Chapter 12: Marine Ecology

URS-EIA-REP-204635

South Stream Offshore Pipeline ENERGISING EUROPE

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12 Marine Ecology

12.1 Introduction

This chapter presents an assessment of the Project's impacts on marine flora and fauna within Russian Federation waters encompassing Russian territorial waters out to 12 nautical miles (NM) and the Russian Exclusive Economic Zone (EEZ) of the Black Sea. The assessment considers impacts arising during the Construction and Pre-Commissioning, Operational and Decommissioning Phases. The most important impacts are predicted to arise during the Construction and Pre-Commissioning Phase. Construction activities, including dredging, seabed intervention and physical placement of the Pipeline on the seabed, have the potential to result in the loss of habitats and directly or indirectly affect associated plant and animal species.

Along the eastern Black Sea coast, faunal groups of particular interest, either due to their value or vulnerability, include a variety of commercial fish species (e.g. anchovy, turbot, sprat etc.), endangered species (e.g. sturgeon), marine mammals and seabirds. Marine flora is also important, particularly red and brown macroalgae. These are discussed further in Section 12.4.

The assessment has identified sensitive ecological receptors (including protected and/or notable habitats and species) within the Project's Area of Influence (as described in Section 12.3.2).

This chapter provides a description of the baseline conditions, assessment methodology, regulatory framework, the measures required to mitigate any significant adverse effects of the Project's Activities and the likely residual impacts assessed after these measures have been employed. The potential for cumulative impacts with other projects in the surrounding area is also considered.

12.2 Scoping

The scope of the marine ecology impact assessment for the Project was defined through a process that identified ecological receptors and potentially significant impacts related to the Project. Baseline information which informed the scoping process largely drew on information gathered from studies undertaken for the South Stream Offshore Pipeline, including feasibility, engineering and environmental surveys carried out in 2009 to 2013 (Section 12.3.3). Key steps in the scoping process for marine ecology comprised the following:

- The Project's Front End Engineering and Design (FEED) was reviewed to identify activities with the potential to significantly affect ecological receptors;
- Ecological receptors within the Project Area of Influence were identified through a review of secondary data, surveys undertaken for the Project (as described in Section 12.3.3), and professional expertise;
- A review of relevant national and international legislative requirements and lender requirements for compliance; and
- An Environmental Issues Identification (ENVIID) was undertaken to assist in the identification of impacts and receptors. During the ENVIID process, each activity was

examined to understand how activities were expected to interact with ecological receptors, which receptors would be impacted and the nature (positive or negative) of the likely impact. The outcome of the ENVIID was an ENVIID register which identified the various elements of the Project and their interaction or potential impact on sensitive ecological receptors.

The marine environment contains many potential receptors and is, therefore, an important consideration in the ESIA process. Marine ecological receptors are diverse and include a wide variety of organisms and habitats. For the purpose of this assessment, marine biota is broadly grouped into the following topics: plankton, benthic communities, fish, seabirds and marine mammals. In addition, the habitats that these organisms inhabit and the ecological processes of these habitats are considered as receptors. Species of conservation value, critical habitats and protected areas are discussed in terms of their importance and in terms of the potential impact that the Project may have on them.

The potential occurrence of species of conservation value was identified using the following sources:

- International United Conservation Network (IUCN) Red Data List (RDL);
- Red Data Book of the Russian Federation (RDBRF); and
- Red Data Book of the Krasnodar Krai region (RDBKK).

12.3 Spatial and Temporal Boundaries

12.3.1 Project Phases

This chapter has appraised the potential for the Construction and Pre-Commissioning, Operational and Decommissioning Phase activities of the Project, to have impacts on receptors. Decommissioning is considered in less detail, see Section 12.5.4.

12.3.2 Project Boundaries

12.3.2.1 Project Area

As described in **Chapter 5 Project Description**, the Project Area is divided into landfall, nearshore and offshore sections. This division is based on technical consideration of different construction activities to be employed in each section, and therefore the terms ‘nearshore section’ and ‘offshore section’ have no ecological meaning in this sense.

The landfall section includes four microtunnels that extend from onshore entry shafts, seaward, under the shoreline and under the seabed, to emerge from the seabed at a water depth of about 23 m, approximately 400 m from the shoreline. The nearshore section then extends from the exit point of the microtunnels for approximately 425 m to the pipeline tie-in with the offshore section at a water depth of about 30 m. The offshore section then extends from this point for approximately 225 km to the boundary between the Russian and Turkish EEZs.

For the purpose of this chapter on marine ecology, the nearshore is considered to also include the area from the shore to 23 m water depth, a distance of approximately 400 m which forms part of the "landfall section" as described for engineering reasons. Because these two sections of the Project Area are ecologically contiguous, they are considered as one in this chapter. From the microtunnel exit point the pipelines will be buried in trenches to a depth of approximately 2.5 to 3 m for a distance of approximately 170 m. From here, out to the edge of the nearshore section (30 m water depth), the pipelines will be coated in concrete and laid directly on the seabed.

During the Construction and Pre-Commissioning Phase of the Project the nearshore section of the Project Area is defined by the maritime safety exclusion zones around the construction vessels, extending out 3 km either side of the outermost pipeline, encompassing:

- The area impacted by sediment dispersion, based on sediment models;
- The route of the four individual pipelines;
- The likely anchor spread and movement locations of vessels directly associated with the pipeline installation and maintenance; and
- The proposed microtunnel exit pits.

The nearshore section Project Area (see **Chapter 5 Project Description** for further details) is approximately 5.2 km^2.

The offshore section is approximately 225 km in length and pipelines will be laid directly on the seabed from the maximum water depth where dredging works will take place (30 m water depth), to the boundary between the Russian and Turkish EEZs. The offshore section of the Project Area is primarily defined by the maritime safety exclusion zones around the construction vessels either side of the outermost pipeline. The Project Area of the offshore section consists of a corridor of 3 km from the boundary of the nearshore section to the 600 m water depth contour, after which the corridor decreases to 2 km width either side of the outermost pipeline from the 600 m water depth contour to the EEZ boundary. The change in corridor width is based on the type of pipe-lay vessel used (**Chapter 5 Project Description**). The offshore section of the Project Area encompasses:

- The route of the four individual pipelines; and
- The likely anchor spread and movement locations of vessels directly associated with the Pipeline installation and maintenance.

The offshore section is approximately 1,080 km^2 which is 206 km^2 from the nearshore boundary to the 600 m water depth contour and 874 km^2 from this to the EEZ boundary.

During the Operational Phase the Project Area will be smaller, defined by the operational exclusion zone of 0.5 km either side of the outside pipelines from the microtunnel exit point to the Russian / Turkish EEZ boundary (end of offshore section).

12.3.2.2 Study Area

The Study Area, or Zone of Influence, for the marine environment has been defined as the area that will encompass the largest extent of predicted potential impacts. In order to capture all impacts, including long range acoustic disturbance, this has been set at a nominal 100 km distance from the Project Area. The baseline study (both secondary and primary data) covers this Study Area. Relevant areas to survey within the Study Area have been determined based on the nature of individual receptors as described below.

12.3.2.3 Survey Areas

Surveys undertaken in 2013 (Section 12.3.3.3) were within the boundaries of the Study Area. The locations of and information related to these surveys are displayed in Table 12.1 and Figure 12.1. Survey Areas refer to the locations in which surveys were conducted for the Project during the feasibility and design stages from 2009 to 2013. The locations of and information related to these surveys (Ref. 12.1; Ref. 12.2) are displayed in Table 12.1 and Figure 12.1. The Survey Areas are separated for each topic (i.e. plankton, seabirds, etc.) and are defined under the topic headings in Section 12.4. Figures within each topic heading show the extent of the Survey Areas for each topic. These figures are:

- Plankton: Figure 12.2;
- Benthic: Figure 12.4;
- Fish: Figure 12.10;
- Seabirds: Figure 12.11 and Figure 12.12; and
- Marine mammals: Figure 12.17.

12.3.3 Baseline Data

Secondary data (i.e. data from third parties not specifically acquired for the Project, including literature reviews, etc.) and existing primary data (i.e. data acquired specifically for the Project through dedicated surveys) were reviewed prior to scoping. Following this, a data gap analysis was conducted and surveys to collect additional primary data were specified. The majority of the baseline information used to support this chapter comes from the results of marine surveys specifically conducted for the Project from 2009 to 2011 (Ref. 12.1), and in 2013 (Ref. 12.2). Details of the survey scopes are given in Section 12.3.3.3.

12.3.3.1 Secondary Data

Where possible, this assessment is based on primary data. Secondary Data were also consulted to inform the baseline of this chapter, as described below:

- The 2009 to 2011 survey reports (Ref. 12.1) included a thorough review of Russian published scientific literature that has been incorporated into this baseline as appropriate;
- Other recent published scientific literature was identified through a British Library data search;
- International, Federal and Regional Red Data Books were consulted in order to identify the potential presence of notable plant and animal species within the Survey Area (Ref. 12.3);
- Designation information for Utrish Specially Protected Natural Area (SPNA)was obtained from a 2009 World Wildlife Fund (WWF) report (Ref. 12.4);

- Information on fish, benthic communities, macroalgae and historic changes in the Black Sea flora and fauna are found in the Black Sea Commission "State of the Environment" reports (Refs. 12.5 to 12.11); and
- Other accounts of Black Sea ecology have been produced by regional NGOs and multilateral organisations e.g. the Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic area (ACCOBAMS) (Ref. 12.12).

12.3.3.2 Data Gaps

As part of the data collection exercise, a gap analysis was conducted to identify areas where existing baseline data were insufficiently detailed to allow for a robust assessment. Furthermore, as the project design has evolved, the potential footprint of the activities has changed. Where secondary data were insufficient to meet these requirements, additional surveys were performed to:

- Increase the data coverage of some surveyed areas, by a combination of denser sampling and the use of underwater video and still photography; and
- Collect data along the modified pipeline alignment, in temporary spoil storage areas and in the proposed spoil dumping ground as well as in areas where the pipeline route changed from the route originally surveyed in the 2009 to 2011 surveys (Ref. 12.1).

The additional surveys undertaken to address the identified data gaps included:

- Benthic ecology surveys;
- Sediment sampling; and
- Visual seabird and marine mammal surveys.

12.3.3.3 Primary Data / Baseline Surveys

A series of marine surveys was conducted between 2009 and 2011 to collect data on marine ecological receptors that might be impacted by the project. These surveys collected ecological and physico-chemical data over a wide area and during several seasons. These surveys served to establish the broad environmental parameters of the Study Area, albeit at relatively low resolution.

Following the gap analysis described above, additional surveys were undertaken in 2013 to:

- Verify and supplement the findings of the previous benthic surveys (Ref. 12.1) in order to obtain a robust benthic habitats map for the assessment of impacts and to act as a baseline for future monitoring; and
- Expand the survey data set to capture areas which have the potential to be affected by the Project that were not previously surveyed, following finalisation of the pipeline alignment.

Table 12.1 and Table 12.2 list the marine ecology surveys undertaken. The survey sampling stations are shown in (Figure 12.1). Survey methodologies are summarised in Table 12.3.

Table 12.1 Marine Ecology Surveys (2009-2011)

Station	Water depth (m)	Distance from shore (km)	Phytoplankton, bacterioplankton, ichthyoplankton			Zooplankton		Photosynthetic pigments of phytoplankton		Macro-zoobenthos				Macro-phytobenthos				Fish			Seabirds and marine mammals*	
			Autumn 2010	Spring 2011	Summer 2011	Autumn 2010	Spring 2011	Autumn 2010	Spring 2011	Summer 2009	Autumn 2010	Spring 2011	Summer 2011	Summer 2009	Autumn 2010	Spring 2011	Summer 2011	Nov 2010	June 2011	Nov 2011	Autumn 2010	Spring 2011
1	32	15.1	✓	✓	-	✓	✓	✓	✓	-	✓	✓	-	-	-	✓	-	✓	✓		✓	✓
2	17	0.4	✓	✓	-	✓	✓	✓	✓	-	✓	✓	-	-	-	✓	-	✓	✓		✓	✓
3	87	7.2	✓	✓	-	✓	✓	✓	✓	-	✓	✓	-	-	-	✓	-	✓	✓		✓	✓
3a	50-100	6.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				-	✓
4	50-100	2.9	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	✓	✓		✓	-
5	~1,000	10.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	✓	✓		-	✓
6	1,510	23.4	✓	✓	-	✓	✓	✓	✓	-	-	-	-	-	-	-	-	✓	✓		✓	✓

Continued...

Station	Water depth (m)	Distance from shore (km)	Phytoplankton, bacterioplankton, ichthyoplankton			Zooplankton		Photosynthetic pigments of phytoplankton		Macro-zoobenthos				Macro-phytobenthos				Fish			Seabirds and marine mammals*	
			Autumn 2010	Spring 2011	Summer 2011	Autumn 2010	Spring 2011	Autumn 2010	Spring 2011	Summer 2009	Autumn 2010	Spring 2011	Summer 2011	Summer 2009	Autumn 2010	Spring 2011	Summer 2011	Nov 2010	June 2011	Nov 2011	Autumn 2010	Spring 2011
7	~1,700	39.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	✓	✓		-	✓
8	1,558	43.2	✓	✓	-	✓	✓	✓	✓	-	-	-	-	-	-	-	-	✓	✓		✓	-
9	2,082	67.6	-	✓	-	-	✓	-	✓	-	-	-	-	-	-	-	-	✓	✓		-	✓
10	2,040	98.5	-	✓	-	-	✓	-	✓	-	-	-	-	-	-	-	-		✓		-	✓
11	>2,000	104.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				-	✓
12	>2,000	137.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				-	✓
13	2,175	174.2	-	✓	-	-	✓	-	✓	-	-	-	-	-	-	-	-				-	✓
14	2,154	172.4	-	✓	-	-	✓	-	✓	-	-	-	-	-	-	-	-				-	-

Continued...

Station	Water depth (m)	Distance from shore (km)	Phytoplankton, bacterioplankton, ichthyoplankton			Zooplankton		Photosynthetic pigments of phytoplankton		Macro-zoobenthos				Macro-phytobenthos				Fish			Seabirds and marine mammals*	
			Autumn 2010	Spring 2011	Summer 2011	Autumn 2010	Spring 2011	Autumn 2010	Spring 2011	Summer 2009	Autumn 2010	Spring 2011	Summer 2011	Summer 2009	Autumn 2010	Spring 2011	Summer 2011	Nov 2010	June 2011	Nov 2011	Autumn 2010	Spring 2011
15	2,150	137.1	-	✓	-	-	✓	-	✓	-	-	-	-	-	-	-	-				-	-
16	2,133	106.7	-	✓	-	-	✓	-	✓	-	-	-	-	-	-	-	-				-	✓
17	1,822	41.9	✓**	✓	-	-	✓	-	✓	-	-	-	-	-	-	-	-				✓	-
18	95	8.2	✓	✓	-	✓	✓	✓	✓	-	✓	-	-	-	-	-	-				✓	✓
19	25	0.9	✓	✓	-	✓	✓	✓	✓	-	✓	-	-	-	-	-	-				✓	✓
1c	0-0.5	0	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	✓				-	-
2c	10	0.2	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	✓				-	-
3c	20	0.4	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	✓				-	-

Continued...

Station	Water depth (m)	Distance from shore (km)	Phytoplankton, bacterioplankton, ichthyoplankton			Zooplankton		Photosynthetic pigments of phytoplankton		Macro-zoobenthos				Macro-phytobenthos				Fish			Seabirds and marine mammals*	
			Autumn 2010	Spring 2011	Summer 2011	Autumn 2010	Spring 2011	Autumn 2010	Spring 2011	Summer 2009	Autumn 2010	Spring 2011	Summer 2011	Summer 2009	Autumn 2010	Spring 2011	Summer 2011	Nov 2010	June 2011	Nov 2011	Autumn 2010	Spring 2011
4c/5s	0-0.5	0	-	-	✓***	-	-	-	-	✓	-	-	✓	✓	-	-	✓				-	-
5c/8s	20	0.4	-	-	-	-	-	-	-	✓	-	-	✓	✓	-	-	✓				-	-
6c/7s	10	0.2	-	-	-	-	-	-	-	✓	-	-	✓	✓	-	-	✓				-	-
7c/1s	0-0.5	0	-	-	-	-	-	-	-	✓	-	-	✓	✓	-	-	✓				-	-
8c/2s	10	0.2	-	-	-	-	-	-	-	✓	-	-	✓	✓	-	-	✓				-	-
9c/3s	0-0.5	0	-	-	-	-	-	-	-	✓	-	-	✓	✓	-	-	✓				-	-
10c/4s	10	0.2	-	-	-	-	-	-	-	✓	-	-	✓	✓	-	-	✓				-	-
11c/6s	20	0.3	-	-	-	-	-	-	-	✓	-	-	✓	✓	-	-	✓				-	-
12c	0-0.5	0	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	✓				-	-

Continued...

Station	Water depth (m)	Distance from shore (km)	Phytoplankton, bacterioplankton, ichthyoplankton			Zooplankton		Photosynthetic pigments of phytoplankton		Macro-zoobenthos				Macro-phytobenthos				Fish			Seabirds and marine mammals*	
			Autumn 2010	Spring 2011	Summer 2011	Autumn 2010	Spring 2011	Autumn 2010	Spring 2011	Summer 2009	Autumn 2010	Spring 2011	Summer 2011	Summer 2009	Autumn 2010	Spring 2011	Summer 2011	Nov 2010	June 2011	Nov 2011	Autumn 2010	Spring 2011
13c	10	0.1	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	✓				-	-
14c	20	0.4	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	✓				-	-
Gillnets	<20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			✓	-	-

* - Seabird and marine mammal transects were also performed, originating at these stations.
** - no zooplankton recorded at this station
*** - phyto and zooplankton only recorded at this stations in August 2011. In addition to the above, fish trawls were conducted in November 2010 and April 2011 and fixed gillnets were used to survey in April 2011 (<20 m WD)

Complete.

Table 12.2 Marine Benthic Ecology, Marine Mammal and Seabird Surveys July 2013

Station	Water depth (m)	Sediment Particle Size Analysis	Macro-zoobenthos Grab Sampling	Seabed video sampling	Seabirds and marine mammals*
1	7			✓	✓
2	9			✓	✓
3	21	✓	✓	✓	✓
4	22	✓	✓	✓	✓
5	11			✓	✓
6	25	✓	✓	✓	✓
7	15	✓	✓	✓	✓
8	4			✓	✓
9	17	✓	✓	✓	✓
10	4			✓	✓
11	13			✓	✓
12	4			✓	✓
13	19			✓	✓
14	18	✓	✓	✓	✓
15	6			✓	✓
16	23	✓	✓	✓	✓
17	23	✓	✓	✓	✓
18	26	✓	✓	✓	✓
19	34	✓	✓	✓	✓
20	51	✓	✓	✓	✓

Continued...

Station	Water depth (m)	Sediment Particle Size Analysis	Macro-zoobenthos Grab Sampling	Seabed video sampling	Seabirds and marine mammals*
21	55	✓	✓	✓	✓
22	71	✓	✓	✓	✓
23	70	✓	✓	✓	✓
24	69	✓	✓	✓	✓
25	69	✓	✓	✓	✓
26	66	✓	✓	✓	✓
27	69	✓	✓	✓	✓
28	69	✓	✓	✓	✓
29	68	✓	✓	✓	✓
30	68	✓	✓	✓	✓
31	70	✓	✓	✓	✓
32	67	✓	✓	✓	✓
33	66	✓	✓	✓	✓
34	73	✓	✓	✓	✓
35	65	✓	✓	✓	✓
36	71	✓	✓	✓	✓
37	110	✓	✓	✓	✓
38	91	✓	✓	✓	✓
39	92	✓	✓	✓	✓
40	513	✓	✓	✓	✓
41	111	✓	✓	✓	✓

Continued...

Station	Water depth (m)	Sediment Particle Size Analysis	Macro-zoobenthos Grab Sampling	Seabed video sampling	Seabirds and marine mammals*
42	502	✓	✓	✓	✓
43	568	✓	✓	✓	✓
44	90	✓	✓	✓	✓
45	369	✓	✓	✓	✓
46	54	✓	✓	✓	✓
47	59	✓	✓	✓	✓
48	71	✓	✓	✓	✓
49	65	✓	✓	✓	✓
50	71	✓	✓	✓	✓
51	71	✓	✓	✓	✓

* - Seabird and marine mammal transects were also performed, originating at these stations.

Complete.

Table 12.3 Survey Methodologies

Receptor	Sampling method	May to June 2009	Nov 2010	April to June 2011	August 2011	2013
Bacterioplankton	Niskin bottle*	-	8 stations, 21 samples	14 stations, 39 samples		-
Phytoplankton	Niskin bottle*	-	8 stations, 21 samples	14 stations, 39 samples	1 station, 1 sample	-
Primary Production	Light-and-dark-bottle method**. Light intensity at depth measured with a Secchi disk†.	-	8 stations, 21 samples	14 stations, 39 samples		-
Zooplankton	Towed Juday net, 0.5 m/s speed Mesh size of 180 µm	-	8 stations, 8 samples	14 stations, 14 samples	1 station, 1 sample	-
Ichthyoplankton	Horizontal fishing with the IKS-80 fish roe net during 10-minute vessel circulation at speed 2.5 knots; Method of total (vertical) fishing (in the layers "bottom – 0 m" or "oxygen deficiency layer – 0 m"), during vessel stop and drifting.		8 stations, 16 samples	13 stations, 26 samples		-
Macro-phytobenthos	Photos within census frames: 25×25 cm (in 0-0.5 m water depth) and 50×50 cm – at the depth 10 and 20. One quantitative sample collected at each station Video transect of three stations (August 2011)	-	-	-	15 stations, 45 samples	-

Continued…

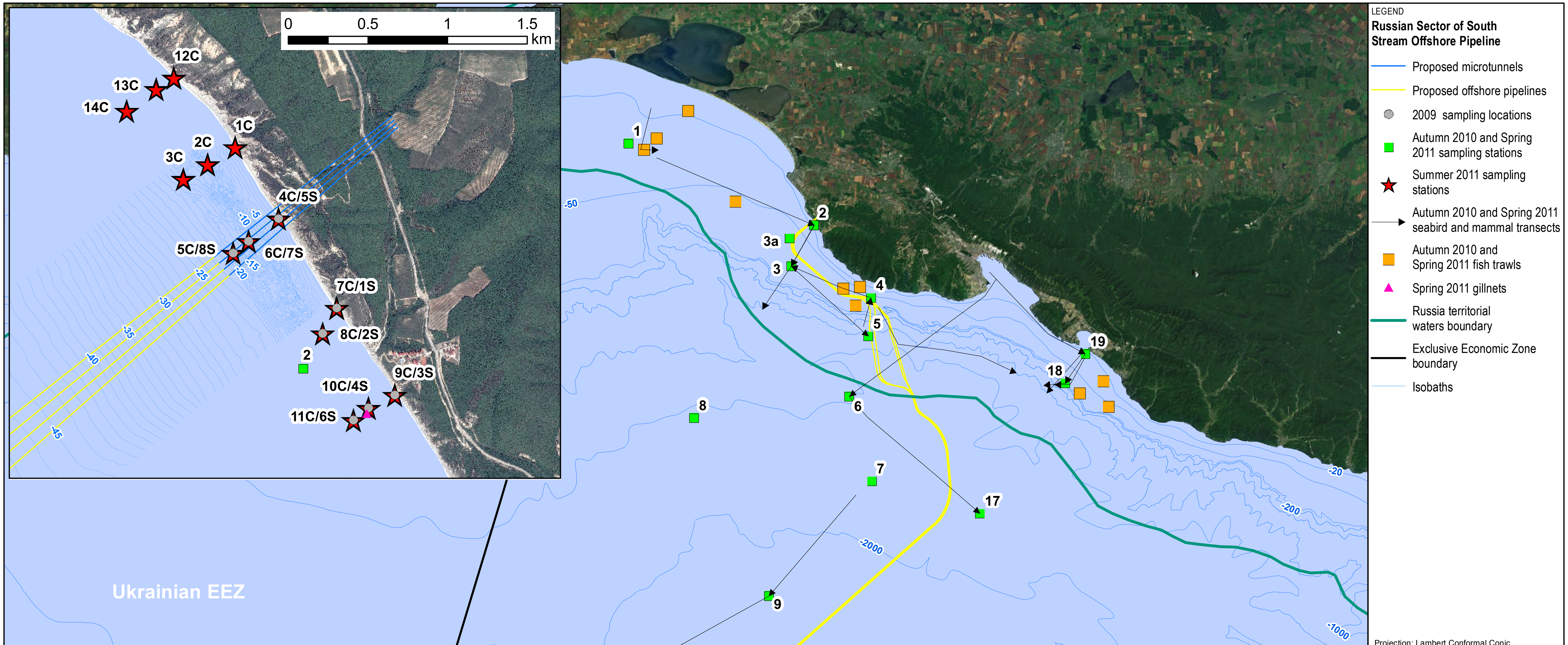
Receptor	Sampling method	May to June 2009	Nov 2010	April to June 2011	August 2011	2013
Macro-zoobenthos	Van Veen grab (0.1 m^2), replicated (May-June 2009 & Nov 2010) Epifaunal collection of macroalgae by diving, replicated (August 2011) Video transect of three stations (August 2011)	8 stations, 24 samples	6 stations, 18 samples	-	15 stations, 45 samples	51 Stations
Fish	32 m multiple depth trawl with cod end. Trawling duration – 15 to 40 minutes, trawling speed – 2.8–3.2 knots. 4 trawls in water depths of less than 30 m, 3 trawls in water depths from 30 to 70 m, 2 trawls in the biotic water depths from 70 to 100 m (November 2010). 32 m multiple depth trawl with cod end. Trawling duration – 30 minutes, trawling speed – 3 knots (April – June 2011). Gillnets in 4 m to 21 m water depth, left in situ for 12 to 19 hours (May – June 2011)		9 trawls	10 trawls 4 gillnets		

Continued…

Receptor	Sampling method	May to June 2009	Nov 2010	April to June 2011	August 2011	2013
Seabirds & marine mammals	Observations were carried out visually, in the day-time. Daily duration of census made up no less than 7–8 hours. For species identification; 10x and 20x binoculars were used. Coastal surveys from coastal near Project Area		10 transects and stations, 9 transects during fish trawls	12 transects		

* A Niskin Bottle can be opened at both ends and the open bottle is lowered into the ocean on a wire from a Research Vessel until it reaches a certain depth and then the bottle is closed.
** A method used to determine the extent of Photosynthesis in an aquatic Ecosystem. Duplicate portions of a water sample are collected. One portion is incubated in a clear bottle, and the other is incubated in a dark, light-impermeable bottle. Following incubation for a prescribed time period, the net uptake of carbon dioxide in each is measured and compared.
† The Secchi disc is mounted on a pole or line, and lowered slowly down in the water. The depth at which the pattern on the disk is no longer visible is taken as a measure of the transparency of the water.

Complete.



Projection: Lambert Conformal Conic

Revision Details	By	Check	Date	Suffix

Purpose of Issue: For Information

Client: South Stream Offshore Pipeline — ENERGISING EUROPE

Project Title: SOUTH STREAM OFFSHORE PIPELINE

Drawing Title: MARINE ECOLOGY SURVEY SAMPLING LOCATIONS (2009-2011)

Drawn	Checked	Approved	Date
DH	RW	MW	04 Mar 2014

URS Internal Project No.	Scale @ A3
46369082	1:800,000

URS Infrastructure & Environment UK Limited
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Telephone (01256) 310200
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www.ursglobal.com

Drawing Number: Figure 12.1 Rev

Plot Date: 04 Mar 2014
File Name:I:\5004 - Information Systems\46369082_South_Stream\MXDs\Report Maps - Russia\Russian ESIA\Offshore Sampling\Figure 12.1 Marine Ecology Survey Sampling Locations (2009-2011).mxd

12.3.4 Data Assumptions and Limitations

In order to carry out this assessment, certain assumptions have been made regarding the input data, and it is acknowledged that some of the data used in the ESIA Report have attendant limitations:

- The assessment is based on a Project description that may be refined during detailed design. Nonetheless, the key design parameters are understood and the ESIA Report is based on these, with additional mitigations specified as appropriate. Design changes which may impact the results of this ESIA Report are captured in the management of change process discussed in **Chapter 5 Project Description**;
- Environmental standards may evolve during the lifetime of the Project. It is not possible to predict such changes but reference to Good International Industry Practice (GIIP) minimises the effect of this uncertainty;
- It has not been possible to provide definitive temporal trends in the baseline due to the differences in season of the various surveys undertaken. The two surveys that coincide (summer 2009 and summer 2013) are far enough apart that comparisons can only be tentative;
- Description of the deep sea environment is based on acoustic data interpretation as well as, some limited visual material and this makes it subjective to a degree. However, given the absence of potentially biogenic deep sea features in the Russian sector, this is not considered a risk to the assessment;
- There are no spatially continuous habitat data, thus mapping is the result of interpolating spot samples. Given the number of samples collected in the 2013 survey, this is considered adequate for the purposes of the assessment, but some uncertainty remains; and
- The ecology of seabirds and marine mammals in the Russian sector is not well understood (in terms of accurate details on migration, breeding etc.). Surveys undertaken for this Project give data on distribution but cannot provide this level of detail.

12.4 Baseline Characteristics

12.4.1 Black Sea Overview

The Black Sea is a semi-enclosed basin and is one of the most isolated from the major world oceans. It has connections to the Mediterranean Sea through the Bosphorus Strait and the Dardanelles Strait in the south-west, and with the Sea of Azov in the north-east through the Kerch Strait. It is a largely brackish water body, with a salinity of 17 to 18‰ on average, due to the massive freshwater influx from rivers including the Danube, Dnieper and Don via the Sea of Azov.

There are two layers of water with different salinity in the Black Sea. An upper brackish layer, with an average salinity of 17‰, results from the massive freshwater influx from rivers including the Danube, Dnieper and Don via the Sea of Azov. Below this is a layer of higher salinity seawater (20 to 30‰), originating from the Mediterranean. This stratification, which creates a distinct and permanent pycnocline[1] around 150 to 200 m, limits the vertical exchange of water between the surface and deeper waters creating a unique chemical and biological environment. Further details of environmental quality, hydrodynamics and seabed dynamics are set out in **Chapter 7 Physical and Geophysical Environment**.

These chemical and biological characteristics have resulted in the following broad marine habitat types in the Black Sea:

- Surface waters (typically 0 to 50 m water depth) are well oxygenated and have a fairly low salinity (typically 18-22‰). Because this zone is photic, it is biologically productive and has historically supported large populations of pelagic fish. There are a number of different benthic habitat types within these shallow waters:
  - Rocky substrates are present throughout the shallow area, including the supralittoral sea cliffs. Hard substrata are important as they allow the development of macroalgal beds that in turn support a highly diverse array of fauna;
  - Sandy sediments are also present in shallow areas where material has been deposited and wave energy has winnowed out fine material. These zones support a range of infaunal communities, typically bivalve dominated; and
  - Mud sediments are present in some low energy areas between 10 to 20 m water depth supporting infaunal communities.
- Mid-depth waters (approximately 50 to 100 m water depth) show decreasing oxygen concentrations and increasing salinity due to the influence of the bottom layer. This is typically referred to as the suboxic zone where the concentrations of both oxygen (O_2) and hydrogen sulphide (H_2S) are extremely low and do not exhibit any perceptible vertical or horizontal gradients (Ref. 12.13). Benthic habitats at these depths, where wave energy at the seabed is largely absent, are often muddy sediments; and
- In deep waters (below about 150 to 200 m) conditions are anoxic, and together with increased H_2S concentrations, restrict the vertical distribution of pelagic and bottom-dwelling metazoan organisms. This lower water layer accounts for as much as 87% of the Black Sea. Muddy sediments predominate in deeper waters, and while little is known about the benthos of the deep Black Sea, chemosynthetic bacteria can occur here. For example, in the anoxic shelf of the north-western Black Sea numerous gas seeps are populated by methanotrophic microbial mats that can form tall reef-like structures, though such have not been detected along the Pipeline route in the Russian sector (Ref. 12.5 and Ref. 12.14).

The Black Sea has a very large catchment area to sea surface area ratio and a densely populated coastal zone, making it highly vulnerable to pressure from land-based human activity. Rapid economic development and a lack of adequate management of marine resources in the later decades of the 20th century resulted in major environmental and ecological changes in the Black Sea. In particular, eutrophication from land-based sources resulted in changes to the diversity and distribution of flora and fauna throughout the Black Sea ecosystem.

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[1] A pycnocline is the cline or layer where the density gradient is greatest within a body of water. Formation of pycnocline may result from changes in salinity or temperature.

Eutrophication gave rise to massive increases in primary production and a shift in the abundance and composition of phytoplankton species in the Black Sea. Larger and more frequent algal blooms increased the flux of organic matter to the seabed inducing a sharp decline of dissolved oxygen and a silting of benthic communities in many areas. Increased incidence of harmful algal blooms (red tides) caused fish kills and the increased turbidity of the water column reduced light availability to benthic macrophytes and seaweeds in deeper waters. The distribution and extent of many algal species, including the red alga *Phyllophora* and the brown *Cystoseira barbata*, that inhabits rocky coasts, have reduced considerably in many areas of the Black Sea including the Russian coast.

There have been corresponding changes in zooplankton, with the loss of some species and a shift from larger to smaller species of crustacean. There has also been a sharp increase in the number of gelatinous species such as jellyfish, although the most drastic change in the zooplankton communities resulted from the invasion of the ctenophore, *Mnemiopsis leidyi*. This species is a voracious predator of copepods, which are important prey items for larval and juvenile fish (Ref. 12.15), and is a direct predator of fish eggs and larvae. The negative effects of this invasion are only recently showing signs of reversal.

Other human activities, in particular uncontrolled fisheries have added to the change in the structure and dynamics of the biology of the Black Sea.

Since the early 2000s, the governments of the Black Sea coastal states have adopted a basin wide approach to pollution prevention, with a strategic goal of restoring the ecological status of the Black Sea to a condition similar to that of the 1960s. Pollution pressure from land based sources although still intense shows a decreasing trend and some improvements in ecological status have been observed. For example, some species that disappeared appear to be recovering and the number and intensity of algal blooms is reported to be lower for all areas (Ref. 12.10).

Information presented in this report on benthic communities focuses on shallower waters of less than approximately 200 m because the diversity and abundance of benthic fauna and flora decreases rapidly with increasing depth due to decreasing light, increasing anoxia and high concentrations of H_2S. Beyond 200 m conditions are completely anoxic. The seabed of the deeper parts of the Black Sea is therefore unlikely to support significant macro- or meiofaunal communities (Ref. 12.9). Microbial reefs associated with mud volcanoes or "gas seeps" are known to occur in waters deeper than 200 m in some western areas of the Black Sea (Ref. 12.16); however, none have been recorded in the Study Area.

This section on baseline characteristics describes the marine habitats, flora and fauna of the Study Area and has been separated into the following sub-sections:

- Plankton;
- Benthic communities;
- Fish;
- Seabirds;
- Marine mammals; and

- Protected Areas and Species.

12.4.2 Plankton

12.4.2.1 Background

Plankton forms the basis of marine food webs and is therefore essential to the structure and functioning of marine ecosystems. As phytoplankton are photosynthetic, they are generally confined to the euphotic zone – the depth of water exposed to sufficient sunlight for photosynthesis to occur; in the open ocean this is typically around 200 m, although in the Black Sea it is in the order of 50 m. Vertical distribution of plankton in the Black Sea is also influenced by the decrease in oxygen from 50 to 100 m water depth (Ref. 12.9).

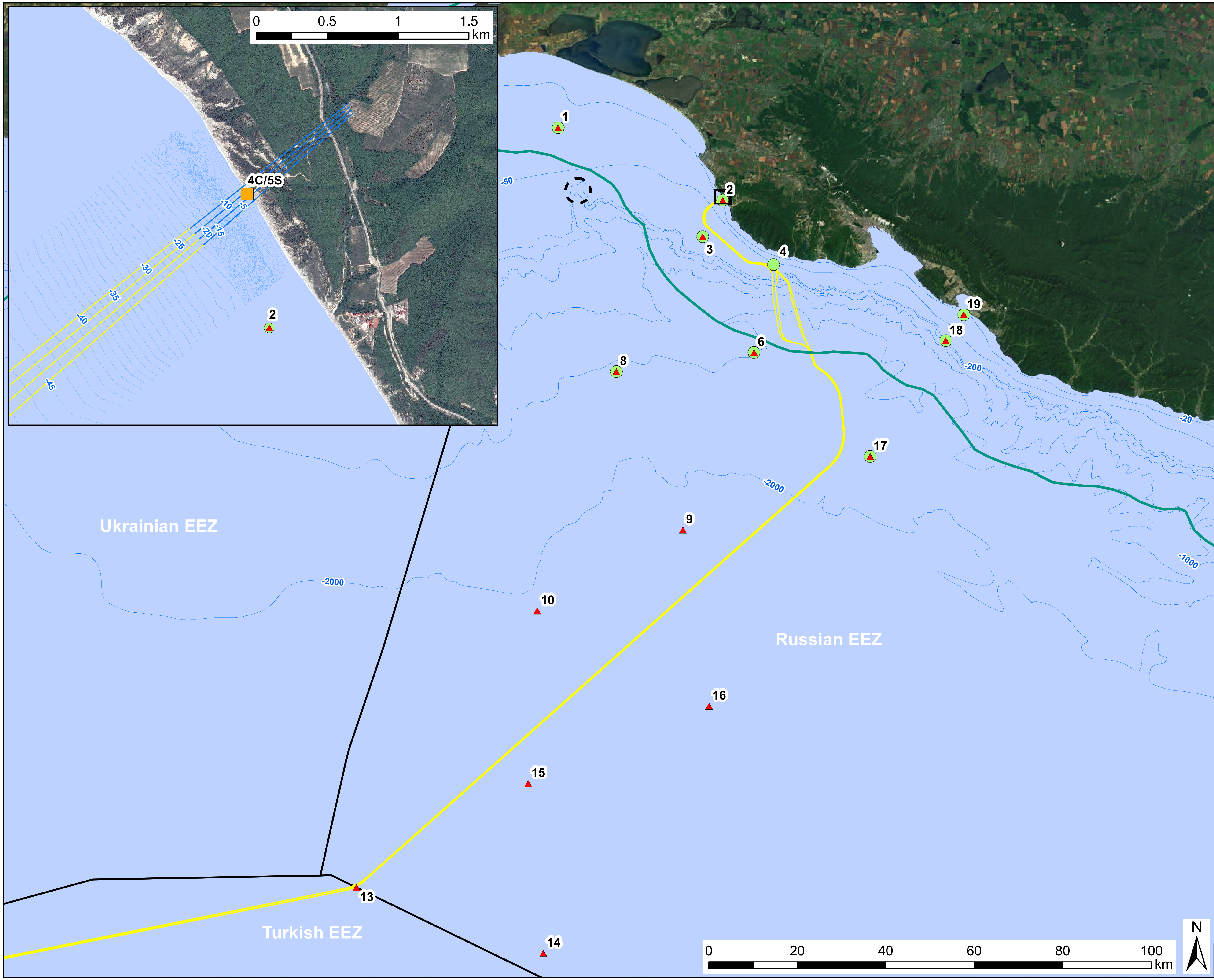
Significant changes in the phytoplankton community were observed within the Black Sea between 1985 and 1994. The existing seasonal succession pattern of a spring diatom bloom followed by blooms of dinoflagellates and then phytoflagellates was disrupted, with a reduction in the diatom component of the spring bloom. This fundamental shift still persists. The reasons for this are not clearly understood, but a variety of natural and anthropogenic causes have been postulated, including a cold period from 1985 to 1994 (Ref. 12.10), hot summers and early warming of the surface layer (Ref. 12.1), damming of the Danube River and a reduction in silicate inputs (Ref. 12.17), and a reduction in inorganic nutrients allowing coccolithophorids to more successfully compete with diatoms (Ref. 12.1).

