EUROPEAN UNION
European Maritime and Fisheries Fund

EASME/EMFF/2014/1.2.1.5/2/SI2.707672 MSP LOT 1/BLACK SEA/MARSPLAN-BS

CASE STUDY 3 BURGAS: LAND-SEA INTERACTIONS

CROSS BORDER MARITIME SPATIAL PLANNING IN THE BLACK SEA – ROMANIA AND BULGARIA (MARSPLAN–BS)

June 2017

CASE STUDY 3 BURGAS:
LAND-SEA INTERACTIONS

June 2017

CROSS BORDER MARITIME SPATIAL PLANNING
IN THE BLACK SEA – ROMANIA AND BULGARIA
(MARSPLAN–BS)

EASME/EMFF/2014/1.2.1.5/2/SI2.707672 MSP LOT 1/BLACK SEA/MARSPLAN–BS

WP1, Activity 1.1, Component 1.1.2.
Case studies with major challenges
within the Romanian and Bulgarian maritime space

CASE STUDY 3 BURGAS: LAND-SEA INTERACTIONS

Authors:

Margarita STANCHEVA · Hristo STANCHEV
Anton KRASTEV · Atanas PALAZOV · Maria YANKOVA

Institute of Oceanology – Bulgarian Academy of Sciences (IO-BAS),
(Project Partner 8)

DISCLAIMER:

This report has been produced with the assistance of the European Union. Its content is the sole responsibility of the Authors (Project Partner IO-BAS) and can in no way reflect the views of the European Commission and Executive Agency for Small and Medium-sized Enterprises (EASME). The European Commission or EASME is not responsible for any use that may be made of the information this report contains.

TABLE OF CONTENTS

Phase I.

CURRENT SITUATION ANALYSIS OF BURGAS STUDY AREA

1. INTRODUCTION

This report presents the results of **Case Study 3 Burgas: land-sea interactions** under the project *Cross border maritime spatial planning in the Black Sea – Romania and Bulgaria (MARSPLAN–BS)*, Grant Agreement: EASME/EMFF/2014/1.2.1.5/2/SI2.707672 MSP LOT 1 /BLACK SEA/MARSPLAN–BS. The project is co-funded by the European Commission through the European Maritime and Fisheries Fund (EMFF), DG MARE: https://ec.europa.eu/maritimeaffairs/index_en. The case study was one of the five case studies with major challenges carried out within the MARSPLAN–BS Project.

1.1. DESKTOP ANALYSIS – SELECTION OF CASE STUDY AREA AND DEFINE GEOGRAPHICAL EXTENT

1.1.1. Burgas case study area

The case study area is geographically located along the south Bulgarian Black Sea coast, in the westernmost part of the largest Bulgarian bay – Burgas Bay, and administratively in the municipality of Burgas (**Figure 1**).

The municipality of Burgas has an area of 515.2 km^2 (Kopralev, 2004) or it comprises 0.46% of the country's territory. It borders with municipality of Pomorie on the north, municipalities Aytos, Kameno and Sredets on the west and municipality of Sozopol on the south. It borders with the Black Sea on the east, as the coastline length of Burgas municipality is 37.25 km.

According to the Maritime Space, Inland Waterways and Ports of the Republic of Bulgaria Act (SG N^o 12/11.02.2000), Burgas Bay is located between the coastline and the straight line joining Cape Emine on the north and Cape Maslen nos on the south.

Jutting deep into the mainland, Burgas Bay is the largest one at the Bulgarian Black Sea coast and it is the westernmost point of the Black Sea – 27º26′54′′E. The coastline is strongly indented and has a length of 167 km based on orthophoto images from 2010 with spatial resolution of 0.5 m. The maritime boundary

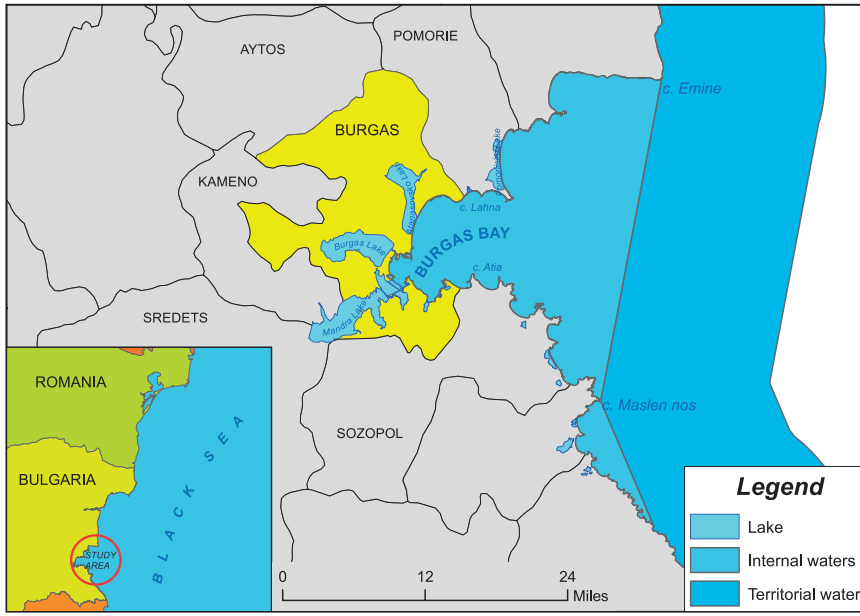

Figure 1. *Burgas case study area – location map*

passing along the line north of Cape Emine (Eastern Balkan Mountains) and Cape Maslen Nos on the south, and has a length of 44.5 km. Along this line, the width of the bay is 32 km and the area is 783 km^2. The maximum depth of the bay within the aforementioned range is 53 m, as the maximum depths at territorial sea reaches 70 m.

The case study area encompasses the *small Burgas Bay*: with the marine area between Cape Lahna on the north and Cape Atia on the south with the seaward boundary of 12 mile zone, and with the land boundary extending from 7 km to 23 km landward at LAU (Local Administrative Units) level (**Figure 1**). The entire municipality of Burgas falls within the 23 km zone along the sea, as 10 km coastal zone area includes more than 50% of territory.

Burgas Municipality includes 14 settlements, as only 2 have the status of towns and the remaining are villages. Population of the municipality, according to the Census data from 2011 is 212,902 people (NSI, 2012). *Circa* 94% of the population

is concentrated in the municipal centre, Burgas city (with population of 200,271 people). Burgas is the fourth largest city in Bulgaria and it is located in the most eastern point of Burgas valley. Burgas is one of the most important ports at the Black Sea with significant infrastructure for supporting the economic activities. The harbour of Burgas is located at the westernmost part of the bay and the main port terminals are: Burgas West; Bourgas East; Fishing Port; Rosenets Oil Terminal *Lukoil Neftohim Burgas*, further described in section 2.3.3. Burgas has a modern international airport, which handles most of the country tourist flow during the peak summer season. The city is a centre of culture, science and art of national importance and is distinguished with rapid developments over the recent years. At the same time the location of the city defines it as particularly sensitive to the protection of environment and natural heritage in response to adverse global processes.

In the surroundings of the pilot area there are valuable natural protected areas (NATURA 2000) and wetlands, important Ramsar sites, such as: lakes of Atanasovsko, Burgas and Mandra, which will be described further in the next sections. These lakes, together with the Pomorie Lake (adjacent in north direction) form the largest wetland along the coast with exceptional conservation value of international and national importance. They run into several smaller rivers whose mouths are swampy.

In this context, the necessity of performing such an investigation at the area of Burgas Bay comes up as a current challenge for sustainable economic development and protection of biodiversity of all wetlands and effective use of natural resources: those are in close proximity of the large city and the existence of various coastal and maritime activities that inevitably have an impact on the environment.

The intensity of both coastal and maritime activities in the study area have been constantly increased and new activities have been initiated or planned over the recent years, that area is often in conflict with other activities or the objectives of environmental protection. Therefore, the study case is focused to investigate the land-sea interactions and the needs of maritime spatial planning.

1.1.2. General approach to the case study

The Directive 2014/89/ of the European Parliament and of the Council of 23 July 2014 has established a framework for maritime spatial planning. The Directive sets the land-sea interaction as one of the minimum requirements for Maritime Spatial Planning (MSP). The use and impact of the sea does not end on the shoreline. Coastal areas are interdependent with the sea in both human use and nature conditions and most of human activities on marine areas are functionally linked to the shore and vice versa (https://coastalandmaritime.wordpress.com).

In Burgas Case Study it is aimed to:

• follow the land-sea interactions with a special focus on biodiversity;

• identify the impact of land infrastructure on wetlands and maritime space;

• it is challenging to find out what are the interactions, conflicts and impacts between uses, sectors and interests both terrestrial and marine;

• identify key stakeholders and involve them in the process of identifying current and future trends, sector priorities and interests;

• develop and visualise different agenda options, recommendations and solutions for identified case area issues.

The Directive 2014/89/EU on maritime spatial planning, existing international guidelines, e.g. UNESCO Marine Spatial Planning: a step-by-step approach toward ecosystem-based management (2009), as well as best practice results and reports from the BaltSeaPlan Project (www.baltseaplan.eu), MASPNOSE Project (www.wageningenur.nl/en/show/Maspnose-Maritime-spatial-planning-in-the-North-Sea.htm), Project on Coastal and Maritime Spatial Planning in Pärnu Bay Area in Estonia and Coastal Municipalities of Latvia (https://coastalandmaritime.wordpress.com/) have been taken as a basis for proposed case study approach. We followed the *Phase 1 Current situation analysis* and *Phase II Analysis of the future evolution* of the Common Methodology of the MARSPLAN–BS project (WP1, Activity 1.2, Component 1.2.2).

The expected results are:

• Develop a methodology and define the land-sea interactions in the Burgas case study area with a focus on biodiversity;

• Define the impact of land infrastructure on the wetlands and maritime space;

• Promote participation of key stakeholders in the process;

• Maps of the main land and sea uses and of natural values;

• Identified, mapped and analysed users-users conflicts and users-environment conflicts;

• Proposed planning solutions and recommendations. Demonstration of test cases issues.

1.2. WORKING ENVIRONMENT

Systematic spatial planning for Burgas has so far mostly been limited to land, yet the need to plan the use of marine areas has become more actual along with an increasing pressure to use the marine area for various purposes. The existing spatial plans dedicated to terrestrial planning therefore do not include maritime areas. There are still various unclear aspects related to competence, planning level, the extent of the rights of county governments in planning of marine areas (there are no county/administrative borders defined in the sea), spatial planning in the exclusive economic zone, etc.

Detailed summary on relevant spatial planning national and EU legislation is made in Component 1.1.3 (Activity 1.1. Initial assessment). Here we just summarised the main legislative acts applicable to the spatial planning of Burgas Municipality.

Spatial planning in Bulgaria is regulated by **Spatial Planning Act** (promulgated State Gazette 1/02.01.2001). This act defines the main possible ways of land use, and how they are determined. Different territories can be used such as urban areas, agricultural areas, forest areas, protected areas, and damaged areas to recover. This is determined by concepts and patterns of spatial development, and master plans. Under the Regulation N° 8 of 14 June 2001 on the scope and content of spatial/master plans the boundaries of coastal strip, the boundaries of zone *A* and zone *B* according to the Black Sea Coast

Development Act (2007) and the territories and areas of the aquatory with the status of immovable cultural heritage are determined with the master plans of the municipalities along the Bulgarian Black Sea coast.

Black Sea Coast Development Act, promulgated, State Gazette 48/2007, last amended in State Gazette 61/ 11.08.2015. This Act aims to: creation of conditions for protection, sustained integrated progress and development of the Black Sea coast; ensuring free public access to the sea shore; protection, preservation and rational use of natural resources; prevention and reduction of pollution; protection of the sea shore from erosion and landslides; and protection of the natural landscape as well as of cultural and historical heritage. Two protected zones are legally regulated in coastal areas: the first protected zone *A* covers part of the Black Sea aquatory, the coastal line and part of the territory falling in a line of width of 100 m, measured horizontally from the borders of the seashore or the sea beaches. The second protected zone *B* covers the territories, falling in the line with width 2 km from the borders of *A* zone, with the exception of the urban territories of the populated places, determined on the date of the enforcement of the act. According to Art. 21 of the Black Sea Coast Development Act with the master plans for the territories of municipalities, as well as with the regulations and standards for their implementation, shall determine the general structure of the territory and spatial requirements for development of the territory and the aquatory; boundaries of the coastal beach strip determined; boundaries of the zones A and B; territories and sections of the aquatory with a status of cultural heritage; the territories designated for economic activity; technical infrastructure facilities of national and regional significance; works for protection of the environment, biological diversity, natural resources and cultural values; territories and aquatories with a restricted regime of development and building up; the general regime for use of the aquatic, forest, land and recreational resources. The master plans and the detailed spatial development plans have to contain the specialised schemes for the contiguous aquatory. The schemes shall reflect the coastal beach strip; sanitary zones; water sports development; underwater archaeology and underwater diving; coast protection and geo pro-

tection facilities and other facilities or sites related to tourist functions of the coast and commercial fishing; implementation of activities related to national security and defence.

National Programme for Development: Bulgaria 2020 is a leading strategic document, which specifies the objectives of development policies of the country by 2020.

National strategy for regional development 2012–2022 defines the long-term goals and priorities in the regional development policy. This document is an integral and allows for coordination of sectoral policies of the territory and contributes to their synchronization. The document is a starting point for elaboration of regional development documents at regional, district and municipal levels.

Regional Development Plan for Southeastern Region 2014–2020. This plan reflects the specific long-term goals and priorities for the development of districts and municipalities included in the territorial scope of the region.

National Spatial Development Concept for the period 2013–2025. It is the first document of spatial planning over the last three decades, which has been developed for all national space under completely different political and socio-economic conditions – membership in the European Union (EU) and the changed attitude towards the content and the role of spatial planning. National Spatial Development Concept provides detailed guidelines for spatial development in the regions and municipalities.

The Municipal Development Plan 2014–2020 for Burgas Municipality is the main strategic document that defines the major goals and priorities for sustainable and integrated socio-economic development of Burgas Municipality until 2020. The strategic framework of this plan is based on the existing potential of the municipality determined by the situation analysis of the current state and development prospects, and the policies within the context of current EU, national and regional strategies for development. The Municipal Development Plan integrates the objectives of various strategic documents developed in the municipality under core policies, creating a common and coherent framework for sustainable and integrated development.

The Municipal Development Plan is in compliance with National Strategy for Regional Development, as well as with Regional Strategy of Southeastern Region and Regional Development Strategy for Burgas District. The plan is consistent with the Master Plan of Burgas Municipality.

Master Plan of Burgas (2010–2030). Its main goal is to provide sustainable development of Burgas Municipality and the adjacent marine area, in accordance with natural and socio-economic assets and to create most favourable living conditions for local population and visitors. Development zones on the territory of the Municipality set out in the Master Plan, according to the Spatial Planning Act are fundamental in defining and implementing the measures of the Municipal Development Plan, which concern the infrastructure and environmental development (Figure 2).

Integrated Plan for Urban Regeneration and Development of Burgas: it is a tool for urban planning and management aims to ensure the integrated impact on the urban environment through the coordination of the place, type and timing of various activities and projects related to the regeneration and development of the urban environment. The objectives and vision of development set up in the Master Plan of the Burgas Municipality and Integrated Plan for Urban Regeneration and Development of Burgas are synchronised.

According to the analysis composed by Spatial Planning Act in Bulgaria the maritime planning with a municipality plan is not possible according to the national legislation as the Spatial Planning Act and other legislation do not provide a basis for extending the boundaries of a municipality to the territorial sea. Thus, municipalities have no territory at sea and the competence of municipality governors regarding the territorial sea is undefined.

The Directive 2014/89/EU for establishing a framework for maritime spatial planning does not interfere with Member States' competence for town and country planning, including any terrestrial or land spatial planning system used to plan how land and coastal zone should be used. If Member States apply terrestrial planning to coastal waters or parts thereof, this Directive should not apply to those waters.

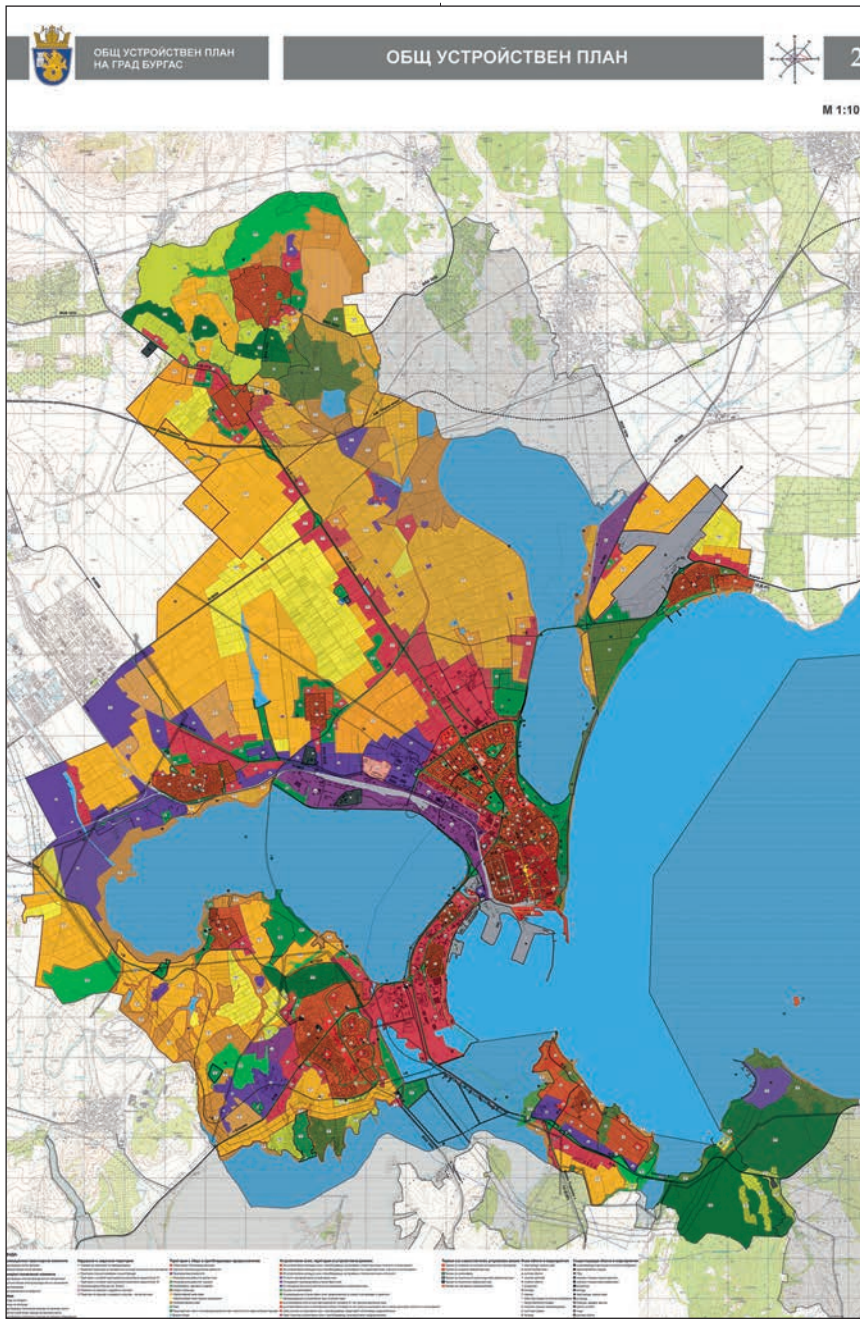

Figure 2. *Master Plan of Burgas*

2. CHARACTERISE NATURAL ENVIRONMENT AND LAND/SEA USES

2.1. NATURAL ENVIRONMENT AND CURRENT STATUS

2.1.1. Nature values and landscapes

Burgas Bay is the largest bay along the Bulgarian Black Sea coast. Its northern boundary is the mole of Pomorie Port, the southern border is Cape Akin and on the west it is bordered with the Burgas valley (Figure 3).

The bay is 11 km wide. The Burgas valley is occupied by three lakes – lagoons: Atanasovsko, Burgas (Vaya) and Mandra. The rivers Aytoska, Sander gully and Chukarska flow into the Burgas Lake and rivers Rusokastrenska, Sredetska, Fakiyska and Izvorska flow into the Mandra Lake. The mouths of these rivers are swampy.

The coast of the bay is highly indented, with numerous small bays (Foros, Ribarski pristan, Atia and Vromos) and Capes (Krotiria, Lahna, Foros, Chukalya, and Atia (St Nikola) (Figure 3). Coastline evolution in the Burgas valley is closely related with geological and neotectonic features of Burgas syncline. In the northern part of the syncline two peninsulas stand out – Nessebar and Pomorie, and in the south – largely jutting out on the west Burgas Bay. They contribute to the high coastline indentation (Popov and Mishev, 1974).

In the southern part of Burgas Bay, the island of St Anastasia is located. Southward between Pomorie town and Cape Foros the erosion coast is built by clays, sandy clays, aleurolites and diatomaceous sandstones (Cheshitev et al., 1992; Peychev and Stancheva, 2009). The coastline of the bay has been heavily modified due to active human activities, as numerous ports for large ships and fishing needs have been built: Pomorie, Sarafovo, Burgas, Rosenets and Atia.

The adjacent coast is relatively low, as in the northern and southern portions the cliff types prevail, while its western part is low and characteri-

ses with wide sand bars and beaches. The beaches are mainly composed of middle-sized sand with 10–25% content of $CaCO_3$ (Dachev et al., 2005). Beaches in Burgas Bay are also characterised with dark colour magnetite sands. The origin of magnetite sand is associated with the input of enriched by heavy minerals alluvial material, located along the river and abrasion terraces, as the content of heavy mineral fraction reaches up to 70–80%. This fraction is mainly represented by magnetite, epidote and titanium, and is formed in result of eroded indigenous pyroxene-andesite rocks (Popov and Mishev, 1974; Peychev, 2004). In north-south direction the larger beaches in the study area are: Sarafovo – area of 79,479 m^2, length of 3,330 m and mean width of 23,9 m; Atanasovska sandy spit – Burgas beach: area of 219,869 m^2, 5,207 m length and 42,2 m mean width, Kraymorie – area of 29,938 m^2, 1,471 m length and 20,4 m mean width (Dachev et al., 2005).

The maximum depth in the small

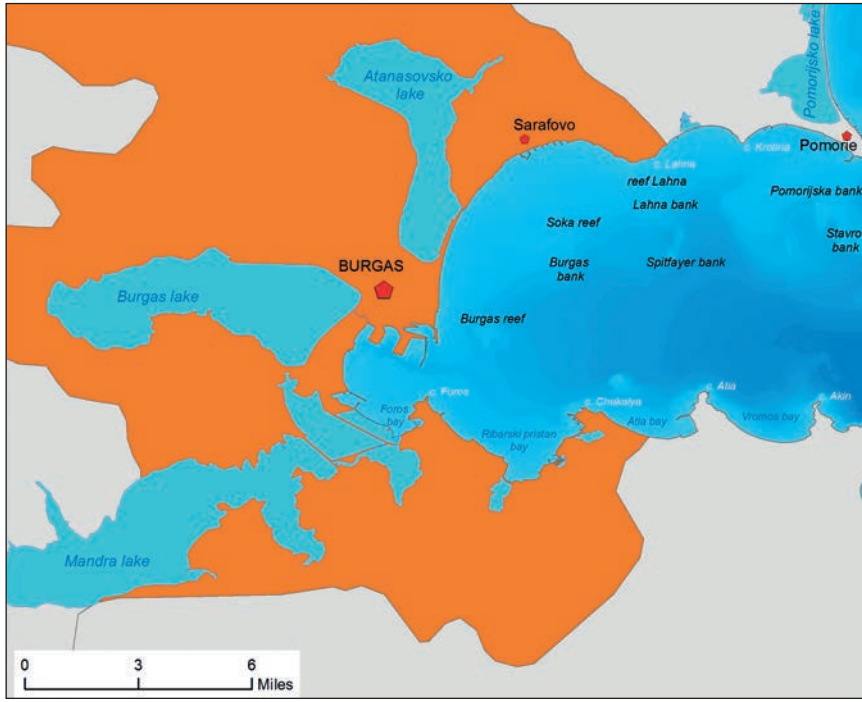

Figure 3. *Burgas study area*

Burgas Bay reaches up to 26 m in its southern part. At underwater coastal slope abrasion terraces (bench) are widely distributed in front of the capes and jutting into the sea peninsulas. In front of the beaches the bottom is covered by middle and fine sands. The average underwater coastal slope is 0.01 as it is lower in the north part of the bay (Peychev, 2004). The northern part of Burgas Bay is featured by several rocky banks, built by Neogene sandstones and limestones as the largest ones are: Pomorie, Stavro, Spitfayer, Lahna and Burgas. Within the bay of Burgas, there are also several reefs: Lahna, Soka, Burgas etc. Its coasts fall within three coastal municipalities: Pomorie, Burgas and Sozopol (Figure 3).

The natural scenery of the study area provides the basic links of Burgas city with the natural suburban areas, creating a specific shape of Burgas, as the urbanised area is entered between 4 basins – Black Sea and three lakes – Atanasovsko, Burgas and Mandra with accompanying wetlands and coastal landscapes. These three lakes together with the neighbouring Pomoriysko Lake, form the largest complex of coastal lakes in Bulgaria. The lakes sustain huge biodiversity and are located at one of the main migration routes of European migratory birds – Via Pontica.

The climate is continental-Mediterranean, with strong Black Sea influence, due to the location of the land jutted out into the deep Burgas Bay. The average annual temperature is 12.7°C (Table 1). Winter is mild, with average temperatures between 1.8 and 4.7°C, while spring is cooler compared with the inland regions (temperatures range between 6 and 16°C). Due to the nature of the coastline and daily

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
Burgas	1.8	3.4	6.0	10.8	16.0	20.4	23.1	23.0	19.4	14.6	9.6	4.7	12.7

Table 1. *Annual monthly temperature (°C) in Burgas (Climate Reference Book for Bulgaria, 1983)*

Meteorological Station	Month (mm)												Annual (mm)
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Burgas	45.0	42.0	35.0	44.0	48.0	56.0	40.0	29.0	36.0	47.0	60.0	58.0	543.0

Table 2. *Monthly average precipitation in Burgas (Koleva and Peneva, 1990)*

course of breeze circulation, the summer is longer and cooler compared with inland, with temperatures between 20.4–23.1°C. Autumn is long and warm (19.4–9.6°C) in result of warming influence of the Black Sea. From climatic point of view, important role has the location of the Burgas valley south of the Stara Planina Mountain, which serves as a barrier against cold winds coming from the north direction.

The average annual precipitation along the coastal zone in Bulgaria is in the range of 411 mm at the north coast to 794 mm at the most southern weather station, as for Burgas it is 543 mm. The highest rate of precipitation in Burgas is measured in autumn and winter, as a result of Mediterranean cyclones that pass through the southern part of Bulgaria. The lowest precipitation is presented during the summer – August (29 mm) (Table 2).

Part of the winter precipitation falls as snow. The first snow has an average date in the end of December, and the last one – in the end of February. Typically, snowfalls are few and perishable. The number of days with snowfall is only 15, as most snow rains in January.

The wind climate formation in the area of Burgas Bay is a result both of atmospheric circulation in this part of the Balkan Peninsula and climate influence of the Black Sea. This influence depends on the relief and generally reaches 30-40 km landward, e.g. the whole territory of Burgas Municipality. The main wind characteristics are the predominant wind direction and the wind speed. Table 3 shows the average monthly wind speeds for Burgas.

Meteorological Station	Month (m/s)												Annual (m/s)
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Burgas	3.0	3.5	4.4	3.6	3.3	3.1	3.3	3.7	3.9	3.5	3.3	2.9	3.4

Table 3. *Average monthly winds (m/s) in Burgas (Climate Reference Book for Bulgaria, 1982)*

Meteorological Station	Number of days with strong winds (≥14m/s)												
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
Burgas	3.3	3.7	3.3	1.9	1.5	1.4	1.1	1.2	2.2	3.1	3.3	2.3	28.3

Table 4. *Number of days with strong winds (≥14m/s) (Climate Reference Book for Bulgaria, 1982)*

The prevailing winds are from E direction – 24.2%, followed by NE – 17.9% and W – 15.7% winds. During winter the frequency of west winds is higher in comparison with summer, when the frequency of eastern winds prevails (Figure 4; Table 4).

In the warm half of the year, from March to October the wind direction along the coast is characterised with constant pace. It is primarily driven by the difference in heating the surfaces of sea and land (*i.e.* breeze), as well as due to the orographic features (slope winds). Changing the breeze on shore and back takes place respectively in the evening and just before noon. The highest number of days with strong winds are recorded during the winter and autumn months (from October to March), as *circa* 3 days during the month are recorded with wind speed > 14 m/s. Totally for Burgas about 28 days in the year are with strong wind speed > 14 m/s. The strongest winds (> 20 m/s) are recorded from N and NE direction.

