MINISTRY OF ECONOMY

Strategic Environmental Assessment (SEA) for Hydrocarbon E&P Activities in Offshore Montenegro

JULY 10, 2015

CAU in association with ELARD and Institute of Researches and Development Regarding Protection at Work		
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LIST OF ACRONYMS

BAT	Best Available Technique
BAU	Business As Usual
BLI	Bird Life International
BOD	Biochemical Oxygen Demand
BOP	Blowout Preventer
CAU	Center for Architecture and Urbanism
CETI	Centre for Eco-toxicological Research
CEFTA	Central European Free Trade Agreement
CITES	Convention on International Trade in Endangered Species
CPT	Cone Penetration Test
CTD	conductivity, temperature, depth
DEP	Daily Egg and Larvae Production
DGPS	Differentially Corrected GPS
DRS	Direct Range System
EBS	Environmental Baseline Study
EC	European Commission
ECRAN	Environment and Climate Regional Accession Network
EEA	European Economic Area
EEC	European Economic Community
EER	Escape, Evacuation and Rescue measures
EIA	Environmental Impact Assessment
ELARD	Earth Link and Advanced Resources Development
EMF	Environmental Management Framework
EMP	Environmental Management Plan
EMS	Environmental Management System
EPA	Environmental Protection Agency
ERA	Environmental Risk Assessment
ESDV	Emergency Shutdown Valve
EHS	Environmental Health and Safety
ESIA	Environmental and Social Impact Assessment

EUR	Euro
EWL	European Waste List
FAO	Food and Agriculture Organization
FDP	Field Development Plan
FPSO	Floating, Production, Storage and Offloading
GDP	Gross Domestic Product
GFCM	General Fisheries Commission of Mediterranean
GHG	Greenhouse Gas
GIS	Geographic Information System
GNSS	Global Navigation Satellite Systems
GOOS	Global Ocean Observing System
GPS	Global Positioning System
HELCOM	Helsinki Commission
HIV	Human Immunodeficiency Virus
HIWN	Hydrographic Institute of War Navy
HSE	Health, Safety and Environment
IAP	Ionian Adriatic Pipeline
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICZM	Integrated Coastal Zone Management
IFC	International Finance Corporation
IMCA	International Marine Contractors Association
IMDG	International Maritime Dangerous Goods
IMO	International Maritime Organization
IPCC	The Intergovernmental Panel on Climate Change
IPH	Institute for Public Health
ISO	International Standards Organization
ITI	Institute of Researches and Development Regarding Protection at Work
IUCN	International Union for Conservation of Nature
LDS	Leak Detection System
LNG	Liquefied Natural Gas
MARD	Ministry of Agriculture and Rural Development
MARPOL	Marine Pollution

MCS	Multi-Channel Seismic
MMS	Mitigation Measures
MONSTAT	Statistical Office of Montenegro
MRF	Material Reclamation Facility
MSDT	Ministry of Sustainable Development and Tourism
MSY	Maximum Sustainable Yield
NASC	Nautical Area Scattering Coefficient
NGL	Natural Gas Liquids
NGO	Non-governmental organizations
nmi	Nautical Mile
NORM	Naturally-Occurring Radioactive Material
OBM	Oil-Based Mud
OECD	Organization for Economic Co-operation and Development
OGP	Oil & Gas Producers
OPEX	Operational Expenditure
OSCP	Oil Spill Contingency Plan
PIDROHS	Public Institute for Development and Research into Occupational Health and Safety
PPE	Personal Protective Equipment
PPP	Precise Point Positioning
RAC SPA	Regional Activity Centre for Spatially Protected Area
SBM	Single Buoy Mooring
SDGPS	Clock and Orbit Corrected GPS
SEA	Strategic Environmental Assessment
SFRY	Socialist Federal Republic of Yugoslavia
SITC	Standard International Trade Classification
SLF	Sanitary Landfill Facility
SNAME	Society of Naval Architects and Marine Engineers
SOPEP	Shipboard Oil Pollution Emergency Plan
SRY	Socialist Republic of Yugoslavia
STD	Sexually Transmitted Disease
TANAP	Trans Anatolian Pipeline

TAP	Trans Adriatic Pipeline
TLP	Tension Leg Platform
TOE	Tons of Oil Equivalent
TRIX	Trophic Index
TTS	Temporary Threshold Shift
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNODC	United Nations Office on Drugs and Crime
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
VSP	Vertical Seismic Profile
WBF	Water-Based Fluid
WBM	Water-Based Mud
WMP	Waste Management Plan
YWN	Yugoslav War Navy

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Member 1 Organization 1

1. INTRODUCTION

1.1 GENERAL

Center for Architecture and Urbanism (CAU) and the Institute of Researches and Development Regarding Protection at Work (ITI), in association with Earth Link & Advanced Resources Development (ELARD) (hereafter named the “Consultant”), were awarded a contract by the Montenegro Ministry of Economy (hereafter named the “Client”) (contract referenced 01-2337/18 and signed on February 28, 2014) to provide professional services for **The Preparation of the Strategic Environmental Assessment of Hydrocarbon Exploration and Production (E&P) Activities in Offshore Montenegro**.

This project aims at: 1) assessing the environmental, social and health impacts of E&P activities in offshore Montenegro; and 2) developing measures for effectively addressing the identified impacts at an early stage of the planning cycle by minimizing or avoiding negative impacts.

The overall goal of the project is to establish a tool that will assist the Ministry of Economy, at the earliest possible stages of decision making, in sustainably managing the E&P activities in offshore Montenegro and fully integrating major environmental and social concerns in subsequent planning stages, including the upcoming licensing round and contract negotiations with oil and gas companies.

1.2 SEA TEAM

The following sections introduce the Consultant responsible for the preparation of the SEA Study.

1.2.1 Center for Architecture and Urbanism (CAU)

Centre for Architecture and Urbanism, CAU, is a result of intensive, international, intellectual and professional cooperation on exchange of ideas between individuals gathered around mutual goals. Globalization and the time when information is perceived as an asset showed that team work of mutually connected individuals worldwide is omnipresent trend in serious projects. In the overall context of spatial planning in Montenegro today, regional and international cooperation, multidisciplinarity, undisturbed flow of knowledge and capital, studious and environmental approach, sustainable development, renewable energy and such are just some of the ‘key words’ that define proper access to this serious discipline.

CAU holds licenses for issuing spatial-planning documents.
CAU specializes in:

- Spatial planning and urbanism
- Economic-demographic analysis and economic-market projections
- Strategic Environmental Impact Assessments
- Environmental Impact Assessments
- Architecture and landscaping
- Transportation and infrastructure
- Construction supervision

- Land Surveying
- Investment projects
- Field research
- Consulting.

1.2.2 Institute of Researches and Development Regarding Protection at Work

Institute of Technical Research exists since 1973. Ever since, it maintains constant contact with business entities in Montenegro in the field of industry, ecology, geology, power supplying, civil engineering, mechanical engineering, water management and technology, and others.

With the foundation of University of Montenegro in 1974, the Institute became its constituent and rightful member.

Since its foundation, the Institute realized numerous scientific-research projects of special relevance for Montenegro and international importance.

After 1992, the Institute focused its research complex on development research as support to economic shifts. At the same time, the Institute is initiator of preparation of technical documents in the field of ecology (EIA, SEA) in Montenegro, and so far has prepared a large number of substantial studies, analysis and other forms of expert work for the purpose of strategic projects in Montenegro.

Founder of the institute, University of Montenegro and the Government of Republic of Montenegro, in 2000, passed decision to transform “The Institute for Technical Research” into “Institute of Researches and Development Regarding Protection at Work” with substantially expanded array of activities given its name.

The Institute has vast experience in preparation of Strategic Environmental Impact Assessments (SEA), Environmental and Environmental-Social Impacts Assessments (EIA and ESIA), Environment Baseline Studies (EBS), as well as in environmental monitoring.

1.2.3 ELARD (Earth Link and Advanced Resources Development)

ELARD is a regional consulting and engineering firm, specialized in environmental management. ELARD has been offering environment-related services for nearly 20 years in the Middle East, North Africa, Arabian Gulf regions and Asia. With its headquarters located in Beirut, ELARD has permanent offices in Baghdad, Damascus, Abu Dhabi and Tripoli. ELARD employs nearly 100 professionals with expertise in numerous fields of environmental engineering and sciences.

ELARD has extensive experience conducting environmental studies in the oil and gas sector, including Strategic Environmental Assessment (SEA), Environmental and Social Impact Assessment (ESIA), Environmental Risk Assessment (ERA), Environmental Baseline Studies (EBS) as well as environmental audits, among other services. The company has significant experience to provide the necessary technical inputs to its local partners and the stakeholders to conduct the SEA study for offshore hydrocarbon exploration and production activities in Montenegro.

1.3 REPORT STRUCTURE

The SEA report comprises the following sections:

- Executive Summary of the SEA Study.
- Section 1: "Introduction" contains an introduction to the SEA Study Report and a brief overview and description of the context of the Project. The structure and content of the SEA Report are outlined in this section, along with an introduction to the SEA team involved in the preparation of the SEA Study.
- Section 2: "SEA Methodology" presents the methodologies adopted in the preparation of the study including a description of the SEA process, baseline studies methodology, stakeholder engagement and public consultation methodology, analysis of E&P scenarios methodology, analysis of alternatives methodology and impact assessment methodology.
- Section 3: "Hydrocarbon Exploration and Production Activities" provides a description of the activities to be conducted during different Programme phases.
- Section 4: "Legal, Institutional and Regulatory Framework" defines the environmental institutions, legislation and standards relevant to the Project.
- Section 5: "Baseline Conditions" includes a description of existing environment.
- Section 6 "Stakeholder Engagement and Public Consultation" presents the findings of the scoping consultation meeting undertaken as part of the SEA Study and summarizes the main issues discussed and raised by stakeholders and how they were addressed in the SEA Study.
- Section 7: "Analysis of Alternatives" presents an analysis and discussion of identified alternatives relating to the choice of drilling technologies, solid waste management options, wastewater management options, hydrocarbon export options and site selection for onshore facilities.
- Section 8: "SEA Framework" presents the SEA framework of objectives, indicators and targets.
- Section 9: "Analysis of E&P Scenarios against SEA Framework" presents the evaluation of 4 E&P scenarios against the SEA framework.
- Section 10: "Impact Assessment and Mitigation" includes impact identification matrices, impact significance matrices and detailed impact assessment and mitigation for the different project phases.
- Section 11: "Environmental Management Framework" includes a summary of proposed mitigation measures, monitoring requirements and the institutional framework for the implementation of the EMP.
- Section 12: "Conclusions and Recommendations" includes main conclusions and recommendations.
- Section 13: "References" lists the bibliography used and cited throughout the text of the SEA Report.

- Section 14: "Appendices" contains 4 appendices to the SEA Report , as follows:
  - Appendix A : Legal and Policy Analysis
  - Appendix B : International Conventions and Protocols Ratified by Montenegro
  - Appendix C : Stakeholders Engagement and Consultation Plan
  - Appendix D : Scoping Report
  - Appendix E: List of SEA preparers

2. SEA METHODOLOGY

2.1 SEA PROCESS

SEA is defined as a "systematic, on-going process for evaluating, at the earliest appropriate stage of publicly accountable decision-making, the environmental quality, and consequences, of alternative visions and development intentions incorporated in policy, planning or programme initiatives, ensuring full integration of relevant biophysical, economic, social and political considerations".

Therefore, the SEA as an instrument is used to help in decision making and aims to bridge the gap between strategic initiatives and programme-level Environmental Impact Assessment (EIA) by providing a systemic analytical approach which can identify and address issues of resource use, efficiency and sustainability, providing as such a step further towards a fully integrated planning approach promoting and enhancing sustainable development.

SEA is pre-defined by identified issues, needs and priorities and evaluates the environmental and socio-economic impacts of policies, plans and programs. It usually covers large geographical areas and is conducted at a regional level. As such, the SEA has the opportunity to address impacts of actions at a strategic level.

The SEA will provide guidelines and recommendations for the preparation of EIAs for specific components of a programme for example by providing an important amount of information to the EIA preparer, especially with respect to baseline conditions, environmental impacts, and possible mitigation and monitoring measures.

The SEA is undertaken in close coordination with the Ministry of Economy's team responsible for the E&P programme as well as members of the Work Group responsible to monitor this assignment. The coordination and alignment serves to ensure that (1) environmental concerns, assets and constraints are properly accounted for in the E&P programme, (2) environmental impacts are minimized, and (3) proper environmental management is applied throughout the development and implementation of the E&P programme.

A specific stakeholder engagement strategy has also been prepared to secure engagement and participation of relevant stakeholders throughout the process.

Figure 2.1 illustrates the SEA process.

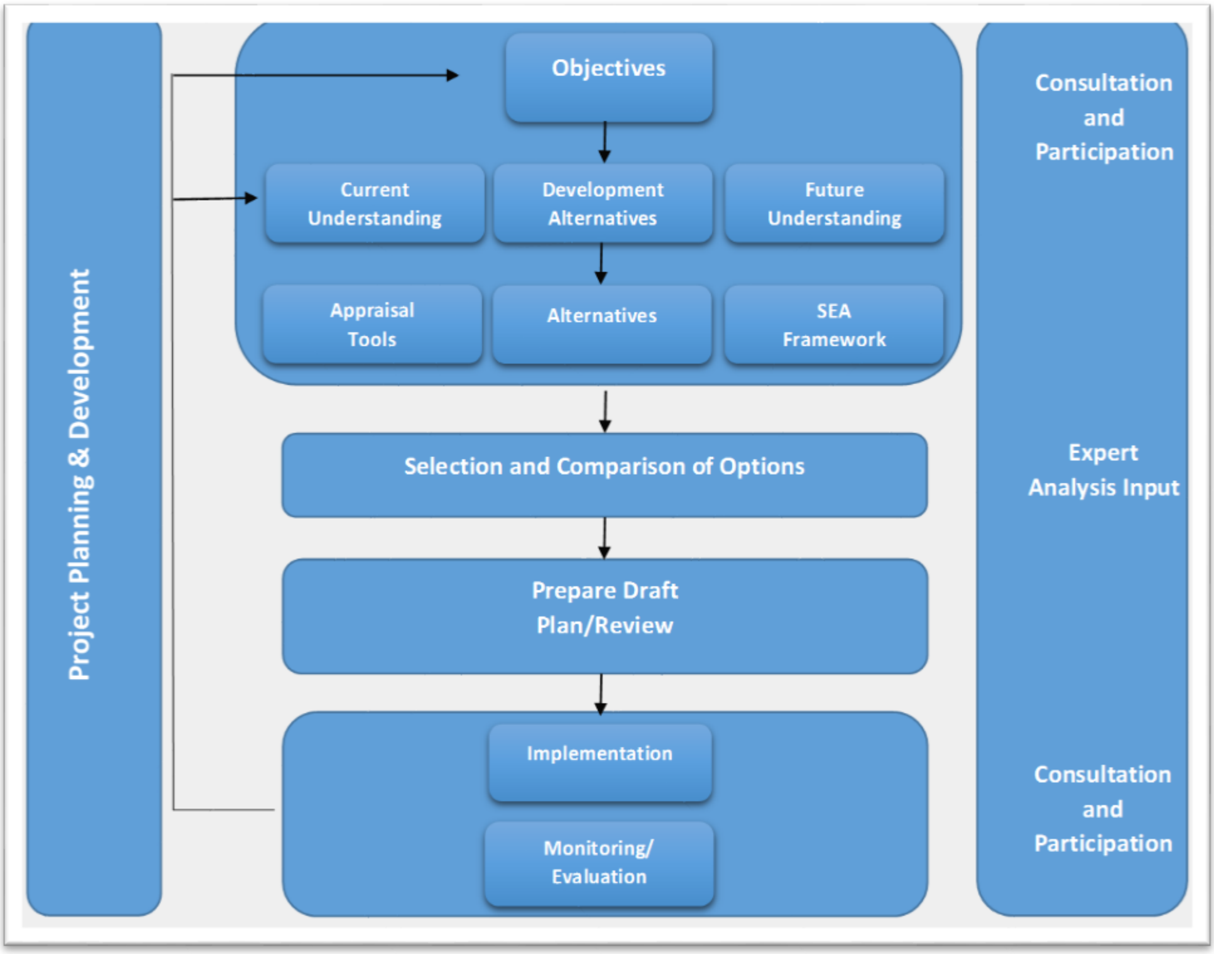

Figure 2.1 SEA Process

2.2 Critical Decision Making Points

The recommendations of this SEA Report shall be duly considered throughout the life cycle of the Programme. Milestones must clearly demonstrate how SEA recommendations were taken into account, particularly in the following critical decision making points:

- License award;
- Approval of exploration plan;
- Approval of development plan; and
- Approval of decommissioning plans.

2.3 Baseline Studies Methodology

Collecting baseline information is a tool providing evidence base for current states of the environment, society, and economy of the country in general and more specifically of the marine environment where the programme will be mostly implemented.

Understanding the current state of the environment is necessary to predict the likely future changes resulting from the implementation of the Programme, and to propose the adequate monitoring plans. Baseline conditions also help in the development of the SEA framework, especially in terms of objectives and indicators.

Baseline data related to the environmental and social components with which the programme is expected to interact was collected through the following means:

- Comprehensive literature review of existing documentations, publications and studies;
- Data received from public agencies;
- Additional inputs and information received during scoping consultations organized on July 24, 2014.

2.4 STAKEHOLDER ENGAGEMENT AND PUBLIC CONSULTATION METHODOLOGY

The main objectives of the stakeholder engagement programme are to introduce the Programme (purpose, nature, scale, duration of proposed activities, risks and potential impacts, etc.), its spatial boundaries and operational requirements to the key stakeholders. The information shall be disclosed to ensure that decision making and potentially affected stakeholders are aware of the Programme and able to obtain information about its different activities. From the early stages of the Programme, the stakeholders shall be given the opportunity to express any concerns they may have about the Programme or its potential environmental and socio-economic effects. They shall be later notified of the SEA main findings.

Consultations are conducted in accordance with the Stakeholder Engagement and Consultation Plan provided in Appendix C, and developed with reference to the following guidance documents:

- Guidelines on Strategic Environmental Impact Assessment (SEA directives) (2001/42) of European Parliament and of the Council of 27th June, 2001 on environmental impact assessment of certain plans and programmes
- Law on Strategic Environmental Impact Assessment ("Official Gazette of MNE", No. 80/05, „ Official Gazette of MNE, No. 73/10, 40/11)
- Law on Environment (Official Gazette of MNE", No. 48/08, 40/10, 40/11)
- Law on Ratification of Convention on Environmental Impact Assessment in a Transboundary Context (ESPOO Convention) (OG MNE, No. 08/08-27)
- IFC Performance Standard 1 - Assessment and Management of Environmental and Social Risks and Impacts. 2012.
- IFC. "Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets". 2007.

A scoping public consultation session including key stakeholders, NGOs and industry representatives was conducted on July 24, 2014 to discuss the contents of the scoping report and obtain necessary inputs for its finalization prior to proceeding with the SEA study.

An SEA results review meeting will be held to validate the main impacts, as well as the proposed mitigation and monitoring measures. In addition, a Public debate session will be organized as per the requirements of Article 19 of the SEA Law. These will be multi-stakeholder workshops to provide an opportunity for different stakeholders to interact and reach consensus on the way forward.

As per the SEA Law of Montenegro (No. 80/05), EU Directive 2001/42/EC (SEA Directive) and the Law on Ratification of Convention on Environmental Impact Assessment in a Transboundary Context (ESPOO Convention) (OG MNE, No. 08/08-27) transboundary consultations with neighboring countries have to be conducted if the programme is expected to have significant effects on the environment in those countries. Transboundary impacts are discussed in Section 8.

2.5 ANALYSIS OF E&P SCENARIOS METHODOLOGY

Based on the outcomes of the scoping phase, a number of indicators have been selected for their primary importance in sustainable development in Montenegro and given their relevance to the programme. The indicators and targets of the SEA framework were used to measure the likely changes in the environmental and social conditions related to each scenario. The evaluation process was based on the potential contribution of each scenario in meeting the targets set by the SEA framework. Table 2.1 summarizes the adopted scoring scheme. The steps below were followed to obtain an average score for each option:

- Indicators with mutually exclusive effects, being assigned a score of 0 (zero), were first identified; for these indicators, the scenarios being assessed does not have an effect;
- The remaining indicators received a score ranging from -6 to +6 depending on the extent to which the option favors (positive score) or disfavor (negative score) reaching the target set in the SEA framework; the trend and extent of contribution was assessed based on experts inputs and professional judgment;
- Professional inputs through discussions were sought to validate/confirm the scores; and
- Average scores were calculated by summing the scores for all indicators and dividing by the number of such indicators.

Table 2.1 Scoring Scheme

Scoring Value Ranges	Details of Scoring Value
+4..+6	Very positive – scenario can significantly contribute towards meeting indicator target
+1..+3	Positive – scenario can contribute towards meeting indicator target
0	Neutral – no positive nor negative contribution of the scenario towards meeting indicator target
-1…-3	Negative – scenario can lead to a diversion away from the indicator target
-4…-6	Very negative – scenario can lead to a significant diversion from the indicator target

2.6 ANALYSIS OF ALTERNATIVES METHODOLOGY

Alternatives can be defined as different means or methods to achieve a pre-defined objective. Best practice in the preparation of a strategic environmental assessment study requires that a reasonable range of alternatives be considered and analyzed.

Alternatives are presented, analyzed and compared, based on their potential technical, legal, environmental and social impacts, costs and institutional feasibility, wherever the data is available.

Since the selection of some alternatives depends on technical factors that are not defined at this stage of the Programme, advantages and disadvantages of these options are provided to facilitate the selection of alternatives at later stages when the data become available.

2.7 ASSESSMENT OF IMPACTS, MITIGATION AND MONITORING

This is a fundamental stage of the SEA process which includes the identification of potential impacts resulting from the Programme, assessment of their significance, identification of mitigation and monitoring measures. The main steps are described in the following paragraphs.

2.7.1 Identification of impacts

For each environmental and socio-economic issue of concern, the sources of potential impacts in each phase of the Programme are identified using screening matrices.

2.7.2 Impact Significance

Programme-related effects are characterized using specific criteria (e.g., direction, magnitude, geographic extent, duration and reversibility) (refer to Table 2.2). A consequence rating is attributed to each effect (refer to Table 2.3). The confidence in the prediction of the consequence of an effect is also assessed.

The SEA process shall ensure that no significant residual impacts remain after implementation of mitigation measures. Measures that are to be followed by operators should be included in the contract with these operator and service providers as applicable.

Table 2.2 Criteria for the Characterization of Impacts

Direction	N	Negative
	B	Beneficial
Magnitude	L	Low: Short-term changes that are unlikely to be noticeable
	M	Moderate: Moderate adverse changes in a component or area that supports the relevant population. Changes may exceed the range of natural variation though with good potential for recovery within a few years without intervention
	H	High: Large effect resulting in long-term, potentially irreparable damage to a component and/or a site of social and/or cultural importance
Geographic Extent	L	Localized
	N	National

	G	Global
Duration	ST	Short-term: Unlikely to be noticeable effect (*i.e.*, falls within the scope of natural variation)
	MT	Medium-term: Measurable effect on the livelihood of those using a resource over a period of weeks
	LT	Long-term: Measurable effect on the livelihood of those using a resource over a period of months
	P	Permanent: Measurable effect on the livelihood of those using a resource over a period of years
Reversibility	R	Reversible
	I	Irreversible

Table 2.3 Consequence Rating Criteria

Criteria	Consequence Rating
Changes that result in a net positive effect to an ecosystem, environment or population	B. Beneficial
Effect leading to regulatory/high level government intervention Negative Direction High magnitude: Severe effect on ecosystem Massive effect over a large area; destruction of sensitive environmental features Long-term or permanent effect: measurable effect on the livelihood of those using a resource over a period of years Irreversible effect resulting in extensive, potentially irreparable damage to an environmental or socio-economic component or a site of social or cultural importance	5. Critical
Effect likely to result in regulatory intervention/action Negative Direction High magnitude: area of effect is extensive and/or encompasses an area that supports a statistically significant proportion of a population or ecosystem Impact of regional significance on sensitive environmental features Long-term or continuous effect resulting in substantial adverse changes in an environmental or socio-economic component well outside the range of natural variation; has a measurable effect on the livelihood of those using a resource over a period of months Reversible; however unassisted recovery could be protracted. Significant damage / effect to a site of social or cultural importance	4. Major
Effect leading to regulatory investigation Negative Direction Moderate magnitude: Moderate adverse changes in a component or area that supports a population. Changes may exceed the range of natural variation though potential for recovery within a few years without intervention is good Area of effect encompasses an area that supports either a moderate or minor proportion of a population or ecosystem Long-term (> 5 years) changes over an area which is not considered to be a component relevant to the assessment; has a measurable effect on the livelihood of those using a resource over a period of weeks; Short-term effect on sensitive environmental features Reversible, moderate damage to a site of social or cultural importance	3. Moderate

Criteria	Consequence Rating
Immediate regulatory notification required Negative Direction Low magnitude: Minor adverse changes in an environmental or socio-economic component. Changes will be noticeable but fall within the range of normal variation and be typically short-lived, with unassisted recovery possible in the near term. However, it is recognized that a low level of effect may remain. Effect on flora, fauna or habitat but no negative effects on ecosystem Medium term effect (1-5 years) in an area that does not encompass a component relevant to the assessment or whose effect is highly localized within a component. Long-term effect over a discrete, small area which does not support a component relevant to the assessment; May be noticed but does not affect the livelihood of those utilizing a resource Reversible minor effect to a site of social or cultural importance	2. Minor
Incident reporting according to routine protocols Negative Direction Low magnitude: Negligible effect on flora, fauna, habitat, aquatic ecosystem or water resources Area of effect is restricted to the immediate vicinity of the source Short-term changes in an ecosystem that are unlikely to be noticeable (i.e. fall within the scope of natural variation); has no discernible effect on the environmental resource as a whole and is likely to go unnoticed by those who already use it Reversible negligible effect to a site of social or cultural importance	1. Negligible

The significance of environmental and socio-economic effects is determined based on an examination of the consequence and the likelihood of occurrence of an impact. The significance rating is obtained by cross-tabulating the consequence rating associated with each effect (Table 2.3) and its likelihood of occurrence (Table 2.4), as shown in Table 2.4.

Table 2.4 Likelihood Evaluation Criteria

Likelihood of Occurrence	Category	Score
Effect is highly likely or certain to occur under normal operating/ construction conditions	Almost Certain	A
Effect is likely to occur	Likely	L
Effect may possibly occur under normal operating/construction conditions	Possible	P
Effect is unlikely to occur under normal construction/operating conditions but may occur in exceptional circumstances; Incident could occur in the worldwide oil and gas industry	Unlikely	U
Incident not expected to occur in the worldwide oil and gas industry	Remote	R

Table 2.5 Significance Rating and Acceptability

		Consequence Rating					
		Negligible 1	**Minor 2**	**Moderate 3**	**Major 4**	**Critical 5**	**Beneficial B**
Likelihood of Occurrence	**Almost Certain A**	1A	2A	3A	4A	5A	BA
	Likely L	1L	2L	3L	4L	5L	BL
	Possible P	1P	2P	3P	4P	5P	BP
	Unlikely U	1U	2U	3U	4U	5U	BU
	Remote R	1R	2R	3R	4R	5R	BR

LEGEND

Consequence Rating	Likelihood	Significance Rating and Acceptability	
1- Negligible 2- Minor 3- Moderate 4- Major 5- Critical B- Beneficial	A- Almost Certain L- Likely P- Possible U- Unlikely R- Remote		Beneficial
			Low- Acceptable
			Medium- Acceptable (with EMS in place)
			High- Unacceptable

2.7.3 *Mitigation and Monitoring*

Mitigation refers to the "elimination, reduction or control of the adverse effects of the policy, plan or program, and includes restitution for any damage to the environment caused by such effects through replacement, restoration, compensation or any other means". Priority is given to impact avoidance, followed by minimization and then compensation.

For each significant effect, the mitigation measures that are set by local legislation and international conventions or "Planned Control Measures" are listed. Additional mitigation measures were proposed when needed. Practical and implementable mitigation measures were proposed to the extent possible.

Indicators to monitor implementation of mitigation measures and their effectiveness are also proposed.

3. HYDROCARBON EXPLORATION AND PRODUCTION ACTIVITIES IN OFFSHORE MONTENEGRO

3.1 LICENSING OVERVIEW

The Ministry of Economy, on behalf of the Government of Montenegro, has announced the first public invitation for the award of the concession contract for exploration and of the concession for production of hydrocarbons in offshore Montenegro.

In the first bid round the Government offered 13 blocks/ parts of blocks in the offshore area for the Production Concession Contract. These are presented in shades in Figure 3.1.

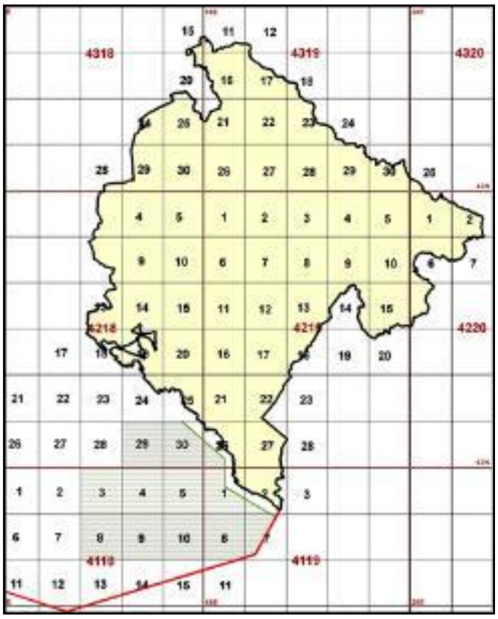

Figure 3.1 Montenegro Offshore Blocks

Explorers in the Montenegrin offshore target different geologic formations depending on the depth of investigation. The range of play concepts are:

- Plio-Pleistocene plays ranging in depth from 600- 1300 meters in depth from sea bed level. Biogenic Gas is charged in high quality turbiditic sands.
- Miocene plays underlying the Plio-Pleistocene bears gas reservoirs in marine shelfal sands as well as the Oligocene.

3.2 OVERVIEW OF HYDROCARBON EXPLORATION AND PRODUCTION PROGRAM IN OFFSHORE MONTENEGRO

A specific Exploration and Production (E&P) programme of activities can not be defined until licenses are awarded to Oil and Gas (O&G) operators, which in turn will define detailed E&P activities. This section nevertheless describes typical activities involved in E&P that shall be used as a basis to undertake the assessment. Subsequent detailed Environmental Impact

Assessment (EIA) studies are conducted based on activities proposed by the awarded companies.

A typical program would consist of three main phases:

- Exploration Phase: including pre-drilling surveys, exploratory drilling and appraisal;
- Production Phase: including development and production; and
- Decommissioning Phase.

As per the Montenegrin Law of exploration and production, the exploration phase may not exceed 7 years on an offshore block (subject to an extension of 2 years) and the production phase may not exceed 20 years (subject to an extension of 10 years). Typical activities associated with each phase are presented in the sections below.

3.2.1 Exploration

3.2.1.1 Additional Prospecting and Pre-drilling Surveys

Various geological and geophysical investigations are typically carried out before initiating the actual exploration activities as part of what is termed "Prospecting Phase". These investigations aim at identifying prospects. Most of these investigations take place before or during the licensing round whereby companies interested in participating in the bidding round would get the chance to view the acquired data and purchase it to undertake its own interpretation and assess the prospectivety for oil & gas and to study the associated risk of exploration.

In the case of Montenegro, and as part of earlier prospecting, various surveys were already acquired. These include about 3,500 km of seismic reflective profiles undertaken during previous years - 1979, 1983, 1984, 1985, 1986, 1988 and 2000 and 3D seismic data acquired over an area of 311 Km^2 (Figure 3.2). Additionally, onshore and offshore well data are also available. These include litho-data, well log suites, cores and geochemical data. Figure 3.2 presents acquired 2D seismic (orange lines), 3D seismic (green block) and exploration wells (black circles). Block delineation is represented by grey lines.

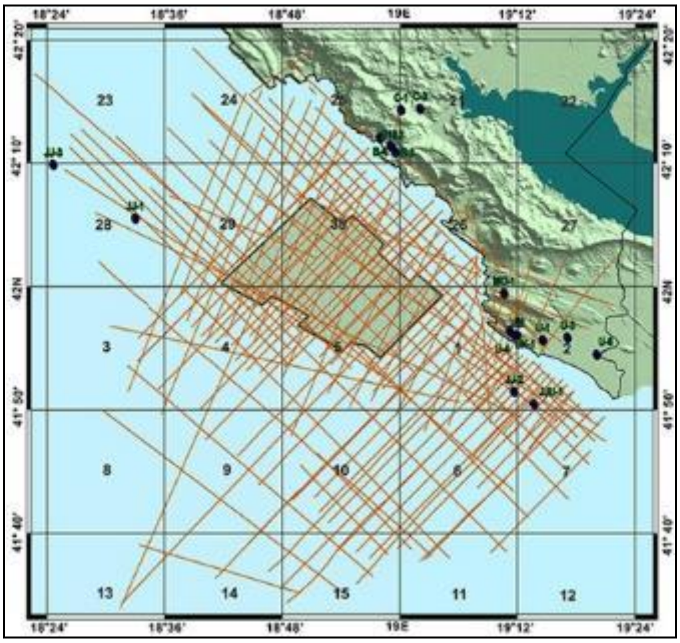

Figure 3.2 Existing Seismic and Well Data in Montenegro (source: geoexpro.com)

Interpretation of the acquired data allowed identification of several prospects within the surveyed area.

Several Pliocene prospects have been identified at depths ranging between 700 m and 1,300 m in waters of 75–120 m. The area of these prospects is covered by 3D seismic data and the gas indicative nature allows the exploration risk to be considered as medium to low.

Potential for oil accumulations within Mesozoic carbonates has also been identified. Both Mesozoic and Palaeogene carbonates form a primary reservoir target offshore Montenegro, with the potential to produce substantial quantities of oil and gas.

An operator would most probably need to carry additional site investigations (geological/geophysical as well as environmental) during exploration before proposing the final drilling site and mobilizing a drilling rig. These are required for better localization of the prospects and are critical for surveying the seabed and shallow zones so that potential drilling hazards can be anticipated. Such investigations could include, but are not limited to:

- **Bathymetric survey**, to produce a high resolution digital terrain model of seabed;
- **Side scan sonar**, to define man-made and natural seabed features across the area of interest;
- **Sub-bottom profiling**, to provide a continuous and very high resolution image of the shallow geological conditions;
- **Magnetometer survey**, to investigate ferrous objects lying on, or buried immediately beneath the seafloor, or to attempt to determine the position of cables, pipelines or abandoned wells that cannot be identified by acoustic means. A Gradiometer can be used for measuring the magnetic gradient between two or more closely spaced magnetometers for more precise results and surveys close to large structures such as platforms.

- **2D multi-channel high resolution seismic**, to investigate top-hole geological conditions at proposed drillings locations across the area. A pre-existing exploration 3D seismic data is deemed an appropriate substitute for this survey.
- **3D multi-channel high resolution seismic**, designed on a site specific basis where initial review or offset drilling experience indicates that the shallow section, or the perceived conditions are particularly complex.
- **Seabed sampling**, to ground truth seabed and shallow soil provinces that are defined during site survey, or that have been pre-defined during the desk study. For an anchored rig it may be necessary to acquire shallow seabed soil evaluation data using a suite of tools appropriate to the soil conditions (grab, box corer, piston corer, gravity corer, vibro-corer or CPT). Samples retrieved should be comprehensively logged and may need to be sent ashore for analysis. If sampling is aimed at defining suspected sensitive environments, care should be taken to acquire a control sample away from the suspect target area.
- **Seabed photographs**, to ground truth acoustic data and allow investigation of discrete areas of concern that are identified during a survey.

The aerial extent of investigations shall depend upon type and quality of existing data, water depth and type of rig to be used. The total depth of investigations below seabed should be to a depth at least 200m below the preferred setting depth of the first pressure containment string, or to a depth of 1,000m below seabed, whichever is greater, irrespective of rig type.

An existing 3D package can replace the above additional investigations given its specifications comply with industry standards, otherwise it can be enhanced by acquiring part of the surveys described above. A workflow chart summarizing surveys that could be selected to be carried based on type of rig and water depth as well as existence of data is provided in Figure 3.3.

It shall be noted that a marine biodiversity survey shall be conducted prior to the initiation of any exploration activity.

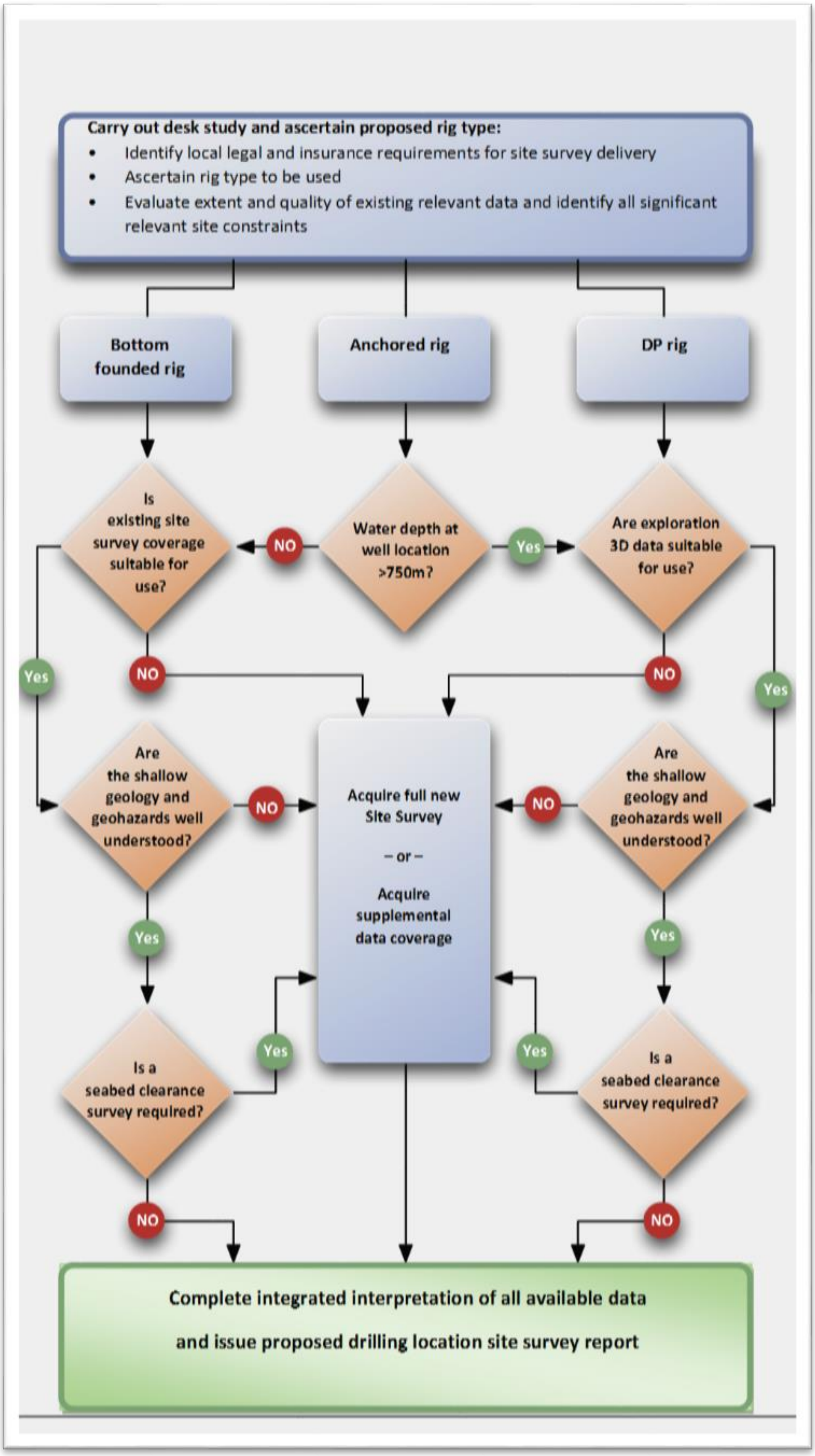

Figure 3.3 Workflow Chart for Deciding on Need for Pre-drilling Surveys

During marine seismic surveys, a slow moving survey vessel (typically streaming at 4 to 6 knots) tows an impulse emitting sound source (an array of multiple airguns). The sound reflects off the sea bottom and the seismic data are recorded by onboard computers and processed to produce profiles of the sub-seabed geology. The data are interpreted by geophysicists to identify potential locations of hydrocarbon reservoirs. A schematic diagram of marine seismic survey operations is provided in Figure 3.4. The 3D vessels have multiple streamers (typically 4 - 20) that are between 3 and 6 km in length, and are towed at a spacing of up to 120 m from one another (Figure 3.5).

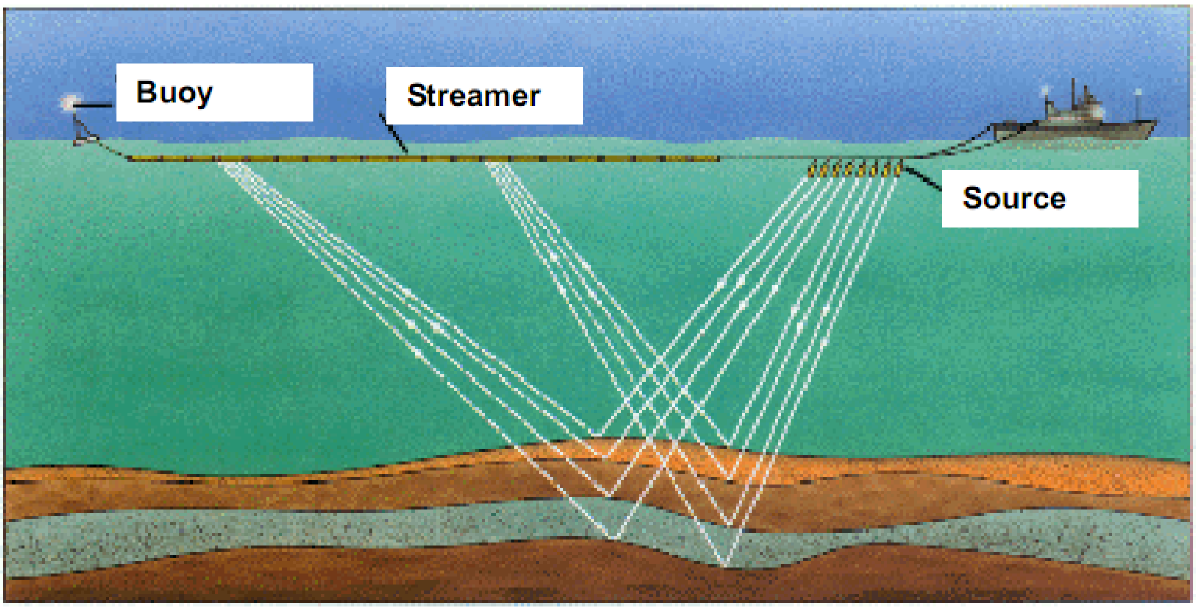

Figure 3.4 Illustration of the Principles of Offshore Seismic Acquisition Surveys

Figure 3.5 Examples of 3D Seismic Survey Vessels

Sound sources (commonly referred to as 'airguns') are underwater pneumatic devices from which high-pressure air is released into the surrounding water. These high energy, low frequency sounds (called 'shots') are produced by the airguns and pulsed downward toward the seabed and propagate through the seabed. The seismic shock waves bounce off the subsurface rock formations and return toward the water surface where an array of receivers (hydrophones) mounted inside streamer cable detects the returning seismic energy. The sound source is submerged in the water, typically at a depth of 5 to 10 m.

3.2.1.2 <u>Exploratory Drilling & Appraisal</u>

After having identified potential drilling locations, an operator would mobilize a rig to start drilling one or more exploratory wells within the boundaries of the awarded block. This aims at proving the existence of hydrocarbons within the identified prospect. While drilling, the penetrated formations will be evaluated through studying the drill cuttings and by acquiring information on the lithology and the petrophysical characteristics of the formations as well as the characteristics of contained fluids through acquisition of cores or logs either while drilling or by using Wireline techniques.

Depending on water depth, depth to target and expected formation pressures as well as weather conditions, different rig types are expected to be deployed during the offshore exploration and production activities. These would range from bottom founded and platform based rigs, to anchored and dynamically positioned rigs. Figure 3.6 presents the bathymetric map overlain by the offshore blocks. Analysis of possible rig types, the advantages and dis advantage of their use is elaborated in Section 7.2.

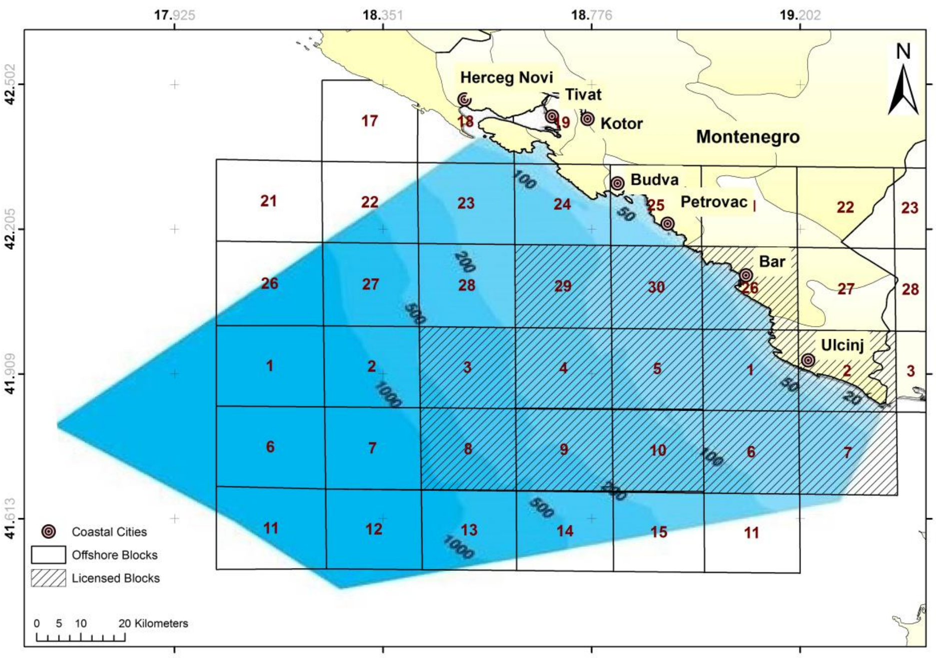

Figure 3.6 Bathymetric Map of Montenegro Overlain by the Offshore Blocks

In the event that hydrocarbons are found within one of the wells, the well would be tested to assess the commerciality of the discovered quantities. This is done by conducting well tests which will reveal the well's production capacity as well as other reservoir parameters such as permeability and pressure and this will help in delimiting the boundaries of the reservoir. This is defined as the appraisal phase.

Wells which prove to be productive will be held and plugged following industry standards in order to be completed at a later stage and used in production. Depending on findings, the reservoir might be appraised by drilling additional wells and carrying more tests.

If the discovered reservoir is deemed non-commercial, the drilled wells would be permanently plugged with cement or mechanical plugs and abandoned. A site clearance survey would be conducted to ensure that any debris from drilling activities is removed from the sea floor around each drilling site.

3.2.2 Development & Production

A Field Development Plan (FDP) is typically prepared based on exploration and appraisal results. This serves as a conceptual project specification for subsurface and surface facilities, and the operational and maintenance philosophy. Once approved, a sequence of activities will follow prior to first production from the field. These would include procurement of construction material, fabrication and installation of facilities as well as commissioning of all plant and equipment. Development planning and production are based on the expected production profile. This shall determine the facilities required and the number and phasing of wells to be drilled. The production profile depends on the driving mechanism within the reservoir and can be split into three main periods:

- **Build -up period**: during which new producing wells shall be drilled;
- **Plateau period:** during which new producing wells may still be brought on stream while existing ones exhibit decline in production. In this period the production facilities will be operating at full capacity and rate of production would be maintained constant.
- **Decline period:** during which production will decline in all wells.

A variety of development and production systems could be used within the licensing area. The type of facilities selected by an operator is based on several factors, including water depth, reservoir type, as well as proximity to existing oil and gas infrastructure and support operations.

3.2.2.1 <u>Offshore Production Facilities</u>

An offshore production platform is rather like a gathering station; hydrocarbons have to be collected, processed and evacuated for further treatment or storage. However, the design and layout of the offshore facilities are very different from those on land for the following reasons:

- A platform has to be installed above sea level before drilling and process facilities can be placed offshore.
- There are no utilities offshore, so all light, water, power and living quarters, etc. also have to be installed to support operations.
- Weight and space restrictions make platform-based storage tanks non-viable, so alternative storage methods have to be employed.

Offshore platforms can be split broadly into two categories: fixed and floating. Fixed platforms are generally classified by their mechanical construction. There are two main types:

- steel jacket platforms
- gravity-based platforms

Floating platforms can also be categorised into three main types:

- semi-submersible vessels
- ship-shaped mono hull vessels (such as floating production, storage and offloading (FPSO))
- SPAR platforms

3.2.2.1.1 Steel Jacket Platforms:

Steel piled jackets are the most common type of platform and are employed in a wide range of sea conditions, from the comparative calm of the South China Sea to the hostile Northern North Sea. Steel jackets are used in water depths of up to 150 m and may support production facilities a further 50 m above mean sea level. In deepwater, all the process and support facilities are normally supported on a single jacket, but in shallow seas it may be cheaper and safer to support drilling, production and accommodation modules on different jackets. In some areas, single well jackets are common, connected by subsea pipelines to a central processing platform (Figure 3.7).

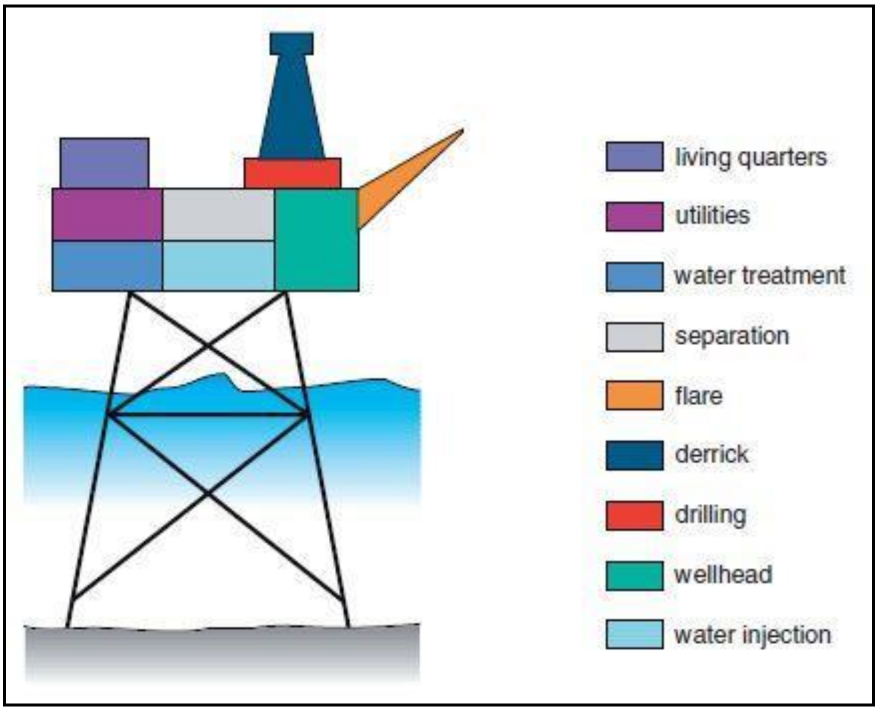

Figure 3.7. Steel Jacket Platform

3.2.2.1.2 Concrete or Steel Gravity-Based Structures:

Concrete or steel gravity-based structures can be deployed in similar water depths to steel jacket platforms. Gravity-based platforms rely on weight to secure them to the seabed, which eliminates the need for piling in hard sea beds. Concrete gravity based structures (which are by far the most common) are built with huge ballast tanks surrounding hollow concrete legs. They can be floated into position without a barge and are sunk once on site by flooding the ballast tanks.

3.2.2.1.3 Floating Production Platforms:

FPSOs (Floating production, storage and offloading) have the capacity to deal with much more variable production streams and additionally provide for storage and offloading of crude. The newer vessels can provide all services which are available on integrated platforms, in particular three-phase separation, gas lift, water treatment and injection.

Ship-shaped **FPSOs** must be designed to 'weather vane', meaning it must have the ability to rotate in the direction of wind or current. This requires complex mooring systems and the connections with the wellheads must be able to accommodate the movement. The mooring systems can be via a single buoy or, in newer vessels designed for the harsh environments, via an internal or external turret (Figure 3.8).

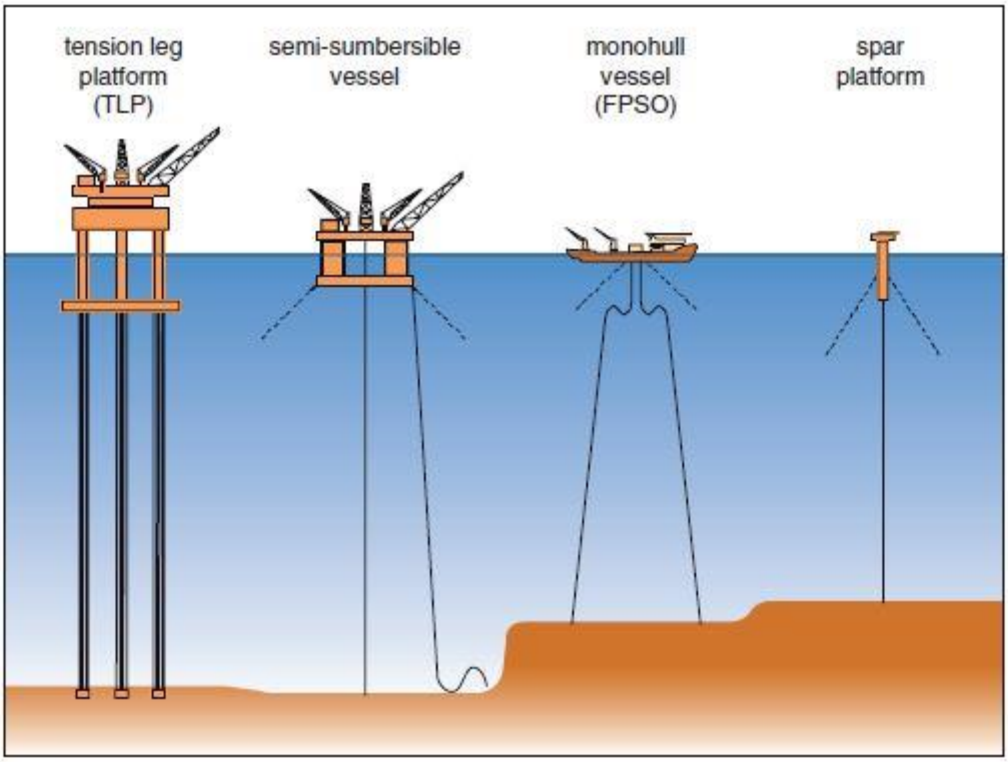

Figure 3.8. Floating Production Systems

The typical process capability for FPSOs is around 100,000 barrels per day, with storage capacity up to 800,000 bbls. However, in the recent deepwater developments in West Africa some FPSOs exist which are over double this capacity.

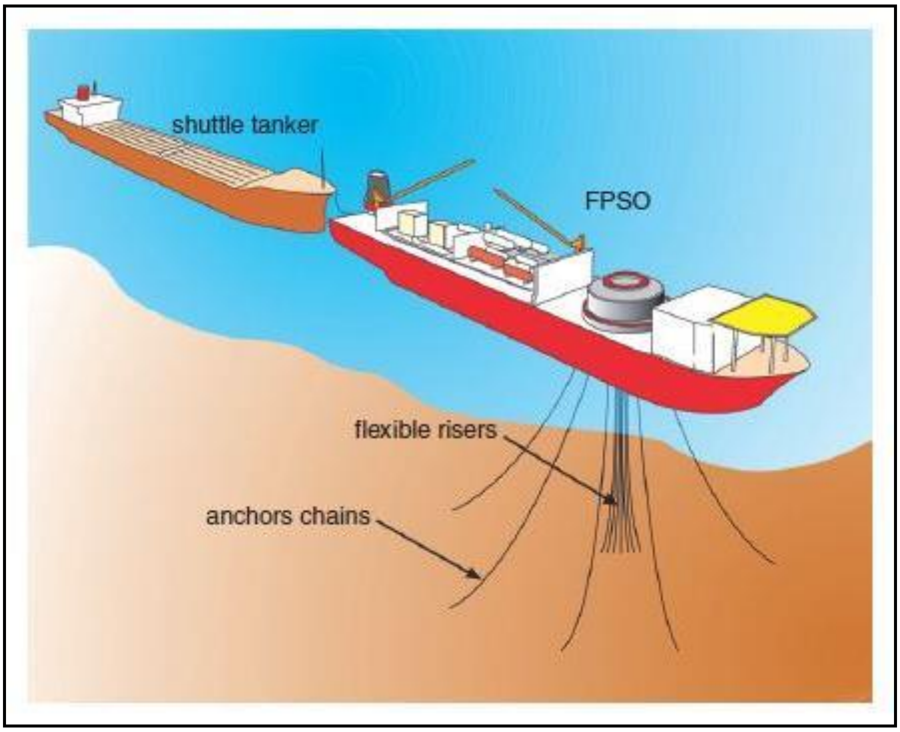

Figure 3.9. FPSO with offshore loading to a shuttle tanker.

SPAR platforms were first employed as a concept by Shell, when it was used as a storage facility for the Brent Field in the North Sea. It had no production facilities but was installed simply for storage and offshore loading (Figure 3.9). More recently, SPAR structures have incorporated drilling, production, storage and offshore loading facilities as an integrated development option.

3.2.2.1.4 **Subsea Production Systems**

Subsea production systems are an alternative development option for an offshore field. They are often a very cost-effective means of exploiting small fields which are situated close to existing infrastructure, such as production platforms and pipelines. They may also be used in combination with floating production systems. Typically, a subsea field development or subsea satellite development would consist of a cluster of special subsea trees positioned on the seabed with produced fluids piped to the host facility. Control of subsea facilities is maintained from the host facility via control umbilicals and subsea control modules. Subsea production systems create large savings in manpower as they are unmanned facilities. However, these systems can be subject to very high operating expense from the well servicing and subsea intervention point of view as expensive vessels have to be mobilized to perform the work. As subsea systems become more reliable this OPEX will be reduced (Figure 3.10).

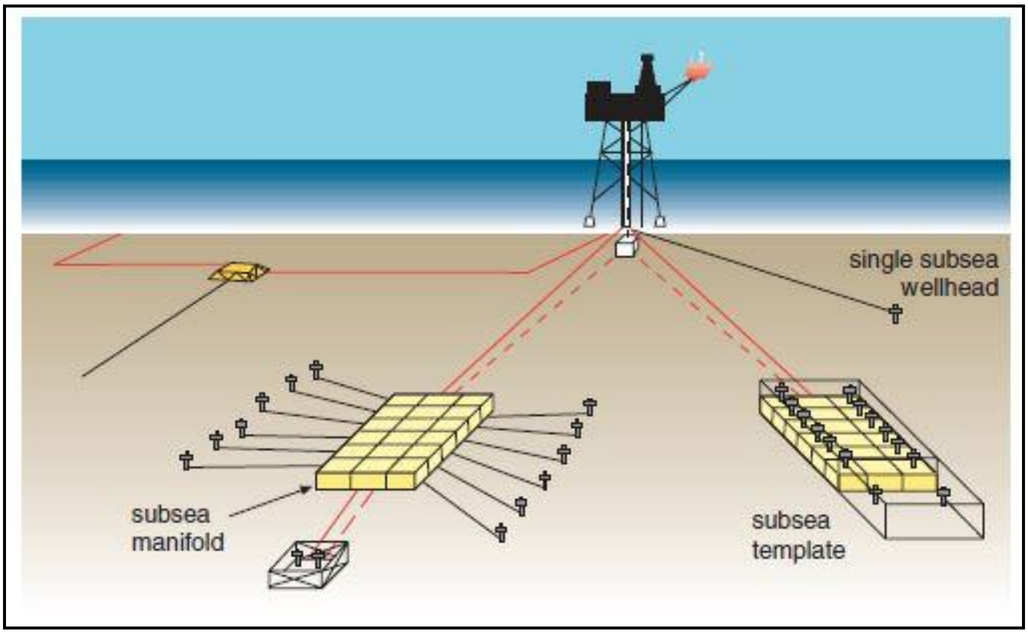

Figure 3.10. Typical subsea field development options- tied back to a host facility.