Historical changes have also occurred in the zooplankton of the north-eastern shelf of the Black Sea, particularly through the accidental introduction of the predatory ctenophore (comb jelly), *Mnemiopsis leidyi*. This introduced species preyed on the indigenous plankton of the Black Sea which led to a major decline in copepod (a type of planktonic crustacean) populations (Ref. 12.7). This situation persisted until 1997 to 1998, with another accidental introduction, possibly from ship ballast water, of the ctenophore *Beroë ovata* (Ref. 12.6). This species is the main predator of *M. leidyi* and subsequently the zooplankton community began to recover both in species composition and abundance (Ref. 12.18).

12.4.2.2 Plankton Survey

Survey Area

Plankton samples were collected at the locations shown in Figure 12.2. Bacterioplankton, phytoplankton, zooplankton and ichthyoplankton were analysed. Summary information on the water depth, distance from shore, as well as survey methodologies is provided in Table 12.1 and Table 12.3.



LEGEND

Russian Sector of South Stream Offshore Pipeline

- Proposed microtunnels
- Proposed offshore pipelines
- Plankton sampling stations (November 2010)
- Plankton sampling stations (April-June 2011)
- Plankton sampling stations (August 2011)
- Licenced disposal site 923
- Russia territorial waters boundary
- Exclusive Economic Zone boundary
- Isobaths

Projection: Lambert Conformal Conic

Revision Details	By / Check	Check Date	Suffix

Purpose of Issue: For Information

Client: South Stream Offshore Pipeline — ENERGISING EUROPE

Project Title: SOUTH STREAM OFFSHORE PIPELINE

Drawing Title: PLANKTON SURVEY AREA

Drawn	Checked	Approved	Date
DH	RW	MW	12 Mar 2014

URS Internal Project No.	Scale @ A3
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Drawing Number: Figure 12.2

Rev:

Plot Date: 12 Mar 2014
File Name:I:\5004 - Information Systems\46369082_South_Stream\MXDs\Report Maps - Russia\Russian ESIA v2\Chapter 12 Offshore Sampling\Figure 12-2 Plankton Survey Area.mxd

Survey Results

Phytoplankton and Primary Production

In autumn (November) 2010, 75 species of phytoplankton were recorded from a total of eight sampling stations. Dinoflagellates represented 52% of the total number of species and were more abundant in the northern samples of the Survey Area (Stations 1 to 3 in water depths of 32 m and 87 m respectively). Diatoms comprised 29% of the total number of species and were more abundant in the south of the Survey Area, around Gelendzhik (Stations 18 and 19 in water depths of 95 m and 25 m respectively) (Ref. 12.1, Table 12.4).

Table 12.4 Taxonomic Composition of Phytoplankton

Systematic group	Autumn 2010		Spring 2011	
	Number of species	**% of total number of species**	**Number of species**	**% of total number of species**
Diatoms	22 (10 L-B)	29 (45% L-B)	28 (18 L-B)	37.4 (64% L-B)
Dinoflagellates	39	52%	39	52%
Chlorophyta	4	5.4%	1	1.3%
Chrysophytes	3	4%	3	4%
Cyanobacteria	2	2.7%	2	2.7%
Cryptomonads	2	2.7%	1	1.3%
Coccolithophorids	1	1.4%	1	1.3%
Euglenophytes	1	1.4%	-	-
Alveolates*	-	-	1	1.3%
Total	**75**	**100**	**75**	**100**

Note: L-B – littoral-benthic species,* - alveolates are protists and include protozoa, ciliates and dinoflagellates

Phytoplankton of the Survey Area were typically marine, with some species associated with lower salinity observed in the surface layer at Stations 1, 18 and 19 (in water depths of 32 m, 95 m and 25 m respectively). However, the contribution of these low salinity species to the community abundance was not substantial; accounting for 8% of the total number of phytoplankton species. In the autumn of 2010, the coccolithophorid *Emiliania huxleyi* was the dominant species in terms of abundance at all stations (Table 12.5).

Table 12.5 Abundance of Dominant Phytoplankton Taxa in November 2010 and April 2011 Surveys

Species name	Maximum abundance, cells per litres (cell/l) (Autumn 2010)	Maximum abundance, cell/l (Spring 2011)	Station No. (Autumn 2010)	Station No. (Spring 2011)
Dominants				
Small flagellates (cells between 2 and 10 μm)	$1.6x10^6$	$4.4x10^7$	18	19
Picoplankton (cells between 0.2 and 2 μm)	Not recorded	$4.2x10^8$	-	19
Emiliania huxleyi	2.8×10^5	$1.2x10^6$	1	18
Subdominants				
Prorocentrum cordatum (dinoflagellate)	9.6×10^3	10.8×10^3	18	1
Thalassionema nitzschioides (diatom)	$6.0x10^3$	$1.6x10^5$	2	16
Prorocentrum micans (dinoflagellate)	2,000	Not recorded	18	-
Gonyaulax polygramma (dinoflagellate)	Not recorded	$6x10^3$	-	19

For all stations and depths sampled in autumn 2010, the greatest contribution to phytoplankton biomass was made by dinoflagellates (up to 90%, Station 19, depth of 0 m), small flagellates (up to 84%, Station 18, the near-bottom layer) and coccolithophorids (up to 50%, Station 1, depth of 30 m). Maximum phytoplankton biomass was, unsurprisingly, recorded in the well–lit surface layer (Ref. 12.1) and generally, the biomass of near bottom samples at all stations was half that of the surface layer most likely because of lower light levels. However, high variability in phytoplankton biomass was observed, a feature typical of phytoplankton populations.

In spring (April) 2011, 75 species of phytoplankton algae were recorded from 14 stations in the Survey Area. Dinoflagellates (52% of the total number of species) dominated in terms of number of species. Diatoms (37.4% of the total number of species) ranked second by abundance after coccolithophorids. There was a high percentage of littoral-benthic forms (up to 64% of the number of diatoms) in the water column as a result of intensive mixing at the shallow-water stations (Stations 1, 2 and 19; less than 30 m water depth). In coastal shallow waters, up to 30 m water depth, a fairly uniform vertical distribution of algae was observed (Ref. 12.1). The highest abundance of phytoplankton was observed at Stations 2 and 19 in 17 m and 25 m water depth respectively.

In spring 2011, when the contribution of picoplankton is discounted, coccolithophorids dominated the total biomass. This is comparable to 2002-2009 data collected from the north-eastern shelf of the Black Sea although a lack of information regarding survey methodology creates a level of uncertainty with this comparison (Ref. 12.1).

A comparison of the dominant species in terms of number between autumn 2010 and spring 2011 surveys is shown in Table 12.5. The data show that phytoplankton are more abundant around the time of the seasonal spring bloom (March to May) as would be expected (Table 12.5).

In summer 2011, 13 species of phytoplankton were recorded at Station 4c. The main contribution to the biomass was from the diatom *Pseudosolenia calcar-avis* (approximately 56% of the total biomass).

Data on primary production and photosynthetic pigment concentration in the Survey Area in spring 2011 are consistent with published data for the spring period of other years (Demidov, 2008 in Ref. 12.1). Two coastal stations (Stations 18 and 19 near Gelendzhik, at water depths of 95 and 25 m respectively) had higher concentrations of chlorophyll and other pigments, possibly due to anthropogenic eutrophication (Ref. 12.1). The biomass of phytoplankton and annual primary production in the Survey Area suggests a mesotrophic nutrient status in the Survey Area (i.e. water containing moderate levels of inorganic nutrients) (Ref. 12.1). Low values for primary production were recorded in Spring 2011 at stations 18 and 19 (in water depths of 95 m and 25 m, respectively) which was attributed to an increase in suspended sediments and corresponding turbidity of the water column and a result of a storm event (Ref. 12.1.).

Zooplankton

Zooplankton samples were collected in autumn 2010 and spring 2011 (Figure 12.2) at the following locations:

- Stations 1 to 4, 6, 8, 17, 18, 19 in November 2010;
- Stations 1-3, 6, 8, 9, 10, and 13 to 19 in April 2011; and
- Station 4c in August 2011.

Surveys conducted in autumn 2010 (Ref. 12.1) identified 24 species of zooplankton (Figure 12.6), including meroplankton[2]. Copepods were the most diverse component of the community and dominated zooplankton abundance at most stations. Across all samples, copepods accounted for an average of 86% of total biomass. Other permanent members of the zooplankton were chaetognaths (arrow worms), ctenophores (comb jellies) and larvaceans (pelagic tunicates) and the meroplankton was composed of the larvae of benthic groups such as bivalves, gastropods, ascidians and barnacles. Arrow worms accounted for an average of 12%

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[2] Species which are only planktonic for some stages of their life cycle

of total biomass. The greatest abundance of zooplankton was at Stations 2 and 18 (in water depths of 17 m and 95 m, respectively).

In April, 2011, 14 species of zooplankton were recorded from 14 samples in the Survey Area (Table 12.6) and the dominant taxa were the copepod crustaceans which accounted for between 68 and 96% of total abundance. Large heterotrophic dinoflagellates and the larvae of molluscs were the next most abundant groups. Highest abundance values were observed at Stations 6 and 8 which are located around 1,500 m water depth near the continental slope edge (Ref. 12.1). The number of species of the meroplankton, primarily the larvae of benthic species, was much lower in spring 2011 compared to autumn 2010.

Table 12.6 Zooplankton Species Observed in 2010 and 2011

Group	Species / form	Autumn 2010	Spring 2011	Summer 2011
No of stations sampled		8	14	1
Dinoflagellates[3]	*Noctiluca scintillans*		H	
Hydrozoans	*Sarsia tubulosa*[4]			M
Ctenophora (comb jellies)	*Pleurobrachia rhodopis*		H	
Cladocera (water fleas)	*Penilia avirostris*	H		H
	Pleopis polyphemoides	H		
	Pleopis tergestina	H		
	Evadne spinifera			H
Calanoid copepods	*Calanus euxinus*	H	H	
	Pseudocalanus elongatus	H	H	
	Paracalanus parvus	H	H	
	Acartia clausi	H	H	H
	Centropages ponticus	H	H	H

Continued…

[3] Dinoflagellates may functionally belong to both phytoplankton and zooplankton; many species are photosynthetic and grouped with the former while larger predatory or grazing forms are grouped with the latter.
[4] Reported as Coryne tubulosa.

Group	Species / form	Autumn 2010	Spring 2011	Summer 2011
	Calanoida, nauplii	M		
Cyclopoid copepods	*Oithona similis*	H	H	
	Oithona nana	H		
	Cyclopoida, nauplii	H		
Harpacticoid copepods	*Ectinosoma* sp.	H		
Cirripedia (barnacles)	Nauplius larvae	M	M	M
Ostracoda (seed shrimps)	*Euphilomedes interpuncta*	M		
Decapoda (crabs, prawns, etc)	Zoëa larvae	M		M
Bivalvia (clams and mussels)	Veliger larvae	M	M	M
Gastropoda (snails)	Larvae	M	M	
Nematoda (roundworms)	Nematoda sp.	M		
Polychaeta (segmented worms)	*Vigtorniella zaikai*	M		
	Spio filicornis			H
Chaetognatha (arrow worms)	*Sagitta setosa*	H	H	H
Copelata (larvaceans)	*Oikopleura dioica*	H	H	H
Tunicata (sea squirts)	Ascidia, larvae	M		
Pisces	Larvae and eggs	M	M	
Total taxa observed		**23**	**14**	**11**

Note: H= Holoplankton (permanent plankton) M= Meroplankton (temporary plankton e.g. larvae etc.)

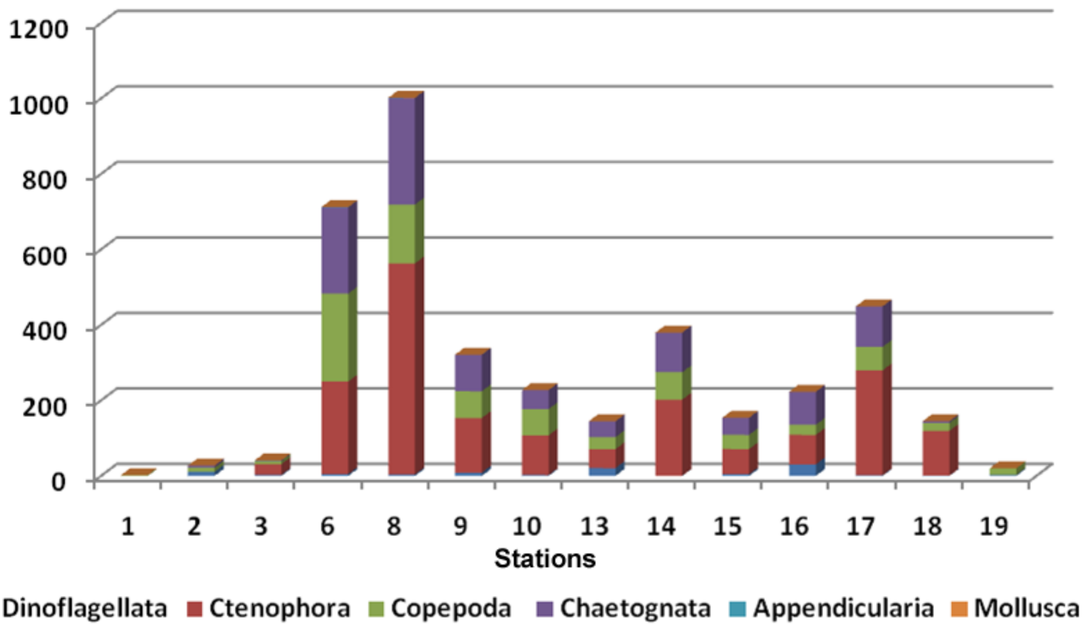
Complete.

The abundance and biomass of zooplankton was spatially highly variable. This difference between stations is typical of the highly patchy nature of zooplankton. Abundance varied between 78 and 3990 individuals/m^3 and biomass from 2 to 1001 mg/m3 per station. Stations located in depths less than 150 m (Stations 1 to 3, 18 and 19) were characterised by large biomass, but lower abundance of zooplankton due to the presence of larger animals such as arrow worms. Station 6 and 8 (water depth of around 1,500 m) had the greatest zooplankton biomass (Figure 12.3).

The biomass of zooplankton was lowest in Stations 1, 2, 3 and 19 (water depths of less than 100 m). In terms of numbers, the community was dominated by arrow worms such as *Sagitta* sp. and mature stages of copepods. Predatory species such as *Sagitta setosa* and the ctenophore *Pleurobrachia rhodopis* dominated the biomass in the majority of deep water stations (i.e. stations in water depths of > 1,500 m) (Ref. 12.1).

Only 11 species of zooplankton were recorded in summer 2011 as only one location was surveyed; Station 4c at less than 20 m water depth (Figure 12.2). Cladocerans dominated the zooplankton community, comprising almost half the abundance and 45% of the biomass. The thermophilic cladoceran *Penilia avirostris* was the most common species (Ref. 12.1).

Figure 12.3 Zooplankton Biomass (g/m^3), Spring 2011



Ichthyoplankton

Ichthyoplankton samples were collected in 2010 and 2011 (see Figure 12.2) at the following locations:

- Stations 1 to 3, 6, 8 and 17 to 19 in November, 2010; and
- Stations 1 to 3, 6, 8, 9, 10 and 13 to 19 in April, 2011.

During the November 2010 survey, the only ichthyoplankton recorded were eggs and larvae of sprat (*Sprattus sprattus*) and whiting (*Merlangius merlangus*). This could be due to the survey period not coinciding with the reproduction period of most fish inhabiting this area of the Black Sea (Ref. 12.1). The maximum abundance in 2010 was observed in coastal areas with the maximum abundance of eggs recorded at Station 1 and larvae at Station 19 in 32 and 25 m water depth respectively (Table 12.1).

Eggs and larvae of fish were determined at almost all stations of the survey. In April 2011, eggs and larvae of sprat were determined at only three of the stations (Station 3, 8 and 17). However, in almost every sample there were young fish of launce (*Gymnamodytes cicerelus*), blennies (*Blennius sp*.) and stickleback (*Pungitius sp*.). During the April 2011 survey, larvae of sprat and prickly pipefish (*Syngnathus phlegon schmidti*) were most numerous (Ref. 12.1).

There were no larvae of any fish species of conservation concern (IUCN Red List or national / regional Red Data Books) collected from either survey.

12.4.2.3 Summary

The phytoplankton community observed in Russian waters was composed of typical marine species, some of which are found in lower salinities. The number of species observed was different between surveys with 75 species recorded from eight stations in spring 2010 and 75 species recorded from 14 stations in autumn 2011. In both surveys, species composition was dominated by dinoflagellates (just over half of all species) and diatoms (around 30%). In terms of abundance small flagellates (a group which can contain some dinoflagallates) dominated the phytoplankton in both surveys. In both 2010 and 2011, phytoplankton species were more abundant at stations in less than 100 m water depth and the highest abundances were generally recorded at the surface. This is to be expected as phytoplankton are photosynthetic species and are usually observed in highest numbers in this euphotic zone which, extends to a depth of 50 m in the Black Sea.

The biomass and production of phytoplankton in the Survey Area suggests a mesotrophic nutrient status which means that the waters are moderately productive with moderate nutrient levels.

Copepods were the most diverse component of the zooplankton community and were dominant in abundance at most stations in 2010 and 2011. In both years, the main contribution to the total biomass comprised four groups; copepods, ctenophores, arrow worms and flagellates. In April 2011, highest abundance values were observed at Stations 6 and 8 which are located around 1,500 m water depth near the continental slope edge whereas in November 2010, the greatest abundance of zooplankton was at Stations 2 and 18 (in water depths of 17 m and 95 m, respectively).

For ichthyoplankton, the difference in the composition during the autumn (2010) and spring (2011) periods corresponded to the reproductive periods of fish. The results of spring investigations in 2011 are comparable with stock data of AzNIIRKh (Azov Research Institute of Fish Industry) for different sectors of the Russian Sector of the Black Sea (Ref. 12.1).

In general, plankton species abundance and biomass was variable and greatest in the spring surveys which correspond with the seasonal bloom in phytoplankton and in turn zooplankton species.

12.4.3 Benthic communities

12.4.3.1 Background and Literature Review

Overview

The northeast region of the Black Sea has historically been considered to comprise two distinct regions: from the Kerch Strait to around Anapa and Gelendzhik in the north, and from Anapa and Gelendzhik to Adler in the south (Ref. 12.6). The oceanography and ecology of these two areas is understood to be distinct, and they have been variously affected by the changes that have affected the entire basin over the last few decades.

The invasion of the ctenophore *Mnemiopsis leidyi* (discussed in Section 12.4.1) affected the benthos by reducing both light and dissolved oxygen available to the seabed communities (through increased sedimentation[5]). Bivalve beds of *Chamelea* sp. and *Gouldia* sp. were displaced from deeper water and *Mytilus galloprovincialis* was completely eliminated at depths of 30 to 50 m. The subsequent reduction of M. leidyi numbers, as a result of predation by another invasive ctenophore, *Beroë ovata*, in the Black Sea resulted in a rapid increase in bivalve recruitment. This was in turn followed by a brief surge in numbers of the large predatory snail *Rapana venosa* as new prey resources became available. As the *R.venosa* population depleted its food resource, its population in turn collapsed and the benthic community became dominated by polychaete worms (Ref. 12.6).

Additional changes in ecology have been noted over the last ten years in relation to the southern region of the Russian coast of the Black Sea. For example, the once extensive areas of the seaweeds *Phyllophora* sp. and *Cystoseira* sp. have been reduced (Section 12.4.1). This has had significant implications for benthic ecology as the structurally complex red algae habitats were replaced by simpler, less diverse communities featuring fast growing pollution tolerant green algae (Ref. 12.6).

The nearshore Project Area runs through the Anapa Bank fishery protected zone. This is legally protected for a number of commercial fish species and is thought to be important for these species due to the benthic communities in the area. Anapa Bank is discussed in more detail in Section 12.4.8.1. In addition, the Utrish SPNA, which is protected for a number of macroalgal species, is located around 2 km at its closest point, from the Pipeline. This is also discussed in detail in Section 12.4.8.1.

Macrophytes

Macrophytes comprise macroalgae (seaweeds) and vascular plants (mainly seagrasses). They are key components of the marine ecosystem as primary producers, providing food to a wide variety of organisms either as living plant matter or detritus. Macrophytes also enrich water with

[5] It has been shown, particularly in eutrophic waters that outbreaks of jellyfish predation can reduce or eliminate the grazing of zooplankton which results in an increased sedimentation of phytoplankton. This may cause severe oxygen depletion and release of nutrients from the anoxic sediment, creating a feedback system and exacerbating the effect (Ref. 12.16).

oxygen and take up dissolved organic matter, thus increasing the quality of coastal waters. Macrophyte stands serve as spawning grounds and shelter for many fishes and invertebrates.

Large perennial algae and grasses are thus habitat forming plants (edificators) in seabed communities that occupy significant areas on the continental shelf.

The marine flora of the Black Sea has been subject to significant changes in both biodiversity and abundance in the past few decades due to eutrophication. For example, a decrease in macrophyte diversity and reduction in extent of perennial algae, such as *Phyllophora* and *Cystoseira*, has been observed across most of the Black Sea together with an increase in the diversity and abundance of opportunist, fast growing green algae that are more tolerant of eutrophic conditions.

On the Russian coast of the Black Sea, macrophytes include some 143 species of macroalgae (41 species of green, 29 species of brown and 73 species of red) and six species of vascular plants (including two seagrass species of the genus *Zostera*). Both species of the seagrass *Zostera* (*Zostera marina* L. and *Z. noltii*) have declined drastically in the Black Sea due to pollution (Ref. 12.19). By the 1980s, seagrass communities on the North Caucasian coast of the Black Sea had practically disappeared (Ref. 12.1) and significant seagrass beds are now confined to Taman Bay and Dinskoy Bay, on the shore of the Strait of Kerch (Afanasiev, Korpakova, 2008 in Ref. 12.1).

The important changes in the past few decades are an increase in the diversity and abundance of green algae and a simultaneous decrease of brown species. There have also been geographical shifts in species distributions as some species have spread to the North Caucasian coast from the other regions of the basin (Ref. 12.1).

Although green algae have become increasingly common as a result of the ecological changes, particularly eutrophication, in past decades, brown algae, such as *Cystoseira* spp., are still locally the most important group in that they form the most widely spread communities throughout the region despite falling abundance and diversity. The stock of *Cystoseira* along the North Caucasus shore has declined from almost 2 million tons to no more than 100 thousand tons in the past 30 years (Ref. 12.8). Nonetheless, it remains the most widely spread and richest macroalgal community along the coast (Ref. 12.1).

Red algae are the most taxonomically diverse group, but form less extensive communities. Large perennial species such as *Phyllophora crispa* (also known as *P. nervosa*) and *Coccotylus truncatus (also known as P.brodiae*) and others, form perennial communities either alone or in combination with *Cystoseira*. This is in contrast to the western Black Sea, where *Phyllophora* was historically the most important alga, forming fields of thousands of hectares.

The type of macroalgal community present is dependent to a large extent on depth. Large scale zonation across the entire photic zone can be observed (Ref. 12.1. and Ref. 12.4) as follows:

- **The Upper photic zone** comprises mosaics of red, green and brown algae, 0 to 2 m water depth;
- **The Mid photic zone** features primarily brown algae, particularly of *Cystoseira* spp., in water depths around 2 to 10 m. These species support a high diversity of macrofauna (Ref. 12.4). There is also a high diversity of red algae, present as epiphytes and understory

cover. The density and extent of the *Cystoseira* zone is greatest at depths of 3 to 5 m. The distribution and density of this algal association has been considerably reduced in recent decades due to poor light penetration resulting from the effects of eutrophication and super-abundance of invasive ctenophores (Ref. 12.20); and

- **The Lower photic zone** (at depths below about 10 m) is characterised by a mosaic of different associations. Red algal species diversity is high although the recent ecological changes observed throughout the Black Sea have resulted in an increase in the presence of several species of green algae. The red alga *Phyllophora* is found at depths of 15 to 20 m though its extent and percentage cover have been considerably reduced in recent decades. In addition, there has been an increase in the presence of green algae at these depths, particularly of *Codium* spp. such that a *Phyllophora-Codium* association is recorded from many areas where *Phyllophora* alone was previously dominant.

Macrozoobenthos

Studies in the first half of the 20th century described the Black Sea benthic fauna as uniform and stable. The most common fauna were molluscs, polychaetes and crustaceans (Ref. 12.21). Since the mid-twentieth century, the benthos of the north-eastern Black Sea has undergone extensive changes. The first of these was the introduction, in 1947, of the large predatory snail *Rapana venosa* (also known as *R. thomasiana*). This resulted in a significant reduction in oyster beds in the Black Sea although it did not have an impact on the distribution of other species or communities (Ref. 12.1). As discussed in Section 12.4.3.1, as *R.venosa* depleted its food resource, its population collapsed and the soft sediment benthic community became dominated by polychaete worms. Another non-native species, the ark shell *Anadara cornea* (also reported as *A. inaequivalvis* and *Cunearca cornea*) became well established in the 1980s. It was first noted in the Black Sea in 1981 near the Bulgarian coast and in 1986 along the Caucasian coast in the region of Tuapse-Shepsy. It has since become one of the dominant benthic species (Ref. 12.9).

However, the greatest changes to the Black Sea benthos started in the 1980s as a result of eutrophication and increases in water turbidity due to increased primary production. The first changes became obvious in the coastal communities of the shelf region to the east of the Crimea peninsula, with shifts in the abundance and biomass of bivalve mollusc species. The common bivalve *Chamelea gallina* was seen to be replaced by more siltation resistant species such as *Polititapes petalina* and *Plagiocardium simile*. The small bivalve *Lucinella divarica*, found in abundances up to 6,500 individuals per square metre (ind./m^2), totally vanished from these communities. Similar shifts to siltation tolerant bivalve species and the final disappearance of *Chamelea gallina* from sand biotopes at depths of 20 to 25 m were observed in the 1980s in surveys carried out between Anapa and Gelendzhik on the north-eastern coast (Nikolaenko, Povchun, 1993 in Ref. 12.1).

Further changes to benthic communities resulted from the explosive proliferation of the ctenophore *Mnemiopsis leidyi* in the late 1980s. As a voracious predator *M. leidyi* reduced zooplankton numbers resulting in further increases in primary production and sedimentation of particulate matter to the benthos (Ref. 12.1). This sharp increase of turbidity caused significant changes in the distribution of macroalgae because of the reduction in light availability. There was a thinning out of the seaweed *Cystoseira*, a decrease in the depth limit to which the species was found and a general degradation of the deep-water vegetation at the southern part of the North Caucasian coast (Ref. 12.1). Another effect of the loss of algal cover was to make some mussels more available to predation by the snail *R. venosa*, resulting in an increase in the predator's numbers. The more recent arrival of a second invasive ctenophore, *Beroë ovata,* which is a predator of *M.leidyi,* has reversed this situation to some extent.

In the southern part of the North Caucasian coast, the reduction in oxygen levels over silty ground has given the bivalve invader *Anadara cornea* a competitive advantage over the previously dominant *Chamelea gallina.* By 1999 even the most developed *Chamelea gallina* communities in depths of 20-30 m had come to be dominated by the non-native species (Ref. 12.1).

Thus, the recent dynamics of the benthic communities of the North Caucasian coast of the Black Sea have been determined by the combined influence of two pelagic invaders *M. leidyi* and *B. ovata* combined with the influence of the carnivore invader *R. venosa* and the appearance of the bivalve competitor species *A. cornea* (Ref. 12.1).

Research carried out by the P.P. Shirshov Institute of Oceanology (summarised in Ref. 12.1) between 1999 and 2007 shows the communities of macrozoobenthos along the North Caucasian coast to be typical for the Black Sea. Coastal reefs and rocky ground to 12 m water depth have a dense cover of *Cystoseira* spp. and are occupied by a community dominated by the small bivalve *Mytilaster lineatus*, crustaceans, gastropod, various bryozoans and other encrusting animals. Permanent macrozoobenthos are absent from marginal littoral sandy areas (to 5 m) because of wave action and substrate instability. At depths between 7 and 20 m a community dominated by the bivalve *Chamelea gallina* is present. This has been replaced in deeper water (20 to 30 m) by *Anadara*, the edible mussel *Mytilus galloprovincialis* from approximately 35 to 50 m, and the horse mussel *Modiolula phaseolina* below 60 m. *Modiolula* beds may extend to the edge of the shelf although this would need to be confirmed by survey. A total of 120 benthic species have been recorded in the region.

12.4.3.2 Survey

Survey Area

The survey locations shown in Figure 12.4 make up the Survey Area discussed in this section for benthic communities. Information on the water depth and distance from shore of each station and survey methodologies is given in Table 12.1 and Table 12.3.

Survey Results

Macrophytobenthos

Phytobenthos surveys were conducted in 2009 and 2011 (Figure 12.4) at the following locations:

- In May to June 2009, samples were collected at Stations 1 to 8s; and
- In August 2011, samples were collected at Stations 1 to 14c, and video footage was obtained from a transect survey between Stations 4c to 6c.

In shallow waters, macroalgae communities were characterised by a relatively low biomass and the prevalence of green algae, primarily sea lettuce (*Ulva sp.*) and *Enteromorpha sp*[6]. At 10 m water depth, biomass was higher and *Cystoseira* was the dominant species. Over 15 m water depth, *Codium, Phyllophora* and in some cases sea lettuce, were dominant, but macroalgal biomass was lower than shallower areas (Ref. 12.1).

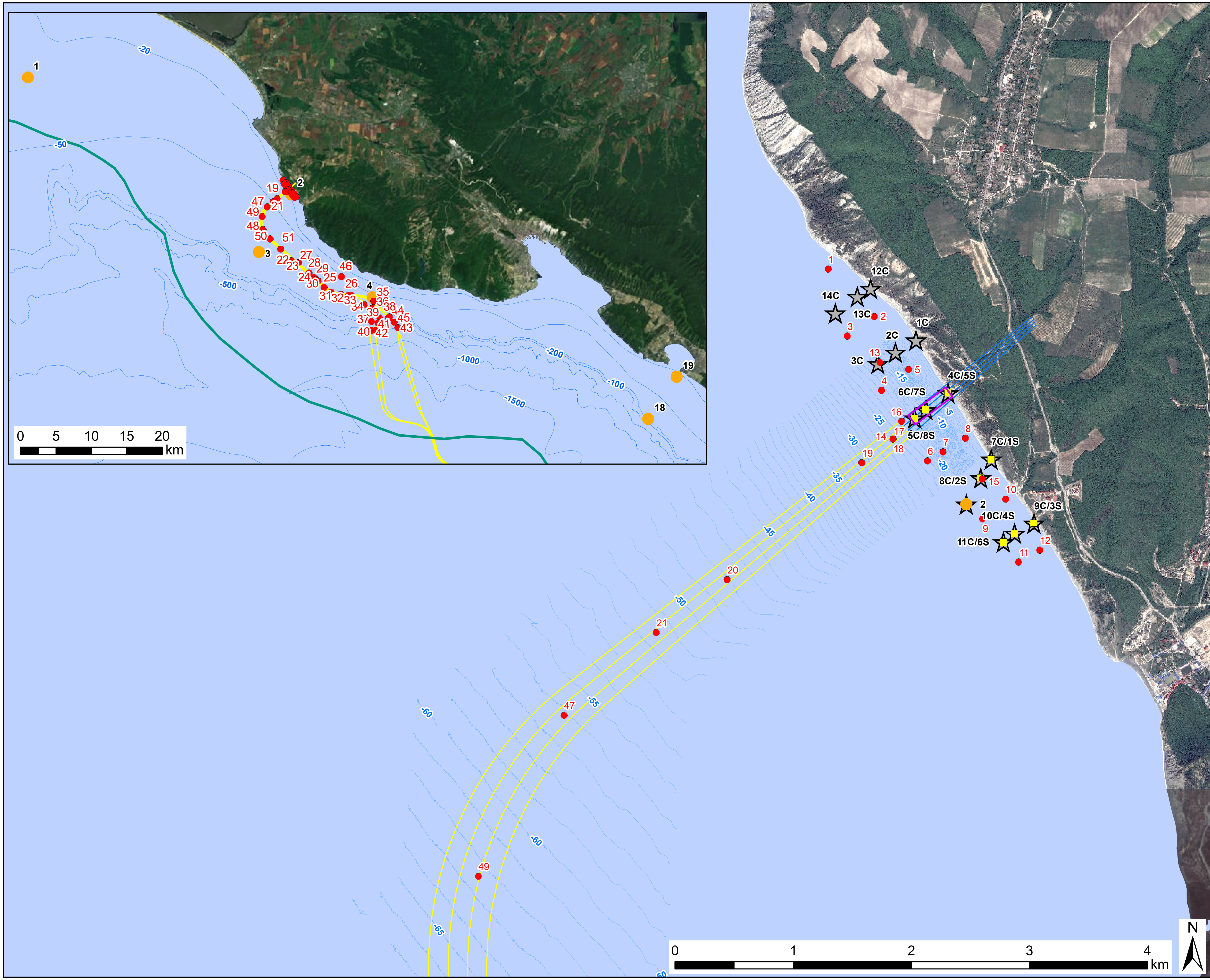
The following algal communities, generally on areas of bedrock and boulders, were observed:

- A *Cladophora dalmatica* community and a *Ceramium ciliatum* / *Padina pavonica* community in shallow waters at the coastline;
- A *Cystoseira crinite / Cystoseira barbata* community at a water depth of approximately 10 m, succeeded by a *Cladostephus spongiosus / Corallina elongata* community; and
- A *Codium vermilara* community succession towards 20 m water depth.

No vascular plants, in particular seagrasses of the *Zostera* genus, were observed during the 2009 and 2011 surveys.

Cladophora communities had the greatest algal biomass. The biodiversity of macroalgae increased with depth in the Survey Area (Figure 12.4). The highest algal diversity was noted at the stations situated at a depth of 20 m (in *Cystoseira* and *Codium* communities) and the lowest at stations in 0 m water depth.

[6] It is currently considered that Enteromorpha is synonymous with Ulva and all the relevant species are now in the latter genus.



LEGEND

Russian Sector of South Stream Offshore Pipeline

- Proposed microtunnels
- Proposed offshore pipelines
- Macrophyto & macrozoobenthos sampling stations (May-June 2009)
- Macrophyto & macrozoobenthos sampling stations (November 2010)
- Macrophyto & macrozoobenthos sampling stations (August 2011)
- Macrobenthos sampling stations July 2013
- Area of video sampling (August 2011)
- Russian territorial waters boundary
- Isobaths

Projection: Lambert Conformal Conic

Revision Details	By Check	Check Date	Suffix

Purpose of Issue: For Information

Client: South Stream Offshore Pipeline — ENERGISING EUROPE

Project Title: SOUTH STREAM OFFSHORE PIPELINE

Drawing Title: BENTHIC SURVEY AREA FOR 2010, 2011 AND 2013 SURVEYS

Drawn	Checked	Approved	Date
DH	RW	MW	04 Mar 2014

URS Internal Project No.: 46369082 — Scale @ A3: 1:30,000

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Drawing Number: Figure 12.4 — Rev:

Plot Date: 04 Mar 2014
File Name: I:\5004 - Information Systems\46369082_South_Stream\MXDs\Report Maps - Russia\Russian ESIA\Offshore Sampling\Figure 12.4 Benthic Survey Area for 2010, 2011 and 2013 Surveys.mxd

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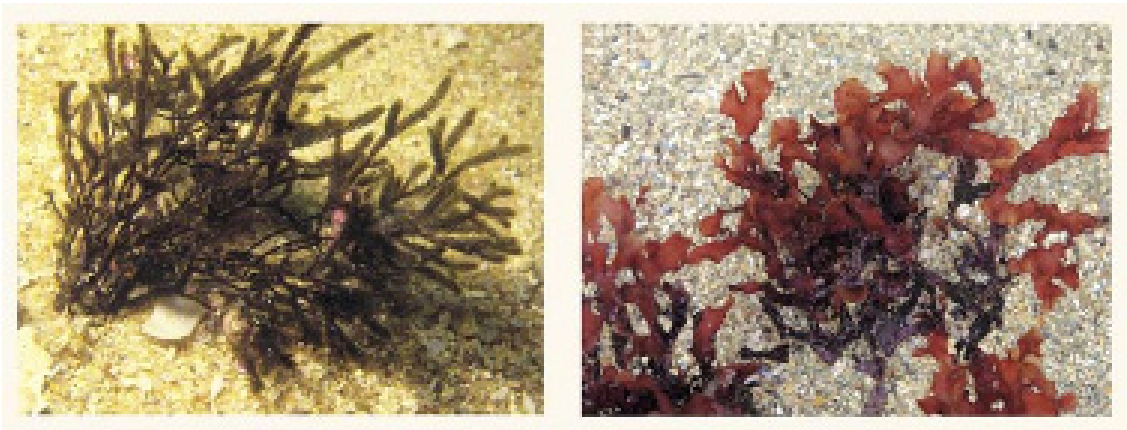
Two species of macroalgae that are listed in the Red Data Book of Krasnodar Krai were found during the survey (Figure 12.5). None were found on the IUCN Red List although the marine realm, and seaweeds in particular, are currently very poorly covered (Ref. 12.3). The brown algal species *Cladostephus spongiosus* and *Phyllophora crispa* were observed along the pipeline route alignment at Station 5. *Cladostephus spongiosus* and *Phyllophora crispa* both also occur in the Utrish SPNA (Ref. 12.4) which is discussed more fully in Section 12.4.8.1.

Table 12.7 presents the total number of species identified at the stations sampled and identifies the stations at which protected species were recorded.

Table 12.7 Macroalgae Species Observed Listed in Red Data Book of Krasnodar Krai (August 2011)

Station	**2c**	**3c**	**5c**	**7c**	**8c**	**9c**	**10c**	**11c**	**12c**	**13c**
Water Depth (m)	**10**	**20**	**10**	**0**	**10**	**0**	**10**	**20**	**0**	**10**
Cladostephus spongiosus	+	+	+		+		+	+		+
Phyllophora crispa [= *P. nervosa*]	+		+					+		
Total number of species present	18	23	16	9	15	5	12	24	9	17

Figure 12.5 Protected Species of Algae Identified during Field Work in 2011 (left to right, *Cladostephus spongiosus* and *Phyllophora crispa*)



Source: (Ref. 12.1)

The August 2011 survey (Figure 12.4) shows that the communities of macroalgae were characterised by relatively low biomass, and a prevalence of the green algae Ulva (which now includes *Enteromorpha*, previously thought to be a separate species but now included in the

Ulva genus). At depths less than 10 m, *Cystoseria* sp. was the most abundant and its biomass was higher in these shallow water areas. At deeper (over 15 m) locations the biomass of *Cystoseira* sp. was lower; *Codium, Phyllophora* and in some cases Ulva were the most dominant macroalgae (Ref. 12.1). The August 2011 survey observed 44 species of macroalgae (seven green, eight brown and 29 red). The maximum species diversity was observed at a depth of 20 m, at stations 3c and 11c (23 - 24 species) with the least diversity at stations 7c, 9c and 12c on the shoreline. The prevalence of brown algae over the green algae, the high population of pollution-intolerant species such as *Padina pavonica* and *Codium vermilara*, and the low number of epiphytes (algae that grow on other species) on *Cystoseira synusia*, indicate a low degree of eutrophication. The macroalgae community observed was similar in composition and biomass to that recorded in the 2009 surveys (Ref. 12.1).

