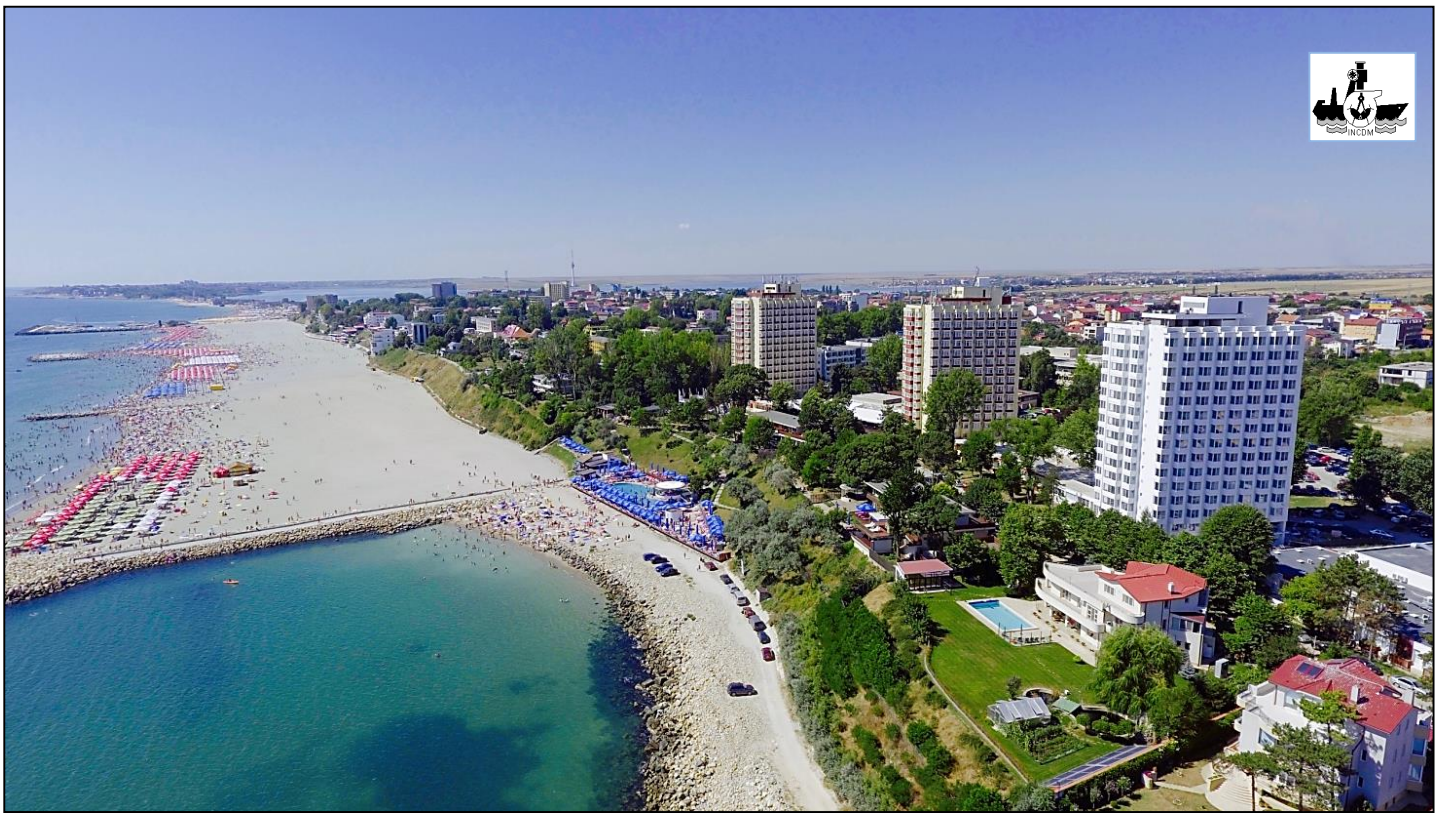
EFORIE Case Study

Cross Border Maritime Spatial Planning in the Black Sea – Romania and Bulgaria

MARSPLAN–BS Project



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CASE STUDY 1 EFORIE
COASTAL EROSION

August 2017

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Cross Border Maritime Spatial Planning in the Black Sea – Romania and Bulgaria
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Case studies with major challenges
within the Romanian and Bulgarian maritime space

CASE STUDY 1 EFORIE (COASTAL EROSION)

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The Eforie Case Study was undertaken by the National Institute for Marine Research and Development "Grigore Antipa", Constanta, Romania, as part of the EU co-funded project on cross border maritime spatial planning in the Black Sea, Romania and Bulgaria (MARSPLAN - BS). The project aimed to study land-sea interactions in the study area, with a particular focus on coastal erosion arising from tourism and port development and on seeking appropriate solutions.

Eforie is to the south of Constanta, extending for 10km along the Black Sea coast, bounded by headlands. It has a rich natural setting, with diverse coastal and marine habitats, including a small freshwater lake and another very salty, separated from the sea by a coastal strip, now heavily developed. Eforie South is a historic spa resort, which has extended with mass beach tourism to Eforie North, where there is also a port, linked to the Danube by a canal. A recent jetty development has improved the port conditions.

The geological, meteorological, hydrological, hydrochemical and ecological conditions of the area are all carefully described in this report. Similarly, the socio-economic characteristics are described, including population growth, transport infrastructure, economic activities, urban growth, services and tourism.

The area is particularly vulnerable to coastal erosion because of hydrological pressures and geological and geomorphological conditions, such as soft cliffs. Shoreline retreat has been exacerbated by human activities, such as urban development that has led to loss of sand dunes, dams on the Danube that have reduced sediment input, and barriers that have impeded sediment flow. A 2011 master plan for coastal protection recommended measures such as dikes to reduce wave energy, groins to accumulate sand and beach nourishment. However, this has had some unforeseen negative effects, such as clogging of Belona Marina by sediment transported from beach nourishment areas. Relocation of this marina is now proposed to a nearby location where water circulation is greater,

Other potential conflicts have been identified, such as between fishing and navigation, and marine protected areas with economic uses. A Sketch Match exercise, involving stakeholder engagement, was carried out to explore options for integrating these and other uses. This allowed participants to draw maps of possible configurations of uses and develop other management proposals. For instance, routes to fishing grounds could be clearly established, mussel farms could be relocated and accredited, and the tourist diving potential of shipwrecks could be developed. Finally, an interaction matrix of human activities was drawn up, as a means of defining functional zones, including for nature protection.

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1. Introduction

1.1 *Purpose of the Eforie case study*

The Eforie Case Study aims to study land-sea interactions with a special focus on coastal erosion within the Eforie shore sector, thus identifying the impact of induced coastal erosion by built environment/port infrastructure on maritime space/ICZM/tourism, and suitable solutions for the harmonization of the tasks related to environmental protection/biodiversity conservation of all surrounding lakes, wetlands and effective use of natural resources. It intends to underline and evaluate some pressures and conflicts, based on literatures, discussion with local authorities and stakeholders opinions.

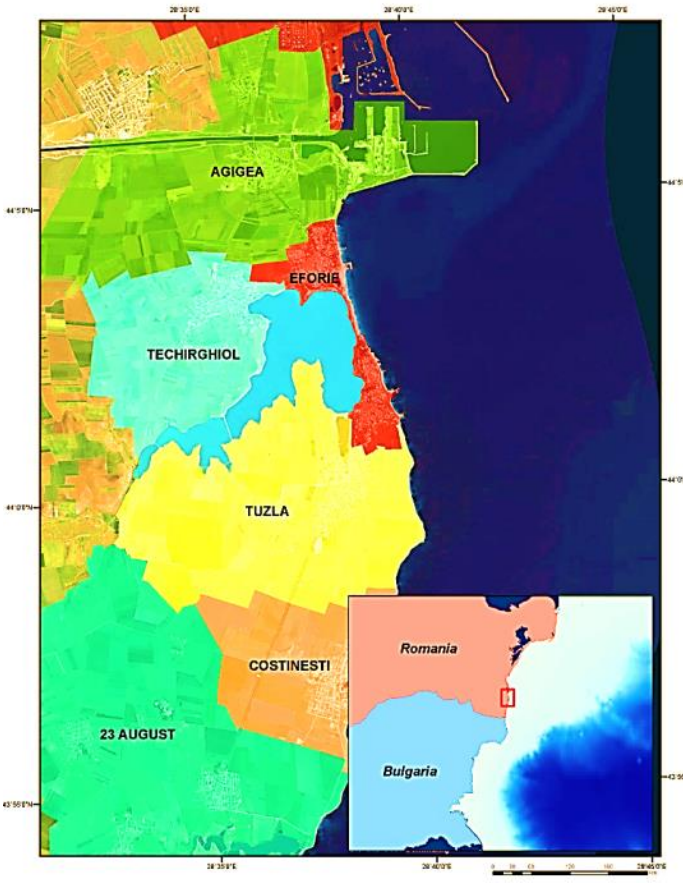


Fig. 1.1. Geographic position of Eforie on the westerr Black Sea coast

The study emphasizes the influence of coastal erosion on the interactions and impacts between activities, sectors and interests, both in terrestrial and marine areas. In this regard, the identification of key stakeholders and their involvement in the process of identification of the current and future trends within the Eforie sector priorities will produce several solutions for identified case area issues, together with specific recommendations and solutions for key issues and conflict resolution between uses and various activities in the coastal and marine areas, adjacent to a large city/port of Constanta, whichi is not always adequately planned.

Due to its location in the adjacent area of the Constanta - Agigea Maritime Port there, but also due to existence of a MPA site and a mass-tourism summer and bathing resort, there are particular needs for MSP in the shore area of Eforie (Fig. 1.1).

Thus, the Eforie North - Eforie South case study was focused on coastal-erosion, paying particular attention to:

- Identification of the main shoreline change causes and their impacts on marine areas (eg. urban development and the tertiary services sector, such as trade, tourism);
- Quantification of natural risks (coastal erosion) and their effects on the natural, social and economic environment (coastal erosion and its implications for tourism development, but also the impact of coastal protection structures on the marine environment);
- Determination of new directions of development, and subsequent uses (e.g.aquaculture);

- Identification and involvement of stakeholders and main players with interests in coastal and marine development within study area;
- Recommendations and solutions for key issues and conflict resolution between shoreline protection, and different practices and activities in coastal and marine areas of Eforie;

As a starting point in developing this methodology, the following were used: Directive 2014/89 / EU on Maritime Spatial Planning and the "Guide to Evaluating Marine Spatial Planning", UNESCO http://openchannels.org/msp-eval-guide, and results from other national and international projects:

- PLANCOAST (INTERREG IIIB NP CADSES Project, with the aim to develop the tools and capacities for an effective integrated planning in coastal zones and maritime areas in the Baltic, Adriatic and Black Sea regions) and the Handbook for Integrated Maritime Spatial Planning elaborated at the end of this project;
- Study on Integrated Coastal Zone Management, Joint Operational Programme "Black Sea Basin 2007-2013" - "Improvement of the Integrated Coastal Zone Management in the Black Sea Region";
- "BaltSeaPlan - Planning the future 2012 of the Baltic Sea, http://www.baltseaplan.eu/;
- AdriPlan - Adriatic Ionian Maritime Spatial PLANing, 2013-2015, http://adriplan.eu/.

1.2. Framework for Integrated Coastal Zone Management in Romania and Maritime Spatial Planning

In line with European recommendations (Recommendation of the European Parliament and of the Council concerning the implementation of integrated coastal zone management in Europe, from 30 May 2002), ICZM in Romania seeks, over the long-term, to balance the benefits from economic development and human uses of the coastal zone, the benefits from protecting, preserving, and restoring coastal zones, the benefits from minimizing loss of human life and property, and the benefits from public access to and enjoyment of the coastal zone, all within the limits set by natural dynamics and the carrying capacity. Before 2014, Maritime Spatial Planning was considered a tool for sustainable development and for ICZM.

The **present Legal framework** for coastal planning of the Romanian Coastal Zone is represented by the Law of Coastal Zone - the "Emergency Ordinance concerning the integrated coastal zone management" (E.O. 202/2002, approved by Law 280/2003 and the methodology concerning the public domain delineation of the state in the coastal zone), acting since 2002 (*Governmental Emergency Ordinance* no. 202/2002) even it never indicates the precise geographical boundaries of the coastal zone.

At the European level, the coastal zone is considered to extend 12 nautical miles in the territorial sea and a strip of 10 km inland, so it may include the most of the large coastal cities.

For the purposes of transitional and coastal water management, in 1992, Law 98, the Convention regarding protection of the Black Sea against pollution (Bucharest Convention) was ratified, and in 1996, the Strategic Action Plan for the Rehabilitation and Protection of the Black Sea was signed by the national representatives and was amended in 2002. Detailed documents are available on www.blacksea-environment.org.

There are three protocols that are part of the Convention:

- The PROTOCOL regarding the protection of the marine environment against pollution from land-based sources. This protocol defines the groups of dangerous and harmful substances and materials;
- The PROTOCOL regarding the cooperation in combating the pollution of the marine environment with oil and other harmful substances;
- The PROTOCOL regarding the protection of the marine environment against pollution from discharge. This protocol defines the groups of dangerous and harmful substances and materials.

- Regarding spatial and territorial planning, land-ownership and land administration, the legal framework includes certain relevant Laws and Ministerial Orders related to spatial planning and land-use are:

- Law no.71/1966 on Infrastructure of National Relevance;
- Law no. 50/1991 on the Authorization of the Construction of Buildings and Some Measures for Housing Construction;
- Ministerial Order no. 91/1991 stipulating the procedures for authorizing and the contents of spatial planning documents;
- Law no. 7/1996 by which a modern general cadaster has to be implemented, but it is still in development, because of insufficient technical and financial resources.
- Law no. 71/1996 regarding the approval of the Land Planning National Plan. Communication Routes - published in the Official Bulletin no. 66/1996;
- Law no. 171/1997 regarding approval of the Land Planning National Plan. Water - Official Bulletin no. 325/1997;
- Law on Regional Development (Law nNo. 151/1998) establishing the institutional framework, objectives, competences and instruments specific to regional development in Romania;
- Law no. 41/2000 regarding approval of the Land Planning National Plan. Protected areas - published in the Official Bulletin no. 152/2000.
- Law no. 350/2001 establishing the rules for territorial and urban planning;
- Law no. 351/2001 regarding approval of the Land Planning National Plan. Village network - Official Bulletin no 408/2001;
- Law no. 575/2001 regarding the approval of the Land Planning National Plan - Zones of natural risk - Official Bulletin no. 726/2001;
- Law no. 464/2004 regarding the approval of the Government Ordinance no. 69/2004 for completion of the article 38 of the Law no. 350/2001 regarding land planning and urbanism (Official Bulletin no. 773/2004) - published in the Official Bulletin no. 1050/2004;

- Laws and regulations of importance for land administration were established by a number of laws:
  - The Leasing Law (no. 36/1997) that arranges the leasing of land;
  - Law no. 213/1998 that establishes the legal status of public property.

In order to reduce the risks from coastal erosion, a **strategic coastal Master Plan for Coastal Protection** was elaborated in 2011, by Halcrow Romania and the Romanian Waters National Administration and Dobrogea Littoral Water Basin Directorate (ANAR - ABADL), which was concerned to promote investments to protect the environment from erosion risks in the most affected areas. After designing the specific Feasibility Studies,

Strategic Environmental Assessment and Environmental Impact Assessment for four priority areas, as identified by the Master Plan, the first phase of priority projects was executed, the designed coastal protections in 2014-2015 in the following areas: Mamaia South; Tomis North/Centre/South and **Eforie North**.

- Legislative Framework for Marine Spatial Planning

- Ordinance no. 18 / 08.24.2016 on MSP;
- Law no. 6/2011 approving Government Emergency Ordinance no. 71/2010 establishing marine strategy;
- Law no. 110/1996 which ratified the United Nations Convention on the Law of the Sea, signed at Montego Bay (Jamaica) on 10 December 1982, and adopted the accession to the Agreement on the implementation of Part XI of the United Nations Convention of the Law of the Sea, signed in New York on July 28, 1994;
- Law no. 17/1990 concerning the legal status of internal marine waters, territorial sea, the contiguous zone and exclusive economic zone of Romania, republished, regulates the juridical statute of the internal waters, territorial sea, the contiguous zone and exclusive economic zone in according to the United Nations Convention on the Law of the sea, ratified by Romania by Law no. 110/1996;
- Water Law no. 107/1996, as amended and supplemented, governing the right to use and the the corresponding obligations resulting from the protection and conservation of water resources, the use of waters, shores and river beds, regardless of the individual or legal entity that manage as well and the works that are built on waters or related to waters and which directly or indirectly cause temporary or permanent changes to water quality or flow regime
- Emergency Ordinance of the Government no. 71/2010 regarding Marine Strategy transposed the Directive 2008/56 / EC of the European Parliment and Conseil from June 17, 2008 establishing a Framework for Community Action in the field of Marine Environmental Policy (the Marine Strategy Framework Directive) was published in the Official Journal of the European Union (JOUE) seria L nr. 164 from 25 June 2008

- Sectorial laws governing domains such as:

- Electricity and natural gas Law no. 123/2012, as amended and supplemented;
- Petroleum Law no. 238/2004, as amended and supplemented;
- Law no. 17/1990 on the regime of internal waters, territorial sea, the contiguous zone and exclusive economic zone of Romania, with subsequent amendments;
- Government Emergency Ordinance no. 35/2010 amending and supplementing art. 2 of Government Emergency Ordinance no. 19/2006 on the use of Black Sea Beach and control of beach activities, approved with amendments by Law no. 186/2010;
- Government Emergency Ordinance no. 23/2008 on fisheries and aquaculture, approved with amendments by Law no. 317/2009, as amended and supplemented;
- Government Ordinance no. 67/2000 ratifying the Framework Agreement on the institutional framework for the setting of interstate transportation system of oil and gas, signed in Kiev on 22 June 1999, approved by Law no. 1/2001;
- Government Emergency Ordinance no. 105/2001 regarding the state border of Romania, approved with amendments by Law no. 243/2002, as amended and supplemented, and Government Decision no. 445/2002 approving the Methodological Norms for the application of Government Emergency Ordinance no. 105/2001 regarding the state border of Romania, as amended and supplemented

2. Structure of the area

2.1. General features

Eforie North - Eforie South is a complex area, with diverse natural habitats (marine, fresh, brackish and very salty waters) which have contributed to the development of important tourist resorts. In the northern part of the Eforie North sector is Agigea Harbor, an extension of Constanta Harbor.

The relief has the appearance of a flat surface, slightly sloping towards the sea, where it ends with a high cliff of 15-30 m and 20-150 m wide beaches. The plateau ends at Lake Techirghiol with a cliff 8-10 m high. The middle sector, around 2 km, corresponds to the coastal belt, between the sea and Techirghiol Lake.

Eforie South is the oldest resort on the Romanian coast of the Black Sea, the first tourist facilities being arranged since 1892. Declared a resort in 1928, it remained the small spa town with seasonal attendance until the 70s, when it started the systematization and construction works of resorts on the coast.

Eforie North resort was founded in 1901, when "Eforia (hospital)" built a venue for mud baths. Construction began to expand after the building of Constanta - Eforie South railway in 1927. In the period 1936-1940 there were built several villas, hotels and restaurants, but without solving utilities problems.

The Eforie city and tourism are growing and expanding in present, along with other tourist activities, marina, water sports, etc. Some very important hydro technical works are also significant in the area, underlining its complexity:

- The Danube - Black Sea Canal building, inaugurated in 1984, had an important role for the development of the port. The peak traffic was 62.3 million tons, in 1988.
- The extension of north jetty of Constanta Port in 2015, permitting a better hydrological climate within the port basin.

2.1.1. Location and limit of the study area in the context of the Romanian littoral

The case study sector is located in the southern Romanian littoral (Fig. 2.1), occupying a central position within it. The sector has a length of ~ 10 km, bounded to the north by Cape Agigea and to the south by Cape Tuzla. The general characteristic of the shoreline is a concave appearance on the general NNW-SSE orientation.

The case study area encompasses both localities of Eforie North and Eforie South, with the marine seaward boundary of 12 nautical mile zone, and the land boundary extending from 7 km to 3,2 km landward at LAU (Local Administrative Units) level.

2.1.2. Administrative territorial and marine aspects

In administrative terms it is part of the SE development region, Constanta County, and at level of local administrative units (LAU) it overlaps entirely on Eforie town and partially on Techirghiol (Techirghiol Lake), Agigea and Tuzla local administrative units.

The administration of Eforie, including the localities of Eforie North and Eforie South, has an area of 9,22 km² and it comprises 0.004% of the country's territory.

It borders the Black Sea to the east, as the coastline length of the affected area is about 10 km (based on orthophoto images from 2008, with spatial resolution 0.5 m and recent UAV surveys).

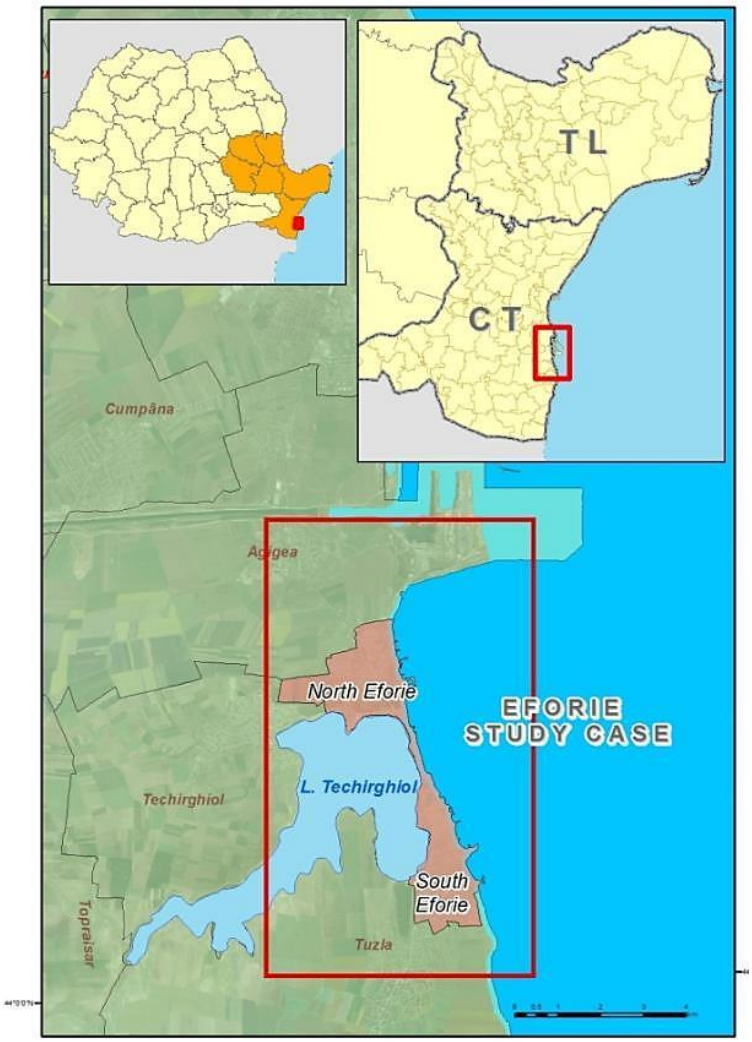


Fig. 2.1.a. Geographic position of Eforie in Romania

The coastline is strongly crenelated due to improvements with coastal constructions for beach and cliffs protections. The Eforie bay's maximum depth at the territorial sea limit is 42.5 m. It is in the sheltered area of the Constanta - Agigea Port.

2.1.3. Physical and hydrological features

From a physical perspective, **Eforie Bay** (Fig. 2.1.a,b,c) can be considered a transitional sector between the two Romanian shore units having as a northern boundary a commercial maritime port, and as a southern border a geographical cape, Cape Singol for Mamaia bay and respectively Cape Turku for Eforie, thus forming an enclosed shore unit and an isolated sedimentary cell due to marine obstacles, on the extremity of the sand barrier, enclosing a marine golf. The geological constituents of the sand barrier between North and South Eforie is of organogenous origin, though both represent an unbalanced sediment situation.

Fig. 2.1.b, c. Geographic position of Eforie in Romania

From the geomorphological point of view, the southern part of the littoral is characterized by the presence of cliffs cut into loess and Sarmatian limestone, interrupted by a few short coastal belts enclosing old river coasts.

The relief is represented by a high cliff shore of 20-30 m, developed on Sarmatian limestone deposits, clay and marl, poorly pitched, covered by a thick blanket of loess that is carved by small depression forms with a narrow beach (100 m width and 10 km long). This has been reinforced by extensive works, and now natural loess cliffs are present only in the northern part of Eforie North.

In the central part of the Eforie sector, around 2 km, corresponding to the coastal belt (beach-barrier), between the sea and Techirghiol Lake, the main factor is defining the evolution of the shore. In this sector the beach has a 100-150 m width, characterized in the past by the presence of sand dunes, destroyed by buildings constructed after 1990s.

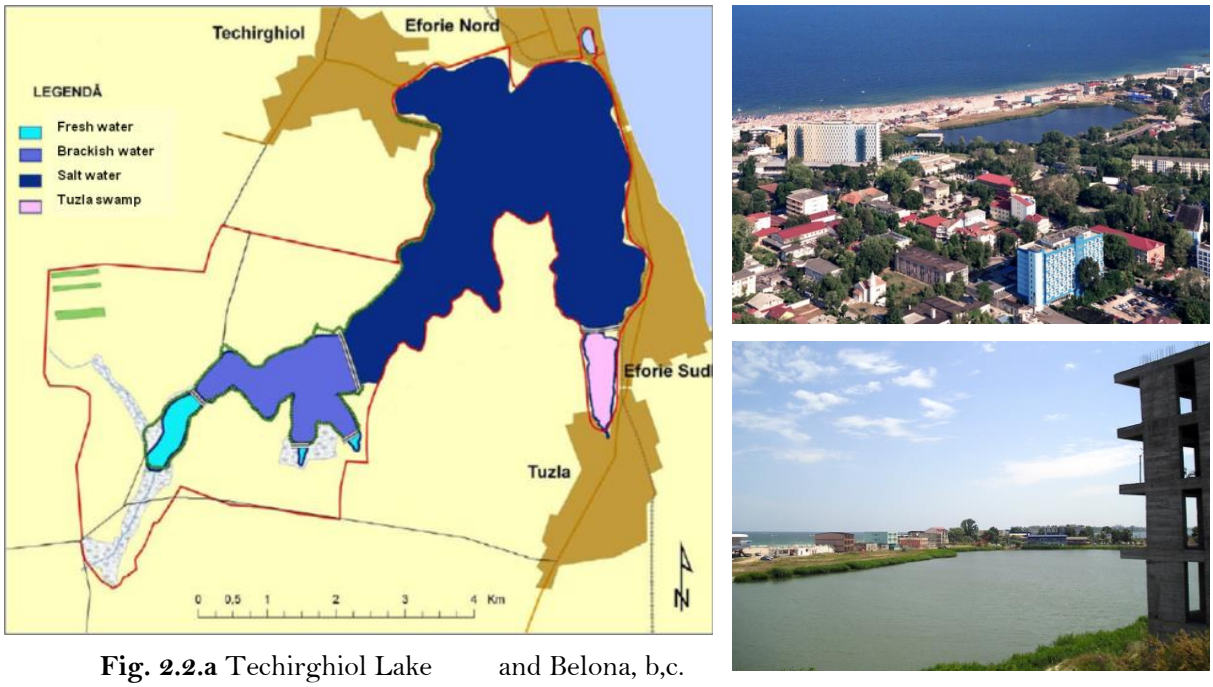


Fig. 2.2.a Techirghiol Lake and Belona, b,c.

Lake Belona, situated in the south of the resort, in the northern part of the beach which separates Techirghiol Lake from the sea, was formed between 1958-1959 for recreational purposes, and is located between two saltwater bodies (Fig. 2.2.b.c).

Techirghiol Lake (Fig.2.2.a) is located in the southern part of the resort and has banks cut in Sarmatian limestone, sometimes reaching calcareous marl which supports the horizon. The lake water mineralization is 4 times greater than that of the Black Sea. Water contains 7 to 8 times more manganese and 22 times more magnesium bromide. The lake water surface is situated under the Black Sea: in 1952 - 1.64 m, and in 1958 - 0.15 m. The maximum depth of the lake in the center is about 6-9 m.

In order to protect the railway from Techirghiol Lake flooding, a channel for excessive discharge was built, in the central part of the sand belt. Its purpose was not achieved due to rapid clogging with marine sediments. In order to protect the Techirghiol Lake a surrounding channel for springs/summer flash-floods collection around/on the versants around Techirghiol Lake was extended. The channel discharges into Belona Lake.

The regional climate is temperate continental moderate, with a strong Black Sea influence, due to the location of the land extending into the southern Dobrogea region, which induces a strong thermal inertia.

The solar radiation balance has a value of 45-50 kcal/cm^2 in the Romanian littoral, where clear sky is predominant during summer (within June and July) and this balance is 8-9 kcal/cm^2, in contrast with the cold season (December and January), when it has negative value, under -1 kcal/cm^2.

In the littoral zone of the Black Sea, the presence of large lacustrine surfaces together with their hydrographic basins and the specific semiarid climate vegetation induce in this region a mild continental climate within a territorial strip of 15-25 km from the shoreline landward, with a specific feature of breeze development (of sea - during day and of land - during night).

The average annual temperature is 11.2°C (Table 2.1). Winter is mild, too, with average temperatures of 1.3 °C, while spring is cooler compared with the inland regions. Due to the eastward coastline orientation, the daily course of breeze circulation, the summer is longer and cooler compared with inland, with average temperatures between 21.2 °C. Autumn is long and warm (average temperature of 13 °C), as a result of the warming influence of the Black Sea (Table 2).

Monthly and annual average air temperature is an important climatic parameter. The annual oscillations of monthly average temperatures are characterized by a maximum in summer and a minimum during winter. The air temperature was analyzed based on monthly averaged time series of air temperature at 10m above surface from the MERRA-2 Model 0.5° x 0.625° (*https://giovanni.gsfc.nasa.gov/giovanni/*) for user-delimited area (bounding box: 28.63°E, 44.00°N and 28.68°E, 44.09°N), for 1980-2016 period. It emphasizing that all lunar averaged temperature has positive value on Eforie area (Table 2.1, Fig. 2.3).

Table 2.1. Monthly averaged time period of the 10m above surface air temperature (°C) for 28.63°E, 44.00°N and 28.68°E, 44.09°N), during 1980-2016 (https://giovanni.gsfc.nasa.gov/giovanni/)

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual	Amplitude
1980 – 2016	3.49	3.98	6.77	11.33	17.06	21.93	24.58	24.61	20.53	15.38	9.99	5.39	13.7	24.6

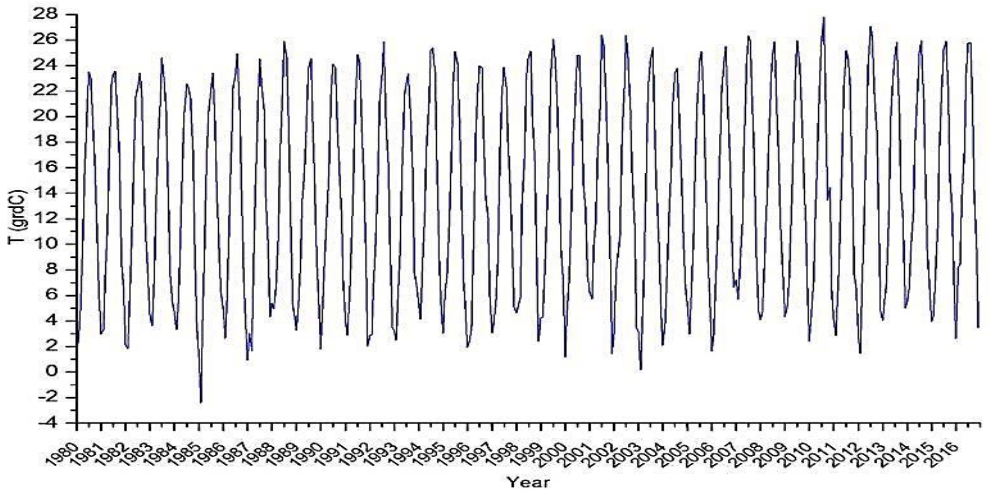


Fig. 2.3. Monthly mean of the 10m above surface air temperature (°C) for 28.63°E, 44.00°N and 28.68°E, 44.09°N), during 1980-2016, *(https://giovanni.gsfc.nasa.gov/giovanni/)*

The extreme values of the air temperature on Eforie area were recorded in 1985 on February a minimum of -2.39°C and a maximum of 27.77°C in 2010 in August (Fig.2.3).

Large non-periodic variations occurring in dependence on the atmospheric processes and evaporation conditions. Under the influence of sea breezes, large quantities of water vapor are displaced from the land and then driven in convective turbulence.

A number of hydrometeorological phenomena such as dew, frost and fog occur in the northwestern Black Sea coast. During water phase transformation processes is effective influenced the temperature. In coastal areas, the atmospheric humidity is generally 80-90% during the winter and 70-80% during the summer. Also, monthly and annual total surface precipitation on the Eforie area registered the highest averaged annual values due to sea proximity. The absolute maximum annual precipitation mentioned in Clima R.P.Române (1962) was 684,8mm (in 1939) at Constanta and 795,8mm (in 1933) at Mangalia. For Mangalia, the analyzed rainfall from a series of 35 years (1965-2000) is about the same as the Constanta station. The yearly average is 412,3mm.

The total surface precipitation was analyzed based on monthly averaged time series from the MERRA-2 Model 0.5° x 0.625° (*https://giovanni.gsfc.nasa.gov/giovanni/*) for user-delimited area (bounding box: 28.63°E, 44.00°N and 28.68°E, 44.09°N), for 1980-2016 period. For Eforie area, a minimum of 325.6mm/year were determined in 1983 and in 2014 a maximum of 821.64mm/year from the available data (Fig. 2.4).

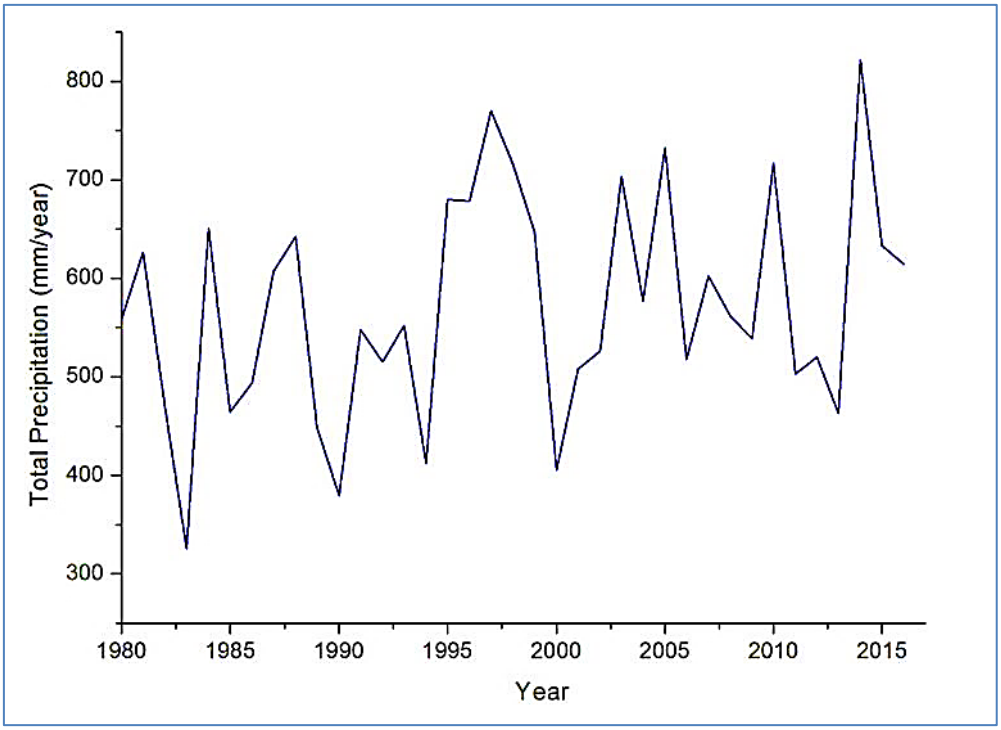


Fig.2.4. Total averaged surface precipitation (mm/year) for 28.63°E, 44.00°N and 28.68°E, 44.09°N), during 1980-2016 (*https://giovanni.gsfc.nasa.gov/giovanni/*)

Annual values of nebulosity are more reduced than in other country regions, due to the predominance of air descending movements within the summer season, breaking up the clouds.

For Eforie, nebulosity data were obtained from the area-averaged of cloud fraction from cloud mask (count of lowest 2 clear sky confidence levels, cloudy & probably cloudy) time series from the MODIS-TERRA (https://giovanni.gsfc.nasa.gov/giovanni/) for user-delimited area (bounding box: 28.63°E, 44.00°N and 28.68°E, 44.09°N), during March 2000 - December 2016.

Cloud cover or nebulosity is expressed in % of the maximum cloud cover. In the analyzed period, 2000 – 2016, total cloud coverage of 90% was determined for January 2014 (no clear sky visible) and a minimum of 15.9% in summer (August 2008) (Fig. 2.5). During warm seasons (July and August) the minimum nebulosity of the period can be observed in Table 2.2.

Table 2.2. Monthly average period of the total cloud cover (%) for 28.63°E, 44.00°N and 28.68°E, 44.09°N area, during 2000-2016 (*https://giovanni.gsfc.nasa.gov/giovanni/*)

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
Eforie area (%)	78.3	74.8	63.7	57.9	46.9	43.6	34.1	33.2	50.3	62.2	72.5	75.9	**57,6**

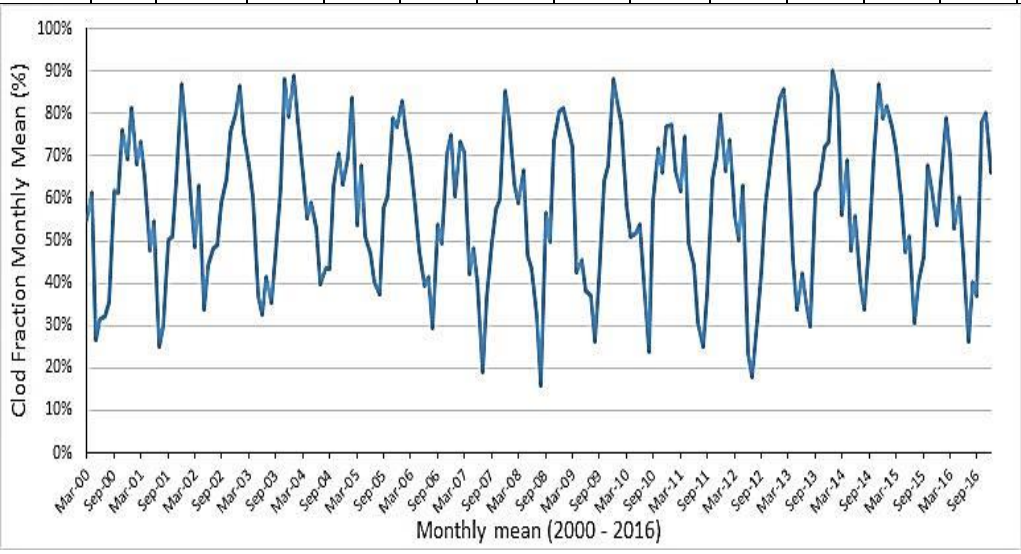


Fig. 2.5. Monthly mean of total cloud cover (%) for 28.63°E, 44.00°N and 28.68°E, 44.09°N area, during 2000-2016 (https://giovanni.gsfc.nasa.gov/giovanni/)

2.1.4. Oceanographic parameters

The hydro-physical characteristics of Eforie Bay are a principal factor determining the hydro-chemistry of the region, biochemical processes and marine organisms' behavior, and vessel design as well. The hydro-physical characteristics include currents, temperature and salinity regimes. Currents in Eforie Bay are southern currents, but they are influenced by wind variability, N, NE and E, and by the marine/rim current, which is anticlockwise. The local coastal currents are influenced by marine obstacles such as dikes orientation and Danube river inputs.

The surface salinity at the Romanian littoral reaches the maximum in summer and the minimum in spring, with variations, from 5 to 18‰ (the mean is 15.5 ‰), due to massive Danube discharges. In April and until July, thermocline shapes are typically that the warm upper layer reaches the sea bottom from shore to 15 m depth.

The sea level on the Romanian littoral reflects the global trend of sea level rise. Data from 1933 to 2002 show a trend of sea level rise of 1.7 mm/year for the Constanta station. Sea level variations due to meteorological causes are more pronounced than tides, which at the Romanian shore have values of 20 cm. The cumulative effects of forces acting on the sea surface can induce in this area variations (relative to the reference level MN75) from -30 cm to +75 cm in the case of strong storms. These extreme variations are brief; the common ones are values of ±12cm at the stations of Midia, Constanta and Mangalia.

Waves' regime (Fig. 2.6) is a marine environment component, crucial to safe navigation within the open sea, as well in the ports areas. The understanding of the marine hydrodynamics in the new changing climate permits a proper investigation for the development of risk mitigation strategies/methodologies and provides rapid response in case of emergency. At the Black Sea coast, the climate is considerably affected by the influence exerted by this basin, both in terms of thermal and dynamics, by changing the heat balance and changing the underlying surface roughness. There is a considerable variability in the atmospheric circulation regime, determined by the relief, location and the configuration; they are specific to the continental temperate climate. The winds recorded in offshore areas show high instability of direction and speed, with no regular winds.

The surface waves, as a result of the energy transferred to the sea through wind action, have a very important role in the formation and evolution of the Eforie shore sector's beaches, in sorting sediment deposits and sediment transport to shore/sea/or along the shore and local water movement that maintains the ecosystem dynamic equilibrium in coastal waters, in their propagation in the main direction of the wind. Because of the location of the southern port jetties, there is a large variety of waves of different frequencies, phases and amplitudes, as a result of the variability of wind force acting on sheltered water surface, and significantly interfered by diffracted waves, in different quantities, thus the energy transferred to the sea is eventually dissipated in the near shore area and at the contact with the shore protections.

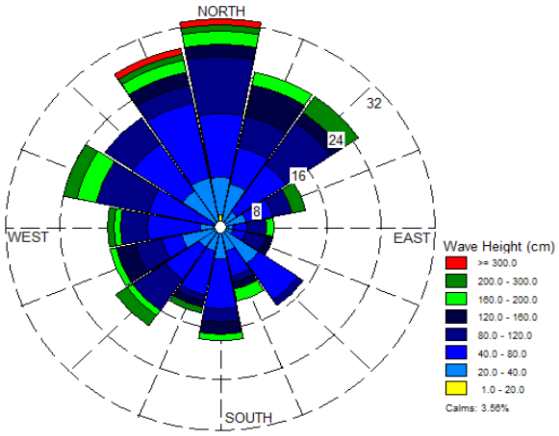


Fig. 2.6. Offshore waves frequencies distributions at the Gloria station

2.2. Ecological situation of the area

2.2.1. Coastal and marine conditions and state

Coastal and marine conditions are important for the welfare of all marine organism. It is important to understand these, in order to explain marine life distribution and natural resources stocks.

2.2.1.1. Hydrochemical conditions, essential as marine organisms environment

This analyse has been carried out by NIMRD GA.