The most basic subsea satellite is a single subsea wellhead with subsea tree, connected to a production facility by a series of pipelines and umbilicals. A control module, usually situated on the subsea tree, allows the production platform to remotely operate the subsea facility via its valves and chokes.

3.2.2.2 Installation of Wellheads

The wellhead sits on top of the actual oil or gas well leading down to the reservoir. A wellhead may also be an injection well, used to inject water or gas back into the reservoir to maintain pressure and levels to maximize production.

Once a natural gas or oil well is drilled and it has been verified that commercially viable quantities of hydrocarbons are present for extraction, the well must be "completed" to allow petroleum or natural gas to flow out of the formation and up to the surface. This process includes strengthening the well hole with casing, evaluating the pressure and temperature of the formation, and installing the proper equipment to ensure an efficient flow of hydrocarbons from the well. The well flow is controlled with a choke.

Completion of offshore wells can be either dry completion (on the deck of an offshore structure) or subsea completions below the surface. The wellhead structure, often called a Christmas tree, must allow for a number of operations relating to production and well workover. Well workover refers to various technologies for maintaining the well and improving its production capacity.

3.2.2.3 Manifolds and Gathering

The dry completion wells on the main field center feed directly into production manifolds, while outlying wellhead towers and subsea installations feed via multiphase pipelines back to the production risers. Risers are a system that allows a pipeline to "rise" up to the topside structure. For floating structures, this involves a way to take up weight and movement. For heavy crude and in Arctic areas, diluents and heating may be needed to reduce viscosity and allow flow.

3.2.2.4 Oil and Gas Transportation Systems

Crude oil and gas from offshore platforms are evacuated by pipeline or alternatively, in the case of oil, by tanker. Pipeline transport is the most common means of evacuating hydrocarbons, particularly where large volumes are concerned. Although a pipeline may seem a fairly basic piece of equipment, failure to design a line for the appropriate capacity, or to withstand operating conditions over the field lifetime, can prove very costly in terms of deferred hydrocarbon production.

3.2.2.4.1 Towing Pipelines

Long pipelines are normally installed using a lay barge on which welded connections are made one at a time as the pipe is lowered into the sea. Pipelines are often buried for protection as a large proportion of pipeline failures result from external impact. For shorter lengths, particularly in-field lines, the pipeline may be constructed onshore either as a single line or as a bundle. Once constructed the pipeline is towed offshore and positioned as required. It has become common practice to integrate pipeline connectors into the towing head, both for protection and easier tie in (Figure 3.11).

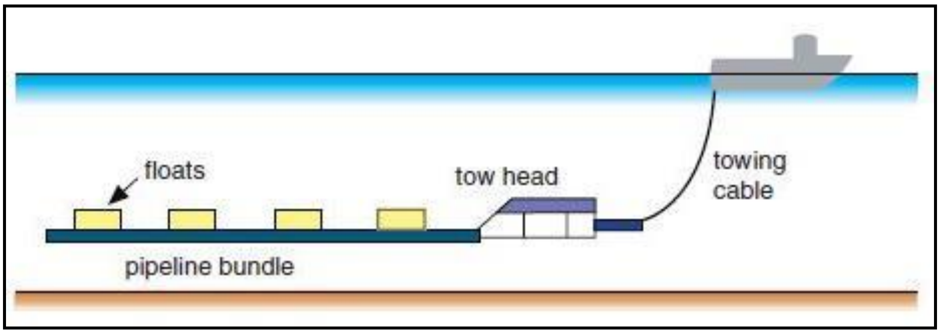

Figure 3.11. Towing a Pipeline

Pipelines are cleaned and inspected using 'pigs'. Pigs usually have a steel body fitted with rubber cups and brushes or scrapers to remove wax and rust deposits on the pipe wall, as the pig is pumped along the pipe. In-field lines handling untreated crude may have to be insulated to prevent wax formation. In recent years much more attention has been given to pipeline isolation, after instances in which the contents of export pipelines fed platform fires, adding significantly to damage and loss of life. Many export and in-field pipelines are now fitted with emergency shutdown valves (ESDV) close to the production platform, to isolate the pipeline in the event of an emergency.

3.2.2.4.2 Tankers

In areas where seabed relief makes pipelines vulnerable or where pipelines cannot be justified on economic grounds, tankers are used to store and transport crude from production centers. The simplest method for evacuation is to pump stabilized crude from a processing facility directly to a tanker (Figure 3.12).

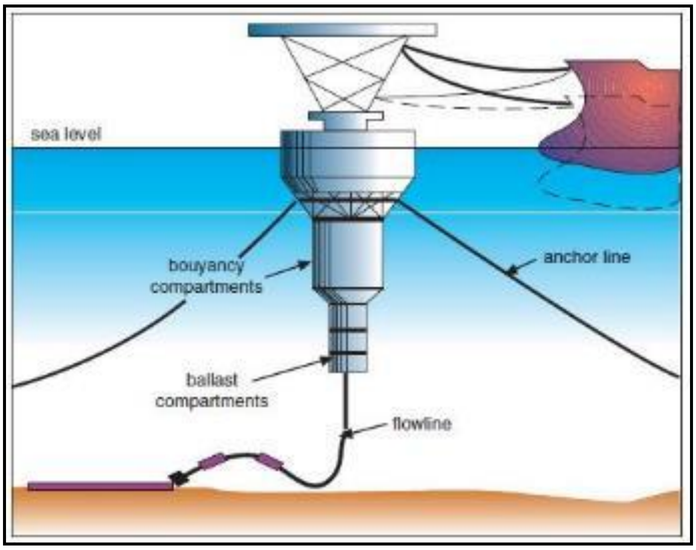

Figure 3.12. Single Buoy Mooring (SBM)

Loading is carried out through a single buoy mooring (SBM) to which the tanker can tie up and rotate around to accommodate the prevailing weather conditions. The SBM has no storage facility, but if a production facility has storage capacity sufficient to continue production whilst the tanker makes a round trip to off-load, then only a single tanker may be required. In some areas, the SBM option has been developed to include storage facilities such as the 'SPAR' type storage terminals. Such systems may receive crude from a number of production centers and act as a central loading point (Figure 3.13).

In some cases, two tankers are used both alternately loading and transporting, or with one tanker acting as floating storage facility and the other shuttling to and from a shore terminal (Figure 3.14).

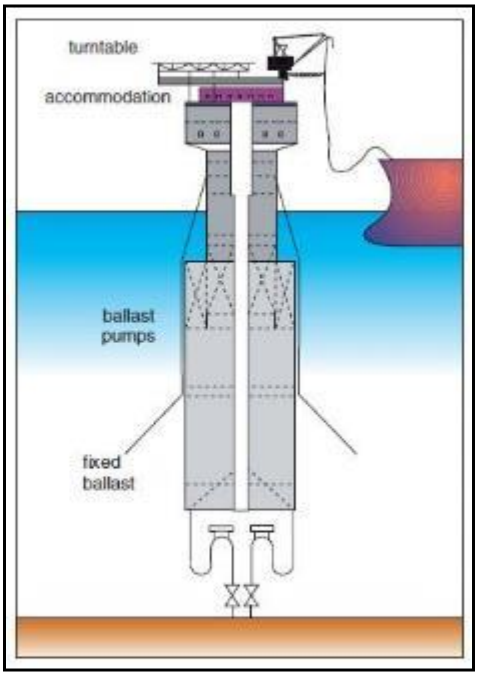

Figure 3.13. SPAR Type Storage Terminal

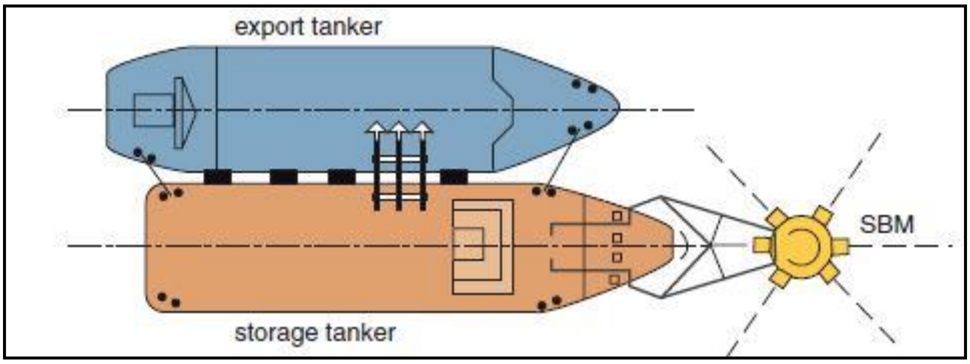

Figure 3.14. Tanker Storage and Export

3.2.2.5 Separation

In the event that wells have pure gas production, gas can be taken directly for gas treatment and/or compression. More often, the well produces a combination of gas, oil and water, with various contaminants that must be separated and processed.

Gas processing consists of separating the various hydrocarbons and fluids from the pure natural gas to produce what is known as "pipeline quality" dry natural gas. Major transportation pipelines usually impose restrictions on the makeup of natural gas that is allowed into the pipeline. Before the natural gas can be transported it must be purified. Whatever the source of the natural gas, once separated from crude oil (if present) it commonly exists in mixtures with other hydrocarbons, principally ethane, propane, butane and pentanes. In addition, raw natural gas contains water vapor, hydrogen sulfide (H2S), carbon dioxide, helium, nitrogen and other compounds. Associated hydrocarbons, known as "natural gas liquids" (NGL), are used as raw materials for oil refineries or petrochemical plants and as sources of energy.

3.2.2.6 Gas compression

Gas from a pure natural gas wellhead might have sufficient pressure to feed directly into a pipeline transport system. Gas from separators has generally lost so much pressure that it must be recompressed to be transported. Turbine driven compressors gain their energy by using a small proportion of the natural gas that they compress. The turbine itself serves to operate a centrifugal compressor, which contains a type of fan that compresses and pumps the natural gas through the pipeline. Some compressor stations are operated by using an electric motor to turn the centrifugal compressor. This type of compression does not require the use of any natural gas from the pipe; however, it does require a reliable source of electricity nearby. The compression includes a large section of associated equipment such as scrubbers (to remove liquid droplets) and heat exchangers, lube oil treatment, etc.

3.2.2.7 Liquefied natural gas (LNG)

Where the distance to the customer is very large or where a gas pipeline would have to cross too many countries, gas may be shipped as a liquid. To condition the gas for liquefaction any CO_2, H_2S, water and heavier hydrocarbons must be removed using natural gas liquid recovery. Once the gas has been condensed the pressure is reduced for storage and shipping. In order to keep the gas in liquid form, the LNG must be kept at temperatures below - 83°C independent of pressure.

A further development is floating LNG facilities, whereby a complete LNG plant is built on a vessel in order to bring the facilities to the gas deposits, which would be a viable scenario for stranded gas accumulations, or regions where there is an absence of gas infrastructure and/or no local gas market.

3.2.2.8 Metering

Metering stations allow operators to monitor and manage the natural gas and oil exported from the production installation. These employ specialized meters to measure the natural gas or oil as it flows through the pipeline, without impeding its movement. This metered volume represents a transfer of ownership from a producer to a customer, and is called custody transfer metering. It forms the basis for invoicing the sold product and also for production taxes and revenue sharing among partners.

Typically, a metering installation consists of a number of meter runs so that one meter will not have to handle the full capacity range, and associated prover loops so that the meter accuracy can be tested and calibrated at regular intervals.

3.2.2.9 Evacuation and Storage of treated exported products

Once oil and gas have been processed the products have to be evacuated from the site. Stabilized crude is normally stored in tank farms at a distribution terminal which may involve an extended journey by pipeline. At a distribution terminal, crude is stored prior to further pipeline distribution or loading for shipment by sea.

Sales gas is piped directly into the national gas distribution network (assuming one exists) and NGL products such as propane and butane can be stored locally in pressurized tanks. NGL products are often distributed by road or rail directly from the gathering station, although if ethane is recovered it is normally delivered by pipeline.

3.2.2.10 Utility systems

Utility systems are systems which do not handle the hydrocarbon process flow, but provide some service to the main process safety or residents. Depending on the location of the installation, many such functions may be available from nearby infrastructure, such as electricity. Many remote installations are fully self-sustaining and must generate their own power, water, etc.

Other installations and plants might also be installed including gas plants, gas compressors in addition to pipelines export systems based on the approved field development plan (FDP).

3.2.3 Decommissioning

When all economical reserves are depleted, the field will be decommissioned. Operators usually try to defer this phase by either reducing operating costs or increasing hydrocarbon throughput. Enhanced recovery techniques are adopted for such purpose. These are means for recovering a proportion of the hydrocarbons that remain after primary production.

However, given that the economic viability of such techniques is very sensitive to oil price, they are more often justified for onshore development rather than offshore ones.

A preliminary decommissioning plan for offshore facilities should be developed that considers well abandonment, removal of oil from flowlines, facility removal, and sub-sea pipeline decommissioning along with disposal options for all equipment and materials. This plan can be further developed during field operations and fully defined in advance of the end of field life. The plan should include details on the provisions for the implementation of decommissioning activities and arrangements for post decommissioning monitoring and aftercare.

4. ANALYSIS OF LEGAL AND POLICY FRAMEWORKS

Of particular importance for the SEA study is to assess early enough before the programme is implemented, the implications and compatibility of the activities with the legal and planning framework. As such the SEA consultant has reviewed the relevant environmental legislation as well as other strategies and plans issued by the Government of Montenegro and assessed the implications to Offshore Hydrocarbon E&P activities.

The analysis of the main relevant legislative texts, their key requirements and implications to the Programme are summarized in Appendix A; while the sub-sections below list the main legislations with relevance to the Programme. Operators and future service providers should be aware of such issues and demonstrate compliance to these recommendations in subsequent EIA studies that shall be conducted for the different phases of the Programme.

4.1 MONTENEGRIN LEGISLATION

4.1.1 Key Legislations on Exploration and Production of Hydrocarbons

Key legislations in Montenegro relevant to exploration and production of hydrocarbons are as follows:

- Law on Exploration and Production of Hydrocarbons (Official Gazette of Montenegro No 41/10, 10/11, 62/13) is fully aligned with EU Directive (94/22/EC). The Law stipulates conditions, methods and procedure of exploration and production of hydrocarbons, as well as other issues of importance to the exploration and production of hydrocarbons. In the area of environmental protection, this Law stipulates, inter alia, that the concessionaire is obliged to undertake all measures to prevent negative impacts on individual environmental segments: air, atmosphere, land, water resources and sea, as well as the living organisms.

- Law on taxation of hydrocarbons (Official Gazette of Montenegro, no 31/14), which introduced the obligation of tax charges on profits from upstream operations related to hydrocarbons;

- Decree on the procedure of blocks restitution and access of third parties to upstream plants (Official Gazette of Montenegro, no 40/11, 56/13), which regulates the detailed terms, conditions and methods of restitution of the allocated area of the block, terms and conditions for access of third parties to facilities and upstream piping network, operation of the upstream pipeline network, and terms and conditions for decommissioning and removal of the plants;

- Decree on the methods of calculation and payment of fees for oil and gas production (Official Gazette of Montenegro, no 14/14), which regulates the amount, criteria and methods of payment of the annual fee for the area used by the concessionaire for the production of hydrocarbons under the concession contract, the criteria for determining the amount, methods of calculation, the base documentation for calculation, and other issues of importance for the calculation of fees for the produced oil and gas for the extracted hydrocarbons on monthly level;

- Rule book on the conditions for environmental protection during operations with hydrocarbons (Official Gazette of Montenegro, no 60/12), which defines the measures to be undertaken during the hydrocarbons exploration and production activities, aiming to protect the environment;

- Rule book on conditions for drilling and construction of facilities for research and production of hydrocarbons (Official Gazette of Montenegro, no 7/14), which defines procedures for the drilling of wells, the design and construction of plants for exploration and production of hydrocarbons, preparation and content of drilling plans and programs, reporting on the drilling operations, sampling and delivery of samples;

- Rule book on the development and production of hydrocarbons (Official Gazette of Montenegro, no 7/14), which regulates the detailed content of hydrocarbons development and production programs, content, methods and deadlines for submission of applications for approval of production testing, approval for hydrocarbons production, and manufacturing reports.

4.1.2 Key Legislations Relevant to the Environment

Montenegro is a leading country in environmental awareness. In 1991 deputies of the Parliament of Montenegro decided to do something that no other state had ever considered, which is declaring Montenegro as the world's first ecological state. This declaration was stipulated in Article 1 of the country's constitution in 1994 "Article 1. STATE: Montenegro is a democratic, social and ecological state". The latest Constitution adopted in 2007 also stipulates in Article 1 that "Montenegro is a civil, democratic, ecological and the state of social justice, based on the rule of law".

Environmental principles in Montenegrin legislation are incorporated in the following legislations:

- Constitution of Republic of Montenegro ("Official Gazette of MNE", No. 1/07) which defines Montenegro as an ecological country.

- Law on Environment (Official Gazette of Montenegro, No 48/08, 40/10, 40/11). With this Law, Montenegro proclaimed itself an ecological country, and local authorities need to work on promoting quality of human environment, reduce all the factors with adverse impact on human life and prevent any harmful impacts on people.

- Law on Liability for Environmental Damage (Official Gazette of Montenegro No. 27/14), which sets out process for determining liability for environmental damages, as well as implementation of prevention and mitigation measures, to prevent and eliminate environmental damages.

- Law on Strategic Environmental Impact Assessment (Official Gazette of the Republic of Montenegro 80/05 and Official Gazette of MNE No. 73/10, 40/11 and 59/11) sets out terms, methods and procedures for assessment of significant environmental impacts of certain plans and programmes.

- Law on Environmental Impact Assessment (Official Gazette of the Republic of Montenegro, No 80/05, Official Gazette of Montenegro, No 40/10, 73/10, 40/11 and 27/13) sets out activities subject to environmental impact assessment, preliminary assessment procedures, public participation in making decisions, procedures for evaluation and verification of environmental impact assessment and criteria for assessment reports. The Law is fully harmonized with EU Directives setting this area and describes procedures for environmental impact assessment and its content for projects which can impact people's lives, environmental in terms of soil, water, air, landscape and cultural heritage quality or can cause misbalance between these. This Law has set of by-laws.

- Decree on projects that require an environmental impact assessment (Official Gazette of Republic of Montenegro, no 20/07 and Official Gazette of Montenegro, no 47/13, 53/14), which defines that is mandatory to carry out environmental impact assessment for the following activities of exploration and production of hydrocarbons: seismic research at sea, drilling of exploratory wells onshore and offshore (excluding shallow exploration wells up to depth of 50 m, which are aimed at taking geological, geochemical and geomechanical soil samples), drilling of contour wells onshore and offshore, drilling of development and production wells onshore and offshore, installation and use of production and transportation installations on land and sea, decomissioning (dismantling and removal) and relocation of production and transport installations, and upstram pipeline network of land and sea.

- Law on Nature Protection (Official Gazette of Montenegro, No 51/08, 21/09, 40/11, 62/13, 06/14) describes nature protection as a whole, including areas with high aesthetic value and nature diversities of particular value for human health, culture, education, science, history, tourism and in general lives of Montenegrin citizens.

- Water Law (Official Gazette of Montenegro, No.27/07 & Official Gazette of Montenegro, No. 32/11, 47/11) sets out legal status and manner of integrated water management, soil and water along the coast, water structures, terms and manner of conducting water activities, as well as other matters relevant for water and water resources management. This law is based on EU Water Framework Directive.

- Law on Air Protection (Official Gazette of Montenegro, No.25/10, 40/11) defines method for monitoring air quality, protection measures, air quality assessment and improvement, as well as planning and air quality management.

- Law on Waste Management in Montenegro (Official Gazette of Montenegro, No.64/11) describes waste management, including prevention or reduction of waste, re-usage, waste collection, transportation, processing and dumbing facilities, monitoring and landfills operating. The Law stipulates limiting amount of generated hazardous waste and specify responsibilities of waste generators.

- Law on Sea (Official Gazette of the Republic of Montenegro, No 17/07, 06/08, 40/11) setting out coastal and marine area of Montenegro as follows: internal sea waters, territorial sea, exclusive economic zone, continental part, entry ban and stopping and exiling vessel.

- Law on Integrated Environmental Pollution Prevention and Control (Official Gazette of Republic of Montenegro, No 80/05, 54/09, 40/11), sets out prevention and control of environmental pollution by issuing integrated permits for facilities and activities that can have adverse impacts on human health, environment, or mineral resources.

- Law on Environmental Noise Protection (Official Gazette of Montenegro, No 28/11, 28/12, 01/14) sets out measures for prevention and mitigation of noise, regulates sound emission and its impact and sets measures for reduction of harmful noise impacts on human health.

- Law on protection of sea against pollution from vessels (Official Gazette of Montenegro, No 20/11, 26/11, 27/14), which regulates protection of the sea from pollution from ships that sail or are moored in national area of sea of Montenegro, waste receipt and handling in ports, and liability and compensation in the event of pollution.

4.1.3 Other Relevant Legislations

- Labor Law (Official Gazette of Montenegro no 49/08, 59/11, 66/12) regulates the rights and obligations of employees accrued by their work, methods and procedure of their achievement, encourages employment and facilitates labor market flexibility by a collective agreement and contract.

- Law on Companies (Official Gazette of Republic of Montenegro no 6/02 and Official Gazette of Montenegro no 17/07, 80/08, 40/10, 36/11) regulates the forms of business activities and their registration. Economic activities are carried out by companies and entrepreneurs. Commercial entities, registered in accordance with this Law, shall be obliged to obtain approval prior to the commencement of activities, if such an approval is required by particular regulation.

- Law on Employment and Work of Foreigners (Official Gazette of Montenegro no 56/14, 28/15) creates the conditions for a more flexible access of foreigners to labor market in Montenegro, in order to harmonize the supply and demand in this market. A foreigner may be employed or work in Montenegro, provided that (s)he obtains: a work permit, a permanent or a temporary residence permit, and valid employment contract or contract for services.

Montenegro strives to become a member of the EU in near future. Hence, harmonization of national legislation with legal EU framework in all departments is one of the national priorities. The above listed Montenegrin legislation shows that a substantial number of by-laws (secondary legislation) was passed to stipulate procedures for environmental protection.

4.2 RELEVANT EUROPEAN LEGISLATION AND LIABILITIES

4.2.1 Exploration and Production of Hydrocarbons

- Directive 94/22/EC of the European Parliament and the Council of 30 May 1994, on terms and conditions for granting and using authorizations for the prospection, exploration and production of hydrocarbons. Law on exploration and production of hydrocarbons is fully compliant with the Directive.

- Directive 2013/30/EC of the European Parliament and the Council of 12 June 2013, on the safety of subsea oil and gas operations, and amending Directive 2004/35/EC, laying down minimum requirements for the prevention of major accidents during the subsea oil and gas operations, and limiting the consequences of such accidents. Montenegro has not harmonized national legislation with the mentioned directive yet, however, it is recommended that all future concessionaires comply with the terms and conditions defined by Directive before its official transposition into Montenegrin legislation.

4.2.2 Energy

EU energy policy focuses on building competitive internal energy market that offers quality service at low prices, development of renewable energy sources, reduction of dependence on import of energy-generating substances, reduction of dependence of energy-generating substances and reduced energy intensity.

Based on Montenegrin Law on Ratification of the Treaty on Establishing the Energy Community from 2006 and based on Decision of Council of Minister of Energy Community from the day of signing the Treaty to this day, Montenegro's responsibilities relating to *Acquis Communautaire* (electric power, gas, environment, competition, renewable energy sources, and energy efficiency) are as follows:

<u>Crude oil / petroleum product supplies</u>

- Directive 2009/119/EC of 14th September, which imposes obligation on member states to keep minimal supplies of crude oil and/or petroleum products and Regulation 1099/2008 of 22nd October, 2008. According to energy treaty, these are not yet mandatory for Montenegro, however, they are expected to be.

<u>Gas:</u>

- Directive 2003/55/EC of European Parliament and Council of 26th June, 2003 on mutual rights to internal market of natural gas;
- Directive 2004/67/EK of 26th April 2004, on measures for maintaining stable natural gas supplying;
- Regulation (EC) No 1775/2005 of the European Parliament and of the Council of 28 September 2005 on conditions for access to the natural gas transmission networks (Text with EEA relevance)
- Directive 2009/73/EC (13 July 2009) introducing common rules for the transmission, distribution, supply and storage of natural gas.

<u>Environment:</u>

- Directive 85/337/EEC of 27 June 1985, assessment of the environmental effects of those public and private projects, amended with Directive 97/11/EC of 3rd March 1997;

- Guidelines on Environmental Impact Assessment (EA directives) (85/337/EEC) of 27 June 1985, on environmental impact assessment of certain public and private projects;
- Directive 2003/35/EC providing for public participation in respect of the drawing up of certain plans and programmes relating to the environment (26 May 2003);
- Directive 1999/32/EC of 26 April 1999 on reduction of sulfur content in certain liquid fuels and was amended with Directive 93/12/EEC;
- Directive 2001/80/EC of 20 October 2001, on limit values of emission of certain air polluters generated in facilities with massive combustion. In January 2016, Directive 2010/75/EU on industrial emissions shall replace Directive 2001/80/EC (of October 2001) on limit values of emission of certain air polluters from facilities with massive combustion;
- Article 4 (2) of Directive 79/409/EEC (2 April 1979), on wild birds protection.

4.2.3 Environment

Other relevant EU guidelines (directives) referring to environment are:

- Guidelines on Strategic Environmental Impact Assessment (SEA directives) (2001/42) of European Parliament and of the Council of 27th June, 2001 on environmental impact assessment of certain plans and programmes;
- Environmental Liability Directive – Directive 2004/35/EK of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage;
- Guidelines on Marine Strategy framework (Directive on Marine Strategy Framework) (2008/56/EC);
- Guidelines on habitats (Habitats Directive) (92/43/EEC) of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora;
- Guidelines on birds (Birds Directive) (79/409/EEC) on wild birds preservation;
- Guidelines on waters (Waters Framework Directive) (2000/60/EC) of the European Parliament and of the Council establishing a framework for Community action in the field of water policy,
- Guidelines on Urban Waste Water (Urban Waste Water Treatment Directive) (91/271/EEC);
- Planning land usage in EU is stipulated indirectly through different directives and regulations referring to usage of natural resources or assessment of various plans and programmes.

4.3 INTERNATIONAL CONVENTIONS AND PROTOCOLS

Montenegro signed and accepted more than fifty international environmental protection agreements and its goals need to be taken into account in the process of assessment of exploration and production of hydrocarbon. Full list of these agreements is shown in Appendix B, some of the most significant being:

- Kyoto Protocol on UN Framework Convention on Climate Changes (1992)
- AARHUS Convention on Information Access
- Convention on Environmental Impact Assessment in a Transboundary Context (1991) - “ESPOO Convention”
- UN Convention on Biological Diversity (1992)
- RIO Declaration on Environment and Development (1992)
- Protocol on SEA (2003) –“Kiev Protocol”
- RAMSAR Convention - Convention on Wetlands of International Importance, especially as Waterfowl Habitat (1971)
- Convention on World Cultural and Natural Heritage Protection (1972)
- Convention on Protection and Usage of Transboundary Waters and International Lakes (1992) –“Water Convention”
- International Convention for the Prevention of Pollution from Ships (MARPOL) (annexes 1to 5)
- Convention for the Protection Of The Mediterranean Sea Against Pollution (Barcelona Convention)
- The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal
- The IMO Ballast Water Management Convention

A description of the last four listed conventions i.e. MARPOL, Barcelona, Basel and Ballast water management conventions is provided below given their particular importance to the programme implementation.

4.3.1 MARPOL Convention

The MARPOL Convention also known as the « Marine Pollution Convention » is an International Convention for the Prevention of Pollution from Ships from operational or accidental causes. The Convention includes the following Annexes:

- Annex I: Regulations for the Prevention of Pollution by Oil (entered into force 2 October 1983). Covers prevention of pollution by oil from operational measures as well as from accidental discharges. It states that:
  - Ship must be proceeding en route, not within a "special area" and oil must not exceed 15 ppm (without dilution). Vessel must be equipped with an oil filtering system, automatic cutoff, and an oil retention system.
  - Shipboard oil pollution emergency plan (SOPEP) is required.

- Annex II: Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk (entered into force 2 October 1983). Includes details the discharge criteria and measures for the control of pollution by noxious liquid substances carried in bulk; some 250 substances were evaluated and included in the list appended to the Convention; the discharge of their residues is allowed only to reception facilities until certain concentrations and conditions (which vary with the category of substances) are complied with. In any case, no discharge of residues containing noxious substances is permitted within 12 miles of the nearest land.
- Annex III: Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form (entered into force 1 July 1992). Contains general requirements for the issuing of detailed standards on packing, marking, labelling, documentation, stowage, quantity limitations, exceptions and notifications. For the purpose of this Annex, "harmful substances" are those substances which are identified as marine pollutants in the International Maritime Dangerous Goods Code (IMDG Code) or which meet the criteria in the Appendix of Annex III.
- Annex IV: Prevention of Pollution by Sewage from Ships (entered into force 27 September 2003). Contains requirements to control pollution of the sea by sewage; the discharge of sewage into the sea is prohibited, except when the ship has in operation an approved sewage treatment plant or when the ship is discharging comminuted and disinfected sewage using an approved system at a distance of more than three nautical miles from the nearest land; sewage which is not comminuted or disinfected has to be discharged at a distance of more than 12 nautical miles from the nearest land.
- Annex V: Prevention of Pollution by Garbage from Ships (entered into force 31 December 1988). Deals with different types of garbage and specifies the distances from land and the manner in which they may be disposed of; the most important feature of the Annex is the complete ban imposed on the disposal into the sea of all forms of plastics. It stipulates that:
  - Disposal of garbage from ships and fixed or floating platforms is prohibited. Ships must have a garbage management plan and shall be provided with a Garbage Record Book.
  - Discharge of food waste ground to pass through a 25-mm mesh is permitted for facilities more than 12 nmi from land.
- Annex VI: Prevention of Air Pollution from Ships (entered into force 19 May 2005); which Sets limits on sulfur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone-depleting substances including halons and chlorofluorocarbons. Sets limits on emissions of nitrogen oxides from diesel engines. Prohibits the incineration of certain products on board such as contaminated packaging materials and polychlorinated biphenyls.

All annexes have been ratified by Montenegro, except for Annex VI on the protection of air pollution from ships.

4.3.2 Barcelona Convention

The 1976 Barcelona Convention for Protection against Pollution in the Mediterranean Sea is a regional convention to prevent and abate pollution from ships, aircraft and land based sources in the Mediterranean Sea. This includes, but is not limited to, dumping, run-off and discharges. Signers agreed to cooperate and assist in dealing with pollution emergencies, monitoring and scientific research. The convention was last amended in 1995. The Barcelona Convention and its protocols, together with the Mediterranean Action Plan, form part of the UNEP Regional Seas Programme; the convention was ratified by Montenegro in 2007.

The key goal of the convention is to 'reduce pollution in the Mediterranean Sea and protect and improve the marine environment in the area, thereby contributing to its sustainable development'.

The Barcelona Convention has given rise to the following protocols addressing specific aspects of Mediterranean environmental conservation:

- 1976 Dumping Protocol (Not Ratified by Montenegro);
- 1976 Emergency Protocol (Not Ratified);
- 2002 Emergency Protocol (Ratified);
- 1980 Land-Based Sources Protocol (Ratified);
- 1982 Specially Protected Areas Protocol (Not Ratified);
- 1995 SPA & Biodiversity Protocol (Ratified);
- 1994 Offshore Protocol: Protocol for the Protection of the Mediterranean Sea Against Pollution Resulting from Exploration and Exploitation of the Continental Shelf and the Seabed and its Subsoil (Not Ratified);
- 1996 Hazardous Wastes Protocol (Ratified);
- 2008 Integrated Coastal Zone Management (ICZM) (Ratified);

4.3.3 Basel Convention

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal was adopted on 22 March 1989 in Basel, Switzerland, in response to a public outcry following the discovery, in the 1980s, in Africa and other parts of the developing world of deposits of toxic wastes imported from abroad.

The main objective of the Basel Convention is to protect Human Health and the Environment against the negative impacts resulting from the generation, management, movement and disposal of hazardous wastes. The Convention controls the transboundary movements of hazardous waste and considers shipments without prior consent as illegal.

The provisions of the Convention center around the following principal aims:

- the reduction of hazardous waste generation and the promotion of environmentally sound management of hazardous wastes, wherever the place of disposal;

- the restriction of transboundary movements of hazardous wastes except where it is perceived to be in accordance with the principles of environmentally sound management; and
- a regulatory system applying to cases where transboundary movements are permissible.

4.3.4 IMO Ballast Water Management Convention

The IMO Ballast Water Management Convention (2004) was ratified by Montenegro on 29/11/2011.

The convention represents a significant step towards protecting the marine environment from the introduction of invasive species from the uncontrolled discharge of ballast water.

The Convention requires all ships to implement a Ballast Water and Sediments Management Plan. All ships will have to carry a Ballast Water Record Book and will be required to carry out ballast water management procedures to a given standard. Parties to the Convention are given the option to take additional measures which are subject to criteria set out in the Convention and to IMO guidelines.

At the time the Ballast Water Management Convention was adopted, suitable technologies allowing this strict standard to be met did not exist. Meanwhile, however, companies all over the world have developed novel systems and technologies which are now undergoing a complex approval procedure at IMO or the national approval authorities.

5. BASELINE CONDITIONS

5.1 INTRODUCTION

Environmental and social baseline conditions might have important implications on the Programme and vice-versa. The SEA consultants have reviewed existing information and conducted an analysis of how the government and future operators should take into account baseline conditions; constraints posed by the existing environment need to be considered in the planning process of the Programme. This analysis is important to define SEA objectives aiming at preserving the quality of the existing environment.

The results of this analysis are summarized in Table 5.57. The SEA report includes detailed baseline chapters with description of each thematic field.

The key objectives of the Baseline Conditions Chapter are to:

- Document the environmental and socio-economic conditions in the area of the Programme implementation with a focus on the key sensitivities and receptors that might be affected by the Programme.
- Address the socio-economic aspects that could influence or be influenced by the Programme development.

5.2 GEOGRAPHIC LOCATION FOR PROGRAMME IMPLEMENTATION

The Programme will be implemented offshore Montenegro in the Adriatic Sea. The coastline of Montenegro is 300 km long, including 6 municipalities namely: Ulcinj, Bar, Budva, Tivat, Kotor and Herceg Novi, they encompass approximately 11% of the national territory. Since Montenegro does not have a rugged coastline, the number of islands in the Adriatic Sea is small, 13 in total, with 9 islands in the Boka Kotorska Bay, while the other four are located along the southern coast.

The license blocks are located against the middle and south shores of the coastal area (i.e. Ulcinj, Bar and Budva) as shown in Figure 5.1.

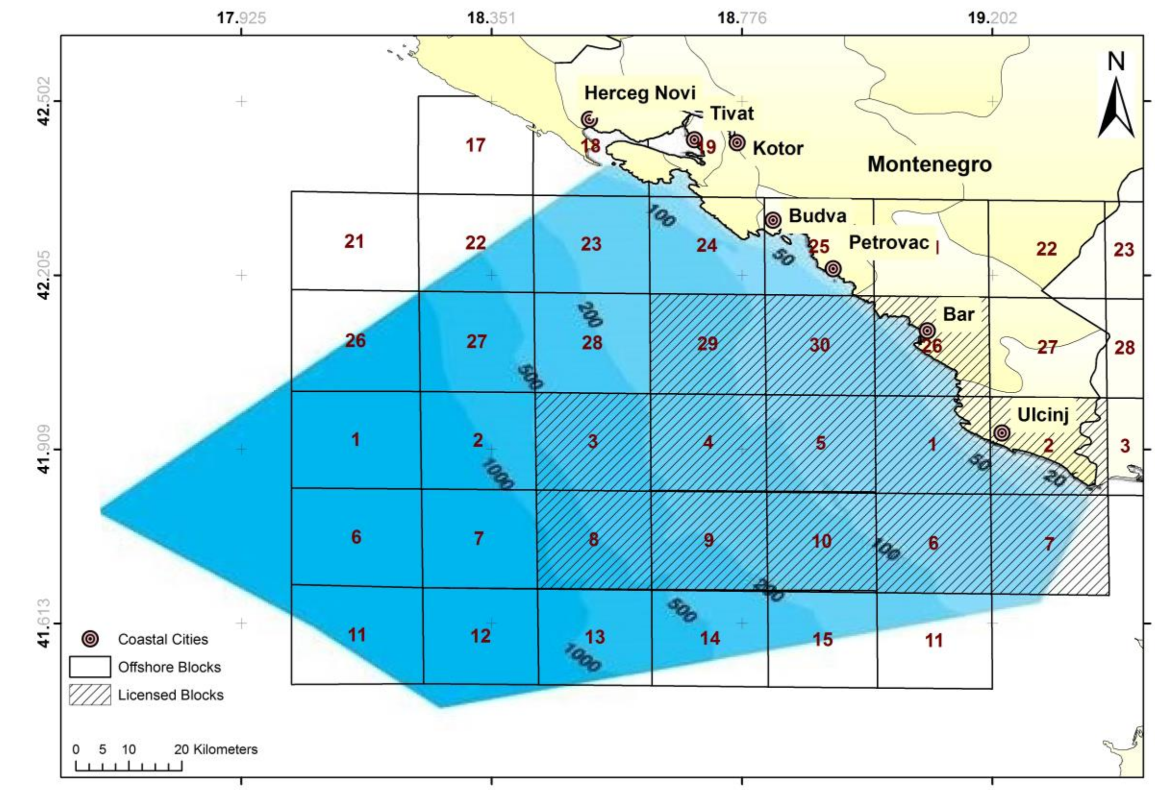

Figure 5.1 Montenegro Coastal Municipalities

5.3 PHYSICAL ENVIRONMENT

5.3.1 Bathymetry

5.3.1.1 Introduction

Bathymetry of the sea bottom is regarded as an essential component of GOOS (Global Ocean Observing System) since, in addition to its importance for the preparation of marine maps, bathymetry is especially expressed in preparation of models of natural processes used for studying the role of oceans in the climate system of Earth. Overall understanding of geological processes, capacity to find and use ocean resources, to model natural processes in the sea and make sea prognoses depend on detailed knowledge of the ocean bathymetry.

Knowledge of ocean currents and their interaction with the topography of the bottom is essential to understand the fate of contaminants that could be possibly released in deep waters or in the sea.

Morphology of the sea bottom has been examined for over a century but only after technologies were developed in the end of 20th century, was it possible to prepare high resolution bathymetric measuring.

5.3.1.2 Bathymetry Offshore Montenegro

For the preparation of bathymetric maps (Figure 5.2, Figure 5.3, Figure 5.4), existing marine and bathymetric maps prepared based on measurements with single ray ultrasound depth meters, were used, since there are no modern digital data from systematic bathymetric measurements for the area of interest. For the analysis of bathymetry of the open sea, sea maps of Hydrographic Institute of Yugoslav War Navy were used (HI YWN). From the maps geo-referenced with GIS tool, isobaths were digitalized and surfaces were calculated (Table 5.1).

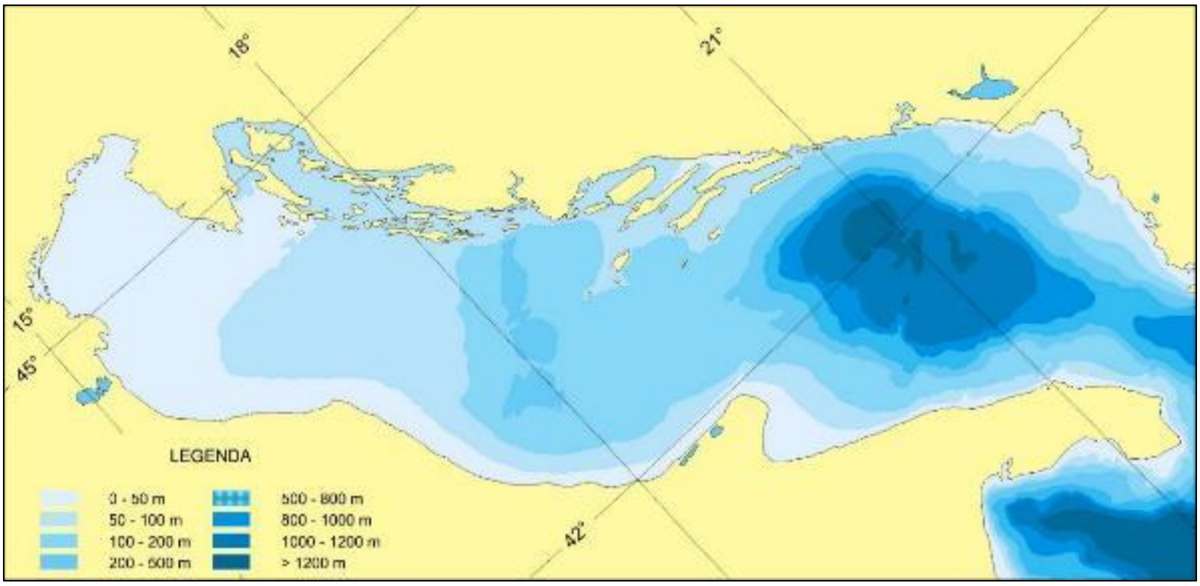

Figure 5.2 Bathymetry of the Adriatic Sea

It shall be noted that boarders of offshore Montenegro are not precisely defined, because delineation with adjoining countries was not fully executed. Used Boundaries of the sea water were given according to existing final and temporary agreements. <u>Thus the calculated surfaces are considered approximate, i.e. conditional.</u>

Table 5.1 Surface of Bathymetric Belts Offshore Montenegro[1]

Bathymetric Belt	Area (km²)	Percentage (%)
0 to 20 m	71	0.9
0 to 50 m	245	3
50 to 100 m	1 558	19
100 to 200 m	1 657	20.4
200 to 500 m	1015	12.6
500 to 1000 m	838	10.4
over 1000 m	2729	33.7

[1] Surface of bathymetric belts are calculated in programme Golden Surfer 10

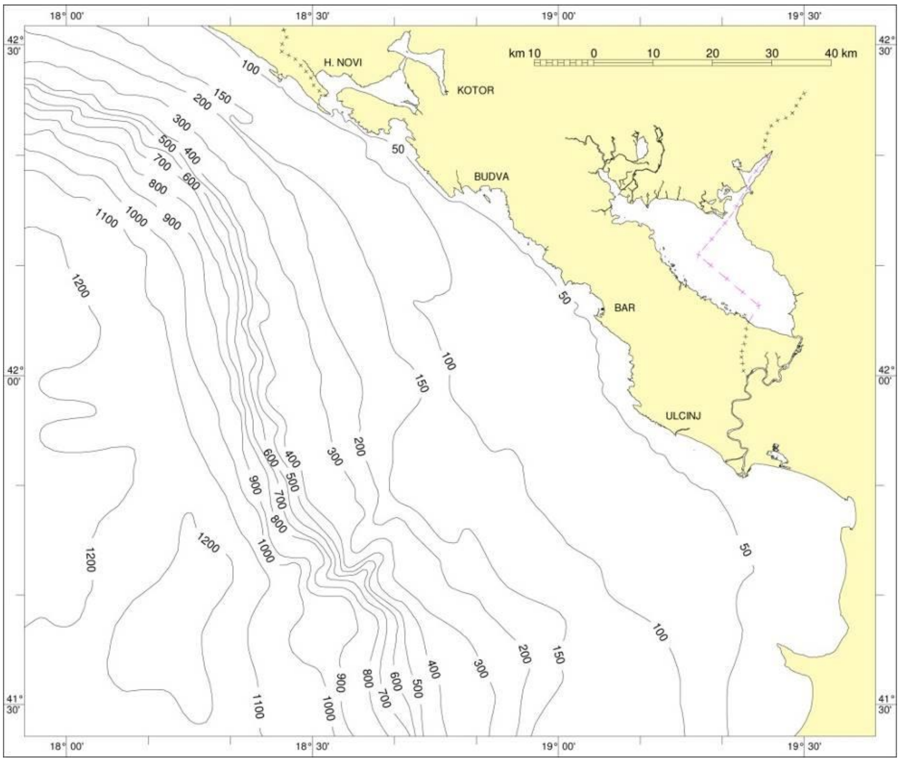

Figure 5.3 Bathymetry of Offshore Montenegro (1) [1]

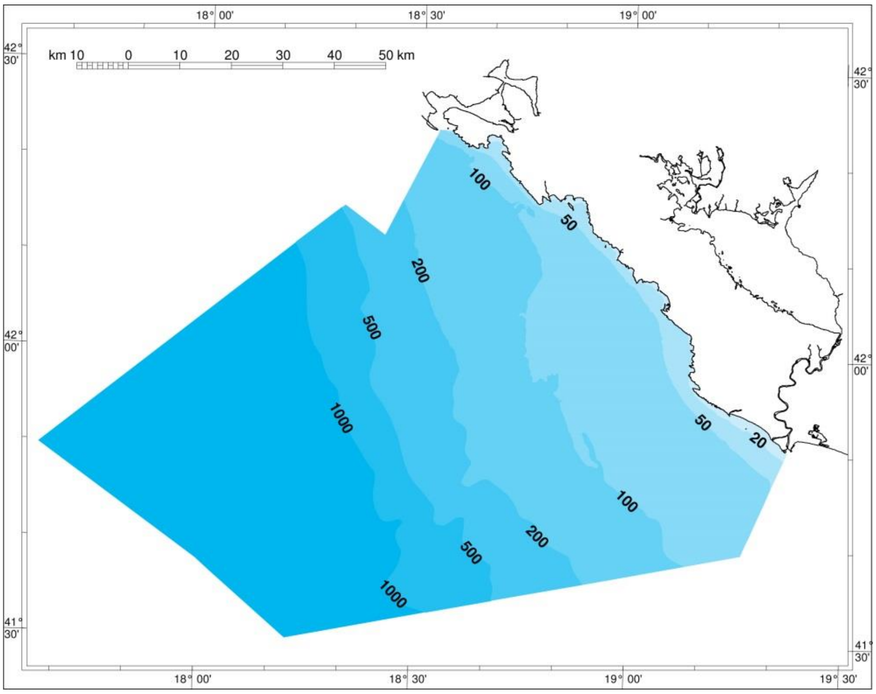

Figure 5.4 Bathymetry of Offshore Montenegro (2) [2]

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[1] Bathymetry was taken from the Sheet 3 Sedimentological maps, scale 1:750 000 issued by HI YWN Split 1985

[2] Isobaths are digitalised from sea maps issued by HIYWR. The map is inserted only for illustration purposes.

Based on Table 5.1, the following can be concluded:

- The area of continental shelf (area limited by depth of 200 m) covers 43,5% of the total offshore area;
- Bathymetric belt (500-1000) meter depth covers only 10,4% of the offshore area, which shows sudden transfer from the shelf into the area of deep south Adriatic valley;
- Bathymetric belt over 1000 meters depth covers 33.7% of the offshore area where exploitation of hydrocarbon resources is difficult,
- Depths up to 20 m are located within a very narrow belt along the shore and they account for 0,9% of the offshore area (outside Boka Kotorska bay), meaning that greater depths in close vicinity to the shore allow for thermal satisfaction which has favorable impact on intensity of diffusion process and dilution of waste waters which reach the sea from the shore via sewage outlets,
- There are no islands or rocks in the waterways in front of the shore. Existing islands and rocks are located in close vicinity to the shore and do not pose a threat to sailing which reduces the risk of offshore accidents caused.

5.3.2 Waves

5.3.2.1 Surface Waves Caused by Wind

In terms of generation of surface waves caused by wind, Adriatic Sea is regarded as closed sea of limited wind capacity. Based on the required conditions for having a fully developed live sea, it can be concluded that these conditions are met in quite rare situations. Only under conditions of long-term stormy wind of SE direction (sirocco), there can be a chance for generating a model of fully-developed live sea.

For the development of this section, data from the Study "Physical-Oceanographic and Hydroacoustic Characteristics of the Adriatic Offshore" issued by the Hydrographic Institute of War Navy (HIWN) in 1990 were mainly used. Modern oceanic methods were used for data processing and analysis. It shall be noted that there are no recent data on monitoring and metering wave parameters in the offshore of Montenegro conducted after the period of preparation of HIWN study.

5.3.2.2 Visual Waves Observation from Boats

Visual observations were conducted from vessels over a course of 20 years and data on frequency of direction of waves of certain height in SFRY coastal sea including Montenegrin were obtained. These data are shown in Figure 5.6 and Table 5.2. Results are only presented for autumn and winter months (January, February, March, November and December) as this is the period of intensive cyclone activity above the Adriatic and most frequent occurrences during strong and stormy winds.

Data for block 19 (Figure 5.5), which mainly covers sea area in front of Montenegrin shore, are presented.

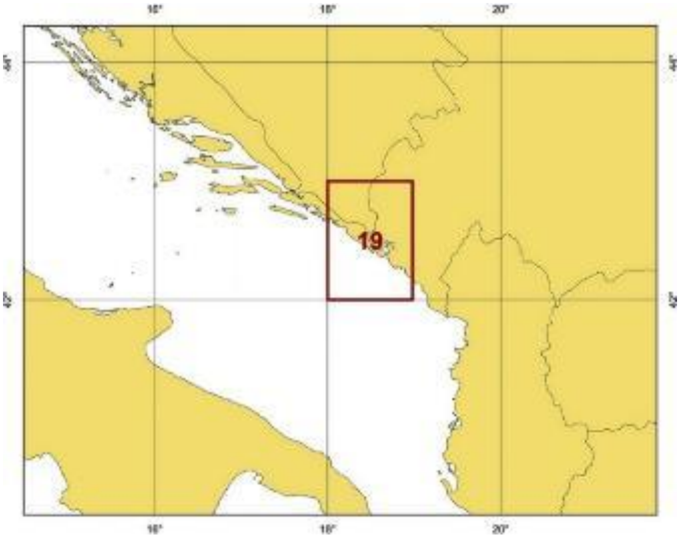


Figure 5.5 Location of block 19 (Area of Presented Data of Visual Waves Observation)

Table 5.2 Characteristics of Block 19 Waves According to Data from Visual Observation

Month	No of observations	Duration of observation	Waves height (m)	Frequency of Wave Height in %								Calm Sea
				N	NE	E	SE	S	SNW	NW	NNW	
			4 i >									
			3 - 3,50									
Jan	140	20 years	2 - 2,50	1		1	1	3	-	-	-	19%
			0,50-1,50	8	17	10	18	3	1	1	4	
			0 - 0,25	1	4	3	3	-	-	-	2	
			4 i >									
			3 - 3,50				1					
Feb	129	20 years	2 - 2,50	1	1	2	1	2				14%
			0,50-1,50	4	20	10	21	5	1	3	7	
			0 - 0,25	2	-	-	2	-	-	1	2	
			4 i >									
			3 - 3,50									
Ma	160	20 years	2 - 2,50	-	1	1	1	2	-	-	1	27%
			0,50-1,50	4	13	10	15	5	1	4	7	
			0 - 0,25	-	3	-	2	1	-	-	2	
			4 i >									
			3 - 3,50					2				
Nov	140	20 years	2 - 2,50	1	-	1	1	1	1	-	-	16%
			0,50-1,50	8	11	4	27	11	3	3	4	
			0 - 0,25	1	1	-	-	1	1	-	2	
			4 i >									
			3 - 3,50						1			
Dec	158	20 years	2 - 2,50	-	2	-	2	2	-	1	-	17%
			0,50-1,50	7	17	10	18	8	2	2	4	
			0 - 0,25	1	1	-	2	1	-	1	1	

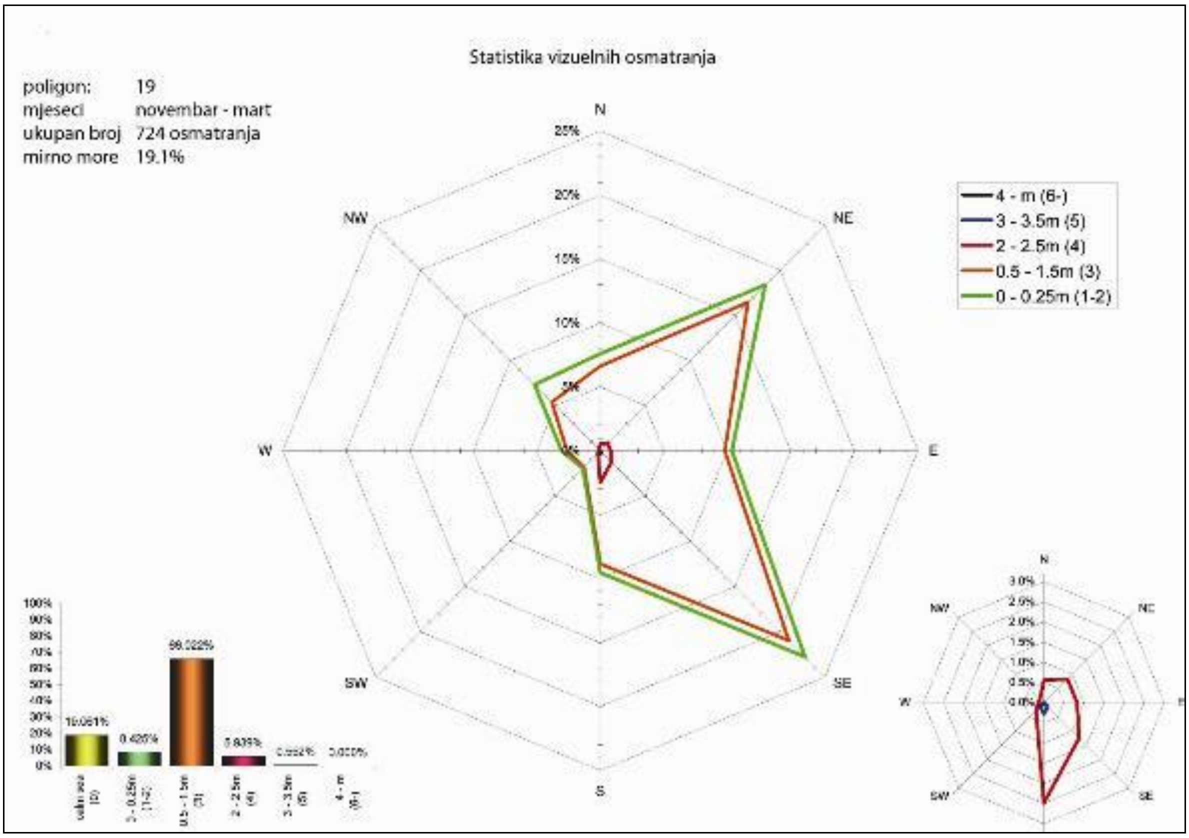


Figure 5.6 Cumulative Chart of Characteristics of Block 19 Waves according to Data from Visual Observation

Findings of data from visual observations are as follows:

- Most frequent waves in southern Adriatic are generated by Bora winds (north-east) and Sirocco (south-east) and Maestral (north-west) in summer period
- In winter period in the southern Adriatic dominant waves are waves of south-east and north-west directions but developed models of waves from north-west and South direction occur quite often
- At spring time, frequency of waves from North-east direction reduces however with prevailing waves from South-east direction, waves from north-east direction still occur
- In summer in southern Adriatic, the most frequent waves are waves from north-west direction (25% of observed waves)
- In autumn the most frequent waves are waves from north-east direction - 23%

5.3.2.3 Instrumental Measurements of Waves

HIWN started conducting instrumental metering in the seventies of the last century. Measuring was organized in such a way to register changes in de-levelling of sea surface caused by wind using wave meters type DATAWELL and KELVIN - HUGES at several permanent locations (stations) in the Adriatic Sea throughout the year except for summer months when instruments were being maintained and prepared for the following season measurements.

Continuous registrations were made daily in synoptic slots (01, 04, 07 etc. hours). Determining the length of registration depended on development of state of the sea. For less developed states, measuring was done at time frames of 5 minutes each. Length of registration for developed states of the sea amounted to 10 minutes or more.

Oštro wave metering station is the only station in Montenegrin Sea where HIWN conducted metering of elements of surface waves. It is located in front of Oštro Cape at the entrance into Boka Kotorska Bay where metering with wave meter KELVIN – HUGES was conducted.

For this station, 7 extreme situations with 150 registrations were processed. Data of two extreme situations with storm sirocco are shown in Table 5.3.

Table 5.3 Data of Stormy Sirocco Events on Wave Metering Station Cape Oštro

Time	$H_{1/3}$ (m)	$H_{1/10}$ (m)	H_{max} (m)	T_{sr} (s)	L_{sr}(m)	Wind
6/7 Jan 1969.g.	4.30	4.95	6.80	7.4	85.0	SSE 20.0 m/s
27/28 Jan 1970.g.	4.15	5.30	7.20	7.0	77.0	SE-S 25.5 m/s

Where:

- **$H_{1/3}$** **substantial wave height –mean height of 1/3 of the highest waves of specific registration**
- **$H_{1/10}$** mean height of 1/10 of the highest waves in one record
- **H_{max}** maximum registration recorded in particular registration
- **T_{sr}** mean (significant) period for certain interval of registration
- **L_{sr}** mean value of wave length, represents an average of horizontal separations from adjoining wave peaks of certain registration

When comparing data obtained by processing visual observations and data obtained by means of instrumental metering, it can be noted that heights of waves from visual observations are substantially underestimated. However, data concerning visual observation can be used for determining frequency of direction of advancement for certain wave models while development of surface wave models is better to be judged based on data of instrumental metering.

Data from nearby wave meter station St Andrija (Dubrovnik) in Croatian waters proves that occurrence of bigger waves in front of the shores of Montenegro is possible. One incident of 8.9 height wave was recorded at night between on 23rd December 1979 during a stormy Sirocco.

it is to be noted that maximum height of waves in the offshore of northern Adriatic was Hmax = 10.8 m and was recorded during a long stormy northern Sirocco, however it is estimated that for a100 years return period, the highest wave in the Adriatic is 13.5 m.

5.3.3 Currents

5.3.3.1 Sea Currents in the Southern Adriatic

Currents in the Adriatic Sea are primarily result of gradient currents (distribution of density), where wind currents, marine shift currents, currents of free oscillations and currents of inertia are superposed to them.

5.3.3.1.1 Average Speed, Most Frequent Directions and Absolute Maximum Speed of Currents in the Subsurface, Intermediary and Bottom Layer of the Southern Adriatic

Data from the Hydrographic Institute of War Navy from Split HIWN were used for the preparation of this study. Most modern oceanic methods and computers with adequate programs at the time of monitoring were used in the process and analysis of parameters. These data can be regarded as relevant and reliable.

Data for southern part of the Adriatic are shown through the processing of mean and maximum speeds of the currents and most frequent directions in the surface, intermediary and bottom layers. For the calculation of all the sizes, long-term monthly mean values were used.

More substantial deviations from presented data can be expected primarily for the periods of massive and stormy winds. In those cases, it is necessary to bear in mind that 3% of wind energy is transferred to friction. Intensity of speed of currents reduces to the bottom due to friction and other factors. In the areas with greater depths (more than 60 m) currents caused by wind substantially lose energy and theoretically, on depths of 200 m, wind impact vanishes.

Mean speeds, most frequent directions and absolute maximum speed in the southern Adriatic sea of Montenegro in the four seasons are presented in Table 5.4.