Other surveys in the region, conducted to inform the Black Sea Commission 'State of the Environment' Report (Ref. 12.9), observed significant macroalgae populations attached to the shells of live molluscs on the soft bottom habitats of the Anapa region and Gelendzhik Bay. The area of this association between the algae and mollusc was large enough for it to be considered a significant contributor to primary production in soft sediment areas (Ref. 12.8).

Macrozoobenthos

Zoobenthos surveys were conducted at the following locations (Figure 12.4):

- During May-June, 2009 samples were collected at Stations 1 to 8s;
- In November 2010, samples were collected at Stations 1 to 4, 18, 19;
- In August 2011, samples were collected at Stations 1 to 14c and video footage was taken along a transect between Stations 4c to 6c; and
- In July 2013 51 stations were sampled by benthic grab and video.

The survey methodology is summarised in Figure 12.3. These locations comprise the Survey Area discussed in this section for zoobenthos.

Results of the 2009 surveys (spring-summer) found the epibenthic amphipod *Gammarus olivii* dominated both biomass and numbers at the shore stations 1S, 3S and 6S.

In 2009, at water depths of around 10 m (Stations 2S, 4S and 7S), the benthos was highly diverse comprising polychaetes, crustaceans, bivalves and gastropods. The substrate at these stations represented a mixture of sand with fine pebbles and shells. The distribution of organisms was uneven and species composition and abundance in repeated samples selected at a distance of 10 to 15 m water depth from each other varied considerably. The small polychaete *Staurocephalus rubrovittatus* and the soldier crab *Diogenes pugilator* were encountered at all stations.

Two samples were taken at stations 6S and 8S at a water depth of 15 m. Sediment composition at Station 6S comprised fine sands, while sediment composition at Station 8S comprised large stones and shells. Due to this difference in sediment type, the composition of the zoobenthic community at these stations differed significantly (Ref. 12.1).

The abundance and biomass of the dominant species recorded in the 2009 survey (less than 20 m water depth) is shown in Table 12.8. At Station 5S, the polychaete *Saccocirrus papillocercus* was the most abundant and at Station 8S three species (the polychaete worm *Melinna palmata*, the acorn barnacle *Balanus improvisus* and the crab *Macropipus arcuatus*) were dominant in number. A total of 15 species of macrozoobenthos were found in the Survey Area in 2009. None of these was a rare (i.e. IUCN Red List Categories 1 to 3, national or regional RDBs as endangered or critically endangered) or legally protected species.

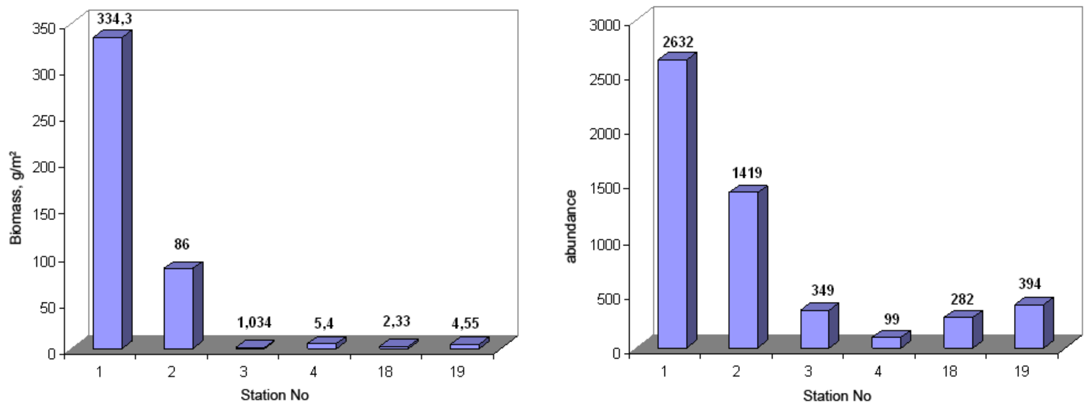
Table 12.8 Abundance and Biomass of Dominant Species in May to June 2009 Survey

Station No.	Species Name	Abundance		Biomass	
		ind./m^2	%	Grams per square metre (g/m^2)	%
1S	*Gammarus olivii*	28685	90.7	25.01	73.6
2S	*Xantho poressa*	145	26.9	13.64	39.0
3S	*Gammarus olivii*	13764	82.4	9.71	41.2
4S	*Staurocephalus rubrovittatus*	290	45.2	-	-
	Macropipus arcuatus	-	-	16.74	72.3
5S	*Saccocirrus papillocercus*	207	29.4	-	-
	Diogenes pugilator	-	-	12.61	42.8
6S	*Gammarus olivii*	7068	80.5	7.23	44.6
7S	*Microspio mecznikowianus*	103	23.8	-	-
	Saccocirrus papillocercus	103	23.8	-	-
	Tricolia pulla	103	23.8	4.13	39.2
8S	*Melinna palmata*	62	17.6	-	-
	Balanus improvisus	62	17.6	-	-
	Macropipus arcuatus	62	17.6	-	-
	Pectinaria koreni	-	-	11.37	44.0

Project surveys conducted in November 2010 extended the Survey Area along the Caucasian coast from near Kerch to near Gelendzhik. A community of *Spisula subtruncata* (reported as

Spisula triangula) was found at Station 1 near Kerch at a depth of 30 m over silty shelly ground (65% shell/gravel, 15%, 0.1 millimetres (mm)). This community was characterised by a relatively high richness of 35 species (13 polychaetes, eight bivalves, four gastropods, five crustaceans, two cnidarian, one nemertean, one turbellarian and one oligochaete). Average total biomass of the community at Station 1 was 334.27 g/m^2, average total abundance was 2,632 ind./m^2, and represented the highest biomass and abundance of any sample taken during the survey (Figure 12.6).

Figure 12.6 Benthic Biomass (g/m^2) and Abundance (ind./m^2) in November 2010 Surveys



Further south, a *Pitar rudis* community was found at Stations 2 (near Anapa) and 19 (near Gelendzhik) at depths of 20 m and 34 m respectively. Bottom sediments at these stations comprised silty sand with shells. The bivalves *Pitar* and *Chamelea* are associated with a wide range of grounds, although they prefer sand deposits. The two stations showed some differences in richness and species composition[7]. The northern site was richer (24 species as opposed to 15 in the south) and had a higher average biomass (86.0 g/m^2 compared to 4.55 g/m^2 in the south) and abundance (1,419 ind. /m^2 compared to 394 ind. /m^2 in the south). The northern sample comprised 10 species of polychaete, two bivalves, two gastropods, six crustaceans, two cnidarians, one nemertean and one phoronid. The southern sample comprised six polychaetes, two bivalves, four crustaceans, one nemertean, one cnidarian and one phoronid. It has been suggested that the impoverishment of the community near Gelendzhik Bay is due to anthropogenic effects (Ref. 12.1), though this site also had an appreciably finer sediment structure (56% particles 0.1 mm, cf. 35% in the northern, shallower sample).

The sample from deeper water (Station 4 at 58.8 m) was characterised by a community dominated by *Plagiocardium papillosum* and *Modiolula phaseolina*. The bottom sediments were silty sand (63% <0.1 mm) with shells, most of which showed evidence of gastropods predation (drill marks). The sample included seven polychaetes, two bivalves, one crustacean and one

[7] Richness is distinct form diversity in that the former considers the total number of species in a sample, while measurements of diversity also factor in their relative abundance.

echinoderm). Average total biomass of the community was 5.4 g/m^2 and average abundance 99 $ind./m^2$.

At depths greater than 80 m, the samples were dominated by the brittlestar *Amphiura stepanovi*. Here the seabed was characterised by fine clay ooze (86-99% < 0.01 mm), oxygen levels were lower and some H_2S was present. The average biomass of this type of community was low, from 1 to 2.3 g/m^2, total abundance ranged from 282 to 349 $ind./m^2$, and was composed of a large number of small-sized polychaetes.

In August 2011, the littoral communities of soft sediments and macroalgal thickets were surveyed at Station 4c, 5c and 6c using a video transect. On sandy grounds at 20 m isobath a *Pitar rudis* community was found, similar to that observed in 2010 but less rich (although high levels of spatial variability in species diversity and abundance is common in marine communities). It included six mollusc species, one polychaete and one bryozoan. The bivalves *Pitar rudis* and *Gouldia minima* dominated the assemblage both numerically and in terms of biomass. At station 14c, which had a reduced gravel component and relatively fine sediment (40% <0.1 mm), a high density of the small bivalve *Lucinella divaricata* was recorded (63 $ind./m^2$). This community also included *Bittium reticulatum*, *Calyptraea chinensis, Mytilus galloprovincialis, Harmothoe reticulata* and *Scrupocellaria bertholletii* in low numbers.

The main macroalga at 10 m water depth was *Cystoseira*, which supported a faunal community comprising 35 species of macrozoobenthos. The bivalve *Mytilaster lineatus* and the snail *Bittium reticulatum* together dominated the biomass of this community (15.48 g/m^2 and 4.04 g/m^2 respectively). *M.lineatus* is one of the main components of seaweed thickets throughout the Black Sea due to its high settlement density and resistance to pollution (Ref. 12.1). This is of wider significance because *M.lineatus* is therefore the main provider of natural bio-filtration along the Black Sea coast and can be present in high densities. The maximum abundance of *M.lineatus* observed in this survey was 2,826 $ind./m^2$ (average 891 $ind./m^2$). The fouling polychaete *Spirorbis pusilla* was also common on algal thalli and *M.lineatus* shells in this community, and is considered a dominant species. The dominance of *M.lineatus* is consistent with historical data collected from 1999 to 2007 by the P.P. Shirshov Institute of Oceanology (summarised in Ref. 12.1) along the North Caucasian coast.

At a depth of 20 m, the main thicket forming algae were *Phyllophora* and *Codium*. The associated faunal community includes 34 species (11 molluscs, 11 crustaceans, 7 polychaetes, 4 bryozoans and 1 hydroid). Again, *M. lineatus* dominated the biomass (10.35–28g/m^2). The snail *Bittium reticulatum* was numerically dominant (910–1,781 $ind./m^2$). The gastropods *Tricolia pulla* and *Rissoa splendida* were present in lower numbers, but in the same order of magnitude as *M.lineatus*. The most significant encrusting animals were the bryozoan *Cryptosula pallasiana* (reported as *Lepralia pallasiana*) and *Spirorbis pusilla.* The high diversity of macrofauna within the algal beds observed in this survey are consistent with other data sources located near Utrish (around 2 km from the Project Area) located along the Caucasian coast (Ref. 12.1 and Ref. 12.4).

In July 2013 a further benthic survey of the coastal area (Figure 12.4), including locations of the proposed seabed intervention work, was carried out. Of the 51 target stations, 10 were in shallow waters (<20 m) where grab samples could not be collected because the seabed comprised mainly bedrock and boulder. There is however, Remotely Operated Vehicle (ROV) video and stills data for all stations, which have been used to identify the benthic communities present.

There was considerable variability in both the number of individuals and the number of benthic species. Grab samples contained between 6 and 397 individuals, and between 2 and 14 different species.

The distribution of invertebrate marine fauna is often correlated with the nature of the substratum and so abundance and number of species has been analysed by sediment type (Table 12.9). This analysis shows that the highest variability in abundance occurred in muddy habitats. The fact that the maximum abundance (397 individuals) is far higher than the average abundance of 66 individuals indicates the highly discontinuous and patchy distribution of fauna typical of marine sediments.

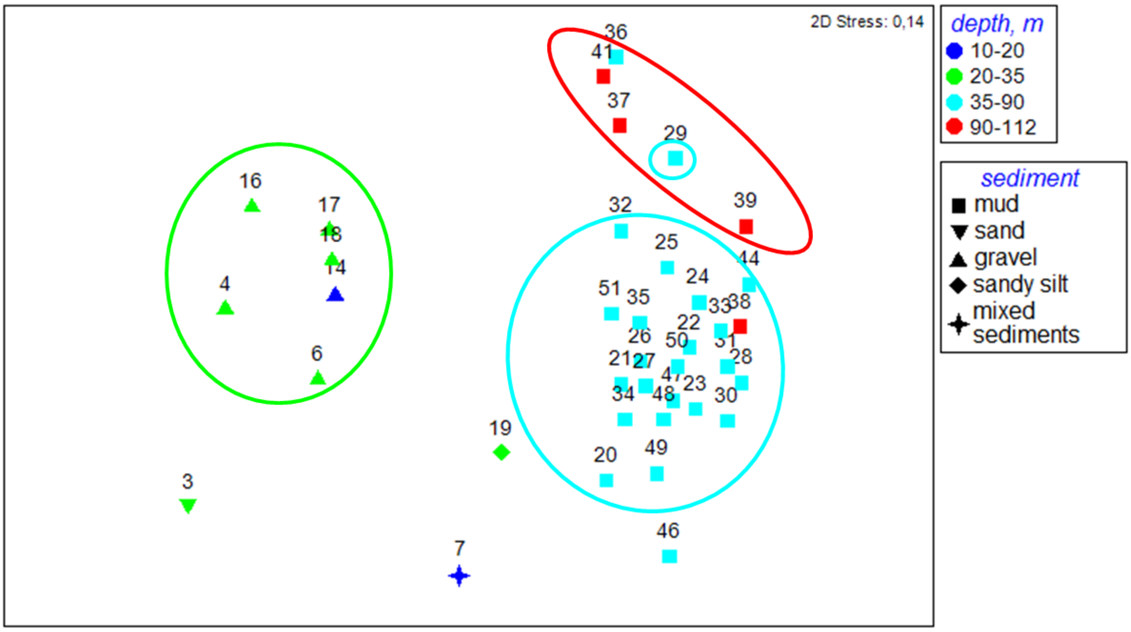
Table 12.9 Abundance And Species Richness by Sediment Type in July 2013 Survey Samples

Sediment Type*	Abundance (ind. /m^2)			No. of Species (Richness)		
	Min	Max	Average	Min	Max	Average
Coarse (gravel)	39	197	100.7	3	11	7.6
Mixed sediment	65	161	100.2	5	9	6.9
Sand	22	34	26.7	2	14	5
Mud	6	397	66.2	4	6	7.2

* Sediment type was classified using the FOLK sediment triangle on the basis of sediment particle size analysis data (Ref. 12.22)

Multivariate analysis of the benthic communities, using PRIMER, identified broad groups that were grouped largely by sediment type with some influence of depth (Figure 12.7). Muddy stations cluster together showing a similar species composition, although a number of samples from between 90 and 112 m are included within a separate group (circled in red), which may reflect changes in species distribution in response to lower levels of oxygen in deeper sites, and/or in response to slight variations in the sediment composition of muds between stations.

Figure 12.7 Multi-Dimensional Scaling (MDS) Plot, using Bray-Curtis Dissimilarity Index, indicating Structural Similarity between Benthic Stations*



* Structurally similar (i.e. with a similar species composition) samples cluster together

There was only one sandy station sampled during the 2013 survey so the species present may not be representative. The sample was characterised by burrowing organisms including the bivalves *Gouldia minima* and *Chamelea gallina* and amphipods of the family Corophiidae. The lancelet, *Branchiostoma lanceolatum*, a species typically found only in sandy sediments, was also present (Table 12.10).

Table 12.10 Average Abundance of Species Present in Sand Samples

Faunal group	Species	Average Abundance (ind. /m^2)
Bivalvia	*Gouldia minima*	8.3
Euchordata	*Branchiostoma lanceolatum*	5.0
Crustacea	*Diogenes pugilator*	4.3
Bivalvia	*Chamelea gallina*	3.7
Crustacea	*Corophiidae*	3.3
Polychaeta	*Schistomeringos rudolphi*	2.0

Species in the mixed and coarse sediments sampled in the Survey Area were dominated by bivalves and polychaetes (Table 12.11 and Table 12.12). The bivalves *Gouldia minima* and *Pitar rudis* are common in both sediment types as are the predatory polychaete *Glycera tridactyla*. Amphipods were also common in coarse sediments (Table 12.12).

Table 12.11 Average Abundance of Top 10 Species Present in Mixed Sediment Samples

Faunal group	Species	Average Abundance (ind./m^2)
Polychaeta	*Spio filicornis*	22.8
Bivalvia	*Gouldia minima*	16.0
Crustacea	*Corophiidae*	7.7
Polychaeta	*Glycera tridactyla*	7.0
Bivalvia	*Pitar rudis*	6.5
Polychaeta	*Capitellidae gen.sp.*	4.0
Polychaeta	*Harmathoe reticulata*	3.8
Bivalvia	*Chamelea gallina*	2.8
Bivalvia	*Anadara inaequivalvis*	2.3
Bivalvia	*Spisula subtruncata*	2.0

Table 12.12 Average abundance of Top 10 Species Present in Coarse Sediment Samples

Faunal group	Species	Average Abundance (ind./m^2)
Bivalvia	*Gouldia minima*	37.1
Polychaeta	*Glycera tridactyla*	14.1
Bivalvia	*Pitar rudis*	10.3
Polychaeta	*Harmathoe reticulata*	7.8

Continued…

Faunal group	Species	Average Abundance (ind./m^2)
Crustacea	*Amphipoda sp.C*	6.4
Polychaeta	*Schistomeringos rudolphi*	6.1
Polychaeta	*Prionospio cirrifera*	5.7
Bivalvia	*Anadara inaequivalvis*	4.3
Bivalvia	*Moerella donacina*	3.0
Polychaeta	*Spio filicornis*	2.8

Complete.

The muddy sediments of the Survey Area support communities dominated by bivalves such as *Modiolula phaseolina* and *Parvicarcium* simile and by a number of polychaete species (Table 12.13). There is, however, considerable variability in total abundance between stations, as shown in Table 12.9, and abundance by species is similarly variable between stations.

Table 12.13 Average Abundance of Top 10 Species Present in Mud Sediment Samples

Faunal group	Species	Average Abundance (ind. /m^2)
Bivalvia	*Modiolula phaseolina*	21.2
Polychaeta	*Aricidea claudiae*	6.9
Polychaeta	*Terebellides stroemii*	5.0
Bivalvia	*Parvicardium simile*	4.4
Polychaeta	*Phyllodoce lineata*	4.1
Bivalvia	*Angulus tenuis*	3.7
Polychaeta	*Capitellidae* gen.sp.	2.8
Polychaeta	*Prionospio cirrifera*	2.3
Polychaeta	*Nereidae* sp. A	1.5
Echinodermata	*Amphiura stepanovi*	1.5

The sediment particle size and biological community data (Figure 12.7) have been analysed together to determine the nature of the benthic habitats in the survey area. Whilst EUNIS biotope codes are not presented for habitats the data has been analysed using similar methods to determine habitat types in the Survey Area (Ref. 12.23). Where a grab sample data was not available, e.g. for the rocky areas, the habitat has been identified on the basis of video and stills images and data from previous diver surveys. A total of nine habitat types in the survey area have been identified. These habitat types are clearly related to depth and nature of the seabed as described below and in Table 12.14 and their distribution is shown in Figure 12.8.

At all stations sampled between 3 and 20 m the seabed was uneven bedrock and boulders with some small patches of sediments between boulders or in crevices in the bedrock. These areas were dominated by algal communities and the depth based zonation of algal species seen in previous surveys was observed.

In the shallower regions, between 3.9 and 11.0 m, there were dense algal communities, with 90 to 100% algal cover, dominated by *Cystoseira* spp. In water depths from approximately 12 to 19 m, samples were also dominated by rocky seabed, but with less dense coverage of algae, predominantly *Codium vermilara*. Diver recordings in previous years' surveys indicate that these algal habitats support a high abundance of the mussel *Mytilaster lineatus* which, is found attached to *Cystoseira thalli* and the small needle whelk *Bittium reticulatum*.

In water depths between 19 and 27 m a variety of sediment types are found including sand, mixed and coarse sediments. There was no bedrock observed in any of the samples in water depths greater than 20 m. The communities in these areas are dominated by infaunal organisms, predominantly burrowing bivalves such as Gouldia minima and *Chamelea gallina* and *infaunal polychaetes* including *Spio filicornis*.

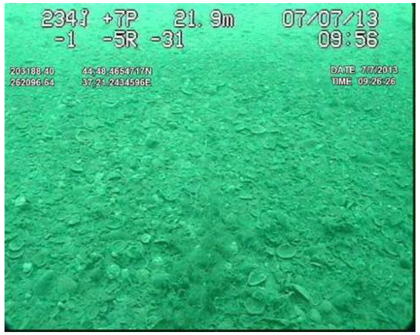
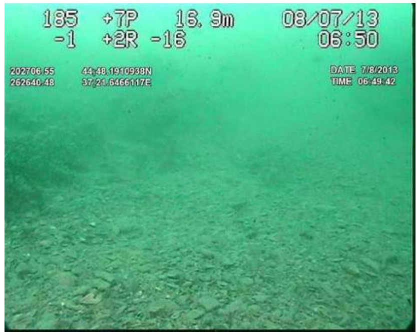
Beyond 33 m water depth the seabed consists of muddy sediments which support communities of burrowing bivalves and infaunal polychaetes. At one station, Station 19, dense patches of large ascidians were observed on the video footage. The number of species per grab sample is not particularly high, between 4 and 6 species, but abundance is highly variable with between 6 and 397 individuals recorded. These communities, as shown in Figure 12.14, were found at all stations sampled between 33 and 113 m.

Muddy sediments were also found at stations in much deeper water, between 365 and 573 m, but at these depths the sediments are completely devoid of fauna because conditions are anoxic below about 150 to 200 m water depth.

Table 12.14 Marine Habitats Identified During the July 2013 Survey

Seabed description	Stations	Depth range of stations sampled	Community type	Representative image
Bedrock and boulders	1, 2, 5, 8-13, 15	3.7 to 11.0	Bedrock and boulders with dense algal communities dominated by *Cystoseira* spp. with *Mytilaster lineatus* and *Bittium reticulatum*	
	7, 9, 11, 13, 13, 14	12.9 to 19.7	Bedrock and boulders with moderate algal cover, primarily *Codium vermilara*, with *Mytilaster lineatus* and *Bittium reticulatum*	

Continued…

Seabed description	Stations	Depth range of stations sampled	Community type	Representative image
Mixed sediment	4, 6	16.9 to 25.0	Mixed sediment with burrowing bivalves (particularly *Gouldia minima*)	
	7	16.9	Mixed sediment with infaunal polychaetes (particularly *Spio filicornis*)	

Continued…

Seabed description	Stations	Depth range of stations sampled	Community type	Representative image
Coarse sediments (gravel)	14, 16-18	19.1 to 26.7	Coarse sediment (gravel) and sand with burrowing bivalves (particularly *Gouldia minima*)	
Sand	3	20.5 to 21.7	Sand with burrowing bivalves (particularly *Chamelea gallina*)	

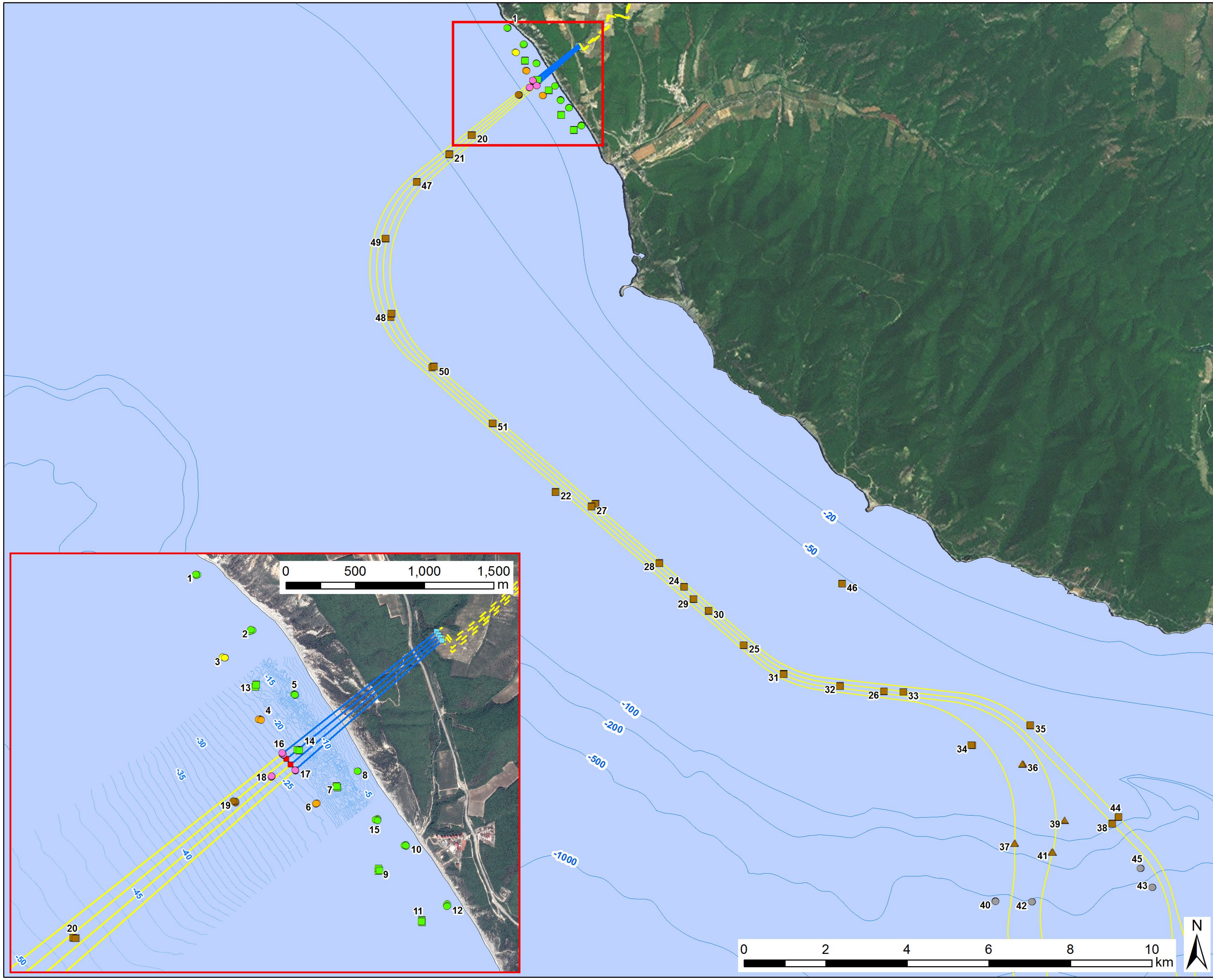
Continued…

Seabed description	Stations	Depth range of stations sampled	Community type	Representative image
Mud	19	33	Mud with burrowing bivalves (*Pitar rudis* and *Chamelea gallina*) and patches of large sediment covered ascidians	
	20-35, 38, 44, 46-51	50.6 to 92.0	Mud with infaunal polychaetes and burrowing bivalves (*Terebellides stroemii* and *Parvicardium simile*)	

Continued...

Seabed description	Stations	Depth range of stations sampled	Community type	Representative image
	36, 37, 39, 41	70 to 113	Mud with burrowing bivalves and anemones (*Modiolula phaseolina* and *Pachycerianthus solitaries*)	
	40, 42, 43, 45	>365	Anoxic deep sea mud with high levels of H_2S and devoid of fauna	

Complete.



LEGEND

Community Groups

- Bedrock and boulders with dense algal communities dominated by *Cystoseira* spp. with *Mytilaster lineatus* and *Bittium reticulatum*
- Bedrock and boulders with moderate algal cover, primarily *Codium vermilara*, with *Mytilaster lineatus* and *Bittium reticulatum*
- Coarse sediment (gravel) and sand with burrowing bivalves (particularly *Gouldia minima*)
- Sand with burrowing bivalves (particularly *Chamelea gallina*)
- Mud with burrowing bivalves (*Pitar rudis* and *Chamelea gallina*)
- Mud with infaunal polychaetes and burrowing bivalves (*Terebellides stroemii* and *Parvicardium simile*)
- Mud with burrowing bivalves and anemones (*Modiolula phaseolina* and *Pachycerianthus solitaries*)
- Anoxic deep sea mud with high levels of hydrogen sulphide and devoid of fauna
- Mixed sediment with burrowing bivalves (particularly *Gouldia minima*)
- Mixed sediment with infaunal polychaetes (particularly *Spio filicornis*)

Russian Sector of South Stream Offshore Pipeline

- Proposed landfall section pipelines
- Proposed microtunnels
- Proposed offshore pipelines
- Microtunnel entry shaft
- Microtunnel exit pit
- Isobaths

Projection: Lambert Conformal Conic

Revision Details	By / Check	Check Date	Suffix

Purpose of Issue

For Information

Client

South Stream Offshore Pipeline — ENERGISING EUROPE

Project Title

SOUTH STREAM OFFSHORE PIPELINE

Drawing Title

DISTRIBUTION OF BENTHIC HABITATS IDENTIFIED FROM DATA COLLECTED DURING 2013 BENTHIC SURVEYS

Drawn	Checked	Approved	Date
DH	RW	MW	19 Mar 2014

URS Internal Project No.	Scale @ A3
46369082	1:85,000

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Drawing Number: Figure 12.8

Rev

Plot Date: 19 Mar 2014
File Name:R:\Report Maps - Russia\Russian ESIA v2\Chapter 12 Offshore Sampling\Figure 12-8 Distribution of benthic habitats identified from data collected during 2013 benthic surveys.mxd

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12.4.3.3 Summary

In shallow waters, where there is rock, cobbles or pebbles for attachment, the benthos is characterised by macroalgal communities. There is distinct zonation of algal communities in the Survey Area, with distinct macrophyte communities at different depth ranges.

In shallow waters (up to 2 to 3 m depth) macroalgae communities characterised by a relatively low diversity and biomass were observed. This includes a community of *Cladophora dalmatica* and an association of *Ceramium ciliatum* and *Padina pavonica*. There was also a prevalence of green algae, primarily sea lettuce (*Ulva sp.*) and *Enteromorpha sp*. In the mid photic zone, from about 3 to 10 m algal communities dominated by large structural brown algae dominate. In particular associations of *Cystoseira* spp. are found, succeeded by a *Cladostephus spongiosus* and *Corallina elongata* as depth increases. At depths over approximately 10 m, communities of *Phyllophora* and *Codium vermilara* are observed. The highest diversity of algae is found in the mid-photic zone and *Cystoseira* communities also support a high diversity of macrofauna and considerable biomass of the mussel *Mytilaster lineatus* in some areas.

Species diversity of macroalgae was greater in the *Cytoseria* and *Codium* communities at 20 m water depth. Abundance and biomass was greatest at 10 m water depth with *Cytoseria* as the most abundant species observed. This is consistent with the historical data of bathymetric heterogeneity along the Caucasian coast of the Black Sea, in which the Survey Area is located (Ref. 12.1 and 12.4). The data from the 2009 and 2011 surveys, which were carried out at different times of the year, indicate that this general distribution pattern is not subject to seasonal changes.

Two species of macroalgae that are listed in the Red Data Book of Krasnodar Krai were found during the 2011 survey. The brown algal species *Cladostephus spongiosus* and *Phyllophora crispa* were observed along the nominal pipeline route alignment at Station 5c.

Macroalgae also supported animal communities, particularly of bivalve molluscs, but also polychaetes and crustaceans. The macrozoobenthic communities of soft sediments are largely determined by the sediment type and comprise a number of infaunal animals, particularly bivalves and polychaetes but also crustaceans, gastropods and echinoderms. There were no macrofaunal species of commercial or conservation importance recorded in the Survey Area.

12.4.4 Deep Sea Benthic Habitats

The deep waters of the Black Sea have recently been shown to support significant biogenic structures in some areas (Ref. 12.7). At certain sites on the northwest Black Sea shelf, carbonate accumulation has formed reef towers structures that can reach several metres in height (Ref. 12.7). These towers may release methane bubbles so that they superficially resemble hydrothermal vent chimneys found on tectonic margins, though they have no associated multicellular life and are characterised by the presence of morphologically and phylogenetically distinct unicellular communities.

Sidescan and ROV data from the deep water parts of the pipeline route have been examined in detail to ascertain the nature of the deep seabed and to identify, as far as possible, the presence of deep sea microbial reefs or other structures (Ref. 12.5). A summary of the findings is presented below but the full report can be found in Appendix 7.1: Abyssal Plain Report.

Small carbonate mounds related to fluid seepage can be identified at a few locations along the Russian shelf edge. On sidescan data, they are hard targets with a typical irregular 'knobbly' appearance. Most cannot be identified on bathymetric data, partly because they are small, low relief features, but also because their occurrence is masked by the typically steep terrain in which they occur. Carbonate mounds occur in the relatively narrow depth band between about 110 and 140 m. This suggests that in addition to fluid seepage, the location of these features is constrained by other factors, most likely the low level of oxygen in the stratified water column. There is no suggestion that these are biogenic structures.

The lower Russian continental slope and the contiguous abyssal plain are generally relatively smooth with a gradient that gradually decreases until the slope merges with the plain. No significant bacterial communities, such as cold seep communities with associated macrofauna, microbial mats or microbial reefs were encountered anywhere along the pipeline route (Ref. 12.5).

12.4.5 Fish

12.4.5.1 Background and Literature Review

A long term data set in the north-eastern Black Sea has been collected by the Azov Fish Industry Research Institute between 2003 and 2011 and is summarised in Ref. 12.1. This information has been used to support this section.

In recent years (the last two decades), 103 species of fish[8] have been recorded from the Black Sea shelf of the Russian Federation (Zaika 2000 in Ref. 12.1). These are divided into several groups according to their lifestyle and biogeographic origin:

- Anadromous species that feed at sea and breed in freshwater include sturgeons (*Huso huso, Acipenser gueldenstadti, A.persicus, A.sturio and A.stallatus*), Sea of Azov-Black Sea herrings or shad (*Alosa pontica*) and Black Sea salmon-trout (*Salmo labrax*);
- Semi-anadromous fish only occur in the least saline areas of the sea and include the Batumi shemaya (*Alburnus chalcoides*) and vimba (*Vimba vimba*);
- Two freshwater species occasionally enter the sea (goldfish *Crassius auratus* and mosquito fish *Gambusia affinis*[9]), but are essentially non-marine;
- True brackish-water species reside in low salinity basins and estuaries. Some are euryhaline (tolerant of a wide range of salinity). This group includes the stickleback *Pungitius platygaster*, and several goby species;

[8] This number must be viewed as approximate due to significant uncertainty regarding the taxonomic status of some species.
[9] Introduced from North America to eradicate malaria mosquitos in the region

- The group of Boreal Atlantic relics is represented by species that prefer colder water, including dogfish (*Squalus acanthas*), sprat (*Sprattus sprattus*), and whiting (*Merlangius merlangus*); and
- The most numerous group of fish are the 'thermophillic' species, generally of Mediterranean origin, that prefer the warm surface layers of the sea. This includes pelagic species such as sardine (*Sardina pilchardus*), garfish (*Belone belone*) and horse-mackerel (*Trachurus mediterraneus*); demersal species such as bogue (*Boops boops*), drum (*Sciaena umbria*) and several species of wrasse; benthic species such as stingray (*Dasyatis pastinaca*), rockling (*Gaidropsarus mediterraneus*) and weever (*Trachinus draco*) and cryptic[10] species such as seahorse (*Hippocampus guttulatus*), clingfish (*Lepadogaster spp.*) and pipefish (*Syngnathus spp.*).

In general, water shallower than 25 m is characterised by the greatest species diversity, particularly over rocky grounds. Numerous species of fish, including some of commercial interest, (refer to **Chapter 14 Socio-Economics** for more discussion on commercial fisheries) use the vegetated shallow waters where thickets of *Cystoseira* provide shelter and cover for spawning. These rocky bottoms are not subject to fish trawling. Areas of sandy substrate appear to support fewer species (Ref. 12.1). The number of species decreases with the increase of the depth with only 20 species recorded below 50 m. This pattern of distribution also reflects the dominance of Mediterranean thermophillic species that prefer the well-warmed surface layers of the sea (Azov Fish Industry Research Institute in Ref. 12.1).

Eutrophication, combined with invasions of non-native species, discussed in Section 12.4.1, and significant over-fishing in recent decades have caused changes in offshore pelagic fish populations (Ref. 12.8). Sprat, horse mackerel, and anchovy (*Engraulis encrasicolus*) populations all collapsed in the 1990s though there have been some recent signs of recovery. Populations of larger pelagic fish such as tuna (*Thunnus thynnus*), swordfish (*Xiphias gladius*), and mackerel (*Scomber colias* and *S.scombrus*) have also substantially declined (Ref. 12.8).

There are a number of fish species caught commercially including sprat, anchovy, horse mackerel, whiting, goatfish and some mullet. However, total fisheries catch is dominated (over 90% of total biomass) by sprat and anchovy (Azov Fish Industry Research Institute in Ref. 12.1). The distribution of many of the commercial fish species is highly seasonal as populations migrate between spawning and feeding grounds. Anchovy overwinter in the Anapa region and sprat and horse mackerel migrate here for feeding, mostly during the warmer spring and summer months (Ref. 12.1). The regional migrations of these species are shown in Figure 12.9:

- Anchovy feed in the area shown during October and November;
- Sprat spawn in mid-March to early April and then migrate to the coastal zone for feeding until late-spring / early summer; and
- Horse mackerel feed near the coast during the summer months.

---

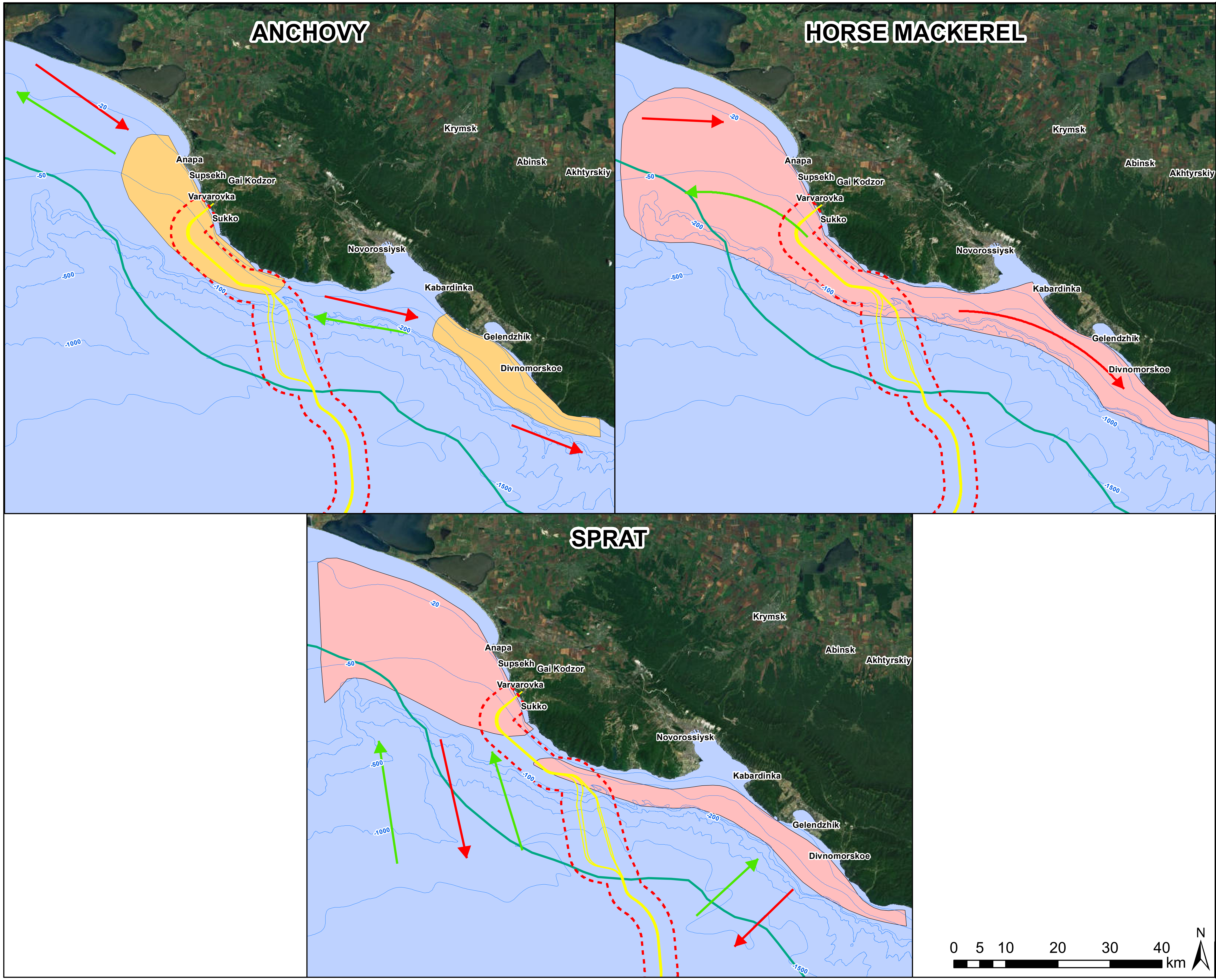
[10] In this context, cryptic species are those that spend most of their time hidden in weeds, under stones etc.

