Chapter 8: Biological Environment

URS-EIA-REP-203876

Table of Contents

Tables

Figures

8 Biological Environment

8.1 Introduction

This chapter presents an assessment of the Project's impacts on marine biology within waters in the Turkish Exclusive Economic Zone (EEZ) of the Black Sea. The assessment considers impacts arising during the Construction and Pre-Commissioning, Operational and Decommissioning Phases. It is during construction that the majority of impacts are predicted to arise; vessel movements and physical placement of the pipeline on the seabed have the potential to disturb species, particularly as a result of noise from vessels impacting fish and cetaceans. An assessment of the potential impact on marine biological receptors from unplanned or emergency events is provided in **Chapter 13 Unplanned Events**.

Within the Turkish EEZ, faunal groups of particular interest, either due to their value or vulnerability, include a variety of commercial fish species (notably anchovy), marine mammals and birds; some species of conservation interest exist in the area. Plankton is also vital to the functioning of the marine food web and is also considered important. These are discussed further in Section 8.5.

This chapter provides a description of the baseline conditions, assessment methodology, regulatory framework, the design controls adopted by the Project, and mitigation measures required to avoid, minimise, repair or offset any significant adverse impacts 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.

8.2 Scoping

The scope of the impact assessment described in this chapter 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 between 2009 to 2013 (see Section 8.4.4). 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 were identified through a process of secondary data review and surveys undertaken for the Project (as described in Sections 8.4.2 and 8.4.4) and professional expertise;
- A review of relevant national and international legislative requirements and lender requirements to ensure legislative and policy 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 (beneficial or adverse) 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 biological environment in which the Project is proposed contains many potential receptors and is therefore an important consideration in the ESIA process. Possible receptors are diverse and include a wide variety of organisms. For the purpose of this assessment, marine biota is broadly grouped into the following topics: plankton, fish, birds 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 interest and any potential critical habitats, are discussed in terms of their importance and the potential impact that the Project may have on them.

The potential occurrence of species of conservation value (listed as Vulnerable or above) was identified using the following sources:

- International Union for Conservation of Nature (IUCN) Red List (Ref. 8.1);
- Red Data Book of the Black Sea – Black Sea Environment Programme (Ref. 8.2); and
- Red Data Book Black Sea, Turkey – Turkish Marine Research Foundation (Ref. 8.3).

8.3 Spatial and Temporal Boundaries

8.3.1 Project Phases

This chapter has appraised the potential for the activities during the construction, operation and decommissioning to have significant effects on receptors if not properly mitigated. Decommissioning is considered in less detail, because it will be the subject of a dedicated assessment near the end of the Project's life, allowing for the incorporation of prevailing technology and Good International Industry Practice (GIIP) at that time.

8.3.2 Project Boundaries

The Project Area is some 470 km in length and 2 km in width, extending along an east west orientation across the north of the Turkish EEZ from the Russia and Turkey EEZ boundary to the Turkey and Bulgaria EEZ boundary. No excavation of or filling over the seabed is anticipated. There will be no landfall facilities within the Turkish Sector. Information on the Project Area is given in **Chapter 1 Introduction**.

The Study Area, and Zone of Influence, for the biological environment has been defined so that it encompasses the area in which impacts are likely to occur in order to define a robust baseline against which to undertake the impact assessment. The Study Area for the biological environment is therefore defined as the central Black Sea encompassing the abyssal plain.

The Survey Areas refer to the locations in which surveys were conducted for the Project during the feasibility and design stages between 2009 and 2011. The locations of and information related to these surveys are shown in Figure 8.1 and Table 8.1. The Survey Areas are defined under the topic headings in Section 8.5 of plankton, benthic, fish, seabirds and marine mammals.

8.4 Baseline Data

The majority of the baseline information used to support this Chapter comes from the results of marine surveys specifically conducted for the Project in 2009 and 2011 (Ref. 8.4). However, secondary data sources (e.g. published literature) were also consulted to provide background information.

8.4.1 Methodology and 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 studies and surveys to collect additional primary data were specified. This is discussed in Section 8.4.2 to 8.4.4.

8.4.2 Secondary Data

Where possible, this assessment is based on primary data. However, a number of secondary data sources were consulted to inform the baseline of this chapter, as described below:

- Survey reports (Ref. 8.4) produced by Peter Gaz for the South Stream Offshore Pipeline included a review of published scientific literature that has been incorporated into this baseline as appropriate;
- Recently published scientific literature which was identified through a British Library data search;
- The Red Data Book of the Black Sea was consulted in order to identify the potential presence of species within the Study Area (Ref. 8.2) as well as international conventions such as the Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic area (ACCOBAMS) (Ref. 8.5); and
- Information on fish and historic changes in the Black Sea flora and fauna are found in the Black Sea Commission "State of the Environment" reports (Ref. 8.6 to 8.9).

8.4.3 Data Gaps

After a review of the data including 2009 and 2011 survey results and available literature, several data gaps were identified. These included data gaps relating to fish and migration and benthic habitats. The data gaps were addressed through primary data gathering and baseline surveys as discussed in Section 8.4.4.

8.4.4 Primary Data and 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.

Table 8.1 Marine Ecology Surveys (2009 and 2011)

Receptor	Sampling method	Jun 2009	Sep to Oct 2011
Phytoplankton	Niskin bottle.*	10 stations at 3 depths: Surface: 0 m; Mid-water: between 5 to 50 m; and Bottom: between 60 to 120 m.	15 stations at 3 depths: Surface: 0 m; mid-water: between 5 to 50 m; and Bottom: between 60 to 120 m.
Primary Production	Light-and-dark-bottle method.** Light intensity at depth measured with a Secchi disk.†		
Zooplankton	Towed Juday net, 0.5 metres per second (m/s) speed. Mesh size of 180 µm.		
Ichthyoplankton	Horizontal hauling (at the surface) in the course of the turning circle of the vessel for 10 minutes at a speed of 2.5 knots. Vertical hauling (from 150 m to 0 m). When the net reached the desired depth, it was hauled at a speed of no more than 1.25 m/s.	10 stations	15 Stations

Continued…

Receptor	Sampling method	Jun 2009	Sep to Oct 2011
Birds and marine mammals	Observations were carried out visually, in the day-time. The observations were conducted along transects by the snapshot method (Gould, Forsell, 1989 in Ref. 8.4) in a forward and perpendicular direction from one side of the vessel and a visual plot 300 x 300 m was selected, within which all bird were counted within 10 to 15 seconds. The main attention was given to flying birds. During the time remaining until the end of the 300 m section, it was viewed again, as some birds sitting on the water could be underestimated in the count. Inspection was carried out with the naked eye; binocular (15x) was used if necessary to identify birds to species level. At the stations, birds were counted only at the first appearance in a radius of 300 m around the vessel. Birds accompanying the vessel were counted only at the first occurrence. The bird species, gender and age were determined as possible.	5 stations; and 6 transects.	12 stations; and 11 transects.
Marine mammals	Specific observations of species and populations of marine mammals were carried out on stations and transects along with bird-watching, in the daytime from the upper deck of the vessel.	5 stations; and 6 transects.	12 stations; and 11 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.

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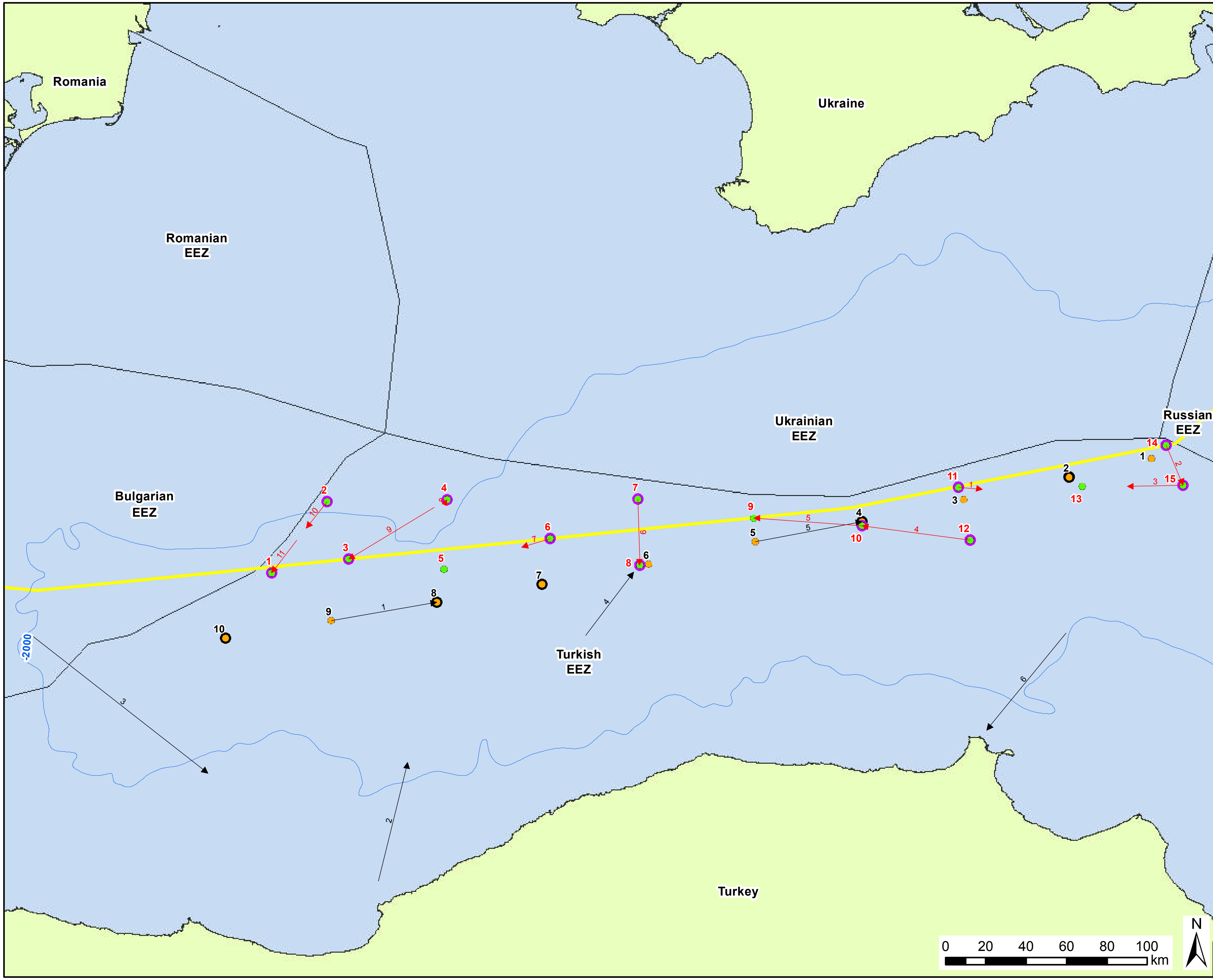

LEGEND

2010 Peter Gaz Survey Locations

- Plankton sampling locations
- Seabirds & marine mammals sampling location
- Transects for bird and mammal surveys

2009 Peter Gaz Survey Locations

- Plankton Stations
- Bird and Mammal Stations
- Bird and Mammal Transects

Turkish Sector of the South Stream Offshore Pipeline

- Proposed offshore pipelines
- 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
SAMPLING LOCATIONS FOR 2009 AND 2011 SURVEYS

Drawn	Checked	Approved	Date
JM	CP	MW	04/10/2013

URS Internal Project No.	Scale @ A4
46369082	1:2,500,000

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Drawing Number: Figure 8.1
Rev

Plot Date: 26 Feb 2014
File Name: I:\5004 - Information Systems\46369082_South_Stream\MXDs\Report Maps - Turkey\Tukey ESIA\Chapter 8\Figure 8.1 Sampling locations for 2009 and 2011 Surveys.mxd

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 Project Area, albeit at relatively low resolution.

Table 8.1 lists the marine ecology surveys undertaken in 2009 and 2011. The survey methods used for each species are discussed under the relevant topic headings. The survey sampling stations are shown in Figure 8.1.

Following a gap analysis of the data, additional analysis and studies were commissioned by South Stream Transport in 2013, namely:

- Expert analysis of Remotely Operated Vehicle (ROV) footage and side-scan sonar data collected from the pipeline route in 2011 to investigate the nature of the benthic environment and the potential presence of any microbial habitats (Ref. 8.10); and
- An in-depth review of fisheries data and interviews with fisheries stakeholders to establish information about the fish species likely to be using the waters of the Project Area (Ref. 8.11, Appendix 9.1: Fishing Study).

The key findings of these studies are presented within this ESIA chapter.

8.4.5 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 impact results of this ESIA Report are captured in the management of change process discussed in **Chapter 5 Project Description**;
- The environmental standards may evolve during the lifetime of the Project. It is not possible to predict such changes but reference to 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 description of the deep sea environment is based on acoustic data interpretation with supporting bathymetry and profile data together with ROV data along the pipeline route and this makes it subjective to a degree. However, given the absence of potentially biogenic deep sea features in the Turkish Sector, this is not considered a risk to the assessment; and

The ecology of birds, particularly seabirds, and marine mammals in the central Black Sea is not well understood (in terms of accurate details on migration, breeding etc.). Surveys undertaken for the Project give data on distribution but cannot provide this level of detail.

8.5 Baseline Characteristics

8.5.1 Black Sea Overview

The Black Sea is a semi-enclosed basin and the world's most isolated sea from any of the major world oceans. It has connections to the Mediterranean Sea through the Bosphorus Strait and the Dardanelles Strait and with the Sea of Azov in the northeast through the Kerch Strait.

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 (20-30‰), originating from the Mediterranean. This stratification, which creates a distinct and permanent pycnocline[1] around 150 to 200 m water depth, limits the vertical exchange of water between the surface and deeper waters creating a unique chemical and biological environment.

The upper water layers of the Black Sea provide a thin aerobic biotic layer. In undisturbed conditions Black Sea faunal biodiversity in this biotic layer is approximately one third that of the Mediterranean Sea because of the low salinity. However, total biomass and productivity of the Black Sea are much higher than the Mediterranean Sea because of the high input of riverine nutrients.

The lower water layer however, which accounts for as much as 87% of the Black Sea volume, is highly anoxic with high levels of hydrogen sulphide (H_2S). As these concentrations increase rapidly past 150 to 200 m water depth due to the restricted ventilation, the diversity and abundance of benthic fauna and flora decrease rapidly with increasing depth. The seabed of the deeper parts of the Black Sea is therefore unlikely to support significant macro or meiofaunal communities due to the anoxic environment (Ref. 8.12). Some protozoa and bacteria are known to inhabit the benthos and deep-sea waters. For example, in the deep anoxic shelf of the north-western Black Sea, in waters deeper than 200 m, numerous gas seeps are populated by methanotrophic microbial mats that can form tall reef-like structures (Ref. 8.13). These have, however, only been observed in the north-western area of the Black Sea. Further details are given in **Chapter 7 Physical and Geophysical Environment**.

The seabed of the Black Sea is divided into the shelf, the continental slope and the abyssal plain. The Project Area is located entirely within the abyssal plain. Importantly, the Black Sea has a very large catchment area to 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 have resulted in major environmental and ecological changes in the Black Sea ecosystem.