- **Nutrients**

According to NIMRD's data analysed during 2009-2014, nutrients' surface distribution highlights the main sources from the Romanian littoral: Danube and other rivers from the NW area and the influence of the largest city, Constanta. The Eforie area is located in the neighbourhood of the Constanta port and one local waste water treatment plant, with potential impact for Eforie, by the two main land-based sources.

Phosphates, (N=227), had 95% of values in the range 0.01-1.49 µM. In Eforie (N=20), the concentrations were within 0.03 - 1.22 µM (mean 0.35 µM, std. dev. 0.26 µM). The maximum/ extreme value was observed during summer, due to the highest anthropogenic input. Overall, according to the proposed targets as good ecological status (GES) for eutrophication (90th percentile less than 0.30 µM), the area is at risk of not achieving it (Fig. 2.7).

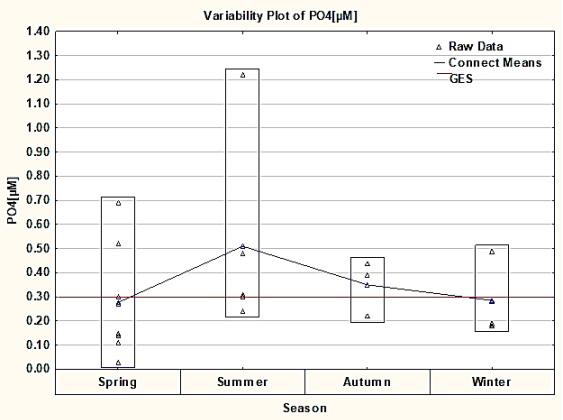


Fig. 2.7. Seawater phosphate concentrations - Eforie area, seasonal variability - 2009-2014

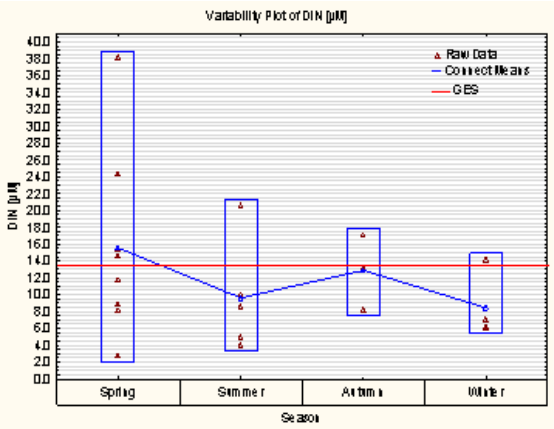


Fig. 2.8. Seawater inorganic nitrogen (sum of nitrite, nitrate and ammonium concentrations) - Eforie area, seasonal variability - 2009-2014

Inorganic nitrogen (DIN, as the sum of nitrates, nitrites and ammonium), at surface (N=222), had a mean of 15.04 µM, median 10.70 µM, std. dev. 17.73 µM, 95% up to 36.67 µM. In the studied area, Eforie (N=20), the concentrations were within 2.76 - 38.17 µM (mean 12.24 µM, std. dev. 8.29 µM). The maximum was observed during spring. According to the good ecological status (GES) for eutrophication (as 90th percentile less than 13.5 µM), the area not achieve risk status (Fig. 2.8).

- **Organic pollutants**

The analysis of organic pollutants was carried out in water and sediment samples taken from the Eforie area.

- **Total petroleum hydrocarbons (TPHs)**

Concentration of TPH in the period 2009-2014 in seawater from the Eforie area ranged from 14.6 to 1034.5 µg/L. Only 23% of the samples exceeded the maximum admissible value (200 µg/L) stipulated by the quality standard for priority substances provided by the Minister of Environment and Water Order no. 161/2006 approving the "*Norms on surface water quality classification to determine the ecological status of water bodies*" (Fig. 2.9).

The concentration of TPH in sediments ranged from 6.2 to 287.7 µg/g. To assess the level of contamination by petroleum hydrocarbons, the values for TPHs in sediments were compared with the maximum admissible concentration (100 µg/g) stipulated by the Minister's Order MAPPM. no. 756/1997. 28% of the samples analyzed exceeded the maximum admissible value (Fig. 2.10).

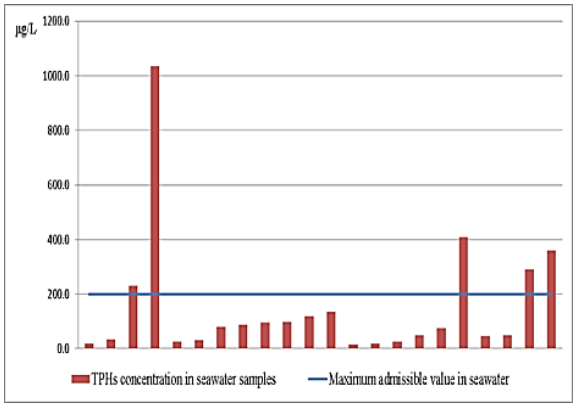


Fig. 2.9. TPHs concentration measured in water, in the Eforie area, 2009- 2014, in relation to the proposed values to define good environmental status

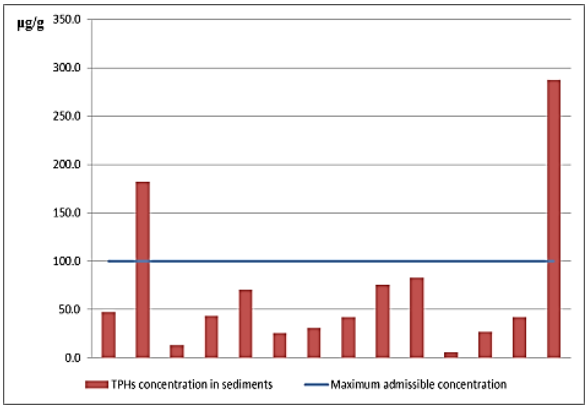


Fig. 2.10. TPHs concentration measured in sediment, in the Eforie area, 2009- 2014, in relation to the proposed values to define good environmental status

- **Polycyclic aromatic hydrocarbons – PAHs**

The analysis of polynuclear aromatic hydrocarbons (PAHs) indicates the presence of the 16 priority hazardous organic contaminants (naphtalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo [a] anthracene, crysene, benzo [b] fluoranthene, benzo [k] fluoranthene, benzo [a] pyrene, benzo (g,h,i) perylene, dibenzo (a,h) anthracene, indeno (1,2,3-c,d) pyrene) in all samples). During 2009-2014, PAHs concentrations in seawater samples ranged between 0.001 and 1.191 µg/L, with the dominant compounds: phenanthrene and anthracene. The other compounds recorded values did not exceed the maximum admissible concentration stipulated by the Minister's Order no. 161/2006. 12.5% of the water samples values of concentration exceeded the maximum limit, which indicates a low level of pollution (Fig. 2.11).

The total content of PAHs in Eforie's marine sediments samples ranged from 0.078 to 3.226 µg/g. 84 % of the analyzed sediment samples had concentrations that exceeded the maximum limit (1.000 µg/g), which indicates a high level of pollution (Fig. 2.12). The dominant compound was naphthalene, with a maximum concentration of 2.1560 µg/g.

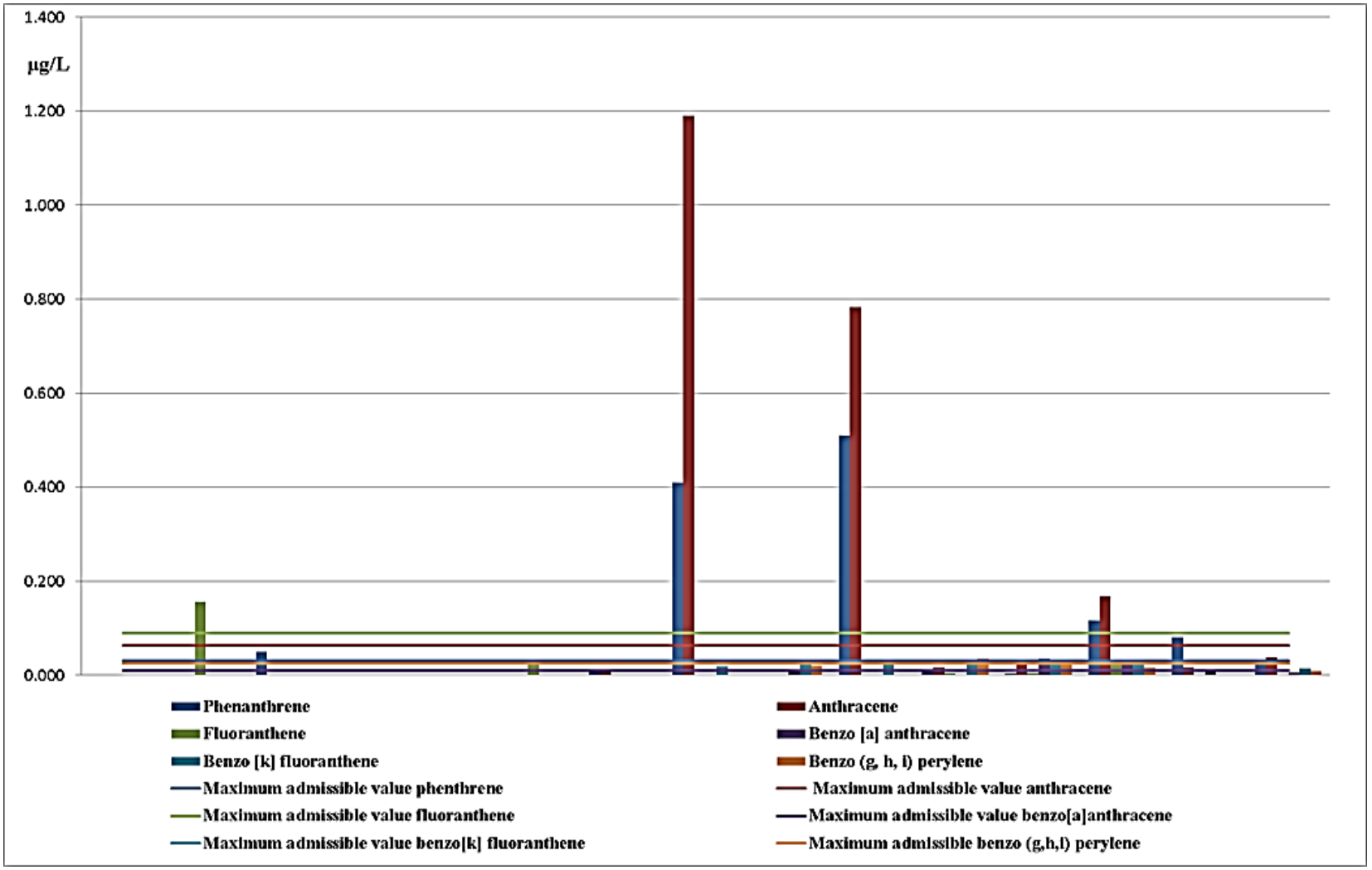


Fig. 2.11. PAHs concentration measured in water, in the Eforie area, 2009- 2014, in relation to the proposed values to define good environmental status

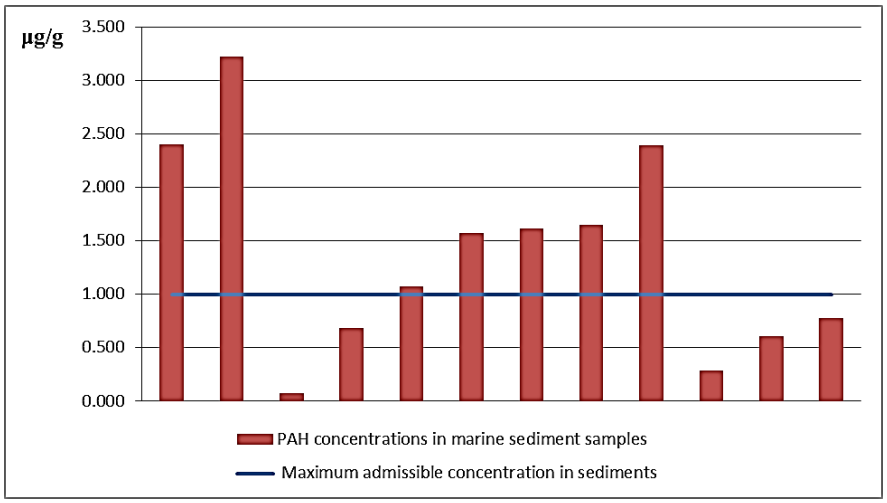
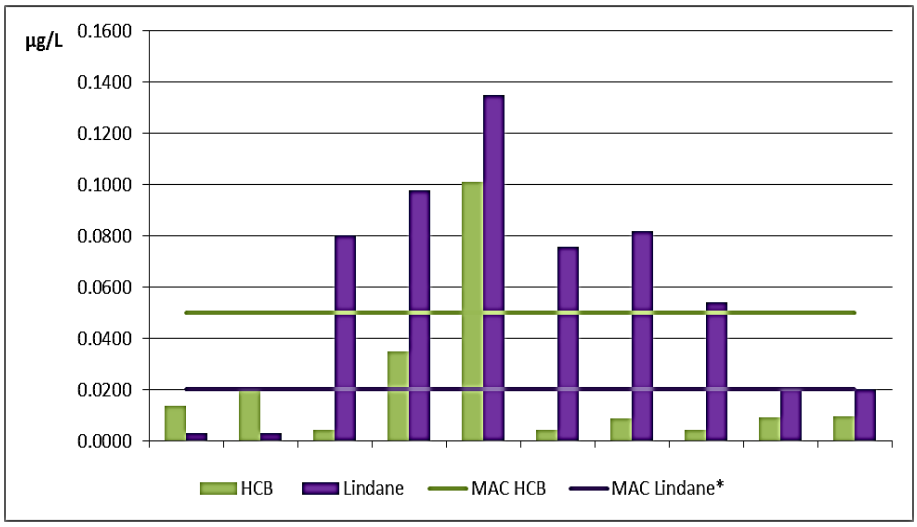


Fig. 2.12. Total PAHs concentration measured in sediments, in the Eforie area, 2009- 2014, in relation to the proposed values to define good environmental status

- **Organochlorine pesticides and polychlorinated biphenyls**

The concentration of organochlorine pesticides varied between 0.002 and 0.135 µg/L and the concentration of polychlorinated biphenyls varied between 0.003 and 0.467 µg/L. The median concentrations for most investigated compounds were at the limit of detection. The highest concentrations were measured for PCB 52, HCB and lindane, which often exceed the threshold (Directive 2013_39_EU). Exceedings of the EQS were also recorded occasionally for HCB, heptachlor, p p' DDT, sum of DDT and sum of cyclodienes (Fig. 2.13, a, b). There is no threshold value set as EQS available for PCBs in water.

Fig. 2.13. a, Concentrations of organochlorine pesticides, measured in water, in the Eforie area, 2009- 2014, in relation to the proposed values to define good environmental status



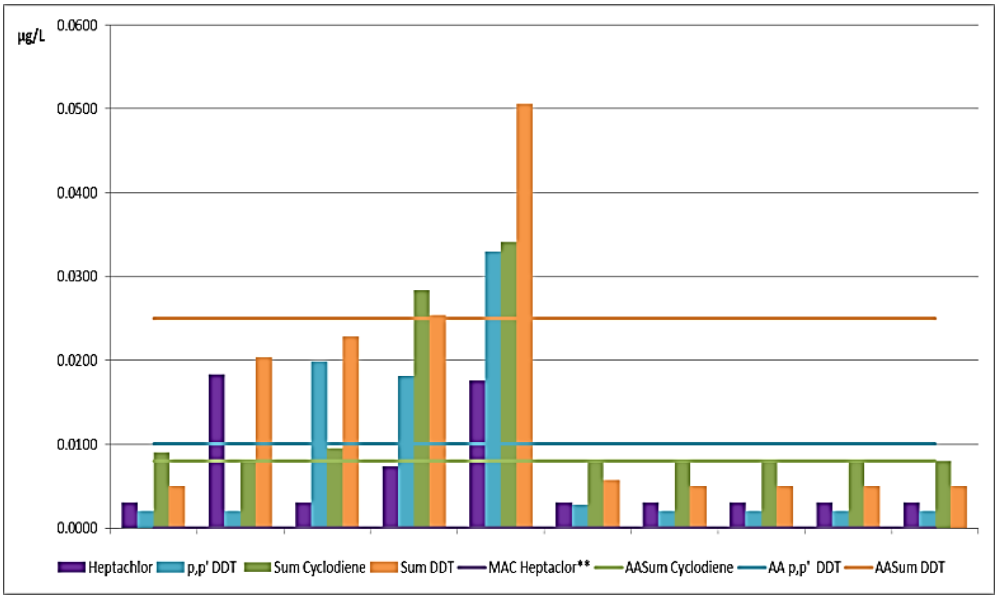


Fig. 2.13.b. Concentrations of organochlorine pesticides, measured in water, in the Eforie area, 2009- 2014, in relation to the proposed values to define good environmental status

In sediments, the concentrations of organochlorine pesticides are shown in Fig. 2.14 a, with limits of 0.0002 and 0.0446 µg/g dry sediment, and of polychlorinated biphenyls, with 0.0003 - 0.1221 µg/g dry sediment. The highest concentrations were measured for HCB, heptachlor, dieldrin, PCB 28, PCB 52 and PCB 101. Exceedances of the proposed threshold for defining good environmental status, were observed for some of these compounds (HCB, PCB 28, PCB 52, PCB 101) (Fig. 2.14 b); for heptachlor, aldrin, endrin, p, p 'DDD and p, p' DDT threshold values have not been yet established.

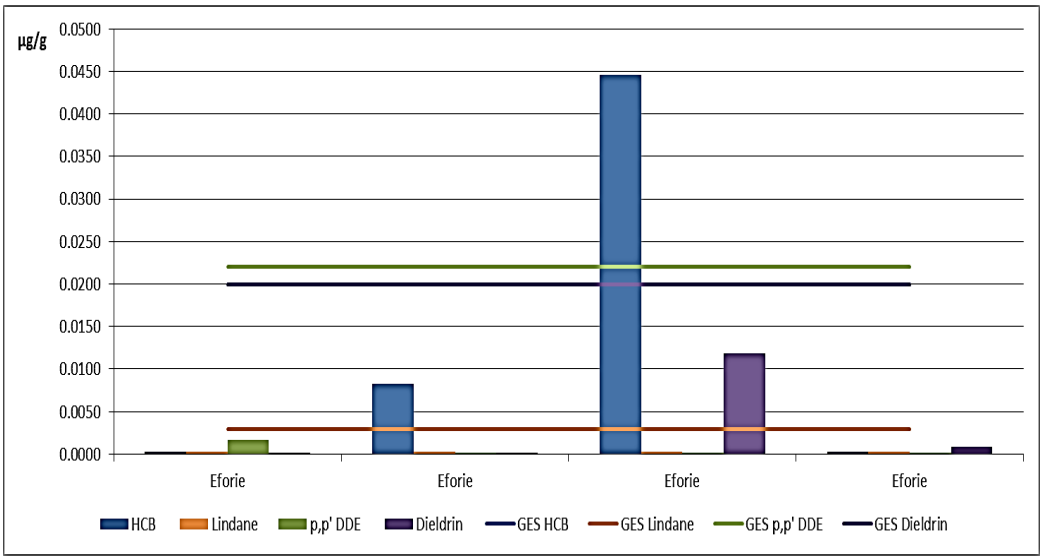


Fig. 2.14. a Concentrations of organochlorine pesticides and polychlorinated biphenyls, measured in sediment, in the Eforie area, 2009- 2014, in relation to the proposed values to define good environmental status

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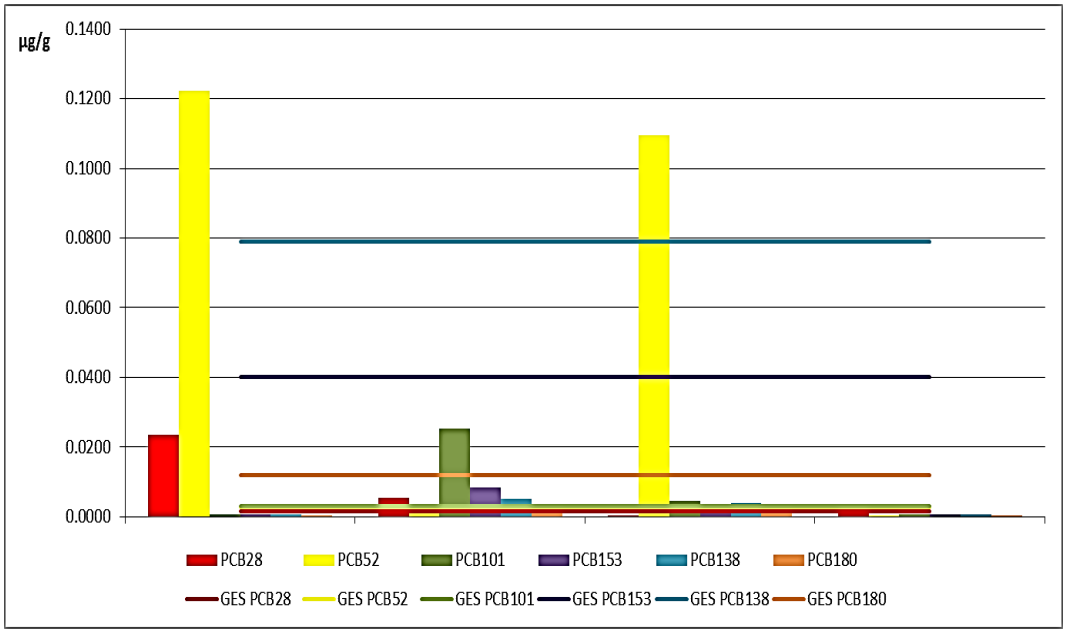


Fig. 2.14. b. Concentrations of organochlorine pesticides and polychlorinated biphenyls, measured in sediment, in the Eforie area, 2009- 2014, in relation to the proposed values to define good environmental status

- **Heavy metals**

The assessment of heavy metals in water and sediments from the Eforie study area (bathymetric strip between 0 and 30 m) is based on the monitoring data produced during 2009-2014. In seawater (surface horizon), concentrations varied between wide variation ranges: (Table 2.3). There is no significant concentrations gradient with increasing distance from the shore; slightly higher levels and extreme values were measured in shallow waters (0-5 m depth). (Fig.2.15 a,b,c,d). Environmental quality standards for marine waters were surpassed only in a small percentage of samples (2-8%). Temporal trends indicated decreased levels in recent years, probably in correlation with the completion of rehabilitation works for Eforie South WWTP. (Fig. 2.16).

Table 2.3. Concentration of heavy metals in seawater in the Eforie study area during 2009-2014

Descriptive Statistics							
	Valid N	**Mean**	**Median**	**Percentile - 10th**	**Percentile - 90th**	**Std. Dev.**	**EQS**
Cu [µg/l]	51	7.37	1.99	0.62	20.06	13.57	30.00
Cr [µg/l]	51	1.95	1.58	0.36	4.38	1.61	
Ni [µg/l]	51	3.08	1.58	0.89	7.66	4.17	34.00
Pb [µg/l]	51	4.52	2.95	1.53	10.30	5.04	14.00
Cd [µg/l]	51	0.93	0.70	0.08	1.78	1.03	1.50

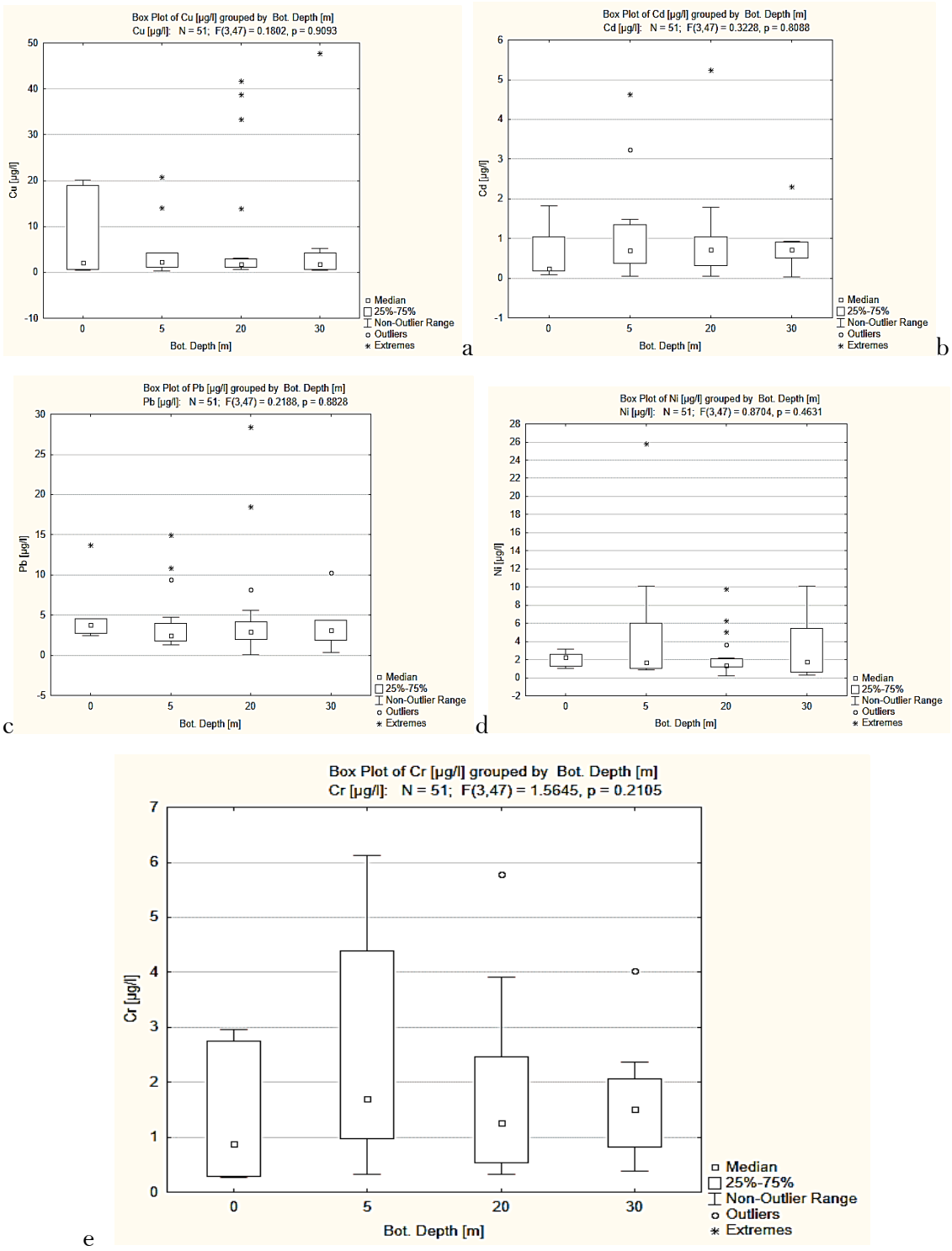


Fig. 2.15. a,b,c,d,e. Concentration of heavy metals in seawater in the Eforie study area during 2009-2014

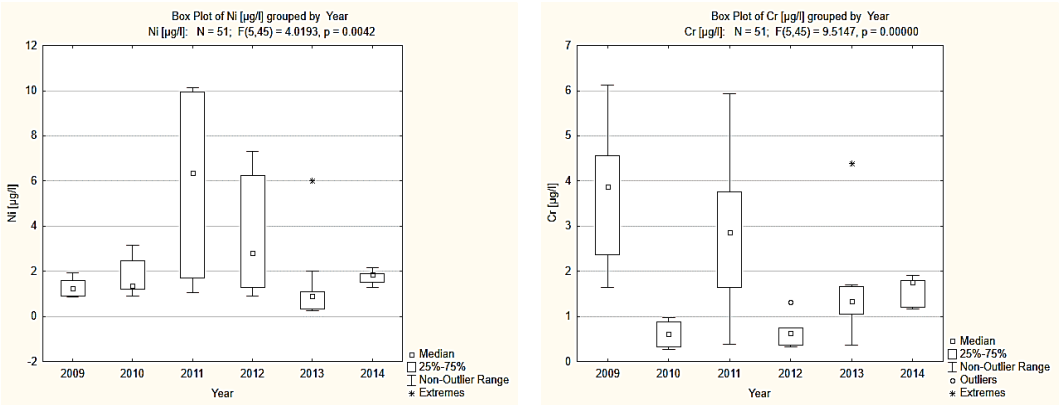
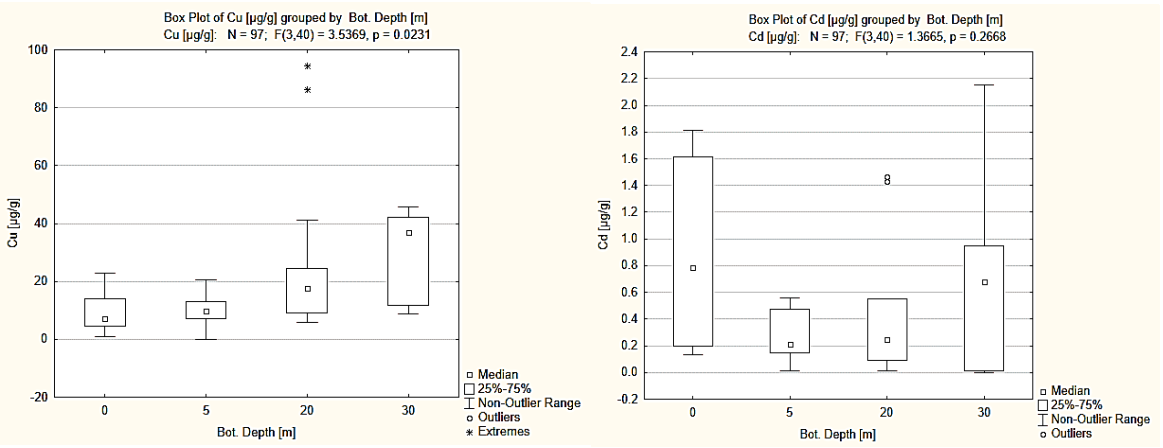


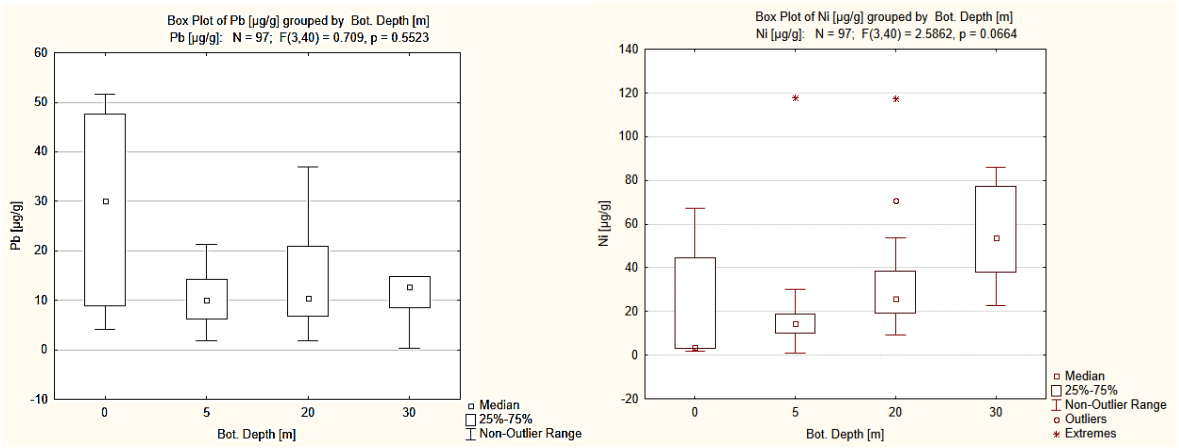
Fig. 2.16. a,b. Trends of concentration of heavy metals in seawater in the Eforie study area during 2009-2014

In the sediments, heavy metals concentrations had wide variation ranges (Table 2.4). Generally, there is an increasing concentration gradient with increasing distance from the shore, heavy metals being correlated with fine grained and organic carbon content of sediments. However, cadmium, lead and nickel presented some elevated values in shore sediments, probably due to anthropogenic influences (Fig. 2.17). Environmental quality standards for marine sediments were surpassed only in a small percentage of samples (7-23%). Temporal trends showed decreased levels in recent years, mainly for cadmium and lead (Fig. 2.18).

Table 2.4. Concentration of heavy metals in sediments in the Eforie study area during 2009-2014

Descriptive Statistics							
	Valid N	**Mean**	**Median**	**Percentile - 10th**	**Percentile - 90th**	**Std. Dev.**	**EQS**
Cu [µg/g]	44	19.44	12.11	5.93	41.31	19.54	40.00
Cd [µg/g]	44	0.87	0.25	0.04	1.81	1.69	1.20
Pb [µg/g]	44	25.03	11.45	3.61	43.71	48.43	46.70
Ni [µg/g]	44	32.20	22.37	3.21	70.85	28.68	35.00
Cr [µg/g]	44	32.44	23.70	7.60	70.01	23.34	100.00





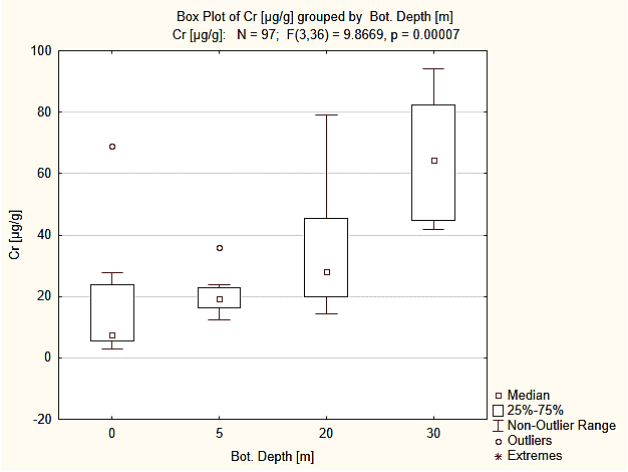


Fig. 2.17.a,b,c,d,e Concentration of heavy metals in sediments in the Eforie study area during 2009-2014

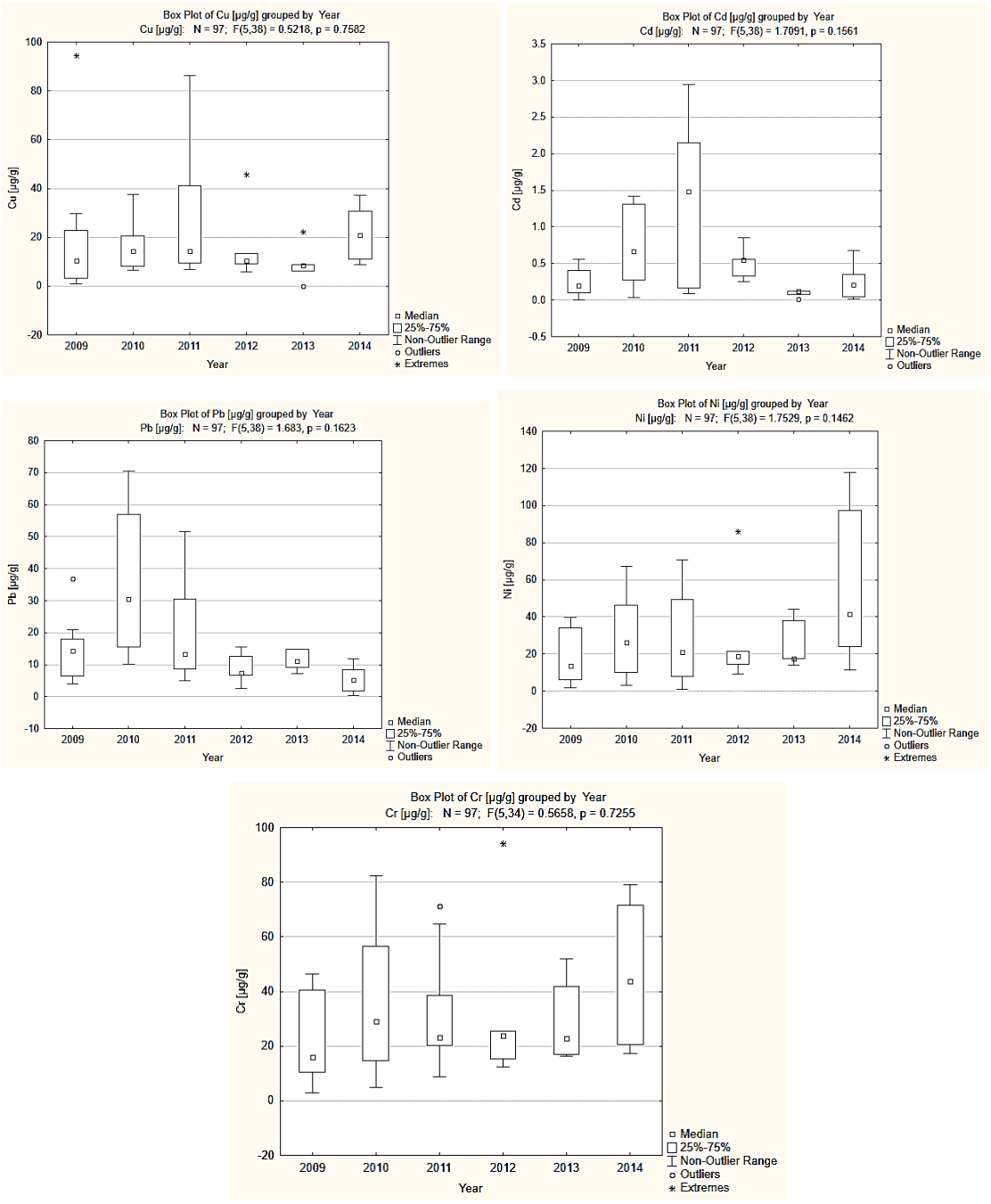


Fig. 2.18.a,b,c,d,e. Trends of heavy metal concentrations in sediments in the Eforie study area during 2009-2014

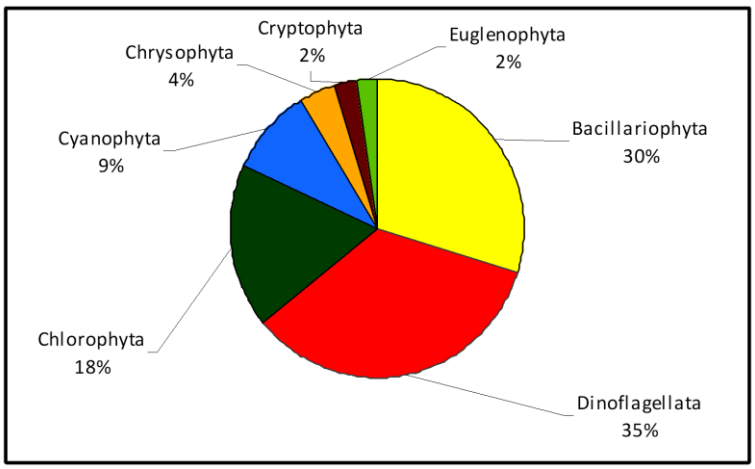
2.2.1.2. Coastal and marine natural resources / biological components

2.2.1.2.1. Natural living resources

- **Phytoplankton**

In the field of MSP and fisheries, phytoplankton has a high potential to support sustainable fisheries management by assuring living vegetable food for different stages of fish life, also creating natural screen for species which exercise their cannibalism Producing blooming phenomenon algae are easy identified by teledetection giving information about size, spread and density.

In the Eforie area 128 species of phytoplankton have been identified, belonging to seven algal taxonomic groups: *Bacillariophyta*, *Dinoflagellata*, *Chlorophyta*, *Cyanophyta*, *Chrysophyta*, *Euglenophyta* and *Cryptophyta* (Petran, 1997). The taxonomic composition is dominated by dinoflagellates in proportion of 35%, followed by 30% diatoms and 18% chlorophytes. The other algal groups *Cyanophyta*, *Chrysophyta*, *Cryptophyta* and *Euglenophyta* are underrepresented, less than 10% (Fig. 2.19).



Regarding the composition of ecological groups according to their resistance to salinity over the entire monitored period, spring, summer, autumn, between 2007 and 2010, the marine and marine-brackish forms were dominant - 67%, while freshwater and freshwater-brackish forms had a share of 33% of the total number of species (Fig.20 a,b).

Fig. 2.19. Distribution of phytoplankton classes

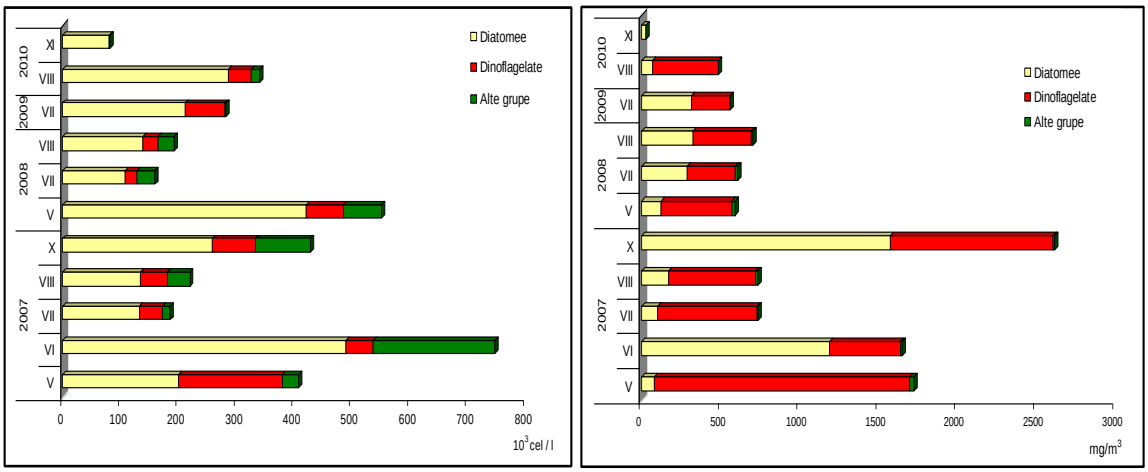


Fig. 2.20. a and b. Phytoplankton community's monthly variations

- **Phytobenthos**

The movable substrate, represented by the sand present on the submerged beach adjacent to the Eforie North and South areas, present on about 75% of this site, is unfavorable for the installation and development of macroalgae vegetation. Instead, in the sector of the site represented by 25 % infralittoral rock, 44 algal species were reported by visual census.

MSP has a potential to support sustainable fisheries management, regulating anthropogenic activities. Macrophytes are important for fish feeding and as habitats for resting, breeding and larvae rearing.

The submerged vegetation of the Eforie area consists of opportunistic species, capable of important seasonal development. During 2009-2014, the biomass of opportunistic species

(both green and red algae) was generated by a limited number of species with a very high capacity of development. In both locations, Eforie North and South, during 2009-2014, the dominant association was the photophilic one *Ulva* - *Cladophora*. Among the red algae, a constant presence was *Ceramium virgatum*, but without an important quantitative development (variation between 50 - 440 g/m², with a maximum value recorded at Eforie North).