- Several species of fish of conservation importance have been observed from the Russian Black Sea coastline caught in fixed gear at commercial fishing stations[11] (Table 12.15). Of particular note is the presence of Russian sturgeon (*Acipenser gueldenstaedtii*) and stellate sturgeon (*Acipenser stellatus*). These sturgeon species are listed by IUCN as critically endangered (Ref. 12.9), though they are not included in the Red Books of either the Russian Federation (RDBRF) or Krasnodar Krai (RDBKK). They were only recorded in single cases, when immature fish were caught (Azov Fish Industry Research Institute in Ref. 12.1) but given their naturally wide ranging habit, it is possible that sturgeon might be present, albeit as individuals, in the Survey Area.
- Table 12.15 Species of Conservation Interest Observed in the North Eastern Black Sea Region

Common name	Latin name	Conservation Status		
		IUCN Global Red list	RDBRF	RDBKK
Russian sturgeon	*Acipenser guldenstaedtii*	CR	-	
Stellate sturgeon	*Acipenser stellatus*	CR	-	-
Beluga sturgeon	*Huso huso*	CR	1	1a
Black Sea salmon-trout	*Salmo trutta labrax*	LC	1	7
Long-snouted seahorse	*Hippocampus guttulatus* (listed as *H.ramulosus* by IUCN)	DD (previously listed as VU)		*
Corb	*Umbrina cirrosa*	-	-	3
Tub gurnard	*Chelidonichthys lucerna*	-	-	2
Leaping mullet	*Liza saliens*	-	-	Annex 3
Chestnut goby	*Chromogobius quadrivittatus*	-	-	5

- IUCN: CR=Critically Endangered; VU=Vulnerable; LC=Least Concern; DD=Data Deficient. Red Data Books: 1=Endangered (1a=Critically Endangered); 2= Vulnerable species declining in number; 3=Rare; 5=Requiring further study; 7=specially Controlled* Not listed but catching prohibited under regional fishing regulations.
-

[11] Comprising 4 set net locations and analyses of catches from four commercial observation stations ("Bolshoy Utrish", "Novorossiysk", "Gelendzhik" and "Arkhipo-Osipovka") (Ref. 12.1)



LEGEND

- Approximate 3km offshore construction safety exclusion zone
- Feeding grounds
- Wintering Areas
- Autumn migration
- Spring migration
- Russian territorial waters boundary
- Isobaths (mbsl)

Russian Sector of South Stream Offshore Pipeline

- Proposed offshore pipelines

Projection: Lambert Conformal Conic

Revision Details	By / Check	Check / Date	Suffix

Purpose of Issue
For Information

Client
South Stream Offshore Pipeline ENERGISING EUROPE

Project Title
SOUTH STREAM OFFSHORE PIPELINE

Drawing Title
MIGRATION, FEEDING AND WINTERING GROUNDS OF ANCHOVY, SPRAT AND HORSE MACKEREL

Drawn	Checked	Approved	Date
AH	RW	MW	04 Mar 2014

URS Internal Project No.	Scale @ A3
46369082	1:700,000

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Drawing Number: Figure 12.9
Rev

Plot Date: 04 Mar 2014
File Name: I:\5004 - Information Systems\46369082_South_Stream\MXDs\Report Maps - Russia\Russian ESIA\Offshore Sampling\Figure 12.9 Migration, feeding and wintering grounds of Anchovy, Sprat and Horse Mackerel.mxd

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Russian sturgeon are very large slow growing anadromous fish, generally taking ten or more years to mature to a size that may exceed 2 m and 100 kg (Ref. 12.26). Adults dwell at depths from 20 to 100 m, exhibiting complicated patterns of spring and autumn runs such that adults and juvenile ranges overlap both spatially and temporally. They feed on a variety of benthic invertebrates and fish. The Russian sturgeon is now very rare in the Black Sea basin where almost all of the species' spawning sites have been lost due to dam construction, except in the lower Danube where some spawning still exists. The last natural population still migrates up the Danube and the Rioni (last recorded in Rioni in 1999), where the sturgeons are heavily overfished and poached (Ref. 12.26). It is estimated that the species' wild native population has undergone a massive population decline of over 90% in the past three generations.

Stellate sturgeon is a smaller species, generally only less than 10 kg though 50 kg specimens are known (Ref. 12.37). It is less benthic in habit than other sturgeon species and may be encountered at the surface on occasion. Though fish may spawn throughout the year (where spawning sites are available), there are two peak spawning runs in spring and autumn. It too has suffered drastic population declines across its range, due to a combination of habitat loss, overfishing and poaching. In addition, its semi-pelagic habit meant that the stellate sturgeon was more affected by the *Mnemiosps leidyi* outbreak (discussed earlier) than other sturgeon species (Ref. 12.3).

Both these sturgeon species were only found as single juvenile specimens in fixed nets at the four commercial observation stations. The Fishing Rules for the Sea of Azov-Black Sea commercial fishing region prohibit the catching of all sturgeon species. Sturgeons also fall within the scope of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) which prohibits trade and movement across national borders of both living sturgeon and sturgeon products (notably caviar) (Ref. 12.3).

Thornback rays are demersal coastal species that inhabits a variety of substrates, including mud, sand, shingle, gravel and rocky areas, mainly recorded at water depths up to 50 m (Ref. 12.1). Young and juveniles predominantly eat small crustaceans, such as shrimps, mysids, amphipods and small crabs. Larger specimens prey on larger crustaceans, including prawns and crabs and will also consume fish. Because it is an important component of many European fisheries, and its numbers are declining, it is classed by the IUCN as near threatened (Ref. 12.3). Thornback rays are non-migratory and in Russian waters are distributed from Novorossiysk to Adler, approximately 50 km to the south of the Pipeline route (Ref. 12.1).

Black Sea salmon spawns in all large mountain rivers all along the Caucasus coast. Because of dams on most of the Black Sea basin’s rivers, most returning adults are unable to reach spawning sites and the anadromous population is now rare. The sea period of the lifecycle has been poorly studied. Because the species has been impacted by the construction of dams (mostly more than three generations ago), it has now considered a stable, albeit rare, population and does not qualify for IUCN Threatened or Near Threatened status despite its scarcity. This species has been observed in fixed stations in the four commercial observation stations.

Long snouted seahorse, currently listed as data deficient by the IUCN (formerly considered vulnerable), were observed at depths of 1 to 30 m throughout the survey area. Seahorses live in shallow water amongst underwater vegetation. Long-snouted seahorses were noted throughout at depths of 1 to 30 m. They breed between April and October, with the timing being dependent on water temperature (Ref. 12.24). Long-snouted seahorses have low dispersal and limited migration (Ref. 12.25). This reduces their ability to colonize new areas, recolonize old ones, and in addition reduces their ability to move when habitat becomes unfavourable. However, the long snouted seahorse matures at an early age, has rapid growth rates, and a short generation time which may assist populations to recover as effects of disturbance cease. Seahorses have been significantly exploited by manufacturers of souvenir products and were initially included in the Red Data Book of the Krasnodar Krai as a protective measure. However, the population of long snouted seahorse in the Black Sea has increased significantly and it was removed from this Red Data Book. It remains on a list of species that are prohibited for catching by the Fishing Rules for the Sea of Azov-Black Sea commercial fishing region.

The corb is a solitary demersal fish usually found over sandy or muddy ground as well as inhabiting seagrass beds. It feeds on a wide variety of invertebrates. Spawning usually occurs from April to June (Ref. 12.38). During the surveys it was recorded at depths of 10 to 50 m but infrequently. Until recent years it has been a preferred object of spear fishing and is now included in the Red Data Book of the Krasnodar Krai and catching it is prohibited.

Tub gurnards are widely in the areas of Bolshoy Utrish, Novorossiysk, Gelendzhik and Arkhipo-Osipovka at depths of 10 to 50 m. It is a benthic species usually inhabiting sand, muddy sand or gravel bottoms where it feeds on a variety of fish and invertebrate prey. The largest of the gurnards, it may grow to 6 kg and live for 14 years (Ref. 12.9). Tub gurnards have been heavily exploited for the manufacturer of souvenirs and by underwater hunters. The pollution of the marine environment as well as illegal fishing has made this species quite rare in the last decade. This species has been entered into the Red Data Books of the Russian Federation and the Krasnodar Territory to ensure its strict protection.

Leaping mullet are native to the Eastern Atlantic, Mediterranean and Black Seas, though they have been introduced to the Caspian. They inhabit coastal waters, sometimes in lagoons and estuaries. The adults are herbivorous though the juveniles feed on zooplankton until about 3 cm, then on benthic invertebrates until 5 cm. The adults feed on algae and vegetal detritus (Ref. 12.38). They reproduce in summer and the eggs are pelagic. The species is of some commercial interest, being consumed fresh, smoked and frozen, as well as for its roe.

Bluefish are a large shoaling pelagic predator. It is a voracious feeder, and has been noted to destroy sardine, anchovy and horse mackerel shoals in excess of its feeding requirements (Ref. 12.11). It is known to spawn and feed in the Survey Area and fingerlings are relatively abundant within 30 km of the coast (Ref. 12.1). Juveniles and adult individuals spend the winter period offshore, outside the Russian sector of the Black Sea.

The presence of sardine (*Sardina pilchardus*) is also noteworthy; although it is not protected it is rare in this area. The sardine is a well-known shoaling pelagic species of considerable economic importance globally, though less so in Russian sector of the Black Sea where it is not common. It shows slight diurnal vertical migrations, moving slightly deeper by day (Ref. 12.25). Sardines feed mainly on planktonic crustaceans. They spawn over a wide area in June to

August. This species was not caught in fixed stations in the four commercial observation stations.

Other notable species are Black Sea turbot (*Scophthalmus maeoticus*) and sprat that form the basis of commercial fisheries, and are the focus of a fisheries protection zone at Anapa Bank, which was initially set up as a protected breeding ground for the former.

The Black Sea turbot can reach 85 cm and 15 kg and attain sexual maturity at the age of seven to ten years. In the summer, they keep close to the shore, where they spawn and feed. Their diet consists of small fish and crustaceans. Annual spawning occurs from May to July. The roe is pelagic and fertility ranges from 3 to 13 million eggs. Black Sea turbot do not undertake long migrations along the coast and only swim locally to feed and reproduce. The North Caucasus and Anapa schools swim in the north-eastern part of the Black Sea (Ref. 12.1).

Sprat are wide ranging pelagic planktivores. The main part of the stock spawns from October until March when the shoals are scattered throughout the central Black Sea. Once the fish have spawned (from mid-March to mid-June) they migrate to feeding grounds over the shelf, usually coinciding with the warming of the surface layers and formation of the stable thermal stratification. During this period, sprat form intensive concentrations at depths between 20 and 80 m on the shelf of the Kerch-Taman area (the Panagiya Cape to the Utrish Cape). Sprat clusters remain in coastal shelf areas until early-October, when they disperse to spawn.

12.4.5.2 Survey

Survey Area

The survey locations given in Figure 12.10 make up the Survey Area discussed in this section for fish. Information on the water depth, distance from shore and survey methodologies is given in Table 12.1 and Table 12.3.

Fish surveys were conducted using fish trawls in November 2010 and June 2011 at a range of depths (15 to 98 m) and gillnet surveys in less than 20 m water depth, were conducted in June 2011 (Figure 12.10) as follows:

- Nine fish trawl transects (Trawl stations 1 to 9) in November 2010;
- Ten fish trawl transects (Trawl stations 1 to 10) in June 2011; and
- Four gillnet surveys in shallow waters (less than 20 m depth) in June 2011.

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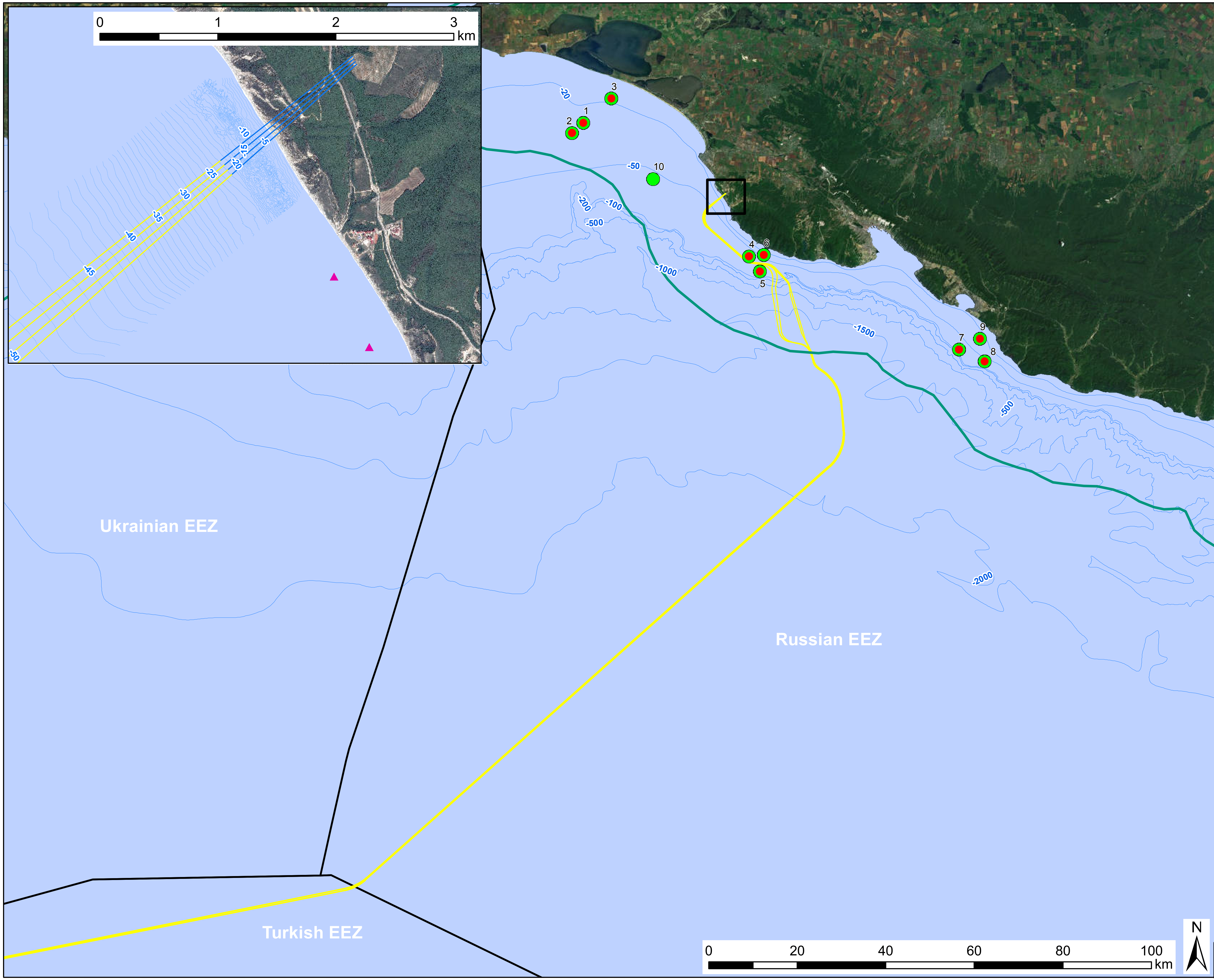

LEGEND

Russian Sector of South Stream Offshore Pipeline

- Proposed microtunnels
- Proposed offshore pipelines
- Fish Trawls (November 2010)
- Fish Trawls (April - June 2011)
- Fish gillnets (April - June 2011)
- Russia territorial waters boundary
- Exclusive Economic Zone boundary
- Isobaths

Projection: Lambert Conformal Conic

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Drawing Title: FISH SURVEY AREA

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File Name:I:\5004 - Information Systems\46369082_South_Stream\MXDs\Report Maps - Russia\Russian ESIA\Offshore Sampling\Figure 12.10 Fish Survey Area.mxd

Survey Results

In November 2010 a total of 15 fish species were found in trawls. Table 12.16 shows the total biomass of fish caught in the trawls and the relative percentages of the main species recorded in trawls in November 2010. The biomass of fish was greatest in the trawls from shallower waters (Trawls 1, 2 and 3 up to 30 m depth) although Trawl 9 biomass, from 28 m, was low. Catches in waters between around 20 and 30 m (Trawl 1, 2, 3 and 9) were dominated by anchovy. In deeper waters (over 30 m), Sprat recorded the highest values for abundance and biomass. Horse mackerel and whiting were also abundant in deeper water trawls (over 60 m water depth).

Table 12.16 Species Composition, Abundance and Weight from Fish Trawls (November 2010)

Trawl No.	Depth range (m)	Total trawl weight (kg/hr)	Species	Latin Name	Percentage of weight	Percentage of Total Trawl Biomass
1	19-20	60.0	European Anchovy	*Engraulis encrasicolus*	100	100
2	28-30	150.8	European anchovy	*Engraulis encrasicolus*	58.8	94.4
			Whiting	*Merlangius merlangus*	0.1	0.1
			Horse mackerel	*Trachurus trachurus*	1.0	1.7
			Spurdog	*Squalus acanthias*	19.2	0.1
			Bluefish	*Pomatomus saltatrix (reported as P. saltator)*	20.8	3.7
3	15-16	94.8	European anchovy	*Engraulis encrasicolus*	89.5	98.1
			Mediterranean horse-mackerel	*Trachurus mediterraneus*	1.0	0.9
			Thornback ray	*Raja clavata*	4.0	0.1

Continued...

Trawl No.	Depth range (m)	Total trawl weight (kg/hr)	Species	Latin Name	Percentage of weight	Percentage of Total Trawl Biomass
			Blotched picarel	*Spicara maena (reported as S. flexuosa)*	5.5	0.9
4	60	0.6	Sprat	*Sprattus sprattus*	6.3	50.0
			Mediterranean horse-mackerel	*Trachurus mediterraneus*	93.8	50.0
5	93-94	0.14	Sprat	*Sprattus sprattus*	82.4	85.7
			Pipefish	*Syngnathus spp.*	17.6	14.3
6	93-98	1.0	Whiting	*Merlangius merlangus*	100	100
7	68-70	21.3	Sprat	*Sprattus sprattus*	41.8	99.7
			Caspian shad	*Alosa caspia*	0.5	0.2
			Black Sea turbot	*Scophthalmus maeoticus*	57.7	0.2
8	40-46	10.3	Sprat	*Sprattus sprattus*	83.1	97.5
			Seahorse	-	4.3	2.3
			Common stingray	*Dasyatis pastinaca*	12.5	0.2
9	28	6.0	Mediterranean horse-mackerel	*Trachurus mediterraneus*	32.9	87.6
			Black Sea shad	*Alosa maeotica*	67.1	12.4

Complete.

In the June 2011 surveys there were 14 species recorded from the trawls and 17 species from the gill nets. There were only 6 species in common between the two sampling techniques giving a total of 25 species observed in both surveys (Table 12.17).

Table 12.17 Fish Species Observed in Trawl and Gillnet Surveys (April - June 2011)

Common name	Latin name	Trawls	Gillnets
Annular sea bream	*Diplodus annularis*		✓
Black drum	*Sciaena umbra*		✓
Black goby	*Gobius niger*	✓	
Black scorpionfish	*Scorpaena porcus*	✓	✓
Black Sea turbot	*Scophthalmus maeoticus*	✓	
Blotched picarel	*Spicara maena* (reported as *S. flexuosa)*		✓
East Atlantic peacock wrasse	*Symphodus tinca*		✓
European Anchovy	*Engraulis encrasicolus*	✓	
Five-spotted wrasse	*Symphodus roissali*		✓
Flounder	*Platichtys flesus*	✓	
Goatfish	*Mullus barbatus*	✓	✓
Greater weaver	*Trachinus draco*	✓	
Grey wrasse	*Symphodus cinereus*		✓
Kilka	*Clupeonella cultriventris*	✓	
Knout goby	*Mesogobius batrachocephalus*		✓
Leaping mullet*	*Liza saliens*		✓
Mediterranean horse-mackerel	*Trachurus mediterraneus*	✓	✓
Painted comber	*Serranus scriba*		✓
Red-mouth goby	*Gobius cruentatus*		✓
Round goby	*Neogobius melanostomus*	✓	✓
Rusty blenny	*Parablennius sanguinolentus*		✓
Sprat	*Sprattus sprattus*	✓	

Continued…

Common name	Latin name	Trawls	Gillnets
Spurdog	*Squalus acanthias*	✓	
Thornback ray*	*Raja clavata*	✓	✓
Whiting	*Merlangius merlangus*	✓	✓

* Species of conservation importance

Complete.

As with the November 2010 trawls the greatest diversity of species observed in 2011 was found in shallow waters. Spurdog (*Squalus acanthias*), sprat, anchovy and Black Sea turbot (*Scophthalmus maeoticus*) and flounder (*Platichthys flesus*) were only found below 25 m. At water depths between 50 to 85 m, species composition was the poorest with sprat, anchovy, whiting (*Merlangius merlangus*), Mediterranean horse mackerel, Black Sea turbot, spurdog and the thornback ray recorded (Ref. 12.1). This was also observed by the Azov Fish Industry Research Institute in Ref. 12.1, which recorded a decrease in species abundance with increasing depth and is also reported elsewhere (Ref. 12.11). The lower species diversity in deeper waters was probably due to the absence of Mediterranean species that prefer warm surface waters and comprise the largest group of the Black Sea's fish fauna. In addition, the anoxic conditions which occur in deeper water (at depths below about 150 m) restrict the vertical distribution of organisms, including bottom-living fish (Ref. 12.8).

Several species of commercially important fish were recorded from the November 2010 and June 2011 trawls, particularly sprat and anchovy.

The species of conservation importance caught during the surveys in November 2010 and June 2011 were the leaping mullet (*Liza saliens*) and the thornback ray (*Raja clavata*).

12.4.5.3 Summary

The Russian coastal area of the Black Sea supports around 103 species, dominated by Mediterranean thermophillic fish. The highest diversity of fish is found in shallow waters, below 25 to 30 m, in association with Cystoseira thickets that provide important fish habitat. The number of fish species declines with increasing water depth.

Trawl and gillnet data confirmed the presence of several commercially important fish, particularly, anchovy and sprat, in the Survey Area. The shallow waters of the coastal region are used by many of these species as feeding grounds.

Two species of fish of conservation importance, the thornback ray and the leaping grey mullet were recorded from trawls and gillnets in the Survey Area. A further seven protected species, whilst not observed in the Survey Area, have been recorded from nearby locations (Table 12.17).

12.4.6 Seabirds

12.4.6.1 Background and Literature Review

The Black Sea lies within the Mediterranean-Black Sea Flyway, and the Caucasian coast forms an important migration route (the Trans-Caucasian Flyway) within this larger zone. Owing to its geographic location and varied landscape the region is ornithologically important (Ref. 12.28). The habitat diversity and climate create conditions suitable for the nesting, migration and wintering for thousands of seabirds. During seasonal migrations the whole Black Sea region carries millions of birds from their European nesting sites to their wintering areas (Ref. 12.28 There are two periods for migration in the north-eastern Black Sea region; one during the spring (mid-February to early-June) and one in the autumn (early-August to end-November) (Ref. 12.1).

The available information on wintering seabirds in the north eastern Black Sea is relatively scarce (Ref. 12.1). Mediterranean shearwaters (*Puffinus yelkouan*), cormorants (*Phalacrocorax carbo*), Arctic skua (*Stercorarius parasiticus*) and several species of gull overwinter along the Caucasian coast, but there are no known large permanent colonies of seabirds in the Survey Area. Other birds known to winter in the area of the North Caucasian coast of the Black Sea includes loons and grebes. In general, there is no large grouping of seabirds on the sea surface in the winter (Ref. 12.1).

The most significant seabird habitats in the Black Sea are found on the north Coast from the Danube Delta in Romania to the Kerch Strait (north of Anapa). **Chapter 11 Terrestrial Ecology** contains more detail on terrestrial habitats for nesting, migrating and overwintering seabirds along the Black Sea coast of Russia.

The seabird species which are known to occur at different times of the year along the north-eastern part of the Black Sea and the sea coast of the Gelendzhik area (60 km south of the Project Area) can be loosely divided into the Groups shown in Table 12.18.

Table 12.18 Seabird and Coastal Species Groups in North-Eastern Black Sea Region (Ref. 12.1)

Group	Information
Loons and Grebes	Fish eating and typically water birds. They mainly nest in freshwater environments. Nests are often floating. In the region, they are found only during migration and wintering, from mid-October to mid-May.
Tube-noses	Typical sea birds. Only one type is known in the region; the Mediterranean shearwater. Shearwaters nest in colonies on sea islands in burrows or crevices of rocks. They feed on small fish, crustaceans and shellfish.

Continued...

Group	Information
Pelecaniformes e.g. pelicans and cormorants	They are typical water birds, but they do use the land. They nest in colonies in inland waters and on the coast. The nearest known nesting areas are the south-eastern part of the Sea of Azov. They are present in the region generally from November to April. They feed exclusively on fish.
Geese	Geese are only found on migrations in the region from late October to mid-November and early March to mid-April. They nest on the ground in open habitats. They are exclusively herbivorous birds, feeding mostly on land.
Swans	They nest on inland waters, but during migration and in winter they can be observed on marine waters. In the region they may occur during migration from September to late April, but they are most common in winter. The closest nesting site is the Sea of Azov. They are herbivorous.
Dabbling ducks	Typically freshwater. They nest on the ground along banks of water courses. They occur during migration and wintering from late August to late May. They feed on phytoplankton and zooplankton and sometimes eat larger invertebrates - crickets, etc.
Diving and sea ducks	They nest primarily along the freshwater shores. In the region they can be observed during migration and, more rarely, during wintering from September to May. They feed mainly on zooplankton, larger invertebrates (crustaceans, molluscs, etc.), sometimes eat small fish.
Coot	Coot nest in fresh and brackish waters or sea bays with dense thickets of rush, reeds and other macrophytes. They are known to nest in the Sea of Azov area. In the region they are likely to be observed throughout the year, but mainly from September to May. Feed mainly on plant foods but can sometimes eat medium-sized invertebrates and small fish.
Raptors	They are associated with water due to their diet of fish. Raptors nest on large trees, usually not further than 1 km from water. They are most likely to be observed in the region in the autumn-winter period.
Waders	Ground-nesting birds that nest near water. They feed on small invertebrates In the described area, most species can occur only during the migrations - from September to late November and from early March to May.

Continued...

Group	Information
Gulls	This group includes ground-nesting colonial birds connected with different bodies of water. "Marine" gulls such as Caspian gull (*Larus cachinnans*) and lesser black-backed gull (*L.fuscus*) are closely linked to marine waters and coasts. All species are found in marine waters primarily at non-breeding times. In the region, gulls are marked both during migration (from September to May) and in winter. Summer residence of some species is not connected with nesting and migrations. All gulls feed mainly on fish.
Terns	Ground-nesting colonial birds. The Caspian tern (*Hydroprogne caspia*) is among them and its environmental requirements are most similar to those of gulls: it nests on the sandy shores of lakes and seas, including the Black Sea, and it mainly feeds on fish. A significant portion of its diet is small fish. Small quantities of terns may be encountered in the region during migrations.

Complete.

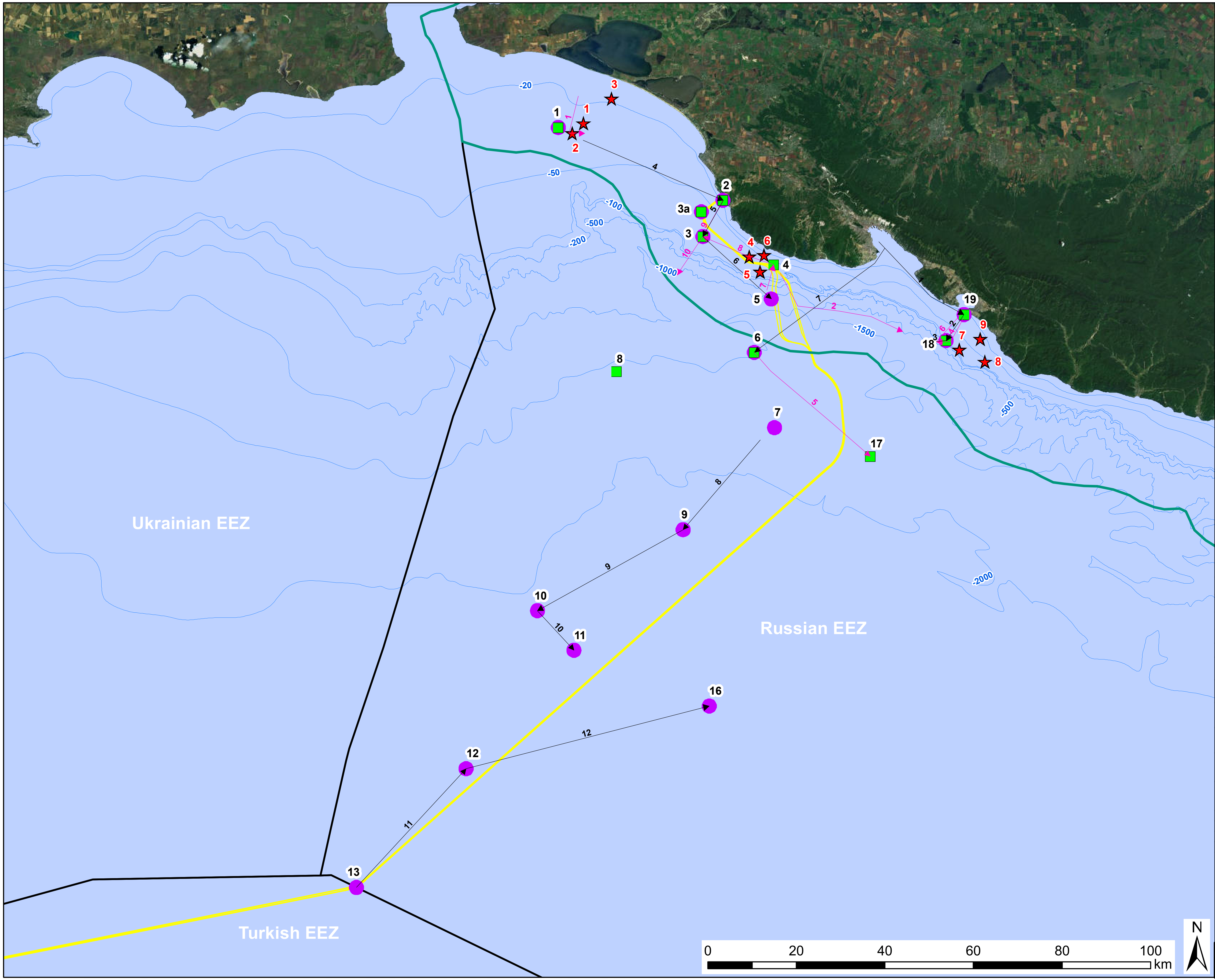
12.4.6.2 Survey

Survey Area

The survey locations given in Figure 12.11 comprise the Survey Area discussed in this section for seabirds. Information on the water depth, distance from shore and survey methodologies is given in Table 12.1 and in Table 12.3.

Seabird transects were conducted in November 2010, April to June 2011 and in July 2013. Figure 12.11 shows the locations of the 2010 and 2011 surveys. Figure 12.12 shows the locations of the 2013 survey. The surveys were conducted at the following locations:

- Ten transects in November 2010;
- Nine transects in November 2010 (during fish trawls);
- Twelve transects in June 2011; and
- In July 2013; 38 transects and 51 stations in coastal region were sampled.



LEGEND

Russian Sector of South Stream Offshore Pipeline

- Proposed offshore pipelines
- Seabirds & marine mammals sampling stations (November 2010)
- Seabirds & marine mammals sampling during fish trawls (November 2010)
- Seabirds & marine mammals sampling transects (November 2010)
- Seabirds & marine mammals sampling stations (April-June 2011)
- Seabirds & marine mammals sampling transects (April-June 2011)
- Russia territorial waters boundary
- Exclusive Economic Zone boundary
- Isobaths

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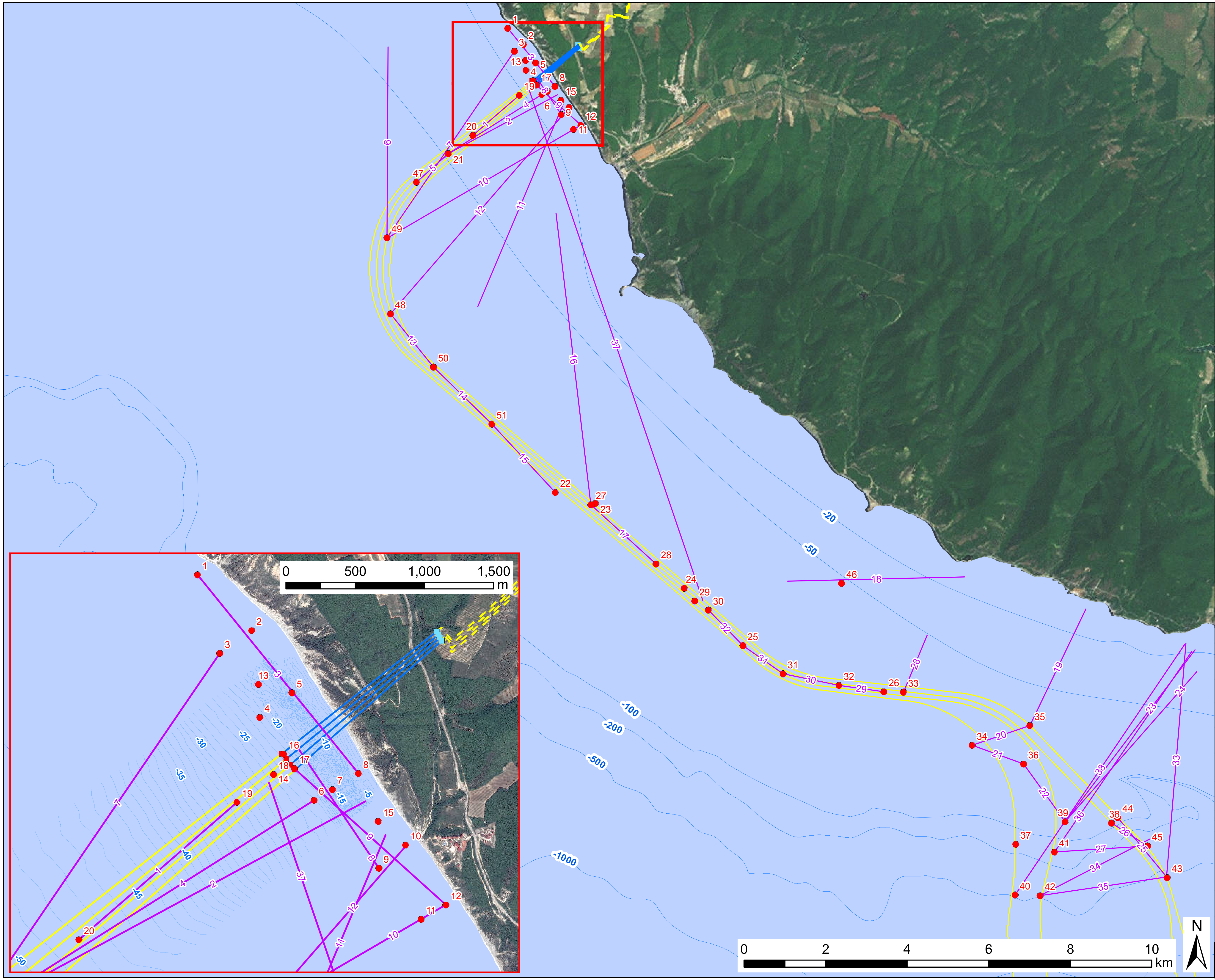

LEGEND

- Fixed survey stations
- Survey transects

Russian Sector of South Stream Offshore Pipeline

- Proposed landfall section pipelines
- Proposed microtunnels
- Proposed offshore pipelines
- Microtunnel entry shaft
- Microtunnel exit pit
- Isobaths

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File Name:I:\5004 - Information Systems\46369082_South_Stream\MXDs\Report Maps - Russia\Russian ESIA\Offshore Sampling\Figure 12.12 Seabird Survey Area July 2013 Survey.mxd

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Survey Results

During November 2010, 24 species of seabird were observed. The Charadriiformes (which includes gulls, skuas, terns, waders and auks) were the most abundant group of seabirds (Table 12.19). Migrations of Charadriiformes in the region take place during spring from March to early June, and in autumn from August to November (Ref. 12.1). The most abundant species that were observed in transects during 2010 were the Mediterranean shearwater (*Puffinus yelkouan*), and the Caspian gull (*Larus cachinnans*), Table 12.19).

In April 2011, a total of 23 seabird species were recorded during transects (Figure 12.11). Large groups of migratory species were observed, such as grebes, which were more abundant than all other species, especially in coastal areas (Ref. 12.1). Grebes are freshwater species which may use coastal areas as a feeding ground. Groups of the black-throated diver (also known as a black-throated or Artic loon, *Gavia arctica*) were also detected. The common cormorant is a typical species for the Black Sea and 110 individuals were recorded. Cormorants were generally found near the coast of Novorossiysk and to the lesser extent near Gelendzhik (south of the Survey Area) (Ref. 12.1). The sandwich tern (*Sterna sandvicensis*), Caspian gull and lesser black-backed gull (*Larus fuscus*) were also abundant in transects throughout the entire Survey Area (Table 12.19).

Charadriiformes were the most commonly observed group of birds during offshore transects. The majority of birds observed were concentrated near the coast (no more than 20 km from land). In offshore areas of the Survey Area (Figure 12.11), the number of seabird sightings was reduced (Ref. 12.1).

The full list of species observed during transects for all three years is shown in Table 12.19.