Solar radiation is one of the major climatic factors and it is very important for people. Along the Black Sea coast solar radiation vary between 2,275 h

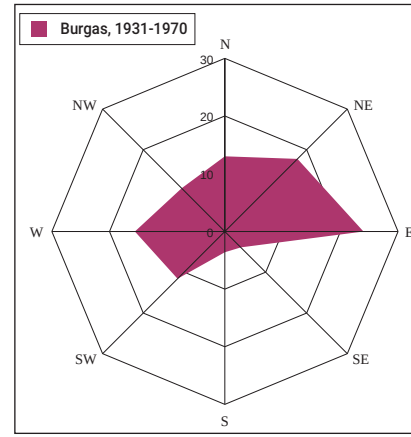

Figure 4.
Wind rose for Burgas, calm days – 18.1% (Climate Reference Book for Bulgaria, 1982)

for Pomorie and 2,082 h for Burgas (Climate Reference Book for Bulgaria, 1978).

Other important climatic characteristics, mainly for maritime navigation, are fogs. Fogs mean a reduction of visibility above the horizontal level of the sea (land) to 1 km and less, as a result of condensation and/or sublimation of water droplets or ice crystals. The southwestern region of the Black Sea, including the Bulgarian Black Sea coast is distinguished with largest repetition of foggy days during the cold season – from October to March. Then the sea forms most of evaporation fog. The average number of days with fog in

these months is 3-5. In winter, at low air temperatures in the area of evaporation, icing conditions on ships and stationary technical equipment occur. During the summer over the Black Sea are formed radiation fogs. Usually they are in small areas and are short-term. The annual number of days with fogs in Burgas is 38.3 (Table 5).

The hydrophysical characteristics of Burgas Bay are a principal factor determining hydrochemistry of the region, biochemical processes and marine biota behaviour. The hydrophysical characteristics include currents, temperature and salinity regimes. Currents in Burgas Bay are relatively variable and the circulation is very sensitive to the wind direction change. N, NE and E winds drive the current system anticlockwise and W, SE and S winds – clockwise (Trukhchev et al., 2004), but the surface components are dominantly flowing along the coast – to west in the northern part along Sarafovo, to south in the central part along Burgas Port, and to east towards Cape Akin (Moncheva, Todorova, et al., 2013). Additionally, local currents may form eddies and plums especially during heavy precipitation periods or during thermocline formation, but the water exchange with the outer part of the bay remains the dominate renewal process for the system (Marinov et al., 2014).

The surface salinity in the bay reaches maximum in summer and minimum in spring. In the bay it varies, respectively, 15–16‰ (the mean is 15.5‰) during the winter-spring period (December-May) and 16.4–17.2‰ (the mean is 16.75‰) in the summer-autumn period (June-November).

Therefore, due to essential seasonal variation of salinity in the bay, two distinct periods of lower and higher salinity are distinguished. The annual water temperature changes in small Burgas Bay have a clearly expressed seasonal course with a minimum in February (about 5°C at

Meteorological Station	Number of days with fog												Annual
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Burgas	5.7	4.6	4.2	3.7	3.4	1.1	0.7	1	1.3	2.7	3.8	6.1	38.3

Table 5. *Number of days with fog at station Burgas (Climate Reference Book for Bulgaria, 1979)*

water surface) and a maximum in August (about 24°C) (Marinov et al., 2014). During winter and summer isothermal conditions are stable. The thermocline forms typically in April and until July the warm upper layer reaches the sea bottom.

Burgas sea level measurement station is one of the oldest along the Bulgarian coast. The sea level observations, performed at Burgas Port using standard pole, started in 1910 (Popova, 1997; Pashova, 2004). In 1928 the station was equipped with stilling-well tide gauge with mechanical paper writing device. Since 2012 this station has been equipped with high accuracy microwave instrument and is able to produce real time data (Palazov et al., 2014). Several factors cause sea level variations along the Bulgarian Black Sea coast: rivers inflow, Bosporus outflow and evaporation, tides, seiches, surf beat and storm surges (Kostichkova et al., 2001). The long-term trends in mean sea level show that they have a cyclic character with seasonal variations. The maximum is in May-June and the minimum is in October. The amplitude for Burgas is about 15 cm on average (Trifonova and Demireva, 2003). Inter-annual (inter-decadal) sea level variations have a period of 30 years and are in order of 16 cm (Trifonova and Grudeva, 2002). The daily values oscillate between 107 mm and 620 mm per year with respect to the local datum, while the tidal range does not exceed 88 mm in a usual year (Pashova and Popova, 2011). Burgas is in line with global trend of sea level rise. Data from 1928 to 2003 show a trend of sea level rise of 1.82 ± 0.40 mm/year for Burgas (Pashova and Belyashki, 2006).

Statistical analysis using long-term data (1928-1987) of the annual diversion h_{max} of the maximal annual levels H_{max} and minimal diversion h_{min} of the minimal annual levels H_{min}

Return period (years)	1	2	5	10	25	50	100
h_{max} (cm)	23.11	41.96	53.23	60.69	70.12	77.12	84.06
h_{min} (cm)	-22.45	-38.63	-48.30	-54.71	-62.80	-68.80	-74.76

Table 6. *Repetition of the maximal diversions h_{max} for Burgas Bay (after Trifonova and Demireva, 2003)*

towards the average long years level H for the Burgas Bay is presented in **Table 6** (Trifonova and Demireva, 2003). The results show the repetition of the maximal h_{max} and minimal h_{min} diversions for Burgas Bay.

The extreme sea level changes in Burgas Bay are driven mainly by meteorological phenomena, such as seiches, which are typical for closed basins like Black Sea. They cause most extreme subsidence of the sea level along the Bulgarian coast. On 25 January 1921 at port of Burgas the sea level subsided 112 cm below the mean level (Grozdev, 2004; Grozdev, 2006). After this the sea level rose about 10 cm above the mean level.

Storm surges along the Bulgarian Black Sea coast causes sea level rise when the winds blow from northeast to southeast and subside in case of western winds. Coastline exposure and shelf topography of Burgas Bay presuppose that storm surges could cause extreme sea level rise. Few of the strongest storms were observed during winter: on 16-22 February 1979 and 7-10 January 1981. Heavy storms occurred also on October 1976, October 1977 and July 2006.

The maximum sea level rise of 159 cm for Burgas Bay was recorded during the storm on 16-22 February 1979, when the sea level measurement equipment was flooded. A reconstruction using neighbouring instruments showed that the sea level rise would be more than 250 cm (Kostichkova et al., 2001).

As the bay of Burgas is the largest one along the Bulgarian coast it can be divided into open (offshore) and coastal (onshore) parts with different wave parameters. There are two coastal meteorological stations for wave observations along the bay of Burgas: Emine and Burgas, which are representative for the open and onshore parts of the bay. The results of ten years of wave observation for different types of waves are presented in **Table 7** showing the percentage distribution (ILF et al, 2011).

Station	No waves	Wind waves	Swell	Mixed
Emine	5.6 %	54.8 %	38.9 %	0.7 %
Burgas	30.2 %	21.2 %	43.2 %	5.4 %

Table 7. *Different types of waves (%) at stations Emine and Burgas (after ILF et al., 2011)*

The annual values of significant wave heights ($H_{1/3}$) vary between 0.2 m in the summer and 1.2 m during the winter (**Figure 5**).

The annual average monthly values of the significant wind wave height is characterised by well-defined seasonal variability. During the warm half-year the mean monthly wind wave heights are mostly ranges from 10 to 50 cm. The annual minimums occur mainly in June and July. In the cold half of the year over 65% of the average monthly wind wave heights are in the range of 50 to 110 cm, with annual maximums in February.

Figure 6 shows the maximum wave height (m) that may occur once at every certain number of years (5, 10, 50 or 100) at stations Emine and Burgas.

The values of extreme significant waves range between 3.76 m for 1 year return period and 5.73 m for 10 year return period.

2.1.2. Cultural heritage

There are many archaeological remains from Antiquity, Middle Ages and Renaissance in the study area of Burgas. A series of archaeological treasures from different eras have been discovered during archaeological studies in recent years. Archaeological sites are public property.

• **Sarafovo**

The ancient port in Sarafovo is the only discovered ancient facility of this type in Bulgaria. Only here along the Black Sea coast can be seen authen-

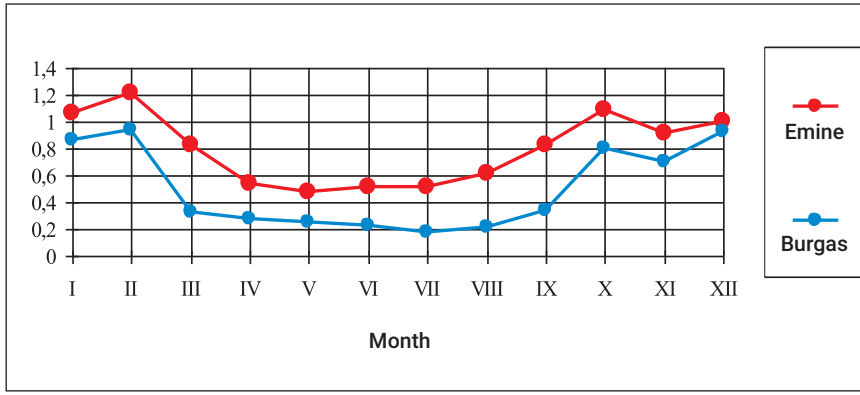

Figure 5. *Average monthly values of significant wave height (m) observed at Emine and Burgas stations (after ILF et al., 2011)*

tic equipment and machines, used to service the sailing vessels during the Roman Age and Late Antiquity. Here are also remains of an antiquity street and city fortress, dating back to 4th–6th Century. According to the latest research, there is also a Christian chapel from 6th–11th Century. Sarafovo is situated on the seaside, around 1.5 km from the main road from Burgas to Varna. There are also remains of the antiquity port underwater, which makes it a unique archaeological site. The fortress and the port offer great viewing conditions to Cape Foros and Burgas. For diving there are underwater viewings and an underwater walk in diving gear to the sunken pier (http://gotoburgas.com/en/places-to-go/view/24). The site obtains cultural heritage with national significance status. A set of preservation measures are in implementation, including rescue archaeological investigations restoration and exposition of the structures, building of infrastructure, old quay restoration, building facilities for surface and underwater observation of various objects (http://greencorridors.burgas.bg/en/index/index/1).

• Ancient and Medieval Fortress and Port Poros / Foros

Cape Foros is located in Poda area (in Kraymorie, south from Burgas). The fortress was built in the middle of the 2nd Century AD by the Roman Emperor Antoninus Pius.

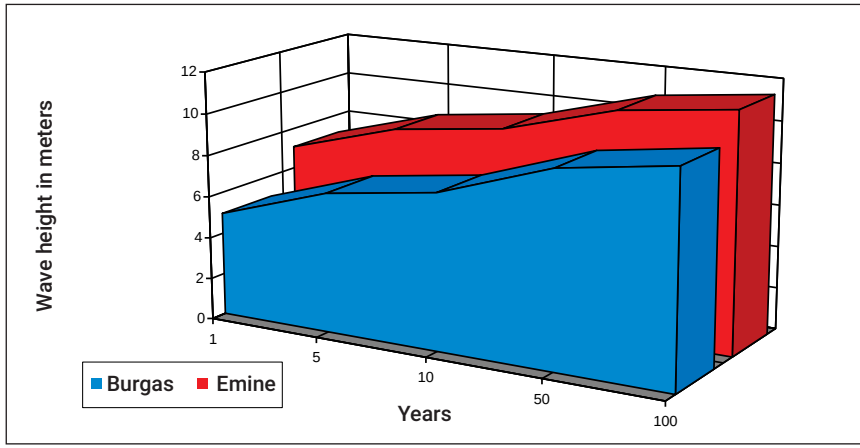

Figure 6. *Average values of significant wave height (m) at certain number of years for stations of Emine and Burgas (after ILF et al., 2011)*

At the beginning a tower (in Latin *Burg*) was built at the swelling. It had locational functions to help boats and small ships entering the lake, and protect them from sinking in the swampy area of the swelling. Cape Foros was known by more common localisations in the European charts from the 13th–17th Century as an old fortress and port under the name Poro (strait) or Poros, which assumes the fortress defended the swelling of Mandra Lake. A stone inscription from the 2nd Century AD (shown in the Archaeological Exposition of Regional Burgas Museum) states that during the Roman Empire at the border of the Roman colony Deultum were built *burgi* (fortifications).

Fortress Burgos /Poros/ is the predecessor of modern Burgas. The area also is famous for a certain memorable battle from the time of the Second Bulgarian State. At the beginning of the 14th Century the Bulgarian Tsar Theodore Svetoslav made his march to the Black Sea coast, where his power spread over Rusocastro, Mesembria, Anchialos, Sozopolis and Agathopolis. Thus, in 1304 at the bridge over the swelling of Mandra Lake also called Skafida (Poros), a crucial battle was held which ended with a significant victory of the legendary Bulgarian ruler over the Byzantine army (Encyclopaedia *Points of interests*, www.burgasmuseums.bg). A set of preservation measures are in implementation, including reconstruction, exploration, full restoration of the tower and fortification system presentation (http://greencorridors.burgas.bg/en/index/index/1).

• St Anastasia Island

St Anastasia Island is located 1.5 km offshore inside the Bay of Burgas, southeast of Burgas. It is formed by solid rock of volcanic origin and has an area of 8.5 ha. The island has the status of natural reserve. Here in the 10th Century emerged a monastery dedicated to Saint Martyr Anastasia, patroness of pharmaceutics and a saviour. The preserved parts of the monastery complex include a church, great monastery building used as monks' dormitory and a place for abbots.

In the 17th–18th Century the monastery was repeatedly attacked by pirates, who plundered and burned it down. The church iconostasis is unique with rich carved decoration, paintings and icons. In 1974 it was

proclaimed a national cultural heritage. In 1925 the great monastery building, with the monks' dormitory and library, was converted into a prison for 43 political convicts. Their escape behind the border in July 1925 gave a reason the island to be renamed to Bolshevik in the years of communist regime, between 1950–1990. In 1975 a museum collection, displaying the history of the island was set up in the preserved premises. The island lighthouse was built in 1854 by a French shipping company and is well preserved even today.

In the waters around the island can be seen rock formations, named *The stoned pirate ship*, *Dragon* and *Mushroom*. They are related to interesting legends recorded in the monastic papers and many literary works of famous artists from Burgas. The island pier and harbour have been recently renovated. Each year the sailings to the island start on 1st of May and every day two ships carry tourists five times per day. During autumn the trips decrease and are one per day with an 18 m long catamaran *Anastasia* of the municipality, which has a capacity for over 70 tourists.

• **Peak Shiloto**

A Thracian ruler residency and Apollo sanctuary is located at the Shiloto hilltop between Burgas Lake and Mandra Lake. Its strategic location is impressive and dominates over large region between two mountains and the sea. It has existed for almost 900 years from the 5th Century BC to the 4th Century AD. Two ports are connected to the residency – at north and south coast of Burgas Lake (http://greencorridors.burgas.bg/en/index/index/1). In the 60s of the 20th Century the place became a military zone and hosted tank training ranges, which have badly fractured the terrain around the Thracian sanctuary. Future restoration activities are suggested by the Municipality of Burgas.

• **Aquae Calidae**

Aquae Calidae – Thermopolis is an ancient Thracian city from I millennium BC built around hot mineral springs. It is situated 15 km northwest of Burgas. A sanctuary dedicated to three nymphs existed at the same place. Emperor Trajan built large Thermae and road station in the 2nd Century AD. Due to their popularity and in order to protect them

from invaders, Emperor Justinian built a fort in 6th Century AD. The city was burned by Emperor Henry II during a crusade in 1204 AD, but the thermal complex survived partially and was restored by sultan Suleiman I Magnificent in 1563. The site was restored with a programme started in 2012 (http://greencorridors.burgas.bg/en/index/index/1).

2.1.3. Biodiversity, natural protected areas and wetlands

Black Sea coast is one of the most attractive destinations in Bulgaria and in the region (Stanchev et al., 2015). Here are concentrated resources and activities of national, regional and local importance. In 1991 in accordance with the Constitution of the Republic of Bulgaria, the sand beaches were declared as state property. As a result of increased economic activities over the recent years, leading to dramatic changes in the natural and cultural landscape, and consequently to irreversible destruction of many ecosystems, there has been a need to take urgent measures for recovery and future development of sensitive areas. Thus, valuable natural resources such as protected areas, wetlands, coastal lakes and marshes, beaches and dunes, forests and forest parks received the status of public property, thereby ensuring strict control of the state as an institution with respect to the management of those resources (Burgas Municipality Master Plan). The expanded tourism developments in the coastal zone of Bulgaria, has led to more intense urbanisation of cities, resorts and suburban areas, including area of Burgas (Stanchev et al, 2015).

As mentioned above, near Burgas there are many protected areas of different categories and status of protection, as most of them are included in the largest EU ecological network NATURA 2000 (http://ec.europa.eu/environment/nature/natura2000/). One of the reasons for high conservation value of Burgas surrounding wetlands, including the adjacent Pomorie Lake, is the fact that they are located at the natural migration route of migratory birds along the Black Sea coast, Via Pontica, and provide space for birds wintering, breeding, resting and feeding. Some of these birds are endangered or valuable for the Europe biodiversity.

NATURA 2000 areas – Sites of Community Importance (SCI) designated according to the Habitats Directive (Council Directive 92/43/EEC) and Special Protection Areas (SPA) designated according to the Birds Directive (Directive 2009/147/EC) located in the study area are shown on Figure 7.

Nationally designated protected sites in the study area are shown on Figure 8. Areas of NATURA 2000 protected areas (marine part only) are indicated on Figure 9.

The first comprehensive habitat mapping of the Black Sea was completed in the framework of the EU Seamap2 Project. As a result, habitat maps, following the EUNIS (European Nature Information System) classification system are available for the majority of the coastal zones of the Bulgarian Black Sea, including the area of Burgas Bay. Results are freely available at the EMODNet Seabed habitats portal: www.emodnet.eu/seabed-habitats.

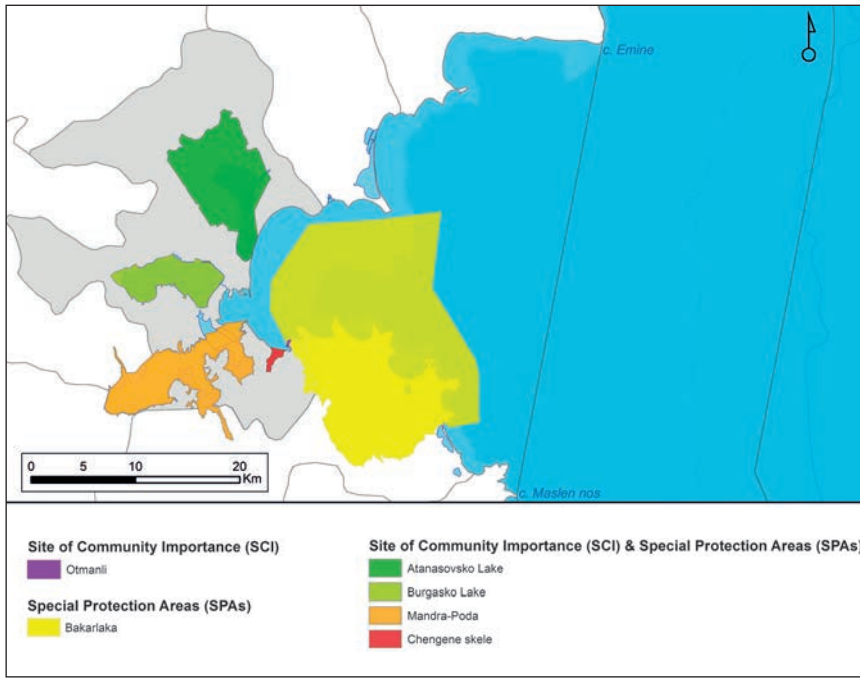

Figure 7. *NATURA 2000 protected areas (terrestrial part) in Burgas study area (data after Ministry of Environment and Water)*

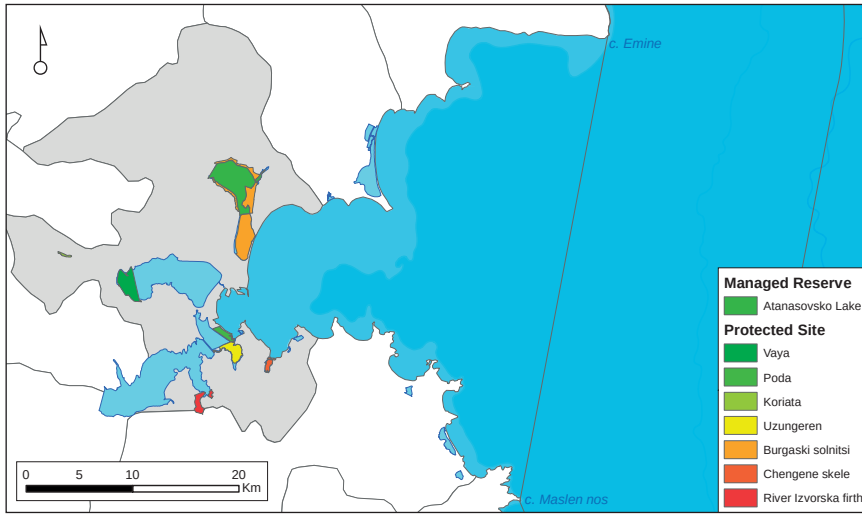

Figure 8. *Nationally designated protected sites in Burgas study area (data after EEA, 2015)*

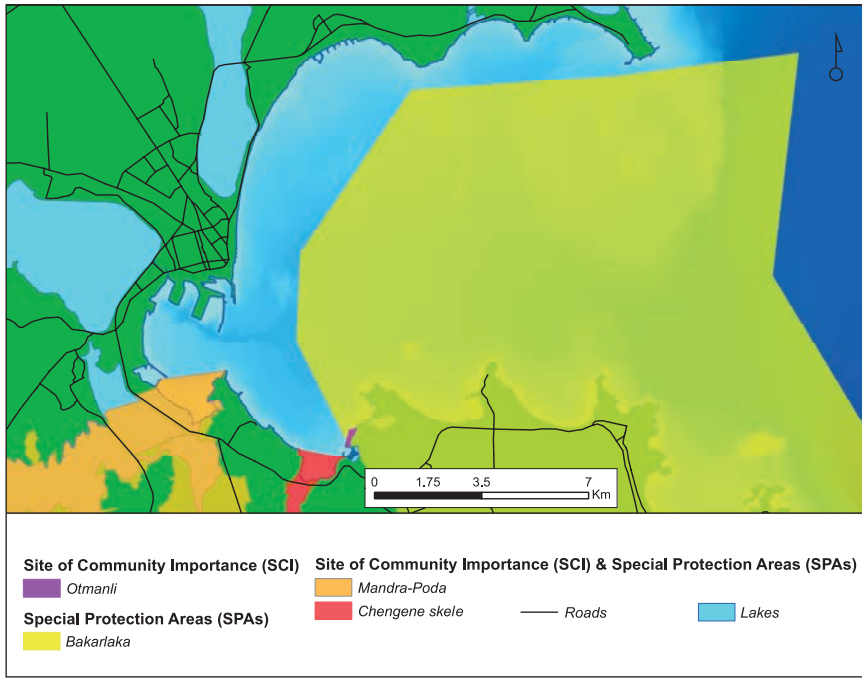

Figure 9. *NATURA 2000 protected areas (marine part) (data after Ministry of Environment and Water)*

Atanasovsko Lake

Atanasovsko Lake is a hypersaline lake which resembles a firth to the north and a lagoon to the south (Popov and Mishev, 1974; Rozdestvensky, 1986). A considerable part of its surface is used for salt production with preserved primitive salt production methods (Black Sea Wet Initiative). Atanasovkso Lake is located in the range of Burgas city between quarters Izgrev and Sarafovo and west of them (**Figure 3**). The lake is a part of Burgas lakes complex and it borders Black Sea to the east by 2 km long Atanasovska sand spit. The salt pans are separated from the sea through a dyke and hydrotechnical equipment with a sluice. The total capacity of the facilities is 3.2 million cubic meters and the average water level is 30 cm. Smaller fresh-water marshes and swamps exist around the lake, as does a system of canals overgrown with marsh vegetation. To the south, the lake borders on the urban part of the town of Burgas and extends approximately 10 km away to the north from the town. The salinity varies between 50 and 80%. The northern part of the lake is connected by canal with the sea, and the salinity is low, while the southern part is particularly used for salt mining. The total area of the lake is 16.9 km^2, having a length of 9 km, width – 4.3 km and depth up to 1 m (www.bsbd.org/UserFiles/File/projects/RNK/Primer%20Burgaski%20zaliv.pdf; Vasilev et al., 2013).

The lake is distinguished by its great biodiversity, mainly bird diversity, and in 1999 it was categorised as maintained reserve. In 1984 the lake was declared as a wetland of international importance under the Ramsar Convention and in 2003 the territory of the Ramsar site was greatly expanded. In 1989 the lake was declared by BirdLife International as Important Bird Area (IBABG036). In 1998 the lake was designated as Corine Land Cover site because of its pan-European importance to the conservation of endangered and rare species of birds. It is also included in NATURA 2000 Network under both directives: Habitats Directive and Birds Directive as protected area BG0000270 Atanasovsko Lake (Ministry of Environment and Waters) (**Figures 7** and **8**).

More than 52 fish species had been present in all Burgas lakes by the end of the last century (www.saltoflife.biodiversity.bg/en/Atanasovsko_Lake-c137). So far, 18 species (*Pseu-*

dorasbora parva, Cobitis strumicae, Atherina pontica, Gasterosteus aculeatus, Pungitius platygaster, Knipowitschia caucasica, Pomatoschistus marmoratus, Sygnathus abaster, Syngnathus typhle, Gambusia holbrooki, Parablennius sanguinolentus, Lepomis gibosus, Mugil cephal, Liza aurata, Liza saliens, Platichthys flesus, Parablennius sanquinolenthus, Cyprinus carpio) have been described, but it is likely that two of these species – Black Sea Blenny (*P. sanquinolenthus*) and carp (*C. carpio*), are no longer present (www.saltoflife.biodiversity.bg/en). Being separated into large number of evaporating and crystallising basins with various salinity, the water surface of the lake together with the canals is a complex system of water bodies which makes impossible the formation of a stable faunistic ichthyologic complex (https://rsis.ramsar.org/RISapp/files/RISrep/BG292RIS.pdf). The Atanasovsko Lake ichthyofauna is highly vulnerable and dependent on the condition of this water body. Water pollution, change in salinity and the hydrological regime, the introduction of competing species and the destruction of breeding sites are some of the main threats for the various fish species (Botev, 1997; Diadovski and Naydenov, 1995; Naydenov, 1997; Diadovski et al., 1996; Michev, 1997). Many of the fish species established in the lagoon are rare, temporary visitors and chance visitors coming from the sea. The three-spined stickleback (*Gasterosteus aculeatus*) and the atherine (*Atherina pontica*) enter the lake from the sea (www.saltoflife.biodiversity.bg/en).

The atherina (*Atherina pontica*) is a pelagic sea fish capable of sustaining large salinity fluctuations and regularly enters the rivers and lakes around the sea (Karapetkova and Zhivkov, 2012). The Caucasian goby and the nine-spined stickleback (*Pungitius pungitius*), are typical semi-saline water residents. The topmouth gudgeon (*Pseudorasbora parva*) a typical fresh-water species, occurs only in the fresh-water marshes around the lake. Some species such as the Caucasian goby, the topmouth gudgeon, the eastern mosquito fish and the three-spined stickleback occur in relatively high numbers and are some of the main food items of the large diversity of fish eating birds present in the lake. The Caucasian goby (*Knipowitschia caucasica*) is one of the most numerous fish species in the lagoon and occurs in all

pools, except in the crystallizer pans (www.saltoflife.biodiversity.bg/en). It is the most typical and constant inhabitant of the lake and endangered with extinction, listed in the Bulgaria Red Data Book (www.saltoflife.biodiversity.bg/en; www.e-ecodb.bas.bg/rdb/en/). The three-spined stickleback is the species which is second highest in numbers. Its population comprises mainly individuals entering from the sea and breeding in the lake. The nine-spined stickleback is present in the lake in small numbers and endangered with extinction, listed in the Bulgaria Red Data Book (www.e-ecodb.bas.bg/rdb/en/). The *Syngnathus abaster* (Syngnathidae) has been observed in the Atanasovsko Lake only during the most recent years (Michev et al., 2003). It enters the sea during the summer and it is possible that some individuals breed in the lake. This rare species is listed in the Bern Convention and in the IUCN (International Union for Conservation of Nature) Red List (www.e-ecodb.bas.bg/rdb/en/). Abundant development is observed also of the mosquito fish *Gambusia holbrooki*, introduced in the country in 1924 (Yankova et al., 2011; Yankova et al., 2013). This species is freshwater, but tolerate salinity up to 7–8‰, and is found in the northern canal along the sea (https://rsis.ramsar.org/RIS-app/files/RISrep/BG292RIS.pdf). At the northeastern part of the reserve there is a quarry full with freshwater where the golden fish *Carassius gibeliois* abundant, and the carp *Cyprinus carpio* develops also in much smaller quantity.

The list of bird species observed in the Atanasovsko Lake grows continuously (www.saltoflife.biodiversity.bg/en; Stoyneva and Michev, 1996). So far more than 318 species have been observed here while migrating, wintering or nesting. They comprise more than 70% of the birds occurring in Bulgaria, which makes the Atanasovsko Lake lagoon first among the sites for watching, studying and conservation of birds (Darakchiev, 1977; Nankinov, 1977; Michev et al., 1981; Michev and Simeonov, 1985; Michev et al., 1999; Nankinov and Kostadinova and Gramatikov, 2007). Of these, 14 are globally endangered species: Dalmatian pelican, Pygmy cormorant, red-breasted goose, lesser white fronted goose, slender-billed curlew, corncrake, ferruginous duck, and 170 species are of European conservation concern (www.e-ecodb.bas.bg/rdb/en).