Table 5.4 Mean Speed, Most Frequent Direction and Absolute Maximum Speed of Currents in Southern Adriatic

Season	Depth (m)	Most Frequent Directions (^{0})	Mean Speed (knots)	Max Speed (knots)
Autumn	5	18	0.44	0.58
	50	310	0.24	0.49
	120	305	0.27	0.43
Winter	5	327	0.44	0.99
	50	294	0.44	0.69
	120	36	0.31	0.38
Spring	5	274	0.41	1.01
	50	265	0.27	0.67
	120	342	0.20	0.35
Summer	5	39	0.41	1.25
	50	96	0.20	0.85
	120	96	0.24	0.60

5.3.3.2 Sea Currents in the Coastal Sea of Montenegro

Data on sea currents are gathered and processed mainly from two previous studies and scientific papers which are: "Preliminary Report for Sewage Solution in the Montenegrin Coast", and the scientific paper "Oceanographic Characteristics of the Sea from Boka Kotorska to Bojana River Mouth", author I. Nožine, M. Tešića and Z. Vučaka.

Analysis of sea currents for the northern part of the coastal sea of Montenegro were made at Location P-1 (42° 18.8' N, 18° 30.3' E) which is located at about 5 nmi south of Oštro cape, and for the southern part at the Location P2 (41° 50.4 N, 19° 06.5' E) about 6 nmi SW from Ulcinj (Figure 5.7).

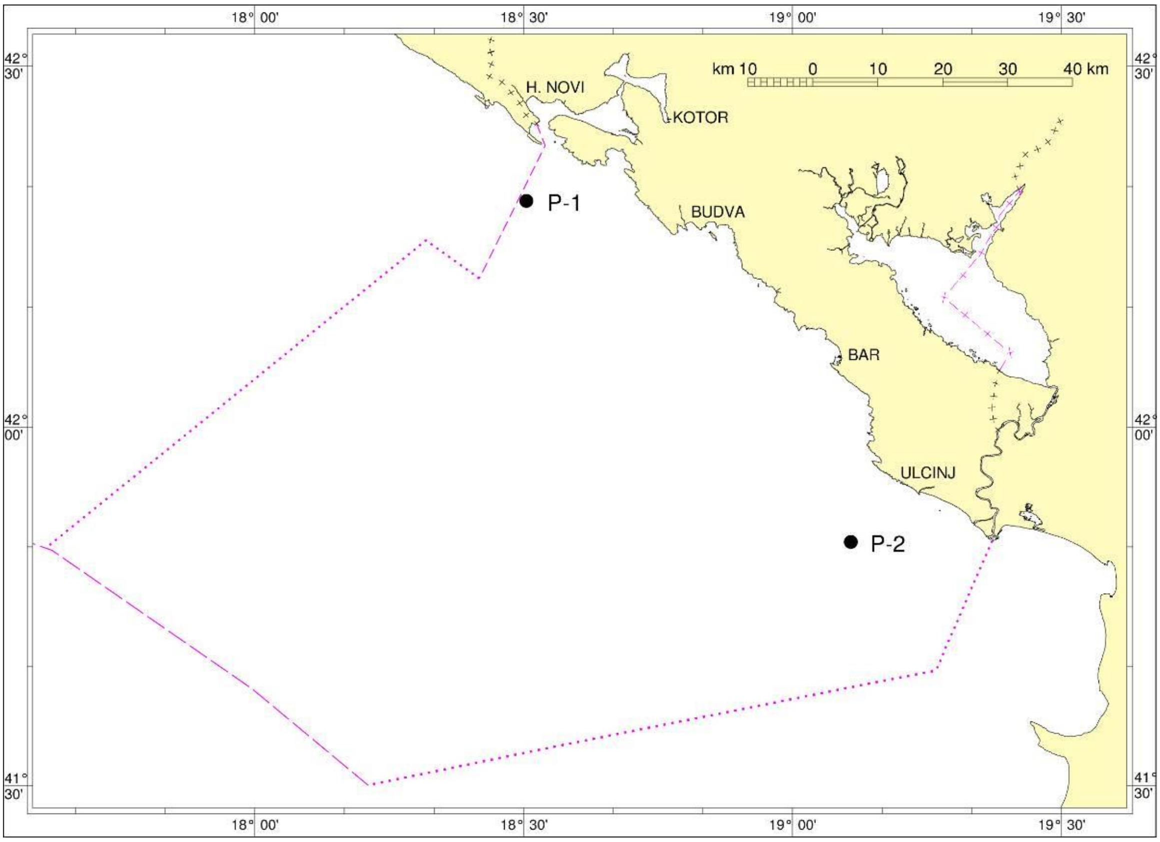


Figure 5.7 Locations of Currents Analysis in the Coastal Sea of Montenegro[1]

5.3.3.2.1 Sea Currents in the Northern Part of the Coastal Sea of Montenegro

For the northern part of the coastal sea (Location P1) analysis of direction and strength of currents were made based on nine 24-hour monitoring from the surface to the bottom at 4 to 9 levels. Monitoring was made in March, June, July, September and October, representing different seasons of the year.

Basic characteristic of this area is legitimate appearance of inlet currents during winter months (Figure 5.8). Direction of currents flow, in the overall profile from the surface to the

[1] Purple colour delineates boundaries of territorial waters and epicontinental belt of Montenegro.
The map is inserted only for illustration purposes. Boarders of the EEZ has not been precisely defined, as delineation with adjoining countries is not fully executed.

bottom is quite parallel with the shore – transport is focused from SE to NW. Intensity of dynamics varies per months, climatological type of the year and depth.

In winter, general direction is NW, resulting speed is 0.4 to 0.7 knots (1 knot = 0.5144 m/sec). Maximum registered speed in the season reaches 0.99 knots, and most often maximum values are 0.5 – 0.8 knots. Minimum speeds are not lower than 0.2 knots.

Impact of gradient currents is dominant, and impact of sea tides and current drifts is of secondary impact.

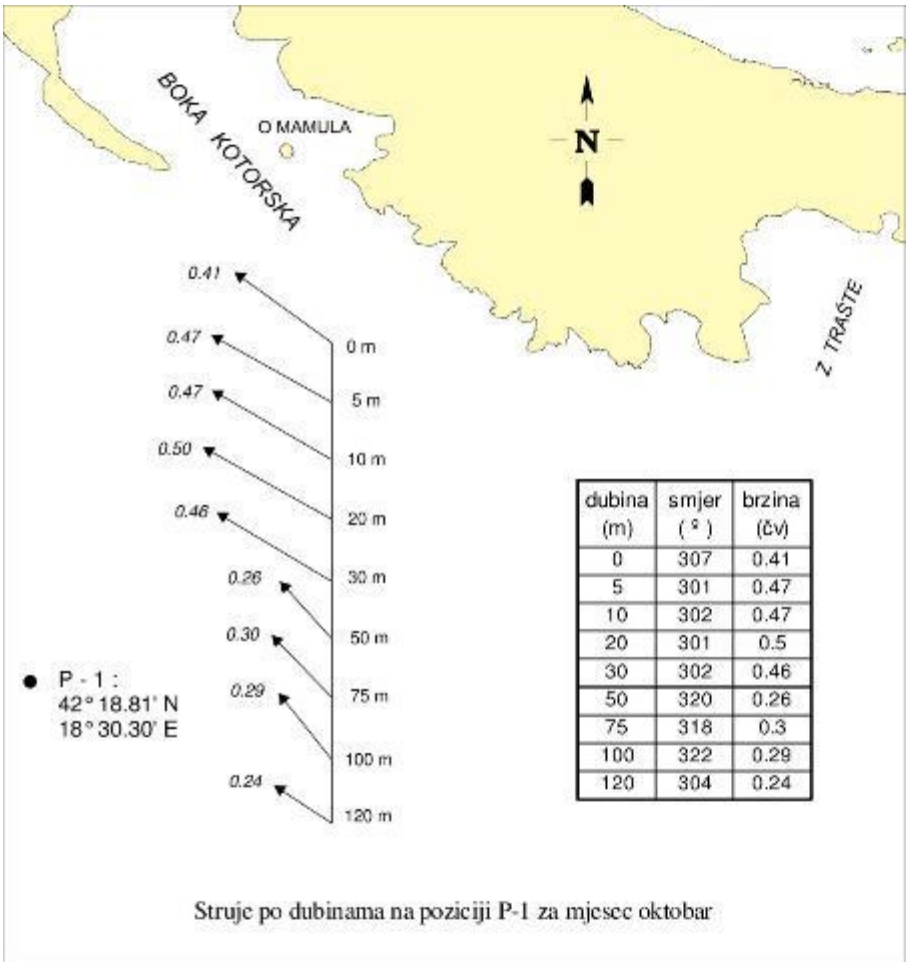
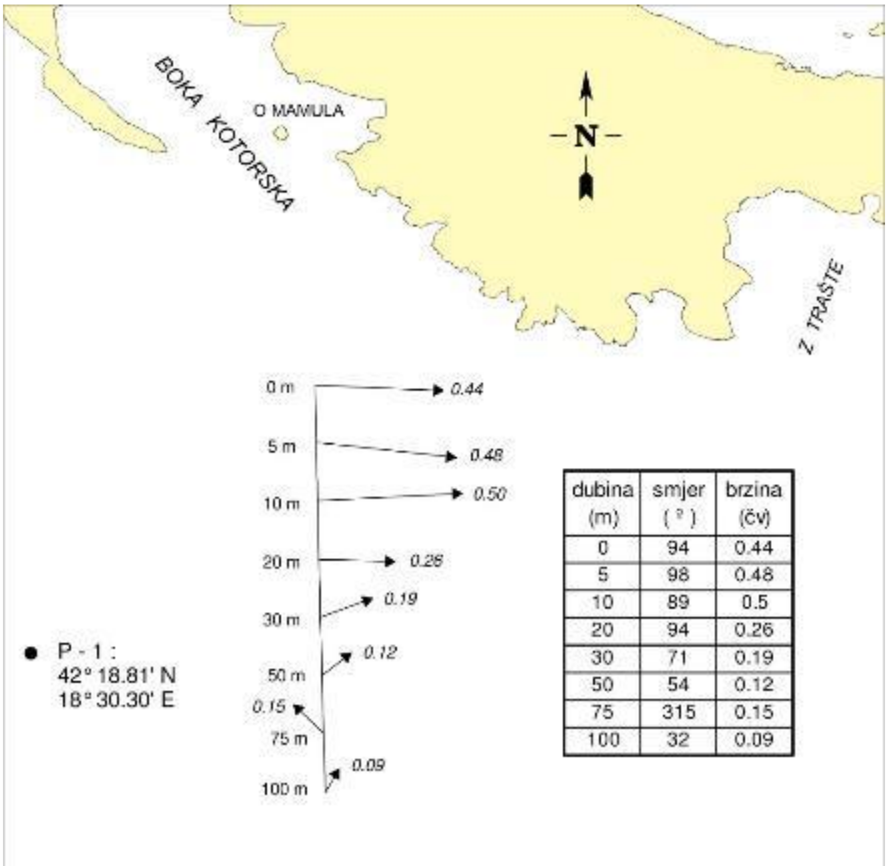


Figure 5.8 Characteristics of Sea Currents at Location P-1 in October

In summer (Figure 5.9), movement of sea mass has diverse direction and stronger intensity, especially in the surface layer; substantially lower speed with increase in depth. General direction of currents is E to SE. Mean speed ranges between 0.2 and 0.6 knots. Maximum speed does not exceed 0.97 knots, and most frequent values range from 0.5 to 0.8 knots. Minimum speeds are mainly from 0.1 to 0.4 knots. Compared with winter period, sea tides are perceivable.



Struje po dubinama na poziciji P-1 za mjesec juli

Figure 5.9 Characteristics of Sea Currents at Location P-1 in July

<u>In spring and autumn</u>, there is presence of transversal currents with greater flow frequencies from the shore to the offshore. Differences per layers, direction and speed are perceivable. Resulting speed in the overall profile varies from 0.3 to 0.75 kn. Mean values varies between 0.2 and 0.8, and maximum values between 0.2 and 1.1 kn.

5.3.3.2.2 Sea Currents in the Southern Part of the Coastal Sea of Montenegro

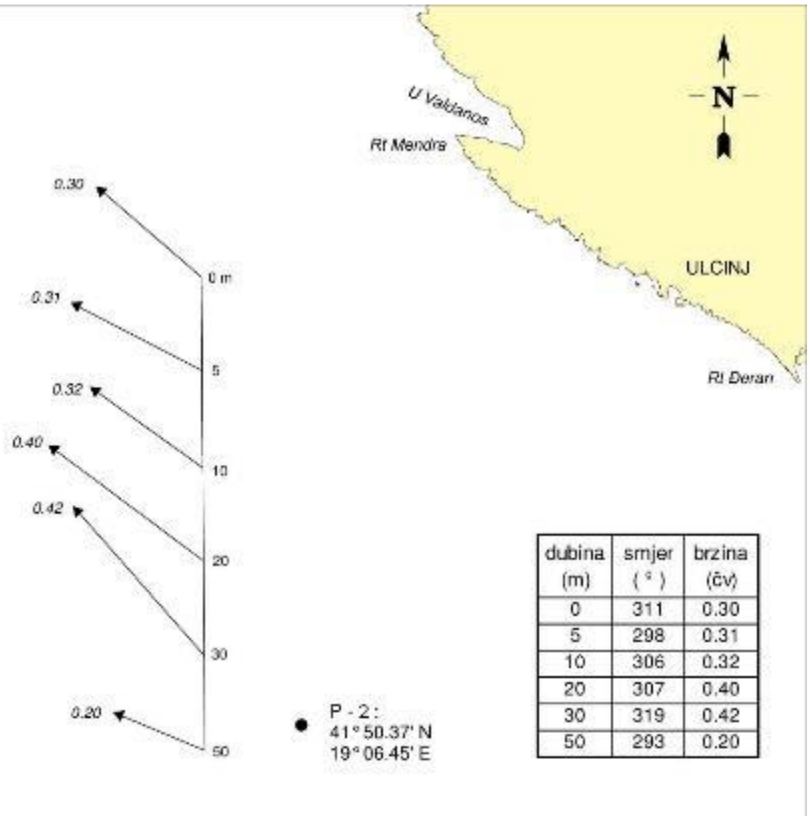
For the southern part of the coastal sea of Montenegro (Location P2), analysis of directions and current power are made based on data from13 stations distributed in the area in the period from 1958 to 1976. Monitoring was conducted in February, March, June, July, September and October at 4 to 6 levels.

At the locations of P1 and P2, flow system is under impact of general circulation of water mass in this area of the Adriatic. For the winter period, typical direction is NW, and in the summer mainly SE. In spring and autumn seasons, the direction depends on climatological characteristics of the particular year and month when monitoring was performed. Also, speed is mainly within the same range as the speed in the northern part of the coastal sea.

Flow in September and October (Figure 5.10) has the characteristics of winter dynamics. Movement of water mass at entire depth has NW direction.

In winter months, general flow moves from SE to NW along the entire depth. In February, speeds are even from surface to bottom and range between 0.45 and 0.65 kn (23 to 34 cm/sec). In March, currents are most intensive in the surface layer and decline linearly towards the bottom and range from 0.65 to 0.24 kn (34 to 12 cm/sec).

Mean values in these two months range from 0.35 to 0.81 kn (18 to 42 m/sec), and most frequent value is around 0.5 kn (26 cm/sec). Maximum values range from 0.51 to 1.13 kn (26 do 58 cm/sec), with biggest frequency of around 0.7 kn (36 cm/sec). Minimum values reflect quite intensive movement in this area. Absolute minimum values range from 0.1 to 0.5 kn (5 to 26 cm/sec), and most frequent minimum value is around 0.25 kn (13 cm/sec).



dubina (m)	smjer (°)	brzina (čv)
0	311	0.30
5	298	0.31
10	306	0.32
20	307	0.40
30	319	0.42
50	293	0.20

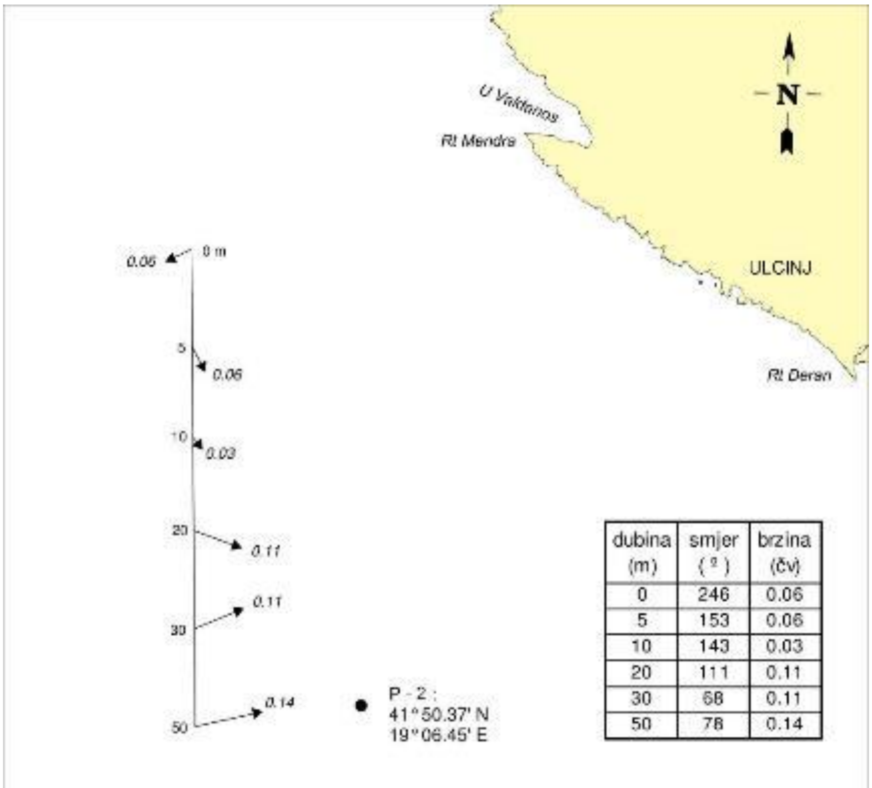
Struje po dubinama na poziciji P-2 za mjesec oktobar

Figure 5.10 Characteristics of Sea Currents at Location P2 in October

In June, water mass moves parallel to the shore at most depths, while to NW and then SE at certain depths (Figure 5.11).

July shows similar characteristics. Mean speed in NW direction is around 0.50 kn (26 cm/sec), and in around 0.35 kn (18 cm/sec) in the SE direction.

Current speeds have relatively high values from 0.19 to 0.59 kn (10 to 30 cm/sec) and average annual value of the speed of the entire water column is 0.35 kn (18 cm/sec). Mean values are even higher and range from 0.2 to 0.7 kn (11 do 36 cm/sec). Maximum recorded values of current movement range from 0.5 to 1.3 kn (26 do 67 cm/sec).



dubina (m)	smjer (°)	brzina (čv)
0	246	0.06
5	153	0.06
10	143	0.03
20	111	0.11
30	68	0.11
50	78	0.14

Struje po dubinama na poziciji P-2 za mjesec jun

Figure 5.11 Characteristics of Sea Currents at Location P2 in June

5.3.3.3 Sea Currents in Boka Kotorska Bay

It shall be noted that data on sea currents, and all other oceanographic parameters for Boka Kotorska Bay, and the entire Montenegrin littoral, are very scarce. There are no indications of monitoring of sea currents in an organized and systematic manner in Boka Kotorska Bay. Still, there is a certain number of studies and scientific papers that deal with monitoring of sea currents in this area. Studies prepared at the end of the eighth decade of last century for the sewer design in the littoral were used as basic source of data on currents. These studies for the area of Boka Kotorska Bay used the entire data fund from 1954 to 1976 while additional sea current monitoring was conducted in bay in 1976.

According to existing data, a more intense dynamic of water masses in the bay appears mainly in the surface layer. Its intensity is the highest at the period of maximal inflow of fresh water (rainfall, onshore inflow and undersea springs). In that period, intensive circulation is present solely at the surface layer up to 5 meter depth, which is a result of surface delevelling, and not constant flow system, so adequate compensation current in deeper layers cannot be counted on, or constant exchange of water masses (Figure 5.12 and Figure 5.13).

Flow in deeper layers is mainly a result of impacts of ebb and flow currents which result in low net transportation and by the extension change of water masses in the entire basin.

In hydrologically unfavorable seasons, intensity of flow is even weaker. It particularly refers to peripheral parts of certain bays (Kotor and Risan bays, Krtolski and Toplanski bays), where circular circulation appears despite poor formation and medium values of current speeds.

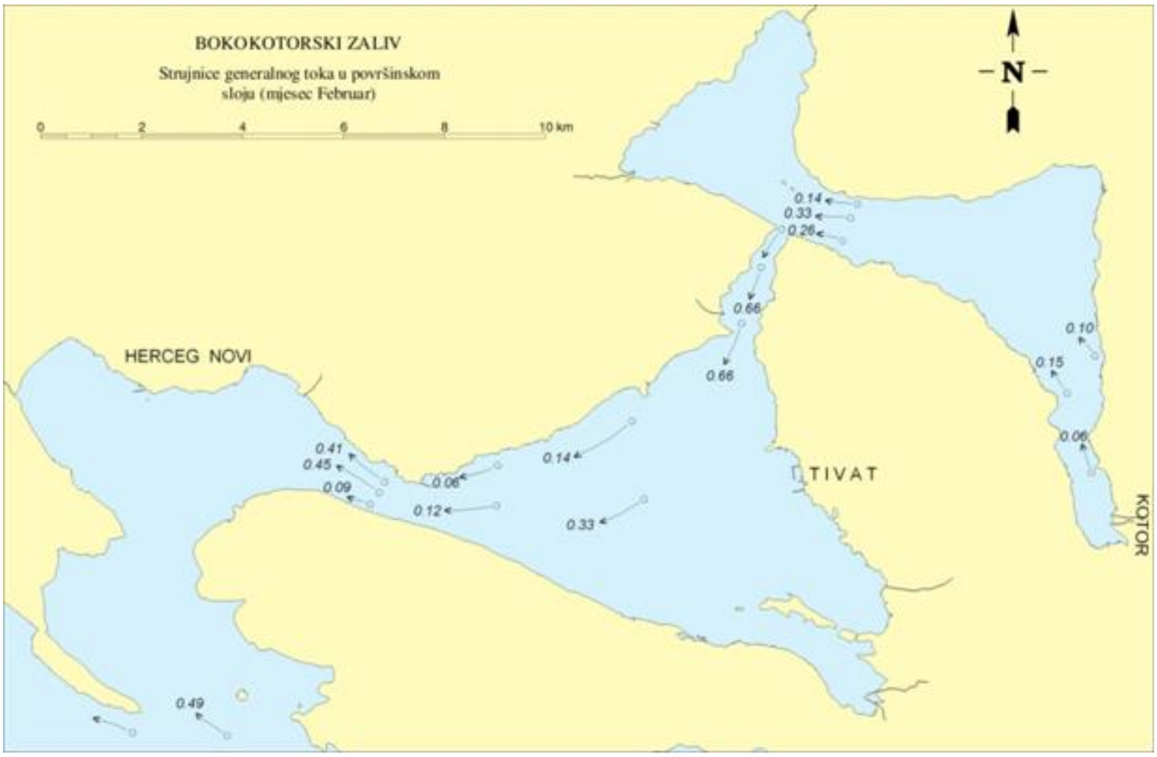


Figure 5.12 Currents of General Flow in the Surface Layer in February

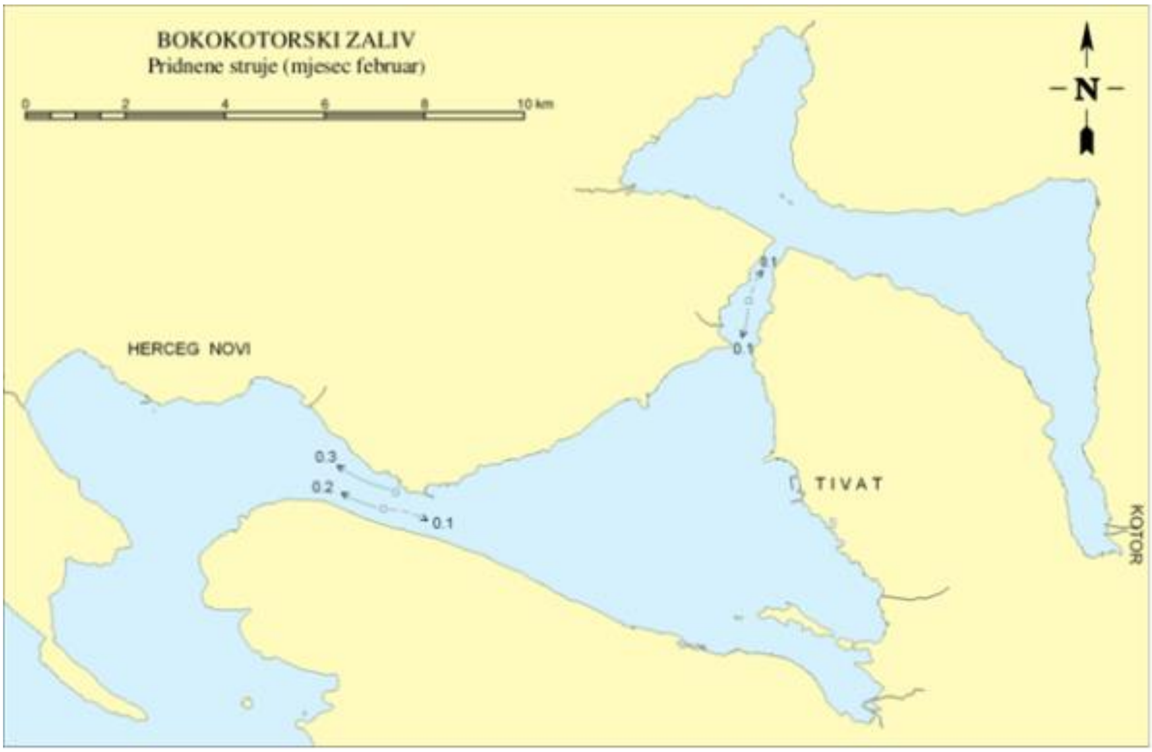


Figure 5.13 Currents of General Flow in the Bottom Layer Straits in February

The situation in Herceg Novi bay is different because of the stronger connection with the offshore through the passage Oštra Cape – Mirište Cape which is 2,794 meters wide.

Results of the dynamics of water masses in Herceg Novi Bay are derived based on the analysis of general currents flow in February and November, obtained based on individual monitoring according to depth on 35 stations; 24-hour monitoring series in February on southern entrance into the bay and two 24-hour monitoring series in July at the junction of Kobila Cape – Kabala Cape (these two 24-satna metering were conducted with the current meters hung on weather buoy with registrations at every 5 minutes).

General flow of water movement in Herceg Novi Bay, both in February and November, show great dependence on the impact from the offshore, especially impact of ebb and flow currents. While surface layer and 5-meter deep layer record intensive output current speed of 0.6 to 0.8 knots (31 to 41 cm/sec), bottom and depth layers mainly receive inlet-outlet currents speed of 0.3 to 0.6 knots (16 to 31 cm/sec).

Kumbor Strait connects Herceg Novi Bay and Tivat Bay. Current speed in Kumbor Strait ranges from 0.1 to 0.3 knots (5 to 16 cm/sec). Currents in Verige Strait (Figure 5.12 and Figure 5.13) have similar intensity, which results in low movement of water in Tivat Bay.

Inlet currents are more frequent in Kumbor Strait so east part of this strait is the boundary of mixing of waters from Herceg Novi and Tivat Bay.

On depths of 20 meters, there is circular flow of currents at speeds of 0.1 to 0.2 knots (5 to 10 cm/sec) which is reflective of periodical changes of inlet and outlet routs of currents in Kumbor Strait. At the bottom layer, there are inlet currents of mean speed of 0.1 knots (5 cm/sec).

Results of the analysis indicate that the exchange of water masses through Kumbor Strait is negligible. Namely, resulting values of currents, which are basis for calculation of net transportation, are minimal in all depts., and range between 0.01 to 0.05 knots (0.5 to 2.5 cm/sec). Mean values of sea currents which indicate cross transportation of water masses range from 0.1 to 0.3 knots (5 to 16 cm/sec). However, overall net daily transportation is minimal.

It can be concluded from geographical and oceanographic aspect that Boka Kotorska Bay is a closed pool with specific hydrographical and dynamic characteristics. Possible pollution in the offshore would have adverse impacts on Boka Kotorska Bay since this basin is connected with the offshore. This impact would be the highest in Herceg Nov Bay as it has direct connection with the offshore and significant water exchange with it.

Internal bays, Tivat and Kotor–Risan Bays would be far less exposed to that adverse impact because of the very limited exchange of water masses through Kumbor Strait and Verige Strait. In this case, limited exchange of water mass with the offshore can be an advantage as it can provide additional time for implementation of cleaning and protection measures in the bay against offshore pollution in case of accidents.

The degree of pollution would depend on the existing hydrological situation. In the period of massive rainfall, strong outlet surface currents would substantially reduce negative effects of offshore pollution (Figure 5.12) which would not be the case in dry summer seasons.

5.3.3.4 Surface Sea Currents

5.3.3.4.1 Data from Previous Monitoring and Studies

Preliminary maps of currents in the surface layer as well as vertical cross sections of flow through Adriatic for summer and winter are prepared based on monitoring data and previous studies.

One of the key properties of surface currents in the Adriatic is the exceptional seasonal rhythm. It is reflected in the fact that in the surface layer in summer, there is a tendency of water leaving the Adriatic and in winter there is a tendency of water entering the Adriatic (Zore – Armanda, 1966).

Preliminary map of sea currents for the surface layer for the Adriatic in winter (Figure 5.14) shows tendency of water entering the Adriatic. Larger water penetration in the surface and intermediary levels is compensated by its descending and exiting in the coastal layer.

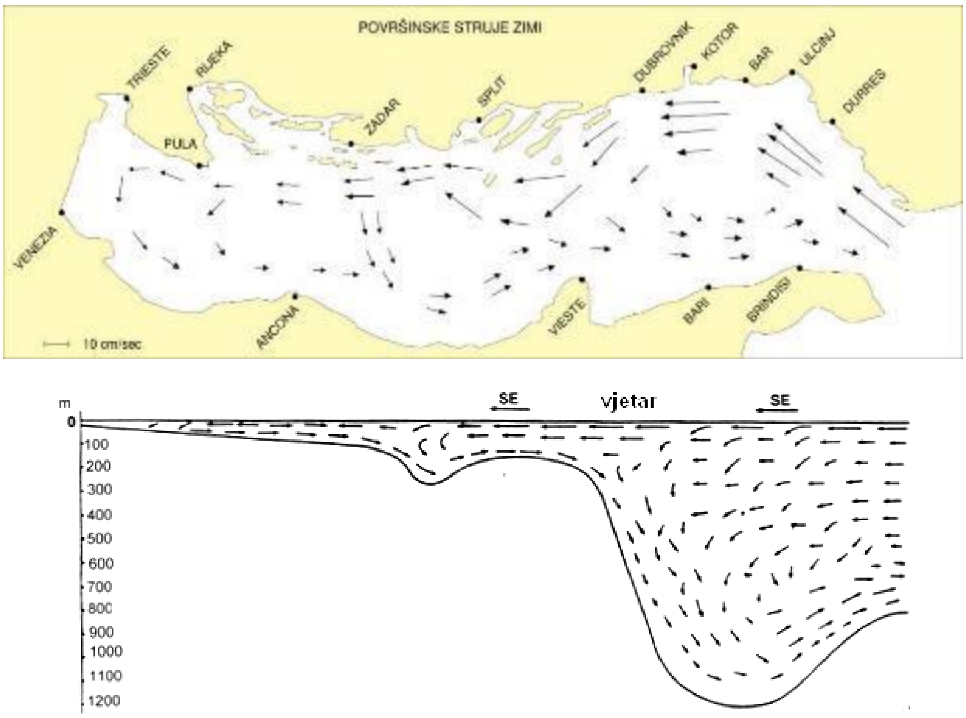


Figure 5.14 Preliminary Map of Sea Currents for the Surface Layer for the Adriatic Sea in Winter

Preliminary map of currents for the surface layer for the Adriatic Sea in summer (Figure 5.15) shows that exit currents are dominant. Water deficit in the surface layer is compensated with water entering in the intermediary layer and rising.

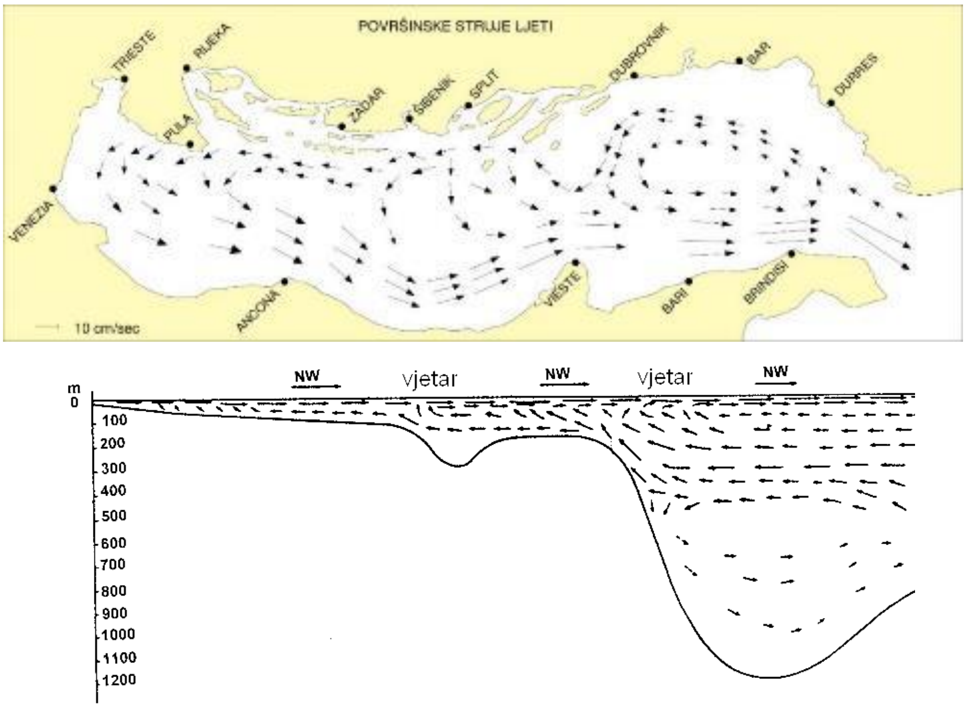


Figure 5.15 Preliminary Map of Sea Currents for the Surface Layer for the Adriatic Sea in Summer

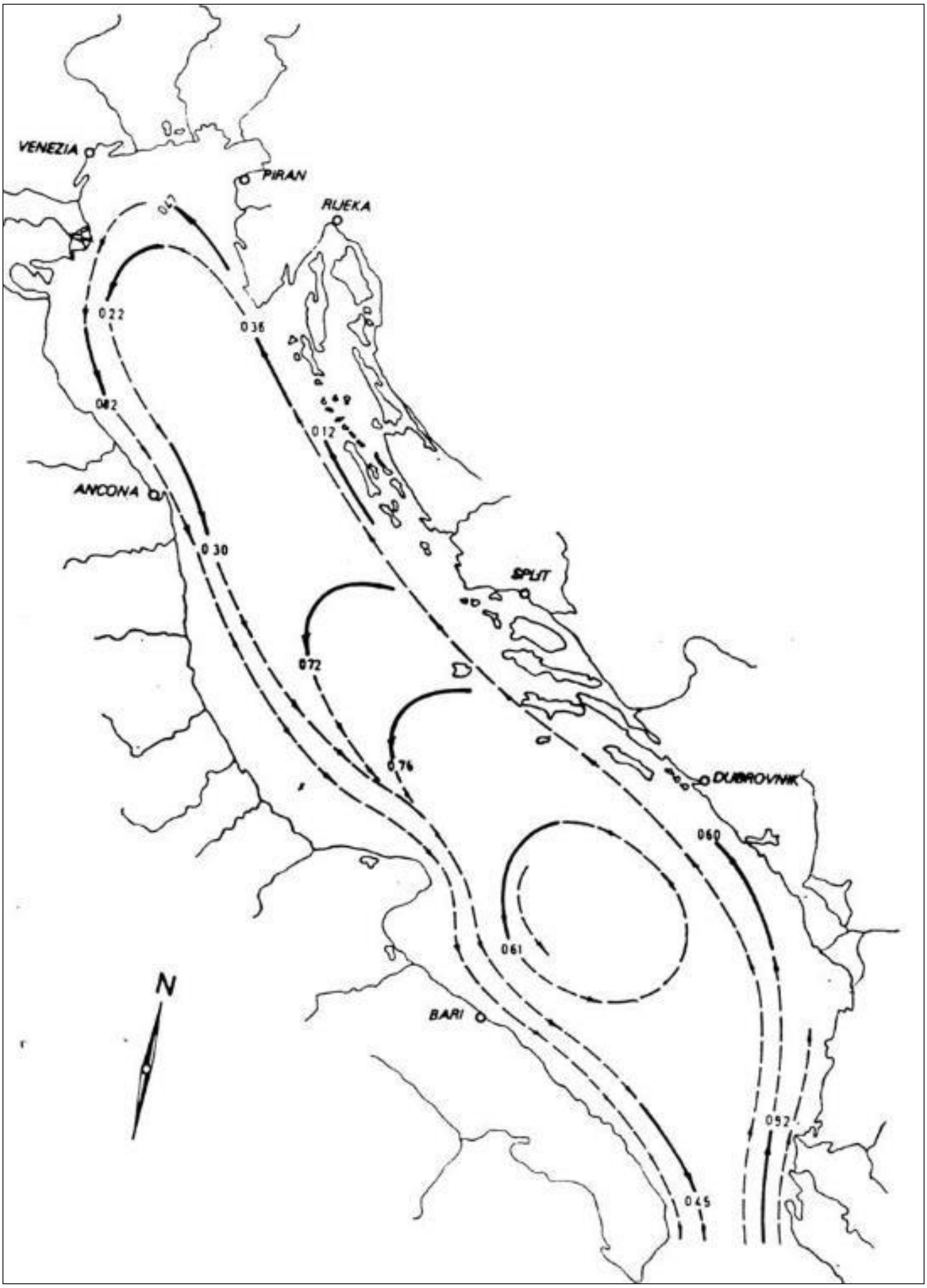


Figure 5.16 Schematic View of Surface Currents; September – October 1974 (mean values in knots)

5.3.3.4.2 Data from Surface Currents Investigations with Drift Cards

During trans-Adriatic oceanographic cruising of research boat HI YWN "Andrija Mohorovičić" in January 1980, surface sea currents were investigated using drift cards.

A total of 1153 cards were thrown on 46 positions. By the end of 1980, 124 cards were found which accounts for 11% of total thrown cards. In addition to the analysis of data about the place and time when the cards were thrown, meteorological conditions in January were also considered, i.e. directly measured data about the wind and state of the sea and data from synoptic situations.

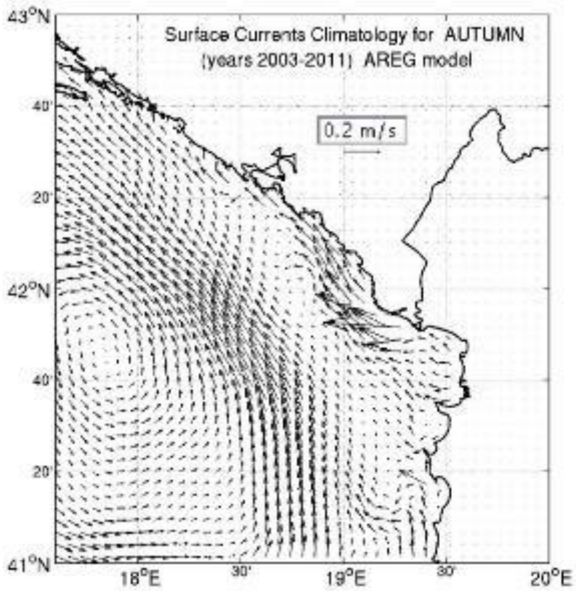
Based on the data obtained from investigations with drift cards it was concluded that there was a strong current of approximately NW direction along the eastern shore in the Adriatic and SE direction along the western shore which is a result of direct wind impact and de-levelling.

The speed of the current along the east shore was slightly above 1 knot as cards were found immediately after a couple of days. However, it can be assumed that the speeds were higher, due to the small number of found cards in the southern Adriatic it was not possible to make certain conclusions.

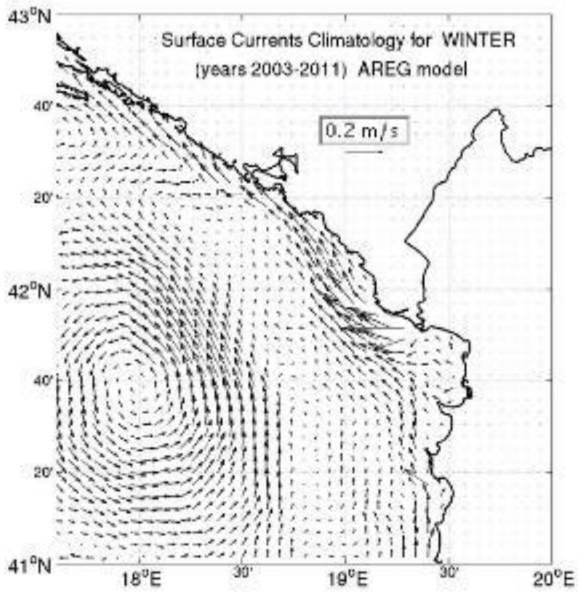
Based on the found cards, there are certain indications on transversal flow from middle part of the southern Adriatic towards the western shore.

5.3.3.5 <u>AREG Model for Surface and Bottom Currents</u>

Results of AREG[1] model of surface currents in the sea in front of Montenegrin shore are shown in Figure 5.17, while the model of bottom currents model is shown in Figure 5.18.



Autumn



Winter

[1] AREG model has horizontal resolution of 5 km

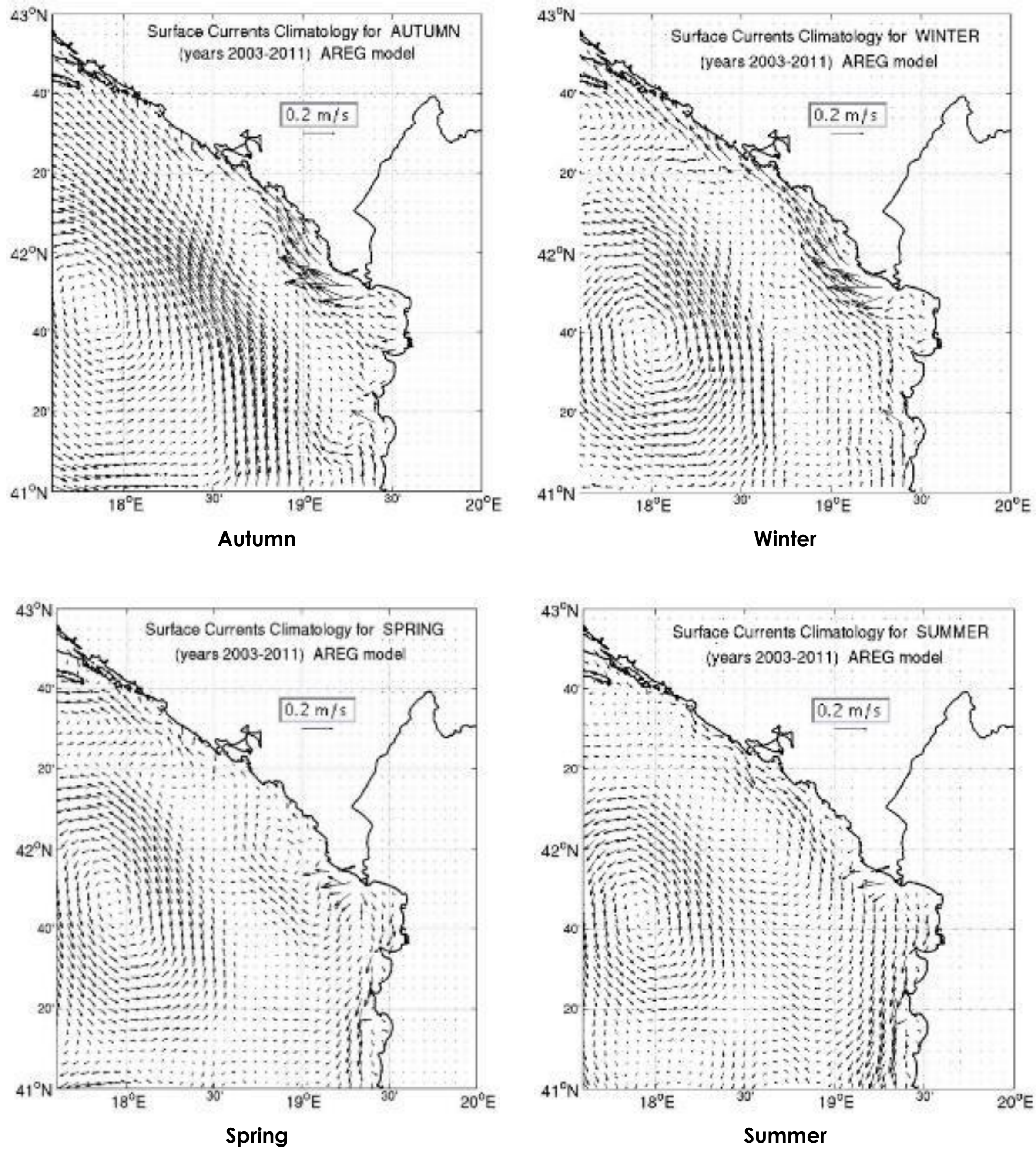
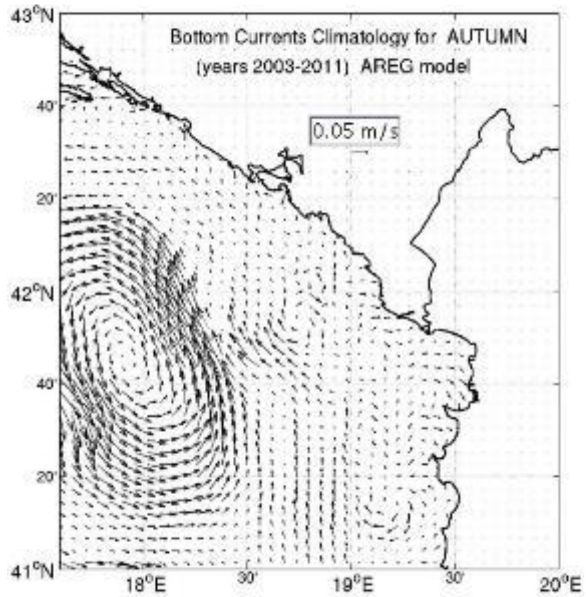
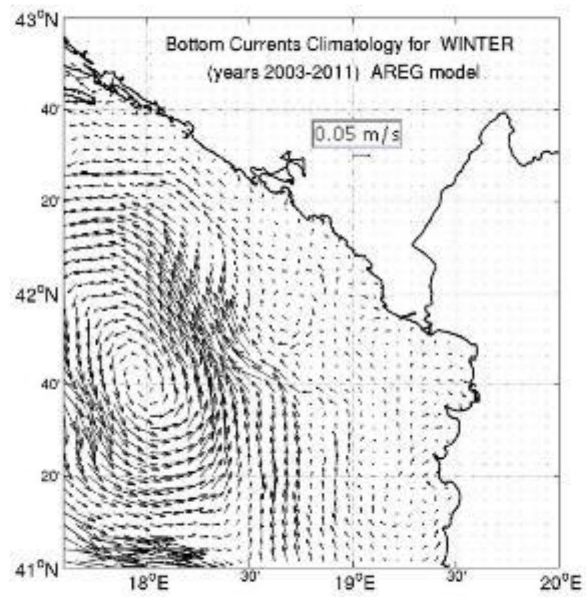


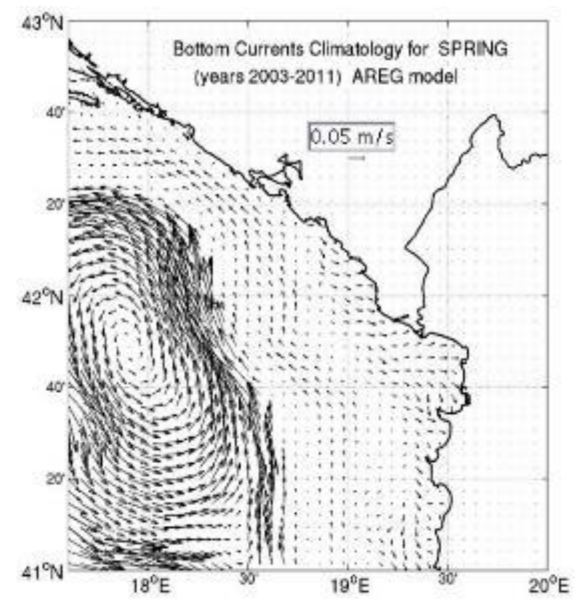
Figure 5.17 Surface Currents - AREG model



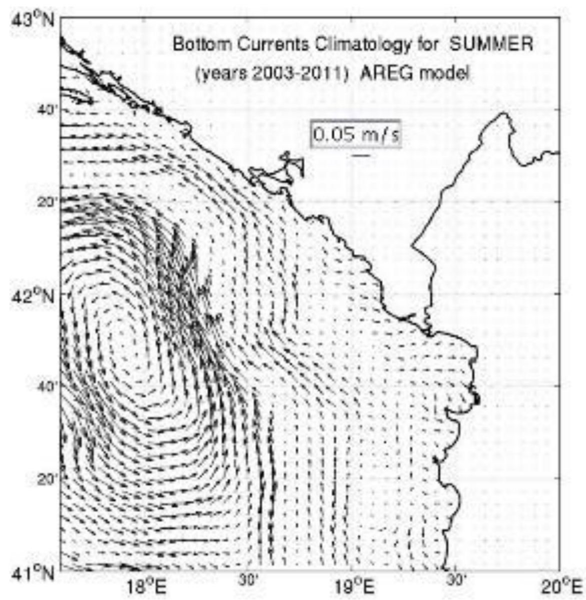
Autumn



Winter



Spring



Summer

Figure 5.18 Bottom Currents - AREG model

5.3.3.6 Summary of Characteristics of Sea Currents

Basic characteristic of the currents of area of southern Adriatic is entrance of currents in the winter period. Direction of the currents in the entire profile, from the surface to the bottom, is quite parallel along the shore, and transport of water masses goes from SE to NW. intensity of currents varies per months, climate type of the year and depth.

In summer months, movement of sea mass has diverse direction and stronger intensity, especially in the surface layer. Speed of the current reduces substantially with increase in depth, and general currents flow direction is E and SE. Unlike in winter, impact of sea tides is visible in summer.

In spring and autumn, presence of transversal currents with greater frequency of flow from the shore to the open sea is notable. Flow per layers differs in speed and direction.

5.3.4 Climate Change

According to the Initial National Communication on Climate Change of Montenegro to the United Nations Framework Convention on Climate Change (UNFCCC), 2010, climate change will have a strong influence on the coastal area due to changes in sea level and sea surface temperature.

For scenario A1B mean annual temperature changes of the Adriatic Sea for the period 2001-2030 range within the limits of 0.04°C to 0.08°C, while for the period 2071-2100 this change is about 1.7 °C. For the "pessimistic" scenario A2 and the period 2071-2100, the change in sea surface temperature is about 2.4°C.

For the period 2071-2100 and the A2 scenario, the upper limit of increase in sea level in the basin of the Mediterranean Sea, including the Adriatic-Ionian basin, is +35 cm, out of which +13 cm as a result of thermal expansion, +18 cm of melting glaciers and permafrost, -2 cm of changes in atmospheric pressure fields over the Mediterranean and +6 cm of changes in circulation in the very basin.

The effect of climate change in the coastal area can be reflected through the following changes (among others):

- Disruption of natural balance;
- Reducing beach area and even disappearance of some beaches;
- The flow of the river systems that empty into the sea will be distracted so much that the space around the rivers will be flooded and destroyed, and practically lost, especially where the coast is low, as Velika Plaža (The great Beach);
- The River Bojana flow will be stopped much before its current end, which means that this whole part of the area, which is now practically even with the surface of the river Bojana will be flooded;
- Tidal waves of cyclonic depression will destroy the structures whose foundations are practically in water, which are currently pounded by even the smallest waves on daily basis. The safety of infrastructure, ports, water breaks, marinas, shipyards, etc. will be endangered, and in particular their normal functioning.
- The walls built at the end of the beaches or immediately by the coast will be destroyed and these areas, so that the water will reach the highest points and distances that have never been reached before , and strong erosive processes will be generated in those zones;
- The sea water - waves will put a strong pressure on the water sources adjacent to the coast, which are used for water supply, so that a large number of sources will be out of use because those will have salt water;
- Possible degradation of plant and animal life in the sea, significant damage to coral reefs, some migration as a result of increasing temperature and temperature amplitudes; and
- Due to a sudden large volume of rainfall in the mountainous hinterland, an enormous influx of fresh water into the waters of the Boka Kotorska Bay is expected to occur, and all that water, as surface runoff or through underground channels will reach the sea and take up the surface layer of water. Due to the presence of fresh water in the winter months when temperatures are below zero, there will be a regular occurrence of frost-icing of the sea, which will have some unforeseeable consequences for this resource.

These impacts will generate strong social and economic consequences. In the first place, the economic and tourism potential of the coast will be reduced, while an investment risk will be increased. Economic activities, such as maritime transport, fisheries, agriculture etc. will constantly be under "stress." Due to climate change-anomaly in some years these coastal resources will be fully compromised. There are almost no distinctive mechanisms of self-defense and self-adaptation.

The adaptation measures proposed in the Initial Communication Report primarily include:

- Developing high quality and very operational services for monitoring the condition of the shore and waves, as the biggest potential danger, and early warning of the existence of danger, several days in advance;
- Amendments to the applicable legislation in the field of spatial planning in order to include the problem of climate change in coastal during the preparation of spatial planning documentation, so as to prohibit the construction and urbanization of the areas that will be exposed to potentially dangerous tidal waves as a result of the new situation;
- The existing infrastructure facilities should be resized to stand the load of new extreme climatic parameters and waves. This means that the existing buildings should be further strengthened and a maximally adapted to new climatic parameters and the new state of the sea level;
- Provide for maximum possible protection of water sources from the penetration of sea water. If possible, specific reservoirs should be moved to higher elevations, where only a few meters more would be enough to keep the situation completely under control;
- Some buildings should be demolished and the inhabitants relocated, thus allowing for an unimpeded propagation of strong tidal waves, with no consequences for the environment and the people; and
- Some parts of the coast, will be completely flooded several times a year, and no life or existence will be possible to be established there. According to the present situation regarding the level of population and urbanization, it is expected that between 10% and 20% of the urbanized coast will be relocated, as a measure of adaptation.

It is to be noted the abovementioned changes in sea level are expected for the period 2071-2100 for the A2 scenario, these changes will be of less significance during the Programme life cycle, but they still have to be considered by the Operators to ensure the integrity of structures located in the sea and in the coastal area.

5.4 ENVIRONMENTAL QUALITY

5.4.1 Air Quality and GHG Emissions

5.4.1.1 Air quality

Protecting air quality in Montenegro has been current since the early 80s of the twentieth century. Since then, the legal framework and concerns about air quality have constantly improved, which allowed the use of identified solutions in practice. The Environmental Protection Agency, which was established in 2009, in accordance with their competences, assumed the responsibility for the implementation of the legislation in this area.

Air quality is monitored in Montenegro with eight (8) stations. Pollutants to be measured at each station are defined by local Regulations as presented in Table 5.5. Reporting of air quality in Montenegro is conducted in compliance with EU requirements.

Table 5.5 Air Quality Measurement Locations and Monitored Parameters

Measuring Point	Zone	Type of Measuring Point	Pollutants measured in order to protect human health	Pollutants measured in order to protect vegetation
Tivat	Maintenance Zone	UB [1]	NO_2, PM_{10}, $PM_{2.5}$,	
Žabljak	Maintenance Zone	RB [2]	O_3 EMEP[5]	
Bar	Southern Zone	UB	NO_2, SO_2, PM_{10}, $PM_{2.5}$, cadmium, arsenic, nickel, benzo (a) pyrene, O_3, CO, benzene	
Pljevlja	Northern Zone	UB	NO_2, SO_2, PM_{10}, $PM_{2.5}$, cadmium, arsenic, nickel, benzo (a) pyrene	
Gradina	Northern Zone	SB [3]	O_3	NOx, SO_2, volatile organic compounds
Golubovci	Southern Zone	SB	O_3	NOx, SO_2, volatile organic compounds
Nikšic	Southern Zone	U	NO_2, SO_2, PM_{10}, $PM_{2.5}$, cadmium, arsenic, nickel, benzo (a) pyrene, O_3, CO, benzene	
Podgorica	Southern Zone	UT [4]	NO_2, PM_{10}, CO, benzene and benzo (a) pyrene, lead	

[1] UB(urban background) Measuring point for measuring pollution in urban area

[2] RB(rural background) Measuring point for measuring pollution in rural area

[3] SB (suburban background) Measuring point for measuring pollution in suburban area.

[4] UT(urban traffic) Measuring point for measuring pollution coming from traffic in urban area

[5] EMEP Cooperation program for monitoring and evaluation of cross-border transmission of air pollutants over long distances in Europe.

Air quality is affected the most by industrial activity and emissions resulting from the combustion of fuels in large and small furnaces, and internal combustion engines. In addition to emissions, concentrations of air pollutants depend on the geographic and climatic characteristics. This is mostly reflected on the concentration of PM particles, which is the biggest problem for the air quality in Montenegro (Figure 5.19). High concentrations and a large number of exceeded permitted daily mean concentrations were most pronounced during the heating season, mainly due to the use of solid fuels (coal and wood). The air quality assessed in terms of the concentration of SO_2, NO_2 and O_3 is within the prescribed threshold limit value, with no major concentration variations on an annual basis.

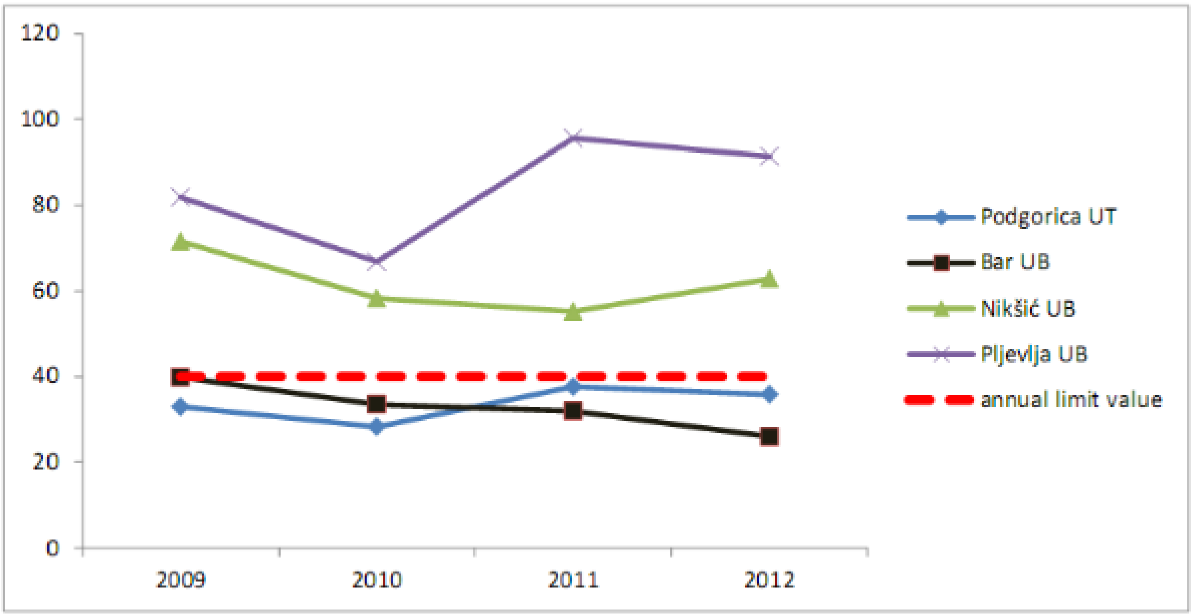


Figure 5.19 Mean Annual Concentrations of PM_{10} (ug/m^3) at traffic and urban background locations

5.4.1.1.1 Monitoring Indicators for Air Quality

Indicators selected to monitor the change in air quality from the programme, and which are included in the national list of environmental indicators, are:

1. Emission of acidifying gases (VA02[1]):

   Key sources of emissions of acidifying gases are the sectors of energy, transport and agriculture. During the period of sanctions, from 1990 to 1995, there was a significant drop in emissions of acidifying gases, primarily of SOx and NOx, due to the overall reduction in economic activity, and primarily a drop in energy production and intensity of transport. After 1995, SOx and NOx emissions showed a steady upward trend which was stabilized for NOx in 2009, around the base value of 1990, while the SOx emissions trend was unstable, probably as a result of changes in the energy sector, which was particularly pronounced in 2009 where a decline was observed in SOx emissions by almost 50% compared to 2008. With intensifying energy production in 2010, the emission levels suddenly increased. In the same reporting period, due to a drop in agricultural production, emissions of NH_3 showed a stable trend of constant slight decline, and in 2010 those amounted to only about 50% of the emissions in 1990.