Table 12.19 Seabird Species Observed during November 2010, April 2011 and July 2013 transects

Species	Ecological Status in NE Black Sea*	Density, birds/km^2 (Nov 2010)	Density, birds/km^2 (April 2011)	Density birds/km^2 (July 2013)
Black-throated diver *Gavia arctica*	Wintering	0.13	5.2	0
Mediterranean gull *Larus melanocephalus*	Breeding and wintering**	0.09	2.1	0
Little gull *Larus minutus*	Wintering	0.98	23.4	0
Black-headed gull *Larus ridibundus*	Wintering	2.07	3.6	<0.1

Continued...

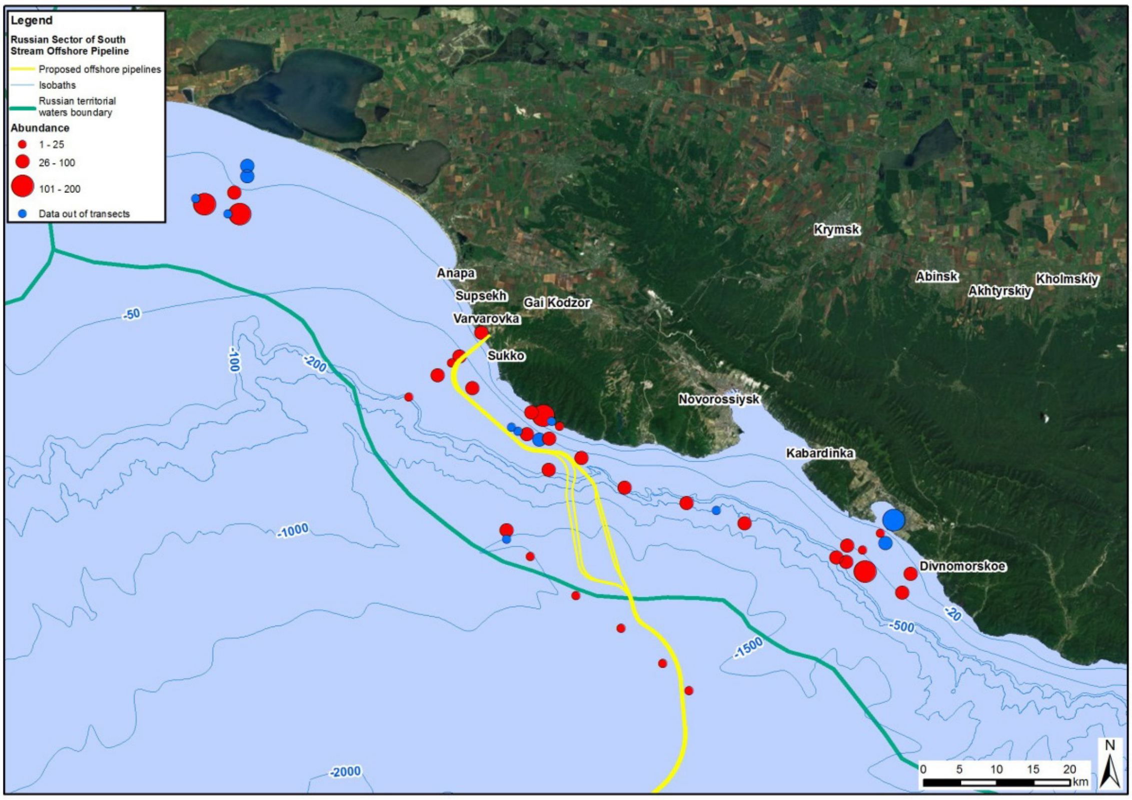
Species	Ecological Status in NE Black Sea*	Density, birds/km^2 (Nov 2010)	Density, birds/km^2 (April 2011)	Density birds/km^2 (July 2013)
Caspian Gull *Larus cacchinans*	Wintering	4.56	9.1	6.9
Sandwich tern *Sterna sandvicensis*	Nesting and wintering**. Resident subadults	0.07	16.2	<0.1
Lesser black-backed gull *Larus fuscus*	Wintering	-	1.6	0
Great-crested grebe *Podiceps cristatus*	Migratory and wintering	-	138.2	<0.1
Red-necked grebe *Podiceps grisegena*	Migratory (nesting and wintering) and resident birds.	-	15.9	0
Black-necked grebe *Podiceps nigricollis*	Migratory and wintering	-	9.1	0
Mediterranean shearwater *Puffinus yelkouan* †	Wintering	3.67	12.6	11.5
Common cormorant *Phalacrocorax carbo*	Nesting and wintering	-	63.7	<0.1
Widgeon *Anas penelope*	Wintering	-	3.5	0
Garganey *Anas querquedula*	Wintering	-	2.6	0
Arctic skua *Stercorarius parasiticus*	Wintering (occasional)		1.0	<0.1
Total	**-**	**11.57**	**307.8**	**18.70**

* Ecological status based on published data Ref. 12.29.
** Some of the Black sea population winters locally, though mostly in the Mediterranean.
† There is significant taxonomic confusion regarding European shearwaters; for the purposes of this report, all have been reported as *P. yelkouan*, which is currently considered the only species that regularly occurs in the Black Sea.

Complete.

In November 2010, the highest numbers of birds were observed at coastal transects (Figure 12.13) (Ref. 12.1). This is similar to the results in April 2011 although more migratory species were observed in April 2011. The density of birds decreases with increasing distance from the shore. At around 40 km offshore, no birds where observed during transects (Ref. 12.1). The abundance (absolute number) of seabirds in the Survey Area is shown in Figure 12.13. Some species were not observed during transects but were seen during sailing time to and from stations; the locations of these species have also been recorded in Figure 12.13 as "data out of transects".

Figure 12.13 Abundance of Birds Recorded During Surveys in November 2010

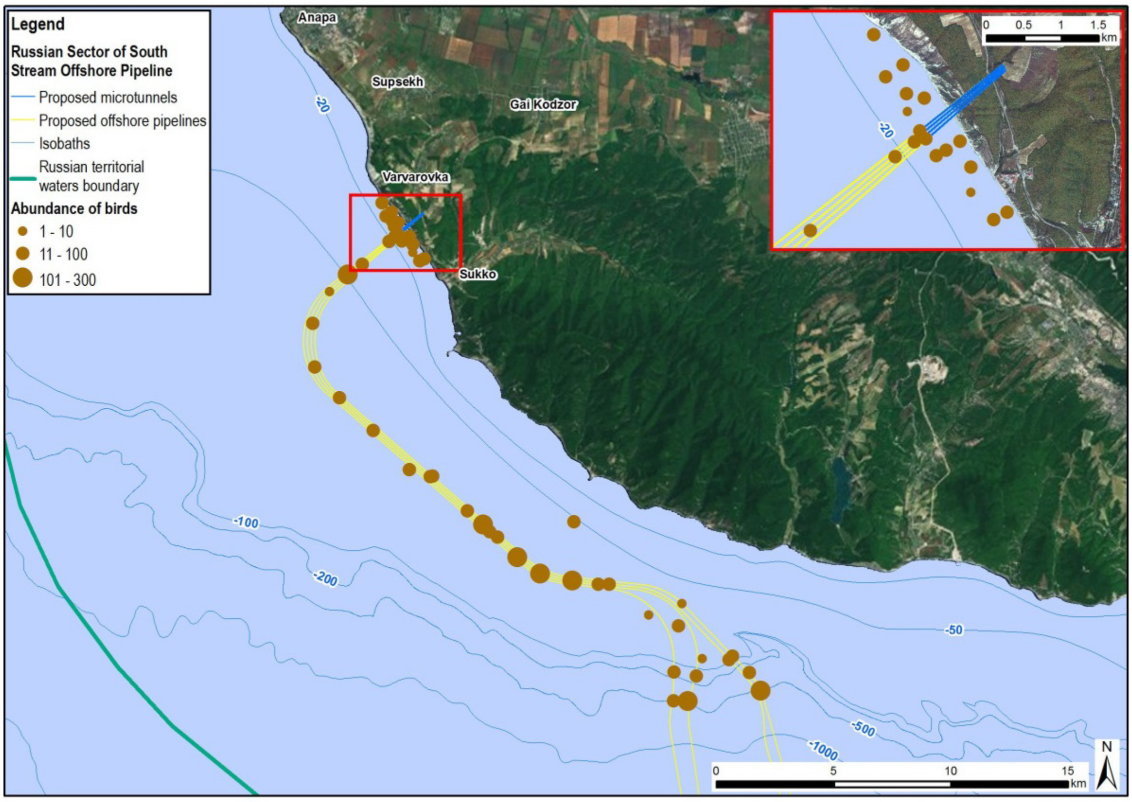


During the July 2013 surveys a total of 13 species were observed. However, two seabird species, the Mediterranean shearwater (*Puffinus yelkouan*) and the Caspian gull (*Larus cachinnans*), dominated seabird numbers (Table 12.19) together accounting for over 98% of transect observations and over 96% of sightings from fixed stations. The abundance of birds was variable throughout the Survey Area (Figure 12.14).

The Mediterranean shearwater was observed throughout the survey area as individual specimens and in small groups of 5 to 10 birds. There were very high densities, up to a maximum of 108 individuals/km^2, mostly in areas away from the very near shore (within a kilometre or two), such as close to the shelf break. The average density of Mediterranean shearwaters across the survey area was 11.5 observations/km^2 with a maximum of 108 individuals/km^2. The average density of the Caspian gull was 6.9 observations/km^2 with a maximum of 30/km^2.

The data from the three surveys reflects the seasonality in the abundance of some bird species in the survey area. In particular, the little gull, sandwich tern, great crested grebe and common cormorant were observed at much higher densities in April compared to July and November although some differences may be due to normal interannual variability.

Figure 12.14 Abundance of Birds Recorded at Stations During July 2013 Survey



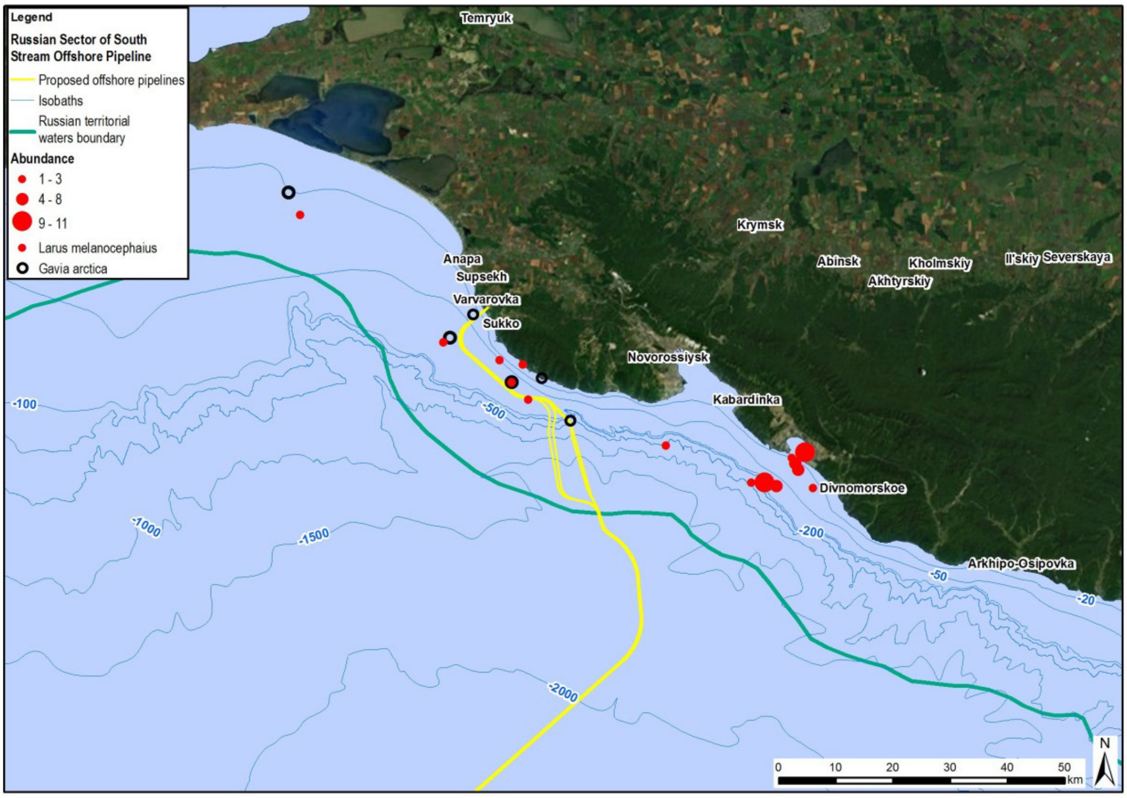
Three species observed offshore are of conservation interest (Table 12.20). These were the only species recorded during offshore surveys that are listed in the Russian Federation (RDBRF) or Krasnodar Red Data Books (RDBKK) or listed as 'vulnerable' or above on the IUCN Red List. The locations of the Red Data Book species observed during 2010 and 2011 surveys are given in Figure 12.15.

Table 12.20 Seabird Species of Conservation Interest Observed in November, 2010, April, 2011 Surveys

Species	Latin name	IUCN Global Red List1	RDBRF2	RDBKK2
Black-throated diver (Artic loon)	*Gavia arctica*	LC	2	2
Mediterranean gull	*Larus melanocephalus*	LC	3	3
Mediterranean shearwater	*Puffinus yelkouan*	VU		

[1]IUCN: LC=Least Concern; NT=Near threatened; VU=Vulnerable; EN=Endangered; CR= Critically endangered; EW=Extinct in the wild; EX=Extinct [2]Red Data Books: 2= vulnerable species and subspecies declining in number; 3=rare species and subspecies.

Figure 12.15 Occurrence of Red Data Book of Russia Bird Species Observed

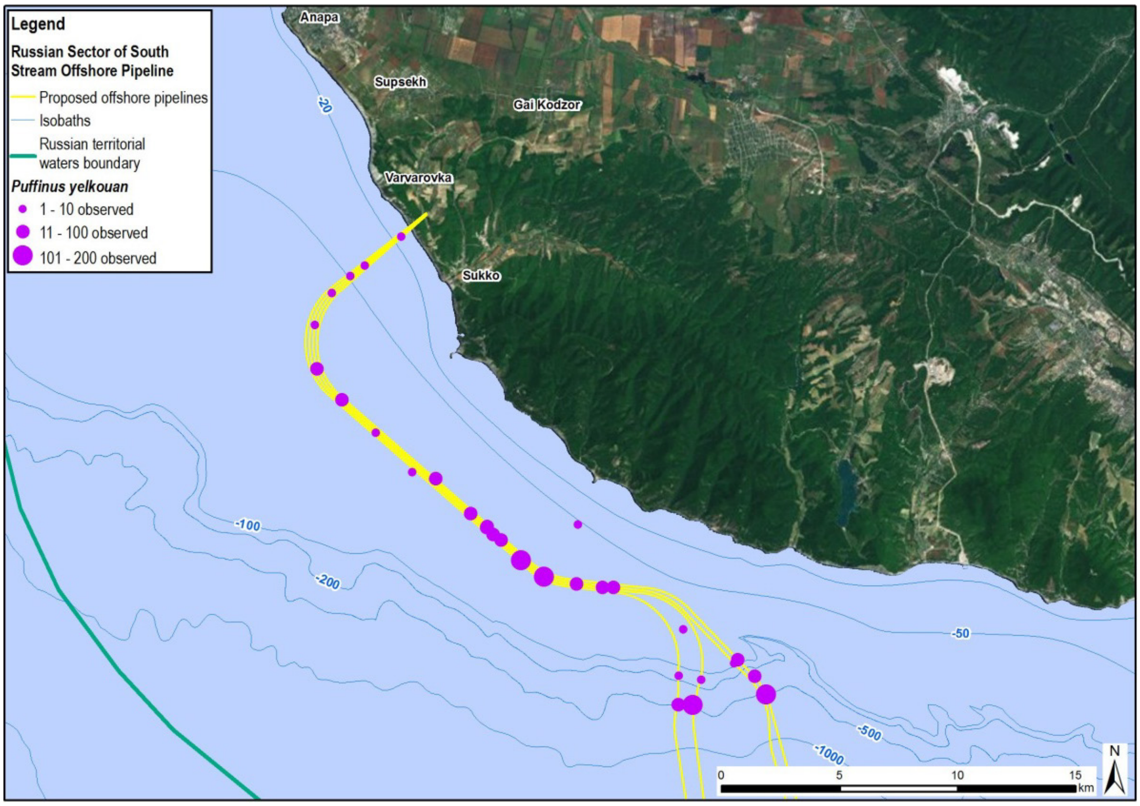


In the July 2013 surveys the only protected species observed was the Mediterranean shearwater, *Puffinus yelkouan* which was present in high abundance, as many as 200 observations at some stations (Fig. 12.16).

An additional protected species that is likely to occur in the Survey Area (Ref. 12.1), but was not directly observed in surveys, is the gull-billed tern (*Gelochelidon nilotica*). This species is in both the Russian and Krasnodar Red Data Books. Notes on these species are provided in Section 12.4.6.2.

The black-throated diver or Arctic loon (*Gavia arctica*) is strongly migratory, breeding in isolated solitary pairs in deep cold lakes or inlets generally at high latitudes from April onwards. When migrating, divers often form flocks of around 50 individuals which then disperse, so that wintering birds generally occur singly, in pairs or small flocks (Ref. 12.29). However, because their diet is predominantly fish, they may occasionally form large congregations in rich coastal fishing areas. Divers overwinter along many European coasts, including the Black Sea, where they are most common in inshore waters along sheltered coasts (Ref. 12.29). Though globally common, black-throated divers are relatively scarce in the Eastern Black Sea, and are thus listed in both Russian Federation and Krasnodar Red Data Books.

Figure 12.16 Occurrence of Protected Bird Species Observed in July 2013 surveys



During the breeding season black-throated divers are threatened by the pollution of breeding waters, as well as disturbance. Wintering birds are vulnerable to coastal oil spills, especially in rich fishing grounds where large congregations may occur. The species is also commonly caught and drowned as by-catch in fishing nets (Ref. 12.3).

The Mediterranean gull breeds almost entirely in Europe, mainly on the Black Sea coast of Ukraine, with a recent spread to the northern Caucasian Plains (Ref. 12.3). Most populations of this species are fully migratory and travel along coastlines between their breeding and wintering areas, although some travel inland across Anatolia or follow major river valleys through Eastern and central Europe (Ref. 12.29). Outside the breeding season the species becomes entirely coastal, favouring estuaries, harbours, saline lagoons and other sheltered waters.

Mediterranean gulls migrate to breeding colonies at lagoons, estuaries and coastal saltmarshes from late-February to early-April, with most beginning to breed from early-May. A significant portion of the population also breeds on lakes and lowland marshes away from the coast (Ref. 12.29). It often breeds near but not among Sandwich terns *Sterna sandvicensis* (which also occurs in the Survey Area), or intermingling with black headed gulls (*Larus ridibundus*) (Ref. 12.3). The migration to the wintering grounds occurs from late-June onwards through to autumn. The gulls breed in colonies, usually of less than 1,000 pairs and occasionally in single pairs amidst colonies of other species.

Mediterranean gulls are susceptible to heavy losses as a result of tourist disturbance at breeding colonies. They may also be threatened by habitat loss resulting from coastal development and by marine pollution (e.g. oil spills and chemical discharges). Eggs and adults are collected from breeding colonies by fishermen in some areas of the species' range (Ref. 12.3), though it is protected in Russia.

The Mediterranean or Yelkouan shearwater (*Puffinus yelkouan*) was formerly considered a subspecies of the Manx Shearwater *(P. puffinus*). It is a gregarious species, nesting in burrows which are only visited at night to avoid predation by large gulls. It breeds on islands and coastal cliffs in the eastern and central Mediterranean in spring and early summer, after which the birds disperse throughout their range.

Mediterranean shearwaters may range widely, with birds ringed in Malta having been observed in the Black Sea. Increasing numbers have been observed entering the Black Sea since the 1970s though there are no recent records of breeding birds there. Non breeding birds are mostly present in the Black Sea from February to October, though some are present all year. This species has been reported to make large scale clockwise movements around the Black Sea, with flocks of up to 20,000 gathering in the north during summer months (Ref. 12.30).

The Mediterranean shearwater is under some threat from coastal development in its breeding range as well as predation of eggs and young by rats and cats. Adult birds are frequently caught in long line fisheries, and may also suffer from depleted food stocks due to the overfishing of anchovy in some areas (Ref. 12.6). Genetic studies suggest that the Mediterranean Shearwater may have suffered a marked population decline historically and thus could be vulnerable to adverse effects of inbreeding (Ref. 12.30). It was formerly classified as a species of least concern by the IUCN but in 2012 this was changed to vulnerable.

12.4.6.3 Summary

In November, 2010, the Caspian gull and the Mediterranean shearwater were the most abundant species observed offshore during transects. These birds were most likely observed wintering in and around the Survey Area. In April 2011, the great-crested grebe had the highest abundance and was most likely migrating along the Black Sea coast. The cormorant was also abundant in this survey and was most likely migrating.

Coastal transects in both years recorded the highest abundances of birds, with no birds observed over 40 km from the coast in transects in April 2011.

Three species of conservation interest were encountered during in the Survey Area; the black-throated diver or Arctic loon, the Mediterranean gull and the Mediterranean shearwater. All three species were recorded in both the November 2010 and April 2011 surveys however, higher abundance of all three species were recorded in the April 2011 survey.

12.4.7 Marine mammals

12.4.7.1 Background and Literature Review

Three species of cetacean reside in the Black Sea and these are listed in Table 12.21 along with their international, national and regional conservation status. The cetacean species off the Russian coast are represented by Black Sea subspecies, namely Black Sea harbour porpoise (*Phocoena phocoena relicta*), Black Sea bottlenose dolphin (*Tursiops truncatus ponticus*) and Black Sea common dolphin (*Delphinus delphis ponticus*). All three are protected at a national level by environmental legislation and governmental decrees (Ref. 12.3).

Table 12.21 Marine Mammal Species Reported from the Russian Black Sea Coast

Species	IUCN Global Red List*	Black Sea Convention**	RDBRF	RDBKK
Black Sea harbour porpoise (*Phocoena phocoena relicta*)	EN	E	3	2
Black Sea common dolphin (*Delphinus delphis ponticus*)	VU	E	Not listed	Not listed
Black Sea bottlenose dolphin (*Tursiops truncatus ponticus*)	EN	E	3	3

* IUCN: VU=Vulnerable; EN=Endangered. Red Data Books: 2= vulnerable species and subspecies declining in number; 3=rare species and subspecies.
** Species included in the *Agreement on Conservation of Biodiversity and Landscapes of the Convention on the Protection of the Black Sea from Pollution* (Ref. 12.31): E= endangered

Harbour porpoises inhabit mainly shallow waters (0 to 200 m deep) over the continental shelf around the entire perimeter of the Black Sea, although they also occur quite far offshore in deep water. Sizeable groups have been observed in the central Black Sea over 200 km from the nearest coast (Ref. 12.27). During warm periods they occur in the Azov Sea and Kerch Strait (among other areas). These different locations may represent geographically distinct breeding-calving-feeding areas.

Harbour porpoises in Russian waters undertake annual migrations, leaving the Azov Sea and north-western Black Sea before winter and returning in spring. The primary wintering areas are in the south-eastern Black Sea, extending into Georgian and Turkish waters. These are also the wintering grounds of anchovy, which, along with sprat, whiting and various goby species, are its principal prey. During their seasonal migration, animals may remain for a few days at different sites (usually bays with abundant fish, e.g. off the southern coast of Crimea) forming dense aggregations of some hundreds of individuals.

The ecology of Black Sea harbour porpoises may be considered unusual. It reflects the high degree of geographical isolation of their habitat, relatively low water salinity, significant seasonal fluctuations in water temperature, and large amount of anoxic waters saturated with H_2S usually below 150 to 200 m (Ref. 12.27).

Until 1983, unregulated hunting was the primary threat and the directed fishery for the porpoise drastically reduced populations. At present, incidental mortality in fishing nets is the most serious threat (Ref. 12.27). The majority (95%) of recorded cetacean entanglements in the Black Sea are of harbour porpoises, mostly in bottom set nets for turbot. Large-scale pelagic and small-scale coastal fisheries may affect Black Sea harbour porpoises indirectly by reducing their prey populations and degrading their habitat (Ref. 12.21). Other industrial activities, including shipping, dredging and hydrocarbon exploitation, also pose a threat (Ref. 12.32); for example an explosion at a gas-drilling platform in the Azov Sea in August 1982 resulted in the deaths of over 2,000 harbour porpoises (Ref. 12.27).

Commercial hunting of Black Sea cetaceans, including harbour porpoises, was banned in 1966 in the former USSR (the present Georgia, Russia and Ukraine), Bulgaria and Romania, and in 1983 Turkey and Russia assumed international obligations to protect Black Sea cetaceans as contracting parties to a wide range of international conventions[12]. At a national level, the harbour porpoise is listed in the Red Data Book of the Russian Federation which means that the species should be monitored and managed by appropriate state or national programmes.

Common dolphins are distributed mainly offshore and visit shallow coastal waters following seasonal aggregations and regular mass migrations of their preferred prey, small pelagic fishes such as anchovy and sprat. Annual winter concentrations of anchovies in the south-eastern Black Sea and to a lesser degree, south of the Crimean peninsula, create favourable conditions for wintering concentrations of dolphins. Summer concentrations of sprats in the north-western, north-eastern and central Black Sea attract common dolphins to different feeding grounds in summer months. Common dolphins avoid waters with low salinity, and this may explain their absence from the Sea of Azov and scarcity in the Kerch Strait (Ref. 12.27).

Last century, the population collapsed because of directed takes. The total number of animals killed is unknown, but it was estimated that before the mid-1950s common dolphins comprised

[12] The Russian Federation is party to the Convention on Biological Diversity (CBD), Convention on the Protection of the Black Sea Against Pollution (Bucharest Convention), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, Appendix II). It is not party to Convention on the Conservation of Migratory Species of Wild Animals (CMS) or the Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS).

94.8% of the total number of Black Sea cetaceans killed and processed in the former Soviet Union (Ref. 12.27).

Reduced prey availability has been considered an on-going major threat to Black Sea common dolphin since the late 1980s. Two mass mortality events that killed unknown but large numbers of common dolphins (in winter to spring 1990 and summer to autumn 1994) coincided with a drastic decline in the abundance of both principal prey species (anchovy and sprat), which has been attributed to overfishing, eutrophication and the invasion of the introduced predatory ctenophore *Mnemiopsis leidyi*, discussed in Section 12.4.1 (Ref. 12.27). This correlation between large die-offs of Black Sea common dolphins and prey scarcity could signify that reduced prey availability compromised the health of the dolphins and increased their susceptibility to viral infection. The 1994 summer-autumn die-off was also associated with an outbreak of morbillivirus (Ref. 12.27).

Bottlenose dolphins are distributed across the Black Sea shelf and may occur far offshore. In the northern Black Sea they form scattered communities of some tens to approximately 150 animals in different locations around the Crimean peninsula, including the Kerch Strait and coastal waters off the western and southern shores. Accumulations are also known to form off the Russian Caucasus and close to the Turkish coast. Bottlenose dolphins typically aggregate during autumn, winter and spring in a relatively small area between Cape Sarych and Cape Khersone. According to a two-year photo-identification study in this area off the southern Crimea this "winter" accumulation consists of animals from other "summer" concentrations. Mean group sizes varied from 2.0 to 2.9 individuals in different surveyed areas (Ref. 12.27).

Bottlenose dolphins are primarily piscivorous (fish eating) in the Black Sea, taking both benthic and pelagic fishes, large and small. A total of 16 fish species have been reported as prey off the Crimean and Caucasian coasts including four species of mullet (*Liza aurata, L.saliens, Mugil cephalus* and *M. so-iuy)*.

In the past, the population of bottlenose dolphins was subject to extensive commercial exploitation for the manufacture of oils, paint, glue, varnish, foodstuffs, medicine, soap, cosmetics, leather, "fish" meal and bone fertiliser. The total number of animals killed is unknown but it is acknowledged by the International Whaling Commission that all Black Sea cetacean populations, including bottlenose dolphins, were greatly reduced by the dolphin fishery. Isolated cases of deliberate killing and harassment (with pyrotechnic devices and firearms) have been reported in coastal fisheries. For instance, at least two bottlenose dolphins were reportedly shot in Balaklava, Ukraine in 2004 (Ref. 12.27).

Since the mid-1960s, hundreds of bottlenose dolphins (probably over 1,000) have been live-captured in Russia, Ukraine and Romania for military, commercial and scientific purposes. The capture operations sometimes caused accidental (but usually unreported) deaths. In recent years, 10 to 20 animals have been taken annually from May to June from a small area in the Kerch Strait (Ref. 12.27). During the 1980s to early 2000s, the number of facilities for dolphin shows and "swim with dolphins" programmes greatly increased in Black Sea countries. The export of bottlenose dolphins from Russia and Ukraine for permanent and seasonal shows also expanded to over 20 countries in Europe and the Middle East. According to CITES statistics, at least 92 individuals were removed from the Black Sea region during 1990 to 1999 and Russia reportedly has exported at least 66 for traveling shows since 1997 (Ref. 12.27).

At present, incidental mortality in fishing gear is probably one of the main threats to Black Sea bottlenose dolphin. They are known to be susceptible to capture in a variety of fishing nets, including bottom-set gillnets for turbot, spiny dogfish, sturgeon and sole, purse seines for mullet and anchovy, trammel nets and trap nets. However, only bottom-set gillnets are thought to take significant numbers, especially during the turbot fishing season between April and June. Small-scale coastal fisheries also affect Black Sea bottlenose dolphins indirectly by depleting their prey populations (Ref. 12.21). Though there has been concern regarding decreasing populations of indigenous mullets (*M. cephalus* and *Lisa* spp.) this might be offset to some extent by the introduced far-east mullet, M. so-iuy, which has since become abundant in the northern Black Sea and may be a factor a recent marked increase in dolphin density along the Crimean coast (Ref. 12.27).

Microbial pollution from untreated sewage in coastal waters poses a chronic risk of opportunistic bacterial infections to bottlenose dolphins, and there is evidence that they (as well as other Black Sea cetaceans) are exposed to morbillivirus infection (Ref. 12.27). Another potential source of exotic infections and genetic "pollution" is the poorly managed intentional releases and spontaneous escapes of captive bottlenose dolphins and other marine mammals from dolphinaria.

12.4.7.2 Survey

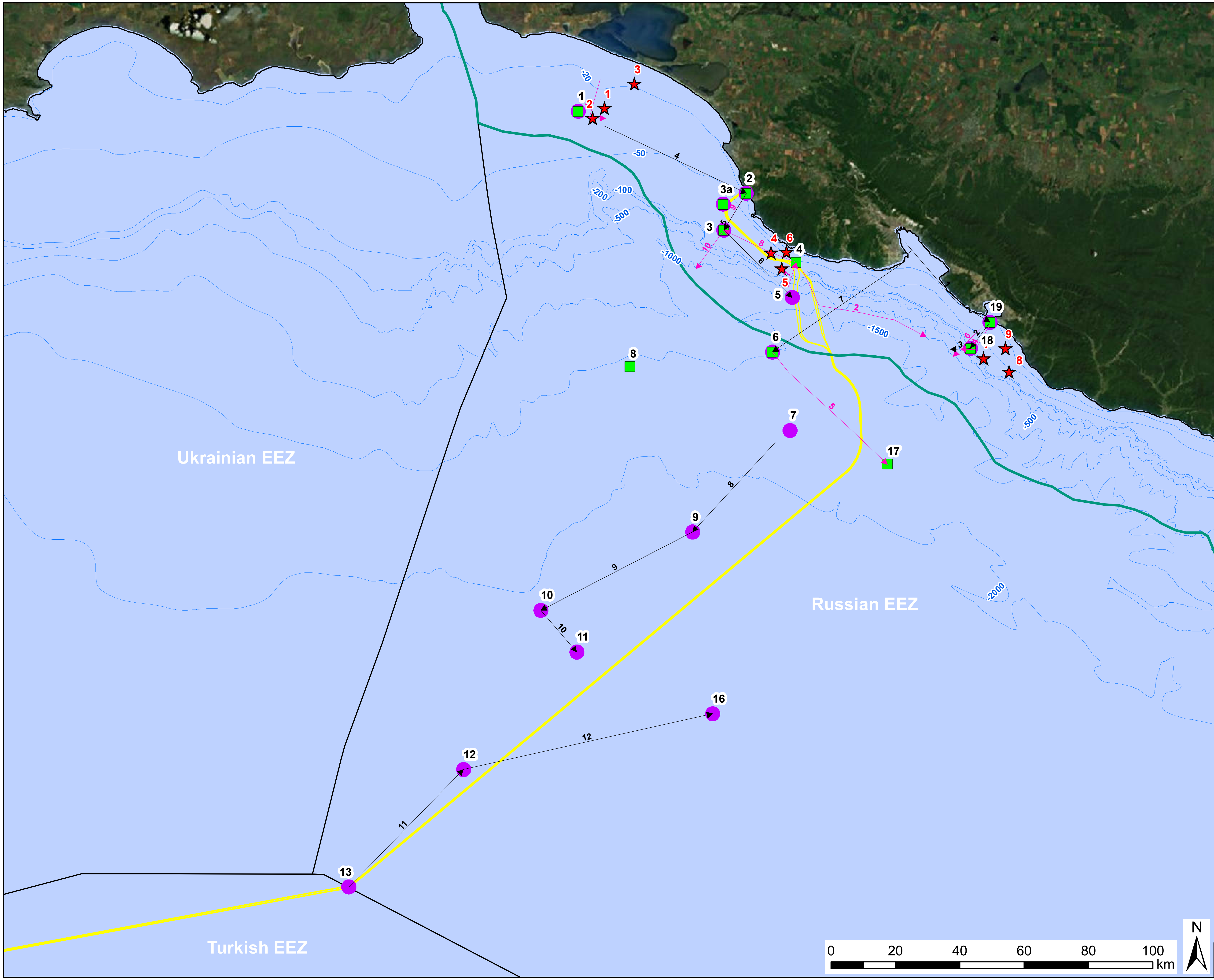
Survey Area

The survey locations given in Figure 12.17 make up the Survey Area discussed in this section for marine mammals. Information on the water depth, distance from shore and survey methodologies is given in Table 12.1 and Table 12.3.

Marine mammals transects were conducted along with the seabird surveys in November 2010, April to June 2011 and July 2013. Figure 12.17 and Figure 12.18 show the locations of these surveys. The surveys were conducted at the following locations:

- Ten transects in November 2010;
- Nine transects in November 2010 (during fish trawls);
- Twelve transects, including some in offshore areas, in June 2011; and
- In July 2013, 38 transects and 51 stations in coastal region were sampled.

Coastal surveys were also conducted in June 2010 in the vicinity of Anapa and along the Russian coast.



LEGEND

Russian Sector of South Stream Offshore Pipeline

- Proposed offshore pipelines
- Seabirds & marine mammals sampling stations (November 2010)
- Seabirds & marine mammals sampling during fish trawls (November 2010)
- Seabirds & marine mammals sampling transects (November 2010)
- Seabirds & marine mammals sampling stations (April-June 2011)
- Seabirds & marine mammals sampling transects (April-June 2011)
- Russia territorial waters boundary
- Exclusive Economic Zones
- Isobaths

Projection: Lambert Conformal Conic

Revision Details	By / Check	Check Date	Suffix

Purpose of Issue: For Information

Client: South Stream Offshore Pipeline — ENERGISING EUROPE

Project Title: SOUTH STREAM OFFSHORE PIPELINE

Drawing Title: MARINE MAMMAL SURVEY AREA

Drawn	Checked	Approved	Date
DH	RW	MW	25 Mar 2014

URS Internal Project No. 46369082 | Scale @ A3 1:1,100,000

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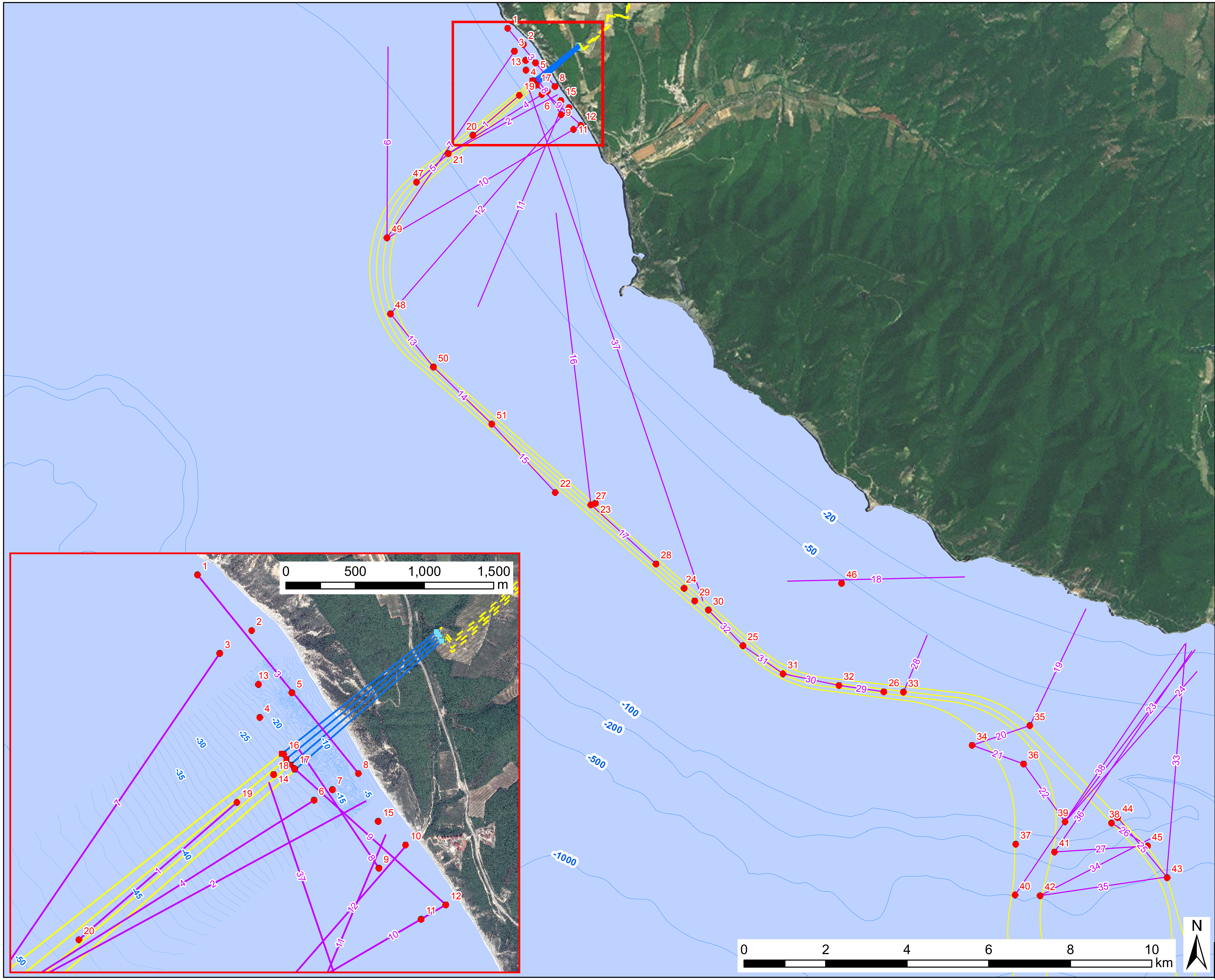
Drawing Number: Figure 12.17 | Rev

Plot Date: 25 Mar 2014
File Name:I:\5004 - Information Systems\46369082_South_Stream\MXDs\Report Maps - Russia\Russian ESIA v2\Chapter 12 Offshore Sampling\Figure 12-17 Marine Mammal Survey Area.mxd



LEGEND

- Fixed survey stations
- Survey transects

Russian Sector of South Stream Offshore Pipeline

- Proposed landfall section pipelines
- Proposed microtunnels
- Proposed offshore pipelines
- Microtunnel entry shaft
- Microtunnel exit pit
- Isobaths

Projection: Lambert Conformal Conic

Revision Details	By / Check	Check Date	Suffix

Purpose of Issue: For Information

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Project Title: SOUTH STREAM OFFSHORE PIPELINE

Drawing Title: COASTAL MARINE MAMMAL SURVEY AREA JULY 2013

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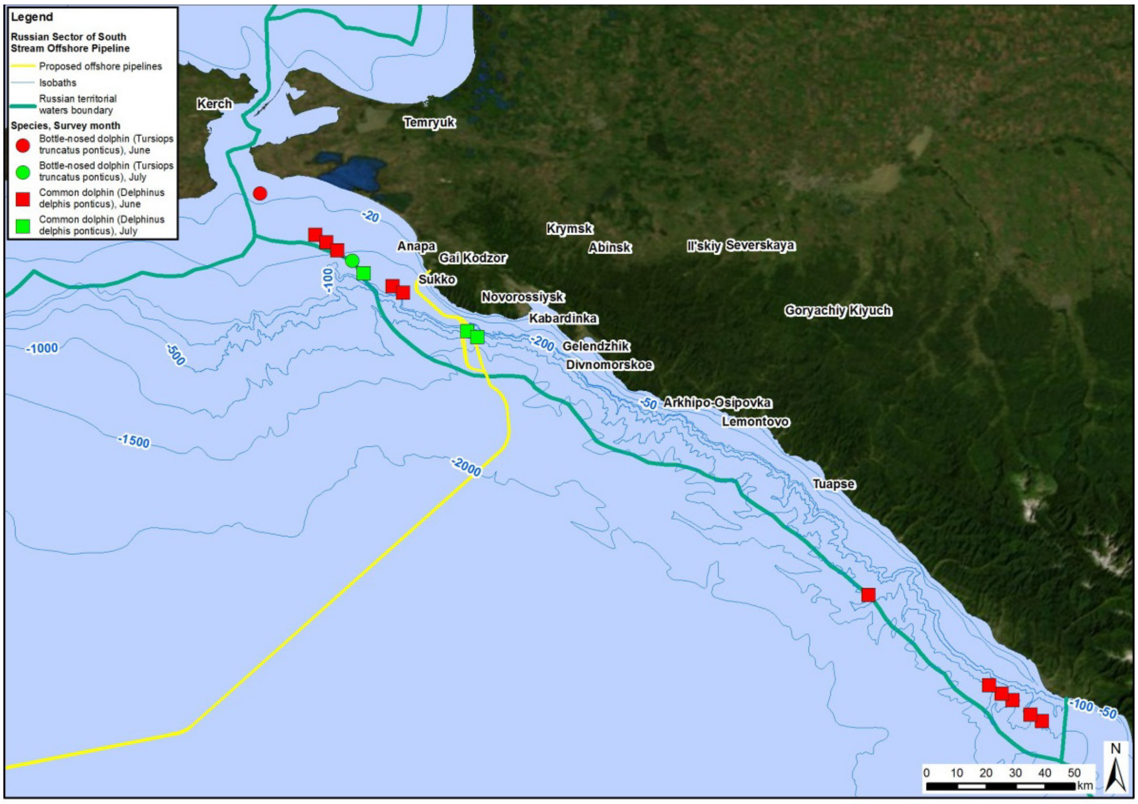
Drawing Number: Figure 12.18 | Rev

Plot Date: 04 Mar 2014
File Name:I:\5004 - Information Systems\46369082_South_Stream\MXDs\Report Maps - Russia\Russian ESIA\Offshore Sampling\Figure 12.18 Coastal Marine Mammal Survey Area July 2013.mxd

Survey Results

In surveys conducted along the Russian Black Sea coast in June 2010, the bottlenose dolphin and common dolphin were observed. The locations for these sightings are shown in Figure 12.19.