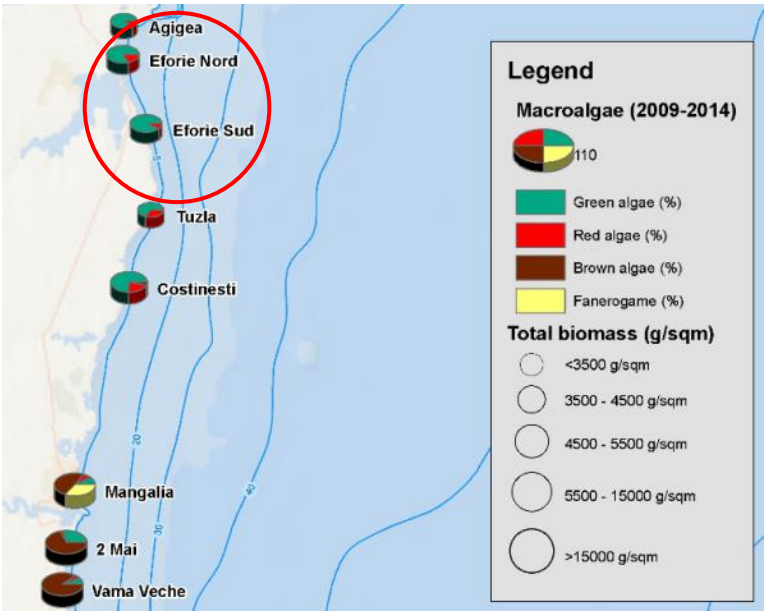


Fig. 2.21. Distribution of macroalgae

The trend observed in the past years at the Romanian coast, namely the important development of *Cladophora* species between 2010-2012, was noticed at these stations, too (Fig. 2.21).

Cladophora sericea was constantly present both at Eforie North and Eforie South. The maximum fresh biomass value was recorded at Eforie North, in 2012 (1,200 g/m²). During the summer of 2009, *Cladophora* did not develop considerable biomasses along the Romanian shore, but, starting with 2010 until 2012, this genus had a particularly intense development, covering (at some profiles even completely) the hard substrate at depths between 0 and 5 m. Starting with 2012, a decrease of the fresh biomass for the *Cladophora* genus was observed, so the dominant genus for 2013 and 2014 was *Ulva* (namely *Ulva rigida* and *Ulva intestinalis*).

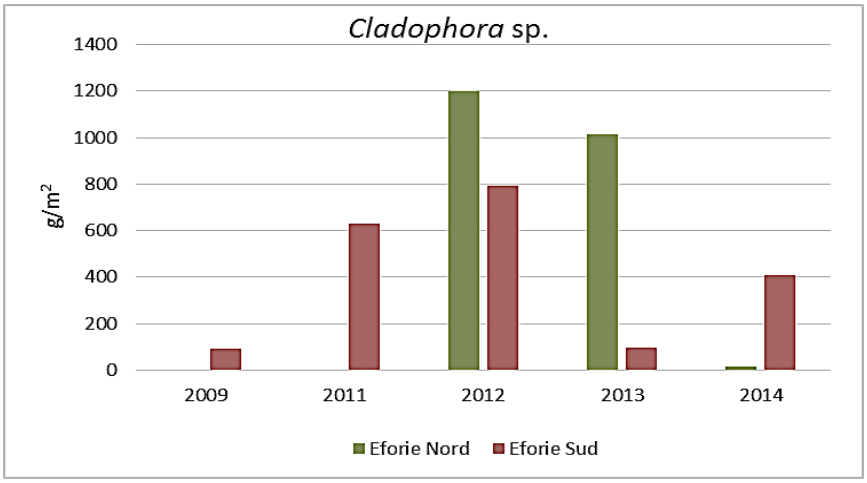
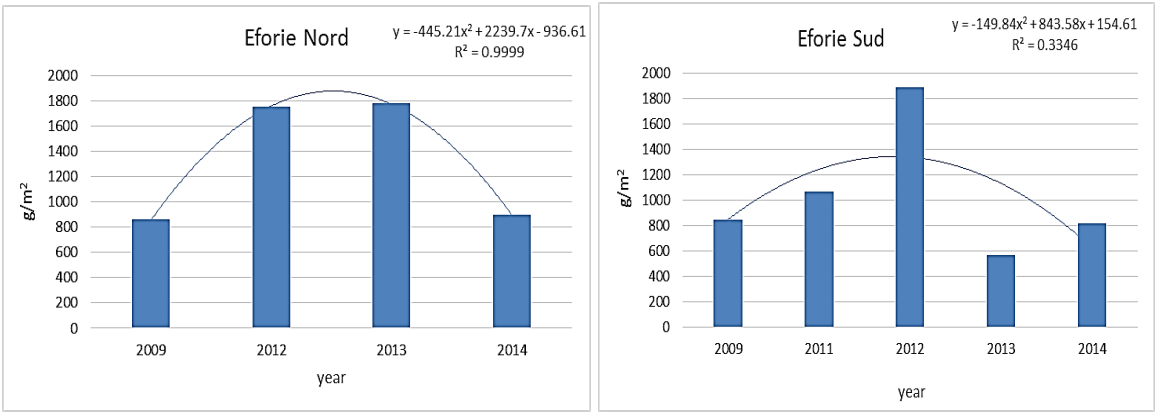


Fig. 2.22. Fresh biomass variation of the dominant genus - *Cladophora*, at Eforie

The high values for the total macroalgae biomass can be observed, with peak values coinciding with the maximum growth of *Cladophora* species period, respectively between 2012-2013 (for Eforie North) and 2011-2012 (for Eforie phytobenthos). Fig.2.22.

2012 was a year with considerable fresh biomasses both at Eforie North (1,780 g/m²) and Eforie South (1,900 g/m²) (Fig. 2.23, a and b)



a) Eforie North b) Eforie South

Fig. 2.23, a,b. Total fresh biomass variation of macrophytes

At Eforie North, the phenomenon of seasonal development for the opportunistic species continued also in 2013 (Fig. 2.23,c), while at Eforie South a decrease of this phenomenon was noticed (Fig. 2.23,d). Starting with the 2014 summer season, for both sampling stations, a decrease of the opportunistic species biomass was observed.

Fig. 2.23, c,d. Stranded macrophytes

- **Zooplankton**

From the point of view of MSP, the dynamics of ecosystem services and their driving forces are greatly influenced by maritime activities, if they are developed. For example, **maritime**

traffic has resulted in an increased load of non-native species. These induced changes have altered the productivity and regulation of **zooplankton** in the marine food chain.

The quantitative structure of zooplankton in this site was dominated by the copepods group, which in 2009 reached a value of 154,444 individuals/m^3. It was also observed that the dominant group of cladocerans in 2007-2009 was replaced in 2010 by the copepods group. Fig.2.24 a, b.

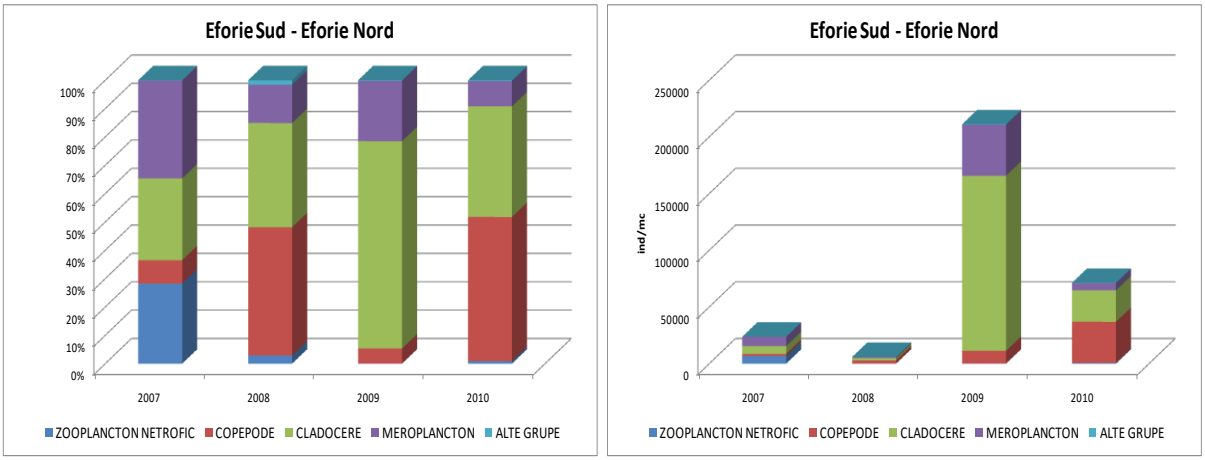


Fig. 2.24. a, b Quantitative structure of zooplankton in the Eforie area

- **Zoobenthos**

Ecosystem approach in *Maritime Spatial* is an important practice and *Planning* for achieving good environmental status; it includes also the benthos/organisms living on the marine substrate assessment.

Eforie has remained the only beach from the southern Romanian coast where the hydrodynamic processes and the natural habitats specific to exposed beaches are present, therefore we can find bivalves like *Donacilla cornea* and *Donax trunculus*. In the site were reported a total of 136 benthic species (Micu, 2004). Fig.2.25.

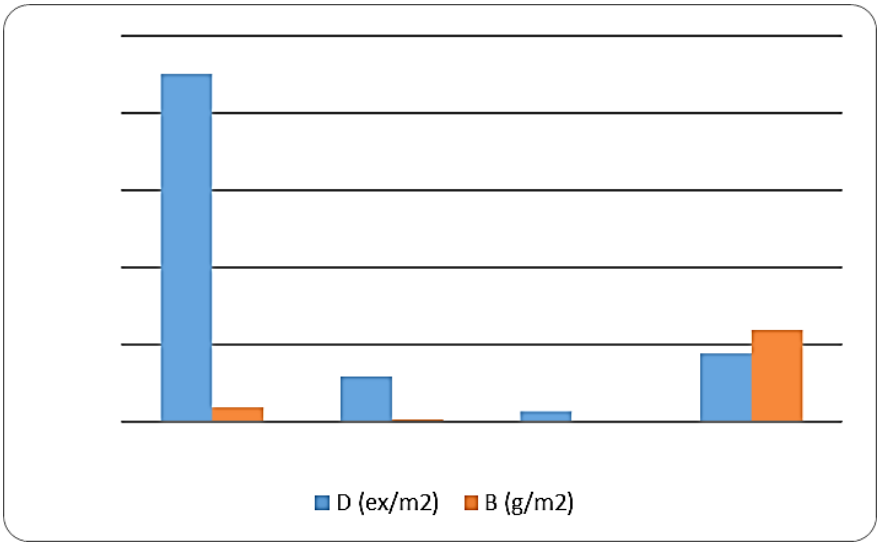


Fig. 2.25. Distribution of quantitative values, density (specimens/m^2), biomass (g/m^2), in ROSCI 00197, the Submerged Beach Eforie North and South, in the autumn of 2010, according to depth

The invertebrate population structure differs according to depth. In this site, 40 species were found during autumn (Micu & Micu, 2006). Mapping the marine benthos it necessary.

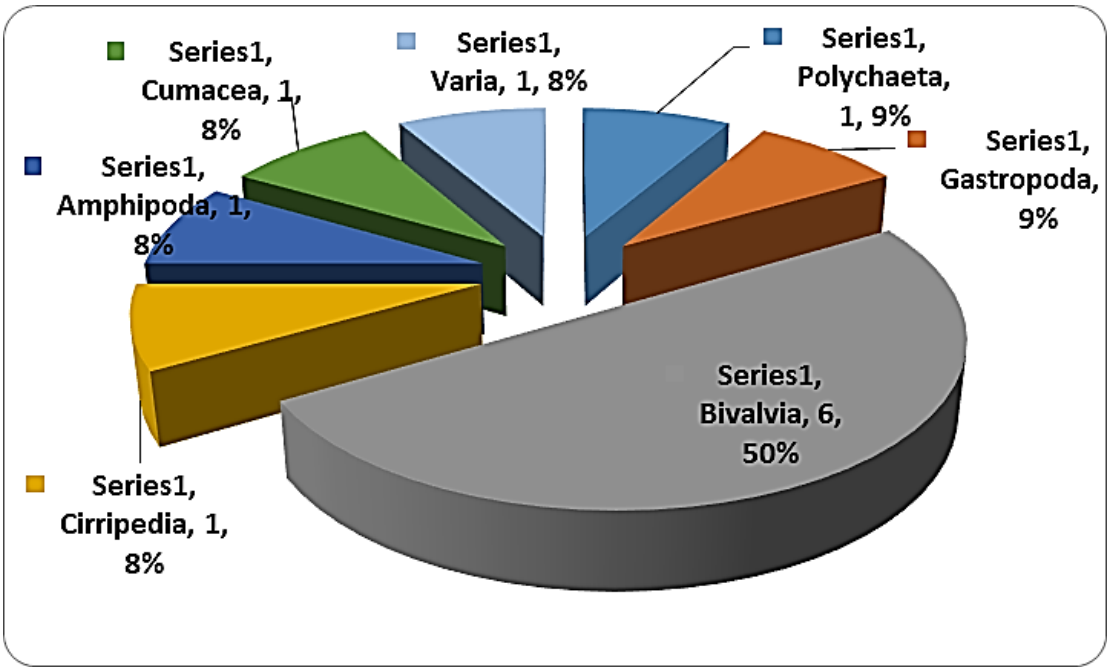


Fig. 2.26. Invertebrates' structure in ROSCI 00197, the Submerged Beach Eforie North and South

- **Ichthyofauna**

Recently reformed, Common Fisheries Policy (CFP) introduces new commitments to implement measures for protecting fish stocks' most productive areas and adds a new policy layer to MSP directly affecting the seafood provisioning in the coastal areas. This could lead to a loss of space for fisheries and possibly the aquaculture sector, if sector-specific requirements are not explicitly considered in relation to other human activities in respective MSP processes.

Due to the hydrodynamic conditions of the Eforie site, its relatively low expansion and depth, the ichthyofauna is less diverse compared with other sites from the southern seaside, with 51 species identified (47 are in the Tab. 2.5).

Table 2.5 List of fish species identified in the Eforie area

Nr. crt.	**List of fish species identified in Eforie area**	Nr. crt.	**List of fish species identified in Eforie area**
	Chondrychthyes	22.	*Symphodus, Crenilabrus, cinereus staitii* Northmann, 1848
1.	Family *Rajidae* *Raja clavata* Linnaeus, 1758	23.	*Symphodus, Crenilabrus, ocellatus* Forsskal, 1775
2.	*Dasyatis pastinaca* Linnaeus, 1758	24.	*Symphodus, Crenilabrus, roissali* Risso, 1810
	Osteichthyes Order *Acipenseriformes* Family *Acipenseridae* *Acipenser gueldenstaedtii* Brandt & Ratzeburg, 1833	25.	*Symphodus, Symphodus, rostratus* Bloch, 1797
3.	*Acipenser stellatus* Pallas, 1771	26.	*Symphodus, Crenilabrus, tinca* Linnaeus, 1758
4.	*Huso huso* Linnaeus, 1758	27.	Family *Trachinidae* *Trachinus draco* Linnaeus, 1758

5.	Order *Clupeiformes* Family *Clupeidae* *Sprattus sprattus* Linnaeus, 1758	28.	Family *Uranoscopidae* *Uranoscopus scaber* Linnaeus, 1758
6.	*Alosa tanaica* Grimm, 1901	29.	Family *Blenniidae* *Parablennius sanguinolentus* Pallas, 1811
7.	*Alosa immaculata* Bennett, 1835	30.	*Parablennius tentacularis* Brunnich, 1768
8.	Family *Engraulidae* *Engraulis encrasicolus* Linnaeus, 1758	31.	Family *Ophidiidae* *Ophidion rochei* Muller, 1945
9.	Order *Anguilliformes* Familia *Anguillidae* *Anguilla anguilla* Linnaeus, 1758	32.	Family *Ammodytidae* *Gymnammodites cicerellus* Rafinesque, 1810
10.	Order *Beloniformes* Family *Belonidae* *Belone belone* Linnaeus, 1761	33.	Family *Callionymidae* *Callionymus lyra* Linnaeus, 1758
	Order *Gadiformes* Familia *Gadiidae* *Gaidropsarus mediterraneus* Linnaeus, 1758	34.	*Callionymus pusillus* Delarochee, 1809
11.	*Merlangius merlangus* Linnaeus, 1758	35.	*Callionymus risso* Le Sueur, 1814
	Order *Syngnathiformes* Family *Syngnathidae*	36.	Family *Gobiidae* *Gobius niger* Linnaeus, 1758
12.	*Syngnathus tenuirostris* Rathke, 1837	37.	*Neogobius melanostomus* Pallas, 1811
13.	*Syngnathus typhle* Linnaeus, 1758	38.	*Neogobius platyrostris* Pallas, 1811
14.	*Syngnathus variegatus* Pallas, 1811	39.	*Proterorhinus marmoratus* Pallas, 1811
15.	*Nerophis ophidion* Linnaeus, 1758	40.	*Aphia minuta* Risso, 1810
16.	*Hippocampus guttulatus* Cuvier, 1829	41.	*Pomatoschistus minutus*
	Order *Mugiliformes*		Family *Scorpaenidae*
	Family *Mugilidae*	42.	*Scorpaena porcus* Linnaeus, 1758
17.	*Liza aurata* Risso, 1810	43.	Order *Pleuronectiformes* Family *Bothidae* *Psetta maeotica* Pallas, 1811
18.	*Liza saliens* Risso, 1810	45.	Family *Pleuronectidae* *Platichthys flesus* Linnaeus, 1758
19.	*Liza ramada* Risso, 1827	47.	Family *Soleidae* *Pegusa lascaris* Risso, 1810
20.	Family *Labridae*		

By fishing with stationary specialized gears, gillnets mainly, during the spring season, the species *Alosa tanaica* and *Alosa immaculata* (Fig. 2.27), have been caught, included in Annex II on species of plants and animals of Community interest whose conservation requires the designation of special areas of habitats as stipulated in 92/43/European Community Habitats Directive.

Regarding the species 4125 *Alosa immaculata* during the investigation period, specimens 4-6 years old predominated, which indicates the use of the site as a transit area for migration. Shads are marine, migratory, gregarious species wintering in the sea and spawning in the Danube. They winter in the deep and far off shore to depths of 50-150 meters. Spawning migration takes place from south to north along the Bulgarian and Romanian coast, up to the Danube mouth, ascending the river.

The migration starts in spring, end of February - early March, at water temperatures of 5-6°C, with maximum in April, at 9-13°C, sometimes until August at 22°C. Spawning takes place in the Danube: upstream of kilometer 180 (Calarasi→ Braila), up to the Iron Gates. After breeding, Pontic shads return to the sea, settling at over 55 meters depth. After

hatching, juveniles move downstream into the sea, stopping for a long time in the front of river mouths (Fig. 2.28).

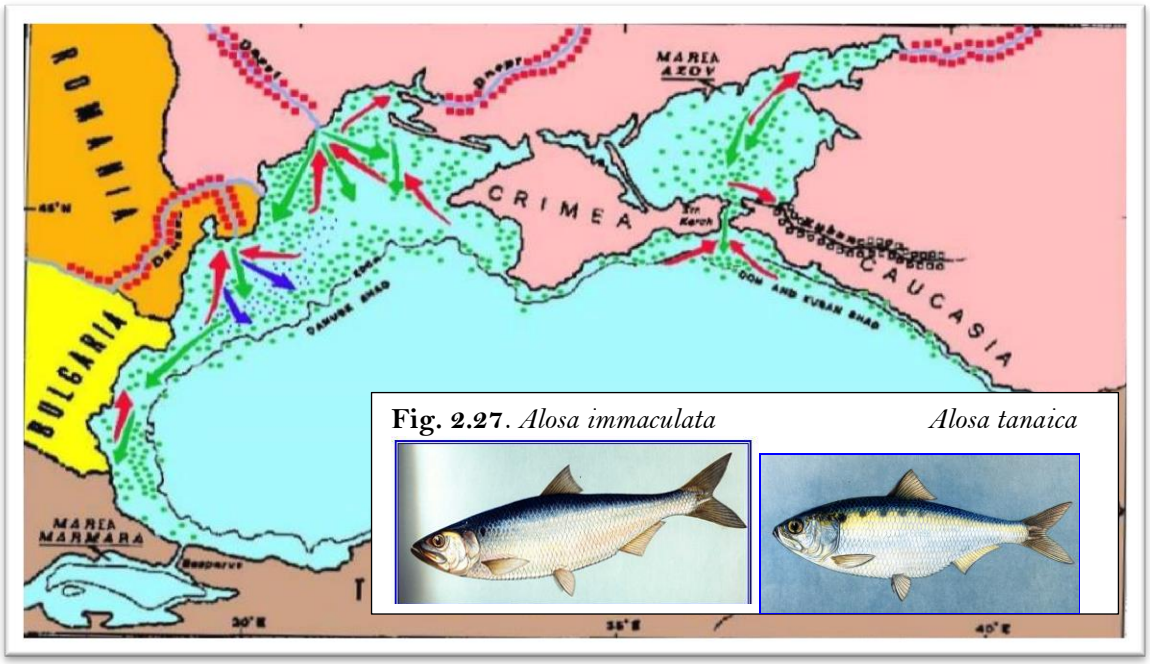


Fig. 2.28. *Alosa tanaica*, migration routes, feeding and wintering in the Black Sea continental shelf area

Alosa immaculata migrates for spawning between May and August.

Alosa tanaica: the degree of endangerment according to International Union for Conservation of Nature is - Least Concern. It is a thermophile species that prefers the shallow coastal waters for most of the year. Black Sea shads winter in the sea, and appear in the spring time near the coast, forming mixed groups with other species of *Alosa*. (Fig. 2.29 a,b).

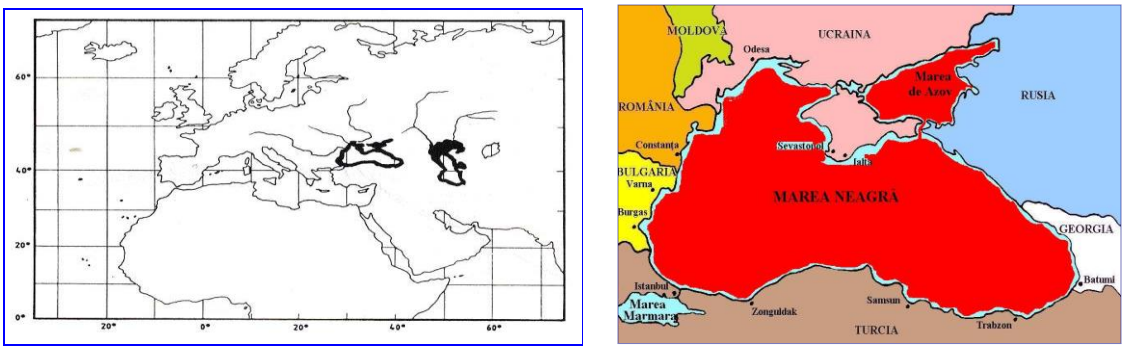


Fig. 2.29 a,b. *Alosa tanaica* distribution

- **Marine mammals**

Two species of dolphins were observed in the site: 1349 *Tursiops truncatus ponticus* and 1351 *Phocoena phocoena relicta*, using this area as a place of passage and feeding (Dumont, 1999).

During 2007 - 2010, it was estimated that the population reduced to 5-6 individuals. (Fig. 2.30 a,b)

Fig. 2.30.a. *Tursiops truncatus ponticus*

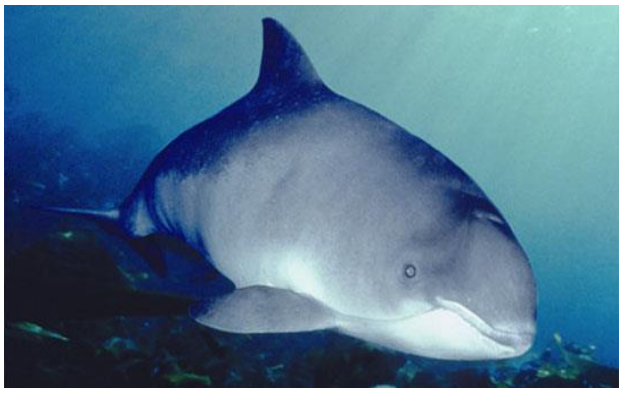


Fig. 2.30.b. *Phocoena phocoena relicta*

Tursiops truncatus ponticus: is characteristic for the entire Pontic basin; according to the International Union for the Conservation of Nature (IUCN), it is considered an Endangered species. The total population of the Black Sea is unknown. Recent estimates of abundance suggest the population comprises several thousands of individuals (24,000-28,000 during 1946-1983, in the Turkish area of Black Sea basin). It is a species protected under the Convention on International Trade for Endangered Species of Wild Fauna and Flora (CITES). (Fig. 2.31)

Phocoena phocoena relicta is, similarly, a characteristic species of the entire Black Sea basin. It is listed as Endangered by IUCN. The reduction of the population (by more than 50%, in the past 30 years) is due to hunting during the prohibited period, incidental catch, habitat degradation, restriction of food sources, some epizootic diseases and adverse climatic circumstances. They migrate in pursuit of fish schools; their favorite food consists in anchovies, sprats and whiting. (Fig. 2.32)

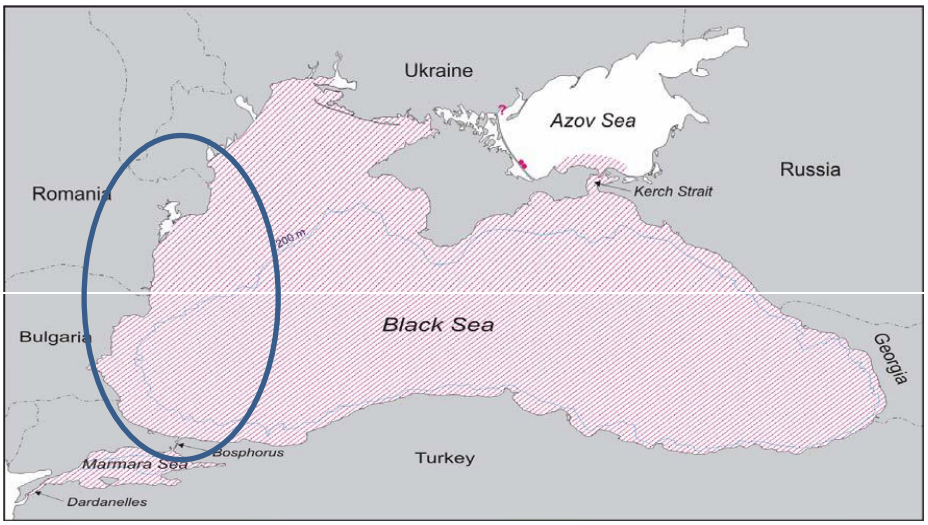


Fig. 2.31. Spatial distribution map of *Tursiops truncatus ponticus*

Surveys for determining the abundance of dolphin species, especially in the northeastern of Black Sea basin, in the Ukrainian and Russian zones, have been carried out for *Tursiops truncatus ponticus* population. The existence of several thousand individuals was revealed, up to 20,000 (Birkun & Frantzis, 2008; Frantzis, 2008).

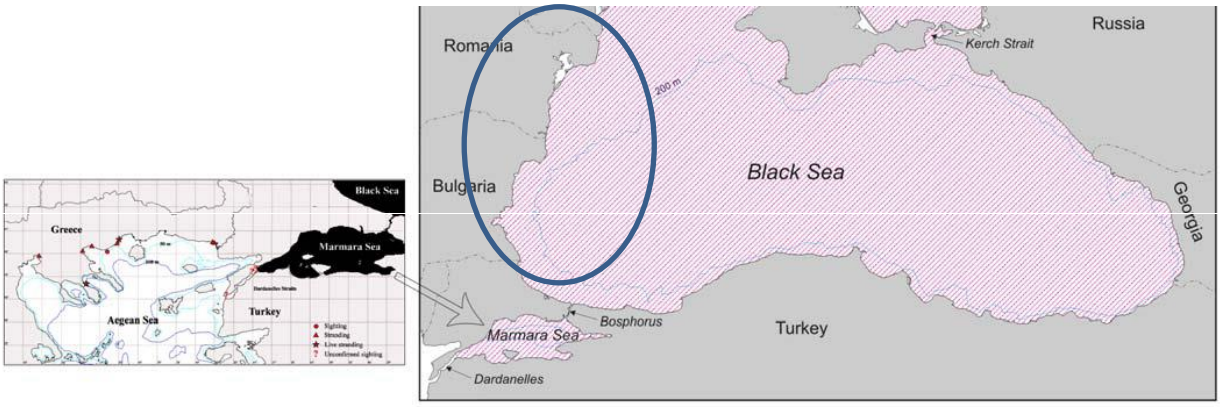


Fig. 2.32. Spatial distribution map of *Phocoena phocoena relicta*

Table 2.6. Natura 2000 marine habitat types from the Eforie area classification

1110 - Sandbanks which are slightly covered by sea water all the time 1110-8 Shallow sands bioturbated by *Arenicola* and *Callianassa*	
Correspondence with Palearctic Habitats	PAL.CLASS. 11.22.
Sublittoral soft seabeds	Mostly animal communities colonizing soft sediments such as mud, sand or gravel of the infralittoral and circalittoral zones
Distribution	All along the Romanian coast, from the Danube mouths to Vama Veche, wherever there are sandy beaches
Structure	Fine siliceous sands in the northern part (from Sulina to Constantza) or biogenic in the southern part (Eforie, Costinesti, Comorova-Mangalia, 2 Mai, Vama Veche) mixed with shell remains and gravel, from the shore to a depth of 3-4 m
Indicator species	In the North (Sulina to Constanta), under the influence of the Danube plume, this habitat is occupied by the biocoenosis of fine sands with *Lentidium mediterraneum*. Beside the dominant species, characteristic are the mollusks *Mya arenaria*, *Cerastoderma glaucum* and *Anadara inaequivalvis*, the crustaceans *Crangon crangon*, *Polybius vernalis* and the fishes *Platichtys flesus* and *Pegusa lascaris*. Shallow fine sands with *Lentidium mediterraneum* characterized by the biocoenosis of *Donax trunculus*, with abundant populations of this bivalve. Due to the high-energy environment, the associated fauna is not very diverse: the gastropod *Cyclope neritea*, the crustaceans *Polybius vernalis* and *Diogenes pugilator*, but abundances may be high.
Conservation value	Very high
1110 Sandbanks which are slightly covered by sea water all the time 1110-4 Well-sorted sands	
Correspondence with Palearctic Habitats	PAL.CLASS.: 11.22.
Sublittoral soft seabeds	Mostly animal communities colonizing soft sediments such as mud, sand or gravel of the infralittoral and circalittoral zones.
Distribution	This habitat is weakly represented or missing north of Cape Midia, because there the muddy bottoms occur at shallow depths. It is well represented in the sandy areas of the southern coast: Eforie, Costinesti, Mangalia
Structure	The upper part is contiguous with the shallow fine sands (3 – 4 m); from there the habitat extends down to 20 - 25 m
Indicator species	The characteristic species are the mollusks *Chamelea gallina*, *Donax trunculus*, *Cerastoderma glaucum*, *Tellina tenuis*, *Anadara inaequivalvis*, *Cyclope neritea*, *Nassarius nitidus*, the crustaceans *Polybius vernalis* and *Diogenes pugilator*, the fishes *Gymnammodytes cicerelus*, *Trachinus draco*, *Uranoscopus scaber*, *Callionymus* sp., *Pomatoschistus* sp.
Conservation value	very high

1110 Sandbanks which are slightly covered by sea water all the time 1110-8 Shallow sands bioturbated by *Arenicola* and *Callianassa*	
Correspondence with Palearctic Habitats	PAL. CLASS.: 11.22.
Sublittoral soft seabeds	Mostly animal communities colonizing soft sediments such as mud, sand or gravel of the infralittoral and circalittoral zones
Distribution	The habitat has a fragmentary distribution, occurring in sparse patches on submerged beaches south of Cape Midia, between 3 and 7m. It is better represented in the sandy areas of the southern coast: Eforie, Costinesti, and Mangalia
Structure	The upper part is contiguous with the shallow fine sands (3 – 4 m); from there the habitat extends down to 7m. The sand is bioturbated to a depth of 1m and the surface of the sediment shows the characteristic mounds and funnels of *Callianassa* and the fecal cast mounds of *Arenicola*.
Indicator species	The species which dominate through ecosystem engineering capabilities are *Arenicola marina* and *Callianassa truncata*. Both species are very rare: *Arenicola* was believed to be extinct, as for *Callianassa* this is the first record of adults from the Romanian Black Sea. Only recently we discovered their presence along the Romanian coast.
Conservation value none	Very high.
1110 Sandbanks which are slightly covered by sea water all the time 1110-9 Sandy muds and muddy sands bioturbated by *Upogebia*	
Correspondence with Palearctic Habitats	PAL.CLASS.: 11.22
Sublittoral soft seabeds	Mostly animal communities colonizing soft sediments such as mud, sand or gravel of the infralittoral and circalittoral zones
Distribution	The habitat forms a continuous belt along the Romanian coast at depths of 10-30 m, on sandy muds. On muddy sands, it has a shallower and more fragmented distribution, occurring between 1-8 m in *Zostera* meadows and on bare submerged beaches (Mamaia, Agigea, Eforie, Costinesti, Mangalia).
Structure	The sedimentary bottom is riddled with the openings of *Upogebia* burrows, which are between 0.2-1 m deep depending on sediment type. High densities of the thalassinids occur over large areas; the biofiltering, bioturbation and sediment resuspension exerted by them have a sizeable influence on the ecosystem.
Indicator species	The ecosystem engineer creating this habitat is the filter-feeding thalassinid crustacean *Upogebia pusilla*. The density of filter-feeding mollusks occurring in this habitat is decreased through competition and larval predation by *Upogebia*. Other species, especially small commensals which inhabit the burrows of *Upogebia*, are facilitated.
Conservation value	Very high. The role of *Upogebia* with respect to biofiltering and benthic-pelagic coupling is highly important for the functioning of the ecosystem.
1140 Mudflats and sandflats not covered by seawater at low tide. (The habitat comprises the supralittoral and midlittoral which are present in all seas. In microtidal seas like the Baltic, Mediterranean and Black Sea {tidal range of about 0.3 m} this habitat is limited to the upper and midlittoral of sandy beaches, it is narrower and does not exhibit the wide tidal flats of the Atlantic shores) **1140-1 Supralittoral sands with or without fast-drying drift lines**	
Correspondence with Palearctic Habitats	PAL.CLASS.: 14
Intertidal and littoral flats	Extensive, flat or nearly flat, surfaces of sands, muds or rocks of the coasts of the oceans, their connected seas and associated lagoons, submerged for part of every tide or for part of the annual cycle, devoid of terrestrial vascular plants. They are of particular importance as feeding grounds for wildfowl and waders. The diverse intertidal communities of invertebrates and algae that occupy them can be mentioned by using the subdivisions of units 11.27 to 11.2A, fanerogamic marine vegetation communities that may be exposed for a few hours in the course of every tide by use of those of

	unit 11.3, brackish water vegetation of permanent pools by use of those of unit 11.4.
Distribution	All sandy beaches of the Romanian coast.
Structure	It occupies the beach part that is covered by waves only during storms. The deposits are made of flotsam which can be vegetal (tree trunks, pieces of wood, terrestrial and freshwater plants, leafs, algae), animal (corpses) or anthropogenic (litter), as well as the dense foam of marine plankton.
Indicator species	The fauna is composed mainly of insects, isopod and amphipod crustaceans.
Conservation value:	Moderate
1140 Mudflats and sandflats not covered by seawater at low tide 1140-2 Supralittoral slow-drying drift lines	
Correspondence with Palearctic Habitats	PAL.CLASS.: 14
Intertidal and littoral flats	Extensive, flat or nearly flat, surfaces of sands, muds or rocks of the coasts of the oceans, their connected seas and associated lagoons, submerged for part of every tide or for part of the annual cycle, devoid of terrestrial vascular plants. They are of particular importance as feeding grounds for wildfowl and waders. The diverse intertidal communities of invertebrates and algae that occupy them can be mentioned by using the subdivisions of units 11.27 to 11.2A, fanerogamic marine vegetation communities that may be exposed for a few hours in the course of every tide by use of those of unit 11.3, brackish water vegetation of permanent pools by use of those of unit 11.4.
Correspondence with plant associations (if appropriate)	None
Distribution	On boulders or cobblestone beaches (Agigea, Tuzla and Vama Veche)
Structure	The habitat occupies the portion of boulder shores or cobblestone beaches that is covered by waves only during storms. The rocks accumulate flotsam and humidity in their interstices, and so deposits do not dry easily
Indicator species	The fauna is made of scavengers, detritivores, decomposers and their predators
Conservation value	Moderate
1140 Mudflats and sandflats not covered by seawater at low tide 1140-3 Midlittoral sands	
Correspondence with Palearctic Habitats	PAL.CLASS.: 14
Intertidal and littoral flats	Extensive, flat or nearly flat, surfaces of sands, muds or rocks of the coasts of the oceans, their connected seas and associated lagoons, submerged for part of every tide or for part of the annual cycle, devoid of terrestrial vascular plants. They are of particular importance as feeding grounds for wildfowl and waders. The diverse intertidal communities of invertebrates and algae that occupy them can be mentioned by using the subdivisions of units 11.27 to 11.2A, fanerogamic marine vegetation communities that may be exposed for a few hours in the course of every tide by use of those of unit 11.3, brackish water vegetation of permanent pools by use of those of unit 11.4.
Distribution	On all sandy beaches of the Romanian coast
Structure	The habitat occupies the beach strip covered by the swash. This strip may be wider or narrower depending largely on sea state, as in the Black Sea the tidal range is very limited (0.3 m). The sand is coarser, mixed with shells and gravel.
Indicator species	The wedgeclam *Donacilla cornea* is characteristic for the southern beaches (Eforie, Costinesti, Mangalia, Vama Veche), while the amphipod *Pontogammarus maeoticus* is characteristic for sandy shores of the Danube Delta

Conservation value:	very high
1170 Reefs : 1170-5 Supralittoral rock	
Correspondence with Palearctic Habitats:	PAL.CLASS.: 11.24
Sublittoral rocky seabeds and kelp forests	Varied, strongly stratified communities colonizing underwater cliffs, reefs and rocky continental shelf seabeds.
Structure:	The supralittoral rock is situated above the water level and is sprayed by waves or flushed during storms. The vertical extent depends on wave regime, solar exposure and the slope. Harsh conditions make this habitat suitable only for a few species: *Verrucaria* lichen crusts, the periwinkle *Melaraphe neritoidis*, isopod crustaceans and the crab *Pachygrapsus marmoratus*. In eutrophicated areas it can be covered by a slippery film of epi- and endolithic cyanobacteria.
Conservation value:	High
1170 Reefs / 1170-6 Upper midlittoral rock	
Correspondence with Palearctic Habitats	PAL.CLASS.: 11.24
Sublittoral rocky seabeds and kelp forests	Varied, strongly stratified communities colonizing underwater cliffs, reefs and rocky continental shelf seabeds.
Distribution	All rocky shores
Structure	The upper midlittoral rock is located in the upper part of the swash zone and is not permanently covered by water, being intermittently wetted by taller waves. The most characteristic species is the cirripede crustacean *Chthamalus stellatus*, now rare on the Romanian coast.
Conservation value	High
1170 Reefs / 1170-7 Lower midlittoral rock	
Correspondence with Palearctic Habitats:	PAL.CLASS: 11.24.
Sublittoral rocky seabeds and kelp forests:	Varied, strongly stratified communities colonizing underwater cliffs, reefs and rocky continental shelf seabeds.
Distribution	all rocky shores
Structure	The lower midlittoral rock is located in the lower part of the swash zone and is covered by water most of the time. High and constant humidity, strong wave action and strong light are the dominant environmental factors for this habitat. Encrusting corallines *Lithophyllum incrustans*, articulated corallines *Corallina officinalis* and ephemeral macrophytes like *Ulva compressa*, *Enteromorpha sp.*, *Cladophora sp. and Ceramium sp.* make up the algal cover. The fauna is characterized by *Balanus improvisus*, *Haliplanella lineata*, *Mytilaster lineatus and Mytilus galloprovincialis*, bryozoans, amphipod and isopod crustaceans, the crabs Pachygrapsus marmoratus and Eriphia verrucosa. If the water is clean *Corallina* and *Mytilaster* may form dense turfs/belts, while in degraded, eutrophicated areas *Cladophora*, *Ulva compressa* and *Balanus* dominate.
Conservation value	High
1170 Reefs / 1170-8 Infralittoral rock with photophylic algae	
Correspondence with Palearctic Habitats:	PAL.CLASS.: 11.24.
Sublittoral rocky seabeds and kelp forests	Varied, strongly stratified communities colonizing underwater cliffs, reefs and rocky continental shelf seabeds.
Distribution	All rocky shores.
Structure:	The infralittoral rock with photophylic algae starts immediately under the

	lower midlittoral, where emersions are only accidental, and stretches down to the lower limit of distribution of photophilic algae. This lower limit is conditioned by the penetration of light and is thus variable, according to the topography and water clarity. Usually in the Romanian Black Sea this limit is around 10 m deep, but in high turbidity areas can be less than 1m. In-between these two boundaries the rocky substratum is covered with a rich variety of photophylic algae. Three subdivisions can be distinguished: - a top layer (0-1 m), where light and wave action are very strong; - an intermediate layer (1-6 m), where light and wave action; - a deep layer (6-10 m), where light and wave action are low. Various facies correspond to each layer.
Conservation value:	Very high. This habitat is the richest and most diverse in the Black Sea. It is dominated by vegetation, and its dynamics are influenced by the life cycle of the algal flora, the composition of which varies according to the season.
1170 Reefs / 1170-9 Infralittoral rock with *Mytilus galloprovincialis*	
Correspondence with Palearctic Habitats:	PAL.CLASS.: 11.24.
Sublittoral rocky seabeds and kelp forests	Varied, strongly stratified communities colonizing underwater cliffs, reefs and rocky continental shelf seabeds.
Structure:	The infralittoral rock with *Mytilus galloprovincialis* reaches down to 28 m deep, the lower limit of rocky bottoms in the Romanian Black Sea. In the photophilic algal zone it overlaps the previous habitat (as mussels are ever present under the changing algal cover) but it continues deeper, beyond its limits. The fauna is highly diverse, including many invertebrate and fish species which occur only in this habitat, some of them rare or protected. Conservation value: Very high. The habitat is very important due to the crucial ecological role of the mussel beds in the self-cleansing capacity of the ecosystem and in the benthic-pelagic coupling. The biological production of this habitat can exceed 10 kg m^{-2}, with a complex foodweb which links it to other habitats.

2.2.2. Environmental protection (NATURA 2000 sites)

Pursuant to the provisions of Emergency Ordinance no. 57 of 20 June 2007, on the regime of natural protected areas, the conservation of natural habitats, wild flora and fauna (Official Gazzette no. 442 of 29 June 2007), approved by Law no. 49/2011, as well as of European Directives 79/409/EEC and 92/43/EEC, the natural protected areas were established at the Romanian marine zone. Three MPAs are situated in the study case area (Fig. 2.33).

1. **ROSPA0076 Black Sea:** site of Community importance, according to the 79/409/EEC Birds Directive, directly nominated Special Protectiona Area for birds - SPA - through GD no. 1284/2007 regarding the declaration of avifaunistic protected areas as an integrating part of the Natura 2000 European ecological network in Romania - 147,242.9 ha;
2. **ROSCI0197 - Submerged beach from Eforie North - Eforie South**: site of Community importance, according to the Habitats Directive 92/43/EEC, established by Decision 2009/92/EC - 141 ha;
3. **ROSCI0273 - Marine area from Cape Tuzla**: site of Community importance, according to the Habitats Directive 92/43/EEC, established by Decision 2009/92/EC - 1,738 ha

Through Order no. 46/2016 regarding natural protected area regime and the establishment of sites of Community importance as part of the European ecological network Natura 2000 in Romania, the total areas of ROSCI0197 and ROSCI0273 increased to 5,716 ha and 4,947 ha, respectively. (Fig.2.34 a,b; Tabel 2.9).

