baltic Sea, the total area of feeding and spawning grounds expected to be impacted is relatively small.

For benthic spawners such as herring or stickleback the physical presence of the pipelines on the seabed may cause an obstruction to spawning. Due to the small area of the substrate that will be impacted by the pipelines' footprint, the impact on feeding and spawning grounds is anticipated to result in a **negative, local** impact of **long-term** duration. Impact significance is expected to be **minor** as these species have a **low** value/sensitivity.

For fish species that spawn in the water column the physical presence of the pipelines on the seabed will not cause an obstruction to spawning. However, as a result of the presence of the pipelines, substrates may accumulate around the pipelines in areas where sediment is fine (e.g. east of Bornholm). Much of the seabed along the proposed pipelines' route is nevertheless sandy or hard bottomed and will not be impacted. Therefore the impact is anticipated to be **insignificant**.

Fish such as cod and flounder spawn in the Bornholm and Gotland Deeps and the physical presence of the pipelines on the seabed will cause an obstruction to spawning to these fish species. However, due to the small area of the substrate that will be impacted by the pipelines' footprint, the impact on feeding and spawning grounds (approximately 100 km of pipelines' route in the Bornholm Deep) is anticipated to result in a **negative, local, long-term** impact of **minor** to **moderate** significance as the sensitivity values of fish present range from **low** to **high**.

Studies have shown that the addition of hard substrates (such as pipelines and materials used during rock placement) into the marine environment may be beneficial to fish populations in certain areas due to an increase in habitat heterogeneity and associated increase in prey availability. Consequently the impact of artificial habitat creation on benthos is anticipated to be **direct**, **long-term** in duration and of **medium** intensity. It may be beneficial for fish communities in some areas. It will be on a **local** scale and have **minor** to **moderate** significance.

Routine inspections and maintenance works on the pipelines may result in localised re-suspension and spreading of sediments along the immediate pipelines' route. This increase in turbidity could potentially have an impact on fish, specifically benthic and demersal species. However, fish generally move away from disturbances and return once the activities have finished.

The following mitigation measures are proposed to address or reduce the significance of the identified potential impacts associated with routine inspections and maintenance works during the operational phase on fish:

- Any seabed intervention work required during operation as a result of necessary maintenance to pipelines will be kept to a minimum
- Disturbance of seabed sediments will be avoided or, in the case of routine maintenance, disturbance of sediments will be minimised

These inspections and works will be infrequent and restricted to the immediate pipelines' route and therefore are anticipated to have an **insignificant** impact on fish. However, should these works be greater than expected, impacts of **minor** significance may result.

Temperature Change

Modelling has shown that the temperature of the water at the surface of an unburied section of pipeline in the immediate vicinity of the landfall near Vyborg could be up to 0.5 º C greater than the surrounding water temperature. Mixing will ensure that water temperatures will reach equilibrium with surrounding water temperatures at a distance of between 0.5 and 1 m from the pipelines. For the buried part of the pipelines in ESR I, modelling has shown that the transfer of heat from the pipelines to the sediment and the surrounding seawater is insignificant. Further away from the landfall near Vyborg, the transfer of heat from the pipelines to the surrounding water as a result of temperature difference between the gas in the pipelines and the surrounding water will be minimal.

No **impact** on fish is anticipated. No specific mitigation measures are proposed.

Release of Contaminants from the Pipeline

The pipeline itself will not make any contribution to contaminants because it is coated in a layer of concrete which is effectively inert. However, devices called sacrificial anodes will be incorporated into the pipeline. These are bands of metal that gradually corrode 'in preference' to steel of the pipeline, thereby prolonging the life of the steel. There will be both anodes made of aluminium and anodes made of zinc. The anodes will contain trace amounts of cadmium. The anodes will slowly dissolve over time and the metals will be released into the water. Not all of the metal used in the anodes will degrade. For example approximately 6,000 tonnes of aluminium will be used in the anodes, of which around 2,000 tonnes will dissolve over the 50-year lifetime of the pipeline. As the dissolved metal enters the water, the levels of cadmium will be too small to measure, the zinc will be similar to background levels – each year around 3,000 tonnes of zinc enters the Baltic Sea from other sources – and the aluminium will be rapidly diluted and carried away by currents at levels that are harmless to the environment. For these reasons the presence of the anodes is unlikely to have a measurable effect on the marine ecosystem.

5.2 Impact on Fisheries during Operation

5.2.1 Pipeline Presence

The presence of pipelines exposed on the seabed might exert some form of impact on fishing activities where the pipelines traverse through areas where bottom trawling is practiced. Impacts will essentially be limited to bottom trawling activities as the use of gear such as gill nets, pound nets, Danish seine and longlines will allow the fishermen to select specific areas, even near the pipelines, without the risk of incidence or obstruction. Pelagic trawlers will be able to avoid the pipeline by allowing sufficient distance between the pipelines and the towed net.