The plover are among the most typical inhabitants of the lagoon. Black-winged stilts, avocets, Kentish plovers, oyster catchers and several tern species are the main nesting species. The Black Sea lakes are Bulgaria's avocet and Kentish plover main breeding sites. They offer abundant food and very convenient nesting sites to these birds. Atanasovsko Lake is home to their largest nesting populations (www.saltoflife.biodiversity.bg/en). Another regular visitor to the lagoon is the slender-billed gull birds (Kostadinova and Gramatikov, 2007). So far it has been nesting in the Atanasovsko Lake, alongside the Mediterranean gull and the Gull-billed tern, unfortunately not every year (Michev et al., 1999; Kostadinova and Gramatikov, 2007). The Atanasovsko Lake is the most famous among ornithologists for its autumn bird migrations (www.saltoflife.biodiversity.bg/en). The lagoon lies along Europe's second largest bird migration route Via Pontica (www.birdsinbulgaria.org). This is the place with the highest concentration of migrating white and Dalmatian pelicans, Marsh harriers, and Red-footed falcons, and is second in the number of Lesser spotted eagles flying over during migration birds (Kostadinova and Gramatikov, 2007). The lake is one of the most suitable overnighting locations for pelicans and storks between the Danube delta and the Bosporus (www.saltoflife.biodiversity.bg/en). Since it does not freeze during the winter, the Atanasovsko Lake is a site of international significance for nesting water birds. Each year it provides shelter to flocks of common Shelduck, Widgeons, Pintails, Mallards and Dalmatian pelicans. Gray and Red-breasted Geese are regular occurrence among the numerous flocks of wintering White-fronted Geese (http://natura2000.moew.government.bg).

Both mezophite and hygrophyte microtherme vegetation are presented by: torphaceous and marshy vegetation with predomination of reed (*Phragmiteta australis*), rush (*Typhaeta latifoliae, Typhaeta angustifoliae*), cene (*Schoenoplecteta lacustris*) and others (Ramsar Convention 2002a). The type of vegetation is distributed nearby the canal, surrounding the reserve, its banks, and parts of the bounding pools and lower sections of the area from the outside. Coenoses of *Phragmites australis* are mostly monodominate and in some parts they overgrow the wall dikes. In the process of formation takes a par-

tial assist *Typha latifolia* and in less percentage on drier places – *Typha angustifolia*. *Salix alba* and *Salix eleagnus* singly or in small groups among the reed could be found.

Halophyte grass coenoses like *Limonieta gmelinii*, *Salsoleta sodae* or with predomination of *Salicornia europea*, *Sueda maritima*, etc. appeared also. Coenoses made by those species in the reserve are located on the mostly salted soils – during seasonal incidentally, or in cases of aquatories with increased concentration of salts in the water in the foothill of the dikes of lower relief. *Salicornia europaea* takes the main part in the coenoses. In some parts it forms pure stands and especially at the recently created dikes it is a pioneer species.

Other halophites mixed with grass species could be found on the dikes, such as – *Sueda maritima*, *Salsola kali*, *Limonium gmelinii*, *Parapholis incurva*, *Aueluropus litoralis* and others (Ramsar Convention, 2002a). Mezoxerotermal grass coenoses with predomination of *Agropyreta intermedie*, *Festuceta pseudovinae*, *Poaeta bubosae*, *Lolieta perennae* with participation of *Cynodon dactylon*, in some places with *Dichantium ischaemum* and *Chrysopogongrillus*. Although relatively rarely, representatives of the typical psamophite vegetation could be found in the coenoses of *Leymeta racemosi*, Amophylleta arenariae, *Centaureeta arenariae* and others (Ramsar Convention, 2002a).

The vegetation on the reserve is represented by hydrophyte, hygrophyte mezophite, and mezoxerophyte associations, some of them secondary in origin on places of previously existed mixed broadleaf forests and shrubs, mixed with halophyllic, xeromesphyte grass coenoses. Changes in the originally existed coenoses are reported due to the considerable anthropogenic impact during the last 50–60 years. Salt manufacturing also leads to ecological changes. For example, the changes of the vegetation cover are closely connected with: changes of the hydrological and salt-balancing regimes, appearance of ruderal species, dike-construction works, agricultural activities that take place in the buffer-zone of the reserve, and with the background pollution from the industrial areas of Burgas and the international airport, as well. The halophyte coenoses, like this of *Salicornia europaea* and *Sueda maritima* could be recognised also

as pioneer ones (Ramsar Convention, 2002a).

The shrub vegetation in the reserve and its buffer zone is scarcely distributed. The wild autochtonos species (*Amygdalus nana*, *Astragalus cicer*, *Genista tinctoria*, *Ononis arvensis*, *Ononis spinosa*, etc.) are singly represented in the traditional herbaceous coenoses. Some slightly specialised species (*Clematis vitalba*, *Prunus spinosa*, *Rosa cannina*, *Rosa pontica*, *Rubus sanguineus*, *Tamarix tetrandra*, etc.) penetrated and developed at the ruderalised terrains. *Syringa vulgaris*, *Tamarix tetrandra* and *Hedera helix* are represented in small groups on the lime substrata in the north-eastern part of the lake, at close vicinity to the sea coast and in the south-eastern part of the buffer zone. Species like *Ficus carica*, *Prunus sativa*, *Hedera helix* could be found somewhere in the reserve territory and in the previous friut-orchards situated in the recent buffer zone (Ramsar Convention, 2002a).

Totally 30 algae species were reported and 14 of them were used in the description given by Ivanov et al. (1964), without delimitation between the freshwater and the brackish and salt part of the reserve. In the compendious list of species found at the wetlands along the Bulgarian Black Sea Coast and in the Black Sea by Petkoff (1932) 180 taxa were included without pointing their exact localities. In the Bulgarian algal flora, (Vodenicharov et al., 1971) 88 species are mentioned as typical of the wetlands (fresh water and brackish ones) along the Black Sea coast, without exact pointing of their localities and 6 species are pointed especially for the salt basins and canals of Burgas salinas. There the species *Oscillatoria bulgarica* from canals of the Burgas salinas are also included (Ramsar Convention, 2002a).

The vascular plants of Atanasovsko Lake have been investigated by Velev (1997). According to him 233 species of higher plants are registered in Atanasovsko Lake. Nine of them are protected by Environment Protection Act (promulgated State Gazette No. 91/2002), twenty species are included in Bulgarian Red Data Book (1 vanished, 3 threatened and 16 rare species). One species – *Corispermum nitidumis* included in the List of Rare, Threatened and Endemic Plants of Europe and two – *Nonea atra* and *Silene thymifolia* are Balkan

endemic species (Ramsar Convention, 2002a).

Burgas Lake (Vaya Lake)

Burgas Lake or Vaya Lake is situated west of the city of Burgas, between the lakes of Atanasovsko and Mandra (Figure 3). Vaya is the largest Bulgarian Black Sea coastal lake, an open firth /liman/ of Pleistocene origin (Popov and Mishev, 1974; Rozhdestvenskiy, 1986). It is located to the west of Burgas, and in contact, along its entire eastern part, with the industrial and residential sections of the town. The lake is 9.6 km long toward the west, and it is up to 4.5 km wide (averaging at 2.8 km). The lake itself is at the sea level, and is approximately 0.2 m higher in its western part, but its northern and southern shores are higher, reaching 15–20 m above the sea level (Vasilev et al., 2013). It is separated from the sea through a sand spit *Komluka*, and it is connected to the sea through an open canal in the area of port Burgas-West (www.bsbd.org/UserFiles/File/projects/RNK/Primer%20Burgaski%20zaliv.pdf/). The lake, which is highly significant for biodiversity (especially avian), is a shallow freshwater-brackish liman with associated marshy areas and extensive reedbeds (Ramsar Convention, 2002b).

At once, Burgas Lake was the most productive lake in Bulgaria where hundreds of tons of fish and crabs were derived. With the construction of Lukoil Oil Refinery however, it has lost its economic importance and over the years repeatedly fresh waters have been transferred from Mandra Lake. In recent years with the reduction of industrial activity along the shores of lake, the pollution has decreased and there is a gradual increase in fish fauna. In 2001 it was last cleaned the canal that connects the lake to the sea. This in turn allows entry of large amounts of sea mullet and other fish species separately several times the lake is restocked with carp and other freshwater fishes (www.bsbd.org/UserFiles/File/projects/RNK/Primer%20Burgaski%20zaliv.pdf).

The lake is a water-receiver of treated waste water sewage of Burgas and some existing manufactures, but also of significant volumes of untreated waste water/sewage from lakeside villages, particularly along the west and north coast. Part of the territory of the Vaya Lake is under

protection according to the national nature protection law. Protected site Vaya encompasses the reed massive located in the south-west part of the lake. It is designated for protection of threatened bird species. In 1989 the lake was designated by BirdLife International as Important Bird Area (IBA) and in 1998 as Corine Land Cover site because of pan-European importance for the preservation of rare and endangered bird species. The lake is also important Ramsar site having an area of 29,000 hectares. It falls in NATURA 2000 under the Birds Directive and Habitats Directive with code BG0000273 Burgas Lake (**Figures 7** and **8**).

Burgas Lake hosts fish species such as the European Eel (*Anguilla anguilla*), *Neogobius fluviatilis*, Prussian Carp (*Carassius gibelio*) and Common Carp (*Cyprinus carpio*) (www.blackseawet.org). The region of the lake supports 245 bird species, 71 of which are listed in the Red Data Book for Bulgaria (1985). Of the birds occurring there, 105 species are of European conservation concern (SPEC) (BirdLife International, 2004), 9 of them being listed in category SPEC 1 as globally threatened, 26 in SPEC 2 and 69 in SPEC 3 as species threatened in Europe. The area provides suitable habitats for 89 birds included in Annex 2 of the Biodiversity Act, which need special conservation measures, of which 80 are also listed in Annex I of the Birds Directive (Directive 2009/147/EC). As the lake is located on the Via Pontica migration flyway, it is one of the most important station points in the birds' migration along the Bulgarian Black Sea coast species (Kostadinova and Gramatikov, 2007). Especially numerous are the Pelecaniformes, Anseriformes, Charadriiformes and Ardeidae bird species. On migration the lake is an important roost for the Dalmatian Pelican *Pelecanus crispus*, the White Pelican *P. onocrotalus* and the Pygmy Cormorant *Phalacrocorax pygmeus* birds (Kostadinova and Gramatikov, 2007). The globally threatened Corncrake *Crex crex* has also been observed in the region as a migrating species. Burgas Lake is of international importance for the wintering of up to 66,000 waterfowl and wetland birds, including the Pygmy Cormorant, Cormorant *Phalacrocorax carbo*, Whooper Swan *Cygnus cygnus*, White-fronted Goose *Anser albifrons*, *Aythya ferina*, and Tufted Duck *Aythya fuligula* (http://natura2000.moew.government.bg). The

lake is the only site in Bulgaria which holds up to 7% of the Black Sea population of the White-headed Duck *Oxyura leucocephala* during the winter birds (Kostadinova and Gramatikov, 2007). The globally threatened Dalmatian Pelican and Red-breasted Goose *Branta ruficollis* have also been recorded there in winter. Burgas Lake is one of the most important breeding sites in the country for the Little Bittern (*Ixobrychus minutus*).

Associations of Reed (*Phragmites australis*), Narrow Leaf Cattail (*Typha angustifolia*) and Common Cattail (*Typha latifolia*) occupy a significant area on the western and north-western shores. Along the lake, swampy meadows and halophytic plant communities are present and arable lands. Despite the insignificant depth of the lake, there is no submerged vegetation apart from patches of Fennel Pondweed (*Potamogeton pectinatus*) in the north, west and east of the lake. The lake is important site to the Otter (*Lutra lutra*) (Black Sea Wet Initiative, www.blackseawet.org).

Complex Mandra-Poda

Mandra Lake was preserved in its natural condition until 1934 when corrections at some of the flowing rivers were performed and dikes were built in its western part to prevent spring flooding. The second major change came in 1963 with the construction of a dam in the eastern part of the lake (www.bsbd.org/UserFiles/File/projects/RNK/Primer%20Burgaski%20zaliv.pdf). Thus, the overgrown with marsh vegetation shoals were destroyed and the connection to the sea was interrupted and the lake became entirely freshwater.

Mandra Lake is the southernmost of the three Burgas lakes (**Figure 3**), having an area of about 1,300 hectares. Its length is 8 km and maximum width 1.3 km. It is situated in a well-shaped valley of the Sredetska River oriented perpendicular to the coastline, as the mouth and the dam are near the southern end of Burgas city (quarter Meden Rudnik). The neighbourhood has a separate waste water treatment plant, which discharges into the lake. Here are located the oxidation lagoons of the Lukoil Neftohim Refinery which pose a serious risk of water contamination with heavy petroleum fractions with high toxicity.

With the construction of the embankment dam in the eastern part

of the lake in 1963, the largest natural brackish lake in Bulgaria turned into an artificial reservoir. The main purpose was both to ensure reliable fresh water source for the needs of irrigation and industry in the region and to ensure the passage of marine barges with iron ore for the underdeveloped at the west end of the lake metallurgical base (currently Promet Steel JSC). The dam Mandra collects water from few rivers: Rusokastrenska, Sredetska, Fakiyska and Izvorska and has a total volume of 145.8 million m^3 and an area of 32.6 km^2 (www.bsbd.org/UserFiles/File/projects/RNK/Primer%20Burgaski%20zaliv.pdf).

Near the sea and the inlet canal is marsh locality Poda, which together with Mandra Lake form the natural complex BG0000271 Mandra–Poda of NATURA 2000 under the two EU Directives – the Birds Directive and the Habitats Directive. Poda is an area south of Burgas, declared as protected in 1989 by order of the Ministry of Environment and Water and granted to the management of the Bulgarian Society for the Protection of Birds (BSPB) (**Figures 7**, **8** and **9**). The protected area Poda was declared in 1994 as Corine Land Cover site and in 2002 as Ramsar site of international importance. It is the first protected territory in Bulgaria, managed by non-governmental organisation. BSPB prepares and implements activities adopted by the Council of Ministers management plan thus making the protected area Poda in a model for sustainable nature conservation, environmental education and ecological tourism. A Conservation Centre to protected area was built for management of wetlands, for organising ornithological tourism and non-traditional forms of recreation, environmental education and scientific research, and as a centre for organising environmental activities.

Mandra Lake is one of the richest in fish ponds throughout the country. There are over 20 species of freshwater fish. Some of them are: zander (*Stizostedion lucioperca*), rudd (*Scardinius erythrophthalmus*), barbel (*Chalcalburnus chalcoides mandrensis*), European bitterling (*Rhodeus sericeus amarus),* roach (*Rutilus rutilus*) and others (http://burgaslakes.org/poda/en/index.html). From fishes (as listed in the Council Directive 93/43/EEA) *Alosa immaculata* is present. As well as fishes listed at Complex Mandra-Poda are Black

Sea Silverside (*Atherina pontica*), European eel *(Anguilla anguilla),* Three-spined stickleback *(Gasterosteus aculeatus),* Caucasian goby *(Knipowitschia caucasica),* Golden grey mullet *(Liza aurata),* Thinlip mullet *(Liza ramada)* and Leaping mullet *(Liza saliens).* Caucasian Goby (*Knipowitschia caucasica)* and Three-spined Stickleback *(Gasterosteus aculeatus)* are species included in the Bulgarian Red Data Book (Ramsar Convention, 2002c). Only the European River Otter (*Lutra lutra*) is included in the Bulgarian Red Book (Begun et al., 2012).

Protected area Poda has preserved a huge amount of biodiversity within the administrative boundaries of Burgas city. The place is one of the richest in the country in terms of bird species variety (http://natura2000.moew.government.bg) and providing a habitat for 265 bird species (Kostadinova and Gramatikov, 2007). These include the only mixed colony of European Spoonbills (*Platalea leucorodia*) on the Black Sea coast; the Glossy Ibis (*Plegadis falcinellus*) and Lesser Herons (Ardea). There are 46 species of nesting birds, the most attractive of which are the Common Tern (*Sterna hirundo*), the greater cormorant (*Phalacrocorax carbo*), various kinds of diving ducks (Aythya), other species of waterfowl (Anatidae) and the Western Marsh-harrier (*Circus aeruginosus*). During the winter months, the area is visited by a variety of migratory species: the Pygmy Cormorant (*Phalacrocorax pygmeus*), the Dalmatian Pelican (*Pelecanus crispus*), the Tundra Swan (*Cygnus bewickii*), and others (Kostadinova and Gramatikov, 2007). The Via Pontica passes directly over the Poda site, and every year brings populations of White Storks (*Ciconia ciconia*), Great White Pelicans (*Pelecanus onocrotalus*), and thousands of other birds – predators, swimmers, and waders (Dimitrov et al., 1997). The site is home to 8 globally threatened species: Dalmatian Pelican (*Pelecanus crispus*), Pygmy Cormorant (*Phalacrocorax pygmeus*), Red-breasted Goose (*Branta ruficollis*), White-headed Duck (*Oxyura Leucocephala*), Ferruginous Duck (*Aythya nyroca*), Greater Spotted Eagle (*Aquila clanga*), Imperial Eagle (*Aquila heliaca*), and *Crex crex* (Dimitrov et al., 1997). Poda holds one of the largest mixed colonies in the country and the biggest on the Black Sea Coast of Spoonbill (*Platalea leucorodia*), Glossy Ibis (*Plegadis falcinellus*), Grey Heron (*Ardea cinerea*),

Little Egret (*Egretta garzetta*), Night Heron (*Nycticorax Nycticorax*), and Purple Heron (*Ardea purpurea*).

The largest area is occupied by the reed (*Phragmites australis*) formation. The height, density, spreading rate and structure of the reed formations are very important for the formation of the ornithofauna composition of the area (especially the nesting one) (https://rsis.ramsar.org/RISapp/files/RISrep/BG1228RIS.pdf). Meadows of seagrasses *Potamogethon pectinatus* are spread in this habitat type which overlaps with 1110 habitat type – sand banks. Ideal habitats for the Glasswort (*Salicornia europaea*) are muddy and salty water basins in protected area Poda. There are also mixed communities of Reed (*Phragmitesaustralis*), (*Artemisia santonicum)* and Sea Rush (*Juncusmaritimus*), as well as associations of *Elymus sabulosus*, *Plantagoscabra*, *Gypsophila trichotoma*, Sea Holly (*Eryngium maritimum*) and Blue Lettuce (*Lactuca tatarica*) (www.blackseawet.org).

Chengene Skele

Chengene Skele is a national protected site, located east of Burgas. It covers 160 hectares and covers part of the Bay Chengene Skele (or Gypsy bay) and part of the territory of Burgas quarter Kraymorie and Marinka village. The area has been included in the list of protected areas since 1995. It was declared as protected area to protect the natural habitats of rare and protected bird species listed in the Red Book of Bulgaria (1985) and the list of endangered species in Europe. It has been included as protected area in NATURA 2000 under both Directives (Birds and Habitats) with code BG0000242 (**Figure 7**, **8** and **9**). The protected area is a small bay at the mouth of the Marinka River located south of the village Kraymorie, near the road Burgas–Sozopol. The estuarial part of the river is with wide and dense reedbeds, mostly reed (*Phragmites australis*), Fernleaf cattail (*Typha angustifolia*) bulrush (*Shoenoplectus lacustris*). In front of the river mouth the bottom of the bay is covered with muddy sediments, forming vast shoals deep 5–10 cm (this is the only one in Bulgaria seaside mud field). The coast is presented by sand strip with rocky sections at some places.

Chengene Skele hosts fish species such as: Sphinx blenny (*Aidablennius*

sphynx), Black Sea Silverside *(Atherina pontica),* Montagu's blenny (*Coryphoblennius galerita),* Three-spined stickleback (*Gasterosteus aculeatus),* Sea horse *(Hippocampus hippocampus*), Thinlip mullet (*Liza ramada*), Knout goby *Mesogobius batrachocephalus),* Round goby (*Neogobius melanostomus*), Ratan goby (*Neogobius ratan*), Turbot (*Psetta maxima*), Southern ninespined stickleback *(Pungitius platygaster)* Peacock blenny (*Salaria pavo*), Ocellated wrasse (*Symphodus ocellatus*) Broad-snouted pipefish (*Syngnathus typhle*) (Begun et al., 2012; http://natura2000.moew.government.bg; www.birdsinbulgaria.org/ovm.php?l=bg).

The Bay of Chengene Skele supports 180 bird species, 52 of which are listed in the Red Data Book for Bulgaria (1985). Of the birds occurring there 80 species are of European conservation concern (SPEC) (BirdLife International, 2004), 6 of them being listed in category SPEC 1 as globally threatened, 21 in SPEC 2 and 53 in SPEC 3 as species threatened in Europe (Dimitrov et al., 1997).

The area provides suitable habitats for 65 species, included in Annex 2 of the Biodiversity Act, which need special conservation measures, of which 58 are listed also in Annex I of the Birds Directive (http://natura2000.moew.government.bg). Chengene Skele is of international importance for the breeding Pygmy Cormorant *Phalacrocorax pygmeus* and Glossy Ibis *Plegadis falcinellus*. The exceptionally rare and globally threatened Slender-billed Curlew *Numenius tenuirostris* has been recorded at this spot several times. The site is of great importance for migrating birds, especially for plovers Charadriiformes (www.birdsinbulgaria.org/ovm.php?l=bg). Important for protection in this habitat are sand banks (1110) with *Zostera noltii* and *Potamogeton pectinatus* meadows, which invertebrate species and fishes inhabit (Begun et al., 2012).

Otmanli

Otmanli is NATURA 2000 protected area (BG0001502) under the Habitats Directive (Council Directive 92/43/EEC) (**Figures 7** and **9**). It is located in the southern part of the Burgas Bay, between fishing village Chengene Skele and Oil Terminal *Rosenets*. The site is about 600 m length and 150–200 m wide and the maximum water depth is 7 m. The adjusting coastline

is low, erosion type. The habitat is located near the site BG0000242 Zaliv Chengene Skele.

List of birds referred to Article 4 of Birds Directive 2009/147/EC and Annex II of Council Directive 92/43/EEC are *Larus argentatus, Larus canus*, *Larus melanocephalus Larus minutus*, *Phalacrocorax carbo* and *Phalacrocorax pygmeus* (http://natura2000.moew.government.bg). Species listed in Annex I of the Council Directive 92/43/EEC – the mammals *Phocoena pocoena* and *Tursiops truncatus* are registered as well.

Important species of fishes present (listed in the Council Directive 92/43/EEC) are *Alosa immaculata and Alosa caspia*. The area provides suitable habitats for grass goby *Zosterisessor ophiocephalus*. The habitat is characterised by mixed communities of seagrasses of the genera Zostera (*Zostera noltii, Zostera marina*) and Zannichellia (*Zannichellia palustris)* on sand-shell substrate. The coverage is spread in the depth range from 1 to 5.5–6 m and at places their distribution is patchy. In summer water transparency are 2–3 m, maximum up to 4 m and the salinity – about 15–17‰. The underwater meadows cover approximately 30% of the underwater seagrass meadows in the southern Black Sea coastal zone of Bulgaria. Their existence is threatened by the proximity of heavily anthropogenic affected area. The area is characterised by eutrophic conditions of the aquatic environment, due to the proximity of the city of Burgas (http://natura2000.moew.government.bg). *Zostera marina* is included in the Red Data Book of Republic of Bulgaria as endangered species (EN) of the IUCN categories, also in the list of the Berne Convention. The presence of *Upogebia pusilla* is noted – endangered species listed in the Black Sea Red Data Book (http://natura2000.moew.government.bg).

Bakarlaka

Bakarlaka is located near Burgas and includes the most jutted into the land part of the Burgas Bay. It bears the name of the ridge Bakarlaka southwest of the town of Sozopol. The larger part of its territory involves littoral area that covers the southern part of the Burgas Bay, Sozopol inlet and Kavatsite inlet, including several islands, as well as a part of the Bulgarian territorial waters several kilometres from the coast between Po-

morie town and Arkutino lagoon.

Its area stretches from the Rosenska River valley on the west to the seacoast eastwards, including the whole coastline from Chengene Skele Bay to Arkutino lagoon. There are several habitats in the area, the largest share being occupied by broadleaved forests of Quercus frainetto with Mediterranean elements, open grasslands with xeromesothermal vegetation with domination of Dichantium ischaemum, Poabulbosa, Lolium perenne, etc., as well as farmland.

Bakarlaka is NATURA 2000 protected area under the Birds Directive (Directive 2009/147/EC) with a code BG0002077 (Figure 7 and 9). Bakarlaka hosts 172 bird species, 43 of which are listed in the Red Data Book for Bulgaria. Of the birds occurring there 73 species are of European conservation concern (SPEC) (BirdLife International, 2004), 3 of them being listed in category SPEC 1 as globally threatened, 24 in SPEC 2 and 46 in SPEC 3 as species threatened in Europe (http://natura2000.moew.government.bg). The area provides suitable habitats for 53 species, included in Annex 2 of the Biodiversity Act, which need special conservation measures, which are also listed in Annex I of the Birds Directive.

Bakarlaka is a bottleneck migration site of global importance, where the flocks of migrating storks and pelicans meet the land after having crossed the Burgas Bay directly from Cape Emine and the easternmost parts of the Balkan Mountain. The storks fly low above the sea and use the thermals over the land to gather height. In spring the stork flocks use the pastures and fields east of Bakarlaka Ridge as a night roost. Considerable numbers of birds of prey also concentrate in the region on migration, by keeping more inland and flying above the ridge, where they roost. Bakarlaka is one of the most important sites in the country for the breeding Middle-spotted Woodpecker *Dendrocopos medius*, Olive-tree Warbler *Hippolais olivetorum*, Spotted Crake *Porzana porzana* and Mediterranean Shearwater *Puffinus yelkouan*.

2.1.4. Loads/pollutions

Data sources

The study area has not been monitored for pollution in a regular pattern. Several attempts to analyse

hydrological specifics have been made. During the last years, according to two EU Directives (EU Water Framework Directive 2000/60/EC and EU Bathing Water Directive 2006/7/EC) consistent pollution surveys have been implemented. Consecutively, long term trends are not possible to be defined, but the current environmental state of the area is available. The following sources are used for the assessment:

1. Water Framework Directive 2000/60/EC (WFD) monitoring implementation by Black Sea Basin Directorate, Varna. According to EU Directive 2000/60/EC monitoring programmes are required to establish a coherent and comprehensive overview of water status within each river basin district. Among others, the monitoring information requirements include classification status of surface water and assessments of changes in status of water bodies. Burgas Bay is identified as Water Body BG2BS000C008. Monitoring and status estimation is implemented by Institute of Oceanology – Bulgarian Academy of Sciences and is reported to the Ministry of Environment and Water of Republic of Bulgaria.

2. Ministry of Health Bathing Water Directive 2006/7/EC (BWD) Reports for bathing water quality 2009–2015. According to EU Directive 76/160/EEC and successively to the new Bathing Water Directive (2006/7/EC) bathing waters are assessed and results are reported to the European Environment Agency (EEA). A combination of 14 microbiological, hydrological and physicochemical parameters is used in the assessment. In Burgas Bay samples are collected at 7 stations – 2 along the northern coast (Pomorie and Sarafovo beaches), 3 – along the western coast (Burgas beach) and 2 – along the south coast (Kraymorie and Chernomorets beaches).

3. Operational Programme Environment 2007–2013: Management of flood risks – selection of measures for Burgas Bay. In frame of the Operational Programme Environment 2007–2013 detailed analyses of flood risks were made and pollution treats were discussed.

4. Relevant scientific hydrological analyses include those made by Galabov et al., (2013), Marinov et al., (2014); Karagyozov et al., etc.

5. Project ECOPORT 8. Environmen-

tal Management of Transborder Corridor Ports. Code SEE/A/218/2.2/X: Pilot Monitoring Plan for Port Burgas.

The environmental pilot monitoring plan (PMP) of Port Burgas was prepared in relation to the Project Environmental Management of Transborder Corridor Ports (ECOPORT 8) under South East Europe Transnational Cooperation Programme by Bulgarian Ports Infrastructure Company (BRICo) and department *Water Use and Management* of the National Institute of Meteorology and Hydrology at the Bulgarian Academy of Sciences (NIMH-BAS). Realisation of the monitoring plan, among others, includes the following stages: analysis of the current situation in Port Burgas and determining sensitive parameters and methodology for the monitoring programme.

Types of sea water pollution

Acidification

The sea water alkalinity is typical both for the entire study area and all monitored separate stations and remains in pH 8–9 range. No deviations are detected. Alkalinity is sensitive to oxygen content and will decrease with oxygen depletion during possible eutrophication. Oxygen decrease in such cases is much more stressing factor than acidification caused by it and the last will not influence significantly the environment and is rather a consequence. Other cause of acidification could be transport, agricultural or urban runoff which is possible in small spots round the source. The area is confined, but the circulation provides sufficient convection of the water masses and would not allow acidification of the entire area from a single source.

Nutrients

Nutrients are responsible for eutrophication and are subject of each environmental survey. In frame of Water Framework Directive 2000/60/EC nitrates, nitrites, ammonia, total nitrogen, phosphates, total phosphorus, silica, iron and manganese are monitored and during Directive 2006/7/EC surveys phosphates are analysed considering it is the limiting factor for eutrophication in the area. The content of each type of nutrients remains in their respective environmentally safe limits both for the entire area and for the separate stations.

