South Stream
Offshore Pipeline
ENERGISING EUROPE

Appendix 9.1: Fishing Study

Appendix 9.1 Fisheries Study

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This report has been prepared by MRAG Ltd.on behalf of South Stream Transport B.V.

Executive Summary

This report has been prepared as part of the South Stream Offshore Pipeline (referred to throughout this report as "the Project") as an Appendix to the ESIA Report. It gives a summary of the most important commercial species and fisheries in the Black Sea as a whole then examines the three countries through which the pipeline will pass Bulgaria, Russia and Turkey. For each country the size of the fleet, the economic importance of the fisheries and the possible effects that the Project may have during the Construction and Pre-Commissioning Phase were evaluated. For all three phases it was assessed that, given the information available, the Project would be unlikely to have any discernible effect upon catches outside the normal annual variations for the countries concerned.

Bulgaria

The Bulgarian fleet had the lowest annual catch of the three countries studied and took only 1% of the Black Sea catch in 2010; only Romania took less (0.05%). All of Bulgaria's fishing fleet operate within Bulgarian waters inside their 24 NM Contiguous Zone; their distant water fleet was dismantled in the early 1990s and as such have no fishing interests outside of Bulgarian waters. The Project is unlikely to have a distinguishable impact on fish stocks that the fishing industry targets and the effect on the commercial fisheries as a whole is likely to be minimal. Fishing grounds are located in the offshore section of the Project Area which will be affected by the safety exclusion zone during the Construction and Pre-Commissioning Phase when the pipe-lay vessel passes through but this will be temporary and localised, approximately 9 to 10 days per pipeline. Effects due to sedimentation and noise during this phase will also be temporary and localised. During operation the exclusion zone will overlap with an area in which beam trawling is currently permitted which will reduce the fishable area for bottom trawling, although this will account for less than 1% of the total permitted fishing area. In addition there is a small fishing community, the Ada Bacha Community, based approximately 2.7 km to the north of the Project Area. The effect of the Project on them is likely to be minimal during construction and pre-commissioning and operation.

Russia

Russian catches represent only around 5% of the total amount caught in the Black Sea. As a fishing nation in the Black Sea they are fourth in terms of total catches, behind Turkey, Ukraine and Georgia. Fishing activity in Russian waters is largely confined to the shallower waters of the continental shelf where concentrations of fish species are greatest, these is no fishing outside their 24 NM Contiguous Zone. Anchovy make up the majority of Russia's Black Sea catch, both in terms of the quantity caught and economic value and is therefore the most important marine fish resource for Russia in the Black Sea.

The impact on the fishing activities will most likely be minimal. While the pipeline landfall section does lie in the proximity of a number of fishing grounds and fixed traps, the use of microtunnelling will reduce the disturbance caused by dredging close to shore as it will limit the extent of seabed disturbance; the noise and light generated during the Construction and Pre-Commissioning Phase will only be temporary and localised allowing migrating fish to pass by, further from shore if necessary. It has also been reported that there is no bottom trawling in the

area, all catches offshore are taken through midwater trawls, purse seines or fixed nets. On this basis, an operational safety exclusion zone on the seabed will have minimal effect on the offshore fleet in the area.

Turkey

Turkey is the dominant country in Black Sea fisheries. As in Bulgaria and Russia, fishing activity in Turkish waters is largely confined to the shallower waters of the continental shelf areas where concentrations of fish species are greatest. The European anchovy makes up the majority of Turkey's Black Sea catch in terms of the quantity caught and economic value and is therefore the most important marine fish resource for Turkey in the Black Sea.

It is unlikely that the pipe-laying activities in the Project Area in Turkey will impact on Turkish fishing activities. Although the Project in Turkey is located in Turkey's Exclusive Economic Zone (EEZ), it is more than 110 km from the coast and little evidence that fishing activity takes place near or in the Project Area has been found. It is unlikely that a fishery does operate in this area due to its distance from the coast with associated low catch per unit effort (CPUE) and the fact that the distribution of fish is largely within the shallower coastal waters as the deeper waters do not support marine life. Most fishing activities target the Turkish coastal wintering grounds of commercially important fish when their aggregations are greatest.

The literature reviewed as part of this assessment identify that only the European anchovy migration route intersects the proposed pipeline route in Turkey. European anchovy migrate through the Black Sea twice a year, however it is unlikely that the pipe-laying activities will impact upon these migrations as the disturbance generated by the activities will result in a relatively small impact zone of only 280 m diameter around the construction spread, which is insignificant in relation to the 125 km width of the migration corridor. Furthermore, the disturbance is likely to only cause a startle response and not a significant change in fish behaviour therefore the European anchovy is likely to avoid the source of disturbance and continue their migrations unaffected.

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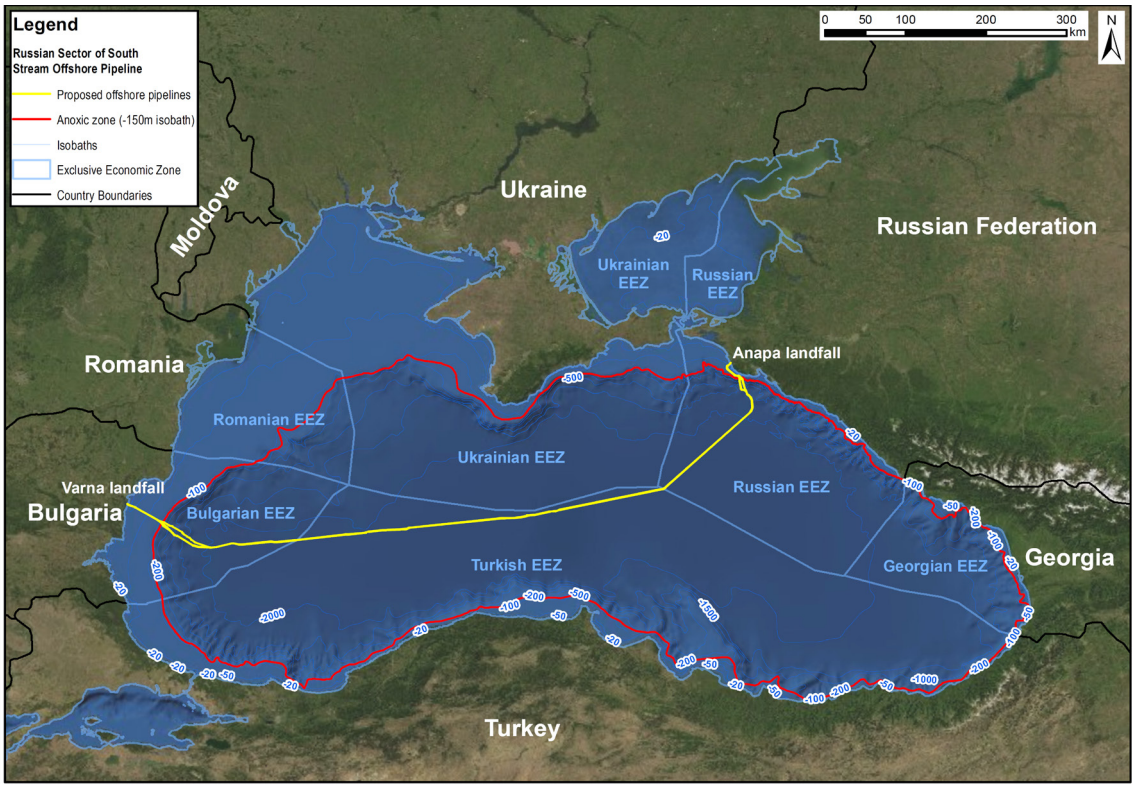
1.1 Physical Characteristics

The Black Sea is located in south-eastern Europe between the East European Plain and the mountain ranges of the Caucasus and Asia Minor Peninsula (the Pontic Mountains). In the northeast, it is connected to the Sea of Azov through to the Kerch Straits, and in the southwest it is connected to the Marmara Sea and the Mediterranean Sea through the Bosphorus and Dardanelles Straits. It has an area of more than 420,000 km^2 and contains about 550,000 km^3 of water, with a maximum depth of around 2,200 m. It is divided into eight regions: Northwest, Southwest, Turkish, Southeast, the Caucasus, the Kerch-Taman, Crimea, and Central regions.

The Black Sea is characterised by low salinity levels due to the fact that it is isolated from the world's oceans and has a positive balance of freshwater receiving about 350 km^3 per year of from three large rivers, Danube, Dnieper and the Don. In the central area of the sea, surface salinity is 18 ‰ increasing to 22 ‰ with depth resulting in the vertical stratification of the water column into a number of layers of different densities. Due to the weak mixing of the waters, deep layers of water below 150 m depth are anoxic and are unable to support life (for any commercially significant species). This limits the fishing grounds to areas on the continental shelf above 150 m (Figure 1.1) for anything but pelagic trawling.

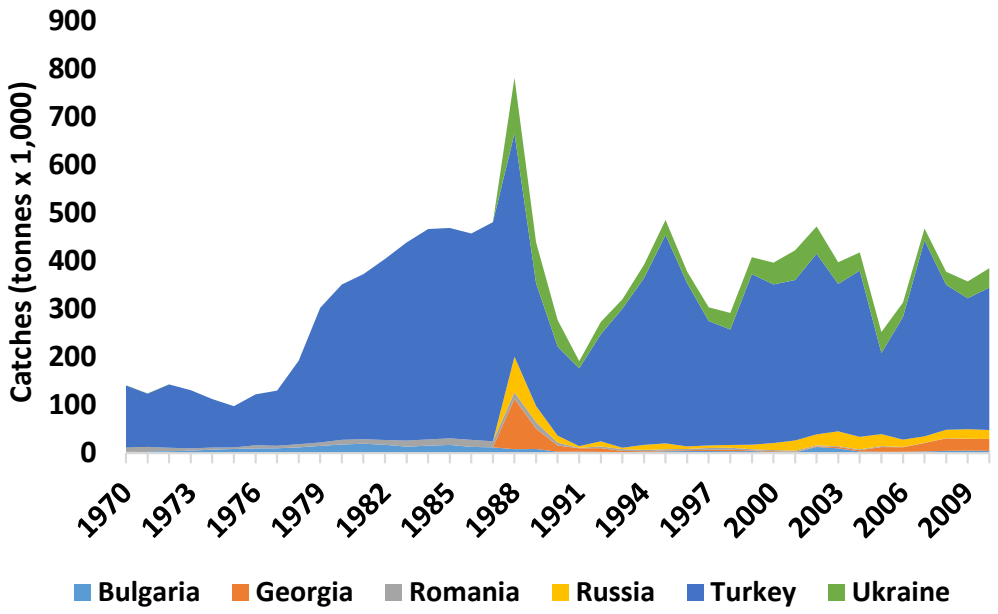
Figure 1.1 Bathymetric map of the Black Sea showing 150 m contour, below which is the anoxic zone, and the route of the South Stream Offshore Pipeline



1.2 Fisheries

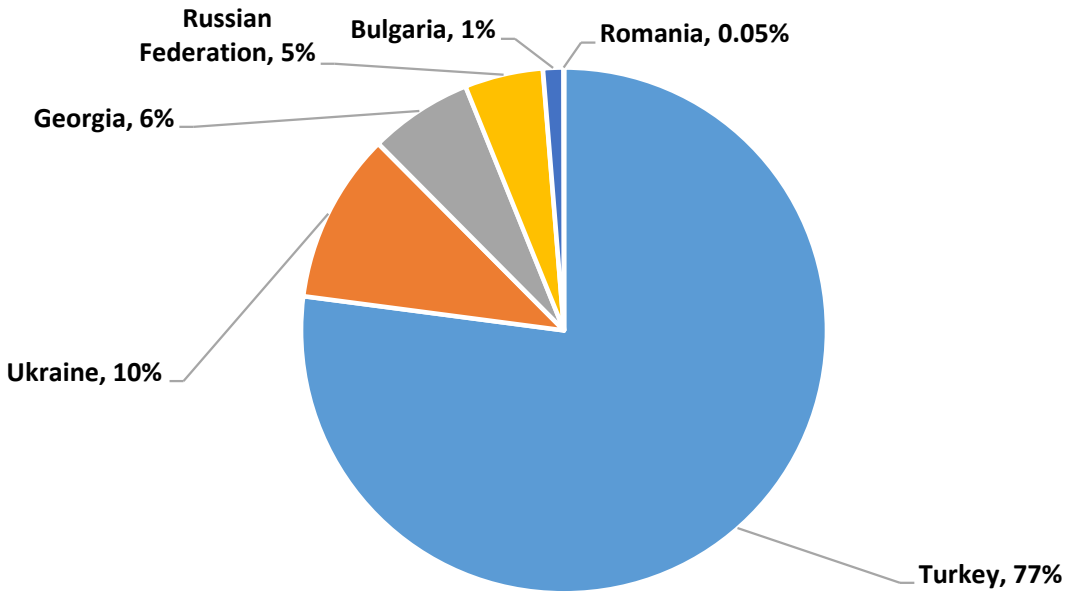
Since the 1970s, when the fisheries in the Black Sea were developing, it is considered that there have been three distinct phases in the fisheries' evolution (Ref. 69), which can be seen in Figure 1.2. Between 1970 and 1988, during the development phase of the modern fishery, catches gradually increased up to almost 800,000 tonnes (t). Between 1989 and 1991 there was a sudden crash with catches falling to 200,000 t. The crash was particularly noticeable in anchovy, sprat and other small pelagic species and was caused by a combination of overfishing, the introduction of the invasive predatory ctenophore (comb jelly) *Mnemiopsis leidyi*, nutrient loading and pollution (Ref. 12). The accidental introduction of the *M. leidyi* led to a major decline in zooplankton abundances and also directly predated upon the larvae and juveniles of some important commercial fish species (Ref. 27, Ref. 53; Ref. 56). This situation persisted until around 1997 to 1998, with another accidental introduction, possibly by ship ballast water, of the ctenophore *Beroe ovata* (Ref. 57). This species is the main predator of *M. leidyi* and subsequently the zooplankton community began to recover both in species composition and abundance (Ref. 58). As a result catches began to increase from 1992 onwards and have fluctuated between approximately 150,000 and 400,000 t. The high degrees of fluctuation have been attributed not only to the changes in biomass of the commercial stocks but also economic fluctuations and profitability of one fishery over another. This is the reason why the species composition of the catch has changed throughout the years with large-sized "food valuable" fish such as turbot (*Scophthalmus maximus),* bluefish (*Pomatomus saltator*) and Atlantic bonito (*Sarda sarda*) being replaced by smaller pelagic species such as European anchovy (*Engraulis encrasicolus*) and sprat (*Sprattus sprattus*), which have a lower unit price and may be used for oil or fishmeal rather than consumed directly (Ref. 12). Fluctuations in the stock abundance of the smaller pelagics can be affected by the abundance of the larger predators such as the bonito.

Figure 1.2 Total landings in the Black Sea between 1980 and 2010 (Ref. 1)



The Black Sea is bounded by six countries: Bulgaria, Georgia, Romania, Russia, Ukraine and Turkey, all of which have fishing interests to different extents. Currently Turkey takes the majority of the catch by volume (77%) followed by the Ukraine (11%), Georgia (6%), Russia (5%) and Bulgaria (1%). Romania also takes a small amount although this accounts for less than 0.5% (Figure 1.3). Of all the fish species taken the small pelagic species are the most significant, with anchovy and sprat accounting for almost 90% of the total catches in 2010 (Table 1.1). The most valuable species is turbot, although catches of this have fallen in recent years and now account for less than 0.1% of the total.

Figure 1.3 Proportion of catches taken by country in 2010 (Ref. 1)



1.3 Commercial Black Sea Fish Species

Assessments for species are done for the Black Sea as a whole, rather than on a country by country basis, by the Scientific, Technical and Economic Committee for Fisheries (STECF) Expert Working Group on Assessment of Black Sea Stocks (EWG). At the last meeting assessments were carried out for seven species: anchovy, sprat, turbot, whiting (*merlangius merlangus*), horse mackerel (*Trachurus mediterraneus*), piked dogfish (*Squalus acanthias*) and red mullet (*Mullus barbatus barbatus*). Data were considered insufficient to assess the rapa whelk (*Rapana venosa*) which is an invasive species in the Black Sea (Ref. 4). Of assessments conducted, only the ones for sprat, turbot, anchovy and whiting resulted in any analytical estimations of the status of the stock size and exploitation, the remainder could only give indications of trends over time. Below is a summary of the main species assessed, which includes a summary of their migration, movements and exploitation in the Black Sea as a whole, country specific information will be given in the relevant Sections. A summary of the main migratory commercial species targeted is given in Annex 1.

Table 1.1 Catches of main species (tonnes) in the Black Sea by country in 2010 (Ref. 1)

Species	Bulgaria	Georgia	Romania	Russian	Turkey	Ukraine	Total	%
European anchovy	65	24,500	48	11,926	203,026	14,050.6	253,616	65.7%
European sprat	4,041		29	5911	56,839	24,652	91,472	23.7%
Whiting	15	15	10	30	11,894	17	11,981	3.1%
Horse mackerel	165	8	7		12,929	189.6	13,299	3.4%
Mullets (all)	140	2	18	321	6,314	287	7,081	1.8%
Bluefish	63				2,887		2,950	0.8%
European pilchard	8			1	1,857		1,866	0.5%
Turbot	46		48		252	207.7	554	0.1%
Sharks Rays etc.	79			29	118	38.3	264	0.1%
Gobies	44		13		38	75.8	170	0.0%
Picked dogfish	77		3			27	107	0.0%
Other fish	35		15	397	1582	873	2,901	0.7%
Total	*4,778*	*24,525*	*191*	*18,615*	*29,7736*	*40,417.2*	*38,6262*	

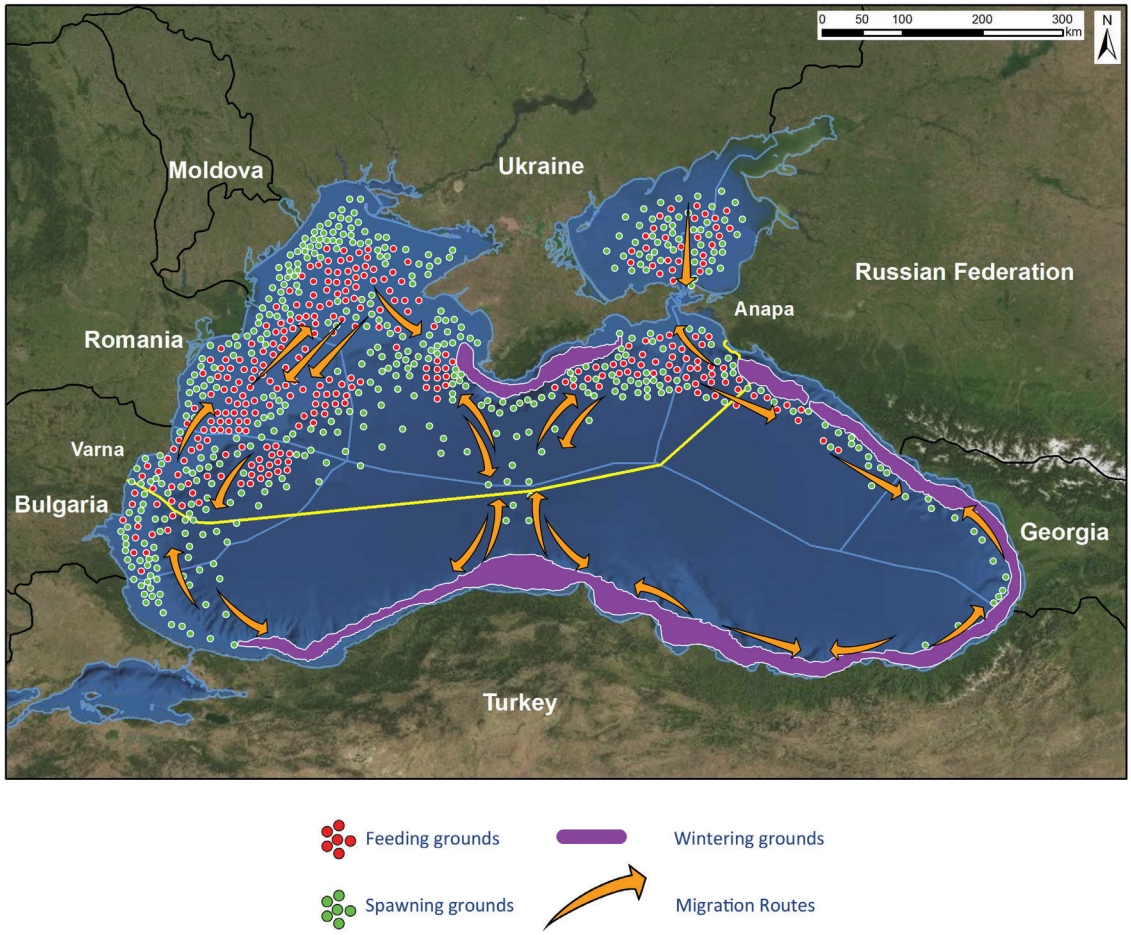
1.3.1 Anchovy (*Engraulis encrasicolus*)

The anchovy is a migratory pelagic species and the most abundant species in the Black Sea (Ref. 40). There are thought to be two distinct stocks of anchovy in the Black Sea; the Azov anchovy (*Engraulis encrasicolus maeoticus* (Ref. 20))[1] and the European anchovy (*Engraulis encrasicolus*) (Ref. 47), although for the purposes of catch reporting they are all recorded as the

[1] This name is not officially accepted on the World Register of Marine Species: http://www.marinespecies.org/aphia.php?p=taxdetails&id=126426

European variety. The Azov anchovy spawn and feed in the Sea of Azov between May and August, then, triggered by falling sea temperatures in September and October, they migrate through the Kerch Strait into the Black Sea to wintering grounds in the coastal areas of the Crimea Peninsula and Russia as shown in Figure 1.4 (Ref. 47). They are targeted primarily by Russian and Georgian fleets.

Figure 1.4 Migratory routes, spawning grounds and feeding grounds of anchovy in the Black Sea (adapted from Ref. 4)

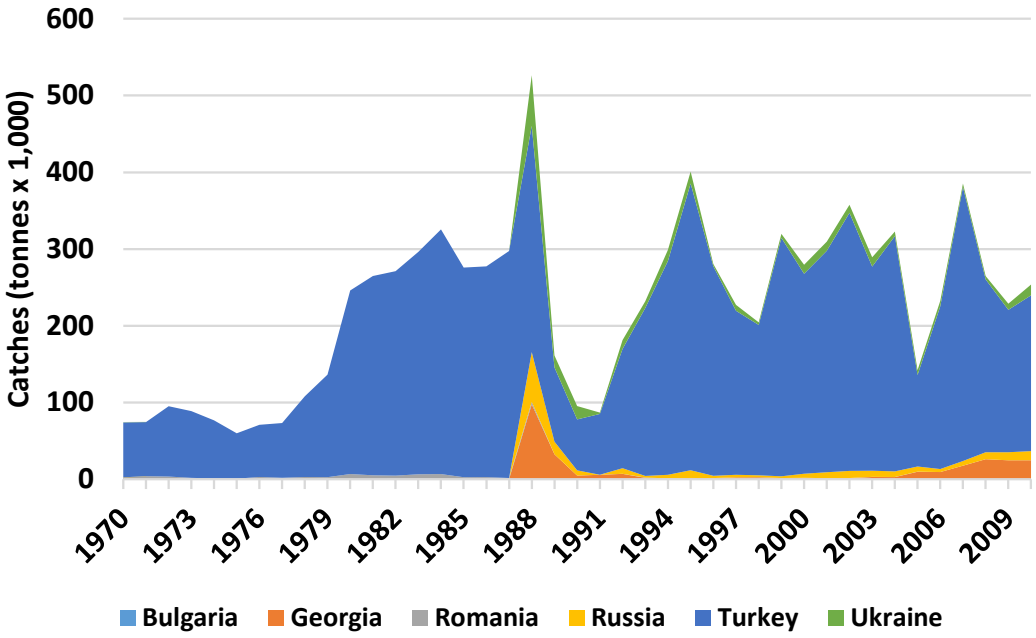


The European anchovy are distributed throughout the Black Sea with the main spawning and feeding grounds in the north-western and western continental shelf of the Black Sea, along the coastal waters of Bulgaria, Romania and Ukraine (Ref. 4). Spawning occurs between May and August (Ref. 44). Spawning activity is also thought to take place in coastal waters in the southern Black Sea (Ref. 45). The main feeding and growth seasons are also in the summer months. In the autumn falling temperatures trigger a southward migration between October and November through the Black Sea and along coastal waters to the Turkish and Georgian coasts where they form dense wintering concentrations (Ref. 4; Ref. 47) and are targeted by commercial fisheries. In the spring, anchovy migrate from southern coastal wintering grounds and return to spawning areas in the north-western coast. The migration route of the European anchovy is either through the middle of the Black Sea or along the western coast.

The exact timings of these migrations vary from year to year and up-to-date information is not available. The Institute of Marine Science at the Middle East Technical University in Turkey is conducting an on-going fisheries research project, in conjunction with the Turkish Ministry of Food, Agriculture and Livestock, to establish the distribution of spawning grounds, over-wintering behaviour and migratory behaviour of anchovy in the Black Sea. However, results from this work were not available at the time of writing (Ref. 48).

Anchovy is mostly taken through the commercial purse seine fishery, with Turkey taking the majority of the catch (over 80% in 2010). The catch in Black Sea countries increased until 1984 when it peaked at 566,000 t before dropping from 526,000t in 1987 to 86,000t in 1988. Between 1995 and 2010 the catches have fluctuated between 135,000 t and 400,000t, in 2010 they were 253,616t. These fluctuations can be seen in Figure 1.5 and have been attributed to a number of possible causes including a change in the target species of Turkish purse seiners (as mentioned in Section 1.2), increase in predators such as the Atlantic bonito and climate change as well as overfishing.

Figure 1.5 Anchovy landings in Black Sea countries 1970 to 2010 (Ref. 1)

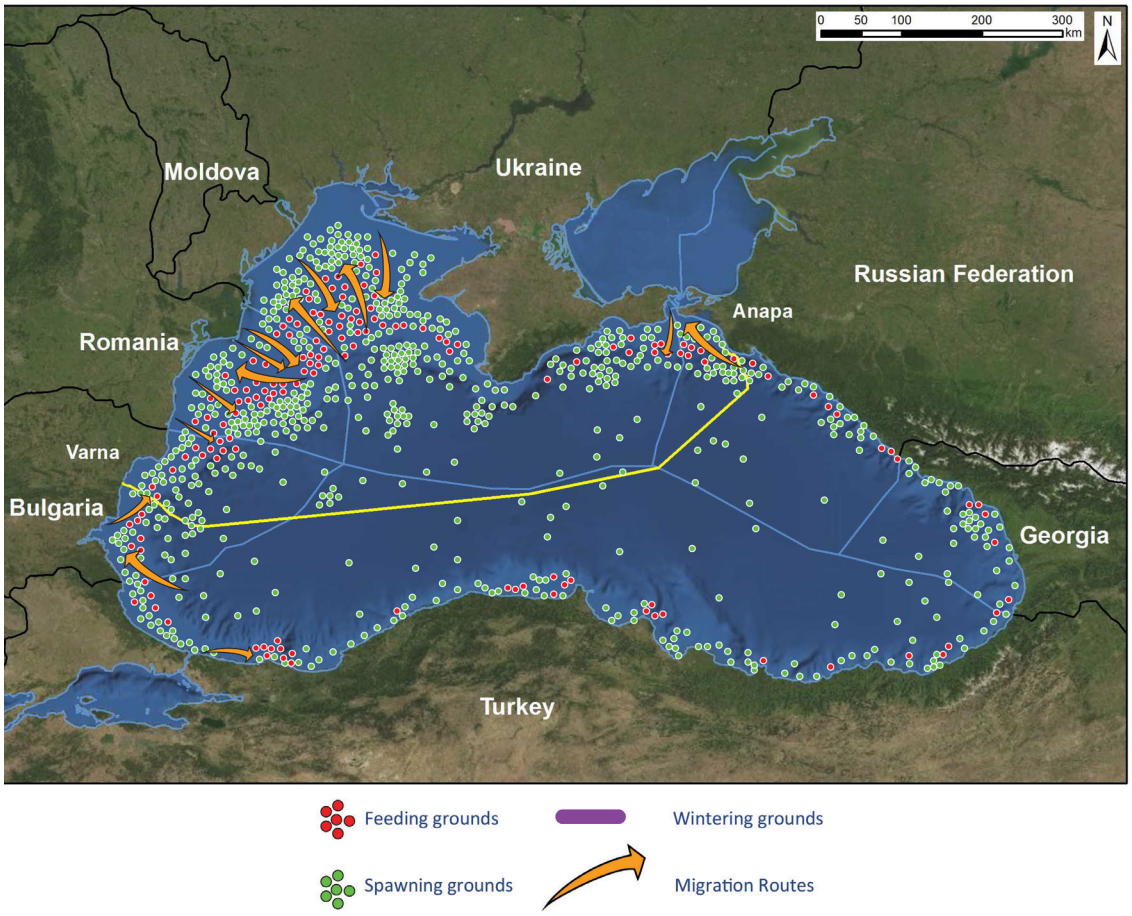


1.3.2 European Sprat (*Sprattus sprattus*)

The European Sprat (*Sprattus sprattus*) is distributed throughout the Black Sea and is considered a single stock, although there is another species, the Azov sea sprat (*Clupeonella cultivenfris*), which is targeted in some areas although not reported in catch records as a separate species. The European sprat undertakes seasonal migrations between inshore feeding grounds and offshore spawning grounds where they spawn near the surface at depths of 10 to 20 m (Ref. 44) as shown in Figure 1.6. Migrations do not take place along coastal waters and

sprat do not have specific wintering grounds. Their migrations are strongly influenced by environmental conditions such as temperature and the availability of trophic resources (Ref. 12).

Figure 1.6 Sprat distribution, migratory routes, spawning and feeding grounds in the Black Sea (adapted from Ref. 4)

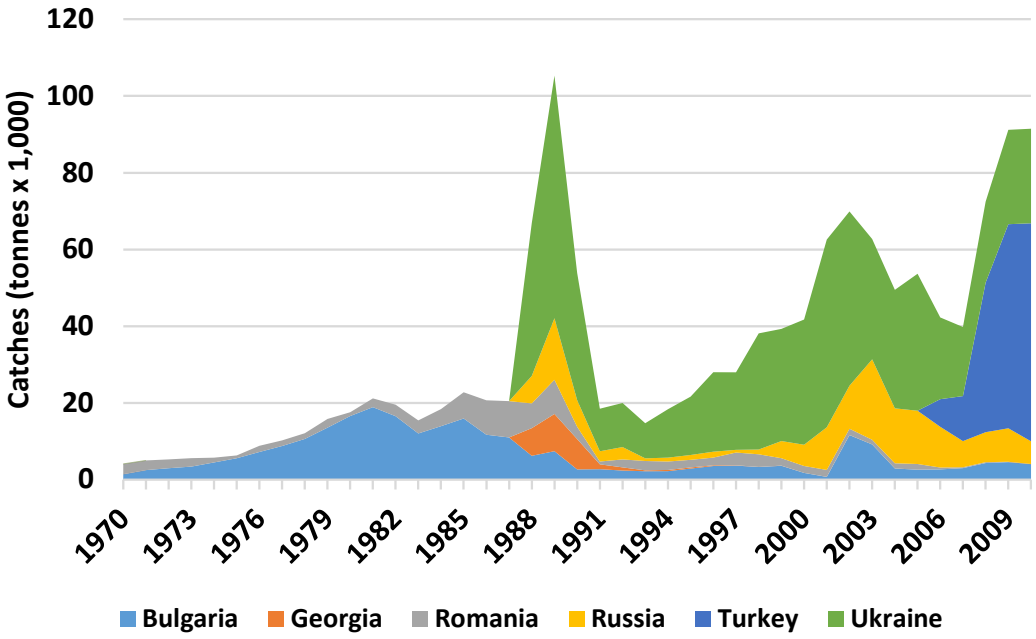


The Azov Sea sprat is present in the Sea of Azov and the north-western area of the Black Sea. It is a brackish water species but also semi-anadromous and fresh water variations also occur. The Azov Sea sprat breeds in early summer in the Sea of Azov peaking in May and also in the lower areas of the rivers from May until the end of summer (Ref. 74). Although it is used as a food product and restrictions are put in place for its capture off the Russian coast, it is not recorded as a species in the General Fisheries Commission for the Mediterranean (GFCM) Capture Production Database (Ref. 1) or recognised as a separate stock by STECF (Ref. 44) and is probably all just reported as European sprat.