Figure 12.19 Cetaceans Observed in 2010 Surveys



In transects conducted in November 2010, the bottlenose dolphin and common dolphin were observed. The most abundant species was the common dolphin. The bottlenose dolphin was only observed during fish surveys, not during transects (Table 12.22).

Table 12.22 Abundance of Marine Mammal Observed during November 2010 transect and trawling Surveys

Species	Fish Trawling		Transects	
	Abundance	Abundance per 10 km	Abundance	Abundance per 10 km
Black Sea common dolphin (*Delphinus delphis ponticus*)	2	1.09	100	6.68
Black Sea bottlenose dolphin (*Tursiops truncatus ponticus*)	18	9.79	0	0.00
Sum total:	20	10.88	100	6.68

Note: there is a level of uncertainty regarding the sightings during this survey. It is unclear if repeat sightings of cetacean species have been accounted for or not, thus these numbers are taken as indicative.

In April 2011 surveys (see locations in Figure 12.17 and Figure 12.18), 89 cetaceans were observed from 19 transects; 9 harbour porpoise, 24 bottlenose dolphin and 56 common dolphin. Harbour porpoises were mainly observed in water depths of less than 50 m and not more than 20 km from the shore (mostly within 5 km of the shore). Four individuals and four groups of two to six harbour porpoises were recorded. Common dolphins observed during the April 2011 survey were widely dispersed in the Survey Area. The majority of individuals (95%) were observed around 40 km from the coast. Seven single individuals and 10 groups from two to 12 dolphins were recorded. Like the harbour porpoise, bottlenose dolphins were more commonly observed in shallower waters (within 15 km of the coast) but were also observed offshore. The spatial distribution of cetacean species is comparable to the data from the IUCN report (Ref. 12.27) which mentions harbour porpoise as more commonly observed in 0-200 m water depth and common dolphins observed further offshore. In total, 26 individuals were recorded, consisting of two individuals and eight groups from two to six (Ref. 12.1).

In July 2013 a total of 269 cetaceans were recorded, 96 individuals observed from 38 transects and 173 from 51 fixed stations. The higher total number of sightings reflects a more intensive survey carried out in coastal waters (all stations and transects were within 8 km of the shore). The common dolphin was the dominant species with 208 observations recorded and there were 42 bottlenose dolphin and 19 porpoise seen in the same period (Table 12.23) (Figure 12.20).

The harbour porpoise was observed in low numbers across the survey area with an average abundance of 2 animals per 10 km transect (Figure 12.20). This species is not particularly gregarious with most animals seen singly or in pairs and no groups of more than four individuals observed.

The common dolphin is the most abundant and widespread cetacean observed in the Survey Area (Figure 12.20). During transect surveys the sightings of common dolphin was an average of 5.4 individuals per 10 km. Mostly adults of the species were observed during the surveys with only two young noted during the entire survey. The common dolphin was present mostly in small groups of 3 to 6 individuals but occasional larger groups of 10 to 12 were seen, as were solitary animals.

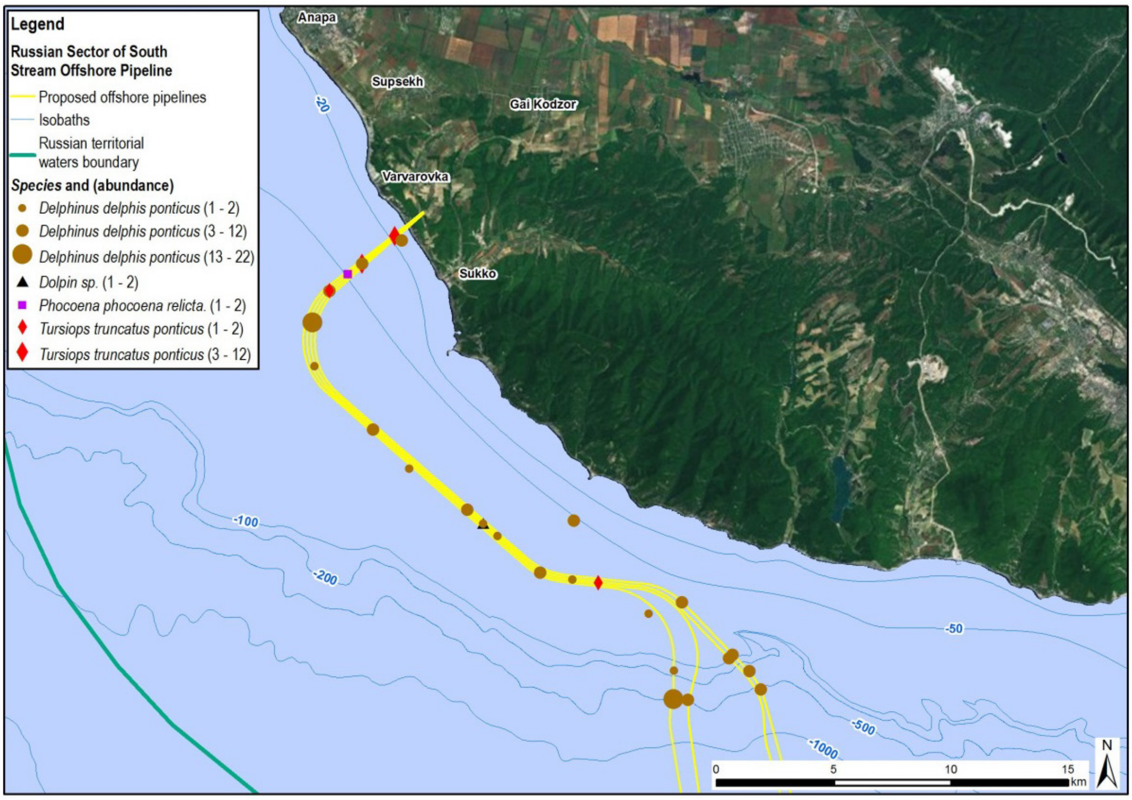
The bottlenose dolphin was also observed, but in fairly low numbers compared to common dolphin, with an average of 2 animals per 10 km of transect (Figure 12.20). They were generally present in small groupings although a group of 12 individuals, including two young, was noted, together with a group of common dolphin, next to a fishing boat.

Table 12.23 Abundance of Marine Mammals Observed during July 2013 Transects

Species	**Transects**	
	No. of animals observed	**Abundance per 10 km**
Black Sea harbour porpoise (*Phocaena phocaena relicta*)	17	1.6
Black Sea common dolphin (*Delphinus delphis ponticus*)	58	5.4
Black Sea bottlenose dolphin (*Tursiops truncatus ponticus*)	21	2.0
Sum total	**96**	**-**

Note: there is a level of uncertainty regarding the sightings during this survey. It is unclear if repeat sightings of cetacean species have been accounted for or not, thus these numbers are taken as indicative.

Figure 12.20 Cetaceans Observed from Stations in July 2013 Survey



12.4.7.3 Summary

There are three cetacean species known to inhabit the Black Sea; the harbour porpoise, bottlenose dolphin and the common dolphin. Harbour porpoise are more commonly observed in coastal areas within 200 m water depth. Common and bottlenose dolphin were observed further offshore than the harbour porpoise.

In coastal surveys in June 2010 and July 2013, all three species (harbour porpoise, bottlenose dolphin and common dolphin) were observed. The common dolphin was the species most likely to be observed; during all surveys in the Survey Area it was more widespread and considerably more abundant than the bottlenose dolphin and porpoise. In the offshore surveys in November 2010, common dolphins were most abundant and bottlenose dolphins were also observed. In April 2011, all three species were also observed. There were more sightings of the common dolphin, indicating it is the most abundant cetacean in the Survey Area. This species was also the most widely distributed cetacean species in the Survey Area. The majority of cetaceans were observed around 40 km from the coast and harbour porpoise and bottlenose dolphins were more commonly found in shallow waters (around 15 km from the coast).

It has not been possible to determine seasonal patterns in the distribution of these species in the Survey Area or known breeding areas or periods due to lack of data.

12.4.8 Protected Areas and Species

Although the pipeline route does not pass directly through any marine protected areas or nature reserves, it does pass within approximately 2 km of the marine part of the Utrish SPNA, and through the Anapa Bank fishery protected zone (Figure 12.21).

There is also the onshore Anapa sanitary protection area located approximately 500 m to the northeast and southwest of the onshore Project Area. Within this sanitary protection area, only works which do not adversely impact the natural resources and the sanitary conditions of the resort area of Anapa are permitted.

12.4.8.1 Protected Areas

Anapa Bank

The designated [13] area known as the 'Anapskya Bank' or 'Anapa Bank' extends over approximately 730 km^2 and is located in the Kerch-Taman region (Figure 12.21). This area is designated as an important fishing ground. Fishing is seasonally restricted to allow the replenishment of fish stocks and trawl fishing and fishing with stationary nets with a cell size of more than 50 mm is forbidden. Since 2011, a section of this area has been made available for sprat and anchovy trawling under the Russian Fishery Regulations (Ref. 12.1).

The Anapa Bank fishery protected zone was initially set up to become a breeding ground for the commercially important Black Sea turbot. The Black Sea turbot can reach 85 cm and 15 kg and attain sexual maturity at the age of seven to ten years. In the summer, they keep close to the shore, where they spawn and feed. Their diet consists of whiting, sprat, gobies, Black Sea goatfish and crustaceans. Annual spawning occurs from May to July. The roe is pelagic and fertility ranges from 3 to 13 million eggs. Black Sea turbot do not undertake long migrations along the coast and only swim locally to feed and reproduce. The North Caucasus and Anapa schools swim in the north-eastern part of the Black Sea (Ref. 12.1).

Fishing for sprat is permitted between the beginning of July and the end of September at water depths of more than 40 m. Commercially exploitable populations are found from April until September and since 2011, fishing in deeper waters (over 40 m depth) has been allowed.

Anchovy fishing is allowed from the beginning of October until the 15 March annually at water depths of more than 20 m. Anchovy fattens and spawns in the Sea of Azov in the summer months and migrates to the Russian and Georgian shores of the Black Sea as waters cool until the following spring. Thus, in the Black Sea territorial waters of Russia, anchovy form commercial concentrations during the cold season from October to April.

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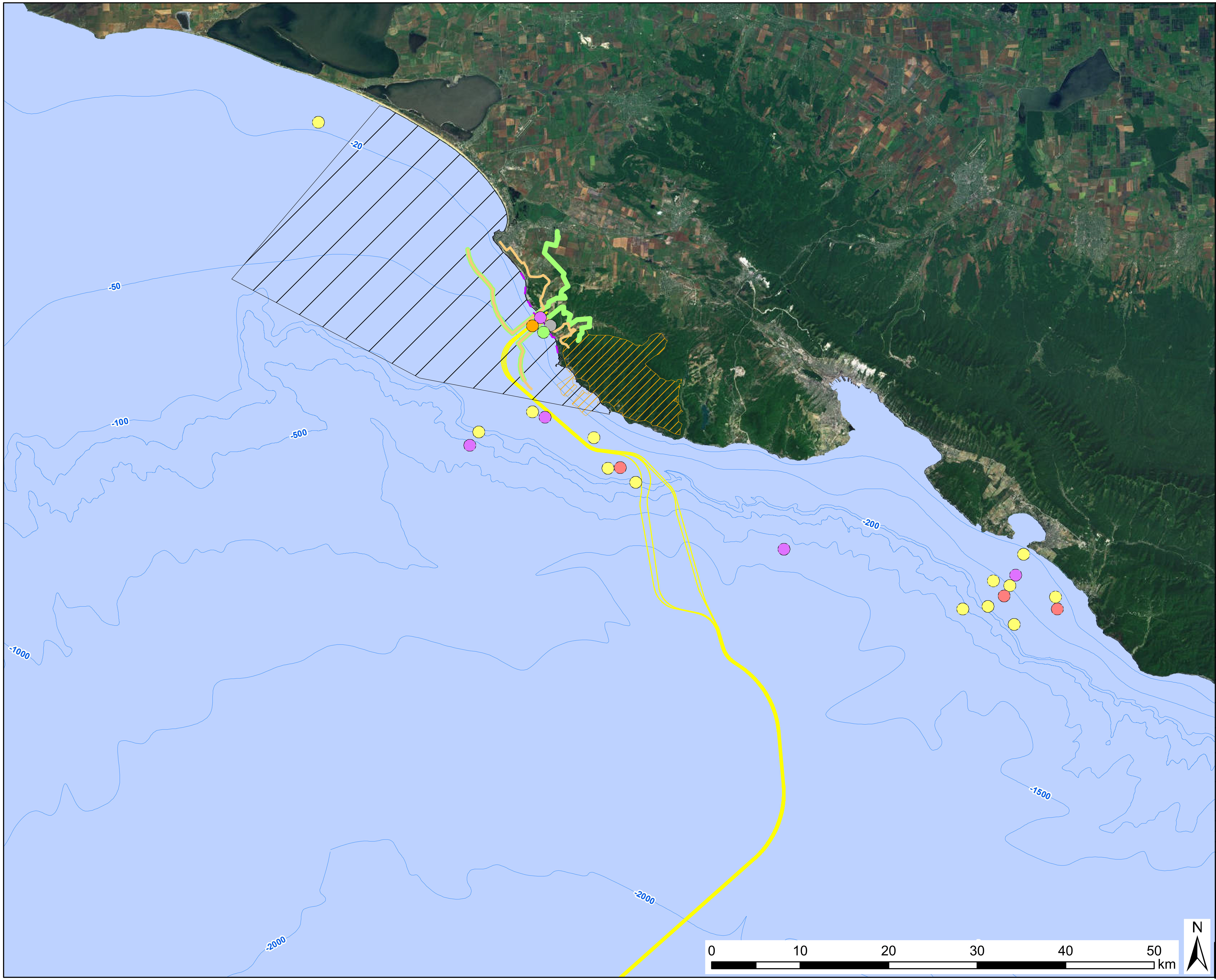
[13] The Anapskaya Bank was initially designated in 1986 by Decree of the Ministry of Fisheries of the USSR. The area where fishing was prohibited was reduced by the Resolution of the Scientific Fishery Council of the Azov and Black Sea Basin in 1999. In 2011 the fishing ban was further reduced and it now merely consists of seasonal restrictions to enable the replenishment of fish stock.



LEGEND

- Cladophoropsis membranacea
- Cladostephus spongiosus
- Gavia arctica
- Larus melanocephalus
- Phylliphora crispa
- Tursiops truncatus ponticus
- The boundary of the first area of sanitary protection zone (exclusion zone)*
- The boundary of the second area of sanitary protection zone (limitation zone)*
- The boundary of the third area of sanitary protection zone (monitored zone)*
- Anapskaya Bank
- Boundary of the state nature reserve "Utrish"

Russian Sector of South Stream Offshore Pipeline

- Proposed offshore pipelines
- Isobaths

Projection: Lambert Conformal Conic

Revision Details	By / Check	Check Date	Suffix

Purpose of Issue
For Information

Client
South Stream Offshore Pipeline — ENERGISING EUROPE

Project Title
SOUTH STREAM OFFSHORE PIPELINE

Drawing Title
PROTECTED SPECIES AND AREAS OBSERVED IN SURVEY AREA

Drawn	Checked	Approved	Date
DH	RW	MW	04 Mar 2014

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Figure 12.21

Rev

Plot Date: 04 Mar 2014
File Name:I:\5004 - Information Systems\46369082_South_Stream\MXDs\Report Maps - Russia\Russian ESIA\Offshore Sampling\Figure 12.21 Protected Species and Areas Observed in Survey Area.mxd

Utrish

In 1988, the Bolshoi Utrish reserve was included in the Register of State Reserves located on the territory of the Krasnodar Region[14]. The total area of the reserve is 5,112 hectares, of which 2,530 hectares is offshore (to a water depth of 40 m) (Figure 12.21). The marine sector of the reserve provides protection for a number of flora and fauna species listed in the Red Books of the Krasnodar Krai and the Russian Federation (algal species are listed in Table 12.24). The Pipeline route does not cross the offshore part of the marine reserve (Figure 12.21) but it is likely that it will host some of the protected species found in the nearby reserve. From surveys conducted on the Abrau Peninsula, some 20 km further east along the coast than the Utrish reserve, the main benthic communities present in the area have been identified. Utrish at its closest point is around 2 km from the Project Area.

The vegetated zone can be divided into three groups broadly based on water depth. In very shallow waters (up to about 2 m water depth) a low biomass mosaic algal community made up of ephemeral greens such as *Enteromorpha* together with *Ceramium ciliation*, *Cladophera* sp. *Lophosiphonia obscure*, *Padina pavonia* and *Dilophus fasciola* is found. This shallow water association is almost uniform for the whole coast (Ref. 12.4).

The mid zone, at depths from 2 to 10 m, is dominated by *Cystoseira* communities, which includes two species; *Cystoseira barbata* and *C. crinita*. Nearly all sampled stations at depths of 2 m, 5 m and 10 m show this association which is characterised by multi-layering of algae and high species richness. The highest algal biomass is observed at depths of 2 to 5 m (up to 35%). Although in some areas algal biomass it is quite high even at 10 m, it usually it drops to less than 1% at the bottom phytal zone. This is primarily due to increasing light limitation at depths of over 10 m, especially in the recent years when dense plankton blooms may attenuate light. The *Cystoseira* communities form the basis of much of the benthos of the north Caucasus region.

The final algal community, found in water depths over 10 m, is dominated by perennial red algae such as *Phyllophora nervosa,* although more recently a second species, the green algae *Codium vermilara* was also found to be equally dominant within the association. This significant change in the bottom phytal zone is a result of the restructuring of the entire ecosystem of the Black Sea due to pollution and other anthropogenic impacts, which has been observed in the latter half of the 20th century (Ref. 12.4).

Preliminary information regarding the composition of the protected species of seaweed in the Utrish reserve is listed in Table 12.24 including information on the conservation status of these species in Russia. There is potential that these species will also be recorded in the waters of the Survey Area although only three species were observed in 2011 surveys (Ref. 12.1).

The dominant *Cystoseira* associations support a diverse invertebrate fauna with high numbers of amphipod, polychaete and gastropod species. However, biomass is dominated by the mussel

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[14] Annex No 2 to the Decision of the Executive Committee of the Krasnodar Regional Council of People's Deputies No 326 of 14.07.1988

Mytilaster lineatus which makes up 70 to 95% of the total community biomass. *Mytilaster* covers the *Cystoseira* thalli in a solid layer, and the older the thallus, the greater the biomass of the molluscs covering it. Thus, *Mytilaster* biomass is often a function of the mean age of the algae which results in an uneven distribution of the mussel.

On soft sediments, macroalgae are absent and fauna dominate with different associations depending on water depth and sediment conditions. On silted sands at a depth of 20 to 25 m a community dominated by the bivalve mollusc *Chamelea gallina* was observed. Other bivalves, particularly *Spisula subtruncata*, together with gastropods and crustaceans were also present in this association (Ref. 12.4).

In silted muddy habitats at depths of 25 to 35 m a more diverse community, dominated by the bivalves *Cunearca cornea* and *Pitar rudis* was observed (Ref. 12.4). These two bivalves made up 61 to 87% of the faunal biomass. Species diversity in the association was dominated by bivalve molluscs and polychaetes together with a small number of gastropods, crustaceans and other taxa.

In water depths of 35 to 50 m, a regional *Mytilus galloprovincialis* community was observed. This comparatively diverse community of 40 species was dominated taxonomically by polychaetes, bivalves and crustaceans with a small number of gastropods, ascidians and other taxa. However, biomass was dominated by bivalves, particularly the dominant bivalve *Mytilus galloprovincialis* which accounted for between 59 and 80% of the total biomass per station sampled (Ref. 12.4).

At depths greater than 50 m a *Modiolula phaseolina* (reported as *Modiolus phaseolinus*) community was observed. The three most common species in this community are the bivalve *M.phaseolina*, the polychaete worm *Terebellides stroemi* and the brittlestar *Amphiura stepanov* that collectively comprise 80 to 99% of the biomass on the stations sampled.

Thus, the distribution of benthic associations in the Utrish area was summarised as follows:

- 1 to 10 m – algal community dominated by *Cystoseira barbata* + *Cystoseira crinita*;
- 10 to 20 m – algal community of *Phyllophora nervosa* + *Codium vermilara*;
- 20 to 35 m – rocky ground – no flora or fauna;
- 20 to 35 m – soft sediments with a mosaic of primarily infaunal animals, particularly bivalves *Chamelea gallina*, *Anadara inaeqivalvis* and *Pitar rudis*;
- 35 to 50 m – an association of fauna dominated by the mussel *Mytilus galloprovincialis*; and
- 50 to 75 m – an association of fauna dominated by the bivalve *Modiolus phaseolinus*.

There were no macro-invertebrates recorded from the Utrish reserve of the Black Sea Coast included in the Russian Red Data Book, but two species of crab are listed in Annex 3 of the Red Data Book of the Krasnodar Krai Region. These are the stone crab (*Eriphia verrucosa*) which inhabits coastal waters and the spider crab (*Macropodia rostrata*) which is found in waters to 50 m.

Table 12.24 Protected Algae Observed in the Littoral Zone of the Abrau Peninsula

Taxon	Conservation status*	
	RDBRF	RDBKK
Siphonocladus pusillus	2	2
Grateloupia dichotoma		3
*Phyllophora crispa = P. nervosa***	2	2
Lomentaria compressa	3	3
Hypoglossum hypoglossoides		3
Dipterosiphonia rigens		3
Arthrocladia villosa		3
Dictyota linearis		3
Dilophus spiralis		3
*Cladostephus spongiosus***		3
Stypocaulon scoparium		3
Stilophora tenella	2	2

* Red Data Books: 2= vulnerable species and subspecies declining in number; 3=rare species and subspecies; 5 = rehabilitated and recovering
** Species observed in 2011 surveys (see Ref. 12.1)

The taxonomic constitution of the fish fauna in the marine part of Utrish is quite diverse and contains 71 species of fish, belonging to 35 families and 15 orders. This makes up nearly 37% of the fish fauna in the whole Black Sea and around 70% of fish species found in the Russian part of the Black Sea. The core of the community consists of Mediterranean migrants, the warm water species. The anadromous and semi-anadromous species that occur here consist of the sturgeon and herring families (Acipenseridae and Clupeidae), while brackish water species exist in the Clupeidae and Gobiidae families. Six species of fish listed in the Red Books of the Krasnodar Krai and Russian Federation are present in the Utrish reserve and so may also be present in the Survey Area (Table 12.25).

In terms of seabirds, Utrish is significant for the conservation of the black-throated diver which is regularly recorded as a migrating and wintering species of the western Black Sea area. The species' successful wintering is determined by the rich food reserve of the Utrish region. A further three species of bird listed in the Red Books have been observed in the Utrish reserve (Ref. 12.1) and may be present in the Survey Area; the black-throated diver, great black-headed gull and the black-headed gull.

12.4.8.2 Protected Species

A number of species of conservation concern, listed in the Red Data Books of the Russian Federation and the Krasnodar Krai or included in the IUCN Red List, have been directly observed in the Survey Area (Table 12.25) (Ref. 12.1). Some of these have also been designated as species of concern by the Black Sea Convention. These are:

- Two species of macroalgae;
- Two species of fish;
- Three species of seabirds; and
- Three species of mammals.

Table 12.25 Protected Species Recorded During Project Specific Surveys

Taxonomic group	Species name	Conservation Status		
		IUCN Global Red List	**RDBRF†**	**RDBKK†**
Macroalgae	*Phyllophora crispa = P. nervosa*	-	-	1
	Cladostephus spongiosus	-	-	3
Fish	Thornback ray (*Raja clavata*)	Near Threatened	-	-
	Leaping mullet (*Liza saliens*)	-	-	3
Seabirds	Black-throated diver (*Gavia arctica*)*	Least concern	2	2
	Mediterranean gull (*Larus melanocephalus*)	Least concern	-	3
	Mediterranean shearwater (*Puffinus yelkouan*)	Vulnerable	-	-
Marine mammals	Bottlenose dolphin (*Tursiops truncatus ponticus*)**	Data deficient	3	3
	Common dolphin (*Delphinus delphis ponticus*)**	Vulnerable	-	-
	Harbour porpoise (*Phocoena phocoena relicta*)**	Vulnerable	3	2

* Subspecies *Gavia arctica arctica*
** Black Sea Convention: Endangered
† Red Data Books: 1 = Endangered, 2= Vulnerable species and subspecies declining in number; 3=rare species and subspecies;

A number of other protected fish species and one seabird, whilst not observed directly in the survey area, have been reported from nearby areas. It is possible, therefore, that these species may be present in the survey area and have for this reason been identified in Table 12.26 (Ref. 12.1).

Table 12.26 Protected Species Observed Near Survey Area from the Utrish Reserve Data, Commercial Fisheries Stations and Incidental Observations During 2011 Surveys

Species	Conservation Status		
	IUCN Global Red List	**RDBRF**	**RDBKK**
Fish			
Beluga sturgeon (*Huso huso*)	CR	-1	1a-
Russian sturgeon (*Acipenser gueldenstaedtii*)	CR	-	-
Stellate sturgeon (*Acipenser stellatus*)	CR	-	-
Black sea salmon (*Salmo trutta labrax*)	LC	2	3
Corb or silver weakfish (*Umbrina cirrosa*)	-	-	3
Chestnut goby (*Chromogobias quadrivittatus*)	-	-	5
Tub gurnard (*Chelidonichthys lucerna*)	-	-	2
Birds			
Gull-billed tern (*Gelochelidon nilotica*)*	LC	-	2

* Black Sea Convention: Rare.
** IUCN: LC=Least Concern; CR= Critically endangered.
† Red Data Books: 1 = Endangered (1a Critical), 2= Vulnerable species and subspecies declining in number; 3=rare species and subspecies; 5 = rehabilitated and recovering.

12.4.9 Critical Habitat

12.4.9.1 Overview

The Project Area lies within some Tier 2 critical habitat as defined by the IFC[15]. It should be noted that the Project Area does not, per se, represent particular habitat that is not replicated

[15] IFC (2012) Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources.

elsewhere in the Russian Black Sea; it is merely part of a wider zone that meets the requisite criteria. Further details of the rationale for the determination of critical habitat are provided in IFC Guidance Note 6[16]. Full details of the determination of marine critical habitat in the Project Area are provided in Appendix 12.1: Marine Critical Habitat Determination.

The critical habitat assessment has based on the establishment of 'discrete management units' (DMUs). Paragraph 65 of Guidance Note 6 defines a DMU as "an area with a clearly demarcated boundary within which the biological communities and/or management issues have more in common with each other than they do with those in adjacent areas". For the purposes of this assessment, the Project has defined three DMUs:

- Coastal Zone: water depths of less than 30 m along the Russian coastal margin of the Black Sea;
- Shelf Zone: between 30 m and 200 m water depth, characterised by muddy substrates with a variety of bivalve, polychaete and burrowing anemone dominated communities; and
- Open Sea: from 200 m water depth to the edge of the Russian EEZ.

12.4.9.2 Critical Habitat for Endangered Species

Beluga, Russian, and stellate sturgeon have been observed on single occasions during surveys in the Study Area. It is unlikely that globally significant populations regularly occur here, though single individuals probably do, thus the coastal zone qualifies as Tier 2 critical habitat for these species based on criterion 1 (supports the regular occurrence of a single individual of a critically endangered species) as defined by the IFC (Ref. 12.33).

Black Sea bottlenose dolphins and harbour porpoises have been regularly observed in the Project Area and it is likely that both the coastal zone and open sea are Tier 2 critical habitat for these species, based on criterion 1 which is defined as "Habitat of significant importance to CR or EN species that are wide-ranging and/or whose population distribution is not well understood and where the loss of such a habitat could potentially impact the long-term survivability of the species" and "habitat containing nationally / regionally important concentrations of an EN, CR or equivalent national / regional listing". The Tier 2 critical habitat classification may also be based on Criterion 2 which is defined as "Habitat known to sustain ≥ 1 percent but < 95 percent of the global population of an endemic or restricted-range species where that habitat could be considered a discrete management unit for that species, where data are available and/or based on expert judgment".

12.4.9.3 Critical Habitat for Migratory and Congregatory Species

Though definitive data are not available, it is reasonable to suppose that both the coastal zone and open sea areas qualify as Tier 2 critical habitat for Black Sea turbot based on criterion 3 which is defined as "*Habitat known to sustain, on a cyclical or otherwise regular basis, ≥ 1*

[16] IFC Guidance Notes are not Project standards for the South Stream Offshore Pipeline Project. They are described in Equator Principles III as follows: 'Guidance Notes accompany each Performance Standard. Equator Principles Financial Institutions (EPFIs) do not formally adopt the Guidance Notes however EPFIs and clients may find them useful points of reference when seeking further guidance on or interpreting the Performance Standards.'

percent but < 95 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle and where that habitat could be considered a discrete management unit for that species, where adequate data are available and/or based on expert judgment."

If the Project Area is considered, data suggest that it does not meet the 1% global or biogeographic population criteria, and although small dense flocks of birds are occasionally observed, they are unlikely to exceed the 20,000 bird threshold specified in IBA's criterion A4. However, the very large scale of the DMUs in this case means that it is reasonable to suppose that the 20,000 bird threshold might be exceeded for the entire coastal area and thus there is the potential for it to qualify as Critical Habitat. It should nonetheless be stressed that this is an artefact of the size of the DMU, rather than a real reflection of the conservation importance of the area to birds per se.

The coastal zone may also qualify as Tier 2 Critical habit under IBA Criterion A4 (see Appendix 12.1 for further details), in that it supports over 20,000 birds. It should be noted however, that this is largely an artefact of the size of the DMU rather than its conservation importance to birds.

12.5 Impact Assessment

12.5.1 Impact Assessment Methodology

The overall assessment methodology is detailed in **Chapter 3 Impact Assessment Methodology,** whereby receptor sensitivity and impact magnitude are used to determine the overall significance of an impact. Specific criteria relating to the sensitivity of marine species and marine habitats, and to the magnitude of marine impacts, are discussed in Section 12.5.1.1.

Impacts are presented below based on discussion according to receptor type, to give a complete picture of the effects of the Project on a given habitat or species group. However, because mitigation is mainly applied at source rather than receptor, it is more appropriate to list mitigation measures according to project activity. This allows a clearer perspective of how an activity can be managed as a whole to minimise, mitigate or manage marine ecological impacts.

This chapter demonstrates Project adherence to the 'mitigation hierarchy' as defined in IFC PS(6), i.e. impacts should be progressively avoided, minimised, and restored, with priority given to the actions which are earliest in the hierarchy. Therefore, the Project has sought and will continue to seek to avoid impacts on biodiversity. When avoidance of impacts is not possible, measures to reduce impacts to an acceptable level and to restore biodiversity, will be implemented. Given the complexity in predicting project impacts on biodiversity over the long term, the Project will adopt a practice of adaptive management in which the implementation of mitigation and management measures are responsive to changing conditions and the results of monitoring until the necessary biodiversity requirements of no net loss / biodiversity gain and fulfilment of management objectives have been achieved.

The project's mitigation strategy will be described in a Biodiversity Action Plan (BAP) and will be designed to achieve net gains of those biodiversity values for which the critical habitat was designated. Development of the BAP will take into consideration relevant industry guidance, and will allow for adaptive management and consultation with stakeholders on topics of conservation related to the Project's biodiversity interests"

The Project involves a wide range of activities that have the potential to impact the marine environment, primarily during the Construction Phase. The relevant activities are summarised in Table 12.27. Decommissioning activities are not known at this time. GIIP is usually to leave marine pipelines in situ, which would have impacts indistinguishable from those set out for the Operational Phase. However, for the purposes of this ESIA Report, wholesale pipe removal is also considered.

Table 12.27 Project Activities in the Russian Marine Environment

Phase	Activity	Offshore	Nearshore
Construction and Pre-Commissioning	Mobilisation of vessels to and from site and vessel movements within construction spread.	✓	✓
	Vessel routine operations (including propulsion, cooling water, water maker, bilges and ballast).	✓	✓
	Pre-construction route surveys, as-built ROV surveys and removal of any obstacles (e.g. wrecks, munitions, boulders).	✓	✓
	Delivery of pipe and other supplies, as well as crew changes.	✓	✓
	Night time working.	✓	✓
	Dredging of microtunnel exit pits, burial of pipeline between 23 m and approximately 26 m isobaths and seabed storage of dredged material.		✓
	Trench backfill and post lay trenching (for main pipe-lay and intervention works).		✓
	Disposal of spoil from slope / seabed intervention works.		✓
	Installation of test heads at the end of the nearshore pipeline section.		✓
	Hydrotesting, including seawater abstraction and discharge of hydrotest solution.	✓	✓

Continued…

Phase	Activity	Offshore	Nearshore
Construction and Pre-Commissioning	Pipeline tie-in, including survey of pipe ends, installation of lifting gear, raising and lowering pipe and de-rigging gear.	✓	✓
	Anchoring and dynamic positioning of pipe-lay vessels.	✓	✓
	Laying the offshore section of the pipe on seabed.	✓	✓
	Inspection, welding and weld-testing of pipe, construction of pipeline crossings, welding of recovery heads and the lowering and raising of pipe during these activities.		✓
Operational	Physical presence of the Pipeline.	✓	✓
	Pipeline inspection (including ROV surveys etc.) and maintenance that will involve some vessel movements and associated generation of small quantities of wastes associated with routine vessel operations.	✓	✓
Decommissioning (Option 1)	Pipeline cleaning by flushing with water and associated water displacement and disposal.	✓	✓
	Filling pipe with seawater and sealing.	✓	✓
	Vessel operations associated with inspection surveys.	✓	✓
Decommissioning (Option 2)	Lifting of pipeline from the seabed.	✓	✓
	Seabed intervention, including excavation of buried pipe.	✓	✓
	Associated vessel operations.	✓	✓

Complete.

12.5.1.1 Impact Assessment Criteria

Receptor Sensitivity

The receptor sensitivity criteria for marine ecological receptors have been harmonised, where appropriate, with those adopted for terrestrial ecological receptors (**Chapter 11 Terrestrial Ecology**), in order to allow for a consistent and integrated approach in assessing the Project's impact on ecology and biodiversity. However, though the approaches are harmonised they are not identical. Where the terrestrial ecological assessment focuses on conservation and protection criteria, the marine assessment includes consideration of ecological function. This is because there are marine species and communities that are important to the ecosystem that are neither rare nor protected by any designation (e.g. bivalves providing bio-filtration, or macroalgae providing habitat for other notable or commercially valuable species). This approach therefore includes consideration of flora, fauna, ecological processes and nature conservation.

It should be noted that for the purposes of this ESIA, the concept of "sensitivity" is more closely related to receptor value (importance) than receptor vulnerability (resistance to change), though elements of both are considered in the criteria. Vulnerability considerations are also incorporated into the criteria for impact magnitude set out below.

The marine environment encompasses a wide variety of ecological receptors as detailed in the baseline section above. At the highest level, these can be divided into habitats and species, for which it is appropriate to derive separate assessment criteria. The main habitat types that occur in the Project Area are:

- Soft substrate benthic habitats;
- Seaweed stands; and
- Deep sea microbial communities.

Potential critical habitat has been identified in the baseline Section 12.4.9, encompassing wide areas of the sea (Appendix 12.1). Because the Project does not have the scope or scale to impact such extended areas, the assessment of impacts relating to critical habitats has focussed on the species for which that habitat is considered critical rather than the habitat itself.

Species are broadly classified into the following groups (though consideration is given to individual named species where they are of particular conservation concern or known to be particularly vulnerable to specific impact):

- Plankton;
- Benthic fauna;
- Fish;
- Seabirds; and
- Marine mammals.