- **Eforie submerged beach (ROSCI0197)** is the only beach not affected by anthropogenic impact. It hosts three habitats of Community interest (1110 - Sandbanks which are slightly covered by sea water all the time, 1170-Reefs and 1140 - Mudflats and sandflats not covered by seawater at low tide). It is the only place in Romania where there are significant populations of the bivalves *Donacilla cornea* and *Donax trunculus*.
- **Marine area from Cape Tuzla (ROSCI0273)** Natural Habitats: 1110 - Sandbanks which are slightly covered by sea water all the time, 1170-Reefs and 1140 - Mudflats and sandflats not covered by seawater at low tide.

Fig. 2.33. Map of natural values (SCI under Habitat Directive, SPA under Birds Directive, Ramsar Wetland convention)

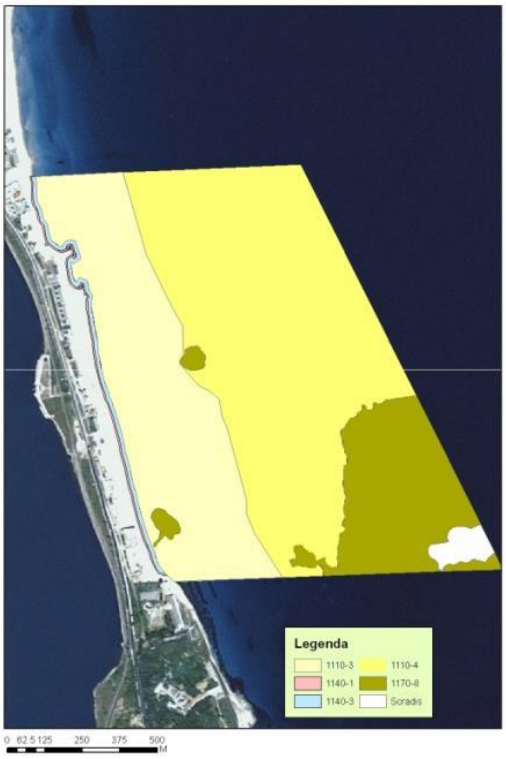


Figure 2.34.a. Map of marine habitats under Habitats Directive (Eforie submerged beach)

Figure 2.34. b. Map of marine habitats under Habitats Directive (Eforie submerged beach)

Both sites also preserve unique species and protect two mammalian species of Community interest (*Phocoena phocoena relicta* and *Tursiops truncates ponticus*) and two fish species of Community interest (*Alosa tanaica*, *Alosa immaculata*), added to other rare species with economic value (beluga, sturgeon, garfish, mullet, mackerel, sprat).

– **Special Protection Area ROSPA0076 Black Sea**: 10 bird species in Annex 1 of the Birds Directive; 20 migratory species listed in the Appendices of the Convention on Migratory Species; 2 globally endangered bird species.

Table 2.8. Eforie Sector's importance for biodiversity and conservation of species/ habitat types considered at European, national and regional level

Protected area in Eforie	Diversity	Uniqueness	Conservation status	Vulnerabilities
Site of Community Importance of Romania 0197 Eforie submerged Beach	Average	*The only place in Romania where there still exists a sandy mediolittoral with *Donacilla cornea;* *The only place in Romania where there are significant populations of the bivalve *Donax trunculus;* *The only beach in the south coast unaffected by hydotechnical structures	very good, especially for 1140-3 and 1110-3	Hydraulic structures that modify the natural sedimentary circulation; Fresh and / or polluted water discharges from the marina; Intensive tourism.

Table 2.9. National classification of habitats present in the Eforie zone

Mediolittoral sand and muddy sands	**Coarse sand with *Donacilla cornea* and occasional *Ophelia bicornis***
Sublittoral rock / other type of hard substrate	*Facies with *Mytilus galloprovincialis* on the infralittoral rock completely or moderately exposed - vertically or horizontally; *Macrofite of green and red algae (*Enteromorpha*, *Ulva*, *Porphyria*) on moderately exposed infralittoral rock or sheltered; *Crusty sponge, colonial ascidia and briozoans / hidrozoans on exposed rock or moderately sheltered infralittoral
Sublittoral sediment	**Donax trunculus* in infralittoral corse sands *Chamelea gallina*, **Lentidium mediterraneum* and **Lucinella divaricata* in clean sands at shalow water. **Mya arenaria* in sands and muddy sands **Anadara inequivalvis* in sands and muddy Sands **Melinna palmata* in muddy infralittoral sands

Fig 2.34. c,d. Macroalgae and *Donacilla cornea*

Table 2.10 Wildlife conservation on fauna of interest .
Present species with regional / community interest in the Eforie area

Species	Conservation	Population	Location, ecology
Fish			
1349 *Tursiops truncatus ponticus*	Habitats Directive, annex II	Resident	The bottlenose dolphin is present in the Romanian marine area in summer, all over the continental shelf. Travels in family groups of 4-6 individuals, and is the most sociable to humans.
1351 *Phocoena phocoena relicta*	Habitats Directive, annex II	Resident	The porpoise is a shallow-water species, 6-200 m depth, which enters the Danube and lagoons, on the entire coast, for food. In winter they migrate to areas of Georgia and Turkey.
4125 *Alosa immaculata*	Habitats Directive, annex II	landscape	Cryophilic pelagic species. Adults approach the shore only during breeding migration in February-April, when it is present in all sites. Brood can often be found in coastal waters.
4127 *Alosa tanaica*	Habitats Directive, annex II	Resident	This species is present along the Romanian coast for most of the year. Thermophilic species, prefer shallow waters.
2488 *Acipenser stellatus;* 2489 *Huso huso*	Habitats Directive, other annex	Resident	Adults are more commonly found in front of the Danube mouth, while the juveniles are spread throughout the continental shelf, especially near the coast.
2553 *Proterorhinus marmoratus*	Habitats Directive, other annex	Resident	Small gobies, easily recognized by its nasal tubes. It is a very common species in rocky habitats and mussel beds.
2551 *Pomatoschistus minutus*	Habitats Directive, other annex	Resident	Small gobies, characteristic for shallow sand habitats. It prefers clean areas with good state of preservation.
Invertebrates			
Donacilla cornea	Regional, Black Sea Red Book, Black Sea Transboundary Diagnostic Analysis, 2007 National, Red List	Resident	Characteristic species for mediolittoral sand; very good indicator of environmental quality; threatened across the Black Sea; in Romania it survives only in Eforie site.
Ophelia bicornis	Regional, Black Sea Red Book, Black Sea Transboundary Diagnostic Analysis, 2007 National, Red List	Resident	Characteristic species for mediolittoral sand; very good indicator of environmental quality; threatened across the Black Sea; in Romania it survives only in Eforie site.
Donax trunculus	Regional Black Sea Transboundary Diagnostic Analysis, 2007 National Red List	Resident	This species can be found in the sandy infralittoral with strongly hydrodynamic conditions. Threatened in the whole Black Sea; in Romania there are still dense populations only in Eforie site.

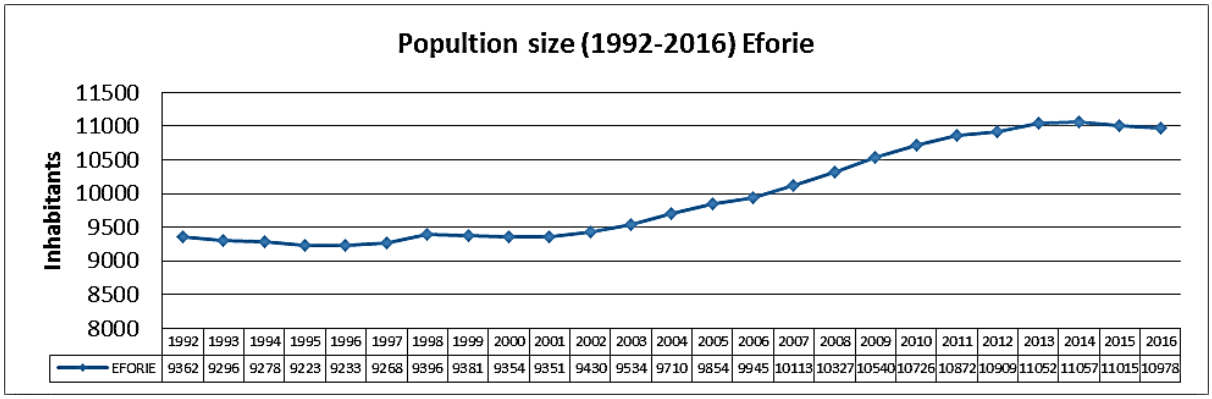
2.3. Social features of the area

2.3.1. Socio-demographic features

The particularities of population trends and demographic phenomena in the Constanta County are that, until 1990, the main component of population growth was migration to this area, especially for Constanta and several other cities. By 1990, the population of Constanta county was in a continuous downtrend, with specific aspects generated by the

effects of migration mainly to peri-urban areas, so now there is an upward movement of the population in the Constanta Metropolitan Area.

Eforie's population declined slightly immediately after 1990, from ~ 9300 individuals to 9200 in 1995 -1997, mainly due to lower natural growth, and increased after 2002, reaching in 2016 to over 10,000 people.



(INSSE - National institute of Statistics)

Fig. 2.35. Population sizes

Fig. 2.36.a,b. Population density during summer season

a.

b.

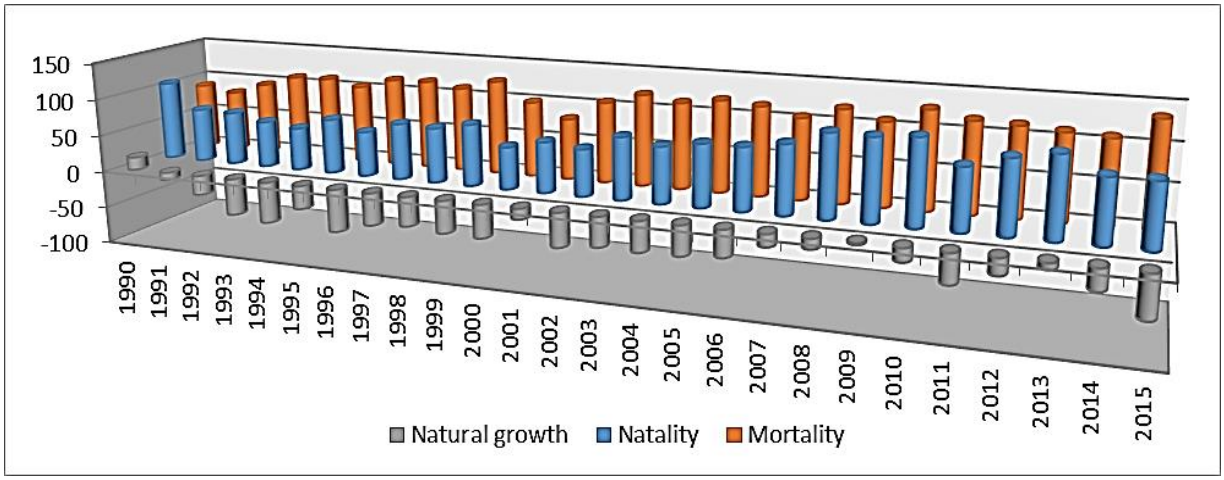


Fig. 2.37. Natality, mortality and natural growth - Eforie town, 1990-2015
(INSSE - National institute of Statistics)

Eforie city's population fell by more than 120 people in 1996 compared to 1990 and

increased by 149 people in 2002-2007 and in 2007-2011, with ~ 400 inhabitants (Fig. 2.36 a,b,c). The increase was due to migration as a consequence of urban development of the city by building new houses.Natural growth has remained in negative trend since 1991, the number of births is lower than that of deaths compared to other adjacent areas, where it is positive (Fig. 2.37).

The last 23 years (1992-2015) were characterized by the ongoing decline in the number of people, with almost 47,000 at the Constanta County level. The changing demographic behavior of couples regarding their reproduction, increased mortality and emigration, caused the population to decline steadily. The age structure of the population has the characteristic of an aging demographic, from the decrease in the birth rate, which has resulted in absolute and relative reduction of the young population (0-14 years). In parallel, increasing life expectancy increased the number and share of elderly population (65 and over). The age pyramid is a representation of the population in each generation which has its own history and shows long-term trends of fertility and birth rate and short-term effects of migration, the demographic policies or of the changes in a century of demographic history. Maintaining long-term low birth narrowed more the bottom of age pyramid.

2.4. Economic aspects of the area

2.4.1. National and international context

The existence of a stable macroeconomic and financial framework in Romania is a precondition for the competitive potential of business. Although forecasts indicate a moderate dynamic of GDP, above the EU average, with the continuing uncertainties of external economic developments, in 2013 Romania registered an economic growth of +3.5%.

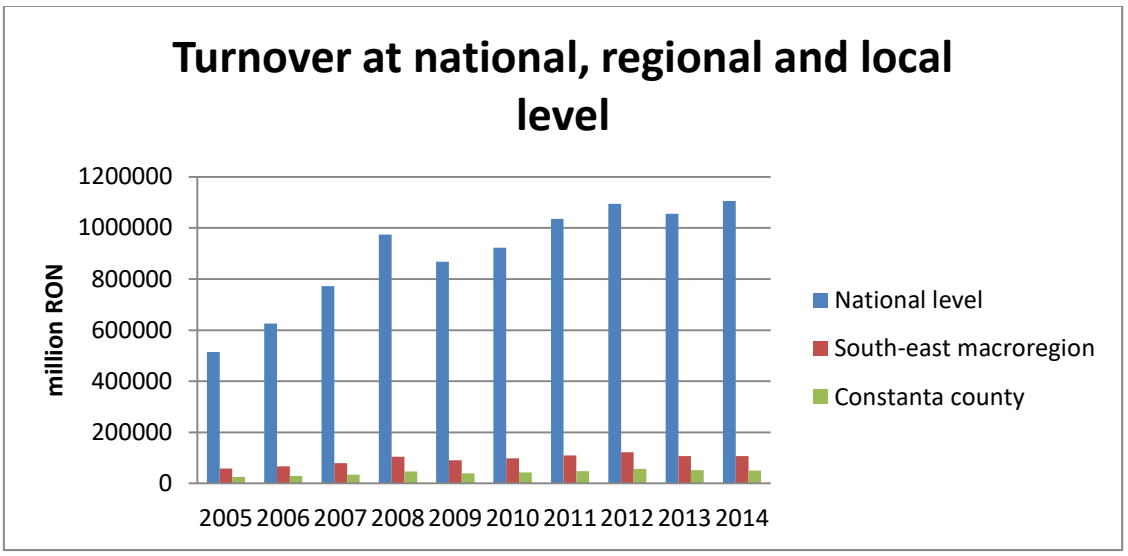
According to the National Competitiveness Strategy 2014 - 2020, the main points of interest in the competitiveness agenda are related to the implementation of public investment projects according to current commitments of the Romanian Government, which indicates an increase in investment spending by 6.00 6.5% - of GDP envisaged for the period 2010 - 2012, 6.5 - 7.6% of GDP on horizon 2014 - 2016. This investment effort in the context of macroeconomic stabilization measures will mainly contribute towards the five areas of strategic investment and employment: energy, mineral resources, agriculture, industry and infrastructure.

The Southeastern Region represents 10.5% of the total national GPD, 57.3 billion lei respectively, Constanta city finishing in first place in GDP / capita in the region, i.e. 7,119 euro / capita.

The metropolitan area economy is complex, the main branches are: port and shipping activity, tourism, services, trade, food industry, machine building, chemical and petrochemical, electrical and thermal energy, wood processing, textile industry (Fig. 2.38 a,b,c).

The analysis of turnover (Fig.2.39) at urban level in the South - East reveals that Constanta municipality is the most powerful, recording a turnover in the year 2012 of 4,116,910,805 Ron, a percentage of 41.6% of the total registered in the South -East. Constanta County's industrial production rose in 2014 by 38%, compared to an average of 10.1% at the national level, according to data centralized by the National Statistics Institute. Turnover in industry registered in turn an increase well above the national average of 13.5%, being

43.7% in 2014. Overall, the national economy and Constanta County's economy, during 2012-2015, recorded appreciable growth, which led to a decline in inflation and a more stable employment.



a

Fig. 2.38. a,b,c. Economic production (turnover) (relevant sectors- extraction and processing oil and gas, manufacturing, electricity power production and delivery, water supply, sanitation, waste management activities, constructions, trade, transport activity and warehouses, hotels and restaurants)

b.

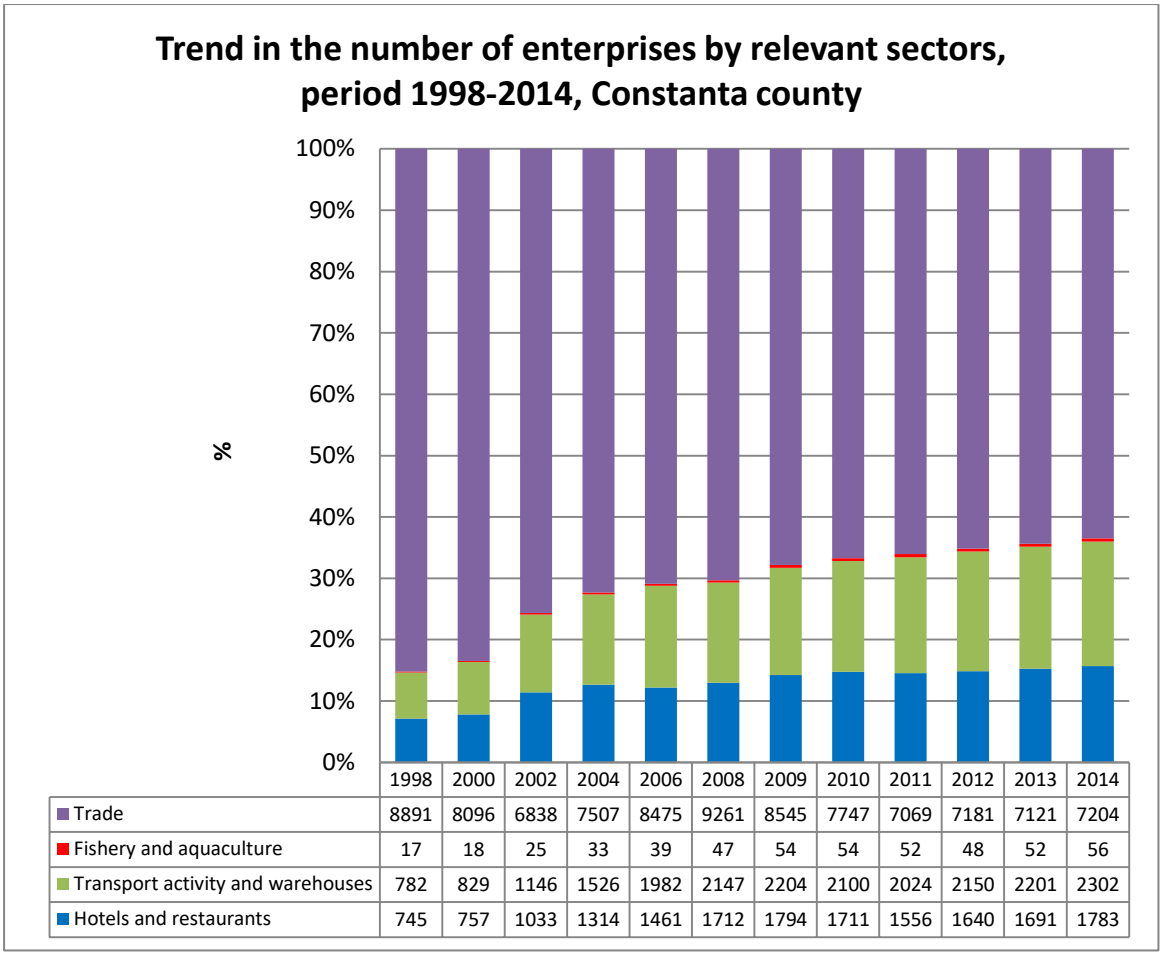
c.

2.4.2. Transport infrastructure

2.4.2.1. Land transport (roads, rail lines)

- **Road network**

The town of Eforie is very well connected with the national and European road network/the Pan-European Transport Corridor no. IV, being served by a direct line on two bridges over the Danube-BS Cannel, at the end of the A2 motorway/"*The Sun's Motorway*", going to the Ferry and Ro-Ro terminal, situated in the southern part of the Constanta port.



	1998	2000	2002	2004	2006	2008	2009	2010	2011	2012	2013	2014
Trade	8891	8096	6838	7507	8475	9261	8545	7747	7069	7181	7121	7204
Fishery and aquaculture	17	18	25	33	39	47	54	54	52	48	52	56
Transport activity and warehouses	782	829	1146	1526	1982	2147	2204	2100	2024	2150	2201	2302
Hotels and restaurants	745	757	1033	1314	1461	1712	1794	1711	1556	1640	1691	1783

Fig. 2.39. The dynamics of enterprise number in the relevant sectors in Constanta County (INSSE data)

The hinterland transport networks of Eforie supports transport related to produced, consumed and forwarded goods to/from the Dobrogea region. During the last decade, the national road DN39 served efficiently the flow of traffic that arrives or departs from/to Constanta and Mangalia Municipalities, although many old transport routes evolve more slowly. Inland transport is benefitting of the Pan European Corridor VII - Danube.

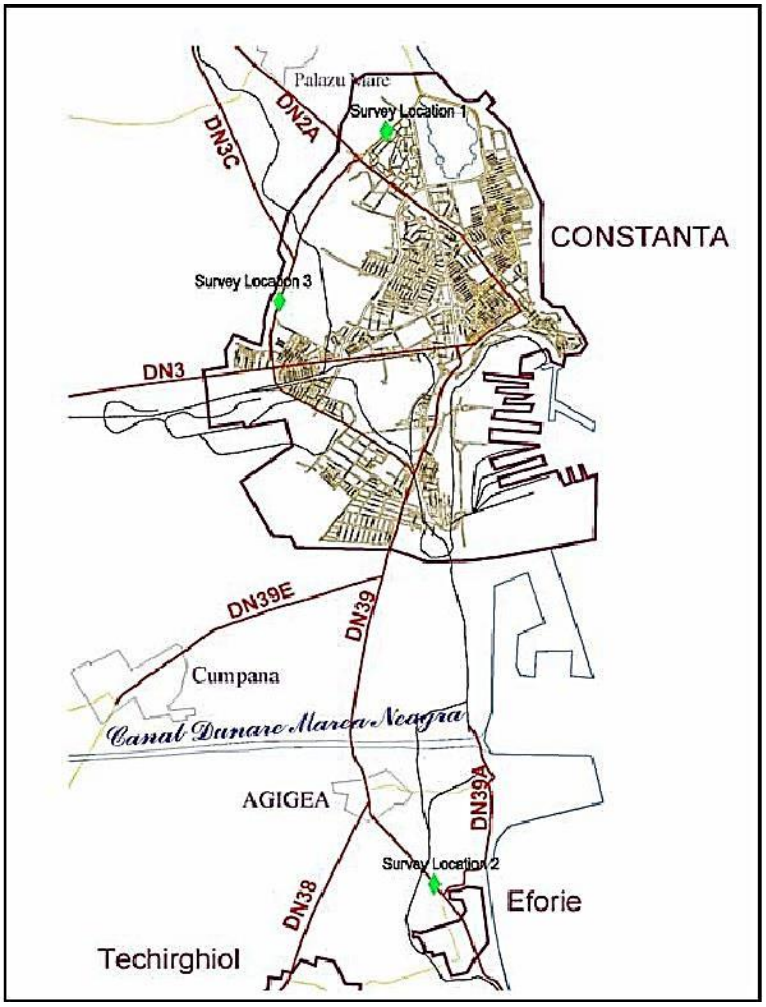


Fig. 2.40. Transport connections to Eforie North

2.4.2.2. Shipping (harbors, naval routes)

In the nearest area of the Eforie sector is the **Port of Constanta,** one of the main distribution centers for the Central and Eastern Europe, with a total area of 3.926 ha. In the northern part of Eforie, generating the biggest geomorphological problems is the port's southern breakwater, 5,560 m long. Constanta Port has a handling capacity of over 100 million tons per year and 156 berths, of which 140 berths are operational. The total quay length is 29.83 km, and the depths range between 8 and 19 meters. These characteristics are comparable with those offered by the most important European and international ports, allowing the accommodation of tankers with capacity of 165,000 dwt and bulk carriers of 220,000 dwt.

Currently, there are several facilities for cargo handling and for improving the transport connections between Constanta South Port and its hinterland, including the neighborhood areas of Eforie (Fig. 2.40).

The Constanta South Port is partly operational. It has 14.6 km of quays, 74 operational berths and handling capacity for containers, ores, coal, phosphate, crude oil and oil products, rolled metals, general goods for platforms and warehouses. Part of the traffic is handled as RO-RO and ferry cargo. The South Port encompasses the entrance to the Danube - Black Sea Canal, which is part of Europe's most important waterway, the Rhine-Main-Danube corridor. The South Port has a dedicated river/maritime basin for transshipment of cargo into river barges.

The Danube-Black Sea Canal links the Port of Constanta to the Rhine-Main-Danube Corridor, offering the most efficient and ecological transport alternative within the hinterland and at the same time a 4,000 km shortening of the sea trade routes coming from Far East and Australia through the Suez Canal. According to European Union and United Nations standards, the Danube-Black Sea Canal has a class VI rating and is an 'F' class inland canal.

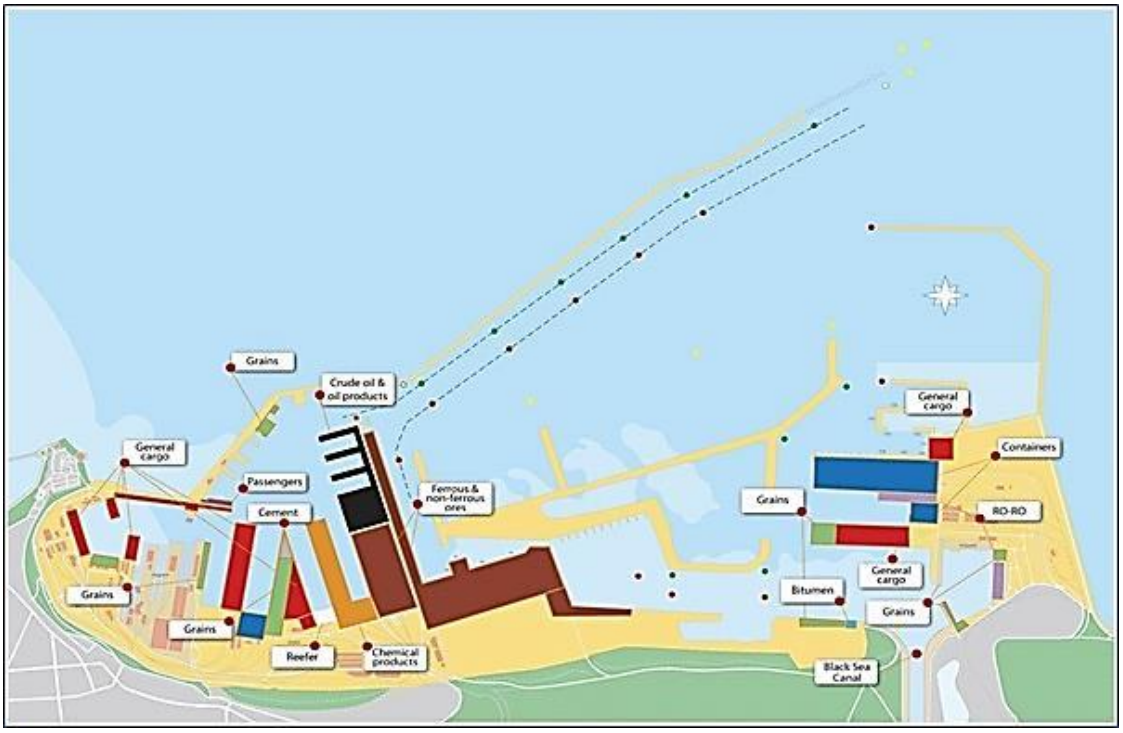


Fig. 2.41.a Constanta - Agigea port (Constanta Port handbook 2015-2016) with impact on Eforie

The 64.4 km long and 90 m wide canal has a water depth of 7 m and 17,5 m clearance under the bridges and the daily running of the waterway is in the responsibility of the National Company "Navigable Canals Administration" located in Agigea village, the northern part of Eforie North town. (Fig. 2.41)

The Eforie Marina is not harmoniously integrated into the local geomorphology, so annual actions of dredging for keeping its functionality is necessary. Access from the town to the port is not easily made by vehicles or on foot. A series of touristic objectives of great interest can be found close to the marina: Belona Hotel, Eforie North promenade, Acapulco Restaurant, Europa's Hotel Casino, Eforie's cold baths of mud facilities. (Fig. 2.42 a,b)

a.

b.

Due to its favorable location and present infrastructure, the marina has a high potential for nautical tourism, sporting activities and entertainment, representing a shelter for yachts and bouts. The capacity of the port allows the arrangement of sporting activities such as boat races. The tourist harbor is not a port for passenger ships sailing along the Black Sea,

only for local routes. The term "marina" defines a port for small boats, tourist boats, sports boats, pleasure boats, with specific design.

The Eforie Marina is the first private marina in Romania, built to European standards. The potential of Eforie marina is fully exploited by the owners, and nautical tourism could become international by including it in a western Black Sea tour.

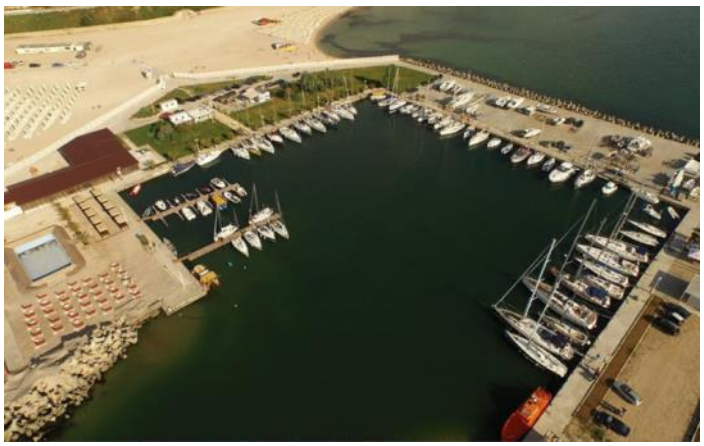


Fig. 2.42. c. Eforie Marina

Access for boats to the Eforie Marina arriving on the water is by a fairway buoys path, with 12 m width and water depth varying between 3.5 and 4.2 m. It can simultaneously accommodate 60 boats with lengths up to 18 m and a maximum draft of 3 m, both in summer and in winter, it is secured 24 from 24 hours. Marina Eforie has a fixed quay crane that can provide launch services or lifting boats from/on the water for craft whose weight does not exceed 5 tones, but for boats that exceed weight of 5 t and whose release at the water can only be done with a contracted crane. Also, the marina has an inclined plane, and for boats wintering there is a special platform available (1st of October to 1st of May).

2.4.2.3. Air transport

Air transport is provided by a local airport in the nearby southern locality of Tuzla, located at 7 km distance from the Eforie, to the south. Tuzla Airport is a national airport and a minor air-gateway, but it has a high impact on local touristic development.

The airport has an area of 36 ha and features a 1,200 m^2 hangar, two administration buildings, two passenger terminals and a new fuel warehouse of 180 m^3. From this airport services are provided for agriculture, surveillance and air advertisement, air taxi, air ambulance, sightseeing flight, and the certificate courses for private pilot (PPL) and parachuting courses.

From Tuzla Airport there are almost daily flights in the Black Sea offshore to various stakeholders operating off the continental shelf of Romania, serving offshore drilling platforms and vessels. Also, there are medical evacuation services offshore, available 24/24, 7/7 through missions flown both day and night. Offshore helicopter flights are carried out, which is the latest in transportation over the sea. Offshore flights are carried out with helicopters which are the latest in transportation over the sea.

2.4.3. Economic sectors of the area

One of the baselines of the economic area of interest is the tourism potential, provided by the proximity of the Black Sea, the existence of accommodation and catering, the existence of natural lakes with therapeutic properties that are unique in the world (Techirghiol), and which facilitated the development of spa tourism. Eforie has an important tourist activity that generates economic growth year after year, representing a successful open door to the world. Another traditional economic direction is represented by port activity. The two seaports, the Constanta Port and Constanta South Agigea Port, along rank the 4th place in Europe, a gateway to the world, with annually an impressive amount of goods being

transited through them. Port activity is complemented by a diversity of opportunities offered by the Danube-Black Sea Canal and Constanta shipyard.

2.4.3.1. The primary sector (agriculture, fishery, aquaculture)

Regarding the **primary economic sector** (extracting and refining raw materials), in the year 2014, in Eforie, activities concerned agriculture (26 ha agriculture land, of which 22 ha arable land and 4 ha orchards and nurseries and 6 ha waters and swamps) and fisheries (aquaculture and fisheries).

- **Fisheries**

There are different types of fishing gears for the active and passive fishery practiced in the inshore and offshore coastal fishery in the Eforie sector (Fig. 2.43 a).

The passive fishing gears include the equipment for catching in general the fish migrating for spawning and feeding in shallow waters, namely: long lines and bottom lines, gillnets for the Danube shad, turbot, mugilidae and gobies, sea pound nets.

Another category of fishing equipment used in the Romanian coastal zone includes the active fishing gear: beach seine, beam trawl, pelagic trawl.


a.

Fig. 2.43. a Fishing harbor

- **Marine aquaculture** in the Black Sea area is a relatively recent development and is still not widespread. Much of the technology and production in the region aims for development in the future, but depends of the economic situation and possibilities for funding.

At present, in Romania, the only private company dealing with the culture of the Black Sea mussel *Mytillus galloprovincialis* is located in the Eforie sector (SC Maricultura Ltd.). The farm consists of 10 long-line system structures. The company can obtain a maximum 150 tones/year of mussel prouction. 2002 was the first year for the marketable production: about 100 t mussels and 1 t oysters (Fig.2.43 b.).

2.4.3.2. Secondary sector (industry, energy, construction, other industrial activities)

The secondary economic sector (processing of raw materials and goods - manufacturing, construction, production and distribution of water, energy and gas) is represented by:

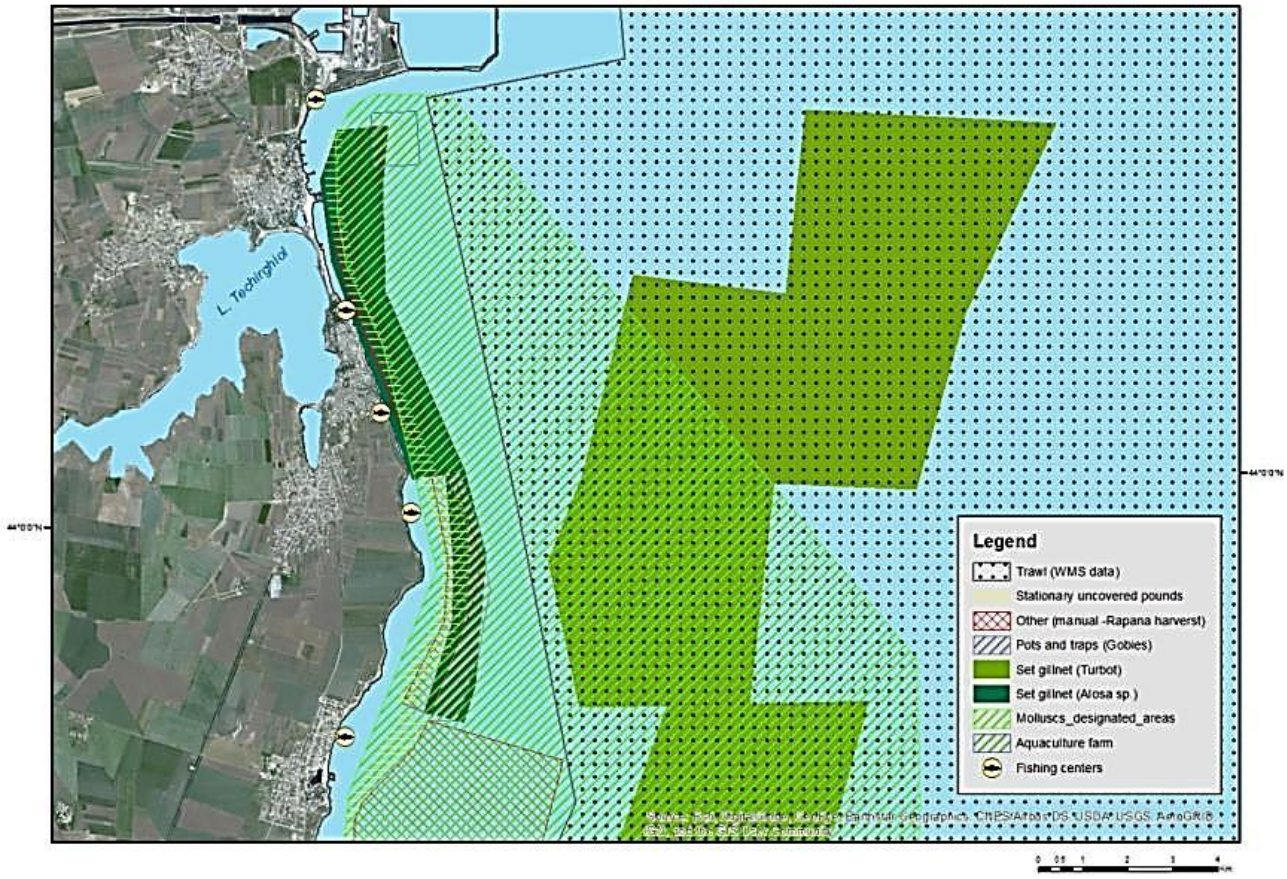


Fig. 2.43. b. Fishing areas by gears in front of Eforie

- constructions - generally private funds, dominated by buildings for residential purpose and trade; it experienced a decrease of ~ 55% of residential construction in 2014 compared to 2012.
- The production and distribution of water and energy.

2.4.3.3. Tertiary sector (trade/commerce, services, tourism)

The tertiary economic sector refers to services for business and consumers - trade, tourism and hotel business, transport, telecommunications, deposits, financial, real estate, services. The Eforie community is mostly touristic, with a significant number of undertakings in this or related fields (many of them owning small businesses). Even if the pace of registrations of companies in the past 3 years has been relatively constant, dissolutions of companies was growing until 2014, so the number of economic agents existing at the end decreased (the most significant percentage decrease being the in 2104, by 13% compared to the previous year).

The port complex consists of the old part to the north and the new part to the south (Constanta South-Agigea). The South Port is partly operational. It has 14.6 km of quays, 74 operational berths and handling capacity for containers, ores, coal, phosphate, crude oil and oil products, rolled metals, general goods for platforms and warehouses. Part of the traffic is handled as ro-ro and ferry cargo. The South Port encompasses the entrance to the Danube-

Black Sea Canal, which is part of Europe's most important waterway, the Rin-Main-Danube corridor.

The South Port has a dedicated river/maritime basin for transshipment of cargo into river barges. Of the cargo handled of Constanta, 80 per cent is bulk cargo. Of that, half is liquid bulk, mainly crude oil and derivative products, and the other half is dry bulk, mainly iron, ore and nonferrous ores, coal, coke, phosphate, apatite, and cereal. The general cargo consists of imports of industrial equipment, foods, fertilizers and chemical products, clothes and electrical appliance and exports of furniture and wood products, metal products, fertilizers, and chemical products, foodstuff, textiles, glass products and cars. (Fig.2.44)

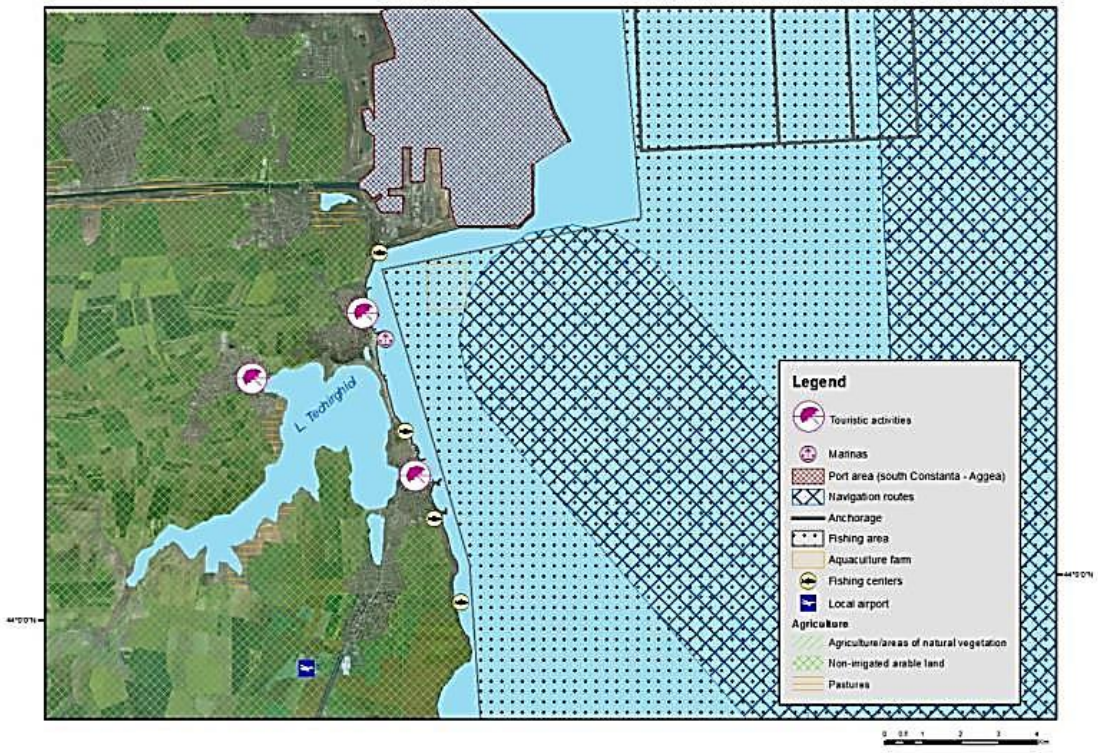


Fig. 2.44. Economic sectors in the Eforie area

The quaternary economic sector is represented by welfare and education.