Experience with numerous offshore pipelines in the North Sea shows that fishery and offshore pipelines can co-exist safely. However, the situation in the Baltic Sea is potentially different, in terms of trawling gear types, size of vessels/engines and seabed conditions. Also, Nord Stream has a bigger diameter than any of the pipelines in the North Sea. Fishermen in the Baltic Sea raised concerns that trawling over the Nord Stream pipeline would not be possible without a risk of losing or damaging trawl gear due to hooking on the pipeline. Therefore, a careful assessment of trawl gear-pipeline interaction during the operation phase is ongoing.

In order to provide the fishermen with the information they requested, Nord Stream will provide detailed background information based on the North Sea experience. In order to model the special conditions found in the Baltic Sea, Nord Stream proposed scale model testing which has been carried out from 16 – 19 December 2008 at the North Sea flume tank at SINTEF in Hirtshals in Denmark. Also, a risk assessment will be carried out by DNV. The results of the scale model testing will be used to inform the risk assessment.

At the moment, there are preliminary results from the scale model tests available. The following sections describe the possible implications of the tests. An update will be made available and discussed with fishing associations, fishermen and the responsible authorities as soon as the test results have been assessed and implemented in the risk assessment.

Pipeline in Freespan Areas of Limited Trawling Activities

In areas where freespans occur due to very uneven seabed morphology (e.g. many sections in the Finnish EEZ) with hard and steep rocky outcrops, bottom trawling activities are limited to very few locations because the probability of damage to gear and nets caused by the rocky outcrops is too high. In these areas, pelagic (i.e. mid-water) trawling prevails. Therefore the impact on fishing activities is anticipated to be insignificant in places where freespans occur due to highly irregular seabed morphology.

Pipeline in Freespan Areas with Bottom Trawling Activities

In areas of freespans where bottom trawling is conducted, there is a potential for the trawl equipment to become snagged on the pipeline. This may lead to damage to the trawling equipment or high forces being exerted on the trawl wire which could result in the wire breaking and subsequent loss of the gear.

In extreme cases of incorrect handling snagging may even lead to capsizing of the fishing vessel. This occurred in UK waters in 1997 when a fishing vessel and its crew were lost. However, the final capsize of the vessel occurred during the recovery of the snagged gear and not as a result of the actual snagging. This emphasises the importance of providing information and training to the fishermen about what to do and not to do in case of snagging or hooking of the trawling gear.

Restriction zones might be necessary in some specific areas where there are freespans and bottom trawling activities. Therefore an impact will occur at those locations within the pipelines' corridors, where trawling vessels sweeping across the pipelines will need to avoid interaction with the pipeline. Vessels sweeping in a traverse pattern across the pipeline corridors may need to lift their gear.

Pipeline on the Seabed in Areas with Bottom Trawling Activities

The scale model tests showed that there may be a risk of gear getting stuck in areas where the pipeline is lying flat on the seabed, especially where the approach angle to the pipeline is small (approx. less than 15 degrees).

Concerning part penetration, the actual seabed condition is an important factor. Where the seabed is soft, the pipeline will sink in and the exposure height decreases. This has an immediate positive effect on the pull-over mechanism. Less force is needed to pull the trawling gear over the pipeline and consequently the hooking probability decreases. Where the sediment is hard, the board will not cut into the seabed when sliding along the pipeline before pulling over. When seabed conditions are in between hard and soft, the pipeline may not have sunk in deep enough to allow for easy pulling over, but the seabed might be soft enough to allow the board to penetrate beside the pipeline. The test results showed that the pull-over forces – although in line with the generally accepted DNV guidelines for overtrawlability calculations – were in some cases higher than the breaking forces of the trawl wires used in the Baltic.

5.2.2 Mitigation

In order to determine the appropriate mitigation measure, Nord Stream will elaborate on exactly which areas are concerned and what length of the pipeline will be affected as well as how the loss of time affects catches.

Possible mitigation measures include adaptations to the trawling gear, restriction zones and, compensation for loss or damage caused to fishing gear. In addition, Nord Stream proposes to develop together with fishermen – involving both national associations and FOGA – a training programme for all Baltic Sea fishermen. This programme will address all questions and give recommendations around fishing and submarine pipelines in order to ensure safe fishing activities.

Adjustment of Trawling Equipment

Adjustment of fishing methods should lead to a significant and reliable reduction of the pull-over forces and consequently a negligible probability of hooking. Again, this will depend on the freespan height.

Lately, a new type of trawling gear, was developed for use in Canadian waters where boulders posed an obstruction to traditional bottom trawling doors. The system guarantees that the trawl doors remain above the seabed during bottom trawling. This type of trawl board has also been tested in the SINTEF tests in December and shows large potential: both the trawl board and the bottom net passed over the pipeline without any problem. Nord Stream is considering conducting tests of this gear in co-operation with fishermen and the supplier. Nord Stream is confident that this could be a viable solution as these trawl boards also have a direct advantage for the fishermen as they move with less resistance on the seabed and thereby reduce fuel consumption.