In order to estimate possible nutrient fluxes in the system two distinct seasonal periods are considered: low and high salinity. Exchange with the offshore waters is found to be the main mechanism for water renewal. During the year the system always exports nutrients however it alters from autotrophic to heterotrophic stage.

The treated waste waters from Waste Water Treatment Plant (WWTP) of Burgas enter the bay with the inflow from Burgas (Vaya) Lake. It receives as well as the partially untreated household waters of Aytos town and those of the villages along the valley of Aytoska River that streaming to Burgas (Vaya) Lake. In addition, the treated waste waters of Lukoil Refinery get in the small Burgas Bay through the discharge of Mandra Lake.

Concentrations of inorganic phosphorous, DIP (dissolved inorganic phosphorous) and dissolved inorganic nitrogen (DIN – a sum of ammonia, nitrite and nitrate nitrogen) in the runoff and precipitation are shown in Table 8. Here, the DIN and DIP concentrations in the Burgas' lakes are estimated taking into account also the diffuse load of nutrients (in general lower comparing to contribution of the waste water) coming from agriculture in the watersheds of the rivers mouthing to the lakes.

Basically, the observational values of DIP and DIN in the small Burgas Bay resemble those typically found in coastal waters. However, it is interesting that elevated concentrations of DIP are observed during high salinity period (an increase of 45% in comparison with low salinity period) even though the input from runoff

Source	Period	DIP, µM/L	DIN, µM/L
Mandra Lake	both	2.724	114.28
Burgas Lake	both	16.454	365.56
Precipitation	both	14.86	102.83
Burgas Port	low salinity	0.835	34.641
	high salinity	1.213	33.243
Adjacent area	low salinity	0.064	19.633
	high salinity	0.323	14.279

Table 8. *Estimated values of DIN and DIP in the runoff, precipitation, port area and bay during low and high salinity period*

is substantially lower due to lower runoff. The possible explanation includes desorption of phosphorus from sedimentary particles. DIN shows in general light variability and as expected remains lower during high salinity period.

The water exchange with the outer part of the bay is the dominate renewal process for the system. Burgas Bay is subject to clear seasonal patterns. For low salinity season (winter–spring) 23 days are required to replace the port water by the fluxes of fresh or marine water, while it takes 32 days for high salinity period (summer–autumn).

Port Burgas area receives a rich supply of nutrients from land-based sources. The small Burgas Bay is always exporting nutrients to the adjacent coastal waters, though the discharges in winter-spring period are prevailed. There is a consequence of the succession from a net autotrophic stage during winter-spring period to heterotrophic conditions in summer-autumn (Marinov et al., 2014).

Toxic substances

Toxic substances are those which are harmful to marine biota and humans when override certain limits. These limits for specific pollutants and priority substances are defined in EU Directive 2013/39/EC and are adopted in Bulgarian legislation. In the course of WFD implementation following specific pollutants and priority substances are monitored: Anthracene, Benzo(a)pyrene, Benzo(b) fluoranthene, Benzo(k)fluoranthene, Benzo(ghi)perylene, Indeno(1,2,3-cd) pyrene, Fluoranthene, Naphtalene, Atrazine, DEHP, Hexachlorobenzene, Pentachlorobenzene, Hexachlorobutadiene, Total DDT, p,p-DDT, Octylphenols, Tributyltin compounds, PCBs, Terbutryn, Ethilbenzen, DEP, DBP, Bisphenol A, Xylenes, Pb, Hg, Ni, Cd, Zn, Cu, Cr(VI), As, Al, Co, Li. Recent investigations do not reveal superseding of the limits provided by the respective directives.

Petroleum hydrocarbons

Petroleum hydrocarbons originate principally from crude oil and consist of a large variety of organics. They are not soluble in water and in most cases, especially mineral oils, float on surface forming large oil spills. These spills prevent gas transportations in and out of water and in most

cases are toxic to marine life and injure marine mammals and waterfowl birds. Even small leaks cover large areas and are capable of causing catastrophic environmental damages.

In the study area the largest risk of oil pollution accidents comes from the Burgas Oil Port, because it handles crude oil, petrol, diesel oil, mono and diethylene glycol, benzene, acrylonitrile, styrene and other chemical products. It is operated by Lukoil Neftohim Burgas.

The activities of limiting and cleaning the polluted areas are performed by the Marine Antipollution Enterprise, JSCO, Burgas branch. The inflow of sludge water in the Rosenets Oil Terminal is as follows:

• Contaminated ballast water from oil tankers;

• Washing water from the handling of oil and oil products tankers;

• Contaminated ballast water from tankers carrying chemical substances;

• Washing water from the handling of tankers carrying chemical substances.

At Rosenets Oil Terminal, there is a network of installations for the partial treatment of sludge water (sewage water, faecal matter, industrial water, etc.). The method and range of equipment and installations used in the treatment of ballast and other wastes cannot guarantee the safety of the environment because the treatment is incomplete. There is an urgent necessity to construct a new network of installations and use a new method for the treatment and recycling of contaminated ballast water. During the exploitation of the Rosenets Oil Terminal there were local leakages and spills of oil, oil products and chemicals due to accidents, repairs and other activities, and as a result part of the soil on the site is polluted (Karagyozov et al.).

The modelling of oil spills in the area proves that the most vulnerable area in case of accidents west of the Rosenets Oil Terminal is the northern internal part of Port Burgas (Galabov et al., 2013).

Microbial pollution

According to the seasonal BWD monitoring there is no exceed of the limits at any of the seven stations and

their state is always *satisfactory* to *excellent*. Northern station typically shows better state than southern.

Plastic debris

Marine litter investigations have not been implemented very often so far, most recent actions are related to research projects. The project MARine Litter, Eutrophication and Noise assessment tools (MARLEN) is funded by BG02 *Integrated management of marine and inland waters* priority BG 02.03: *Improved monitoring of marine waters* co-financed by the Financial Mechanism of the European Economic Area (EEA FM) 2009–2014. IO-BAS is leading Beneficiary of the project together with Burgas Municipality. The main objectives involves creation of tools for assessment of the marine environment through the application of new technologies and best practices to tackle the lack of marine data; detection and classification of marine litter in coastal areas; regular monitoring in near real-time marine eutrophication of surface waters; monitoring of underwater noise; increasing capacity to assess the state of the environment and personnel training; improving the cooperation between research institutes, regional and local authorities.

Runoff pollution sources

Waste domestic waters and first flush waters enter a pumping station and are conveyed to the city waste water treatment plant. The emergency pipes from the city sewerage discharging into Port of Burgas area that existed in the past have already been removed and the waters enter pumping stations to be transferred to the waste water treatment plant, and the constructed emergency pipes are out of Port of Burgas aquatory. The inflows marked on **Figure 10** are mainly inflows from private ports and inland inflows from coastal lakes. The treated waste waters from WWTP of Burgas city which do not always correspond to normative requirements, enter with the inflow of Vaya Lake, as well as the untreated waters of Aytos town and the villages along the river valley of Aytoska River which flows into Vaya Lake. The inflow of waters from the lake is carried out via a canal connection situated between Port West and the private port – Port Burgas. The treated waste waters of *Lukoil Neftohim Burgas*, enter the small Burgas Bay with the inflow of Mandra Lake, as well as the waters

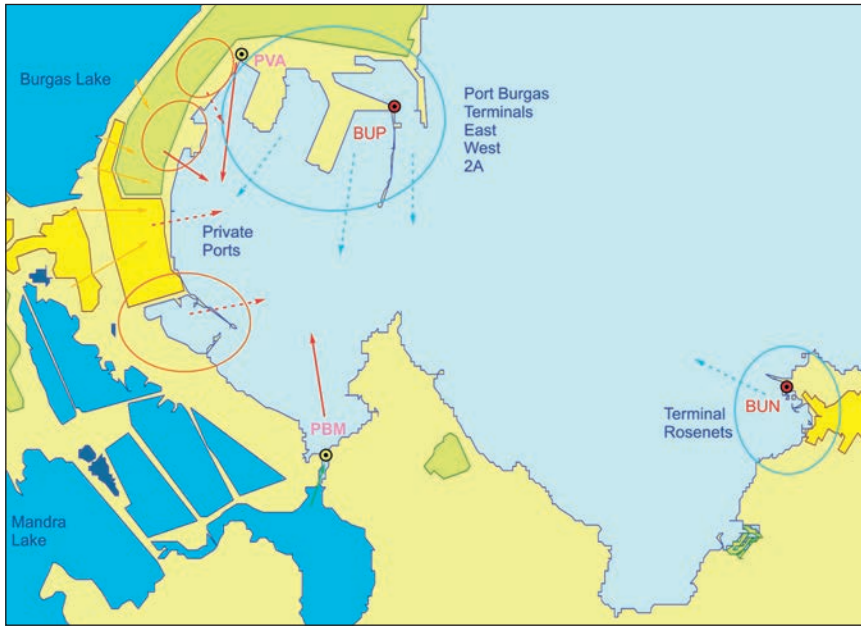

Figure 10. *Port activities interaction with activities of adjacent industrial units in Burgas Bay*

from the populated areas along the river valley of Sredetska River via Sredetska River.

2.1.5. Erosion risks and flood hazards

Between Pomorie town and Cape Foros, where the study area is located, the erosion coast is built by clays, sandy clays, aleurolites and carbonate sandstones (Peychev and Stancheva, 2009 after Cheshitev et al., 1992). In the area of Burgas Bay, the most significant landslides are these of circus-shaped type, as one is located at the coast in Burgas quarter Sarafovo (Peychev, 2004). The landslide is 3 km long and 280 m wide with three step-like strips separated by swampy depressions. The slip surface is located in the Pliocene clays over which slip clays, limestone and sandstone seam. The highest average erosion rate of 1.05 m/y was measured along the coast at this section before coastal defence with dike completed in 2003. Nowadays, due to the performed coast-protection activities the average rate of erosion ranges from 0.19 to 0.29 m/y (Peychev and Stancheva, 2009).

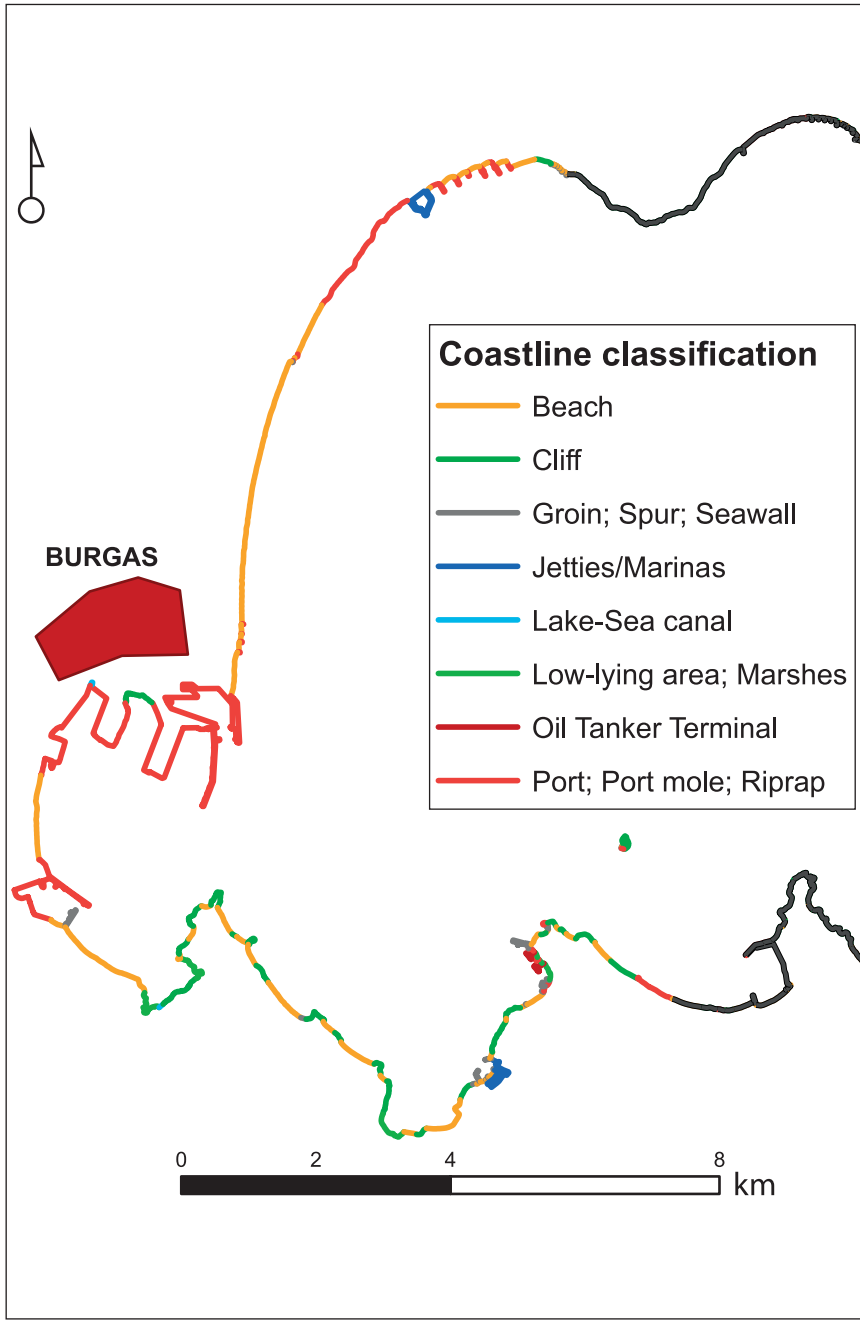

Figure 11. *Coastline classification of study area*

Based on recent predictive map for coastal erosion and classification of Bulgarian coast by geological structure and cliff height, the coast of study area was categorised as being medium hazardous to erosion (Stanchev et al., 2013). The coastline of study area (administratively to the borders of Burgas Municipality) has a length of 37.25 km based on very high resolution orthophoto images from 2011. Sand beaches comprise circa 50% of the coastline having a total length of 17.2 km, whereas cliff sections have a length of 7.5 km. There is a large number of cross- and long-shore port and coastal defence structures along the coast of study area with different purposes, including: groins, dikes, rip-raps, seawalls, ports, port moles, spurs etc. and they account a total length of 30 km (Figure 11). Burgas beach has the largest length, reaching 5.8 km and stretching from the port mole of Burgas Port on the south and coastal dike at Sarafovo on the north. Considerably smaller in width and length are beaches in the southern part of the bay formed between cliff sections at the existing capes.

Previous studies found that the coastline of Burgas Bay is one of the most heavily armoured along the Bulgarian coast (Stancheva, 2009; Stanchev et al., 2013). Such armouring is due to the construction of many port developments/infrastructure (here is located one of the largest Bulgarian port: Burgas, as well as Rosenets Oil Terminal). In 2015 the new fishing port of Sarafovo was launched.

In contrast to climate change-induced sea level rise, which can be predicted over a middle-time scale, the extreme sea level rising associated with storm surges, tsunamis and rain-storms could have a short, but particular devastating impact on coastal areas. Significant coastal changes typically occur during such extreme events, as well as huge disasters, damages of near-shore infrastructures (harbour, roads, buildings and civil structures), increased human disease and even loss of life.

On the base of 1:50 000 scale topographic maps the low-laying territories along the Bulgarian coast potentially endangered to risks of flooding at given scenarios of extreme sea level rise between 0 and 5 m were identified (Palazov et al., 2007; Stanchev et al., 2009).

The performed analysis showed that 14 towns, 17 villages, 13 sea resorts and 7 small campsites would be affected by extreme sea level rise of 5 m (Figure 12). Number of affected coastal population counted almost 100 000 from all 549 765 residents in these sites. Low-laying areas around Burgas city were identified as ones of most vulnerable to inundation.

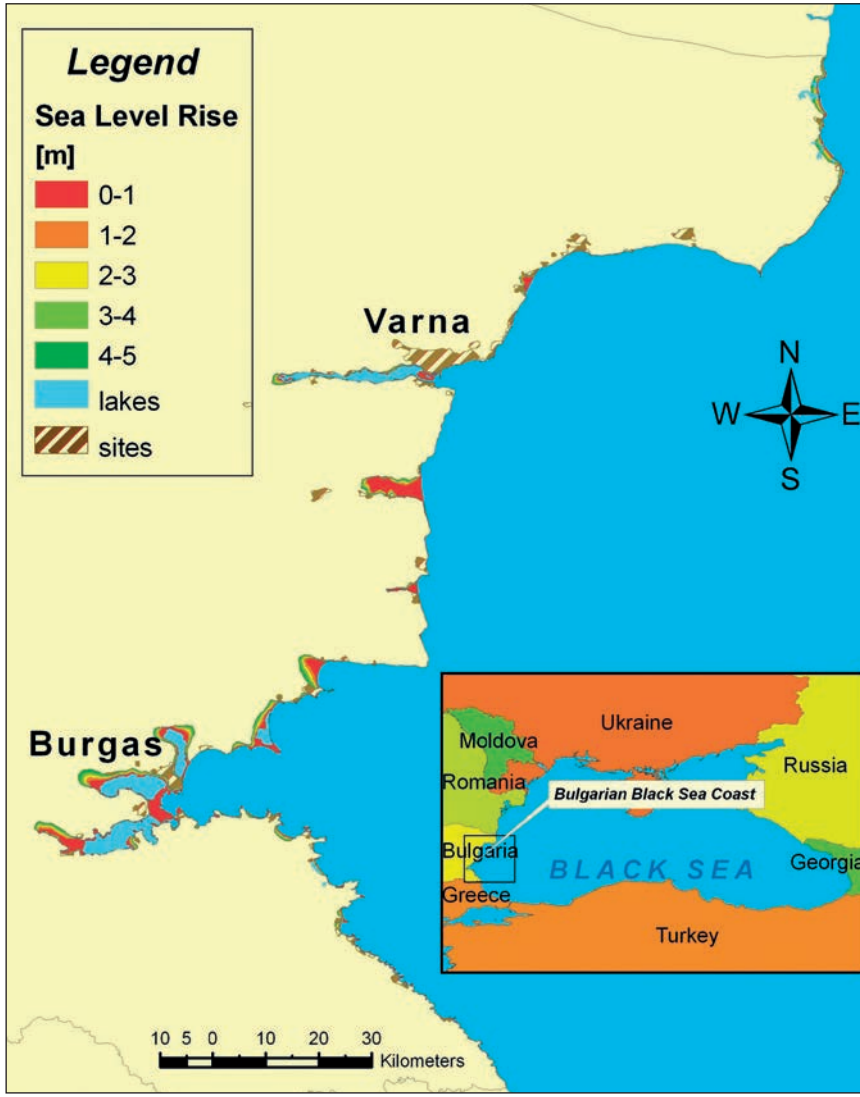

Figure 12. *Low-lying territories along the Bulgarian coast (after Palazov et al., 2007)*

These results were confirmed recently by implementation of the project, focused on the risk of inundation along the Bulgarian coast (www.bsbd.org/bg/index_bg_2934486.html; www.bsbd.org/UserFiles/File/projects/RNK/Primer%20Burgaski%20zaliv.pdf).The most vulnerable areas at scenarios of sea level rise of 3 m were identified (Figure 13):

1. Sarafovo beach and fishing port;

2. Atanasovsko Lake and its adjacent low-lying areas, Road I-9 *Durankulak–Varna–Burgas–Malko Tarnovo*, Burgas salt plant;

3. Beach of Burgas, promenade and tourist infrastructure;

4. Ports of Burgas and the adjacent railway lines and tracks;

5. The existing industrial zone between the sea and Burgas Lake;

6. About 75% of the territory of the neighbourhood *Pobeda*;

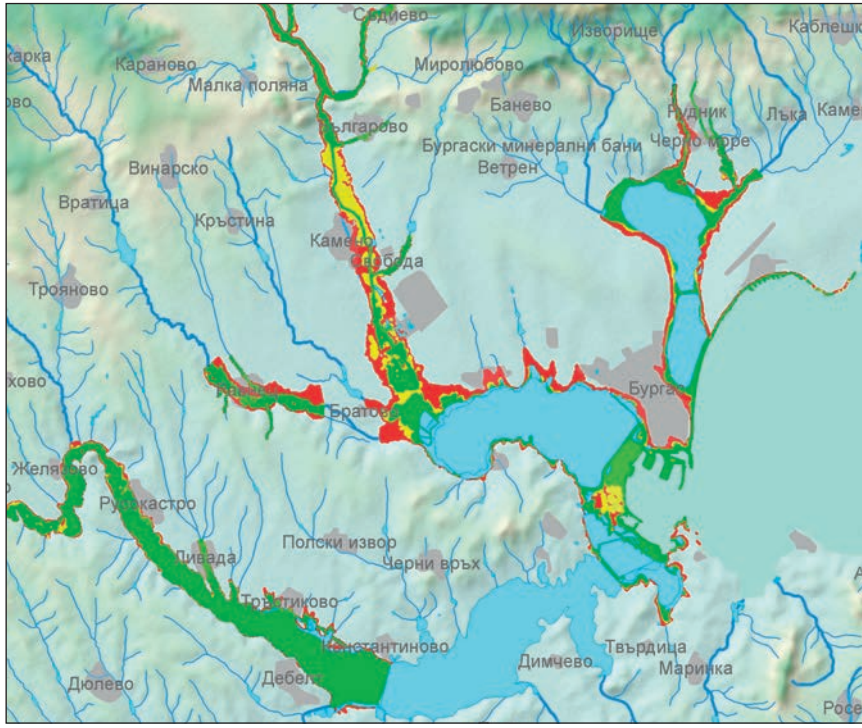

Figure 13. *A fragment of map, shows potentially inundated areas in the study area, in case of sea level rise of 3 m (after www.bsbd.org/bg/index_bg_2934486.html)*

7. Low-laying areas around Burgas Lake – industrial zones, agricultural land, forests, residential area, industrial sites, roads, shops, hypermarket and storage area around it with a depot for liquid hazardous waste of oil production, landfill construction waste, protected areas;

8. The strip between the sea and Mandra Lake – Poda, pumping stations, fishponds and roads.

2.2. URBAN DEVELOPMENT AND POPULATION GROWTH

Burgas originated as a small fishery village on the coast. With its expansion, the city occupies more and more areas, which are currently divided into residential complexes, *Slaveykov*, *Izgrev*, *Zornitsa*, *Bratia Miladinovi*, *Lazur* and *Meden Rudnik* and industrial zones – *North*, *South*, *Pobeda*, *Sarafovo* and *Meden Rudnik*. The dynamics of the development of the city and the physical limits of its

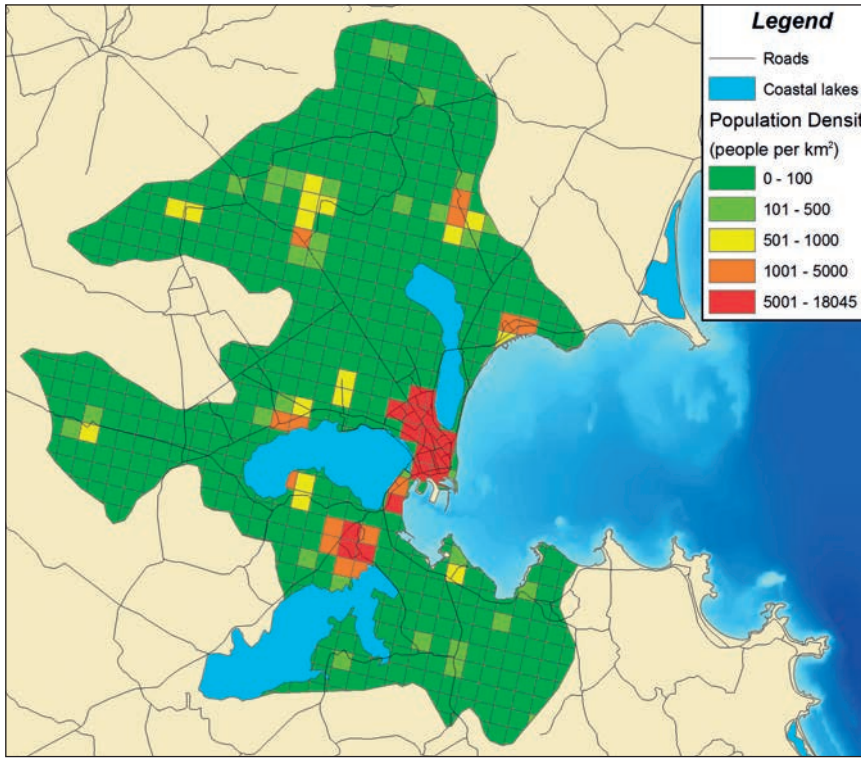

Figure 14. *Population density in Burgas Municipality (NSI, 2012)*

territorial expansion (lakes, sea, and industrial zones) imposed a gradual integration within the city in 1987 of the closest villages – Kraymorie, Sarafovo, Lozovo, Gorno Ezerovo.

The average population density of municipality is quite high: 412 people/km^2. For comparison, the average population density in the country for 2011 is 67 people/km^2 for the entire country (**Figure 14**). Currently, the urban areas in the municipality of Burgas occupy over 64 km^2 (**Figure 15**), which makes *circa* 12.5% of the total area of municipality. *Circa* 45 km^2 or 70% of all urban areas in municipality are located in Burgas city (www.eea.europa.eu/data-and-maps/data/ecosystem-types-of-europe).

Administratively the study area comprises the municipality of Burgas. It has an area of 515.2 km^2 (Kopralev, 2004) and it is the 57th largest municipality in Bulgaria. Population of the municipality, according to data from the Census of 2011 (NSI, 2012) is 212,902 people, which accounts 2.89% of the country's population.

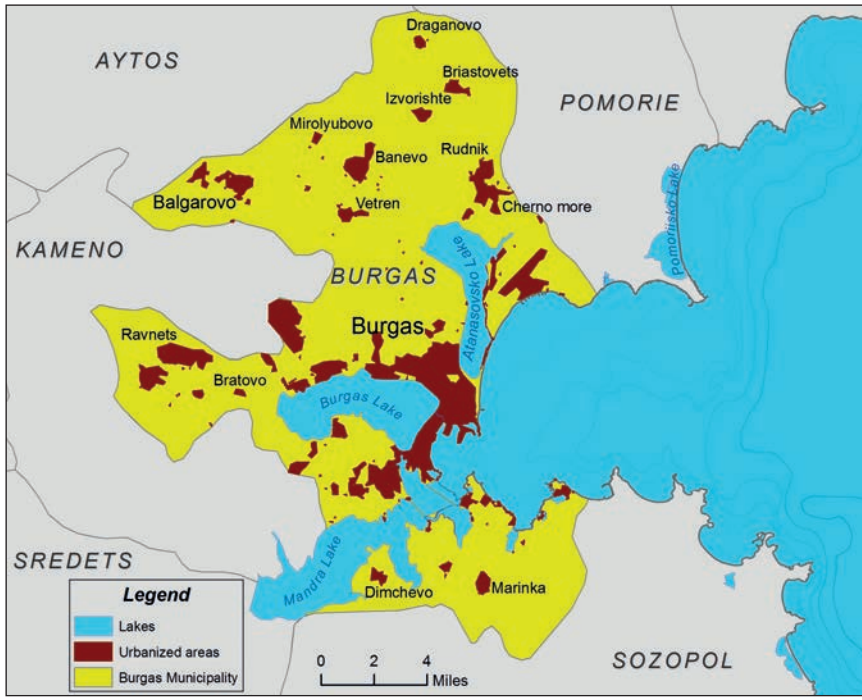

Figure 15. *Urbanised areas in Burgas Municipality*

The municipality of Burgas includes two cities, the municipal centre Burgas and the town of Balgarovo, as well as 12 villages (**Figure 15**).

Changes of population from 1934 to 2011, based on Census data by National Statistical Institute of Bulgaria (NSI), showed that coastal population of Burgas has increased from 53,778 people in 1934 to 212,902 people in 2011, or *circa* 300% (NSI, 2012) (**Figure 16**). Population of Burgas Municipality is heavily urbanised, as it is mostly concentrated in the city of Burgas. **Table 9** presents population changes recorded in the last nine Censuses from 1934 to 2011. There was a remarkable growth in urban population, in particular in the period 1934-1985, when it increased from 50,000 to 200,000 residents, while the rural population kept a constant trend and even decreased. Since 1985 the municipality of Burgas has preserved and maintained this high population number and thus being one of municipalities in Bulgaria with slight decrease of population. This is mainly due to the geographical location of the municipality on the sea coast, attracting large number of people and tourists and boosting the economic developments (Stanchev et al, 2015).

The population growth for the city of Burgas is even more remarkable: Census data from 1934 show that Burgas city accounted *circa* 77% of total municipal population, furthermore in 2011 this number of population reached up to 94%. By contract, the rural population of Burgas Municipality decreased over the same period, as four rural sites have half less number of population in 2011 compared to population number in 1934.

There are also changes in the status of the population sites. Two villages, Vetren and Banevo (**Figure 15**) were adjusted to Burgas city in 2009 (State Gazette, No 11/10.02.2009).

The attractiveness of Burgas, as large administrative centre, has been proved as well as by the decision of citizens of Izvor village. Until 2009 Izvor was a village included in the Sozopol Municipality. In 2009 there was a referendum and the residents of Izvor village decided to join the municipality of Burgas. The accession of the two villages to the city of Burgas also has affected their lands. In this way the settlement and rural areas of Burgas have also increased, which influences the territorial balance of the city.