2.4.4. Key issues, challenges regarding the Eforie sector

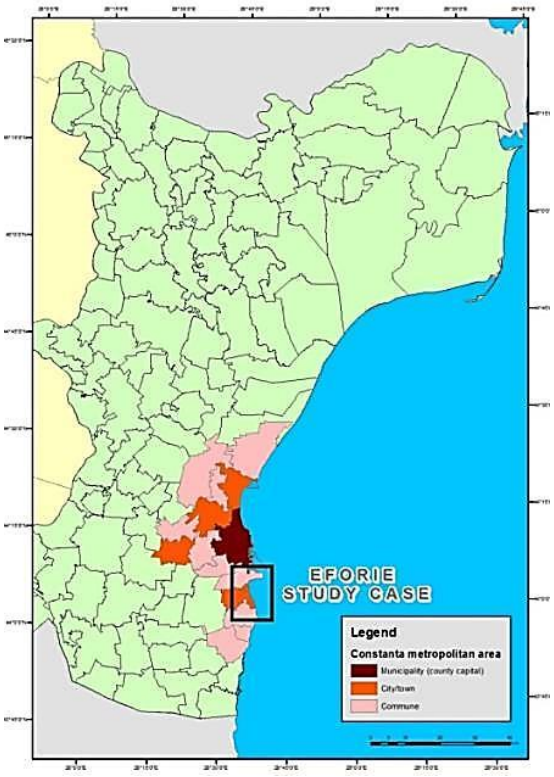
2.4.4.1. Settlements development

2.4.4.1.1. Structure and characteristics (urban-rural) in regional context (Constanta metropolitan area)

The Constanta Metropolitan Area (Fig.2.45) is the first administrative structure of its kind in Romania falling within the EU administrative model, established in 2007. It comprises, apart from Constanta (municipality rank of national importance with potential influence at European level, the most important city in the region South Development - East), a number of urban and rural communities located in the proximity.

The Constanta Metropolitan Area gathers localities up to 30 km from the city of Constanta in an administrative entity, in order to foster the uniform socio-economic development of localities. It consists of 16 municipalities: Constanta City, 5 towns (Navodari, Ovidiu, Murfatlar, Techirghiol and Eforie) and 10 communes (Agigea, Cumpăna, Valu lui Traian, Poarta Alba, Corbu, Mihail Kogalniceanu, Tuzla, August 23 and Costineşti) including

related villages. Within this area, Constanta, with the neighboring localities, focuses a permanent population of 434,265 inhabitants (62% of the total county population), concentrated on an area of only 30% of the county and an average number of floating population in touristic high season of at least 145,000 people. Most of the population is concentrated in urban areas (357,681 inhabitants, of which 283,872 inhabitants in Constanta and other cities components of the Constanta Metropolitan Area), the remaining population of 76.584 inhabitants being concentrated in rural areas.



- **The key challenge** is urban concentration of the population, greatly varyingnumbers of people increasing during summer season because of sunbathing tourism with socio-environmental consequences: the necessity to improve the infrastructure, accommodation and recreation locations, specific services, traditional activities rehabilitation and development, at least with positive impact on the people income, but with huge impact on the environment.
- The main **measures** have to be linked with ICZM, including a good management of solid and liquid wastes, techniques for water treatments, limiting the contaminants releasing.
- Adding, as very important:

Fig. 2.45. Constanta Metropolitan Area

- Mitigation of the impact of the increasing population from the coast on the marine environment.
- Development of the bio-technologies (aquaculture, etc.) for water filtration and purification.
- Supporting environmental protection and biodiversity conservation.

2.4.4.1.2. Housing, density of building zones

. The development of Black Sea resorts began in the late nineteenth century, following the administrative organization of Dobrudja, annexed to the Romanian Principality after the War of Independence. A tentative system of holidaying and spa treatment services was built, but at a local scale, which was also supported by the Romanian Royal FamilyThe "Techirghiol - (Ion) Movilă" bathing establishment, named after its founder, was developed on virgin ground, between the beach and Techirghiol village, near the lake of the same name and became later Eforie South, when it was separated from the town of Techirghiol in 1921, following the implementation of a local systematization plan. Fig.2.46.

Eforie North, formerly part of the Techirghiol commune, was transformed into a bathing resort beginning in 1920 and became an independent urban commune on 1 November 1933, when it was separated from Techirghiol and renamed "Eforia bathing and spa resort".

The development plan for the Techirghiol - Eforie Nord resort also included a number of construction phases that took concrete form in the appearance of new parcels of land.

Reports from that period provide a true picture of the town's urban planning history, which evolved without any real coherence. Fig.2.46.

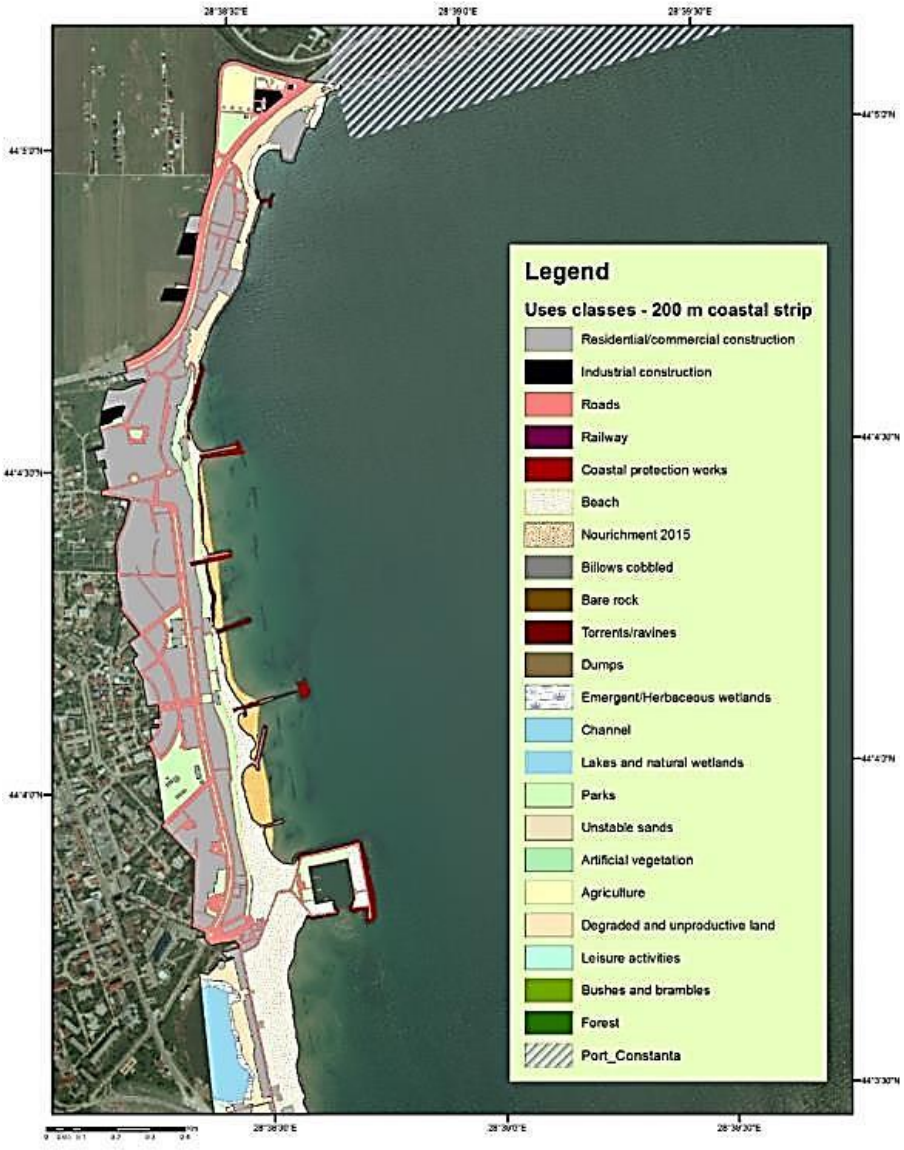


Fig.2.46. Land uses in coastal zone – Eforie North

In 1936, the resort had five hotels, two hot and mud baths, including one that was new, a cold seawater bathing facility, a space for the sale of food produce, and a town hall run restaurant, built in 1936, which shared a building with the post office and police station.

So that a town whose population doubled or tripled in the summer season would function well, the regulations divided the territory into four zones, according to building types: Zone I - the commercial quarter and civic center; Zone II - the district of grouped villas; Zone III - the district of individual villas; Zone IV - the workers' district.

After the Second World War, in particular after 1955, Eforie North developed according to a vast systematization plan for the Black Sea coast (1955-1965), which annexed the old part of the town, building outside it and not on top of the original structures. The main objectives of the communist state were to create two large zones of differing character, one to the south of Constanța, made up of Eforie South, Eforie North, Techirghiol and Agigea, which were to form a single complex for health cures and treatment, and the other to the north of Constanța, set aside exclusively for rest and recreation.

The division was carried out over time, by means of the differentiated reorganization of the towns, the consolidation and modernization of beaches, the expansion of seafront promenades, the establishment of all the necessary facilities, and the most efficient exploitation of Techirghiol Lake and its curative mud. The extension of summer-season buildings in Eforie North added to the functions of the old villas and nationalized hotels, and the architects involved in this program initiated by the communist state were able to

insert the new buildings into vacant lots, linking them up to the built areas, as part of a vision that took into account the existing urban core.

At present, the urban system in the Eforie's Romanian Black Sea area is extended with close connection with agricultural lands of the town area, together with the mass-tourist development on the sea shore, being focused on residential development related to the coastal strip in close proximity of Black Sea or Techirghiol Lake.

In modern times, the regression of architectural values is noticeable, despite the differentiated reorganization of the towns, and the consolidation of beaches. This is a serious issue, acting irreversibly to the detriment of the conservation of the local character.

After 1990, the need for space for new constructions, especially private homes and small accommodation units, resulted in the city expanding, especially in the area near the sea (Fig. 2.47, 2.48, 2.49). Several buildings in the area adjacent to the Lake Techirghiol sector appeared, which gradually destroyed the dune system. The constructions were carried out at less than 100 meters from the shoreline, in some cases even less, and are heavily damaged during storms.

The key challenge, The **main measures** and addings are underlined during the stakeholders meetings (Chapter 4.5.4)

*2.4.4.1.3. **Community services** (water management, power generation and distribution, production and transport of heat, domestic waste management)*

Drinking water supply in Eforie is drawn from deep sources from various drilling depths in a centralized system. The first underground water catchment was completed in 1930 by wells in Eforie-North, with a flow rate of 400 m^3/day, which operated until 1958. Between 1950-1962 the water supply system of the coast was developed through deep drillings at Eforie North, Eforie South and Techirghiol, and construction of 2 tanks (2 x 1,000 m^3) and a water tower (volume 300 m^3) at Eforie North and Eforie South, 2 tanks (2 x 1000 m^3) in Techirghiol, 50 km of distribution network and performs adduction 500 mm Biruinţa - Eforie South Castels.

The Eforie area is currently served by one wastewater treatment plant located in Eforie South, with mechanical and biological facilities, rehabilitated in 2010-2015 through the Sectoral Operational Programme Environment. Until 2010, the station had only mechanical treatment and discharged directly into the bay north of Cape Turcului.

Given the age of the former treatment plant and the advanced state of degradation, it was necessary to demolish almost all the structures and reconstruct other facilities fitted with new equipment. The new wastewater treatment plant is located in Eforie South, between Tuzla swamp and Lake Techirghiol, with a maximum capacity of 745 liters/second.

The sizing of the technical capacity takeover of wastewater was done for 140,000 people, the population during the summer, and 69,000 inhabitants, the permanent population. The objective is to collect and treat wastewater from Eforie, Agigea, Tuzla, Techirghiol, Costinesti and Schitu, being integrated into the sewage system. The Eforie South treatment plant was rehabilitated and built as a station with tertiary treatment, sludge stabilization for operation under load which envisages:

- Biodegradation of organic carbon compounds, nitrification and denitrification;
- Dephosphorization so that effluent treatment plant complies with the provisions of regulations for quality in force, unloading discharges into the Black Sea.

- Stabilization of sludge from the process, until the final disposal conforming to environmental conditions;
- Dehydration stabilized sludge for final disposal;
- Transport of sludge to final storage location;
- Treatment and removal of odors for reduction of specific pollutants resulting from degradation of organic substances produced in treatment plants, taking into account the objectives closing premises or basins cover.

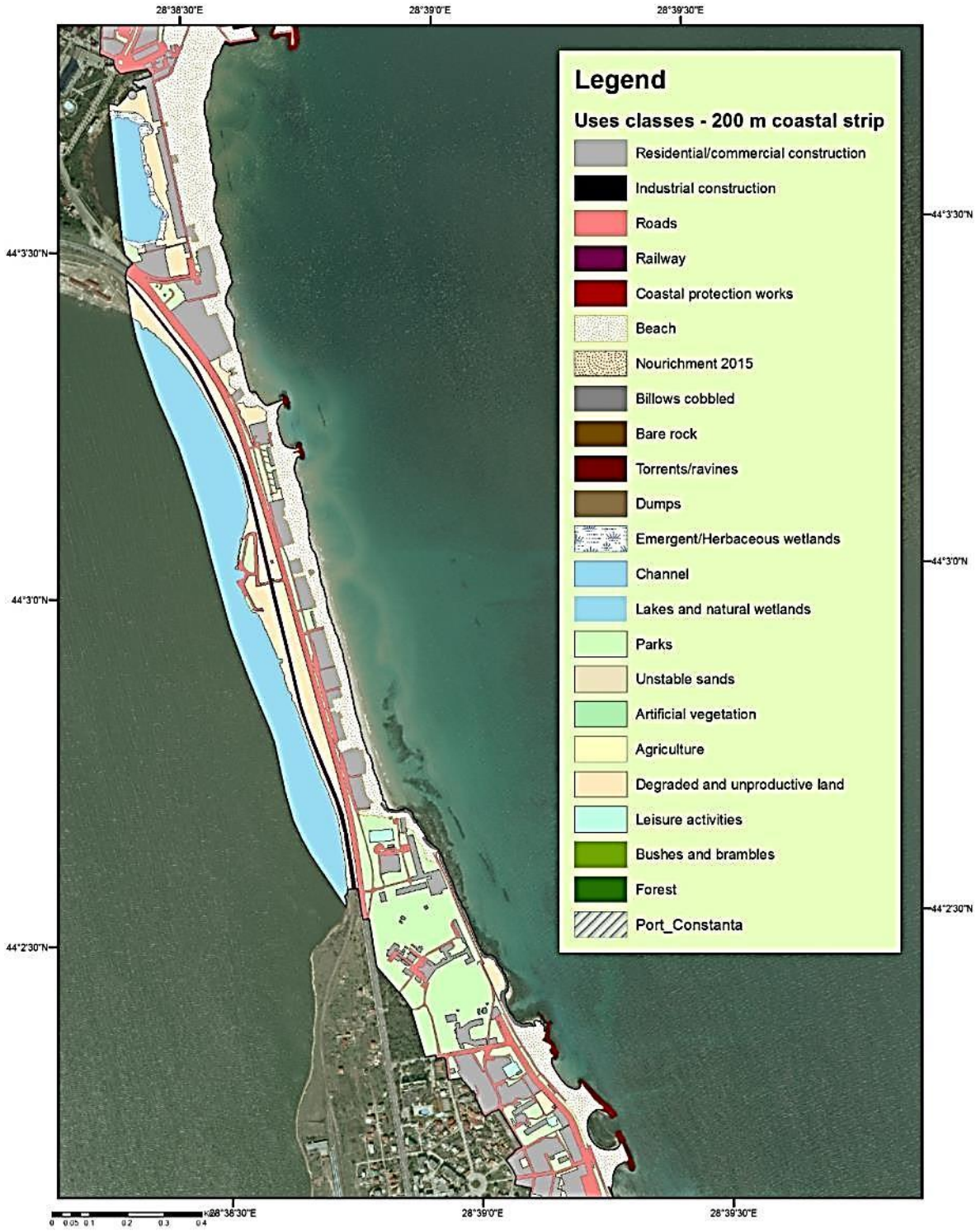


Fig.2.47. Land uses in coastal zone – Eforie Central part

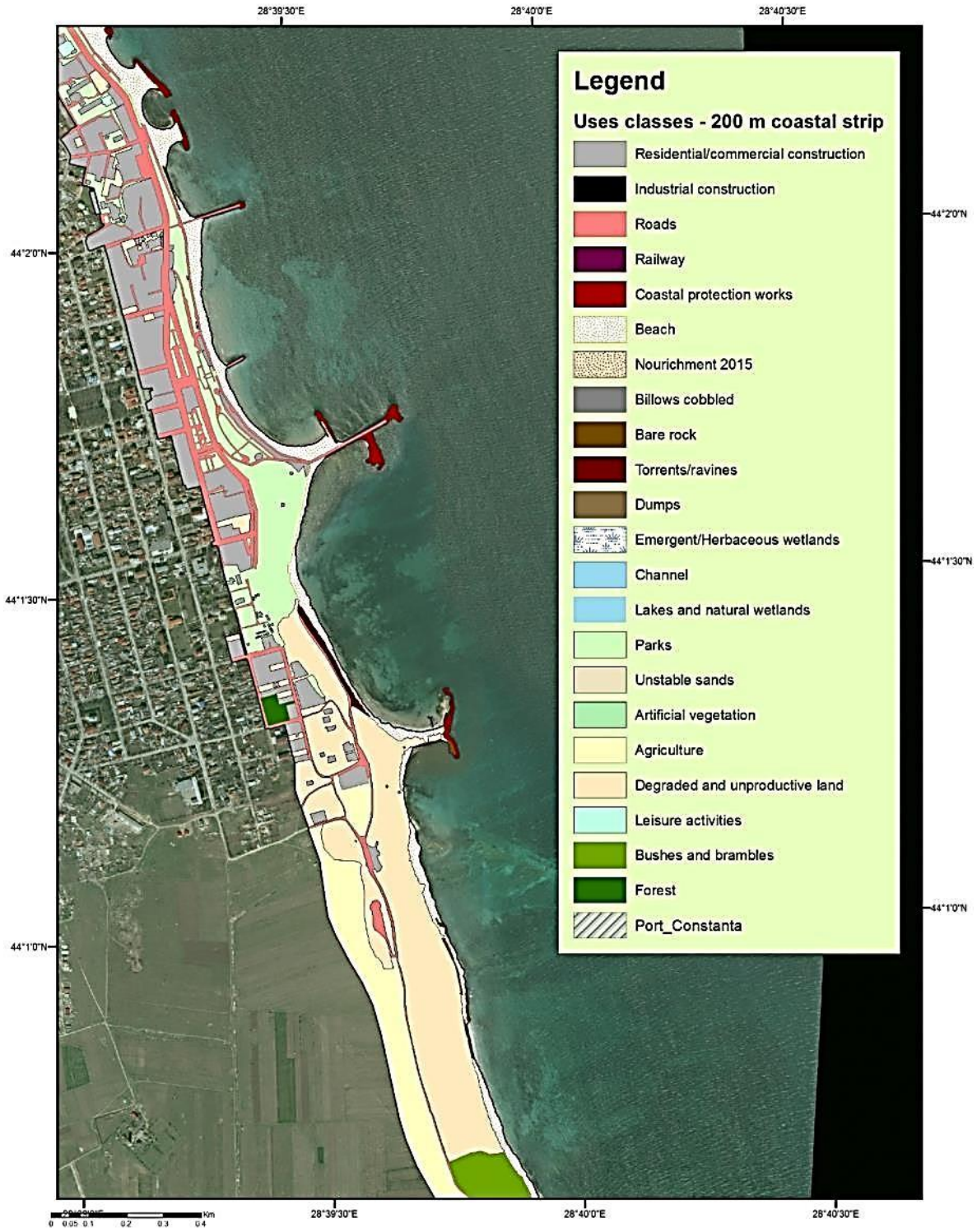


Fig.2.48. Land uses in coastal zone – Eforie South

Through the rehabilitation of the wastewater treatment plant, the situation was corrected where untreated wastewater was discharged directly into "sensitive waters" of the Black Sea, thus improving the quality of bathing water in the seaside area, thereby lowering the risk of illness to the population and relaunching the local industrial fishing activity safely. Also, the station meets EU standards on the quality of treated water, protecting environmental conditions of the coastal area, contributing to population health through

enhancing the quality of bathing water and creates conditions for "Blue Flag" classification of beaches from this area.

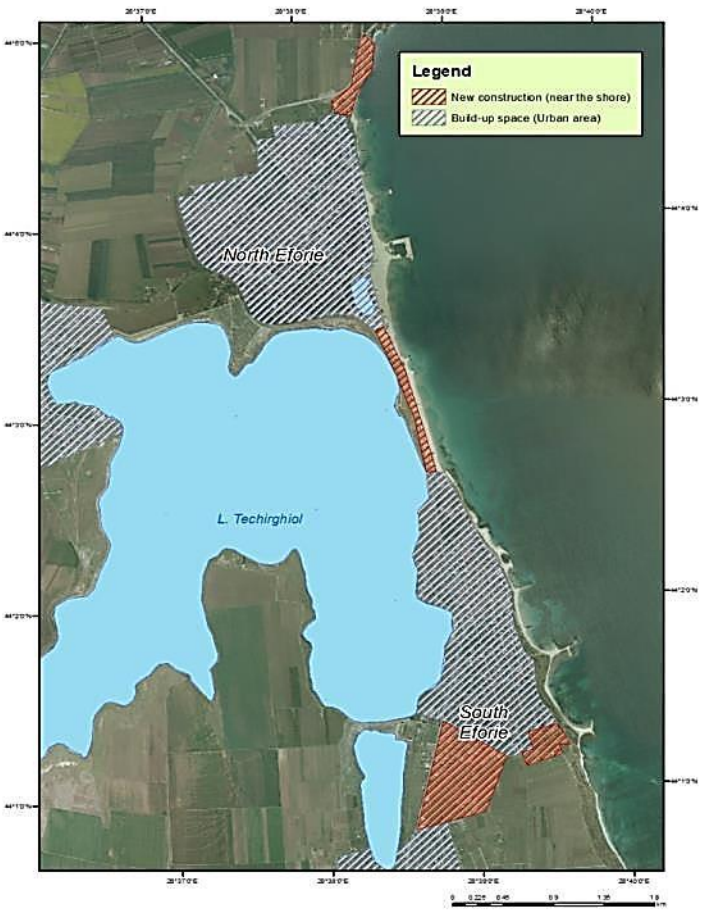


Fig. 2.49. New buildings area in the Eforie sector

In terms of drinking water supply, the area is served by the "Littoral" interconnected system of the Constanta County Autonomous Water Administration (RAJA). According to statistics, in 2006, the length of the drinking water distribution network was 70.3 km, the percentage increasing no more than 10% compared to 1992. The length of the sewage network was 97.1 km in 2006, growing by only 10% compared to1992.

In the frame of the project "Rehabilitation and modernization of the water supply and sanitation in the region of Constanta, Ialomita", financed from the Cohesion Fund, Priority I of the Sectoral Operational Programme Environment, completed in 2015, the expansion and rehabilitation of water sources were realized, as well as investments in water supply and waste water sector. After completion of the investment, the proportion of the population connected to the water supply system increased from 93.1% to 97.7%.

Along with other ongoing projects, the percentage will reach 100%, thus achieving compliance with the requirements of European Directives.

The completion of these projects will ensure increased coverage of treatment of wastewater, reducing the risk to health by extending the sewerage network to cover the population is currently dependent amenities disposal to reduce the risk associated pollution of surface water and groundwater and reduce flood risk to sewage collection networks.

The Eforie area is not currently connected to the gas supply, the process is ongoing. Distribution and supply of electricity is provided by ENEL Distribution Dobrogea, the area being fully electrified.

Regarding the production and distribution of heat, Eforie has partially centralized production and distribution of thermal energy. In 2006 the thermal energy distributed was 3457 Gcal.

Currently, the Constanta County sustainable waste management is assisted by the County Waste Management Plan, a strategic document which aims to design waste stream through a global vision of the stages of waste management and help identify gaps and weaknesses of the system to be solved by integrated planning and sustainable solutions and identifying economically and ecologically adapted to specific local conditions.

Waste of any kind resulting from human activity is an actual issue, due to continued growth in quantities and types and also because of increasing raw materials quantities, reusable materials and energy that can be recovered and introduced into the economic flow.

The current practice of collecting, transporting and landfilling waste is still inadequate in many cases, causing a negative impact on the environment and facilitating the multiplication and dissemination of pathogens and their vectors. The main forms of risk and impact caused by deposits of municipal and industrial waste are: changes in landscape and visual discomfort, air, waters pollution, changes in soil fertility and composition of ecological. Air pollution is caused by the landfill gases, the uncontrolled burning of waste and improper way of collecting and transporting waste.

There is an inert waste storage facility within the Constanta port, Gate 9, near the berth 103, on specially arranged site. It has an area of 41,472 sqm and, at present, the waste existing in the perimeter is about 90,000 tonnes. The current capacity of the landfill is 45,000.37 cubic meters, and after closing the ramp (undefined term), the land will be used for placement of port units.

The Cumpăna sorting station has a sorting capacity of 450 tons/year; in 2013 were sorted about 99 tons of recyclable waste.

Biodegradable municipal wastes represent the biodegradable fraction of household and similar mixed wastes collected and the biodegradable fraction of municipal waste collected separately, including wastes from parks and gardens, markets, street waste. In the Constanta County, in urban areas there are no initiatives for separate collection of bio-waste.

The separate collection of recyclable waste is achieved in areas where separate systems of recyclable waste collection from households exist (Năvodari, Constanta, Eforie, Corbu; Cumpăna; Ovidiu). In 2013, SC POLARIS M HOLDING SRL completed the collection points in Eforie with 36 selective waste containers 2.5 m.

The key challenge, The **main measures** and addings are underlined during the stakeholders meetings (Chapter 4.5.4)

2.4.4.2. Tourism activity

Tourism, along with port activity, is the strongest economic sector and a key development pole for the Constanta Metropolitan Area. This sector had enjoyed a strong interest in the 2007-2013 programming period, where a number of important projects of modernization and creation of infrastructure were financed through the Regional Operational Programme.

Spatially, Eforie North and South are characterized by a high tourism potential. The existence of a rich heritage of natural resources - spa and wellness potential of the Black Sea littoral, parks - and cultural - historical sites, monasteries, very close Danube Delta, - has boosted the sector.

The European Social Fund under the Operational Programme of Administrative Capacity Development, called DMI 1.3 the *Improvement of the organizational effectiveness*; SMIS Code 15312; Contract funding from the European Social Fund under Operational Programme Administrative Capacity Development no.212 / 02.11.2010- with the with the Ministry of Interior Administration led to important changes in the activity of Eforie City Hall:

- Improving government services through a planned and structured transmission of information with high interest in the needs and goals of the institution, under the 2010-2015 Development Strategy of the Eforie City Hall Administration;
- The improvement of control activities through effective communication, reducing the time to resolve tasks;

- In January 2012, 57 civil personnel were trained, 260 days, which received diplomas specializations as procurement expert, financial manager and teamwork, inspector of human resources, English for the local administration, ECDL, working in team frame, interpersonal communication, sustainable development, public administration, equal opportunities in public administration and quality management systems for public administration.
- The purpose of the training was to improve the organizational effectiveness of Eforie City Hall.

Other projects proposed and implemented by Eforie City Hall coordination, were 1) Engineering and Construction Projects; 2) Ecological Projects; 3) Projects for beaches consolidation. Other projects are foreseen: 1) Tourist promenade of Eforie Nord; 2) Project untitled *Walking on the bike at European level;* 3) Recreation parks modernisation.

The Eforie resorts have a double specialization, respectively leisure and spa, and offer many possibilities for the cure and treatment of a wide range of diseases using the salt water and sapropelic mud. The region's tourism potential has allowed the development of tourist activities focused on different types of tourism: health tourism, leisure and recreational tourism, cultural tourism, soft sport tourism, business tourism. Natural therapeutic resources are indicated in various treatments. Two important tourist segments prevail, the first is the passive tourists, the "sunlust" type, who desire sun and beach services, representing the majority, and the tourists who prefer health treatment and therapy. An additional segment is represented by people living in the surrounding areas (i.e. Tulcea, Braila, Galati counties) or from Bucharest (access by motorway) who prefer seaside resorts, including Eforie, for weekend relaxation.

The total accommodation capacity of the resorts is more than 16,500 places in hotels of 1-4 stars (87 hotels, totalizing more than 12,000 places), villas, bungalows and guesthouses (almost 4,000 places). In general, large accommodation is predominant (the average number of accommodation units is rounded to 105 for Eforie North) and the predominance of hotels as accommodation unit (80% of the total number of resort accommodation), the same is applicable for restaurant as type of food unit (81%) (Fig. 2.50)

The analysis of the number of beds in the period 1990-2015 (Fig. 2.51) showed a decrease by almost a third in 1994, and more than 50% in 2011 compared to 1990. The main reason for this decrease is the takeover of hotels built during 1960-1990 by private companies that have not invested in their modernization and remain in disrepair.

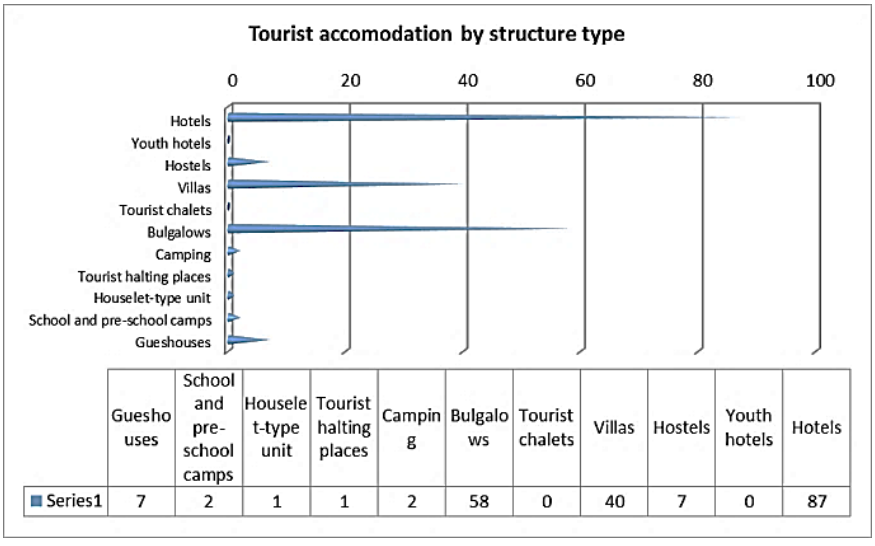


Fig. 2.50. Structure of accommodation facilities in the Eforie sector

The accommodation capacity increased by ~ 1,000 beds in 2015 compared with previous years, due to the partial reopening of the "Steaua de Mare" Complex (with a total of more than 1,000 beds at full capacity) and the construction of new hotels, but without the large capacity of complexes of the period before 1990. The number of beds is higher if we take into account particular accommodation without tourist classification, which do not appear in statistics.

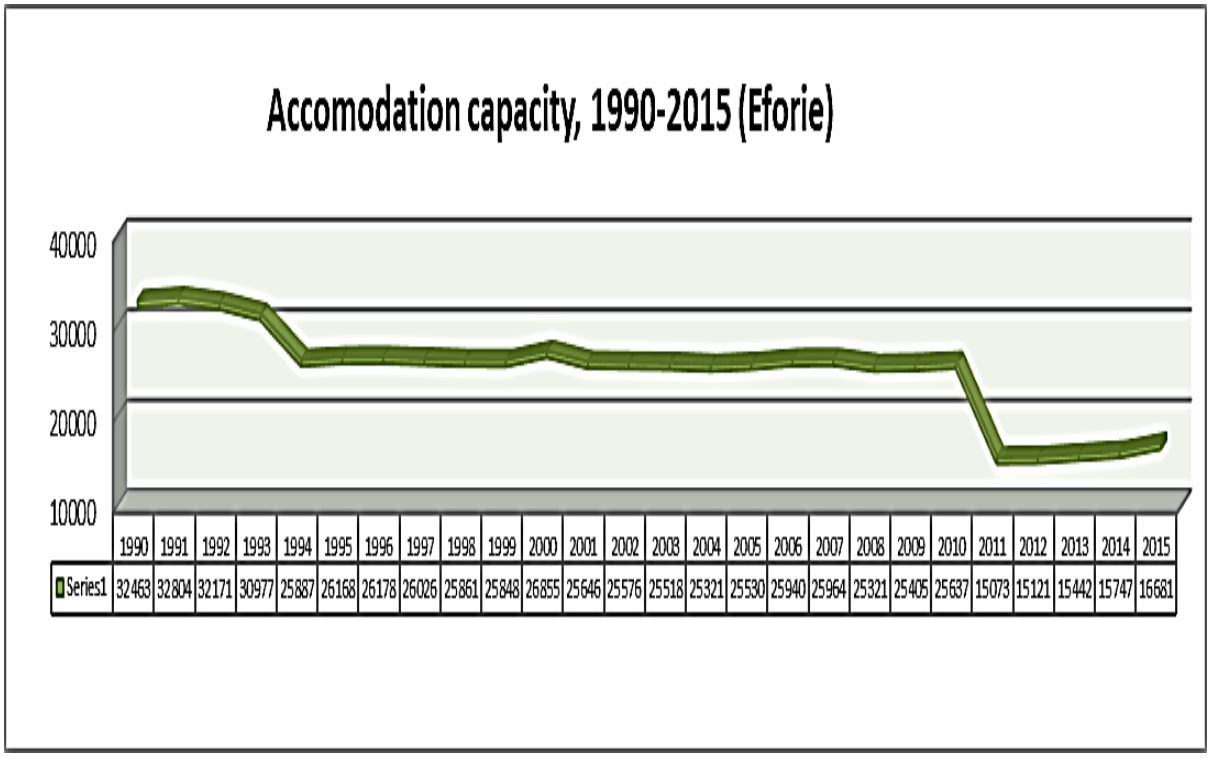


Fig. 2.51. Accommodation capacities in the Eforie sector

In terms of tourist traffic (Fig. 2.52), the analysis of statistical data on the number of arrivals has highlighted several aspects:

- Pronounced seasonality, the summer months, particularly July and August being the busiest, reaching over 50,000 arrivals; the peak month is August, for both domestic and foreign tourists, when considering arrivals and overnight stays. The resorts are affected by seasonality, because almost all accommodation units openness in April and are closed in September or October. The treatments facilities contribute only in a limited extend to this reduction.
- The number of arrivals increased in the period 2010-2011 by 10-20% per year, following a period of decline (2012-2013) by about 25% in July (during the economic crisis that overlapped) and an increase of more than 25 % in 2015 (August);
- The year 2016 brought significant growth of over 20% in July (statistical data for August are not available yet); the increase in 2015-2016 was due both reorientation of tourists, both Romanian and foreign, to the Romanian coast in the context of political events in Turkey, but also because of beaches recovery (through artificial sanding) in the framework of the protection and rehabilitation program of the southern part of the Romanian Black Sea coast - Constanta and Eforie North.

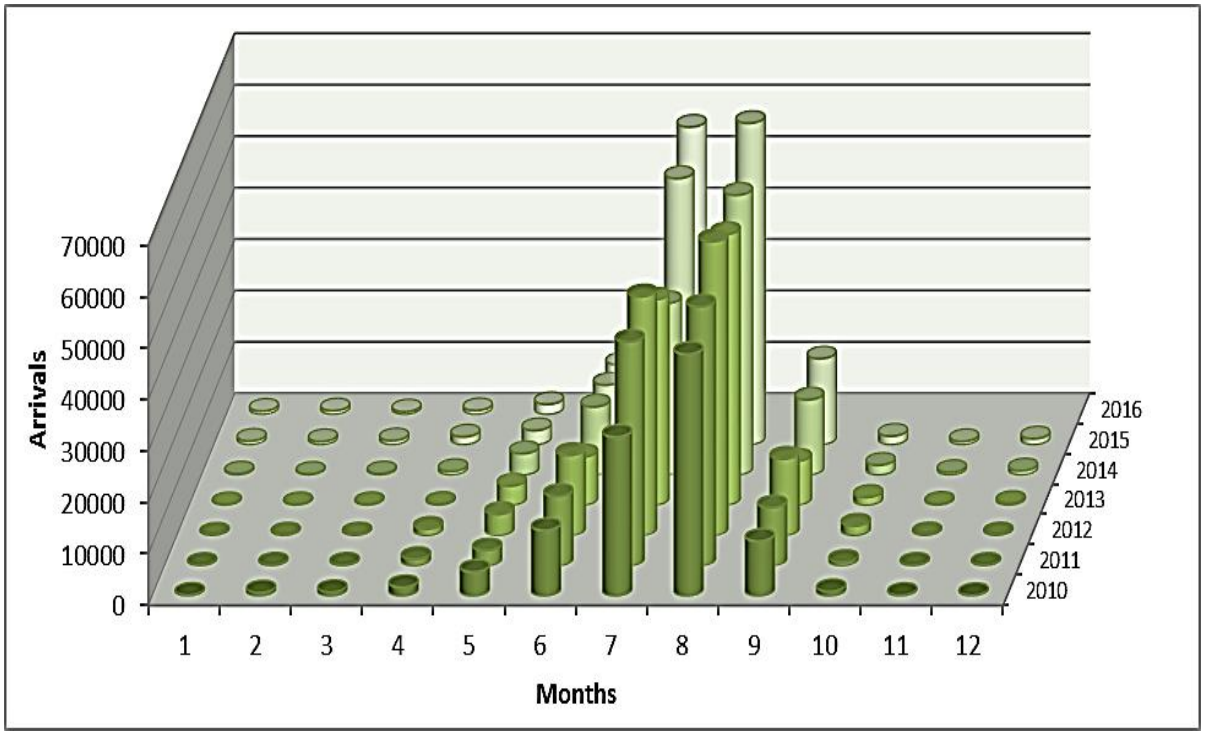


Fig 2.52. Annual visits for the Eforie sector

3. Pressures

3.1. Natural hazard, risks, vulnerabilities

3.1.1. Coastal erosion

3.1.1.1. Management plans, technical studies, research projects aimed to minimize coastal erosion, increase the value of the coastal zone and create new tourist beach areas

In order to minimize coastal erosion, increase the value of coastal zone and create new tourist beach areas, during 2005 - 2013 scientific and technical documentation was developed for a Master Plan of the Romanian coastal zone of the Black Sea based on two projects:

- "Study on the Protection and Rehabilitation of the Southern Romanian Black Sea Shore" (2005 – 2007, JICA)
- "Technical Assistance for the Preparation of Projects under Priority Axis 5. Implementation of adequate infrastructure of natural risk prevention in the most vulnerable areas. Major intervention domain 2 - Reduction of coastal erosion" (2010 – 2013, beneficiary ABADL).

The Master Plan provides the strategic vision of Romanian Black Sea management, providing a prioritized, sustainable, long-term approach, oriented to manage and combat erosion consequences and implications on the environment, marine ecosystems, economic and social values of the coastal area.

In these projects, a plan has drawn up to protect the coast, consisting in protection measures for short, medium and long term, which will run for more than 30 years. These works include measures to reduce wave energy (height) that reach the shore, silting of beach with dams for sand stability (spurs) and measures to retain sand on the beach (by

building new dams, repairing the existing "breaking wave" dikes and construction of dikes perpendicular to the shore).

In the short term (2013-2015), five priority projects are planned in the southern Romanian coast, in order to reduce the risk of coastal erosion and rehabilitation for 7.1 km of shore in the next location: South Mamaia, North Tomis, Tomis Center, South Tomis and North Eforie. The beach area resulted after nourichment is about. 33.7 ha.

3.1.1.2. Local conditions

3.1.1.2.1. Hydrological factors

The highest frequency - 37-40% of cases - is represented by waves with a height of 0.5-1.0, followed by waves with very low height (0.0-0.5 m) - 27-28% of cases - and waves with height 1.0-1.5 m in 17-18% of cases. The average value of the wave height was 0.95 m and ~ 3.7 m height is exceeded only in 1% of the cases. The frequency of waves more than 4 m high is very small, less than 1%.

Regarding the seasonal distribution - the average height of waves in winter (November to March) is 1.0-1.2 m, 2.2-2.3 m wave exceeding 10%, and those which exceed 4.1-4.4 m just 1%. For the warm season, the average values are 0.78-0.79 m for wave height.

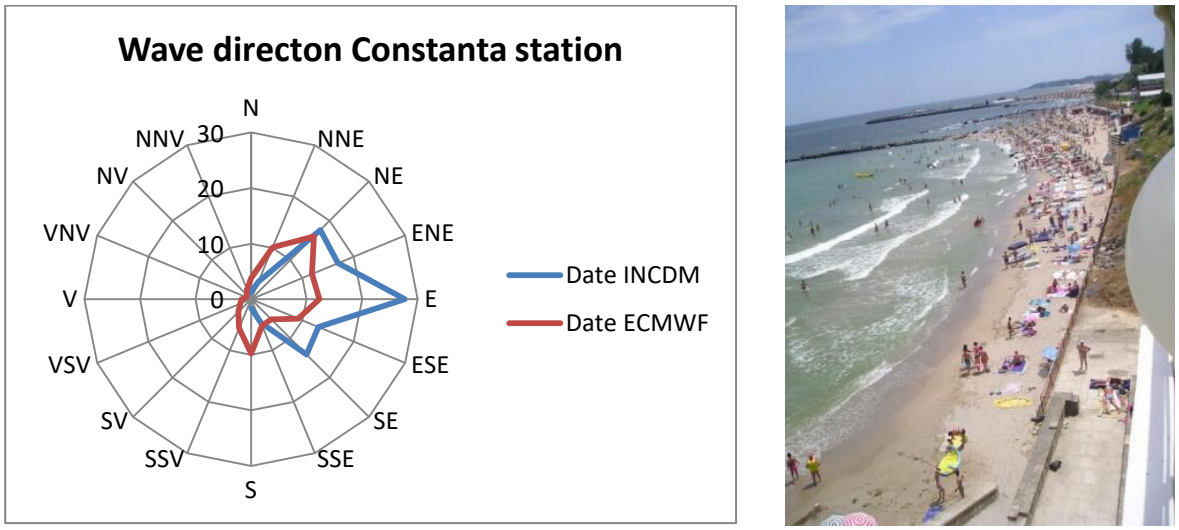


Fig. 3.1. a,b. Wave direction Constanta (1971-2005) producing coastal erosion

The frequency distribution of the wind directions correspond with the waves regime, having the highest frequency in the directions NE and E (28% for the direction E, *INCDM data*). For the same directions the highest waves were also recorded

Currents (Fig.3.2 a,b) in the Eforie Bay are southern currents, but they are mainly influenced by wind variability (N, NE and E) and by the marine/rim current which is anticlockwise. The local coastal currents are influenced by marine obstacles such dikes orientation and Danube river inputs

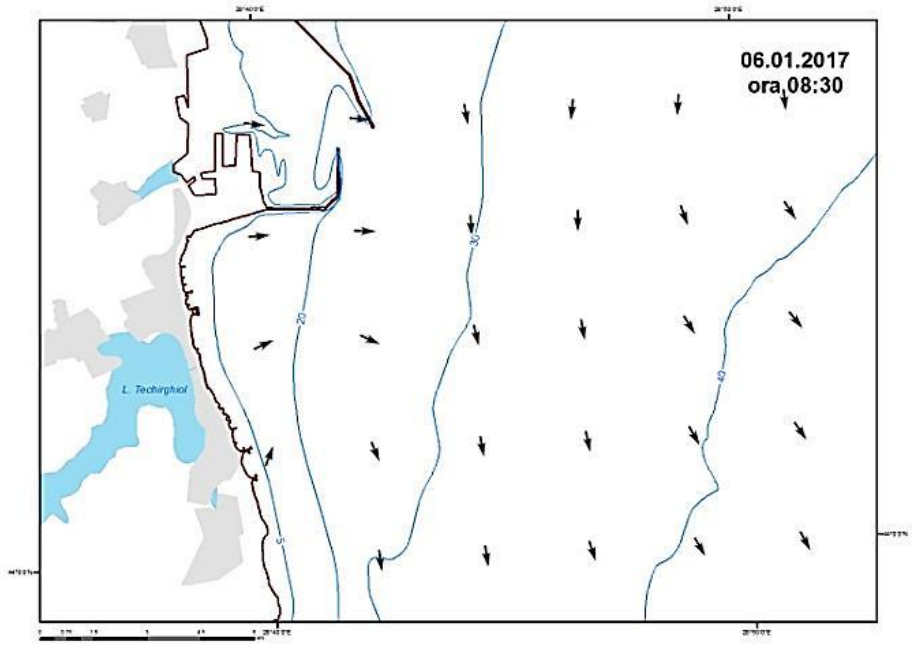


Fig. 3.2.a. Currents' direction (model results) a) N-NE wind

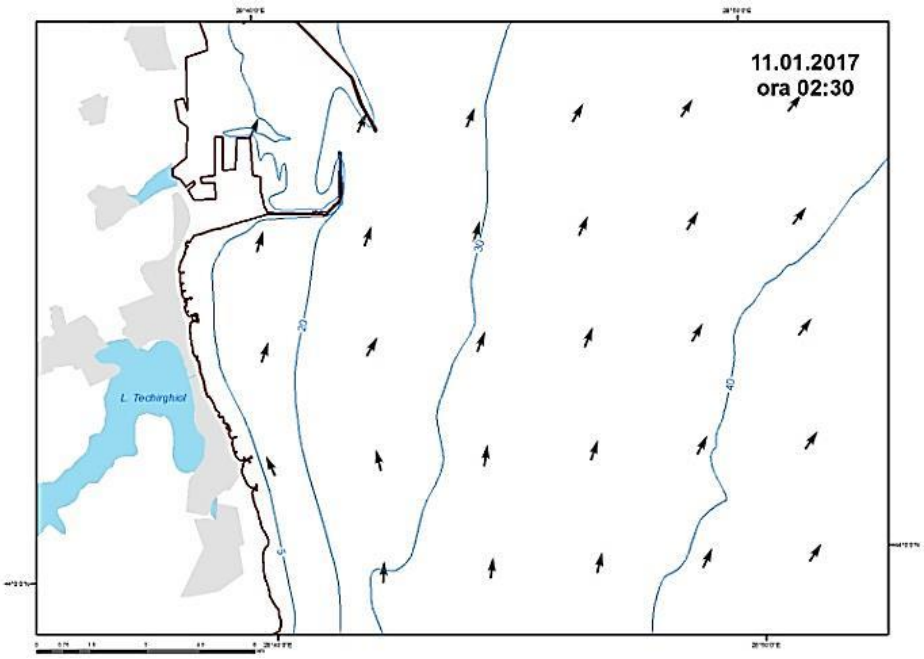


Fig. 3.2.b. Currents' direction (model results) b) S-SE wind

The sea level is a complex parameter, in medium and long terms, which determines the position of the shore-line and in the short-term may intensify the erosion of flooding areas.