Sprat fishing takes place on the continental shelf between depths of 15 m to 110 m and is conducted during the day with mid-water trawls when aggregations are denser. The main fishing gears are mid-water trawls, pelagic pair trawling (Turkey only) and uncovered pound nets. The main fishing season in Bulgarian and Russian waters is between April and October (with mid water trawlers) and in Turkey in spring and autumn (with pair trawlers). Figure 1.7 shows the sprat catches by Black Sea countries since 1970, with the exception of the Ukraine,

catches remained fairly constant until 2007 when Turkey entered the sprat fishery and catches increased to 91,000t in 2010 (62% from Turkey), although Bulgarian, Russian and Ukrainian fleets also increased their catches.

Figure 1.7 Sprat landings in Black Sea countries 1970 to 2010 (Ref. 1)

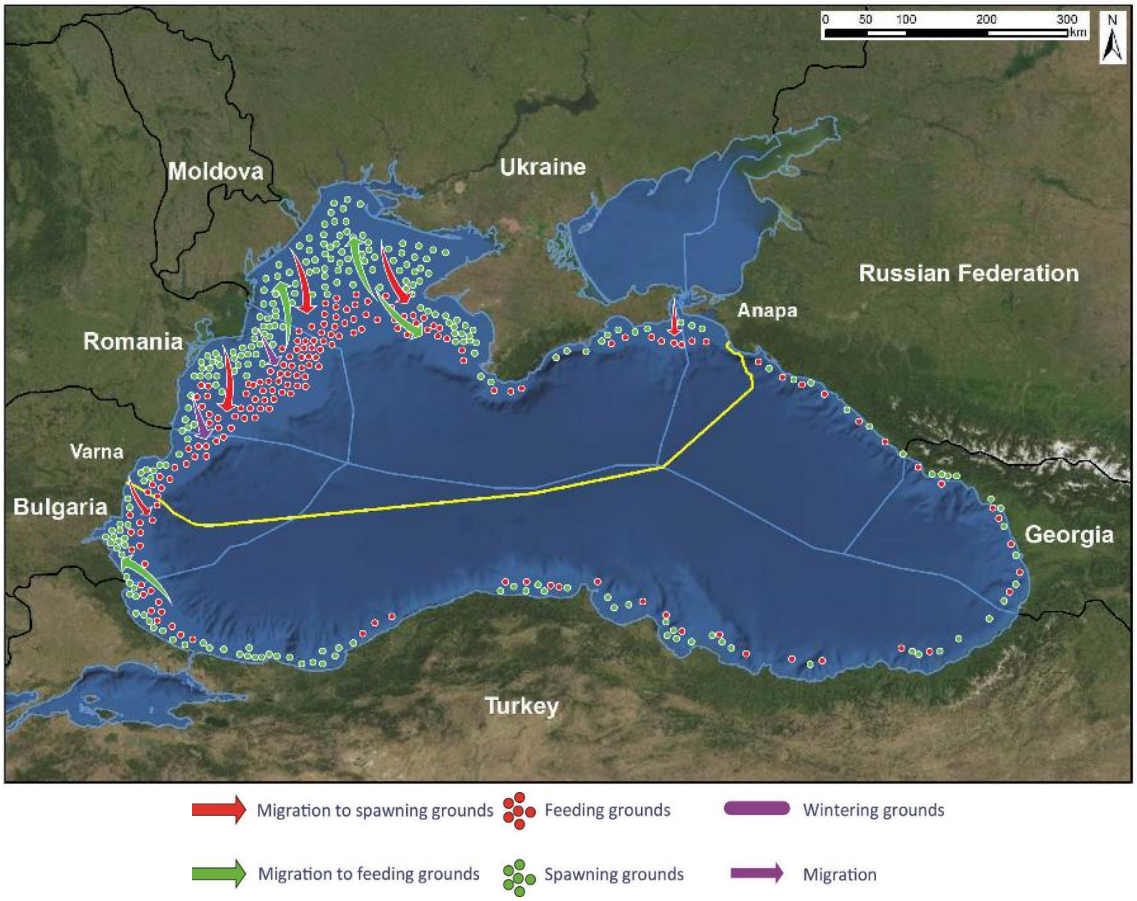


1.3.3 Whiting (*Merlangius merlangus*)

Whiting (*Merlangius merlangus*) is one of the most abundant species within the Black Sea. It is a demersal species found mainly on mud and gravel seafloors but also occasionally sand and rock. It does not undertake long migrations, instead spawning during the winter season within its habitat area (Figure 1.8). It occurs all along the shelf, most often at depths between 60 m to 120 m but sometimes up to 150 m. Dense commercial concentrations are formed but not every year, normally every 4 to 6 years, and as a result it is not normally selected as a target species but often caught as by-catch on trawl fisheries, particularly for sprat, or in fixed nets in the coastal areas and therefore it may not be reported. The southern area of the Black Sea is the only area where it is found on a more regular basis and Turkey is the only country that actively targets this species through either trawl fishing or gillnets. Gillnets account for 15% of the catch with the remainder taken through bottom trawling (Ref. 4).

Figure 1.9 shows that catches of whiting between 1970 and 2010 with Turkey taking almost 100% of the reported catch, although some were taken by Romania in the 1980s. Catches peaked towards the end of the 1980s but as with other species this was followed by a sharp drop and steady decline.

Figure 1.8 Distribution of whiting within the Black Sea showing migratory routes, spawning and feeding grounds



1.3.4 Turbot (*Scophthalmus maeticus*)

Turbot (*Scophthalmus maeticus*) occurs over all shelf areas of the Black Sea coastal states and is commercially the most valuable species to be exploited. It is mainly taken using gillnets, apart from Turkey, the only country where bottom trawling is permitted (minimum mesh size 40 mm). In 2010 there were 225 Turkish vessels targeting turbot (Ref. 12).

Annual surveys are carried out in both Bulgaria and Romania and these have determined that the species is distributed all along the continental shelf with the largest abundance in water depths between 50 and 75 m. Adults migrate to shallower waters and aggregate during the spawning period in spring after which they move into deeper waters (100 m to 140 m). Feeding and spawning areas and the movement between them are shown in Figure 1.11.

Turkey and Ukraine have been the main countries to exploit the stock, with small amounts also taken by Bulgaria and Romania. Catches since 1989 are shown in Figure 1.10. The highest catches were registered in 1995 and since 2007 catches have remained below 1,000t, although it is thought that there is a large, non-reported catch several times higher than the official reported catch (Ref. 12).

Figure 1.9 Whiting landings in Black Sea countries 1970 to 2010 (Ref. 1)

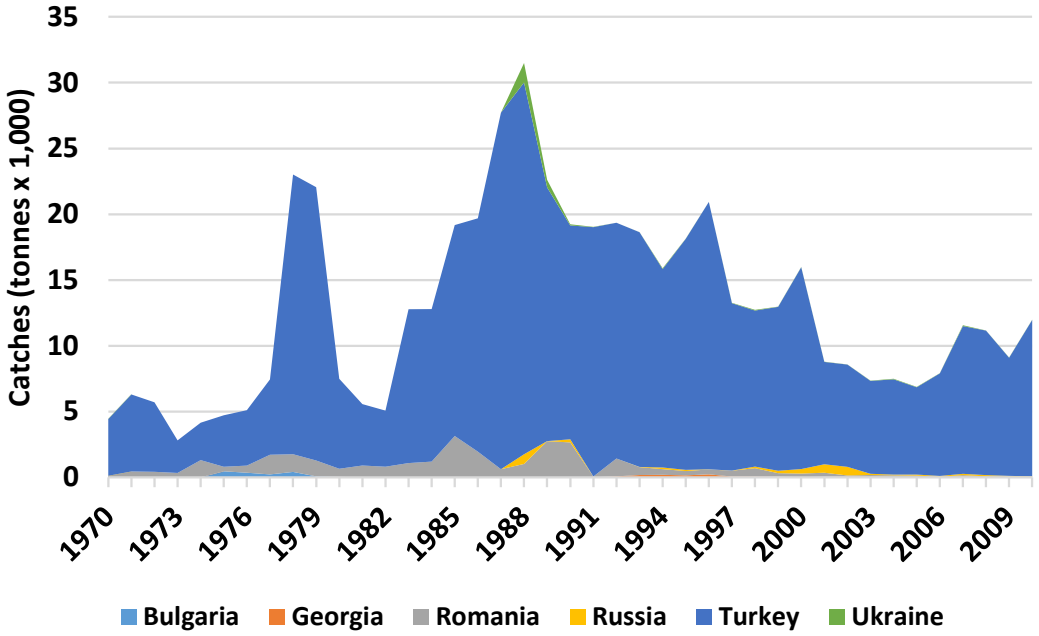


Figure 1.10 Turbot landings in Black Sea countries 1992 to 2012 (Ref. 1)

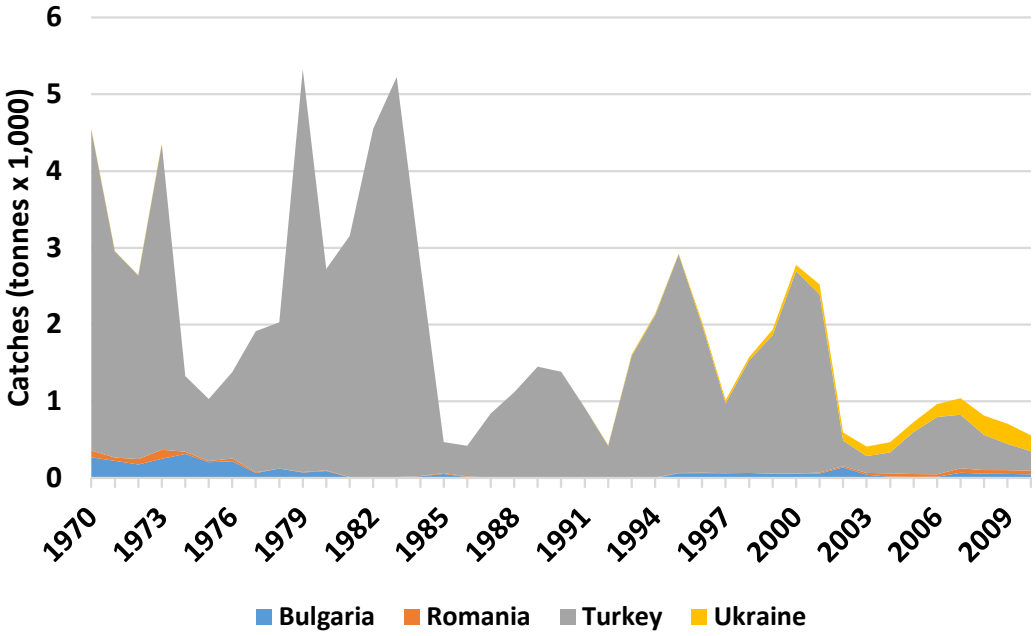
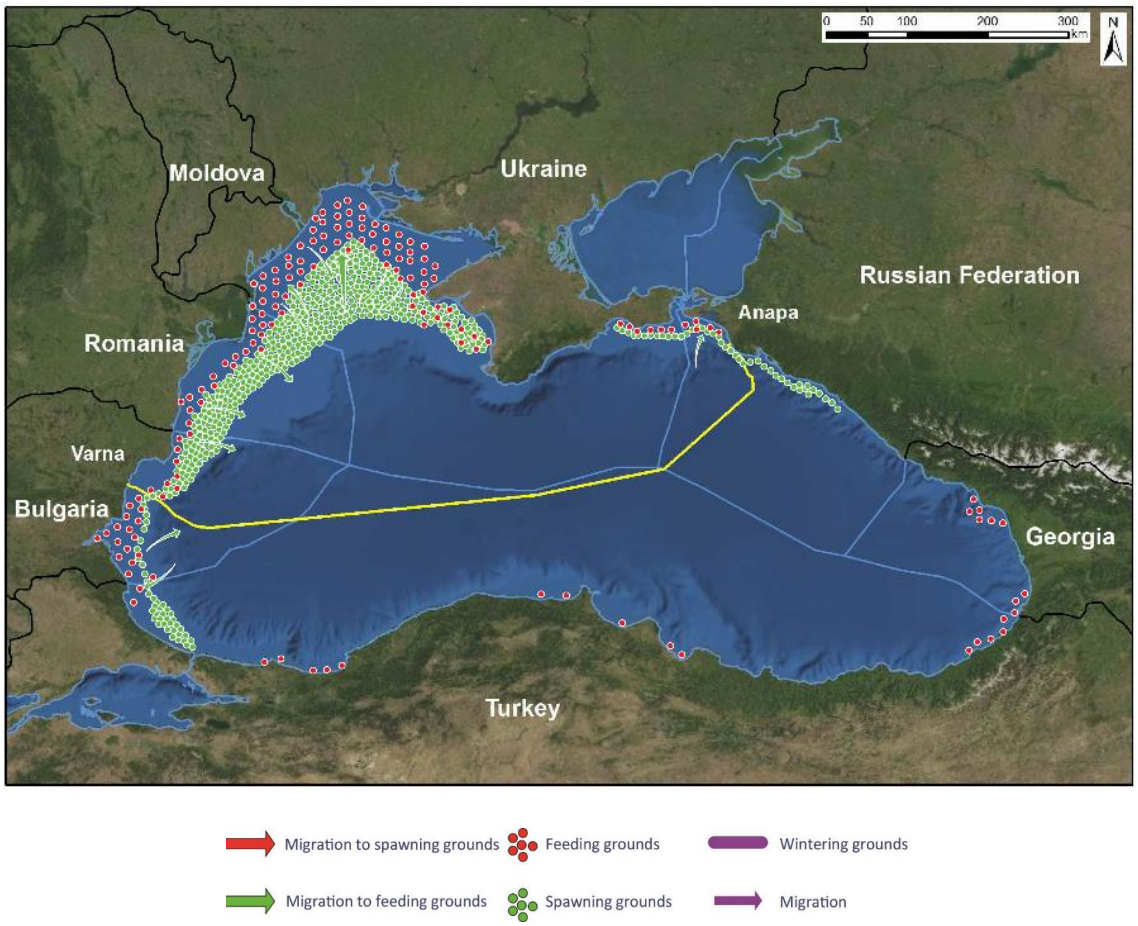


Figure 1.11 Turbot distribution, migratory routes, spawning and feeding grounds in the Black Sea (Ref. 67)



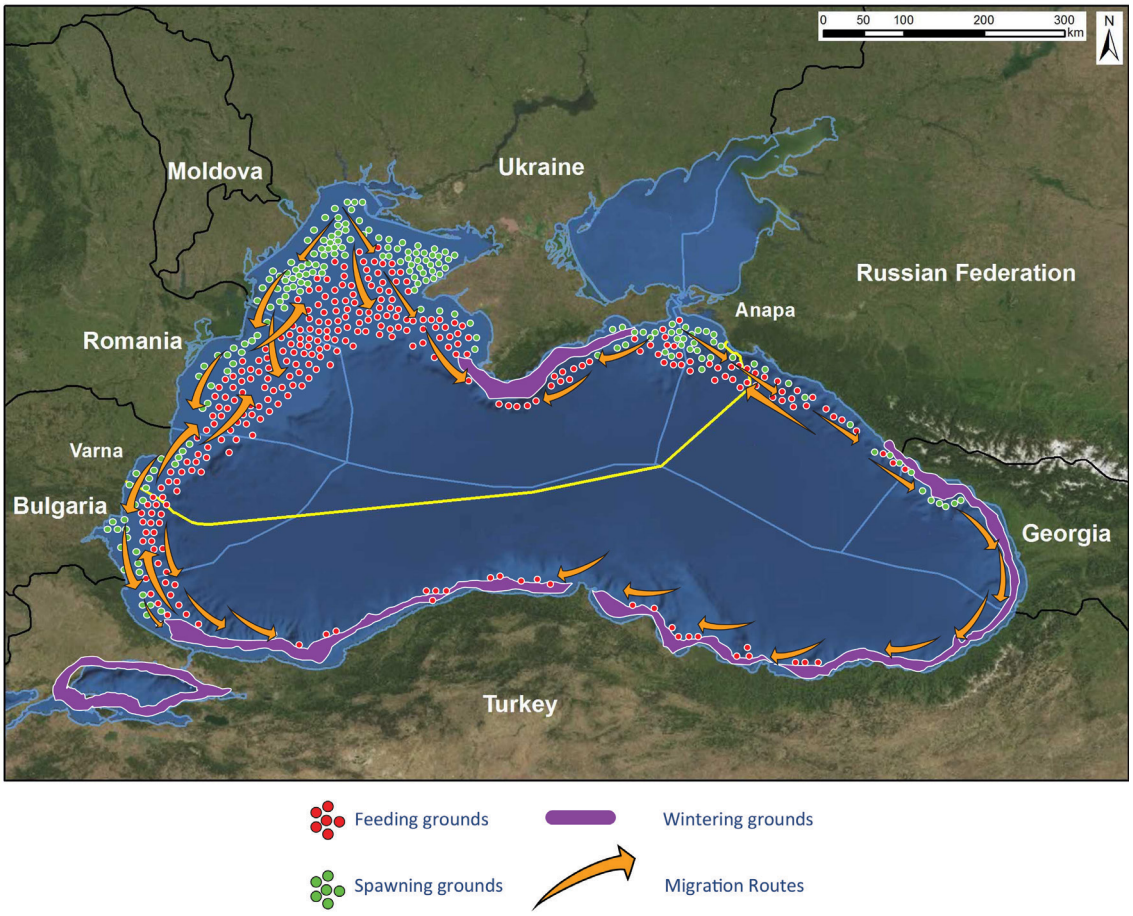
1.3.5 Mediterranean Horse Mackerel *(Trachus mediterraneus)*

The Mediterranean horse mackerel (*Trachus mediterraneus*); because of its wide distribution and large seasonal migrations forms the basis of a shared stock between different Black Sea countries, as seen in Figure 1.12 (Ref. 12). For the basis of reporting it has previously been recorded as either Mediterranean horse mackerel or Atlantic horse mackerel (*Trachus trachus*) however the species caught is actually the Black Sea horse mackerel (*Trachus mediterraneus ponticus),* a distinct subspecies (Ref. 60; Ref. 53). Their main spawning and feeding grounds are in the north-western and western continental shelf regions of the Black Sea, but they also spawn in the north east of the Black Sea along Russian coasts. In the autumn (September to November) they migrate along the coastal waters to wintering grounds which are situated in the coastal waters of Turkey, Georgia, Russia and the Crimea Peninsula. In the spring (Mid-April) they migrate back to feeding and spawning grounds (Ref. 4).

The stock is almost exclusively exploited by Turkey (97%) with negligible amounts from other countries. It is caught in the wintering grounds of the southern Black Sea by purse seiners and mid-water trawlers; catch is mostly made up of fish aged 1 to 3 years (they mature at age 1 to

2). Catches are currently estimated at 21,258 t (Figure 1.13) and they are at their highest level since the late 1980s, where they reached over 100,000 t.

Figure 1.12 Black Sea horse mackerel distribution, migratory routes, spawning and feeding grounds in the Black Sea (adapted from Ref. 4)

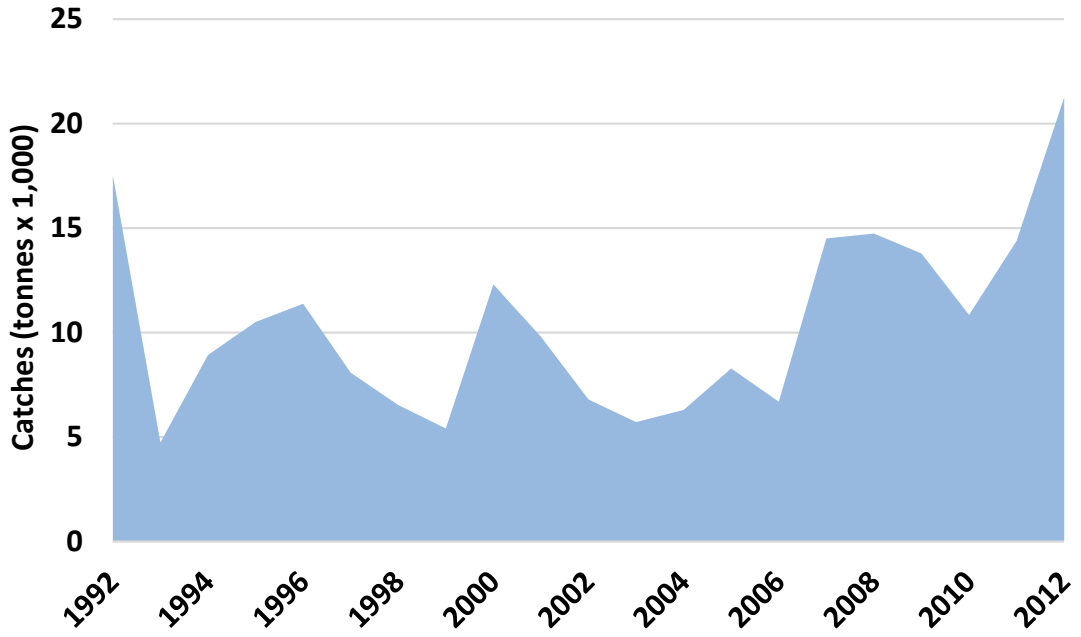


1.3.6 Atlantic Bonito (*Sarda sarda*)

The Atlantic bonito (*Sarda sarda*) is the most important of the larger pelagic commercial species such as bluefish (*Pomatomus saltator*) in the Black Sea. They migrate from the Aegean Sea and Sea of Marmara into the Black Sea between April and August to spawn and feed (Ref. 4). The spawning grounds within the Black Sea are large but they spawn mainly in the north-western and western parts of the Black Sea between the end of May until the middle of July (Ref. 43). In the autumn, adult Atlantic bonito migrate back into the Sea of Marmara. Part of the stock also migrate along the southern coast of the Black Sea forming shoals and they remain in these wintering grounds until the beginning of March when they begin to migrate north to their spawning grounds (Ref. 49). The rest of the stock migrates back to the Marmara Sea and Aegean Sea.

The majority of the stock is exploited by Turkey, the annual landing of the stock decreased, starting from 1980 with small peaks in catches every 5 years, 2002 saw the lowest catch of 4,000 t but then 2005 saw a historical record catch of 60,000 t. They are mainly fished between August and February, with the highest levels caught between September and October. They are caught either from artisanal boats using driftnets or with purse seiners. Small amounts are also taken by Bulgaria and Romania (Ref. 4).

Figure 1.13 Horse mackerel landings in Black Sea countries 1992 to 2012 (Ref. 37)



Transboundary Issues

Within the Black Sea there are number of commercial species that are considered shared by the countries bordering it (Table 1.2); they are either migratory species, entering and exiting the Black Sea through the straits connecting it to the Mediterranean, or endemic (although they may migrate within Black Sea). Impacts to some of these species, caused by the Construction and Pre-Commissioning or operation or the South Stream Offshore Pipeline within any of the three countries' EEZs that the pipeline passes through have the potential to influence fisheries in other Black Sea countries. This is particularly true of species that migrate between EEZs, where disturbances to their normal migratory routes in one country could reduce or prevent their entry into another.

Table 1.2 Commercial species considered by scientists to be shared resources (Ref. 2)

Species	Characteristic
Engraulis encrasicolus (European Anchovy)	Endemic
Trachurus m. ponticus (Black Sea horse mackerel)	Endemic
Sprattus sprattus (sprat)	Endemic
Merlangius merlingus (Whiting)	Endemic
Squalus acanthias (Piked dogfish)	Endemic
Scophthalmus maeoticus (turbot)	Endemic
Mullus barbatus ponticus (Black Sea striped mullet)	Endemic
Liza aurata (Golden grey mullet)	Endemic
Mugil cephalus (Flathead grey mullet)	Endemic
Rapana venosa (Rapana whelk)	Introduced from the Pacific
Sarda sarda (Atlantic bonito)	Migratory
Scomber spp (Mackerels)	Migratory
Alosa caspia (Caspian shad)	Anadromous
Pomatomus saltator (Bluefish)	Migratory

2 Bulgaria

2.1 Fisheries in Bulgarian Waters of the Black Sea

2.1.1 Background

Bulgaria has a coastline of 378 km on the Black Sea and has land frontiers with Turkey, Greece, Macedonia, Serbia and Romania. All the fishing activities take place within its contiguous zone (up to 24 NM offshore) with the majority being within Territorial Waters (12 NM). Offshore fishing vessels operate up to depths of around 100 m and use either demersal gear (bottom-set gillnets), or pelagic (midwater trawls or hooks and lines); there are also some areas where bottom beam trawling is permitted for rapa whelk). In shallower waters close to the coastline, small scale artisanal fisheries use stationary pound nets, gillnets and hooks-and-lines. The main landing ports are Balchik, Burgas, Varna, Sozopol and Nessebar.

The composition of landed catch includes 36 species of fish, molluscs and crustaceans. The most important pelagic fish species are sprat, Mediterranean horse mackerel and anchovy. Demersal fish species with commercial importance are turbot, gobies (*Gobiidae sp.*) and piked dogfish, in the last decade the rapa whelk has become the most commercially valuable mollusc. The landed catches of the main species during the last decade are presented in Table 2.1.

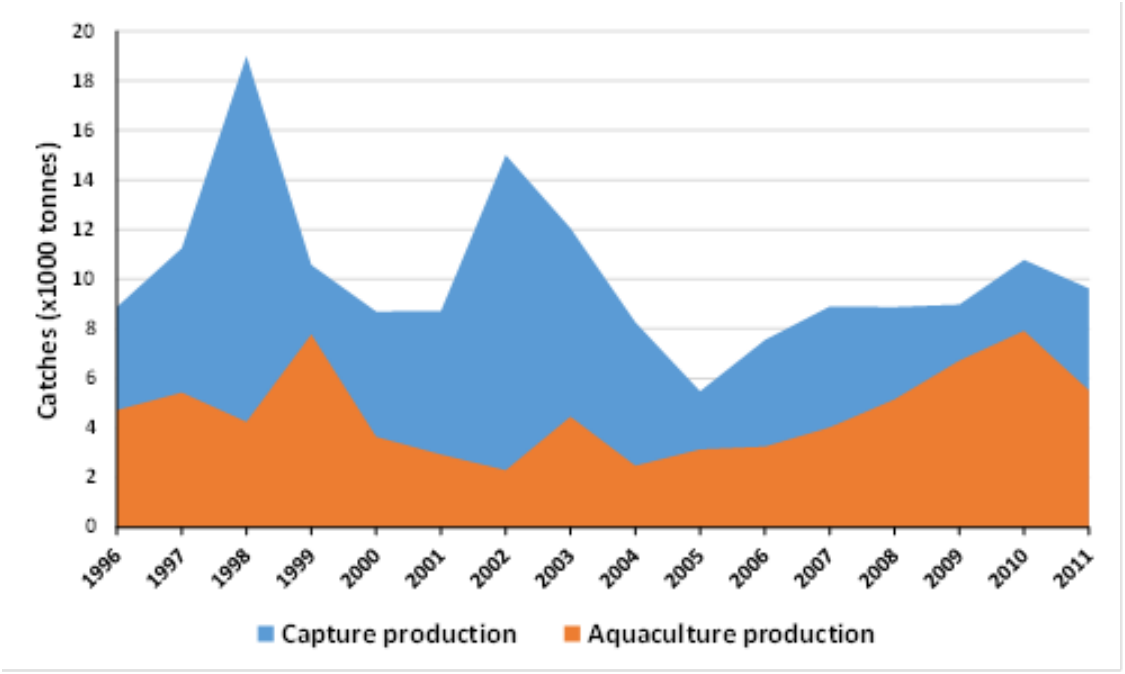
Table 2.1 Landings (tonnes) of the target fish species during the period 2002-2012 (Rounded, Ref. 8)

Species	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sprat	11595	9155	28895	2575	2655	2985	43035	4551	4040	3950	2836
Rapa whelk	698	325	24275	511	27735	4310	28171	2214	4830	3119	3793
Gobies	142	1252	79	49	31	74	5	7	44	85	89
Horse mackerel	142	142	74	29	63	116	180	177	165	393	381
Anchovy	237	131	88	14	6	607	28	42	57	18	8
Piked dogfish	100	51	47	15	6	24	23	10	77	81	42
Turbot	136	41	16	13	15	67	55	525	465	38	36

The Bulgarian fleet currently operates exclusively in the Black Sea following major changes in the early 1990s as the state owned high seas fleet that operated extensively in the Atlantic Ocean was scrapped (Ref. 6). This, combined with the collapse of pelagic stocks throughout the Black Sea led to a subsequent drop in catches from around 100,000 t per year throughout the

1980's up to 1989 down to 50,000 t in 1990 reaching its lowest level of 250 t in 1994. Since then there has been a partial recovery and between 2005 and 2010 catches increased steadily, dropping off slightly in 2011 to just under 10,000 t. Figure 2.1 shows the catch landed by Bulgarian vessels over the last 15 years; the figures include freshwater fish caught inland. In addition aquaculture production (freshwater and marine) also underwent a steep decline from its peak of over 14,000t in the early 1980s to just over 2,000t in 2002 but, like the capture fisheries, it increased steadily between 2005 and 2010, dropping off to its current level of just over 5,000 t (Figure 2.1).

Figure 2.1 Bulgaria fish capture production and aquaculture production 1996 – 2011



Ada Bacha Fishing Community

In addition to the commercial fishing operations there are a number of smaller, artisanal fisheries that operate along the coast. The nearest to the pipeline is the Ada Bacha Community ('the Community' hereafter). The Community is a non-governmental organisation that is located approximately 2.7 km to the north of the pipeline (Figure 2.2).

In total, the members of the Community own approximately 20 boats varying in size from 3.4 m to 6.8 m. All are powered by outboard engines ranging in power between 4 hp and 90 hp with the majority being between 4 hp and 10 hp. These allow them to get to their fishing grounds which, depending on the season and species, range from the peninsula, approximately 2.5 NM to the north, to about 3 NM to the south of the current restricted zone around the Galata gas pipeline and a maximum of 4 NM out to shore.

Fishing is done mostly using monofilament gillnets, which are attached to the bottom using weights and supported with floats on the surface. Driftnets are also used (similar to gillnets but not attached, or attached only at one end to the boat) as well as hooks on vertical longlines in

deeper water; angling is also practiced from the shore. Gillnets can be up to 600 m long and hang down 20 to 30 m depending on the species targeted, they are often damaged by cetaceans coming into contact with them and need to be replaced at least once a year.