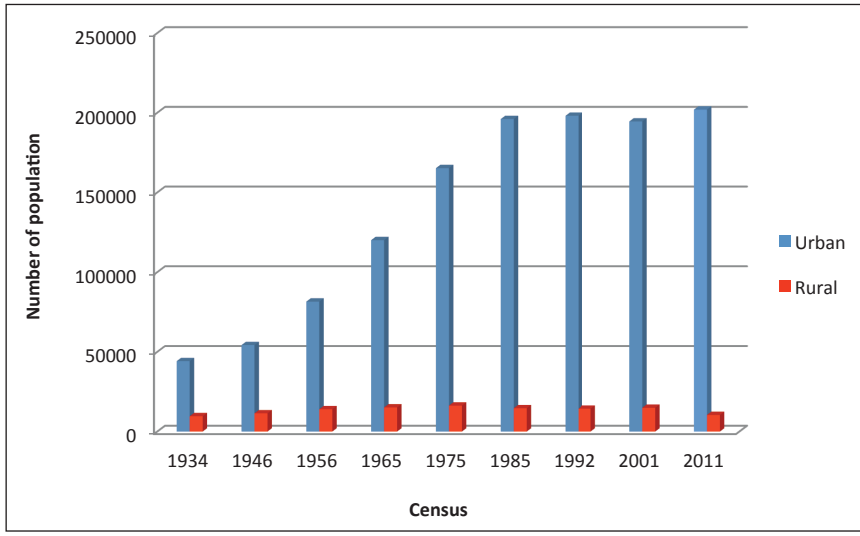

Figure 16. *Changes of urban and rural population in Burgas Municipality for 1934-2011*

Population site	Population								
	1934	1946	1956	1965	1975	1985	1992	2001	2011
Briastovets	950	958	823	688	431	374	326	311	290
Draganovo	380	369	253	318	370	382	419	452	433
Ravnets	1,327	1,750	2,109	2,180	2,140	2,065	1,795	1,568	1,323
Mirolyobovo	451	553	466	338	276	179	162	169	107
Banevo	1,052	1,060	1,195	1,351	1,392	1,457	1,547	1,792	0
Vetren	699	788	832	1,530	2,889	2,188	2,208	2,297	0
Balgarovo	2,543	2,919	2,426	2,550	2,486	2,280	2,407	2,122	1,695
Bratovo	391	470	472	478	356	255	191	165	146
Marinka	743	849	1,023	1,004	1,237	1,244	1,229	1,281	1,177
Tvurditsa	501	659	683	573	567	501	500	490	488
Izvorishte	540	613	493	277	279	278	272	349	389
Izvor									541
Rudnik	2,155	2,947	5,258	2,328	2,968	3,023	3,030	3,489	3,507
Cherno more	0	0	0	3,743	3,145	2,521	2,447	2,353	2,361
Dimchevo	418	419	411	326	223	171	191	189	174
Burgas	41,628	51,323	79,091	117,517	162,756	193,752	195,686	192,390	200,271
Total	53,778	65,677	95,535	135,201	181,515	210,670	212,410	209,417	212,902

Table 9. *Changes of population in Burgas Municipality over 1934-2011*

2.3. EXISTING KEY ECONOMIC ACTIVITIES

2.3.1. Coastal and marine tourism

Tourism, in particular coastal tourism, is one of the fastest growing economic sectors in the world (UNEP, 2009; UNWTO, 2013). Tourism in Bulgaria plays a key role, generating more than 10% of GDP, thus being a prominent sector boosting the local economy (Tourism Sector, Bulgaria 2012). Circa 70 % of overnight stays in the whole country in 2011 based on data from National Statistical Institute were recorded in fourteen coastal municipalities. Tourism in the Burgas study area is mainly seasonal, with many jobs connected to the provision of accommodation in the coastal zone. Main factors favouring the development of tourism in the Burgas Municipality are:

- Existence of large sand beaches;
- Bioclimatic resources;
- Cultural and historical heritage;
- Protected Areas;
- Forest resources;
- Good business environment.

Within the municipality of Burgas there are five main touristic sites – Burgas, Sarafovo, Kraymorie, Otmanli – Park Rosenets and Burgas Mineralni Bani (Spa) – Vetren village (Figure 17).

One of the most valuable resources in the municipality of Burgas is the coastline with large sandy beaches. The study area is a popular tourist destination for many nationals and foreigners as it is distinguished by beautiful landscape and existence of large sand beaches. Burgas city also plays a role of distributor of tourist flow to the adjacent resorts in north and south direction. This is partly due to the existence of Burgas airport, situated in the Sarafovo neighbourhood. A total of 2,360 320 passengers to 125 destinations of 40 countries have been served at Burgas airport in 2015. The largest, despite a decrease of 22%, remains the share of the passengers to and from Russia, followed by the UK (9% increase) and Germany (decrease of 16%). In 2015 there was an increase in the number of the passengers to and from Poland, the Czech Republic, Israel, Belgium, Finland and others.

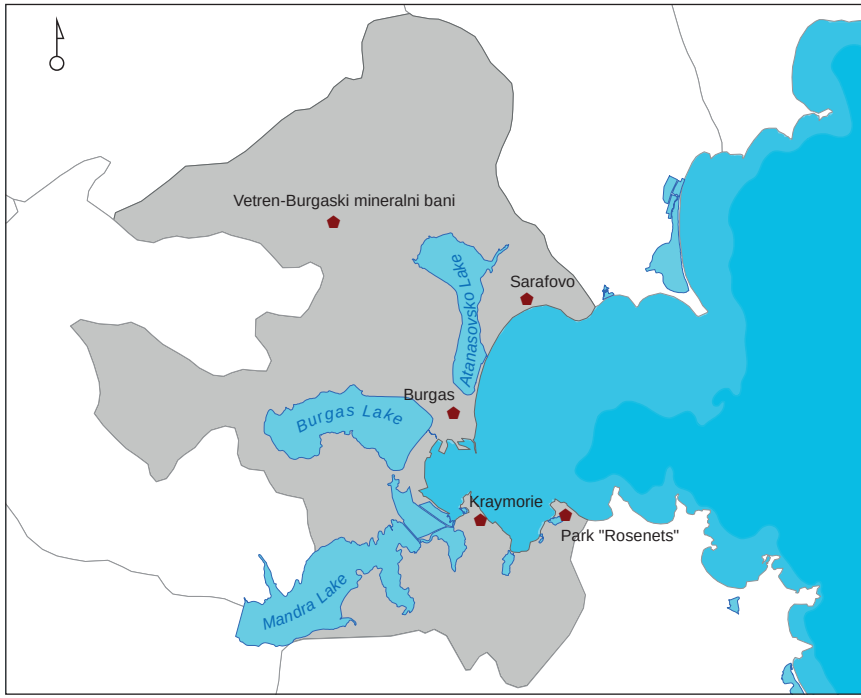

Figure 17. *Main tourist sites in Burgas study area (after Master Plan of Burgas)*

A decrease was registered for the passengers from Belarus, Norway, and the Netherlands (www.bourgas-airport.com/PressCenter/News/tabid/66/language/en-US).

Another important infrastructure that supports tourism growth is the newly built Trakya highway, linking the capital Sofia and southern Bulgaria parts, respectively south Bulgarian Black Sea coast. Due to the increased demand, many national and foreign tourists prefer to stay at small resorts outside the municipality of Burgas. There has been a steady trend of avoiding heavily urbanised territories and preference to stay at resorts and holiday villages.

The tourism sector in Burgas Municipality over 1999–2011 is characterised with following parameters:

• Hotels (**Figure 18**)

The number of accommodation fa-

cilities in Burgas Municipality for the period 1999-2011 increased from 11 in 1999 to 53 in 2011, or the growth of hotels is *circa* 380%.

• Tourist beds (**Figure 19**)

For the same period the number of tourist beds increased from 1,537 in 1999 to 4,443 in 2011. This means that each hotel in Burgas in 1999 had an average of 143 tourist's beds, while in 2011 this number decreased to 83 tourist beds. Therefore, it is suggested that during this period mainly small and family hotels were built.

• Number of overnight stays (**Figure 20**)

The number of overnight stays in Burgas Municipality during 1999–2011 varied between 153,098 in 1999 and 344,543 overnight stays in 2000. Since 2005 the number of overnight stays has retained high with 200,000 overnight stays per year.

• Number of tourists (**Figure 21**)

The number of tourists in Burgas Municipality varies between 64,764 in 2003 and 105,895 in 2007. In 2011 the municipality accommodated a number of 91,281 tourists with 235,975 overnight stays. Therefore, the average tourist stay was 2.5 days, which means the tourist's beds in the city of Burgas have been used mainly for short business trips.

A negative trend is approaching the Burgas city to the sea and its development landward, which alter its type of seaside town and reduces its quality of a sea resort. According to the Master Plan of Burgas, tourism in the municipality has very good

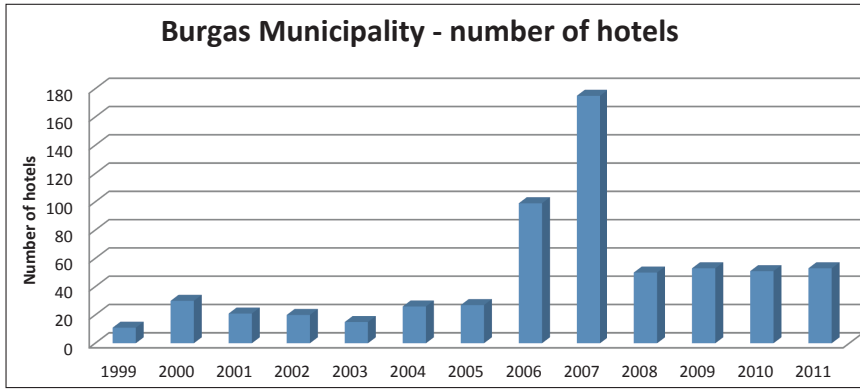

Figure 18. *Number of hotels in Burgas Municipality (data after NSI)*

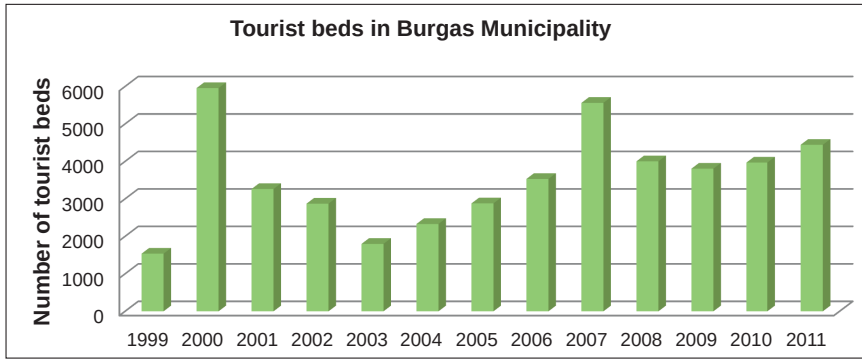

Figure 19. *Number of tourist beds in Burgas Municipality (data after NSI)*

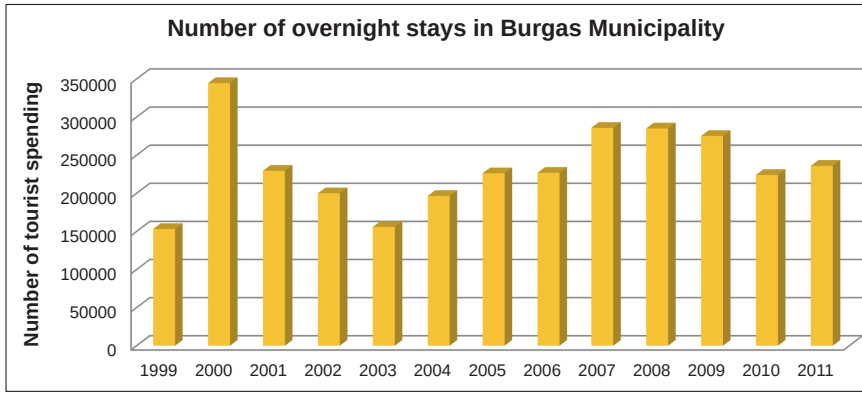

Figure 20. *Number of overnight stays in Burgas Municipality (data after NSI)*

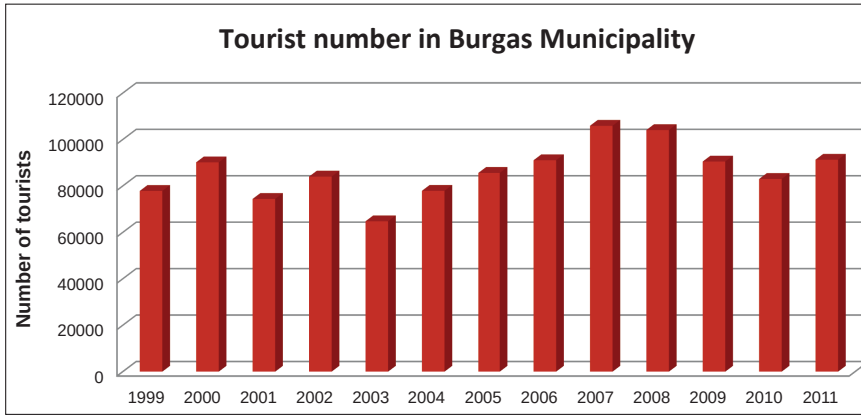

Figure 21. *Number of tourists in Burgas Municipality (data after NSI)*

prospects for development in the presence of a favourable investment environment. Projected levels of all indicators characterising the tourism business in the municipality of Burgas, and in future perspective mark a growth. This growth is significantly delayed in terms of absolute growth of employees. The grounds for determining the projected levels of tourism development in the municipality of Burgas are related to:

• increase of tourist flow;

• improving the use of tourist facilities;

• significantly improve service and qualifications of people employed in tourism;

• development of new forms such as yacht tourism, expanding the share of cultural and historical and wellness tourism;

• construction of an aggressive marketing policy to target groups by age, income, cultural and cognitive interests and hobbies;

• maintaining a quality tourism offering in all aspects: product, people, services, information, experience;

• increasing the number of foreign tourists by attracting overseas markets (US, Canada, Japan and others), with the development of congress- and balneotourism.

It is estimated that in 2030 the persons employed in tourism sector will be around 20,000–22,000. The additional development of tourist services in the municipality is expected to employ around 5,000–6,000 persons and even more up to 2030. The attracted population in the municipality of Burgas due to new tourist developments is expected to exceed the total annual number of local population (Master Plan of Burgas).

Maritime tourism is also driving further developments such as new marinas and expansion of cruising. Ports are also important with regard to tourism as starting points and destinations for leisure and excursion boats.

2.3.2. Fishing and aquaculture

There is a wide range of fishing species in Burgas study area. Some species are local stocks: *Sprattus sprattus*, *Mugil cephalus*, *Merlangius merlangius, Psetta maxima* represen-

tatives of family Gobiidae etc., and other are migratory – *Engraulis encrasicholus*, *Trachurus mediterraneus ponticus*, *Alosa pontica*, *Pomatomus saltatrix*, *Sarda sarda* etc. (EC Study, 2011). In the last decade from the molluscs, an increasing commercial value has had the blue mussel (*Mytilus galloprovincialis*) along with the Rapa whelk (*Rapana venosa*). The catch of the Rapa whelk is going on during the summer through diving method. In 2013 the national legislation was amended to allow the beam trawling targeting Rapa whelk (EAFA, 2015). Since 2013 the beam trawling has been allowed in the preliminarily established zones only. There are different types of fishing gears for active and passive fishing that are used in the study area for marine fishing. Bulgarian legislation prohibits the bottom trawling except for scientific purposes. The main fishing gears on the board of the fishing vessels are trawls, gillnet (for turbot fishing) and pound nets (for pelagic species), (EAFA, 2015). The landed catches of sprat, horse mackerel, anchovy and red mullet by different fishing gears for 2015 in fishing port of Burgas are presented on Figure 22.

Sprat is one of the most important fish species, being fished and consumed traditionally (Raykov et al., 2008). The main fishing method for sprat is mid-water trawling, although smaller vessels also use ring-netting. In 2015 for the Bulgarian Black Sea

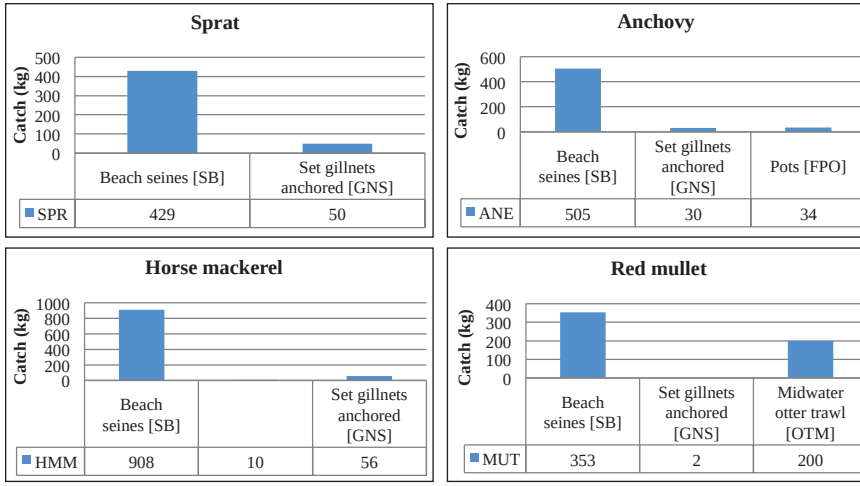

Figure 22. *Landings of sprat, horse mackerel, anchovy, and red mullet for 2015 in the fishing port of Burgas (quantities in kilograms) by different fishing gears*

Species	3 Alpha Code	Beach seines [SB]	Set gillnets anchored [GNS]	Handlines and pole-lines (hand-operated) [LHP]	Pot [FPO]	Midwater otter trawl [OTM]
		Percentage	Percentage	Percentage	Percentage	Percentage
Horse mackerel	HMM	93%	6%	1%		
Anchovy	ANE	89%	5%		6%	
Sprat	SPR	90%	10%			
Red mullet	MUT	64%				36%

Table 10. *Percentage of fishing techniques used for catch in Burgas, 2015*
*Notes: * The largest percentage of the landed fish is caught by beach seines*

waters landings of sprat were 3,296 tons – established biomass was 44,282 tons (EAFA, 2015). A fishery exists for turbot, a stock considered heavily exploited, but under-declaration of landings hampers management (Raykov et al., 2008). In 2015 the total landings of turbot were 43 tons (EAFA, 2015). The research surveys done in 2015 in the Bulgarian Black Sea waters showed an increase in the biomass of turbot and decrease of the biomass of sprat (EAFA, 2015). The established biomass of turbot population in 2015 is 1,248 tons. Table 10 shows the percentages of the fishing techniques used for the catches of four species in 2015. The table produced using the landing declarations.

Pound nets are part of the aquatory of the Black Sea, defined under the terms of Bulgarian Fisheries and Aquaculture Act (Promulgated SG 41/24.04.2001), where a stationary net gear for passive marine fishing is set up in a deepness of 8–12 m. Via the underwater facilities (nets), the fish is guided to a certain part (house, trap), that is harvested by the fishermen with usually small and open air boats (Report, Operational Programme fisheries sector development republic of Bulgaria 2007–2013). Target species are migratory species such as anchovy, horse mackerel, dogfish and other species. There are 6 pound nets registered in the study area (Figure 23).

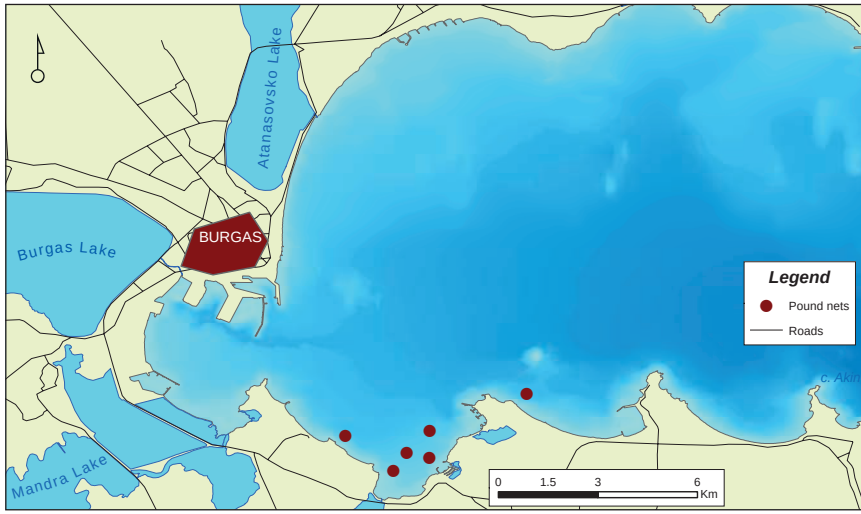

Figure 23. *Pound nets in Burgas study area (data after EAFA, 2016)*

The main raised species in marine aquaculture in Bulgarian Black Sea part is the Black Sea mussel (*Mytilus galloprovincialis*). The production in the country in 2015 was 3,372 tons. One of the main objectives of Bulgaria was to increase the collection and quality of the statistical data about the aquaculture farms. Questionnaires for the aquaculture sector were updated in 2014 and again in 2015. Measures were taken on raising the awareness of the owners or managers of farms about their obligation to submit the questionnaires and in 2014 were achieved 100% answers from respondents (EAFA, 2015). In the maritime space of the study area there is no one farm for Black Sea mussel *Mytilus galloprovincialis*.

In 2015, the Bulgarian fishing fleet consisted of 1,979 registered vessels, of which 1,204 were active, and the remaining 775 vessels were inactive. The active fleet had a combined gross tonnage (GT) of 5.0 thousand tonnes, engine power of 39.6 thousand kilowatts (kW) and an average age of 23 years. The major part of the vessels composes the small-scale segment (89.7% in 2015) with an engine power of 20.8 kW and a large-scale fleet segment (10.3% in 2015) with an engine power of 16.9 kW (EAFA, 2015). Concerning the dis-

tribution of vessels on ports, it can be noticed that most of the capacity is registered at the port of Burgas. The main ports used by fishermen for landing catches are situated in Burgas.

The fishing port in Sarafovo was modernised with the support of European Fisheries Fund (EFF), 2007-2013, under *Measure 3.3. Investments in reconstruction and modernisation of fishing ports, landing sites, and shelters* of Operational Programme for the Bulgarian fisheries sector. The main purpose of the construction of a modern fishing port in the municipality of Burgas was to increase the control over illegal fishing activities. The establishment of a market for first sale of fish at the Sarafovo Port provides fishermen with the opportunity to directly sell their catches. At the same time this serves as a regulator of fish sales as the end the user is provided with fish without any resellers being involved. Burgas Municipality, in its capacity as a port operator, exercises control over the fish market in view of sales transparency and balance (http://ec.europa.eu/fisheries/cfp/emff/doc/op-bulgaria-fact-sheet_en.pdf).

Port Sarafovo has capacity of 100 places for vessels with length up to 10 meters, 20 places up to 10–15 meters and 10 places for vessels with length up to 20 m.

In 2013, Sofia-based private investment company Clever Synergies Investment Fund (CSIF) acquired port operator *Fish Port* in Burgas with all cold-storage facilities and other industrial facilities for processing and storage of fish.

The municipality of Burgas has a plan for reconstruction and modernisation of fishing port in urban entity Fishing village *Chengene skele* with funds from the European Fisheries Fund (EFF) (https://oppex.com/notice/TED_8f2ca27de178347e02e7d8112864c1e9). Plans for the reconstruction of the port foresee to provide additional 110 places for fishing vessels – fishing boats and fishing vessels up to 8 m, up to 9 m and 20 m and to build service buildings and facilities according to EU requirements. Planned construction includes building with administrative functions unloading zone platform for catch, sorting and primary processing of catches, fish market, and storage area for temporary preservation of

waste, repair workshop. For fishing village Chengene skele and Fish port there is no official information available regarding capacity of places for vessels and catches of fishes.

2.3.3. Maritime transport, ports and shipping

Logistics is one of the priorities of the spatial planning as a mean for economic development and a prerequisite for achieving social and regional cohesion. The Burgas Municipality regional structure is complex defined by specific terrain. Districts are spread and separated by water bodies, forests and fields. The complex disperse structure of Burgas is also characterised by busy transport corridors. Burgas is a point of Pan-European corridor VIII. It is a logistic junction of Pan European Orient/East Mediterranean transport corridor connecting ports of Bremen, Hamburg and Rostock with Black Sea ports (Burgas), Aegean Sea (Athens) and Adriatic Sea (Patra) through Czech Republic, Slovakia, Romania, Bulgaria and Greece. The corridor bonds road, railroad junctions and important ports and airports. Highway *Trakia* is a part of the corridor.

Road network

There are over 1,100 km roads of four classes serving the study region. Two of them are international routes crossing the area east-west and north-south directions providing the area with cargo traffic from EU countries. Urban road network includes about 60 km of roads which are reported to be in relatively inappropriate condition (Project ECOPORT 8). Urban transport is reported to be sufficiently developed and is a subject of constant improvement by municipality projects.

Railroad network

Burgas is a terminal point for two national railroad routs, serving national and international passenger and cargo traffic. They are included in the European Agreement on Important International Combined Transport Lines and Related Installations (AGTC) creating technical capabilities for combined international transport using road, railroad, river and maritime means by door-to-door technique favouring additional transit traffic. There are three local railroad routs in the area serving dedicate companies: Burgas Port, East and

West industrial zones, Promet Steel JSC, Burgas Sugar Plant LTD, etc.

Air transport

Burgas International Airport is 10 km away from the city centre; its runway strip is 3,200 m long, supports Boeing 747 and An 124 size aircrafts and process more than 2 million passengers per year (www.bourgas-airport.com/). Its development is directly connected to the touristic industry in the region. The load is specifically seasonal. Types of flights are following: passenger charters, regular international flights, local flights, cargo charters and general aviation.

Maritime transport

Sea transport plays major role for the study area, defined by historical, geographical and economic factors. Burgas Bay is the westernmost waterbody of the Black Sea and is formed as a large bay, wide open to the sea. The convenience for building ports was estimated by ancient travellers, navigators and traders. As described in section 2.1.2 two ancient ports were discovered in the area – one at Sarafovo quarter and the other – at Cape Foros.

The favourable geographic position and opportunity for intermodal transportation by air, sea, rail and road make it excellent for receiving and redirecting of cargo traffic. Through Burgas Port access to Asian transport hubs by Black Sea route TRACECA (Transport Corridor Europe-Caucasus-Asia) is provided as well as to traditional and developing local Black Sea routes and to the global shipping system.

Ports and shipping

Maritime transport in the study area is serviced by four public ports and three ports with specific purpose.

Public transportation ports:

- Port Burgas West
- Port Burgas East
- Fishing Port
- Rosenets Oil Terminal – *Lukoil Neftohim Burgas*

Ports with specific purpose:

- Dockyard Port
- Port Transstroy
- Port Burgas Shipyard

Port of Burgas is one of two most important international ports in Bulgaria located on the Black Sea coast – the other is Varna Port, located on the north coast. The port is located at the far end, in the western part of Burgas Bay. It has been exploited since 1893. Its biggest expansions were performed in 1980 and in the period 2001–2008. The port of Burgas is a public transport port of national importance. It handles bulk and general cargo, as well as serves passenger and cruise ships.

Bulgarian Ports Infrastructure Company (BPICo) is a state-owned company at the Ministry of Transport, which governs the infrastructure of the public transport ports with national importance. BPICo is the owner and carries out the investment policy of Port Burgas. The exploitation management of the port is performed by the other state company at the Ministry of Transport – the operator *Port of Burgas* EAD. The coordination activities related to navigation and the safety shipping in the port, the supervision and organisation of the protection of the marine environment, control activities at the accepting and processing of waste, control on the observation of the technical safety of the port facilities, labour safety and safety of cargo operations are performed by Executive Agency *Maritime Administration* (EAMA), branch Burgas, to the Bulgarian Ministry of Transport.

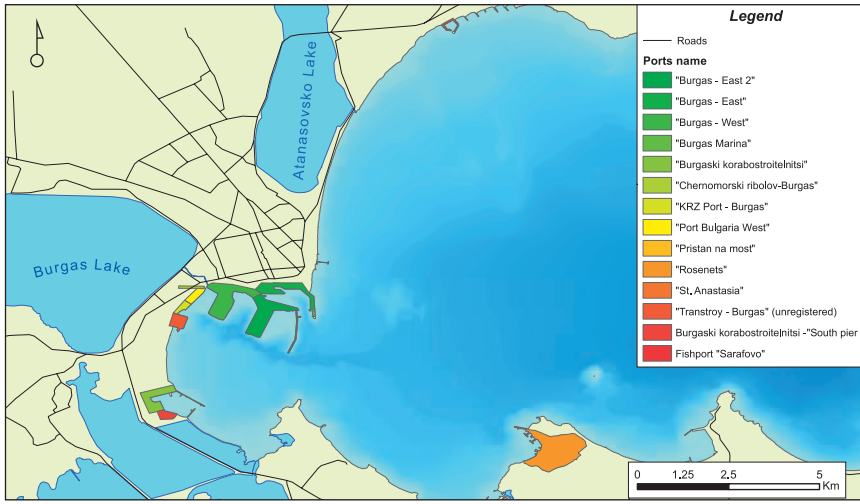

Figure 24. *Location of Burgas ports (data provided by EAMA, 2016)*

Port of Burgas includes the following terminals: East terminal, Bulk cargoes terminal, Bulk terminal 2A, West terminal, Oil Terminal Rosenets, (Figure 24). The Oil Terminal Rosenets serves entirely the private company *Lukoil Neftohim Burgas* JSC.