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

Eutrophication due to excessive nitrogen from land based sources has caused a number of adverse processes that have changed the diversity and distribution of flora and fauna throughout the Black Sea ecosystem. Eutrophication has given 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 have increased the flux of organic matter to the seabed inducing a sharp decline of dissolved oxygen and a silting of benthic communities in many coastal areas. Increased incidence of harmful algal blooms (red tides) is reported to have caused the death of many fish (Ref. 8.14).

There have been changes in zooplankton, with the loss for example of some species and a shift from larger to smaller species of crustacean. There have also been sharp increases in the number of gelatinous species such as jellyfish, although the most drastic change in the zooplankton communities has 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. 8.15), and is a direct predator of fish eggs and larvae. This situation persisted until 1997 to 1998, with another accidental introduction of the ctenophore *Beroe ovata* (Ref. 8.16). This species is the main predator of *M. leidyi* and subsequently the zooplankton community began to recover both in species composition and abundance (Ref. 8.12). The effects of these invasions are only recently showing signs of reversal.

Whilst these changes have been most pronounced in coastal waters there have been some changes in species composition in waters in the centre of the Black Sea (Ref. 8.4). Since the early 2000s the governments of the Black Sea coastal states have adopted a basin wide approach to pollution reduction and towards the strategic goal of restoring the ecological status of the Black Sea similar to that observed in the 1960's. Pollution pressure from land based sources, although still intense, shows a decreasing trend, and some improvements in ecological status have recently been observed. For example, some species that had disappeared are now found to be recovering and the number and intensity of algal blooms is reported to be lower for all areas.

8.5.2 Plankton

8.5.2.1 Background and Literature Review

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 of the open sea (the water layer exposed to sufficient sunlight for photosynthesis to occur). This zone is typically up to 200 m deep in the open ocean, but is only approximately 50 m deep in the Black Sea. Vertical distribution of plankton in the Black Sea is also influenced by the rapid decrease in oxygen below the pycnocline (Ref. 8.6).

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 in the community structure of phytoplankton 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. 8.12), hot summers and early warming of the surface layer (Ref. 8.4), damming of the Danube River, a reduction in silicate inputs (Ref. 8.14) and a reduction in inorganic nutrients allowing coccolithophorids to more successfully compete with diatoms (Ref. 8.4).

A large phytoplankton biomass provides a supply of food for the species of phytoplankton feeding zooplankton. In recent years there has been a sharp increase in the abundance of *Noctiluca scintillans, infusoria* such as *Mesodinium rubrum, scyphozoan* jellyfish and copepods such as *Oithona minuta* and *Acartia clausi* (Ref. 8.15). Many of these species are likely to be present in the waters of the Turkish EEZ.

There is little information on the specific species composition of zooplankton in the central Black Sea as most studies have concentrated on coastal areas. However, it is known that many species common in coastal waters such as the copepods *Calanus exinus* and *Pseudocalanus elongatus*, the arrow worm *Sagitta setosa*, the jellyfish *Aurelia aurita* and ctenophores such as *Pleurobranchia rhodopis* and *Mnemiopsis leidyi* are all present in the central Black Sea.

The average zooplankton biomass in central areas is very similar to coastal areas, (excluding the north-western shelf) in comparison with many other seas, including the neighbouring Mediterranean Sea. This is due to a fairly intensive vertical-exchange above the pycnocline in central areas of the Black Sea and horizontal water-exchange between central and coastal areas (Ref. 8.17). There is however, considerably less variability in spatial and temporal abundance in open waters compared to the coast. The seasonal pattern in the open ocean is also different with a peak in the summer compared to spring and autumn in coastal areas. This is due to the differences in nutrient availability and hydrological conditions.

The effect of anthropogenic nutrients observed in the Black Sea in the 1970's and 1980's, including increased primary production and changing phytoplankton community composition, were limited to coastal and shelf waters. No changes in phytoplankton communities were observed in the central basin of the Black Sea until the mid-1980s, coinciding with an onset of regional cold climatic conditions. It is generally recognised that the phytoplankton regime shift observed in the central Black Sea is due to an increase in the bottom-up flux of nutrients into the euphotic layer during cold conditions and not the impact of anthropogenic nutrients. This effect is also observed in the occurrence of winter phytoplankton blooms in the central Black Sea (Mikaelyan et al., 2013 in Ref. 8.4). In general, however, the level of productivity in the central Black Sea is much lower than in coastal and shelf waters, a fact reflected in the lack of any major fisheries in the central basin. More information on fishing activity in the Turkish EEZ is provided in **Chapter 9 Socio-Economics**.

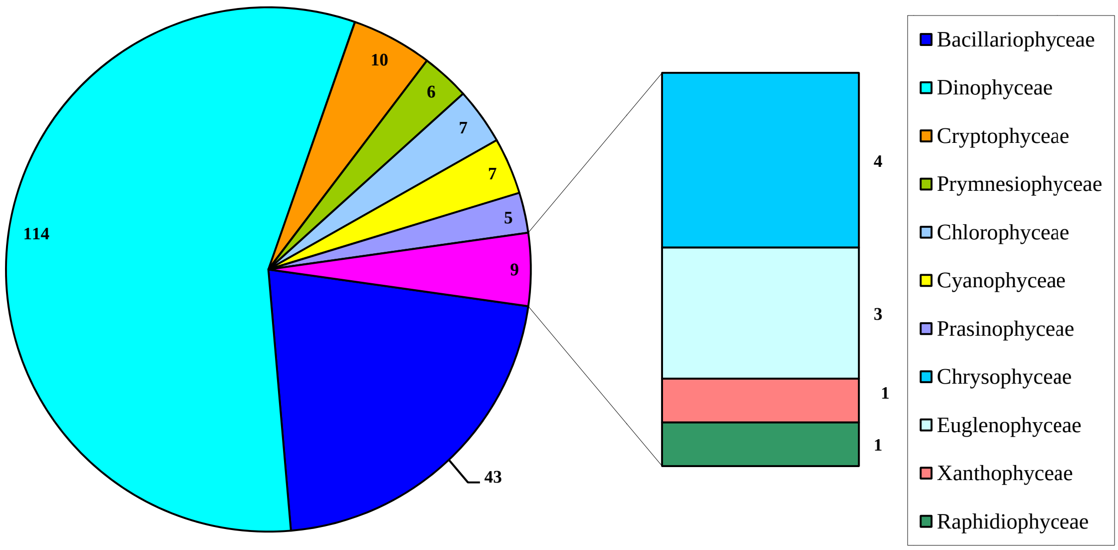
Due to the man-made and natural factors mentioned above, phytoplankton blooms changed from being isolated incidents to becoming annual or inter-annual events. The diatom *Skeletonema costatum* for instance typically undergoes a population explosion in the spring, when the number of cells may reach 1 x 10^8 cells per litre (cells/l), whereas in the 1960s the maximum did not exceed 1.8 x 10^6 cells/l (Ref. 8.15). Initially, some authors believed that these phytoplankton blooms were a positive event, because they produced an increase in biological productivity which in turn increased catches of anchovy and sprat (plankton feeding fish species). But there were other factors which may have been equally responsible for the increase in anchovy and sprat catches, namely: the reduction by that time of large pelagic predators (e.g. mackerel, bonito and bluefish), or the intensification of commercial fishing because of the greater number of fishing vessels and the use of trawls (refer to Section 8.5.4). It is likely that all of the above factors contributed to the temporary increase in the catches of small plankton-feeding fish (Ref. 8.15).

8.5.2.2 Plankton Survey

Phytoplankton

Overall, the 2009 and 2011 results are similar. Eighty three (83) species of planktonic algae were found, belonging to seven taxonomic groups observed in 2009, with dinoflagellates accounting for around 63% of all species. In 2009, dinoflagellates accounted for 56% of total species. The breakdown of the 201 species and 11 classes recorded in 2011 can be seen in Figure 8.2. Of interest is the presence of the potentially toxic algae genus Alexandrium (5 species) and the first recording in open waters of the species *Chaetoceros aequatorialis* and *Chaetoceros ceratosporum*.

Figure 8.2 Taxonomic Characteristics of Phytoplankton in the Area Surveyed in Sept and Oct 2011



Species diversity was highest in surface layers (65 to 95) and pycnocline layer (35 to 75) and lowest in waters below 100 m (13 to 28). Species composition was fairly uniform throughout the Survey Area as shown (over 70% similarity between stations). Abundance and biomass were both highly heterogeneous and highest in surface waters with diatoms and dinoflagellates accounting for 50% and 30% of the total respectively. Photosynthetic pigments were low, as indicated by high water transparency, and pigment ratios, highest at 40 to 50 m, indicative of diatom biomass dominance.

Zooplankton

The limited data available for zooplankton in the Central Black Sea shows a strong seasonal variability with biomass ranging from 2 to 4 g/m^2 in September to 16.5 g/m^2 in October. The surveys undertaken in 2009 recorded biomass values of between 2.2 and 6.8 g/m^2 and were dominated by copepods; other organisms included larvae of bivalves and polychaetes, chaetognaths (arrow worms), appendicularians (pelagic tunicates) and low numbers of ctenophores. Importantly, some individuals of the invasive ctenophores *Beroe ovata* and *Mnemiopsis leidyi* were also captured. Species composition of zooplankton in surveys undertaken in 2009 and 2011 showed a highly variable total abundance and biomass of zooplankton with between 75 to 2,040 individuals per m^3 and 13.5 to 43 miligrams per cubic metres (mg/m^3). This very patchy distribution is possibly linked to local water movements and currents and is similar to phytoplankton abundance described earlier (Ref. 8.4).

The autumn 2011 survey (Ref 8.1) showed zooplankton biomass in the range of 1.89 to 59.73 mg/m^3, a greater range than in 2009 and about half of that recorded in the Bulgarian sector of the Black Sea in September 2011. As in December 2009, the community was dominated by copepods (approximately 85% of total animals present of which 50 to 85% were *Calanus exinus*) with few large animals such as jellyfish and chaetognaths recorded but contributing most to biomass. A total of 27 taxa belonging to eight phyla were recorded including crustaceans, cnidaria, ctenophora, chaetognatha and chordate and the greatest diversity exhibited by Crustacea (14 taxa). Overall abundance and biomass distribution was similar to that recorded in 2009.

More detailed analysis of the autumn 2011 survey showed an overall dominance of cold water species (*Calanus euxinus, Pseudocalanus elongatus, Oithona similis*) and some eurythermic species (*Paracalanus parvus, Acartia clausi, Sagitta setosa, Oicopleura dioica*). Of note were a new invasive species (first discovered in large numbers in 2005 in Sevastopol Bay), *Oithona brevicornis* and the ecologically important dinoflagellate *Noctiluca scintillans* recorded in low numbers. A cluster analysis of the data showed composition as similar at all stations (most stations with a similarity of over 70%); similar distribution amongst phytoplankton reflects the relatively uniform habitat available in the waters of the central area of the Black Sea (Ref. 8.1).

Ichthyoplankton are discussed under the fish section (Section 8.5.4).

8.5.3 Benthos

8.5.3.1 Background and Literature Review

The benthic habitat of the Turkish EEZ is entirely within the Black Sea abyssal plain, where water depth varies between 2,000 and 2,200 m and the seabed is generally uniform muddy sediments. The benthic sediments are completely anoxic and high in H_2S concentrations and are unable to support the meio- and macrofauna that are observed in deep water habitats in other seas and oceans. However, microbial reefs associated with mud volcanoes or "gas seeps" are known to occur in waters deeper than 200 m but these have only been observed in some western areas of the Black Sea (Treude et al., 2005 in Ref. 8.4).

8.5.3.2 Abyssal Plain Study

A dedicated review of 2011 video and side-scan sonar survey data (Ref. 8.10), focussing on seabed features in the Survey Area. The benthic Survey Area consisted of a 1 km wide corridor either side of the centreline of the pipelines. Topography within the Project Area ranges from essentially flat (eastern section) to a complex of channel levee systems with an elevated ridge rising 50 m above the main abyssal plain. The detailed review revealed no carbonate mounds or mud volcanoes and no microbial mat communities of any kind were observed. Possible active pockmarks were observed at certain locations (**Chapter 7 Physical and Geophysical Environment**). The full study of the abyssal plain is presented in Appendix 8.2: Seabed Survey Report.

8.5.4 Fish

8.5.4.1 Background and Literature Review

Fish populations in the Black Sea have been drastically reduced as a consequence of eutrophication, overfishing and plankton reduction associated with the population boom of *Mnemiopsis leidyi*, as discussed in Section 8.5.1. Additionally, the number of fish species sharply decreases with the increase in water depth as waters become anoxic below approximately 150 m depth restricting the vertical distribution of organisms, as well as bottom-living fish species (Ref. 8.12). There are no bottom dwelling or demersal fish species within the Project Area because at the abyssal plain conditions are anoxic and high in H_2S concentration.

Sprat (*Sprattus sprattus*), Black Sea horse mackerel (*Trachurus mediterraneus ponticus*), and the European anchovy (*Engraulis encrasicolus*) populations all collapsed in the 1990's, though recently there have been some signs of recovery. Populations of larger pelagic fish such as tuna (*Thunnus thynnus*), swordfish (*Xiphias gladius*), and chub and Atlantic mackerel (*Scomber colias* and *S.scombrus*) have also substantially declined (Ref. 8.7). Of these species, the chub and Atlantic mackerel and tuna are listed as endangered on a regional level in the Red Data Book of the Black Sea, Turkey and the swordfish is listed as critically endangered on a regional level (Ref. 8.3).

A recent review of the Turkish Black Sea fish fauna (Ref. 8.18) showed that Atlantic and Mediterranean species comprised 62% of the total species, 7% were cosmopolitan or commonly found around the world, 29% were endemic to the Black Sea and 2% were introduced species such as haarder or so-iuy mullet (*Liza haematocheilus*), barracuda (*Sphyraena obtusata*) and Atlantic salmon (*Salmo salar*).

The most common species likely to be present in the surface waters of the Turkish EEZ include sprat, anchovy, Black Sea garfish (*Belone belone euxini*), three-spined stickleback (*Gasterosteus aculeatus*), Black Sea pelagic pipefish (*Syngnathus schmidti*), golden grey mullet (*Liza aurata*), leaping mullet (*Liza saliens*), flathead mullet (*Mugil cephalus*), haarder or so-iuy mullet, bluefish (*Pomatomus saltatrix*), Black Sea horse mackerel, Atlantic bonito (*Sarda sarda*) and chub mackerel. Of these species, the Black Sea garfish and Black Sea pelagic pipefish are endemic whilst all other species are cosmopolitan. The Black Sea garfish is listed in the Red Data Book of the Black Sea (Ref. 8.2) as endangered whilst the chub mackerel is listed as endangered on the Red Data Book of the Black Sea, Turkey as endangered (Ref. 8.3).

Pelagic spawners, such as mullets, are usually only present offshore during the breeding season (summer) and generally frequent shallower waters (Ref. 8.18). There is very limited data on the occurrence of fish in the waters of the Central Black Sea. However, considering the lack of fisheries in these areas and the low levels of productivity of plankton, the density of fish is not likely to be particularly high and will be limited to pelagic species such as sprat, anchovy and horse mackerel.