For the Romanian seaside, the measurements from Constanta (1933 - present) show an average sea level of 16.1 cm, a minimum of -2.4 (1943) and a maximum of 32.4. In 2005, the sea level rise trend was 1.34 mm / year for the period 1933-1997 and 1.9 mm / year for 1997-2014.

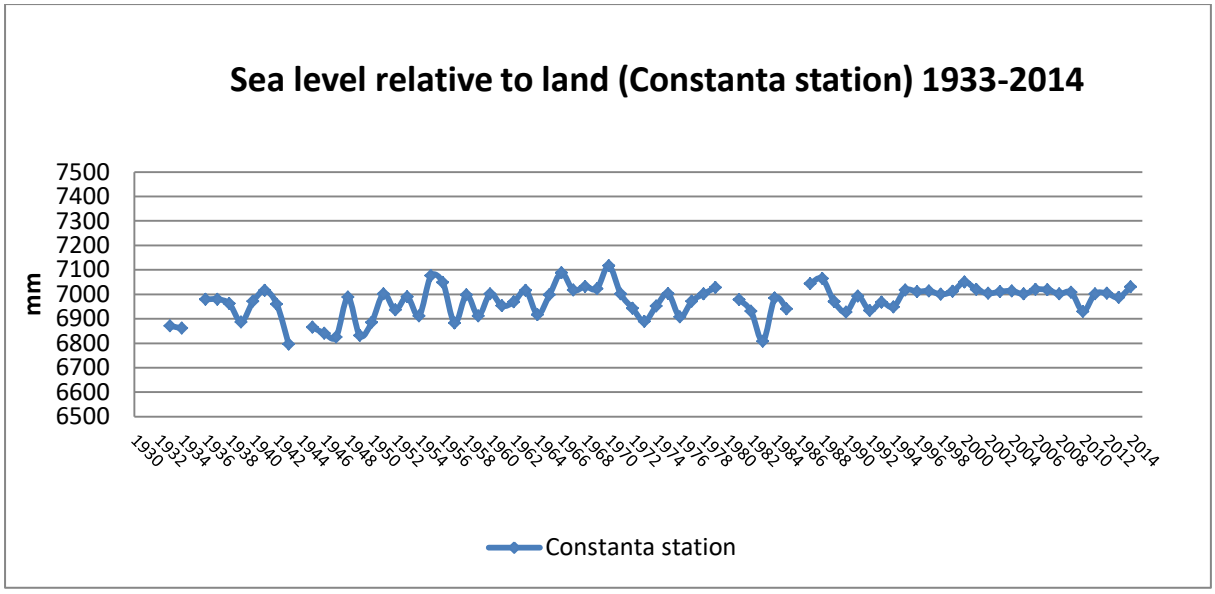


Fig. 3.3. Sea level in the Constanta station (1933-2014, NIMRD data)

Sea level variations due to meteorological causes are more pronounced than tides, which at the Romanian shore have values of maximum 20 cm. The cumulative effects of forces acting on the sea surface can induce in these area variations (relative to the reference level MN75) from -30 cm to +75 cm in case of strong storms (Fig. 3.3).

3.1.1.2.2. Geology and sediments

The concave cliff side arches between the promontories are the limestone Sarmatian plate headlands which appear at the surface, forming the foothold for wide bays. The Sarmatian plate continues from the promontories to the sea at shallow depths.

Natural cliffs are formed (constituted) from a succession of loess levels that are separated by paleosoils, which have at their base red clay horizon from the Villafranchian age, that sit on organogenous Sarmatian limestones.

Generally, the cliff beaches surfaces are poor, this small extension on the one hand is due to the relatively high platform coastal slope near the shoreline (1: 5-1: 20) and on the other hand to the greatly diminished intake of silt.

The stratification of the shore (cliff) is represented by:

- to a depth of 2.8 m fine sand to coarse (loess), brown - gray
- 2.8 -8.0 m - deep gray clay, plastic and hard surface
- the base to a depth of 8.0 m made of degraded limestone bedrock.

Stratification of seabed - Eforie North:

- seabed up to a depth of 2 m - sand
- Between 2- 5 m depths - layer of sandy clay;
- The depth of 5 m - base composed of degraded limestone bedrock.

The sand in general has a yellowish-brown color and it is course or medium (mean diameter of grain 0.3 - 0.6 mm). The organogenous sand is predominant and it is made from crushed oyster shells - 62-83%, limestone fragments - 3-25%, quartz up to 25% and heavy minerals 0.01-16%.

The site of Eforie includes submerged beach of the littoral bar Eforie, that separates the Techirghiol lake of the Black Sea. He is included in southern Romanian littoral unit, consisting mainly of soft cliffs comprise mainly of Quaternary loess, with the presence of discontinuous base of Sarmatian limestone, interrupted by low sandy coastal longitudinal bars located in front of coastal lakes. On this littoral unit, there is a heterogeneous lithological constitution of the seabed, dominated by the presence of finer or coarser sands. Subsidiary, it meets Sarmatian limestone beneath the sands emerging as elevated, known as reefs. Sedimentation processes are dominated by wave action and longshore currents, being specific to sandy beaches processes.

Southern and southeastern parts of the perimeter is dominated by submerged limestones, encountered both as smooth plate or reef form with a height of up to 4-5 meters above the adjacent bottom. The reef is characterized by an irregular surface, marked by limestone fractures. In lowland areas between limestones promontories are deposits of sand and the carbonated plate is covered in many parts with compact coarser gravel, mixed with sand.

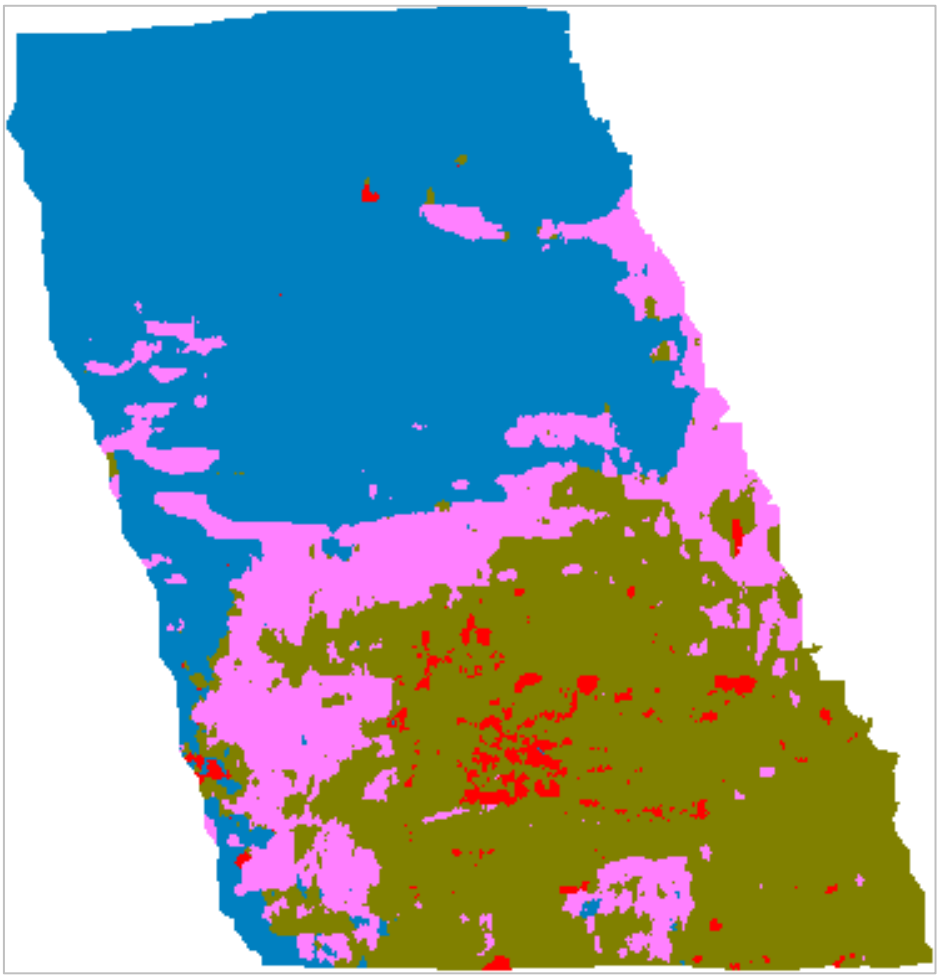


Fig. 3.4. Acoustic facies distribution - Eforie site. Fine sands: blue, violet - coarse sand, olive - coarser gravel limestones, red - rock exposure limestone

The seabed of the northern half of the perimeter is covered with sandy sediments, sometimes with undulations induced by longshore current, mainly in the central-eastern. In the central-western zone an extensive general east-west orientation is observed, covered with coarse and very coarse sand fractions. Sands coarse clasts sometimes presents numerous fine detritus fraction. *Litoclasts* identified have diverse origin, and they are carbonate type, but its meet green schists and quartz fragments, in their vast majority being resulted from the disaggregation of the limestone seabed or from adjacent cliffs and blocks, including concrete with varied lithology used in coastal engineering works and destroyed by repeated action of exogenous agents.

The disposal of the coarse sands, bodies' shapes and its undulations on their surface suggest a connection with the sea currents. More than 50% of the perimeter is covered by the fine sandy sediments. Around obstacles on the seabed in the north and northeast, due to fishing gears and abandoned stones, the bottom currents have dug elongated forms of erosion, having depths of decimeter order and metric sizes. These structures are arranged in alignment with the overall east-west orientation, with the same orientation as the bodies of coarse sand. (Fig. 3.4.)

3.1.1.3. Shore and seabed geomorphology features and sediment transport

The **Eforie North - shore sector** is characterized by landscaped beaches at the base of strengthened cliffs. The 10-15 m high promenade is arranged in steps and grassy slopes, with longitudinal paved walkways and access stairs. At the base, a retaining wall with vertical parapet of stone blocks consolidate almost the entire length. When the infiltration of surface water (groundwater aquifer) reaches the clay level which is relatively impermeable, it will accumulate, causing landslides and cliff collapses. Added to this is the direct abrasion of waves at their base in areas with narrow beach.

The **Techirghiol littoral belt** is a beach-barrier which closed Techirghiol Lake toward the sea. With a width of 150-200 m, the coastal belt which separates the marine firth relict of Techirghiol stretches over a length of 2 km between Eforie North and South. In natural conditions, the strip would have had heights of 1-2.5 m in Eforie North and 3.5-5 m in Eforie South, with the development of dunes, generally stabilized with xerophile vegetation. Currently, the sand belt's height doesn't exceed 2 to 2.5 m, the dunes are totally destroyed by buildings that have been built on the beach. The shore is straight. The average diameter of the sand grain is ~ 0.3 mm.

The Eforie South sector is a cliff sector, which arches between promontories that end with abrasion thresholds (submerged platforms); beaches are narrow, housed in coastal wells (large bays with poor circulation of water between them). The cliff has a height of 30-50 m, its embankment is grassy along the beach, and is equipped with walkways and access stairs which are affected by subsidence processes. The entire sector has been severely affected by erosion. At Cape Turcului, the land subsidence and erosion have affected the entire cliff, from the top of its slopes.

The submerged relief is a complex one, especially in the shallow water due to the discontinuous presence of the Sarmatian plate, on both extremities of the sand barrier, characterized by relatively regular, but steep slopes of the profiles.

The Eforie Submerged Beach is the only beach at the southern Romanian coast that has not been changed so far through the construction of massive structures to protect the coastline. Here is the only place where the natural hydrodynamics, sedimentary dynamics, habitats and characteristic species of an exposed sandy beach are preserved. Here mid and infra

littoral sandy habitats have the biggest share and the best condition conservation state of Romania.

Coastal sediment cells are defined as units where natural processes are relatively autonomous with distinct sedimentary intakes (source), transported volumes (sediments) and outputs (accumulations or deposits) of non-cohesive sediments. Changes along the shoreline of sedimentary cells are in general independent of changes in the upstream or downstream cells, though, where there are no borders or mobile borders for coarse sediment transport, it is essential that connections are considered.

The considered sector is part of the Eforie-Tuzla sedimentary cell. In this sector, a divergence of the general coastal alluvial transport to the south along this section of coast occurs, induced by the break-wave levees (which stretches 11 km wide). In the southern part of the break-wave dam from Agigea to the South of the Techirghiol beach barrier, the alluvial longitudinal transport is generally from south to north, due to the refraction of waves behind the break-wave dam and the significant role of the south storm waves.

Coastal structures (such as the touristic port Belona, break-wave dikes and protection systems in Eforie North) have a local impact on alluvial transport and accumulation rates. As a result, there is an accumulation of sediments in the southern area, in front of the Belona port, and also small alluvial accumulations in bays created between artificial dikes.

The net southern coastal alluvial transport is resumed at the southern end of the Techirghiol beach barrier and extends to Cape Tuzla. The southern border of this sedimentary cell, Tuzla Cape, represents a promontory in shallow water at a considerable distance towards the sea. This feature acts as a permeable barrier for transported sediments to the south. The offshore portion of the Tuzla Cape ceases, however, to constitute a boundary during storms, when movement generated by waves transports the sediment to the south (in case of north storms) or north (in the case of south storms).

Fig.3.5 a, b. Eforie Coast in different stage of erosion

3.1.1.4. Shore evolution in the last 100 years

Anthropogenic activities that impact the coastal zone resulted in a substantial reduction of the sediment flow system on the Romanian seaside. This severe reduction of sediments led to coastal erosion and retreat of the shoreline since 1850, rapidly accelerating in the past four decades. The construction, expansion and maintenance of dams and canals from the Sulina area (Fig.3.5 c) since the 19th century disrupted the movement of sediments to the south. In addition, the construction and the operation of the Iron Gates dam and other dams on the Danube have drastically reduced the amount of sediment reaching the Black Sea from

the Danube basin. These conditions will not modify, so the trend of shoreline changes must be considered in the context of much lower amounts of sediment.

According to the studies conducted in the Black Sea coastal area, the erosion of beaches and cliff degradation were recorded. The infiltration of surface waters into the clay and direct abrasion of waves on the base of the cliffs cause collapses and landslides life-threatening to locals and tourists and affecting the stability of the buildings located at the top of the cliffs, thus preventing the socio-economic development of the entire area (Fig. 3.5 a,b,d,e).

Fig.3.5 c, Sulina Channel

Fig. 3.5. c and d. - Landslides under the promenade alley/sidewalk Eforie South

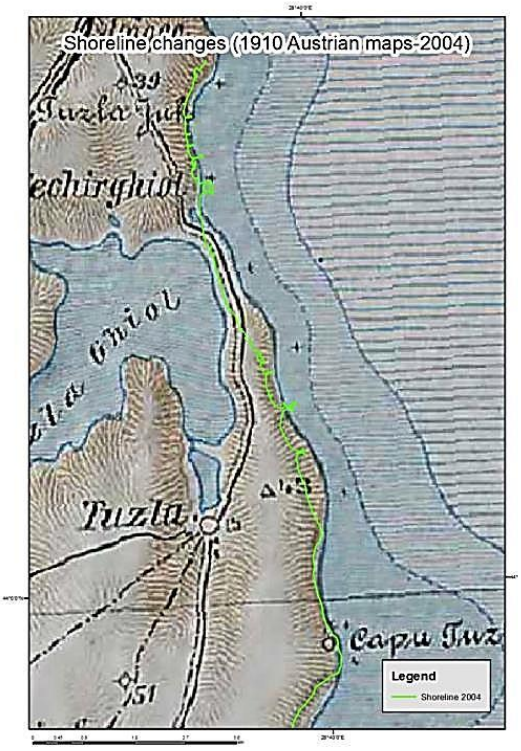


Fig. 3.6. Shore changes between 1910 and present

Analyzing the maps from different periods (Austrian Maps 1910, Fig. 3.6, Topographic maps 1975-1980) and current measurement (GPS and aerial photos), it was found that the shore has retreated about 40 - 50 m in the last 75-100 years. Because the area is a cliff shore about 10 m high, the shoreline retreats parallel with the gradual collapse of the cliffs. The further collapse of the cliff threatens the safety of hotels, restaurants and other buildings located near the edge.

The Cliff between Agigea and Eforie North is subject to the active abrasion that occurs to the limestone bentonite clays, differentiating abrasion of shelves and niches. (Fig. 3.6).

The rate of erosion in Eforie North is variable along the beach, averaging 0.5 m/ ear, depending on the presence of coastal protection works. This means that, without coastal protection works, buildings in the vicinity of the beach, several major hotels and

The erosion processes caused the decrease of the beach width corresponding to the Techirghiol coastal belt, especially in the southern sector (Sanatorium area), where there were withdrawals approx. 50-60 m in the period 1981-present. The coastal belt was heavily affected during the period 1990-present due to human activities - the dunes were destroyed by buildings erected on the beach.

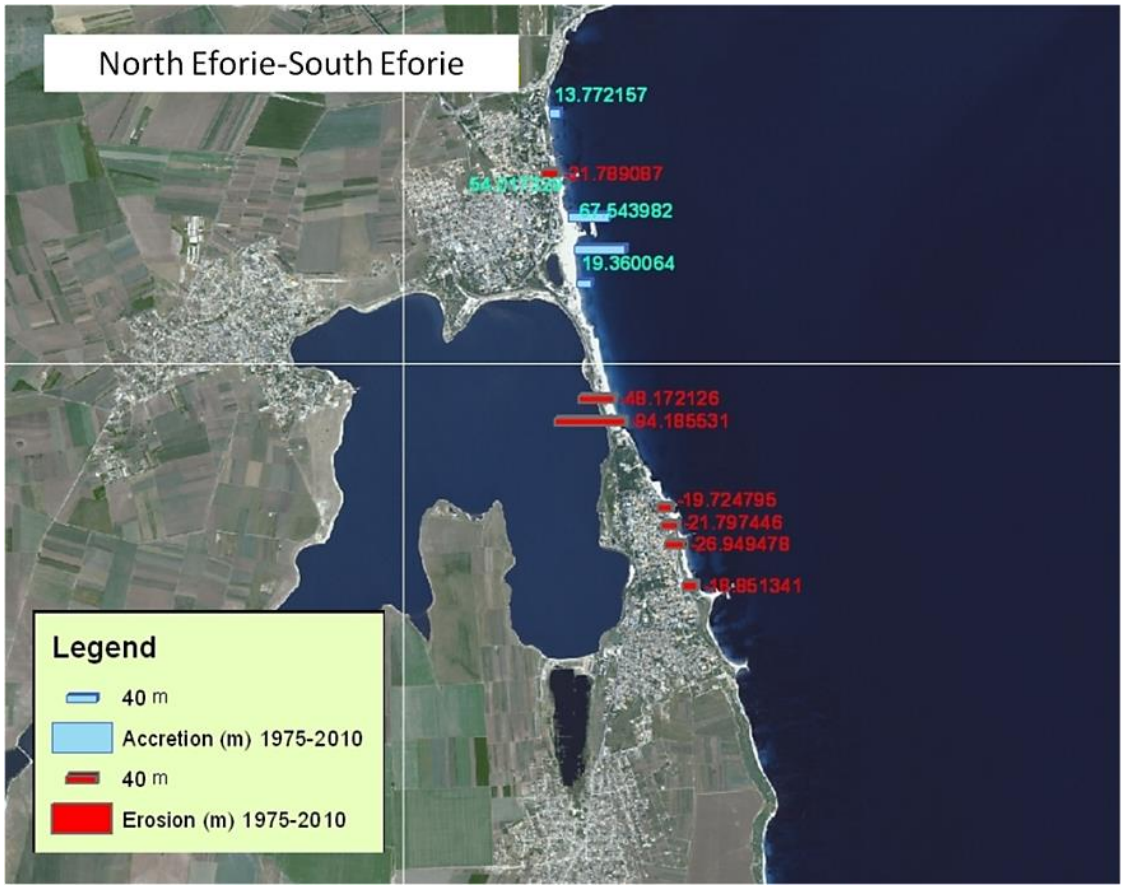


Fig. 3.7. Shoreline changes in the last 25 years

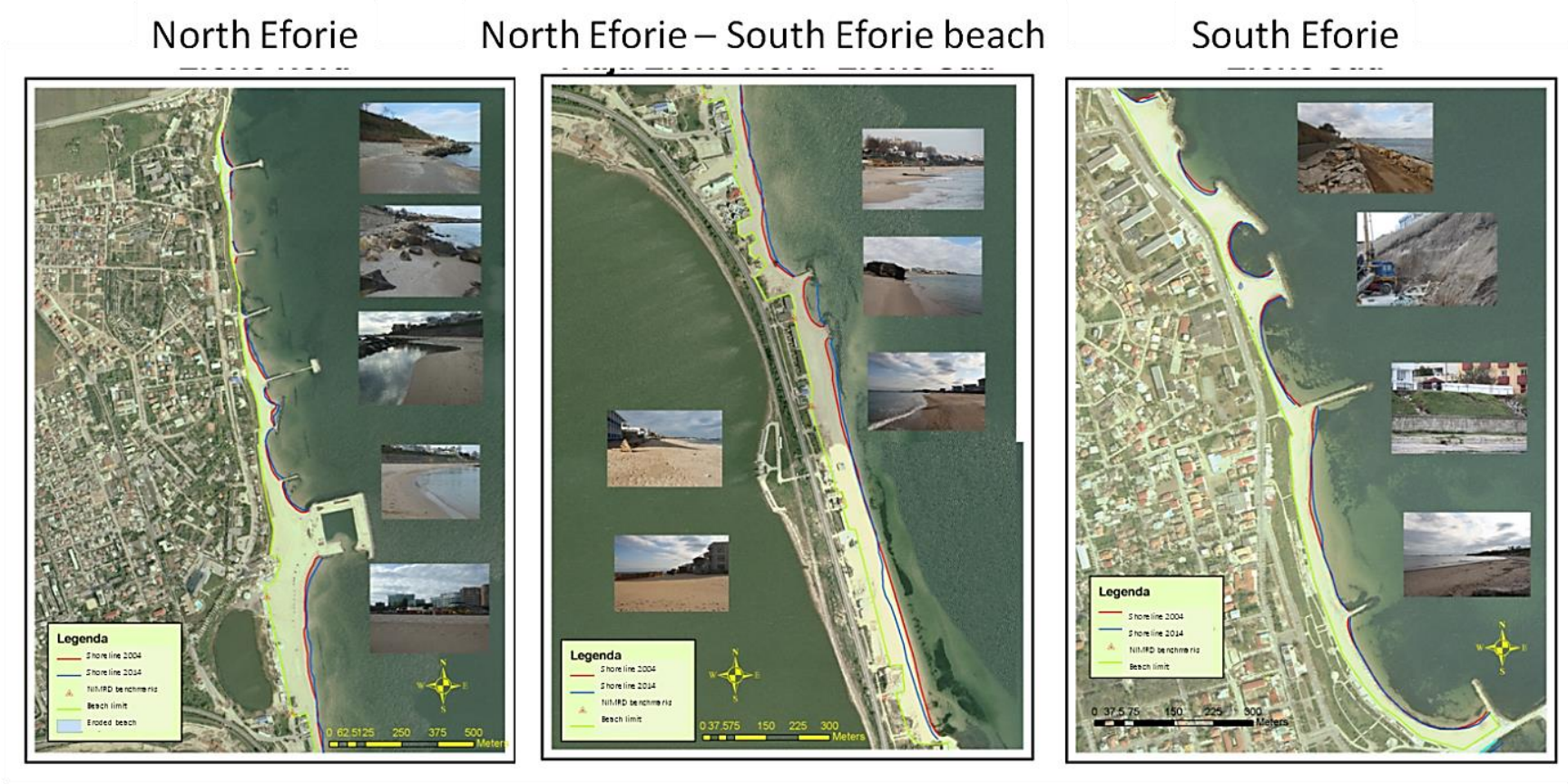
The **Eforie South shore sector** shows a high cliff, with a relatively low height, which underwent several slides of the land from upper part, due to saturation with water from irrigation of the soil. The base of the cliff is well protected by beaches and marine fences, reducing the danger represented by waves' erosion. (Fig. 3.5 c).

The Cape Turcului sector has been affected by landslides and collapses of the cliff due to local geological conditions: the clay layer at the base of loess deposits and the presence of an aquifer that discharges in shore area. These coastal dynamic can produce economic loss without protection, but Eforie area is under consolidations and sand nourishment projects in developing. However, the coastal erosion effects on tourism facilities and attraction is significant due to the landscape damaging, with its consequences in economic loss.

3.1.1.5. Coastal defense

Until the 1970s, development works and consolidations of the cliff were achieved by building retaining walls, aiming to protect the shore. The waterfront contained three paths, at different levels, each separated by grass slopes, communicating with the beach by stone stairs.

Fig.3.8. a,b,c. Shoreline changes in the last 10 years



In the period 1956-1960, six groins were placed to expand the beach in the Eforie North perimeter, considering that longitudinal sediment transports in the area are strong enough to ensure the sanding. Later, after expanding the South Constanta port, the erosion processes intensified, resulting, in the period 1981-1986, in the construction of longitudinal submerged and permeable dikes (Fig. 3.9).

In the same period, a touristic port was built next to the Hotel Belona. Initially, these constructions have caused an accumulation of sand, which subsequently decreased until 2014-2015, the beach disappearing entirely in some sectors.

For the protection of the accumulative formation of the Techirghiol littoral belt, two T-shaped dams were implemented during 1970-1971 near the site of children's summer camp and, subsequently, in 1985 - 1986, was built a chain of longitudinal submerged permeable dams.

The improvements in Eforie South were conducted in two stages: from 1956 to 1960 - the construction of 7 groynes - and 1983-1985 - 5 longitudinal submerged dikes. Overall, due to the groins degradation, a lower quality of beaches from the Eforie resort was reported, by increasing the number and size of pebbles and mussels deposits that are accumulated on the emerged beach.

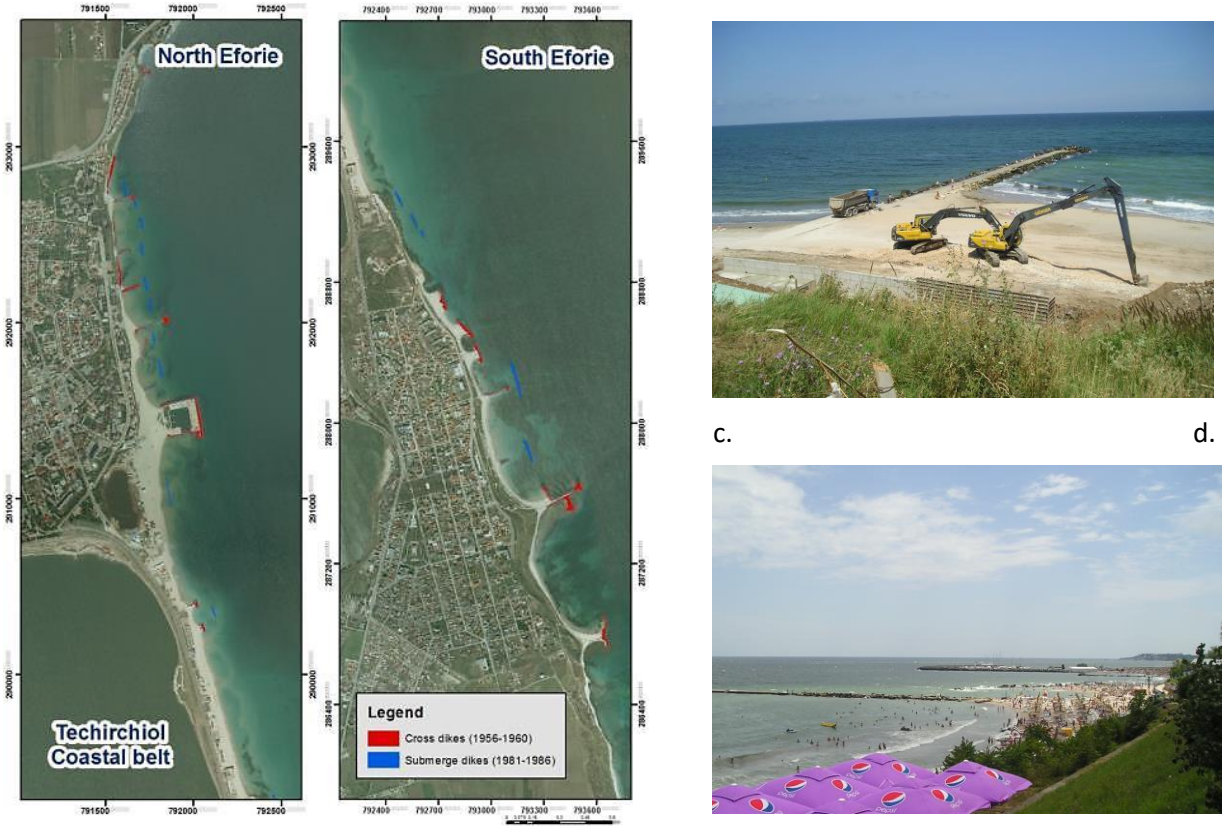


Fig. 3.9. a,b,c,d Coastal constructions for Eforie shore protection - before 2015

In order to reduce the risks from coastal erosion, a **strategic coastal Master Plan for Coastal Protection** was elaborated in 2011 by Halcrow Romania and the Romanian Waters National Administration, the Dobrogea Littoral Coastal Water Basin Directorate (ANAR – ABADL), which was concerned to promote investments to protect the environment from erosion risks in the most affected areas. After the designing of specific Feasibility Studies, Strategic Environmental Assessment and Environmental Impact Assessment for four priority areas, as identified by the Master Plan, the first phase of priority projects was executed in 2014-2015 in the following areas: Mamaia South; Tomis North/Centre/South and **Eforie North**.

The problems proposed to be solved in this project can be summarized as follows (Fig. 3.10 a,b,c; Fig. 4.4):

- width of beaches reducing, in several sectors;
- sandy nourishing in a large area from the coast to the sea (till 50 meters)
- the danger of collapsing cliffs, mainly due to geotechnical instability at the top still exists.

In this regard, the coastal protection works achieved were:
- Rehabilitation of dikes/groynes perpendicular to the shoreline with more than 500 m
- Construction of new break-wave dikes parallel to the shore - 675 m
- Artificial nourishment of the beach on 1.2 km, over one million cubic meters of sand

a. b.

c.

Fig. 3.10. a,b,c. Eforie North before and after coastal protection works (2015/ 2016)

The design of the new protection scheme was done based on yearly averaged incoming waves result in a dominant wave energy direction, with accompanying equilibrium coastline, which agrees well with a natural behavior of the existing shoreline. The overall orientation of the computed shoreline corresponds with the present post-construction orientation of the coastline. The XBeach model was used for simulation of the existing hydro-morphological development patterns, in order to calculate the effect of the proposed structures, the submerged breakwater and the breakwater extensions, justified, as well as artificial beach extension in this sector (Fig. 3.11a,b).

The computed response of the beach due to extreme events shows that the desired extensions with respect to the maximum coastline retreat were met, when a beach level of MN75+2.2 m were applied.

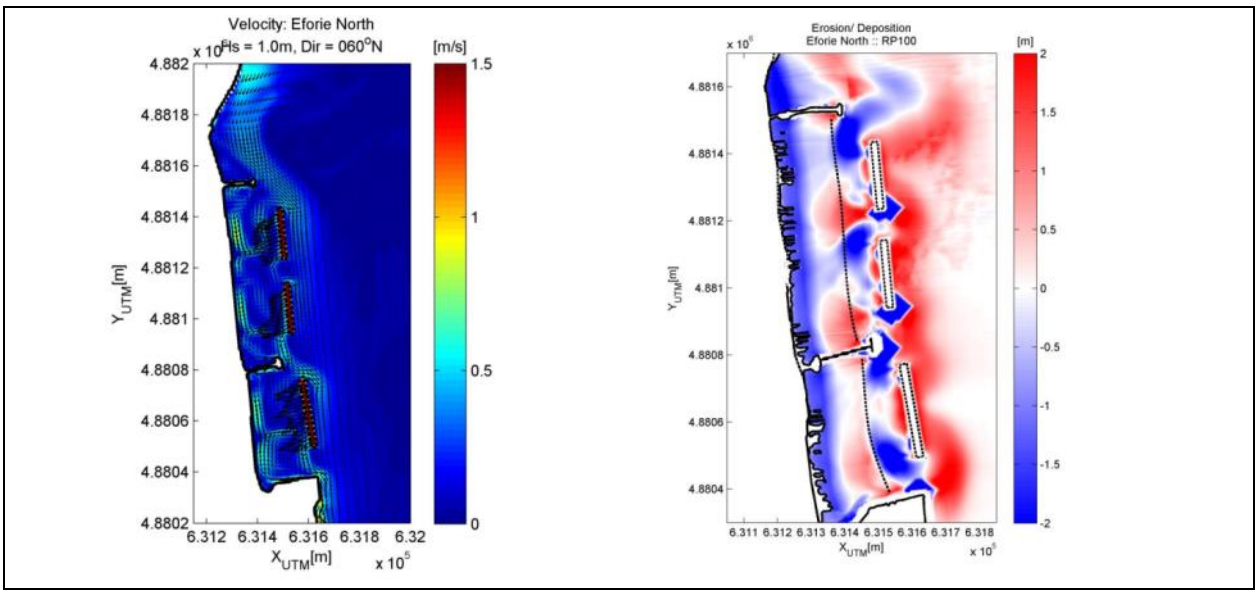


Fig. 3.11*a. Simulated nearshore flow field (colors: flow magnitude, arrows: flow direction) as induced by the offshore wave field* ***Fig11****b. Erosion/deposition profile for Eforie North for a storm event with a return period of 1/100 years and the Reference Layout, with defined spline visible as dashed line just offshore of the active surf zone.*

For the storm with a 100-year return period, this level was comparable with the maximum expected water level due to long waves and results in a relatively strong retreat of the beach crest. It is also found that a large amount of sediment is lost during storms because of the interaction between the flow patterns induced by the submerged breakwaters and the active surf zone.

It is therefore suggested to apply an increased beach level in combination with a relocation and/or redesign of the shape of the submerged breakwaters in the final design. Thus, the contribution of the extreme event to the average loss is only limited due the low probability of occurrence of the extreme event and in order to compensate the annual loss rates required circa 11,500 m3 (on a yearly basis to prevent a persistent retreat of the beach profile due to the storm losses caused by storm events

Fig.3.12. Eforie North - actual protection scheme - 2016

On given the total length of the beach, this results in an erosion of 525 m3/m1 beach per 50 years, hence (for a 5m thick layer) in over 100 m landward shift of the coastline, which require annual maintenance for correction. (Fig. 3.12).

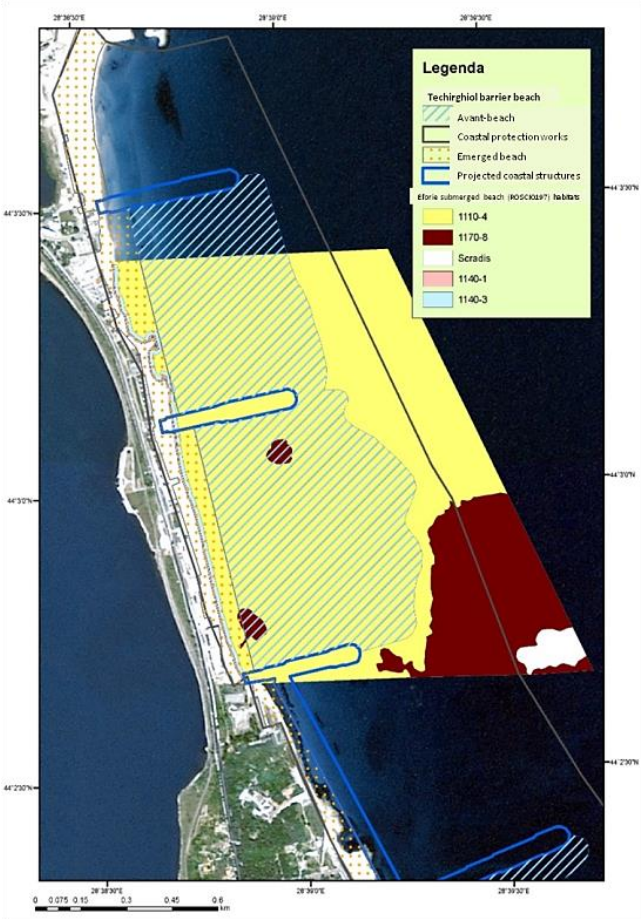
3.1.1.6. *Ecological effects of coastal protection works*

Despite its functional usefulness, the coastal constructions have an impact on the marine habitats and species/aquatic ecosystems were manifested through morphological changes,

physical parameter change, pollution, change in sediment composition, etc. For the next stage of coastal protections implementation there will be certain affected areas. Fig.3.13.

Thus, due to the increase of turbidity level, imposing a gradual clogging, affecting the optical regime in the same time, a change occurred within the algal micro flora, which further affected the macrophytes algae. From 122 species, 70 remained in 1980, out of which only 20 were in significant populations, and only 24 taxa were registered in 1982.

Main impact of the hard coastal constructions was related to the change of adjacent medium-littoral textures, due to the increase of organic materials either dissolved or particulates, which final effect is of installing anaerobic conditions. These situations will require further detailed inventory/monitoring in the context of new facilities extensions.



The impact of the new coastal defence work must be evaluated in the next future due to the fact that in the Eforie area there are unique species of bivalve mollusks, *Donacilla cornea* and *Donax trunculus*, still surviving today. Due to their ecological requirements, water purity, oxygen, salinity, the mere presence of the two species was a good indicator of marine water quality. They were declared extinct from the Romanian coast in all the literature from the period 1980-2000, during the period of high eutrophication and the ecological decline of the Black Sea.

The macroalgae fields for fish stocks as habitats for rearing feeding, wintering, breeding are of utmost importance. The case of *Cystoseira barbata* is very well known for biodiversity loses, as a common species spread in the southern coast (Tuzla - Vama Veche).

Fig.3.13. Coastal protection impact through Natura 2000 habitats

After 1980, it almost disappeared at 0.5-2 m depth for 150-200 m wide strip (from the coast to the sea, due to gradual extension of the port activities and coastal protection works).

This species has a high ecological role. From 1971 (5,600 t), it decreased to 120 t in 1979, remaining today only as isolated populations, with high impact on the diminishing benthic invertebrates, amphipods, gastropods, crabs, etc., as well as the fish (habitats), mainly for species of Bleniidae and Labridae.

Also, the case of the marine fanerogam *Zostera*, in the southern littoral, is related to a gradual loss, further affecting fish species of the Sygnatidae family (*Hippocampus guttulatus*, *Syngnathus argentatus* etc.).

3.1.1.7. Other natural risks: Floods, strong winds, waves, earthquakes

- **Low-laying area of Techirghiol sand belt**

The low-laying sand belt of Techirghiol is the most vulnerable area to winter storm surges. In order to protect the sand-belt separating the Techirghiol Lake and Black Sea it was built a drainage system for the collection of the floods from inlands/lake side, during springs/summer flash-floods collection around/on the versants around Belona Lake. Due to its inefficiency, drainage there poses a risk of liquefaction at earthquakes, with all its consequences on the building stability.

This risk can be mitigated in this area after the new phase of implementation of the Masterplan for coastal protection, recommending several solutions of artificial beach extension, including three groins and massive sand nourishment.

The beach/cliffs and bathing areas are affected by improper maintained drainage systems and overfill outfalls, in the actual development/extension stage of the local/Eforie South waste water treatment station (Fig. 3.14 a, b).

a. b.

Fig. 3.14 a, b. Overfill pipe - Eforie South waste water treatment station

3.2. Pressures on marine environment

A wide range of human activities may affect the marine environment. Several regional seas conventions have developed a significant list of activities, and some of the main effects they may have on marine habitats and species.

Examples of possible human activities and their effects:

- Coastal and sea infrastructures, including Danube – Black Sea Channel, pipelines, new planned oil facilities and wind farms;
- Transport, navigation, transport infrastructure;
- New constructions on the coastal zones;
- Exploration and extraction of mineral resources: sand, gravel for nourishment;
- Pollution: liquids pollution: chemical, nuclear, biological; organic waste and minerals;

There are other activities with possible impacts. Tab.11.

Table 3.1. The effects of human activities

Physical effects	*Chemical effects*	*Biological effect*
- Destruction and fragmentation of habitats; - Removing and substrate	- Contamination with organic compounds: eg. pesticides; heavy metals, hydrocarbons, nuclear waste;	- Extermination of target species and non-target; - Injury bodies that can subsequently cause death or

modification, turbidity etc; - Disposal; - Noise pollution; - Visual pollution; - Changes in water temperature, salinity, currents, etc.	- Increasing organic matter, nutrient changes: coastal urban waste water, waste from rivers polluted drainage from agricultural activities, eutrophication etc.	inability to reproduce; - Driving, burial, emersions species not mobile; - Introduction of pathogens; - Changes in population: structure and / or dynamic; - Introduction of genetically modified organisms

In this respect, Romania has recently issued Order 19 of 2010, of the Ministry of Environment and Forests for the approval of the methodological guide on proper assessment of the potential effects of the plans and projects on protected natural areas of community interest with present effect.