[1] Indicator-based State of the Environment Report of Montenegro, 2013.

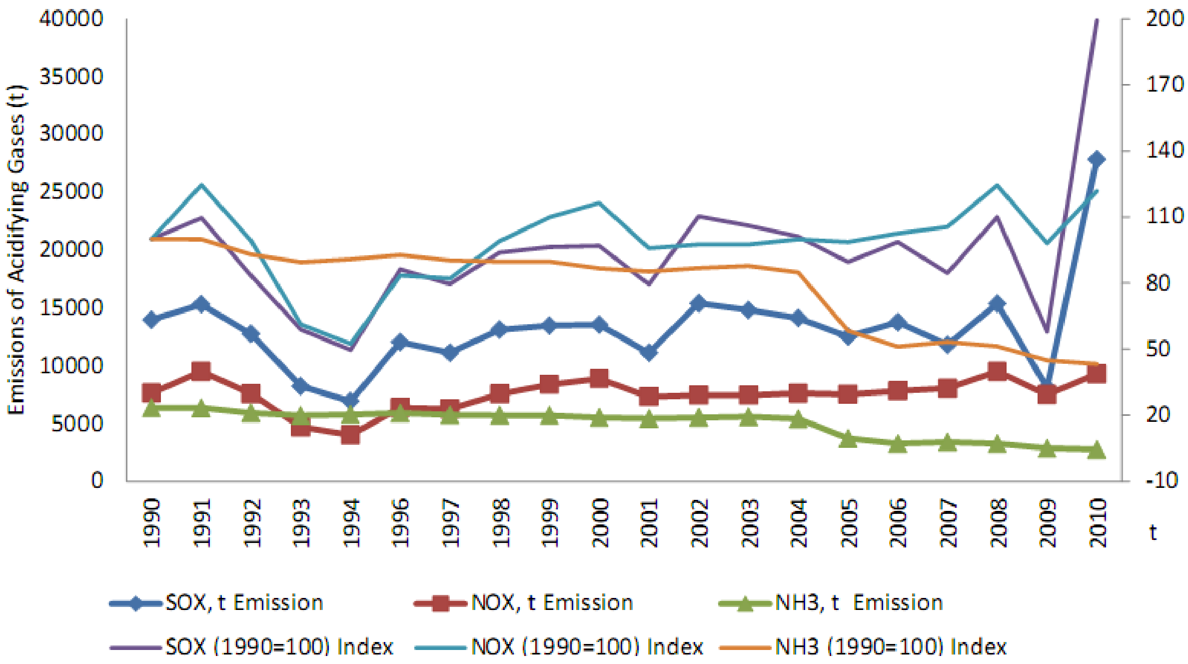


Figure 5.20 Emissions and indices of emissions of acidifying gases, 1990-2010.

2. Emission of ozone precursors (VA03[1]):

The key sources of ozone precursor emissions are the sectors of energy, transport, public services, institutions and households, as well as forest fires. During the period from 1990 to 2010, the trend of precursor emissions of NOx, NMVOC and CH_4 recorded sporadic fluctuations while CO emissions varied greatly during the reporting period. Marked changes in CO emissions are related to the level of industrial production, energy production, the intensity of road traffic, and especially the number of fires which were the most numerous during the summer months of 2007. In comparison to 2009, in 2010 a discrete increase of CH_4 and NMVOC was recorded, and a noticeable increase in the level of NOx emissions due to the intensified energy production and reduced level of CO emissions due to a drop in industrial production.

[1] Indicator-based State of the Environment Report of Montenegro, 2013.

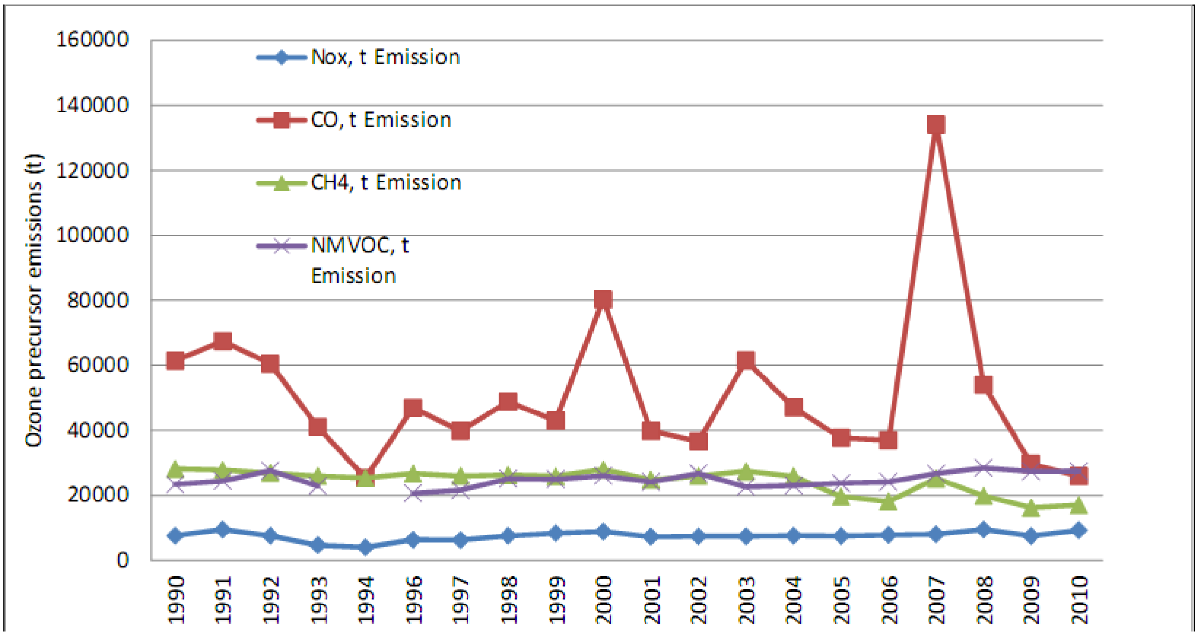


Figure 5.21 Ozone Precursors Emission, 1990-2010

3. Emission of primary suspended particles and precursors of secondary suspended particles (VA04[1]):

The key sources of emissions of primary suspended particles of dust particles smaller than10 m (PM_{10}) and powdery substances smaller than 2.5 μm ($PM_{2.5}$) are production processes, public services, institutions and households, energy production and agriculture.

In 2010, 42% of the total emissions of PM_{10} came from the production process, 27% from the sector of public services, institutions and households, 15% from agriculture and 12% from the sector of energy production. The sector of public services, institutions and households had the largest share in the emission of $PM_{2.5}$ amounting to 50%, while the production processes emitted about 30% of $PM_{2,5}$.

Between 1990 and 1994, there was a decrease in emissions of PM_{10} and $PM_{2.5}$ due to reduced industrial and energy production. After this period, there was mostly an upward trend in emissions of these pollutants with sporadic drops. A significant increase in emissions of powder materials due to large-scale forest fires was recorded during summer in 2007.

[1] Indicator-based State of the Environment Report of Montenegro, 2013.

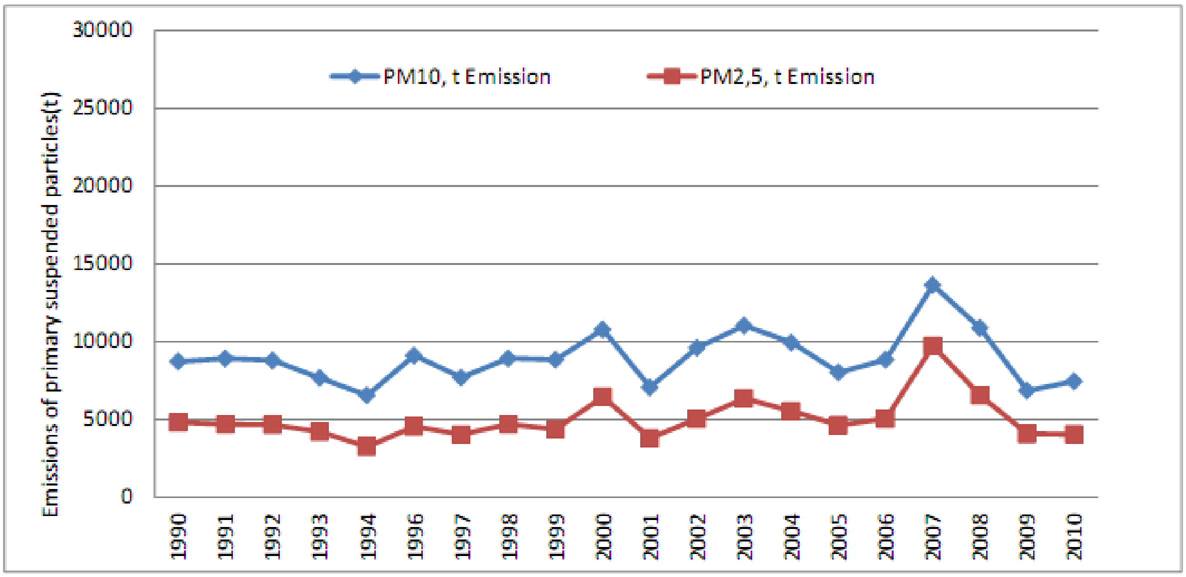


Figure 5.22 Emission of primary suspended particles, 1990-2010.

5.4.1.2 GHG Emissions

Montenegro is among the so-called Non-Annex 1 Parties of The United Nations Framework Convention on Climate Change, under this Convention Montenegro belong to the group of countries, which are developing countries with no obligation of quantified reduction of emissions of greenhouse gases. But, the country is required to periodically prepare GHG inventories as a part of its National Report/ Communication to the UNFCCC and must report on the steps it is taking or envisage undertaking to implement the Convention. Besides, Non-Annex I Parties, consistent with their capabilities and the level of support provided for reporting, should submit their first biennial update report by December 2014.

Direct greenhouse gas emissions, covered by the Kyoto Protocol (CO_2, N_2O, CH_4, etc.) are gaseous constituents of the atmosphere that absorb and retransmit the infrared radiation and get into the atmosphere naturally or as a result of human activities.

Based on the initial national communication report of Montenegro the energy sector had the highest share in total GHG emissions in 2003 equals to 49.9%, the share of Industrial Processes was 35.5%, Agriculture accounted for12.3% and Waste accounted for 2.3%.

An overview of GHG CO2eq emissions is shown by energy sub-sectors in Table 5.6.

Table 5.6 GHG Emissions with Percentage Shares in Total Emissions by Energy Sub-Sectors

Energy Sub-Sector	Baseline Year 1990		Year 2003	
	Emissions in CO2eq (Gg)	Share in Total Emissions (%)	Emissions in CO2eq (Gg)	Share in Total Emissions (%)
Energy Conversion	1,356.07	52.8	1669.96	62.9
Industrial Production and Construction Industry	612.42	24.4	427.87	16.2
Transport	380.92	15.2	406.86	15.3

Services	101.87	4.1	86.25	3.2
Households	57.73	2.2	46.04	1.7
Agriculture /fishing industry/ forestry	31.27	1.3	19.62	0.7
TOTAL	2,540.28	100.0	2,656.60	1000

Ref: http://www.unfccc.me/

The sub-sector of transport contributes to the anthropogenic emissions primarily through fuel consumption in road transport (90% of energy consumption in the transport sector,), while the total contribution of this sub-sector to the total emissions from energy sector amounts to 15.3%.

5.4.1.2.1 Monitoring Indicators for GHGs

Indicators selected to monitor the change in GHG emissions due to the programme are:

1. CO_2 emissions from E&P activities: After the implementation of the Programme GHG emissions from oil and gas activities shall be quantified and monitored.
2. Trends in greenhouse gas emissions (KP04[1])

GHG emissions in Montenegro are monitored by the EPA based on emissions of certain pollutants and especially those that cause climate change at the global level. This monitoring is based on emissions data from major sources classified by major emitting sectors (IPCC nomenclature) with 1990 as the baseline year, namely: energy (supply and use of energy), transport, industrial (process not including emissions from the fossil fuels combustion process for energy use), agriculture, waste and other (non-energy sectors). In the reporting period, as a clear consequence of the crisis in early 90s of the last century, emissions were reduced by over 50% over a 5 year period. However, already in 1998 the GHG emissions reached those from the baseline year of 1990. In the period 1998-2008, there was an evident growing trend, as a result of energy consumption in virtually all sectors other than the industry. The last year observed recorded, as a result of the global economic crisis, a new decline in industrial production and consumption of energy which caused the decrease of greenhouse gas emissions to a level lower by 22% than that for the baseline year. GHG emissions in 2010 were, equivalent to 0.01% of global emissions.

[1] Indicator-based State of the Environment Report of Montenegro, 2013.

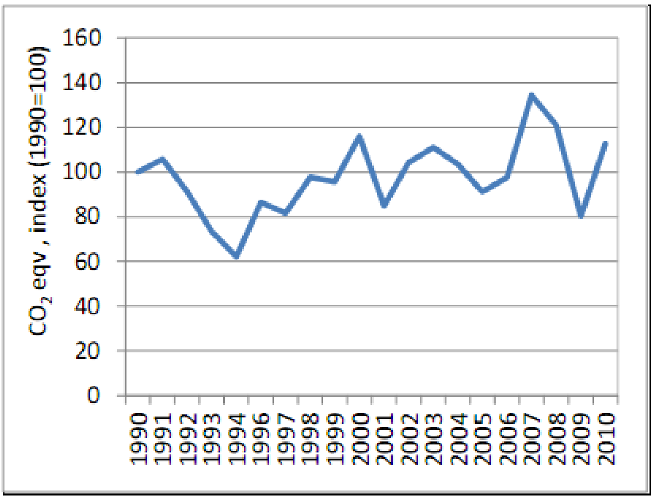


Figure 5.23 Greenhouse Gas Emissions Index (1990-2010)

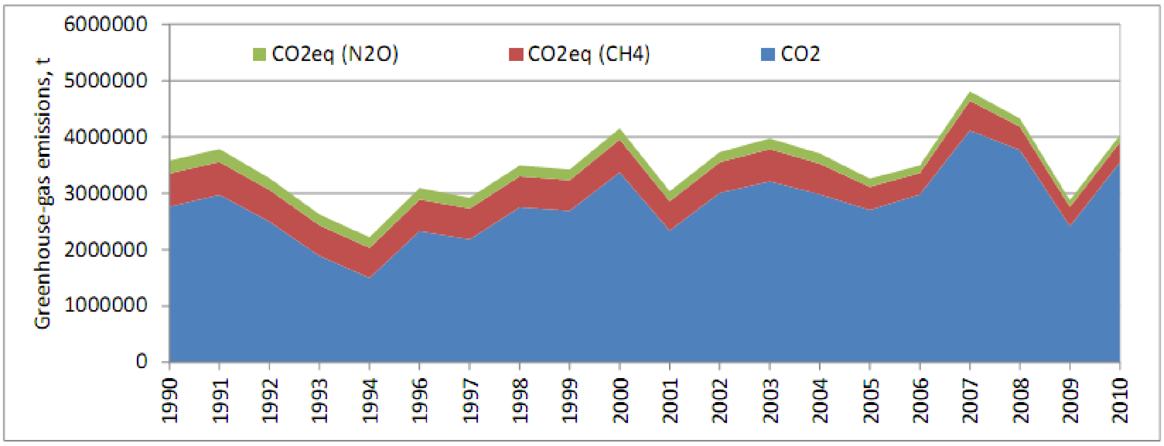


Figure 5.24 Greenhouse Gas Emissions (1990-2010)

5.4.2 Sea Water Quality

5.4.2.1 <u>Temperature, Salinity and Sea Density</u>

5.4.2.1.1 Introduction

Temperatures of sea water of the Adriatic Sea fall behind relevant values of air temperatures for about a month. Lowest temperatures are recorded in February, and highest in August.

Along the east shore, annual variations of surface water range between 14 – 18°C, and in the open sea the average is around 12°C. Daily variations of surface temperature are the highest in the summer and in average amount to 1.5°C. They are slightly higher along the shore and in shallow waters and lower in deep waters.

Density is usually expressed with specific weight. It is regarded that a liter of sea water of 35‰ salinity at the temperature of 17.5 °C has the weight of 1027 grams, while the weight of distilled water at temperature of 4 °C and pressure 0 atmospheres weighs exactly 1000 grams. If temperature is considered as a constant value (17.5 °C) density depends mainly on salinity. The analysis used sigma-t density, determined as follows:

sigma-t = $(\rho-1)x10^3$

Isopycnic course (lines connecting points of the same density) is similar to isohaline course (lines connecting points of the same salinity).

5.4.2.1.2 Methodology of Monitoring and Data Processing

Data were gathered over a long period of time of sea water monitoring and sampling. Temperature was measured with reversing thermometer by Richter & Wiese with accuracy of 0.02 °C, with portable multiprobes type ME-44 and 54 (Meerestechnik electronic GMBTT), SBE probes (Sea Bird Electronic) with accuracy of temperature parameters of 0.004 °C, conductivity 0.003 mS/cm and depth 0.02%.

For the purpose of determining salinity, sea water samples were taken with Nansen and Niskin bottles and analysis was performed using induced laboratory salinity meter type Autolab MK V, precision 0.02‰.

Based on the data on temperature and salinity, density was calculated using standard oceanographic tables (Tables for rapid computation of density and conductivity of sea water).

SBE probes are fitted with temperature, conductivity and pressure sensors. Salinity was calculated directly (from data for salinity), and depth was calculated from data for pressure.

5.4.2.1.3 Temperature, Salinity and Sea Density in the Coastal Sea of Montenegro

In the area of southern Adriatic, seasonal sweetening of surface water happens quite frequently. The highest is spring sweetening and the smallest is autumn. Winter and summer water sweetening is moderate. Fresh water comes from Bojana River and northern Albanian rivers.

At depth of 20 m to the bottom, halinic values in salinity column are even and are mutually approximate.

Summer surface pycnocline[1] is strong and includes the layer up to 30 m depth. A jump in surface increase in density, due to surface sweetening, appears at winter time. Spring pycnocline has moderate gradient.

In the layer below 50 m, seasonal values of density of sea water slightly vary. Autumn is exception because density is slightly lower because of higher autumn temperature in water column.

Data from 1948 on changed minimum extreme halinic value of 3.62‰ is disputable although possible because monitoring was conducted at spring time and closer to Bojana River mouth.

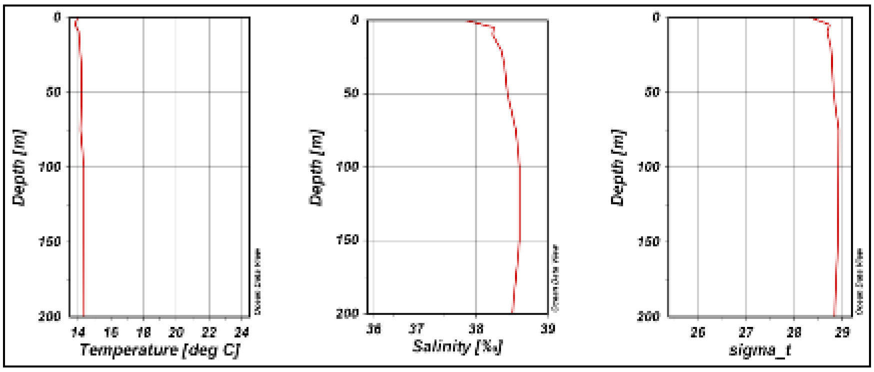
Table 5.7 and Figure 5.25 are prepared based data for the area of coastal sea of Montenegro (temperature 780, salinity 765 and sigma-t 765).

[1] A pycnocline is the layer where the density gradient is greatest within a body of water.

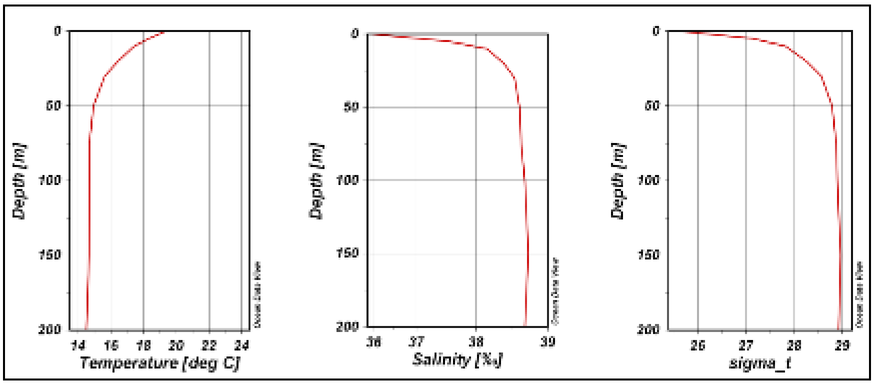
Table 5.7 Average and Extreme Values of Temperature, Salinity and Water Density in the Coastal Sea of Montenegro

Season	Depth (m)	Temp (ºC)	Mean Temp	Extreme Temp	S (‰)	Mean Salinity	Extreme Salinity	Sigma T	Mean sigma
WINTER	0	13.98	14.28	Minimum 11.57 at 10 m 18/03/ 1973	37.83	38.52	Minimum 3.62 at 0 m 28/05/ 1948	28.33	28.86
	5	13.83			38.26			28.74	
	10	14.07			38.24			28.69	
	20	14.14			38.36			28.77	
	30	14.20			38.41			28.79	
	50	14.24			38.45			28.82	
	75	14.16			38.57			28.93	
	100	14.36			38.62			28.92	
	150	14.37			38.62			28.91	
	200	14.39			38.52			28.84	
SPRING	0	19.40	15.12		35.91	38.58		25.59	28.72
	5	18.36			37.57			27.14	
	10	17.44			38.16			27.83	
	20	16.45			38.40			28.26	
	30	15.64			38.55			28.57	
	50	14.95			38.62			28.79	
	75	14.71			38.64			28.88	
	100	14.71			38.69			28.90	
	150	14.69			38.74			28.97	
	200	14.52		Maximum 27.06 At 0 m 10/07/ 1968	38.69		Maximum 39.02 at 0 m 13/07/ 1967	28.93	
SUMMER	0	24.29	15.81		37.8	38.72		25.68	28.65
	5	23.27			38.25			26.33	
	10	22.08			38.44			26.81	
	20	18.93			38.60			27.86	
	30	16.95			38.66			28.35	
	50	15.40			38.70			28.75	
	75	14.91			38.74			28.89	
	100	14.78			38.78			28.96	
	150	14.68			38.83			29.00	
	200	14.72			38.79			28.97	
AUTUMN	0	18.37	16.17		38.41	38.67		27.79	28.52
	5	18.33			38.36			27.76	
	10	18.39			38.65			27.74	
	20	18.45			38.53			27.86	

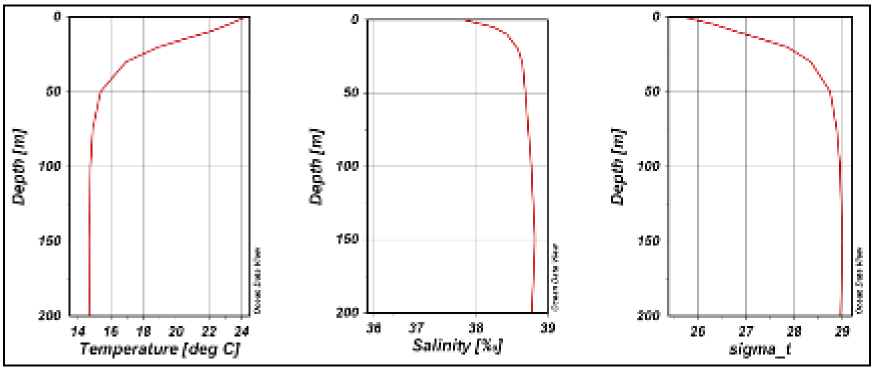
Season	Depth (m)	Temp (ºC)	Mean Temp	Extreme Temp	S (‰)	Mean Salinity	Extreme Salinity	Sigma T	Mean sigma
	30	18.23			38.56			27.95	
	50	18.27			38.64			28.25	
	75	16.09			38.64			28.54	
	100	15.59			38.69			28.69	
	150	15.01			38.74			28.07	
	200	14.95			38.79			28.92	
Mean annual value			**15.35**			**38.62**			**28.54**



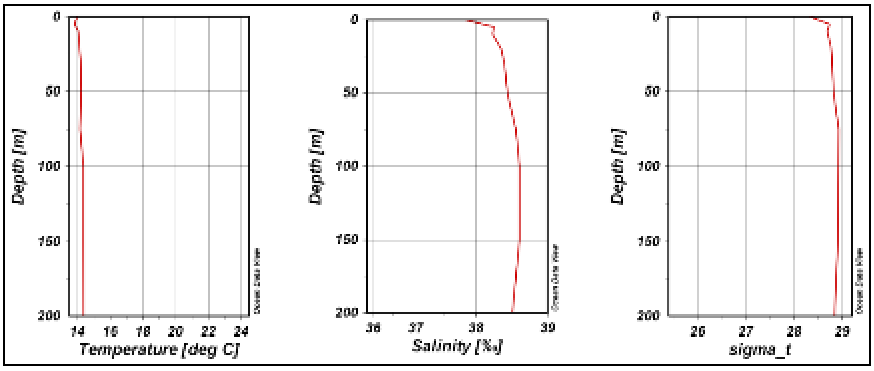
Winter



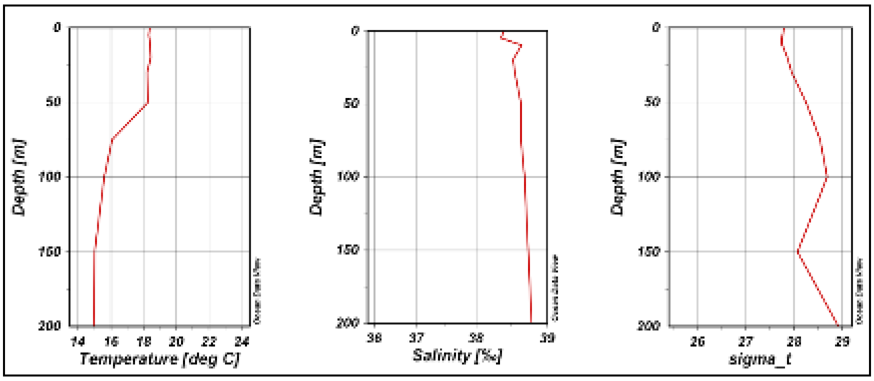
Spring



Summer

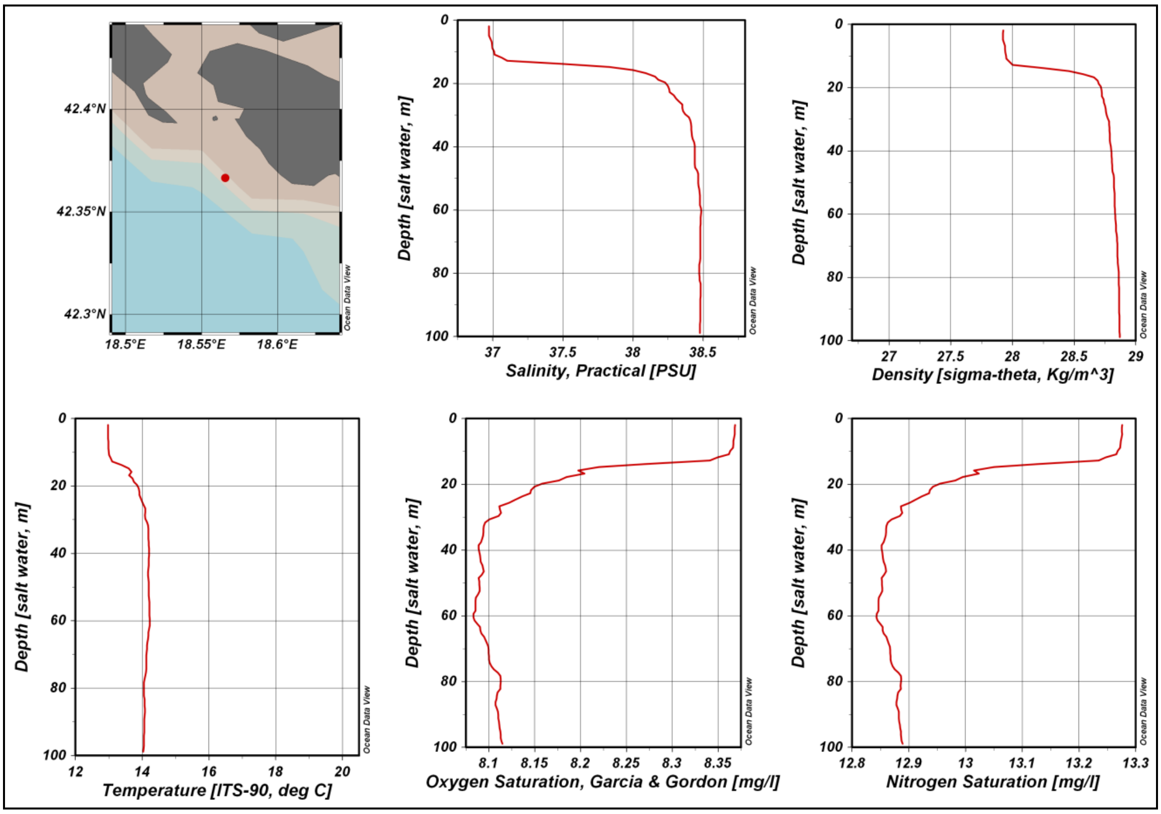


Winter

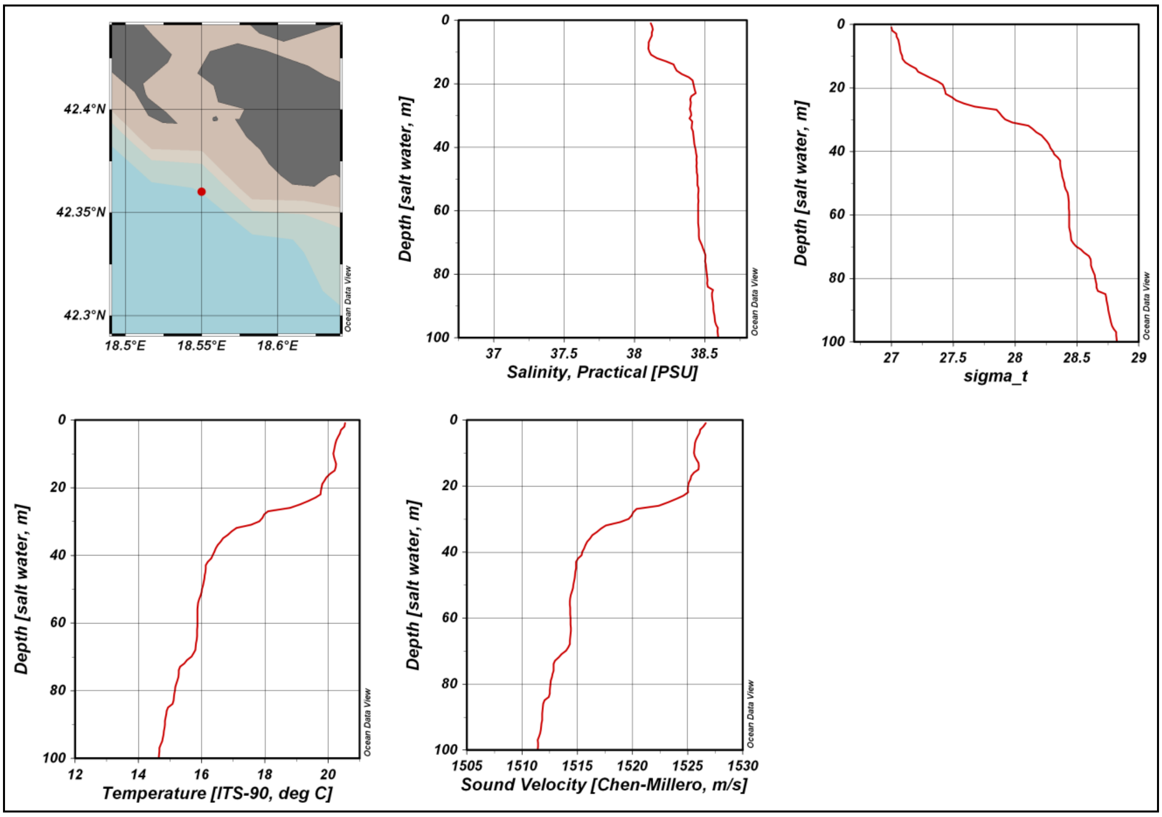


Autumn

Figure 5.25 Profiles of Mean Temperature, Salinity and Water Density Values Offshore Montenegro

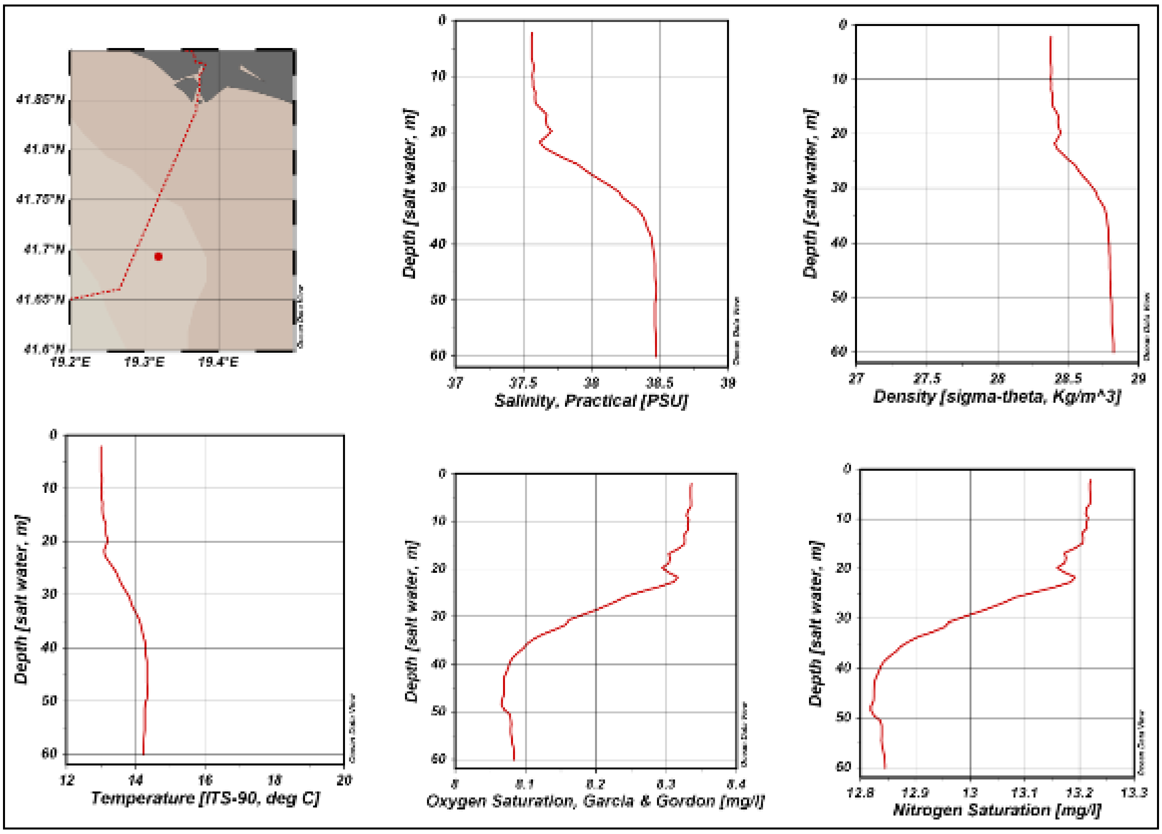


08 March 2010

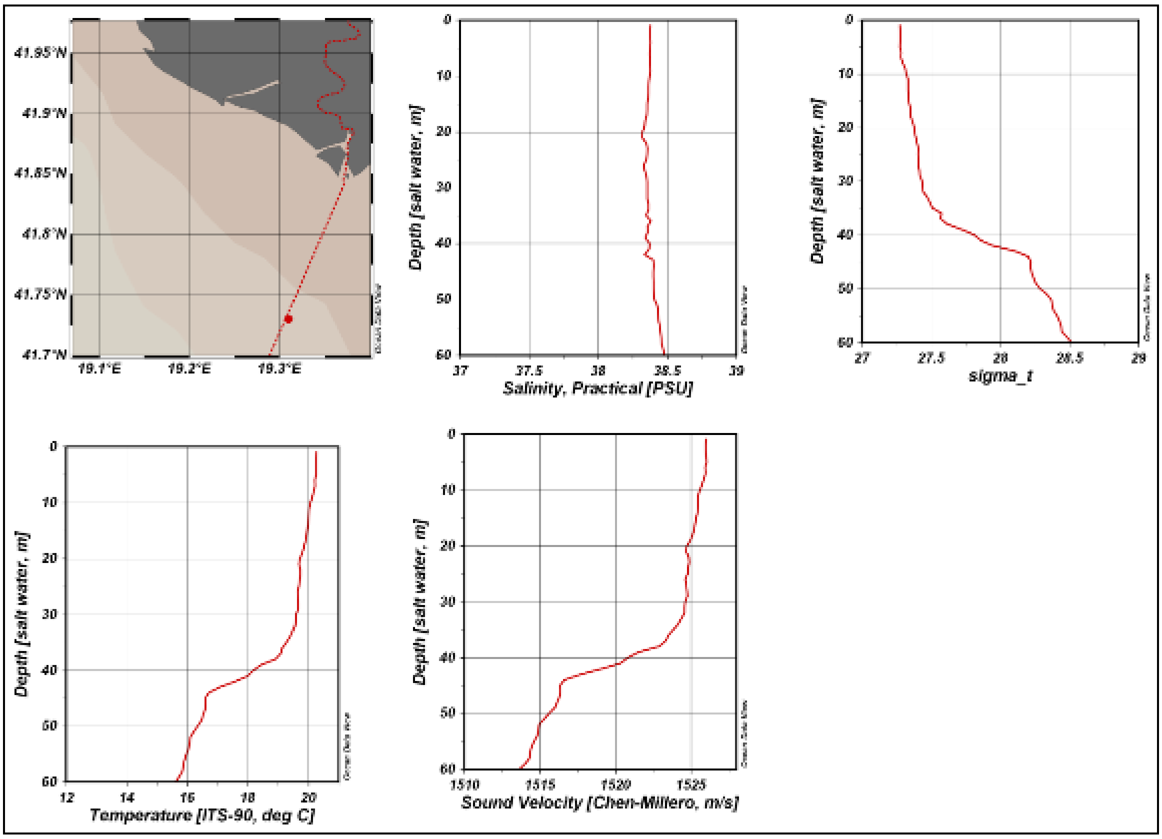


02 October 2007

Figure 5.26 Thermo-Halinic Properties of Sea Water in the Area in Front of Boka Kotorska Bay in Mar and Oct

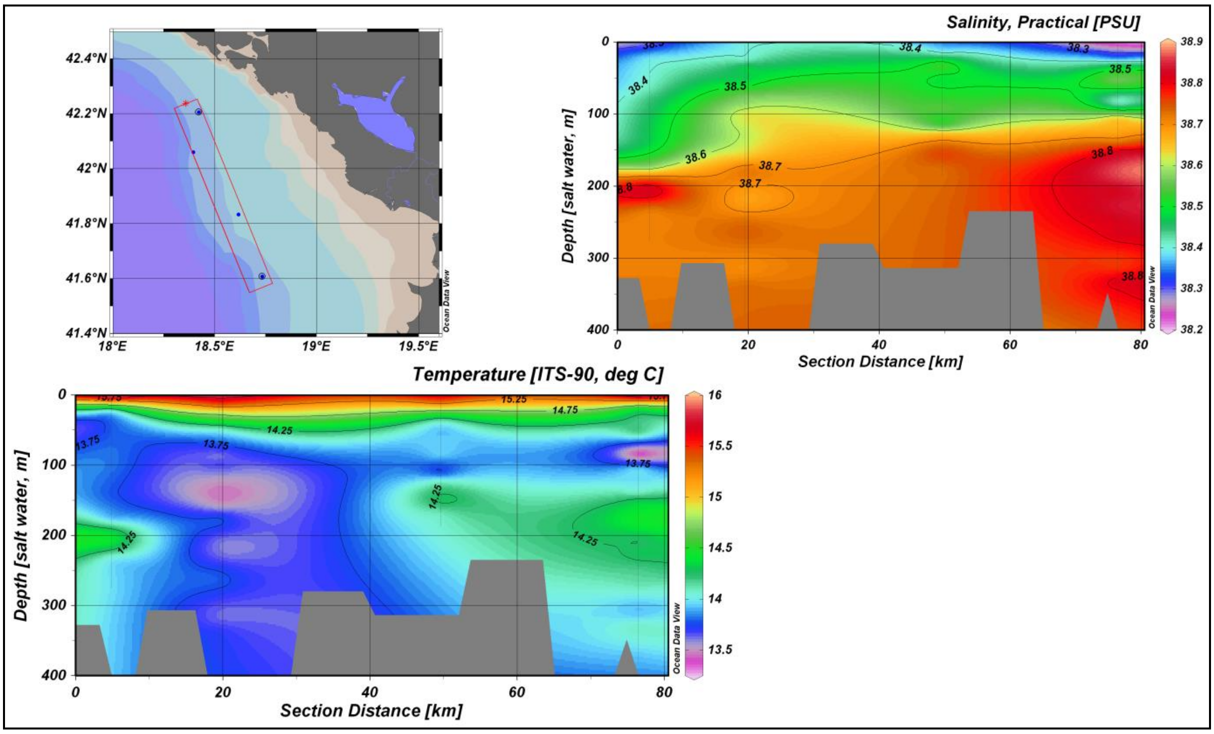


8 March 2010

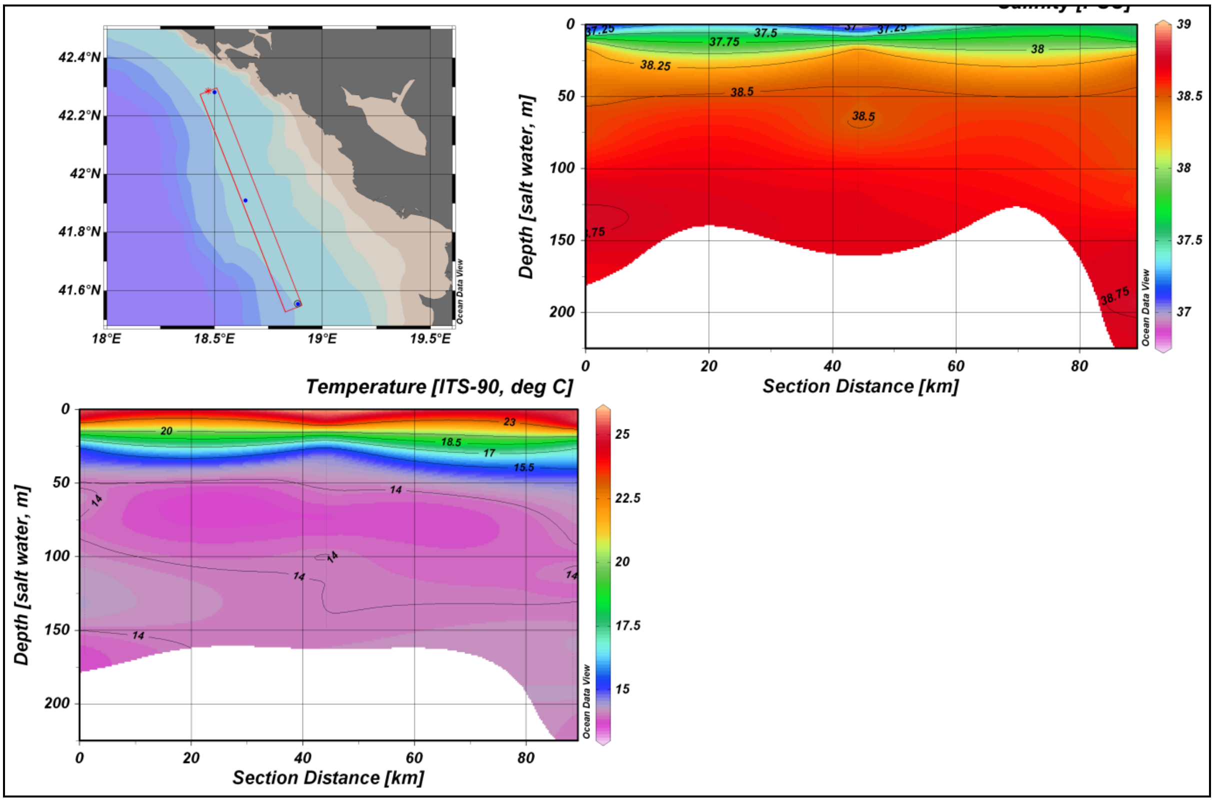


02 October 2007

Figure 5.27 Thermo-Halinic Properties of Sea Water in the Southern Part of the Coastal Sea in Mar and Oct



19-24 April 2009



14 July 2009

Figure 5.28 Transects with Display of Thermo-Halinic Properties of Sea Water in Montenegro in Apr and Jul

5.4.2.2 *Transparency and Sea Color*

5.4.2.2.1 Introduction

Transparency and color of the sea are significant factors for identification of certain types of sea pollutants. In addition, optical properties of the sea are of great importance for a more complete analysis and interpretation of physical, chemical, biological and other parameters of the sea.

Seasonal distribution of global radiation in the southern Adriatic shows that transparency should be highest in summer and lowest in autumn, and also higher at spring time rather than at winter time, thus, shade of color should be brighter in summer and darker in autumn.

Impact of river water and detritus inflow is quite substantial for transparency and sea color. Impact of river water on sea water is evident. Transfer from one mass to the other is clearly distinguished by a line on the sea surface.

Coastal sea of Montenegro is under strong impact of Bojana River and Albanian rivers which carry substantial amount of eroded material from their middle and upper streams. Impact of subsea vortexes, especially in Boka Kotorska, whose activity is closely related to rainfall intensity, is also significant.

5.4.2.2.2 Methodology of Metering and Display of Results

Sea transparency is measured by the depth at which observer loses sight of Secchi disk on the shielded side of the boat.

Sea color is estimated in comparison with Forel-Ule scale of color gradation from I to XXI (blue to dark-brown color) compared to Secchi disc immersed up to half the depth at which the board disappears out of observer's sight. (N.G.Jerlov, 1968.)

Data on transparency and color are collected from measurements conducted in a square grid of 15 x 15 nmi (nautical miles) that covers the entire Adriatic.

For the purpose of data processing, Adriatic Sea is divided into northern, middle and southern parts. Each of these areas is divided into: coastal, channel, inter-island belt up to the boundary of SFRY territorial sea, and offshore and coastal belt up to the border of Italian territorial sea.

Sea color in the explored areas is determined by frequency of number of appearances of the same color per year, i.e. season.

5.4.2.2.3 Data Fund

The amount of data available for the study area and used in the preparation of this section is provided in Table 5.8. For the purpose of a more complete analysis of transparency and color, all the factors that impact these sea characteristics (illumination intensity, diffusion reflection and light reflection in the sea, state of the sea, cloudiness and windiness, shore impact, depth and sea bottom deposits, waves and currents, temperature and salinity of the sea, inflow of fresh water and suspended material in it) were considered.

Table 5.8 Data Fund of Measuring Sea Transparency and Color in the Southern Adriatic (1956 to 1989)

Area	Amount of Data per Season (reading)								Total Amount of Data	
	Winter		Spring		Summer		Autumn		SECCHI Transparency	Color
	S	C	S	C	S	C	S	C		
Coastal belt	27	4	102	9	36	22	12	8	177	43
Offshore	65	46	177	134	136	87	65	48	443	315

Note: S = Secchi Transparency, C= Color

5.4.2.2.4 Sea Transparency in the Coastal Sea of Montenegro

The highest transparency is in **summer** with an average of 32.6 meters. High transparency can be partially ascribed to the fact that measuring is often made during calm and sunny weather. Summer transparency ranges from 23 to 38 meters and these values cannot be regarded as minimum or maximum in this season.

Lowest mean transparency is recorded in **autumn** (21.5 meters). It is the season of the calmest sea with great inflow of fresh water, great cloudiness and poor insolation. Impact of sea currents is substantial as they transport suspended material to the area. Absolute annual minimum of transparency of 14 meters appears in that period. Maximum autumn transparency is 26 m.

Mean transparency in **winter** of 24.4 m is slightly lower than **spring** which amounts to 25.2 m. In winter, the range between the lowest and highest transparency is 15 to 23 m, and at spring time from 19 to 31 m. Lower winter transparency can be justified with the constant movement of the sea.

Mean annual transparency values and sea color in the southern Adriatic are presented in Table 5.9, and mean and Maximum annual transparency are shown in Figure 5.29 and Figure 5.30 respectively.

Table 5.9 Mean Annual Transparency and Range of Sea Color in the Southern Adriatic

Southern Adriatic	Transparency	Color	
	Secchi	F-U scale	Color Range
Coastal belt	15.5	III – IX	Light-blue to light-green
Offshore	23.7	II – IV	Blue to dark-green-blue

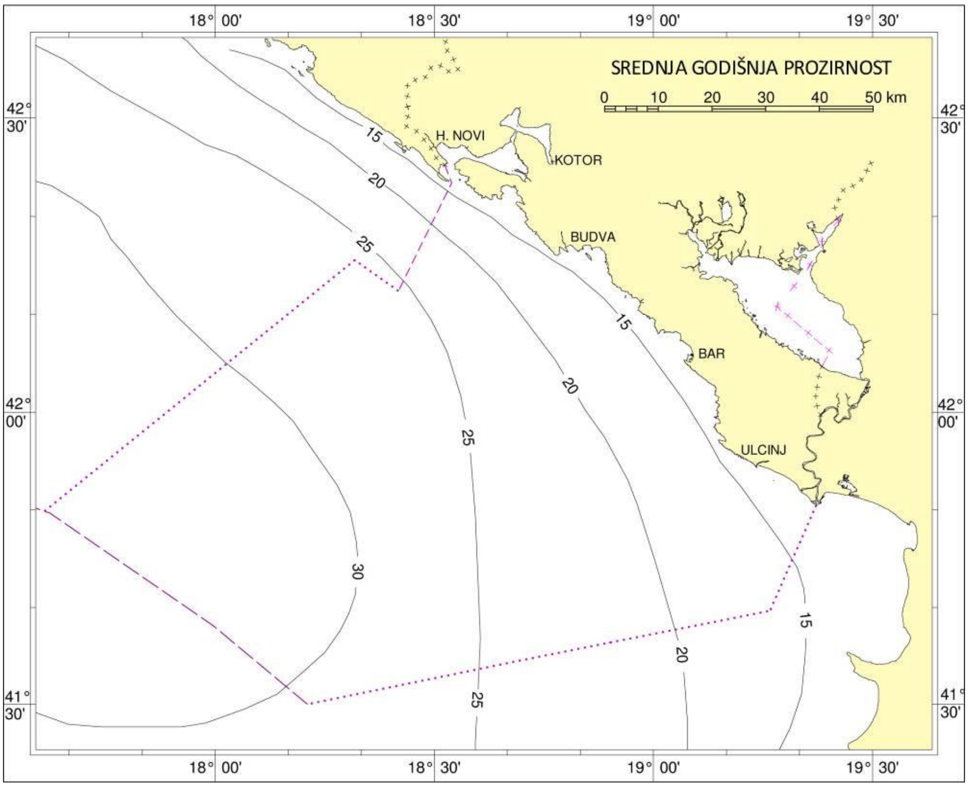


Figure 5.29 Mean Annual Transparency in Meters

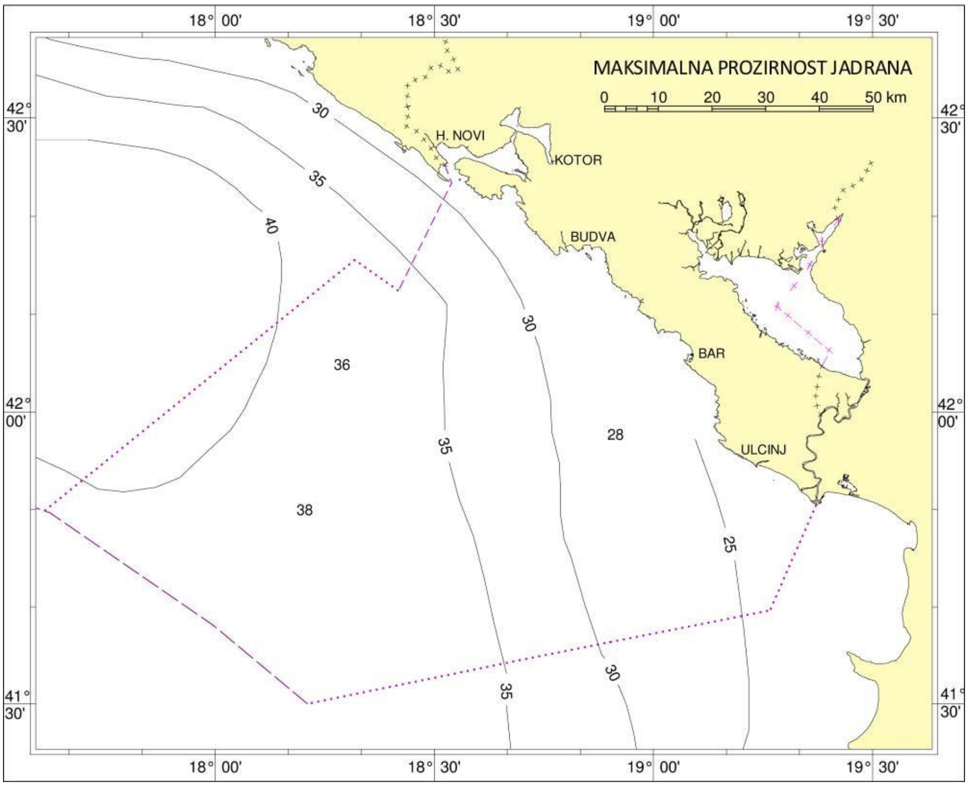


Figure 5.30 Maximum Annual Transparency in Meters

5.4.2.2.5 Sea Color in the Coastal Sea of Montenegro

Blue color is dominant in summer at the entire area of the southern Adriatic, including coastal sea of Montenegro. In autumn impact of rainfall and inflow of fresh water is evident. In that period, the color of the sea corresponds to V degree of Forel scale (blue-green color). At certain points the sea is dark-green which corresponds to VII degree per Forel.

Sea color changes in different seasons in Montenegro are presented in the following tables and figures.