Sensitivity criteria have been developed separately for habitats and species, as set out below in Table 12.28 and Table 12.29 respectively. Where possible both international and national criteria and standards have been applied. It should further be noted that on occasion a receptor is assigned a sensitivity range. This is to allow the adoption of a precautionary approach to highlight specific potential vulnerabilities within a wider context (e.g. the presence of species of conservation interest in an assemblage that is otherwise less sensitive) but where the impacts can be managed by the same set of Project design controls and mitigation measures.

Table 12.28 Receptor Sensitivity Criteria for Marine Habitats

Sensitivity	Description	Applicable Legal Standards
High	A site, habitat or assemblage of species which has designated conservation status at an international and national scale; or Areas of particular biodiversity importance, that my support populations of restricted range, endemic or endangered species, or is in itself unique or threatened*; or Areas that support large populations (in a national or international context) of migratory species**; or Habitats that provide key ecosystem functions.	International: Designated areas or habitat under IUCN category Ia to IV (Habitat / Species Management Area and above). Russia: Designated habitat in Russian law on "On Specially Protected Natural Areas" No. 33-FZ.
Moderate	A site, habitat or assemblage of species which has designated conservation status at a National scale; or 'Natural Habitat' IFC classification: Areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition.	Designated habitat in Russian law on "On Specially Protected Natural Areas" No. 33-FZ.
Low	Habitats occurring outside of any designation; or 'Modified Habitat' IFC classification: Areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition. Modified habitats may include areas managed for agriculture, forest plantations, reclaimed coastal zones, and reclaimed wetlands.	None applicable
Negligible	Habitats that are either appreciably degraded or disturbed by human activity or have high proportions of invasive / non-native species; or Do not support any key ecosystem functions.	None applicable

* As listed on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species
** There criteria are similar to those used by the IFC to determine "Critical Habitat". It should be stressed however, that designation of critical habitat is not in itself a criterion, rather the result of applying conservation criteria. Either modified or natural habitats may be considered critical if they support the appropriate species or processes. A marine critical habitats appraisal has been carried out in parallel to this ESIA and presented in Appendix 12.1.

Table 12.29 Receptor Sensitivity Criteria for Marine Species

Sensitivity	Description	Applicable Standards
High	A species population that has designated conservation status at an international and national scale; A species that is globally rare; or A keystone species fundamental to the functioning of the ecosystem.	International: Listed in Black Sea Red Data Book (Black Sea Environment Programme) categories 'Vulnerable' and above. Listed in IUCN red data book category 3 to 6 (Vulnerable and above). Listed under the Bucharest Convention. Russia: Listed in Red Data Book of the Russian Federation or Krasnodar Krai.
Moderate	A species population that has designated conservation status at a national or regional scale; A species common globally but rare locally; Important to ecosystem functions; or Under threat or population in decline.	Listed in Red Data Book of the Russian Federation or Krasnodar Krai.
Low	A species not protected by law; Not critical to other ecosystem functions (e.g. as prey to other species or as predator to potential pest species); or Common nationally.	None applicable
Negligible	Common / abundant locally; or Not important to other ecosystem functions.	None applicable

Habitats

Soft substrate benthic habitats include sandy and silty seabed at a variety of depths. This habitat type supports a diversity of benthic communities and infaunal species. The precise composition of the flora and fauna depends on several physico-chemical variables such as water depth, sediment particle size and organic content. This mosaic of different communities includes areas dominated by the mussel *Modiolula phaseolina* and other bivalves. The significance of this is that such communities provide an important ecological service due their bio-filtration capacity when present in high abundance. The mobile nature of soft seabed means that soft substrate benthic communities are often able to withstand physical perturbation and to re-establish disturbed areas relatively quickly. Despite their abundance and wide distribution, the important ecological roles these communities serve (as, inter alia, structural species, prey and bio-filters), means they are considered generally only moderately sensitive.

Seaweed-dominated communities exist on hard substrates. Most notable of these are algae of the genera *Phyllophora* and *Cystoseira*. *P. brodiaei* and *P. nervosa* are listed as vulnerable in the Black Sea Red Data Book while *Cystoseira barbata* and *C. crinata* are both listed as endangered in the Black Sea Red Data Book. *P.crispa* (=*P.nervosa*) is listed as vulnerable in the RDBKK. Macroalgal stands are known to exist in the Project Area and a dense *Cystoseira* community is present at a water depth of approximately 10 m, becoming sparser at depths between 10 m and 20 m. *P. crispa* was also recorded in the Survey Area (though not in discrete stands) and is thought to be present in the Utrish nature reserve which is located, at its closest point, around 2 km from the Project Area. These habitats are considered highly sensitive.

Very little is known about the offshore deep water seabed of the Black Sea abyssal plain. Anoxic conditions and the presence of H_2S mean that only sulphur metabolising bacteria and one infaunal species of microscopic metazoan have been observed to survive in these zones. It is thought that such communities are widespread in the deep sea, but the specific diversity and abundance of organisms in this habitat is not known. In some circumstances deep sea bacterial communities can form reef structures or microbial mats, though such communities were not observed along the Pipeline alignment (Ref. 12.15; Appendix 7.1) and in the Black Sea they are thought to be confined to the northwest shelf. On the basis of available survey data, deep sea microbial communities are considered to be low sensitivity.

Species

Plankton are not particularly sensitive to the impact of pipe-laying activities. Their dispersed nature, very high numbers and relatively short generation time means the populations themselves are resilient, even though some sensitive and rare species, e.g. sturgeons, have planktonic larvae. Project Activities alone have relatively little scope to impact the water column, and thus plankton are generally considered of moderate to low sensitivity. The reason the sensitivity is not assessed purely as low is due to the possible presence of the larvae of endangered species in the ichthyoplankton.

Although some benthic invertebrates are mobile, their generally small size gives them a restricted ability to avoid large scale impacts. Because of this, and the fact that they can be important in overall ecosystem functions and services (e.g. biofiltration, food for fish), benthic invertebrates are considered of moderate sensitivity.

Several protected fish species have been recorded in the Project's ecological surveys, most notably two species of sturgeon that are critically endangered (Russian sturgeon, *Acipenser guldenstaedtii* and Stellate sturgeon, *A.stellatus*). Two other protected species; the thornback ray (*Raja clavata* listed under IUCN as Near Threatened), and leaping mullet (*Lisa saliens* listed in the RDBKK), were recorded in the Survey Area. Records from Utrish also suggest the presence (albeit occasional) of the critically endangered beluga sturgeon (*Huso huso*). Despite the ability of many fish to avoid some areas of impact, the presence of endangered species means the fish community is considered to be of moderate to high sensitivity.

A wide variety of shore and seabirds inhabit the Russian nearshore at different times of year. Birds are most vulnerable to disturbance when nesting or moulting and their ability to avoid sources of impact is reduced. Three locally endangered species are present in the Project Area; the black-throated diver *Gavia arctica*, the Mediterranean gull *Larus melanocephaus* and the Mediterranean shearwater *Puffinus yelkouan*. The latter is also globally vulnerable. Despite the limited scope for the Project to interact with seabirds, the presence of endangered species in the Survey Area for at least part of the year means their sensitivity as receptors is considered moderate to high.

Whilst highly mobile and generally able to avoid areas of adverse impact, the sensory acuity of marine mammals means they have the potential to be impacted by high levels of unnatural sound in the ocean. Two of the three cetacean species that occur off the Russian coast, namely harbour porpoise (*Phocaena phocaena relicta*) and bottlenose dolphin (*Tursiops truncatus ponticus*) are globally endangered and included in the RBDs of the Russian Federation and Krasnodar Krai. The third species, the common dolphin (*Delphinus delphis ponticus*), is globally vulnerable and listed in the Black Sea (Bucharest) Convention Annex III, but is not in the Russian RDB. Because of their protected status, marine mammals are considered highly sensitive receptors.

A summary of the receptors considered within this chapter and their associated sensitivity ranking is provided in Table 12.30 below.

Table 12.30 Marine Ecology Receptors

Receptor	Sensitivity Ranking
Species	
Plankton	Moderate to Low
Benthic invertebrates	Moderate
Fish	Moderate to High
Seabirds	Moderate to High
Marine mammals	High
Habitats	
Soft substrate benthos	Moderate
Seaweed stands (*Cystoseira* communities)	High
Deep sea microbial communities	Low

Impact Magnitude

Consistent with the approach outlined above, common impact magnitude criteria have been developed for marine and terrestrial ecological receptors as shown in Table 12.31 and Table 12.32. As the magnitude of potential impacts upon habitats and species is highly variable and difficult to quantify these definitions have been developed, in line with **Chapter 3 Impact Assessment Methodology**, to provide case specific flexibility based on professional judgement and experience in GIIP. These criteria, as previously mentioned, include consideration of the degree of change as well as the ability of receptors to withstand that change. Furthermore, in assigning magnitude, environmental controls built into the design of the project are considered.

Table 12.31 Marine Habitat - Impact Magnitude

Magnitude	Description
High	The project may adversely affect the integrity of an area or region, by substantially changing in the long term its ecological features, structures and functions, across its whole area, that enable it to sustain the habitat, complex of habitats and/or population levels of species that makes it important.
Moderate	The area's integrity will not be adversely affected in the long term, but the Project is likely to affect some, if not all, of the area's ecological features, structures and functions in the short or medium term. The area or region may be able to recover through natural regeneration and restoration.
Low	Neither of the above applies, but some minor impacts of limited extent, or to some elements of the area, are evident but easy to recover through natural regeneration.
Negligible	Indiscernible from natural variability.

Table 12.32 Marine Species - Impact Magnitude

Magnitude	Description
High	Impact on a species that affects an entire population causing a decline in abundance and/or change in distribution beyond which natural recruitment (reproduction, immigration from unaffected areas) would not return that population or species, or any population or species dependent upon it, to its former level within several generations*, or when there is no possibility of recovery.

Continued…

Magnitude	Description
Moderate	Affects a portion of a population and may bring about a change in abundance and/or a reduction in the distribution over one or more generations[22], but does not threaten the long-term integrity of that population or any population dependent on it. The size and cumulative character of the consequence is also important. A moderate magnitude impact multiplied over a wide area would be regarded as a high magnitude impact.
Low	Affects a specific group of localized individuals within a population over a short time period (one generation or less), but does not affect other trophic levels or the population itself.
Negligible	Indiscernable from natural variability.

* These are generations of the animal or plant species under consideration not human generations

Complete.

Determining Impact Significance

As outlined in **Chapter 3 Impact Assessment Methodology** of this document, the significance of an impact on an identified and valued receptor is determined as a relationship between the sensitivity of the receptor and the magnitude of the predicted impact. The relationship between receptor sensitivity and impact magnitude, and the resultant significance of an impact (positive or negative), is presented in Table 12.33 and definitions of the impact significance ratings are given in Table 12.34.

Table 12.33 Impacts Significance Matrix

		Receptor Sensitivity (Vulnerability and Value)			
		Negligible	***Low***	***Moderate***	***High***
Impact Magnitude (Extent, Frequency, Reversibility, Duration)	***Negligible***	Not significant	Not significant	Not significant	Not significant/Low*
	Low	Not significant	*Low*	Low/Moderate†	Moderate
	Moderate	Not significant	Low/Moderate	Moderate	High
	High	Low	Moderate	High	High

* Allows technical discipline author to decide if impact significance is Not Significant or Low.
† Allows technical discipline author to decide if impact significance is Low or Moderate.

Table 12.34 Impact Significance Definitions

Adverse Impacts	**High**	Significant. Impacts with a "high" significance are likely to disrupt the function and value of the resource / receptor, and may have broader systemic consequences (e.g. ecosystem or social well-being). These impacts are a priority for mitigation in order to avoid or reduce the significance of the impact.
	Moderate	Significant. Impacts with a "moderate" significance are likely to be noticeable and result in lasting changes to baseline conditions, which may cause hardship to or degradation of the resource / receptor, although the overall function and value of the resource / receptor is not disrupted. These impacts are a priority for mitigation in order to avoid or reduce the significance of the impact.
	Low	Detectable but not significant. Impacts with a "low" significance are expected to be noticeable changes to baseline conditions, beyond natural variation, but are not expected to cause hardship, degradation, or impair the function and value of the resource / receptor. However, these impacts warrant the attention of decision-makers, and should be avoided or mitigated where practicable.
	Not significant	Not Significant. Any impacts are expected to be indistinguishable from the baseline or within the natural level of variation. These impacts do not require mitigation and are not a concern of the decision-making process.

12.5.1.2 Modelling Undertaken

While no specific ecological modelling has been undertaken, this section draws on the results of sediment dispersion modelling with respect to benthic impacts, and on the results of acoustic modelling with respect to the impacts of underwater noise on fish and cetaceans. Details of the sediment dispersion and underwater noise modelling are provided in Appendix 12.2: Sediment Dispersion Study and Appendix 12.3: Underwater Noise Study respectively.

12.5.2 Assessment of Impacts: Construction and Pre-Commissioning

12.5.2.1 Introduction

Compared to other Project phases, construction and pre-commissioning activities have the greatest scope to impact the marine environment, and all the receptors discussed above may be impacted at some stage. However, the Project has been designed to reduce a number of impacts at source. Design controls have been categorised by potential impact from a given Project activity. These design controls attempted to firstly either avoid or minimise the risk of an impact considering the IFC mitigation hierarchy as discussed in **Chapter 3 Impact Assessment Methodology**. Potential construction and pre-commissioning impacts are assessed on this basis. Additional mitigation and monitoring measures are then identified that can further reduce impacts to as low as possible, and the residual impact is assessed. The design controls included in Table 12.35 relate to Construction and Pre-Commissioning, Commissioning and Operational and Decommissioning Phases and have been included in the pre-mitigation impact assessment in Section 12.5.2.2, 12.5.3.2 and 12.5.4.2.

Table 12.35 Design Controls

Design Controls in Project Description
A Seabed Intervention Construction Management Plan (CMP) will be prepared including measures for minimising turbidity, managing overspill etc.
Open trench dredging will be minimised.
Microtunnelling will be performed at the shore approach / landfall instead of open cut trenching.
Rock placement will be kept at the practical minimum to ensure pipeline stability and safety and in accordance with detailed design.
The appointed pipeline installation contractor will be required to develop anchor patterns and procedures and undertake a risk assessment to minimise impact to areas of concern.
Implement a Dredging Management Plan to ensure careful spoil handling and minimise release of material to the water column.
To reduce the risk that stored dredge spoil may be dispersed during winter storms, storage of dredged materials in winter will be restricted within the deepest half of the temporary storage area where practicable.
An anchor handling survey to identify areas in which anchoring will be permitted will be carried out within the Project Area (including the pipeline corridor where anchoring will take place), the area of which will be calculated by the contractor and agreed with South Stream Transport.
Chemical additives in the hydrotest solution will be sodium bisulphite, which is of low acute toxicity in the marine environment and does not bioaccumulate. Sodium bisulphite is included by OSPAR on the list of chemical that Pose Little or No Risk (PLONOR) to the environment.
The microtunnelling drilling fluid will be a mixture of drill cuttings and a slurry made of water and bentonite (a natural, inert, non-toxic clay)) which is pumped through hoses to the tunnel boring machine (TBM) cutting head to lubricate the cutting head. Bentonite is listed in OSPAR's PLONOR list of additives that Pose Little or No Risk to the environment (PLONOR). OSPAR refers to the Oslo and Paris Conventions for the Protection of the marine Environment of the North-East Atlantic (OSPAR Conventions).
The exit point for the hydrotest solution will consist of either a four or six inch diffuser positioned approximately 1 m above the seabed and which will reduce the speed of water flow exiting the pipe, thereby reducing turbidity, scour and sediment plumes. The diffuser also acts as an aerator, improving the oxygen concentration in the water and compensating for the scavenging effect of the sodium bisulphite.
The suction hoses for the hydrotest will be equipped with suitable strainers (2 mm screen mesh). Water will be collected in a break tank (water tank fitted with filter systems) on board the supply vessel. From the break tank, water will be pumped through a filtration skid to remove all particles larger than 50 microns.

Continued...

Design Controls in Project Description
After a successful hydrotest, the Pipeline will be dewatered and chemically conditioned (dried) using Monoethylene Glycol (MEG). MEG will not be disposed into the sea but will be pumped from the subsea test head to the support vessel via a down line, received and stored in suitable secure tanks to be disposed or recycled by an approved waste handling company.
All bunkering activities will be undertaken in accordance with the Vessels and Marine Transport activity-specific CMP, which will be developed as part of South Stream Transport's Construction Phase ESMP. The CMP will contain activity-specific requirements, to be met by both South Stream Transport and the appointed contractors (and sub-contractors).
All vessel discharges and wastes will be compliant with Marine Pollution (MARPOL) Convention, Bucharest Convention and national regulations, cognisant of the Black Sea's status as an IMO special area with respect to garbage and wastes containing hydrocarbons. Compliance with national regulations and Bucharest Convention. For information on the regulations governing the discharges of grey / black waste, sewage, garbage, bilge and oily water that will be adopted by the Project (refer **Chapter 18 Waste Management).**
If a Trailing Suction Hopper Dredger (TSHD) is used, the dredged material will be deposited directly onto the seabed to reduce the dispersion of sediments. It is anticipated that the dredged material will be temporarily stored for approximately two to three months.
Wastes to be offloaded at suitable port / harbour facilities and collected and transferred by appropriately licenced hauliers to licenced disposal sites suitable for the wastes being received.
A project integrated waste management plan will be drawn up to ensure wastes are minimised at source, recycled / re-used where possible and otherwise managed responsibly. Adherence to vessel-specific Waste Management Plans which will include provisions for segregating waste on board, having secure areas for storage of hazardous waste and recycling / reuse where practicable. Any waste water arising from operational maintenance activities (e.g. pigging of pipelines) will be collected on site in tanks and transported from site by an appropriately approved waste haulier to an appropriate waste treatment site in accordance with current waste management regulations.

Complete.

12.5.2.2 Assessment of Potential Impacts (Pre-Mitigation)

Receptors and their associated sensitivity have been identified above. This section provides an assessment of potential impacts to these receptors using the impact magnitude and receptor sensitivity matrix discussed in **Chapter 3 Impact Assessment Methodology**. A summary of the impacts identified and their pre- and post-mitigation significance ranking is provided in Table 12.38.

Plankton

Vessel operations will generate waste that may affect plankton as follows:

- Cooling water discharges may cause localised changes in water quality relating to excess heat and the presence of biocides. This may cause thermal and /or chemical stress to biota in the immediate vicinity, though it will be a highly localised effect; and

- Vessel wastes discharges, if highly turbid, may locally reduce light levels and temporarily affect phytoplankton photosynthesis. Suspended solids may also interfere with the filter feeding mechanisms of some zooplankton species and affect the behaviour of visual predators that eat zooplankton.

Vessel wastes will be managed in line with MARPOL and national regulations, thus these impacts are of negligible magnitude to a receptor of moderate to low sensitivity and are therefore assessed as **Not Significant**.

Plankton may be affected by the re-suspension of sediments (particularly associated with dredging and nearshore storage of dredged spoil) that reduces photosynthesis, interferes with filter feeding and alters the rate of visual predation on plankton.

Dredging or dumping at the microtunnel exit pits results in the formation of a sediment plume after dredging works start. The sediment plume drifts in the direction of the ambient currents along the Russian coastline. When assessing the impact to plankton of suspended solids, a threshold of 10 milligrams per litre (mg/l) is usually applied[17]. Plume modelling (see Appendix 12.2) using conservative criteria predicts that the impact area for this threshold is 16.2 km^2. It should be noted that this is very much a worst case scenario, as it does not allow for flocculation and other processes that will tend to remove material from suspension rapidly. In reality, sediment in water tends to form density flows that sink rapidly. A range of studies conducted since the 1990s have shown that sediment discharges into the marine environment will tend to form a density current and flow near-instantaneously to the seabed (convective descent), carrying most of the turbid body rapidly to the seabed. There, it dynamically collapses to form a horizontally moving turbid near-bed layer from which the solids content reconsolidates onto the seabed. A percentage of this descending flow (of the order of a few per cent of the solids by weight) will mix with the ambient water mass during the descent and form a more slowly dispersing far-field plume. Another factor that increases the settling rate of suspended sediments and reduces the extent of surface plumes is the tendency for fine material to flocculate. When factoring in these mechanisms of flocculation and convective descent, the extent of the surface plume is very significantly decreased. The area encompassed by the plume (at concentrations over 10 mg/l) is predicted to be in the order of 0.22 km^2 and will extend approximately 700 m from the source. The significance of this is that, because of natural flocculation processes, the plume will not impinge on the Utrish SPNA marine reserve.

The maximum area of the surface plume for offshore seabed interventions is predicted at 4.7 km^2 while, because of the tendency of most suspended particles to sink, the near bed plume is significantly larger, possibly covering an area of 150 km^2.

Despite the fact that sediment plumes may extend for an appreciable extent, they are transitory phenomena, and most dense near the seabed, that will only affect a very small proportion of the plankton, negligible in the context of natural population variability and predation. This is likely to be a short-term negligible magnitude to a receptor of moderate to low sensitivity, generating a **Not Significant** impact.

[17] 10 mg/l is the recommended Maximum Permissible Concentration (MPC) for suspended solids for Russian seawater shelf zones.

Hydrotesting the Pipeline will involve seawater abstraction and discharge of hydrotest solution, containing oxygen scavenger. The discharge will comprise approximately 8,000 m^3 of seawater containing 250 parts per million (ppm) of sodium bisulphite, which is a non-toxic substance and on the OSPAR List of substances used and discharged offshore which are considered to Pose Little Or No Risk to the environment (PLONOR). The discharge will be essentially non-toxic and take place approximately 1 m above the seabed. Subsequent cleaning and drying may also involve the discharge of solid wastes and drying agents, although these will be recovered and disposed of on land. This impact is likely to be a short term negligible magnitude to a receptor of moderate to low sensitivity, leading to an impact that is **Not Significant**.

Seawater abstraction may result in the entrainment of plankton. These will be subject to physical stresses and may result in mortality. However, as only a very limited number of localised individuals will be affected this is a short term negligible magnitude to a receptor of moderate to low sensitivity. The impact is thus **Not Significant**.

Light from night-time works may result in changes in the vertical distribution of plankton however, as this is localised, it will be of negligible magnitude to a receptor of moderate to low sensitivity. The impact is thus **Not Significant**.

Benthos

Vessel wastes may affect benthic communities in a variety of ways:

- Suspended solids in vessel wastes may locally reduce the photosynthetic ability of marine macrophytes. Particles may also interfere with the filter feeding mechanisms of some invertebrates. Settling material, if present in appreciable quantities, may smother benthos in shallow water. The volume of suspended material from vessel waste is likely to be low so that the magnitude of the impact is low; and
- Decomposition of organic material in kitchen wastes, grey water etc. may locally reduce dissolved oxygen levels, causing physiological stress, displacement and/or behavioural changes in benthos.

Vessels must be compliant with the requirements of MARPOL when discharging wastes to the marine environment and are prohibited from discharging within 3 NM of the shoreline.

The above are negligible magnitude events to a receptor of moderate to high sensitivity (in the case of seaweed stands) that will generate, at most, **Low** significance impacts prior to mitigation.

Seabed disturbance may occur through several different activities, including surveys and inspections, obstacle removal ("pre-sweeping"), dredging, pipe-laying, post-lay trenching and rock placement / seabed intervention. This is the most significant aspect associated with the Project, potentially affecting large areas of the seabed and associated species and habitats, as detailed below. Impacts to benthos are significant not only from the perspective of biodiversity, but also the ecological processes that benthos provides, namely primary production, nutrient cycling and biofiltration.

The Project may generate dredged spoil from offshore trenching and profiling. Dredged spoil in the nearshore (i.e. from the dredging of the microtunnel pits and transition trenches) will be temporarily stored in designated offshore storage areas. This material will be subsequently re-dredged and used for trench backfill following pipe installation. A certain amount of offshore dredged material (estimated volume of 42,500 m^3) may be disposed of at an existing underwater disposal site (no. 923, located on the Russian continental slope, see Figure 12.2 for location). In the event that any dredge spoil is identified as contaminated or requires disposal on land, the spoil will be treated as construction waste and appropriately stored, transported and disposed of (see **Chapter 18 Waste Management**). However, baseline studies undertaken to date do not indicate that this is likely.

When the TBM emerges into the microtunnel exit pit, there will be a small discharge of slurry into the marine environment, comprising rock particles and a natural clay mineral, bentonite. Bentonite is listed in OSPAR's PLONOR list of additives that Pose Little or No Risk to the environment. However, this will be carefully controlled by reducing the pressure of slurry supplied to the TBM on nearing emergence to the exit pit and immediate shutdown of the TBM slurry circuit when the TBM emerges into the exit pit. Since bentonite is denser than seawater, the slurry will tend to settle on the seabed rather than mix with the surrounding water column. Furthermore, the depth of the exit pit (approximately 6 m below the natural seabed surface) will reduce the exposure of the slurry to seabed currents and will capture the majority of slurry discharged from the tunnel. It will therefore not have any significant impact on benthos.

Benthos will be directly impacted by substrate loss that will cause some direct mortality in the nearshore dredged area. Approximately 0.85 ha of seabed will be dredged for the microtunnel exit pits and short lengths of buried pipeline to approximately 26 m isobaths. Temporary storage of dredged spoil will occupy a nominal 10 ha (based on a dredged volume of approximately 100,000 m^3). This will impact a coarse sediment community characterised by burrowing bivalves such as *Gouldia minima* and *Chamelea gallina.* Further offshore, 5.3 ha of seabed will be pre or post trenched for stability reasons, and another 13.1 hectares (ha) subject to rock backfill and dumping for protection, in an area of mud dominated by bivalves such as *Parvicardium similis* and *Modiolula phaseolina*. The total area directly affected by these activities is thus estimated at approximately 29.25 ha. The unburied pipeline will also impact approximately 1,350 ha (13.5 km^2) of seabed (assuming a 60 m bundle width over 225 km), causing disturbance and re-suspending sediments, the majority of which will be in the anoxic deep sea and not affect any macrobenthic communities.

Disturbance from pipe-lay vessel anchors and chains is predicted to affect approximately 6.3 ha per kilometre of laid pipeline in deeper water (up to 600 m water depth). For each anchoring point, it has been assumed that a conventional anchor spread of twelve 20 to 25 tonne anchors will be used with an average chain length of 200 m. The total seabed affected by anchoring will therefore be approximately 190 ha (1.9 km^2) affecting soft substrate benthic habitats and deep sea microbial benthic communities. Given the limited extent of the seabed disturbance and the ability of soft benthic habitats and associated fauna to withstand and recover from physical perturbation, the magnitude of the impact is assessed as low on a receptor of moderate sensitivity, resulting in an impact of **Low** significance prior to mitigation. Deep sea microbial communities are of low sensitivity, and there is a limited seabed footprint so impacts are considered of **Low** significance prior to mitigation. However, the Project is committed to undertaking an anchor corridor survey with the aim of identifying and avoiding or minimising disturbance to sensitive habitats including establishing exclusion zones where practicable.

In addition to direct seabed loss, resettling of suspended solids and increased turbidity may cause some smothering resulting in direct mortality as well as impairing the ability of some organisms to feed, respire and photosynthesise.

Modelling has been carried out to assess the extent of the plume from seabed intervention works. As previously described, the flocculation of material and the formation of density flows tends to make sediment plumes sink rapidly, thus the seabed impacts may be greater than the near-surface impact. Seabed works associated with dredging and storage of material at the microtunnel exits are predicted to cause a plume in excess of 10 mg/l that covers approximately 0.2 km^2. Plumes will disperse to background levels in 60 to 120 hours depending on wind and current direction. In the context of seaweed photosynthesis, this is considered a negligible level impact on a high sensitivity receptor, generating impacts of **Low** significance prior to mitigation.

Convective descent of turbid plumes carries most of the material rapidly to the seabed forming a horizontally moving turbid near-bed layer from which the solids reconsolidate onto the seabed. Typically the bulk of the material accumulates in an annular area on the seabed with a diameter 1 to 3 times the water depth. The deposit is lenticular, with decreasing deposition thickness at the edge. From the perspective of ecological impacts, different organisms can tolerate various levels of smothering. Seaweed stands are sensitive to relatively thin layers of sediment reducing their photosynthetic ability, though as they grow in shallow water, re-suspension by wave action tends to limit the build-up of sediments. Dense algal cover in the Project Area is generally confined to water approximately 10 m deep or shallower, with sparse cover between approximately 10 and 20 m and burrowing bivalve communities beyond this depth. At 10 m water depth, waves 1 m high and 5 m long will generate near-bed orbital velocities of 0.15 metres per second (ms^{-1}), sufficient to re-suspend fine sand and recently deposited muds (Ref. 12.34). Such conditions occur regularly and wave maxima generated by storm events are even capable of initiating motion in fine sediments to 40 m depth, thus resettling sediment will not persist or accumulate.

Modelling shows that the area of seabed likely to experience more than 5 mm of deposition is limited to approximately 35 to 46 ha depending climatic conditions, approximately half of which will be landward of the tunnel exits where seaweed communities are prevalent (see Appendix 12.2 for further details). Much of this will be rapidly re-suspended and transported away by wave action. The region's overall integrity in terms of community structure and the ecological processes that benthic communities provide will not be impacted, though some ecological features will be affected on a local scale. Given the temporary nature and relatively limited areal extent of seaweed beds affected, this is considered a low level impact on a high sensitivity receptor, generating impacts of **Moderate** significance prior to mitigation.

Infaunal benthic invertebrates in soft substrate habitats are generally better able to tolerate sediment deposition and a threshold of 5 cm is commonly applied (Ref. 12.35). Tunnel exit works are predicted to cause this level of deposition over approximately 5 ha. The maximum deposition thickness for offshore seabed interventions is not predicted to exceed this threshold and there are no changes to sediment type expected. Because of the very small area impacted, this is considered a low level impact on a moderate sensitivity receptor, generating impacts of **Low** significance, prior to mitigation.

Minor disturbance associated with pre-construction route surveys, crossings etc. are negligible magnitude activities that will have a **Not Significant** impact prior to mitigation.

Hydrotest discharge may result in localised deterioration of water quality (due to low dissolved oxygen concentration), alteration of hydrodynamic regime and resultant seabed disturbance. However the discharge will only contain sodium bisulphite which is classified by OSPAR as PLONOR (poses little or no risk), thus no chemical effects are anticipated. The discharge structure itself will be elevated at least 1 m above the seabed to reduce re-suspension of sediments and will take place beyond the depth where sensitive seaweed communities are present. Effects will therefore be temporary and localised, and no appreciable long or medium changes will accrue to benthic communities as a result. This is thus considered a short-term and negligible magnitude impact to a receptor of moderate sensitivity, which means a **Not Significant** impact prior to mitigation.

Fish

Vessel operations have the following potential impacts on fish:

- Decomposition of organic material in uncontrolled disposal of kitchen wastes etc. may locally and temporarily reduce dissolved oxygen levels, causing physiological stress, displacement and/or behavioural changes in fish; however as the Project will comply with MARPOL discharge controls this will not arise in reality. Conversely, kitchen wastes may attract some species to feed though the scale of this effect is likely to be trivial; and
- Cooling water discharges may cause localised changes in water quality relating to excess heat and the presence of biocides. This may cause thermal and/or chemical stress to biota in the immediate vicinity, though it will be a highly localised effect.

The above effects are considered negligible therefore any associated impact is **Not Significant** to fish.

Light from night-time works may affect fish, either by direct attraction or through alterations in the distribution of planktonic prey. Because of its highly localised nature, this is a negligible magnitude impact to a moderate to high sensitivity receptor, thus at most of **Low** significance prior to mitigation.

The impact of dredging, pipe-laying and seabed intervention on fish will be variable depending on their habit, habitat and life stage. Open water pelagic species will be essentially un-impacted as they can readily avoid noise sources and are not prone to the effects of near bed sediment plumes or seabed deposition, while small, benthic dwelling species may be more severely impacted (on a localised scale) through habitat loss, loss of food resource and smothering. High concentrations of suspended solids associated with dredging plumes may cause damage to gills in some cases, while in others may help avoid predation, though the latter is a more transient effect. As previously mentioned, sediment plumes generated by seabed intervention will be of limited extent (relative to the overall habitat and distribution range) and duration, as will areas of significant seabed deposition. In some cases, seabed disturbance is attractive to fish as it exposes infaunal prey that might otherwise be inaccessible. Moderate levels of turbidity are also beneficial to some species in avoiding visual predators, though the scale of such effects will be small. The impact of seabed disturbance to fish is likely to affect a localised proportion of the population for less than one generation at any given location and is thus a negligible to low magnitude impact to a receptor of moderate to high sensitivity resulting in, at most, **Moderate** significance impacts prior to mitigation. With respect to pelagic fish offshore, the impacts will be **Not Significant**.

Noise and vibration will be generated by several Project Activities, including the passage of vessels, microtunnelling in the nearshore, dredging, trenching, pipe-laying and rock placement (see Appendix 12.3). Low levels of noise may also be generated during commissioning, testing and operational flow. Fish may be either hearing specialists or hearing generalists; the former are usually species with swimbladders that are connected to the ear and are more sensitive to noise. Black Sea shad (*Alosa maeotica*), Caspian shad (*A.caspia*), sprat (*Sprattus sprattus*), kilka (*Clupeonella cultriventris*) and anchovy (*Engraulis enccrasicolus*) possess specialised gas ducts extending to the inner ear and are hearing specialists. Hearing generalist fish (such as sturgeon, turbot, and skate) are less sensitive both in terms of sound level and frequency range.

Acoustic impact analysis showed that sound levels generated by pipe-laying and trenching in the Black Sea are insufficient to cause mortality or injury to fish. The approach used is based on criteria developed by Stadler and Woodbury from hearing studies of fish exposed to airgun sounds (see Appendix 12.3 for further details). This is most commonly applied to pile driving injury range estimation but can be reasonably applied to continuous sound. Exposure to a few loud sounds is more damaging to fish that exposure to a larger number or longer duration of quieter sounds therefore, the use of the Stadler and Woodbury criterion (187 dB re $\mu Pa^2 s$) is precautionary when applied to exposure to continuous sound and yields very conservative estimates of effect range and area.

Modelling results show a theoretical maximum injury effect range of 0.9 to 1.6 km, corresponding to an effect area of 5 to 6.8 km^2 (Appendix 12.3). It should be noted that this is a very conservative estimate, as much vessel noise is high frequency and fish generally have no sensitivity to high frequency sound with the exception of some fish specialised in hearing very high frequency sound, such as cod which are not present in the Black Sea. In addition, fish will move away from loud noises and their actual exposure in reality will be significantly less.

Weighted metrics, specifically the dB_{ht} technique, are based on the hearing sensitivity of the target species and the loudness of the noise as experienced by the animal. Using weighted thresholds, it was found that behavioural effects (given by the 75 dB_{ht} threshold) may be apparent in some hearing specialist fish such as sprat or kilka in some situations[18] (though not shad or anchovy). Anchor handling is the activity most likely to generate such responses, and in shallow water may extend up to 260 m from activity, with an affected area of approximately 0.2 km^2. In deepwater, where anchor handling will not take place, the pipe-laying vessel itself may generate similar impacts at a lesser range of approximately 140 m (area of effect approximately 0.06 km^2). No impacts are predicted to hearing generalist species.

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[18] Audiograms for sprat and kilka were not available for use in the modelling exercise and herring, a close relative, was used as an analogue. Given that anchovy are also closely related and no impacts are predicted based on the anchovy audiogram, the use of herring in the model may have resulted an over-estimation of impact ranges.

Because noise will affect a localised group of individuals over a short time period, and because there are no protected species that are hearing specialists, the generation of noise is considered a medium term, low magnitude impact on a receptor of moderate sensitivity of **Low** significance. Additional detail of the acoustic modelling is provided in Appendix 12.3.

Seawater abstraction for hydrotesting may result in the entrainment of small fish. These will be subject to physical stresses and some mortality. Larger fish may also be impinged in the intake structure, undergoing physical trauma, but only a very limited number of localised individuals will be affected. This is likely to be a short term low magnitude impact on a receptor of moderate to high sensitivity. The significance of the impact is thus **Moderate** significance prior to mitigation.

Hydrotesting will involve the limited discharge of seawater containing no more than 250 ppm sodium bisulphite, which is classed by OSPAR as PLONOR. While not toxic, this water may have reduced oxygen content and thereby result in some respiratory stress to fish in the immediate vicinity. Effects will nonetheless be highly localised and restricted to only a few individuals within the population. No appreciable changes will accrue to the community as a whole. This effect is thus considered short term impact of negligible magnitude on a receptor of moderate to high sensitivity. The significance of the impact is thus **Not Significant** prior to mitigation.

Seabirds

Vessel movements during mobilisation, surveying and pipe-laying activities have the potential to temporarily disturb seabirds. However, these are highly mobile animals generally able to avoid areas of disturbance, and the density of seabirds at sea is generally low, though occasional dense flocks of both Mediterranean shearwaters (*Puffinus yelkouan*) and great crested grebe (*Podiceps cristatus*) have been observed near the coast. This will thus be a low magnitude impact to a receptor of moderate to high sensitivity, leading to impacts of **Moderate** significance prior to mitigation.

Seabirds will not be directly affected by trenching etc. Indirect, short term effects may occur to a localised part of the population as a result of displacement or loss of prey in the nearshore. This is considered a negligible magnitude impact to a receptor of moderate to high sensitivity, leading to **Low** significance impacts prior to mitigation.

There will be occasions where night-time works are required necessitating the use of floodlights. Light can affect migrating birds and cause mortality from bird strikes on highly illuminated offshore installations. The source of illumination (the pipe-laying vessel spread) will be transient at any given location and have limited scope to interact with night-flying birds. Because only a small number of localised individuals will be affected, this is considered a short term low magnitude impact to a receptor of moderate to high sensitivity, resulting in impacts of **Moderate** significance at most prior to mitigation.

Marine Mammals

Vessel movements during mobilisation, surveying and pipe-laying activities have the potential to temporarily disturb marine mammals. Collisions may also occur. However, these are highly mobile animals with acute sensory perception and are generally able to avoid areas of disturbance and only a few individuals are likely to be affected, if any. This will therefore be a medium term, low magnitude impact to a high sensitivity receptor, leading to impacts of **Moderate** significance prior to mitigation.

Cooling water discharges and other effluent streams from vessels may cause localised changes in water quality relating to excess heat and the presence of biocides. This may cause thermal and/or chemical stress to animals in the immediate vicinity, though it will be a highly localised effect and easily avoided by cetaceans, thus this is a negligible magnitude impact to a high sensitivity receptor, leading to impacts of **Low** significance.

Light from night-time works may affect marine mammals through alterations in the distribution of prey. Because of its highly localised nature and its potential to only impact a very limited number of individuals, this is a negligible magnitude impact to a high sensitivity receptor, likely to be **Not Significant** prior to mitigation.

Marine mammals are less impacted by seabed changes or sediment suspension than fish or benthos, as they are air breathing and do not rely exclusively on sight for navigation or feeding. However, indirect effects from the displacement of their food resource may occur. The effects of seabed disturbance on marine mammals are short term and will only affect a few individuals thus it is a negligible magnitude impact to a high sensitivity receptor, of **Low** significance prior to mitigation.

Noise from vessel movements, pipe-laying and trenching can negatively impact marine mammals as it influences their ability to echolocate, communicate and can cause physical harm (through risk of disorientation leading to beaching, as well as in extreme cases, trauma to the auditory apparatus). Noise can cause certain cetacean species to vacate feeding areas, as it interferes with acoustic prey location.