8.5.4.2 Ichthyoplankton Survey and Fisheries Study

No dedicated fish surveys were undertaken for the Project. However, ichthyoplankton surveys were undertaken in 2009 and 2011 which, although not comparable to dedicated fish surveys, are considered a good indicator of fish species that may be present in the waters of the Turkish EEZ.

In December 2009, catches at the ten stations consisted of the eggs of one species; sprat (*Sprattus sprattus*). Sprat spawns from October to March in the northern shelf areas of the Black Sea, which coincides with the timing of the survey. Juvenile fish were represented by only one species; whiting (*Merlangius merlangus*), observed at two stations (Stations 4 and 7). Some by-catch in plankton nets included yearlings and adults of Black Sea pelagic fish species and are shown in Table 8.2. The Black Sea pelagic pipefish was the most numerous species caught during these trawls.

Table 8.2 Species Composition of Black Sea Pelagic Fish Species Caught in 10 Ichthyoplankton Trawls in the Project Area in December 2009

Latin name	Common name	IUCN Red List	Number of Individuals	Biological Status (stage of maturity of the gonads)
Engraulis encrasicolus	European anchovy	Not listed	2	Yearling
Gasterosteus aculeatus	Three spined stickleback	Least concern	4	Sexually mature individuals
Merlangius merlangus	Whiting	Not listed	2	Juveniles
Mugil cephalus	Striped (flathead) mullet	Least concern	1	Yearling
Sprattus sprattus	Sprat	Not listed	7	Sexually mature individual
Syngnathus schmidti	Black-Sea pelagic pipefish	Not listed	13	Sexually mature individuals

In the autumn 2011 (September to October) ichthyoplankton survey in the Turkish EEZ (Ref. 8.4), four species of fish were obtained using vertical and horizontal hauls from 15 stations. Eggs, larvae and juveniles of anchovy, sprat and Black Sea pelagic pipefish were observed in vertical hauls, and sprats, Black Sea pelagic pipefish and Black Sea horse mackerel in the horizontal hauls (Table 8.3 and Table 8.4).

Table 8.3 Composition, Frequency of Occurrence and Average Abundance of Ichthyoplankton from Vertical Hauls in the Turkish EEZ Central Black Sea September and October 2011

Species	Eggs		Larvae		Juveniles	
	No. of Stations	Average Abundance (ind/m^3)	No. of Stations	Average Abundance (ind/m^3)	No. of Stations	Average Abundance (ind/m^3)
Anchovy	2	0.0040	4	0.0120	0	0
Sprat	1	0.0015	1	0.0013	0	0
Black Sea pelagic pipefish	1	0.0667	0	0	1	0.0012
Black Sea horse mackerel	0	0	0	0	0	0
Average for survey	**-**	**0.0703**	**-**	**0.0135**	**-**	**0.0012**

Table 8.4 Composition, Frequency of Occurrence and Average Abundance of Ichthyoplankton from Horizontal Hauls in the Turkish EEZ Central Black Sea September and October 2011

Species	Eggs		Larvae		Juveniles	
	No. of Stations	Average Abundance (ind/m^3)	No. of Stations	Average Abundance (ind/m^3)	No. of Stations	Average Abundance (ind/m^3)
Anchovy	4	0.0011	13	0.0369	3	0.0009
Sprat	0	0	0	0	0	0
Black Sea pelagic pipefish	0	0	1	0.0005	1	0.0002
Black Sea horse mackerel	1	0.0002	0	<0.0001	1	0.0002
Average for survey	**-**	**0.0007**	**-**	**0.0277**	**-**	**0.0009**

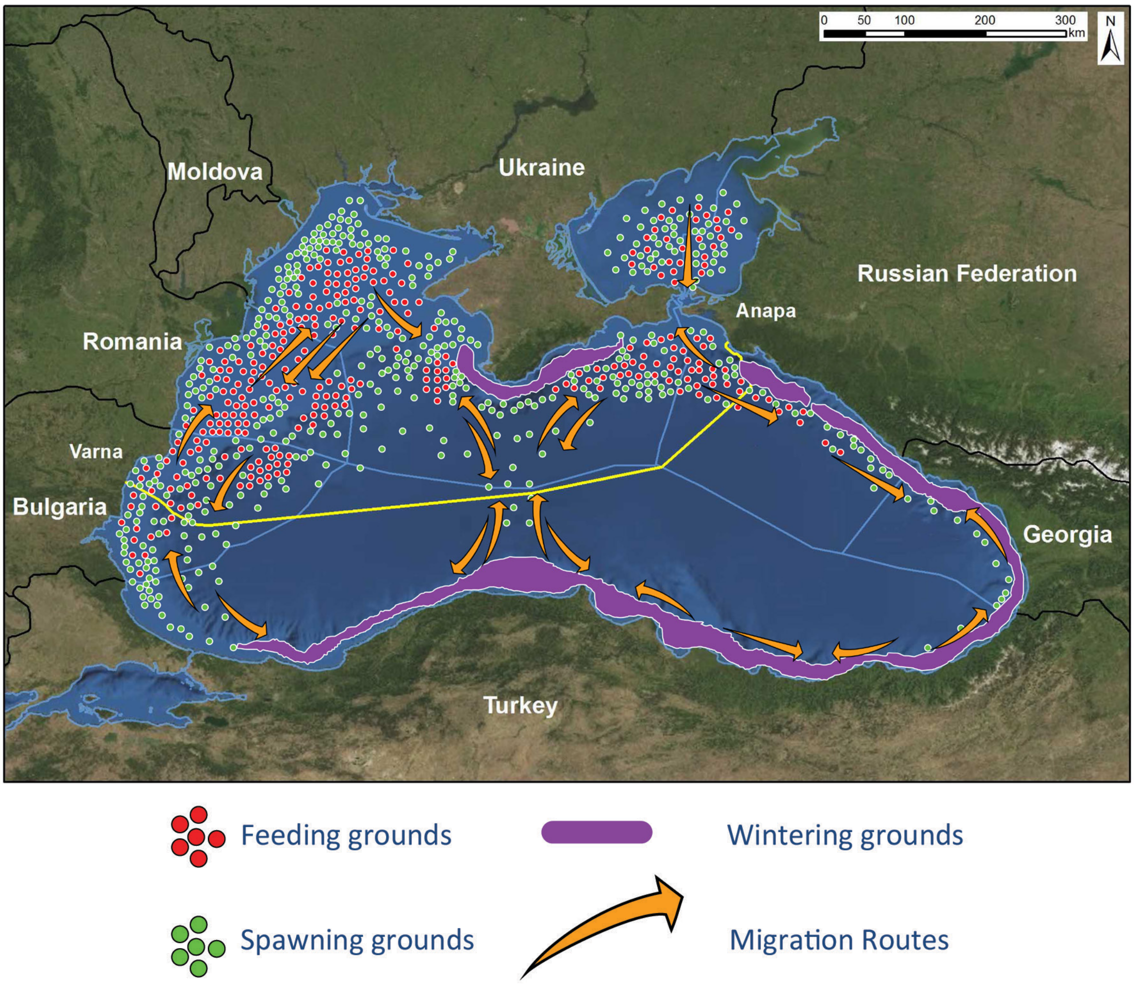
The distribution of these stages (eggs, larvae, juveniles), however, was very patchy with the stages of most species only observed at a few stations. Only the larvae of anchovy were widespread, being observed at 13 out of 15 stations sampled by horizontal hauls, albeit in low abundance. In these horizontal hauls anchovy larvae made up about 80% or more of the total abundance of ichthyoplankton (Ref. 8.4).

In the composition of ichthyoplankton, fish larvae dominated both in numbers and biomass. Eggs and larvae of anchovy were dominant. The results of the 2009 and 2011 surveys (Ref. 8.4) indicate that the abundance and biomass of the ichthyoplankton is low, particularly when compared to data from coastal regions (Ref. 8.4). Whilst the larvae of anchovy were the most abundant ichthyoplankton, and the most widespread, being observed in most of the areas sampled, abundance across the area was very low. The main spawning and feeding grounds for anchovy occur in the north-western and western continental shelf of the Black Sea, along the coastal waters of Bulgaria, Romania and Ukraine (Ref. 8.19). In addition to anchovy preference for shelf areas, the central Black Sea has much lower levels of productivity and consequently less availability of zooplankton prey for the developing larvae. Of all species caught in ichthyoplankton trawls, the Black Sea Pelagic Pipefish is the only species listed in the Red Data Book of the Black Sea, Turkey (Ref. 8.3).

The following information is taken from the Fishing Study provide in Appendix 9.1. Demersal fishing takes place along Turkey's coastline in water depths of up to around 100 to 150 m, after which anoxic conditions prevent the occurrence of demersal species. Therefore, benthic or demersal species of fish will not occur within the Project Area and only pelagic species are likely to be found although the larvae of some demersal species may be found. The four small pelagic species of importance, both in terms of quantity caught and economic value, caught in Turkish waters of the Black Sea are European anchovy, sprat, Black Sea horse mackerel and Atlantic bonito with anchovy accounting for over 60% of the catch in Turkish waters. Other pelagic species such as bluefish, scad (*Decapterus macarellus*) and European pilchard are caught in quantities that represented less than 3% of the total catch in 2011 and are therefore considered less important for this ESIA Report (Ref. 8.11). The Fishing Study (Ref. 8.11) also considered the potential interaction of fish migration routes and spawning, feeding or wintering grounds with the Project activities. The migration route of the anchovy is of greatest relevance to the Project, as it crosses the Black Sea and passes through the Project Area. The migratory routes, spawning and feeding areas of other pelagic species in the Black Sea do not occur near the Project Area.

European anchovy are distributed throughout the Black Sea with the main spawning and feeding grounds along the coastal waters of Bulgaria, Romania, Ukraine and the Russian Federation (Ref 8.20). Spawning occurs between May and August over continental shelf areas (Ref. 8.21) with the main spawning areas on the north-western and western shelf of the Black Sea (Ref. 8.19). The main feeding and growth seasons are also in the summer months. They winter in the coastal waters of Turkey and Georgia. Anchovy display two seasonal migrations as shown in Figure 8.3.

Figure 8.3 Migratory Routes, Spawning Grounds and Feeding Grounds of Anchovy (*Engraulis encrasicolus*) in the Black Sea (Ref. 8.20, Ref. 8.21)



A southward migration occurs between October and November through the Black Sea and along coastal waters to the Turkish and Georgian coasts (Ref. 8.19 and Ref. 8.21). In the spring, anchovy migrate from southern coastal wintering grounds to spawning areas in the north-western Black Sea. These migration routes pass through the Black Sea from northern coasts to southern coasts, and back again, and therefore will pass through the Project Area. This migration corridor is thought to be approximately 125 km in width (Figure 8.3). However, the exact timings of these migrations are understood to vary year to year, and up-to-date information is not available. Other pelagic species which undergo migrations within the Black Sea include sprat, Black Sea horse mackerel and Atlantic bonito. However, these species do not migrate through the Project Area or the Turkish EEZ. A summary of the biology of the main migratory species in the Turkish EEZ is given in Table 8.5.

Table 8.5 Summary of Fish Species Likely to be Present in the Turkish EEZ

Species	**Anchovy** (*Engraulis encrasicholus*)	**Sprat** (*Sprattus sprattus*)	**Black Sea horse mackerel** (*Trachurus mediterraneus ponticus*)	**Atlantic bonito** (*Sarda Sarda*)
Demersal or pelagic	Pelagic	Pelagic	Pelagic	Pelagic
Preferred habitat	Coastal species, enters lagoons, estuaries and lakes for spawning.	Inshore, occasionally entering estuaries (especially juveniles).	Distributed across the whole Black Sea, usually near bottom in 50 to 100 m depths, also in surface waters.	Epipelagic, neritic, occasionally enters estuaries.
Spawning season	May to August, peaks middle of June to end of July.	Mainly spring and summer	Summer	May to July
Spawning characteristics	Mainly in northwest area but also to the South within Turkey's EEZ. Pelagic multiple spawners, temperature dependent. Females can spawn over 50 times per year.	Open sea, between depths of 10 to 20 m. Eggs pelagic, juveniles distributed over larger area near the surface, young drifting inshore.	Spawning success negatively correlated to sea surface temperature. Eggs pelagic.	Enter from Sea of Marmara to spawn. Eggs and larvae pelagic.
Effects of noise	Moderate: probable hearing specialists may affect migrations.	Highly sensitive to low frequency sounds.	Moderate: hearing specialists.	Moderate: possible hearing specialist

Continued…

Species	**Anchovy** (*Engraulis encrasicholus*)	**Sprat** (*Sprattus sprattus*)	**Black Sea horse mackerel** (*Trachurus mediterraneus ponticus*)	**Atlantic bonito** (*Sarda Sarda*)
Migration	October to November. Migrates through the Black Sea and along coasts from North western spawning and feeding grounds to wintering grounds along the Turkish and Georgian coasts. Reverse migration in the spring.	Seasonal migrations between winter feeding inshore and summer spawning offshore grounds.	Highly migratory species through Black Sea. Migrates north in mid-April, for reproduction and feeding. September to November migrates south along Bulgarian coast towards Anatolian and Caucasian coasts.	Highly migratory, enter Black Sea between April and August to spawn and feed, reverse migration on autumn. Juveniles migrate along southern coats of Black Sea and winter there.
Diet	One of the main consumers of zooplankton.	Feeds on planktonic crustaceans.	Other fish including sardine, anchovy and small crustaceans.	Cannibalistic, also feeds on small schooling fishes and invertebrates.
Notes	Most important stock in Turkish EEZ in terms of amount and value of annual landings. Important role as prey species. Tolerates high range of salinities.	Can tolerate wide range of salinities. Sprat fishing by pelagic trawls is only permitted along the Samsun Shelf.	All Black Sea horse mackerel treated as a unit stock but consists of four local sub-populations – south-western (Bosporic), northern (Crimean), eastern (Caucasian) and southern (Anatolian).	Preferred catch for most of the anchovy purse seiners due to high market value.