Table 5.10 Range of Sea Color (Degree per Forel-Ule) in the Southern Adriatic

Winter		Spring		Summer		Autumn	
Degree per F-U scale	Color range	Degree per F-U scale	Color range	Degree per F-U scale	Color range	Degree per F-U scale	Color range
II to V	Blue to blue-green	III to VII	Light blue to dark green	II to IV	Blue to dark blue-green	II to V	Blue to blue-green

Table 5.11 Main Present Sea Colors in the Coastal Sea of Montenegro

Degree per F-U scale	Color
II	Blue
III	Light blue
IV	Dark green blue
V	Blue-green

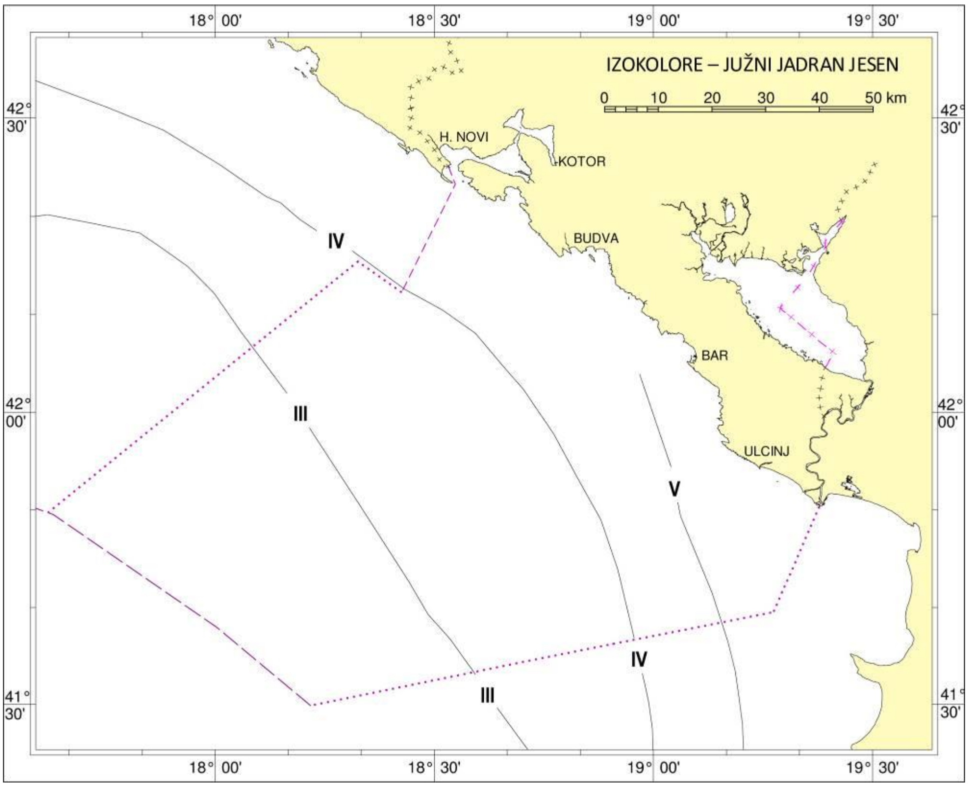


Figure 5.31 Isocolor Lines of Sea Color at Autumn in the Costal Sea of Montenegro

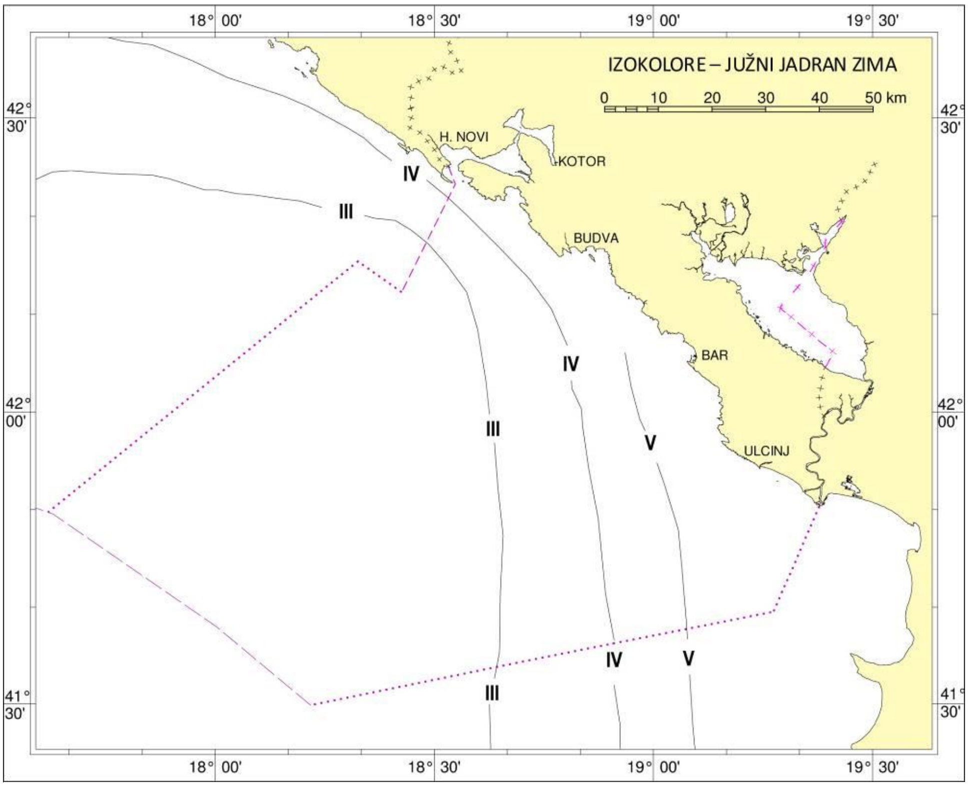


Figure 5.32 Isocolor Lines of Sea Color at Winter in the Costal Sea of Montenegro

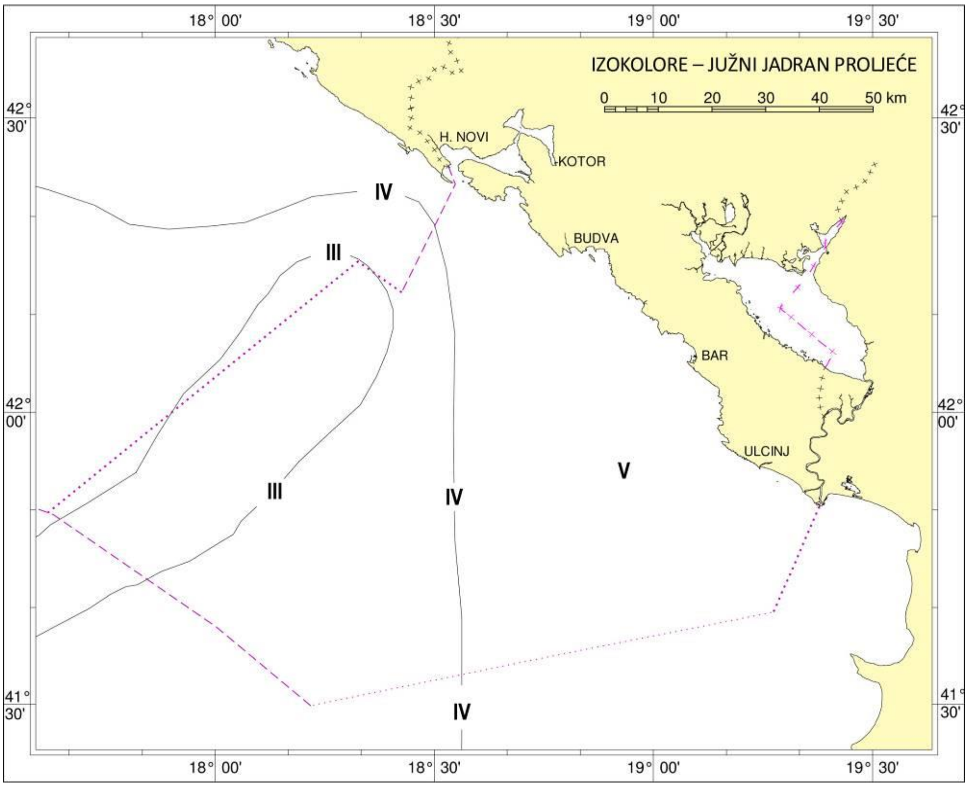


Figure 5.33 Isocolor Lines of Sea Color at Spring in the Costal Sea of Montenegro

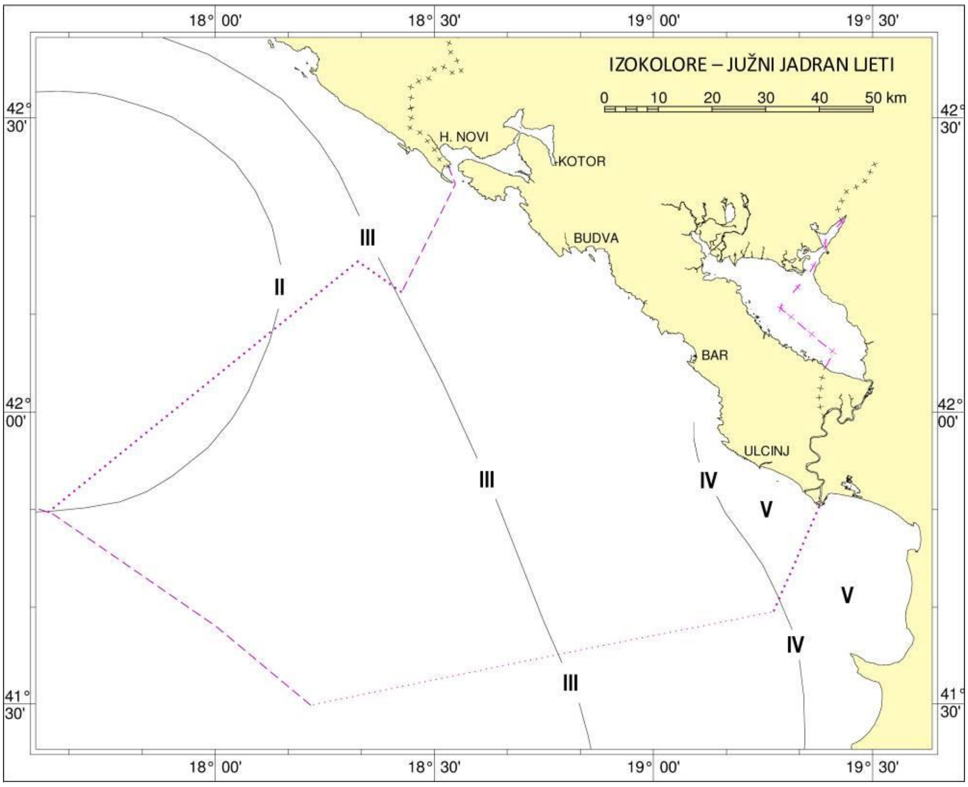


Figure 5.34 Isocolor Lines of Sea Color at Summer in the Costal Sea of Montenegro

5.4.2.3 Sources of Pollution in Coastal Sea Waters and Analysis Results[1]

The main source of pollution in coastal sea waters in Montenegro is sewage discharges into the sea, which introduce nutrients that can stimulate excessive development of phytoplankton and algae, leading to eutrophication. At certain locations, concentration of nutrients and chlorophyll increase in summer months as a result of the increase in the number of residents/tourists in coastal areas in that period. The most sensitive areas along Montenegrin shore are Boka-Kotorska Bay and Bojana delta.

Monitoring of phytoplankton and algae during 2005 and 2006, registered occasional increase above acceptable limits in certain coastal areas (Budva, Kotor, H.Novi).

Monitoring conducted in 2007 and 2008 showed that the quality of water in summer months was satisfactory at almost all coastal areas.

Results of physical-chemical and micro-biotic analysis in 2009 revealed that water characteristics in all locations were within the limits of the requested category. The biggest microbiological pollution was identified at Sveti Stefan and Bar Marina.

Results of water analysis in 2010 and 2011 showed that majority of samples were within the requested category.

Based on analysis results in 2012 and 2013, the quality of sea water in public beaches was very satisfactory with occasional variations from requested category.

[1] Information on state of environment from 2008 – 2014: Environmental Protection Agency and data from www.morskodobro.com (2005-2014.)

5.4.2.4 Monitoring Indicators for Sea Water Quality

The indicator selected to monitor the impacts of the programme on sea water quality is: "Quality of sea water for swimming (microbiological and physical chemical parameters) (M01)". This indicator is included in the national list of environmental indicators, however monitoring has started few years a go and there are no available data on the trend of this indicator according to 2013, SoE Report.

5.4.3 Sediments

Systematic exploration of recent bottom of the Adriatic Sea began quite late. First samples were taken by "Hvar" expedition in 1948-1949. Numerous expeditions from 1964 to 1990, organized by HIYWN in the area of the territorial sea of SFRY and international waters, collected and granulometricly processed 4,396 samples.

5.4.3.1 Methodology of Sampling, Processing and Presentation of Data

HI YWN collected samples from the sea bottom using grab Schipek and DS-252 that grabs surface layer of the recent bottom up to 15 cm depth of deposits. In certain places, samples were collected by means of gravity corer 3 m long.

Positions of the sampling points are determined with electronic positioning system Raydist DRS- H and Mini Ranger Falcon IV, radar and terrestrial navigation. On points were samples were taken, depth was also measured.

Collected samples were processed in the laboratory by means of Macroanalysis and Granulometric method of sifting and particles size analysis using hydrometer method. Smaller amount of samples was subject to full mineralogical-petrographic analysis.

Based on the size of the particles (grains), sediments are divided into gravel, sand, silt (dust) and clay:

- Clay - sediments grains smaller than 0.002 mm
- Silt (dust) - sediments grains size 0.002 to 0.06 mm
- Sand - sediments grains size from 0.06 mm to 2.0 mm
- Gravel - sediments grains, more or less rounded, diameter 2 mm

These four basic types of sediments are found in the shallow sea or shelf belt in the Adriatic. In the area of bathyal zone sediments deposits include only silt and clay (called mud).

The size of the grain sediments is determined by granulometric analysis. Sediments that contain more than 75% of grains of relevant type are regarded as pure basic type. Mixtures are referred to by the dominant basic type in the mixture, which is why the legend contains names such as: muddy sand, sandy mud. Rocky bottom is also marked on the map.

5.4.3.2 Sampling Result

Based on the obtained data, first general map of recent sediments of the Adriatic was prepared (portion of that map is shown in Figure 5.35).

Results of that research are shown in the Atlas of recent sediments in the Adriatic Sea, at scale 1:750 000, HIRM, Split, 1985.

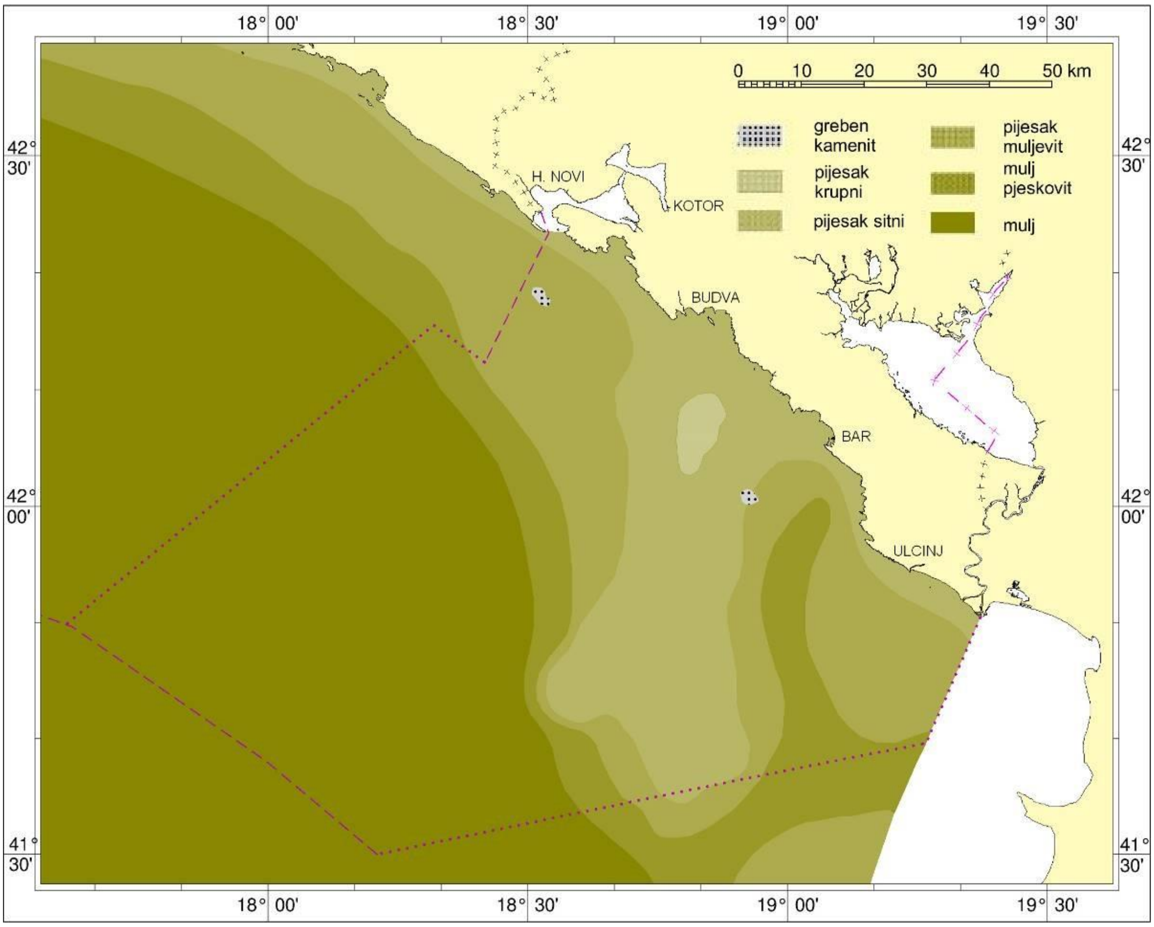


Figure 5.35 Recent Sediments in the Adriatic Sea

5.5 ECOSYSTEMS AND BIODIVERSITY

Neither flora nor fauna of Adriatic Sea or Mediterranean Sea are sufficiently explored. This particularly refers to benthic endobionts, in particular interstitial or mesofauna, followed by parasites and benthic bathyal and meso and bathypelagic fauna of the South-Adriatic Valley.

5.5.1 Phytoplankton

Phytoplankton algae are basic producers of organic substances in water environments. They are primary organic producers which directly or indirectly sustain the entire wildlife in water. These microorganism are the first link in food chains. However, their excessive growth can lead to enriching the ecosystem with nutritious substances, i.e. eutrophication, which is followed by changes in phytoplankton community, algae growth and increase in biomass and leads to possible toxic blooming of algae. If the amount of accumulated organic substances exceeds carrying capacity of the system, hypoxia can leady to decrease in fishing and oyster yield, poor water quality and can affect the entire ecosystem (Cognetti, 2001).

Mediterranean has been mainly characterized as oligotrophic area due to poor concentration of inorganic phosphorous that limits primary production (Thingstad *et al.*, 2005). Lately, this ecosystem is under strong anthropogenic impact (Bianchi & Morri, 2000; Béntoux *et al.*, 2002), and as result of climate changes, pollution, increased marine transportation, brought in species, changes in distribution of anthropogenic species (Vadrucci *et al.* 2003). The same applies to the Adriatic where anthropogenic impacts caused by tourism, agriculture and industry, marine transportation and port activities are increasing, which particularly applies to north of the Adriatic. South Adriatic is characterized as extremely oligotrophic. However, in addition to generally oligotrophic character, the coastal area is under increasing anthropic impact and increased eutrophication (Viličić, 1983).

The surveyed area covered in this section is Montenegrin coastal zone, in addition to areas outside the bay that are under strong impact of the open sea where changes in water masses are higher and contribute to lower production of phytoplankton. This section includes data from researches for the years of 2009, 2010, 2011 and 2012 for a period from April to September.

The area of Montenegrin coastal zone hosts four key groups of phytoplankton that are:

- *Bacillariophyceae* (Diatom)
- *Dinophyceae* (dinoflagellate)
- *Prymnesiophyceae* (Coccolithophores)
- *Chrysophyceae* (Silicoflagellates).

Analysis of phytoplankton material was made using standard methodology (Utermöhl, 1958). Bigger fraction of micro plankton (cells > 20μm) was analyzed to the species using adequate keys that apply to this area. Phytoplankton species of micro-phytoplankton are used as indicators of eutrophication, both their presence and their thickness. Small fraction of nano-plankton (cell < 20μm) is shown as total amount per surveyed position. The amount of phytoplankton (micro and nano-plankton) is expressed with numerical values to the unit of volume of sea water (number of cells/l) per surveying positions.

Average values of micro-plankton ranged up to 10^4 cells/l. the biggest average number of micro-planktons was recorded in Bay of Bar (4.4 x 10^4 cells/l), also, increased number of micro- planktons was found in Ada Bojana m(2.6 x 10^4 cells/l). Lowest average value of micro-planktons was in Luštica-Dobra luka (1.2 x 10^4 cells/l) as shown in Figure 5.36. According to Kitsios and Karydis (2001, 2002) this area was characterized as meso-eutrophic (approaching to eutrophic area), which is indicative of increase in anthropogenic impact. The average value of nano-planktons was up to 10^5 cells /l and the highest value was in Ada Bojana (3.48 x 105 cells/l). Elevated average number of nano-planktons was recorded at Luštica- Dobra luka amounting to 3.39 x 10^5 cells/l, where micro-plankton was lowest. The average lowest value of nano-plankton (2.8 x 10^5 cells/l) was in Trašte Bay (Figure 5.36).

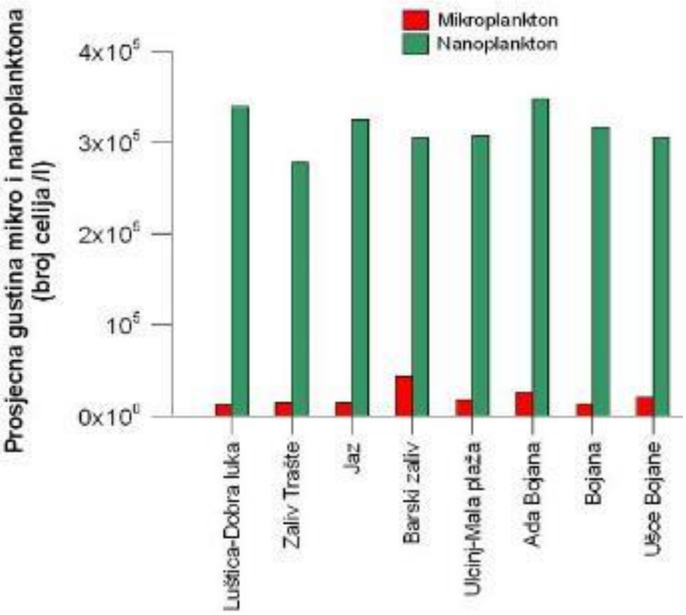


Figure 5.36 Average Density of Micro and Nano Plankton in the Surveyed Area

In terms of phytoplankton groups, diatoms were dominant in all locations. It is due to their ability to adjust to various, very often turbulent, outdoor conditions (Burić *et al.,* 2007), given that they are eurivalent group of organism. Despite being adjustable to different conditions, they are more typical for cooler period (late winter, early spring). Highest average density of diatoms (4.2 x 10^4 cells/l) was recorded in Bay of Bar where the average micro-plankton was the highest. This is reflective of the domination of this group of phytoplankton which constituted the biggest part of micro-plankton.

Minimum average value of diatom was recorded at Luštica-Dobra luka and amounted to 1.02 x 10^4 cells/l (Figure 5.37). Dinoflagellate were less present and reached an average value of 10^3 cells/l. The highest average value of Dinoflagellate was 3.4 x 10^3 cells/l at Ulcinj – Mala plaža. Dinoflagellate grows better in warmer period when water mass turbulence is lower. The highest value of others phytoplankton groups consisting of Coccolithophores, Silicoflagellates and Chlorophytes was recorded at Bojana River mouth (1.1 x 10^3 cells/l) (Figure 5.37).

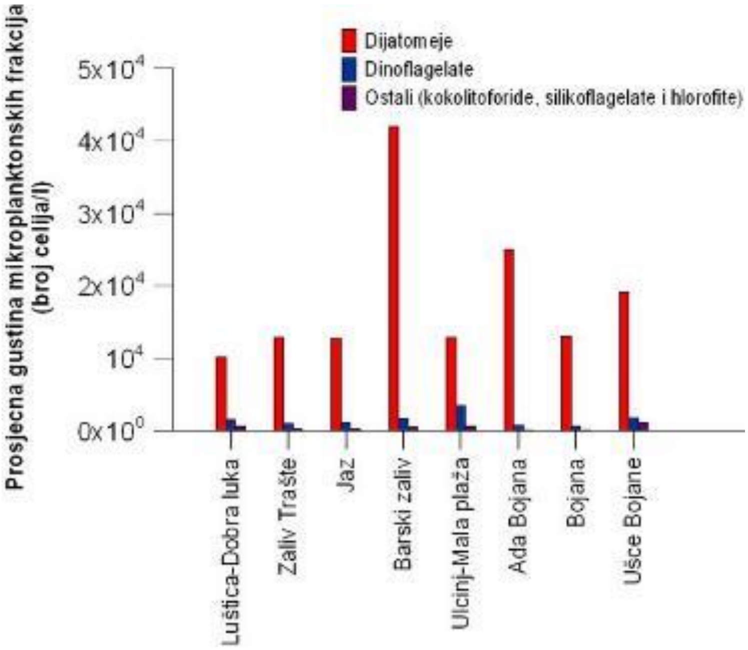


Figure 5.37 Average Density of Micro-Plankton Fractions in the Surveyed Area

During the survey, prevailing species were: *Chaetoceros affinis*, *Ch. curvisetus, Ch. diversus, Licmophora paradoxa, Navicula* spp., *Pleurosigma angulatum, P. elongatum, Proboscia alata, Pseudo-nitzschia spp. and Thalassionema nitzschioides.* Most prevailing species of dinoflagellate were: *Gymnodinium* spp., *Gonyaulax polygramma*, *Prorocentrum micans*, *Prorocentrum minimum*, *Protoperidinium diabolum*, *P. tubum*, *Neoceratium furca*, *N. fusus*, *N. tripos*. As for toxic dinoflagellate, prevailing species included *Dinophysis fortii, D. acuminate and D. acuta;* however, they w not very numerous. With regards to coccolithophores the most prevailing were *Calyptrosphaera oblonga*, *Syracosphaera pulchra* and *Rhabdosphaeara tignifera*. In respect to silicoflagellates, dominant species was *Dictyocha fibula*. Diatom species that were dominant during the survey were mainly typical for areas rich in nutritious material (Relevante & Gilmartin, 1980, Drakulović *et al,*. 2011, 2012).

Phytoplankton biomass is expressed with the concentration of chlorophylls *a*. the highest average concentration of chlorophylls *a* was recorded at Ada Bojana and amounted to 1.065 mg/m^3. Minimum concentration of chlorophylls *a* was recorded at Jaz (0.546 mg/m^3), and it was also low at the location where microplankton was the lowest. The highest average concentration of chlorophylls *a* was not at the same location where average value of microplankton was the highest (Figure 5.38). This inconsistency can be explained based on the fact that photosynthetic activity, apart from the number of cells, depends on the size, composition of phytoplankton species, physiological state of the cell and ecologic factors (Ninčević & Marasović, 1998).

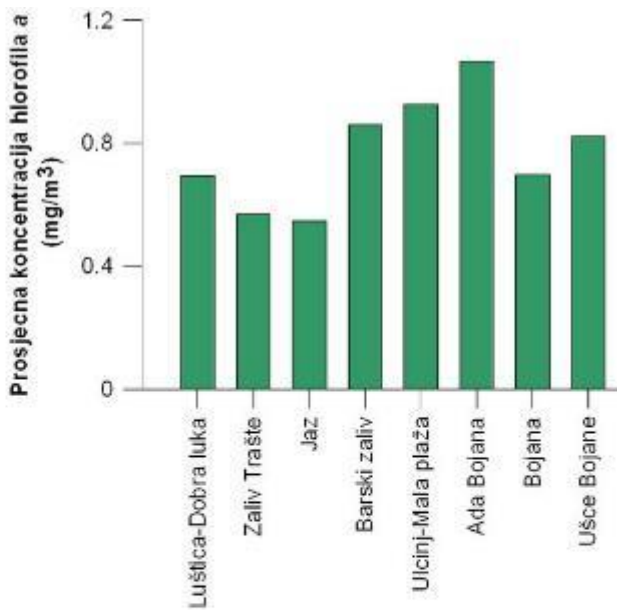


Figure 5.38 Average Concentration of Chlorophylls in the Surveyed Area

According to Ignatides (2005) criteria, based on the average concentration of chlorophylls a the area is characterized as eutrophic, as the average value was 1.065 mg/m^3.

5.5.2 Zooplankton

Amounts of zooplankton are affected by the depth of water column, trophic status and temperature regime (Harris *et al*., 2000). Succession of species and group of zooplankton, as well as changes in their amount, over the year, is integrated response of ecosystem to hydrometeorological changes (Beaugrand, 2005). Plankton communities play important role in ecosystem functioning and biochemical cycles (Roemmich & McGowan, 1995). Mesoplantkon is characterized by high diversity of taxonomic categories that assume different ecological positions and meaning in tropic network of sea (Kiørboe, 1997). Zooplankton is a chief source of food for fish larvae, therefore it has substantial impact on their survival, potentially more than the temperature (Beaugrand *et al*., 2003). Information on spatial and weather variations of structures of zooplankton communities and succession of species, i.e. groups is of fundamental importance for understanding functioning of ecosystem in different environment. Many studies showed that zooplankton can be used as indicator for monitoring state of marine ecosystems and water masses and hydro-climate changes (Beaugrand, 2005, Eloire *et al*., 2010).

Zooplankton material was collected at 8 sites in the offshore of Montenegro from locations shown in Figure 5.39. Sampling was done during 2009 within MEDPOL project. Zooplankton was collected with plankton net type Nansen, density 125 µm, opening diameter 55 cm and 150 cm length, in a vertical move from bottom to the surface. Material was conserved and neutralized with sea solution of formaldehyde final concentration 2.5% and analyzed in laboratory using stereomicroscope Nikon SMZ800, with enlargement from 25 to 50 times. Each sample is divided into subsamples 1/8, 1/16, 1/32, 1/64 and 1/128, depending on number of individuals in total sample. For rare and meagre species, the entire sample was analyzed. All quantitative values were expressed as number of individuals per cubic meter (ind m^{-3}).

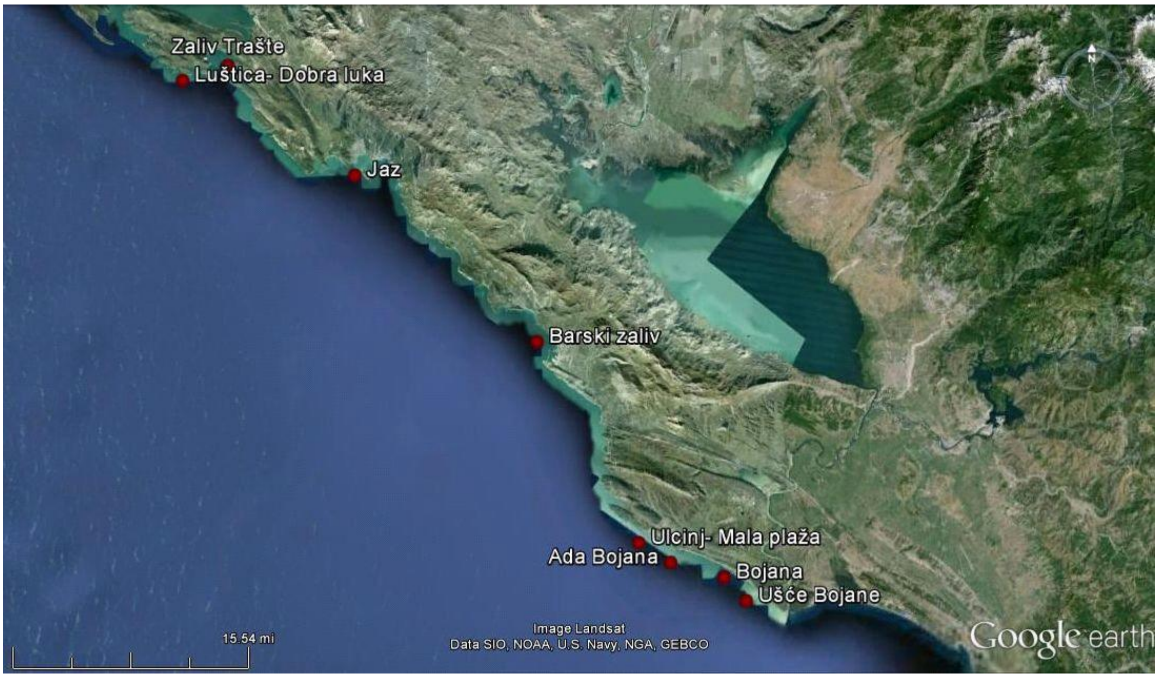


Figure 5.39 Surveyed Area for Net Zooplankton

The overall amount of zooplankton per site is shown in Figure 5.40. Substantially higher values were recorded at Bojana River mouth. These results were expected given that Bojana River is a basic source of fresh water. The total amount of zooplankton at the sites ranged as follows:

- Luštica-Dobra Luka: from 1089 to 7839 ind m^{-3}
- Zaliv Trašte: from 2217 to 25964 ind m^{-3}
- Jaz: from 1732 to 25171ind m^{-3}
- Barski zaliv: from 4726 to 24716 ind m^{-3}
- Ulcinj- Mala plaža: from 3227 to 14185 ind m^{-3}
- Ada Bojana: from 4571 to 19104 ind m^{-3}
- Bojana: from 1601 to 10560 ind m^{-3}
- Ušće Bojane: from 5657 to 74972 ind m^{-3}

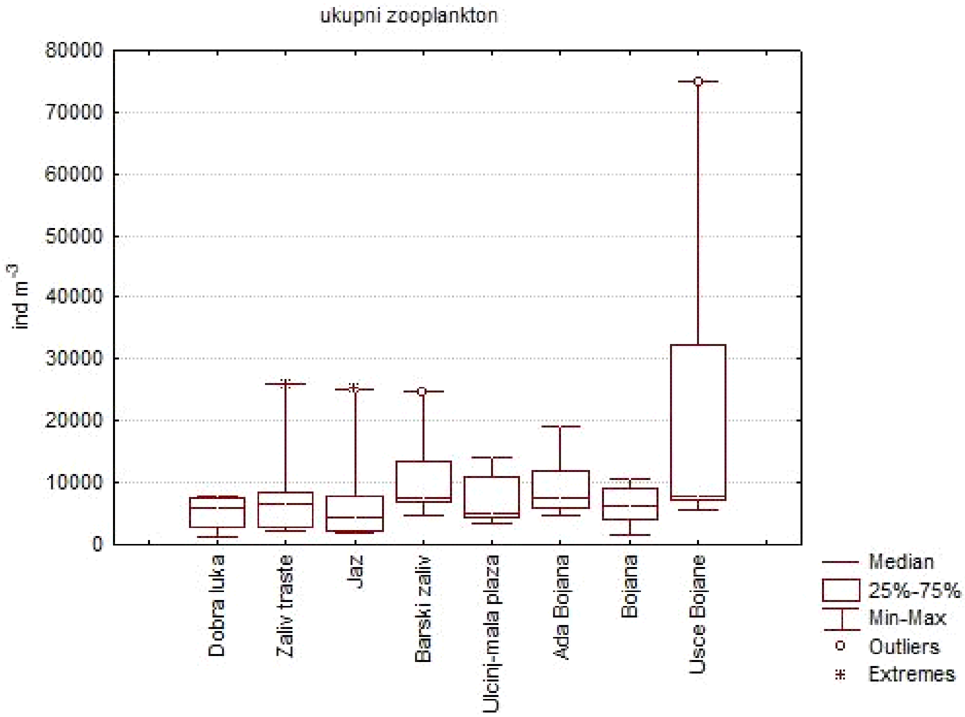


Figure 5.40 Total Number of Zooplanktons at Surveying Period

Procedural presence of the most numerous groups in overall zooplankton showed that the most numerous groups during the surveying period were copepods, followed by cladocera that were also numerous but solely over certain period of the year, that is summer when sea temperature is higher and convenient for parthenogenetic development of individuals in that group when they reach high values over a short period of time. This is not notable in average perceptual values shown in Figure 5.41, because extremely low values over several months tend to mask such periodical maximums. The only substantial portion during surveying of cladocera was noted at Bojana River mouth, which is a key source of nutritious salts which is also an important factor in the development of such organisms.

Table 5.12 Percentage of Copepod and Cladocera of the Overall Zooplankton in the Surveying Period

Group	Cladocera (%)	Copepoda (%)	Ostalo (%)
Luštica Dobra luka	6.79	88.94	4.27
Trašte Bay	7.22	89.36	3.42
Jaz	1.38	93.27	5.36
Bay of Bar	7.09	87.21	5.70
Ulcinj Mala plaža	3.47	73.69	22.83
Ada Bojana	5.91	85.50	8.59
Bojana	6.66	79.17	14.18
Bojane River mouth	45.52	49.17	5.32

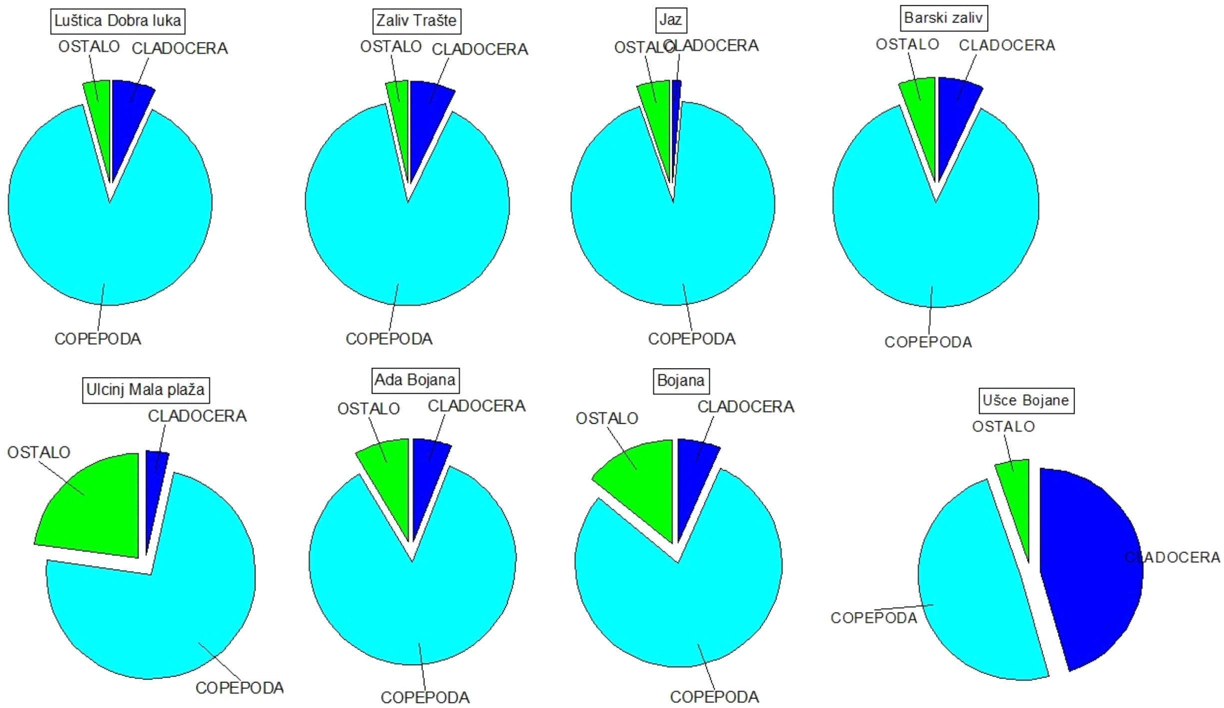


Figure 5.41 Average Percent of Copepod and Cladocera of the Overall Zooplankton in Surveying Period

A total of 92 zooplankton species was registered during the survey period as shown in Table 5.13.

Table 5.13 Zooplankton Species Registered Offshore in Montenegro

HYDROMEDUSAE	COPEPODA	CHAETOGNATHA
Podocorryne minima	*Calanus helgolandicus*	*Sagitta minima*
Podocoryne minuta	*Mesocalanus tenuicornis*	*Sagitta setosa*
Obelia spp.	*Nannocalanus minor*	*Sagitta inflata*
Clytia haemispherica	*Paracalanus nanus*	
Liriope tetraphylla	*Paracalanus parvus*	**MYSIDACEA**
Eutima gracilis	*Calocalanus pavo*	*Siriella clausi*
Eirene viridula	*Calocalanus contractus*	
Rhopalonema velatum	*Calocalanus styliremis*	**THALIACEA**
Aglaura hemistoma	*Calocalanus sp.*	*Doliolidea*
Solmundella bitentaculata	*Ischnocalanus plumulosus*	*Thalia democratica*
Solmissus albescens	*Meynocera clausi*	
	Clausocalanus arcuicornis	**LARVE**
SIPHONOPHORAE	*Clausocalanus jobei*	*Bivalvia*
Lensia subtilis	*Clausocalanus pergens*	*Gastropoda*
Muggiaea cochi	*Clausocalanus furcatus*	*Polychaeta*
Muggiaea attlantica	*Pseudocalanus elongatus*	*Ciripedia*

HYDROMEDUSAE	**COPEPODA**	**CHAETOGNATHA**
Sheronectes gracillis	*Ctenocalanus vanus ad*	*Echinopluteus*
	Euchaeta hebes	*Ophiopluteus*
OSTRACODA	*Scolecithricella dentata*	*Bipinaria*
	Diaixis pygmoea	*Acthinotricha*
CLADOCERA	*Centropages typicus*	*Ova pisces*
Penilia avirostris	*Centropages kroyeri*	*jaje incuna*
Evadne spinfera	*Isias clavipes*	*Pisces*
Evadne tergestina	*Temora stylifera*	
Evadne nordmani	*Temora longicornis*	**PROTOZOA**
Podon intermedius	*Labidocera wollostoni*	*Noctiluca scintillans*
Podon polyphemoides	*Candacia giesbrechti*	
	Acartia clausi	**PTEROPODA**
APPENDICULARIA	*Acartia longiremis*	*Limacina trochiformis*
Oikopleura dioica	*Oithona nana*	*Limacina inflata*
Oikopleura longicauda	*Oithona plumifera*	*Limacina bulboides*
Oikopleura fusiformis	*Oithona setigera*	*Creseis acicula*
Oikopleura gracilioides	*Oithona similis*	*Creseis virgula*
Fritillaria borealis	*Oncaea sp*	
Fritillaria pellucida	*Euterpina acutifrons*	
Fritillaria haplostoma	*Microsetella spp.*	
Fritillaria formica	*Macrosetella sp.*	
	Sapphirina spp.	
	Coryceus spp.	

Dominant species of the overall zooplankton were mainly calanoida copepod, but primarily *Paracalanus parvus, Acartia clausi, Clausicalanus jobei, clausocalanus arcuicornis, Temora stylifera,* while dominant species from cyclopoida copepod are types of taxon *Onceaidae,* as well as *Oithona nana*. Given net density of 125 µm domination of small-size fraction of copepod is expected. *Penilia avirostris*, a type from cladocera group, is dominant. It is particularly numerous at Bojana River mouth where in addition to favorable temperatures, there is also a large amount of nutritious salts, transferred via Bojana River into the sea, which is yet another condition for survival for this species.

Estuary and neritic types of zooplankton, which are more abundant in Bojana River mouth, are more adapted to variable environmental conditions (temperature, salinity, presence of organic matter) which makes them more resilient to potential changes of environment caused by explorations of hydrocarbon. However, open sea types, in particular copepods are adjusted to living in stable environments, so each change in such conditions would have substantial impact on their production, causing substantial changes in food chain, and later the very reproduction of those species (Hansen *et al.,* 2012).

5.5.3 Phytobenthos and Zoobenthos

Exploration of benthos in the open part of Montenegrin offshore mainly included macrobenthos i.e. organisms bigger than 1 mm. Even though a number of research projects in the past 10 years has increased substantially and database was updated with large number of species, there is still a gap in respect to certain animal species. In regards to phytobenthos, data gap is a bit less substantial because the biggest concentration of phytobenthos exist in the coastal part which has been surveyed to a higher extent compared to deeper levels.

Analysis of data refers to the area of continental shelf (to 200 m depth), which is divided into shallow part, i.e. Infralittoral (30 m depth) and deeper part of Circalittoral (from 30 to 200 m depth) as well as bathial ladder, i.e. area of Continental Slope (from 200 to 4000 m depth).

5.5.3.1 Distribution of Phytobenthos and Zoobenthos in Infralittoral Part

The narrow coastal belt can be described as the best explored part of Montenegrin sea water in terms of benthos organisms. This primarily refers to area of around 30 m depth where explorations were carried out mainly by means of autonomous diving. Exploration of this part of the coastal zone conducted by RAC SPA (2013) showed that 119 types of benthos (invertebrates, algae and marine flowering plants) inhabit this zone (Figure 5.44).

Detailed explorations of certain clusters of organisms showed greater number than the above indicated, which can be expected considering that the mentioned research was short-term. Data showed that 43 types of Echinodermata populate the coastal shelf zone (Petović & Marković, 2013).

In the northern part of the seaside, the coast is mainly rocky and steep; it flattens and becomes sandy towards the south. Rocky shore plummets downwards and continues in muddy-sandy soil to transform into muddy-clay that covers large part of the sea bottom in the lower circalittoral. Along the rocky shore, the upper part of infralittoral is often covered in well preserved meadows of *Posidonia oceanica*, which at certain points reach 33 m depth. The upper layer of infralittoral is not rich in algae, but it is dominant in the "barren" part, i.e. degraded rocky base. This base is inhabited by numerous sea urchins *Paracentrotus lividus* and *Arbacia lixula* and calcified algae. Barren spreads at depths between 0.5 and 10-12 m.

Figure 5.42 ***Posidonia oceanica***

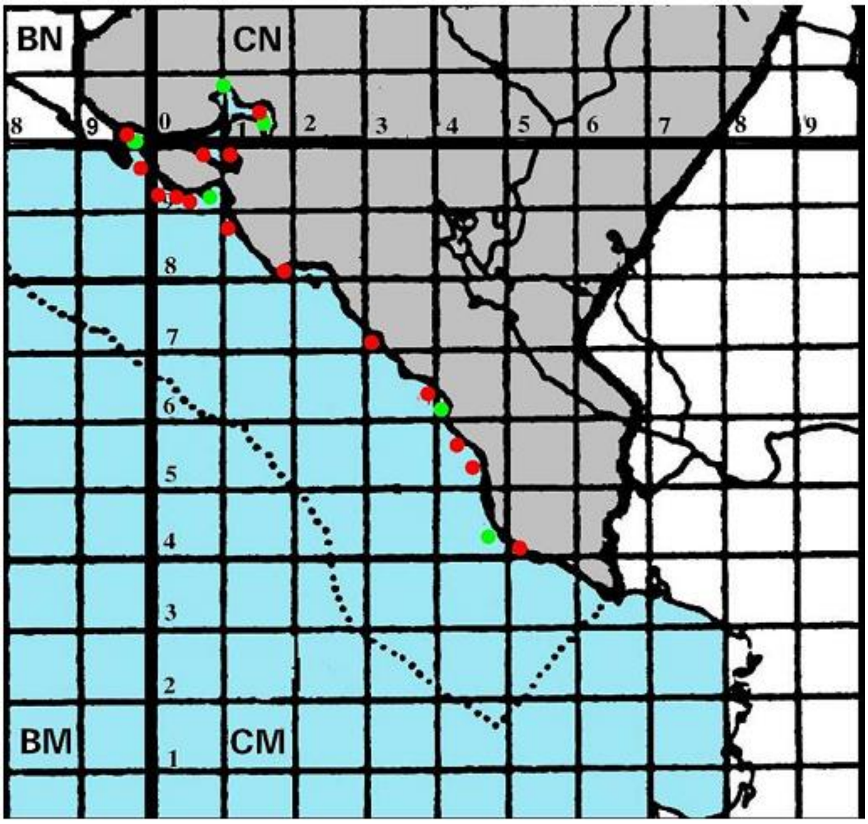


Figure 5.43 ***Posidonia oceanica* Distribution**[1]

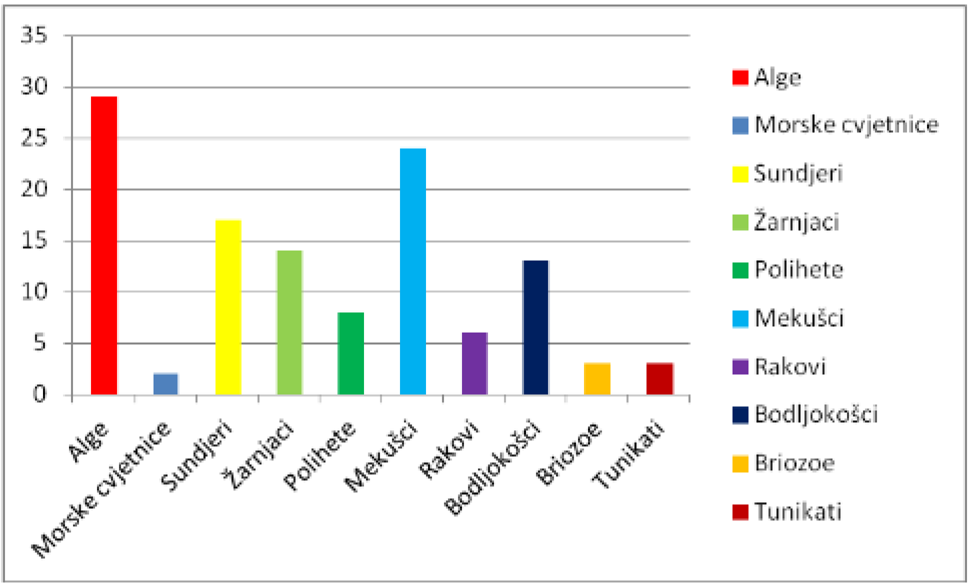


Figure 5.44 **Number of Algae, Marine Flowering Plants and Invertebrates Recorded during Exploration Conducted by RAC SPA (2008-2012)**

This type of habitat is developed on rocky base destroyed by collecting date shells (*Lithophaga lithophaga*) and overfishing. As there is no main predator, sea urchins spread

[1] National Action Plans, produced within the project Strategic Action Programme for the Conservation of Biological Diversity in the Mediterranean Region (SAP BIO), Podgorica, Montenegro, March 2004. http://www.webcgteam.com/tekstovi/national_action_plans_montenegro_en.pdf

fast under such conditions and since they feed on algae, they do not allow them to spread to a higher degree. Areas with Cystoseira spp or other brown algae are local character and not very frequent. In the southern part of Montenegrin aquatorim, soft base is dominant, mostly sand and mud so Cymodocea nodosa can be found at the depth of 5-6 m.

5.5.3.2 Distribution of Phyto and Zoobenthos in Circalittoral Part

This zone includes depth of around 30 meters to 200 m. in terms of exploration of benthos organisms, this area was accessible for exploration mainly via fishing boats. Basic data regarding composition and amount of certain benthos organisms were obtained during realization of MEDITS project when 5 layers of depth were explored (10-50 m, 50-100 m, 100-200 m, 200-500 m and 500-800 m depths) in Montenegrin territorial waters.

At 100 m depth, there are numerous representatives of Cnidarians (*Alcyonium palmatum, Lytocarpia myriophyllum, Pennatula rubra, Pteroeides spinosum*), Echinodermata (*Anseropoda placenta, Astropecten aranciacus, Astropecten irregularis pentacanthus, Echinus acutus, Marthasterias glacialis, Ophiura ophiura, Eostichopus regalis, Amphipholis squamata, Centrostephanus longispinus, Chaetaster longipes, Echinus acutus, Ophidiaster ophidianus, Stylocidaris affinis*), tunicate (*Ascidiella spp., Ascidia virginea, Botryllus schlosseri, Didemnum maculosum, Didemnum spp., Distomus variolosus, Halocynthia papillosa, Phallusia mammillata, Pyura spp., Ascidia mentula, Diazona violacea, Pyura duro, Pyura microcosmus*), molluscs (*Anomia ephippium, Hiatella arctica, Modiolarca subpicta, Glossus humanus, Pteria hirundo*), bryozoa (*Frondipora verrucosa*) and spongia (*Ircinia spp., Suberites domuncula, Tethya aurantium, Tethya citrina*). *Pteria hirundo* with 2922 individuals per km^2 was the most numerous, while *Botryllus schlosseri* with mass of 154 kg/km^2 was dominant in terms of weight at this depth layer.

In the layer from 100 to 200 m depth, in terms of invertebrates, there are cnidarians (*Alcyonium palmatum, Epizoanthus arenaceus*), echinodermata (*Anseropoda placenta, Astropecten aranciacus, Astropecten irregularis pentacanthus, Chaetaster longipes, Cidaris cidaris, Ophidiaster ophidianus, Eostichopus regalis, Stylocidaris affinis*), tunicate (*Ascidia virginea, Diazona violacea, Phallusia mammillata, Pyura duro*) and molluscs *Pteria hirundo*. Dominant species in number was sea cucumber *Eostichopus regalis* with 103 individuals per km^2 which was also dominant in biomass of nearly 14 kg per km^2.

In regards to phytobenthos, marine flowering plants are not present at this depth, their lower limit of spreading is determined by the depth of sunlight penetration which in our conditions ranges from 25 to 33 m. In respect to algae, there are data on the presence of *Cystoseira foeniculacea* and *C. spinosa* at depths of around 30 m (Mačić, 2010). In the zone of circalittoral, there are algae that participate in construction of coral biotic community.

5.5.3.3 Distribution of Zoobenthos on Continental Slope (Bathyal Zone)

This depth layer includes marine zone from 200 m onwards. In the bathyal zone of Montenegrin offshore, there are *biotic communities of bathyal mud* on mobile base, developed in form of two facies. In the upper layer of biotic community at 200 to 350 meter depth, there are facies of soft muds with fluid surface skin characterized by *Nephros norvegicus, Thenea muricata, Funiculina guadrangularis, Parapenaeus longirostris,* etc. (Gamulin-Brida, 1974). In deeper part of biotic community of bathyal muds at depths between 400 and 500 m there are facies of sandy mud and fine gravel. There are well developed settlements of *Terebratula vitrea*, depth acidias *Hormathia coronata*, starfish *Brisingella coronata* and often there can be sea urchins *Cidaris cidaris* and *Echinus acutus* (Gamulin-Brida, 1974). In the area of solid substrate, there is biotic community of large branchy depth corals.

Data obtained from MEDITS project indicate that the area of bathyal zone is populated with representatives of cnidarians (*Alcyonium palmatum, Funiculina quadrangularis, Pelagia noctiluca*) and Echinodermata (*Astropecten irregularis pentacanthus, Cidaris cidaris, Echinus acutus, Echinus melo, Eostichopus regalis*). The most numerous were *Echinus melo* with 140 individuals/km^2 which was dominant with biomass as well (4 kg/km^2).

Recent explorations of the continental slope conducted during 2013 included 7 locations with depths ranging from 426 to 543 m depth. Results showed that clay-muddy base is most dominant populated with representatives spongia (*Desmacella sp*.,*Pachastrella monilifera*), cnidarians (*Callogorgia verticillata*, *Dendrophyllia cornigera*, *Leiopathes glaberrima*, *Lophelia pertusa*, *Madrepora oculata*, *Paramuricea macrospina)*, molluscs (*Delectopecten vitreus*, *Spondylus gussonii*, Nudibranchia), anelida (*Vermiliopsis sp*.), crustacean (*Munida tenuimana*, *Rochinia rissoana*, *Stylocheiron sp*., *Paromola cuvieri*, *Bathynectes maravigna)*, Echinodermata (*Cidaris cidaris*, *Odontaster sp*.) and fish (*Phycis phycis*, *Helicolenus dactylopterus*, *Hoplostethus mediterraneus*, *Pagellus bogaraveo*) (Angeletti *et al.,* 2014).

5.5.3.4 Protected Benthos Species and Habitats

In the area of interest for this study, there are 25 species of plants and animals registered according to local / international legislation as rare, protected, endangered or species with limited exploitation, as presented in Table 5.14.

Table 5.14 Rare, Protected, Endangered or Species with Limited Exploitation According to Local and International Legislation

Latin name for species	Barcelona Convention	IUCN	Bern Convention	Status in Montenegro
Posidonia oceanica (L.) (Delile, 1813)	x	x	x	x
Cystoseira amentacea var. stricta Montagne, 1846	x		x	x
*Cystoseira spinosa (*Sauvageau, 1912)	X		x	
Lithophyllum lichenoides (Philippi, 1837)	x		x	
Cladocora caespitosa (Linnaeus, 1767)		x		x
Centrostephanus longispinus (Philippi, 1845)	x		x	x
Paracentrotus lividus (Lamarck, 1816)	x		x	
Ophidiaster ophidianus (Lamarck, 1816)	x		x	x
Holothuria forskali (Delle Chiaje, 1823)		x		x
Holothuria polii (Delle Chiaje, 1823)				x
Holothuria tubulosa (Gmelin, 1788)		x		x
Holothuria impatians (Forksal, 1775)				x
Lithiphaga lithophaga (Linnaeus, 1758)	x		x	x
Pinna nobilis (Linnaeus, 1758)	x			x
Luria lurida (Linnaeus, 1758)	x		x	x
Scyllarides latus (Latreille, 1803)	x		x	
Scyllarus arctus (Linnaeus, 1758)	x			
Hippocampus ramulosus (Leach, 1814)				x
Palinurus elephas (Fabricius, 1787)	x			
Homarus gammarus (Linnaeus, 1758)	x			

Epinephelus marginatus (Lowe, 1834)	x		x	
Axinella demicornis (Esper, 1794)				x
Axinella cannabina (Esper, 1794)				x
Tonna galea L.	x		x	x
Tethya aurantium (Pallas, 1766)				x

5.5.3.5 <u>Alien Species</u>

The coastal belt of Montenegrin coastal zone was explored for alien species. Results showed that there are nine species that originate from other remote areas, often from Indian or Atlantic Oceans (Table 5.15). Among the registered species, there are phytobentos algae from genus *Chlorophyta* and Rhodophyta as well as crustacean *Decapoda*, molluscus *Gastropoda, Bivalvia* and fish (Zenetos *et al.,* 2011).

Table 5.15 List of Alien Species Registered at Montenegrin Coastal Zone

Species	First registered	Origin
Caulerpa racemosa var. cylindracea	2004	ST Pacific
Womersleyalla setacea	2003	Indo-Pacific
Asparagopsis taxiformis	2006	Pantropic
Callinectes sapidus	2006	West Atlantic
Melibe viridis	2003	Indo-Pacific
Bursatella leachi	2009	Circumtropical
Crassostrea gigas	1977	NW Pacific
Fistularia commersonii	2007	Indo-Pacific
Sphoeroides pachygaster	2008	Tropic Atlantic

5.5.3.6 <u>Pelagic Species of Fish and Hatchering of European Anchovy (Engraulis Encrasicolus) in the Area of Open Water of Montenegrin Offshore</u>

Figure 5.45 Fish Catching and Fish Eggs

Adriatic Sea is an integral part and shallow bay of the Mediterranean Sea, so it has all general properties of Mediterranean ichthyofauna. So far, 449 fish species were registered in the Adriatic Sea (Dulčić & Dragičević, 2011), whereas the number has been constantly increasing, in particular due to increased entrance of fish from the Red Sea that belong to ichthyofauna of Indian Ocean (Indian-Pacific Fauna), over Suez Canal, opened in 1869, primarily into east Mediterranean (Levant).

Assessment of biomass of pelagic resources (primarily European anchovy and European pilchard) in Montenegrin territorial and adjoining international waters for a decade has been subject to exploration of Marine Biology. Basic goal of the exploration is to determine biomass of pelagic fish species, percentage of prevalence and their spatial distribution.

The highest number of bone fish, lays eggs in free water, and for most species that lay eggs at the bottom, larvae and post-larvae are planktonic. Eggs, larvae and post larvae of these species live in plankton which is why they are called ichthyoplankton. Successful growth and survival of ichtyoplantkon has key impact on dynamics of fish population, therefore studying of these development stadiums is one of key tasks of fish biology.

Explorations that refer to European anchovy hatchering (*Engraulis encrasicolus*, L.) in the open sea of Montenegrin offshore are of exceptional importance especially because spatial distribution of eggs and fish larvae, assessment of mortality, reproductive parameters of adult fish population (hatchering, i.e. sexes, portion quality) through mathematical calculation gives assessment of production of eggs and larvae which leads to assessment of biomass of adult population of fish. Explorations started in 2005 in Montenegrin territorial waters, and continued in 2008 when the area of Montenegrin and Albanian territorial and neighboring international waters was included. Since 2010, Marine Biology Institute has been intensely participating in exploration and assessment of biomass of pelagic resources in the area of entire southern Adriatic Sea. Results of these explorations, which will be in part presented in this study and they refer to years 2010 and 2012, are presented each year to the Task Force of General Fisheries Commission of Mediterranean (GFCM) which contributes to the importance of these explorations that have been conducted in the rest of the Mediterranean for over 30 year. Results of exploration in 2013 still have not been presented to GFCM, and will not be included in this study.

Sea currents have great impact on spatial distribution of ihthyoplankton given that eggs and early larvae are not capable of movement, or to confront movement of water, so their position depends solely on dynamics of water masses, and are being passively carried by them.

<u>Hatchegging zone and/or fish feeding zone are regarded as zones of special importance, therefore it is necessary to ensure their preservation, promotion and protection.</u>

Since ichthyoplantkon is mainly located in water pillar between 0-20 m depth, its position is mostly affected by surface currents (Figure 5.14, Figure 5.15).

Assessment of biomass of pelagic resources and spatial distribution of plankton type of fish was prepared with application of two direct methods simultaneously – daily production of European anchovy eggs and larvae method (Daily Egg Production Method) and method of acoustic assessment.

Sampling of ichthyoplankton was done in hatchegging season, with surveying boat "G.DallaPorta" which is property of the Institute for Exploration of Marine Fishery from Ancona, Italy (Istituto di Scienze Marine, Consiglio Nazionale delle Ricecrche). In the process of ichthyoplankton sampling, two types of plankton nets were used. The net used in 2010 was Pairovet (modified CalVet) plankton net (Figure 5.46). The second type of net, used in 2012, is

WP2 net (Figure 5.47). The net is pulled vertically at 0.5 to 1 m/s. Maximum sampling depth was 100 m at each position (Figure 5.49,A). Temperature and salinity data were collected using SeaBird CTD probe (Figure 5.48).

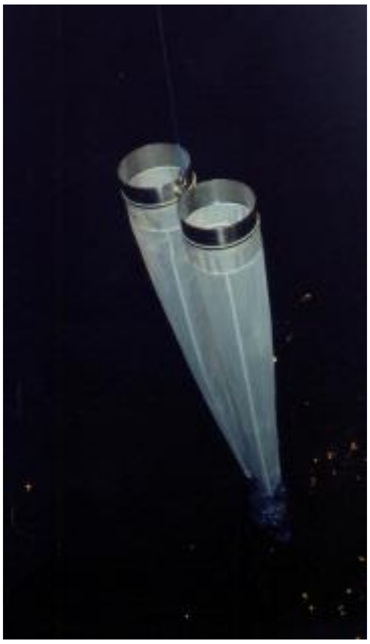


Figure 5.46 Pairovet Mreža

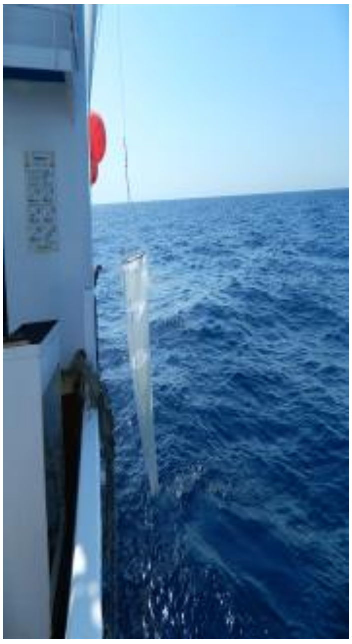


Figure 5.47 Hensen Mreža

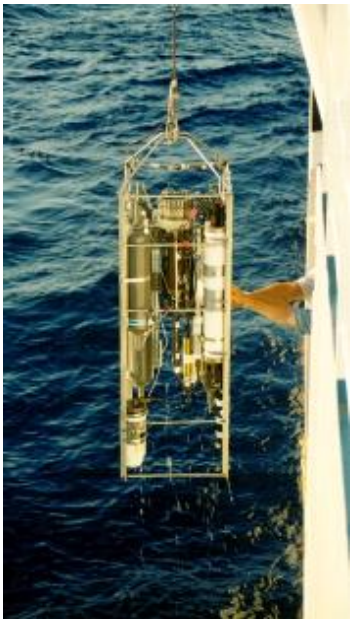


Figure 5.48 Seabird Sonda

Acoustic method was implemented on transects at a distance of 10 nautical miles and presented vertically to the coastal line (Figure 5.49,B). Transects are set at a distance of 1 – 1.5 nmi from the shore to 200 m isobaths thus covering the most significant part of the zone of distribution of small pelagic fish species. In Montenegrin waters (in the northern part of the surveyed area) it was not possible to monitor shallower segments (< 80 meters) due to proximity to the shore.