Burgas East Port is situated in the old eastern sea basin. General cargoes of all kinds, metals, wood, paper, and foodstuff are handled at Terminal East. Also, due to operational reasons, bulk cargoes – coal, sugar, ammonium nitrate and small shipments of concentrates could be worked.

Bulk cargoes terminal includes the old Terminal for Bulk Cargoes. There coals, coke, ores and ore concentrates, clinker and grain were processed using the existing covered warehouse. A coastal facility is installed for handling liquid cargoes – mainly fuels, chemicals and ethanol. A pipeline connects the site with the tank farm Naftex, near Terminal West. There are also filling up station for tanker rail cars and ethanol storage tanks in the vicinity.

Terminal 2A was built under the Port of Burgas Expansion Project as a first stage of the Plan for port of Burgas development. It is intended for handling of bulk cargoes mainly- coal, coke, ores and concentrates, clinker, etc. The facility is equipped with most sophisticated handling technology, capable of highest efficiency.

Burgas West Port handles generally metals of all kind, RO-RO and container traffic. A modern cold storage facility is built on port's area. In 2013 a new international passenger terminal was put in service.

Rosenets Oil Terminal serves exclusively *Lukoil Neftohim Burgas* activities and the latter is its principal operator.

According to data, provided by EAMA, for number of passengers visited Burgas Port during 2011 to 2015, the maximum number was recorded in 2014, with more than 56,000 tourists visits (Figure 25). In 2015, after the crisis of Crimea, the passenger number decreased to 15,000. Possible reasons for this decrease are the ongoing crisis in Crimea and overcharges to pass through the Bosphorus. This decline in cruises not only affected Burgas study area, but also all Black Sea countries. In addition, during the

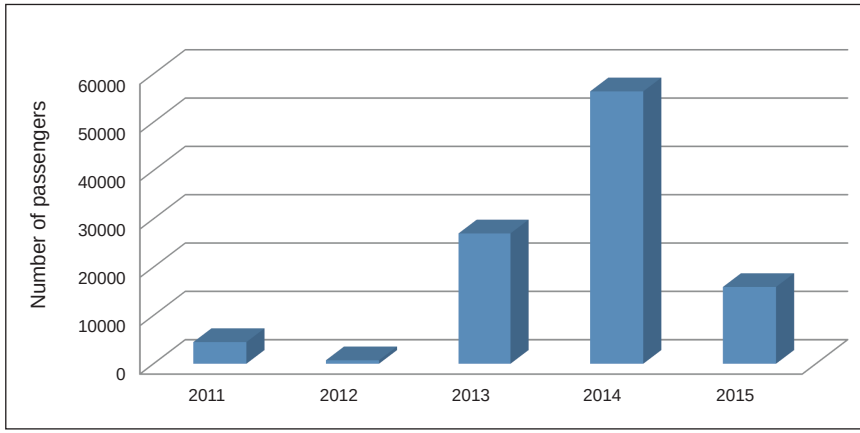

Figure 25. *Number of passengers – Burgas Port (data provided by EAMA)*

summer of 2016 there was also a complicated situation in Turkey after the attempted coup.

Over 2011–2015 a dynamics was observed in the number of ships visiting the port of Burgas (**Figure 26**): the lowest number was in 2011, when 1,443 ships visit the port of Burgas and the highest number was registered in 2014 with number of 1,635 visited ships.

Despite the decreased number of ship visiting the port of Burgas, it has been a growth in cargo (**Figure 27**): from 13.6 million tons in 2011 to 16.22 million tons in 2015.

The shipping oil transport is leading in Burgas study area as shown on Figures 27 and 28.

2.3.4. Oil production and industry

Burgas is important industrial centre. Some industries are typical for Burgas and are structural for the country like light and dark oil products manufacturing, chemical fibre, plastics and other chemical products production. In late 1950's the region was determined by government as the oil industry centre of the country, considering the geographical factors.

As Burgas Bay is the westernmost waterbody of the Black Sea and is formed as a large bay, wide open to the sea, the area is appropriate for

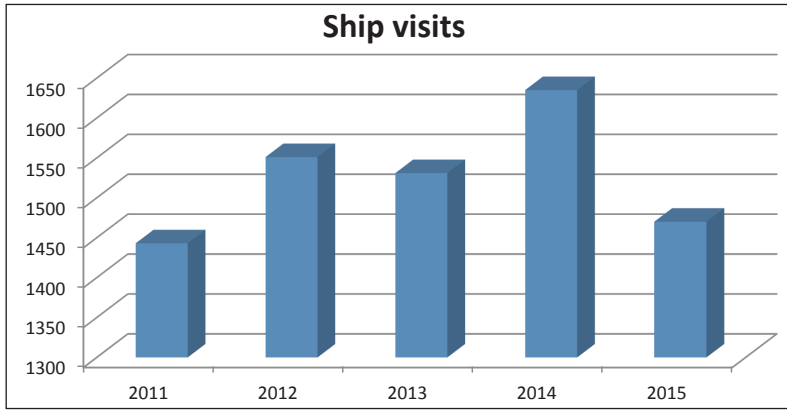

Figure 26. *Number of ship visits at Burgas Port during 2011-2015 (data provided by EAMA)*

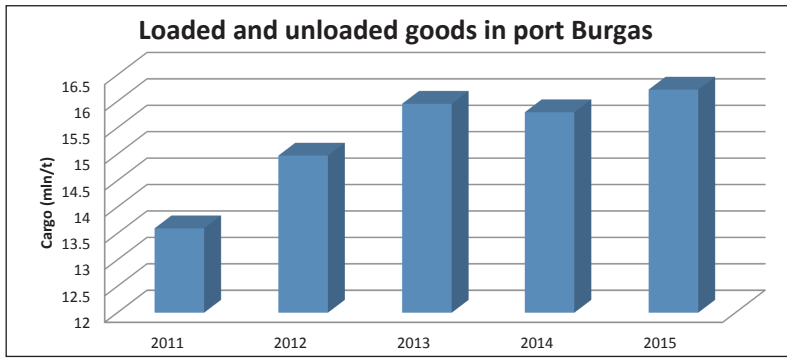

Figure 27. *Loaded and unloaded goods at Burgas Port (data provided by EAMA)*

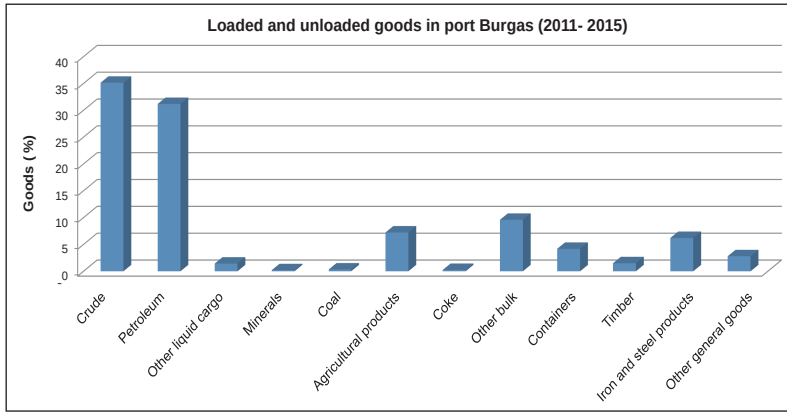

Figure 28. *Goods at Burgas Port for 2011-2015 (%), data provided by EAMA*

port oil terminals construction – important factor, since main oil supply is considered to be maritime transportation. Also convenient road and rail road communications exist.

First oil refinery – *Neftohim* and Oil terminal *Rosenets* were built in 1961–1963 and continuously developed according to the market requirements with additional facilities for oil products manufacturing. Its production capacity is primary processing of 9.5 million ton oil per year and it is the largest one in the South–Eastern Europe. Until 1999 the refinery was public property and since that year was acquired by Lukoil company. Since 2011 *Lukoil Neftohim Burgas* obtained 35 years' concession for the Oil terminal *Rosenets* operation.

In last 15 years 2.6 billion USD were invested in reconstruction in accordance to EU requirements for motor fuels up to EURO-5 standard. New capacities were commissioned for processing of solid production process waste and a treatment plant to process the waters of Rosenets Port Terminal which provides full process waste utilisation and quality of the discharged waters in accordance with the European Union legislation. An advanced automated tank truck filling station was built for motor gasoline, diesel fuels and JET as per the law-regulated technology for bottom filling. The station is equipped with advanced coupling devices for fuel loading and an automatic system for vapour recuperation which achieves reduction of the emissions of volatile organic compounds to the atmosphere three times more that the European requirements.

The construction and commissioning of three units producing products as per European standard EURO-5 were completed – HDS/HDA Unit with a capacity of 1.7 million t/y, Prime G Unit with a capacity of 1.1 million t/y and Methyldiethanolamine Regeneration Unit with a capacity of 0.4 million t/y. The revamps and constructions of the production capacities in the period 2003–2010 led to reduction of sulphur dioxide emissions from the motor fuels produced from 117 thousand tons to 7.4 thousand tons per year. The improved energy efficiency of the units contributed to the decrease of refinery costs for utilities by 21% and the emissions of greenhouse gases like carbon dioxide.

A super advanced process complex is under construction for in-depth vacuum residue processing with a capacity of 2.5 million t/y to the amount of more than 1.0 billion US dollars. The new capacities will increase the processing depth from 76% to 90% and will provide for fuel oil production with sulphur content below 1% in accordance with the European requirements. With this complex the Company becomes one of the only dozen refineries all over the world which have similar technology for super in-depth processing.

The refinery is located north-west of Burgas and close to Kameno village, north of Burgas (Vaya) Lake. Since it is the far largest industrial facility in the region, the emissions originating from its production are continuously controlled by authorities. Recently large fines (about 300,000 EUR) were reported to be issued by RIEWs (Regional Inspection of Environment and Water) against the company considering deviation of legislation.

After treatment the refinery wastes are deposited in reservoirs of oil products – oxidizing lakes near Mandra Lake (south of Burgas). After 40 days, waters are discharged in Usungeren water intake.

Besides the refinery with its global significance, in last two decades, activities in SMEs sector increased. Production of thinners, solvents, paints, linseed oil, fuels, cleaning and waterproofing materials, resins, adhesives, fiberglass, and antifreeze and washer fluid for cars was developed. Also, biogas installations design and construction have been started.

2.3.5. Salt mining

On the Bulgarian Black Sea coast salt production has a centuries-old tradition, dating back to the 3rd Century BC. In the study area of Burgas Bay for more than 100 years apart from birds, the Atanasovsko Lake has been also used by people for the extraction of salt. Saltpans of the lake have been established since 1906. Currently in the lake are located evaporators of the *Black Sea Salt* LTD – owners of the lake, which produce about 40,000 tons of sea salt per year (Salt of Life Project, www.saltoflife.biodiversity.bg/en/; http://greencorridors.burgas.bg/bg/objects/view/6).

Through the salt production, several social and environmental state programs have been also implemented.

With salt iodisation for food purposes the deficit of iodine has been eliminated and by salt extraction the development of malaria syndrome has been suppressed. The extraction of salt has created and maintained biodiversity of hundreds of flora and fauna species in Atanasovsko Lake, which is part of the Ramsar Convention. It was found that the production of salt is directly proportional to average winter numbers of waterfowl in the lake and with maintaining the good environmental conditions in the reserve increases the production of salt as well. Salt production is carried out even today in the traditional way, and it is one of the best examples of business that is not only environmentally friendly, but even creates suitable conditions for nesting of many birds (the dikes, used to separate the watersheds, are a favorite place for nesting by terns and gulls). Currently the salt production company activities comply with the needs of species that inhabit the lake. The technology of salt production is related generally to the concentration of seawater, in several stages to the level of saturation compared to NaCl (sodium chloride). At the beginning of each season of salt production using concentrated sea waters are used, stored during the winter in deep earthen reservoirs – spare pools. After crystallisation of the sea salt (with layer thickness of 3–6 cm), it is collected, washed in spiral classifiers, and by means of conveyor belts is stored outdoors in the form of pyramidal shapes (bohori). Salt production depends greatly on the climate peculiarities of the summer season (Salt of Life Project, www.saltoflife.biodiversity.bg/en/).

Lye is a byproduct of salt production in Atanasovsko Lake and contains only inorganic substances – sodium chloride, magnesium, potassium, sulphur, etc. It forms after the evaporation and concentration of salt in the lake water. Black Sea lye has a proven medical effect – it is used for treatment and prevention of diseases associated with the locomotor mechanism, skin sores and wounds, varicose veins, and colds.

Therapeutic mud is a sedimentary product of the closed salt lake. It is pure and homogeneous, dark grey to black in colour and smells of hydrogen sulphide due to the many decaying microorganisms. It contains inorganic ingredients such as silica, sand, gypsum, iron and aluminium

compounds, hydroxides and salts. This composition was formed by millennia of decay of single-celled organisms, algae, fish, crabs, mussels. One centimetre of therapeutic mud is formed for at least one year (http://greencorridors.burgas.bg/en/objects/view/6).

2.3.6. Military defence

There is no available official information on legally ensured maritime zones for military trainings in the study area. Military exercises are conducted by the Ministry of Defence of Republic of Bulgaria and most recently also by the Border Police in connection with the increased migration pressure on Europe. Therefore, for the purposes of this case study it was assumed that all maritime area is used for military trainings.

2.3.7. Others

Dredging/dumping locations

Dredging and dumping works are performed to keep the shipping navigation operational and safety navigation depth in the area of ports and canals. In the area of Burgas Bay there is only one dumping ground located at 20 nautical miles east from Burgas city between the lines separating vessel traffic. For the last five years there has not been dredging of the Burgas Port.

Sea bed /underwater cables

The underwater cable lines located in the marine area are indicated on the nautical maps under Bulgarian jurisdiction as published by the Hydrographic Office to the Navy.

2.4. POTENTIAL INTERESTS AND LAND/SEA USES

At present, despite statutory opportunity to build private ports – marinas, ports for public transport or special purpose such do not yet exist. The exception is Fishing Port.

There is a scheme *Transport* (included in the integrated plan of Burgas) and two activities are planned: additional works to the Port Sarafovo and shelter to the fishing village Chengene skele (it is not currently working); Kraymorie – there are shelters, pending restructuring of the port of Burgas East as public; there is an idea to build a port at Cape Foros; to the port of Burgas West – no investment plans, for Burgas Dockyard

Land/Sea uses	Developments expected up to 2030
Coastal tourism/maritime tourism	Recreation in coastal zone, new infrastructure developments and tourist flow will continue to grow. The focus will be on business, cultural and spa tourism. An increase of cruise tourism, yachting, and recreational boating is also expected
Coastal protection	Enlargement of coastal protection structures (groins, coastal dike, etc.) are planned
Transport infrastructure on land	Investments in road and rail infrastructure are expected
Burgas Port	Investments in ports infrastructure planned. Establishment of Fishing village in the area of Chengene skele. Island St Anastasia – plans for seasonal shelter
Dredging for ports	Despite no dredging has been made over the last five years, more dredging to be expected to serve for larger ships at ports
Dumping	Dumping sites are legally defined in the maritime space of the large Burgas Bay behind 20 nm eastward of Burgas Port. With increased dredging activities the dumping activities are expected to be much more
Shipping and maritime transport (goods/passengers)	It is expected an increase of the number of ships, shipping frequency, transported goods and passengers
Shipping oil	Continues increase of oil transportation through the pilot area
Marine aquaculture	Interests for development of turbot and so-iuy mullet farms (only at project levels, no developments yet)
Fishing	Pressure on fisheries is expected to continue; increased importance of sustainable fishery management
Military activities (onshore and offshore)	No information available
Natura 2000 protected areas (terrestrial and marine)	Increased importance; management plans expected. More marine protected zones likely to be added as data become available
Sea bottom habitats (valuable habitats)	Mapping of the sea bottom habitats has been carried out under EU SeaMap 2 Project and new more detailed mapping is planned

Table 11. *Potential interests in land/sea uses in Burgas study area up to 2030*

Port – it is planned an extension for 2 berths; establishing Fishing village in the area Chengene skele and keeping old traditions of fisheries in new modern conditions; for Island St Anastasia – there is a wharf, and it will be shaped as a seasonal shelter.

Aquaculture – there is an idea for turbot and so-iuy mullet, but there is no development, only at the project level and still there are no plans for further development of aquacultures.

At the central Beach of Burgas there are plans to extend groins for additional accumulation of sand on the beach and more effective capture of longshore sediment transport; south of Sarafovo neighbourhood – there are plans for coastal protection and completion of existing coastal dike and on the north – a construction of coast-protection structures is foreseen.

Tourism: Burgas Municipality has resources to develop marine tourism, with a focus towards business tourism, congress tourism, route-cognitive-, cultural- and spa- tourism. Over the new planning period (2010–2030) Burgas Municipality should mobilise its resources – tourism, human, local institutions and structures in order to develop tourism. It should be offered qualified and attractive tourist product secured with tourist information and marketing to attract more tourists and brings additional income to the local population.

Future industrial projects – local authority is not involved, rather it is a ministerial decision. Data for concessions and livestock farms – could be provided from Burgas Regional Administration.

Identified potential interests and plans in land/sea uses in the pilot area that are expected to be developed according to the Master Plan of Burgas (until 2030) and expert assessments are shown in Table 11.

2.5. PREPARATION OF MAPS FOR CURRENT LAND AND SEA USES AND INTERESTS AND OF NATURAL VALUES

The legally ensured land and sea uses of the Burgas Bay study area are indicated on Figure 29.

All coastal and marine conservation areas in Burgas study area are indicated on Figure 30.

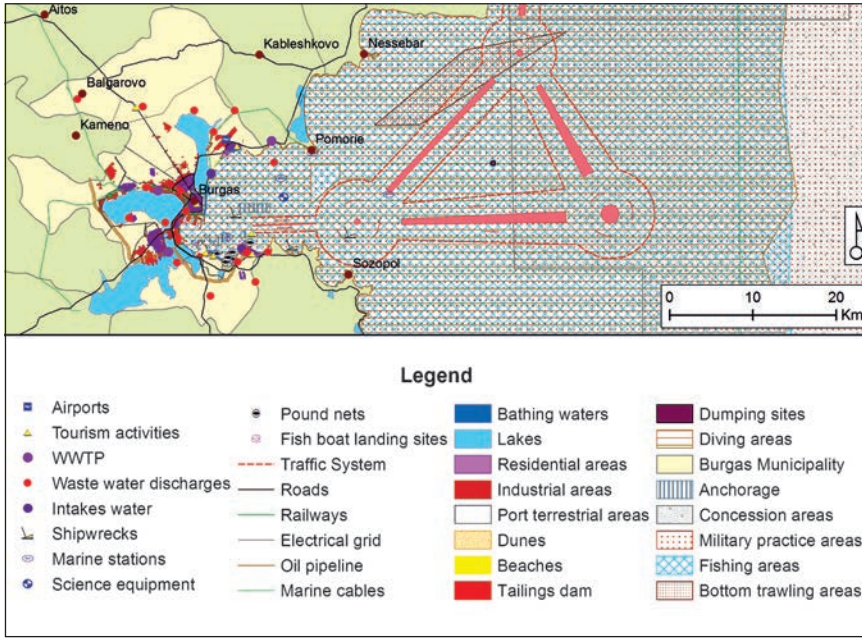

Figure 29. *Map of current land and sea uses in the study area*

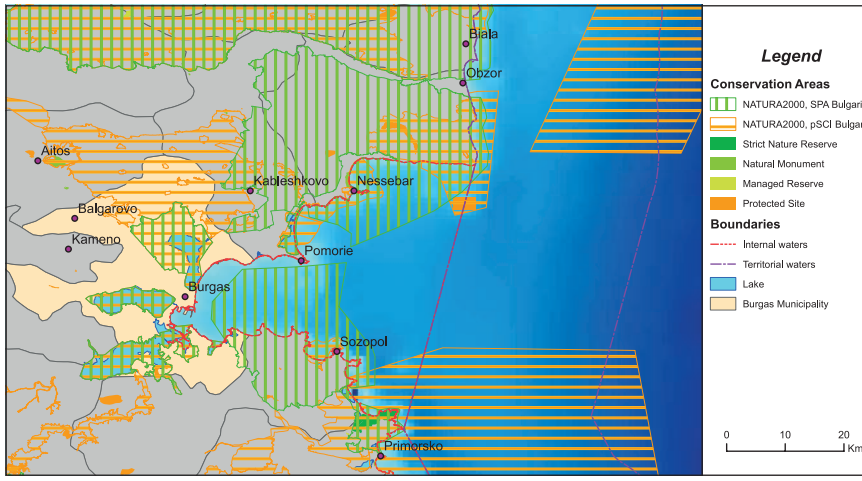

Figure 30. *Map of natural values in Burgas study area*

3. IDENTIFYING KEY STAKEHOLDERS FOR LAND AND SEA SECTORS IN THE STUDY AREA AND STAKEHOLDERS INVOLVEMENT

3.1. IDENTIFY KEY STAKEHOLDERS

Identification of relevant stakeholders began early in elaboration of the case study compiling a tentative list of stakeholders either involved in the MSP process or potentially affected by the results.

Key stakeholders:

- Burgas Municipality
- Burgas Regional Administration
- Port of Burgas
- Lukoil Neftohim Burgas
- Local fisheries
- Scuba diving centres
- Tourist operators and agencies, hoteliers, owners of campsites
- NGOs, environmental organisations
- Executive Agency of Fishery and Aquaculture

3.2. INVOLVEMENT OF KEY STAKEHOLDERS

Stakeholders are at the heart of MSP and their expertise and knowledge are crucial to identifying the current and future trends of a specific sector and contributing to its development. In the frame of stakeholder involvement the following meetings and events were conducted to inform them as well as to find needed information and data:

- Informal work meeting with representatives of Burgas Municipality (8th of April 2016, Burgas, Bulgaria);
- Event for Presenting the MARSPLAN–BS Romania and Bulgaria Project and the institutional and legislative framework for maritime spatial planning (29th of November 2016, Varna, Bulgaria), organised by Project Partner 1 Ministry of Regional Development and Public Works of Bulgaria.

Photo provided by MRDPW of Bulgaria

The work meeting on 8th of April 2016 had the following agenda:

1. Presentation of MARSPLAN–BS Project and methodology for Case Study 3 Burgas;

2. Discussion on coastal and maritime human activities in Burgas Municipality. Potential interests in the coastal zone and maritime area. Identifying key stakeholders.

3. Discussion on existing and potential conflicts, issues or compatibilities between users and users-environment and land-sea interactions.

The meeting was attended by MARSPLAN Project team from IO-BAS: Dr. Margarita Stancheva, project coordinator; Dr. Maria Yankova, biology expert; Dr. Hristo Stanchev – GIS expert, and Anton Krastev – ecology expert.

By the side of Burgas Municipality the meeting was attended by the chief architect of Burgas Municipality Ms. Veselina Ilieva and architect Ms. Katya Dimitrova.

The meeting started with general presentation of the main MARSPLAN–BS project objectives and expected results of project implementation.

Photo provided by MRDPW of Bulgaria

The meeting continued with discussion on the main maritime and coastal (land) uses in the area of Burgas Municipality as well as which are the potential interests for development and who are the key stakeholders in the municipality. The meeting also discussed existing and potential conflicts, issues or compatibilities between users and users-environment and land-sea interactions.

At the MARSPLAN–BS Event on 29th of November in Varna, Bulgaria the main findings and outcomes of elaborated case study on land-sea interactions were presented to participating stakeholders and were discussed. Also the proposed planning solution for the sea-sea uses conflict between shipping/navigation and diving (described in *Phase II Analysis of future evolution*) was presented and discussed in details with project partners and respective stakeholders.

4. IDENTIFYING INTERACTIONS, CONFLICTS, COMPATIBILITIES AND IMPACTS BETWEEN USES, SECTORS AND ENVIRONMENT

4.1. IMPACT OF LAND INFRASTRUCTURE ON WETLANDS AND MARITIME SPACE (WITH FOCUS ON BIODIVERSITY)

In Burgas study area, the impact (direct or indirect) of land infrastructure on the wetlands is substantial as all wetlands are located in immediate proximity of urbanised and industrial areas and of a large city.

Impacts on Atanasovsko Lake

Changes in the originally existed coenoses in Atanasovsko Lake have been reported due to the considerable anthropogenic impact during the last 50–60 years. Salt manufacturing also has led to ecological changes. For example, the changes of the vegetation cover are closely connected with: changes of the hydrological and salt-balancing regimes, appearance of ruderal species, dike-construction works, agricultural activities that take place in the buffer-zone of the reserve, and with the background pollution from the industrial areas of Burgas and the international airport, as well. The halophyte coenoses, like this of Salicornia europaea and Sueda maritima could be recognised also as pioneer ones (Ramsar Convention, 2002a). As the lake is situated in the surroundings of Burgas and consequently it is subject to high pressure because of its proximity to such densely populated city and the international airport of Burgas, located east of the lake. The lake is used for traditional salt production and the habitats which are typical of this wetland are heavily dependent on this activity in its present form. The lower economic efficiency of the traditional salt production process and the obsolete infrastructure pose risks to salt production in its current form and are considered a serious threat for the maintenance of the wetland in general (Vasilev et al., 2013). The largest threat is that of direct habitat alteration or destruction. This may result from salt pan modernisation or inconsistent economic activities such as replacement or de-

struction of old dykes. Large, tall and wide soil dykes are constructed for salt production. These become overgrown with vegetation very quickly and are, therefore, unsuitable for nesting by species such as the avocet, the black-winged stilt the Kentish plover, the common tern and the little tern which inhabit the coastal lagoon (www.saltoflife.biodiversity.bg/en). Studies have shown that these species prefer nesting on low dams boarded with planks. The sudden raising of the water level in some pools early in the summer and their emptying during the autumn is not always consistent with the needs of the nesting and feeding birds.

With its location in the town, the Atanasovsko Lake is subject to strong anthropogenic pressure. Frequently people go along the dykes in order to collect brine shrimp eggs, look for marsh worms, walk a pet or go to the pools of curative lye. This disturbs the inhabitants of the lagoon. Very often, the outlying pools and the canal are polluted with domestic and construction waste. Pollution of the water in the canal around the lake is a hazard both to the inhabitants of the lake and to the coastal lagoon habitat. The complex of various habitats in the Atanasovsko Lake attracts a vast diversity of birds (Michev et al., 1999).

The coastal lagoon is of exclusive significance for several species of narrow adaptation, as well as for the migration and wintering of a significant number of birds. All these birds are threatened by the large number of predators freely entering the lagoon (www.saltoflife.biodiversity.bg/en). Stray dogs, foxes and jackals roam freely along the dykes and destroy entire plover and common tern colonies. The inhabitants of the coastal lagoon are endangered not only within the reserve, but also around it. Hunting is practiced around the protected area during the winter, causing additional disturbance of the birds. Thousands of white-fronted, greylag and red-breasted geese winter every year in the lake. These species are globally endangered, but becomes prey to hunters from time to time. Conservation measures include a management plan for the reserve that has been adopted in 2003.

A number of information and awareness-raising activities, regular biodiversity monitoring and restoration of the infrastructure and preservation

of the traditional salt producing activities have been carried out under projects of nongovernmental organisations and scientific institutes (Vasilev et al., 2013).

Impacts on Burgas (Vaya) Lake

The most significant impact to Burgas (Vaya) Lake is the change of the landscape of the protected area. Another impact is the increased quantity of the chemicals in the water of Vaya Lake because they are absorbed by the plants (http://burgaslakes.org/poda/en/opazvane.html). The overall condition of the wetland is unsatisfactory, with a trend toward deterioration of the bird protection conditions. The general threats are: excessive anthropogenic pressure – backfilling of wetland sections and construction, pollution with oil products, chemical products and solid municipal waste, overfishing and use of fishing facilities which pose hazards to the birds, illegal hunting and fishing, significant disturbance, deteriorated connection of the lake to the sea, electrical lines which are a hazard for the birds and windfarm construction plans (Vasilev et al., 2013). Proper management of the reed beds is crucial for the existence of open areas used by the water birds for feeding and resting. The poor quality of water in Vaya Lake is a serious threat for the maintenance of feeding base for many birds and for the protection of the fish reserves in the water basin. The reason for the pollution is the industrial waters, although purified, from the northern and southern industrial zones pour into the lake (http://burgaslakes.org/poda/en/opazvane.html).

Noise pollution caused by the international road passing through the eastern part of the lake is also an impact. The road is the reason for the pollution of the coast with household wastes. Considerable threat for the conservation of biodiversity in Vaya Lake is poaching. The illegal fishing decreases the number of fish species in the water basin. Sometimes poachers go fishing during the breeding period and thus endanger the fish reserves in the lake. Many rare and endangered birds and reptiles become victims of poachers' nets. Poaching disturbs the species that nest, feed or rest in Vaya Lake (www.birdsinbulgaria.org/ovm.php?l=bg). Fishing and sand extraction are practiced in the area, but the most serious threat to this site comes from oil in-

dustry refinery (Ramsar Convention, 2002b). Conservation Measures include a management plan prepared in 2005. Singular activities (improved enforcement against poaching, monitoring, construction of artificial islands attracting pelicans to nest), but no human and financial resources have been secured for complete implementation of the plan. The application of some of the measures provided for in the plan started in 2010 within the BSPB project under the EU LIFE+ programme (mainly to increase the capacity of the local institutions, build partnerships etc.), (Vasilev et al., 2013).