A number of activities involve the generation of man-made sound underwater and this has the potential to impact cetaceans. The noise-generating activities associated with the Construction and Pre-Commissioning Phase have been identified as:

- Pre-lay sonar surveys;
- Vessel movements;
- Microtunnelling,
- Trenching;
- Rock placement;
- Pipe-laying; and
- Pre-commission testing.

Detailed noise modelling has been carried out to assess the potential impact underwater noise will have on cetaceans. The noise modelling has included consideration of single sources, combined sources (from vessel spreads) as well as cumulative exposure over time (24h). The potential of noise to cause injury or behavioural alterations has been assessed and is summarised below. Full details are provided in Appendix 12.3.

In keeping with the latest scientific approaches, injury effects assessment has been based on the cumulative sound exposure level (SEL) over a period of 24 hours. The pipe-laying operation (loudest among any possible activities at the three representative sites) has been modelled including realistic motion of pipe-lay vessel and support vessels such as pipe carrier ships shuttling to resupply (Appendix 12.3). Two sets of criteria are available and currently considered valid for the assessment of ranges to injury[19] from continuous noise: the Southall *et al.* criteria and the Finneran and Jenkins criteria (also referred to as the "US Navy criteria"):

- The former uses a single threshold of 215 dB re μPa2-s SEL weighted according to the hearing class of the subjects using Type 1 weighting curves (M-weighting); and
- The latter uses variable thresholds and newer Type 2 weighting functions that take into account subjective loudness and some additional data collected since the Southall et al. study. For Mid Frequency cetaceans (MFC) such as dolphins the threshold is 198 dB re μPa2-s SEL with Type 2 MFC weighting. For High Frequency cetaceans (HFC) such as porpoises the threshold is 187 dB re μPa2-s SEL with Type 2 HFC weighting.

The results of the SEL based assessment have been presented in terms of the modelled area exposed to cumulative levels above the threshold over a 24 hour period (area of effect), as well as a range of effect that provides a linear "width" of the footprint relative to the main pipe-lay vessel. Because of the irregular and elongated shape of the cumulative footprint along the pipe-lay route, the effect range cannot be computed as a radius for equivalent area and is instead measured from the swath width of the footprint with suitable consideration of its shape. The injury footprint of the operations is estimated to be very limited. Porpoise in close proximity to pipe-laying (20 to 60 m) may experience PTS, corresponding to an impact area of 0.6 to 1.3 km^2.

Various criteria are available to assess the potential impacts of underwater noise on cetacean behaviour. Traditionally an un-weighted criterion for behavioural effects onset at 120 dB re μPa has been used commonly referred to as the "Level B Harassment" criterion. This approach, in use in the USA since 1997, has several acknowledged shortcomings, most importantly that marine species vary widely in their sensitivity to sound, and especially to the frequency range which they hear. Thus this "one size fits all" criterion is considered inappropriate in some specific instances and the approach is currently under review by NOAA/NMFS[20] (Ref. 12.36). It should not be totally ignored or dismissed out of hand however, due to its current widespread use. It is therefore included here for completeness and reference to common practice. It is also a criterion still cited as the only acceptable approach for the harbour porpoise by studies as recent as 2012[21] that explicitly exclude the use of weighted metrics criteria for that species because of its unique susceptibility and reaction to sound stimuli.

Weighted metrics behavioural criteria for species other than harbour porpoises could be considered, but their applicability in the case of continuous sounds such as those from vessels is

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[19] Defined as the onset of permanent threshold Shift (PTS); i.e. the point at which hearing may become impaired and from which the animal cannot recover.

[20] The new approach, currently undergoing peer review, is an attempt to create a more nuanced scientific set of criteria. It is likely to result in either an increase in the Level-B threshold, based on the understanding that animals will tend to avoid noise sources thereby reducing their exposure, or to be related more closely to ambient noise levels in the marine environment. These new guidelines are due to be issued in the near future.

[21] Criteria And Thresholds For U.S. Navy Acoustic And Explosive Effects Analysis

not confirmed and the relatively high reaction thresholds that arise from their use would be difficult to defend by comparison with empirical evidence.

Audiogram based behavioural effect were chosen as the most defensible criteria given the availability of reliable audiograms for dolphins. There remains a degree of uncertainty in the use of audiogram referenced levels (dB relative to hearing threshold, or dB_{ht}) regarding which threshold to adopt for the onset of behavioural disturbance. A commonly used set of criteria are the fixed thresholds of 75 and 90 dB_{ht} for all species as onset of mild and pronounced behavioural reactions respectively. However validity especially of the higher threshold has been questioned and evidence can be found for reaction at significantly lower levels. Taking the different elements into account, the 75 dB_{ht} threshold is considered a reasonably conservative and defensible estimator of the onset of behavioural disturbance in cetaceans and has been used for this assessment.

Based on audiogram weighted criteria, behavioural effect ranges for individual vessel operations are only estimated to be significant for dolphins and porpoises with effect ranges never exceeding 1.5 km at any modelled location. A summary of the predicted ranges and areas of effect is presented in Table 12.36.

Table 12.36 Predicted Behavioural Impact Ranges for Cetaceans Based on 75 dBht

Activity	Season	Bottlenose dolphin		Harbour porpoise	
		range (km)	area (km^2)	range (km)	area (km^2)
Dredging: Microtunnel Exit and Transition Trench	February	0.35	0.35	0.81	2.04
	August	0.38	0.44	0.98	2.16
Pipe-Pull Stationary	February	0.28	0.01	0.28	0.01
	August	0.28	0.01	0.28	0.01
Pipe-Laying with Active Anchor Handling; Shallow water	February	0.15	0.01	0.20	0.05
	August	0.15	0.01	0.18	0.05
Pipe-Laying (DP)	February	0.70	0.02	0.57	0.06
	August	0.70	0.02	0.57	0.06
Pipe-Laying with Active Anchor Handling, mid-depth	February	0.57	0.01	0.55	0.04
	August	0.57	0.01	0.55	0.04

Continued...

Activity	Season	Bottlenose dolphin		Harbour porpoise	
		range (km)	area (km^2)	range (km)	area (km^2)
Crew Change (for pipe-laying operation) mid-depth	February	0.68	0.68	1.17	3.37
	August	0.72	0.60	1.48	3.80
Rock-Dumping: Cable Crossing, Equipment Delivery	February	0.11	0.05	0.30	0.27
	August	0.11	0.05	0.32	0.30
Pipe-Laying (J-Lay)	February	0.50	0.06	0.40	0.19
	August	0.50	0.06	0.40	0.19
Crew Change: (for pipe-laying operation) - deepwater	February	0.60	0.49	0.91	1.67
	August	0.63	0.56	1.01	2.28

Complete.

Unweighted metrics predict behavioural impacts over a wider range; up to 46.7 km for a pipe-laying spread with anchor handling vessels in shallow water, but as previously discussed, this is considered highly conservative and actual impact ranges may well be less than this.

In addition, cetaceans may be exposed to sonar noise during pipeline inspection. There are well accepted impact criteria for sonar sources that are based on the instantaneous root-mean-square sound pressure level metric (rms SPL). For injury, a generic (NMFS) standard threshold of 180 dB re 1 µPa un-weighted is commonly used. For behaviour effects, there are US Navy criteria specifically for sonar sources. Their criteria for mid-frequency and high-frequency cetaceans are based on Type I weighting of the SPL and do not provide a single threshold value but rather refer to a Behavioural Response Function (BRF) that assesses the probability of a behavioural impact from a given SPL. Accordingly, a reasonably precautionary 25% probability of response to a weighted SPL of 160 dB re dB re 1 µPa has been used as the principal criterion. However, as previously explained, harbour porpoises are excluded from this criterion due to the high susceptibility to disturbance of this species and the recommend NMFS standard threshold of 120 dB re 1 µPa un-weighted is used. In all cases, cetaceans would need to be closer than 10 m to the source for any possibility of injury. The longest range predicted impacts are approximately 1 km from the source, specifically to porpoises in mid-depth waters. Behavioural impact ranges to other cetaceans from sonar are consistently less than 250 m. The ranges over which behavioural impact might be observed are summarised in Table 12.37.

Table 12.37 Predicted Behavioural Impact Ranges for Sonar Source

Threshold	Season	Shallow water		Mid-Depth		Deep water	
		range (km)	area (km^2)	range (km)	area (km^2)	range (km)	area (km^2)
Generic (NMFS) threshold (120 dB re 1 µPa rms SPL un-weighted) Porpoise	February	0.98	0.46	0.95	0.23	0.90	0.18
	August	0.99	0.47	1.01	0.23	0.90	0.18
Mid-Frequency cetacean behaviour threshold (160 dB re 1 µPa SPL) Dolphin	February	0.22	0.0011	0.14	0.0007	0.12	0.0005
	August	0.22	0.0011	0.14	0.0007	0.12	0.0005

The analysis shows that sound levels generated by pipe-laying, trenching and associated activities are unlikely to cause significant injury to marine mammals. Though there is the potential for PTS very close to vessel spreads, in reality it is unlikely that cetaceans will approach loud sound sources. Noise will affect a group of localised individuals over a short time without affecting the overall population, thus the generation of noise is considered a medium term, low magnitude impact to a high sensitivity receptor, of **Moderate** significance prior to mitigation.

Additional details of the quantitative underwater noise assessment can be found in Appendix 12.3.

Cetaceans may be exposed to hydrotesting discharge, but as it is non-toxic, the only impact will be secondary due to possible localised displacement of prey. This is a short term negligible magnitude impact to a high sensitivity receptor, giving a **Not Significant** to **Low** significance prior to mitigation.

12.5.2.3 Mitigation and Monitoring

A wide variety of mitigation measures can be applied to minimise or otherwise reduce the construction and pre-commissioning impacts of the Pipeline. Mitigation will be applied at different stages in the Project to minimise impacts and to reflect GIIP. A significant part of the mitigation is achieved through design (e.g. nearshore microtunnelling, see Table 12.35 for design controls) to prevent impacts occurring.

Additional management measures will be implemented as necessary to reduce the impact to a level of a practical minimum. These are discussed below and are grouped by each potential impact arising from the Project Activities in Table 12.27.

It is important to note that impact categories may cover a broad range. For example a moderate impact could be relatively localised and affect a limited set of receptors, or approach the threshold of breaching a regulatory limit. Clearly to design an activity so that its effects only just avoid a major impact is not good practice thus the emphasis for mitigation is on demonstrating that the impact has been reduced to practical minimum, rather than necessarily be reduced purely in terms of its rating.

Disturbance / Injury of cetaceans, seabirds and fish

- Vessel speed will be reduced where seabirds on the water surface and/or marine mammals are known to be present, and vessels will not approach animals unless it is not possible to avoid doing so;
- Specific protocols for mammal and bird interactions will be drawn up in a contractor's management plan and qualified (e.g. Joint Nature Conservation Committee registered course or equivalent) Marine Mammal Observers (MMO) will be present during pipe-laying operations to assist in managing such interactions on a case by case basis. This plan will specify the number, location, deployment and procedures to be used;
- Vessel engine power will be "ramped" up where practicable, to allow cetaceans that may be nearby to move away from sources of loud underwater noise and vibration;
- Appropriate lighting design during night-time works will be implemented, including use of directed illumination, screens, shades, timers, actuators, etc. as required. Skyward and seaward light projection will be eliminated as far as safe and practicable, by removing unnecessary illumination, reduction of light intensity and shielding of light sources during the night, and in low visibility and bad weather conditions. This will apply particularly during the most active migration period for migrating birds (between the end of March and the end of May, as well as mid of September to the end of October);
- Intake screens for water abstraction will be used to prevent ingress of fish and large invertebrates. The design of screens should be optimised to minimise injury and/or mortality;
- Water intakes will be designed to minimise seabed disturbance and impingement or entrainment of marine organisms by appropriate positioning and reduction of the velocity of the intake;
- The hydrotest water intake will be fitted with appropriate screens to minimise entrainment of organisms;
- Limit activities to be carried out within the "coastal offshore environment" defined as the continental shelf out to 25 km along the pipeline route during May in order to avoid any disturbance to fish spawning;
- Preparation of a Biodiversity Action Plan (BAP) and a Biodiversity Management Plan (BMP)[22]; and
- Use of modern vessels and plant and undertaking of regular maintenance checks.

[22] According to IFC guidance (GN6), a BAP consists of any number of biodiversity-related actions that need to be carried out by a company to fulfil the needs of a particular requirement, request or expectation (e.g., Lender compliance, legal requirement, stakeholder concerns), particularly if the EISA process has identified information gaps that need to be filled. A BMP should be developed when the baseline, impact assessment and proposed mitigation measures are complete and the only remaining issue is to collate such information into one implementable and auditable Management Plan.

Changes to Water / Sediment Quality

- A Project integrated waste management plan will be drawn up to ensure wastes are minimised at source, recycled / re-used where possible and otherwise managed responsibly (see **Chapter 18 Waste Management);**
- If biocides or other additives are required in the cooling water system, or for general cleaning purposes any chemical additives should be selected on the basis of least risk to the environment and will not contain carcinogenic, mutagenic or reprotoxic components;
- Intakes will be positioned or oriented to minimise seabed disturbance;
- Intake screens will be used to prevent entrainment of fish and large invertebrates. The design of screens should be optimised to minimise injury and/or mortality;
- Where dredging is required, the choice of dredger will be made to minimise sediment re-suspension (within engineering constraints). A chute, to deposit sediment close to the seabed to minimise turbidity will be used. Additional turbidity reduction measures will be used where practical, particularly where sediment is to be temporarily re-deposited in nearshore storage areas; and
- Implement a Dredging Management Plan.

Seabed disturbance / Habitat Loss

- Dredging areas are contained within the maritime safety exclusion zone, and variables such as dissolved oxygen, suspended solids, and/or accretion rates will be monitored at defined distances from the dredging activities to verify that excessive sediment suspension is avoided;
- Overspill from dredgers or barges will be avoided;
- Cooling water discharges from the pipe-laying vessel should be operated to achieve maximum dispersion;
- Dewatering pipe orientation, diffuser design and discharge velocity will all be optimised to achieve maximum dispersion and minimal seabed disturbance from pipeline dewatering. Discharge will be through a four or six-inch diffuser positioned approximately 1 m above the seabed, to reduce the speed of water flow as it exits the pipe in order to reduce turbidity and possible creation of sediment plumes;
- Pumped discharge of sediment back in to the trenches will be carefully targeted with the outlet as close as practicable to the trench bottom to ensure the majority of sediment is contained within the trenches; and
- Rock placement and seabed intervention will be kept at the practical minimum to ensure pipeline stability and safety. This also has the benefit of minimising impacts to sensitive biotopes.

Monitoring

Ecological monitoring is necessary to verify the predicted impacts of pipeline installation, to demonstrate the efficacy of mitigation and to document the recovery of impacted receptors from temporary impacts. Monitoring programmes will be designed to interface with surveys carried out for the Project, to ensure inter-comparability of pre and post-construction data.

An environmental monitoring plan has been developed for the Russian national EIA process, as required by Russian regulations, comprising construction and post construction monitoring of water, sediments, plankton (including phytoplankton, zooplankton and ichthyoplankton), benthos, fish, birds and mammals. The precise details (e.g. location of sampling stations etc.) may need to be revised in future, but in principal, this will form the basis for monitoring in the Russian sector. If impacts are detected during construction, additional post-construction monitoring will be developed by the Project. Monitoring may be required not only for the receptor but also the Project aspects that have the potential to generate impacts. Monitoring will therefore comprise:

- In-field monitoring of relevant receptors; and
- Monitoring of the implementation (and therefore effectiveness) of mitigation measures and management controls.

The ESIA Report has identified the following key components for which monitoring will be required.

- Water column monitoring: In order to verify the predicted impacts of sediment re-suspension, a variety of physical and chemical parameters, including but not limited to suspended solids and pollutants, will be monitored during and post-construction;
- Sediment monitoring: Key sediment characteristics will be monitored during and post construction to verify the predicted seabed impacts. Parameters will include geological and ecological variables such as particle size distribution and the presence of hydrocarbons and heavy metals;
- Plankton: Plankton monitoring is stipulated in the Russian EIA Report, though this ESIA Report has determined there is no scope for significant impacts. Nonetheless, such monitoring may have some value in better understanding the variability of the receiving environment;
- Benthic communities: Monitoring of benthic communities is fundamental to the Project's Overarching Environmental and Social Monitoring Programme, as this is the principal marine ecological receptor. Monitoring during and post-construction will allow verification of predicted impacts and an assessment of the degree and speed of recovery of impacted areas. Monitoring will also be designed to account for seasonality and be of sufficient duration to allow for longer term variations;
- Fish: Monitoring of fish populations during and post-construction will be carried out to determine the state of local populations. Species of conservation importance, including rare and endemic species and subspecies are of particular interest in this regard;
- Seabirds: Monitoring of seabird distribution during and post-construction will be carried out to determine the state of local populations and their distribution. While the Russian EIA Report stipulates monitoring during construction, additional longer term research will deliver a greater understanding of the status of seabird populations and the importance of the Project Area to them; and

- Marine Mammals: Monitoring of cetaceans during and post-construction will be carried out to verify the extent of impacts, particularly with respect to underwater noise. Because of their conservation status, additional research –based monitoring is appropriate (see below).

Biodiversity monitoring will be integrated into the Project's overall Environmental and Social Management System (ESMS). In this way, the results of the program can be clearly linked to management actions and the results used to evaluate the effectiveness of its mitigation strategy. This is in line with IFC Performance Standard 1, which emphasizes a "plan, do, check and act" management system. Further detail is provided in the Project's Environmental and Social Management Plan (ESMP) described further in **Chapter 22 Environmental and Social Management**.

In addition, because critical habitat has been identified for certain pelagic fish, seabirds and cetaceans, there is an additional requirement for biodiversity monitoring. South Stream Transport's mitigation strategy, which will be designed to comply with IFC PS6 and to achieve net gains, must be described in a Biodiversity Action Plan (BAP). Once a sufficient Biodiversity (or Ecological) Management Plan (BMP) is in place, that adequately describes on-site mitigation measures, the BAP need only describe the plans to achieve net gains. One of the common ways in which projects deliver biodiversity benefits is the use of offsets. However, in this instance, where a biodiversity offset is not part of the mitigation strategy (partly due to the absence of significant residual impacts, and partly due to the difficulty in securing a marine offset), net biodiversity gains will be obtained by identifying additional opportunities to enhance habitat and protect and conserve biodiversity. The implication of this for the Project's Overarching Environmental and Social Monitoring Programme, particularly for fish, birds and mammals, is that it must be appropriately designed to meet research objectives that enhance knowledge to the point that conservation measures can be tangibly improved. The scope of such programmes will be developed in consultation with relevant parties to ensure the maximum benefit is delivered.

The Project will produce a Biodiversity Action Plan (BAP) which will include the mitigation strategy for identified critical habitats. The BAP is currently being produced and will include all relevant parties and stakeholders identified to help achieve net gain. Further information on the likely scope and implementation of the monitoring programme is provided in **Chapter 22 Environmental and Social Management**.

12.5.2.4 Residual Impacts: Construction and Pre-Commissioning

The residual impacts of the Project Construction and Pre-Commissioning phases are detailed in Table 12.30. Mitigation designed into and applied to the Project will reduce the majority of impacts to marine ecological receptors to **Low** or **Not Significant**. Not significant impacts relate either to very localised and infrequent activities, or to those impacts that are within the limits of the natural variability of the system and thus effectively undetectable. These impacts, which are not considered further, comprise the following:

- Seawater abstraction for cooling water purposes will have no appreciable impact on sensitive receptors;

- Any disturbance arising during inspection surveys etc. is of a very small spatial extent and duration and is thus insignificant. The same holds true for maintenance inspections of the operational Pipeline;
- Installation of test heads is a brief activity of very limited spatial extent and involves no appreciable discharges or disturbance;
- Turbulence from dynamic positioning of vessels will be localised to such a degree that the impact will be insignificant; and
- Disturbance and waste generation from a series of small scale, brief construction activities such as welding of well heads, raising pipe ends for tie-ins etc. are not significant.

A conservative and precautionary approach has been adopted in this assessment leading to some possible exaggeration of the significance of potential impacts, in order to ensure that sensitive marine ecological receptors are protected as far as practicable. Nonetheless, residual impacts to key benthic receptors are assessed as low:

- Excavating the nearshore approach trench and tunnel exit pit will lead to the loss of benthic habitat of different types and potentially generate suspended solids. Benthic habitats and their associated biota will experience a **Low** significance impact, as a result of their regenerative ability and the limited extent of the impacts; and
- Pipe-laying (and the associated anchor footprint of the pipe-laying vessel) will have a **Low** significance impact on soft substrate benthic habitats. No highly sensitive habitats exist along the pipeline alignment seaward of the tunnel exit.

Similarly, trench backfill, post-lay trenching and seabed intervention will have a **Low** significance impact on soft substrate.

Because underwater noise is above background levels, it is considered a low magnitude (as opposed to negligible) impact. The impact to highly sensitive cetaceans from underwater noise has therefore been assessed as of **Moderate** significance before mitigation, based on strict application of the significance matrix (Table 12.33). Because noise cannot be attenuated to negligible levels, the residual impact on cetaceans, after mitigation is still of **Moderate** significance according to the matrix. However, this is not compatible with the definition of "moderate impacts" in Table 12.34, i.e. *"result in lasting changes to baseline conditions, which may cause hardship to or degradation of the resource / receptor, although the overall function and value of the resource / receptor is not disrupted*." As previously described, modelling of the acoustic impact of the construction spread has shown that sound is unlikely to cause mortality or injury to marine mammals and likely to only affect a group of localised individuals over a short time without affecting the overall population. This degree of impact is consistent with the definition of **Low** significance because, though changes are detectable, they are very short term (no more than a few days duration) and *"not expected to cause hardship, degradation, or impair the function and value of the resource / receptor."* It is therefore considered appropriate to rank the significance of the impact as **Low**.

A summary of the potentially significant impacts (i.e. those other than **Low** or **Not Significant**), showing receptor sensitivity, impact magnitude, proposed mitigation and residual impact significance is given in Table 12.38.

Table 12.38 Assessment of Impacts: Construction and Pre-Commissioning

Activity	Potential Impact	Receptor(s)	Receptor Sensitivity	Impact Magnitude/ Likelihood	Pre-Mitigation Impact Significance	Mitigation Measures	Residual Impact Significance
Mobilisation of vessels to/from site and vessel movements within construction zone. Delivery of pipe and other supplies by supply vessel, including crew changes. Vessel routine operations (including propulsion, cooling water, water maker).	Physical disturbance of animals at sea surface (as distinct from acoustic effects) and possible collision risk.	Marine mammals	High	Low	Moderate	Trained MMO and specific protocols for mammal and bird interactions in the contractor's management plan. Will include: • Minimise unnecessary vessel movements. • Reduce vessel speed where mammals may be present. • Avoid aggregations of birds and mammals.	Low, direct, short term
		Seabirds	Moderate to High	Low	Moderate		Low, direct, short term
Inspection, welding and weld-testing of pipe.	Birds (particularly those that migrate at night) may be attracted to lights and suffer damage as a result of collisions with vessels.	Seabirds	Moderate to High	Low	Moderate	Remove unnecessary illumination, reduce light intensity and shield light sources during the most active migration period for birds.	Low, direct, short term

Continued…

Activity	Potential Impact	Receptor(s)	Receptor Sensitivity	Impact Magnitude/ Likelihood	Pre-Mitigation Impact Significance	Mitigation Measures	Residual Impact Significance
Dredging of microtunnel exit pit/nearshore pipeline trench and storage of dredged material Trench backfill and post lay trenching (for main pipe-lay and intervention works) Rock dumping (for main pipeline and seabed intervention works)	Seabed disturbance and rock placement will lead to direct displacement or loss of benthic communities as well as changes in the physical nature of the seabed that affect the distribution of benthos. Resettling material may smother benthos, affecting the ability of invertebrates to feed.	Soft substrate benthos	Moderate	Low	Moderate at worst	Where dredging is required, the choice of dredger will be made to minimise sediment re-suspension (within engineering constraints). A chute, to deposit sediment close to the seabed to minimise turbidity, will be used. Additional turbidity reduction measures will be used where practical, particularly where sediment is to be temporarily re-deposited in nearshore storage areas. Avoid overspill from dredgers. Post-lay trenching techniques will be used that will minimise disturbance to the seabed Seasonal restriction (May) on coastal works to protect spawning fish.	Low, direct and indirect, medium term
Laying pipe on seabed, including by S-Lay method (30-600 m water depth), including abandon pipeline to seabed at 600 m water depth and recovery to J-Lay vessel Laying pipe on seabed by J-Lay method (over 600 m water depth)		Benthic invertebrates	Moderate	Low	Low		Low direct and indirect, medium to short term

Continued…

Activity	Potential Impact	Receptor(s)	Receptor Sensitivity	Impact Magnitude/ Likelihood	Pre-Mitigation Impact Significance	Mitigation Measures	Residual Impact Significance
	Suspended material may temporarily and locally reduce the light available to macrophytes.	Macrophyte stands	High	Low	Moderate		Low direct and indirect, medium term
	Resettling material may smother benthos, reducing photosynthesis.						
	Suspended material may temporarily and locally affect fish respiration as well as predator/prey interactions, particularly for fish that rely on sight to feed or avoid predation.	Fish	Moderate to High	Negligible to Low	Moderate at worst		Low, direct and indirect, medium term, some possible positive impacts of habitat creation

Continued...

Activity	Potential Impact	Receptor(s)	Receptor Sensitivity	Impact Magnitude/ Likelihood	Pre-Mitigation Impact Significance	Mitigation Measures	Residual Impact Significance
	Rock placement may create artificial reef which may provide suitable habitat for fish. Dredging may expose otherwise inaccessible prey to fish.						
	Noise may cause behavioural changes over a limited area	Fish	Moderate	Low	Low	Trained MMO and specific protocols for mammal and bird interactions in the management plan. Will include: Minimise unnecessary vessel movements. Reduce vessel speed where mammals may be present. Avoid aggregations of birds and mammals.	Low direct, short term
	Noise may cause low level behavioural changes over a wide area. Possible temporary auditory impairment in direct proximity to activity (within 20 m).	Marine Mammals	High	Low	Moderate		Low (see text in Section 12.5.2.4) direct, short term

Continued…

Activity	Potential Impact	Receptor(s)	Receptor Sensitivity	Impact Magnitude/ Likelihood	Pre-Mitigation Impact Significance	Mitigation Measures	Residual Impact Significance
Seawater abstraction for hydrotesting	Entrainment of animals with water intake	Fish	Moderate to high	Low	Moderate	Water intakes will be designed to minimise seabed disturbance and impingement or entrainment of marine organisms by appropriate positioning and reduction of the velocity of the intake. Use of intake screens	Low, direct, short term

Complete.

12.5.3 Assessment of Impacts: Commissioning and Operational Phase

12.5.3.1 Introduction

Because the scope of activities associated with the operational and commissioning impacts is small in comparison with the Construction and Pre-Commissioning Phase, the number of receptors is limited to those that might be affected by the continued presence of the Pipeline on the seabed or be disturbed by inspection and maintenance activities. Essentially this comprises the seabed communities in deeper water where the pipe will not be trenched and the fish associated with those benthic communities, as well as seabirds and marine mammals.

Inspection activities may generate small amounts of ship wastes as described in Section 12.5.2, though to a lesser degree. All vessel discharges and wastes will be compliant with MARPOL and national regulations thus will have a negligible impact and are not considered further.

12.5.3.2 Assessment of Potential Impacts (Pre-Mitigation)

Benthic Habitats

The physical presence of the Pipeline may alter local hydrodynamics and sediment transport, with secondary impacts to benthic communities (similar in nature to those described above but much reduced in extent). This will be a highly localised effect, and will decrease over time as the seabed reaches its new equilibrium. The fact that seaweed stands are confined to the area where the Pipeline will be buried eliminates the possibility of impact to highly sensitive benthic communities.

The pipelines and associated seabed intervention will provide hard substrate in areas where such is absent and act as an artificial reef that will be colonised by sessile biota. This may therefore increase the habitat and species diversity locally and have a limited positive effect.

It is thus considered that the effects of the presence of the operational Pipeline on benthic communities is long term and of low magnitude and **Low** significance prior to mitigation and may provide localised benefits.

Fish

The pipelines and associated seabed intervention will provide hard substrate in areas where such habitats are absent and so will act as an artificial reef and/or fish aggregation device. This is partially due to the shelter provided by the pipe structures themselves and partially due to the colonisation of the concrete coated pipe and seabed intervention by epifauna on which fish feed. This phenomenon has been observed on numerous pipelines and is exploited by fishermen in some parts of the world (e.g. the North Sea).

However, because most of the Pipeline will be in areas where fish do not occur, the effects of the presence of the operational Pipeline on fish will be long term and of negligible magnitude and **Low** significance prior to mitigation.

Seabirds

Pipeline inspection and maintenance will involve some vessel movements. The limited frequency and extent of such activities means that any interaction with seabirds will be minimal. This therefore considered a negligible magnitude impact of **Low** significance at worst prior to mitigation.

Marine Mammals

As with seabirds, vessel movements (including vessel noise) associated with Pipeline inspection and maintenance is a low magnitude impact of **Moderate** significance prior to mitigation.

Alien Species

As with construction, vessel movements during the Operational Phase have the potential to inadvertently introduce non-native species, though this is exceptionally unlikely given the limited duration and frequency of vessel deployment for inspection and maintenance. Despite its low probability of occurrence, the possibility of population or community wide effects makes this a **High** significance impact prior to mitigation, for all marine ecological receptors.

12.5.3.3 Mitigation and Monitoring

Given the limited scope of operational impacts of the Pipeline compared with those identified in association with the Construction and Pre-Commissioning Phase, mitigation is limited to a subset of the measures described above for management for vessel movements and operations etc. during inspection and maintenance, specifically:

- A qualified MMO will be present to assist in managing mammal interactions;
- Vessel movements during inspection and maintenance will be kept to a practical minimum to minimise disturbance to marine mammals and seabirds;
- Vessels will not approach animals unless it is not possible to avoid doing so;
- Vessel wastes will be managed as per the construction phase, compliant with MARPOL, Bucharest Convention and National regulations (see Section 12.5.2.3); and
- Similar vessel management and controls will apply to inspection and maintenance boats as for construction vessels, to minimise the risk of accidentally introducing non-native organisms.

Operational monitoring will be integrated into the Project's Overarching Environmental and Social Monitoring Programme, as developed for the Russian national EIA previously outlined and detailed in the Project's ESMP.

12.5.3.4 Residual Impacts: Commissioning and Operational Phase

The limited scope of operational and commissioning impacts compared to those identified for the Construction and Pre-Commissioning Phase means that no significant residual impacts are expected following the implementation of the above mitigation measures. The potential operational effects, their mitigation and residual impacts are summarised in Table 12.39.

Table 12.39 Assessment of Impacts: Commissioning and Operational Phase

Activity	Potential effect	Receptor	Sensitivity	Magnitude	Pre-mitigation impact significance	Mitigation measures	Residual Impact significance
Maintenance / repair to pipelines (including span correction, etc.)	Physical and acoustic disturbance and possible collision risk.	Marine mammals	High	Low	Moderate at most	Trained MMO and specific protocols for mammal and bird interactions in the contractor's management plan. Will include: • Minimise unnecessary vessel movements. • Reduce vessel speed where mammals may be present. • Avoid aggregations of birds and mammals.	Low, direct, short term

12.5.4 Assessment of Impacts: Decommissioning Phase

12.5.4.1 Introduction

Decommissioning of the South Stream Pipeline will be carried out according to prevailing international and national legislation and regulations and best practices regarding environmental and other potential impacts.

A review, and relevant studies if necessary, will be undertaken during the Operational Phase to confirm that the planned decommissioning activities utilise GIIP and are the most appropriate to the prevailing circumstances and future land use. The review will outline management controls and demonstrate that the decommissioning activities will not cause unacceptable environmental and social impacts. The decommissioning activities will also require all relevant approvals and authorisations from the Russian Government departments responsible at the time.

It must be therefore stressed that the assessment of decommissioning impacts set out below is provisional, based on current practices and technologies. It is not intended to be definitive, but may serve as a high level comparison between broad strategies.

Essentially two options are available; namely in situ decommissioning or pipe removal.

- In situ decommissioning involves cleaning the Pipeline and filling it with seawater. The receptors that might be impacted are thus the same as those for the operational Pipeline, with the additional possibility that some fish or swimming invertebrates may be entrained during pipeline flooding; and
- Removal of the Pipeline is essentially a similar operation to pipe-laying, but in reverse. The receptors and degree of impact will thus be similar to those identified for the construction phase.

The generic significant impacts that may be associated with decommissioning are summarised below, though pending the Project's decommissioning studies at the appropriate time, these are not fully assessed here.

12.5.4.2 Assessment of Potential Impacts (Pre-Mitigation)

Plankton

As with construction, it is highly unlikely that either decommissioning option will result in any appreciable effects on plankton or planktonic systems.

Benthic Habitats and Organisms

If the Pipeline is to be decommissioned and abandoned in situ, the discharge of cleaning water may result in local deterioration of water quality, alteration of hydrodynamic and resultant seabed disturbance potentially affecting the benthic community on a localised scale. Effects will be localised and no appreciable changes will accrue to ecological features.

Benthos will be disturbed by rock removal and excavation of the Pipeline in the nearshore and in some limited parts of the offshore area where seabed intervention has been required. In addition, resettling of suspended solids may cause some smothering resulting in direct mortality as well as impairing the ability of some organisms to feed, respire and photosynthesize.

Importantly, less resilient seaweed communities are predominantly confined to the area landward of the tunnel exit and may experience less severe impacts. Different areas of seabed will be impacted to differing degrees, but as with Pipeline installation it is highly unlikely that the region's overall integrity will be impacted.

Fish

The impact to fish of pipeline recovery will be variable. Small, benthic dwelling species are likely to be more severely impacted through habitat loss, loss of food resource and smothering. Re-suspension of sediments may cause damage to gills in some cases.

Noise and vibration will be generated during excavation and pipe lifting. Sound levels are likely to be similar to those generated by trenching and pipe-laying (see Section 12.5.2), thus are unlikely to cause mortality or injury to fish.

Seabirds

Seabirds may be disturbed and displaced from feeding areas by vessels, or if pipe needs to be removed from the shore crossing tunnel. Additional indirect, short term effects may occur to a localised part of the population as a result of displacement or loss of prey in the nearshore area.

Marine Mammals

Vessel movements during pipe recovery may disturb marine mammals. Collisions may also occur. However, as discussed on Section 12.5.2, these animals are generally able to avoid areas of disturbance and only a few individuals are likely to be affected.

Noise and vibration generated during excavation and pipe lifting will have similar impacts to those generated by trenching and pipe-laying (see Section 12.5.2).

12.5.4.3 Mitigation and Monitoring

In the event that the Pipeline is to be abandoned in situ, the following mitigation will reduce adverse impacts to marine ecological receptors. It must be stressed that this is an indicative list of the types of mitigation that may be applied. Evolving technology and regulatory frameworks will mean that the actual management methods may differ by the time the Pipeline needs to be decommissioned:

- Non-toxic chemical additives to be used for pipe cleaning;
- The discharge of cleaning waters will all be optimised to achieve maximum dispersion and minimal seabed disturbance;
- Seawater intakes during pipe flooding will be designed to minimise impingement and entrainment of marine organisms by appropriate positioning and minimising the velocity of the intake, as well as to minimise seabed disturbance; and

- If the pipe is to be flooded, intake screens will be used to prevent entrainment of fish and large invertebrates and minimise injury and/or mortality.

If the Pipeline is to be removed, the mitigation required will be similar in essence to that for pipe-laying described and seabed interventions, in summary:

- Where excavation of the pipe is required, the choice of equipment will be made to minimise sediment re-suspension (within engineering constraints). Additional turbidity reduction measures may also be used, particularly in more sensitive areas;
- Dynamically positioned (DP) vessels will disturb the seabed less than anchored barges, (though there is likely to be a trade off with respect to noise, as DP vessels are often noisier);
- All vessel discharges, wastes and ballast will reflect GIIP and be compliant with any international and national regulations pertaining at the time; and
- Monitoring will be required whichever decommissioning option is selected. In the event that the Pipeline is removed, a comprehensive suite of monitoring comprising decommissioning and post decommissioning monitoring of water, sediments, plankton, benthos, fish, birds and mammals will be required consistent with that developed for the Construction and Pre-Commissioning Phase.

A detailed scope for appropriate monitoring will be developed at the time of decommissioning, taking into account prevailing environmental conditions, GIIP and available technology.

12.6 Unplanned Events

The potential impacts associated with unplanned events are discussed in **Chapter 19 Unplanned Events**.

During the Construction and Pre-Commissioning Phase of the Project, unplanned events in the marine environment may occur as a result of maritime accidents involving one of more vessels. The resultant effects of these unplanned events will be limited to accidental pollution incidents involving fuel and oils which could result in a significant adverse ecological impact. The design controls that will be in place to reduce the risk of occurrence of the above potential events, as well as the mitigation measures that will be enforced to minimise the consequences associated with the events, are discussed in **Chapter 19 Unplanned Events**.

Vessel operations also have the potential to inadvertently introduce invasive alien species, either in ballast water, on the biofilm inside ballast tanks or carried as fouling organisms on the hull.

During the Operational Phase of the Project unplanned events at sea may occur as a result of accidental leakages of natural gas from the subsea Pipeline. This could be incurred by third-party vessel interaction with the Pipeline by events including sinking, grounding and anchor or dropped object (such as a container) damage to the Pipeline.

12.7 Cumulative Impacts

The cumulative impacts associated with the Project relating to marine ecology are assessed in **Chapter 20 Cumulative Impact Assessment**.

12.8 Conclusions

The Construction and Pre-Commissioning Phase of the Project has the greatest potential to impact marine ecological receptors, particularly benthic communities. Many impacts are reduced to **Low** or **Not Significant** through project design and mitigation measures, principally by careful routing and choice of dredging and trenching technology that minimises impact to the seabed and sensitive benthic communities.

Operational and commissioning impacts relate to the presence of the Pipeline on the seabed directly and indirectly affecting habitat structure, as well as disturbance due to inspection and maintenance activities. These impacts are all potentially moderate at most, prior to mitigation. Operational impacts are largely mitigated through ensuring the stability of the pipe on the seabed and through control of vessel activities during inspection and maintenance. These mitigation measures will reduce operational and commissioning impacts to marine ecological receptors to **Low** significance.

While it is not possible to fully assess decommissioning impacts at this stage, it is possible to contrast two broad strategies; namely in situ abandonment and pipe recovery. The former generates impacts broadly similar to those of the Pipeline Operational Phase, while the latter generates impacts broadly similar to the Construction and Pre-Commissioning Phase, and are thus amenable to similar mitigation strategies.

The key residual impacts to marine ecological receptors are thus as follows:

- The nearshore approach trench will lead to the loss of benthic habitat of all types and generate plumes of suspended solids. Benthic habitats and their associated biota will experience a **Low** to **Moderate** significance impact, as a result of their regenerative ability and the limited extent of the impacts;
- Pipe-laying (and the associated anchor footprint of the pipe-laying vessel) will have a **Low** to **Moderate** significance impact on benthic habitats;
- Trench backfill, post-lay trenching and seabed intervention will similarly have **Low** to **Moderate** significance impact on both shallow water and deep water seabed habitats; and
- Acoustic impacts are likely to be of **Low** significance to fish and cetaceans.

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