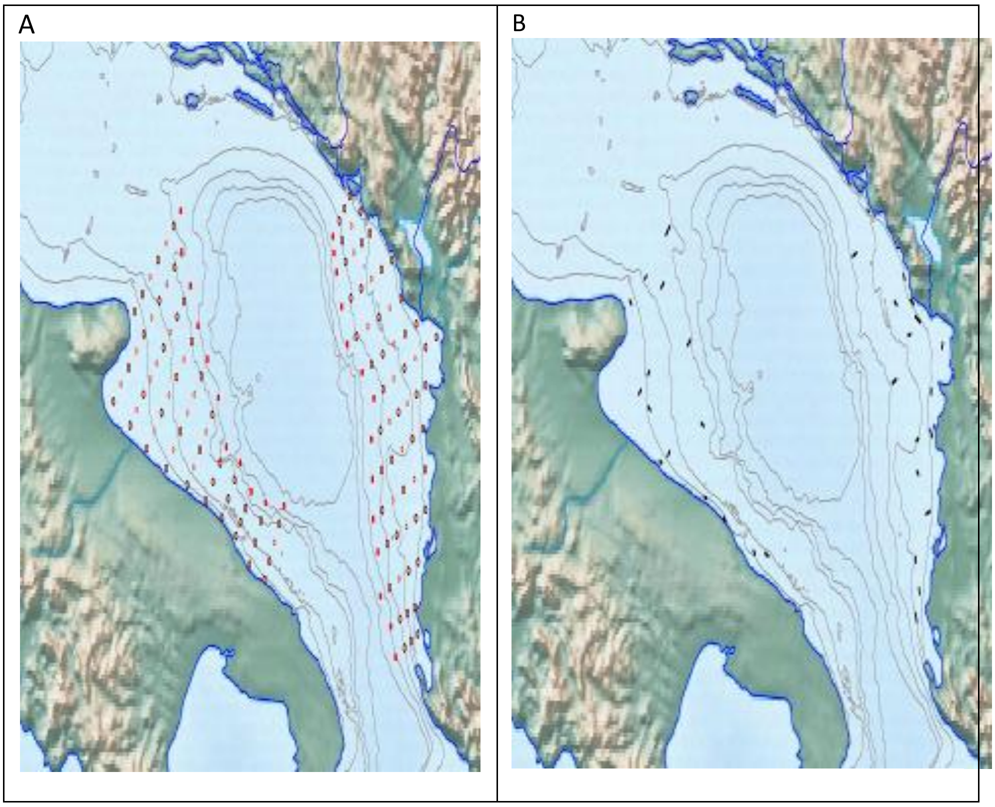


Figure 5.49 A. Positions of Ichthyoplankton Sampling.
B. Movement of Pelagic Trawler Where Sampling of Anchovy Adults Was Made

5.5.3.7 Spatial Distribution of Pelagic Fish Species and Hatchegging Zones in the Area of South-East Adriatic

Objective analysis of data was done using Surfer Golden Software 8 programme with application of kriging method (Figure 5.50 A & B). Results from 2010 survey showed that anchovy hatchegging zone stretches along internal part of the surveyed area, between the coastal zone and isobaths of around 100 m, while results from 2012 survey showed a slightly wider hatchegging zone stretching to 150 m isobaths.

Density of population of pelagic fish (Figure 5.51 and Figure 5.52) using acoustic method was determined in accordance with NASC coefficient (Nautical Area Scattering Coefficient) after eliminating noise and echo data obtained from organisms which were not targeted during the survey.

In addition to anchovy and European pilchard (*Sardina pilchardus*), which were targeted species during the survey with usage of the two aforementioned methods, the following species constituted substantial share:

- *Boops boops*, bogue
- *Sarda sarda*, Atlantic bonito
- *Spicara smaris*, picarel
- *Spicara maena*, blotched picarel
- *Trachurus trachurus*, Atlantic horse mackerel
- *Trachurus mediterraneus*, Mediterranean horse mackerel

- *Scomber japonicus*, chub mackerel
- *Sardinella aurita*, Round sardinella
- *Mullus barbatus*, species of goatfish
- *Merluccius merluccius*, European hake
- *Loligo vulgaris*, European squid
- *Alloteuthis media*
- *Trygla lucerna*, tub gurnard

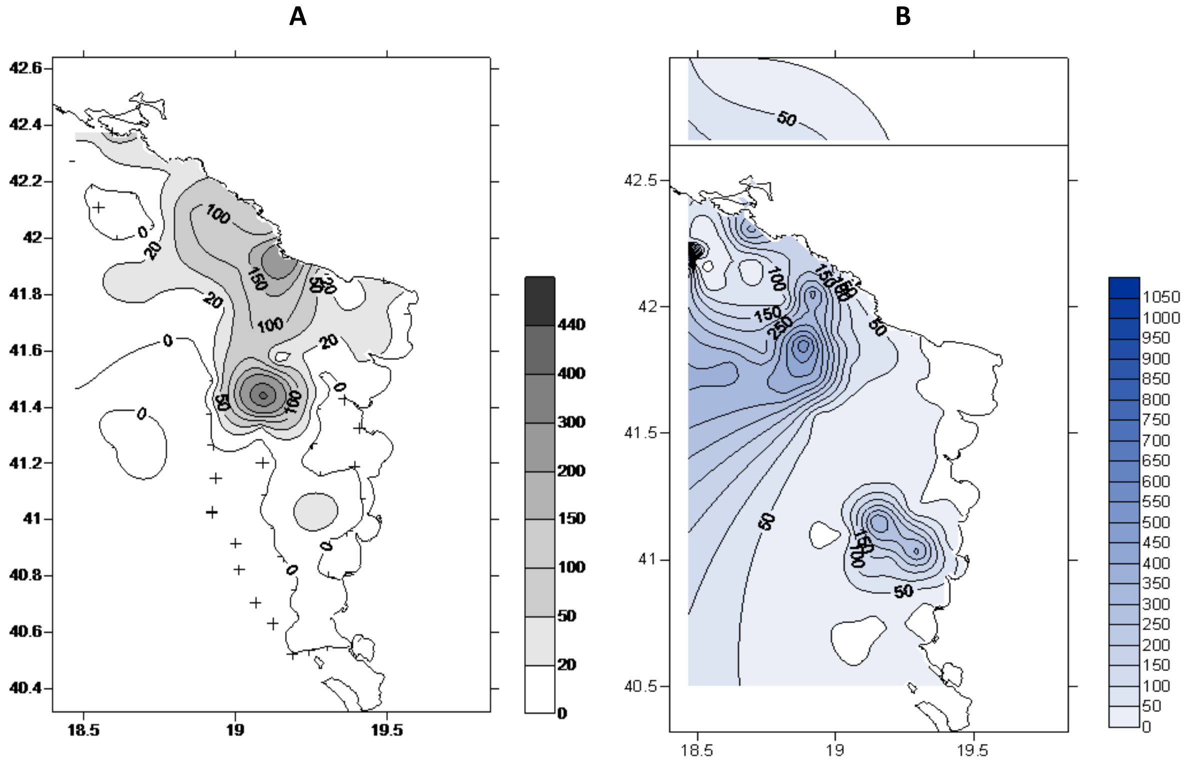


Figure 5.50 Spatial Distribution of Anchovy Hatchegging in Southeast Adriatic (A. 2010 & B. 2012)

Fluctuation in biomass of anchovy, European pilchard and other pelagic fish species is usual phenomena given that those are pelagic, short-lived species. Long term surveys of biomass and anchovy and European pilchard distribution in the area of southeast Adriatic show prevalence of anchovy in Montenegrin waters between 2002 and 2005, while European pilchard was prevailing species in all subsequent surveys (2008-2012). Bearing in mind the above mentioned fluctuations and fact that those are migratory species, variations in distribution of species in this part of the Adriatic can be expected.

Given the fact that anchovy and European pilchard represent a significant trophic connection between zooplankton and larger fish and predatory species of sea mammals in more productive seas (Cury *et al.*, 2000), in fishery biology, special attention is attached to hatchegging and feeding zones of these species.

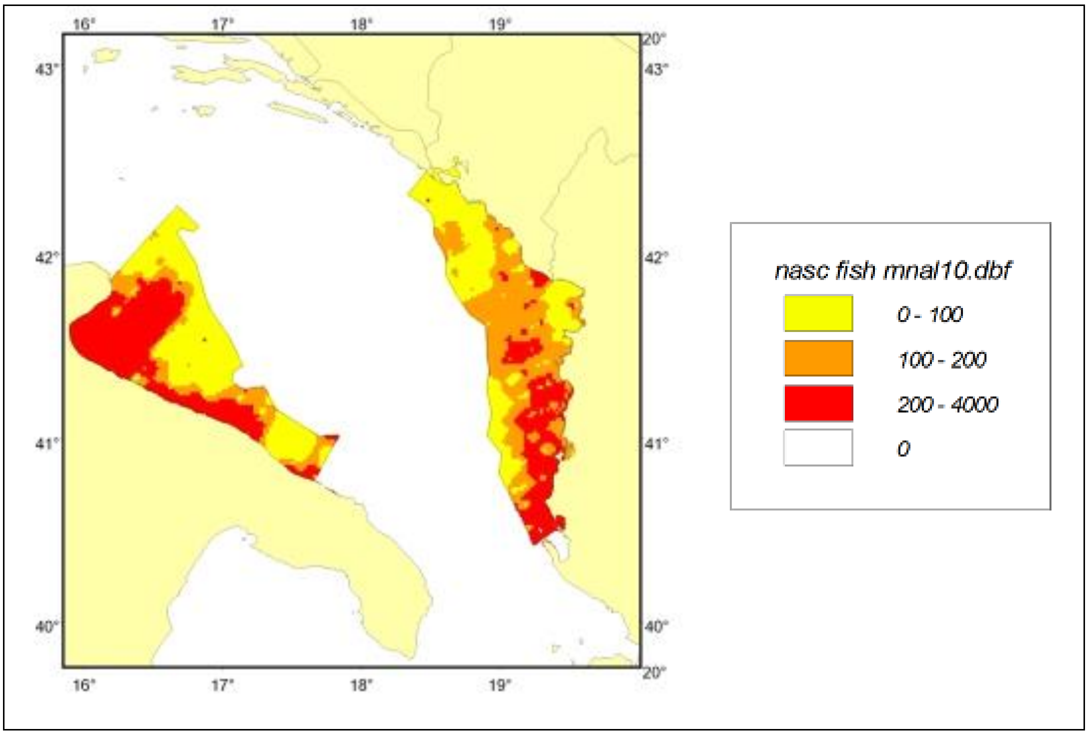


Figure 5.51 Spatial Distribution of Pelagic Species – Biomass Shown Per Density (2010)

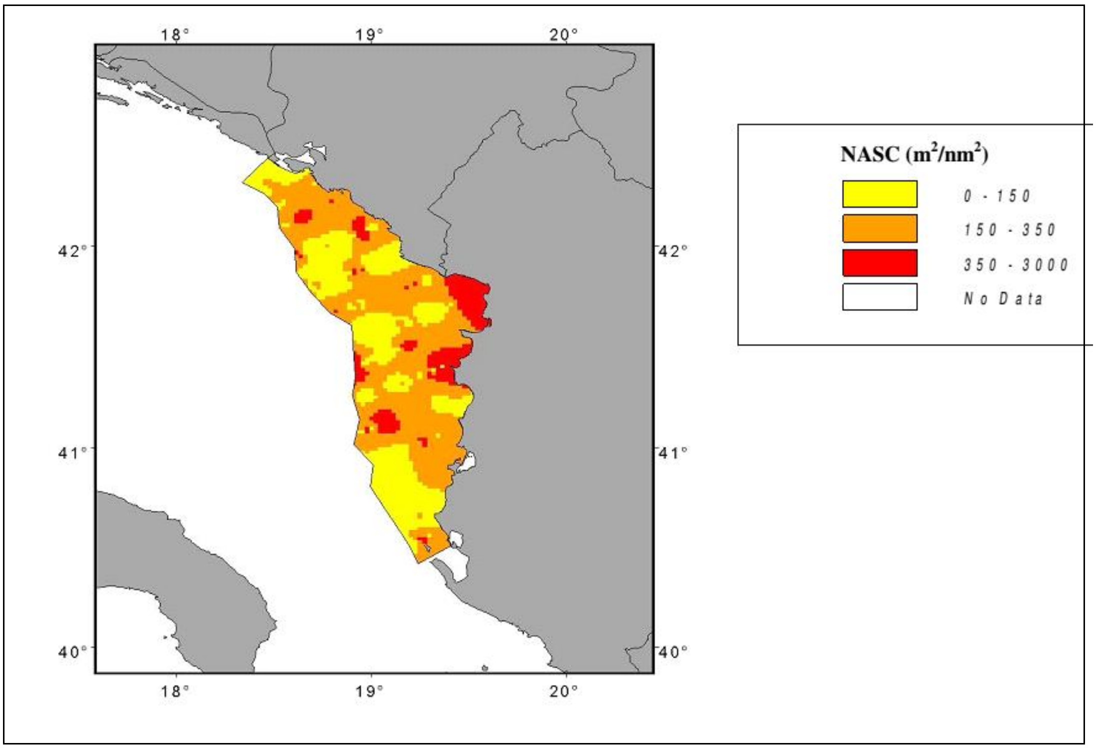


Figure 5.52 Spatial Distribution of Pelagic Species – Biomass Presented per Density (2012)

5.5.4 Sea Mammals

Mammal species that can often be found in the Adriatic are common dolphin, striped dolphin, while common dolphin – once the most common species amongst dolphins in the Mediterranean – is regarded as regionally extinct species. Whales are not often found and do not reside constantly in the Adriatic Sea, but occasionally enter the Adriatic from the Mediterranean Sea. Mediterranean monk once populated caverns and caves in the Montenegrin offshore, but today this species is regarded extinct in this area.

Common dolphin (*Delphinus delphis*), short-beaked common dolphin (*Tursiops truncatus*), striped dolphin (*Stenella coeruleoalba*), Atlantic spotted dolphin (*Stenella frontalis*) and Riso's dolphin (*Grampus griseus*), as well as the Mediterranean monk seal are species protected by Decision on placing certain flora and fauna species under protection (Official Gazette of MNE, 76/2006). Montenegro is signatory of various international conventions which include protection of all or individual species of sea mammals:

- ACCOBAMS Agreement (Bonn Convention) refers to all species of dolphins and whales;
- Barcelona Convention (R-1979) Amendments (Acc. 2001). SPA Protocol (R-1988). Protocol Concerning Specially Protected Areas and Biological Diversity;
- Bern Convention, Addendum II amongst other species includes the common dolphin.

IUCN red list for the Mediterranean is shown in Table 5.16. Categorization of endangered species in the Adriatic does not yet exist, and status for some spices in the Adriatic varies than the one in the Mediterranean (Common dolphin (*D. delphis*), regionally extinct species in the Adriatic, is categorized as endangered species in the Mediterranean).

Table 5.16 Sea Mammals That Reside in the Mediterranean and their Status According to the IUCN Red List (IUCN, 2014)

Species	Conservation status according to IUCN [1]
Cetartiodactyla	
Mysticetes (Baleen Whales)	
Fin Whale (*Balaenoptera physalus*)	VU
Odontocetes (Toothed Whales)	
long-finned pilot whale (*Globicephala melas*)	DD
common bottlenose dolphin or the Atlantic bottlenose dolphin (*Tursiops truncatus*)	VU
rough-toothed dolphin (*Steno bradanensis*)	LC
Cuvier's beaked whale or the goose-beaked whale (*Zyphius cavirostris*)	LC
False Killer Whale (*Pseudorca crassidens*)	DD
harbour porpoise (*Phocoena phocoena*)	LC
Short beaked common dolphin (*Delphinus delphis*)	LC
Orca, killer whale (*Orcinus orca*)	DD
Striped dolphin (*Stenella coeruleoalba*)	LC
Riso's dolphin (*Grampus griseus*)	LC
sperm whale (*Physeter macrocephalus*)	VU
Carnivora	
Pinnipedia	
Mediterranean monk seal (*Monachus monachus*)	CR

[1] IUCN categories: DD: Data Deficient; EN: endangered; LC: least concern; VU: vulnerable; CR: critically endangered.

5.5.4.1 Whales and Dolphins

The most common type of dolphin in Montenegrin waters are common bottle nose dolphin (*Tursiops truncatus*) and striped dolphin (*Stenella coeruleoalba*). Common bottle nose dolphins are mainly located close to the shore, often at around 100 m depths. They usually pile in smaller groups (of 3 do 10 individuals), however, cases of larger groups (15 + individuals) were reported. There are no scientific data on the number of individuals of common bottle nose dolphin in Montenegro, but during The First Photo Identification Survey of whales, dolphins and sea turtles (Montenegro Cetacean Photo ID Survey 2013) in spring-summer of 2013, around 70 individuals of common bottle nose dolphin were identified.

Striped dolphin is a species that resides in deep seas and rarely goes to depths lower than 200 m. during Photo ID surveying of whales and dolphins in Montenegro in 2013, no stripped dolphin was found, however, surveying included solely Montenegro's territorial waters.

Short-beaked common dolphin (*Delphinus delphis*) once was the most common dolphin species in Adriatic, however, today it has probably vanished. In the middle of 20th century, there was an active campaign of killing these dolphins due to the damages they cause to the fishermen by ripping their fishing nets to get food, which substantially contributed to extinction of this species from the Adriatic.

There are hardly any data on other species. One specimen of fin whale (*Balaenoptera physalis*) was spotted in 2012 in Boka Kotorska Bay. The whale most probably entered the bay accidentally and spent a few days looking for a way out.

In summer 2013, aerial surveying of the Adriatic was organized and three types of dolphin were identified in Montenegrin waters: common bottle nose dolphin, striped dolphin and goose beaked whale (Figure 5.53).

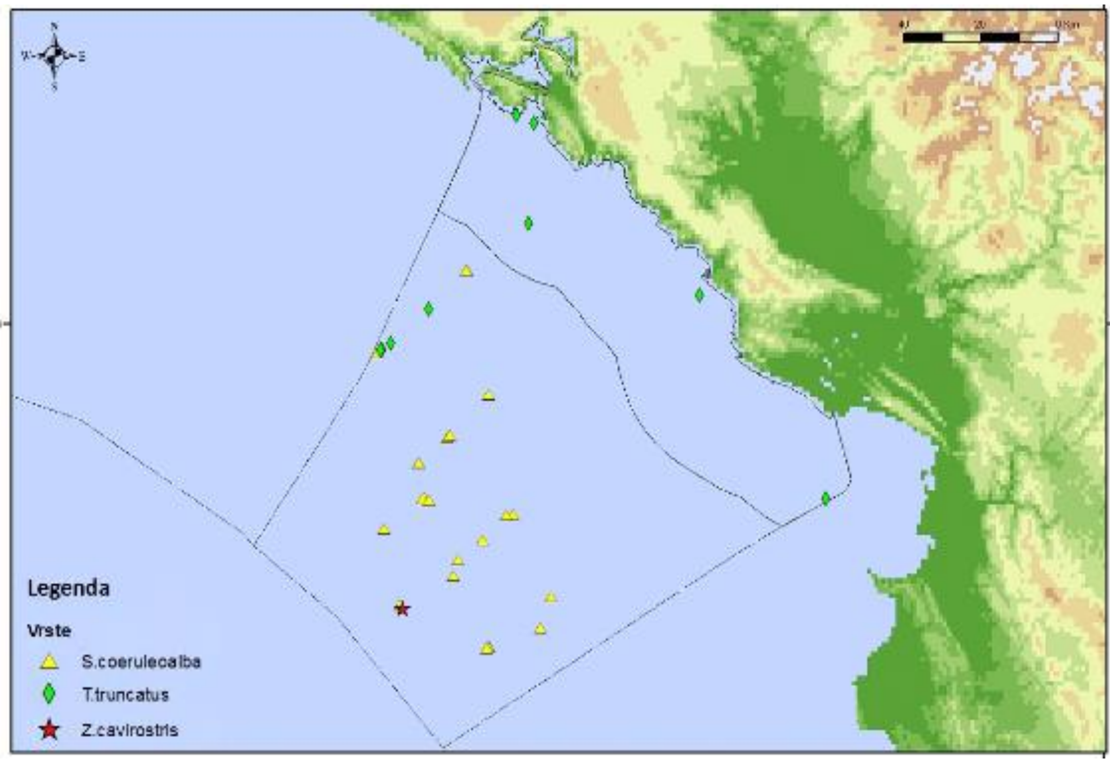


Figure 5.53 Whales and Dolphins Spotted in Montenegro in Aerial Surveying of the Adriatic, 2013

5.5.4.2 Mediterranean Monk Seal

In past, in the area of Montenegrin littoral, it was possible to spot Mediterranean monk seal (*Monachus monachus*), a type of seal (Pinnipedia) that resides in the Mediterranean Sea. Today it is considered that Montenegro does not have living specimens of this species, although it is assumed that individuals form Greek populations can go through the Strait of Otranto in search of caverns and caves suitable for giving birth. In Croatia, where it was also regarded as extinct, there were several reported cases of the monk seal, especially in the northern Adriatic (Pula).

The Mediterranean monk seal is a protected species in Montenegro by Decision of placing certain wildlife species under protection (O.G. MNE, 76/2006).

Institute for Marine Biology at the University of Montenegro is currently conducting marine caverns and caves surveying in Montenegrin littoral, and one of survey targets is to find traces of monk seal dwelling in caverns and caves.

Sea mammals' research in Montenegro is at a starting point. Institute for Marine Biology continues to carry out Photo ID surveying of dolphins and whales, however, it is a painstaking and demanding surveying.

5.5.5 Sea Turtles

The Mediterranean Sea is home to three species of sea turtles: green sea turtle (*Chelonia mydas*), leatherback sea turtle (*Dermochyls coriacea*) and loggerhead sea turtle (*Caretta caretta*).

Decision on placing certain wildlife species under protection (O.G. MNE, 76/2006) includes loggerhead and green sea turtle, but does not mention the leatherback turtle. The IUCN identified loggerhead and green sea turtle as endangered species (Table 5.17), while leatherback is categorized as vulnerable.

Table 5.17 Sea Turtles that Reside in the Mediterranean Sea and their Status According to IUCN Red List (IUCN, 2014)

Type	IUCN Category[1]
loggerhead sea turtle (*Caretta caretta*)	EN
green sea turtle (*Chelonia mydas*)	EN
leatherback sea turtle (*Dermochyls coriacea*)	VU

[1] IUCN categories: EN: endangered; VU: vulnerable

Sea turtles are protected also by following international conventions that Montenegro is signatory of:

- Barcelona Convention. Amendments (Acc. 2001). SPA Protocol;
- Barcelona Convention, Protocol Concerning Specially Protected Areas and Marine Biodiversity;
- Bern Convention
- CITES – Convention on International Trade in Endangered Species;
- Biodiversity Convention.

The loggerhead is the most frequently found turtle in the Adriatic. It breeds mainly in the Ionian Sea and the Mediterranean in general, however, there are a few nests in the Adriatic shore in south of Italy. During the survey of sea turtles and sea mammals, Institute for Marine Biology at University of Montenegro observed various adults and juniors of the loggerheads, but majority of them is marked in Albania. Younger specimens are pelagic and feed on medusa and other animals, and after a few years they move to sea bottom for food. They remain carnivores throughout their entire life. North Adriatic is one of several important locations for feeding in the Mediterranean, to which they probably go by following circulation of sea currents, which leads them through Montenegrin waters.

Green sea turtle lays eggs only on few beaches in Cyprus and Turkey. It is very rare in the Adriatic. Institute for Marine Biology has a registry of young green turtle for spring 2013 at Bigovo near Kotor. Green sea turtle adults are herbivores and they feed on sea grass *Posidonia oceanica* and *Cymodocea nodosa*. Young specimens are pelagic and they feed on medusa and other animals and when they reach 30 cm in length of the shell they become herbivores.

The leatherback sea turtles do not breed in the Mediterranean but individuals entre the Mediterranean and Adriatic Sea in search of food.

During aerial surveying of the Adriatic in 2013, individuals of loggerhead were spotted in Montenegrin waters, especially in the offshore area (Figure 5.54).

Sea turtles surveying in Montenegro is at a starting point and there isn't sufficient information to estimate state of population in territorial waters and epicontinental belt on scientific basis.

Such explorations require a lot of effort and funding and further researches are certainly recommended to ensure better management of resources.

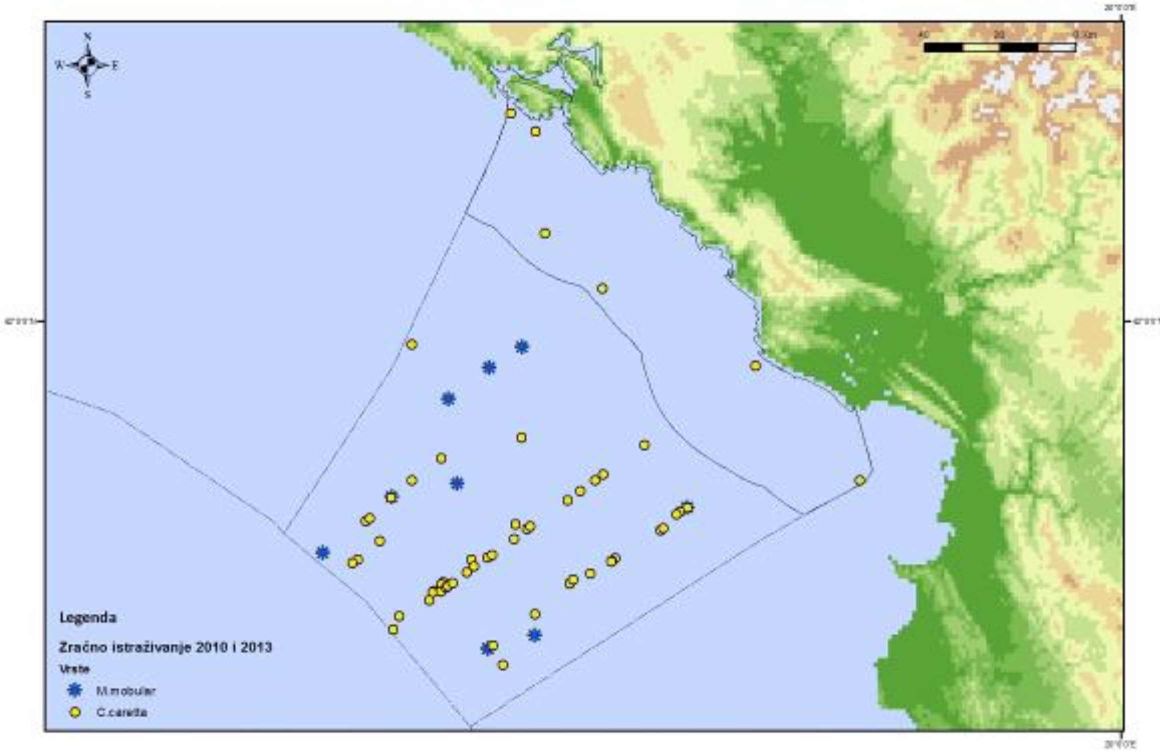


Figure 5.54 Sea Turtles and Eagle Rays Spotted in Aerial Surveying of the Adriatic in 2013

5.5.6 Fisheries on the Southern Adriatic (Fish, Cephalopodes, Crustacean) – Commercial and Recreational

In terms of number of fish species, Adriatic Sea is regarded as one of the wealthier seas, however, respective of the fish population density and exploitation options, it is regarded as a poor sea. The Adriatic Sea is recorded to have 407 fish species and sub-species (no Cyclostomata): 353 species and subspecies from Osteichtyes group and 54 species from Selachii or Chondrichtyes group, which is 70% known species and subspecies in the Mediterranean (around 579 species and subspecies) (Šoljan, 1965; Grubišić, 1967; Daoudi, 1987; Dulčić & Lipej, 2004; Jardas, 1997; Jardas, 1999). Indicated number of species and subspecies in the Adriatic Sea is categorized in 2 classes, 22 types and 117 families, including substantial number of taxonomic inter-groups (sub-class, sub-order, sub-family, etc.). Out of the total number of families, 21 of them constitute part of the class of cartilaginous fish and the rest are bony fish.

These 407 species and subspecies cannot be regarded as precise number due to various reasons, being 1) some species may not reside permanently in the Adriatic, they enter the Adriatic occasionally to hunt. Some rare species were spotted just once or several times; 2) the majority of south-Adriatic basin has not been ichthyologically explored thoroughly, especially at depths exceeding 500 meters, so it is logical to expect larger numbers of fish species after detailed surveying; and 3) there are still certain dilemmas on systematic categorization of certain fish species.

In regards to the cartilaginous fish, the most numerous is *Rijade* family, consisting of 11 species. Regarding bony fish, the most numerous is *Gobiidae* family consisting of 44 species and 1 subspecies, followed by *Labridae* family with 18 species, *Sparidae*, also with 18 species, *Blennidae* with 17 species. On the other hand, most fish families in the Adriatic is poor in species, as far as 74 families have 1 or 2 species.

According to some authors, there are 205 fish species living in the southern Adriatic part of which is Montenegrin territorial sea. Of that number, 140 populates Boka Kotorska Bay (Merker & Ninčić, 1973; Joksimović, 2007).

In a research made by ichthyologists from Slovenia and Croatia on Balkan biodiversity published by Kluwer Academic Publishers-London 2004, authors claim that they found 24 new Adriatic species, registered in the last decade. They explain this phenomenon by changes in climate and oceanographic factors which are evidently occurring in the Adriatic Sea basin, and by invasion of species from the Red Sea through Suez Channel. Those species took over 100 years to master temperature and other barriers and appear in the Adriatic. The Chapter: New Species in the Adriatic and Mediterranean Seas, Dulčuć and Dragičević (2011), includes 46 new species, scientifically described in the Adriatic Sea.

There are 241 species of decapodas living in the Adriatic (Kirinčić & Števčić, 2008) including, Decapoda Natantia and Decapoda Reptantia. With this, the Adriatic is regarded to be qualitatively a well explored sea given the fact that the number of surveyed decapodas in the entire Mediterranean, according to D'Udekem D'Acoz (1999) findings, is 340 species. Increase in number of registered decapodas in the past years is result of intensive oceanographic surveying and monitoring based on sampling using grabber, dredge and pull-nets from fishing vessels.

Decapoda Reptantia (species adjusted for crawling) include some of economically viable crustaceans, such as: *Palinurus elephas* (spiny lobster, crayfish or cray), *Homarus gammarus* (lobster), *Nephrops norvegicus* (shrimp), *Scyllarides latus* (Mediterranean slipper lobster), *Maja squinado* (European spider crab, spiny spider crab or spinous spider crab) whilst Decapoda Natantia (species adjusted for swimming) include *Parapenaeus longirostris* (Nika shrimp), *Melicertus kerathurus* (caramote prawn), *Aristeus antennatus* (red shrimp) and *Aristaeomorpha foliacea* (giant red shrimp).

In the southern Adriatic, according to Merker-Poček (1973), there are 77 registered decapoda species, categorized in 25 families. There are more Reptantia at smaller depths (up to 200 m), so their frequency per individual and weight rapidly drops parallel with increase in depth. However, certain species of Decapoda Natantia are more numerous at higher depths, especially the species: *Aristeus antennatus* and *Aristaeomorpha foliacea* which in many Mediterranean countries have great commercial importance, and in some they are halved. In Montenegrin waters, all deep marine species are poorly explored and poorly fished since activities of net vessels, due to their age and poor technical equipment, are limited to coastal waters. Amongst decapoda, the best explored species is deep-water rose shrimp, *Parapenaeus longirostris*, and lately great attention is being attached to commercially the most important type of decapoda, shrimp *Nephrops norvegicus*, which populates biological community of muddy sea bed of the Adriatic offshore and biological community of bathyal muds of south-Adriatic Valley. Its distribution depends more on the type rather than the depth.

Majority of species and subspecies of fish, except some endemic, in regards to biogeography, belongs to Mediterranean and Mediterranean-Atlantic area, i.e. east-Atlantic boreal province. Mediterranean biogeographic group forms 22% of Adriatic ichthyofauna, Mediterranean-Atlantic around 65%, cosmopolitan and other broader geographic species 11%, while Adriatic endemic species are quite few (some *Gobiidae*, *Syngnathidae*, *Acipenseridae*).

Composition of communities in certain parts of littoral, bathybenthal and abyssal does not solely depend on the depth but also on the nature of sea bottom whether rocky, sandy, muddy, scaly bottoms or meadows of sea flowering plants. Rocky bottom is usually rich in biomass and number of present types of plants and animals. In the Adriatic, it is mainly found along east shore, i.e. in front of Montenegrin coast. It is characterized by reefs, shallow areas that rise from great depth almost to the surface. Presence of benthos species of fish but also large flocks of pelagic fish swimming around is typical for reefs (Buljan & Zore-Armanda, 1971).

Sandy bottom is not as populated as rocky and it is less present in Montenegrin waters, mainly around Bojana River mouth. It is not particularly rich in fish however, there are certain types of fish, such as common soles. Muddy bottom covers most of the Adriatic Sea bottom; it is commercially considered the most valuable type of sea bed as it is used for commercial fishing with nets from vessels which exploit biological resources, primarily fish.

Undersea meadows are usually located in the coastal area and intensively perform photosynthesis. Bottoms with this cover are usually of great importance, especially in regards to reproduction of fish and as hiding place for younger fish.

Deep southern Adriatic, which has not been fully explored yet, is believed to home certain types of species of cephalopods and crustaceans that have not yet been described as findings in the Adriatic.

The most prevailing biological communities in the Adriatic Sea are terrigenous sediments detritions bottom of the open island area and open sea and muddy bottom of open sea.

Bio community of coastal terrigenous sediments, which in eastern Adriatic includes areas of channels and bays (Boka Kotorska Bay) are particularly populated by fish species *Spicara flexuosa* and *Serranus hepatus*, followed by *Mullus barbatus*, *Pagellus erythrinus* and other species chiefly bentopelagic species. For bio community of the muddy bottom of open sea, that includes mainly open area of central and southern Adriatic, generally with loam and clay sediments, *Gadidae* family is typical and dominant species are *Merluccius merluccius* and *Trisopterus minutus capelanus*, in addition to *Trachurus trachurus* and other bentopelagic species. Still, poorly mobile or fixed species of many other biosystematically lower animal groups (ex. sponges, cnidarians, Echinodermata, crustaceans) form real character of benthos communities and not fish.

For fish communities living in pelage, open water mass is their living space which makes them poorly or zero-dependent of sea bottom. These species are referred to as highly-migratory species that swim daily changing locations, mainly in search of food.

According to the Law on Sea Fishing and Marine Culture of MNE (Sl. List RCG 56/09), fishing sea of republic of Montenegro includes part of the coastal sea and epicontinental shelf. The line where river water flows into the sea causing the sea to lose its salinity is regarded as boundary of fishing sea.

In fact, unlike the fishing sea, fishing area of interest for Montenegro is much wider since it starts from the tital zone (mediolittoral) and stretches across the continental shelf, continental slope and flat plain in the southadriatic valley. For fishing and collecting benthos and semi-pelagic species, the most important are coastal belt of internal sea and shelf area (up to 200 m depth) which, just like in the entire Adriatic, is very narrow. At the height level of entrance into Boka Kotorska, shelf boundary is at around 9.5 nmi, and at Bojana river mouth at around 34 nmi from the coast. Besides the shelf, fishing of benthos species (according to Italian data) is also lucrative in the continental slop at depths from 500 to 600 m, because those are scampi settlements. Unlike fishing for benthos species, area of pelagic species fishing is economically effective all the way to the boundaries with Italian territorial waters.

Development of sea fishing after war period up to the 90's of last century in Montenegro was unknown. Besides Boka and area around Ulcinj, where fishing dates from the era of Nemanjic's rule, fishing on the other part of the shore was almost non-existent. In the 70's and 80's of last century, except intrusions of Italian fishing boats, only one Montenegrin net fishing boat was operating. All this resulted in preservation of the fish fund, which reflected on high amount of catch per net towing hour at that time (around 60 kg/h). However, in 1992/93 number of fishing boats started growing rapidly, so from 1997/98 there were 196 registered vessels for professional or supplementary fishing. Of that number, there were 17 ships and 14 fishing boats (8.65 shois/1000 km2). After 2000, there was a decrease in the fishing fleet, so from 2001 benthos fish fishing fleet is comprised of 17 ships and net boats. Such activity affected the natural state and doubtlessly lead to decrease in the number of fish population in the sea. Catch per hour of towing net dropped from 60 kg\h to 20 kg\h (Regner & Joksimović, 2002; Joksimović *et al.*, 2006).

For that reason, in 1997, Institute for Marine Biology launched a programme for monitoring and assessment of demersal biomass in Montenegrin shelf. Biomass has been estimated using coastal area method, when commercial fishing boats were used. Objective analysis of spatial distribution of biomass, performed by means of kriging method revealed that two areas had higher values (Carr, 1990); those are the areas between Budva and Petrovac up to 100 m isobaths and at the entrance into Boka Kotorska bay, up to 150 m isobaths. It is most likely that these concentrations are result of special hydrographic conditions, most probably permanent frontal zone in the right area and inflow of water from Boka Kotorska bay which is rich in nutrients than the open sea.

On the other hand, under impact of Bojana River, biomass is very small while number of caught non-adult individuals is far greater than in other parts of the shelf. That area evidently is a feeding place for young fish and it needs to be given special attention while operating fishing vessel.

From 2004, MEDITS explorations of abundance and biomass of benthos organism in the territorial sea of Montenegro are being performed which include all batimetric stratums (0-200 meters depth, 200-500 m and 500-800 meters depth). Results for abundance and biomass of the most prevailing fish species in different depth stratums are shown in Table 5.18. The biggest diversity of ichthyofauna was recorded in the stratum of up to 200 m depth, where at the same time biomass index is highest. In that stratum, the biggest number of economically important species is present: *Mullus barbatus*, hake *Merluccius merluccius*, sea bream *Pagellus erythrinus* etc. as depth increases, the number of present species decreases, so in the stratum of 200 to 500 m there are only 30 species, whilst stratum 500 – 800 m has solely 18 fish species. At the same time, composition of ichthyofauna changes so all these stratums have representatives of deep sea fauna. With increase in depth and decrease in species, biomass index drops (kg/km^2).

Table 5.18 Benthos Fish Species per Abundance Indexes (N/km2) and Biomass (kg/km2) per Depth Stratum (10-200, 200-500 and 500-800 m)

Latin name	Local name	Depth Stratum (m)	Abundance Index (N/km^2)	Biomass Index (kg/km^2)
Spicara flexuosa	Pickerel	10-200	24143.71	263.83
Mullus barbatus		10-200	6615.82	97.57
Spicara smaris	Pickerel	10-200	4896.81	72.23
Merluccius merluccius	Hake	10-200	4354.97	72.17
Trachurus trachurus	Atlantic horse mackerel	10-200	3112.47	23.74
Lepidotrigla cavillone	large scale gurnard	10-200	2035.20	49.47
Scomber (Pneumatophorus) japonicus	Chub mackerel	10-200	1941.31	23.08
Gadiculus argenteus	Silvery pout	10-200	1501.84	11.18
Serranus hepatus	Brown comber	10-200	1489.84	21.15
Pagellus erythrinus	Sea bream	10-200	1080.46	10.70
Aspitrigla cuculus	Red gurnard	10-200	738.16	29.86
Macroramphosus scolopax	longspine snipefish	10-200	682.81	25.73
Boops boops	bogue	10-200	633.77	2.64
Scyliorhinus canicula	small-spotted catshark	10-200	555.11	17.52
Capros aper	Boar fish	10-200	517.69	82.23
Deltentosteus(Gobius) quadrimaculatus	Four-spotted goby	10-200	473.06	0.95
Argentina sphyraena	Lesser argentine	10-200	471.86	2.05
Trisopterus minutus capelanus	Mediterranean poor cod	10-200	448.80	5.19
Citharus linguatula (macrolepidotus)	Spotted flounder	10-200	281.00	1.22
Arnoglossus laterna	Mediterranean scaldfish	10-200	268.78	6.13
Helicolenus dactylopterus	blackbelly rosefish	10-200	242.68	1.44
Dentex macrophthalmus	Large-eye dentex	10-200	230.46	13.65
Trachurus mediterraneus	Mediterranean horse mackerel	10-200	214.84	2.86
Leusueurigobius (Gobius) friesii	Fries's goby	10-200	191.19	12.24
Merluccius merluccius	European hake	200-500	1416.86	37.14
Chlorophthalmus agassizii	Shortnose greeneye	200-500	875.12	4.95
Glossanodon leioglossus	Smalltoothed argentine	200-500	651.13	6.77

Latin name	Local name	Depth Stratum (m)	Abundance Index (N/km²)	Biomass Index (kg/km²)
Helicolenus dactylopterus	blackbelly rosefish	200-500	479.23	25.68
Molva dipterygia	blue ling	200-500	411.52	6.25
Maurolicus muelleri	Muller's bristlemouth fish	200-500	369.84	0.22
Scyliorhinus canicula	small-spotted catshark	200-500	328.17	4.27
Micromesistius poutassou	blue whiting	200-500	203.15	20.21
Phycis blennoides	Greater forkbeard	200-500	187.53	11.10
Gadiculus argenteus	silvery pout	200-500	182.32	0.70
Mullus barbatus	Mullus barbatus	200-500	135.44	8.02
Lepidorhombus boscii	four-spot megrim	200-500	88.55	8.28
Arnoglossus rueppelli	Ruppell's scaldfish	200-500	83.34	0.65
Capros aper	Boar Fish	200-500	83.34	1.25
Leusueurigobius (Gobius) friesii	Fries's goby	200-500	78.14	0.10
Macrorhamphosus scolopax	longspine snipefish	200-500	57.30	0.52
Lepidorhombus whiffiagonis	megrim or whiff	200-500	46.88	6.72
Lepidotrigla dieuzeidei	spiny gurnard	200-500	46.88	0.89
Pagellus bogaraveo	Blackspot seabream	200-500	26.05	1.88
Peristedion cataphractum	African armoured searobin	200-500	26.05	0.39
Trachurus trachurus	Horse mackerel	200-500	20.84	3.44
Acantholabrus palloni	scale-rayed wrasse	200-500	15.63	0.68
Raja clavata	Thornback ray	200-500	15.63	2.77
Nezumia sclerorhynchus	Roughtip grenadier	500-800	580.23	11.01
Lampanyctus crocodilus	jewel lanternfish	500-800	438.14	6.51
Phycis blennoides	Greater forkbeard	500-800	165.78	29.60
Trachyrhynchus trachyrhynchus	Mediterranean longsnout grenadier	500-800	153.94	24.39
Hoplostethus mediterraneus	silver roughy	500-800	130.26	11.72
Galeus melastomus	blackmouth catshark	500-800	94.73	17.95
Hymenocephalus italicus	Glasshead grenadier	500-800	71.05	0.30
Mora moro	Common mora	500-800	71.05	10.42
Helicolenus dactylopterus	blackbelly rosefish	500-800	47.37	10.07
Chimaera monstrosa	Rabbit fish	500-800	23.68	7.67
Etmopterus spinax	velvet belly lanternshark	500-800	23.68	1.55
Lepidorhombus boscii	four-spot megrim	500-800	23.68	3.28
Coelorhynchus coelorhynchus	Hollowsnout grenadier	500-800	11.84	0.12
Gadella maraldi	Gadella	500-800	11.84	0.06
Merluccius merluccius	European hake 2	500-800	11.84	40.20
Nettastoma melanurum	Blackfin sorcerer	500-800	11.84	0.71

Latin name	Local name	Depth Stratum (m)	Abundance Index (N/km²)	Biomass Index (kg/km²)
Symbolophorus veranyi	Large-scale lantern fish	500-800	11.84	0.12

Cephalopods had the highest biomass index at stratus up to 50 m depth (156.6 kg; Table 5.19) while the highest value of abundance index was recorded in 50-100 m stratum (17498.2 N/km²). Both indexes had the lowest value at the deepest surveyed stratum.

Table 5.19 Abundance Indexes (N/km²) and Biomass Indexes (kg/km²) for Cephalopods, According to Stratus' Depths (10-50, 50-100, 100-200, 200-500 and 500-800 m)

Depth stratums (m)	Abundance index (N/km²)	Biomass Index (kg/km²)
10-50	5532.5	168.0
50-100	17498.2	156.6
100-200	3884.3	114.8
200-500	1458.5	78.2
500-800	142.1	9.9

In stratum up to 200 m depth, the most numerous species is European squid (*Loligo vulgaris*) with 3112.5 individuals per km², while southern shortfin squid (*Illex coindetii*) has the highest biomass index of 49.5 kg/km² (Table 5.20). In that stratum, most economically important species of cephalopods are caught through boat fishing. These species include, in addition to the two above mentioned species, musky octopus (*Eledone moschata*) and curled octopus (*E. cirrhosa*), common octopus (*Octopus vulgaris*), Lesser Flying Squid (*Todaropsis eblanae*) and Common Cuttlefishes (*Sepia officinalis*). And other species from this stratum can be also used for human nutrition however, due to small catch or small size of the individuals, they are not important for commercial fishing.

In stratum from 200 to 500 m depth, dominant species are types of squid, *Illex coindetii* and *Todaropsis eblanae*, both in respect to abundance and biomass.

Least number of cephalopods was recorded at depths from 500 to 800, that is two species, *Ancistroteuthis lichetensteinii* and squid (*Todaropsis eblanae*).

Table 5.20 Type of Cephalopods per Abundance Indexes (N/km²) and Biomass (kg/km²) per Depth Stratum (10-200, 200-500 and 500-800 m)

Latin named	Depth Stratum (m)	Abundance Index (N/km²)	Biomass Index (kg/km²)
Alloteuthis media	10-200	2151.2	6.4
Alloteuthis subulata	10-200	189.4	0.8
Eledone cirrhosa	10-200	79.8	8.5
Eledone moschata	10-200	75.3	10.0

Latin named	Depth Stratum (m)	Abundance Index (N/km²)	Biomass Index (kg/km²)
Illex coindetii	10-200	2035.2	49.5
Loligo vulgaris	10-200	3112.5	23.7
Octopus vulgaris	10-200	36.6	13.5
Rondeletiola minor	10-200	9.1	0.0
Rossia macrosoma	10-200	9.1	0.2
Scaeurgus unicirrhus	10-200	3.0	0.3
Sepia elegans	10-200	847.8	6.3
Sepia officinalis	10-200	2.1	0.3
Sepia orbignyiana	10-200	116.3	3.0
Sepietta oweniana	10-200	48.5	0.2
Sepiola robusta	10-200	31.8	0.2
Todaropsis eblanae	10-200	148.6	11.7
Eledone cirrhosa	200-500	20.8	3.3
Illex coindetii	200-500	515.7	21.8
Loligo forbesi	200-500	10.4	1.6
Octopus salutii	200-500	15.6	1.8
Pteroctopus tetracirrhus	200-500	5.2	4.9
Rondeletiola minor	200-500	135.4	0.4
Rossia macrosoma	200-500	26.0	1.6
Sepietta oweniana	200-500	83.3	0.4
Todarodes sagittatus	200-500	20.8	2.7
Todaropsis eblanae	200-500	625.1	39.8
Ancistroteuthis lichtensteinii	500-800	23.7	0.5
Todaropsis eblanae	500-800	106.6	8.3

Crustaceans had the highest biomass index (kg/km²) in stratum from 100 to 200 m depth (18.78 kg/km², Table 5.21), while the highest abundance index was in stratum from 200 to 500 m depth (3734.89 N/km²). Both indexes were lowest at stratum up to 50 m depth (0.91 kg/km² i 45.53 kg/km²).

Table 5.21 Abundance Indexes (N/km2) and Biomass Indexes (kg/km2) for Crustaceans, According to Stratus' Depths (10-50, 50-100, 100-200, 200-500 and 500-800 m)

Depth stratums (m)	Abundance index (N/km^2)	Biomass Index (kg/km^2)
10-50	45.53	0.91
50-100	378.46	2.89
100-200	2488.78	18.78
200-500	3734.89	16.89
500-800	899.96	9.04

Among crustaceans, only two types of decapods were recorded in stratum up to 200 m depth, European spider crab *Maja squinado* and deep-water rose shrimp *Parapenaeus longirostris*, which was most numerous in stratum up to 200 m and stratum from 200 to 500 m depth. This species has the highest biomass index of all registered species of decapods (11.18 kg/km^2 in stratum up to 200 m and 12.34 kg/km^2 in stratum 200-500 m) (Table 5.22) and is commercially the most important type of decapods. In stratum 200 to 500 m, arrow shrimp, *Plesionika heterocarpus*, shows great values. It is edible but does not have commercial importance. Shrimp, *Nephrops norvegicus* shows low abundance and biomass index. At stratum 500 to 800 m, dominant species are *Aristeus antennatus and Polycheles typhlops*.

Table 5.22 Types of Crustaceans According to Abundance (N/km2) and Biomass (kg/km2) Indexes per Depth Stratum (100-200, 200-500 and 500-800 m)

Latin name	Depth stratum (m)	Abundance index (N/km^2)	Biomass Index (kg/km^2)
Maja squinado	10-200	3.03	0.18
Parapenaeus longirostris	10-200	1501.84	11.18
Chlorotocus crassicornis	200-500	5.21	0.01
Nephrops norvegicus	200-500	72.93	2.00
Parapenaeus longirostris	200-500	1844.01	12.34
Plesionika antigai	200-500	67.72	0.08
Plesionika heterocarpus	200-500	1745.04	2.45
Aristaeomorpha foliacea	500-800	59.21	1.18
Aristeus antennatus	500-800	272.35	5.80
Plesionika martia	500-800	201.31	1.07
Polycheles typhlops	500-800	355.25	0.95
Sergestes arcticus	500-800	11.84	0.04

During 2008 and 2010, surveying in the deep part of south Adriatic valley was carried out at depths from 900 to 1200 meters. List of all encountered species in this area, as well as their density are shown in Table 5.23.

Table 5.23 List of Species Registered by Sampling Using Trawl in FAO AdriaMed Project (2008 & 2010) and Their Density

Species	Local name	Density %
Bony fish		
Argyropelecus hemigymnus	half-naked hatchetfish	54.55
Bathypterois dubius	Mediterranean spiderfish	4.55
Benthosema glaciale	Glacier Lantern Fish	90.91
Cataetyx alleni		4.55
Cerastocopelus maderensis	Madeira lantern fish	13.64
Chauliodus sloani	Sloane's viperfish	81.82
Coelorhyncus mediterraneus	Dugorepac rilaš	40.91
Cyclothone braueri	Bent - tooth lightfish	4.55
Electrona rissoi	Electric lantern fish	4.55
Gadella maraldi	Gadella	4.55
Hygophum benoiti	Benoit's lanternfish	4.55
Lampanyctus crocodilus	jewel lanternfish	95.45
Lampanyctus pusillus	Pygmy lanternfish	54.55
Lepidion lepidion	Mediterranean codling	77.27
Lobianchia dofleini	Dofleini's lantern fish	13.64
Lophius budegassa	Blackbellied angler	4.55
Maurolicus muelleri	Mueller's pearlsides	9.09
Melanostigma atlanticum	Atlantic soft pout	22.73
Mora moro	Common mora	36.36
Nettastoma melanurum	Blackfin sorcerer	13.64
Nezumia aequalis	Common Atlantic grenadier	40.91
Notacanthus bonapartei	Shortfin spiny eel	13.64
Notolepis rissoi	Pacific spoon-nose eel	4.55
Notoscopelus elongatus		13.64
Phycis blennoides	Greater forkbeard	4.55
Polyacanthonotus rissoanus	Smallmouth spiny eel	4.55
Stomias boa	Boa Scaly Dragonfish	36.36
Symbolophorus veranyi	Large-scale lantern fish	40.91
Trachyrhynchus trachyrhynchus	Mediterranean longsnout grenadier	63.64
Vinciguerria poweriae	Power's deep-water bristle-mouth fish	13.64
Cartilaginous fish		
Chimaera monstrosa	Morski pacov	18.18

Species	Local name	Density %
Etmopterus spinax	Kostelj crnac	36.36
Galeus melastomus	Mačka crnousta	81.82
Raja nidaraniensis	Norveška raža	4.55
Rakovi		
Acanthephyra pelagica	Dubokomorska crvena kozica	40.91
Aristeus antennatus	Crvena kozica	36.36
Bathynectes maravigna	Dubokomorski veslač	4.55
Gennadas elegans	Mala mekušica	72.73
Geryon longipes	Dubinski crveni rak	9.09
Pasiphaea sivado	Bijelo kristalna kozica	27.27
Plesionika heterocarpus	Streličasta kozica	9.09
Plesionika martia	Zlatna kozica	13.64
Polycheles typhlops	Pješčani oklopnik	40.91
Pontophilus norvegicus	Norveška kozica	63.64
Pontophilus spinosus	Boljikava kozica	4.55
Sergestes arcticus	Člankovita batipelagična kozica	59.09
Sergestes henseni	Hensenova batipelagična kozica	13.64
Sergestes robustus	Snažna batipelagična kozica	86.36
Sergestes sargassi	Sargaška batipelagična kozica	4.55
Sergestes vigilax	Živahna batipelagična kozica	4.55
Glavonošci		
Ancistroteuthis lichtensteini	Anđeoska lignja	18.18
Chiroteuthis veranyi	Veranijeva lignja	9.09
Chtenopteryx sicula	Zuborepa lignja	9.09
Galiteuthis armata	Bodljasta lignja	13.64
Heteroteuthis dispar	Neobični bobić	9.09
Histioteuthis reversa	Lignja dragulj	27.27
Onychoteuthis banksi	Borealna lignja	9.09
Todarodes sagittatus	Lignjun veliki	9.09

Resources of small blue fish in the offshore are still quite limited for massive commercial fishing, so these resources are not being exploited to such extent. Initial explorations and assessments of these resources commenced in 2002 and have been continuous until 2013 by means of echo-probe and DEP method (Daily Egg and Larvae Production Method). Results indicate that around 60% of the catch of all pelagic types of fish consists of European pilchard, *Sardina pilchardus*, around 30% of anchovy *Engraulis encrasicolus*, while the remaining 10% accounts for other pelagic and semi-pelgaic species: Horse mackerel *Trachurus trachurus*, Atlantic mackerel *Scomber scomrus*, Chub mackerel *Scomber japonicus*, Bogue *Boops boops* etc. (Azzali *et al*, 2002; Regner *et al.*, 2006; Regner *et al.*, 2007).

There are no data on precise biomass of coastal types of fish, crustaceans and cephalopods, however, it is believed that the amount of catch is substantial. Nearly all types of drift nets are used (poponice, polandare i prostice) and fishing nets with hooks. Smaller share is caught using trawling nets (šabakunom i migavicom).

All conducted explorations of benthos resources biomass as well as parameters for population dynamics of economically important types of fish, hake *Merluccius merluccius*, *Mullus barbatus,* Sea bream and crustaceans, deep water rose shrimp *Parapenaeus longirostris* indicate that benthos settlements in Montenegrin littoral at this moment are at the verge of being overfished. Regardless of already indicated factors, which, with increase in number of ships could affect reduction in biomass, the most important is to assume protection measures to ensure that the catch does not exceed maximum biologically permitted boundaries. If intensity of trawler boat fishing would maintain at the estimated, by means of legal regulations, MSY of 602.6 tonnes per year which can be achieved with fishing effort of 1190 fishing days and prevent usage of nets with openings less than 20 mm, demersal resources would probably recover (Regner & Joksimović, 2001; 2002; Regner *et al.*, 2002, Joksimović, 1999; 2000; GFCM, 2012).

The manner of commercialized fishing applied in the fishing area of Montenegrin littoral are:

- Fishing of demersal (near the bottom) types of fish, crustaceans, cephalopods, by trawling the nets – trawlers
- Fishing of pelagic fish (small and large blue fish) using floating nets, drag nets and drift nets
- Fishing for coastal, pelagic, semipelagic and bottom fish species, crustaceans and cephalopods (commercial fishing of shells at Montenegrin littoral is undeveloped) with drift nets, coastal dragnets, "ciplarama" purse seine net , "kalimerom" - Shore-operated lift net, bottom pull-nets and various other types of hooks, artificial light, etc.

Sport fishing is also conducted with different types of hooks (povrazima, kanjčenicama, omecima, samolovkama, panulama, fishing rods with natural or artificial baits, parangalima do 200 udica), artificial light up to 400 candelas and underwater guns.

Estimated biomass of demersal resources is twice lower than similar assessment in 1973 when it amounted to 3400 tonnes (Jukić, 1973), while nowadays it amounts to 1700 tonnes. Decrease of catch from 60 to 20 kg of fish per hour also shows that settlements of commercial types of fish have reduced. Also, percentage of cartilaginous fish in the overall catch dropped from 32% to 20%. Even though number of trawling boats and their fishing reduced from 1999, it has been observed that biomass continues to decline. Based on these data, it was estimated that biologically Maximum Sustainable Yield - MSY of these resources is 602 tonnes a year, i.e. calculated optimal fishing stress of 1190 days a year (Regner *et al.,* 2002).

By gathering information the fishermen and using rough statistics, it is assumed that annual catch is around 1200 tonnes a year of quality types of fish, crustaceans and cephalopods (Regner *et. al*., 2002).

Ministry of Agriculture and Rural Development the authority responsible for marine fishing. Basic document that sets out marine fishing sector in Montenegro is Law on marine fishing and marine assets 56/09 and Rulebook on closer defining marine fishing published in Official Gazette 2011 and 2013.

Other applicable regulations related to fishing are: agreements (Code of Conduct for Responsible Fishing, UN Convention on the Law of the Sea, 1982), directives and recommendations of General Fisheries Commission for the Mediterranean, which Montenegro is a member of since 2007, as well as IUCN Red List, EC Red List, Bern Conventionand CITES convention. With the Decision on placing rare, scarce, endemic and endangered flora and fauna species ("Official Gazette of MNE " No. 25/06), certain number of fish and other sea organisms protected at the territory of Montenegro, must not be killed, destroyed, removed from their habitats, damaged and destroyed except for scientific, research and development purposes. Table 5.24 contains a list of protected species in Montenegro and their degree of protection.