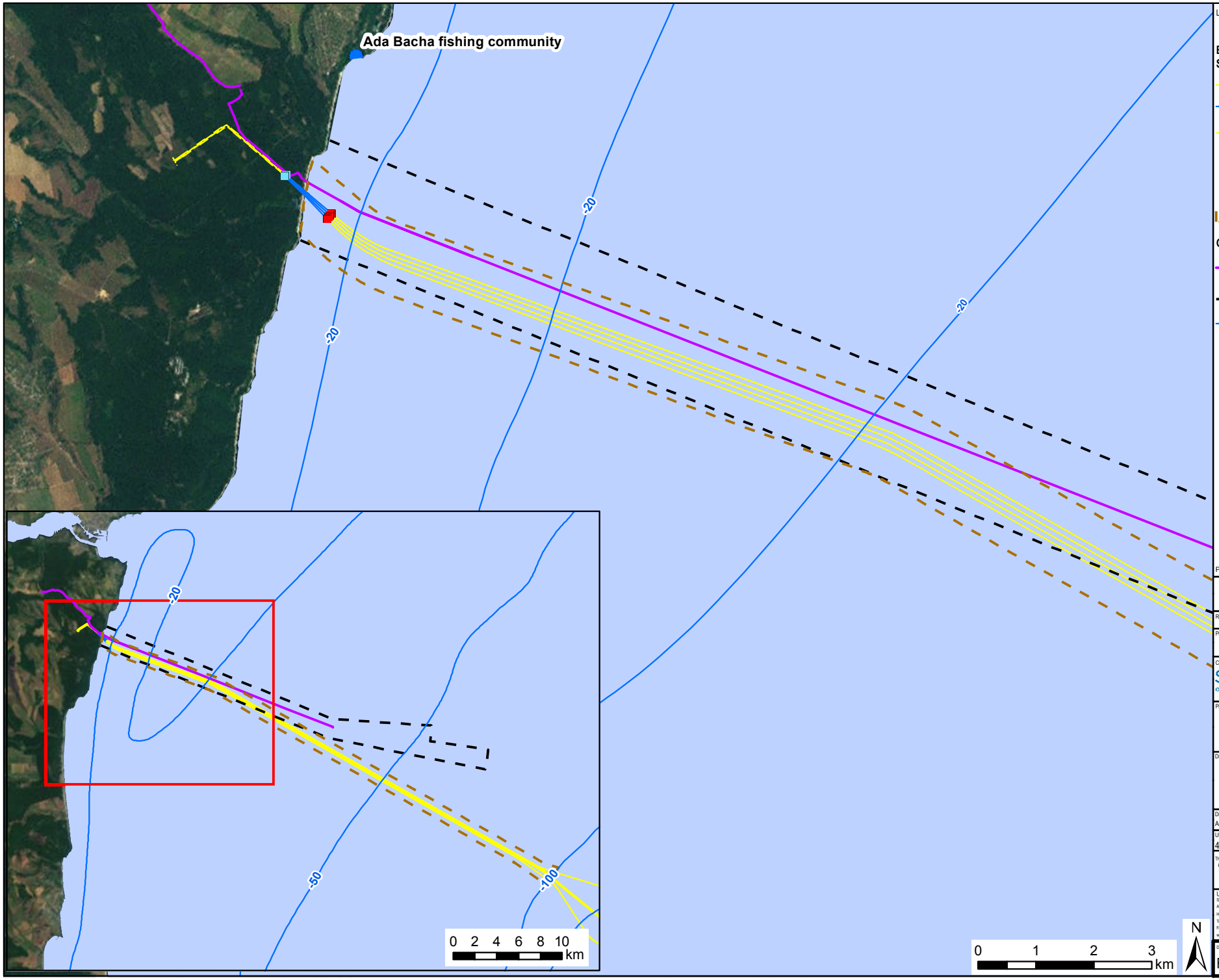
The Community targets a number of different species, most of which are migratory, so the time of year they are targeted will depend on when they migrate past the area where the Community operate. For some species, such as blue fish, this period may be very short, about 4-5 days on their north to south migration. Details of the fishing seasons for the main species are given in Table 2.2; it shows that there is a period in June and July where little or no fishing takes place.

Table 2.2 Fishing seasons, by species, for the Ada Bacha Community

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Goby			■	■	■							
Bluefish								■	■	■		
Bonito									■	■	■	■
Shad	■	■	■	■								■
Horse mackerel									■	■	■	
Flathead mullet	■	■									■	■

A summary of the main species caught by the community is given in Table 2.3; catch weights are estimates by the Head of the Community and are not official catch statistics. In addition to catches shown in Table 5 the Community have caught red mullet and garfish (*Belone belone euxini*) in the past, although these haven't been seen for 5 to 6 years; turbot are no longer fished due to quota restrictions. They are also planning to start a mussel farm in the bay outside the Community; it will cover an area of approximately 50 ha.

Income will depend on what they catch; income per person, as estimated by the Head of the Community, ranged between 1,000 lev in a good month down to around 200 lev in the poorer months. There is little processing done on site and most of the catches were sold on to export companies, such as Sever Export based in Varna who come down to the Community to collect it in refrigerated vans. Some fish are also sold privately to individuals. Most of the fishermen had no other source of income; the women in the Community normally work cleaning and sorting the fish within the Community although some also had work in Varna.



LEGEND

- Ada Bacha fishing community

Bulgarian Sector of South Stream Offshore Pipeline

- Proposed offshore pipelines
- Proposed microtunnels
- Proposed landfall section pipelines
- Microtunnel entry point
- Microtunnel exit point
- Proposed South Stream offshore pipeline exclusion zone

Galata Pipeline Infrastructure

- Existing Galata gas pipeline
- Existing Galata gas pipeline exclusion zone
- 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: THE LOCATION OF THE ADA BACHA COMMUNITY IN RELATION TO THE PIPELINE AND OPERATIONAL PHASE EXCLUSION ZONE

Drawn	Checked	Approved	Date
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Drawing Number: Figure 2.2 — Rev:

Plot Date: 02 Sep 2013
File Name:\15004 - Information Systems\46369082_South_Stream\MXDs\Report Maps - Bulgarian\Bulgarian EIA\Chapter 15\Figure 15.14 Galata Gas Pipeline Exclusion Zone and Proposed South Stream Pipeline.mxd

Table 2.3 Approximate catches taken by the Ada Bacha Community during 2012 – 2013 season

Species	Catch	Approximate value (lev/kg)
Goby	50-100 kg	3
Bluefish	600 – 700 kg	20
Bonito	100 kg	5 to 6 but sometimes 10
Shad	Unknown	5
Horse mackerel	2,000 kg	5 to 6
Flathead mullet *(Mugil cephalus)*	200-300 kg	4 to 5
Leaping mullet *(Liza saliens)*	Unknown	3
Sardine *(Sardina pilchardus)*	Unknown	2 to 3

2.1.2 Economic Value of the Catch

The economic performance of the Bulgarian fleet (which only operate in the Black Sea) has been poor in recent years and has been operating at a loss. For instance, it generated a total income of €4.65 million in 2010 but the total operating costs came to €8.03 million (around 173% of total income). This decline has been continuous since 2008 and is attributed largely to increased crew wages (up 150%) and rising fuel costs (up 28%) during this time. In addition Bulgarian vessels receive an average first sale landing price of just 0.23 €/kg, the lowest of all the EU fleets (compared to Portugal, the highest, 7.81€/kg) (Ref. 4). The catches of the main species along with the average, wholesale, price received are given in Table 6.

Table 2.4 Total catch (tonnes) and average price (BGN per kg) for main commercial species (Ref. 8).

Year	Indicator	Catch Species						Total Catch
		Turbot	*Sprat*	*Horse Mackerel*	*Rapa*	*Blue Fish*	*Other*	
Gear Code		**GNS**	**OTM**	**OTM, FPO**	**NO,NK**	**OTM, GNS**	**-**	
2008	catch	55	4,309	180	2,871	25	226	7,666
	average price	6.92	0.68	2.11	0.65	5.88		
2009	catch	52	4,537	177	2,213	52	364	7,395
	average price	5.42	0.69	2.39	0.57	5.74		
2010	catch	46	4,030	165	4,831	64	550	9,686
	average price	6.95	0.41	2.31	0.27	7.03		
2011	catch	38	3,958	395	3,119	29	609	8,148
	average price	9.1	0.6	3.27	0.26	8.65		
2012	catch	63	2,836	381	3,793	551	531	8,156
	average price	13.51	0.72	2.12	0.87	3.65		

Gear codes: **GNS** – Set gillnets (anchored). **OTM** – Midwater otter trawls. **FPO** – Pots. **NO, NK –** Gear not known or not specified (note. *Rapa* is normally harvested using divers or dredged).

2.1.3 Employment in the Fishing Industry

The Bulgarian fisheries sector contributes around €14 million to the Bulgarian economy and although it provides a relatively small contribution to National employment (0.38% of the national workforce) it provides vital employment at a regional level particularly in coastal areas and communities, including the Varna Region (e.g., the town of Byala) and Burgas Region (e.g. the town of Nessebar). In 2003 there were approximately 12,260 fishing industry employees throughout Bulgaria of which 16% were women (Ref. 3). More recent reviews showed that the number of fishermen employed by the 99 enterprises that make up the Bulgarian fleet in 2010 was 3,993, considerably higher than recent previous years although this is thought to be due to incomplete data (Ref. 4). A further 2,230 people were employed in the 26 processing plants throughout Bulgaria in 2008 (Ref. 5).

The majority of the commercial fishing fleets are based at the ports of Balchik, the city of Varna, Nessebar, the city of Burgas and Sozopol. Varna and Balchik are located to the north of the landfall section and Burgas, Nessebar and Sozopol are located to the south. In 2011 there were a total of 99 fishing enterprises registered in the Bulgarian fleet. Of these, 68% only owned a single vessel, 30% owned 2-5 vessels and only 2% owned 6 or more vessels (Ref. 4).

The fish processing industry within Bulgaria employs around 2,230 people in 26 working plants, the most significant product being that of the rapa whelk, whose meat is removed from the shell, boiled, frozen and exported to Japan or other East Asian areas. There are currently six companies processing rapa whelk who either catch them using their own vessels or take them alive directly from the fishermen (Ref. 11).

Fishery businesses in the Varna area are concentrated in the vicinity of the small port on the north side of the southern channel linking Varna Lake with Varna Bay, opposite the town of Asparuhovo. This is the operational base of 'Sever Export' one of the leading private fishing companies engaged in both fishing and fish processing in Varna. Sever Export fishes in the offshore section of the Project Area, over 19 km from the shore and runs four of its own fishing vessels, each 24 m long which target rapa whelk. Its main export is the rapa whelk (referred to as 'topshell'), which it has been processing since the late 1990s. It employs over 100 processing staff and can produce up to 6 tonnes of topshell per day. Annually it exports between 400 and 450 tonnes of frozen, boiled topshell meat (Ref. 11) and has an annual turnover of between US$2.5 million and US$5 million (Ref. 11). Elektra EOOD is another major commercial fishing company, also based in Varna. Chernomorski Ribolov Burgas AD, SD Ding Sozopol, SD Ding Sozopol, Buldjak AD Burgas and Atlantik AD are all commercial fishing companies based in Burgas, with Atlantik AD also having representation in Varna.

2.2 Fishing Fleet

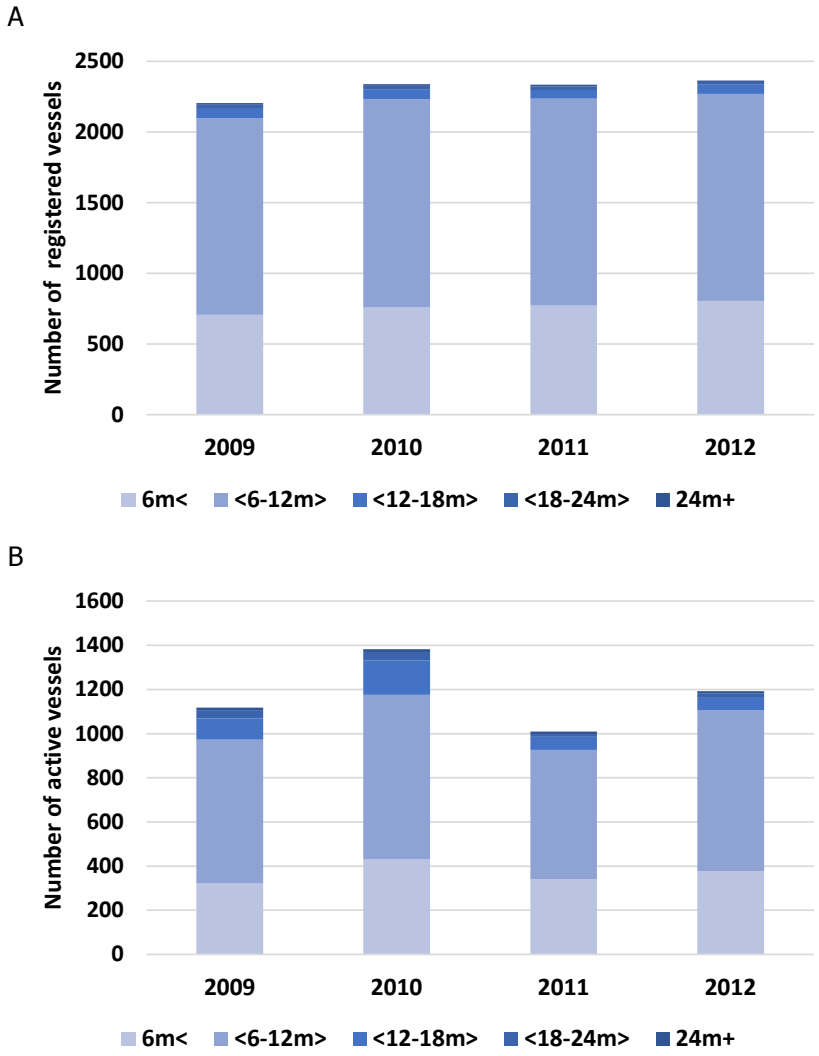
Information about the Bulgarian fleet is recorded in the Fishing Vessel Register (FVR) and maintained by the National Agency of Fisheries and Aquaculture (NAFA). Information includes Length Over All (LOA), gross tonnage (GT), engine power (kW), registration number, vessel age and vessel owner and home port. Fisheries licences are granted each year and fishing gear is checked by NAFA inspectors prior to the licence being issued. Most of the fishing fleet is based out of Balchik, Burgas, Varna and Sozopol. The main ports used by fishermen for landing catches are situated in Varna, Burgas, Sozopol, Balchik, and Nesebar with some small landing sites and shelters at Primorsko, Tzarevo, Ahtopol, Otmanly Ropotamo and Ada Bacha.

The Bulgarian fleet has undergone a transformation over the last 30 years. From 1965 to 1990 Bulgaria headed a large high-seas fleet active in the Atlantic and the south-eastern Pacific (30 high capacity trawlers and six transportation vessels) (Ref. 7), but from the early 1990s these activities were terminated and the fleet refocused on the Black Sea coastal zone. Since 2007 there has been a general decreasing trend as regards the number of vessels and their overall capacity, with a particularly sharp decrease experienced in 2010. Currently the fleet is mainly made up of small-scale vessels used by fishermen operating at a short distance from the shore, many fish for their own consumption and sell what they can locally.

In 2012 the Bulgarian fleet consisted of 2,366 registered vessels; of these only 31 exceed 18 m LOA and over 98% (2,335) were less than 12 m LOA. Of all the vessels registered, only around

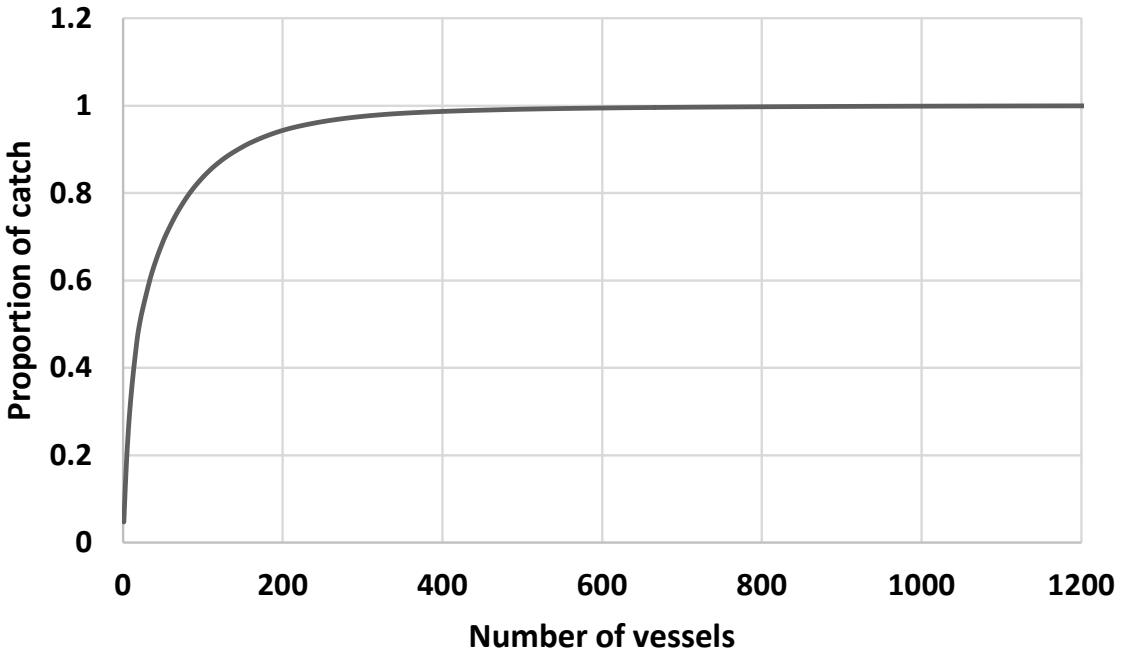
50% are really active. Figure 2.3 shows the main difference can be attributed to vessels between 6 and 12 m (Ref. 8). Most of the vessels over 18 m are over 20 years old and are inefficient for fishing, due to the lack of equipment and engines appropriate to their tonnage. The condition of the Bulgarian fishing fleet is regarded to be relatively poor in terms of on board safety facilities, working conditions, hygiene, product quality, energy efficiency, selectivity of the gears and environmental impact (Ref. 4).

Figure 2.3 Number of vessels registered by size class in Bulgaria 2009 – 2012 A) total number of registered vessels. B) Total number of vessels actively fishing (Ref. 8)



By examining vessel catch records (Ref. 8) it can be seen that although there were 1,192 vessels active in 2012 (with 1,189 recording catches), 50% of the total catch was taken by only 20 vessels (Figure 2.4). The majority of these were around 25 m in LOA and fishing using mid-water trawling, most probably for sprat.

Figure 2.4 Proportion of the catch taken by number of vessels



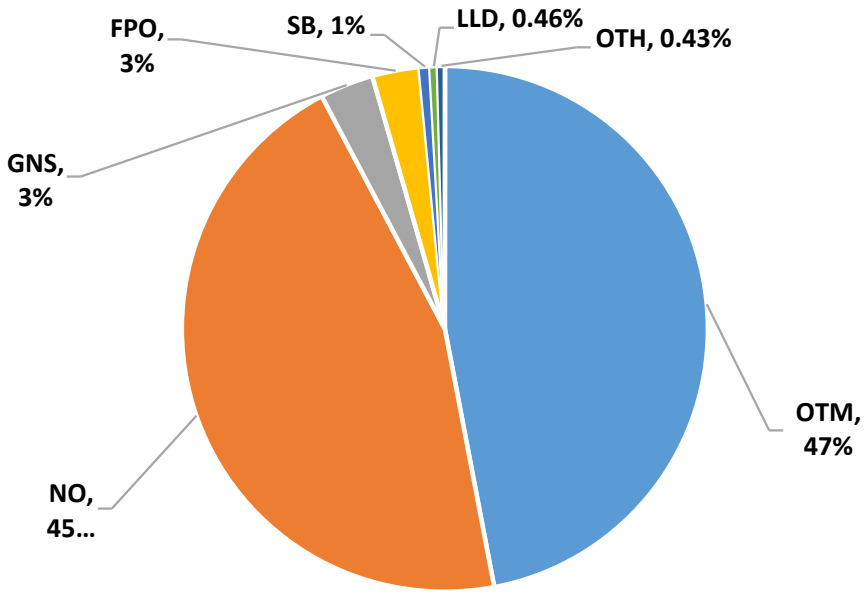
The logbook data (Ref. 8) also show that the largest vessel operating in the fleet in 2012 was 27.2 m LOA with a main engine power of 574 kw and a GT of 79.61 t, there were 10 vessels of around 25 m with engine powers varying between 200 kw and 220 kw with GTs between 100 t and 120 t (Ref. 70), all vessels were polyvalent (operating a number of different fishing gears, either midwater otter trawls, gillnets or longlines) and would switch gear depending on the season and the target species.

The majority of catches are taken using midwater otter trawls (OTM) and a gear category recorded as 'NO' or unclassified. According to the vessel registry (Ref. 70), the majority of 'NO' are registered as having gillnets as their primary gear and midwater otter trawls as their secondary gear, some also report as having used longlines so it is unclear on the exact type of gear 'NO' refers to. A breakdown of gear types used by proportion of catch taken is shown in Figure 2.5, OTH (other) is a combination of minor gear types that account for less than 0.5% of the catch, specifically LLS, LHP, PTN, LNS, GND, GNC and GTN. A list of gear codes used is given in Table 2.5.

Marine Aquaculture

Marine aquaculture currently consists only of mollusc farming and seaweed, and it accounts for less than 1% of the total freshwater and marine aquaculture production (in 2010 Bulgaria harvested 911.84 tonnes of the mussels (*Mytilus galloprovincialis* and *Mytilus edulis*) (Ref. 14). The Bulgarian coast does not have appropriate gulfs or depths suitable for marine aquaculture, although land based farms on the coast and underwater net cages present a potential alternative solution for the future.

Figure 2.5 Gear type by proportion of catch (Ref. 8)



In 2005 there were 18 farms for marine aquaculture; 16 producing mussels and two producing kelp algae (*Cystoseira spp.*), in 2012 the number went up to 40. The farms are located primarily in the central and northern areas of the Bulgarian coast, with the largest one covering an area of around 157 ha approximately 20 km south of Balchik. Within the Varna region there are currently 2 registered farms, Moreski Oasis Mussel Farm and the Setlavi Mussel Farm, both are located to the north of Varna port with the closest being approximately 16 km from the Pipeline. A full list of the mussel farms off the Bulgarian coast is given in Annex 2.

In addition, members of the Ada Bacha Community are developing a 50 ha mussel farm approximately 2.5 km to the north of the Pipeline that they plan to become operational from 2014. Mussels are also collected recreationally along Pasha Dere and Chernmorets beach within the vicinity of the Project Area, a small business sells them (along with other seafood) on Chernomorets beach for 2.5 lev/kg.

2.3 Fishing Areas

The main fishing grounds are coastal (30 to 40 m in depth) and offshore (up to 100 m in depth). Most of the fishing activities are carried out in territorial waters (12 NM), but some fishing also occurs further out. Open sea fishing practices are either demersal (using bottom-set gillnets) or pelagic (using pelagic trawls), whereas in shallower waters close to the coastline fishers tend to use stationary net traps, gillnets or hooks-and-lines.

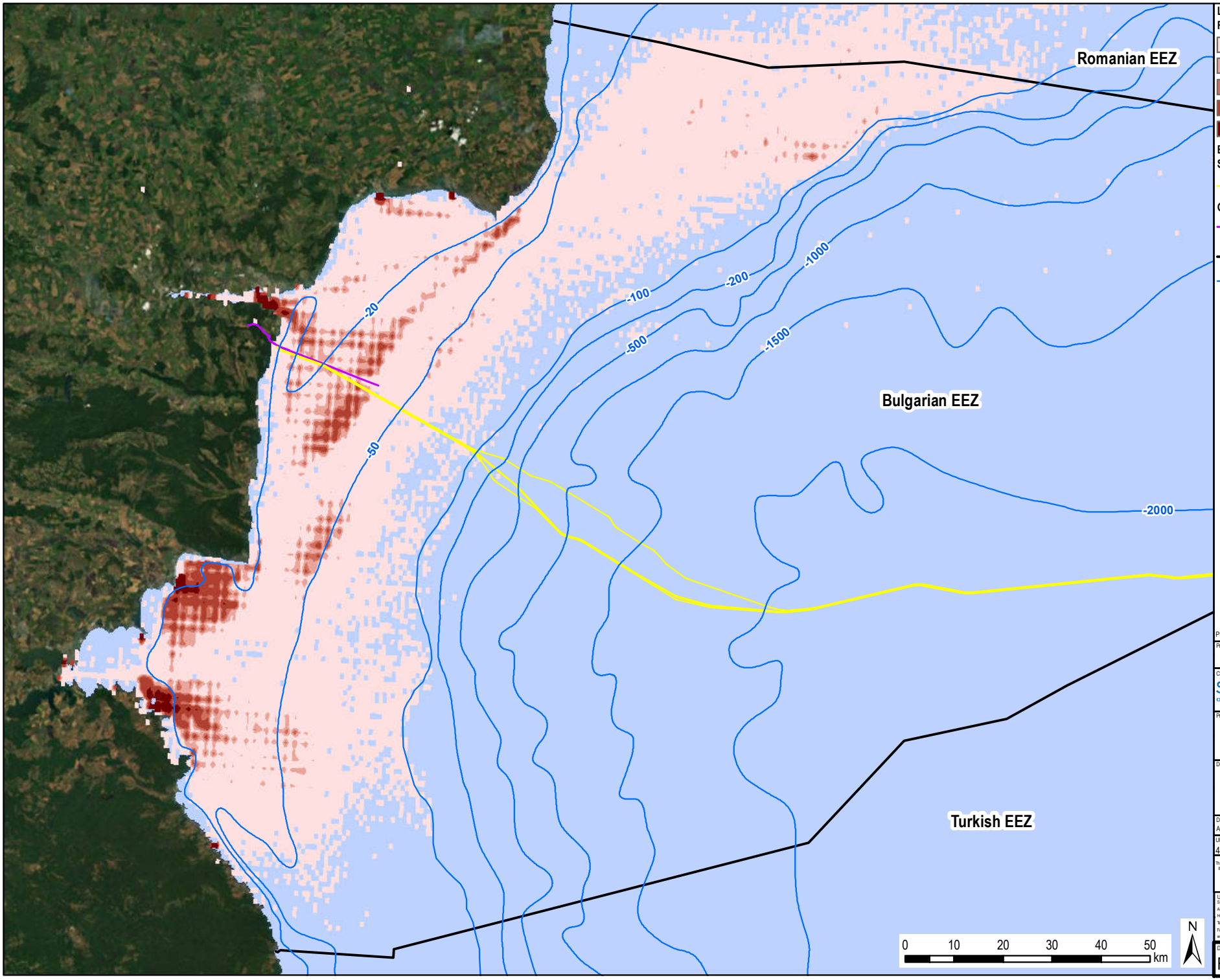
Table 2.5 Gear codes used in logbook returns

Code	Description	Demersal / Pelagic
OTM	Midwater otter trawls	Pelagic
GNS	Set gillnets	Demersal
FPO	Traps (Pots)	Demersal
SB	Beach seines	Demersal
LLD	Drifting longlines	Pelagic
LLS	Set longlines	Demersal
LHP	Hand lines and pole lines (hand operated)	Pelagic
NO/NK	Gear not known / unspecified	Unknown
PTN	Midwater pair trawls	Pelagic
LNS	Shore operated stationary lift nets	Pelagic
GND	Driftnets	Pelagic
GNC	Encircling gillnets	Pelagic

The fishing grounds are shown in more detail in Figure 2.6, which is based on three years of data from vessels' Vessel Monitoring System (VMS); as of 1 January 2012, 111 vessels have had these units installed and running. The VMS transmits a position signal over fixed time intervals (for most of these records one hour) to the countries' Fisheries Monitoring Centre (FMC), which monitors and stores them.

Figure 2.6 shows these VMS signals, aggregated in 0.01 degree by 0.01 degree squares (approximately 0.9 km^2), between 2010 and 2012 with the darker squares representing the areas where vessels have spent most time, the lighter areas represent their entire range The main fishing areas are to the south off Burgas and off Varna, between 10NM and 16NM offshore. The darker areas in or near ports do not necessary represent fishing grounds but show where there is a concentration of vessels, tracks can also be seen between the fishing grounds and the ports.

Figure 2.7 shows the vessel activity in more detail off Varna and around the location of the Pipeline. There appears to be a fishing area approximately 10 NM out to sea, with the main concentration of activity to the south. Darker lines leading out of Varna represent vessels travelling to and from the port to the fishing grounds.



LEGEND

Fishing Grounds (no. of vessels)

- 1 - 33
- 34 - 53
- 54 - 76
- 76 - 205
- 205 - 15084

Bulgarian Sector of South Stream Offshore Pipeline

- Proposed offshore pipelines

Galata Pipeline Infrastructure

- Existing Galata gas pipeline
- Exclusive Economic Zone boundary
- Isobaths

Projection: Lambert Conformal Conic

Purpose of Issue: For Information

Client: South Stream Offshore Pipeline — Energising Europe

Project Title: SOUTH STREAM OFFSHORE PIPELINE

Drawing Title: FISHING GROUNDS OFF BULGARIA CONSTRUCTED FROM VMS DATA 2010-2012

Drawn	Checked	Approved	Date
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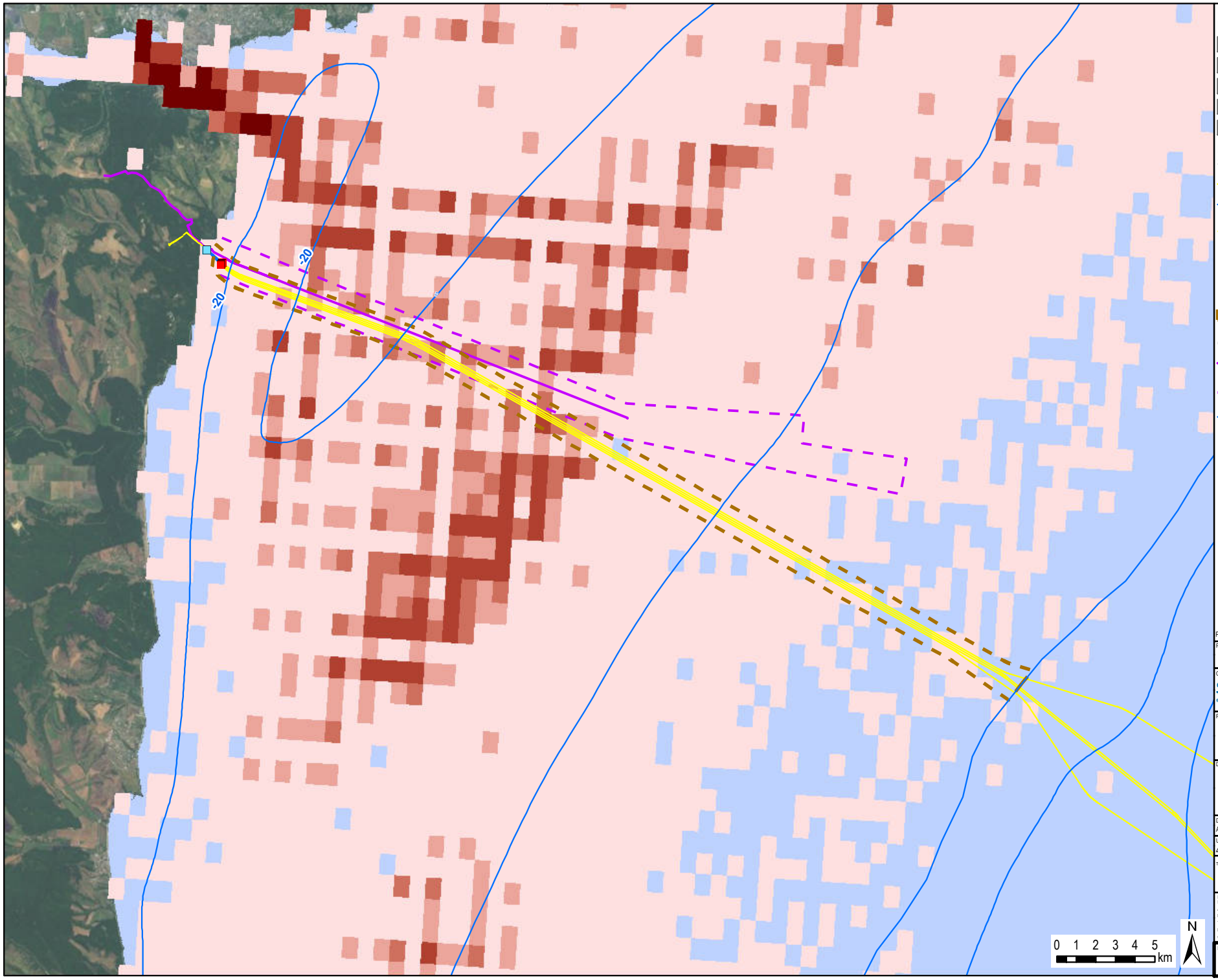
Drawing Number: Figure 2.6

Rev:

Plot Date: 03 Jun 2014
File Name: I:\SIG\4 - Information Systems\46369082_South_Stream\MXDs\Report Maps - Turkey\Turkey ES\AA\Appendix - Fisheries\Figure 2-6 Fishing grounds off Bulgaria Constructed from VMS data 2010-2012.mxd



Projection: Lambert Conformal Conic

Purpose of Issue: For Information

Client: South Stream Offshore Pipeline — Energising Europe

Project Title: SOUTH STREAM OFFSHORE PIPELINE

Drawing Title: FISHING GROUNDS OFF VARNA AREA IN THE VICINITY OF THE PIPELINE

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Plot Date: 03 Jun 2014
File Name:1:50/04 - Information Systems\46369082_South_Stream\MXDs\Report Maps - Turkey\Turkey ESIA\Appendix - Fisheries\Figure 2-7 Fishing grounds off Varna area in the vicinity of the pipeline.mxd

A number of permanent fish traps are also in place; the nearest to the Bulgarian landfall section is owned by the Ada Bacha fishing community and is at N 43°07'75" E 27°55'99", outside the community base approximately 3 km north of the pipeline.