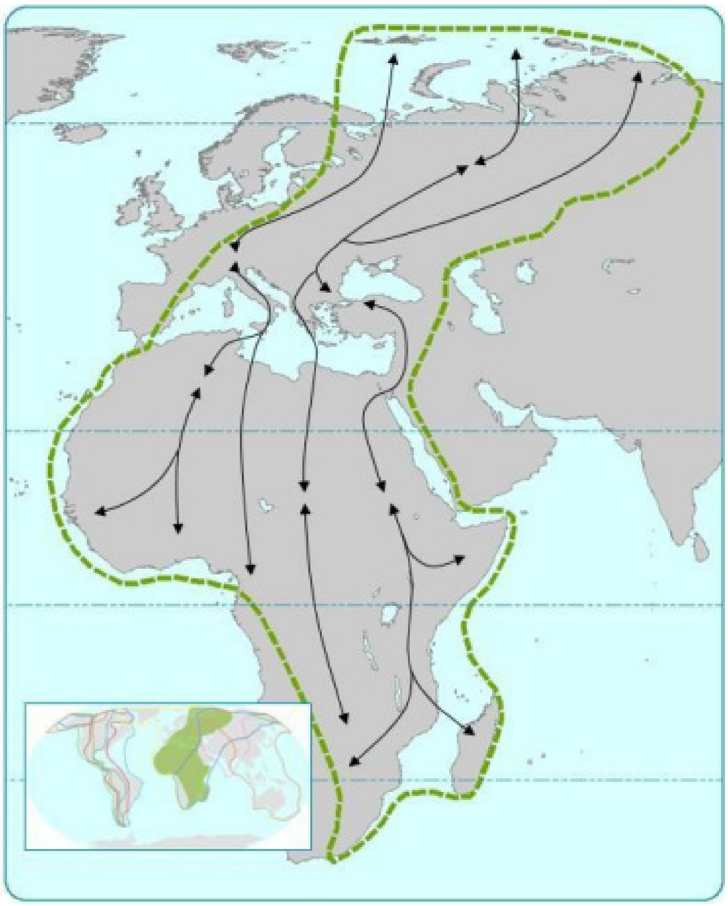
Complete.

8.5.5 Birds

8.5.5.1 Background and Literature Review

A number of migration routes stretching from the Arctic to South Africa occur around and over the Black Sea for birds that overwinter, nest and roost in coastal locations (Ref. 8.7). However, in the central Black Sea Turkish EEZ, there are no nesting sites and so the birds observed in this region are restricted to a small number of species that may be feeding or migrating through the area. The central Black Sea is outside the main Mediterranean/Black Sea Flyway migration route, which connects Europe with Africa. The Mediterranean / Black Sea Flyway is shown in green in Figure 8.4. This route is typical of many flyways, following mountain ranges and coastlines, sometimes rivers, often taking advantage of updrafts and other wind patterns to avoid geographical barriers such as large stretches of open water. Thus, the area is not important for large numbers of migrating birds although data on the occurrence of birds in the central Black Sea is scarce (Ref. 8.7).

Figure 8.4 Mediterranean / Black Sea Flyway



Note: the green dashed line denotes the Mediterranean / Black Sea Flyway with the main migration routes shown as black lines

Several species of seabird common along the Turkish coast were also observed offshore in the Survey Area including the Mediterranean shearwater, *Puffinus yelkouan* and several species of gull. Whilst most feeding takes places in coastal areas, there will be foraging offshore, such as when pelagic fish species like mullet are spawning in open waters. The little gull, *Larus minutus* and the Mediterranean Gull *Larus melanocephalus* may also be seen offshore as they make regular migrations between feeding and breeding grounds around the Black Sea.

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. This species may range widely, with birds ringed in Malta having been observed in the Black Sea. Increasing numbers have in fact been observed entering the Black Sea since the 1970's 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. 8.22).

The species 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. 8.7). 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. 8.23). It was formerly classified as a species of least concern by the IUCN but in 2012 this was changed to Vulnerable (Ref. 8.1).

The little gull can be found breeding in northern Scandinavia, the Baltic, western Russia and Siberia. Its distribution expands in winter to include most of the Mediterranean, Black Sea and Caspian Sea coastlines, as well as the Atlantic coast of Europe (Ref. 8.24). This species is fully migratory and usually arrives in its breeding areas from late-April to late-May and leaves in late-July (although its movements are poorly documented). The species is gregarious and breeds from late-June in mixed-species colonies and sub-colonies occasionally as large as 2,000 individuals, sometimes also in more solitary scattered pairs (Ref. 8.24). The little gull has an extremely large range, the population trend appears to be increasing and population's sizes are very large. As such this species is evaluated as least concern on the IUCN Red List (Ref. 8.1).

The Mediterranean gull breeds almost entirely in Europe. Most populations 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. 8.22). 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. 8.22). It often breeds near but not among Sandwich terns (*Sterna sandvicensis*), or intermingling with black headed gulls (*Larus ridibundus*) (Ref. 8.4). 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.

In addition to seabirds, there are a number of bird species recorded in the Survey Area which are not environmentally linked to the sea, or generally not found in the open sea. These include Black-necked grebe (*Podiceps nigricollis*), whooper swan (*Cygnus cygnus*), common starling (*Sturnus vulgaris*) and skylark (*Alauda arvensis*). The encounter with such birds away from the coast is largely due to climatic effects associated with the onset of winter. These birds have a tendency to stay on the northern Black Sea coast before the arrival of cold weather when they are forced to migrate to the southern coast. In addition, there are three birds of prey which have been recorded including the Peregrine falcon (*Falco peregrinus*), the Saker falcon (*Falco cherrug*) (respectively listed in the Red Data Book of the Black Sea as endangered and vulnerable) and the goshawk (*Accipiter gentilis*). During migration some birds fly across the Black Sea from south to north so that even in the heart of the Black Sea there can be found entirely terrestrial birds such as larks, starlings, corncrake and snipe.

The bird species which are known to be present at different times of the year in the central Black Sea region can be divided into the Groups shown in Table 8.6.

Table 8.6 Bird Species Groups in Black Sea Region (Ref. 8.4)

Group	Information
Loons and Grebes (Gaviiformes and Podicipediformes)	Fish eating and typically water birds. They mainly nest in freshwater habitats. Nests are often floating. In the region, they are found only during migration and wintering, from mid-October to mid-May.
Tube-nosed (Procellariformes)	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.
Cormorants (Pelicaniformes)	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.
Waders (Charadriiformes)	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.
Gulls (Charadriiformes)	This group includes ground-nesting colonial birds connected with different bodies of water. "Marine" gulls (e.g. the Caspian gull) 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 present in the region 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.

Continued...

Group	Information
Terns (Charadriiformes)	Ground-nesting colonial birds. The Caspian tern is among them and its environmental requirements are most similar to those of gulls. It nests on the sandy shores of lakes and seas and it mainly feed on fish. A significant portion of their diet is small fish. Small quantities of terns may be encountered in the region during migrations.

Complete.

Whilst representative species from all the bird groups in Table 8.6 are observed in Turkish coastal waters only a few species have been identified as nesting in the region. This is not within the Project Area. There are several Important Bird Areas (IBAs) where nesting species are found. The European shag (*Phalacrocorax aristotelis*), nests on the Şile coast, the Kűre Mountains and Akkuş Island and on the Kizilirmak Delta there are breeding populations of the black stork (*Ciconia nigra*), the great bittern (*Botaurus stellaris*) and the purple heron (*Ardea purpurea*). The squaco heron (*Ardeola ralloides*) nests in the Yeşilirmak Delta. Representatives of all groups are observed in IBAs on the Turkish coast. The eastern Turkish EEZ in the Black Sea has been proposed as a candidate IBA by Birdlife International numbers of Mediterranean shearwater meeting the threshold specified in Birdlife International's criterion A4iii (*Site known or thought to hold, on a regular basis, 20,000 waterbirds or 10,000 pairs of seabirds of one or more species*) (Ref. 8.25).

8.5.5.2 Birds Survey

Surveys were conducted in June 2009 in an area which included the entire Turkish Black Sea (EEZ and territorial waters) (Figure 8.1) and subsequently in September and October 2011. Observations were performed in the daytime from the survey vessel at stations and on transects between the stations; the snapshot method was used along these transects (Gould & Forsell, 1989 in Ref. 8.4). Observations were undertaken in a forward and perpendicular direction from one side of the vessel and a visual plot 300 x 300 m was selected, within which all birds were counted within 10 to 15 seconds. The main attention was given to flying birds. During the time remaining until the end of the 300 m section, transects were viewed again, as some birds sitting on the water could be underestimated in the time of the 'snapshot'. Inspections were carried out with the naked eye, although a binocular (15x) was used if needed to identify birds to species level.

At the stations, birds were accounted for only at the first appearance in a radius of 300 m around the vessel. Birds accompanying the vessel were accounted for only at the first occurrence. The bird species, gender and age were determined whenever possible.

In the summer 2009 surveys, 20 taxa were observed with 18 identified to species level. In total, 1,195 birds were seen: 299 at stations and 934 during transects (Table 8.7). During field studies conducted in autumn 2011 (Ref. 8.4), 30 taxa of birds were observed, 27 of which were identified to species level. In total, 339 individual birds were seen; including 156 recorded from observation stations and 183 from transect counts (Table 8.7).

Table 8.7 Abundance of Bird Species Observed During the 2009 and 2011 Surveys

Species Name	Common Name	Red Data Book Black Sea	IUCN Red List Category	Number Observed (Sep and Oct 2011)			Number Observed (Jun 2009)		
				Stations	Transects	Total	Stations	Transects	Total
Accipiter gentilis	Eurasian or northern goshawk	N/A	LC	1	-	1	-	-	-
Alauda arvensis	Eurasian Skylark	N/A	LC	-	-	-	3	2	5
Anas platyrhynchos	Mallard	N/A	LC	-	-	-	-	30	30
Anthus pratensis	Meadow Pipit	N/A	LC	-	-	-	7	-	7
Ardea cinerea	Grey heron	N/A	LC	-	11	11	-	-	-
Circus cyaneus	Northern Harrier	N/A	LC	-	-	-	1	-	1
Columba livia	Rock Pigeon	N/A	LC	-	-	-	-	2	2
Cygnus ygnus	Whooper Swan	N/A	LC	-	-	-	-	1	1
Delichon urbica	House Martin	N/A	N/A	7	3	10	-	-	-
Egretta alba	Great Egret	N/A	N/A	-	-	-	-	2	2

Continued…

Species Name	Common Name	Red Data Book Black Sea	IUCN Red List Category	Number Observed (Sep and Oct 2011)			Number Observed (Jun 2009)		
				Stations	Transects	Total	Stations	Transects	Total
Erithacus rubecula	European robin	N/A	LC	-	1	1	-	-	-
Falco cherrug	Saker falcon	VU	EN	-	1	1	-	-	-
Falco peregrinus	Peregrine falcon	EN	LC	2	-	2	-	-	-
Falco sp.	Falcon sp.	-	-	-	2	2	-	-	-
Ficedula parva	Red-breasted flycatcher	N/A	LC	4	-	4	-	-	-
Fringilla coelebs	Chaffinch	N/A	LC	1	-	1	-	-	-
Fulica atra	Eurasian Coot	N/A	LC	-	2	2	-	7	7
Gavia arctica	Black-throated loon	N/A	LC	1	1	2	11	50	61
Gavia sp.	Loon sp.	N/A	N/A	-	-	-	-	17	17
Hirundo rustica	Barn swallow	N/A	LC	32	1	33	-		
Larus cacchinans	Caspian Gull	N/A	N/A	20	23	43	178	273	451
Larus canus	Mew Gull	N/A	LC	-	-	-	2	3	5

Continued...

Species Name	Common Name	Red Data Book Black Sea	IUCN Red List Category	Number Observed (Sep and Oct 2011)			Number Observed (Jun 2009)		
				Stations	Transects	Total	Stations	Transects	Total
Larus fuscus	Lesser black-backed gull	N/A	LC	4	2	6	-	-	-
Larus minutus	Little gull	N/A	LC	12	97	109	-	1	1
Larus ridibundus	Black-headed Gull	N/A	L	--	-	-	4	2	6
Larus sp.	Gull	N/A	-	-	2	2	-	-	-
Motacilla flava	Western yellow wagtail	N/A	LC	2	-	2	-	-	-
Motacilla alba	White wagtail	N/A	LC	38	7	45	-	-	-
Phalacrocorax carbo	Common cormorant	N/A	LC	-	1	1	1	70	71
Phoenicurus phoenicurus	Common redstart	N/A	LC	2	2	4	-	-	-
Phylloscopus collybita	Chiffchaff	N/A	LC	3	-	3	-	-	-
Phylloscopus sp.	Warbler	N/A	All	1	1	2	-	-	-
Podiceps cristatus	Great-crested grebe	N/A	LC	3	-	3	-	9	9
Podiceps grisegena	Red-necked grebe	N/A	LC	-	1	1	-	-	-

Continued...

Species Name	Common Name	Red Data Book Black Sea	IUCN Red List Category	Number Observed (Sep and Oct 2011)			Number Observed (Jun 2009)		
				Stations	Transects	Total	Stations	Transects	Total
Podiceps nigricollis	Black-necked Grebe	N/A	LC	-	-	-	-	2	2
Podiceps sp.	Grebe Sp.	N/A	N/A	-	-	-	-	5	5
Puffinus yelkouan	Mediterranean Shearwater	VU	VU	14	19	33	45	452	459
Stercorarius parasiticus	Arctic skua	N/A	LC	3	6	9	-	-	-
Sterna sandvicensis	Sandwich tern	N/A	LC	3	-	3	-	-	-
Sturnus vulgaris	Common Starling	N/A	N/A	-	-	-	47	6	53
Sylvia atricapilla	Eurasian blackcap	N/A	LC	1	-	1	-	-	-
Sylvia curruca	Lesser whitethroat	N/A	LC	1	-	1	-	-	-
Turdus philomelos	Song thrush	N/A	LC	1	-	1	-	-	-
Total				**156**	**183**	**339**	**299**	**934**	**1,195**

IUCN Red List Category: NA no category yet, LC Least Concern, VU Vulnerable, EN Endangered, All, All categories for this genus (LC, VU, NT, EN). Red Data Book: N/A not listed, EN Endangered, VU Vulnerable

Complete.

The greater number of birds observed in summer 2009 is due to two species recorded in great numbers: the Mediterranean shearwater and the Caspian gull, which are resident species in the Black Sea. These two species accounted for 44% of all individuals observed during transects. Table 8.7 lists the birds observed during the 2009 survey and their conservation status.

The Project Area had very low numbers of birds during the autumn 2011 survey with an average density of only 0.96 individuals/km^2 and a maximum of 3.2 individuals/km^2. This was probably due to the low levels of productivity in the central Black Sea, the large distance from coastal feeding areas, that the migration period over the Black Sea is during the spring and the preference of most migrating birds to avoid large expanses of open sea. During the main migration period (April to May) bird observations in the central Black Sea may be higher (Ref. 8.4).

Seabirds were the most common birds observed, accounting for well over half (60.7%) of all birds seen. The most common species was the little gull (109 sightings), followed by the Caspian gull (43 sightings), and the Mediterranean shearwater (33 sightings) (Ref. 8.4).

The diversity of gulls in the Survey Area in 2011 was extremely low with only three species of the genus *Larus* observed: the little gull, the lesser black-backed gull, *Larus fuscus*, (Table 8.7) and the Caspian gull. The little gull is a typical pelagic species and the least dependent on coastal food sources. It is known that this species migrates towards the Black Sea, Bulgaria and Georgia, and so it can be assumed that the Black Sea is a fairly traditional migration corridor of this species (Yudin and Firsova, 2002 in Ref. 8.4). During the counts, little gulls were observed mainly in small groups from two to six individuals with some concentrations of more than ten birds, and single birds were also noted on several occasions.

Caspian gulls were present primarily as single individuals, sometimes in pairs, and in some cases up to five groups of individuals. About half of all Caspian gulls encountered were young birds of the first or second year. The density of populations of Caspian gulls was low, with a maximum of 0.53 individuals (ind.)/km^2 (Ref. 8.4). Photos of birds observed during surveys are shown in Figure 8.5.