Impacts on wetland complex Mandra Lake – Poda

The main threats to coastal wetland of Mandra Lake involve significant human impacts – construction of coastline sections of the wetland and destruction of the natural habitats (particularly wet meadows) in the area, excessive water use, development of the surrounding infrastructure, chemical and solid municipal waste pollution from the watershed area, excessive fishing and use of fishing facilities endangering the birds, illegal hunting and fishing, significant disturbance, existence of electrical power lines which are hazardous to birds, wind-farm and recreation facility construction plans (Vasilev et al., 2013). The Mandra Lake is the main source of industrial water for the Lukoil Oil Refinery. A petrol line runs across the complex of Mandra Lake-Poda and may cause significant damage to the wetland in an accident. The preparation of a management plan was started in 2005, but not completed. Singular activities (improved enforcement against poaching, monitoring, construction of artificial islands attracting pelicans to nest), but no human and financial resources have been secured for complete conservation of the wetland. The application of some of the required nature conservation measures started in 2010 within the BSPB project under the EU LIFE+ Programme, especially to increase the capacity of the local institutions, build partnerships etc. As a result of systematic conservation over the years the coastal wetland Poda is in a very good condition (Vasilev et al., 2013). Cooperation between NGOs and governmental institutions has been achieved in organising the Nature Conservation Centre for the protected territory and

for wetland management, organisation of bird-watching tourism and non-traditional recreational activities, ecological education, scientific researches and as a place for conducting conservation activities. The increasing anthropogenic pressure is due to the proximity of the large city, port, transport and other infrastructure and related pollution, poaching by hunting and fishing, eutrophication of the wetland, plans to expand the Burgas port and construction of facilities for transporting natural gas, introduction of non-native species, overfishing.

A management plan was elaborated and put into action in 2002. The main activities envisaged in the plan (management and maintenance of the habitats and populations of the target species by management of reed massifs, provision of artificial nesting sites, improved enforcement against poaching, monitoring, education etc.) have been realised, and the required resources have been provided by the BSPB. In 2010, the activities were continued with an entire complex of measures provided for in a BSPB project within the EU LIFE + programme, aiming, among other things, to raise the partnership-building capacity of the local institutions, to ensure sustainability of wetland conservation.

Impacts on protected area Chengene Skele

The territory of protected area Chengene Skele is rather small and consequently it is very sensitive to all human activities carried out in and around the area. Hunting, fishing and the collection of plant and animals during the breeding season, as well as poaching, cause disturbance to birds. The fishing activities influence directly the fish stocks and the food of fish-eating birds. There are cases where water birds fall into fishery nets. The area is particularly sensitive to all kind of building activities, as well as to tourism, recreation and fishing (www.birdsinbulgaria.org/ovm.php?l=bg). An international road to the south border of the country crosses the eastern part of the complex, which causes significant waste and noise pollution, as well as death of the small animals, including birds. There is a potential impact of large-scale oil spill from the oil pipeline, which crosses the Chengene Skele, as well as from the oil terminal of Burgas Port situated nearby.

Impacts on protected area Bakarlaka

The protected area of Bakarlaka is under expanded anthropogenic pressure due to the existence of the densely populated tourist settlements (www.birdsinbulgaria.org/ovm.php?l=bg). The continuing urbanisation related to the intensive development of tourism, enlargement of the settlements cause fragmentation, deterioration and even loss of habitats mainly in the coastal zone. The significant human impact on the area is determined also by concentration of people at valuable areas along the coast and by illegal deposition of waste in many places in grassland habitats even in arable lands. The area of Bakarlaka is particularly sensitive to construction of high facilities, especially plans of development of wind farms both on the land and in the sea. This development could disturb the free movement of birds, especially of soaring migratory birds, and will limit to a significant extent the access of birds to the suitable habitats (www.birdsinbulgaria.org/ovm.php?l=bg). They will cause direct collision and killing of them, fragmentation and loss of valuable habitats used by birds for feeding and soaring, as well as places for avoiding of severe weather conditions. They will be a barrier for thousands of migratory soaring birds and night migrants on their flyway to the south and north and will cause further decline in their populations (forest habitats are threatened by overexploitation of forest resources and afforestation with nonindigenous species). Removal of old semi-dead trees and those with halls limits the possibilities for woodpeckers to find proper breeding grounds and food (www.birdsinbulgaria.org/ovm.php?l=bg).

The primary impacts on the wetlands and maritime space of the Burgas study area include:

• Change of the natural landscape of the wetlands due to expanded urbanisation;

• Increase of economic activities and abandonment of naturally or human maintained wetlands;

• Pollution of wetlands and maritime space due to the close proximity with densely populated town, port and industrial areas, in particular Lukoil Refinery;

• Illegal fishing and hunting from the wetlands;

• Coastline constructions/corrections and change of the water-body morphology and hydrological regime of the lakes/wetlands;

• Proximity of an international road to the wetlands causing noise and waste pollution, as well as death of small animals and birds.

Potential impacts on wetlands and maritime space

Oil industry is by far the major economic activity in the study area. It uses Mandra Lake as water source, which might lead to excessive water use. It also deposits preliminary treated waste waters for oxidizing in decanters located in the Burgas and Mandra lakes vicinity. The waste waters are left for 40 days before considered *clean* and are safely released in the Usungeren water intake (www.natura.bsnn.org/pdf/Ezerata_na_Burgas_Mandra-Poda.pdf).

The decanters are potential threat due to possible overflowing in case of floods. Furthermore, during strong precipitation an air quality decrease in the area has been reported.

Pipeline supply and transportation system across the wetlands is also a potential threat for ecological state in case of emergency. In June 2015 a large petrol leak occurred and part of the Burgas Lake was contaminated. Specific measures were implemented in order to prevent further damages. Direct impact to the marine environment is still not recorded, although in case of floods untreated waste waters could reach the Burgas Bay area and contaminate the sea water. No rescue measures are publically announced in case of such an event. Ports waste and contaminants generation is usually prevented by port authorities with strict measures and control. Potential threats for the ecological state are leaks during chemicals transfer, fuel bunkering and budge waters. Another potential threat is posing by dredging and dumping of the materials. Specific sites are defined for material deposition. In case of their overloading a serious impact is expected both on the ecosystem and bathing waters quality in the region.

Potential threat is also dumping of industrial wastes, coal and fertilisers in port areas. Another impact of the port infrastructure on the maritime space is the intensity of the vessels traffic. Because specific rules are

implemented in such areas other activities as tourism, fishing and coastwise traffic could be hampered. The port activities and vessels traffic could lead to noise pollution in the area, influencing the marine life.

4.2. INTERACTIONS BETWEEN LAND AND SEA BASED ECONOMIC ACTIVITIES AND SPATIAL USES, AND ENVIRONMENT

On the base of produced maps of land/sea uses and of natural values, and analysis on current economic activities and natural landscape in the study area, the main land-sea interactions were identified. The results are shown in a conflict/synergy (land-sea interactions) matrix (Figure 31). In the matrix coding, with green colour are indicated interactions without conflict and compatibilities between land and sea activities, and with environment. With yellow colour are indicated weak conflicts between land and sea uses and with coastal and marine environment. With red colour are indicated interactions with conflicts in the land-sea uses and environment. Empty boxes denote to no interactions identified.

For the described study area in total 16 different coastal land uses and 22 sea uses were identified. Land-sea interactions without conflict are 44, weak conflicts are 100, 16 conflicts were identified and 192 no interactions between land and sea uses were indicated.

The coastal land uses without any interactions are electrical grid and natural gas pipeline; the airport activities indicated only synergies with sea uses (five interactions with yachting tourism, water sports, engine boat sports and military practice areas). The highest number of land-sea conflict interactions was indicated for the oil pipelines of Lukoil Refinery, waste water discharge and tailing dams (with quality of bathing waters, coastal fishing, intake waters and protected areas).

The sea-land conflicts (uses-uses and uses-environment) that were identified mainly include: waste water discharge in the maritime area has negative impact on coastal tourism, terrestrial protected areas and wetlands; dredging activities have negative impact on coastline morphology, sediment transport and sustainability of sand beaches and

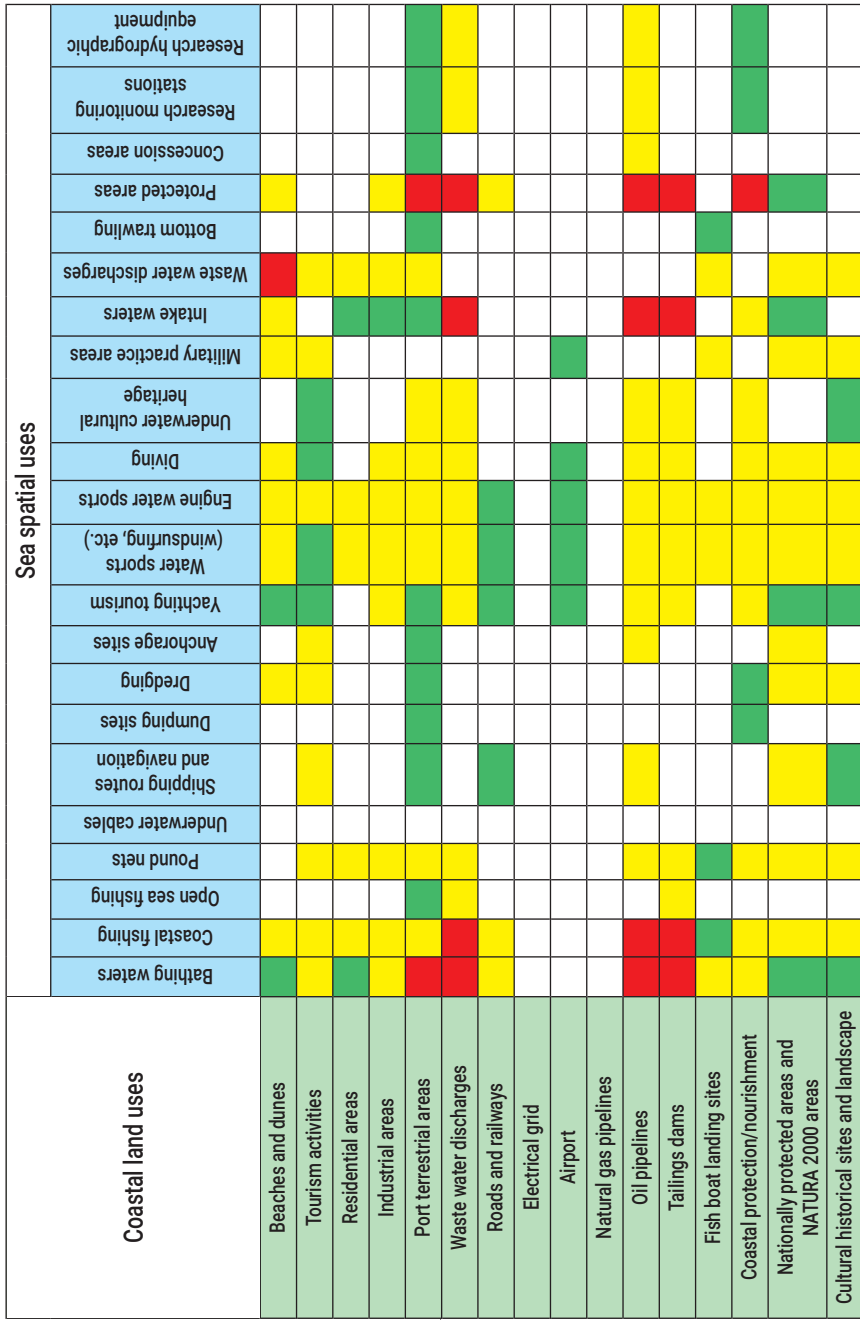

Figure 31. *Land-sea interactions matrix for Burgas study area*

dunes as their action is similar to sand mining and extraction; anchorage sites can affect coastal tourism; various types of marine litter from the passing ships and other shipping activities have an adverse impact on beaches and coastal tourism. Marine litter, in particular plastic, is a serious offence to the visual and aesthetic sensitivities of tourists and local visitors to beaches (Galgani et al., 2013). Solid waste and littering can degrade the physical appearance of the water and shoreline and cause serious damages to marine biota. Sea-land military trainings can also affect coastal tourism, beaches, dunes, wetlands and other terrestrial protected areas, and historical cultural heritage. Potential sea-land conflict interaction would occur due to the oil spill pollution in a marine accident which can cause severe damages not only to marine area as well as to the coastline: wetlands, beaches, coast-protection structures, rocky cliffs and all ecosystems. Similarly, the coastal tourism industry can be harmed by direct impact of oil spills to beaches and waterfront properties and other infrastructure.

4.3. MAPPING THE MAIN CONFLICTS OF USE AND OF ENVIRONMENT IN THE MARITIME PILOT AREA

Based on the analysis of human uses in the maritime space of Burgas study area a map of the main conflicts of use and of environment was produced to visualise the results of assessment (Figure 32).

The overlay of the various data layers presents the current and potential conflicts between sea uses and environment across the marine study area and gives a first indication on the location of the conflict hotspots. Such conflict hotspots could arise due to a number of factors as overlapping of areas devoted to other possible sea uses or in particular area which are ecologically sensitive to human uses or in areas where overlapping uses are spatially incompatible (www.baltseaplan.eu).

In result of performed Geographic Information System (GIS) spatial analysis, 22 different sea uses were identified in Burgas maritime study area. Major part of the area is recorded as spatially overlapped multiple uses – mostly military trainings,

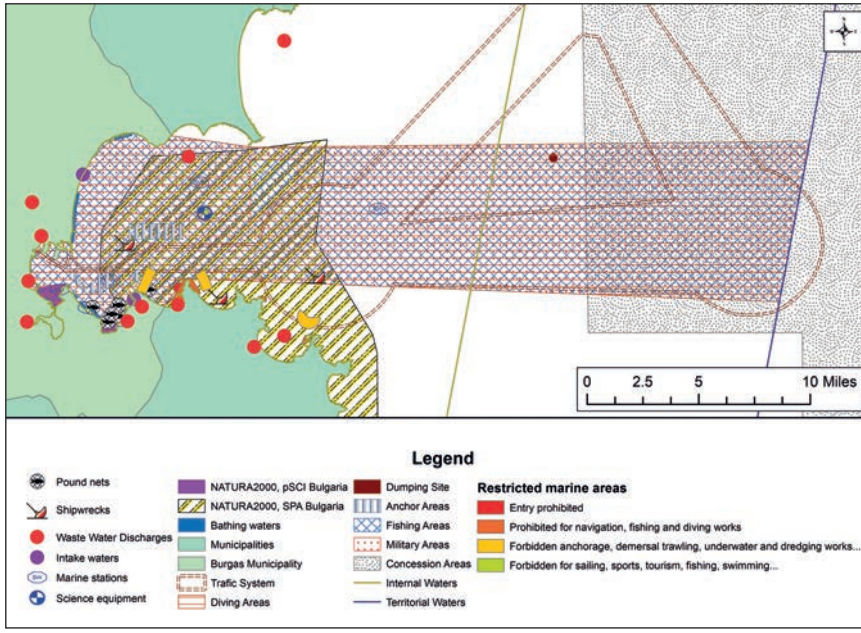

Figure 32. *Map of spatially overlapped uses in the marine study area*

fishing, diving, shipping and navigation, yachting and engine boats. There are also defined restricted zones indicated on the nautical maps produced by the Hydrographic Office to the Navy in Bulgaria. Other areas with temporary restrictions are those with navigation warnings and their locations can be found on the website of Bulgarian Ports Infrastructure Company (www.vtmis.bg). Based on the data published on nautical maps in the marine area of Burgas Bay the next four permanently restricted zones are indicated:

• Entry prohibited areas: the area with the strict ban, which prohibits the entry and execution of any activity;

• Areas of forbidden anchorage, demersal trawling, underwater and dredging works, bottom trawling and underwater explosions;

• Areas of forbidden sailing, sports, tourism, fishing, swimming, anchoring, diving operations and underwater explosions;

• Areas prohibited for navigation, fishing and diving works.

The primary group of current and potential sea uses-uses and uses-environment conflicts due to the spatial overlapping of uses in the marine study area are as follows:

• Shipping and navigation vs. fishing

• Shipping and navigation vs. bathing waters

• Shipping and navigation vs. nature conservation (NATURA 2000)

• Shipping and navigation vs. diving

• Anchoring vs. fishing, bathing waters and nature conservation (NATURA 2000)

• Fishing/pound nets vs. water sports, yachting and diving

• Dredging and dumping vs. bathing waters

• Dredging and dumping vs. nature conservation (NATURA 2000) and underwater cultural heritage

• Waste water discharge vs. bathing waters

• Waste water discharge vs. nature conservation (NATURA 2000)

• Underwater heritage (shipwrecks) vs. shipping and navigation

• Military trainings are in conflict with almost all sea uses and with environment.

Potential conflict can arise in case of marine accident related to ship traffic and risks of oil pollution, which is danger for the nature conservation, fishing, bathing waters, tourism and recreation.

Potential conflict can arise in case of waste water discharge accident. There is one waste water discharge located in the marine area of Burgas Bay. In case of such accident, non-treated waste water can impacted on bathing waters, fishing and nature conservation.

Phase II.

ANALYSIS OF THE FUTURE EVOLUTION

1. PROPOSE PLANNING SOLUTIONS (TERRESTRIAL AND MARITIME) TO DIFFERENT CONFLICTS: KEY ISSUES/CHALLENGES FOR MSP IN THE PILOT AREA AND RECOMMENDATIONS

1.1. PLANNING SOLUTIONS FOR THE LAND-SEA USE CONFLICT BETWEEN WASTE WATER DISCHARGE/TAILING DAMS AND WETLANDS AND BATHING WATERS/COASTAL TOURISM

ISSUES:

The discharge of waste waters (both domestic and industrial) into the wetland lakes in the study area and location of several tailing dams might cause significant pollution of the lakes (waters and nature conservation) as well as of bathing waters in the marine part and respectively has a negative impact on coastal tourism.

The treated waste waters from Waste Water Treatment Plant (WWTP) of Burgas enter the bay with the inflow from Vaya Lake. It receives as well as the partially untreated household waters of Aytos town and those of the villages along the valley of river Aytoska that streaming to Burgas (Vaya) Lake. In addition, the treated waste waters of the biggest oil processing and petrochemical plant in the country – *Lukoil Neftochim Burgas*, get in the small Burgas Bay through the discharge of Mandra Lake. Potential increase of pollution of Vaya Lake will largely affect also the pollution of Burgas Bay because the two water areas are connected by canal. Since the bay has much higher self-purification ability, its waters do not reach high levels of contamination, but it might be a serious danger in swimming and bathing.

In summary, the large industrial companies and facilities are among the main potential sources of pollution of existing wetlands and Burgas Bay (www.bsbd.org/UserFiles/File/projects/RNK/Primer%20Burgaski%20zaliv.pdf). The most important of them are:

Lukoil Neftohim (the main site) – the waste waters from central treatment

plant are discharged in the second pond from the system of oxidation ponds;

Lukoil Neftochim – Oil Terminal Rosenets – waste waters from the site, after local treatment plant are discharged into the fourth oxidation pond, which is a natural wetland;

Naftex Petrol Ltd – Oil base Burgas: playground storage of petroleum products (petrol, diesel) – waste waters after local treatment plant are discharged into the canal connecting Vaya Lake with the sea;

Building materials company with purification facility (tailing dam) – waste waters after treatment plant are discharged into the Mandra Lake;

Burgas Shipyard – ship repair and shipbuilding. The waste waters after local treatment plant are discharged into the Black Sea, in the belt of sanitary protection;

Burgas Lake Vaya–96 Ltd sand quarry. The waste waters after precipitation in two units of sedimentation equipment are discharged into the Vaya Lake;

Andela AD, Burgas – tailing dam Gorno Ezerovo: waste waters after local treatment plant are discharged into the Vaya Lake;

Factory constructions Lozovo, Burgas, north industrial area: the waste waters after local treatment plant are discharged into the Vaya Lake;

WWTP of Burgas with capacity of 397,700 people equivalent. It is a conventional scheme for mechanical and biological treatment of waste waters from the town of Burgas (without quarter Meden Rudnik), with built disposal facilities for removal of nitrogen and phosphorus. The treated waters are discharged into the Vaya Lake;

Port Burgas West – ongoing project for inclusion of waste waters to the WWTP of Burgas city.

POTENTIAL SOLUTIONS:

From a technological and environmental perspective Lukoil Neftohim has developed too extensively its production site, and Burgas Lake has been effectively used as an open collector for waste waters. In addition, the sedimentation pools have been exported at a large distance from the initial source of liquid waste. Therefore one potential recommendation

is reclamation of sedimentation pools in order to avoid future pollution of the surrounding wetlands, in particular Burgas Lake and respectively the sea waters in the Burgas Bay.

1.2. PLANNING SOLUTION FOR THE SEA-SEA USES CONFLICT BETWEEN SHIPPING/NAVIGATION AND DIVING

ISSUES:

Over the recent years the recreational scuba diving tourism has become popular and has attracted many tourists in Bulgaria. Numerous scuba diving centres have been established to explore interesting underwater dive-sites, such as shipwrecks, natural formations, rocky reefs, archaeological remains etc.

One of the most popular dive-site attractions in the area of Burgas Bay is the *Mo Pang* wreck. The shipwreck and its associated artefacts retain a high recreational importance for diver visitation. It is located at a water depth of 20 m, which allows for visitations by recreational divers or even by tourists having low experience. At the same time the ship is 9.5 nautical miles east of Burgas and falls in the roundabout in close proximity to the buoy traffic separation (Figure 33).

This fact poses direct danger to the ship traffic as well as to the divers. On this basis, in accordance with Regulation N° H-7 from 12.06.2008 to perform diving and other underwater activities (State Gazette N°59/ 01.07.2009), issued by the Ministry of Defence, Ministry of Interior and Ministry of Transport of Bulgaria, it should be required preliminary permission for diving visitations from EAMA. However this creates difficulties for tourist activities of diving centres: often there is an issued permission, but it is not possible to visit the site due to the bad weather. Moreover, the diving centres are not able to plan even in a short term the activity with tourists willing to dive.

POTENTIAL SOLUTIONS:

In relation with development of a new ship routing system (Case Study 4 in MARSPLAN–BS Project elaborated by EAMA) in the context of MSP, potential solution of this conflict is to shift the location of the round-

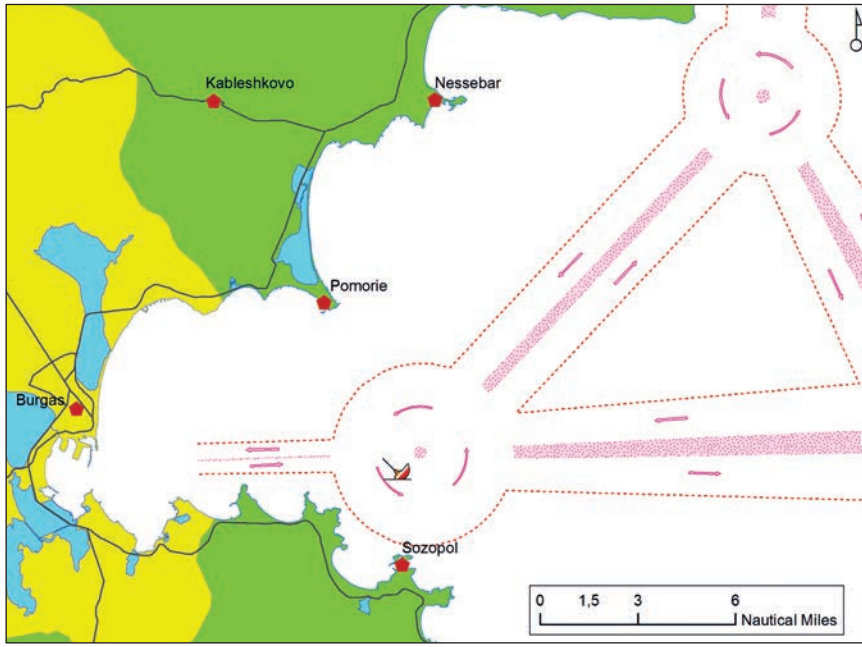

Figure 33. *Current state of the ship routing system in Burgas Bay*

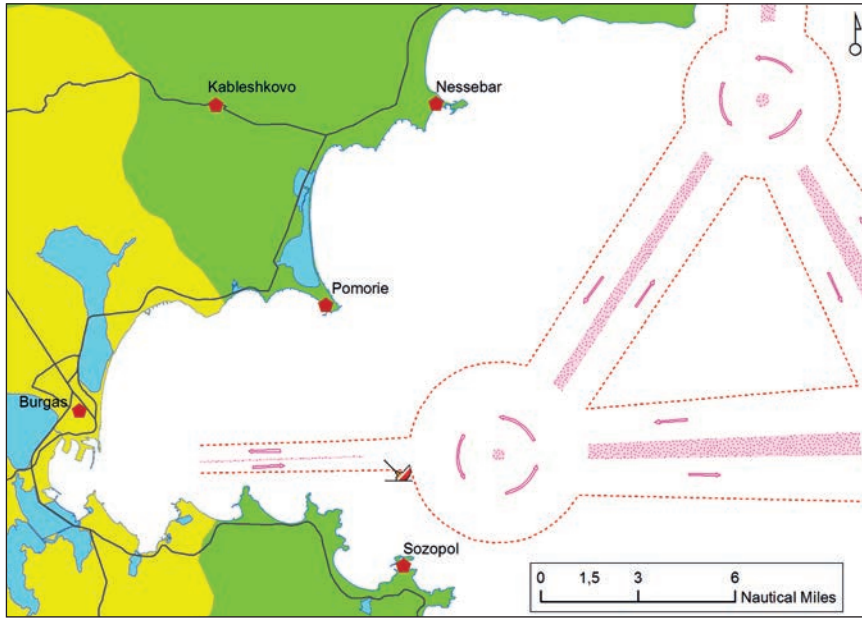

Figure 34. *Potential solution for changes of the ship routing system*

about to the east (approximately with 2.5 nautical miles), so that the wreck *Mo Pang* to remain outside (Figure 34). This will inevitably facilitate the operations of diving centres in saving time and effort for requesting permissions between them and EAMA. Last but not least, this will eliminate the risks to life and health of the tourists-divers, and will remove a potential obstacle to ship traffic. Such a solution will increase the tourist flow, and will help the small businesses in the study area.

2. LESSONS LEARNED

The land-sea interactions (LSI) are fundamental and one of the most complex interactions as the marine and land environment are in fact one system. The Directive 2014/89/EU of 23 July 2014 establishing a framework for maritime spatial planning, Article 7 sets up the MSP requirements to consider the land and sea uses interconnected, as cited: *"in order to take into account land-sea interactions should this not form part of the maritime spatial planning process as such, Member States may use other formal or informal processes, such as integrated coastal management. The outcome shall be reflected by Member States in their maritime spatial plans"*.

Through maritime spatial planning it is required to promote coherence of the resulting maritime spatial plan or plans with other relevant processes. The main challenges that still exist are related to the definition of *an interaction*: What does *land-sea interactions* entail? What are the perceived barriers for addressing *land-sea interactions* successfully? Should there be a geographic or other boundary for considering *land-sea interactions*? (Fairgrieve, 2016).

In order to promote the sustainable growth of maritime economies, the sustainable development of marine areas and the sustainable use of marine resources, maritime spatial planning should apply an ecosystem-based approach as referred to in Article 1(3) of Directive 2008/56/EC with the aim of ensuring that the collective pressure of all activities is

kept within levels compatible with the achievement of good environmental status and that the capacity of marine ecosystems to respond to human-induced changes is not compromised, while contributing to the sustainable use of marine goods and services by present and future generations.

At this stage the most important for implementing MSP in Bulgaria is the establishment of proper legal basis for MSP in accordance with the Directive 2014/89/EU, including land-sea planning and harmonisation in accordance with the principles of MSP. A draft for Amending and Supplementing the Law on Maritime Spaces, Inland Waterways and Ports of the Republic of Bulgaria was prepared at expert level. With this draft amendments are envisaged in all related acts and regulations. The draft covers 100% legislative transposition of MSP Directive. However as of the end of 2016 there has not been yet a political decision for designation of the Competent National Authority responsible for MSP under the Directive 2014/89/EU.

Human resources and information basis for MSP are still insufficient at municipality and national level. Both land and sea uses should be sustainable and based on ecosystem approach as to the Directive on MSP. Bulgarian coastal zone and marine space currently are organised and planned by the respective legal acts, but for the complex land-sea interactions is needed a dedicated maritime spatial planning to reflect all conflicts on the land and in the sea space. There is still no common understanding how it would be best to divide responsibilities and also how to draw the administrative borders in the sea (Martin et al., 2012). Therefore the relationship with terrestrial planning is inevitable and terrestrial planning authorities shall give consideration to marine plans when developing their master plans. Especially for land-sea interactions during the maritime spatial plan preparation, the defined National Competent Authority and terrestrial planning authorities should consult each other, but also collaborate closely throughout the planning process to ensure consistency in their respective plans. In this process it is required to engage with others more inland to discover their interests in the marine areas and to think jointly on economic and ecological systems to discover who has a

stake in the sea – direct or indirect (Abspoel, 2016).