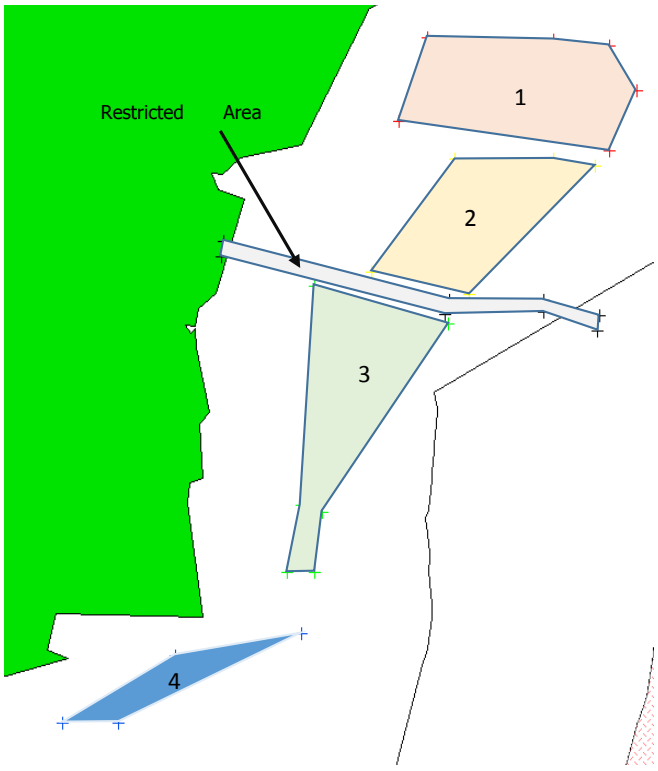
2.3.1 Area and Gear Restrictions

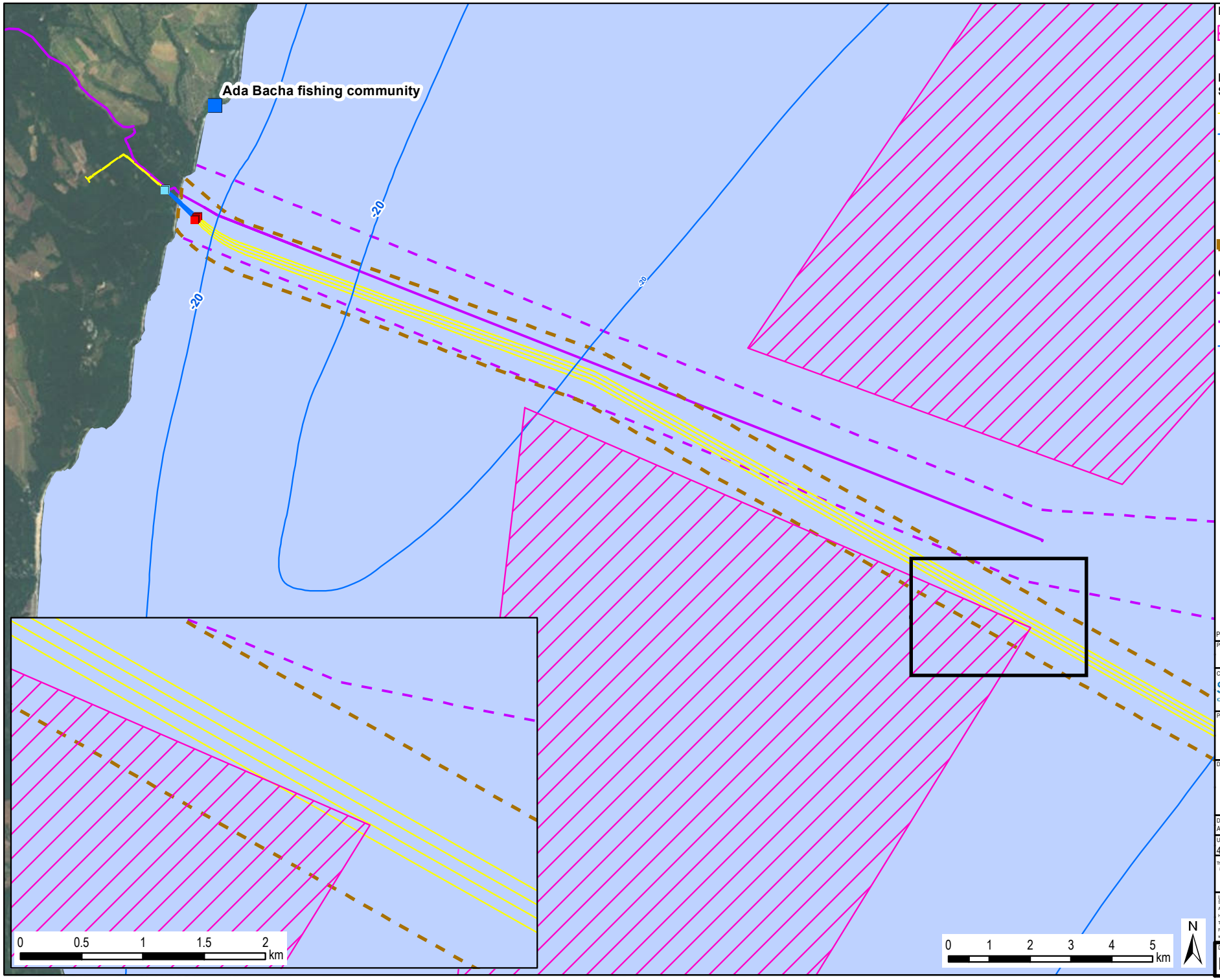
Under the Bulgarian Fisheries and Aquaculture Act (FAA) a ban was put in place for all forms of destructive fishing, including bottom trawls and dredges, within Bulgarian waters. However this was recently changed to allow beam trawling for the rapa whelk in five specific areas as determined by the Bulgarian Ministry of Agriculture and Food. These areas are shown in Figure 2.8. Areas 2 and 3 lie to the north and south of the Pipeline, with the northern boundary of Area 3 overlapping with the Pipelines' route (Figure 2.9).

There is also the Galata gas pipeline exclusion zone (designated by the Department of Maritime Administration in Varna as Area 310), which is shown in Figure 2.8. This area has been designated to protect the Galata gas pipeline from third party activities and is closed to fishing, construction of mussel farms, dredging activities and anchoring.

In addition to the above restrictions there are also limitations to the type of gear that can be used in some coastal areas around river outlets put in place to minimise interference with the migratory routes of anadromous fish species.

Figure 2.8 Areas where beam trawling is permitted for *Rapana venosa* (Area 5, not shown, is located to the south) and Galata gas pipeline exclusion zone (Area 310), closed for all fishing activities.





LEGEND

- Areas permitted for beam trawling
- Ada Bacha fishing community

Bulgarian Sector of South Stream Offshore Pipeline

- Proposed offshore pipelines
- Proposed microtunnels
- Proposed landfall section pipelines
- Microtunnel entry point
- Microtunnel exit point
- Proposed South Stream offshore pipeline exclusion zone

Galata Pipeline Infrastructure

- Existing Galata gas pipeline
- Existing Galata gas pipeline exclusion zone
- Isobaths

Projection: Lambert Conformal Conic

Purpose of Issue: For Information

Client: South Stream Offshore Pipeline — Energising Europe

Project Title: SOUTH STREAM OFFSHORE PIPELINE

Drawing Title: GALATA GAS PIPELINE EXCLUSION ZONE AND PROPOSED SOUTH STREAM PIPELINE

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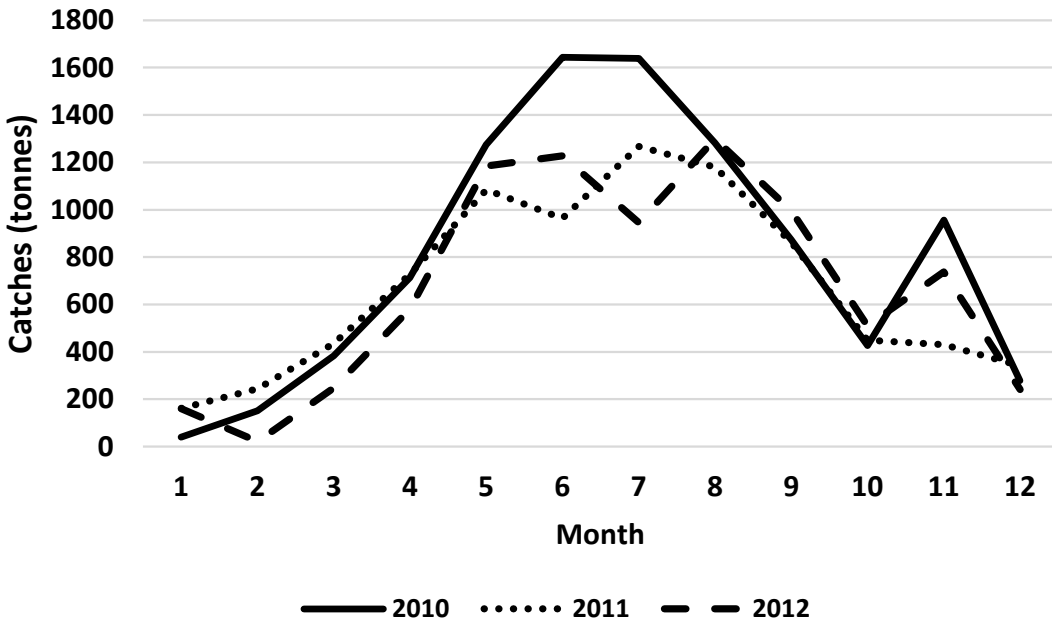
Plot Date: 03 Jun 2014
File Name:I:\5004 - Information Systems\46369082_South_Stream\MXDs\Report Maps - Turkey\T.Likey ESIA\Appendix - Fisheries\Figure 2.9 Areas 2 and 3 and their proximity to the South Stream Offshore Pipeline and Exclusion Zone.mxd

2.4 Seasonality

Figure 2.10 shows the seasonality of the fishing activities in terms of the landed catches, sourced from logbook data (Ref. 8). Landings peak in the summer months, between May and August with another small peak in November. January appears to have the lowest activity.

Figure 2.10 Seasonality of the fishing activity (Ref. 8)



2.4.1 Seasonal Restrictions

There is a ban on fishing, with all gear types, for turbot from the 15th April for 60 days and for fishing for gobies with nets from 15th April to 15th May, this coincides with the spawning times for both species. Other seasonal restrictions are also in place but these relate to fresh water species (Ref. 13).

2.5 Target Species Relevant to the Project

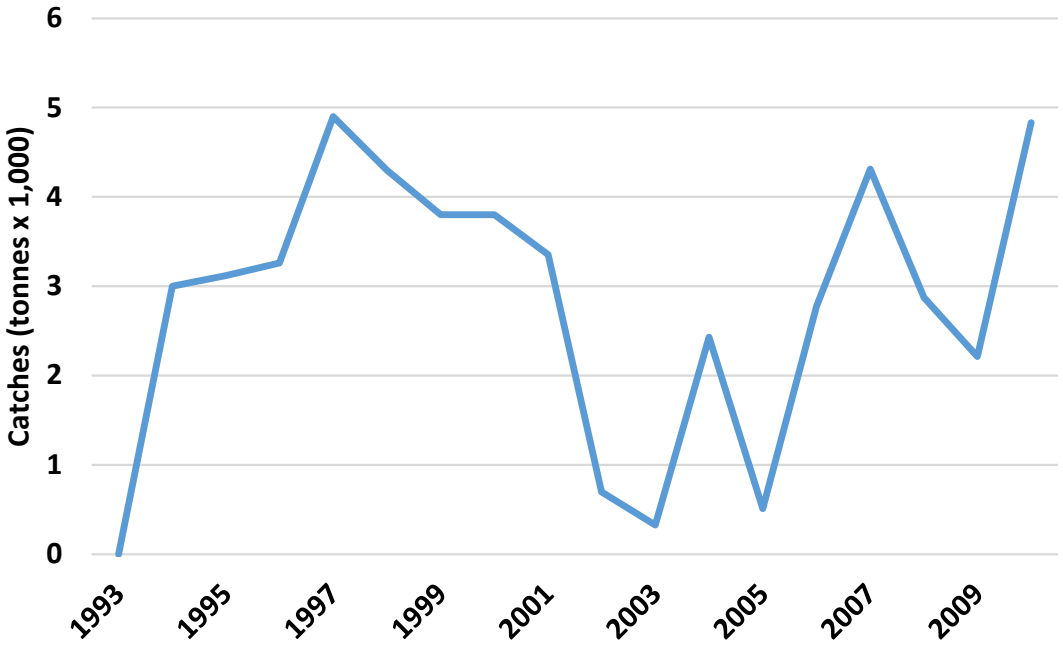
The fishing grounds off Bulgaria lie in the migratory path of a number of different migratory species (Section 1.3) however the most significant to the industry are the rapa whelk (non-migratory) and the sprat (limited migrations between onshore and offshore areas).

Rapa Whelk (*Rapana venosa*)

The rapa whelk is located all around the Black Sea shelf down to depths of 40 m but is found in highest densities along the Ukrainian and Bulgarian coasts. It is an invasive species, native to the Yellow Sea, Bohai Sea, East China Sea and Sea of Japan. It predates primarily on bivalves

including oysters and mussels and has had some severe impacts in the Black Sea causing collapses on some of the local populations. Due to insufficient data there is no current assessment done but catches of Bulgaria remain high though fluctuating (Figure 2.11) with 3,793t being caught in 2012, accounting for around 60% of the catch. They move inshore in summer to spawn on compact, sandy areas of seabed, after spawning they move to deeper water where they bury themselves in the seabed sediments. The fishing season is in summer, when they are easier to catch on the seabed surface. They are mainly harvested though bottom trawling, using a beam trawl. Although banned in Bulgarian waters, there are a number of areas where beam trawling for rapa is permitted (Figure 2.8 and Figure 2.9); they are also caught using divers. Most processing is carried out in Varna (Section 2.1.3). The effects of noise on the animal are unknown. Sedimentation may have a moderate effect as being a demersal animal it could affect their breeding and feeding, either directly or impact their prey. Turbidity is unlikely to affect them as they are a non-visual predator.

Figure 2.11 Catches of *Rapana venosa* by the Bulgarian Fleet 1993 - 2010

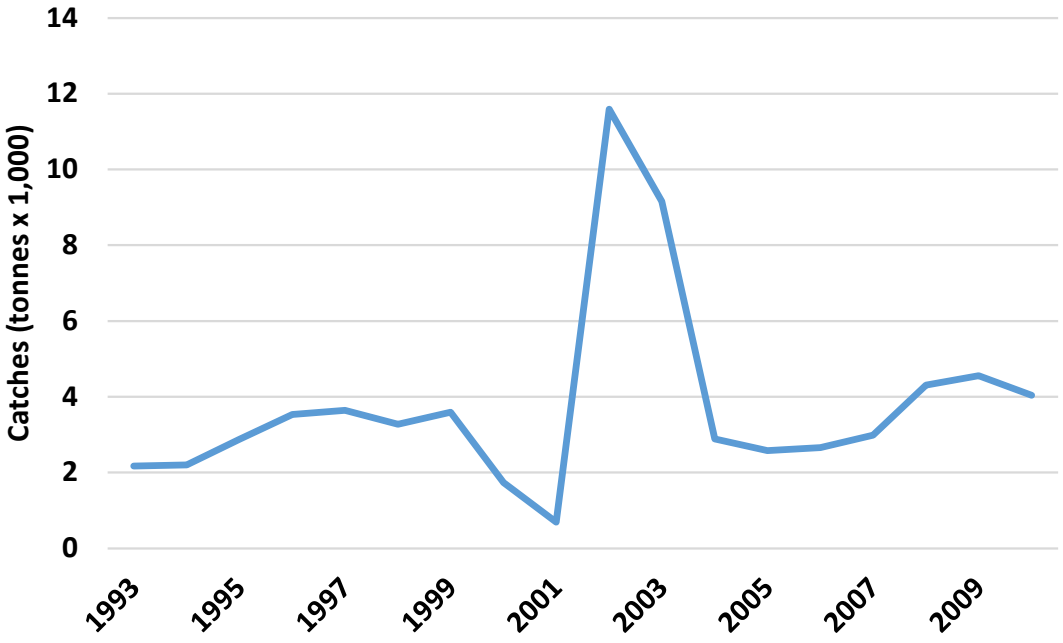


Sprat (Sprattus sprattus)

A profile of sprat is given in Section 1.3.2. Along with the Rapa whelk, sprat account for over 90% of the total catches by the Bulgarian fleet, in 2012 2836t were landed in Bulgarian waters, although this represents only around a third of the quota of 8,032t set for Bulgaria in that year. Catches peaked in 2002 at just over 11,000t, after a steep decline they recovered partially but have been declining again in recent years (Figure 2.12). They are normally fished on the continental shelf, between depths of 15 and 110 m, during the day using midwater trawls or uncovered pound nets nearer to shore. Special permission is required if vessels wish to fish beyond the 12 NM territorial zone. Fishing season is normally over the winter months as sprat move inshore to form aggregations over their winter feeding ground, in spring and summer

they move to deeper water over the shelf to spawn, up to 100 km offshore. They have no set wintering grounds and their movements are highly dependent on environmental conditions, particularly water temperature. Low catches in some areas of the Black Sea have been attributed to warmer waters on the continental shelf causing them to move elsewhere. They are a visual predator, feeding mainly on planktonic crustaceans, and are known to avoid turbid waters, although they are unlikely to be affected by sedimentation as they are pelagic spawners with pelagic eggs and larvae. They have also been shown to be highly sensitive to low frequency sound.

Figure 2.12 Catches of sprat by the Bulgarian fleet 1993 - 2010



2.6 Impacts

2.6.1 Construction and Pre-Commissioning Phase

2.6.1.1 Sedimentation

Seabed sediment dispersion caused by the construction of the microtunnel and the seabed dredging process could impact adversely on fish or other marine resources and subsequently the commercial or artisanal fisheries.

Sedimentation during the trenchless shore crossing Construction Phase will be limited to the exit point locations of the four pipelines; located at a depth of approximately 12 m about 420 m offshore, where exit pits will need to be dredged[001]. Depending on the construction method

used there may be additional discharge of drill cuttings and slurry (made up of water and bentonite[2]), however the quantity and dispersal of this discharge will be minimised through a number of measures put in place during the construction process (refer to **Chapter 5 Project Description**).[002]

Sedimentation will also result from dredging activities from the trenchless shore crossing exit points out to a distance of approximately 2 km offshore and a depth of approximately 24 m. Sediment modelling has shown that the sediment plume will be present throughout the proposed dredging activities, thought to be about 40 days in total (10 days per pipe), but disperse 4 to 6 hours after activities cease. The affected distance northward (towards Ada Bacha) is about 2.5 km, just before the location of the community, although the anticipated sedimentation is low (5 mg/l) (Ref. 71). Southwards the spread of the plume would be further but confined within 5 km.

Increased sediment may affect fish in two ways: through increased turbidity caused by high suspended sediment concentrations reducing the capacity of visual predators to locate prey, or sediment settling on the seabed smothering eggs and possible prey items for some benthic feeders and restricting the settlement of larvae. Both of these have the potential to reduce the reproductive capacity of the fish causing a reduction in stocks over time or causing fish to locate elsewhere, although the effects are likely to be minimal given the anticipated timescale for the nearshore section of the Construction and Pre-Commissioning Phase is less than 12 months with the actual nearshore (up to 2 km) dredging scheduled for around 40 days.

Of the commercial fish species, sprat will be the most likely to be affected by the turbidity as they are known to avoid turbid waters. While the sediment plume does appear over some of the fishing areas (based on Figure 2.7) the dispersal of the plume is rapid (4 days after the end of dredging (Ref. 71)) and the higher concentrations of suspended sediment are near the seabed so the effect will be temporary, localised and only have the potential to affect the fishery if it occurs during the winter fishing season. There may be some effect of sedimentation on Rapa populations although it appears that the plume does not significantly impact any of the permitted Rapa fishing areas. The majority of the fish species targeted by the Community are pelagic spawners and species and are migratory (i.e. will pass through the area), so it is unlikely they will be adversely impacted by sedimentation or turbidity. There may be some effect on their feeding grounds but this is also likely to be minimal. Of the species targeted by the Community, the species most like to be adversely affected is the goby, as it has demersal eggs that stick to solid substrates and thus have the potential to be smothered. A mussel farm is also planned for the bay outside the Community; however, mussels are relatively resistant to sedimentation and, in this case, are far enough away (i.e. over 2 km) not to be significantly affected.

2.6.1.2 Loss of Fishing Grounds

The impact on fishing from the safety exclusion zones during the Construction and Pre-Commissioning Phase as well as the need to avoid the additional supply and pipe-laying vessels

[2] Natural, inert, non-toxic clay.

operating in fishing areas may restrict the available fishing grounds or restrict navigation of fishing vessels to fishing grounds.

The effect of the restrictions on marine navigation during the Construction and Pre-Commissioning Phase is dependent on the physical extent of the exclusion zones and the time of year during which the restrictions are put in place.

The exclusion zone during the Construction and Pre-Commissioning Phase will be a 'moving' circle (progressing between approximately 1.5 and 2.75 km per day, depending on the type of vessel used) of about 2 to 3 km radius around the pipe-lay vessel, thus extending 2 to 3 km north and south of the pipeline route during pipe-laying. Near the coast, this radius will be a maximum 2 km. Therefore, it will not extend to restrict shipping to and from Ada Bacha harbour. It will also be defined and operationally managed to avoid any significant interference with maritime traffic and vessels approaching the harbour. Due to the use of a trenchless shore crossing technique (microtunnelling) for all four pipelines, there will be no dredging until the exit points of the microtunnels.[003] The microtunnel exit points vary between a minimum of 545 m (pipeline #4) and maximum of 584 m (pipeline #1) from where the pipelines cross the shoreline. The microtunnel exit pit associated with pipeline #4 is located nearest to the coast; a distance of approximately 420 m. When the dredging is taking place, an exclusion zone of 0.5 km around the dredging vessel will be maintained.

During pre-commissioning there will be an exclusion zone of 0.5 km radius around the vessels engaged in the pre-commissioning activities, which will be anchored at the tie-in location. The exclusions zones and related restrictions will be coordinated with, and approved by the Bulgarian Maritime Authorities, who will also define procedures for their implementation, for example where the pipe-lay vessels cross shipping lanes.

For commercial vessels the main potential for impact will be when the pipe-laying enters the offshore area into the fishing grounds shown in Figure 2.6 and Figure 2.7. Prior to that there may be some minor inconvenience if vessels have to navigate their way around the safety exclusion zone on their way to and from the fishing grounds, along the routes shown in Figure 2.7.

The Community currently depends largely on fishing within an area of their landing site, approximately 2.5 NM (approximately 4.6 km) to the north, 5.5 NM (approximately 10 km) to the south and 3.5 NM (6.5 km) offshore. They do not fish in the Galata gas pipeline exclusion zone (Area 310) but their fishing grounds do extend to the south of it. This was indicated as the maximum extent of the fishing depending on the time of year and species targeted and it is probable that the majority of effort is closer to the Community. Their vessels are small (between 3.4 and 6.8 m in length, with engine power mostly ranging between 4 hp and 10 hp) and as such are more geographically constrained in their fishing activities than larger commercial vessels, with a realistic range for the smaller engines being around 10 NM (assuming a speed of 5 knots giving a travelling time to and from the fishing grounds of 4 hours).

The local and temporary nature of the safety exclusion zone means that the effect of the Construction and Pre-Commissioning Phase on navigation and fishing activities for commercial vessels and the Community will be minor and likely to be indistinguishable from the baseline or the usual limits of variation of catch. It is unlikely that the Community will look for new fishing

grounds outside the areas they currently fish but may concentrate more of their fishing to the north or circumnavigate the safety exclusion zone, leading to increased fuel costs. Restrictions when the pipe-lay vessel is close to shore could prevent them leaving and they would need to either re-locate their boats further north or cease fishing.

2.6.1.3 Noise and Light

Noise, vibration and light generated by the dredging, pipe laying and support vessels may affect fish migration patterns or cause dispersal of some benthic species which may reduce catches and revenues for artisanal fisheries.

A full assessment of the likely effects of noise generated during the Construction Phase on fish is given in Ref. 27. This shows that the avoidance reactions are likely to be most significant on hearing specialist fish (sprat and anchovy). In shallow water active anchor handling during pipe-laying results in the highest behavioural effects ranges of 480 m for sprat and 130 m for anchovy. In mid water anchor handling results in effects over 600 m for sprat and 500 m for anchovy. Similarly, when the crew change vessel is part of the pipe-laying spread behavioural effects over 600 m are seen in sprat but not in anchovy. In deep water, behavioural effects are only seen for sprat where pipe-laying results in a behavioural effects range of 700 m. Shad species and hearing generalists are not predicted to be affected due to noise from Project activities. It will possibly alter the migration routes for some of the hearing specialist species causing them to move further offshore and out of the normal fishing grounds of the Community. Commercial vessels targeting pelagic fish may need to alter their fishing patterns temporarily to account for the displaced movement. It is unlikely to have any effect on vessels targeting the rapa whelk.

Light may also attract zooplankton to the surface and in turn some small (and some larger) pelagic species, altering their distribution within the body of water and possibly their normal fishing areas, although this impact would be minimal.

These impacts would be adverse but temporary and given the migratory nature of most of the target species the impact on catches and revenue would be small and likely to be indistinguishable from the baseline or the usual limits of variation of catch.

2.6.1.4 Summary

Commercial Fleet

On the basis of the analysis presented above, it is unlikely there will be any effect on the catches of the Bulgarian fleet. Should any effects occur it is unlikely they will be outside the normal variation in the annual catches and will be indistinguishable from those recorded in the baseline study.

Ada Bacha

The Ada Bacha Community rely mainly on fishing for their livelihood, and their sensitivity is therefore considered to be moderate. Considering the three potential impact pathways described above, the overall impact is likely to be temporary and reversible. Fishermen will be

able to focus on alternative areas within their established grounds if necessary. Thus, the overall impact is considered to be low.

2.6.2 Operational Phase

2.6.2.1 Loss of Fishing Grounds

Impact on fishing due the safety exclusion zone put in place during the Operational Phase of the South Stream Offshore Pipeline.

After construction, a permanent 0.5 km (0.27 NM) Operational Phase exclusion zone[3] with respect to fishing is likely to be imposed from the trenchless crossing offshore pits (approximately 420 m offshore at the nearest point to the coastline) out to a water depth of 100 m, to prevent damage by third party activities; this will be agreed in consultation with the appropriate authorities and it will be in addition to the existing Galata gas pipeline exclusion zone (Area 310), which extends 0.5 NM on either side of that pipeline. [005] It extends out several kilometres to a depth of over 65 m and is closed to fishing, construction of mussel farms, underwater dredging activities and anchoring. Figure 2.9 shows the Galata gas pipeline exclusion zone (Area 310) along with the proposed South Stream Offshore Pipeline Operational Phase safety exclusion zone and is it evident that the two exclusion zones will mostly overlap as far out to sea as approximately 13 km (or 7 NM) from the shore. Overall, the anticipated South Stream Offshore Pipeline Operational Phase exclusion zone is expected to be only a small extension of the existing Galata gas pipeline exclusion zone, by approximately 150 m to the south (at the widest point). Approximately 11 km out to sea the two exclusion zones will diverge, this is outside the Community's normal fishing grounds but will overlap with one of the permitted areas for Rapa fishing (Area 3) for a distance of around 5 km. It will also increase the area of exclusion zone over current fishing grounds (Figure 2.7) and, depending on the restriction in place (all fishing or just bottom trawling); this will remove some of the fishable area.

Commercial fisheries and the Community currently operate with the existing Galata gas pipeline exclusion zone in place. The Community do not carry out any fishing operations within the existing Galata gas pipeline exclusion zone but their fishing grounds do extend approximately 2 to 3 NM to the south of its southern boundary. Most of the species they target (bluefish, horse mackerel, bonito, shad and sardine) are migratory and are caught as they pass through the fishing grounds; there is some flexibility in where they can be caught. The less migratory species, such as gobies, are caught closer to the Community and the extended exclusion zone (existing Galata gas pipeline exclusion zone and South Stream Offshore Pipeline Operational Phase exclusion zone combined) is likely to have minimal additional impact. If the purpose of the South Stream Offshore Pipeline Operational Phase exclusion zone is just to restrict bottom trawling or dredging then there will be no additional impact as the Community only use fixed nets, drift nets and hooks and lines. There will be a small impact on the commercial fisheries as the Operational Phase exclusion zone will remove some of the fishable area for rapa whelk in

[3] The precise distance is yet to be confirmed, this assessment has assumed it will be 0.5 km.

Area 3 (less than 5%), the Operational Phase exclusion zone may also affect other demersal fisheries if the setting of bottom nets is prohibited as the restricted zone passes over active fishing grounds.

Recommended mitigation would consist of notices to mariners, chart updates and surface marker buoys to reduce risks of contact, although the pipeline should also show up clearly on depth finders used by fishing fleets.

2.6.2.2 Noise

Impact on Fish Migration or Behaviour Patterns Due to Any Noise or Vibrations Emitted by the Pipeline During Operation

A representative of the Community stated that certain species of fish did not cross the Galata pipeline because of the noise it generated during operation (i.e. the gas flowing through the pipeline). This was the reason suggested by the Ada Bacha fishermen for the perceived reduction in catches of bonito and the bluefish. Studies have shown that some fish species are particularly sensitive to low frequency sound (0.1 to 100 Hz) resulting in low frequency sources being used to induce fish avoidance around dams and power plant intakes in some areas (Ref. 72). Although these studies were specific for two species (Baltic herring *(Clupea harengus membras)* and Atlantic salmon *(Salmo salar)*) it is possible that low frequency noise will also affect other species, particularly migratory ones, possibly disturbing their navigation and orientation. In shallower water the sea surface and the seabed reflect the sound and increase the distance travelled (Ref. 73). It is possible that, rather than not crossing the Galata gas pipeline at all, certain migratory species travel further offshore to deeper water before crossing, putting them outside the current Community fishing grounds. However, the underwater noise assessment undertaken for the Pipeline (Ref. 27) shows that effects during operation will not be significant particularly compared to those already caused by the Galata gas Pipeline. As the pipeline will be underground, in the trenchless crossing up to 584 m offshore and buried in 2.5 m deep trenches up to 2 km offshore, noise and vibrations will be minimised. As such, there should be little change in catches.

The Community will not attempt to identify new fishing grounds outside where they already fish as the combined Galata gas pipeline and South Stream Offshore Pipeline exclusion zone will have little if any impact on them. This was a view shared by the representative of the Community, who felt if they could operate with the Galata gas pipeline exclusion zone in place then they could also manage with the South Stream Offshore Pipeline Operational Phase exclusion zone. Changes in the migratory patterns of fish as a result of the South Stream pipeline are likely to be minimal as the species affected will have already altered their behaviour because of, or become habituated (Ref. 54) to, the Galata gas pipeline. The magnitude of impact on the Community during the Operational Phase is considered to be negligible.

Commercial fisheries may need to adjust their fishing patterns if there are alterations in the migratory routes of any of their target species. The commercial species most affected would probably be sprat which has been shown to be sensitive to low frequency noise. The most likely outcome would be that they would shift their wintering grounds to avoid the noise generated during the operation of the pipeline. Commercial fleets would need to alter their fishing patterns and normal fishing grounds to account for this.

2.6.2.3 Vessel Maintenance

Vessel use during the Operational Phase will be limited to periodic (annual or every 5 years) maintenance surveys. [006] The impacts of operation are the same as during construction to a lesser degree. As such, the scope for any potential impact with fish or fisheries is greatly reduced and not considered to be significant.

2.6.2.4 Summary

Commercial Fleet

On the basis of the analysis presented above, it is unlikely there will be any lasting effect on the catches of the Bulgarian fleet. Should any effects occur it is unlikely they will be outside the normal variation in the annual catches and should be indistinguishable from those recorded in the baseline study.