Figure 8.5 Lesser Black-backed Gull (*Larus fuscus*) and the Black Throated Loon (*Gavia arctica*) Observed during Autumn 2011 Surveys

The Mediterranean shearwater was present in lower numbers in 2009 and 2011 (459 in 2009 versus 33 in 2011). The great density of this species in June is most likely associated with this species feeding in the Survey Area.

Of the 459 Mediterranean shearwater observed during the June 2009 survey, over 300 of these were identified in more coastal transects (Transect 2 and 6 on Figure 8.1).

Also observed in 2011 were the Arctic skua, sandwich terns and a small number of other gulls, all in very low numbers (Table 8.7). Such low density of seabirds is probably due to the unfavourable feeding conditions as also indicated by low levels of productivity and the absence of fisheries. The number of sandwich tern observed was also extremely low. This species is one of the most common seabirds in Turkish coastal areas (Ref. 8.4). During the entire observation period there were only three individuals of this species registered.

In conclusion, the abundance and diversity of birds recorded in the central Black Sea were low, particularly in the autumn of 2011. Higher numbers observed in June in 2009 may be due to seasonal changes due to prey availability but could also be due to year on year differences. The most commonly observed species, albeit still in relatively low abundance, were the Mediterranean shearwater and the Caspian gull. Two other birds species included in the Red Data Book of the Black Sea (Ref 8.2) were observed during the autumn 2011 survey: the peregrine falcon, which is listed as Endangered and the Saker falcon, which is listed as Vulnerable. In addition, these species are listed by IUCN Red List as endangered and of least concern respectively. The Mediterranean shearwater is also listed in the Red Data Book of the Black Sea, Turkey as vulnerable on a regional level (Ref. 8.3).

With regard to seabirds typically considered terrestrial, surveys undertaken in 2009 and 2011 registered 12 species of passerine birds, for a total of 108 individuals. Other birds regularly observed during 2011 include rural and urban swallows and white wagtails while small flycatchers, warblers and redstarts were scarce. A tentative list of birds considered as strictly non-seabird species is included in Table 8.8; importantly some of these, such as the Eurasian blackcap, *Sylvia curruca*, are associated with freshwater environments as well as being terrestrial.

Table 8.8 Non-Seabirds Observed During 2009 and 2011 Surveys

Species Name	Common Name	IUCN Red List	Red Data Book of the Black Sea
Accipiter gentilis	Eurasian or northern goshawk	LC	NE
Alauda arvensis	Eurasian Skylark	LC	NE
Anas platyrhynchos	Mallard	LC	NE
Anthus pratensis	Meadow Pipit	LC	NE
Ardea cinerea	Grey heron	LC	NE

Continued….

Species Name	Common Name	IUCN Red List	Red Data Book of the Black Sea
Circus cyaneus	Northern Harrier	LC	NE
Columba livia	Rock Pigeon	LC	NE
Cygnus cygnus	Whooper Swan	LC	NE
Delichon urbica	House Martin	LC	NE
Egretta alba	Great Erget	LC	NE
Erithacus rubecula	European robin	LC	NE
Falco cherrug	Saker falcon	EN	NE
Falco peregrinus	Peregrine falcon	LC	NE
Falco sp.	Falcon sp.	-	-
Ficedula parva	Red-breasted flycatcher	LC	NE
Hirundo rustica	Barn swallow	LC	NE
Motacilla flava	Western yellow wagtail	LC	NE
Motacilla alba	White wagtail	LC	NE
Phoenicurus phoenicurus	Common redstart	LC	NE
Phylloscopus collybita	Chiffchaff	LC	NE
Phylloscopus sp.	Warbler	-	-
Sturnus vulgaris	Common Starling	LC	NE
Sylvia atricapilla	Eurasian blackcap	LC	NE
Sylvia curruca	Lesser whitethroat	LC	NE
Turdus philomelos	Song thrush	LC	NE

NE Not Evaluated; LC Least Concern, EN Endangered.

Complete.

A small number of birds (just over 5% of total observations) that spend time in freshwater and coastal areas, but are not known to feed in the open sea, were recorded. These included loons, grebes, the common coot and the grey heron. Several of these species are known to migrate between breeding and feeding grounds, but this is mostly to coastal areas therefore they are uncommon visitors to the Central Black Sea (Ref. 8.4).

There were several other species of birds more commonly associated with inland habitats observed during the autumn 2011 survey. Some of these were in relatively high abundance, particularly relative to the abundance of seabirds. There were 45 sightings of the white wagtail, *Motacilla abla*, 33 of the barn swallow, *Hirundo rustica*, and ten of the house martin, *Delichon urbicum*. There were sporadic sightings of birds like the robin, chaffinch and chiffchaff, birds that may have been blown off course from their normal inland habitat. The grey heron (*Ardea cinerea*), was seen in 2011.

There were also three birds of prey observed during the survey: the peregrine (Falco peregrinus), Saker falcon (*Falco cherrug*) and goshawk (*Accipiter gentilis*). There was no available data on the migration of such birds of prey over the Black Sea, but this area is covered by the Mediterranean / Black Sea Flyway.

8.5.6 Marine Mammals

8.5.6.1 Background and Literature Review

Three species of cetacean (other than occasional vagrant specimens) are known to occur in the Black Sea and are represented by subspecies. These are the Black Sea harbour porpoise (*Phocoena phocoena relicta*), the Black Sea bottlenose dolphin (*Tursiops truncatus ponticus*) and the Black Sea common dolphin (*Delphinus delphis ponticus*). They are listed in Table 8.9 along with their international and regional conservation status.

Table 8.9 Marine Mammal Species within the Black Sea

Species	IUCN Red List*	Black Sea Convention**	Red Data Book of the Black Sea†
Black Sea harbour porpoise (*Phocoena phocoena relicta*)	EN	E	EN
Black Sea common dolphin (*Delphinus delphis ponticus*)	VU	E	VU
Black Sea bottlenose dolphin (*Tursiops truncatus ponticus*)	EN	E	EN

* VU – Vulnerable, EN – Endangered
** Species included in the Agreement on Conservation of Biodiversity and Landscapes of the Convention on the Protection of the Black Sea from Pollution (Ref. 8.26): E – Endangered,
† EN – Endangered, VU – Vulnerable

There is a considerable body of data on the marine mammals of the Black Sea including a basic summary by Kleinenberg published in 1956 (Ref. 8.4), several aerial surveys undertaken between 1967 and 1987, IUCN funded aircraft and ship based investigation on the status and distribution of cetaceans in the Black Sea presented at a working meeting in 2006 and the Agreement on the Conservation of Cetaceans in the Black Sea Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS) website and a recent overview of the cetacean populations prepared by Birkun in 2008 (Ref. 8.5).

The Black Sea common dolphin is known to prefer the open sea but is sometimes spotted near shores if following shoals of pelagic fish. It has been recorded throughout the Black Sea including the Bosphorus Strait and the Sea of Marmara. Primary food sources include anchovy, sprat and pipefish. The abundance of common dolphins according to ACCOBAMS is shown below in Table 8.10.

Table 8.10 Abundance of Common Dolphin in the Black Sea (Ref. 8.5)

Area Surveyed Area / Length	Observation Type	Date	Abundance Assessment	Source
NW, N and NE parts of the Black Sea within the territorial waters of Russia and Ukraine, 31,780 km^2/ 2,230 km	Vessel registration	September-October 2003	5,376 (2,898 to 9,972; 95% CI*)	Birkun et al., 2004
SE part of the Black Sea within the territorial waters of Georgia, 2,320 km^2/211 km	Vessel registration	January 2005	9,708 (5,009 to 18,814; 95% CI*)	Birkun et al., 2006
The central part of the sea outside the territorial waters of Russia and Turkey, 31,200 km^2/660 km	Vessel registration	September-October 2005	4,779 (1,433 to 15,945; 95% CI*)	Krivokhizhin et al., 2006

* CI – Confidence Interval, A range of values so defined that there is a specified probability that the value of a parameter lies within it.

The greatest threats to common dolphins include outbreaks of disease (such as morbillivirus epizootic), reduction in fish prey abundance, water pollution, ctenophore outbreaks and pelagic trawls.

As for the common dolphin, the Black Sea bottlenose dolphin is considered a subspecies and is listed as endangered by the IUCN Red List. The total population is unknown but is believed to be a few thousands spread out across the whole of the Black Sea. Primary food items include flounder, stingray, mackerel, mullet and anchovy. Unlike the common dolphin, the Black Sea bottlenose prefer to stay in the shelf zone, but are occasionally found in the open sea. The most significant threats to this subspecies include by-catch in fishing nets and possibly parasitic infestations resulting in mass mortality events in 1990. The abundance of bottlenose dolphins according to ACCOBAMS (Ref. 8.5) is shown in Table 8.11. Much of the recorded distribution of this subspecies is on the northern and eastern shores of the Black Sea.

The Black Sea population of harbour porpoises, also a subspecies, is mainly located in coastal areas with water depths of less than 200 m where they feed on benthic and demersal species. They tend to be solitary animals but are sometimes seen in small groups. The exact size of the population is unknown. According to ACCOBAMS (Ref. 8.5), it may now be as high as 10 to 12 thousand individuals. Main threats to this species of dolphin include: mortality in bottom gill nets, injuries and anxiety, contamination of the environment (Black Sea harbour porpoises accumulate in the subcutaneous fat, higher concentrations of organochlorine pesticides than porpoises in other oceans as well as other Black Sea species of dolphins) and reduction in food resources as a result of overfishing of prey species and the invasion of the Black and Azov seas by the predatory ctenophore *M. Leiydi*. Other population limiting factors include diseases and abnormal weather conditions.

Table 8.11 Abundance of Bottlenose Dolphins in the Eastern Black Sea (Ref. 8.5)

Area Surveyed Area / Length	Observation Type	Date	Abundance Assessment	Source
The Kerch Strait, 890 km^2/353 km	Aerial registration	August 2002	88 (31–243; 95% CI*)	Birkun et al., 2003
The Kerch Strait, 862 km^2/310 km	Vessel registration	August 2003	127 (67 to 238; 95% CI*)	Birkun et al., 2004
NE Black Sea shelf, 7,960 km^2/791 km	Aerial registration	August 2002	823 (329 to 2,057; 95% CI*)	Birkun et al., 2003
NW, N and NE of the Black Sea within the territorial waters of Russia and Ukraine, 31,780 km^2/2,230 km	Vessel registration	September-October 2003	4,193 (2,527 to 6,956; 95% CI*)	Birkun et al., 2004
SE part of the Black Sea within the territorial waters of Georgia, 2,320 km^2/211 km	Vessel registration	January 2005	0	Birkun et al., 2006
SE part of the Black Sea within the territorial waters of Georgia, 2,320 km^2/211 km	Vessel registration	May 2005	0	Komakhidze, Goradze, 2005
SE part of the Black Sea within the territorial waters of Georgia, 2,320 km^2/211 km	Vessel registration	August 2005	0	Komakhidze, Goradze, 2005
The central part of the sea outside the territorial waters of Russia and Turkey, 31,200 km^2/660 km	Vessel registration	September-October 2005	0	Krivokhizhin et al., 2006

* Confidence interval

The harbour porpoise inhabits 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 in waters of over 2,000 m depth (Ref. 8.27). 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 (Ref. 8.27). Bottlenose dolphins are distributed across the Black Sea shelf and may occur far offshore. In the northern Black Sea they form scattered communities numbering tens of individuals to approximately 150 animals in different locations around the Crimean peninsula. Accumulations are also known to form close to the Turkish coast (Ref. 8.27).

8.5.6.2 Mammal Survey

Observations of marine mammals were carried out on stations and transects in June 2009 (Figure 8.1), coincident with seabird surveys. Results included a description of the observed marine mammal species and numbers and a summary of observed marine mammals along transects and at stations is reported in Table 8.12.

Table 8.12 Abundance of Marine Mammals Observed during Transect and Station Surveys – 2009

Transect / Station	Species	Number of Individuals
Transect		
1	Common dolphin	22
2	Common dolphin	13
3	Common dolphin	3
9	Common dolphin	10
Total		48
Station		
2	Common dolphin	2
7	Common dolphin	5
8	Common dolphin	2
Total		9

In 2009, only the common dolphin was recorded. The absence of other marine mammals may be due to a number of factors including:

- Bottlenose dolphins are quite rare in the open sea and do not always follow vessels;
- Harbour porpoises are a very inconspicuous species and typically can only be observed in calm weather. There are also known to be very few individuals in the central part of the Black Sea; and
- Survey Area is not a significant breeding or feeding area for all three species of dolphins.

The 2011 surveys recorded both the common dolphin and the bottlenose dolphin as shown in Table 8.13.

Table 8.13 Results of Observations Over Marine Mammals at Transects in Autumn 2011

Transect / Station	Species Name	Abundance, Individuals
Station		
10	Black Sea common dolphin	2
	Black Sea bottlenose dolphin	4
	Total	*6*
Transect		
2	Black Sea common dolphin	8
4	Black Sea bottlenose dolphin	2
5	Black Sea bottlenose dolphin	4
	Black Sea common dolphin or Black Sea bottlenose dolphin	1
9	Black Sea common dolphin	4
	Black Sea bottlenose dolphin	4
11	Black Sea common dolphin	5
	Black Sea common dolphin or Black Sea bottlenose dolphin	1
	Total	*29*

The total number of observations of both species was very low, with sightings at only one (Station 10) of the 15 stations and only five of the 15 transects surveyed. This suggests the occurrence of dolphins in the central Black Sea is both low and sporadic, which probably reflects low prey availability in this part of the Black Sea (Ref. 8.4). The distribution of cetaceans observed during the 2011 survey is shown in Figure 8.6.

The low numbers recorded are believed to be due to a number of factors including:

- Dolphin numbers are known to decrease with distance from shore; and
- Observations were made in the deepest parts of the Central Black Sea.

A comparison of the number of species and individuals observed in 2009 and 2011 is shown in Table 8.14. The total number of individuals is greater in 2009 than 2011. It could be due to better conditions in June than October for observing marine mammals. There is very little data on the seasonality of cetacean numbers in Turkish waters although migration patterns within the Black Sea are fairly well understood. All three Black Sea cetacean species move to feeding grounds for the winter. The common dolphin and harbour porpoise migrate south to feed in the coastal waters of Turkey and Georgia and the bottlenose dolphin migrates to the eastern part of the Black Sea.