Table 5.24 Protected Fish Species in Montenegro and the Degree of their protection

Latin name	Local name	Red list IUCN[1]	Red list EU[2]	Bern[3]	Status CITES[4]	CG.[5]
Acipenser naccarii	Adriatic sturgeon	VU		Appendix II	Appendix II	Z
Acipenser sturio	sturgeon	CR		Appendix III	Appendix I	Z
Acipenser stellatus	starry sturgeon	EN		Appendix III	Appendix II	Z
Huso huso	beluga	EN		Appendix III	Appendix II	Z
Cetorhinus maximus	basking shark	VU			Appendix II	Z
Carcharodon carcharias	great white shark	VU			Appendix III	Z
Lamna nasus	porbeagle	VU				Z
Mobula mobular	giant devil ray	EN				Z
Hippocampus guttulatus	long-snouted seahorse	DD			Appendix II	Z
Hippocampus hyppocampus	short-snouted seahorse	DD			Appendix II	Z

1 IUCN Red list: **VU** =vulnerable, **EN**= Endangered, **CR** = critically endangered**, DD=** data deficient.

2 Economic Commission for Europe: European Red List of Globally Threatened Animals and Plants and recommendations. categories: **R** = rare species not endangered by due to sensitivity are regarded as risky. **K** = species with insufficient data to be categorized, **K*** = species whose status is being regarded (ICBP) and are soon to be categorized, **E** = species that are endangered, survival of those species is endangered if impact of negative factors continues

3 Bern Convention (Convention on the Conservation of European Wildlife and Natural Habitats). Bern 1979. Categories : **A II** = strictly protected species with special protection measures, including ban on killing, capturing, keeping, disrupting, etc., **A III** = species that undergo protection measures, including closed season, limited exploitation, local bans and turnover control.

4 CITES (Washington Convention) (Convention on Interception trade in Endangered Species of Wild Fauna and Flora) Washington, 1973. Category: **An 1** = species at danger of extinction under actual or potential trade impact

5 Decision on placing rare, scarce, endemic and endangered flora and fauna species ("Official Gazette of MNE " No. 25/06). Species marked **Z** are protected and those species and their development forms must not be killed, destroyed, removed from their natural habitats, damaged or destroyed in any way, except for scientific-research and development purposes

5.5.7 Birds

Montenegro's location along a major migratory route (the Adriatic flyway, apart from Gibraltar and Aegean corridors, is the third most important in Europe) and diversity of natural habitats result in high avian diversity.

According to Bird Life International (BLI), there are 311 species of birds in Montenegro, 12 of them are globally threatened. Among 21 species of seabirds, one is categorized as vulnerable (*Clangula hyemalis*) and one as endangered (*Melanitta fusca*) (Table 5.25). There are 262 migratory birds, those with a protection status according to IUCN are presented in Table 5.26.

Acording to Bird Life Intenational, Montenegro has 5 Important Birds Areas (IBAs) shown in Figure 5.55, which are:

1. Biogradska Woods
2. Durmitor
3. Sasko Lake
4. Skadar Lake
5. Ulcinj Saltpans

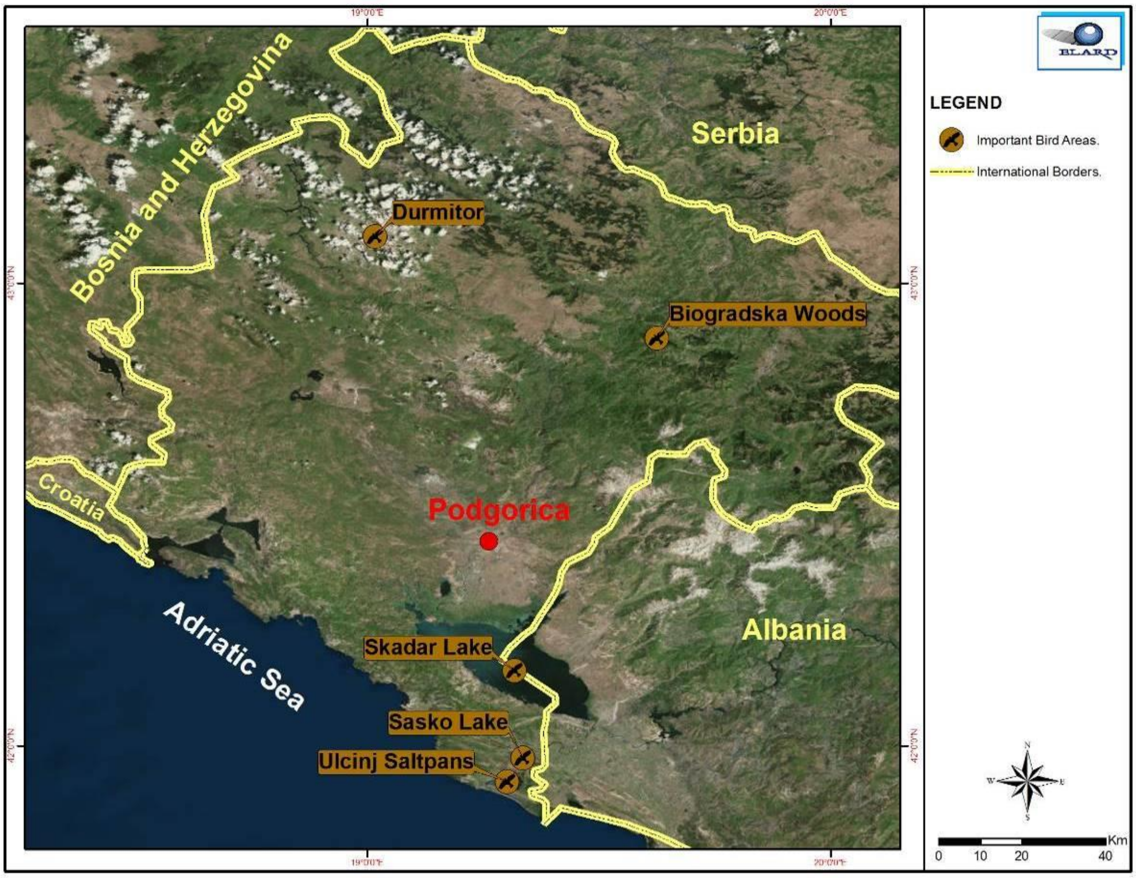


Figure 5.55 Important Bird Areas in Montenegro according to BLI

According to the Center for the Protection and Research of Birds of Montenegro, there are 13 Important Bird Areas, namely: Bojane Delta, Rumija, Buljarica, Skadar Lake, Tivatska solila, Ćemovsko polje, Prokletije, Plav Lake, Niksic accumulation, Hajla, Biogradska Mountain/Bjelasica, Durmitor and Cijevne Canyon; and 7 potential sites, namely: River Zete Valley, Kucke planine, Visitor, Komovi, Golija, Pivska visoravan and Ljubisnja (Figure 5.56).

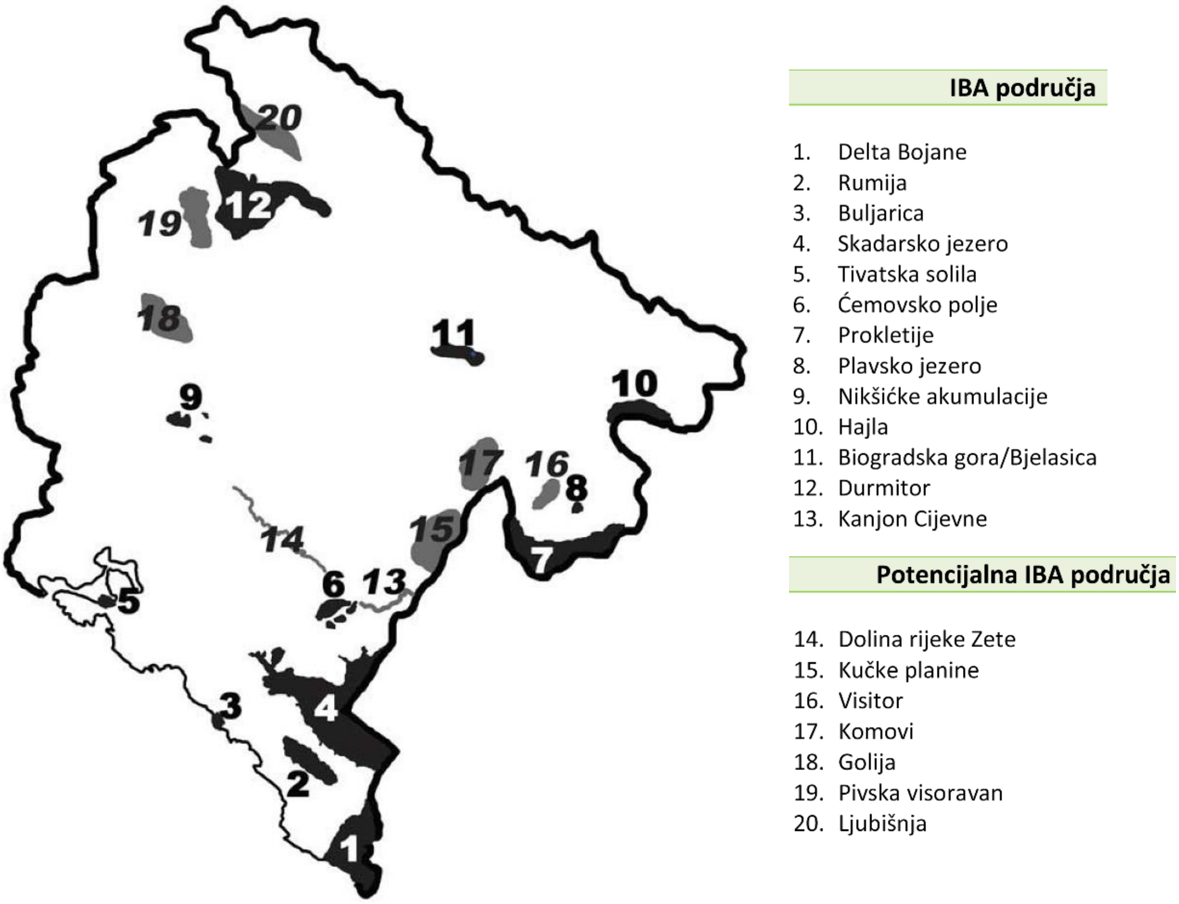


Figure 5.56 Important Bird Areas according to the Center for the Protection and Research of Birds of Montenegro.

Marine birds nest either in the coastal area and small number of its islands, peninsulas and capes, but mainly in Croatian part of the Adriatic shore, i.e. islands

Table 5.25 Sea Birds in Montenegro

Scientific name	Common name	Red List Category
Aythya marila	Greater Scaup	LC
Bucephala clangula	Common Goldeneye	LC
Chlidonias niger	Black Tern	LC
Clangula hyemalis	Long-tailed Duck	VU
Gavia arctica	Arctic Loon	LC
Gavia stellata	Red-throated Loon	LC
Hydrocoloeus minutus	Little Gull	LC
Larus canus	Mew Gull	LC
Larus fuscus	Lesser Black-backed Gull	LC
Larus melanocephalus	Mediterranean Gull	LC
Larus michahellis	Yellow-legged Gull	LC
Larus ridibundus	Black-headed Gull	LC

Scientific name	Common name	Red List Category
Melanitta fusca	Velvet Scoter	EN
Mergus merganser	Goosander	LC
Mergus serrator	Red-breasted Merganser	LC
Pelecanus onocrotalus	Great White Pelican	LC
Phalacrocorax carbo	Great Cormorant	LC
Podiceps cristatus	Great Crested Grebe	LC
Podiceps grisegena	Red-necked Grebe	LC
Podiceps nigricollis	Black-necked Grebe	LC
Sterna hirundo	Common Tern	LC
Sternula albifrons	Little Tern	LC

Table 5.26 Important Migratory Species

Species	Common Name	Red List Category
Numenius tenuirostris	Slender-billed Curlew	CR
Neophron percnopterus	Egyptian Vulture	EN
Branta ruficollis	Red-breasted Goose	EN
Falco cherrug	Saker Falcon	EN
Melanitta fusca	Velvet Scoter	EN
Aythya nyroca	Ferruginous Duck	NT
Falco vespertinus	Red-footed Falcon	NT
Milvus milvus	Red Kite	NT
Aegypius monachus	Cinereous Vulture	NT
Circus macrourus	Pallid Harrier	NT
Tetrax tetrax	Little Bustard	NT
Gallinago media	Great Snipe	NT
Limosa limosa	Black-tailed Godwit	NT
Numenius arquata	Eurasian Curlew	NT
Coracias garrulus	European Roller	NT
Anser erythropus	Lesser White-fronted Goose	VU
Clangula hyemalis	Long-tailed Duck	VU
Pelecanus crispus	Dalmatian Pelican	VU
Clanga clanga	Greater Spotted Eagle	VU
Aquila heliaca	Eastern Imperial Eagle	VU
Acrocephalus paludicola	Aquatic Warbler	VU

5.5.8 Protected Areas and Areas of Special Significance

5.5.8.1 Protected Areas[1]

Based on the national legislation, a great number of natural assets in Montenegro is placed under protection, many of which protect the most important components of biodiversity in the places where it occurs (in situ protection). A large part of the activities conducted in these areas focus on the protection of the biodiversity where it occurs in the nature, i.e. on the spot. The development of the national network of protected areas, (both existing and proposed areas for protection), represents an important part of the policy of the Government of Montenegro to protect representative types of all habitats, ecosystems and plant and animal species that occur. The projection of the national network of the protected areas of nature in the Physical Plan of Montenegro (PP MNE) from 2008 is provided in Table 5.27.

Table 5.27 Protected Areas of Nature in Montenegro

Name and National Category of Protected Areas of Nature	Surface (ha)	Share in State Territory (13,812 km²) %
National parks – total 101.733ha		7.77%
Skadar Lake	40.000	
Lovćen	6.400	
Durmitor	33.895	
Biogradska gora	5.400	
Prokletije	16.038	
Reserves of nature – total 650ha (outside NPs 150ha)		0.047%
- in NP Skadar Lake: Manastirska tapija, Pančeva oka, Crni žar, Grmožur and Omerova gorica	420	
- in NP Durmitor: Crna Poda	80	
Salt Pans in Tivat[2]	150	
Monuments of nature – total 13.638,54ha (outside NPs 7.736,54ha)		0.987%
Đalovića gorge	1.600	
Lipska cave	/	
Cave Magara	/	
Cave Globočica	/	
Cave Spila kod Trnova / Virpazar	/	
Cave Babatuša	/	
Novakovića cave, near Tomaševo	/	
Pit Duboki do, in Njeguši	/	
Canyon of the Piva river	1.700	
Canyon of the Komarnica river	2.300	
Communities of the Montenegrin pine (Pinetum mughi montenegrinum) in Ljubišnja (1.000ha), Durmitor (5.200ha) and Bjelasica (400ha)	1.000 + (5.600)	
Communities of Bosnian pine (Pinus heldraichii) in Orjen (300ha), Lovćen (300ha) and Rumija (100ha)	400 + (300)	
Individual dendrological facilities: Quercus robur scuteriensis at Ćurioc near Danilovgrad, Quercus pubescens in Orahovac near Kotor, olive trees at Mirovica, the Old Bar and Ivanovići, Budva etc	/	
Beaches of the Skadar Lake	(<2)	

[1] Fourth National Report of Montenegro to the Convention on Biological Diversity, https://www.cbd.int/doc/world/me/me-nr-04-en.pdf).
[2] Tivat salt pans have been put under protection by the Decision of the Nature Protection Agency no 01 – 12 of 26/ 12/ 2008 in the category „special nature reserve“, in accordance with a procedure initiated based on the previously valid Nature Protection Law („Official Gazette of FRMN“ no. 36/77and 2/89), Articles 41 and 42, and in relation with the provisions from Article 126, paragraph 3 of the new Nature Protection Law („Official Gazette of Montenegro“ no 51/08).

Name and National Category of Protected Areas of Nature	Surface (ha)	Share in State Territory (13,812 km²) %
Velika plaža in Ulcinj	600	
Mala plaža in Ulcinj	1,5	
Bech Valdanos	3	
Beach Velji pijesak	0,5	
Beach Topolica, Bar	2	
Beach Sutomore	4	
Beach Lučica, Petrovac	0,9	
Beach Čanj	3,5	
Beach Pećin	1,5	
Buljarica	4	
Petrovačka Beach	1,5	
Beach Drobni pijesak	1	
Beach Sveti Stefan	4	
Beach Miločer	1	
Bečićka Beach	5	
Slovenska Beach, Budva	4	
Beach Mogren	2	
Jaz	4	
Beach Pržno	2	
Savinska Dubrava, in Herceg Novi	35,46	
Botanical reserve of laurel and oleander, above the well Sopot near Risan	40	
Botanical garden of mountain flora, in Kolašin	0,64	
Botanical garden of the General Kovačević, in Grahovo	0,93	
Park "13 jul" and "Njegošev Park", in Cetinje	7,83	
Park near hotel Boka, in Herceg Novi	1,2	
Town park, in Tivat	5,897	
Park of the Castle at Topolica	2	
Special natural features areas – 354,7ha (of which 43,3ha in the category monument of nature)		0.025%
Hill Spas, above Budva[1]	163,2	
Semi-island Ratac with Žukotrljica	30	
Island Old Ulcinj	2,5	
Hill Trebjesa, Nikšić	159	
Areas protected by municipal decisions - 15.000ha		1.086%
Kotor – Risan Bay, Municipality Kotor	15.000	
TOTAL, UNDER PROTECTION	**124,964.24**	**9.047%**

[1] In compliance with the new Nature Protection Law („Official Gazette of Montenegro 51/08), the review procedure of the category and the protection status applies to this territory. In line with the findings of the Protection Study (produced by the Nature Protection Agency) a new protection concept has been proposed for this territory so that the western slopes of the Hill Spas, including also the promontory Mogren, have been classified into the protection category „monument of nature" (category II of protected natural assets), and the eastern slopes of the Hill Spas in the protection category „*Special natural features area*" (category III of protected natural assets). The surfaces of the mentioned areas are: (i) zone A „monument of nature" – 43,3ha (22,1+21,2) i (ii) = zone B „area of exceptional features" – 119,9ha. Based on the Study, the competent body(ies) of Municipality Budva should adopt an adequate act on proclamation – categorization of this protected natural asset

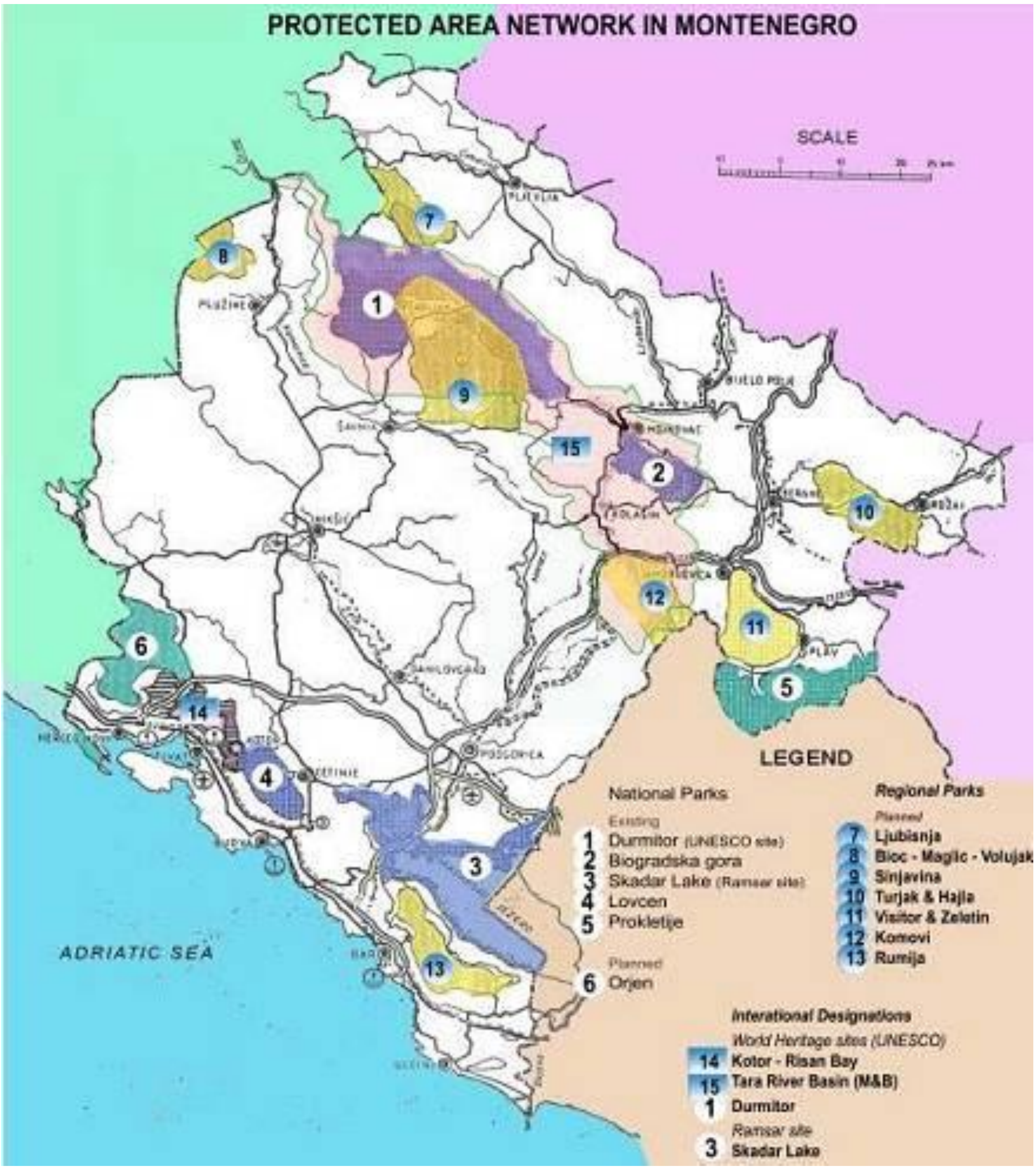


Figure 5.57 Protected Areas in Montenegro[1]

[1] Fourth National Report of Montenegro to the Convention on Biological Diversity, Ministry of Spatial Planning and Environment, Podgorica 2010.

Internationally protected natural assets in Montenegro include:

- Skadar Lake National Park (40,000 ha) has been protected as Ramsar Site since 25 December 1995, when it was registered in the list of wetlands of international importance as a habitat of water birds (the Ramsar List), with the Ramsar Convention (The Convention on Wetlands of International Importance, especially as a habitat for water birds).
- Durmitor National Park with the canyon of the River Tara (33,895 ha) has been protected since 1980 as a World Natural Heritage Site (UNESCO World Natural and Cultural Heritage List.
- The basin of the River Tara (182,899 ha) has been protected as the World Biosphere Reservation (Program "Man and Biosphere" - M&B, UNESCO), since 17 January 1977, based on the Convention Concerning the Protection of World Natural and Cultural Heritage (UNESCO).
- The Bay of Kotor and Risan (15,000 ha) has also been protected as a World Heritage Site (UNESCO World Natural and Cultural Heritage List) since 26 October 1979, based on the provisions of the Convention Concerning the Protection of World Natural and Cultural Heritage (UNESCO). Before being placed under international protection, this area was protected under national legislation.

5.5.8.1.1 Marine Protected Areas

No marine protected areas are declared in Montenegro yet. However, some areas are under consideration. Figure 5.58 shows the areas of special significance and the proposed sites for the protection, and these are as follows:

- Three areas of special significance according to the Law on Nature Protection, these are: Velika plaža, Buljarica and Tivatska solila.
- Proposed sites for the protection: Boka Kotorska gulf, Mamula up to the ness of Mačka, ness of Trašte up to Platamun (where protected area extends from ness of Žukovac to ness of Kostovica), ZPM Katič, ness of Volujica up to Dobre vode settlement, ness of Komina up to ness of Old Ulcinj (Stari Ulcinj), gulf of Valdanos up to Long Beach (Velika plaža), Seka Đeran and southern area of Long Beach up to delta of Bojana River[1].

[1] Source: CAMP, RAC-SPA.

Figure 5.58 Areas of Special Significance and Proposed Sites for Protection

5.5.8.2 Centers of Biodiversity[1]

Almost all the mountainous regions of Montenegro can be treated as centers of diversity for vascular flora, including (i) Durmitor, (ii) Prokletije massif, and (iii) Mediterranean Dinarides (Orjen, Lovćen, Rumija, Njeguš mountains). Sites with 1,200-1,400 taxa (species and subspecies combined) include: (a) Durmitor with Bioč including the canyons of the rivers Tara, Piva and Sušica; (b) Bjelasica, Komovi and Prokletije with Visitor, Žijovo, Hum Orahovski, (c) Canyon of Cijevna river; (d) Mrtvica Canyon, (e) Skadar Lake with northern slopes of the Rumija mountain. The areas of the Prokletije massif, Moračke mountains, Bjelasica and Komovi are recognized as centers of endemic flora.

The most important biodiversity centers of birds in Montenegro include the region of Skadar Lake and Ulcinj, as well as mountain areas of Durmitor, and Prokletije. Bio-centers of mammal diversity in Montenegro are the mountainous regions of Durmitor, Sinjavina, western side of Prokletije, Komovi and Bjelasica, with smaller concentration of species in eastern side of Prokletije, central parts of Montenegro, northern parts of Boka-Kotor bay and Orjen mt and coastal Dinarides (Lovćen mt, Rumija mt with Skadar Lake).

[1] Fourth National Report of Montenegro to the Convention on Biological Diversity, Ministry of Spatial Planning and Environment, Podgorica 2010.

The coastal region of Montenegro and its hinterland - Skadar Lake, Lovćen and Prokletije are considered as most significant centers of biodiversity of Reptiles and Amphibians on the Balkan Peninsula and in Europe.

Montenegro, with more than 3,200 plant species, is floristically one of the most diverse areas in the region, comparable only to Greece and Bulgaria. The "S/A" index of Montenegro for vascular plants is 0.837, which represents the highest recorded of all European countries. Similarly, an index of the density of nesting birds in Montenegro has a value of 0.557, which is higher than the figure for the Balkans as a whole (0.435). At a global level, Montenegro is included within the Mediterranean biodiversity hotspot and the following Global Ecoregions: European-Mediterranean Montane Mixed Forests (no. 77), Mediterranean Forests, Woodlands and Scrub (no.123), and Mediterranean Sea (no. 199) and the Balkan Rivers & Streams (no. 180); and, together with the mountainous area of Bulgaria, comprises one of the 153 centers of globally significant floral diversity.

Areas that are internationally important for rare, endemic and endangered species in Montenegro are identified following Important Bird Areas (IBA): Skadar Lake, Ulcinj Saltwork, Šasko Lake, Durmitor and Biogradska gora.

Concerning Important Plant Areas (IPA) in Montenegro 22 sites are identified as follows: Jerinja glava mt, Lukavica mt, Trebjesa mt, Starac mt, Bogićevica mt, Visitor mt, Hajla mt, Skadar lake, Orjen mt, Lovćen mt, Rumija mt, Velika Ulcinjska beach, Babji zub mt, Piva river canyon, Tara River canyon, Komarnica River Canyon, Mrtvica Canyon, Cijevna River canyon, Lim River canyon, Komovi mt, Durmitor mt and Biogradska gora.

Identification of Important Fungi Areas (IFA) is not provided so far, but could provide additional reasons for protection of existing and new / potential Protected Areas.

5.5.8.2.1 Centers of Biodiversity for Marine Species and Marine Habitats

As shown in Figure 5.59, there are three areas that are considered as centers of diversity for marine species and marine habitats. The important species in each area are listed in Table 5.28.

Table 5.28 Centers of Biodiversity for Marine Species and Marine Habitats[1]

Diversity Center	Important Marine Species
1	*Posidonia oceanica; Cymodocea nodosa; Zostera noltii; Zostera marina; Cystoseira spinosa (including C. adriatica); Axinella cannabina; Geodia cydonium; Tethya sp. plur.; Lithophaga lithophaga; Luria lurida (= Cypraea lurida); Pinna nobilis; Hippocampus ramulosus; Caretta caretta; Holothuria impatiens; Holothuria polii; Holothuria tubulosa; Savalia savalia (žuta); Leptogorgia sarmentosa*
2	*Posidonia oceanica; Cystoseira amentacea (including var. stricta and var. spicata); Cystoseira spinosa (including C. adriatica); Axinella damicornis; Centrostephanus longispinus; Ophidiaster ophidianus; Lithophaga lithophaga; Luria lurida (= Cypraea lurida); Mitra zonata; Pinna nobilis; Caretta caretta; Holothuria forskali; Holothuria polii; Holothuria tubulosa*

[1] University of Montenegro, Faculty of sciences and Mathematics (November 2012.)

Diversity Center	Important Marine Species
3	*Posidonia oceanica; Cymodocea nodosa; Cystoseira amentacea (including var. stricta and var. spicata); Cystoseira spinosa (including C. adriatica); Axinella damicornis; Ophidiaster ophidianus; Lithophaga; Pinna nobilis; Tonna galea; Hippocampus ramulosus; Caretta; Holothuria polii; Holothuria tubulosa*

Figure 5.59 Centers of Diversity for Marine Species and Marine Habitats

Figure 5.60 shows the intersection of the areas of special significance, biodiversity centers, protected areas and important bird areas in the coastal region with the proposed blocks for exploration and production.

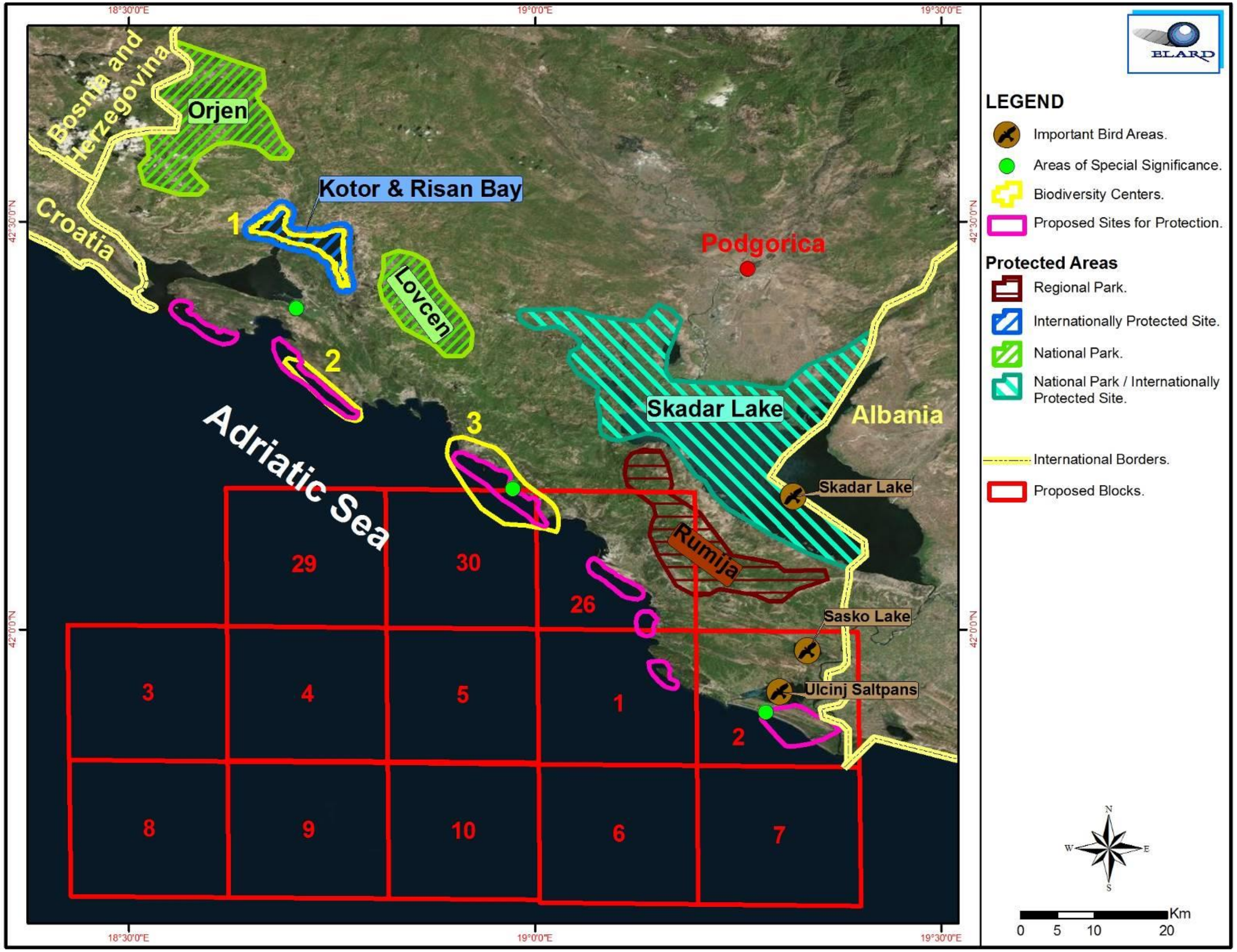


Figure 5.60 Intersection of Important Biodiversity Areas in the Coastal Region with the Proposed Blocks.

5.5.8.3 *Key Biodiversity Areas*

Key Biodiversity areas in Montenegro as prepared by the University of Montenegro, Faculty of sciences and Mathematics in November 2012, are shown in Figure 5.61. Species and habitats in the key biodiversity areas in the coastal zone are provided in Table 5.29.

Table 5.29 Species and Habitats in Some of the Key Biodiversity Areas[1]

Key Biodiversity Area	Present Species/Habitats	
Kotor/ Tivat/ Lovcen	Habitats	6170 Alpine and subalpine calcareous grassland; 6220 *Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea; 62A0 East sub-Mediterranean dry grasslands-Scorzoneretalia villosae; 8120 Calcareous and calcshist screes of the montane to alpine levels (Thlaspietea rotundifolii); 8130 Western Mediterranean and thermophilous scree; 8210 Calcareous rocky slopes with chasmophytic vegetation; 95A0 High Oromediterranean pine forests
	Amphibians and Reptiles	*Lissotriton vulgaris*; *Triturus macedonicus*; *Hyla arborea*; *Rana shqiperica Podarcis melisellensis*; *Algiroides nigropunctatus*; *Adriolacerta oxycephala*; *Mauremys caspica*; *Emys orbicularis*
	Mammals	*Delphinus delphis; Stenella coeruleoalba; Tadarida teniotis; Tursiops turcatus*
	Marine species and marine habitats	*Posidonia oceanica; Cymodocea nodosa; Zostera noltii; Zostera marina; Cystoseira spinosa (including C. adriatica); Axinella cannabina; Geodia cydonium; Tethya sp. plur.; Lithophaga lithophaga; Luria lurida (= Cypraea lurida); Pinna nobilis; Hippocampus ramulosus; Caretta caretta; Holothuria impatiens; Holothuria polii; Holothuria tubulosa; Savalia savalia (žuta); Leptogorgia sarmentosa*
Ada Bojana/ Šasko lake/ Velika plaža	Habitats	1210 Annual vegetation of drift lines; 1310 Salicornia and other annuals colonising mud and sand 1410 Mediterranean salt meadows (Juncetalia maritimi); 1420 Mediterranean and thermo-Atlantic halophilous scrubs (Salicornetea fruticosi); 2110 Embryonic shifting dune; 2120 Shifting dunes along the shoreline with Ammophila arenaria (white dunes); 2190 Humide dune slack; 2220 Dunes with Euphorbia terracina; 2240 Brachypodietalia dune grasslands with annuals; 2270 Wooded dunes with Pinus pinea and/or Pinus pinaster; 3170 Mediterranean temporary ponds; 92A0 Salix alba and Populus alba galleries
	Invertebrates	*Crematogaster montenigrinus*
	Amphibians & Reptiles	*Rana shqiperica; Podarcis melisellensis*; *Natrix tessellata*; *Mauremys caspica*; *Emys orbicularis*; *Platyceps najadum*; *Elaphe situla*
	Birds	*Phalacrocorax pygmeus; Pelecanus crispus; Platalea leucorodia;Anas penelope; Crex crex; Recurvirostra avosetta,; Numenius arquata; Limosa limosa ; Philomachus pugnax; Larus minutus; Larus ridibundus; Larus michahellis; Aythya fuligula*
	Mammals	*Delphinus delphis; Lutra lutra;Miniopterus schreibersii; Mus spicilegus adriaticus; Myotis blythii; Rhinolophus blasii; Tadarida teniotis; Tursiops turcatus;*

[1] Protected Area Gap Assessment with Comprehensive Plan for A Representative PAS (Protected Area System), University of Montenegro, Faculty of sciences and Mathematics (November 2012.)

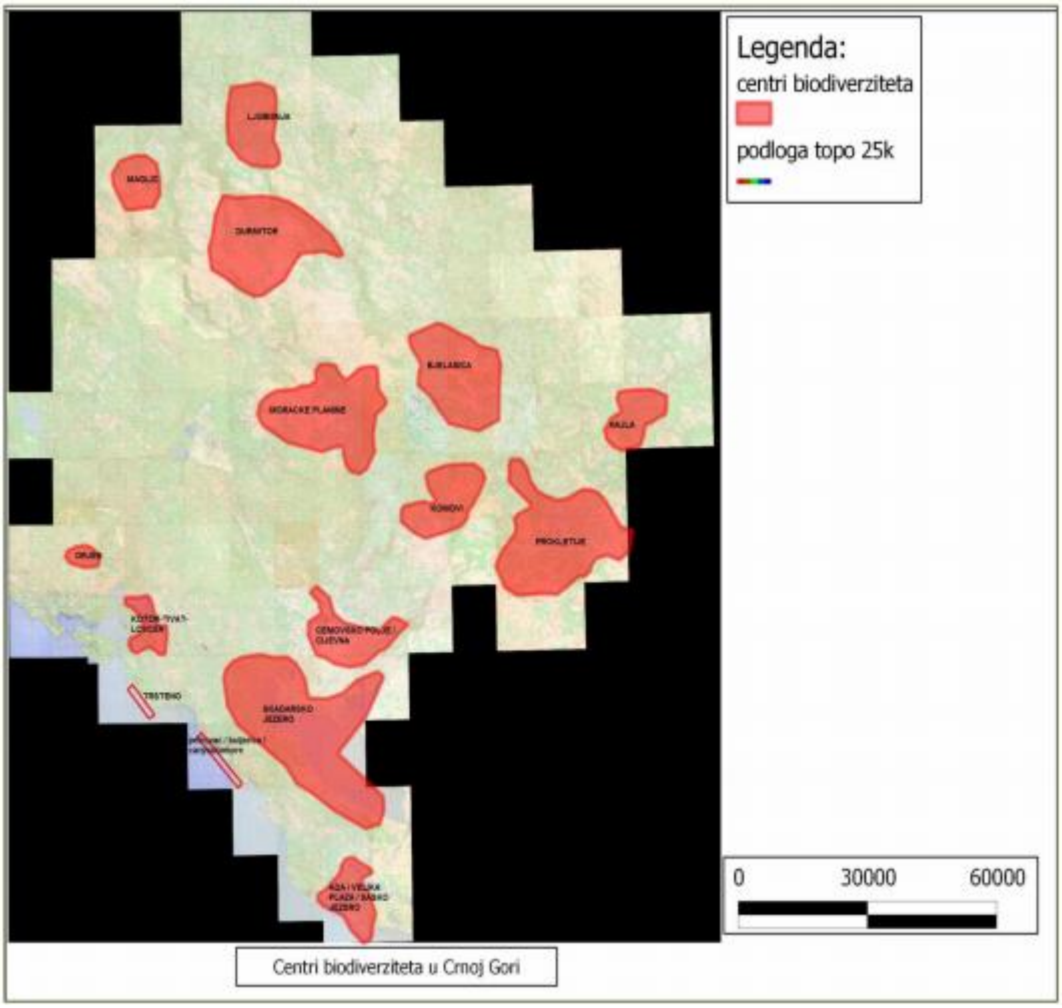


Figure 5.61 Key Biodiversity Areas in Montenegro

5.5.8.4 EMERALD Network[1]

The Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) and the legislation of the European Union regulate the protection of the threatened species and habitat types which are emphasized in the biogeographical regions on the state territory. The EMERALD Network consists of 32 sites (Figure 5.62) - areas of special interest for the protection (ASCI) which should be established by the member countries present of the Bern Convention. Creation of the EMERALD Network in Montenegro started in 2005 within the project funded by Council of Europe and implemented by the Ministry of Environmental Protection and Physical Planning in cooperation with the Council of Europe and Montenegrin experts. During 2008, project was finished and the standard forms were completed for most of the Emerald Network sites in Montenegro (central EMERALD database is in the Institute for the Protection of Nature). Meanwhile, EMERALD database has been reviewed (quality control check) by Council of Europe and then improved / updated.

[1] Fourth National Report of Montenegro to the Convention on Biological Diversity, Ministry of Spatial Planning and Environment, Podgorica 2010.

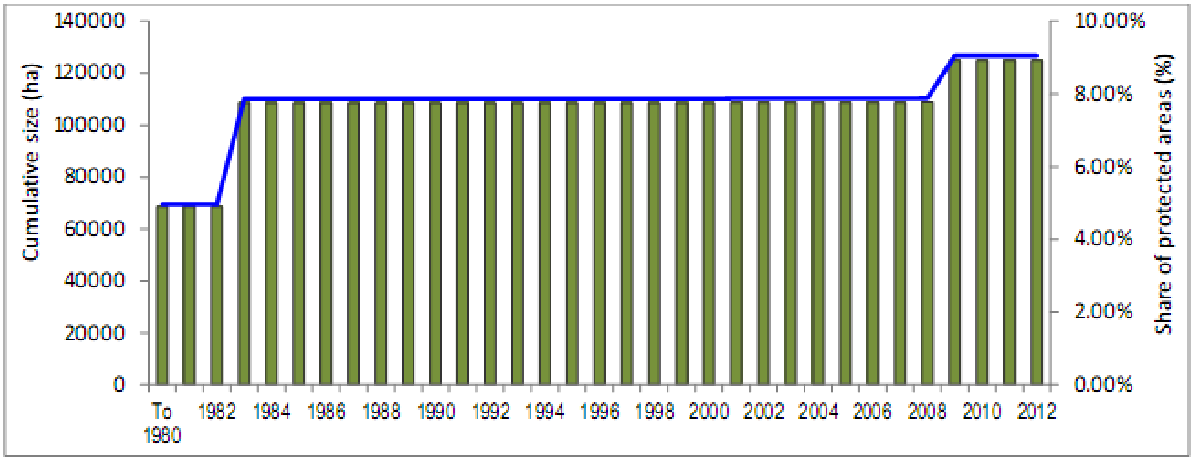
Figure 5.62 EMERALD Sites Network

5.5.9 Monitoring Indicators

The following indicators are proposed to monitor the impacts of the Programme on ecosystems and biodiversity:

1- The change in number and area of protected areas and their floor area (B07) which is included in the national list of environmental indicators.

The trend of increasing protected areas can be characterized as unstable, primarily due to the evident stagnation in the period of 1983-2009. Specifically, the size of protected areas in this period increased slightly. Since the protected areas, in this period, were relatively modest areas and as a such did not significantly contribute to increasing the share of nationally protected natural areas compering with total territory of Montenegro. The proclamation of the National Park "Prokletije" in 2009 made a significant contribution to the increase of protected areas but still insufficient to meet the established national and international objectives. After 2009, stagnation in proclaiming new protected areas was again recorded. Particularly, it is necessary to note that Montenegro is the only country in the Mediterranean which has no protected marine areas.



Graph 81 . The cumulative size of protected areas in Montenegro to 2012

Figure 5.63 The Cummulative Size of Protected Areas in Montenegro, 1980-2012.

2- Trend of introduction of invasive species (B05)

So far in Montenegro no systematic research of invasive plant species has been carried out, and yet the data were collected through individual research projects. Therefore there are no precise data on all taxa: their distribution, how much damage was already inflicted to natural ecosystems, which areas are the most vulnerable.

When it comes to marine species, according to the report, on the basis of literary data, a total of nine invasive species was recorded. In the field, during the research of 2008, only Caulerpa racemosa var. Cylindracea was recorded. Three species (Asparagopsis taxiformis, Callinectes sapidus and Bursatella leachi) were observed during these field studies, but their photos were documented by Dr. Vesna Mačić. According to the above mentioned report, five species are considered to be established (stable) in our sea, three occur periodically, while the status of the species Crassostrea gigas is unknown, and otherwise this species is entered for aquaculture purposes, i.e. breeding.

3- Trend and geographic distribution of concentration of chlorophyll in vertical water column (M02) and Nutrients / Concentration of nitrates and phosphates and their ratio (M03)

Since the monitoring of marine ecosystem in Montenegro began in 2008, available data are not enough to describe the trend of these indicators. However, current data can be the baseline for monitoring of the impacts from the programme.

4- Trophic index (TRIX index) (M04)

Data for this indicator are available for the period 2009-2011. Trophic status depends on the availability of nitrogen and phosphorus for primary production, in terms of determining phytoplankton biomass and oxygen saturation.

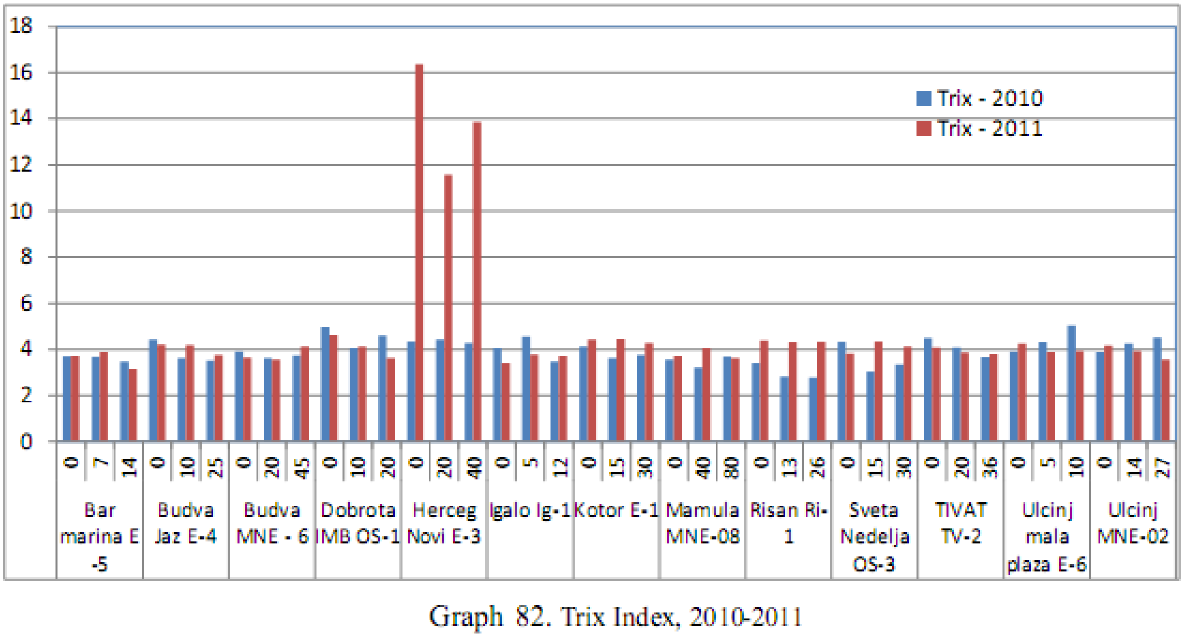


Figure 5.64 Trix Index, 2010-2011.

Information provided in Figure 5.64 shows the results in 2010 and 2011, because the tests for 2009 were carried out only in the months of April and October. The TRIX index below 2 is usually related to the open sea and the low production of phytoplankton, and over 6 is related to very productive coastal sea. Values around 4 are typical of low-productive seas. The figure above shows that the TRIX index values are about 4 which is an average value for the Adriatic Sea. However, on the basis of available data, the average value for 2009 was a little over 6 which was unusual for the sea of Montenegro, but this might be related to the fact that in the summer of 2009 "sea blooms" were recorded.

5- Species Diversity (B01)

According the "Indicator-based State of the Environment Report of Montenegro, 2013", it is not possible to express the trend of this indicator as there are no reliable data available that could be compared with the previous period.

6- Status of marine fish stock (R01)and Aquaculture production(R02)

As described in section 5.5.6, the marine fish stock and aquaculture production is decreasing, however precise data of the trend of this indicator are not published in the SoE Report as the data were deemed to be not enough for the illustration of the indicator.

7- Number of spills reaching the coast:

The number of spills reaching the coast can be an indicator of the impacts of the programme on marine ecosystems, since oil spills from accidental events might have catastrophic impacts on the components of the marine ecosystems.

8- Number of injured/killed sea birds; Number of injured/killed sea mammals and turtles; and Number of threatened marine mammal species:

Monitoring and reporting of these numbers as part of the Programme's environmental monitoring plan is important to detect future changes that might be a result of the implementation of the Programme. Existing data that can reflect these indicators could not be obtained to be included in this report.

9- Extent of joint cooperation programmes and projects in the Adriatic Sea

Joint cooperation programmes and projects are increasing in the Adriatic Sea, and this upward trend is expected to continue during the Programme implementation, as this new sector will open the doors for new areas of cooperation.

5.6 ARCHEOLOGICAL AND CULTURAL HERITAGE

Montenegro has registered a total of 357 immovable archaeological and cultural monuments (historical, artistic, building, ethnological etc) sites. These are divided into three categories:

- Category I - Exceptional significance – 35 (some of these sites are also on the World Heritage list that are subject to special protection determined by law)
- Category II - Great significance – 135
- Category III - Local significance – 187.

Immovable and movable cultural heritage in Montenegro is in a very bad condition and unfavorable position, due to the fact that at its larger part, as well as at the most important monument units, basic monument values have been jeopardized, with the tendency of the further change of integrity, loss of the monument values and historical origins.

The monuments of culture, i.e. some monument units which are not brought to their purpose, are in the totally neglected or ruined state, and due to the lack of organized and designed protective activities over them, they are left to the direct and unavoidable influence of the time and vandal actions of individuals.

For the protection of immovable cultural heritage, documentation basis and permanent researches are of crucial importance, and based on that, new documentation is formed and the existing is also supplemented with information on monument values and identity of monument units. The state of documentation indicates a need for exploring all monuments of culture, and especially of archaeological locations.

Center for archaeological researches has not formed documentation on archaeological researches and archaeological material, and separate problem represents the fact that recognition of the terrain has not been done nor the archaeological map of Montenegro in order for it to be elaborated, which as a strategic document should include overview of all existing and potential archaeological locations in Montenegro. In that way it would help enable their adequate treatment in the process of elaboration and adoption of the plans and investment programs.

Inadequate communication of local government authorities regarding immovable cultural heritage is reflected especially through the process of elaboration of urban plans in which the institutions for protection of the monuments of culture are not included on a timely basis. Elaborators of the plans, without respecting the principles of protection during the treatment of existing state, mostly give solutions for legalization of the illegal construction, unplanned upgrading of the facilities, and infrastructural and other development solutions of the settlements with protected wholes or monumental units and superimpose it to their milieu look and harmony.

Existing solutions on archaeological researches and excavations are not comprehensive, and the issue of underwater archaeology is practically undeveloped[27].

Figure 5.65 Archeological Sites in Montenegro[28]

[27] Spatial Plan of Montenegro until 2020.
[28] SEA Energy strategy of Montenegro, COWI, April 2013.

Concerning underwater cultural heritage, Montenegro has many archaeological sites that are still in situ and protected by the law, and there are many more that have not yet been explored or discovered. There are two good examples of how unexplored the underwater cultural heritage is. Firstly, the recent discovery of two sunken ships in Boka bay, discovered during bottom mapping and bathymetry recordings of the bay in 2009, and secondly the discovery of the architectural remains of ancient temple capitals in Maljevik, also in 2009. In Maljevik in 2010, the Local museum of Bar has conducted archaeological digs in partnership with Southampton University from UK and UCLA from USA. Some other recordings of underwater archaeology were done in the 1980s and 1990s but not many excavations were conducted as Montenegro did not have, and still does not have, staff and adequate equipment to meet professional and methodological standards. Montenegro has two underwater archaeological sites that are protected by the law, the Bay of Bigovica in Bar and the under-ocean area between cape Strpački and cape Murove in Risan. However, there is a list of registered underwater archaeological sites which are not protected by the law, but whose cultural importance is recognized through a new group of Laws protecting cultural heritage. Their legal protection will be therefore re-evaluated[29]:

- Njivice, Hercegnovski zaliv
- Malo rose
- Žanjice
- Uvala Žanjic
- Ostrvo Lastavica
- Karatoč
- Kumbor
- Zaliv Trašte
- Uvala Bigova
- Uvala Pržno
- Tivatski zaliv
- Otok Gospe od otoka
- Uvala Dobra luka
- Marina Budva
- Slovenska Plaža
- Katič
- Petrovac
- Luka Bar
- Rt Volujica
- Obala Velja Zabija
- Barski zaliv
- Uvala Malčjevik
- Stari ulcinj
- Uvala Valdanos
- Velika Plaža
- Ulcinj
- Hrid Đeran

Also, Montenegro is a State Party to the Convention on the Protection of the Underwater Cultural Heritage, having ratified the Convention on 17th July 2008.

[29] Montenegro National Report on underwater cultural heritage. Report Made in the UNESCO Regional Meeting in Istanbul 25 -27 October, 2010.

Figure 5.66 Excavation at Maljevik and Bigovica © Dusan varda

5.6.1 Monitoring Indicators for Archeology and Cultural Heritage

The indicators proposed to monitor the likely impacts of the Programme on archeological and cultural heritage include:

1. The number of incidents/ activities that could result in damage to cultural and archaeological heritage sites;
2. Allocated funds to preserve/ promote cultural and archaeological heritage sites; and
3. The number of discovered underwater archaeological sites and shipwrecks.

Existing data about these indicators could not be obtained to include in this report.

5.7 LANDSCAPE

The variety of landscapes is of great value and represents the richness of any country. In Montenegro this diversity appeared in a combination of exceptional natural values alongside with different local traditions in spatial use, which resulted from reflection of cultural-historical and socio-economic circumstances.

With biogeographical and environmental analysis of the Montenegrin territory, 10 landscape types can be recognized, as follows:

- E-Mediterranean,
- lower sub-Mediterranean,
- Mediterranean-flysh,
- flat land-swampy,
- higher sub-Mediterranean,
- hilly-silicate,
- mezophile,
- mountainous,
- highmountainous and
- anthropogenic landscape type

Identification of landscape units should take into account natural spatial characteristics as well as the effects of human presence in the area so that in Montenegro, 21 basic landscape units can be recognized as follows:

1. Boka Kotorska Bay including peninsula Lustica;
2. Cijevna Canyon;

3. Coastal area with Bay of Buljarica;
4. Tara River Valley;
5. Tivatska Solila;
6. Durmitor and Sinjajevina;
7. Ulcinj area dunes and Ada Island;
8. Piva area;
9. Bojana River Valley, Zogajsko Mud, Solana Ulcinj and Šasko Lake;
10. Pljevlja Plateau;
11. Mountain massifs of Orjen, Lov cen and Rumija;
12. Polimlje; and
13. Karst Plateau of western Montenegro;
14. Rožaje area
15. Skadar Lake area;
16. Prokletije Massif
17. ZetaBjelopavli ci Plain;
18. Bjelasica and
19. Nikšic Field;
20. Komovi
21. Canyon valleys in Moraca watershed;

This division includes also some smaller landscape units, mostly including vulnerable ecosystems with outstanding specific features and identity.

Starting points for further spatial arrangement from the aspect of landscape, are as follows:

- Diversity of landscape shapes represents the basis for developing certain economy branches, referring to principles of sustainable development;
- Protection of valuable natural entities with original Mediterranean biodiversity, and preservance of landscape on the Montenegrin seaside and in its hinterland.

The sea coast – area of nature of special importance – is "a shore belt bounded by the line that is hit by the greatest waves during most severe storms, but also it is a part of the land which by its nature and purpose serves for using the sea for maritime traffic and sea fishing and other purposes related to the use of the sea, not narrower than 6 meters" (Law on Sea Property). Natural and landscape values of the coast have been suffering from pressure of increasing tourism and urbanization, which causes degradation of natural areas that give the Mediterranean character to this region. Increasing tourism and urbanization also endanger certain components of biodiversity[30].

5.7.1 Monitoring indicators for Landscape and Visual Amenity

Indicators proposed to monitor the impacts of the Programme on landscape and visual amenity include:

1- landscape visual quality (land use aesthetic /scenic value and terrain/ luminosity)

2- Acceptability of change in landscape by the public.

Monitoring of these indicators shall start prior to Programme implementation in order to provide a baseline conditions that future changes can be measured based on.

[30] Spatial Plan of Montenegro until 2020.

5.8 SOCIO-ECONOMICS

5.8.1 Introduction

The objective of this socio-economic section is to present the baseline conditions in areas of: employment, education, crime, economic activities, and transportation infrastructure as well as to analyze possible consequences (positive and negative) which exploration and production of hydrocarbons would impose on these areas in Montenegro in general and more specifically in the Coastal Region.

5.8.2 Analysis of Demographic Trends

5.8.2.1 Population and Households

There is a constant rise in the country's population, especially in the towns of Budva and Tivat between 1991 and 2003. From 2003 to 2011, in the towns of Kotor, Herceg Novi and Ulcinj, the number of residents slightly decreased but did not affect the overall increase at the national level.

More than 50% of state territory, i.e. the Northern Region, accommodates less than one third of the overall population. Due to internal migrations of population from the Northern Region to the Middle and Coastal Regions, the number of residents of the Northern Region has decreased by 7.2% between 2003 and 2011 while the number of residents of the Middle and Coastal Regions increased by .9% and 3.7% respectively.

The Coastal Region is attractive for migrants, both inbound and outbound. The highest migration of population was recorded from 1991-2003 (37.6% migrants).

Table 5.30 details the changes in population between 2003 and 2011 in various Montenegrin regions and towns.

Table 5.30 Changes in Population between 2003 and 2011

	2003	2011	Index 2011/2003	Average Age
Montenegro	612,267	620,029	101,27	37.2
Northern Region	191,610	177,837	92,81	37.3
Middle Region	277,279	293,509	105,85	36.6
Coastal Region	143,378	148,683	103,70	38.4
Bar	39,539	42.,48	106,35	37.9
Budva	15,488	19,218	124,08	36.5
Herceg Novi	32,254	30,864	95,69	40.0
Kotor	22,599	22,601	100,01	39.5
Tivat	13,422	14,031	104,54	38.0
Ulcinj	20,076	19,921	99,23	37.8

Source: MONSTAT

Accordingly, the number of households has changed with the changes in the number of residents. The number of households in the Northern Region witnessed a reduction by 2.4%, while it increased in the Middle Region by 11.3% and in the Coastal Region by 15.3%. Table 5.31 shows the changes in in the number of households between 2003 and 2011 in various Montenegrin regions and towns.

Table 5.31 Changes in Number of Households (1991-2011)

	2003	2011	Index 2003/2011
Montenegro	180,517	192,242	106.50
Northern Region	54,167	52,884	97.63
Middle Region	80,490	89,559	111.27
Coastal Region	45,860	52,884	115.32
Bar	12,477	13,789	110.52
Budva	5,218	7,042	134.96
Herceg Novi	11,076	11,09	100.13
Kotor	7,29	7,604	104.31
Tivat	4,502	4,834	107.37
Ulcinj	5,327	5,44	102.12

Source: MONSTAT

In 2011, the average number of household members in the Coastal Region was 2.95 members (Budva and Herceg Novi 2.8, Tivat 2.9, Kotor and Bar 3 and Ulcinj 3.5), 3.36 in the Northern Region, and 3.27 in the Middle Region; while at the level of Montenegro, it was 3.2 members.

With regard to the population's gender structure in the Coastal Region, women account for 51.2%. Comparing gender structure per age groups, in young ages groups, men are predominant, while in the middle-age group and older population, women are predominant.

The population in the Coastal Region is categorized as old with an average age of 38.4 years (male 37 and female 39.4) similarly to other regions in Montenegro. The oldest population is in Herceg Novi (average age 40), and the youngest in Budva (average age 36.5). Youth (0-19) percentage of the overall population ranged from 21.8% in Kotor to 26.6% in Ulcinj, while elderly (65 and more) ranged from 9.9% in Budva to 15% in Kotor.

In 2011, the population density in the Coastal Region was 94.09 residents/km², substantially above Montenegrin average of 45 residents/km². The densities in each town were as follows: 307 resident/km² in Tivat, 157 resident/km² in Budva, 132 resident/km² in Herceg Novi, 79 resident/km² in Ulcinj, 71 resident/km² in Bar, and 68 resident/km² in Kotor.