Ada Bacha

The Underwater Noise Assessment (Ref. 27) shows that there will be no significant noise impact during the Operational Phase, particularly in relation to those already caused by the Galata gas pipeline. As such, there should be little change in catches related to pipeline noise.

The Operational Phase exclusion zone will also have little if any impact on Ada Bacha, as the extension to the existing Galata gas pipeline exclusion zone is expected to be minor (i.e. less than 150 m in the nearshore section). This view was shared by the representative of the Community, who felt if they could operate with the Galata gas pipeline exclusion zone in place then they could manage with the South Stream Offshore Pipeline Operational Phase exclusion zone in place. Changes in the migratory patterns of fish as a result of the South Stream Offshore Pipeline are likely to be minimal as the species affected will have already altered their behaviour because of, or become habituated (Ref. 54) to, the Galata gas pipeline. Thus, the magnitude of impact on the Community during Operational Phase is considered to be negligible.

3 Russia

3.1 Fisheries in Russian Waters of the Black Sea

3.1.1 Background

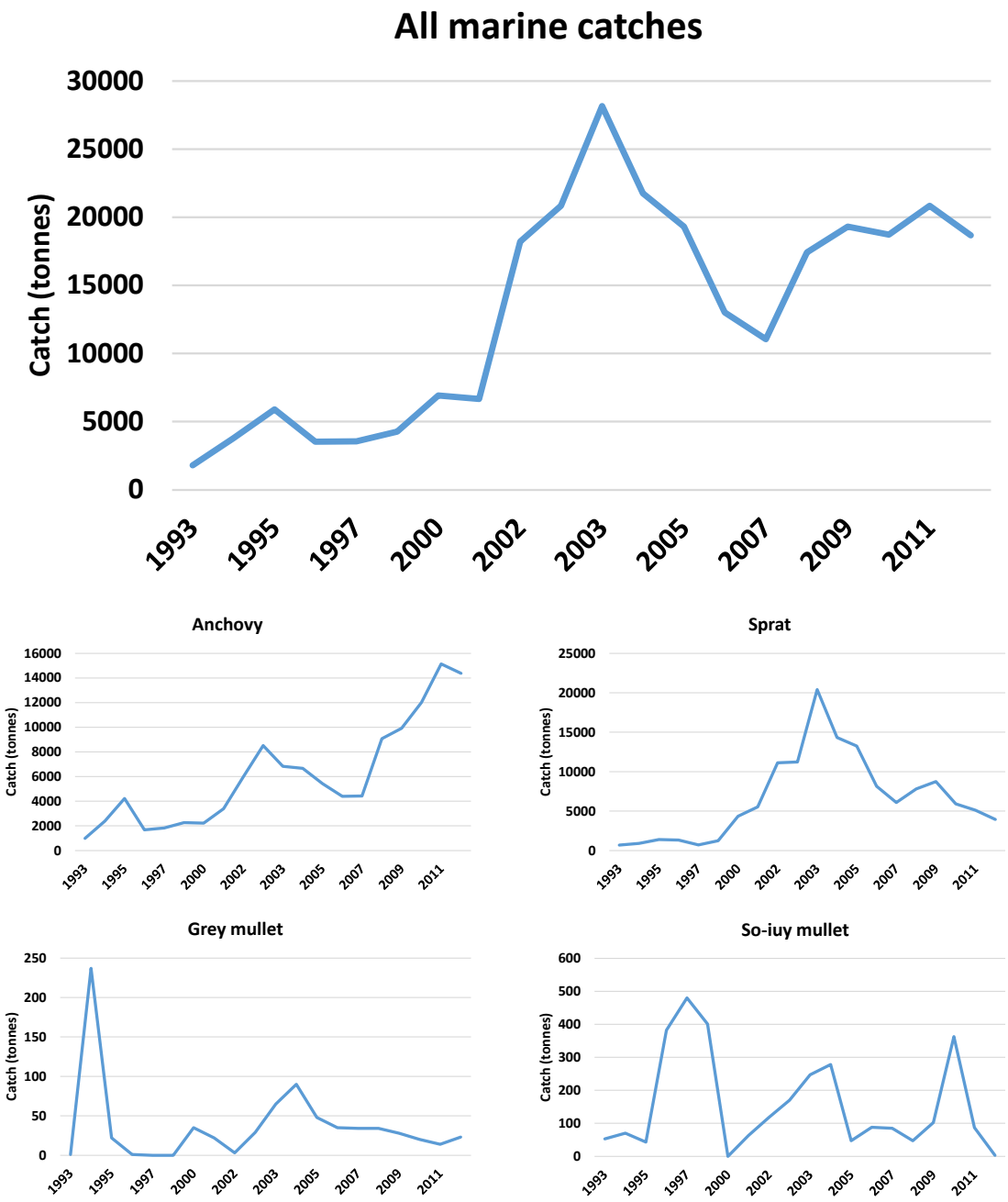
The fishery study area extends from the Kerch Taman area along the coast to Arkhipo-Osipovka, east of Novorossiysk (Ref. 15). This area extends across the two Black Sea administrative fishing zones as distinguished by the federal fisheries research institute for the region, AzNIIRKh[4]. The first of these is the Kerch Taman area extending from the Sea of Azov to Utrish near Anapa and the second of these extends from Utrish to the border with Georgia.

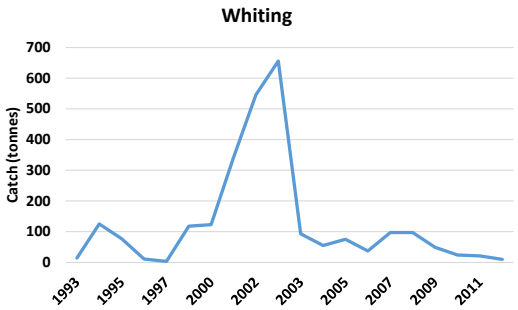
The importance of fishing in the region has declined in recent decades. Up to the mid-1980s catches ranged from 65,000t to 68,000t per year but there was sharp 14 fold drop in the early 1990s, partly due to the invasion of the predatory ctenophore *M. leidyi* and the consequent ecosystem-wide changes affecting most of the Black Sea and also in part due to the demise of the USSR and the apparent lack of recapitalisation leading to a contraction of the industry and a significant reduction in fishing effort (Ref. 24).

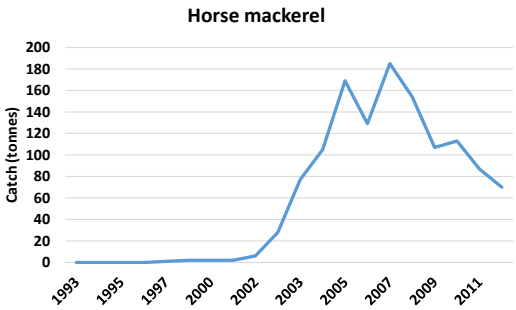
The most important Russian fishery in the Black Sea, in terms of the proportion taken, is for sprat with Russia accounting for approximately 6.5% off all the catch taken in the Black Sea in 2010 (Figure 3.1). However before the large increase in Turkish sprat catch over the last 5 years, Russia accounted for 15 to 20% of the total catch in the Black Sea. In the 1990s production in Russia fell to 700t but rose rapidly to 21,000t by 2003 with the introduction new trawling technology. It has, however, declined subsequently and by 2012 it had fallen to just under 4,000t (Figure 3.1), only a fraction of the Total Allowable Catch (TAC) of 21,000t. This is due to the reductions in the fleet numbers, the obsolescence of the vessels and difficulties in processing and marketing (Ref. 15), it is also due to the warming of the waters in the winter months on the shelf interrupting the normal onshore migration patterns of the fish. Catches of other species show a highly fluctuating pattern, with most showing similar downwards trends as sprat in recent years; the exceptions being anchovy and flounder (*Platichthys flesus)* which have increased, in the case of anchovy by more than double.

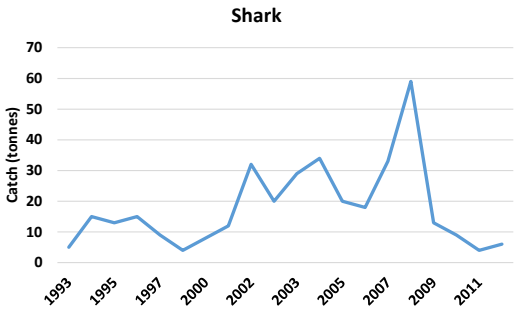
[4] This is a direct regional office of the Federal Fisheries Committee based in Moscow.

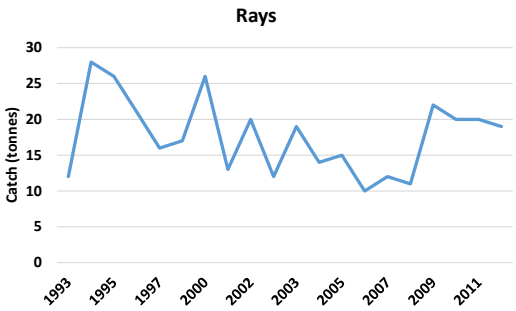
Figure 3.1 Catches by the Russian Fleet in the Black Sea by Main Species 1993 – 2012 (data from Ref. 37)

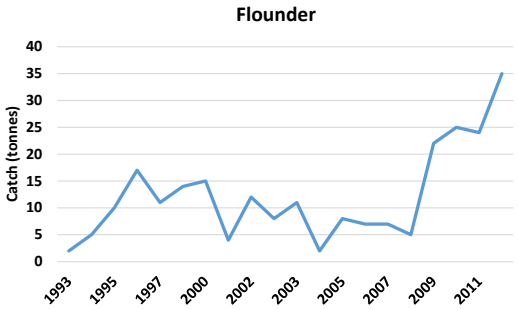


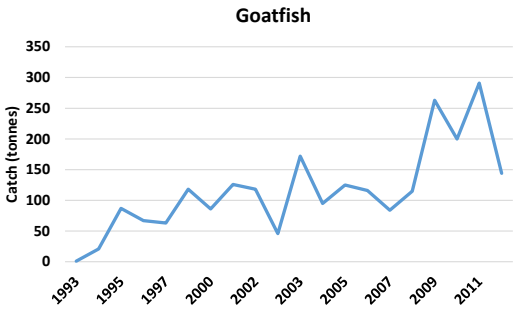


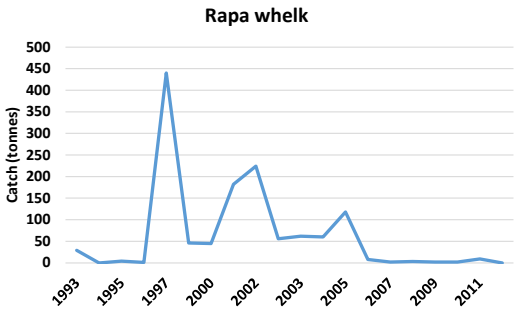


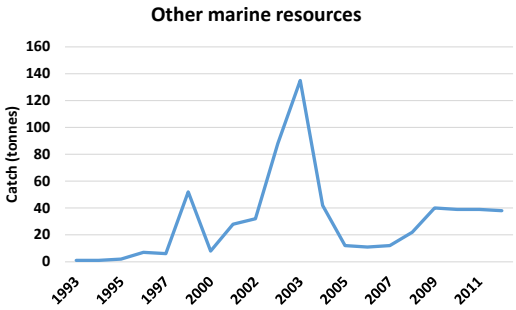












The legal context is set by the Law on a Russian Exclusive Economic Zone, which was adopted in 1998 and formed the legal foundation for state rule in the economic use of sea areas in Russia. In December 2004 a new Federal Fisheries Law came into effect which stated that resources are to be managed by a quota system based on TAC and regulated by 'Rules of Commercial Fishing in the Basin of the Azov Sea' and 'Rules of conduct for fisheries, the protection and exploitation of living resources in the Economic Zone' (Ref. 15; Ref. 16). There is, therefore, a clear legal and management regime in place which regulates the fishery and its users.

3.1.2 Economic Value of Catch

The contribution of Black Sea fisheries to the overall national fish catch is low, however it is a major contributor to the Krasnodar Krai economy, in which the project is located, providing residents and tourists of the Krasnodar Krai, Rostov Oblast and other regions of Russia including Moscow with fish products. The demand for these has stimulated the development of the coastal fisheries.

Between 2010 and 2012 there was little variation in the cost of the unprocessed main commercial fish species. The wholesale prices of unprocessed fish, according to the main fishers' organisations (IP Atanov, LLC "Temrouk - Ryba", IP Sekova) are given in Table 3.1. Prices in Table 8 are given in RUB per tonne, wholesale value of unprocessed fish (Ref. 37)

Prices vary according to demand and availability of species, the high prices for sprat in 2012 were due to low catches, caused by high temperatures in the inter and the resulting lower levels of migration onto the shelf zone and subsequent lower reproduction levels. Other price ranges reflect the size of the fish, with larger fish obtaining higher prices (Ref. 37).

Table 3.1 Prices of the Main Commercial Fish Species Caught by the Russian Black Sea fleet 2010 – 2012.

Year	Species	Price at start of season	Price at end of season
2010	Anchovy	35,000	20,000
	Sprat	11,000 – 14,000	7,000
	Whiting	60,000 – 80,000	60,000 – 80,000
2011	Anchovy	40,000	25,000
	Sprat	11,000 – 14,000	7,000
	Whiting	60,000 – 80,000	60,000 – 80,000
2012	Anchovy	40,000	25,000
	Sprat	14,000 – 17,000	14,000 – 17,000
	Whiting	60,000 – 80,000	60,000 – 80,000

Other current (2013) prices given for various species during interviews with fishing companies included between 30,000 and 40,000 RUB per tonne for horse mackerel, piked dogfish, thornback ray and pontiac shad, 100,000 to 150,000 RUB per tonne for mullets, over 300,000 RUB per tonne for turbot and 300,000 for farmed mussels (Ref. 38).

3.1.3 Employment in the Fishing Industry

The number of people employed in the industry is small. In 2010, Peter Gaz (Ref. 15) recorded there being two large companies employing up to 100 people, three medium companies employing up to 30 fishermen and nine smaller companies normally associated with a few smaller vessels and fishing brigades using passive gear such as set nets and traps which may have only 15 employees.

Currently prominent in the region are:

- Novorossiysk;
    - Atanov Yu. A. (sole trader, fishing for anchovies, sprat, gobies; wholesale and retail);
    - FUGU Ltd (Фуry OOO). Fishing, aquaculture, fishing farms, retail, wholesale, selling and buying fishing vessels; and
    - SPK RK Parizhskaya Kommuna – (Gelendzhik).
- Anapa;
    - RAM Ltd (PAM OOO) – (Anapa) fishing, freezing and selling small Black Sea fish;
    - RPK Briz – (Varvarovka, Anapa), fishing, fish processing;
    - Moresky Club – (Bolshoi Utrish, Anapa). Fishing (traps), mussel farming; and
    - Kalkan Ltd - (Anapa district) turbot breeding.
- Krasnodar Krai;

Association of Fishermen and Fish-Processors of the Southern Region (Krasnodar Krai):

- The First of May, Ltd, Workmen's Association (ARTERL) - (Krasnodar Krai) – wholesale, retail, fishing, aquaculture, mariculture;
- Rybka ot Petrovicha - (Krasnodar Krai) – fish processing, fishing, aquaculture, mariculture;
- Tatrinov (Sole trader) – (Krasnodar Krai) – processing, retail, wholesale, fishing, logistics; and
- Rassvet - (Temryuk).

- Rybkolkhoz im. Khvalyuna – (Temryuk district, Taman' stanitsa).

Of these, the largest single enterprise is that of the entrepreneur Yuri Atanov whose business accounts for 4,600t of the catch. The second largest is Temriuk-Ryba Ltd. with 2,100t but this company deals mainly with fish from the Sea of Azov (Ref. 34).

As with the fleet, the number of companies has also been declining. For example the number in operation from 2003 to 2006 was 19 whereas from 2007 to 2010 it was only 14 (Ref. 15). One of the reasons for this is the decline in the catch of fish. For example, up to 2010, sometimes only about half the sprat quota was actually caught. However, within the last few years the mechanism of allocation of the national quota has changed from direct allocation to specific companies to allocations based on applications from new entities for a quantity of their choosing, although the total national allocation is still in place. This means that though designated companies are automatically given a share of the quota, any company that has capacity can apply for an allocation; this measure is designed to encourage participation in the

fishery. During interviews one company (RPK Briz) stated that the main limitation on catches was due to the lack of demand and the inability to sell the fish, given a bigger market they would catch more. As a result, across the whole of the Krasnodar Krai, the number of entities involved in fishing and fish products increased from 52 in 2009 to 72 in 2012[5] (Ref. 15). Some increases in catches have also been reported although this is not yet a clear trend given the short time period the new mechanism has been in operation. The specific effects of the new allocation system in the coastal regions around Anapa (and hence near the Pipeline) are not yet clear.

3.2 Fishing Fleet

The Russian fisheries sector in the Black Sea is relatively small. This is reflected regionally where it only contributed 0.1% of the Gross Domestic Product GDP of Krasnodar Krai in 2009 (Ref. 28). This was derived from 3,900 t anchovy, 2,200 t sprat and around 600 t of assorted demersal species including whiting, turbot and red mullet. The fleet is commensurately small, having contracted steadily over the last decade (Table 3.2, vessel classes in Cyrillic given in Table 3.3). Further to the data presented in Table 3.2, interviews with local companies indicate that the number of active vessels is currently much smaller with a maximum number of between 6 and 10 vessels operating over the winter months between November and March.

Table 3.2 Fishing Vessels in Use in the Area of the Panagiya Cape – Arkhipo-Osipovka Over Time (Ref. 15).

Index	Vessel types							Number of vessels
	СЧС-150	СЧС-225	МРСТ	МРТК	ПТР	МРТР	РС-300	
	2003-2006							
Fluctuation	0-1	8-12	1	1-2	13-16	2	1-3	29-32
Average	-	10	1	2	14	2	2	30
	2007-2010							
Fluctuation	-	4-7	1	1-2	11-13	1-2	1-2	16-28
Average	-	6	1	1	12	1	1	21

[5] These figures are indicative of how the new mechanism works in the region (which includes freshwater and aquaculture in territory).

The contraction of the fleet is reflected in the large number of vessels currently being offered for sale. For example, a stern trawler has a recommended resale price of EUR 130,000 (Ref. 29) which new might cost $ 2 million (EUR 1.4 million) at international prices.

There are still a wide variety of vessel types operating in the fishery as can be seen from Table 3.2. Their typical gear specifications, given in Table 3.3, indicate where they are capable of fishing, e.g. purse seine or mid-water trawling for pelagic species, they also carry fixed gill nets and will trawl near the bottom (but not touching the bottom) for some demersal species. The power indicates their potential to damage the pipelines if they make contact with the pipeline, higher powered vessels are more likely cause damage as it is likely they will be towing heavier gear. Typical vessels operating in the area are shown in Figure 3.2.

In addition to these larger vessels there are a number of smaller vessels that service a nearshore fishery consisting of a number of fixed traps and nets that target migratory species. The nearest to the pipeline have been identified as being approximately 4 km to the south.

In general the fleet and the industry are being undercapitalised. Most of the vessels are former Soviet fleet, and effectively obsolete. The Vice Governor of Krasnodar Krai recently suggested that the industry needs an investment of USD 10 to 15 million to replace the deficient vessels and that the smaller vessels need a dedicated harbour at a site in Bolshoi Utrish rather than land their catches amongst the tankers and other larger commercial vessels in the existing ports (Ref. 32).

The majority of the vessels use pelagic or surface gears to catch pelagic fish (mainly anchovy). The most common are purse seines which are permitted within the entire Russian Black Sea territorial waters. Trawl nets are also commonly used although only midwater trawling is permitted; the nets must not come into contact with the seabed. There is no pair trawling recorded in Russian sector of the Black Sea. Some vessels are also equipped to use passive gear, either as their primary or secondary gear type. This will normally consist of a fixed bottom net and will be used to target bottom species such as turbot and rays.

Table 3.3 Fleet Specifications (Ref. 30 & Ref. 31)

	Maximum length	Width	Displacement	Dead-weight (tonnes)	Power (principal engine)
СЧС 150 (Medium-sized Seiner)	25.23 m	5.6 m	190 t	33 t	150 HP
СЧС 225 (Medium-sized Black Sea seiner, trawl and purse seine)	23.7 m	6.4 m	104 t (with cargo)	40 t	2220 kW (300 HP); 2 additional engines @ 25 kW
МРСТ (Small seiner-trawler)	21.94 m	6. 0 m	104 (96) t (max)	24 (26) t	150 H(1 additional @ 40 HP)
МРТК (Small stern trawler)	25.45 m	6.8 m	174 t	30 t	315 HP/220 kW
ПТР (Refrigerated transport vessel), details for ПТР-50, Design 01340, Kirovets)	31.85 (31.63) m	7.08 m	242 t (max)	76 t	300 HP + 2@40 HP (additional)
МРТР (Small refrigerated fishing trawler, Design 1282, Karelia)	31.80 (31.60) m	7.33 m	318 (330) t (max)	88 (85) t	1@300 HP + 2@100 HP (add.)
PC 300 (Fishing seiner)	29.34 m	6.20 m (est.)	240 (227) t (max)	64 (52) t	300 HP + (additional engine-generators), HP 1@65 (1@63) 1@20 (1@28) 1@8 (1@14)

Figure 3.2 Examples of trawlers operating in the Project area. A) Trawler / seiner operating out of Anapa, length approximately 15 m. B) Trawler / netter operating out of Balshoi Utrish, length 17 m vessel power 150 hp

A)

B)

3.3 Fishing Areas

Russia's coastal waters are located in the north-eastern part of the Black Sea. This area stretches from northwest to southeast almost 500 km from Cape Panagia to Adler. The coast is divided into four commercial districts, based on the width of the shelf: Kerchensky Pre-Straits Area (more than 50 km), the Anapa Bank (where the pipeline will be located) up to 30 km; the Novorossiysk - Tuapse area (up to 10 km) and the Tuapse-Adler or Greater Sochi area (up to 5 km). However fishing activities are coastal and limited to the internal and territorial seas of Russia within 12 NM of the coast.

In addition to the offshore fishing there are a number of fixed traps and nets in place close to the coast to target migrating fish such as mullet, they are normally serviced by smaller vessels (<5 m). There is also a mussel farm approximately 4 km to the south, currently producing around 15 tonnes of mussels on an annual basis.

3.3.1 Area and Gear Restrictions

The following prohibitions for gear use are in place:

Bottom trawling is prohibited in the area over Anapa Bank;

Mid-water trawls are prohibited for Azov and Black Sea anchovy when they are used on the bottom. The depth is identified by the position of the otter-board and the lower layer of the trawl from the presence of sponges, molluscs, etc.;

Mid-water trawling of sprat is banned within the Anapa Bank (when operating at the bottom), as identified by the position of the otter-board (used to hold the mouth of the net open) and the presence of bottom dwelling sedentary creatures: molluscs, sponges, etc. in the net; and

Bottom trawling for anchovy (using any gear) is prohibited and bottom trawling for sprat is prohibited over Anapa bank. The presence of benthic species in the nets is seen as an indication that the otter boards or foot rope of the net have been in contact with the seabed and are thus too deep.

3.4 Seasonality

The fisheries of the Russian Black Sea shelf as a whole are very seasonal, relating to the migratory movements of the target stocks. This is reinforced by the regulations of the Federal Fisheries Agency (Ref. 34) in association with the territory research institute (Ref. 35). For the major fish stocks the fishing seasons are defined below:

3.4.1 Seasonal restrictions

Black Sea anchovy, Anapa Bank lift nets:

- 1 October to 15 March, at sea, with mid-water trawls and purse seines, including the waters of the Anapa Bank, beyond a depth of 20 m;
- All year round, at sea, with gill nets; and

- 1 October to 15 March, conical lift nets from vessels using light as an attractant with fish pumps.

Black Sea anchovy, sprats, whiting, sand smelts using gill and cast nets

All year round, at sea, with gill nets and cast nets.

Sprat trawls:

- 1 April to 31 October, at sea, mid-water trawls; and
- 1 July to 30 September – within Anapa Bank but only at depths exceeding 40 m.

Whiting trawls:

Throughout the year, at sea, with mid-water trawls.

Turbot:

- 1 February to 31 October, at sea, gill nets and trawls; and
- With single-wall fixed flatfish nets, trawls, inshore during the spawning season in following locations:
- 1 April to 15 May – from the mouth of the Psou River to Cape Kodosh;
- 15 April to 31 May- from Cape Kodosh to Cape Doob; and
- 1 May to 15 June – from Cape Doob to Cape Panaguia (located around the Project Area).

Goatfish:

- Commercial fishing of goatfish in the Black Sea is carried out throughout the entire the year with stake and draft nets and small trawls. From September 1 to June 30 fishing is done with single-walled nets.

Target Species Relevant to the Russian Sector

Most of the commercial fish stocks in the Russian Sector of the Project show some seasonal movement or migration throughout the Black Sea which is outlined in Section 1.3, information specific for the Project Area for the most important commercial species are considered below.

Sprat (*Sprattus sprattus, Clupeonella cultriventris*)

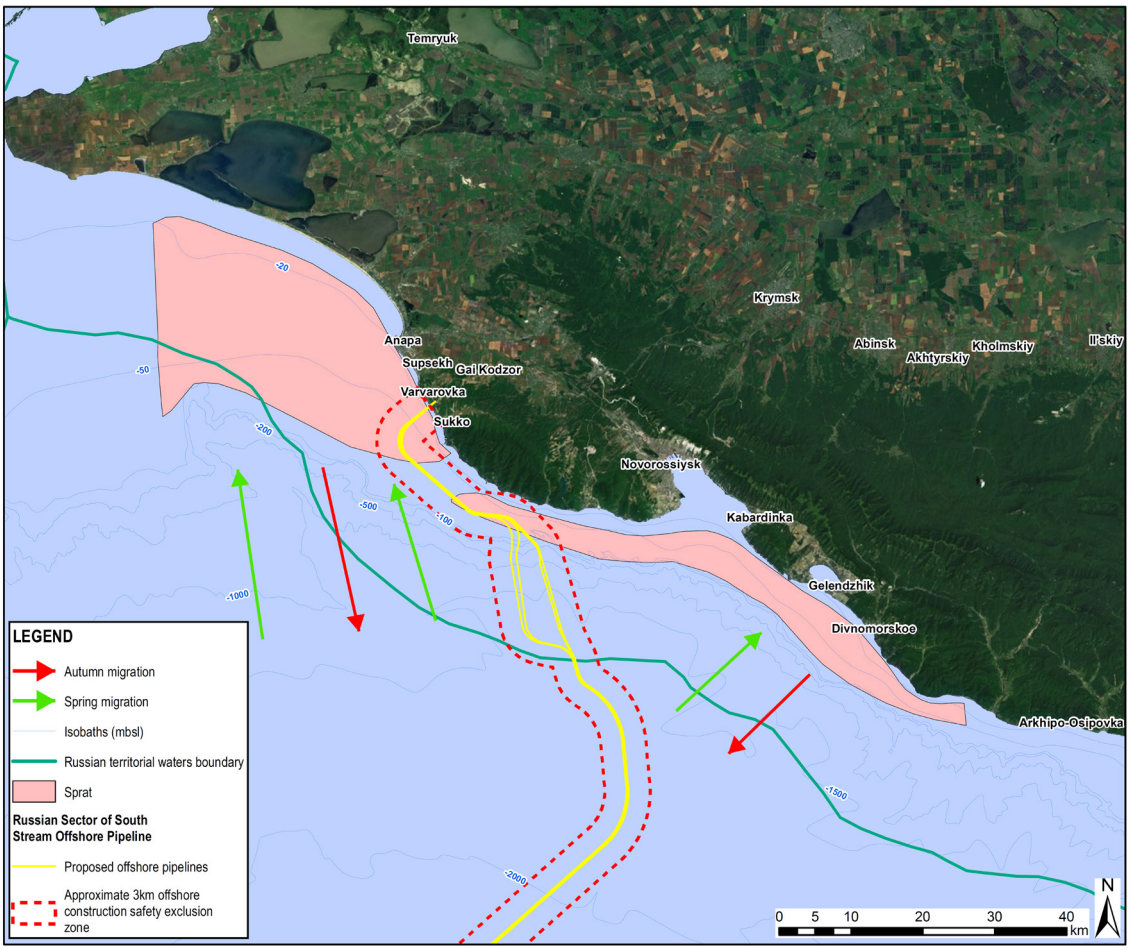
There are two species of sprat caught in Russian waters, the Black Sea sprat and the Azov Sea sprat, although for the purpose of reporting everything is recorded as the Black Sea sprat. During the summer months (March to October) sprat feed in the shallower, coastal waters, up to 80 m deep. They follow a diurnal 'pattern of vertical migration and will move to the surface at night to feed off planktonic crustaceans and to the bottom layers to feed during the day. During this time the fish will form dense aggregations which form the main commercial concentrations for the fishery operating in this area between March and September. The major concentrations are found on the continental shelf of the Kerch-Taman region as far south as Anapa and Utrish and also around Novorossiysk north to Arkhipo-Osipovka. The narrow

continental shelf further south restricts the aggregation of sprat and the fishery is sparser (Figure 3.3).

At the end of the feeding period, during October, there is an intense period of growth followed by a mass spawning migration out to sea beyond the continental shelf. Spawning takes place off the coast of Russia from October to March in the upper layers of water (10 m to 20 m), with females producing 6,000 to 14,000 eggs. At the end of the spawning period in March or April, the adults will move back to the feeding grounds in the continental shelf; juveniles remain in the open sea, beyond the shelf, and will be highly dispersed.

Sprat is one of the most numerous, high yielding, short-cycle species in the Black Sea, the most intensive period of fishing in the Project Area is reported to be during the third week of March when sprat moving from spawning to feeding form aggregations with anchovy which are targeted by fishers.

Figure 3.3 Movements and Distribution of Sprat Concentrations over Summer on Shelf in Project Area (Ref. 15)

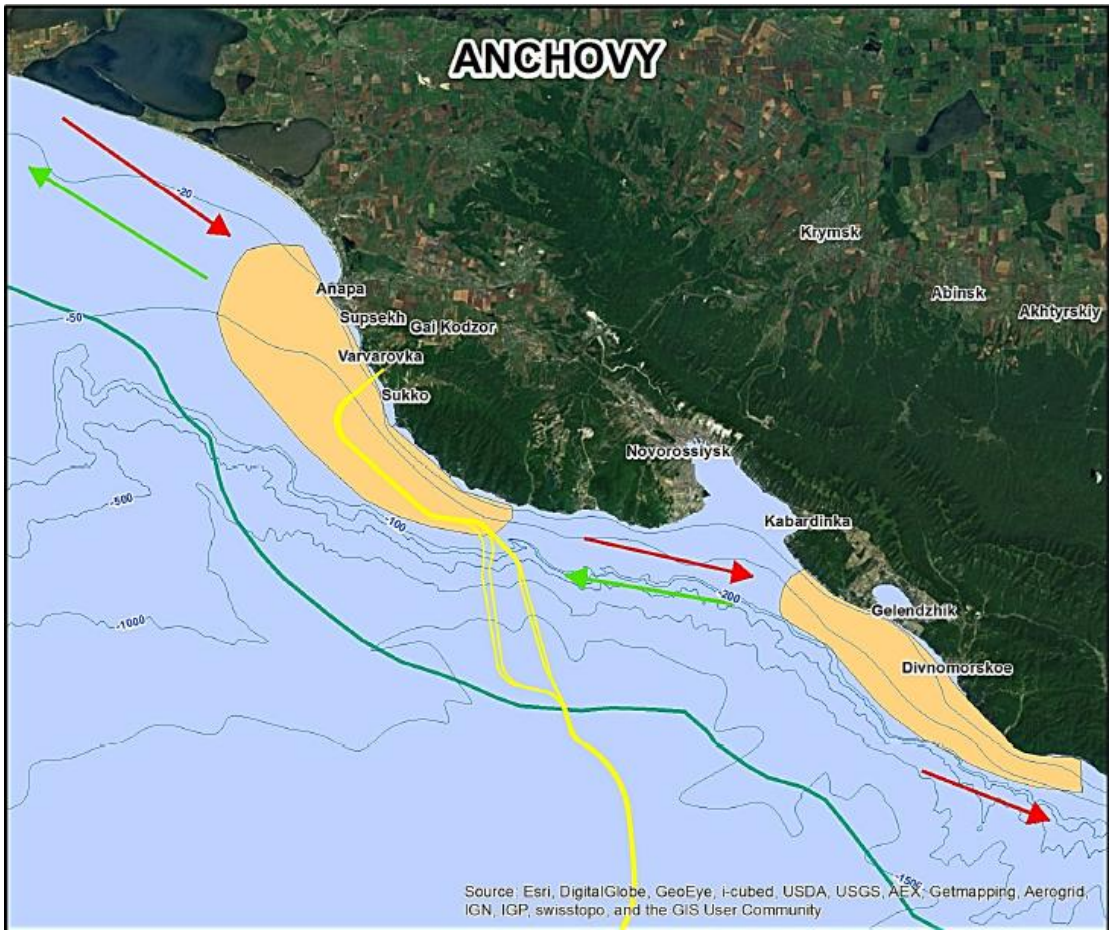


Azov Anchovy (Engraulis encrasicolus maeotica)

Of the two species of anchovy present in the Black Sea only the Azov anchovy is considered part of the target stock for Russian fleets.