Table 8.14 Summary of Species and Total Number of Marine Mammals in 2009 and 2011

Name	Summer 2009			Autumn 2011		
	At Stations	At Transects	Total	At Stations	At Transects	Total
Common dolphin	9	48	57	2	17	19
Bottlenose dolphin	-	-	-	4	10	14
Common or bottlenose dolphin	-	-	-	-	2	2
Total	**9**	**48**	**57**	**6**	**29**	**35**

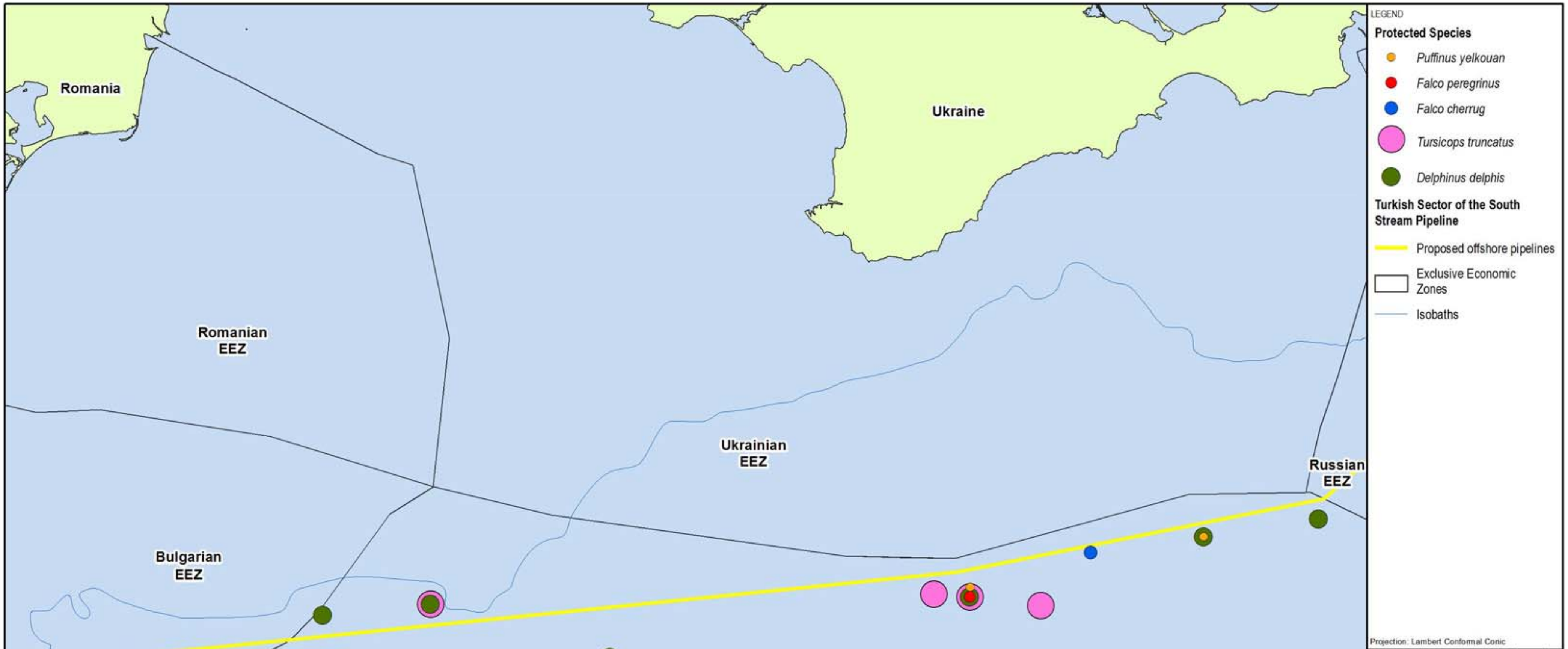
8.6 Species of Conservational Concern

A number of species of conservation concern which are included in the IUCN Red List (Ref. 8.1), the Red Data Book (RDB) of the Black Sea (Ref. 8.2) or the Red Data Book of the Black Sea, Turkey (Ref. 8.3) have been directly observed or are known to exist in the Survey Area are listed in Table 8.15.

Table 8.15 Species of Conservation Concern Potentially Occurring in Turkish Waters

Species	Status		
	IUCN (Ref. 8.1)	**RDB Black Sea (Ref. 8.2)**	**RDB Black Sea, Turkey (Ref. 8.3)**
Fish			
Atlantic Bluefin Tuna (*Thunnus thynnus*)	DD	EN	EN
Chub mackerel (*Scomber colias*)	LC	EN	EN
Mackerel (*Scomber scombrus*)	LC	EN	EN
Swordfish (*Xiphias gadius*)	LC	EN	CR
Black Sea garfish (*Belone belone euxini*)	NE	EN	NE
Mammals			
Black Sea bottlenose dolphin (*Tursiops truncatus ponticus*)	EN	EN	EN
Black Sea common dolphin (*Delphinus delphis ponticus*)	VU	EN	VU
Black Sea harbour porpoise (*Phocoena phocoena relicta*)	EN	EN	EN
Birds			
Mediterranean shearwater (*Puffinus yelkouan*)	VU	NE	NE
Peregrine falcon (*Falco peregrinus*)	LC	EN	NE
Saker falcon (*Falco cherrug*)	EN	VU	NE

NE Not Evaluated; DD Data Deficient; LC Least Concern, NT Near Threatened; VU Vulnerable; EN Endangered; CE Critically Endangered.



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: OBSERVATIONS OF BLACK SEA RED DATA BOOK SPECIES OBSERVED DURING THE AUTUMN 2011 SURVEY

Drawn	Checked	Approved	Date
JM	CP	MW	06/12/2013

URS Internal Project No.	Scale @ A4
46369082	1:2,500,000

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Drawing Number: Figure 8.6

Rev:

Plot Date: 11 Apr 2014
File Name: I:\5004 - Information Systems\46369082_South_Stream\MXDs\Report Maps - Turkey\Tukey ESIA\Chapter 8\Figure 8.6 Observations of Black Sea Red Data Book Species Observed During the Autumn 2011 Survey.mxd

8.7 Critical Habitat

8.7.1 Overview

The Project Area intersects critical habitat as defined by the IFC PS6[2]. It should be noted that the Project Area does not, *per se*, represent particular habitat that is not replicated elsewhere in the Turkish Black Sea; it is merely part of a wider zone that meets the requisite criteria. Further details of the determination of critical habitat are provided in IFC Guidance Note 6[3].

8.7.2 Discrete Management Units (DMUs)

The guidance note for IFC PS6, states that the determination of critical habitat should be based on a "discrete management unit" (DMU) which is an area that has a definable boundary (ecological or political) within which the biological communities have more in common with each other than they do with those outside the boundary.

One DMU was identified in the Study Area; the Open Sea DMU. The Project potentially affects both the seas surface and the seabed in all phases. Available data from a study of the deep sea basin show a relatively featureless seabed over a wide area. Because the deep sea benthos are microbial and non-motile and there are no species of concern; the seabed is not considered as part of the critical habitat assessment or Open Sea DMU.

In the case of the open waters of the Black Sea, where uniform conditions extend over a wide area and species are correspondingly widely dispersed (e.g. cetaceans and some fish species), the Open Sea DMU is very large and has both ecological and political boundaries. In this case, an Open Sea zone was defined as the Turkish EEZ of the Black Sea seaward of the 100 m isobath, where open water species range widely. Critical habitat is defined in Paragraphs 16 of IFC PS6 as areas with high biodiversity value. This includes areas that meet one or more of the following criteria:

- *Criterion 1*: Critically Endangered (CR) and/or Endangered (EN) species;
- *Criterion 2*: Endemic and/or restricted-range species;
- *Criterion 3*: Migratory and/or congregatory species;
- *Criterion 4*: Highly threatened and/or unique ecosystems; and
- *Criterion 5*: Key evolutionary processes.

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

[3] 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. EPFIs [Equator Principles Financial Institutions] 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.'

The Project did not identify the Open Sea DMU as critical habitat for Criterion 2, 4 or 5 but did identify the Open Sea DMU as critical habitat for Criterion 1 and 3 as discussed in the following sections.

Critical habitat can also be defined as either Tier 1 or Tier 2. Tier 1 is considered more sensitive. No Tier 1 habitat has been identified in relation to the Project.

8.7.3 Critical Habitat for Endangered Species

The ESIA Report identifies globally, nationally and regionally critically endangered and endangered species present within Study Area. This has been completed with reference to the following:

- IUCN Red List of Threatened Species (Ref. 8.1);
- Black Sea Red Data Book (Ref. 8.2); and
- Red Data Book Black Sea, Turkey (Ref. 8.3).

For the purposes of screening for critical habitat, species listed as either endangered or critically endangered in any of the aforementioned lists have been included in the assessment. In addition, species likely to be present, but not directly observed in Project surveys, are included.

Black Sea bottlenose dolphins and harbour porpoises have been observed in the Project Area and it is likely (based on the guidance provided in IFC Guidance Note 6) that the open sea is 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".

8.7.4 Critical Habitat for Migratory and Congregatory Species

Migratory and congregatory[4] fish species likely to be present in offshore Turkey include sprat (*Sprattus sprattus*), anchovy (*Engraulis encrasicolus*), Black Sea garfish (*Belone belone euxini*), bluefish (*Pomatomus saltatrix*), Black Sea horse mackerel (*Trachurus mediterraneus ponticus*), Atlantic bonito (*Sarda sarda*) and chub mackerel (*Scomber colias*).

All the above species have a very wide distribution, encompassing the Black Sea, Mediterranean and in some cases the adjacent Eastern Atlantic and are at the edge of their range in the Black Sea. Though accurate population data are unavailable, it is reasonable to assume that the open

[4] Tending to gather into a group

sea may contain more than 1% of the population of at least one of these species. It thus qualifies as Tier 2 critical Habitat based on criterion 3(b) Habitat known to sustain, on a cyclical or otherwise regular basis, ≥ 1 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.*

Because the area under consideration cannot be considered a "site" per se, application of International Bird Areas and Ramsar criteria is problematic. However, because flocks of Mediterranean shearwaters have been observed, the Open Sea DMU meets the 1% biogeographic population criterion for this species[5].

The threshold specified in Birdlife International's criterion A4iii (Site known or thought to hold, on a regular basis, 20,000 waterbirds or 10,000 pairs of seabirds of one or more species) may also be met thus a precautionary appraisal suggest the open sea is Tier 2 critical habitat for migratory seabirds.

Once again, it should be noted that this is largely a factor of the widely ranging nature of these fish and the necessarily large size of the open sea defined; the potential for impact to these species at a population level is negligible.

8.8 Impact Assessment

8.8.1 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 habitats and the magnitude of marine impacts are discussed in Section 8.8.1.1.

Impacts are presented in this section based on receptor type, to give a complete picture of the effects of the Project on a given habitat or species group. Mitigation has also been presented per receptor type to allow a clear perspective of how impacts to any given species or habitat can be managed to minimise or manage significant marine ecological impacts.

The process of identifying 'design controls' and 'mitigation measures' relevant to marine ecology has considered the mitigation hierarchy (**Chapter 3 Impact Assessment Methodology**), as specified in IFC PS1 and PS6, i.e. in which impacts are progressively avoided, minimised, and restored (or offset if necessary), with priority given to the actions which are earliest in the hierarchy. Offsetting is only considered if these measures do not result in a reasonable expectation of no net loss of biodiversity (or a net gain in respect of critical habitats).

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[5] IUCN quotes a global population of 15,300 to 30,500 pairs, meaning that a local population of 306 to 610 birds meets this criterion

For the Project, efforts were made to firstly avoid or prevent, then minimise or reduce adverse impacts, through the application of 'design controls'. Thereafter, 'mitigation measures' were identified to avoid, minimise or restore adverse impacts incapable of management by the application of design controls. Finally, consideration was given to offsetting or compensation in order to achieve 'no net loss' of biodiversity, or in the case of impacts affecting critical habitat 'net gains' in biodiversity, where significant residual adverse impacts remained after the application of design controls and mitigation measures. Note that, given the difficulty in predicting impacts on biodiversity over the long term, the Project will adopt a practice of adaptive management in which the nature and implementation of management and mitigation measures, and where necessary, offsetting or compensatory measures, are responsive to changing conditions and the results of monitoring.The Project involves a wide range of activities that have the potential to impact the marine environment, primarily during the construction. The relevant activities are summarised in Table 8.16.

Table 8.16 Project Activities in the Turkish Marine Environment

Phase	Activity
Construction and Pre-Commissioning	Mobilisation of vessels to and from Project Area and vessel movements within construction spread.
	Vessel routine operations (including propulsion, cooling water, water maker, bilges and ballast).
	Delivery of pipe and other supplies, as well as crew changes.
	Night time working.
	Dynamic positioning of pipe-lay vessel.
	Laying the pipe on seabed.
Operation	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 (similar to operation).
Decommissioning (Option 2)	Lifting of Pipeline from the seabed.
	Vessel operations associated with pipe removal (similar to construction).

8.8.1.1 Impact Assessment Criteria

Receptor Sensitivity

The assessment of receptor sensitivity includes consideration of ecological function. This is because there are species and communities that are important to the ecosystem that are neither rare nor protected by any designation (e.g. planktonic carbon fixation and nutrient cycling). This approach therefore includes consideration of fauna, ecological processes and nature conservation.

It should be noted that for the purposes of this ESIA Report, 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 8.4). At the highest level, these can be divided into habitats and species, for which it is appropriate to derive separate assessment criteria. There is only one benthic habitat type in the Study Area:

- Deep-water soft substrate benthic habitats.

Species are broadly classified into the following groups (though consideration is given to individual species where they are of conservation concern or keystone species):

- Plankton;
- Fish;
- Birds; and
- Marine mammals.

Sensitivity criteria have been developed separately for habitats and species, as set out in Table 8.17 and Table 8.18 respectively.

Table 8.17 Receptor Sensitivity Criteria for Marine Habitats

Sensitivity	Description	Applicable Standards
High	A site, habitat or assemblage of species which has designated conservation status at an international and national scale; Areas of particular biodiversity importance, that may support populations of restricted range, endemic or endangered species, or is in itself unique or threatened*; Areas that support large populations (in a national or international context) of migratory species**; or Habitats that provide key ecosystem functions.	Designated areas or habitat under IUCN category Ia to IV (Habitat/Species Management Area and above)

Continued…

Sensitivity	Description	Applicable Standards
Moderate	A site, habitat or assemblage of species which has designated conservation status at a National scale; or 'Natural Habitat' IFC PS6 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.	N/A
Low	Habitats occurring outside of any designation; or 'Modified Habitat' IFC PS6 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.	N/A
Negligible	Habitats that are either appreciably degraded/disturbed by human activity or have high proportions of invasive/non-native species; or Do not support any key ecosystem functions.	N/A

* As listed on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species.
** These criteria are similar to those used in IFC PS6 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 summarised in this ESIA Report.

Complete.

Table 8.18 Receptor Sensitivity Criteria for Marine Species

Sensitivity	Description	Applicable Standards
High	A species population that has designated conservation status at an international scale; A species that is globally rare; or A keystone species fundamental to the functioning of the ecosystem.	Listed in IUCN red list (Vulnerable and above).
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 Black Sea Red Data Book (Black Sea Environment Programme) categories 'Vulnerable' and above.

Continued…

Sensitivity	Description	Applicable Standards
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.	N/A
Negligible	Common / abundant locally; or Not important to other ecosystem functions.	N/A

Complete.

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 applied 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 design control and mitigation measures.