- **Human activities in Natura 2000 sites**

Human activities in marine Natura 2000 sites are regulated by the same rule of the Habitats Directive as the land area. Article 6 of the Habitats Directive applies where there is the likelihood that the influence of an activity or a combination of activities is significant.

The Commission's Communication to the Council and European Parliament of 24 October 2005, "*Thematic strategy on the protection and conservation of the marine environment*", is also a relevant reference document identifying the various pressures on the marine environment.

The related pressures include commercial fishing, oil exploration and gas transportation, storage in humid and in the environment of substances and nutrients that are harmful and hazardous, discharge of waste, including the dumping of contaminated dredged sediments, underwater noise and physical degradation of habitats due the dredging and extraction of sand and gravel.

3.2.1. Urban and tourism development pressure

Urban development is considered a very important issue from the point of view of the sustainable development of the region, investments being a priority. As a result of the main development of the mass tourism in the area of Eforie, several issues act locally, respecting the balance between tourism request and the environmental carrying capacity (Fig.2.36, a,b,c).

Tourist facilities and housing along the coast of the Black Sea are an excessive pressure for the region, as well as for the entire coastal zone of the Dobrogea region.

Mass tourism developed over here and is concentrated in a band of resorts along the southern littoral sector, with a peak season limited to 4 months (June – September), maximally 5 months of the year (including October).

The tourism and touristic services developed mainly in the area of Eforie can cause a negative cumulative impact on the marine environment by the changes of natural landscape resulting from infrastructure construction, landfilling; destruction of vegetation.

Seasonality of tourism, which increase local population in summer has relevant implications for environmental management (of waste, wastewater, etc.) with consequent impacts on the environment.

Over-pressure by tourists of the well-preserved natural sites constitutes a real problem in the coastal zone, as this can generate increased wear of the natural environment.

All of these will ultimately lead to the destruction of those natural features that have given the attractiveness of the site for tourism.

3.2.2. Pressure of other activities on the marine space

3.2.2.1. Pollution, including noise pollution

Marine pollution is one of the biggest global threats the marine environment and biodiversity conservation are facing. It can equally be a significant threat at local level.

Consequently, the authority responsible for the conservation status of the Natura 2000 site, based on inventories and conservation status assessments, will determine and establish the necessary conservation measures for the site, specific threats to each species/habitat, barriers to achieving the desired conservation status, including identifying conflict management. Tab.12.

Table 3.2. Threats for Habitats and/or vulnerable species leading to Conflicts Management

Threats	Habitats and/or vulnerable species	Conflicts Management
Coastal protection works	1140 - habitat destruction and fragmentation, changing currents and sediment circulation dynamics by building dams	Water Basin Administration Dobrogea - Littoral
	1110 - habitat destruction and fragmentation, changing currents and circulation sedimentation dynamics by building dams	
	Donacilla cornea - sanding burial by massive habitat destruction, changing environmental conditions	
	Trunculus donax - burial by sanding, habitat destruction, changing environmental conditions	
Illegal urban development of the coastal strip	1140 - the destruction and fragmentation of habitat by illegal constructions, changing currents and circulation sedimentation dynamics by building dikes to protect illegal constructions	Building owners
	1110 - Released pollutants and wastewater during construction and during operation of buildings	
Motorized recreational crafts in the site	1140, 1110 *Donacilla cornea*, *Donax trunculus* - intensive pollution of coastal waters by oil	Leisure business owners located on the beach
	Tursiops truncatus ponticus, *Phocoena phocoena relicta*, noise pollution of the marine birds	
	Tursiops truncatus ponticus, *Phocoena phocoena relicta*, seabirds - risk of collision	
The density of tourists on beach	1140, 1110 - nutrient water pollution - secretion product, and chemicals - beach cosmetics	Tourism companies administering the beach
	Donacilla cornea, *Donax trunculus* - direct destruction of species by trampling	
	Tursiops truncatus ponticus, *Phocoena phocoena relicta*, noise and pollution of the marine birds hazardous waste degradable plastic bags	
Garbage thrown randomly generated by tourists	*Tursiops truncatus ponticus*, *Phocoena phocoena relicta*, seabirds - and hazardous waste degradable plastic bags, which can be ingested by animals	

Taking all of these into account, the "*Conservation of natural habitats and habitats of species*" - Habitats Directive 92/43 / European Economic Community - deals with the problem of establishing and maintaining Natura 2000. In this regard, Article 6 stipulates certain provisions governing the conservation and management of Natura 2000 sites. The article contains three main provisions:

- Article 6, paragraph 1, stipulates the establishment of the necessary conservation measures and focus on the positive and proactive participation. The main objective is the maintenance or restoration of habitats and species to a "*favorable conservation status*";
- Article 6, paragraph 2, provides some measures to avoid the deterioration of habitats and disturbance to a large extent species. This emphasis on preventive measures;
- Article 6, paragraph 3 and paragraph 4, stipulate a series of procedural safeguards and independent plans and projects of government that can exert a considerable influence on a Natura 2000 site.

The European Commission has published two reference documents on management of human activities closely related to Natura 2000. The first of these is called Managing Natura 2000 sites, Article 6 of the Habitats Directive 92 / 43 / European Economic Community. The second document covers the Assessment of Plans and Projects which exert considerable influence on Natura 2000 sites, providing methodological advice on the provisions of Articles 6, paragraph 3 and paragraph 4, of the Habitats Directive 92/43 / European Economic Community as regards the assessment of plans and projects which exert considerable influence on Natura 2000 sites, with similar rules for sea or land environment.

Another relevant legislation act governing future development plans or development projects that can have an impact on a Natura 2000 site is on assessing the influence exercised by these activities on the environment by:

-Directive 85/337 / Council of European Economic Community 27 June 1985 on the assessment of certain public and private projects on the environment - Environmental Impact Assessment Directive. The Environmental Impact Assessment procedure verifies that the environmental impact of the project is identified and assessed before granting the necessary authorization. The public and environmental authorities will be consulted regarding the application to obtain agreement on development and environmental information and the results of this consultation will be taken into account in the authorization procedure for the project. The public will be informed of the decision later.

The conservation measures that will be established will aim to maintain or restore the species and habitat for which the site was designated to a favorable conservation status.

The measures will be applied by the competent authorities. Identifying the competent authority depends on its type, e.g. related to transport, exploitation of marine resources.

Natural elements protected subject to similar pressures need similar protection. However, depending on the position of the site and the type of measure necessary responsibility on the implementation of these measures may vary.

Consequently, the necessary conservation measures and the participants who will handle subsequent implementation and their entry into force will be identified together with the custodians and stakeholders, so that a sustainable management plan is ensured. The custodian will implement all measures under its competence and ask the competent bodies to take measures in sectors that meet them.

3.2.2.2. Marine fishery

In March 2001, the Commission sent the Council and European Parliament the Communication 143/2001 which presented relevant elements of a strategy on the integration requirements of environmental protection into the Common Fisheries Policy. (Fig.2.43)

This document illustrates how different fishing activities, including aquaculture, interact with the marine environment in various ways:

- directly, by removing both target species and species present in accidental stocks, which may lead to an unfavorable conservation status for some of them, causing thus their eradication or extinction at local level;
- indirectly, by modifying the energy flow through the food web, which may affect the conservation status of other species of the ecosystem, e.g., elimination of predators can cause some problems for the conservation of the species eaten by these predators;
- directly, by trawling the seabed, although this is prohibited in Romania's territorial waters, or indirectly: e.g. sediments or waste from some aquaculture installations by modifying the physical environment and threatening the diversity of habitats that could procedure in turn, an influence on their ability to accommodate both commercial species and non-commercial;
- ecological changes due to either natural causes or human intervention which in turn affects the productivity of marine ecosystems and hence fisheries. Many examples of such effects, indicates why it is necessary to fully integrate environmental considerations into fisheries management. Besides the legal obligation arising from the Treaty, is laid down and ethical obligation to take measures to ensure that these effects do not worsen, becoming unmanageable or irreversible.

In accordance with national law, the Ministers of Agriculture and Rural Development's Order no. 449/2008, in the Romanian Black Sea trawling is permitted only with pelagic trawl beyond the 20 m bathymetric contour and fishing vessels can operate only if they install a satellite monitoring system as this is obligatory (Ministerial Order of Agriculture and Rural Development No. 7/2010).

3.2.2.3. Military activities

Some military activities may have considerable influence on the marine environment. The most widespread current concerns are related with the impact of sonar activities on marine mammals. Military technology sector develop active sonar systems becoming more sophisticated and more powerful in order to identify more silent submarines.

The sound produced by lower frequency sources can spread hundreds of kilometers underwater. As Black Sea cetaceans have a high capacity of hearing and orientation in space and highly sensitive vascular systems, the use of powerful sonar systems can harm these species. These sonar sounds may also affect fish and their behavior.

All cetacean species listed in Annex IV of the Habitats Directive Habitats benefit from a strict protection regime under Community legislation in European waters. Therefore, Article 12 applies to the protection of cetaceans, including the obligation to avoid deliberate disturbance of all European Union waters, inside and outside Natura 2000 sites.

Regarding the protection of Natura 2000 site, it will be taken into account that, for new plans or military projects that could exert a significant negative influence on them, Article 6 paragraphs 3 and 4 of the Habitats Directive provides a balanced framework to address possible conflicts of interest between military activities and aspects of nature protection.

4. Conflicts evaluation, mapping and other methods for spatial analyses

4.1. GIS Management System and Remote Sensing

A Geographic Information System (GIS) is a computer-based information system used to digitally represent and analyze geographic features. It is used to input, store, manipulate, analyze and output spatially referenced data (Burrough and McDonnell, 1998). A GIS can be distinguished from database management systems or from visualization packages through its specialized capability for spatial analysis.

Geographic Information System (GIS) is a powerful tool that can be applied in the process of MSP:

- identifying, locating and visualizing the cover and spatial distribution of bio-geo-physical, socio-economical, governance features, resources, and uses in the form of maps;
- the tools are used as indicators of the state compared in different areas or the change of the effects management has on given biophysical, socio-economical and governance factors state over time.
- GIS tools can combine several types of spatial data by overlaying the spatial distribution of different features (pressure and threats, bio-geo-physical features, sensitive habitats etc.).

The use of GIS for coastal and marine zone management has expanded rapidly during the past decade. For optimum efficiency, geo-referenced data should be properly stored in geo-databases built on spatial data model design (Prélaz Droux, 1995) (Fig. 4.1). Maps are essential, both for decision-making by field staff, and also for information communication targeting the stakeholders involved (decision-makers, managers, scientists etc.).

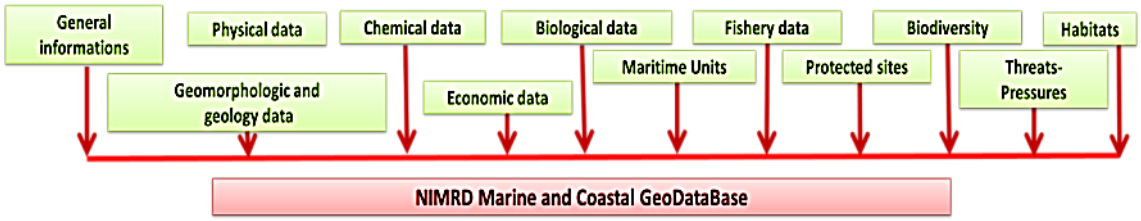


Fig. 4.1. Marine and coastal database

- *Spatial extent of the study area*

The extent of the Eforie case study area was necessary, clearly defined in the same coordinate system, delineated by a bounding polygon at an appropriate spatial resolution. A bounding polygon allowed a better selection and analysis of the relevant information. In defining the extent, a sufficient margin is included to allow the inclusion of features which may have an influence on the case study (Cape Tuzla, Techirghiol Lake, Constanta Port).

- *Data source, compilation and standardization*

Integrating and transforming the existing data and geographic information for the determination of the flow of primary and processed data in order to extend a geographic database includes the inventory of all mapping (historic or recent) data, teledetection data (satellite or photogrammetry) and annual/seasonal monitoring data available (shoreline, beach profiles, chemical and physical water characteristisc), in parallel with the direct investigation of the specific issues (pressure, threats) of the case study.

In order to examine the changes produced in the marine coastal zone, mainly historical maps and satellite images of different resolutions were used toghether with current GPS measurements and aerial photos, including the current monitoring data (in-situ data - oceanographic data, sediments data), as well as the spatial distribution and analysis of marine and coastal uses and activities.

The following **historical maps** were used:

- Austrian topographic maps from 1910 / topographical surveys of the military of the Habsburg Empire, scale 1: 200 000
- Detailed topographic maps (1970, 1975, 1980) at different scales
- Topographic/cadastral maps, Ministry of Agriculture, 1:5000, 1962
- Topo-hydrographic maps (1951, 1993, 2007) - Maritime Hydrographic Directorate at different scales (1:750.000 - 1:10.000);

The photogrammetric images / aerial photographs - Satellite images SPOT 2007 / IKONOS2007, national orthophotos 2005/2008/2010; DTM coastal strip 2010/2012, aerial photos (UAV, drones) were used after the processing (georeference process and vectorization). (Fig. 4.2a.b)

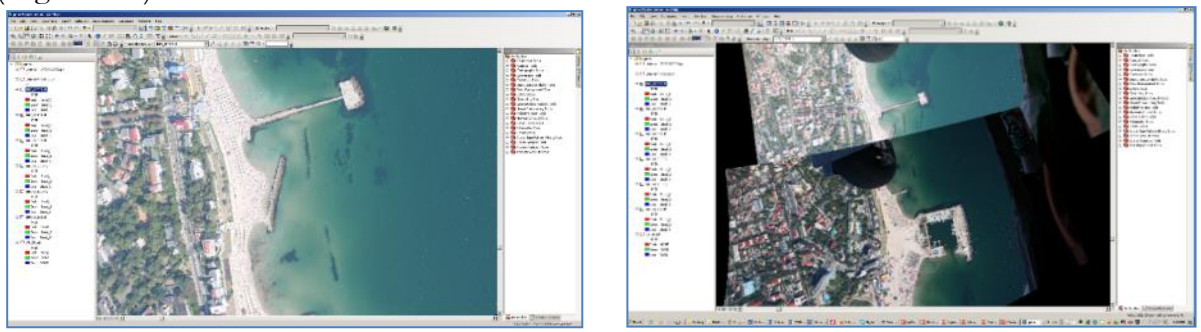


Fig. 4.2.a.b. Aerial photos used for the Eforie case study

The Corine Land Cover database (1990, 2000 and 2006) was also taken into consideration. By using the LCCS 1990/2000 and 2006 database, comparisons were made, in order to detect land use changes.

Other data sources were Copernicus, a European system for monitoring the Earth (earth observation satellites and *in situ* sensors) and EMODNET databases.

The coordinate systems used were Stereo 70 (ellipsoid Krasovsky, Datum Dealul Piscului) and WGS 1984 UTM zone 35N.

The application of GIS to integrate, display, query and analyze information is widely recognized as valuable for ecosystem-based decision-support and MSP (Ehler and Douvere, 2009; FAO, 2013). The basic requirements for MSP include an inventory of important ecological areas, current human activity and the identification of conflicts or threats among and between uses and the environment (Douvere and Ehler, 2009; Tallis et al., 2010).

Spatial data represents information about the shape, location, relationships:

- **Raster** - satellite images, aerial photos and ortophotoplans, sonograms, scanned maps, photos, etc, 3D models (DTM), spatial analisys;
- **Vector data** (points, lines, polygons) – monitoring stations, activities and uses, threats and pressures, benchmarks, geodetic points, beach profiles, bathymetric profiles, shoreline, vegetation line, advancing wave line, sampling points, hydraulic structures, substrate, protected areas.
- **Tables associated (related)** – in situ chemical, biological and physical measurement, waste water discharges, profile measurements, weather conditions, water-level, different characteristics etc.

The following analyses were made:

- Mapping of marine bio-geo-physical features and associated human activity
- Quantification of coastal and marine features, human activities, pressures and threats
- Identification of zonal conflicts, concentration of uses, priority conservation areas

4.2. Land - Sea conflicts of interest

Land - Sea conflicts of interest key have identified by literature review, expert judgment, local knowledge and stakeholder involvement.

- Maritime Spatial Planning (MSP) aims to minimize the conflicts among different sea uses, as well as their negative effects by allocating space and applying zoning for different uses,

improving decision-making and delivering an ecosystem approach to managing human activities in the marine environment.

- Planning for sustainable resource management is based on weighing priorities, translating these priorities into policies and finally defining goals, identifying responsibilities for each step and establishing a time frame for action and review (Nwilo, 1995).
- In order to practice effective marine management, planners need to understand the way the natural environment and human activities are interconnected to form a system. Key aspects of the system include the following information themes:
- Biological: type and extent of ecosystem, primary productivity, species diversity and abundance, nursery grounds and life cycles;
- Physical: topography, geology, temperature, salinity, nutrients, tides, sea level and current, meteorology, sediment types and distribution, flooding and erosion/ accretion;
- Socio-economic: human population distribution and growth, economic activities and land use;
- Legal and institutional: land tenure system, resource use rights, relevant laws and regulations, responsible agencies and availability of financial and human resources (Borrego, 1994).
- Each of these activities is greatly influenced by activities within and beyond the coastal zone. It is for this reason that the resolution of conflicts in the use of coastal and marine resources requires a broad perspective on the environmental process and interaction among human activities.
- The coastal and marine zone of Romania is experiencing increasing pressures mainly due to population increase, urbanization, agriculture growth, fisheries, and industry. The coast is subject to erosion, water pollution, decline of renewable resources, loss of biological diversity, wetlands losses and destruction of landscape. The need to deal in the future with the impacts of climate change in combination with finding adaptive responses is also an issue.

The main threats for the Eforie marine and coastal area are:

- **Coastal urbanization**, mainly as a result of *population concentration*, *holiday houses*, *uncontrolled tourism development* and *growth of recreational activities*. The uncontrolled development has negative effects on the marine environment and landscape and it increases the pressures on the ecosystem, which lead to the loss of habitats ultimately.

- **Fig. 4.4.** Beach tourism intensity during high season

- The population in Eforie increased since 2002 from ~ 9,500 inhabitants to ~11,000 inhabitants due to migration from the main urban center (Constanta) and urban development of the city by building new houses. In the last 20 years, the city expanded with more than 30%, being focused on residential and tourism development related to the coastal strip in close proximity of the Black Sea or Techirghiol Lake.
- Urban development of coastal strips can cause the destruction and fragmentation of habitat by illegal constructions, changing currents and sediment dynamics, but also through pollutants and wastewater discharges during construction and during operation of these buildings.
- The number of tourists has increased steadily since 2011-2012, with pronounced seasonality resulting in a concentrated impact during summer months when the population grows in the area several times.
- The high density of tourists (Fig. 4.4) on the beach can cause nutrients or chemical pollution, direct destruction of shellfish populations by trampling, generation of non-degradable dangerous wastes (plastic bags).

- **Pollution** (Fig. 4.5) is one of the most critical problems in this case due to the development of the urban center. The uncontrolled disposal of the solid waste and sewage discharge have a negative impact on the quality of sea water taking into account that seawater recovery time is slow and the consequences on the marine environment are obvious.

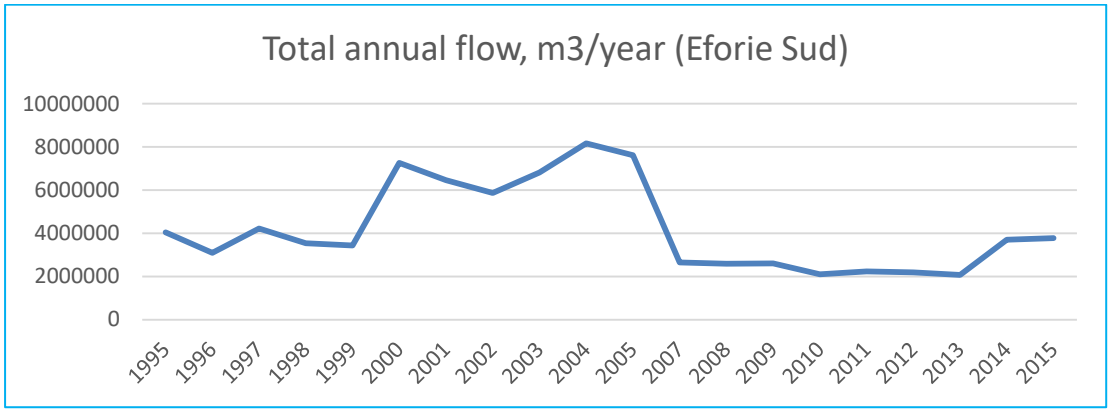


Fig. 4.5. The total annual flow of the wastewater treatment plant in Eforie

- The Eforie area is currently served by one wastewater treatment plant located in Eforie South, with mechanical and biological treatment facilities, rehabilitated in 2010-2015, with a maximum capacity of 745 liters second.
- Until 2010, the station had only mechanical treatment and discharged directly into the bay north of Cape Turcului.

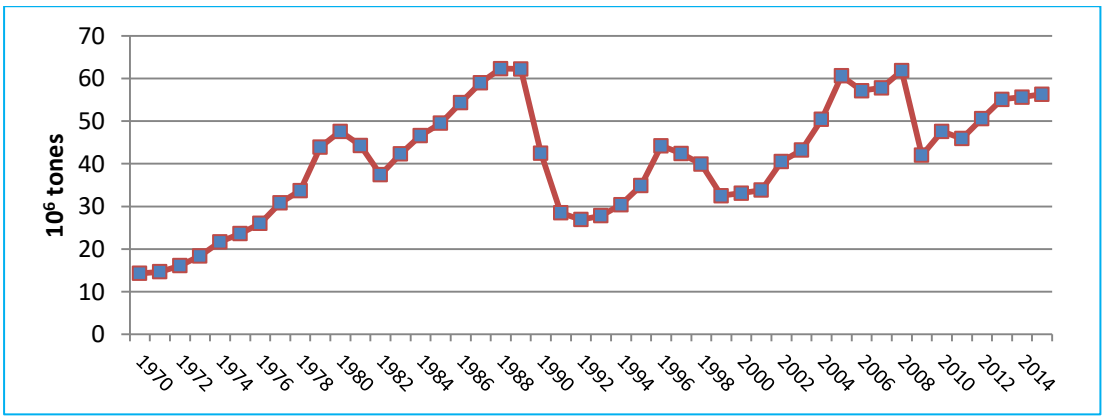


Fig. 4.6. Marine and river traffic (1970-2014)

- **Increasing the impact on the environment -** in the Eforie zone there are three Natura 2000 sites (2 under Habitats Directive and 1 under Birds Directive). Coastal protection works, beach nourishment, the increasing demand for space for touristic activities, nautical sports, new constructions - mainly holiday houses, increasing port traffic negatively influenced the functions of natural habitats and species.
  - More than 1.2 km of shore was already subject to coastal protection works (more than 1 km of new or rehabilitated dams/dikes and beach nourishment) witch impacts on the marine habitats and species/aquatic ecosystems through morphological change, physical parameter change, pollution, change in sediment composition etc. For the next years the coastal protection works will extend to another 4.5 km, including the Natura 2000 site **Eforie submerged beach (ROSCI0197),** which is the only place in Romania where there are significant populations of the bivalves *Donacilla cornea* and *Donax trunculus*.
  - In 2014, the Port of Constanța (Fig. 4.6) handled a total traffic of 55,641,910 tones (54,763,130 long tons; 61,334,710 short tons) of cargo and 668,293 twenty-foot equivalent units (TEU). According to the NSI, ~ 32 million tons of goods where transported in the maritime sector transportation by the end of 2010 and the traffic increased to more than 50 - 60 million tones until 2014, part of the traffic being represented by ores, coal and crude oil and oil products, and chemical products.
- **Decrease of biotic resources** together with the alteration of key **ecological processes**;

Marine fish populations are shared natural resources for the Black Sea countries. Must be mentioned that Romanian coast has an open continental underwater platform wich is area of fish migration, feeding and breeding. The marine fishery was the most affected sector by the dramatic changes produced in the Black Sea ecosystem, due to freshening and terrestrial impact, habitats degradation, feeding sources diminishing and over-fishing, including in Eforie area. The fisheries themselves contributed to the worsening of the ecological status and fish stocks diminishing.

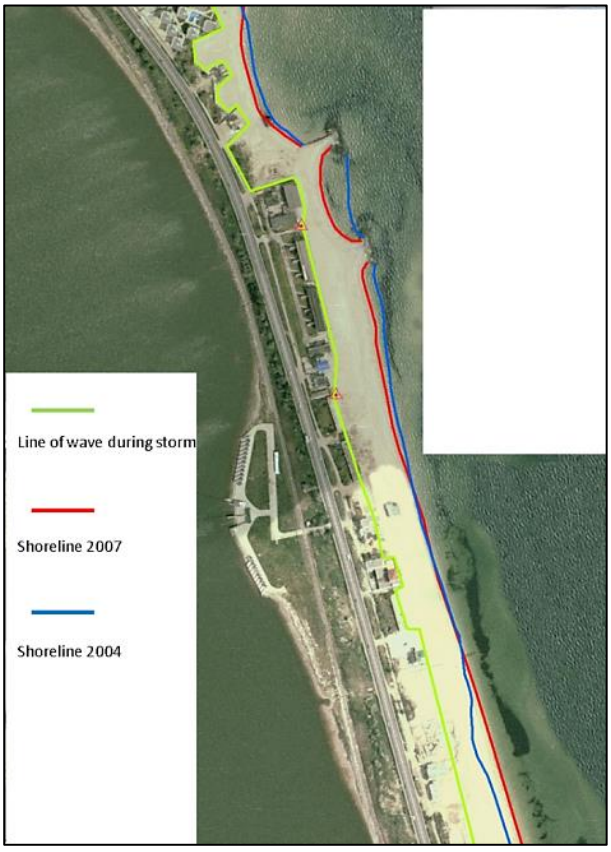


Fig. 4.7. a) Urban development on the Techirghiol barrier beach;
b) Building affected by waves during storm; c) Wave line during storm

- **Increasing environmental and other risks** due to climate change and sea level rise and (increasing of extreme storms, coastal erosion, increase of seawater temperature, changes of salinity and biological diversity reduction.)

The Eforie area is affected by erosion of beaches and cliffs degradation. Infiltration of surface water to the clay and direct wave abrasion on the base of the cliffs caused the shore to retreat with about 40 - 60 m in the last 75-100 years, in parallel with the gradual collapse of the cliffs. This landloss threats locals and tourists and the stability of the buildings located at the top of the cliffs, thus preventing the socio-economic development of the entire area.

After 1990, the need for space for new constructions, especially private homes and small accommodation units, resulted in city expanding, especially in the area near the sea. Several buildings appeared in the area adjacent to the Lake Techirghiol sector, which gradually destroyed the dune system. The constructions were carried out at less than 100 meters from the shoreline, in some cases even less, and are heavily damaged during storms (Fig. 4.7a,b,c).

The conflict between activities for coastal protection (sand nourishments) and touristic navigation/port activities is very clearly emphazised in the case of the Belona Marina, a small port, originally a sheltered area for boats used for the extension of the Constanta-Agigea port jetties. Due to its placement at small depths, the inner part of the marina is filled by the adjacent sediment deposits drived by waves and currents. This unsuitable location is giving a lot of problems for fishing and/or small recreation boats, due to the formation of a bar at the port mouth (Fig. 4.8).

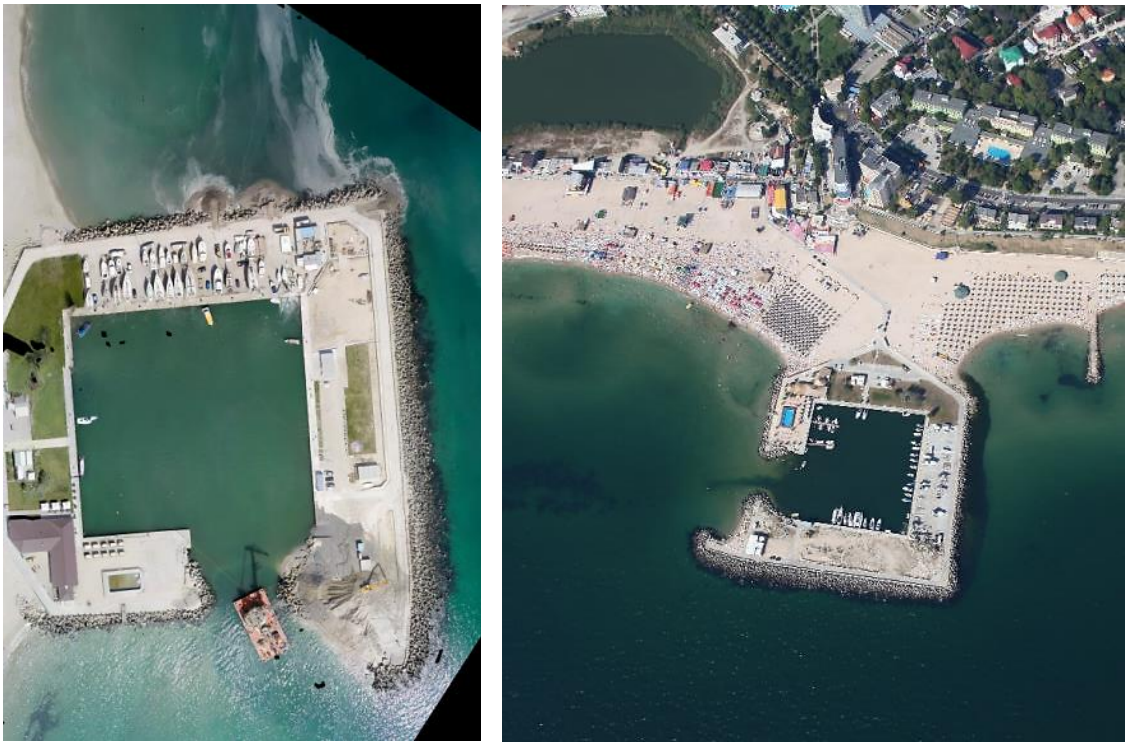


Fig. 4.8. a and b. Clogging of the Belona Marina due to its placement within shallow area with large deposits of sediments

Thus, each year certain dredging works are required for the hot season preparations, but often they are not effective as a result of redistribution enforced by longshore sediment transport (Fig.4.9. a.b), now masively supplied by the new local soft protections works.

Fig.4.9. a.b. Coastal erosion effects and works for consolidation

The neccesary action for this case is relocation, and for this action an appropriate place is located only 1 km north, at the port jetty insertion, were there is no sand due to the intense circulation produced by wave reflection and difraction.

- Increasing threats to the heritage and diversity of the area, due to rapid urbanization of coastal areas, with consequent **impacts on the traditional socio economic** structure.

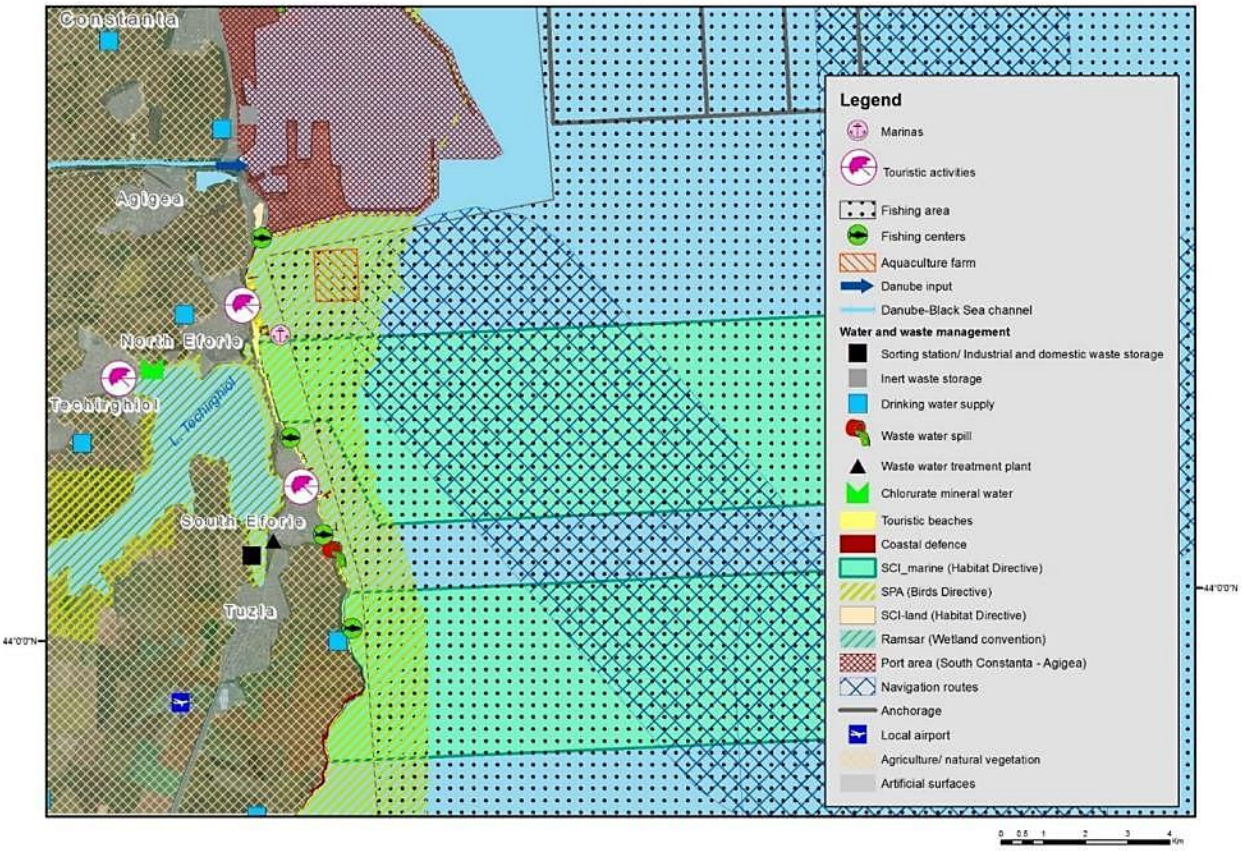


Fig. 4.10. Present Uses of marine and coastal space in Eforie area resulted by analyses

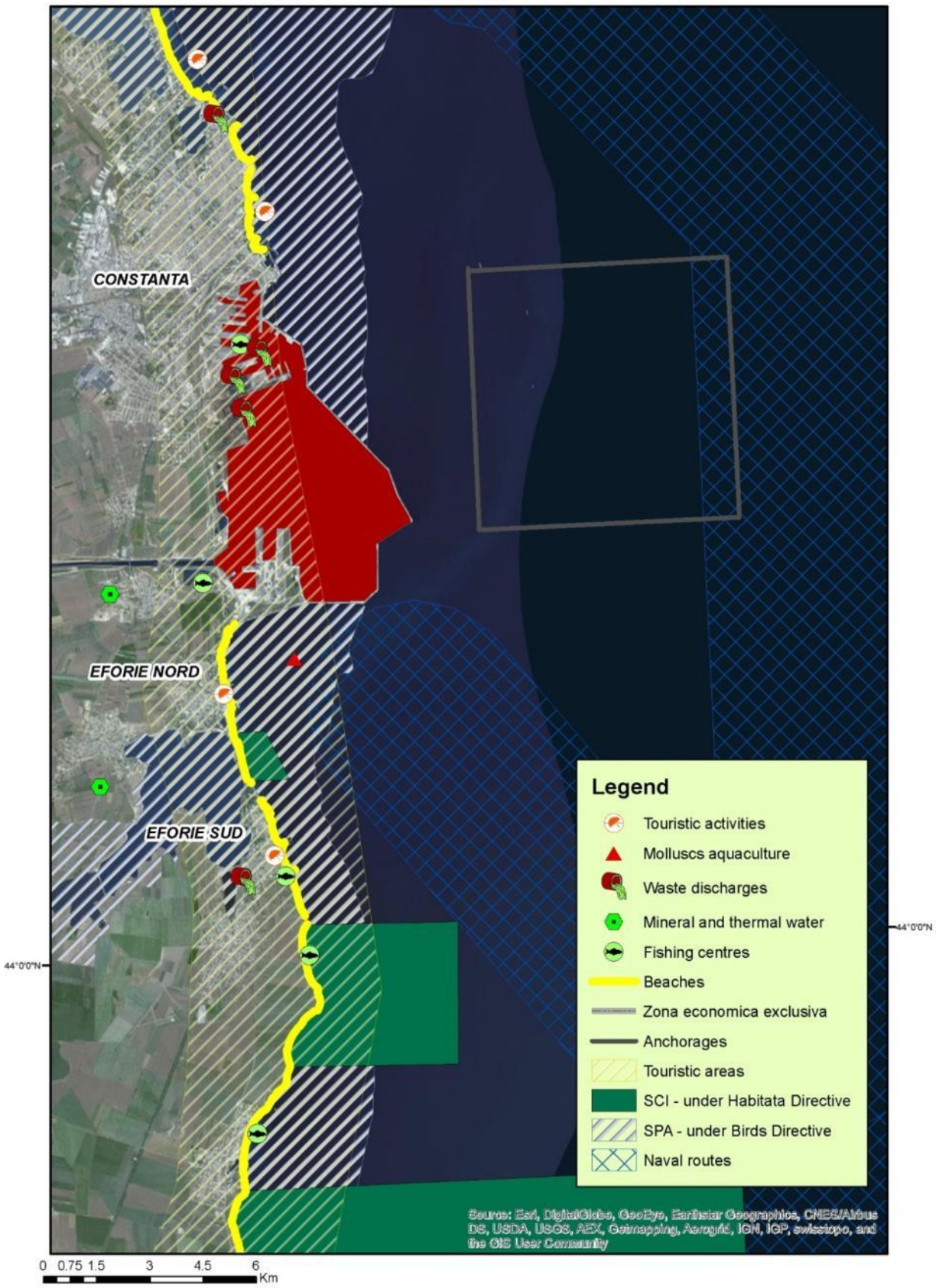


Fig. 4.11. Uses of marine and coastal space in the Eforie area including surrounding zones in 2015

4.3. Conflicts of interest between marine activities and uses

They are identified by literature review, expert analysis of spatial data, GIS overlay, and meetings with stakeholders.

An important conflict in the area is that of fishing and aquaculture and commercial and touristic navigation, for continuous and seasonal intervals, respectively (Fig. 4.10).

A general conflict of interests is that of military operations with all other activities and uses, during winter and spring trainings, and another insurmountable conflict is the incompatibility between MPAs and all sort of activities in the area, respectively: firstly, protection works/activities, secondly, tourism and navigation, thirdly aquaculture and fisheries.

Also a notable conflict that of the often opposite activities represented by housing, also, including the coastal protection, and architectural landscape arrangement, forgotten in many Eforie's areas. It should be mentioned the conflict between social-cultural activities and mass-tourism and its aggressive commerce, often in associated during summer time with noise pollution. Social impacts of mass tourism is becoming a widespread problem in many touristic places, including in Eforie areas.

4.4. Infrastructural deficiencies and conflicts

Because of its placement in shallow depth, the southern area of the new Eforie beaches, the Belona Marina is in infrastructural conflict with the new extension of the soft protections works, now significantly supplied with more than 1 mil. cubic meter of sand, thus requiring each year dredging works of its entry channel for summer season preparation. Also, often the dredging are not effective, as a result of redistribution brought about by longshore sediment transport.

The conflict is associated with high expenses, as the relocation of the marina is necessary, in a right place, without strong longshore sediment transport. Such a location is only 1 km north, at the Constanta port south jetty insertion, where the sand is missing due to a rocky bottom and an intense circulation produced by wave reflection and diffraction. For this sector, the Masterplan for protection designated a coastal artificial village extended towards sea.

4.5. Stakeholders' involvement for problems identification and solutions

Stakeholder consultation is an objective necessary to prioritise problems, to identify land - sea interaction, and to score conflict among uses. The stakeholder involvement is linked to above illustrated results and this will be underlined in this chapter.

4.5.1. Sketch match - interactive participatory process

Sketch Match is an interactive planning method, developed by the Government Service for Land and Water Management in the Netherlands (DLG)[1] to bring insight into spatial development issues together with regional partners. The sketch match is a method that is used to identify and visualize potential development paths and so facilitate the decision-making process for managers, policymakers and local stakeholders. It is an intensive process that organizations and other interested parties can use in their own development areas.

A Sketch Match is a series of interactive design sessions lasting up to three days in which participants (citizens, policymakers, farmers and other stakeholders), under supervision of a

spatial designer and a process supervisor, analyse and work out the spatial problem in a specific region.

A Sketch Match works like a creative pressure cooker by bringing together a group of interested parties to work intensively on a common design. This creates a lot of enthusiasm and often accelerates the decision-making process. This is worked out with maps and 3-D GIS visualizations. The result of a Sketch Match is a spatial design, in the form of a ground plan, map, book, visual story, model, 3-D GIS visualization, or whatever form suits the project best.

Various disciplines come together in a Sketch Match: layout, GIS, ecology, hydrology, hydraulics, socio-economy, spatial planning etc. A thorough preparation, including a clear picture of the design assignment and the players involved, is very important. It holds that if the right people with the right expectations sit down at the design table, they increase the chance of success.

A good Sketch Match brings parties together as people begin to understand each other's wishes and interests. It increases the support because participants accept a common plan, which they themselves have also sketched out. In the plan, they see their own wishes and interests represented, as well as the wishes and interests of others. A Sketch Match can thus act as a crowbar widening the frameworks in a creative way. Every Sketch Match consists of three phases:

- Registration and preparation;
- Sketch Match Session;
- Completion.

Each mentioned phase was accomplished by NIMRD "Grigore Antipa" Constanta, "Danube Delta"NIRD Tulcea and University "Ovidius" Constanta for the Eforie pilot case study on 16.11.2017. The workshop was held in Eforie South City Hall (14 project team members).

General objective: to elaborate development plans along the coastline of Eforie North and South, aiming at identifying potential solutions for integrating protective measures of coastal areas in the context of Maritime Spatial Planning. It was given particular attention to the local economy and access to natural resources.

Secondary objectives: to acquaint stakeholders with the objectives and context of MARSPLAN BS project, to share the current state of the case study, to inform about the methods of spatial analysis on the interactive maps and the economic objectives of the study area. The purpose of this working meeting was to gather scientific community interested in space marine and maritime spatial planning authorities and stakeholders (Fig.4.12 a,b,c), nature conservation and economic environment in the coastal zone of LAU Eforie North - South, representatives of local communities and civil society (23 representatives) to work together to identify common threats and solutions for territorial development and coastal protection.