The Azov anchovy live 3 to 4 years, mature at 1 year and will normally die after their second spawning season. They pass through the Kerch Strait in March to early April and into the Sea of Azov where they both feed and spawn during the summer although some remain outside to spawn over the continental shelf. During autumn they migrate out to their wintering grounds, passing southwards along the coast to winter mainly in the southern Black Sea near Sochi and Adler and into Georgian waters. The largest commercial concentrations in Russian territorial waters occur in mid-December in the Kerch-Taman area, moving south to the Bolshoi Utrish and Anapa areas later in the month. The Russian anchovy fishery is therefore seasonal, targeting the migrating shoals in spring and winter (Figure 3.4). These shoals are normally exploited using purse seine and midwater trawl vessels; cooperative fishing brigades will also set taps or fixed nets across the main migratory routes, either servicing them directly from the shore or from small tender boats.

Figure 3.4 Movements and Distribution of Azov Anchovy Concentrations Over the Shelf in the Project Area (Ref. 15)



Legend: wintering areas orange; autumn and spring migrations red and green arrows respectively; pipeline yellow

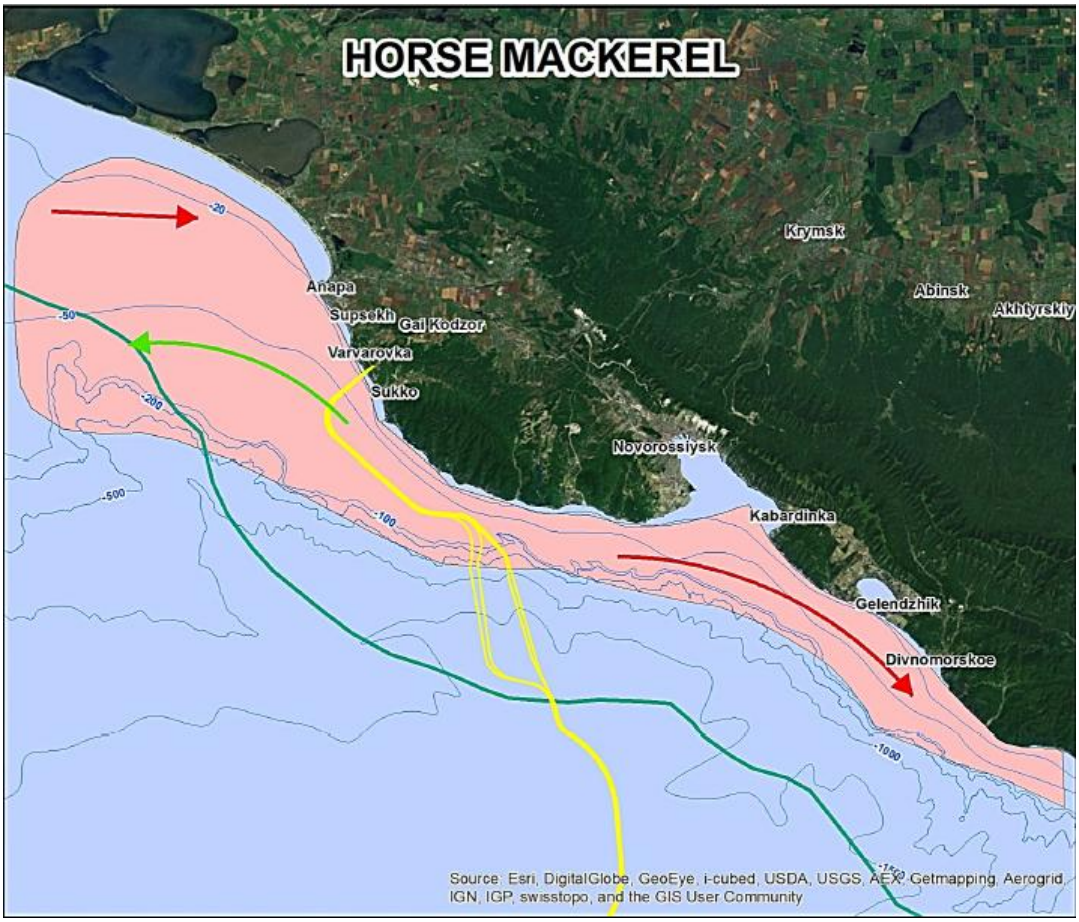
Mediterranean Horse Mackerel (*Trachurus mediterraneaus*)

In Russian territorial waters, Mediterranean horse mackerel will winter at depths of up to 80 m, with the main wintering aggregations recorded to the south around Sochi and Adler and on the Georgia shelf. As the water becomes warmer between March and April the Mediterranean horse mackerel aggregations break up and they migrate at shallow depths along the Russian coast the Kerch – Taman area. Spawning is prolonged; lasting for 2 to 3 months from late June to early September, the most intensive spawning period is during July. One of their main summer feeding grounds is the continental shelf around Anapa, in which the Project Area is located (Figure 3.5).

They are reported to be difficult to catch due to their mobility during migration. The main fishery is during winter with an annual catch of around 240t, they are normally caught using attractant lights at night with lift nets from small vessels.

Since Mediterranean horse mackerel like other pelagic species respond to light then the illumination of the pipe-laying vessel may have a potential impact.

Figure 3.5 Movements and Distribution of Horse Mackerel Concentrations in Summer Over the Shelf in the Project Area (Ref. 15)



Legend: Feeding grounds in pink; autumn and spring migrations in red and green arrows respectively; the South Stream Offshore Pipeline pipelines indicated by yellow lines.

Demersal Fish Species

Demersal fish typically migrate less extensively than pelagic species. Nevertheless, there are some appreciable migrations. The Black Sea turbot, *Scophthalmus maeoticus,* is one of the most valuable commercial species with an international price of around $4,000/t. It is now very scarce with an average annual catch of 10.6t over the last five years. The species tends to move from deeper water in the winter into the shallower waters in the spring to spawn and feed between April and September. Black Sea turbot are permanent inhabitants on the shelf around the Project Area and protection of this stock was one reason for the designation of the Anapa Bank fishery protected area. Another species, the Azov turbot (*Psetta maxima maeotica*), is also observed to the northern part of the Anapa region with both species occupying the same habitats and often forming mixed concentrations.

The most common demersal species, the whiting usually occurs from 30 to 100 m depth preferring cooler water where the temperature does not undergo significant fluctuations. Whiting show very few systematic movements with the exception that the younger individuals move inshore. They undergo fractional spawning[6], with eggs being released on the shelf all year round. In winter they spawn nearer the surface, up to 80 m and in summer in the deeper, cooler water at temperatures between 9°C and 11°C. Dense concentrations of whiting are to be found on the Anapa Bank, Southern Ozereevka and Arkhipo-Osipovka. The annual catch has been very variable from 3t in 1997 to 655t in 2002 but in the recent decade catches have been relatively low, between 50t and 100t, largely due to a lack of demand (Ref. 15).

The other main bottom dwelling target species is the red mullet or 'barabulka' (*Mullus barbatus barbatus*) which occurs in two populations, one sedentary, remaining around Sochi and Georgia, and one migratory which moves seasonally along the coast as far as the Straits of Kerch. It contributes an annual 110 t to the catch.

3.5 Impacts

3.5.1 Construction and Pre-Commissioning Phase

3.5.1.1 Sedimentation

There will be some disturbance of sediment during the dredging of the microtunnel exit pits and transition trenches but the sediment modelling has shown the duration of this operation will be approximately 1.5 to 2 days (depending on the scenario assumed) and the plume disperses rapidly to the lowest detectable level as it is carried down the coast over a 4 to 5 day period in the most in the most extreme case. The results show that this will not be at an intensity or duration that would influence either the fish or the fishing. There is a mussel farm located close to shore approximately 3.8 km to the south of the Pipeline, covering an area of 100 m by 300 m (Figure 3.6). The sediment modelling shows that it will come within the sediment plume during

[6] Release of eggs at intervals, usually over several days or weeks. This allows more, smaller and immature eggs to be carried in a limited abdominal cavity space.

the exit pit dredging operations under one scenario (clockwise currents) approximately 12 to 84 hours after the commencement of dredging (it is estimated there will be 1.3 days dredging per pipeline). While the amount of suspended sediment reaches high levels (over 394 mg/l) the rapid dispersal of the plume means it is unlikely to have any lasting effect on the farm. The maximum sediment thickness above the farm is estimated to be 1.8 to 2.6 mm, not enough to negatively affect the filter feeding mussels.

Figure 3.6 Boundaries of the Mussel Farm (outlined in red) and Location of Fish Traps (yellow circles). The Approximate Position of the Pipeline is Outlined in White

3.5.1.2 Loss of Fishing Grounds

A safety exclusion zone of approximately 3 km (1.6 NM) radius will be enforced during construction to avoid incidents with marine traffic, including fishing vessels.[007] The construction activity and the associated 3 km safety exclusion zone will mean that a certain area will be lost to fishing during construction due to exclusion from the grounds. The nearshore section of the Project Area commences at the exit point of the microtunnels, located approximately 400 m from the coast at a water depth of approximately 23 m and extends approximately 425 m out to a water depth of 30 m. From the microtunnel exit point the pipelines will be buried in trenches to a depth of approximately 2.5 - 3 m for a distance of approximately 170 m. From here, out to the edge of the nearshore section (30 m water depth), the pipelines will be coated in concrete and laid directly on the seabed. [008] The main fishing season for sprat occurs during the summer months, according to the regulations it runs from 1st July to 30th September.

However, this is permissible only at water depths greater than 40 m which is beyond the depth, at which the buried pipeline emerges. Therefore interference with the sprat fishery, which is largely confluent with the anchovy grounds, during construction, is unlikely. Moreover, any loss of fishing area will be less important to the sprat, anchovy and other pelagic fisheries since they use mid-water methods which are less dependent on specific areas.

The loss of access to potential fishing grounds due to the safety exclusion area during construction of the nearshore section will be relatively small. An estimate of the shelf area above 100 m depth between Arkhipo-Osipovka and the northerly limit of the Anapa Bank, which is largely coincident with the anchovy feeding grounds (Figure 3.4), is approximately 2,235 km^2 whilst the area of the 3 km exclusion zone around the near shore construction will be around 14 km^2, less than 0.01% of the shelf area which constitutes the fishing grounds. [009]

More direct impacts might be felt by the fishing operations for benthic and demersal species since there will be loss of access to a specific area of fish habitat during construction due to the exclusion zone particularly around the nearshore section construction works. This, however, will be limited to 3 km either side of the works and cover a relatively small area.[010]The potential for impacts will be further limited due to the absence of any bottom fishing in the area, although Table 3.2 and Table 3.3 show that the smaller class of trawl vessel can trawl for benthic and demersal species, it is likely that they do this using a midwater trawl setup and fish close to, rather than on, the bottom. In addition, demersal species make up only 9% of the total catch and are normally caught using fixed nets. Thus any seabed exclusions or loss of grounds are likely to have a minimal effect on the fleet.

In summary, the 3 km exclusion zone around the pipe-laying vessel may cause some temporary but moving loss of fishing area and restricted access. However, the pipe-laying vessel spread can be readily circumvented although there may be some inconvenience and increased costs incurred due to the need for fishing vessels to have to steam further to avoid the safety exclusion zone around the construction spread.

3.5.1.3 Noise and Light

The greatest potential impact of the Construction and Pre-Commissioning Phase, and the greatest concern outlined by the fishing companies interviewed, is the possible disturbance to fish migration through noise. Fish stocks migrating along the coast, principally the anchovy and horse mackerel and, to a lesser extent, some of the bottom dwelling species such as migrating red mullet are most likely to be impacted. Anchovy migrate along the coast from the Kerch Strait to the southern wintering areas off Sochi and the coast of Georgia. The main north south autumn migration is October to November whilst the return spring migration is April through June. The Pipeline cuts across this line of movement (Figure 3.4). Sprat is not so directly implicated as they display an inshore/offshore migration movement (Figure 3.3). With regard to the spring and autumn movements of sprat between the shelf and the open water, the Pipeline is mostly aligned with these inshore/offshore movements of the shoals and should therefore not be a barrier. The fish may avoid the immediate vicinity of pipe-laying activity but there should be no impediment to inshore/offshore movement.

In addition to the offshore fisheries there are also a number of nearshore fishing activity, these consist of fish traps and fixed nets, so far all identified only to the south of the pipeline. The

closest traps identified are owned by the Zao Moresky Club, who operate out of Bolshoi Utrish. They operate at least four fixed traps and a mussel farm, all serviced by a fleet of small vessels (Figure 3.6), located approximately 5 km to the south. The fish traps are designed to trap migrating fish, the most significant to the Zao Moresky club being the red mullet with catches of around 50t per year, it also catches around 3t of horse mackerel and small amounts of pontiac shad (about 0.5 t). The traps are placed in fixed positions and rely on the regular migration of the different species through the area, changes in migratory patterns may mean that the fish will miss the traps altogether and the traps may need to be relocated. This is unlikely to affect catches red mullet, which will always tend to migrate close to shore, but may influence the routes of the horse mackerel and pontiac shad, which are pelagic and more likely to pass by further from shore.

Microtunnelling and trenching will take up to 15 months (refer to **Chapter 5 Project Description**). This activity, however, only extends 170 m out to sea beyond the microtunnel exit pits, in water of less than 30 m, after this the pipe is laid directly on the seabed. [011] In contrast, as Figure 1.3 shows, the anchovy movements and concentrations can extend to almost the 100 m isobath, some 10 km from the shore, thus there fish could potentially bypass the construction area.

The pipe-laying vessel will be a moving source of continuous noise and light. The anticipated noise level from vessels used in the pipeline construction is between 169 and 192 dB re 1µPa @ 1 m (Ref. 27). Weighted metrics, specifically the dB_{ht} technique, are based on the hearing sensitivity of the target species and the loudness of the noise as experienced by the animal. Using weighted thresholds, it was found that behavioural effects (given by the 75 dB_{ht} threshold) may be apparent in some hearing specialist fish such as sprat or kilka in some situations[7] (though not shad or anchovy because they have a different hearing range). Anchor handling is the activity most likely to generate such responses, and in shallow water may extend up to 260 m from activity, with an affected area of approximately 0.2 km^2. In deep water, where anchor handling will not take place, the laybarge itself may generate similar impacts at a lesser range of approximately 140 m (area of effect approximately 0.06 km^2). No impacts are predicted to hearing generalist species.

As virtually all fishing takes place within 12 NM (equivalent to 21.6 km) of the coast (Ref. 15), there should always be an undisturbed corridor of 5 to 6 km through which fish can pass. Moreover, since the vessel lays pipes at between 2.5 and 2.75 km per day, over a 21.6 km distance then it should only take around nine days to traverse the fishing zone on the main continental shelf area down to 100 m water depth where the fish migrate. It might possibly be a little longer since the alignment of the Pipeline across the shelf at this point is not straight but, bearing in mind the periods of migration of both the anchovy and mackerel is at least 2 months, any disturbance will only be temporary. A further mitigating factor to consider is that fish are also likely to become habituated to vessel noise sources (Ref. 24).

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

For the majority of the Pipeline alignment to 100 m water depth, the four pipelines will be laid more or less in parallel. The planned process is to build the first pipeline completely after which the remaining three pipelines will be laid in sequence over three to four years. Thus, the disturbance from the vessel in terms of noise and night time illumination will be restricted to more or less nine days per pipeline. It is further noted that the authorities have put a ban on any construction activity taking place in waters to 100 m depth during the month of May, which coincides with the peak of the main spring anchovy migration, thereby reducing even further the opportunity for impact.

The fact that the vessel will be brightly illuminated at all times mean that light also must be considered as an impact. However, the attraction effect of light is relatively localised and also is only a factor at night and thus can be bypassed by the migrating fish at least during the day.

To provide an overall point of comparison with regard to the net effects of construction, in an equivalent situation, monitoring of the fish densities during construction at sites along the North Stream pipeline in the Baltic showed no changes attributable to construction and there was no discernible impact on fish catches over the period (Ref. 23). The fisheries in the Baltic do include several species related to those of the Black Sea including sprat, which also forms a major fishery there.

Winter is the main season for anchovy fishery (1st October to 15th March) whilst summer is the main season for fisheries for sprat (1st April to 31st October) and turbot in the open sea. There is thus no period of the year without a major fishery which would have provided the opportunity to carry out the major part of the near shore construction without any potential impact on the fishery.

3.5.1.4 Summary

On the basis of the analysis presented above, the likelihood of the fishing industry experiencing a reduction in catch during the construction and pre-commissioning phase is considered to be minimal with no distinguishable differences outside normal annual fluctuations.

3.5.2 Operational Phase

3.5.2.1 Loss of Fishing Grounds

Beyond approximately 600 m from the shoreline, the pipeline will lie unburied on the seabed. It will be a potential hazard for fishing vessels as it can contact with their gear. To ensure that the pipelines are not damaged by third party activities (e.g. dragged anchors, fishing gear, etc.) during the Operational Phase, exclusion zones will be put in place along the pipeline route to restrict activities that may damage the pipelines. The exclusion zones will be agreed in consultation with the appropriate authorities. [012] It is anticipated that the exclusion zone will extend to 0.5 km (0.27 NM) either side of the outermost pipelines from the microtunnel exit pit until the Russian / Turkish EEZ boundary. The full width of the exclusion zone would therefore be a corridor of up to approximately 1.5 km allowing for the spread of the four pipes, although this would be increased as the pipelines diverge further offshore.

Notwithstanding the establishment of an Operational Phase exclusion zone, the proscription against using the mid-water trawls on the seabed for anchovy means that fishing is unlikely to interfere with the Pipeline on the seabed. Similarly, the fact that most sprat, horse mackerel and whiting are caught in mid-water trawls further minimises risks of contact with the Pipeline. Fixed nets are used for demersal species such as turbot, as this is a passive gear it is unlikely to interact with the pipeline.

The prohibition of fishing in the exclusion zone along the Pipeline will successfully prevent any interaction between fishing gear and the Pipeline, which is only likely to be between midwater trawlers fishing near the bottom. Through interviews one company (RPK Briz) stated that it will actively avoid the area when it knows the coordinates of the exclusion zone.

There will be some inconvenience through access restrictions, when the exclusion zone is in place which will result in some loss of fishing area but in terms of the area of shelf where bottom fishing can take place it is very small as can be seen from the maps, Figure 3.3 to Figure 3.5). In relation to the estimated shelf area above 100 m of 2,235 km^2, referred to above, the area of a 1.5 km exclusion zone over the pipeline to a depth of 100 m is not significant.

3.5.2.2 Noise

Once construction is over, the main source of impact is the pipeline itself. A pipeline on the seabed should not pose a physical barrier to fish movement nor as a deterrent noise source particularly since the main migratory species are pelagic species which live in the waters well above the pipeline.

The results of monitoring of the North Stream pipeline showed that following construction the actual density of bottom dwelling species increased in the vicinity presumably as the fish used it as a refuge (Section 3.5). If this is combined with a fishing exclusion zone along the pipeline then this could act as a protected area for some fish which could emerge as a positive impact.

3.5.2.3 Vessel Maintenance

Vessels use during operation will be limited to periodic (annual or every 5 years) maintenance surveys. The impacts of operation are the same as during construction to a lesser degree. As such, the scope for any potential impact with fish or fisheries is greatly reduced and not considered to be significant.

3.5.2.4 Summary

On the basis of the analysis presented above, the likelihood of the fishing industry experiencing a reduction in catch during the operational phase is considered to be minimal with no distinguishable differences outside normal annual fluctuations.

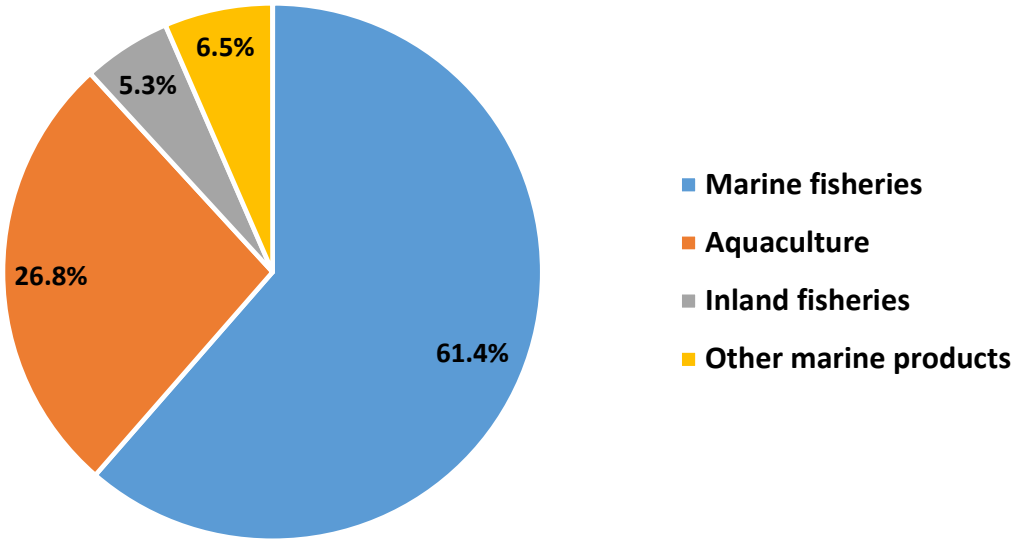
4 Turkey

4.1 Fisheries in Turkish Waters of the Black Sea

4.1.1 Background

There are four sectors of commercial fish production in Turkey; marine fisheries, aquaculture, inland fisheries and other marine products (e.g. crustaceans and molluscs). Marine fisheries account for the largest proportion of fish production as illustrated in Figure 4.1.

Figure 4.1 Distribution of fish production by sector in 2011 (Ref. 39)



Turkey's marine fishing regions are the Mediterranean Sea, the Black Sea, the Aegean Sea and the Sea of Marmara. Of these regions the Black Sea accounts for the largest proportion of production with 77.2% of Turkey's total catch in 2011. The Turkish Black Sea fishing region is divided further into two fishing regions; the East Black Sea and West Black Sea, and is bordered by 15 coastal provinces as shown in Figure 2.9. The East Black Sea Region includes the coastal provinces from Artvin to Sinop, and the West Black Sea Region is comprised of coastal provinces from Kastamonu to Kirklareli.

Figure 4.2 Map of Turkey showing provinces

The main fishing grounds are determined by the location of the feeding, spawning, wintering grounds and migratory patterns of fish. These are concentrated in the shallower waters of the continental shelf area around the rim of the Black Sea, and are largely constrained by the rapid descent of the sea basin to abyssal depths of more than 2,000 m. The semi-enclosed nature of the Black Sea has led to a lack of exchange of water with other oceans and the development of an anoxic basin below the depth of approximately 150 m which is completely devoid of fish life. As such, the 150 m depth contour can be used as a proxy boundary for fishing activity in Turkey's EEZ in the Black Sea. Figure 4.3 presents Turkey's catch from the Black Sea between 1970 and 2011 and shows a high degree of variability following the pattern of other Black Sea fisheries discussed in Section 1.2.

Turkey's Black Sea catch is made up predominantly of small pelagic species such as European anchovy and sprat, which between 2007 and 2011 accounted for nearly 90% of the total catch as shown in Table 11. Other species include the Mediterranean horse mackerel and whiting which are caught almost exclusively by Turkish fleets as a target species according to catch records.

With the exception of the late 1980s and early 1990s, anchovy has always been the most important catch, by weight, only recently, since 2007, has it started to decrease to be replaced by sprat (Figure 4.4).

Figure 4.3 Turkey's Black Sea marine fish catch 1970 – 2011 (Ref. 1)

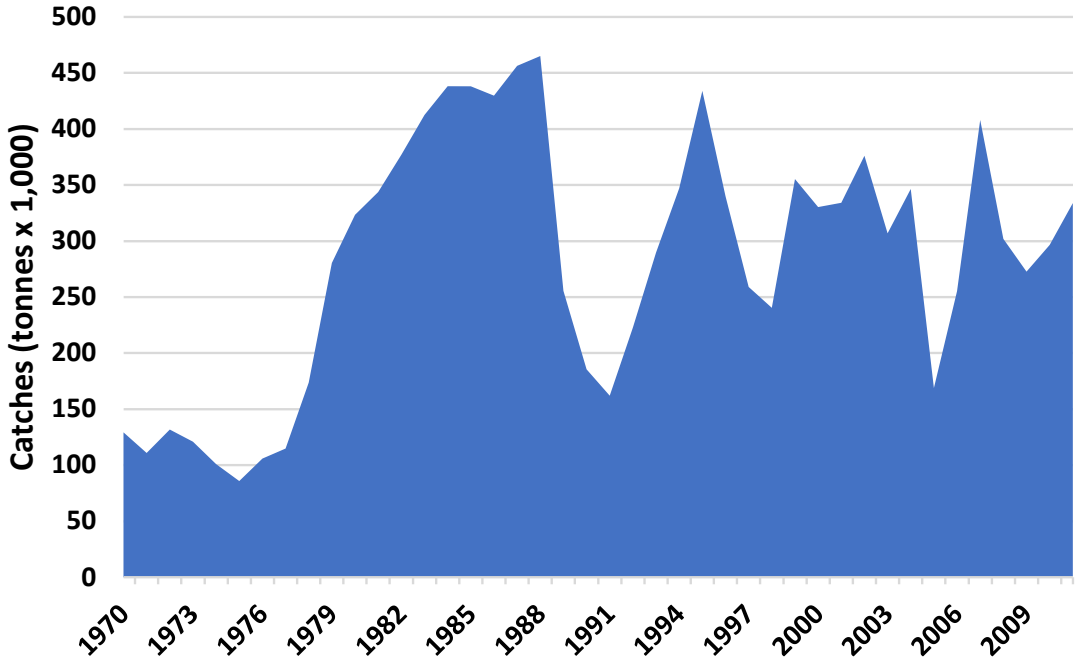


Figure 4.4 Distribution of Turkey's Black Sea catch between European anchovy and other species (Ref. 68)

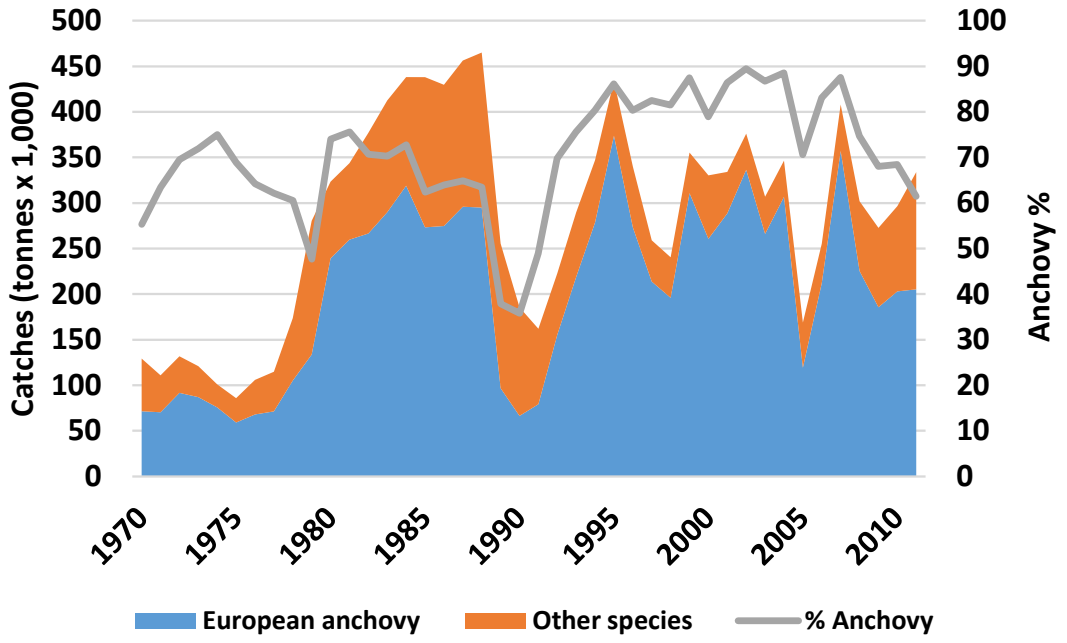


Table 4.1 Top 10 species caught in Turkish waters of the Black Sea (2007 – 2011) (Ref. 37)

Common Name	Scientific name	Type	Turkish name	% of 2011 catch
European anchovy	*Engraulis encrasicolus*	Pelagic Migratory	Hamsi	61.5
Sprat	*Sprattus sprattus*	Pelagic Migratory	Çaça	26.0
Mediterranean horse mackerel	*Trachurus mediterraneus*	Pelagic Migratory	Istavrit (Kraça)	4.3
Whiting	*Merlangius merlangus*	Demersal Migratory	Mezgit	2.4
Atlantic bonito	*Sarda sarda*	Pelagic Migratory	Palamut-Torik	2.0
Scad (Atlantic horse mackerel)	*Trachurus trachurus*	Pelagic Migratory	Istavrit (Karagöz)	1.0
Striped red Mullet	*Mullus surmuletus*	Demersal	Tekir	0.9
European pilchard	*Sardina pilchardus*	Pelagic	Sardalya	0.6
Bluefish	*Pomatomus saltator*	Pelagic Migratory	Lüfer	0.5
Grey mullet	*Mugil cephalus*	Demersal	Kefal	0.3

4.1.2 Economic Value of Catch

In Turkey, the fisheries sector (including inland fisheries, aquaculture and secondary sectors such as processing and manufacturing) represents around 0.3% of GDP and is not considered an important part of the national economy (Ref. 41). The contribution and importance of fisheries to the economies of the coastal provinces of the Black Sea is likely to be greater than that of the national economy. In 2011 the total value of marine fish products in Turkey was 927.88 million Turkish Lira, of which marine fish products from the Black Sea accounted for approximately 57%.

Table 12 presents the most valuable species caught in the Black Sea and their percentage of the total value of marine fisheries products in Turkey. European anchovy are the most important

species in the Black Sea in terms of quantity caught and overall value of catch but being a low value species they represent less than 25% of the total value of marine fisheries products despite accounting for over 50% of the catch.

Of the fish caught in the Black Sea by the Turkish fishing fleet, 98.4% are destined for various marketing channels, 0.4% are consumed by the fishers i.e. do not enter any market, and 1.2% are not processed or consumed at all (discarded as by-catch, used for bait or general wastage) (Ref. 68). There are a number of marketing channels for the marine catch. These markets and the proportion of the catch distributed to each are presented in Figure 4.5.