Habitats

Very little is known about the offshore deep water seabed of the Black Sea abyssal plain. Anoxic conditions and the presence of hydrogen sulphide limit biodiversity on the seabed. Only sulphur metabolising bacteria and a single infaunal species of microscopic metazoan have been observed to survive in these conditions (Ref. 8.28). It is thought that sulphur metabolising bacterial communities are widespread in the deep sea, but the diversity and abundance of organisms in this habitat is not fully known. In some circumstances deep sea bacterial communities form reef structures or microbial mats, though such communities were not observed within the Project Area (Ref. 8.13) and in the Black Sea they are thought to be confined to the northwest shelf. The diversity and abundance of microscopic organisms in this habitat is not fully known but they are not important to ecosystem functions in the Black Sea because there is very little water exchange between the bottom waters and the surface where pelagic organisms are found. On the basis of available survey data, deep-water soft-substrate communities are considered of low sensitivity.

Species

Plankton's dispersed nature, very high numbers and relatively short generation time means their populations are highly resilient and generally considered of low sensitivity.

There is very limited data on the occurrence of **fish** in the waters of the central Black Sea, where the Project Area is located. Plankton surveys indicate the presence of pelagic species such as anchovy, sprat and horse mackerel but numbers recorded are very low. Anchovy may be present in higher numbers during seasonal migrations between the north and south coasts of the Black Sea. The low levels of productivity of plankton and absence of fisheries in the central Black Sea are indicative of the low density of fish in this region. Of the fish species potentially present in Turkish waters, tuna, chub mackerel, mackerel, swordfish and garfish are listed as species of concern (vulnerable or above) on national, regional and international inventories of conservation statuses. Species diversity and abundance is anticipated to be lower than in coastal waters. Only one species migrates regularly through the Project Area. The expected presence of some endangered species coupled with the low species abundances means that the sensitivity of fish communities in the Project Area is considered to be moderate.

For **birds**, whilst most feeding takes places in coastal areas, there will be some species foraging offshore when pelagic fish species like anchovy are migrating between the northern and southern coasts of the Black Sea. The most common birds seen in the Project Area were the Mediterranean shearwater, which has an IUCN status of Vulnerable and the Caspian gull. The little gull and the Mediterranean gull may also be seen offshore as they make regular migrations between feeding and breeding grounds around the Black Sea.

In addition to seabirds, there were a number of bird species recorded in the Survey Area that are environmentally not linked to the sea (i.e. are not dependant in the sea for food or shelter), or generally not found in the open sea. Whilst the main migration routes do not cross the central part of the Black Sea there are some birds that migrate from south to north so that even in the heart of the Black Sea some entirely terrestrial birds, such as larks and starlings were observed. During surveys two falcon species were observed; the peregrine falcon (*Falco peregrinus*) listed as Endangered in the Red Data Book of the Black Sea and the saker falcon (*Falco cherrug*) listed as Endangered in the IUCN Red List and Vulnerable in the Red Data Book of the Black Sea. The presence of low numbers of endangered and vulnerable 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 underwater sound. Two of the three cetacean species in the Black Sea can occur in offshore waters, namely bottlenose dolphin (*Tursiops truncatus ponticus*) and common dolphin (*Delphinus delphis ponticus*). Bottlenose dolphin are globally and regionally endangered whilst common dolphin are globally vulnerable and listed in the Black Sea (Bucharest) Convention Annex II. Both species are included in the Red Data Books of the Black Sea and the Black Sea, Turkey (Ref. 8.2 and 8.3). Because they are species of conservational concern 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 8.19.

Table 8.19 Marine Ecology Receptors

Receptor	Sensitivity Ranking
Habitats	
Soft substrate benthos	Low

Continued…

Receptor	Sensitivity Ranking
Species	
Plankton	Low
Fish	Moderate
Birds	Moderate to High
Marine mammals	High

Complete.

Impact Magnitude

Consistent with the approach outlined above, and in **Chapter 3 Impact Assessment Methodology** of this ESIA Report, common impact magnitude criteria have been developed for marine and terrestrial ecological receptors as shown in Table 8.20 and Table 8.21. As the magnitude of potential impacts upon habitats and species is difficult to quantify and is highly variable, these definitions have been developed based on professional judgement and experience in GIIP to provide case specific flexibility in the assessment of impacts. 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 8.20 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/region'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 8.21 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.
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*, but does not threaten the long-term integrity of that population or any population dependent on it.
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/plant species under consideration not human generations.

Determining Impact Significance

As outlined in **Chapter 3 Impact Assessment Methodology** of this document, the significance matrix shown in Table 8.22 provides basic guidance for the determination of impact significance; however, the resulting significance level is also checked against the definitions in Table 8.23, interpreted on the basis of professional judgement and expertise, and adjusted if necessary.

Table 8.22 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 8.23 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.

8.8.1.2 Modelling Undertaken

While no specific ecological modelling has been undertaken, this section draws on the results of acoustic modelling with respect to the impacts of underwater noise on fish and cetaceans. The noise modelling assessment is provided in Appendix 8.1.

8.8.2 Assessment of Potential Impacts: Construction and Pre-commissioning

8.8.2.1 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 through the development of Project design controls which are set out in Table 8.24. 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 practicable, and the residual impact is assessed. The Project design controls included in Table 8.24 relate to the Construction & Pre-commissioning and Operational

Phases and have been included in the pre-mitigation impact assessment in Sections 8.8.2.2 and 8.8.3.2.

Table 8.24 Design Controls

Design Controls
All bunkering activities will be undertaken in accordance with the Vessels and Marine Transport activity-specific Construction Management Plan (CMP) which will be developed as part of South Stream Transport's 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 the International Convention for the Prevention of Pollution From Ships (MARPOL), Bucharest Convention and national regulations, cognisant of the Black Sea's status as an International Maritime Organisation (IMO) special area with respect to garbage and wastes containing hydrocarbons. 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 (**Chapter 12 Waste Management**).
An Integrated Waste Management Plan will be drawn up by contractors 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.

8.8.2.2 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 8.27 in Section 8.8.2.4.

Benthos

Vessel wastes can affect benthic communities by releasing organic matter to the water column that may settle and decompose on the seabed which can create anoxic conditions. However, in the deep areas of the Black Sea the water column and seabed, below 150 to 200 m water depth are completely anoxic and high in hydrogen sulphide (H_2S). Benthic communities are absent in the Project Area because of these natural conditions and any biology is limited to microbial organisms adapted to anoxic conditions. Impacts from vessel wastes will be of a negligible magnitude to a receptor of low sensitivity and so the impact is **Not Significant**.

Seabed disturbance, resulting in increased turbidity and resettlement of suspended solids, which can cause smothering, may occur through pipe-laying. However, there are very few marine ecological receptors on the floor of the abyssal plain, limited to microbial organisms capable of surviving in anoxic conditions. There was no indication of any structural microbial communities, such as those forming mats or reef structures on the seabed. Thus, pipe-laying is of negligible magnitude to a receptor of low sensitivity so that the resulting impact is assessed as **Not Significant**.

Vessel operations associated with pre-construction route surveys (using ROVs) etc. are negligible magnitude activities, to a receptor of low sensitivity that will have a **Not Significant** impact on the benthos.

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 waste discharges may locally reduce light levels and 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, as the extent of impact both spatial and on the planktonic population will be small, to a receptor of low sensitivity and are therefore assessed as **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, small extent impact and thus will be of negligible magnitude to a receptor of 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 highly localised and small in spatial extent, it will be of negligible magnitude to a receptor of low sensitivity. The impact is thus **Not Significant**.

Fish

Vessel operations have the following potential impacts on pelagic fish:

- As the Project will comply with MARPOL discharge controls, locally reduced dissolved oxygen levels in surface waters causing physiological stress, displacement and/or behavioural changes in fish is unlikely to arise. Conversely, kitchen wastes may attract some species to feed, though the scale of this impact 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 short-term and highly localised impact.

These impacts will be highly localised and short-term and so vessel operations are considered to have negligible impacts on a moderate sensitivity receptor 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 and short-term nature, this is a negligible magnitude impact to a moderate sensitivity receptor; therefore any associated impact is **Not Significant** to fish.

Seawater abstraction may result in the entrainment of small fish, fish larvae and eggs. 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 sensitivity. The impact is thus **Not Significant.**

Noise and vibration will be generated by the passage of vessels and pipe-laying. Low levels of noise may also be generated during construction activities.

Fish may be either hearing specialists or hearing generalists; the former are usually species with swim bladders that are connected to the ear and are more sensitive to noise. Sprat and anchovy possess specialised gas ducts extending to the inner ear and are hearing specialists. Hearing generalist fish (such as tuna) are less sensitive both in terms of sound level and frequency range.

Acoustic impact analysis (Appendix 8.1) showed that sound levels generated by pipe-laying in the Black Sea are insufficient to cause mortality to fish. The approach used is based on criteria developed from hearing studies of fish exposed to airgun sounds. 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 following criterion, 187 dB re µPa2, are precautionary when applied to exposure to continuous sound and yield very conservative estimates of effect range and area.

Modelling results show a theoretical maximum injury effect range of 0.4 km, corresponding to an effect area of 3.8 km^2. 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 sound above these higher frequencies (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, in some situations[6] (though not anchovy). Modelling has suggested that the pipe-lay vessel may generate noise impacts at a range of approximately 0.5 km (area of effect approximately 0.1 km^2). No impacts are predicted to hearing generalist species.

[6] Audiograms for sprat 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.

Migratory species, such as anchovy, could be impacted by either the physical presence of vessels or noise generation from vessels impacting migratory routes and/or patterns. Anchovy are the only species in the Black Sea known to migrate across the Project Area (Section 8.5.4.1). However, as the construction spread will only be moving at approximately 2.75 km per day it can be considered a stationary object and anchovy will be able to avoid this area. Migrating schools of fish are fast moving and their presence at a particular point is temporary. The main migration corridor could extend around 125 km (Ref. 8.11) in width through the Turkish EEZ and the main impact radius is 0.5 km in hearing specialists. This impact zone is transitory and is a very small part of the width of the anchovy migration corridor. Underwater noise is therefore unlikely to result in disorientation or cessation of migratory behaviour.

Because noise will affect a small group of individuals over a short time period the generation of noise is considered a low magnitude impact on a receptor of moderate sensitivity. The significance of the impact is thus, at most, of **Low** significance. Additional detail of the acoustic modelling is provided in Appendix 8.1.

Birds

A number of migration routes stretching from the Arctic to South Africa occur around and over the Black Sea for birds that overwinter, nest and roost in coastal locations. In the Turkish EEZ, there are no nesting sites and so the birds observed in this region are restricted to a small number of species that may be feeding or migrating through the area. The central Black Sea is outside the main Mediterranean/Black Sea Flyway (Figure 8.4) migration route, which connects Europe with Africa. It is not important for large numbers of migrating birds although data on the occurrence of birds in the central Black Sea is scarce.

Vessel movements during 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. Furthermore, the density of seabirds at sea in the central Black Sea area is generally low and birds tend to be present during migration and unlikely to be present on the sea surface in any significant number. Vessel movements could impact a small group of individuals during migration periods and impacts are highly localised to around the construction spread. This will thus be a negligible magnitude impact to a receptor of moderate to high sensitivity therefore any associated impact is **Not Significant** to birds.

Night-time works are required and they necessitate the use of floodlights. Light can affect migrating birds and cause mortality from bird strikes on highly illuminated offshore installations. The source of illumination (e.g. the pipe-laying vessel) 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 negligible to low magnitude impact to a receptor of moderate to high sensitivity, resulting in impacts of **Moderate** significance.

Marine Mammals

Vessel movements during mobilisation, surveying and pipe-laying activities have the potential to temporarily disturb marine mammals. Collisions may also occur, though this is highly unlikely with small cetaceans. 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.

Cooling water discharges and other effluent streams from vessels may cause localised changes in water quality relating to excess heat and the presence of wastes. 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. This is thus a negligible magnitude impact, as it is small scale, short term and unlikely to cause injury or mortality to a high sensitivity receptor, thus likely to be **Not Significant**.

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 short term negligible magnitude impact to a high sensitivity receptor, likely to be **Not Significant**.

Noise from vessel movements and from the pipe-lay vessel 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 pipeline construction and pre-commissioning have been identified as:

- Pre-lay surveys;
- Vessel movements; and
- Pipe-laying.

Detailed noise modelling has been carried out to assess the potential impact of underwater noise on cetaceans. The noise modelling has included consideration of single sources, combined sources (from vessel spreads) as well as cumulative exposure over time (24 hours). The potential of noise to cause injury or behavioural alterations has been assessed and is summarised below. Full details are provided in Appendix 8.1.

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 activity has been modelled including realistic motion of pipe-lay vessel and support vessels such as pipe carrier ships shuttling to resupply. Two sets of criteria are available and currently considered valid for the assessment of ranges to injury[7] from continuous noise: the Southall et al. criteria and the Finneran and Jenkins criteria (also referred to as the "US Navy criteria"):

[7] 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.

- 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 activity is estimated to be very limited.

Various criteria are available to assess the potential impacts of underwater noise on cetacean behaviour. Traditionally, an un-weighted criterion for the onset of behavioural effects of 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[8]. 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 (Ref. 8.29) 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 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

[8] National Oceanic and Atmospheric Administration / National Marine Fisheries Service: 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 educing 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.

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 1.01 km for at any modelled location. It should also be noted that this range is based on the audiogram of the harbour porpoise which is more sensitive to noise than dolphins. As harbour porpoise are unlikely to be seen in great numbers in or near the Project Area (none were observed during 2009 to 2011 surveys), this can be considered precautionary. A summary of the predicted ranges and areas of effect is presented in Table 8.25.

Table 8.25 Predicted Behavioural Impact Ranges for Cetaceans Based on 75 dB_{ht}

Activity	Season	Bottlenose Dolphin		Harbour Porpoise	
		Range (km)	Area (km^2)	Range (km)	Area (km^2)
Pipe-Laying	February	0.5	0.06	0.4	0.2
	August	0.5	0.06	0.4	0.23
Crew Change	February	0.6	0.53	0.92	1.74
	August	0.64	0.61	1.01	2.26

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 from the source for any possibility of injury. The longest range predicted impacts are approximately 120 m from the source. The ranges over which behavioural impact might be observed are summarised in Table 8.26.

The analysis shows that sound levels generated by pipe-laying are unlikely to cause mortality or injury to marine mammals. Noise may 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. Additional details of the quantitative underwater noise assessment can be found in Appendix 8.1.

Table 8.26 Predicted Behavioural Impact Ranges for Sonar Source

Threshold	Season	Range (km)	Area (km^2)
Generic (NMFS) threshold (120 dB re 1 µPa rms SPL un-weighted) Porpoise	February	< 0.01	< 0.0001
	August	< 0.01	< 0.0001
Mid-Frequency cetacean behaviour threshold (160 dB re 1 µPa SPL) Dolphin	February	0.12	0.0005
	August	0.12	0.0005

8.8.2.3 Mitigation and Monitoring

The approach to mitigation is described above at section 8.8.1. Specific mitigation measures are discussed below and are grouped by each potential impact arising from the Project Activities in Table 8.16. 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:

- 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 contractors' management plans and trained Marine Mammal Observers (MMO) will be present during pipe-laying operations to assist in managing such interactions on a case by case basis;
- Use modern vessels and plant and undertake regular maintenance checks;
- 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;
- Preparation of a Biodiversity Action Plan (BAP) and a Biodiversity Management Plan (BMP);
- 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) if mass strikes of birds with vessels and superstructures detected; and

- Intake screens for water abstraction will be used to prevent ingress of fish, including eggs and larvae and large invertebrates. The design of screens should be optimised to minimise injury and/or mortality.