4.5.2. Thematic maps and development

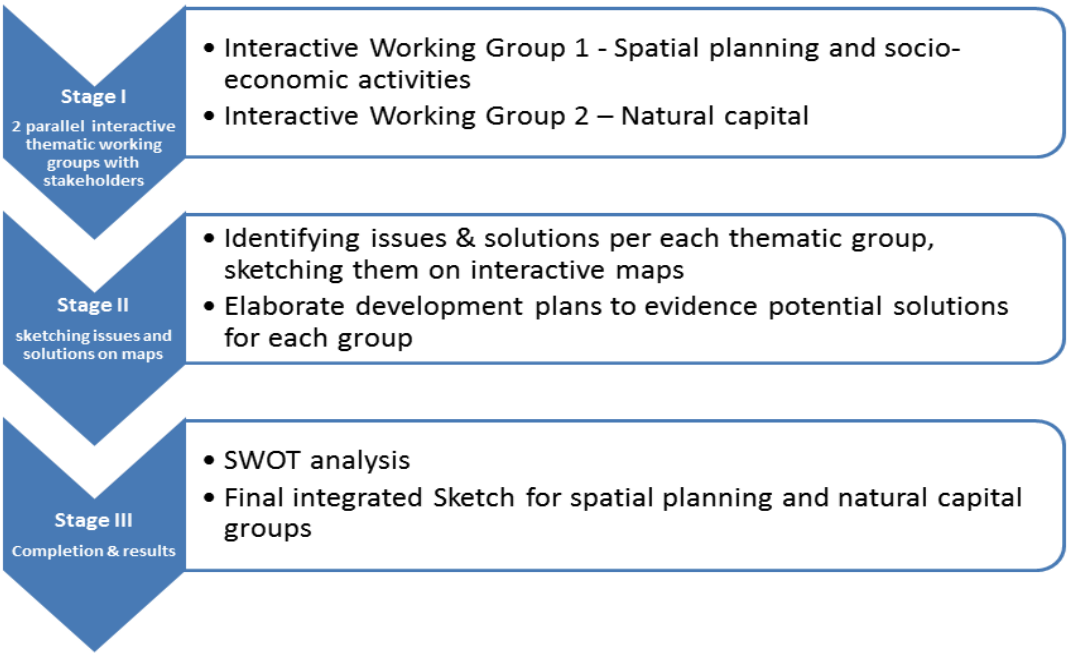
For a good approach of the participatory method, it was necessary to use maps of the studied area in order to have a better perspective of the place. The used maps scale was the same for each one in order to have the possibility to transpose elements from one map to another. Attendees were asked to draw on the maps the areas they considered important for economic development and spatial planning, the vulnerable one in terms of biodiversity and socio-economics, what are the main solutions needed to solve the problems identified and how they can be approached (maps of natural values, activities and uses).

4.5.3. Workshop session

The participants were divided in 2 (two) groups, with the following topics: natural capital & spatial planning and socio-economic development. The members for each group were chosen taking into consideration their field of activity and expertise and split in 2 (two) groups. Further, the participants, together with the assigned experts, drew their ideas on overlays for every thematic map.

Fig. 4.12. a.b.c.Introduction of participants

Figure 4.13 Stages of Sketch Match interactive participatory process



4.5.4. Overview of results and key points

Working Group 1 – Spatial planning and socio-economic activities group (Fig.4.14)

Items	Identified issues	Proposed solutions and opportunities
Sailing routes	- location for fisheries tools installing • with landing sites • at Agigea near the southern port dike, • children camp Eforie South, • beach near Turk Cape and Tuzla • on navigation routes of leisure vessels • regatta departing of Belona Port - areas in front of port entrance cannot be overlaid with another activity	- seasonal fishing activities conducted outside shallow waters should have specific routes to/from fishing grounds - water sports should be regulated on the marine area, not only in the beach area - eg. skyjets, activity that runs until 20 meters depth in the Eforie area - it was proposed to create corridors for each activity on the sea- leisure and fishing activities and search / lives rescue vessel - the need to condition all activities regarding sea transport by the obtaining of navigation permits
Areas as refuge for ships in distress	- case of vessel Medi failed at a depth of 20-30 m front of South Eforie and the possibility that it may have reached the shore (sand zone) - example of conflict between environment and the possibility of vessel and crew saving	- setting a place of refuge for ships where it can intervene from land to help ship and crew - proposal for the refuge - inside Agigea port but here it is the possibility of conflict with aquaculture facilities - the mussels farm could be moved in a better place
Coastal protection projects	- the coastal protection projects affect Natura 2000 sites - nourishments in North Eforie area were affected the aquaculture facilities by increasing turbidity; this activity is anyway affected by the vicinity of the harbour	- the last alternative of the project considers leaving 2 cells (bays) immediately south after Belona Port that it will not affected by sand nourishment - port replacement is not possible but measures for mitigation are anyway recommended
Increasing of the tourist density with pressure on *Eforie resort* coast and sea area	- in 2016 it was registered an increased number of tourists, especially in Eforie North, due to the beach extended area - this increasing also meant greater pressure on the tourism beaches	- improving waste management, services regarding • this high concentration of people in a relatively small area near the sea, • increasing of water sports frequency, etc.
***Eforie South* wastewater treatment plant in operation since about 3 years**	- in present, the pipe discharging is at 5 m depth - until three years ago the pipe overflowed directly on the seafront in South Eforie causing serious environmental problems in the area, considering the fact that the wastewater treatment plant had only mechanical stage	- extension of secondary and tertiary steps of the treatment plant - extension of pipeline or outfall

Military areas	- in the Agigea port is a training area for military divers - military exercises take place also in areas including Natura 2000 sites and affects both specifically mammals and habitats	- at ~ 20 m depth it takes place military activities and trainings; in these areas, other activities are prohibited only during periods of military exercises
Research / monitoring activities	- NIMRD monitoring stations - bathymetry measurements conducted by Hydrographic Office are affected by other activities developed in the area (seines, boats) to be bypassed diverting transects for bathymetry - loan sand pits are not configured on navigation maps - mine historical fields are known - currently being checked the Tuzla zone	- correction of polygons - all changes that occur in the configuration of the seabed must be notified and marked on maps (extraction of sand) - exist different types of trawl hooks that do not appear on the map
Extension of Natura 2000 protected areas	- being a new enlarged marine protected areas custody has not been yet attributed to the whole new area - the new area overlaps to port entrance (port runway) and this is a big legislative mistake (subject of conflicts) - it overlaps with areas where fishing activities are carried out	- correction of polygons - necessity of biodiversity conservation - supporting the development of aquaculture finding the best solution for the all activities harmonization
Archaeological sites and protected areas Natura 2000 requests	- presence in the area of shipwrecks - it is a request for the involvement of local authorities (town hall) to have permissions to decide in the marine space issues: e.g. o beaches administration o authorization for construction o control the activities of the area	- should be established the tourism development and diving archeology possibilities

The stakeholders in the groups were interested in the content of the maps exposed on the tables. Combined with the other thematic maps and with ortophotos background, the users started to think thoroughly regarding the importance of the coastal zone for their areas (Fig. 4.14).

Working Group 2 - Plenary session of ecology group results for spatial planning (Fig.4.15)

This group had as an overall objective the Marine Environment, Nature Protection, Biodiversity in the Eforie North and Eforie South littoral zone; and the double impact from the sea to the coast (coastal erosion) and from the coast to the sea (anthropogenic impact), adding land – sea analyse. From the methodological point of view, the discussions were divided into three subjects: problems, qualities and potential concerning the study area.

Fig. 4.14. Map drawn under stakeholders consultation (Working Group 1)

Working Group 2 - Plenary session of ecology group results for spatial planning

Items	Identified issues	Proposed solutions and opportunities
NATURA 2000 marine protected areas	- Eforie Nord - Eforie Sud Submerged Beach (ROSCI0197), is the only beach in the Southern Romanian coast which has not been modified until 2016, through the construction of massive structures to protect the coastline - only in this area it is preserved the habitats characteristic of a sandy beach exposed and its natural hydrodynamics - it is the only place from across the Romanian seaside where the mere presence of the two species was a	- marine area from Cape Tuzla (ROSCI0273). In the Cape Tuzla area, the rocky reef-like seabed has the widest coverage towards dry land and here is the most rugged relief of the Romanian Black Sea - consequently, here can be encountered the most diverse range of such habitats kind and hence a very rich and varied fauna

	good indicator of marine water quality - species like the corneous wedgeclam *Donacilla cornea* and *Donax trunculus* are still surviving, because of the ecological requirements, which are present in this area: water purity, oxygen content, salinity.	- protected species which appear here, such as Common bottlenose dolphin *(Tursiops truncates)*, harbor porpoise (*Phocoena phocoena),* should be monitored in the aim of conservation
Fishery Activities	- existing fishing, fishery, aquaculture and fish processing areas: "*Cherhanaua lui Matei*", farm, '*Gulf of fishermen*", mussels farm "*Maricultura*" - regarding the fish installation, they are in the same place since about 50 years (in spite of all surrounding changes) - is not taken into consideration the change of the current routes of navies in the recent years; this could impact and could be a reason of the low catches registration	- limiting fishing activities and other marine activities in the frame of marine protected areas is reclaimed - Natura 2000 areas are restrictive for marine activities but more permissive for Fishing activities, possible under certain conditions - it is recommended (by the other hand) as fishing areas to not be affected by navigational routes (including those belonging to recreational boating)
Techirghiol Lake **- is a nature reserve, including attractiveness of the area / landscape diversity / areas reclaimed as protected areas: *Natura 2000* sites, *Techirghiol Lake* – Ramsar site** **- is an international well-known as balneary resort for health, due to the therapeutically mud produced under peloidogenessis processes**	- due to its qualities with international significance the Lake is an important source of income for the Eforie area - there are three Custodians of Techirghiol Lake reserve: ANMR, Sanatorium Techirghiol, and Romanian Waters Administration - erosion and landslide processes are presented - the therapeutical mud of the lake is poorer by the qualitative point of view; main reasons are: o the divided of the lake in three parts with different salinities o the influx of fresh water from the land areas has caused a decrease of water salinity, loss of biodiversity, eutrophication o the pressure of the terrestrial impact on the lake water o the mud is concentrated in the central part of the lake o extraction of approximately 2,000 tons of mud / year is done through excavation o mud exploitation leads to edges collapse of extraction area o sanding with sand dredged from Belona marina (port) and which is added on the Techirghiol Lake beach /coast - other sources of pollution, are: o wastewater spills and leaks of the built area borders Lake Techirghiol o discharged back into the lake of	- has to be found a middle way to harmonize the status of nature reserve with the present status of anthropogenic reserve - the qualitative reahabilitation of natural resources: mud, *Artemia, Chladophora* - strengthen on the west side of Lake Techirghiol and rehabilitation in the national and European road benefit - recovery of water quality - recovery of organisms' quality and natural resources bio-potential - stopping the terrestrial pressures

	the 90% of the used mud from sanatorium o buildings around Techirghiol Lake affect the quality of mud, influencing productivity; also, the wastes discharges	
Belona Lake **Surprisingly, it is a freshwater lake located between Black Sea and *Techirghiol Lake* (hypersaline), due to freshwater internal springs**	- lake destination is recreation - It needs to be and it is a plan to be rehabilitated in few months - lack of delimitation of areas designed for fuel storage for touristic boats (it was mentioned that the private Marina situated in Eforie North has such types of facilities)	- the access to the area was restricted for vehicles exceeding 3.5 tones - there is a project proposal with European funds from the mayor of Eforie, for cleaning and arranging Lake Belona walkways
North and South Eforie Beaches	- the width of coastal belt is very small narrow between the North and South Eforie, being vulnerable and weak - lack of regulations on distances between the leisure areas on the beach (nautical activities, beach bars etc.); in these terms, there is necessary to identify the institutional frame responsible and an institutional cooperation (between Romanian Waters, Port Administration, City Halls) in order to accomplish it - the buildings on the coastal area were made over an important geological area (forested dunes) – a sedimentary reservoir in the case of heavy storms - storage of polluted dredged sand in a touristic area – several areas are registered on beaches - there are no restrictions for entertainment bases located directly on the beach (the fuel for ski jets are stored directly on the beach)	- there must be a certain distance between nautical bases do not affect the marine environment; authorizations are given by Romanian Waters Administration and Coast Guard - urban planning for coastal areas should take into account the distance from the beach - the city hall organised a committee of emergency for this situation with Emergency Situations Inspectorate, Prefecture and Romanian Water (owning the water surface nearby) - tourism activity, including the access to the cold baths area may be affected by consolidation works carried out by the municipality
Ports activities and infrastructure. ***Belona marina*****/port**	- the existence of an enclosure for anchoring small boats - there are organized sailing competitions - regular dredging of sediments in the quay of Belona harbor and repositioning in the north area of the port (still water) part of it being transported in the Lake Techirghiol ("Sincai" area) for sanding beach - the sediments of Belona marina may be contaminated with hydrocarbons from boats - the sediment transport and stock of them to tourism beach area and the the Techirghiol Lake border affect both ecosystems	- it requires a thorough analysis of sediment. Those who do dredging should receive a notice from approved institutions - conflict situation harmonization due to the intersection of navigation routes end protected area in the port zone (due to the expansion of protected areas) - consideration of port relocation
Others	- building on littoral zone in Eforie	- the city hall organised a

	North and Eforie South and between them leads to habitats degradation; the main example is dune protected area (which constituted natural flood protecting areas). It is almost lost - bank erosion between Eforie North and South, which has determined landslide of Garii street (the street that serves the Train station and on which there are like 7-8 households), which is in danger of sinking - 52 m length and 13 m subsidence. Because of this situation, the access is restricted for heavy vehicles - the existence of a pipeline spill into the sea about which the stakeholders do not know if it is still intact or has crevices	committee of emergency for this situation with the Emergency Situations Inspectorate, Prefecture and Romanian Waters (owning the water surface nearby). It was mentioned that closing Eforie Train station road will have a high impact on tourism sector, so there is the major need to strengthen the banks

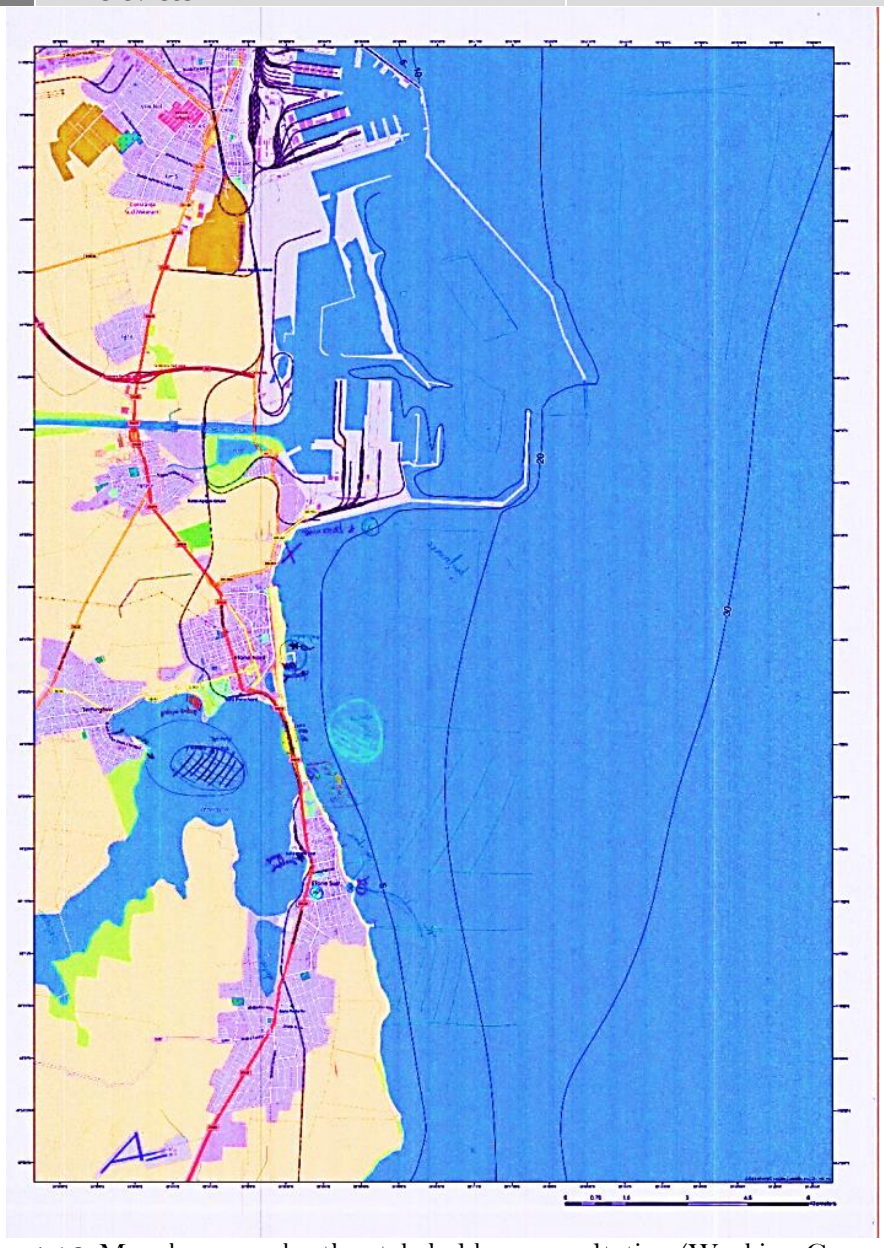


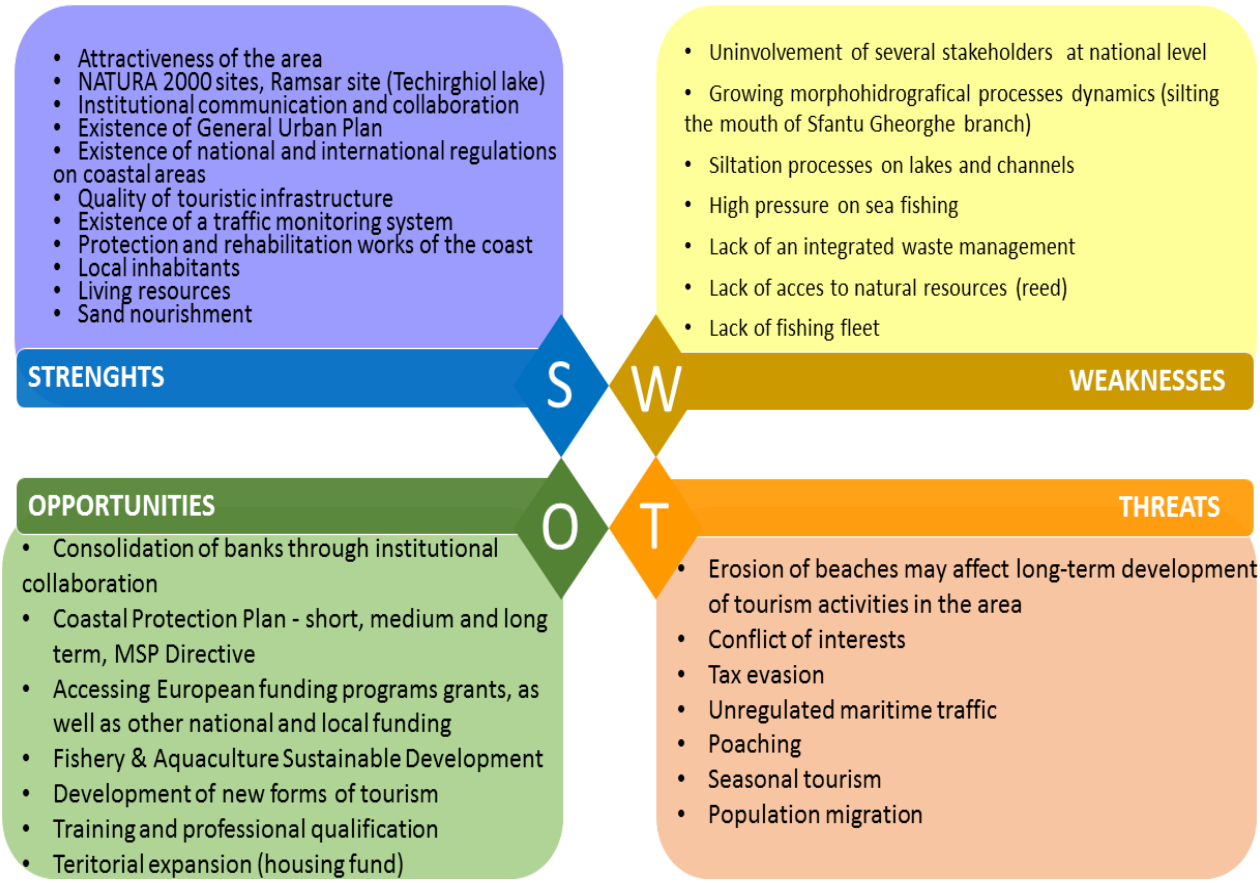
Fig. 4.16. Map drawn under the stakeholders consultation (Working Group 2)

The results presented emphasize a future possibility of territorial development and coastal protection for the Eforie North and South coastal area, in accordance with MSP Directive. Must be added the assessment of the impact of new hydrotechnical works and the necessity of a good integrated management both on the coastal but also on the marine part. The new approach has to take into account the land-sea interaction, too.

Further, from the working groups were identified strengths, weaknesses, opportunities and threats at the first sight.

The map is a mirror of all discussions resulted form the meeting with stakeholders, highlighting its main strengths in the results obtained, SWOT Analyses and mapping. (Fig.4.16).

Fig. 4.17. SWOT analysis for the Eforie North and South coastal area



A comprehensive map resulted from previous designed during stakeholder consultation was elaborated in GIS system (Fig.4.18).

The results presented above emphasize a future possibility of territorial development and coastal protection for the Eforie North and South coastal area, in accordance with MSP Directive. It should be added that the assessment of the impact of new hydrotechnical works and the necessity of a good integrated management both on the coastal and the marine parts. The new approach have to take into account the land-sea interaction, too.

The Sketch match planning methodology proved to be a success for the Eforie case study, assuring a good cooperation process with different stakeholders and experts, raising awareness among stakeholders related to a sustainable use of their coastal area and their particular landscape. The success of this approach was assured due to the interdisciplinary topics debated

during the design workshop, thus combining and integrating land planning with biodiversity, social and economical aspects.

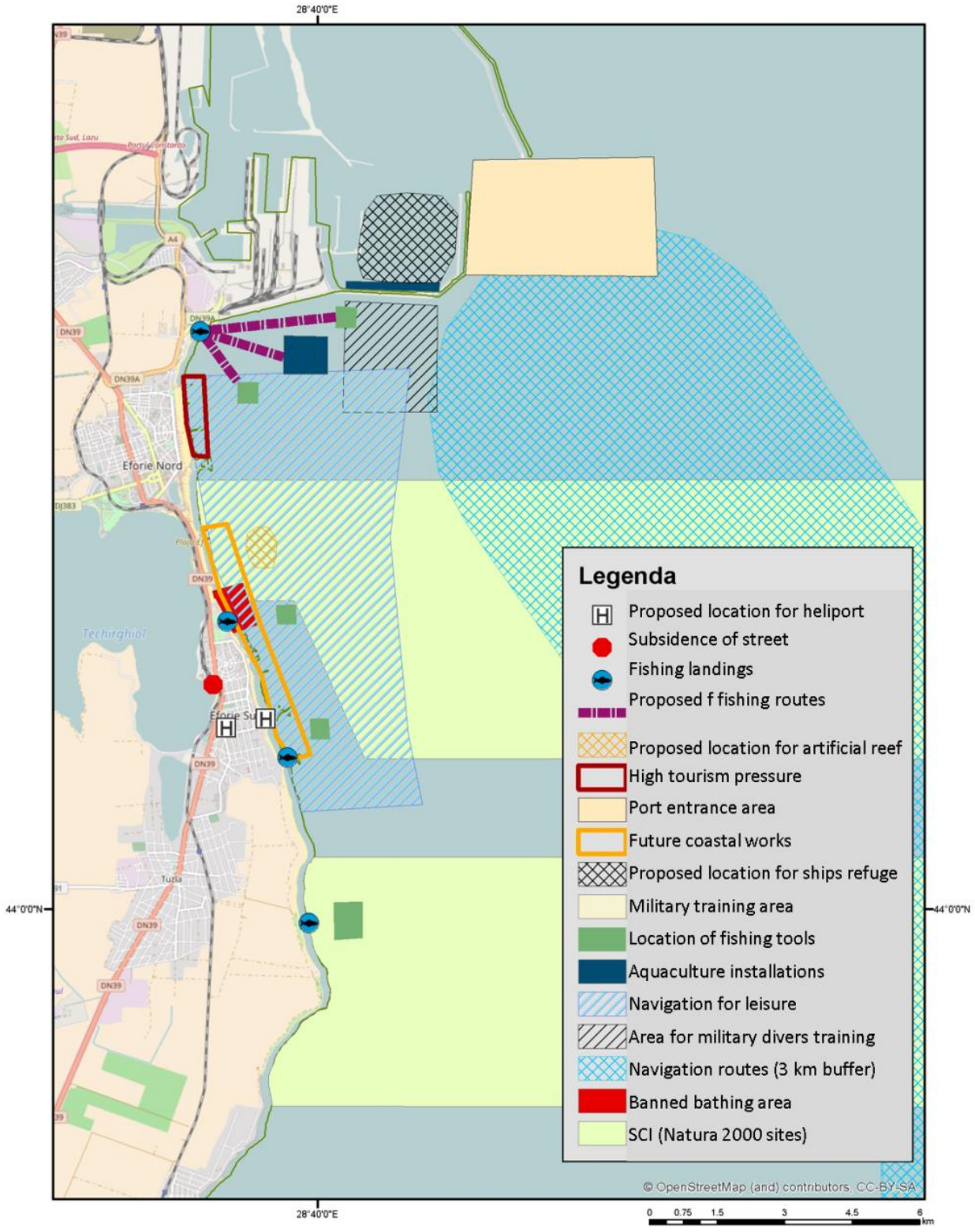


Fig. 4.18. Uses of marine and coastal space (stakeholders involvement)

The final sketch took into consideration all the possible solutions drawn by stakeholders according to their point of view and interest, giving in this way the possibility of a better future coastal area management. It is important that the awareness risen among the participants

during the planning sessions to continue beyond the project, for a better inter-institutional collaboration.

Important factors for this meeting success and evaluation of all marine uses and activities, are:

- Enthusiasm and motivation of participants
- Availability of good thematic maps
- Important preparation before the workshop (1 month before and a previous non-formal meeting with stakeholders)
- Well-considered selection of participants based upon insight in the stakeholder-network

5. Functional - Spatial Zoning

5.1. Scoring methodology and Corresponding Scores

The matrix of conflicts was analyzed and quantified by means of the GeoReference Interactions Database (GRID) developed in the framework of the COEXIST project.

GRID (GeoReference Interactions Database) is a web-based flexible database and tool to analyse interactions (conflicts and synergies) in marine coastal areas. With GRID it is possible to fix interactions between activities and to represent them using matrix, and maps. Furthermore it allows calculation of the total conflict score for a specific area and comparison of stress levels from different scenarios.

GRID has a GIS (Geographical Information System) module which allows analysis of spatial distribution of current and future activities (fisheries, aquaculture, energy etc.) and interactions (existing/ potential synergies and conflicts). From a methodological point of view the analysis on which the tool is based on identifies the potential overlapping of coastal and maritime uses in four consecutive steps:

- Identification of maritime uses. The maritime activities identified for the analysis are organized in five main categories of use: maritime transport, tourism; fishery and aquaculture, environmental protection, coastal defense and military use.
- Definition of temporal and spatial attributes for each maritime use. Each maritime use is classified according to four attributes that characterize possible spatial and temporal overlapping uses. Following the COEXIST methodology (Shultz et al., 2010), the attributes are defined through experts' judgment, as follows: (i) vertical domain, i.e. position on water column (A = surface/pelagic, B = whole water column, C = bottom/benthic area); (ii) activity spatial domain (1 = small, 2 = medium, 3 = large); (iii) activity temporal domain (1 = short, 2 = medium, 3 = long/permanent); mobility (F = fix or M = mobile).
- Calculation of the "conflict score" for each pair of maritime uses insisting on the same cell of analysis. Maritime uses, which are located in the same cell of analysis, are confronted in pairs. The "conflict score" of each pair of maritime uses is the result of the application of three rules of calculation. The rules, taken from the COEXIST methodology (Shultz et al., 2010), mathematically represent the level of potential spatial and temporal conflict between maritime uses.
    - **Rule 1**: if the vertical domain of activity 1 is different from the vertical domain of activity 2 and none of them concerns the whole water column, then the conflict score is 0;
    - **Rule 2**: If both activities are "mobile", then the conflict score is equal to the minimum of the temporal domain plus the minimum of the spatial domain.

- **Rule 3:** If Rule 1 and Rule 2 cannot be applied, then the conflict score is equal to the maximum value of the temporal domain plus the maximum value of the spatial domain.

From the application of the above rules and related values, the "conflict score" of each pair of uses is calculated, ranging from 0 (no conflicts between uses) to 6 (highest level of conflicts between uses). One of the first standardised tools which was implemented in GRID was the visualization of the interaction matrix which reflects the level and type of interactions (conflicts and synergies) between activities. These matrices are produced with the help of experts' knowledge and comprise qualitative levels of conflicts ranging from "no" to "high". GRID tried to implement a good practice for COEXIST, aiming at the identification of interactions and their quantification. Therefore, a set of criteria should be applied to define a conflict and to quantify it in order to be represented on a matrix. Besides conflicts, some synergies were identified, such as, for example, between fisheries and aquaculture (Fig. 5.1).

5.2. Evaluation of the Spatial Importance and Vulnerability Analyses

Based on the criteria of use and management, the Eforie coastal zone is classified in the following functional zones (Article 9 of the Methodology/07.04.2004): Table 5.1

Terrestrial zone	Land-sea interface zones	Marine zone
- Tourist beaches - Undeveloped beaches that include dunes and sand vegetation - Cliff zones - Natural reserves	- Ports and related constructions - Hydrotechnical works, constructions - submerged and emerged, for the coastline protection; - Work consolidating cliffs	- Waterways and harbors - Military sector for specific mission - exercises for vessels - Shellfish farms

Based on national legislation, the following functional zones that include the Eforie sector can be defined:

Coastal dry land	*Coastal marine zones*
- Industrial/harbor zones: *Midia, Constanta South-Agigea* - Tourist zones: *Eforie resorts* - Agricultural/forest zones: *Agigea, Eforie South,* - Residential areas - Coastal city incorporated space - Military zones: Tuzla lighthouse - Industrial/harbor zones: *Midia, Constanta South-Agigea* - Tourist zones: *Eforie resorts* - Agricultural/forest zones: *Agigea, Eforie South,*	- Reserves: Natura 2000 - Habitat Directive - Eforie submerged beach (ROSCI0197), Marine area from Cape Tuzla (ROSCI0273), Bird Directive - Black Sea (ROSPA0076) - Transport sea routs: Constanta South-Agigea Port - Industrial fishing zones: on the whole coast of the concerned sector - some have passive fishing, others active - Tourist navigation: Belona port - Reserves: Natura 2000 - Habitat Directive - Eforie submerged beach (ROSCI0197), Marine area from Cape Tuzla (ROSCI0273), Bird Directive - Black Sea (ROSPA0076) - Transport sea routs: Constanta South-Agigea Port - Industrial fishing zones: on the whole coast of the concerned sector - some have passive fishing, others active

Fig. 5.1. Interaction matrix of the human activities carried out in the coastal area of the Eforie case study obtained through the GRID WebGis application; red squares: conflicts; green squares: synergies; white squares: no interaction. The level of interaction is scored between 0 and 6.

Uses	Coastal constructions	Coastal protection	Harbors	Navigation routes	Anchorage	Urban residues	Urban development	Dumping	Pelagic trawl	Stationary uncovered pounds	Pots and traps	Set gillnet	Manual rapana harvesting	Mussel farm	Natura 2000 sites	Refurbish beaches	Ship wrecks	Beach tourism	Recretional diving	Nautical sports	Marinas	Recretional fishing	Military areas
Coastal constructions		0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	0	2	0	0	0	0	0
Coastal protection			2	3	3	0	0	0	0	0	0	0	0	3	5	3	0	3	0	1	3	0	0
Harbors				3	3	0	5	0	0	0	0	0	0	2	6	0	0	5	1	1	3	3	0
Navigation routes					5	0	0	2	1	5	5	5	2	3	3	0	0	0	1	3	2	1	3
Anchorage						0	0	2	1	5	5	5	2	3	6	0	2	2	1	3	3	2	3
Urban residues							0	0	0	0	0	0	0	4	6	0	0	5	5	3	2	5	0
Urban development								0	0	0	0	0	0	2	6	0	0	5	0	0	5	0	0
Dumping									3	3	3	3	3	3	6	2	4	1	4	2	2	2	3
Pelagic trawl										4	4	4	4	5	3	0	4	0	1	0	0	1	5
Stationary uncovered pounds											4	4	4	5	3	0	3	0	5	0	0	5	5
Pots and traps												4	4	5	3	0	5	0	5	0	0	5	5
Set gillnet													4	5	3	0	3	0	5	0	0	5	5
Manual Rapana harvesting														5	3	0	3	0	4	3	0	4	5
Mussel farm															3	0	4	0	5	5	5	5	5
Natura 2000 sites																	3	5	2	3	2	3	6
Refurbish beaches																	0	5	0	0	2	0	0
Ship wrecks																		0	4	2	0	3	4
Beach tourism																			0	2	0	2	2
Recretional diving																				2	0	2	4
Nautical sports																					2	2	4
Marinas																						0	3
Recretional fishing																							2
Military areas																							

- Residential areas - Coastal city incorporated space - Military zones: Tuzla lighthouse	- Tourist navigation: Belona port - Military navigation: Constanta South - Agigea port, military training areas - Zones with an economic potential that have a series of explicit conflicts of interest, in the economic activities and in the coastline ecosystem component - Harvesting grounds for mollusks: Shellfish Directive (Zone 3 Agigea Mangalia).

6. Conclusions

In Romania the legislation related to Maritime Spatial Planning, (29 August 2016) was elaborated.

The Eforie study is challenging because it emphasizes the influence of coastal erosion on the interactions and impacts between activities, sectors and interests, both in the terrestrial and marine domains.

From the physical perspective, the Eforie North and South can be considered a transitional sector between the two Romanian shore units having as the northern boundary a commercial maritime port crossed by the big systematic channel Danube-Black Sea and the southern boundary the geographical cape, Cape Singol for Mamaia bay and respectively Cape Turku for Eforie, thus representing an enclosed shore unit and an isolated sedimentary cell by marine obstacles; on the extremity of the sand barrier, closing a marine golf.

The climate instability is due to strong winds, waves, variability of temperatures, salinity, density, floods alternating with droughts periods.

Eforie resort is surrounded by a large variety of land, wetlands (small freshwater Belona Lake, between Black Sea and the hypersaline Techirghiok Lake), traditional and new activities, shown in the produced maps. Between Eforie North and South there is a very narrow and vulnerable coastal belt.

The sea water quality is good, resulting in the diversity of habitats and specificity of fauna and flora and abundance of some important species. Macrophytes are important for fish feeding and as habitats for resting, breeding and larvae rearing. MSP plans to potentially support a sustainable fisheries management, regulating anthropogenic activities.

From the point of view of MSP, the dynamics of ecosystem services and their driving forces are influenced by maritime activities, where they are developed. For example, maritime traffic overpasses the new designated habitats and has induced changes which have altered the productivity and regulation of different organisms in the marine food chain and resulted in an increased load of non-native species.

The metropolitan area economy is complex; its main sectors are: port and shipping activity, tourism, services, trade, food industry, machine building, chemical and petrochemical, electrical and thermal energy, wood processing, textile industry. The new buildings zones and investment are presently developing.

According to the National Competitiveness Strategy 2014 - 2020, the main points of interest in the competitiveness agenda are related to the implementation of public investment projects according to current commitments of the Romanian Government, which indicates an increase of investment spending.

Concerning Eforie's population, natural growth has remained negative since 1991, the number of births is lower than that of deaths compared to other adjacent areas, where it is positive (Fig. 2.37). The last 23 years (1992-2015) were characterized by the ongoing decline in the number of people, with almost 47,000.

Spatially, Eforie North and South are characterized by a high tourism potential.The key challenge is the urban concentration of the population, floating number of people drastically increasing during summer season because of sunbathing tourism with socio-environmental consequences: the necessity to improve the infrastructure, accommodation and recreation locations, specific services, traditional activities rehabilitation and development, at least with positive impact on the people income, but with a huge impact on the environment.

However, the coastal erosion effects on tourism facilities and attraction is significant due to the landscape being damaged, with its consequences in economic loss. For a period of 50 years, the total average sediment loss amounts has been 575,000 m^3.

In order to reduce the risks from coastal erosion, a strategic coastal Master Plan for Coastal Protection was elaborated in 2011 by Halcrow Romania and the Romanian Waters National Administration, the Dobrogea Littoral Coastal Water Basin Directorate (ANAR – ABADL. Some other natural risks, registered, are: floods, strong winds, waves, earthquakes.

Different human pressures registered are related to different kinds of pollution with impacts on habitats and living organisms, evaluated as the main physical, chemical, biological effects. Examples of human activities and their effects are: coastal and sea infrastructures, including Danube – Black Sea Channel, pipelines, new planned oil facilities and wind farms; transport, navigation, transport infrastructure; new constructions on the coastal zones; exploration and extraction of mineral resources: sand, gravel for nourishment; pollution: liquids pollution: chemical, nuclear, biological; organic waste and minerals.

Consequently, the necessary conservation measures and the participants who will handle subsequent implementation and their entry into force will be identified together with the custodians and stakeholders, so that a sustainable management plan is ensured. The nominated custodians will implement all measures under their competence and ask the competent bodies to take measures in sectors that meet them.

The main measures have to be linked with ICZM, including a good management of solid and liquid wastes, techniques for water treatments, limiting the contaminants releasing. Also:

- Mitigation of the increasing population impact from the sea coast to the marine environment.
- Development of the bio-technologies (aquaculture, etc.) for water filtration and purification.
- Strongly supporting the environment protection and biodiversity conservation.

Some sources of pressures are also: storage in humid substrate and in the marine environment of substances and nutrients that are harmful and hazardous, discharge of waste, including the dumping of contaminated dredged sediments; underwater noise and physical degradation of habitats due the dredging and extraction of sand and gravel.

In accordance with national law, the Minister of Agriculture and Rural Development Order no. 449/2008, in the Romanian Black Sea trawling is permitted only with pelagic trawl beyond the 20 m bathymetric contour and fishing vessels can operate only if they install a satellite monitoring system (Ministerial Order of Agriculture and Rural Development No. 7/2010). Trawling the seabed is prohibited in Romania's territorial waters, directly or indirectly: e.g. sediments or waste from some aquaculture installations which modify the environment (physically) and/or threatening the diversity of habitats that could procedure in turn, an influence on their ability to accommodate both commercial species and non-commercial.

The use of GIS for coastal and marine zone management has expanded rapidly during the past decade. For optimum efficiency, geo-referenced data should be properly stored in geo-databases built on spatial data model design (Prélaz Droux, 1995). Maps are essential, both for decision-making by field staff, and also for information communication targeting the stakeholders involved (decision-makers, managers, scientists etc.). These have been prepared:

- Maps of marine bio-geo-physical features and associated human activity
- Quantification of coastal and marine features, human activities, pressures and threats
- Identification of zonal conflicts, concentration of uses, priority conservation areas

Land - sea conflicts of interest key have identified by literature review, expert judgment, local knowledge and stakeholder involvement. Problems have been identified, olutions proposed and opportunities identified using a SWOT analysis.

Stakeholder methods and also Functional - Spatial Zoning analyses have been some of methods applied. *Scoring methodology* and *Corresponding Scores* permitted the matrix of conflicts quantifying by means of the GeoReference Interactions Database (GRID), appositely developed in the framework of the COEXIST project.

In consequences:

- The study proves the existence of significant pressures from coastal erosion, and the need for a good beach/cliffs management is quite imperative. Despite the new implementation of the coastal protection, the nearshore areas remain under risk of coastal erosion and the need for maintenance continues together with initiatives to identify complementary ways and possibilities for coast consolidation.
- However, the coastal erosion, emphasizing an unbalanced sediment situation in the area, adjacent to the Constanta Port, has a strong effect on economic aspects of the area encompassing human activities and nature attractiveness, sometimes significantly affected by the landscape damaging, habitat losses during major hydro-meteorological events.
- The influence of the coastal erosions on the socio-economic activities, is reflected in associated interactions, conflicts and controls between stakeholders' various activities in coastal and marine areas of the coastal zone.
- The continuation of the implementation of the coastal protection is required by the actual stage of erosion, despite its environmental impacts, and its mitigation is necessary for the consideration of the environmental friendly solutions.
- The new extensions of the beach surfaces included in the coastal protection produced, for the moment, a small impact on local tourism industry/economies developments related to the tourists number, due to a delay in the recreational and service facilities areas.
- The new tools for mapping/electronic cartography of the main uses/resources and activities used in Maritime Spatial Planning provide a strong support for an integrated decision system towards conflicts harmonization and stakeholders awareness;
- The new development opportunities could be related to the extension of the tourist season activities through cultural, recreational and bathing activities, in tourist facilities such as thermal aqua-parks, aquarium/marine science museum.

Several recommendations for conflict resolution are the following:

- impact limitation of the coastal constructions works;
- promoting large scale tourism industry (all-inclusive complexes);
- sustaining the aquaculture in the sheltered area of the Constanta - Agigea Port.

This study also demonstrated:

- Pressures from the coastal part are still high and need very good management;
- The area remains under the risk of coastal erosion and the initiatives to identify ways and possibilities for coast consolidation need to be continued.

One way of a better future of this study area is spatial planning realized from the coast to the sea.

Specific Recommendations on on-going coastal erosion measures (considering environmental friendly methods) are related to the mitigation of impacts of existing hard and soft coastal protection measures, as artificial beaches extensions, implemented on coastal and maritime space of Eforie.

Due to a major maritime port in the adjacent area of cutting the sediment source supply, the design and implementation of the Masterplan for protection did not manage to consider certain environmental-friendly solutions.

Thus, a specific recommendation is to extend carefully sand nourishment, as a soft measure for coastal protection, in places where now there is no sand, though this will affect the biodiversity by changing the habitat type in the area. As the tourist/investment pressure is at high levels, the relocation of habitats should be considered, as well as the delimitation of strictly natural "island" of coastal development, as nature sanctuaries, refuges in an anthropic shore area. The local landscape will be promoted and emphasized by such escapes, together with the embellishment of the natural attractiveness of Eforie's coastal areas.

Lessons Learned

The main lesson from Eforie's area is that coastal protection is only temporary, and having a vision on large scale/general issues and the subsequent design and maintenance of such works is crucial.

In the Eforie area, several series of coastal protection solutions have been gradually implemented, over several decades (dams, concrete walls, sand nourishments, etc). Planners and engineers should consider this experience in their intervention and improvement over a natural area, which subsequently needs reshaping/naturalization and natural landscape promotion.

Conflicts identified have to be attenuated and the potential role of MSP is huge in contributing to the aim for the wellbeing and progress of the population, and harmonising activities with the necessity of nature conservation.

The erosion in Eforie sector is differentiated by the presence of the Constanta Port jetties, hydrotechnical works and the abiotic resources of the coastal system. On the units of the sector, the erosion is extending differentiate by the presence of sand belt/closed barrier island of Techirghiol lake.

Because the sand belt of the Techirghiol Lake is substantially eroded, despite of implementation of small underwater longitudinal breakwater, with magnitude of tens of meters, and the both, Eforie North and Eforie South protected shores are more stable, due to presence of hydrotechnical constructions.

The impact of erosion on beach tourism is apparent for touristic activities due to the beach surfaces retreat, but in the same time, activities such as infrastructure for maritime port, ruttier and railway transport, surface/water management works are considering it the magnitude of it, in the context of climate changes. The statistic distributions show for the return periods notable modifications for above mentioned infrastructure design.

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CASE STUDY 1 EFORIE
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