Table 4.2 Top 10 species of the Black Sea by economic value (Ref. 68)

Species	Price (Turkish Lira (TL/Kg))	Value of species caught in Black Sea (TL)	% of total value of marine fisheries products in Turkey
European Anchovy*	**	221.94 million***	23.9
Sprat	0.73	63.27 million	6.8
Atlantic bonito	8.05	54.14 million	5.8
Horse mackerel	3.75	53.97 million	5.8
Whiting	5.47	44.42 million	4.8
Striped red mullet	9.67	28.94 million	3.1
Bluefish	12.07	21.96 million	2.4
Scad (Atlantic horse mackerel)	4.65	15.58 million	1.7
Red mullet	17.46	5.69 million	0.6
Turbot	35.23	5.09 million	0.5
Other species	-	13.69 million	44.6
Total value of Black Sea marine fish products	*528.83 million*		*56.9*
Total value of Turkey's marine fish products	*927.88 million*		

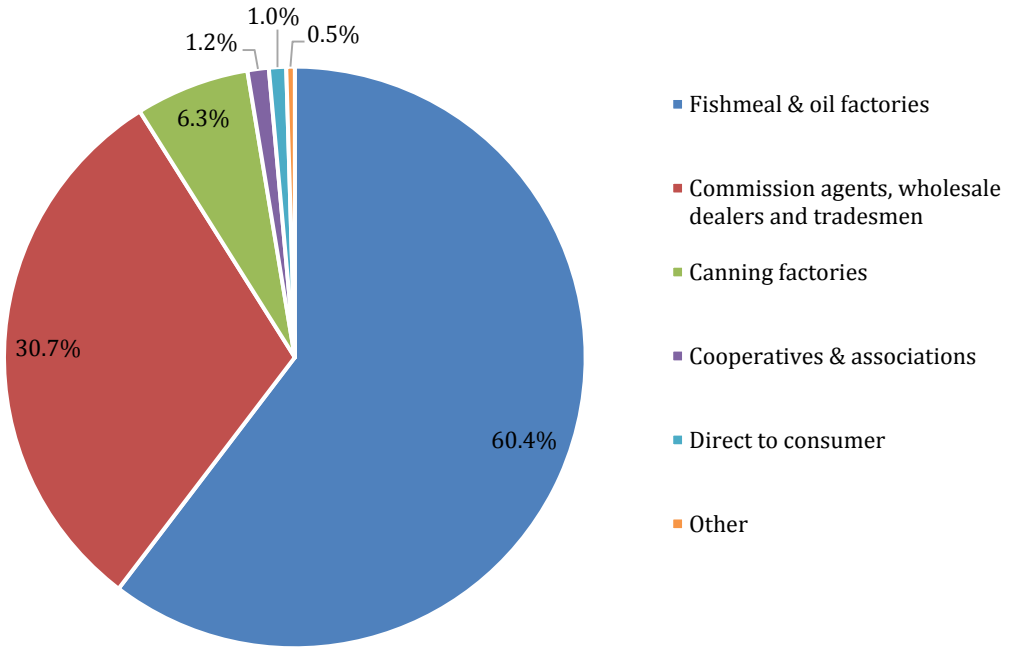
*Includes anchovy for fish meal and fish oil.
** Price varies for anchovy and anchovy used for fish meal and fish oil.
*** An approximate figure based on percentage of Anchovy caught in the Black Sea and total anchovy value (Ref. 68).

Figure 4.5 Proportion of catch distributed to different marketing sectors in 2011 (Ref. 68)

4.1.3 Employment in the Fishing Industry

Fishing activities in the Black Sea fishing region involved 16,486 Turkish workers in 2011 which represents approximately 44% of the total workforce engaged in fisheries operations in Turkey as a whole (Ref. 68). The Black Sea fishing region is bordered by 15 coastal provinces (Figure 4.2). The workforce engaged in fisheries in these Black Sea coastal provinces (including Istanbul) represents approximately 0.22% of total employment in this area, compared to the national proportion of 0.16% of workers involved in fisheries (Ref. 68, Ref. 40). The type of workers range from paid crew members on fishing vessels to partners and household members of fishers working without pay. The types and distribution of workers is presented in Figure 4.6. Full time workers account for approximately 96% of fishers working in the Black Sea, 85% of which are between the ages of 20 and 55 years, 11% are above the age of 55 years and 4% are under the age of 20 years (Ref. 68). However, these employment figures do not necessarily include those involved in secondary activities such as processing, packaging, marketing and distribution, manufacturing of fish processing equipment, net and gear making, ice production and supply, boat construction and maintenance (Ref. 55). Approximately 17% of workers are unpaid household members or partners of the fishers and it is likely that some of these workers will be involved in secondary services such as cleaning and processing fish, but the exact numbers could not be determined. The Food and Agriculture Organisation (FAO) of the United Nations (UN) assumes that for each person directly engaged in fisheries production globally in

Figure 4.5 Proportion of catch distributed to different marketing sectors in 2011 (Ref. 68)



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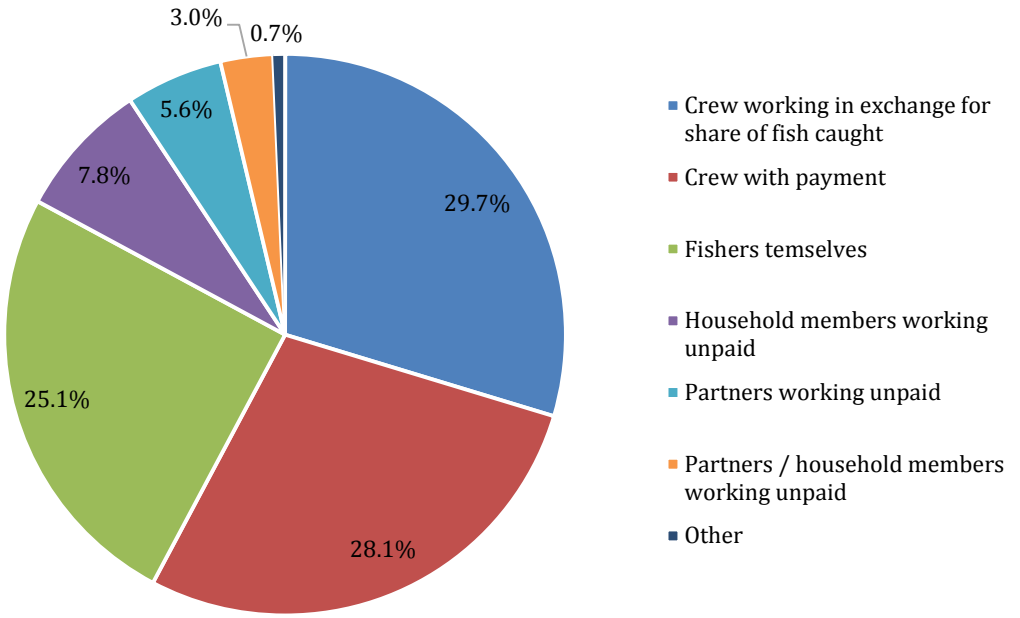
2010 about three to four related jobs were generated in secondary activities (Ref. 55). Using this as a guide the number of workers involved in all aspects of the fishery sector in the Black Sea coastal regions could be as many as 65,000.

Figure 4.6 Types and distribution of Turkish workers in the fishing industry in the Black Sea in 2011 (Ref. 68)



4.2 Fishing Fleet

Under Turkey's Fisheries Law, all vessels operating in commercial fishing activities in Turkish waters have to be registered and must obtain a fishing license. The vessel license authorises a certain fishing vessel to conduct certain fishing activities only. The license appears in the fleet registry and is valid for two years (Ref. 51). Fishers taking part in commercial fisheries also require official registration and a fishing license which is valid for five years (Ref. 51). In 1991 the construction and licensing of new vessels over 12 m was not permitted and licensing of new fishing vessels was stopped altogether in 1997. Since 2002, in order to prevent the expansion of the Turkish fleet, new vessels are only allowed to enter the fleet if an existing vessel exits the fleet, i.e. to replace the existing vessel. In these replacement instances a maximum 20% increase in length is permitted (Ref. 52).

In 2012 there were 5,113 Turkish vessels operating in the Black Sea (Ref. 40). Table 4.3 shows that artisanal vessels accounted for approximately 86% and the remaining 14% are commercial vessels which include trawlers (6%), purse seiners (3%), multi-purpose vessels (3%) and carrier vessels (2%) (Ref 1.4). A large proportion of the vessels are less than 10 m in length (80%) and are under 10 GT (83%). More than half (60%) of the vessels use engines less than 100 HP. Eighty-five percent of vessels operate without hired crew, 9% have between one and

four members of crew and 5% of vessels have more than five crew members. These figures indicate that the Turkish fishing fleet in the Black Sea is mainly composed of artisanal fisheries. However, despite the artisanal nature of the majority of the fishing fleet it is the commercial trawler and purse seine vessels that account for the greatest proportion of the catch as they fish for European anchovy which dominate Turkey's catch in the Black Sea.

Table 4.3 Characteristics of the Black Sea Fishing Fleet in 2012 (Ref. 68)

Characteristic	Categories	No. of vessels	% of vessels
Operation type	Trawler (>12 m)	289	5.7
	Trawl-purse seiner	158	3.1
	Purse Seiner (>12 m)	181	3.5
	Carrier vessel	112	2.2
	Other vessel	4,373	85.5
Construction Material	Wood	4,638	90.7
	Metal	442	8.6
	Fiberglass	33	0.6
Tonnage (gross ton)	1-4	3,645	71.3
	5-9	610	11.9
	10-29	334	6.5
	30-49	146	2.9
	50-99	177	3.5
	100-199	119	2.3
	200+	82	1.6
Engine power (HP/kW)	1-9.9	1,367	26.7
	10-19.9	689	13.5
	20-49.9	979	19.1
	50-99.9	1,000	19.6
	100-199.9	489	9.6

Characteristic	Categories	No. of vessels	% of vessels
			Continued…
Engine power (HP/kW)	200-499.9	346	6.8
	500+	243	4.8
	Without engine	0	0
Length (m)	1 - 4.9	0	0
	5 - 7.9	2,758	53.9
	8-9.9	1,333	26.1
	10-11.9	217	4.2
	12-14.9	222	4.3
	15-19.9	160	3.1
	20-29.9	276	5.4
	30-49.9	140	2.7
	50+	7	0.1
Total no. of vessels operating in the Black Sea	*5,113*		

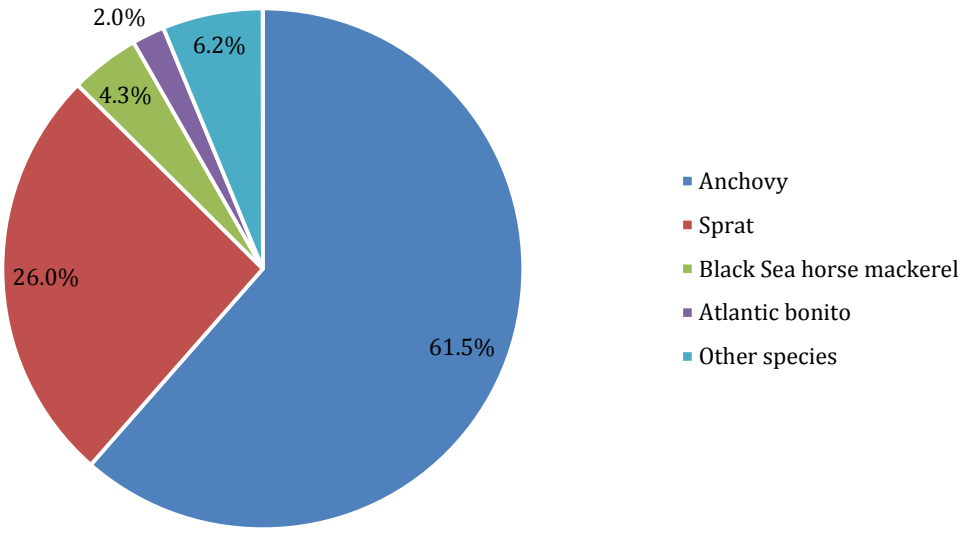
Complete.

4.3 Target Species of Interest to the Project

Due to the location of the Pipeline in Turkey's EEZ and its closest point to Turkey's coast being more 110 km to the south, it is highly unlikely that demersal fisheries will be affected. Demersal fishing takes place along Turkey's coastline in waters up to a maximum of 150 m, after which anoxic conditions prevent the occurrence of any commercially important demersal species. The main fishing grounds are determined by the location of the feeding, spawning, wintering grounds and migratory patterns of fish. These are concentrated in the shallower waters of the continental shelf area around the rim of the Black Sea, and are largely constrained by the rapid descent of the sea basin to abyssal depths of more than 2,000 m. The semi-enclosed nature of the Black Sea has led to a lack of exchange of water with other oceans and the development of an anoxic basin below the depth of approximately 150 m which is completely devoid of fish life. However, large commercial vessels may, on occasion, fish up to 50-60 miles from the coast during anchovy season (Ref. 75).

The four small pelagic species of importance, both in terms of quantity and economic value, caught in Turkish waters of the Black Sea are European anchovy, sprat, Black Sea horse mackerel and Atlantic bonito as shown in Table 11 and Table 12. All other species represent only 6.2% of the total catch. Figure 4.7 illustrates the species composition of the Turkish Black Sea catch in 2011.

Figure 4.7 Species composition of Black Sea catch in 2011 (Ref. 37)



4.4 Target Species Relevant to the Project

The main commercial pelagic species display migratory behaviour in the Black Sea and some of their migratory routes may cross international boundaries. The migratory routes, feeding and spawning areas are discussed in Section 1.3. Of greatest relevance to Turkey is the anchovy as it crosses the pipeline on its migratory route to and from the wintering grounds off the Turkish coast. The migratory routes, spawning and feeding areas of other pelagic species in the Black Sea do not occur near the Pipeline in Turkey's EEZ and are unlikely to be affected by the pipeline.

European Anchovy (*Engraulis encrasicolus*)

Turkey is responsible for, on average, 92.8% (by weight) of all anchovy caught in the Black Sea (Ref. 12 and Ref. 37), as shown in Figure 4.8. In 2011 European anchovy accounted for 61.5% of all marine fish caught by Turkish fleets in the Black Sea (Ref. 37), it is therefore highly significant to Turkish fisheries.

Figure 4.8 Distribution of anchovy catches between Turkey and other Black Sea countries, 1996 – 2011 (Ref. 12 & Ref. 37)

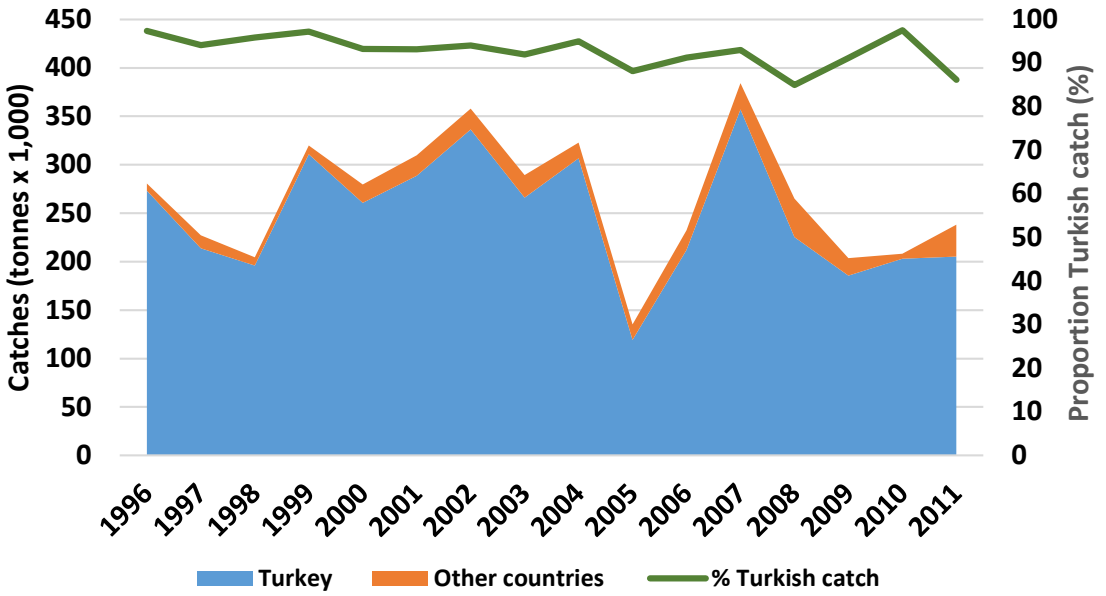
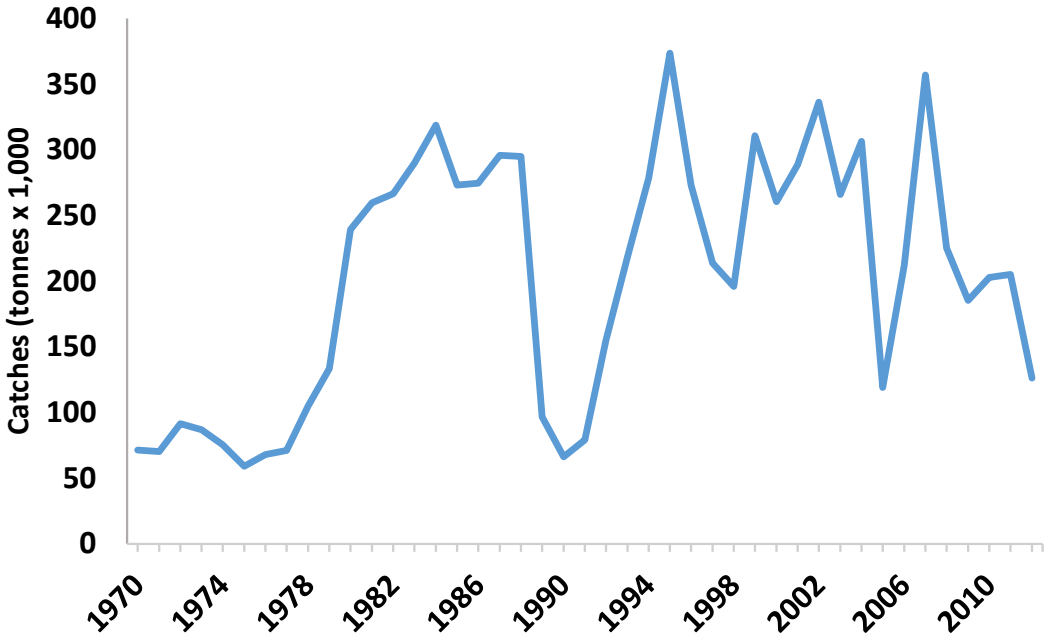


Figure 4.9 shows the Turkish historical catch data of anchovy in the Black Sea from 1970 to 2012[8]. Anchovy catches were high in the 1980s, but in the late 1980s the stock collapsed due factors described in Section 1.2. The Black Sea stock partially recovered from 1995 to 2005 (Ref. 45). In 2005 the European anchovy catches dropped to just over 119,000 tonnes, this has been attributed to the fact that the purse seine fishing fleets, which target both European anchovy and Atlantic bonito, prefer to catch Atlantic bonito due to its higher price per kg. In 2005 the Atlantic bonito catch reached a peak of over 70,000 tonnes which indicated that effort was directed to the Atlantic bonito fishery rather than the European anchovy fishery thereby resulting in a lower catch of European anchovy (Ref. 44). However, after 2007 catches dropped again and this could be the result of climatic changes, an increase in the abundance of predators or overfishing (Ref. 44). The exact cause of decreasing catches has not been established by the scientific community. However, the European anchovy is considered to be overfished and there are recommendations from the Expert Working Group on the Assessment of Black Sea Stocks (EWG) of the European Commission's Scientific, Technical and Economic Committee for Fisheries (STECF) to reduce anchovy catch by 41% in 2013 (Ref. 37).

[8] Data for 2012 is provisional as stated by TUIK.

Figure 4.9 European anchovy catch by the Turkish fleet from 1970 to 2012 (Ref. 40)



Fishing for European anchovy takes place in the coastal waters of Turkey where anchovy form large concentrations in their wintering grounds (Figure 1.4). It is unlikely that fishing for anchovy takes place in near the Pipeline due to the distance from Turkey's coast, the effort required to reach this area and the temporary nature of the European anchovy's presence in these offshore waters, i.e. during migration only. Data on Vessel Monitoring Systems and from log books are not available from Turkey's Ministry of Food Agriculture and Livestock. The fishing season for anchovy begins in October, although the exact date varies year to year, and lasts until April (Ref. 37). Anchovy are caught predominately by commercial purse seiner vessels which target wintering concentrations in Turkish coastal waters, although in recent years mid-water trawling for anchovy has begun (Ref. 37).

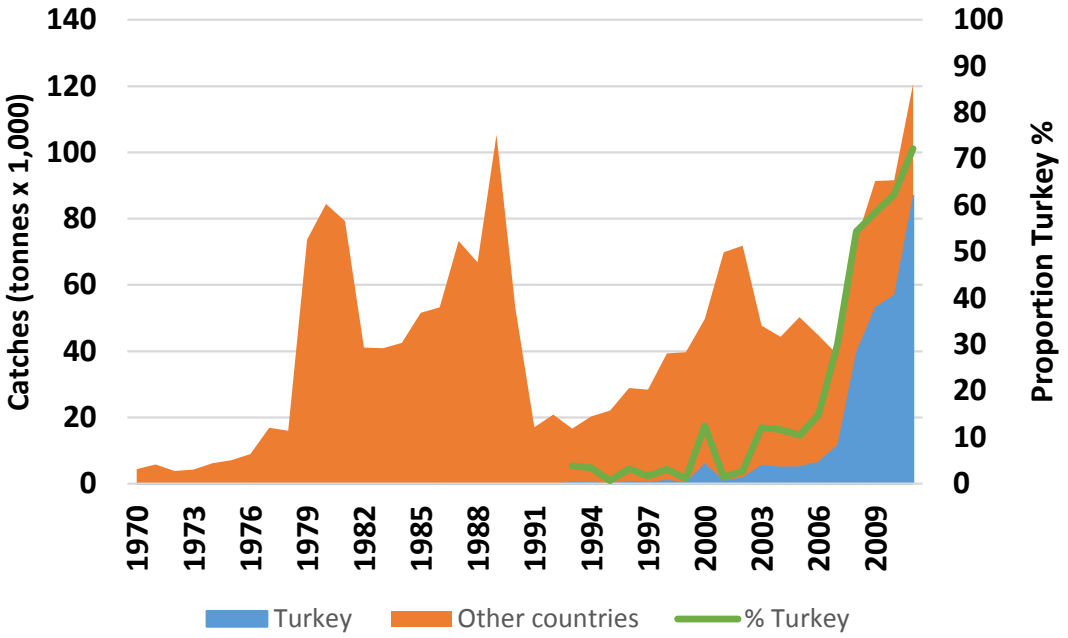
The migration routes of the anchovy are discussed in Section 1.3.1. They are a highly migratory, transboundary species and from Figure 1.4 it can be seen that they will cross the pipeline, either through the centre of the Black Sea or down the west coast, past Romania and Bulgaria. Should the construction of the Pipeline affect their normal migratory route it may alter the time or area of their arrival at the wintering grounds to the south where they are normally targeted by the Turkish fleet, or possibly prevent them arriving at all.

Sprat *(Sprattus sprattus)*

Sprat is a pelagic schooling species and the second most abundant species in the Black Sea after European anchovy (Ref. 42). In 2012, sprat was the second most valuable small pelagic species (in terms of total catch) caught in the Black Sea by Turkish vessels (Ref. 37).

Figure 4.10 presents the historical catch data for the Black Sea sprat fishery and shows Turkey's increasing dominance in recent years.

Figure 4.10 Distribution of catch for sprat between Turkey and other Black Sea countries between 1970 and 2011 (Ref. 12)

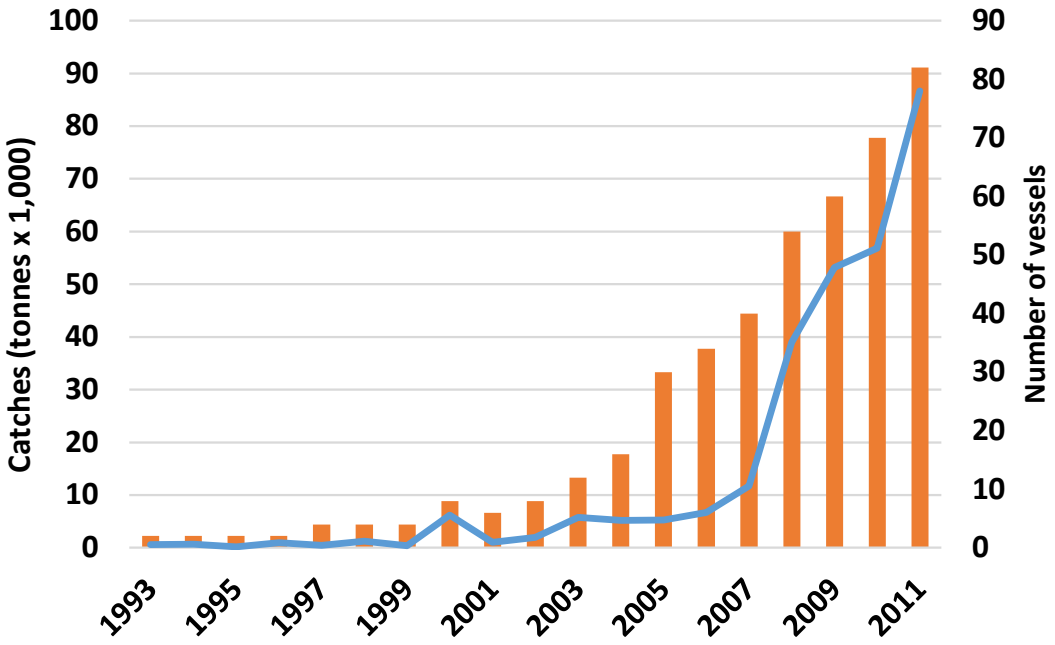


There have been fluctuations in the stock over the past decades with a collapse in 1990 due to factors described in Section 4.1.1, a subsequent recovery was recorded up to 2008 and it has remained stable in recent years (Ref. 37). Catches have increased in recent years, more than doubling since 2007 due mainly to the intensification of the Turkish sprat fishery, reaching an historical peak of 120,710 t was in 2011 (Ref. 37). The EWG of STECF consider that sprat is now exploited above a level that is sustainable (Ref. 37).

Figure 4.11 presents the historical Turkish catch data and the number of vessels involved in the Turkish sprat fishery in the Black Sea from 1993 to 2012. The number of vessels has increased markedly from eight in 2008 to 82 in 2011 (Ref. 1.8), this indicates a surge in fishing effort and may be due to vessels switching from other fisheries or previously unused but registered vessels entering the sprat fishery. This recent intensification of the Turkish sprat fishery occurred due to its promotion by the Commercial Fishery Advice of General Directorate of Fishery in 2002 (Ref. 4).

Sprat migrations are discussed in Section 1.3.2. The feeding grounds, spawning grounds and migration routes are not near the Pipeline in Turkey's EEZ; however the onshore sections of the Pipeline in Bulgaria and Russia do coincide with spawning and feeding grounds of sprat (Figure 1.6).

Figure 4.11 Black Sea sprat catch data 1993 – 2012 (Turkey) (Ref. 37)



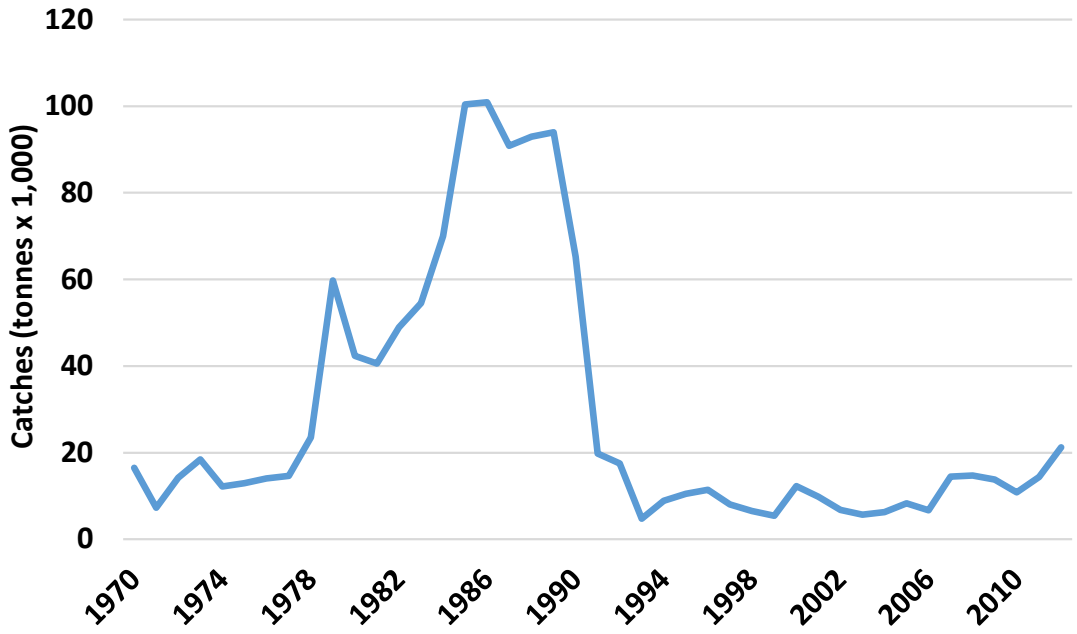
Sprat are targeted in Turkish waters, on the continental shelf between depths of 15 to 110 m. Fishing takes place during the day when aggregations are denser (Ref. 4). The fishing season begins in September and ends in May and is subject to depth restrictions between certain dates in order to protect spawning adults and juveniles in the coastal zone (Ref. 4). The main fishing gear used in the Turkish sprat fishery are pelagic pair trawls which work at depths of 20 to 40 m in the spring and 40 to 80 m in the autumn (Ref. 4). Sprat fishing by pelagic trawls is only permitted along the Samsun Shelf and therefore there is no fishing activity in the vicinity of the Pipeline.

Mediterranean Horse Mackerel *(Trachurus mediterraneus)*

The Black Sea horse mackerel (*Trachurus mediterraneus ponticus*) is a sub species of the Mediterranean horse mackerel (*Trachurus mediterraneus*). It is a migratory pelagic species and until recently was the second most important pelagic catch along Turkey's Black Sea coast (Ref. 4). Turkey is responsible for approximately 97% of Black Sea horse mackerel catches (Ref. 42).

Figure 4.12 shows the historical Turkish catch data of horse mackerel from 1970 to 2012. Horse mackerel stocks collapsed in the early 1990s due to factors described in Section 1 and the stock still remains in a depressed state (Ref. 42).

Figure 4.12 Horse mackerel catch by the Turkish fleet in the Black Sea from 1970 to 2012 (Ref. 40)



Horse mackerel are caught in coastal Turkish waters where they form dense concentrations in their wintering grounds (Section 1.3.5); there is limited or no fishing activity in the vicinity of the Pipeline. It is caught primarily in the winter and predominantly by purse seine nets although other gears including bottom trawls, pelagic trawls, gill nets and long-lines are used (Ref. 4).

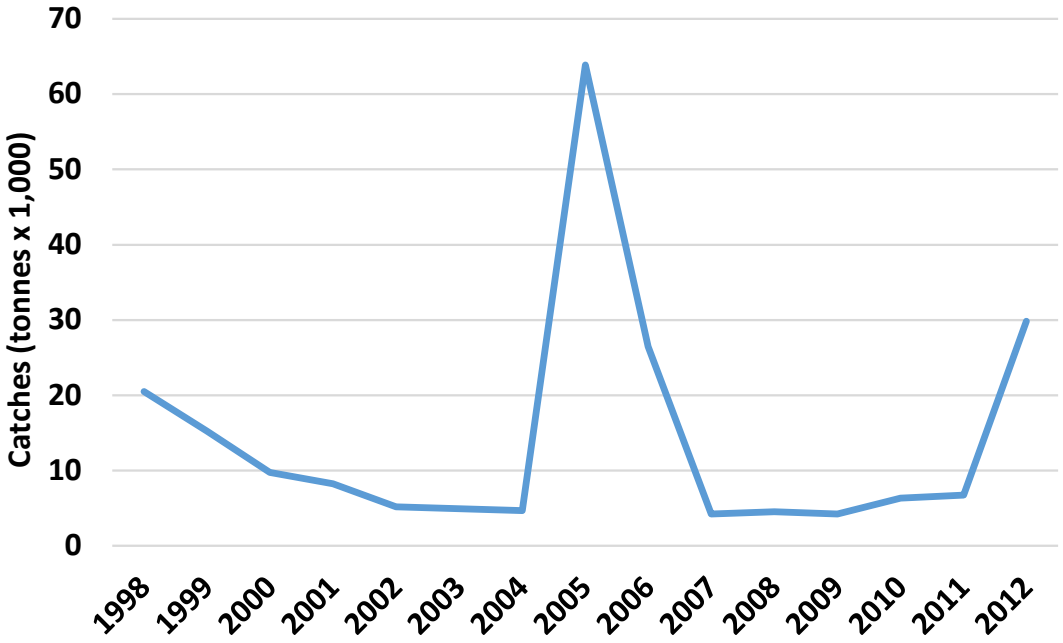
The spawning grounds, feeding grounds and migration routes of horse mackerel are not near the Pipeline in Turkey's EEZ, however the onshore sections of the Pipeline in Bulgaria and Russia do coincide with the spawning and feeding grounds, and migration routes (Figure 1.12).