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. As indicated in Section 8.8.1, the Project will adopt a practice of adaptive management in which the nature and implementation of management and mitigation and management measures, and where necessary, offsetting or compensatory measures, are responsive to changing conditions and the results of monitoring.

A monitoring plan is required for the Turkish national EIA, as required by Turkish regulations, and will be confirmed with the relevant Turkish authorities. If impacts are detected during construction, additional post-construction monitoring may be developed by the Project, consistent with the adaptive management approach referred to above.

This ESIA Report has identified the following component for which monitoring will be required:

- *Seabirds and Marine Mammals*: Post construction survey of seabirds and marine mammals to record species abundance and distribution will be carried out from Project vessels deployed for routine external inspection surveys.

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 PS1, which emphasises 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 16 Environmental and Social Management**.

In addition, because critical habitat has been identified for certain seabirds and cetaceans, there is an additional requirement for biodiversity monitoring/research. The Project’s mitigation strategy will be designed to comply with IFC PS6 and to achieve net biodiversity 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 protect and conserve biodiversity. The implication of this for the Project’s monitoring programme, particularly for birds and mammals, is that it must be appropriately designed to enhance scientific knowledge and thereby improve conservation measures for those species of conservation concern. The scope of such programmes will be developed in consultation with relevant parties to ensure the maximum benefit is delivered.

The foregoing will be described in a Biodiversity Action Plan (BAP) which will be designed to achieve net gains of those biodiversity values for which the critical habitat was designated.

8.8.2.4 Residual Impacts: Construction and Pre-Commissioning

The residual impacts of the Project construction and Pre-Commissioning are detailed in Table 8.27. As a result of the Design Controls discussed in Table 8.26 and the mitigation measures described above, the majority of residual impacts to marine ecological receptors have been assessed as either **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 in this Section, comprise the following:

- Seawater abstraction for cooling water purposes will have no appreciable impact on sensitive receptors and is thus **Not Significant**;
- Any disturbance arising during inspection surveys etc. is of a very small spatial extent and duration and is thus **Not Significant**;
- Turbulence from dynamic positioning of vessels will be localised to such a degree that the impact will be **Not Significant**; and
- Disturbance and waste generation from a series of small scale, brief construction activities are **Not Significant**.

Lighting impacts on seabirds have been assessed as **Moderate** significance before mitigation. As indicated above, appropriate lighting design is a mitigation measure. The residual magnitude is assessed as **Low**.

Impacts of vessel movements causing disturbance to birds and mammals have been assessed as **Moderate** prior to mitigation. The use of trained MMO and development of specific protocols to minimise interactions will be implemented as mitigations and the residual magnitude is assessed as **Low**.

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 8.22). 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 8.23, 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 will 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."*

A summary of residual impacts showing receptor sensitivity, impact magnitude, proposed mitigation and impact significance is given in Table 8.27.

Table 8.27 Assessment of Impacts: Construction and Pre-Commissioning Phase

Activity	Potential Impact	Receptor	Receptor Sensitivity	Impact Magnitude	Pre-Mitigation Impact Significance	Summary of Mitigation Measures	Residual Impact Significance
Mobilisation of vessels to and from Project Area and vessel movements within construction spread. Delivery of pipe and other supplies by supply vessel, including crew changes. Vessel routine operations (including propulsion, cooling water, water maker). Night time works. Pre-lay / as-built surveys. Laying the pipe on seabed.	Vessel wastes / discharges could indirectly impacts species by decreasing water quality. Light from night-time works can attract species. Seawater abstraction can cause entrainment of species.	Plankton	Low	Negligible	**Not Significant**	None required	-
		Fish	Moderate	Negligible	**Not Significant**		-
		Mammals	High	Negligible	**Not Significant**		-
	ROV operations associated with pre-construction route surveys.	Benthos	Low	Negligible	**Not Significant**	None required	-

Continued…

Activity	Potential Impact	Receptor	Receptor Sensitivity	Impact Magnitude	Pre-Mitigation Impact Significance	Summary of Mitigation Measures	Residual Impact Significance
Mobilisation of vessels to and from Project Area and vessel movements within construction spread. Delivery of pipe and other supplies by supply vessel, including crew changes. Vessel routine operations (including propulsion, cooling water, water maker). Night time works. Pre-lay / as-built surveys. Laying the pipe on seabed.	Physical disturbance of animals at sea surface (as distinct from acoustic effects) and possible collision risk.	Birds	Moderate to high	Low	**Moderate**	Trained MMO and specific protocols for mammal and bird interactions in the contractors' management plans. Will include: • Minimise unnecessary vessel movements. • Reduce vessel speed where mammals may be present. • Avoid aggregations of birds and mammals.	**Low,** direct, short term
		Mammals	High	Low	**Moderate**		**Low,** direct, short term
	Birds (particularly those that migrate at night) may be attracted to lights and suffer damage as a result of collisions with vessels.	Birds	Moderate to high	Negligible to 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	Receptor Sensitivity	Impact Magnitude	Pre-Mitigation Impact Significance	Summary of Mitigation Measures	Residual Impact Significance
Mobilisation of vessels to and from Project Area and vessel movements within construction spread. Delivery of pipe and other supplies by supply vessel, including crew changes. Vessel routine operations (including propulsion, cooling water, water maker). Night time works. Pre-lay / as-built surveys. Laying the pipe on seabed.	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 contractors' management plans. Will include: • Minimise unnecessary vessel movements. • Reduce vessel speed where mammals may be present. • Avoid aggregations of birds and mammals. • Vessel engine power will be "ramped" up where practicable.	**Low** direct, short term
	Noise may cause low level behavioural changes over a wide area. Possible injury in direct proximity to activity.	Marine Mammals	High	Low	**Moderate**		**Low** direct, short term (see text in Section 8.8.2.4)

Complete.

8.8.3 Assessment of Potential Impacts: Operational Phase

8.8.3.1 Introduction

Because the scope of activities associated with the operational and commissioning impacts is small in comparison with the Construction 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.

Inspection activities may generate small amounts of ship wastes as described in Section 8.8.2.2 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.

8.8.3.2 Assessment of Potential Impacts (Pre-Mitigation)

Benthic Habitats

The pipeline will provide hard substrata on the seabed but in the absence of any biology apart from microbial life the presence of a pipeline will not have any impact on the benthos. This is therefore considered a negligible magnitude resulting in a **Not Significant** impact.

Plankton

Impacts from operation will be more limited in extent and frequency than during construction as vessel activities will be limited to once every one to five years. As such, impacts are anticipated to be of negligible magnitude and **Not Significant** to plankton.

Fish

Pipeline inspection and maintenance will involve some vessel movements including vessel noise. The limited frequency and extent of such activities means that any interaction with fish will be minimal. This therefore considered a negligible magnitude impact and **Not Significant** to fish.

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 resulting in a **Not Significant** impact.

Marine Mammals

The movement of vessels (including vessel noise) associated with pipeline inspection and maintenance is a **negligible** magnitude impact and **Not Significant** to marine mammals.

8.8.3.3 Mitigation and Monitoring

Although no significant impacts are anticipated, maintenance vessels will adopt the following minimisation measures, following the IFC mitigation hierarchy outlined in **Chapter 3 Impact**

Assessment Methodology, for management for vessel movements and operations etc. during inspection and maintenance, specifically:

- Vessel movements during inspection and maintenance will be kept to a practical minimum to minimise disturbance to marine mammals and seabirds; and
- Vessels will not approach animals unless it is not possible to avoid doing so.

8.8.3.4 Residual Impacts: Operational Phase

The limited scope of operational and commissioning impacts compared to those identified for the Construction and Pre-Commissioning Phase means that residual impacts are expected to be **Not Significant**. The potential operational impacts, their mitigation and residual impacts are summarised in Table 8.28.

8.8.4 Assessment of Potential Impacts: Decommissioning Phase

Decommissioning of the South Stream Offshore 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. 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 Turkish government departments responsible at the time.

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; or
- 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.

Impacts that may be associated with decommissioning will be assessed as part of the process of developing detailed decommissioning management plans and are not assessed in this ESIA Report.

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

Table 8.28 Assessment of Impacts: Operational Phase

Activity	Potential Impact	Receptor	Receptor Sensitivity	Impact Magnitude	Pre-Mitigation Impact significance	Summary of Mitigation Measures	Residual Impact significance
Maintenance and repair to pipelines (including span correction, etc.)	Vessel wastes and discharges could indirectly impacts species by decreasing water quality.	Plankton	Low	Negligible	**Not significant**	None Required	-
	ROV operations associated with maintenance.	Benthos	Low	Negligible	**Not Significant**	None Required	-
	Noise may cause behavioural changes over a limited area.	Fish	Moderate	Negligible	**Not Significant**	None Required	-
	Physical disturbance of animals at sea surface and possible collision risk.	Birds	Moderate to high	Negligible	**Not Significant**	None Required	-
	Noise may cause low level behavioural changes over a wide area.	Marine Mammals	High	Negligible	**Not Significant**	None Required	-

8.9 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 or more vessels. The resultant effects of these unplanned events will be limited to accidental pollution incidents involving fuel and oils. This in turn might lead to impacts (unmitigated) of moderate magnitude on receptors of low and moderate sensitivity, leading to impacts of moderate, possibly high significance, depending on the receptor affected. The probability of an accident leading to a pollution incident ranges from unlikely to extremely remote. Further, incident response measures would be deployed which would limit the magnitude of impact, and thereby the resulting significance.

Vessel operations 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. Historically, some introductions of alien species have had extreme ecological consequences, either directly through the introduction of benthic predators such as *Rapana venosa* or through system wide perturbations as exemplified by the invasion of the planktonic ctenophore *Mnemiopsis leidyi*. In other instances, such as the introduction of the bivalve *Anadara inaequivalvis*, the effects have been less severe and in the case of *Beroe ovata*, have in fact served to redress some of the ecological the perturbations caused by *M.leidyi*. Despite its low probability of occurrence, the possibility of population or community-wide effects on the ecology of the sea makes this a potential impact of high significance.

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.

In the event of an uncontrolled gas release from the pipeline, the gas flow will be shut off as soon as practicable. For approximately one third of the pipeline in the Project Area gas will not leak from the pipelines. This occurs where the external pressure around the pipeline (i.e. the pressure of the seawater) is greater than the pressure of the gas within the pipeline. Any gas released from the remainder of the damaged sub-sea pipeline would rise through the water column as a plume of gas bubbles. On reaching the sea surface, the gas would disperse into the air. No marine ecology receptors are anticipated to be affected by the accidental release of gas.

Chapter 13 Unplanned Events discusses the impact assessment and potential mitigation measures associated with these events.

8.10 Cumulative Impacts Assessment

As is set out in **Chapter 14 Cumulative Impacts**, the Turkish Petroleum Corporation (TPAO) has confirmed that there are no existing oil and gas explorational drilling or development activities occurring within or near to the Project Area. However, TPAO advised of two possible oil and gas exploration and production projects which may be brought forward over the next three years, namely the Tuna Prospect, in the northwest of License Area 3921 and the Sile Prospect in License Area 3920. There is also the potential for cumulative impacts from the South Stream Offshore Pipeline – Russian and Bulgarian Sectors.

Given that these two TPAO prospects are at a very early stage of evaluation, there is no information on the extent of development (e.g. extent of seismic surveys or number and extent of well heads), and consequently little on which to base an assessment of the potential for cumulative impacts. TPAO has indicated however that if oil or gas is discovered in the 'Tuna Prospect' license area 3921, it could be necessary to construct a pipeline(s) to carry the hydrocarbons south, thus intersecting the Project Area during the Operational Phase of the Project.

There is the potential for noise from seismic surveys to interact with noise from Project vessels. Noise impacts for the Project are experienced out to a distance of 1 km for mammals and around 0.5 km for fish. Seismic activity can impact fish and mammals more significantly than vessel noise however, as the extent, type and frequency of the TPAO seismic surveys is not known, no quantitative assessment can be undertaken.

In terms of cumulative impacts between different sectors (Russia, Turkey and Bulgaria) of the South Stream Offshore Pipeline, these are unlikely given that the construction spreads will be around 500 km apart and noise impacts in the form of mild avoidance behaviour of fish or mammals (which are the furthest reaching associated with activities) will not extend more than 1 km from the vessel.

Further details on the cumulative schemes are given in **Chapter 14 Cumulative Impact Assessment**.

8.11 Conclusions

The Construction and Pre-Commissioning Phase of the Project has the greatest potential to impact marine ecological receptors. With the exception of impacts on marine mammals as a result of noise emissions, all residual impacts have been assessed as **Low** significance or **Not Significant** through the adoption of design controls and the implementation of mitigation measures.

The impacts on cetaceans from underwater noise were initially assessed as of **Moderate** significance after mitigation. However, such significance is not compatible with the definition of "moderate impacts" as applied throughout the Project and therefore expert judgement has been applied, in line with **Chapter 3 Impact Assessment Methodology**. The resulting impacts, after mitigation, are consistent with the definition of "low significance" and it is even arguable that noise emissions from the construction spread would result in negligible impacts because they would not cause "*noticeable changes to baseline"*. However, it is considered precautionary, and thus appropriate, to rank the significance of the impact as **Low** and not negligible.

Similarly, the impacts associated with the Operations Phase have been assessed as being **Not Significant**.

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

Because the Project footprint has been shown to intersect critical habitats, the Project Standards require that the following be demonstrated (as stated in Paragraph 17 of PS6 of the IFC Performance Standards):

1. *No other viable alternatives within the region exist for development of the project on modified or natural habitats that are not critical.* Because of the scale of the Project and the wide distribution range of species such as dolphins and porpoises, any pipeline in the Black Sea would intersect critical habitat and thus there is no alternative available.
2. *The project does not lead to measurable adverse impacts on those biodiversity values for which the critical habitat was designated, and on the ecological processes supporting those biodiversity values.* The ESIA Report demonstrates that marine ecological impacts are of low significance, with no reduction in biodiversity (beyond very localised and temporary impacts and not to critical habitat features) or any substantial change to ecological processes.
3. *The project does not lead to a net reduction in the global and/or national/regional population of any Critically Endangered or Endangered species over a reasonable period of time.* The ESIA Report demonstrates no population level impact to protected or rare species.
4. *A robust, appropriately designed, and long-term biodiversity monitoring and evaluation program is integrated into the client's management program.* The Project has committed to a programme of ecological monitoring and focused research that will include the features pertinent to critical habitats. Given that the potential impacts of the Project are Low, then implementation of monitoring and research programmes represents a biodiversity benefit, by strengthening the scientific basis on which conservation programmes may be based, thereby enhancing their value. The project's mitigation strategy will be described in a Biodiversity Action Plan and will be designed to achieve net gains9 of those biodiversity values for which the critical habitat was designated.

[9] PS6 states that Net gains are additional conservation outcomes that can be achieved for the biodiversity values for which the critical habitat was designated.

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