Lack of data was also a challenge for identifying land-sea interactions for Burgas study area, mainly data on: detailed map of the bottom habitats, data on impacts of different activities on the land and marine environment, data on dredging and dumping, data on yachting and marine sports, data on military training activities, data on direct impact of Lukoil Neftohim on the environment and wetlands, data about sediments specific substances content, data on oil spills and ship accidents and many other.

GIS and mapping provide the best way of improving decision support elements of the MSP approach. GIS allow us easily to view, understand, question, interpret, and visualise data in many ways that reveal relationships, patterns, and trends in the form of maps, reports, and charts. Since there are many user-friendly GIS software packages currently available and also many users who are untrained in cartography, one of the biggest problems is a poorly designed map. Such poorly designed map can conveys a misinformation and result in poor decision-making (Ehler and Douvere, 2009). MSP requires far more data from far more data sources (creators, owners, custodians, public and private) than is provided within marine cadastre initiatives, programmes, systems and legal mandates alone. Marine cadastre should be considered as part of spatial data infrastructures (SDI), considering its importance for coastal and marine stakeholders. Then, these spatial data should be easily accessed to get the basic dynamic information. The very complexity of MSP, involving land-sea interactions, significantly complicates the legal, jurisdictional and data management requirements for both marine cadastre and MSP (Longhorn, 2016).

Data gathered during the case study should be used as guidance for further repetition models for the Bulgarian Black Sea coast and Black Sea Basin that would be developed with a more consistent methodology and approach. Also the land-sea conflict/synergy matrix and maps of human uses and spatial overlay in marine area could be used as models for further studies on land-sea interactions along other study areas. A lot of research is still needed to propose the most relevant decision on

planning and managing land-sea interactions. As coastal and marine research is time and costs consuming it should be the responsibility of the Competent Authority on MSP in Bulgaria to initiate the relevant research and monitoring programme and proper funding.

Involving key stakeholders in the development of MSP is essential for a number of reasons: the most important is because MSP aims to achieve multiple objectives (social, economic and ecological) and should therefore reflect as many expectations, opportunities or conflicts occurring in the MSP area (Ehler and Douvere, 2009). Ways must be found to involve the key stakeholders, for one large industrial companies, such as *Lukoil Neftohim* and Burgas Port and much more cooperation is needed amongst these stakeholders.

Stakeholders should be identified in a transparent way with providing an overview of relevant institutions with information on their responsibilities, interests and respective contact person (developing a stakeholder map) (Käppeler et al., 2012).

NOTES

REFERENCES

Abspoel, L. 2016. Maritime Spatial Planning in the North Sea. The Dutch experience: Looking from the sea to land, seeing land-sea interactions, and making multi-level governance work. Ministry of Infrustructure and Environment, Scottish Coastal Forum, 10 March 2016

BaltSeaPlan Project (www.baltseaplan.eu)

Black Sea Coast Development Act. 2008. Promulgated, State Gazette N° 48/15.06.2007, effective 1.01.2008, last amended by State Gazette N° 61/ 11.08.2015

Black Sea Wet Initiative. Discover Black Sea coast. 38 Black Sea Wetlands to visit. Publication financed by the Enterprise for Management of Environmental Protection Activities (EMEPA), Ministry of Environment and Water, Bulgaria. www5.moew.government.bg/wp-content/uploads/filebase/Nature/Natura2000/RAMSAR/Black_Sea_Wet_Catalog-Final.pdf

Begun T., Muresan M., Zaharia T., Dencheva K., Sezgin M., Bat L., Velikova V., 2012. Conservation and Protection of the Black Sea Biodiversity. Review of the existing and planned protected areas in the Black Sea (Bulgaria, Romania, Turkey) with a special focus on possible deficiencies regarding law enforcement and implementation of management plans. EC DG Env. MISIS Project Deliverables. www.misisproject.eu

Botev, I. 1997. Water Chemistry of Atanasovsko Lake. In: Michev, T. (Ed). 1997. Ecology and Conservation of Atanasovsko Lake Nature Reserve. Collection of Final Scientific Reports of Experts, BSBCP, Sofia

BirdLife International, 2004. Birds in Europe: *Their Conservation Status* www.birdlife.org/community/2011/01/birds-in-europe-their-conservation-status

Cheshitev, G. et al. 1992. Geological map of Bulgaria in scale 1:100 000 (In Bulgarian)

Climate Reference Book for Bulgaria. 1978. Vol. 1: Solar radiation and Sunshine. Sofia, 99 p. (in Bulgarian)

Climate Reference Book for Bulgaria. 1979. Vol. 2: Air humidity, fog, horizontal visibility, clouds, snow. Sofia, 811 p. (in Bulgarian)

Climate Reference Book for Bulgaria. 1982. Vol. 4: Wind, Sofia (in Bulgarian)

Climate Reference Book for Bulgaria. 1983. Vol. 3: Air temperature, soil temperature, frost. Sofia, 440 p. (in Bulgarian)

Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. Official Journal of the European Union L 206, 22.7.1992, p. 7

Dachev, V.Z., Trifonova, E.V. and Stancheva, M. K. 2005. Monitoring of the Bulgarian Black Sea Beaches. (In), Guedes Soares, Garbatov & Fonseca (eds.) *Maritime Transportation and Exploitation of Ocean and Coastal Resources* Taylor & Francis Group/ Balkema, 1411–1416

Diadovski, I., H. Naydenov. 1995. Hydrological Study of Atanasovsko Lake. In: Michev, T. (Ed). 1995. Project *Atanasovsko Lake*. Collection of prelim. reports of experts, BSBCP

Diadovski, I., P. Naydenova, H. Naydenov. 1996. Ecological Assessment of Hydrological Conditions and Contamination of Atanasovsko Lake Nature Reserve. In: Ecology '96, Intern. Symp., Burgas

Dimitrov, M., K. Niagolov, A. Kovachev, P. Iamkov, L. Profirov. 1997. Important Bird Areas in Bulgaria. BSPB Conservation Series. Book 1. Kostadinova, I. (comp.). BSPB, Sofia, BG, 109-112

Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy. Official Journal of the European Union, L 327

Directive 2006/7/EC of the European Parliament and of the Council of 15 February 2006 concerning the management of bathing water quality and repealing Directive 76/160/EEC. Official Journal of the European Union, L 64/37

Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds. Official Journal of the European Union, 26.01.2010:7-25

Directive 2013/39/EU of the European Parliament and of the Council of 12 August 2013, amending Directives 2000/60/EC and 2008 /105/EC as regards priority substances in the field of water policy. Official Journal of the European Union, L 226/1

Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning. Official Journal of the European Union, L 257/135

Environment Protection Act, 2002. Promulgated State Gazette N° 91/25.09.2002, last amended by State Gazette N° 62/14.08.2015

EAFA (Executive Agency for Fisheries and Aquaculture), 2015. Bulgarian annual report for collection and management of fisheries data, 2015

EC study. 2011. Regional social and economic impacts of change in fisheries – dependent communities, Case study: Burgas. Assessment of the status, development and diversification of fisheries-dependent communities, Region: Black Sea coast, North of Burgas city, 67 pp. (http://ec.europa.eu/fisheries/documentation/studies/regional_social_economic_impacts/bulgaria_en.pdf)

European Environment Agency (EEA), 2015. Nationally Designated Areas (National CDDA). www.eea.europa.eu/dataand-maps/data/nationally-designated-areas-national-cdda-10

EU SeaMap 2. Creation of an homogeneous seabed habitat map covering all European seas, MARE/2012/10 – LOT 3 Physical Habitats, Contract Number – SI2.657872, Knowledge base for growth and innovation in ocean economy: Assembly and dissemination of marine date for seabed, 2013-2016. www.emodnet.eu/seabed-habitats

Ehler, Ch., Douvere, F. 2009. Marine Spatial Planning: a step-by-step approach toward ecosystem-based management. Intergovernmental Oceanographic Commission and Man and the Biosphere Programme. IOC Manual and Guides № 53, ICAM Dossier No. 6. Paris: UNESCO. 2009 (English)

Encyclopaedia *Points of interest*. Regional Historical Museum Burgas, www.burgasmuseums.bg/index.php?tab=home&lang=bg&page=encyc&enc=poi&eid=25

Fairgrieve, R. 2016. Managing coastal interactions. Scottish Coastal Forum, Flourishing Communities/Productive Seas Workshop 3 – February, 2016

Fisheries and Aquaculture Act, 2001. Promulgated, State Gazette 41/ 24.04.2001, last amended State Gazette 102/ 29.12. 2015

Galabov, V., A. Kortcheva, G. Kortchev, J. Marinski. 2013. Contamination of Burgas Port waters with oil. Conference: Global Congress on ICM, 30 Oct–03 Nov 2013, E. Ozhan (editor), Marmaris, Turkey, 1077-1086

Galgani, F., Hanke, G., Werner, S., and De Vrees, L. 2013. Marine litter within the European Marine Strategy Framework Directive. ICES Journal of Marine Science, 70: 1055–1064

Grozdev D. 2004. Extreme sea level variations in the Bulgarian part of Black Sea, Proc. of the Union of Scientists – Varna, 2'2003, 1'2004, 65–69, (In Bulgarian)

Grozdev D. 2006. Extreme deeds of waves and sea level along the Bulgarian Black Sea coast, Proc. of the International scientific conference *Global changes and regional challenges*, Sofia, 28-29 April 2006, (In Bulgarian)

ILF, ERM, GEOMARINE, KIIP. 2011. Report on the assessment of environmental and social impact – Bulgaria, Oil pipeline project Burgas-Alexandroupolis, Chapter 4.1, 2011, (In Bulgarian)

Integrated Plan for Urban Regeneration and Development of Burgas. Project BG161PO001/1.4–07/2010/004 Operational Programme for Regional Development 20017–2013

Ivanov, K., A. Sotirov, A. Rojdestvenski, D. Vodenicharov. 1964. Lakes in Bulgaria. Publ. Inst. Hidrol. Metereol. (Sofia), XVI, 242

Käppeler, B., Toben, S., Chmura, Gr., Walkowicz, S., Nolte, N., Schmidt, P., Lamp, J., Göke C. and Mohn, Cr. 2012. Developing a Pilot Maritime Spatial Plan for the Pomeranian Bay and Arkona Basin. BaltSea Plan Report 9, ISBN 978-3-86987-408-1 (www.baltseaplan.eu)

Karagyozov, C., M. Karaivanova, V. Ivanov. Review of Oil and Waste Streams in the Port of Burgas. Lecture 9. 1 University *Prof. Dr A. Zlatarov*, Burgas

Karapetkova M., Zhivkov, M. 2012. The fishes of Bulgaria, (In Bulgarian)

Koleva, E., Peneva, R. 1990. Climate Reference Book for Bulgaria. 1990. Precipitation in Bulgaria. Publ. House of Bulgarian Academy of Sciences, Sofia (In Bulgarian)

Kopralev, I. 2004. Regions for Planning, Districts and Municipalities in Bulgaria. Publishing house *Petar Beron*, Sofia, pp. 335. (In Bulgarian)

Kostadinova I., M. Gramatikov (Eds.) 2007. Important Bird Areas in Bulgaria. Second revised edition. Bulgarian Society for the Protection of Birds, Conservation Series Book 11, Sofia, BSPB, 639 pp. (In Bulgarian with English Summary)

Kostichkova D. R., Z. K. Belberov, E. V. Trifonova, D. I. Grudeva. 2001. Sea level surface variations in Burgas bay, Proc. of the Institute of Oceanology, Bulgarian Academy of Sciences, vol. 3, 3–12 (In Bulgarian)

Longhorn, R. 2016. Marine Spatial Planning & Marine Cadastre: Challenges and Issues. INSPIRE Conference GSDI Marine SDI Workshop, Barcelona, 29/9/2016

Marine Litter, Eutrophication and Noise assessment tools (MARLEN) Project. Funded by BG02 *Integrated management of marine and inland waters* priority BG 02.03: *Improved monitoring of marine waters* co-financed by the Financial Mechanism of the European Economic Area (EEA FM) 2009–2014

Marinov, D., S. Miladinova, J. Marinski. 2014. Assessment of Material Fluxes in Aquatorium of Burgas Port (Bulgarian Black Sea Coast) by LOICZ Biogeochemical Model. In: Book of proceedings of 3rd IAHR Europe Congress, Porto, 14–16 April 2014

Maritime Space, Inland Waterways and Ports of the Republic of Bulgaria Act. 2000. Promulgated State Gazette № 12/11.02.2000, last amended by State Gazette № 14/20.02.2015

Martin, G., Aps, R., Kopti, M., Kotta, J., Remmelgas, L., and Kuris, M. 2012. Towards a Pilot Maritime Spatial Plan for the Saaremaa and Hiiumaa Islands. BaltSea Plan Report 4, ISBN 978-3-86987-410-4 (www.baltseaplan.eu)

MASPNOSE Project (www.wageningenur.nl/en/show/Maspnose-Maritime-spatial-planning-in-the-North-Sea.htm)

Master Plan of Burgas. Period 2010–2030

Michev, T. (Ed). 1997. Ecology and Conservation of Atanasovsko Lake Nature Reserve. Collection of Final Scientific Reports of Experts, BSBCP, Sofia

Michev, T., V. Pomakov, D. Nankinov, B. Ivanov. 1981. Wetlands of international importance in Bulgaria. In: Proceed of Reg. Symp. under Project 8-MAB, Blagoevgrad, 20–24.10.1980, Sofia, BAS, 448-462

Michev, T., Simeonov S, 1985. Changes in Bird Fauna of Bulgaria over last Thirty Five Years (1950-1984). In: Inter Symp. *Protection of natural areas and the genetic fund they contain. Project Nº 8 on the programme MAN and Biosphere* MAB, UNESCO, 23–28.09, Blagoevgrad, Collection of reports, S., BAS, 203- 217

Michev T, Profirov L, Dimitrov M , Nyagolov, K. 1999. The Birds of Atanasovsko Lake: Status and Check List. Bourgas Wetlands Publication Series, 1, Bulgarian – Swiss Biodiversity Programme, Bourgas, 34 pp

Michev T, Velev V, Stefanov V, Popov D, Botev I, Nqgolov K, Profirov L, Stoineva M, Marinov M, Dimitrov M, Kostov N, Andreev S, Mihov S, Naidenov H. 2003. Plan for management of Atanasovsko Lake

Ministry of Environment and Water. Project *Information system for protected zones of the Bulgarian NATURA 2000 network*, Available at: http://natura2000.moew.government.bg, last accessed: March 2017

Moncheva, S., Todorova, V. et al., 2013. Initial assessment report on marine environment according to art. 8 from MSFD. Contract Nº 203/09.08 2012, Ministry of Environment and Water (MOEW), 498 p. retrieved in pdf: http://bsbd.org/UserFiles/File/Initial%20Assessment.pdf

Municipal Development Plan 2014–2020 for Burgas Municipality. 2014

Nankinov, D. 1977. The structure of the Ornithofauna of Atanasovsko Lake. Scientific Papers of Plovdiv University *P. Hilendarski*, 15, 4, 97 –103

Nankinov, D., Darakchiev A. 1977 The Structure of the Ornithofauna of Atanasovsko Lake – May 1978. – Scient. publ. of Plovdiv Univers. *P. Hilendarski*, Plovdiv, 15, 4, 97–103. (in Bulguarin)

NATURA 2000 Network, http://ec.europa.eu/environment/nature/natura2000/

National Programme for Development: Bulgaria 2020. www.eufunds.bg/archive/documents/1357828564.pdf

National Regional Development Strategy of the Republic of Bulgaria for the period 2012–2022. Ministry of Regional Development and Public Works, Sofia, 2012, 200 p

National Spatial Development Concept for the period 2013–2025. 2012. www.bgregio.eu/media/Programirane/NKPR_ 28012013_Last_en.pdf

NSI (National Statistical Institute), 2012. Population, Volume 1, Part 3: Populations According to the Censuses by Districts, Municipalities and Settlements, Sofia, p. 523

Naydenov, C. 1997. Hydrology and hydrography of Atanasovsko Lake. In: Michev, T. (Ed). 1997. Ecology and Conservation of Atanasovsko Lake Nature Reserve-. Collection of Final Scientific Reports of Experts, BSBCP, Sofia

Operational program fisheries sector development (2007–2013) strategy and description of priority axis and measures

Palazov, A., Stanchev, H., Stancheva, M. 2007. Coastal population hazards due to extremal sea level rise – Sunny beach resort case study. Proc. of the 4th International Conference: Global Changes and Problems – Theory and Practice, 20–22 April 2007 Sofia, Bulgaria, 93–97

Palazov A., A. Stefanov, V. Marinova, V. Slabakova. 2014. Operational Oceanography Products and Services for Maritime Industry. 7th EuroGOOS Conference, Lisbon, 28-30 October 2014

Pashova, L. 2004. Contemporary studies of the Black Sea level fluctuations and prognoses of the future. Proc. of the International symposium on *Modern technologies, education and professional practice in geodesy and related fields*, Sofia, 4–5 November, 2004, 521–531 (In Bulgarian)

Pashova L., Belyashki, T. 2006. Geodetic research of Black Sea level long term changes, NEWS, Bulgarian Academy of Sciences, 6 (34), 2006, 1–2, (In Bulgarian)

Pashova, L., Popova, S. 2011. Daily sea level forecast at tide gauge Burgas, Bulgaria using artificial neural networks. Journal of Sea Research, 66.2, 154-161

Peychev, V. 2004. Morphodynamical and lithodynamical processes in coastal zone, Publishing house *Slavena*, Varna, 231 pp. (In Bulgarian)

Peychev, V., Stancheva, M. 2009. Changes of Sediment Balance at the Bulgarian Black Sea Coastal Zone Influenced by Anthropogenic Impacts. Compt. Rend. Acad. Bulg. Sci, 62(2): 277–285

Petkoff, St., 1932. Sur la flore algologique de la Mer Noire. – Bull. Soc. Bot. Bulg. (Sofia)

Popov, V., Mishev, K., 1974. Geomorphology of the Bulgarian Black Sea coast and shelf, Publishing house of the Bulgarian Academy of Sciences, 267 pp. (In Bulgarian)

Popova M., 1997. IOC/GLOSS Training Workshop on Sea Level Data Analysis, IOC Workshop Report No. 133, Paris, 25 September 1997

Project Coastal and Maritime Spatial Planning in Pärnu Bay Area in Estonia and Coastal Municipalities of Latvia (https://coastalandmaritime.wordpress.com/)

Project Green Corridors – popularisation of nature, cultural and historical heritage in Burgas and Kirklareli regions. Contract Ref. N° RD-02-29-173/ 01.07.11. IPA CBC Programme Bulgaria and Turkey (http://greencorridors.burgas.bg/en/index/index/1/)

Project ECOPORT 8. Environmental Management of Transborder Corridor Ports. Code SEE/A/218/2.2/X: Pilot Monitoring Plan for Burgas Port

Ramsar Convention 2002a. Information Sheet on Ramsar Wetlands (RIS): Atanasovko Lake www.wetlands.org/RSIS/_ COP9Directory/Directory/ris/3BG003en.pdf

Ramsar Convention 2002b. Information Sheet on Ramsar Wetlands (RIS): Vaya Lake www.wetlands.org/RSIS/_COP9 Directory/Directory/ris/3BG010en.pdf

Ramsar Convention 2002c. Information Sheet on Ramsar Wetlands (RIS): Poda. www.wetlands.org/RSIS/_COP9Directory/Directory/ris/3BG008en.pdf

Raykov V., Staicu I., Radu G., Maximov V., S. Nicolaev, 2008. Specificity of the fishery and common fishery policy implementation a case study of the western part of the Black Sea Cercetari marine I.N.C.D.M. Nr. 38, 223–232

Red Data Book of Bulgaria. v. 2, BAS, Sofia, 1985, 184 pp

Regional Development Plan for Southeastern Region 2014–2020. 2013. Ministry of Regional Development and Public Works, www.mrrb.government.bg

Regulation No H–7 from 12 June 2008 for performing diving and other underwater activity. State Gazette No 59/01.07.2009, last amended State Gazette No 14/18.02.2014

Rozhdestvenskiy, A. 1986. Hydrochemistry of the Bulgarian sector of the Black Sea. Bulgarian academy of Sciences Publishing House, Sofia, 1986, 189 p. (in Bulgarian)

State Gazette, No 11/10.02.2009.

Stoyneva, M., T. Michev. 1996. Scientific Backgrounds of the Ecological Monitoring of the Reserve *Atanasovsko Lake* (South-eastern Bulgaria) and its Use in Future Management of this Important Wetland. In : Ecology '96, Intern. Symp., Burgas, 4–6 September 1996, v. 5, 154–156

Spatial Planning Act. 2001. Promulgated State Gazette N° 1/02.01.2001, last amended by State Gazette N° 15/ 23.02.2016

Stanchev, H., Palazov, A., Stancheva, M. 2009. 3D GIS Model for Flood Risk Assessment of Varna Bay due to Extreme Sea Level Rise. Journal of Coastal Research, Special Issue 56, 1597–1601, ICS2009 (Proceedings) Portugal

Stanchev, H., Young, R., Stancheva, M. 2013. Integrating GIS and high resolution orthophoto images for the development of a geomorphic shoreline classification and risk assessment — a case study of cliff/bluff erosion along the Bulgarian coast. J Coast Conserv, (17): 719—728. DOI 10.1007/s11852-013-0271-2

Stanchev, H., Stancheva, M. Young, R. 2015. Implications of population and tourism development growth for coastal zone in Bulgaria. J Coast Conserv, 19 (1), 59–72, DOI: 10.1007/s11852-014-0360-x

Stancheva, M. 2009. Indicative GIS-based Segmentation of the Bulgarian Black Sea Coastline for Risk Assessment. Compt. Rend. Acad. Bulg. Sci, Volume 62, N° 10, 1311–1318

Todorova, V., Micu D, Panayotova, M, Konsulova, T. 2008. Marine Protected Areas in Bulgaria – Present and Prospects

Tourism Sector, Bulgaria. 2012. Ministry of Foreign Affairs of Denmark: Retrieved in pdf from: http://bulgarien.um.dk/da/~/media/Bulgarien/Documents/Sector%20reports%20May%202012/Sectoranalyses_Tourism.ashx)

Trifonova, E., D. Demireva. 2003. An Investigation of Sea Level Fluctuations in Varna and Burgas, Proc. of the Institute of Oceanology, Bulgarian Academy of Sciences, vol. 4, 3–9

Trifonova, E., D. Grudeva. 2002. Sea level surface variations in Burgas and Varna bays, Proc. of the *Second International Conference on Oceanography of the Eastern Mediterranean and Black Sea: Similarities and Differences of Two Interconnected Basins*, Ankara, 14–18 October 2002, TUBITAK Publishers, Ankara, Turkey, 151–155

Trukhchev, D., D. Ivanov, R. Ibrayev, D. Ivanova, T. Patzireva, A. Rabie. 2004. Hydrophysical Study of Bourgas Bay. Modelling the Synoptic Circulation Patterns, Comptes Rendus de l'Academie Bulgare des Sciences, 57, 3—29

UNEP. 2009. Sustainable Coastal Tourism: An integrated planning and management approach, United Nations Environment Program, Priority Actions Program. Retrieved in pdf from: www.unep.fr/shared/publications/pdf/DTIx1091xPA-SustainableCoastalTourism-Planning.pdf

UNWTO. 2013. UNWTO tourism highlights. Retrieved in pdf from: http://mkt.unwto.org/publication/unwto-tourism-highlights-2013-edition

Vasilev, V. et al., 2013. National Action Plan for Conservation of Wetlands of High Significance in Bulgaria. Sofia, 2013, Publication of Bulgarian Biodiversity Foundation, ISBN: 978-954-9959-63-5

Vodenicharov D, Draganov St, Temniskova D. 1971. Flora of Bulgaria. I. Algae. Sofia

Velev V. 1997. The Vegetation of the Nature Reserve *Atanasovsko Lake* and of its Buffer Zone (General Characteristic and Phytocenologic Map). In: Michev, T. (ed). 1997. Ecology and Conservation of Atanasovsko Lake Nature Reserve. Collection of Final Scientific Reports of Experts, BSBCP , Sofia

Yankova, M., Raykov, V., Ivanova P., Mgeladze, M., Diasamidze, R., Radu, Gh., Nicolaev, S., Agapov, St., Grinchenko, M., Ozturk, B., Oral, M., Bat, L., Karpova, E., Shlyakhov, V. I., Boltachev, A. I. 2011. Non-native Black Sea Fishes List. Black Sea Commission Publication, www.blacksea-commission.org/_publications.asp

Yankova, M., Pavlov, D., Ivanova, P., Karpova, E., Boltachev, A., Bat, L., Oral, M., Mgeladze, M. 2013. Annotated check list of the non native fish species (Pisces) of the Black Sea. J. Black Sea/Mediterranean Environment, Vol. 19, N° 2: 247 255. ISSN: 1304–9550

www.bsbd.org/UserFiles/File/projects/RNK/Primer%20Burgaski%20zaliv.pdf, Project DIR-51211229-1-171: Development of management plans for the risks of flooding, Operational Programme *Environment 2007–2013*

www.burgaslakes.org/poda/en/index.html

www.birdsinbulgaria.org/ovm.php?l=bg

www.bourgas-airport.com/PressCenter/News/tabid/66/language/en-US. Burgas Airport

http://ec.europa.eu/fisheries/cfp/emff/doc/op-bulgaria-factsheet_en.pdf. European Maritime and Fisheries Fund (EMFF) Bulgaria

http://gotoburgas.com/en/places-to-go/view/24

https://oppex.com/notice/TED_8f2ca27de178347e02e7d8112864c1e9, Burgas Municipality

www.eea.europa.eu/data-and-maps/data/ecosystem-types-of-europe, EEA, 2015.

www.e-ecodb.bas.bg/rdb/en/, Red Data Book of the Republic of Bulgaria (Digital edition)

http://natura2000.moew.government.bg/

www.natura.bsnn.org/pdf/Ezerata_na_Burgas_Mandra-Poda.pdf, Burgas Lakes – area protected by whom? Project: Public support for sustainable management of NATURA 2000 zones along Bulgarian Black sea coast. Programme: EEA Grants

www.saltoflife.biodiversity.bg/en. Salt of Life Project (Urgent Measures to Restore and Secure Long-term Preservation of the Atanasovsko Lake Coastal Lagoon/ LIFE11 NAT/BG/000362, financed by LIFE+ Programme of the EU

https://rsis.ramsar.org/RISapp/files/RISrep/BG292RIS.pdf, Information Sheet on Ramsar Wetlands.

https://rsis.ramsar.org/RISapp/files/RISrep/BG1228RIS.pdf, Information Sheet on Ramsar Wetlands

www.vtmis.bg, Bulgarian Ports Infrastructure Company

The MARSPLAN–BS project aims to support the implementation of the EU Directive for Maritime Spatial Planning (Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014) for maritime spatial planning (MSP) in the Black Sea and to facilitate the cross-border maritime spatial planning.

The project focuses on the cross-border maritime spatial planning of Romania and Bulgaria (the only one EU Member States in the Black Sea Basin), but it will also expand the co-operation framework with the rest Black Sea countries. The project also aims to consolidate the cross-border cooperation and exchange of information between Romania and Bulgaria on issues related to maritime area; to establish the vision and strategic goals for Black Sea area relevant for maritime spatial planning, while also taking into consideration the land-sea interaction; to elaborate the pilot maritime spatial plan for the cross-border area Mangalia-Shabla; to contribute to a wider dissemination of the information gathered on MSP, Black Sea area and best practices to all stakeholders of the Black Sea Basin.

LEAD PARTNER:

Ministry of Regional Development, Public Administration and European Funds (MRDPAEF) – Romania

PROJECT PARTNERS:

- Ministry of Regional Development and Public Works (MRDPW) – Bulgaria
- Ministry of Environment, Water and Forests (MEWF) – Romania
- National Institute for Marine Research and Development *Grigore Antipa*, Romania
- Danube Delta National Institute for Research and Development Tulcea (DDNI TULCEA) – Romania
- National Institute for Research and Development in Construction, Urban Planning and Sustainable Spatial Development (Urban-INCERC) – Romania
- Ovidius University of Constanta (OUC) – Romania
- Institute of Oceanology – Bulgarian Academy of Sciences (IO-BAS) – Bulgaria
- Executive Agency Maritime Administration (EAMA) – Bulgaria
- Bulgarian Ports Infrastructure Company (BPIC) – Bulgaria

NOTES

CASE STUDY 3 BURGAS: LAND-SEA INTERACTIONS

Authors:

Margarita STANCHEVA
Hristo STANCHEV
Anton KRASTEV
Atanas PALAZOV
Maria YANKOVA

Institute of Oceanology – Bulgarian Academy of Sciences

Cover photos:

Dr. Margarita Stancheva, IO-BAS, Bulgaria
Dr. Hristo Stanchev, IO-BAS, Bulgaria
Prof. Robert Young, PSDS-WCU, USA

ISBN: 978-954-9490-48-0
ISBN: 978-954-9490-49-7 (pdf)

EUROPEAN UNION
European Maritime and Fisheries Fund

EASME/EMFF/2014/1.2.1.5/2/SI2.707672 MSP LOT 1/BLACK SEA/MARSPLAN-BS

WP1, Activity 1.1, Component 1.1.2

Case studies with major challenges within the Romanian and Bulgarian maritime space

ISBN: 978-954-9490-48-0