Atlantic Bonito (Sarda sarda)

Atlantic bonito (*Sarda sarda*) has the second highest economic value per kg (8.05 TL/kg, (Table 12) among the pelagic fish species in the Black Sea (Ref. 37). Turkey accounts for most of the Atlantic bonito catch in the Black Sea (Ref. 12). The causes of the fluctuations in Atlantic bonito catches have not been established by the Scientific Community but they could be linked to combination of environmental factors and overfishing (Ref. 12).

Figure 4.13 presents the Turkish catch data of Atlantic bonito in the Black Sea from 1998 to 2012 (catch data prior to 1998 is not available).

Figure 4.13 Atlantic bonito catch by Turkey in the Black Sea from 1998 to 2012 (Ref. 37)



Atlantic bonito are caught in coastal Turkish waters where they form dense concentrations in their wintering grounds; it is unlikely that fishing for Atlantic bonito takes place near the Pipeline due to the fact that their concentrations are greatest is coats waters. Large scale and small scale Turkish vessels target Atlantic bonito using purse seines and gill nets respectively. Fishing for Atlantic bonito occurs between August and February, peaking in September and October (Ref. 43).

The Black Sea contains large spawning grounds for Atlantic bonito which migrate from the Aegean Sea and Sea of Marmara into the Black Sea between April and August to spawn and feed (Ref. 4). Atlantic bonito spawn in the north-western and western parts of the Black Sea between the end of May until the middle of July (Ref. 46). In the autumn, adult Atlantic bonito migrate back into the Sea of Marmara. Part of the stock also migrate along the southern coast of the Black Sea forming shoals and they remain in these wintering grounds until the beginning of March when they begin to migrate north to their spawning grounds (Ref. 52). The spawning grounds, feeding grounds and migration routes are in coastal waters and are not near the Pipeline in Turkey's EEZ. However, the onshore section of the Pipeline in Bulgaria does coincide with spawning grounds and migration routes.

4.5 Impacts

4.5.1 Construction Phase

There are two ways in which the Construction Phase of the South Stream Offshore Pipeline could impact fisheries in the Turkey's EEZ:

1. A direct impact on fishing activities; and
2. The impact on the migration route of the European anchovy through the Project Area.

4.5.1.1 Impact on Fishing Activities

The main fishing grounds for pelagic fish species, and therefore the main areas of fishing activity, are contained within the 150 m depth contour (Figure 1.1), which can be used as a proxy boundary for fishing activity. Sprat fishing only takes place along the Samsun Shelf in depths of up to 80 m. European anchovy, Black Sea horse mackerel and Atlantic bonito are targeted in their wintering grounds which are located in the shallower coastal waters of Turkey. The Project Area is more than 110 km from Turkey's coastline and at depths of between 2,000 m – 2,200 m. Large commercial vessels may, on occasion, fish up to 50-60 miles from the coast during anchovy season (Ref. 9.75). However, there is no indication from fisheries that pipe-laying activities would impact fishing in the Project Area. Rather, fisheries noted that there may be maritime health and safety implications if pipe-laying activities were to coincide with anchovy season, as lighting from the pipe-laying vessel may attract anchovy which could result in these larger fishing vessels following the anchovy to the pipe-laying vessel. However, fisheries concurred that the Project's maritime safety measures were appropriate to ensure no accidents arise.

4.5.1.2 Impact on Migration Route of the European Anchovy

The European anchovy migrates through the Black Sea between October and November from spawning and feeding grounds in the northwest continental shelf area of the Black Sea to feeding grounds in the coastal waters of Turkey as described in Section 1. A reverse migration takes place between April and June. The Turkish construction schedule indicates that there is potential for the pipe-laying activities of all four pipelines to coincide with the migration route of the European anchovy, as shown in Table 4.4 (migration periods shown in red).

The main source of the impact on fish and fisheries is the noise generated by vessels in the construction spread. The Project noise report (Ref. 50) has indicated that the construction spread will have a significant noise profile during its operation. Using weighted thresholds[9], it was found that mild behavioural effects (given by the 75 dB_{ht} threshold) may be apparent in

[9] 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.

some hearing specialist fish such as sprat or kilka in some situations[10]. In deep water, where anchor handling will not take place, the laybarge itself may generate mild behavioural impacts at a range of approximately 140 m (area of effect approximately 0.06 km^2). No impacts are predicted to hearing generalist species. Mild avoidance responses typically involve startle behaviour but will not necessarily result in disorientation or cessation of migratory behaviour

Table 4.4 Construction Schedule and Fish Migration

Construction	Winter 2014	Spring 2015	Summer 2015	Autumn 2015	Winter 2015	Spring 2016	Summer 2016	Autumn 2016	Winter 2016	Spring 2017	Summer 2017
Pipeline 1											
Pipeline 2											
Pipeline 3											
Pipeline 4											

European anchovy are categorised as hearing specialists[11] and are therefore considered sensitive to underwater noise. However, weighted thresholds from the anchovy's audiogram indicates it will not be sensitive to the noise range generated by pipe-laying vessels and there are no behavioural impacts predicted. Therefore, the migration of anchovy is not likely to be affected by construction activities.

The Project Area within Turkey's EEZ is 470 km long and the construction spread will be moving at a rate of 2.5 km to 2.75 km per day and will therefore take approximately 6 months to complete its transit of the EEZ. The construction spread will therefore represent a moving point source of noise and the impact area arising from this will be approximately 280 m in diameter around the vessel spread. This impact zone is transitory and is a fraction of the width of the migration corridor of any other hearing specialist fish. Therefore, the impact area is not significant and there would be plenty of space either side of it for any fish to continue their migration unaffected by the pipe-laying activities.

A further mitigating feature is that fish can become habituated to repetitive sound (Ref. 63). Thus, the slow transit of the vessel may allow some habituation before maximum exposure is

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

[11] Fish may be classed as hearing specialists or hearing generalists based on their sensitivity to underwater sound. Classification is determined by the internal physiology of the fish and relates to the presence or absence of a swimbladder, and its connection to the inner ear (Ref. 50).

achieved. It is known that the noise of a large tanker is around 177db, which is a little higher than that of the vessel where the maximum is 162db Ref. 27; Ref. 64). The Black Sea has major vessel traffic routes across it much used by super-tankers and container vessels going to Russia's largest port of Novorossiysk. It is known that at least 800 tankers over 10,000 deadweight (DWT) cross the Project Area every year (Ref. 66). There are a number of main shipping lanes from the Bosphorus, Romania and Bulgaria in the east to ports in Russia and Georgia in the west. There is a considerable probability therefore that the European anchovy stock will already be habituated to such sounds (Ref. 65).

The construction spread will also be a source of light which could act as an attractant to fish. However, the radius of its attractant effect will be much more limited than that of noise and, additionally, the attractant effects is only at night leaving the daytime free for movement. Possible effects must therefore be very limited.

In summary, it can be concluded from the above discussion that the pipe-laying activities in Turkey's EEZ will have no significant overall disruptive effect on the seasonal migrations of the European anchovy and consequently on the associated fishery. Some confirmation of this can be taken from the results of the Nord Stream Pipeline Project monitoring programme where an identical method of pipe-lying was used. Monitoring of the fish and fisheries showed that there were no significant effects on the population of various fish species along the pipeline construction route following construction and, equally, there were no changes to the regional fisheries in the Baltic over the period of construction, including small open water species such as sprat (Ref. 65).

4.5.1.3 Summary

On the basis of the analysis presented above, the likelihood of the fishing industry experiencing a reduction in catch during the construction and pre-commissioning phase is considered to be minimal with no distinguishable differences outside normal annual fluctuations.

4.5.2 Operational Phase

Since the pipeline will lie on the abyssal plain at a depth of below 2,000 m in the anoxic zone during operation and no benthic fishing occurs in this area, there is no probability of it interacting with the benthic fisheries. Vessel use during operation will be limited to periodic (annual or every 5 years) maintenance surveys. [015] The impacts of operation are the same as during construction to a lesser degree. As such, the scope for any potential impact with fish or fisheries is greatly reduced and not considered to be significant.

4.5.2.1 Transboundary Issues

Five species; the European anchovy, Mediterranean horse mackerel, Atlantic bonito, piked dogfish and red mullet, have been identified as migrating from spawning and feeding grounds in the north-western and western continental shelf areas of the Black Sea to coastal waters in Turkey. Profiles of these species are presented in Annex 1. An assessment has been conducted with regards to the impact of the Construction and Operational Phases of the Pipeline in Bulgaria on the spawning grounds, feeding grounds and migration routes of these species. It has been concluded that it is unlikely that the construction activities and the subsequent

operation of the Pipeline will have an impact on the feeding grounds, spawning grounds and migration routes. Therefore, it is unlikely that there will be any knock on impact on these species in Turkish waters. With regards to the Construction and Operational Phases of the Pipeline in the Russian waters, no species have been identified as migrating from Russian waters into Turkish waters; the Azov anchovy is a different stock to the European anchovy and does not migrate to Turkish waters.

4.5.2.2 Summary

On the basis of the analysis presented above, the likelihood of the fishing industry experiencing a reduction in catch during the operational phase is considered to be minimal with no distinguishable differences outside normal annual fluctuations.

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Glossary

Term	Explanation
Anadromous	Fish that migrate up rivers from the sea to breed in fresh water.
Anoxic	Absence of oxygen.
Artisanal fishery	A fishery involving fishing households (as opposed to commercial companies), using relatively small amount of capital and energy, relatively small fishing vessels (if any), making short fishing trips, close to shore, with the catch being sold, bartered to traded mainly for local consumption (including that of the fishing households).
Benthopelagic	Living and feeding near the bottom as well as in mid-water or near the surface. Feeding on benthic as well as free swimming organisms.
Contiguous Zone	A band of water extending from the outer edge of the territorial waters (which are usually 12 NM from the coast) up to 24 NM from the coast, within which a state can exert limited control for the purpose of preventing or punishing infringements of its customs, fiscal, immigration or sanitary laws and regulations.
Demersal	Demersal fish live and feed on or near the seabed. They can be contrasted with pelagic fish.
Diurnal vertical migration	Pattern of vertical migration occurring on a daily basis, such as in some copepods and fish.
Draft nets	Single wall of netting attached to a floating head rope and a weighted ground rope, designed so that a bag is formed into which the catch is drafted or hauled. Normally used in rivers or river estuaries.
Fixed gillnets	Either stretched between two or more stakes driven into the bottom within the tidal area along the coast to target coastal species or be weighted to the seabed with weights attached to the ground line (footrope) supported by floats on the upper line (headrope). Can be used to catch demersal or pelagic fish.
Pelagic	Pelagic fish live near the surface or in the water column, but not on or near the seabed. They can be contrasted with demersal fish.
Pound nets	Net walls, anchored or fixed on stakes, reaching from the bottom to the surface. Nets are opened at the surface and include various types of fish herding and retaining devices. Normally used to target migrating, pelagic species.
Purse seine	A long net, which falls as a curtain from a floating head rope, used to surround shoals of fish. After encirclement, the bottom rope is pulled tight to trap the fish in the 'purse'.
Territorial Waters	A belt of coastal waters extending at most 12 nautical miles from the baseline (low water mark) of a coastal state.

Term	Explanation
Turbid	Water containing suspended particles or sediment.

Abbreviations

Term	Explanation
CPUE	Catch Per Unit Effort
EEZ	Exclusive Economic Zone
EC	European Commission
EWG	Expert Working Group on the Assessment of Black Sea Stocks
FVR	Fishing Vessel Register
GDP	Gross Domestic Product
GFCM	General Fisheries Commission for the Mediterranean
GT	Gross Tonnage
HP	Horse Power
LOA	Length Over All
NAFA	National Agency of Fisheries and Aquaculture (Bulgaria)
STECF	Scientific, Technical and Economic Committee for Fisheries
TAC	Total Allowable Catch

Annex 1: Profiles of migratory species

Species	European anchovy (*Engraulis encrasicholus*)	Sprat (*Sprattus sprattus)*
Stock status	SSB stable 600,000 – 700,000t since 2007. Subject to overfishing (F=0.66)	SSB within Black Sea 300-400,000 tonnes, short term scenario predicts same level for 2014 at current level of exploitation. Currently exploited unsustainably
Demersal/pelagic	Pelagic	Pelagic
Preferred habitat	Coastal species, enters lagoons, estuaries and lakes for spawning.	Inshore, occasionally entering estuaries (especially juveniles).
Spawning season	May – August, peaks middle of June to end of July.	Mainly spring and summer
Spawning characteristics	Mainly in north west 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 10-20 m. Eggs pelagic, juveniles distributed over larger area near the surface, young drifting inshore.
Effects of noise	Moderate: probable hearing specialists may affect migrations.	Highly sensitive to low frequency sounds.
Effect of sedimentation	Low: eggs, juveniles and fish pelagic.	Low: eggs, larvae and fish pelagic. Possible effect on prey species.
Effect of turbidity	Visual planktivore, heavy turbidity may reduce ability to locate prey.	Visual predator, known to avoid turbid waters.
Migration	October – 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.
Diet	One of the main consumers of zooplankton.	Feeds on planktonic crustaceans.
Notes	Most important stock in Black Sea 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

Species	**Mediterranean horse mackerel** (*Trachurus mediterraneus*)	**Atlantic bonito** (*Sarda Sarda*)
Stock status	Only relative stock trends assessed. No clear trend since 2004 but SSB in 2011 increased over previous year.	Not assessed.
Demersal/pelagic	Pelagic.	Pelagic.
Preferred habitat	Distributed across the whole Black Sea, usually near bottom in 50 – 100 m depths, also in surface waters.	Epipelagic, neritic, occasionally enters estuaries.
Spawning season	Summer.	May – July.
Spawning characteristics	Spawning success negatively correlated to sea surface temperature. Eggs pelagic.	Enter from Marmara Sea to spawn in northern parts of the Black Sea. Eggs and larvae pelagic.
Effects of noise	Moderate: hearing specialists, show greatest startle response to low frequency sounds, 0.1 – 2khz.	Moderate: possible hearing specialist.
Effect of sedimentation	Low: eggs, juveniles and fish pelagic.	Low: eggs, larvae and fish pelagic.
Effect of turbidity	Visual predator, heavy turbidity may reduce ability to locate prey and communication between schooling fish.	Visual predator, which may be affected by heavy turbidity.
Migration	Highly migratory species through Black Sea. Migrates north in mid-April, for reproduction and feeding. September - 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	Other fish including sardine, anchovy and small crustaceans.	Cannibalistic, also feeds on small schooling fishes and invertebrates.
Notes	All Black Sea horse mackerel treated as a unit stock but thought to consist 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.

Species	**Piked dogfish** *(Squalus acanthias)*	**Red mullet** *(Mullus barbatus barbartus)*
Stock status	Spawning Stock Biomass estimated to be 14,776 tonnes (2011), below historical high of 100,000 tonnes. Currently overexploited.	No estimate of total stock size but assessments indicate spawning stock Biomass levels reduced from higher levels in 2004-2008.
Demersal/pelagic	Demersal	Demersal
Preferred habitat	Demersal but also found mid-water and occasionally on surface	Live near gravel, sand and mud bottoms of the continental shelf. 5 – 100 m
Spawning season	Mating probably occurs in winter, spawning period March – May.	June – September, most in mid-summer.
Spawning characteristics	Ovoviviparous, Females migrate to shallower depths, separate from males, near coasts. Births occur between April – May and August – September.	Spawns on muddy, sandy bottoms between 10 and 55 m. Moves to shallow water to spawn in May then returns to deeper water. Eggs and larvae pelagic up to 1.5 months.
Effects of noise	Unknown	Unknown
Effect of sedimentation	Low: Young born live.	Low, eggs and larvae pelagic. May affect prey species.
Effects of turbidity	Low, uses weak electrical signals to detect prey.	Low
Migration	Highly migratory, autumn feeding migrations to north, associated with anchovy and horse mackerel. Reproductive migrations towards coastal shallows take place in spring and autumn.	Along coast of Bulgaria migrates to Turkish and Sea of Marmara waters in September – November for winter feeding. Some years schools remain on Bulgarian coast and die in cold winters.
Diet	Small pelagic species, in Black Sea follows anchovy and horse mackerel migrations.	Crustaceans, molluscs, worms and other small invertebrates.
Notes	IUCN status vulnerable.	Black Sea RDB Endangered (EN).

Annex 2 Mussel farms located off the Bulgarian coast (Ref. 8)

UROR Number	Farm – Name	Date of Registration	Farm – Location - GPS coordinates
02100002	Mussel Farms	13.06.2002	In the aquatory of the Black Sea, north-east of Sveti Ivan Island, Sozopol Bay and 1600 m from Sozopol, Sozopol municipality, Burgas region, points coordinates: p. 1:42*26'08.10" N and 27*40'47 82" E; p.2: 42*26’29.88" N and 27*41'10.20" E; p.3: 42*26
02100012	Mussel Farm	18.01.2005	The area of the North Nesebar Bay Lat=42*39’58”N, Long=27*44'13"E, Lat=42*39'58"N, Long=27*44'43"E, Lat=42*39'49"N, Long=27*44'13"E, Lat=42*39'49"N, Long=27*44'43"E
02100013	Chateau M-1 Mussel Farm	22.03.2005	Aquatory of Sozopol-Primorsko M1 - Lat=42*21'8"N, Long=27*44'2"E, Lat=42*21'5"N, Long=27*44'6"E
02100014	Chateau M-2 Mussel Farm	22.03.2005	Aquatory of Sozopol-Primorsko M2- Lat=42*20’45’N, Long=27'45'5"E, Lat=42*20'2"N, Long=27*45’8"E
02100015	Chateau M-3 Mussel Farm	22.03.2005	Aquatory of Sozopol-Primorsko M3 - Lat=42*17'98"N, Long=27*46'51"E R=2 cab.
02100016	Chateau M-4 Mussel Farm	22.03.2005	Aquatory of Sozopol-Primorsko M4 - Lat=42*17’6"N, Long=27*46'45"E, R=2 cab.
03100006	Kranevo Mussel Farm	23.03.2005	Aquatory of The Black Sea, 1 mile north-east of Cape Ekrene and 0.8 miles from the coastal line with a total area of 250000 m2, a square with dimensions of 500 m x500 m and coordinates as follows: p.1: 43*20'33.6 N and 28*05'30.0 E; p.2: 43*20’27.4 N and 28*05'50.5 E; p.3
08100003	Kavarrnenski Bay	25.06.2004	A quadrant with dimensions of 600 m X 400 m in the aquatory of Kavarna, Cape Chirakman with coordinates: p.A:

UROR Number	Farm – Name	Date of Registration	Farm – Location - GPS coordinates
	Mussel Farm,		43*23.5' N and 028*17.8 E; p. B: 43*25.5' N and 028*21.0' E; p. C: 43*23.3' N and 028*21.0 E; p. D: 43*23.3' N and 028*17.8'E; p.E 43*24.4'N and 028*19.4' E
08100004	Mussel Farm	01.07.2004	A quadrant with dimensions of 600 m X 400 m in the aquatory of Kavarna, Cape Chirakman with coordinates: p.1: 43*24'18.9" N and 28* 19'30. 4" E; p.2: 43*24'18" and 28*19'57" N; p.3: 43*24'05. 1" N and 28* 19'56.1" E; p. 4: 43*24'06" N and 28*19'29.5" E
08100008	Zelenka Mussel Farm	18.04.2006	A quadrant in the aquatory of Kavarna with coordinates: 43*24.40 N and 28*20.00 E; 43*24'07 N and 28*19’98 E, 43*24’05 N and 28*20'55 E; 43*24'38 N and 28*20'57 E
08100010	Black Mussels Farm	15.05.2006	In the aquatory of The Black Sea, at a distance of 3.5 miles from Kavarna port, within the boundaries of the village of Bulgarevo, in front of Zelenka area, Kavarna municipality, Dobrich region, irregular hexagon – with an area of 1572 dka, with the following coordinates: p.1: 43*23’13.5 N and 28*24'40 E, p.2: 43*22'56 N and 28*25'40 E; p. 3: 43*22'41 N and 28*25'40 E; p.4: 43*22'40.5 N and 28*26'12 E; p 5: 43*22'16N and 28*26'12.5 E; p.6: 43*22'51 N and 28*24’34.5 E
02100018	Akrotira Mussel Farm	07.02.2007	In the aquatory of the Black Sea, in the vicinity of the village of Bulgarevo, Kavarna municipality, Dobrich region, in the south-west region about 1 km from Bulgarevo village, in the area of Dalboka, 640 m from the coast, rectangle with an area of 84.203 dka, with the following coordinates: p. 1: 43*23'50.4 N and 28*23'09.4 E; p. 2: 43*23'44.6 N and 28*23'19 E; p. 3: 43*23'37.1 N and 28*23'10.5 E; p.4 43*23'42.9N and 28*23'00.9 E
08100011	Siyad-Stefka Atanasova Mussel Farm	09.02.2007	An area south of Nesebar, in the Akrotira locality, 500 m from Cape Akrotiriya, defined by a circle with a radios of 50 m, with an area of 7.854 dka and with coordinates of the area centre as follows:42*38'26 N and 27*42'36 E; 42*38'26 N and 27*42'36 E
02100019	Morski Darove Mussel Farm	14.02.2007	In the aquatory of the Black Sea, in the area of Kavarna, municipality, Dobrich region, located I mile south-east of Kavarna pier and 0.5 miles from the coastal line, with an area of 125 dka, rectangle with dimensions of 250 m X 500 m

UROR Number	Farm – Name	Date of Registration	Farm – Location - GPS coordinates
			with coordinates as follows: p. 1: 43*23'893 N and 28
08100012	Kavarna farm for the production of mussels	05.12.2007	p.1: 43*23'893 N and 28*22'320 E; p.2: 43*23'868 N and 28*22’688 E; p.3: 43*23'733 N and 28*22'672 E;p.4: 43*23'758 N and 28*22'303 E
08100013	Kavarna Mussel Farm	20.12.2007	In the aquatory of the Black Sea, 5 km north of Primorsko, south of Cape Maslen, irregular rectangle with dimensions 400 m X 262.5 m X 375 m X 225 m and with coordinates as follows: p.1: 42*18'08 N and 27*46'49 E; p.2: 42* 18' 16 N and 27*47'02 E; p.3: 42* 18' 10 N and
08100014	Dalboka 1Mussel Farm	07.02.2008	p.1: 42*18'08 N and 27*46'49 E; p.2: 42*18'16 N and 27*47'02 E; p.3: 42*18'10 N and 27*47'08 E;p.4: 42*18'02 N and 27*46'54 E
08100015	Dalboka 2 Mussel Farm	07.02.2008	In the aquatory of the Black Sea, in an area located 1.6 miles south-west of Kavarna pier and 0.7 miles from the coastal line, with an area of 2000 dka, a rectangle with coordinates: p.1: 43*24'15.6" NLat and 28* 18'24.6"ELong; p.2: 43*24'15.6" NLat and 28* 19'15.0" ELong; p.3: 43*23'56
02100024	Sveta Agalina Mussel Farm	16.01.2009	In the aquatory of the Black Sea, Kaliakra Bay, 305 m from the coast, 34 dka of aquatic area in total, in the vicinity of the village of Bulgarevo, Dalboka locality, Kavarna, municipality, Dobrich region – a rectangle with coordinates:
02100025	Aqua Food Mussel Farm	23.03.2009	In the aquatory of the Black Sea, about 3 km south of Nesebar, Ravda Bay, Burgas region, with an area of 187.776 dka, 565 m from the coast, with the following coordinates: p.1: 42*38'17 N and 27*41'45 E; p. 2: 42*38'40 N and 27*41'62 E; p. 3: 42*38'50 N and 27*41'36 E
02100026	Angel Divers Mussel Farm	24.03.2009	In the aquatory of the Black Sea, in the area of the bay of Cape Ravdaenski, the village of Ravda, Nesebar municipality, Burgas region, with an area of 380.458 dka, 715 m from the coast with the following coordinates: p. 1:

UROR Number	Farm – Name	Date of Registration	Farm – Location - GPS coordinates
			42*37'55 N and 27*41'01 E; p.2: 42*37'55 N and 27*41'30 E; p. 3: 42*37'36 N and 27*41'
02100027	Vetrohi Mussel farm	01.04.2009	In the aquatory of the Black Sea, in the area of Vetrohi Bay, Primorsko municipality, Burgas region, with an area of 40.216 dka with the following coordinates: p. 1: 42*20'15.0 N and 27*46'20.0 E; p. 2: 42*20'11.0 N and 27*46'32.0 E; p. 3: 42*20'01 N and 27*46'26.5 E; p.4: 42*20'05.1 N
02100028	Sea Sunrise Mussel Export Farm	11.05.2009	In the aquatory of the Black Sea, in an area north of Cape Maslen, Sveta Paraskeva Bay, Primorsko municipality, Burgas region, with an area of 35. 651 dka, with the following coordinates: p. 1: 42*19'13.7 N and 27*46'36.2 E; p. 2: 42*19'19.3 N and 27*47'37.3 E; p. 3: 42*19'20.3 N and 27
03100012	V D Trans – Cape Ekrene Mussel Farm	11.05.2009	In the aquatory of the Black Sea, in the area of Cape Ekrene, south of the village of Kranevo jetty, Balchik municipality, Dobrich region, with an area of 250 dka, with the following coordinates: p.1: 43*19'48.5 N and 28*04'36.1 E; p.2 43*19'38.8 N and 28*04'53.9 E; p. 3: 43* 19'25.8 N and 28*04'40.7E
03100013	B H D – Golden Sands Mussel Farm	27.05.2009	In the aquatory of the Black Sea, in the area north of Golden Sands Yacht Club, south of Kranevo jetty, Balchik municipality, Dobrich region, with an area of 250 dka, with the following coordinates: p.1: 43* 18'23.7 N and 28*03'45.6 E; p. 2: 43*18'18.0 N and 28*04'06.3 E; p.3
03100014	MMD 03 - Golden Sand Mussel Farm	28.05.2009	In the aquatory of the Black Sea in the area north of Golden Sands Yacht Club, south of Kranevo jetty, Balchik municipality, Dobrich region, with an area of 250 dka, with the following coordinates: p. 1: 43*18'53.3 N and 28*04'00.9 E; p.2: 43*18'47.6 N and 28*04'21.6 E; p. 3
08100016	Neks Consult Mussel Farm	07.10.2009	In the aquatory of the Black Sea, south-east of Cape Ikantalak, south of Topola village, Kavarna municipality, Dobrich region, quadrant with coordinates: p. 1: 43*23'50.5" N and 28*15'16" E; p.2: 43*23'48. 2" and 28*15'38.3"N; p.3: 43*23'41.7"N and 28* 15'38. 6” E; p.4: 43*23'43. 3" N and

UROR Number	Farm – Name	Date of Registration	Farm – Location - GPS coordinates
02100029	Arapya Mussel Farm	27.10.2009	In the aquatory of the Black Sea, in the area of Arapya locality, within the boundaries of the town of Tsarevo, Tsarevo municipality, Burgas region, with an area of 49.384 dka, with the following coordinates: p. 1: 42*11'16.3 N and 27*50'47.2 E; p. 2: 42* 11'22.4 N and 27*50'40.2 E; p. 3: 42* 11 '26.8 N and 27*50'46
02100031	Sveta Agalina Mussel Farm	11.11.2009	In the aquatory of the Black Sea, in the area of Cape Sveta Agalina, north of Beglik Tash locality, within the boundaries of the town of Primorsko, Primorsko municipality, Burgas region, with an area of 572.667 dka, with the following coordinates: p. 1: 42*20'39.4 N and 27*44'58.1 E; p. 2: 42*20'55.6
02100032	Mirius Mussel Farm	11.11.2009	In the aquatory of the Black Sea, in the area south of Cape Maslen, in the area of Mirius jetty, east of the Beglik Tash locality, within the boundaries of the town of Primorsko, Primorsko municipality, Burgas region, with an area of 439.396 dka, with the following coordinates: p. 1: 42*17'55.3 N and 27*46'3
08100017	Mussel Installation Trans Topola	03.12.2009	In the aquatory of the Black Sea, in the area south-east of Cape Ikantalak, within the boundaries of the village of Topola, Kavarna municipality, Dobrich region
02100033	Mussel Installation Trans Sozopol	04.12.2009	In the aquatory of the Black Sea, in the area north-east of Cape Sveta Agalina, within the boundaries of Sozopol, Sozopol municipality, Burgas region
08100018	Kalkan Tepe Mussel Farm	16.03.2010	In the aquatory of the Black Sea, between the villages of Topola and Bozhurets, Kavarna municipality, Dobrich region, a polygon with point coordinates: p.1: 43*24'04.8" N and 28*16'31.1"E; p.2: 43*24'11.4"N and 28*17'14.6"E; p. 3: 43*23'39.7" N and 28*17'23.6" E; p.4: 43*23'33.1
03100017	C'est la vie – Ivan Kirov Mussel Farm	22.03.2010	In the aquatory of the Black Sea, in the area of Kranevo, Balchik municipality, Dobrich region, with an area of 239. 8 dka, with the following coordinates: p. 1: 43* 19'06.2 N and 28*04'42.7 E; p. 2: 43* 19' 15.9 N and 28*05'05.8 E; p. 3: 43*19'04.7 N and 28*05'14.7 E; p.4: 43* 18'55.0 N and 28*04'

UROR Number	Farm – Name	Date of Registration	Farm – Location - GPS coordinates
03100018	Setlavi Mussel Farm	15.05.2010	In the aquatory of the Black Sea in the area of Golden Sands resort, Varna, Primorski region, Varna municipality, Varna region, with an area of 160. 07 dka, with the following coordinates: p. 1: 43*14'41.6 N and 28*02'15.0 E; p.2: 43*14'53.4 N and 28*02'21.9 E; p. 3: 43*14'48.9 N and 28*
02100034	Kavatsite Mussel Farm	17.05.2010	In the aquatory of the Black Sea, in the area of Kavatsite Bay, within the boundaries of Sozopol, Sozopol municipality, Burgas region, with points coordinates: p. 1: 42*23'20. 0" N and 27*43'03.3" E: p. 2: 42*23'20.0" N and 27*43'21.0" E: p. 3: 42*23'05.0" N and 27*43’00.0“ E
03100020	Morski Oasis Mussel Farm	03.11.2010	In the aquatory of the Black Sea, in the area of Cape Ekrene, Aksakovo municipality, Varna region, with an area of 265.436 dka, with the following coordinates: p. 1: 43*18'26.42 N and 28*04'45.25 E; p. 2: 43*18'45.54 N and 28*04'53.88 E; p. 3: 43*18'49.84 N and 28*04'35.83 E; p.4: 43* 18'30.74
02100035	Emona Sea Mussel Farm	08.11.2010	In the aquatory of the Black Sea, south-east of Cape Emine, Nesebar municipality, Burgas region, with point coordinates: p. 1: 42*41'53. 8" N and 27*52'40.3" E: p. 2: 42*41'53.8" N and 27*52'46. 9" E; p. 3: 42*41'45.6" N and 27*52'46.9"E; p. 4: 42*41'45. 6" N
03100021	Midea Mussel Farm	21.01.2011	In the aquatory of the Black Sea, in front of Cape Ekrene, the village of Kranevo, Balchik municipality, Dobrich region, with an area of 400 dka, with the following coordinates: p. 1: 43* 19' 11.94 N and 28*05'30.97 E; p.2: 43*19'17.89 N and 28*05'46.77 E; p. 3: 43*19'46. 74 N and 28*05'26.35 E; p. 4: 43* 19'40.70
03100023	Gumi Nira 94 Mussel Farm	17.06.2011	In the aquatory of the Black Sea with an area of 473.094 dka, in the area in the vicinity of Galata district, Varna, Varna region, in the coastal waters and the following coordinates: p. 1: 43*06'56.8 N and 27*56'02.2 E; p. 2: 43*06'56.8 N and 27*56'24.5 E; p. 3: 43*07'28.0 N and 27*5