Pipeline Design Adjustments

Pipeline design adjustments are related to full or partial burial of the pipelines and routing.

The need for and extent of burial of pipeline is subject of an on-going study. This will be combined with a sensitivity analysis of required ‘pull-over’ force against pipeline exposure. Surveys of the pipeline in operation will establish the actual extent of pipeline burial for a final assessment of how the pipeline affects trawling activities.

To reduce restriction zones, Nord Stream has already taken fishing activities into account when developing its installation corridor for the pipelines. The route was optimised both in order to reduce free span areas and to lay the pipelines with a small distance in between.

Training

In order to guarantee that fishermen will know how to fish in areas near the pipelines, Nord Stream will ensure there will be professional training of all Baltic fishermen and information material available for all areas around the pipeline. The pipeline and its positions including information on free spans will be integrated into charts that will be made available to the fishermen through appropriate distribution channels and during training sessions.

Nord Stream is continuing to further engage in a dialogue with the fishermen and responsible authorities in order to better determine the extent of the impacts and to identify interventions that may be made to minimise impacts to commercial fishing e.g. limiting restriction zones and to come to a viable solution.

Restriction Zones

Practical experience shows that due to e.g. large freespan heights, safe fishing activities may not be possible and that therefore bottom trawling restriction zones might have to be established. This is being discussed at a national level.

5.2.3 Compensation

If the ongoing studies identify significant long term impacts on fishing activities Nord Stream will establish a compensation scheme for the loss of catch.

5.2.4 Unplanned Events

Nord Stream conducted a risk assessment on unplanned events (engine or winch failure, failure of navigation system etc.) which will now be updated based on the results of the scale model test and further insights gained from the fishermen.

Ghost Nets

In case of an unplanned event where fishing gear gets snagged and cannot be retrieved the remaining “ghost nets” will have to be retrieved to keep the seabed clean and ensure the smooth surface of the pipeline is maintained. This is an integral part of the pipeline inspection, maintenance and repair management system. Should this kind of incident not be reported to Nord Stream regular monitoring of the pipelines will identify and solve this kind of issue.

5.2.5 Damage to fishing equipment

Experience gained from the extensive network of submarine pipelines in the North Sea where intensive fishing in the presence of subsea pipelines has taken place over many years indicates that the occurrence of significant incidents involving fishing equipment and anchors snagging on pipelines is rare.

As discussed above, impacts are essentially limited to bottom trawling activities. The use of passive gear such as gill nets, pound nets, Danish seine and longlines will allow the fishermen to select specific areas, even near the pipelines, without the risk of incidence or obstruction. Pelagic trawlers will be able to avoid the freespans by allowing sufficient distance between freespan sections of the pipelines and the towed net.

There have been questions asked as to whether the surface of the pipeline was smooth enough to trawl along it without risking any damage to trawling equipment. The steel sheets forming moulds for the polyurethane infill on each joint have been of particular concern. However, they are made of rather thin sheet metal and no sharp edges are anticipated to develop, not even when they corrode. To make sure no unforeseen problems occur, Nord Stream will check them during regular inspections.

The alignments of the pipelines will be identified on navigation charts. Nord Stream will also provide information on the pipeline elevation (top of pipeline) relative to the seabed (precise and reliable information will only be available once the pipeline is in operation as it is difficult to determine exactly how deep it will sink in the seabed during pre-commissioning and commissioning). Vessels will therefore be able to minimise the likelihood of snagging their fishing gear (or anchors) on the pipelines by either avoiding trawling in the vicinity of free spans or by ensuring that nets and anchors are lifted when free span locations are approached. This notwithstanding, the pipelines may also attract fishermen to fish in the vicinity of the pipelines, because of the perceived higher number of commercial fish near the pipelines or rock fill because fish are known to aggregate near artificial structures on the seabed.

5.2.6 Restriction on navigation for fishing vessels

It is possible that survey vessel movements and maintenance and repair operations on the pipelines' foundations during the operational phase will restrict the passage of fishing vessels. During the first few years of operation, a survey vessel will conduct an external inspection of the pipelines once every one or two years. The vessel will be equipped with various types of sensors, such as cameras and scanners, to inspect the general condition of the pipelines. It is possible that these inspections will lead to intervention works to ensure that the pipelines remain stable on the seabed. Passage of fishing vessels may be interrupted during these activities. However, due to the small-scale and infrequent nature of these operations, their impact on navigation and passage of fishing vessels will be **insignificant**.

5.3 Summary

Nord Stream is striving to minimise restriction zones and to minimise risk due to fishing gear-pipeline interaction. Therefore the following actions will be taken:

- Determination of inevitable restriction zones based on present design and risk assessments, including the results of the scale models test
- Assessment of the full or partial burial of pipeline to reduce restriction zones
- Investigation of potential fishing method and gear adjustments to reduce restriction zones
- Determination of least number of unavoidable restriction zones based on the results of the previous steps

This process is ongoing in close cooperation with the fishermen and the responsible authorities.