5.8.2.2 Apartments

Spatial and socio-economic transformations occurred during the past decades in the Coastal Region due to various incidences, such as: the 1979 earthquake, the change in number of residents and their structure, the migrations, the ownership structure, the real-estate demand, etc, resulting in a great increase in residential fund and spatial expansion of settlements and their residential zones, often in the form of unplanned development, population erosion of the coastal hinterland, which caused abandonment of apartments and decay of residential stock. The biggest share of these changes occurred under heavy impact of tourism development, which attracted population from other parts of Montenegro.

Data of the 2011 census shows that, apart from occupied apartments, there is also a large number of temporarily empty or abandoned apartments, as well as second homes, which are regarded as a significant tourism resource.

Of the total number of apartments in the Coastal Region:

- 120,398 residents occupy 48,114 apartments (39.96%),
- 1.055 (0.88%) are used for both residence and economic activities,
- 3,377 (2.80%) apartments are used solely for economic activities,
- 42,054 (34.93%) apartments seasonally used,
- 23,420 (19.45%) are temporarily empty,
- 1,334 (1.12%) are abandoned, and
- 1,034 (0.86%) apartments on which there is no information.

Table 5.32 below provides a more detailed breakdown of apartments' uses in the various Coastal Region towns. If we compare the number of households with the number of residential apartments, we can conclude that Bar, Budva, Herceg Novi and Ulcinj are short on apartments for rent, while Kotor and Tivat record surplus of residential units.

Residential apartments account for 40% of the total residential potential, thus it is possible to increase the complementary tourist capacities.

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Table 5.32 Breakdown of Apartments per Usage in the Coastal Region in 2011

Municipality	Total	Residential	Housing and Economic Activities	Temporarily Unused	Abandoned	Seasonal	Economic Activities	No Data
Bar	33,371	13,638	202	6,071	715	11,832	740	173
	100.0%	40.9%	0.6%	18.2%	2.1%	35.5%	2.2%	0.5%
Budva	23,805	6,401	473	4,765	55	10,684	1,269	158
	100.0%	26.9%	2.0%	20.0%	0.2%	44.9%	5.3%	0.7%
Herceg Novi	24,287	10,744	115	4,266	201	8,408	394	159
	100.0%	44.2%	0.5%	17.6%	0.8%	34.6%	1.6%	0.7%
Kotor	13,516	7,381	57	2,691	195	2,597	253	342
	100.0%	54.7%	0.4%	19.9%	1.4%	19.2%	1.9%	2.5%
Tivat	9,656	4,671	47	2,326	53	2,382	138	39
	100.0%	48.4%	0.5%	24.1%	0.5%	24.7%	1.4%	0.4%
Ulcinj	15,763	5,279	161	3,301	125	6,151	583	163
	100.0%	33.5%	1.0%	20.9%	0.8%	39.1%	3.7%	1.0%
Total	**120,398**	**48,114**	**1,055**	**23,420**	**1,344**	**42,054**	**3,377**	**1,034**
	100%	**39.96**	**0.88**	**19.45**	**1.12**	**34.93**	**2.80**	**0.86**

Source: MONSTAT

5.8.3 Employment

5.8.3.1 Employment and Labor Market

The term "Employed" includes all the persons working within a company, institution or organization or individual employer regardless of the nature of their employment, i.e. fixed term employment or on an open-end basis or full time or part time. As of January 1st 2009, the total number of employees in Montenegro, includes foreigners pursuant to article 1 of the Law on Employment and Work of Foreigners ("Official Gazette of Mne", No. 22 of 02nd April, 2008), which came into force on January 1st 2009. Foreigner can be employed, i.e. work in Montenegro under conditions set out by laws, collective contract, ratified and published international contract and generally accepted rules of international law".

The labor market in Montenegro is characterized by a gap between available labor force and labor market needs which results in high rates of long-term unemployment and youth unemployment. In efforts to reduce youth unemployment, the Programme of Professional Capacities was launched in January 2013 as well as the "Let's employ our youth on seasonal jobs" project by the Employment Bureau.

The total number of employees in 2013 was 171,474, 3% higher than in 2012. The increase in the number of employees in 2013 was recorded in 15 out of total of 19 sectors; mainly as follows:

- 33.1% in administrative and support service,
- 10.6% in agriculture, fisheries and forestry,
- 8.5% in accommodation and food services, and
- 7.5% in art, entertainment and recreation.

The decrease in number of employees was recorded as follows:

- 2% in power supply, gas, steam and air conditioning section,
- 1.2% in the processing industry sector,
- 1.0% in the mining and quarry sector, and
- 0.6% in wholesale and retail sale.

Table 5.33 Employment per Economic Activity

Economic Activity	2011	2013	% Change 2013/2011	Share (%)
Agriculture, forestry and fishing	2,224	2,771	24,6	1,6
Mining and quarrying	2,041	1,874	-8,2	1,1
Processing industry	15,254	12,879	-15,6	7,5
Power, gas, steam supply and air conditioning	2,894	3,031	4,7	1,8
Water supply, wastewater management, controlling the process of waste removal and similar activities	4,604	4,773	3,7	2,8
Construction works	8,024	8,463	5,5	4,9
Wholesale and retail sale, repair of motor vehicles and motor bikes	37,478	37,456	-0,1	21,8

Economic Activity	2011	2013	% Change 2013/2011	Share (%)
Transport and storing	9,315	9,935	6,7	5,8
Accommodation and food services	10,989	14,333	30,4	8,4
Informing and communication	4,703	4,887	3,9	2,8
Financing and insurance activities	4,169	4,467	7,1	2,6
Real-estate operations	1,226	1,4	14,2	0,8
Professional, scientific and technical activities	6,234	7,19	15,3	4,2
Administrative and supporting activities	2,974	4,975	67,3	2,9
State administration and defense, mandatory social insurance	18,793	20,541	9,3	12,0
Education	12,282	13,25	7,9	7,7
Health and social welfare	10,945	11,001	0,5	6,4
Art, entertainment and recreation	4,254	4,611	8,4	2,7
Other catering activities	3,339	3,637	8,9	2,1
TOTAL	**161,742**	**171,474**	**6,0**	**100,0**

Source: MONSTAT

Table 5.34 Employment per Town in the Coastal Region

Town	Year	Employees
Bar	2011	10,961
	2012	10,980
	2013	11,541
	2014	11,497
Budva	2011	11,002
	2012	11,516
	2013	12,409
	2014	12,560
H. Novi	2011	10,568
	2012	10,429
	2013	10,168
	2014	10,471
Kotor	2011	6,298
	2012	6,472
	2013	6,876
	2014	6,560
Tivat	2011	3,278
	2012	3,422
	2013	3,702
	2014	4,070
Ulcinij	2011	4,122
	2012	4,278
	2013	4,550
	2014	4,651

Source: MONSTAT

5.8.3.2 Unemployment

The average number of registered unemployed persons in 2013 was 32,190, which is 6.7% higher than in 2012.

Lowest unemployment rates at the end of 2013 were registered in Budva (8.74%), Plužine (9.7%), Herceg Novi (10.49%) and Podgorica (11.25%) whilst the highest were recorded in Andrijevica (32.5%), Bijelo Polje (26.59%), Kolašin (26.24%) and Mojkovac (24.45%).

The unemployment problem is particularly prominent in the northern parts of Montenegro due to the decline in economic activities over the past two decades, and depopulation of rural areas with the migration of residents from the north to the middle and coastal regions.

When looking at unemployment per region, number of unemployed and unemployment rates have increased in all three regions, with the biggest fluctuations registered in the Middle Region, which was reflected through the number of advertised vacancies.

The number of the unemployed in the Northern region by the end of 2013 reached 12,810 corresponding to 37.1% of the total number of unemployed in Montenegro. Unemployment rate in 2013 was 21.9%.

In 2013, in the Middle Region, number of the unemployed was 14,977 corresponding to 43.4% of the total number of unemployed in Montenegro. Unemployment rate in the Middle Region by the end of 2013 was 13.1%

The number of unemployed in the Coastal Region by the end of 2013 reached 6,727 corresponding to 19.5% of the total number of the unemployed in Montenegro. The unemployment rate in the Coastal Region at the end of 2013 was 11.7%.

5.8.3.3 Employment of Foreigners

Even though based on the labor market analysis it is possible to conclude that the market supply is substantially higher than the demand; yet if civil engineering, hospitality and agriculture are analyzed separately, it can be concluded that demand for particular professions exceeds the supply.

According to the Employment and Work of Foreigners Law, every year (by the end of October) the Government passes a decision setting the number of work permits for foreigners for the following year. The allowed number of foreigners work permits is based on the ration between demand and supply in the labor market, opportunities for employment of local labor force, communicated needs of employers, and the scope and structure of employed foreigners in the previous year.

According to the Employment Agency, in 2010 the majority of foreigners work permits were issued by the Employment Bureau in Bar (with offices in Budva and Ulcinj) 4,636 or 44.2%, followed by Podgorica (with offices in Cetinje, Kolašin and Danilovgrad) 2,891 or 27.5% and Employment Bureau in Herceg Novi (with offices in Tivat and Kotor) 2,451 or 23.5%.

According to 2013 data, the Employment Agency in 2013 issued 93.6% of the total issued work permits in seven coastal municipalities and Podgorica. Biggest share of work permits was issued in: Budva 4,462 or 31.46%, Podgorica 3,020 or 21.29%, Herceg Novi 1,872 or 13.2%, Bar 1,817 or 12.81%.

Broken down per education, the majority of issued work permits were for unqualified labor force (10,650 or 75.09%) and semi-qualified labor force (2,066 or 14.57%), which accounts for 12,716 permits or 89.66%.

46.98% (6,663) of work permits were issued for foreigners from Serbia, 20.33% (2,884) from Bosnia and Herzegovina, 12.59% (1,786) from the Russian Federation, and 6.81% (966) from Macedonia.

Broken down per activities, work permits were approved for the following areas: accommodation and food services (29.67%), civil engineering (18.7%), wholesale and retail (16.64%). Regarding age structure, the prevailing category is people aged between 30 and 40, who account for 28.58% (3,874) followed by older than 50 accounting for 20.59% (2,791).

By October 2014, the number of work permits issued in the Coastal Region are as follows[31]:

- Bar – 2292
- Budva - 5415
- Ulcinj - 735
- H.Novi – 2518
- Kotor - 1106
- Tivat - 1736

Since the numbers above do not include November and December, it can be concluded that the number of work permits issued in 2014 is equivalent to the average for 2013.

These data confirm that the Coastal Region and its labor market depend on foreign labor force and that despite state policy to more intensively involve local labor force in seasonal jobs, a substantial portion of jobs in tourism, hospitality and civil engineering will still rely on foreign labor force.

Exploration and production of hydrocarbon shall lead to an increase in seasonal workers and an increase in foreigners, which will substantially affect the supply, not only affecting the quality but also the price of labor force, i.e. reduction in the cost due to increasing competition.

5.8.3.4 Companies

In the second quartile of 2012, the number of companies in Montenegro was 23,788, registering an increase of 11.6% compared to the first quartile of 2012 and a decrease of 12.6% compared to the end of 2011.

When comparing the towns within the coastal region, Budva included most of the companies (2,294 in 2011 and 2,590 in 2012), followed by Bar (2,085 in 2011 and 2,185 in 2012), Herceg Novi (1,808 in 2011 and 2006 in 2012), Ulcinj (911 in 2011 and 999 in 2012) and Tivat (614 in 2011 and 712 in 2012).

[31] Analysis of government policy in the area of determining number of work permits for foreigners with comparative analysis for the region, Podgorica, November 2014.

According to MONSTAT data, 4.06 thousand companies were founded in Montenegro in 2013. Of that number, the biggest number was founded in Podgorica (818 companies), Herceg Novi (702 companies) and Bar (545 companies). There were slightly less companies founded in Budva than in Bar (536 companies).

According to the same source, 2014 recorded 1.08 thousand inactive companies in Montenegro – companies which for the observed year did not perform certain activities, do not have employees and are not making a turnover. Most of them were in Podgorica, 33.2%, Bar 10,2 % and Budva 8,6 %.

Of the total number of companies, 9% are foreign companies and divided over the towns as follows: Bar: 17.6%, Budva: 22.3%, Herceg Novi: 8.6%, Kotor: 6.1%, Tivat: 5.6%, and Ulcinj 3.8%[32].

It can be expected that the exploration and production of hydrocarbon will result in the establishment of new companies in the Coastal Region, whose basic activities will be focused on meeting primary needs of exploration and production activities.

5.8.3.5 SWOT Analysis – Employment

Strengths	Weaknesses
• Taxation is lower than in majority of EU countries • Greater flexibility as result of reform of Labor Law • Evident economic development after the crisis	• Disloyal competition of grey economy • Incoherence between labor power supply and labor market demands • Unsuccessful implementation of policy for reduction in number of hired foreign workers for seasonal jobs • Unemployment, unemployed young people • Increase in the number of companies with blocked giro accounts or at loss
Opportunities	**Threats**
• New jobs based on realization of new projects • Changes in orientation of youth in selection of their university education in accordance with labor market demands • Giving priority to local labor force in seasonal employment	• Unemployment of a larger number of highly educated people • Lack of incentives for investments in human resources and insufficiently developed awareness on the necessity of such investment • Lack of cooperation between companies and institutions that offer high education

[32] Statistical office Monstat, Announcement no. 263, year 2014

5.8.4 Education

5.8.4.1 Preschool Education

Preschool education is crucial for children's overall growth, development, and forming of their personality. It also allows parents to resume their careers and not stay home with their children.

The Southern Region has 15 public preschool institutions (Table 5.35) in addition to several private ones.

Table 5.35 Public Preschool Institutions

Municipality	Name of Public Preschool Institution
Bar	Vukosava Ivanović – Mašanović
	Svetionik
Budva	Budva
	Petrovac
	Prčanj
	Sveti Stefan
	Ljubica Jovanović –Maše
H. Novi	Naša radost – Igalo
	Zelenika
	Pčelica- Bijela
Kotor	Risan
	Radost
Tivat	Tivat
	Bambi - Radovići

5.8.4.2 Primary Education

Primary education is acquired in elementary schools start at fourth grade and reach the ninth grade. Before 2005, primary schools stopped at the eighth grade and in 2005 the ninth grade was included.

The Coastal Region has 31 elementary schools: ten schools in Bar, three in Budva, four in Herceg Novi, five in Kotor, two in Tivat, and five in Ulcinj, as detailed in Table 5.36.

Table 5.36 Elementary Schools in the Coastal Region[33]

Town	Name of Public Preschool Institution
Bar	Anto Đedović
	Blažo Jokov Orlandić
	Bratstvo - Jedinstvo
	Đerđ Kastrioti Skenderbeg
	Jovan Tomašević
	Jugoslavija
	Kekec
	Meksiko
	Mrkojevići
Budva	Mirko Srzentić
	Stefan Mitrov Ljubiša
	Druga osnovna škola
H. Novi	Dašo Pavičić
	Ilija Kišić
	Milan Vuković
	Orjenski bataljon
Kotor	Ivo Visin
	Nikola Đurković
	Njegoš
	Savo Ilić
	Veljko Drobnjaković
Tivat	Branko Brinić
	Drago Milović
Ulcinj	Bedri Elezaga
	Boško Strugar
	Mark Nuculović
	Maršal Tito

Music schools are available in Bar, Budva, Tivat, Herceg Novi, Ulcinj, and Kotor[34]. Kotor also has a facility for the disabled, the Institute for Education and Rehabilitation of Persons with Hearing and Speaking Difficulties.

The number of students in elementary schools was not very different between the years 2011/2012 and 2012/2013; slight increases were recorded in all towns except Kotor, which witnessed a minimal decrease (Table 5.37). This is due to the absence of migration from the Southern Region, absence of influx of population in the past five years, and consistency in birth rates in this region.

Table 5.37 Number of Pupils in Elementary Schools in the Coastal Region[35]

Town	Number of Pupils in 2011/2012	Number of Pupils in 2013/2014
Bar	4,633	4,714
Budva	2,140	2,273
H.Novi	2,984	3,035
Kotor	2,098	2,014
Tivat	1,480	1,523
Ulcinj	2,355	2,213

[33] www.roditelji.me
[34] www.macg.me Music Association of Montenegro
[35] Statistical Office of Montenegro Monstat, *Announcement*, No.96,16. April 2014.

5.8.4.3 High School Education

The Coastal Region has 10 high schools. As shown in Table 5.38 below, three of them are located in Bar, two in Budva, one in Herceg Novi, two in Kotor and Ulcinj and one in Tivat.

Table 5.38 High Schools in Municipalities in the Southern Region[36]

Municipality	Name of Public Preschool Institution
Bar	Niko Rolović
	Agricultural High School
	Vukadin Vukadinović
Budva	Danilo Kiš
H. Novi	Ivan Goran Kovačić
Kotor	Gimnazija
	High School for Maritime Affairs
Tivat	Mladost
Ulcinj	Drita
	Bratstvo I jedinstvo

5.8.4.4 Adult Education

Schools for adults in Montenegro enable people above 15 years, considered adults, to get primary education. Adults can complete primary school by attending classes or passing final exams. Primary education of adults is organized for grades from 1 to 9 and spans over four years. After primary education, adults acquire high school education as part-time students in high schools.

In Herceg Novi, the University for Workers was founded in 1959, with a main activity of providing education for adults. University for Workers offers the following activities: school for primary education of adults, school for foreign languages, computer training courses, paint school and various cultural activities.

5.8.4.5 University Education

Montenegro has three universities: University of Montenegro, and two private universities: "Mediterranean" University and "Donja Gorica" University. In addition, the Ministries of Education and Science issue work licenses to individual private faculties.

The faculties located in the Coastal Region are as follows:

- The University of Montenegro Faculty of Marine Studies and Marine Biology Institute in Kotor

[36] www.roditelji.me

- The University of Montenegro Faculty of Applied Physiotherapy in Igalo
- The Mediterranean University Faculty of Law in Podgorica
- The Mediterranean University Faculty Tourism (MTS) in Bar

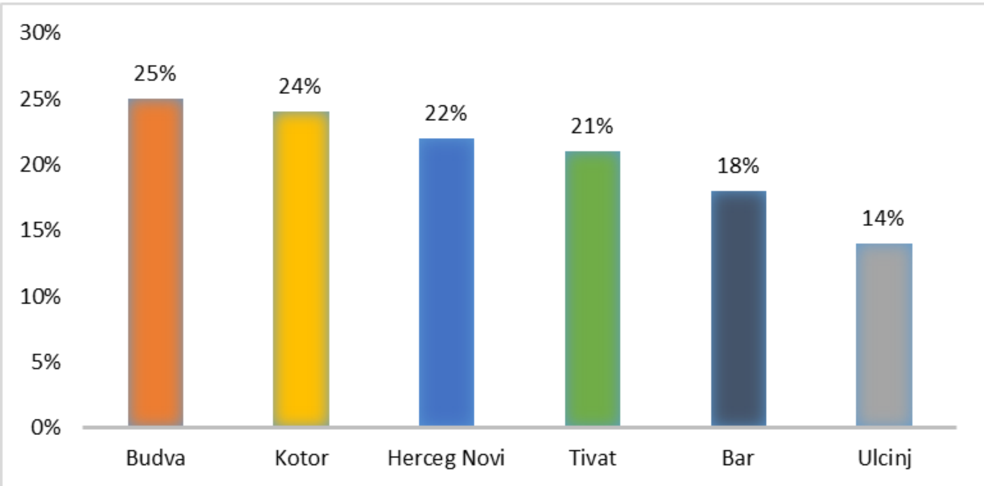
As for independent private faculties in the Coastal Region, there are the following:

- Faculty for Business Management in Bar
- Faculty for Management in Herceg Novi
- Faculty for Mediterranean Business Studies in Tivat
- Faculty for Business and Tourism in Budva
- Faculty for Business Economy in Bar
- Faculty for International Management in Miločer – Budva
- Marine Faculty in Bar

Most universities and faculties offer a three year program followed by a fourth specialization year. Some offer masters degrees and PhD programmes.

Figure 5.67 shows the share of population with higher education in the towns of the Coastal Region[37]. As shown in the graph, percentages vary between 14% in Ulcinj and 25% in Budva. Compared to an overall national average of 17%.

Figure 5.67 Population with Higher Education



Exploration and production of hydrocarbon will allow for more employment opportunities for citizens with higher education and the Marine Biology Institute in Kotor should have a significant role in the exploration phase.

With the development of this new sector, it is expected that the youth will change their focus from tourism and business programmes, for which there are not enough employment opportunities to meet the demand of graduating students.

[37] Statistical Office of Montenegro Monstat, *Announcement*, No.157, 2012, p.2

5.8.4.6 SWOT Analysis – Education

Strengths	Weaknesses
• Presence of needed infrastructure in preschool education, i.e. public and private kindergartens • High rate of preschool education • High rate of primary education • Presence of an adequate number of high schools • Presence of a variety of faculties and programmes	• Poor material base for consistent application of reformatory processes in education • Absence of vocational – mixed schools in most towns • Absence of high schools in smaller towns • Insufficient conditions for additional improvement of, in particular, talented children
Opportunities	**Threats**
• Focus on reforms in the educational system in accordance with developed countries standards to allow for activation of substantial international support • Opening of new public or private high schools • Development of awareness on necessity of education • Development of new areas of education meeting the labor market demand • Implementation of a permanent education system	• Excessive concentration of private faculties with the same study programmes • Large number of graduates for whom there are opportunities based on the current labor market demand

5.8.5 Criminality

5.8.5.1 Term Criminality and Jurisdiction of Police in Revealing and Fighting Criminal Actions

Criminality is a social phenomenon which includes criminal acts in a particular location at a particular time. According to the general understanding of criminality, it includes any punishable act i.e. behavior sanctioned in particular legal system. Sociological factors affecting criminality are: economic or industrial crisis, poverty, wealth (undertaking illegal actions, i.e. acquiring capital through most severe forms of economic and organized crime), unemployment, and migration.

No contemporary society, including Montenegrin, can eradicate criminality or to a substantial extent decrease crime rate at the national level, without seriously addressing the above indicated sociological factors through developing and then implementing adequate strategies.

According to the reports of the Police Administration on state and security in Montenegro, the security situation in Montenegro was good in the past five years, despite the economic crisis which affected all spheres of social life, the numerous protests and citizens' rallies caused by social problems, the emergency situation caused by weather elements, and the political and other events.

5.8.5.2 State and Achieved Results per Areas of Criminality

In 2012, the Police administration registered 5,827 criminal acts, showing a 5% decline compared with 2011[38]. In 2013, total of 5,899 criminal offences were registered, resulting in a 1% increase compared to 2012[39].

Table 5.39 Criminal Acts in Biggest Towns in all Three Regions[40]

Municipality	2008	2009	2010	2011	2012
Podgorica	2.541	2.443	1.944	1.746	1.591
Bar	986	1.119	940	1.025	1.054
Budva	652	632	501	450	622
H. Novi	801	832	846	630	667
Nikšić	1.395	1.112	993	899	723
Berane	906	886	881	723	562
Bijelo Polje	720	775	590	418	389
Pljevlja	276	302	299	256	219

Table 5.39 shows that there is a declining criminality rate by 2012 followed by an increase trend in 2013 in certain towns. However, this analysis cannot be applied to the biggest towns of the Coastal Region, because Bar and Budva record a decline in criminal acts while Herceg Novi shows an increase similarly to the rest of the country. Criminality rate (number of registered criminal acts prosecuted ex officio per 1000 residents) is 9.4. The highest criminal rate was registered in Budva and amounts for 29%, which is less than in 2012 when it was 32.4%, while in Herceg Novi it was 16.9%, and 19.6% in Bar[41].

Based on the above, it is evident that criminality rate is highest in the southern region compared with the central and northern regions.

In terms of criminal acts against property (thefts, extortion, etc.), it is observed that this trend is growing at the national level of Montenegro. In 2012, there were 15% more executed criminal acts against property than in 2011 but in 2013, there was a decline in this type of

[38] Report of the Ministry of Interior and Human Resources Agency, supervised by the Ministry for 2012, p. 39
[39] Report of the Ministry of Interior and Human Resources Agency, supervised by the Ministry for 2012, p. 39
[40] Report of the Ministry of Interior and Human Resources Agency, supervised by the Ministry for 2012, p. 39
[41] Same as above

criminal acts. So, in 2013 there were 2,470 criminal acts against property which is 41.8% of the total number of registered criminal acts[42].

In Bar in 2011, there were 499 registered criminal deeds against property. The following year, this trend increased to 573 perpetrated criminal deeds against property. In 2013, there were 319 registered criminal acts against property.

Budva registered 199 criminal acts against property in 2011, the following year that number decreased to 114. In 2013, this number increased by more than 50% and amounted to 288.

Herceg Novi recorded an increase in the above indicated type of criminal acts so in 2011 there were 260 criminal deeds against property registered, 388 in 2012, and 418 in 2013.

Criminal acts in the economic sector accounted for 13% of the total number of registered criminal acts. Economic criminal acts in 2012 in Bar accounted for 11.5% of the total number of criminal offences, 10.2% in Budva, 15.5% in Berane, 3.3% in Pljevlja, and 9.8% in Nikšić and 25% in the Capital of Montenegro.

According to the number of registered corruptive criminal offences in 2012[43], towns of the Coastal Region showed lower number of registered criminal offences of this type than other regions. Herceg Novi had 4 criminal offences of corruption, Budva 6, and Bar 7.

Activities of special check-ups contributed substantially to achieving positive results in the fight against crime.

Based on a survey conducted by United Nations Office on Drugs and Crime, the risk of falling victim to a crime such as robbery, theft or personal assault in Montenegro is moderate. Consequently, the vast majority of the population (over 80 per cent of citizens) feel very or fairly safe walking alone after dark, with few differences between urban and rural areas (Figure 5.68).

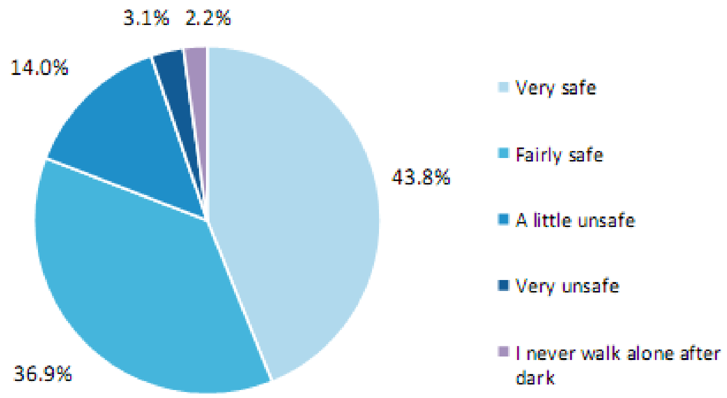


Figure 5.68 Percentage Distribution of Adult Population According to Feeling of Safety, Montenegro (2010) [44]

[42] Report of the Ministry of Interior and The Human Resources Management Authority, supervised by the Ministry for 2012, p.56
[43] Same as above

Exploration and production of hydrocarbon could lead to an increase in crime rate which presently is higher than in the northern region but also than in central region. The main reason is that the Coastal Region would be even more open to foreign citizens, seasonal workforce and migrations from two neighboring regions. An additional sociological factor that affect criminality is wealth, i.e. acquiring capital through aggravating forms of economic and organized crime could be demonstrated with certain individuals who will take part in oil and gas activities.

Despite the above, the fact that O&G activities will also result in reduction of unemployment and poverty rate can not be neglected. Unemployment and poverty are severe sociological factors that lead to an increase in crime rate.

5.8.5.3 SWOT Analysis – Crime Rate

Strengths	Weaknesses
• Tendency in reduction of crime rate • Developed capacities for international and regional police force cooperation • Lower crime rate compared with surrounding countries • Police restructuring and setting up of its organizations in accordance with EU standards	• Inadequate gender and national division in police force members • Insufficiently developed ration of trust and partnership between police and citizens, NGOs, and media • Insufficiently developed structural integrity of police
Opportunities	**Threats**
• Favorable safety ambiance • Completion of legal framework • Modern and efficient police organization • Trained and professionally qualified police members • Promotion of information system	• Lack in material-technical equipment compared with EU standards • Insufficient efficiency in fighting organized crime, corruption and terrorism

5.8.6 Poverty

Absolute poverty line for Montenegro in 2012 was €182.43 per equivalent adult, which is approximately €7 more than in 2011. In 2012 11.3% of the population had equivalent consumption below the absolute poverty line (Table 5.40). Portion of persons in the poverty was increased from 9.3% in 2011 to 11.3% in 2012. The available indicators of trends in

[44] United Nations Office on Drugs and Crime, Vienna, Corruption in Montenegro: bribery as experienced by the population, 2011.

average earnings and consumption show in 2012 that the increase of poverty rate expected the results of these economic trends.

Table 5.40 Poverty Estimation for Montenegro, 2012[45]

Poverty Indicator	2010	2011	2012	Change (2011-2012)
National absolute poverty line (in €,	169.98	175.25	182.43	7.18
Poverty rate (%)	6.6	9.3	11.3	2.0
Poverty gap (%)	1.1	2.0	2.8	0.8
Poverty severity (%)	0.3	0.7	1.4	0.7

In 2012 poverty increased in urban and decreased in rural areas. Observing urban areas, poverty rate was 8.1 % in 2012, while in 2011 it was 4.4%, in other words the rate was increased for 3.7 percentage points. In rural areas the minimum poverty rate was in 2010 (11.3%), while in 2011 was 18.4%. In 2012 compared to 2011 poverty rate in rural areas decreased for 0.3 percentage points and it was 18.1%.

There are significant differences in the extent of poverty in the region between the North and other parts of the country. Table 5.41 shows that the poverty rate in North region is almost two times higher than poverty rate in Central region and Southern region. Poverty rate in North region was 18.3% in 2012. In that region there is 30.9% of the total population of Montenegro, but there is also 50.2% of all the poor. Poverty rate in Central region is 7.9%, and in South 9.0%.

Table 5.41 Poverty Estimations by Geographic Areas, 2012[46]

Regions	Poverty rate	Relative poverty risk	Share of the poor	Share of total population
North	18.3%	1.62	50.2%	30.9%
Center	7.9%	0.70	35.9%	51.6%
South	9.0%	0.80	13.9%	17.4%

5.8.7 Monitoring Indicators for Employment, education, criminality and poverty

Indicators proposed to monitor the impacts of the programme on employment, education, criminality and poverty include:

1. Employment rate
2. Population with university degree
3. Percent local labor working for oil and gas companies or service companies
4. Ratio of local and regional nationalities working in the sector
5. Crime rate increase

Historic records of these indicators are available in MONSTAT data, as presented in previous sections.

[45] MONSTAT-Poverty Analysis in Montenegro in 2012.
[46] MONSTAT, Poverty Analysis in Montenegro in 2012.

5.8.8 Analysis of Economic Trends[47]

5.8.8.1 General Macro-Economic Indicators

After regaining independence, Montenegro experienced a period of strong economic growth, which is now relatively limited due to the negative impact of the world's economic and financial crisis. The characteristics of the period between 2009 and 2011 show a decline in direct foreign investments, negative balance of public finances, and increase in unemployment. The table below summarizes certain macro-economic indicators in Montenegro.

[47] Taken from Strategy for Regional Development of Montenegro from 2014 – 2020

Table 5.42 Basic Macro-Economic Indicators for Montenegro

Macroeconomic Indicators	2007	2008	2009	2010	2011	2012	2013	IX 2014
GDP at current prices (mil. EURO)	2.680,0	3.085,6	2.981,0	3.104,0	3.234,0	3.148,9	3.327	3.393,0
GDP real growth rate	10,7	6,9	-5,7	2,5	3,2	-2,5	3	
GDP per capita in EURO	4.28	4.908	4.72	5.006	5.211	5.063	5.063	
GDP PPS per capita	10	10.7	9.7	10.2	10.6	10.3	–	
Industrial production – growth rate %	0,1	-2	-32,2	17,5	-10,3	-7,1	10,6	-12.9
Processing industry – growth rate %	9,3	-11,3	-38,6	-0,3	6,8	-10,1	-5,0	
Inflation, consumer process method (%) – December	4,2	8,5	3,6	0,7	2,8	5,1	0,3	
Number of tourists	1.150.000	1.188.100	1.207.700	1.263.000	1.373.500	1.439.500	1.492.006	1.517.376
No. of employed persons	216.902	166.221	174.152	161.742	163.082	166.531	171.474	173.595
Unemployment rate (%)	11.9	16.8	19.1	19.7	19.7	19.7	19.5	
Export of goods and services (mil. EURO)	1.156,4	1.226,4	1.027,8	1.157,7	1.382,6	1.389,4	1.390,1	
Import of goods and services (mil. EURO)	2.305,7	2.880,5	1.948,8	1.960,5	2.099,6	2.166,4	2.065,5	
Trade balance (mil. EURO)	-1.149,3	-1,654,1	-921,0	-802,9	-717,0	-776,9	-675.4	
Direct foreign investments – net (mil. EURO)	524,9	567,6	1.066,5	552,0	389,1	461,1	323,9	
Poverty rate (%)	8,0	4,9	6,8	6,6	9,3	11,3		

Sources: MONSTAT, Eurostat, CBMNE, Ministry of Finances of Montenegro, Employment Agency of Montenegro

GDP at current prices in 2013 was 3.327 million euros. From 2006 to 2008, GDP in Montenegro recorded very high growth rate compared with EU member states and candidate states, but in 2009, due to the economic crisis, Montenegro entered a recession when real GDP had a negative growth rate of 5.7%.

Many sectors recorded a significant slowdown of activities, primarily processing industry and civil engineering. Economic recovery has become notable since 2010. After that, a negative economic growth was recorded in 2012 while 2013 recorded an exit from recession and a real increase in GDP by 3.5%. In 2013, the GDP per citizen was €5,063.

The crisis effect was mostly expressed through a decline in direct foreign investments which decreased from 1.066,5 million euros in 2009 to 323.9 million euros in 2013. Foreign trade deficit is still highly present.

In 2013, export was five times lower than import. Increase of public debt and budgetary deficit was recorded in the sphere of public finances. At the end of 2013, the public debt reached 1.933,0 million euros or 57.95% of GDP. Budgetary deficit in 2012 was 6.8% of GDP, while in 2013 it was estimated at 3.9% of GDP.

Since there are no official data on gross domestic product at the level of local government units, it is estimated according to earlier assessments, the share of the Coastal Region GDP from the total GDP ranges between 26.6 and 31%.

The tables below show values and structure of GDP between 2010 and 2013 in total and by economic activity.

Table 5.43 Gross Value Added per Economic Activity

Economic Activities	**Gross value added in current prices, in thousands of EUR**			
	2010	**2011**	**2012**	**2013**
Agriculture, forestry and fishing	239,495	256,726	232,012	266,886
Mining and quarrying	37,702	33,725	33,591	36,067
Processing industry	144,512	162,535	135,462	136,986
Power, gas, steam supplying and air conditioning	143,115	65,424	89,708	137,229
Water supplying, waste water management, controlling the process of waste removal and similar activities	56,721	67,230	68,862	66,669
Construction works	151,904	158,081	145,192	136,280
Wholesale and retail sale, repair of motor vehicles and motor bikes	348,770	391,686	386,333	388,391
Transport and storage	144,915	150,880	130,287	125,738
Accommodation and food services	154,425	207,176	210,511	217,672
Informing and communication	176,614	164,957	154,588	148,352

Economic Activities	Gross value added in current prices, in thousands of EUR			
	2010	2011	2012	2013
Financing and insurance activities	124,515	131,838	129,081	138,399
Real-estate operations	183,605	219,875	226,273	227,155
Professional, scientific and technical activities	72,737	88,175	89,858	76,990
Administrative and supporting activities	25,059	26,755	29,352	37,363
State administration and defense, mandatory social insurance	255,073	256,930	246,306	246,541
Education	138,877	139,272	142,854	138,824
Health and social welfare	135,589	121,959	124,377	128,876
Art, entertainment and recreation	39,710	39,807	38,834	45,222
Other catering activities	13 ,99	19,637	22,133	24,156
Household activities as employer	…	…	…	…
Activities of extra-territorial organizations and units	…	…	…	…
Total gross value added	**2,587,237**	**2.,704,668**	**2,635,614**	**2,723,796**
Product taxes minus product subventions	516,618	529.,392	513,243	603,281
GROSS DOMESTIC PRODUCT	**3,103,855**	**3,234,060**	**3,148,857**	**3,327,077**

Source: Izvor: Monstat, Crna Gora u brojkama 2014

Table 5.44 GDP per Economic Activity

Economic Activities	GDP (%)			
	2010	2011	2012	2013
Agriculture, forestry and fisheries	7,7	7,9	7,4	8.0
Whole sale and retail sale	11,2	12,1	12,3	11.7
Accommodation and food services	5,0	6,4	6,7	6.5
Informing and communication	5,7	5,1	4,9	4.5
Real estate operating	5,9	6,8	7,2	6.8
State administration and defense, mandatory social insurance	8,2	7,9	7,8	7.4
Other	56,3	53,8	53,7	55.1

Source: MONSTAT, Montenegro in Figures 2014.

5.8.8.2 The Coastal Region Economic Activities

The Coastal Region covers 11.6% of Montenegro's territory with 293.5 km of coastal shore length. It has 23.4% of Montenegrin population and accounts for 26.5% of economic products of Montenegro.

The dominant economic sectors of this region, further detailed in the following sub-sections, are: tourism and hospitality, transportation, Mediterranean agricultural production, as well as small economy and trade.

5.8.8.3 Tourism

5.8.8.3.1 Introduction

Bearing in mind the substantial tourism resources, proximity of emission markets and more than half a century of history of international tourism, tourism is predetermined as a drive power of new development cycles and a strategic priority for Montenegro.

Montenegro's striving to grow into a recognizable tourist destination has led to country's orientation towards new development philosophy according to which orientation to sustainable tourism contributes to increase in attractiveness of certain destinations and wellbeing of their local people.

It is necessary to stress that natural and landscape values of Montenegro, especially in the Coastal Region, have been suffering pressure from growing tourism and urbanization, which causes impoverishment of natural landscapes that give the Mediterranean character to this area, as well as endangerment of certain components of biodiversity.[1] The ecological dimension has greater impact on the value of tourist destination with growth of ecological awareness of tourists. Acknowledging challenges of endangering biodiversity, stress is on establishing balance, changes in tourist attractions and preservation of environment[2]. In that regard, the strategic goal for tourism development in Montenegro by 2020 was defined as follows: with application of principles and goals of sustainable development Montenegro will create strong position as global high-end tourist destination, tourism will provide population of Montenegro with sufficient jobs and growth in life standard, and the country will generate incomes in a stable and reliable manner[3].

To make tourism sustainable and to achieve social and economic impacts in the non-developed part of the country (mainly northern), it is necessary to create diversified products and sustainable management of tourists destination. Even though Montenegro has natural potentials and it is close to rich potential emission markets, the fact that other countries also have natural resources have to be considered, and the road to achieving competitiveness in tourism needs to be based on long-term trends as well as long term monitoring of global tourist market.

[1] Ministry for Economic Development: Spatial Plan of Montenegro by 2020, Podgorica, 2008, p. 53.

[2] Vitić-Ćetković, A.; Jovanović, S.; Krstić, B.: Determinants of Montenegro and Serbia Tourism Competitiveness Improving in the Terms of Globalization, Journal: »Economic Themes«, 01/2012, COBISS.SR-ID 17960194, ISSN: 0353-8648, p. 52.

[3] Ministry of Tourism and Environmental Protection: Strategy for Tourism Development by 2020, Podgorica, 2008. p. 20.

5.8.8.3.2 Tourism and Sustainable Development of Montenegro

Tourism is regarded as one of the most important sources of income in Montenegro as well as a potential for opening new work places, reduction of poverty, enticement of responsible relationship with the environment and responsible resources management and accessibility to education.

Montenegro declared itself as an "ecological state" in 1991, which is a unique idea that insufficiently reflects reality. The fact is that in the past 15 years Montenegro has seen realization of increasing number of foreign investments aimed at revitalizing this economic sector[1]. However, there are numerous challenges regarding competitiveness of the destination, de-seasoning of demand and attraction of high-end tourists which trigger the need for monitoring trends on international market that are related to increase in ecological awareness and need for diversification of destination's offer.

The Basic document that should establish new competitive position of Montenegro is

The "Master Plan Strategy for Tourism Development in Montenegro by 2020" was passed in 2001and reviewed in 2008. Vision of Montenegro, as competitive tourist destination, indicated in this document is formulated in the following way: in the first half of the year, it will be a high quality Mediterranean destination, and in the second half, a destination for active holiday.

From the time the Master Plan was given green light (2001), Montenegro made some improvements in terms of infrastructure, promotion, structure of hotels and accommodation, etc., however, there was a lack in the application of the master plan. 2008 Master Plan Revision is important so as to integrate sustainable tourism project in different parts of Montenegro. The Reviewed Master Plan for Tourism from 2008 focused on the need to offer diversification and adjusting services to meet new desire of tourists at the same time concentrating on sustainable development. In order to better valorize potential and maximize good sides but also to eliminate weaknesses, there is tendency to connect hinterland and coastal zone into a unique and quality tourist experience.[2]

National Sustainable Development Strategy was passed in 2007, which is compatible with the Master Plan in regards to environment. It is interesting that both documents acknowledge substantial regional differences in Montenegro. Northern region is underdeveloped, while central and southern regions are more developed. Strategic priorities, tourism and agriculture, which can generate multiple effects are not adequately connected. Underdevelopment of the northern region can substantially endanger sustainability, especially in terms of relationship towards natural resources.

National Sustainable Development Strategy promoted sustainable development in tourism sector as development "(i) that abides with mutually balanced economic, ecological and social principles; (ii) that does not deplete natural resources, but uses them to an extent that ensures their availability for future generations; (iii) that preserves cultural diversity and

[1] Ministry of Spatial Development and Environmental Protection: National Biodiversity Strategy with Action Plan for period between 2010 and 2015, July 2010. p. 35.

[2] Ministry of Tourism and Environmental Protection: Strategy for Tourism Development in Montenegro by 2020, Podgorica, 2008., p. 4

identity, while stimulating social harmony; and (iv) in addition, bears in mind tourists satisfaction. "[1]

In October 2007, the Parliament ratified the Convention on Protection of Marine Environment and Coastal Area of the Mediterranean (Barcelona Convention) and four relevant protocols, while activities on ratification of new protocol of this convention are ongoing – Protocol on Integral Management of Coastal Area of the Mediterranean, signed on 21st January, 2008 in Madrid by majority of Mediterranean countries. In addition to other measures for protection of the coast and nature, it envisages ban on construction at 100 m distance from the shore, for all new projects for which preparation of planning documentation is initiated after ratification of the Protocol at Montenegrin Parliament, with possibility of exemption in certain cases, including realization of project of public interest[2].

It should be noted that the Spatial Plan of Republic of Montenegro and Amendments, stresses on the necessity of the strict spatial reservation for realization of special projects. The necessity for protection of the corridors defined for the development of traffic lines, space for hydro accumulations, zones with deposits of mines and raw materials and areas for development of agriculture and tourism is emphasized. Those planning postulates have been only partly achieved, but they have not been abandoned.

The fact that Montenegro was granted an EU candidate status affects the need for a stronger orientation towards sustainable development and more intensive marketing of tourist destinations, as well as balanced regional development. To achieve this goal, it is necessary to: a) develop a more diverse tourist offer (development of rural, agro, eco, planning, cultural, sport and other forms of tourism, especially north of the country; b) integrate sustainability criteria in the process of approving tourist development projects"[3] and c) spreading the knowledge of sustainable development.

Natural resources in Montenegro are an important asset for the development of tourism. However, some of the challenges tourism in Montenegro is facing are: the promotion of environmental protection management system, mitigation of regional differences through development of tourism at the entire country and investments in road infrastructure development.

5.8.8.3.3 Quantitative and Qualitative Analysis of Tourism Sector in Montenegro

According to MONSTAT data, there were 1,492,006 tourist arrivals in Montenegro in 2013 which is 3.6% higher than in 2012, while the number of overnight stays is 2.8% higher than in 2012 amounting to 9,411,943 , 89.4% of which were foreign tourists, and 10.6% were domestic tourists.

In 2013, most overnight stays were by tourists from Russia (28.1%), Serbia (25.1%), Bosnia and Herzegovina (7.5%), Ukraine (5.6%), Kosovo (3.3%), Poland (2.7%), Germany (2.3%), and France (2.2%). Tourists from other countries had 23.2% overnight stays.

[1] Ministry of Spatial Development and Environmental Protection: National Biodiversity Strategy with Action Plan for period between 2010 – 2015, (proposal) July 2010., p. 35
[2] Ministry of Tourism and Environmental Protection: Strategy for Tourism Development in Montenegro by 2020, Podgorica, 2008., p. 9
[3] Ministry of Spatial Development and Environmental Protection: National Biodiversity Strategy with Action Plan for period between 2010 – 2015, (proposal) July 2010, p. 80-81.

97% of overnight stays in 2013 were realized at coast towns, 1.2% at the capital city, 1.1% at mountain towns and the remaining 0.7 % at other tourist sites and other places.

In tourism, there is a misbalance between built accommodation capacities and insufficient development of the so called, additional tourism offer. In addition, special problem is insufficiently developed technical infrastructure, first of all roads and water supply, and then lack of developed waste waters channeling, treatment and disposal/releasing systems in the largest part of the Montenegrin territory i.e. in the majority of urban and other settlements.

Besides very successful results in modernization and construction of tourism superstructure during the last years, functional and technical condition of the majority of hotels and other accommodation facilities is still inadequate. Existing structure of accommodation capacities is against strategic objectives of tourism development of Montenegro, especially in relation to planned increase in share of basic accommodation capacities (to app.40%). Weekend houses and apartments as a kind of sub-optimum use of tourism resources, participate with even 44% in total accommodation capacities and basic accommodation capacities only with 13.62 % (hotels only with 9.68%).

Nautical tourism is an important tourism sector in the coastal region, the number of cyclic trip of foreign vessels are presented in Table 5.45, while the number of cruises realized in the internal sea waters of Montenegro, as well as number of passengers arrived in Montenegro during these cruises are presented in Table 5.46.

Table 5.45 Cyclic trips of Foreign Ships in Montenegro

	Number of Cruises and Passengers		
	2013	**2012**	**2013/2012 (%)**
Cruises	409	348	117.5
Passengers	314,961	244,084	129

Source: MONSTAT, 2013

Table 5.46 Arrivals of Foreign Vessels in Nautical Ports

	2012		2013		2013/ 2012 (%)
	Number of Cruises	**%**	**Number of Cruises**	**%**	
Total	2,987	100%	3,786	100%	126.7
By flag					
Albania	--	--	2	0.1	
Austria	163	5.5	135	3.6	82.8
France	94	3.1	96	2.5	102.1
Greece	28	0.9	23	0.6	82.1
Croatia	336	11.2	348	9.2	103.6
Netherlands	43	1.4	66	1.7	153.5
Italy	248	8.3	262	6.9	105.6
Germany	155	5.2	157	4.1	101.3
Scandinavian countries	33	1.1	57	1.5	172.7
Slovenia	35	1.2	41	1.1	117.1

	2012		2013		2013/ 2012 (%)
	Number of Cruises	**%**	**Number of Cruises**	**%**	
Switzerland	22	0.7	30	0.8	136.4
United Kingdom	400	13.4	500	13.2	125.0
USA	468	15.7	607	16.0	129.7
Other countries	962	32.2	1,462	38.6	152.0
By vessel length					
Up to 6 m	339	11.3	404	10.7	119.2
From 6 to 8	191	6.4	249	6.6	130.4
From 8 to 10	245	8.2	319	8.4	130.2
From 10 to 12	518	17.3	693	18.3	133.8
From 12 to 15	719	24.1	734	19.4	102.1
From 15 to 20	324	10.8	464	12.3	143.2
Over 20 m	651	21.8	923	24.4	141.8
By vessel type					
Moto yachts	1,430	47.9	1,993	52.6	139.4
Sailboat	1,053	35.3	1,079	28.5	102.5
Other	504	16.9	714	18.9	141.7

Source: MONSTAT, 2012 and 2013.

In order to adequately valorize its tourist potential, Montenegro has to overcome some key obstacles, especially in the coastal region, these include:

- Devastation of tourist resources with over-construction of apartments;
- Short tourist season of two to three months in the summer;
- Inadequate road infrastructure;
- Problems with water and power supply;
- Inadequate wastewater and solid waste treatment infrastructure;
- Inappropriate distribution of accommodation places, mainly located at the coast
- Big oscillation in number of tourists between peak season and shoulder seasons at the coast, which has negative repercussions on life of local people
- Low level of awareness of tourist development needs amongst local people.

5.8.8.3.4 Nature- Based Tourism as a Development Perspective in Montenegro

National policy promotes the development of tourist activities based on nature, where biodiversity plays an important role[1]. Nature-based tourism activities include: bird watching, photo safari, biking, hiking, rafting, filming scientific and documentary films, etc. There is also potential for the development of “swamp bird watching” at Skadarsko Lake, Ulcinjska Salt Plant, Ada Bojana as well as Tivatska solila, and for watching predator birds and forest species at National parks in Durmitor and Biogradskoj Gora.

[1] Ministry of Spatial Development and Environmental Protection: National Biodiversity Strategy with Action Plan for period between 2010 – 2015, (proposal) July 2010

Montenegro is investing in marketing to position itself as a recognized destination for nature-based tourist activities, however, the number of tourists who have the motivation to participate in such activities (ex. hiking) is still insufficient. People in Montenegro use the advantages that national parks and other natural areas offer to a limited extent, due to the poorly developed culture of outdoor activities such as hiking, mountaineering, camping, etc.

It shall be noted that tourist activities may affect biodiversity. The carrying capacity (limit of maximum permitted number of visitors) of many tourist areas in Montenegro was not estimated adequately, including protected natural areas.

5.8.8.3.5 Tourism in the Coastal Region of Montenegro

The natural shore in Montenegro is the most attractive area for various market segments, so preservation of its properties and view is a precondition for preservation of natural balance and development of tourism for a longer period of time.

Tourism, marine economy and partially agriculture and fishing as well as the usage of mineral raw materials (sand, stone and exploration of oil and gas) are the key economic activities in the Coastal Region. In the previous period, these activities have been unsustainably exploiting natural resources in the coastal belt (primarily space and landscape values). It can be said that today the coastal area of Montenegro is greatly "spent" on various economic and other activities, and that it has gone through substantial change in natural and landscape values.[1]

Measures to control and mitigate the pressure on the environment and integrate patterns of green economy in sectorial policies are prerequisite for sustainable tourism in the coastal area. Although regulations request the preparation of environmental impact assessment studies during projects' planning stages, this has not been sufficiently applied, which lead to intensive, and in certain cases, unplanned and uncontrolled development of tourist accommodation buildings along nearly the entire Montenegrin shore[2]. This particularly refers to Budva, Ulcinj, along Bojana River, Port Milena and Velika plaza (the Grand Beach), Buljarica, Tivat and Luštica Peninsula[3].

The length of coastline of Montenegro is 293.5 km. It has 117 beaches with a total length of 73 km. There are possibilities for the expansion of existing beaches in addition to possibilities for investing new beaches; and this will provide a total maximum capacity of 270,000 guests at the same time4. Whereat, not only presently available beaches are taken into account but also possibilities of their expansion, as well as development of artificial beaches between rocks of Adriatic coast.

Share of marine tourism in the overall overnight stays for decades has been around 96% - 97%, which is reflective of excessive role of coastal tourism compared with overall tourist potentials in Montenegro. Seasonal distribution of tourist turnover at the coastal zone is very

[1] Same as above
[2] Ministry of Spatial Development and Environmental Protection: National Biodiversity Strategy with Action Plan for period between 2010 – 2015, (proposal) July 2010, p. 35
[3] Same as above
[4] Ministry of Tourism and Environmental Protection: Strategy for Tourism Development in Montenegro by 2020, Podgorica, 2008.

unfavorable with dominant concentration of tourist turnover in summer months which indicates that capacities are not being used rationally and sufficiently.

The development of tourist accommodations along the coast has to be handled with extraordinary care because the carrying capacity of the municipalities in this region is already almost exhausted. The number of tourists during the peak July August causes negative impacts like overburdened traffic infrastructure, congested urban centers because of lack of parking places, lack of water, polluted beaches and roadsides, etc.

5.8.8.3.6 Monitoring Indicators

The indicators selected to monitor the likely impacts of the Programme on tourism are:

1. Tourist arrivals (T01)

Data available for the period 2000-2012 show an overall increase in tourist arrivals at an annual rate of 9% with the trend of a steady increase. The share of domestic and foreign tourists in the total number was stable at around 13% and 87% respectively.

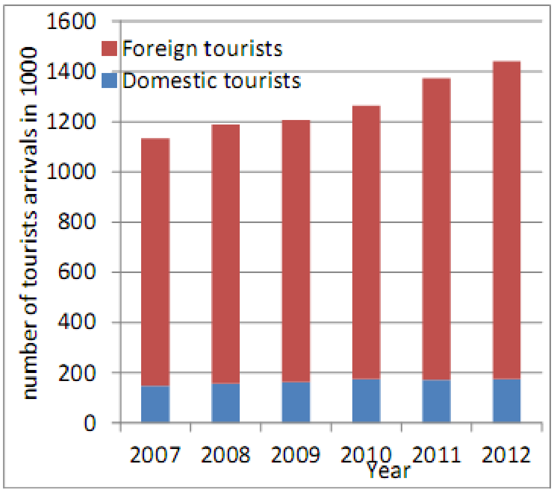


Figure 5.69 Number of Tuorists Arrivals, 2007-2012.

2. Number of tourists on cruise lines (T04)

The indicator tracks the number of cruise trips generated in the territorial waters of Montenegro, as well as the number of travelers who visited Montenegro. A cruise is a tourist journey lasting for several days according to a specific, elaborated plan of cruises. The number of passengers on board is the number of passengers not including crew members. A cruise passenger is any person who arrived by ship, regardless of age, and is not a member of the crew.

Data available for the period 2007-2011 show the overall increase of tourists on cruises. The number of trips also had a slight growth trend. In 2011 there were 319 international cruise lines in Montenegro with 187,171 passengers. In comparison to 2010, the number of cruises increased by 1.9%, while the number of passengers on these cruises increased by 31.6%. According to the flag that they flied, the structure of ships that sailed into the territorial waters of Montenegro in 2011 was as follows: Malta (34.8%), Bahamas (24.1%), Panama (9.4%), Belgium (8.8%), Portugal (6.0%), Marshall Islands (5.3 %), France (4.7%), Bermuda (2.2%), Greece (1.6%) and others.

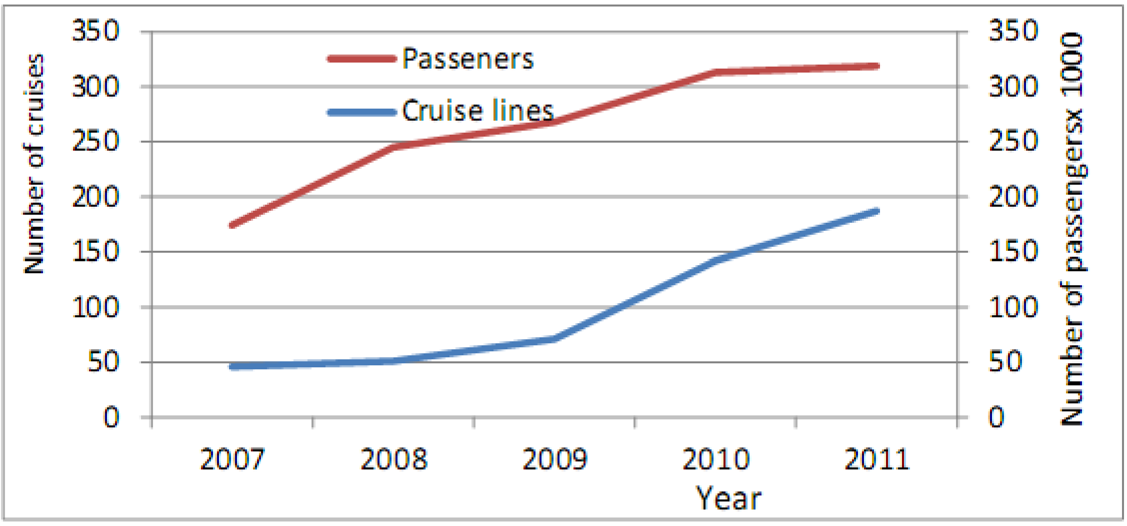


Figure 5.70 The trend of International Cruise Lines, 2007-2011.

3. Investment in alternative modes of tourism

Investment in alternative modes of tourism is a necessity for the sustainable development of tourism sector and to reduce the pressure on coastal areas. This indicator would reflect the changes in investments in tourism sector after the implementation of the Programme.

5.8.8.4 Agriculture

Agriculture in the Coastal Region is of particular relevance, both for local consumption and as a complimentary activity to tourism. Agricultural production includes growing of subtropical fruits (olives, tangerines), citruses, continental fruit, vegetables, flowers and medicinal herbs is typical as well as processing of southern fruits. Of the overall 13,633 ha of agricultural land in the Coastal Region, 7,919 ha (59%) are being used.

Olive trees are the prevailing fruit species in Montenegrin coastal zones, it is particularly important in Bar, where there are around 120,000 olive trees. In the past decade, the number of citruses trees has increased of which tangerines have the biggest share. There is a large number of citrus fields in the Ulcinj and Bar (tangerines, lemon) with around 90,000 trees. The agricultural productions of these trees exceed the needs of Montenegro for southern fruits and due to the shortage in refrigerating capacities, shares of production are being imported.

The Montenegrin strategy for agricultural development includes:

1. Primarily locating olive and citrus plantations in the coastal zone;
2. Protecting the coastal zone of regional and national importance from construction activities;
3. Fertile lands located around Donjeg and Gornjeg Štoja, north of Ulcinj and in Bratiška valley, are to be developed given their good potential for farming owing to the Mediterranean climate;

4. It is necessary to provide long term protection of certain agricultural land to justify future investments in capital projects needed for improvement of agricultural production and increase in crops' yield (irrigation, drainage, terraces etc.);
5. Infrastructure development should be located outside fertile agricultural land, suitable for long term agricultural production. Fertile lands are quite limited, and as agriculture and horticulture continue to develop, larger areas with fertile soil will be required;
6. It is necessary to secure possibility and inducement to local entrepreneurs to invest as food demand increases.

5.8.8.5 Marine Fisheries and Marine Culture

Freshwater and seawater fishing as an economic branch is not developed to such an extent to ensure significant revenues. Seawater fishing was falling behind substantially given inadequate view of its importance and complementarity, especially with the tourism sector, which resulted in low investments in purchase of equipment, organization and promotion of this activity.

Yet, the fishing sector has recorded substantial progress in terms of development of fisheries and their application contributing to a rational management of certain fishing areas and an improved relationship with the environment.

The following two main problems have been identified during the development of the fishing sector:

1. Procedures for setting and declaration of general and special nature reservoirs has not been fully implemented; and
2. Insufficient control and prevention of poaching.

The Department of Marine Fishery in the Ministry of Agriculture and Rural Development, monitors resources, assesses biomass of these resources, and sets a biologically permitted level of usage. The department also sets laws on freshwater and marine fishing, in harmony with the EU legislation.

The Marine Biology Institute, initiated in 1997, monitors marine fish resources, estimates demersal (benthos) and pelagic resources, and sets limits for fishing quantities of these resources (600 tonnes of white fish and 15,000 tonnes of small blue fish).

The commercial fishing fleet for benthos fish consists of 17 ships and 156 boats (around 180 permits for small coastal fishing have been registered), while the pelagic fishing fleet basically does not exist, providing opportunities for the development of this type of fishing. Opportunities lie in establishing a fleet of large and strong fishing boats capable of exploiting resources in the continental slope at depths from 300 to 600 meters (epicontinental shelf of Montenegro).

Mariculture in Montenegro was rather symbolic with low yields, especially in respect to the present opportunities. Explorations of the Marine Biology Institute from Kotor show that the sea basin, especially in Boka have excellent natural characteristics for natural development and artificial breeding of maricultures. It refers to both, collection of dark and red algae and breeding of mussels and pacific oysters. Boka's capacity for breeding mussels is estimated to 300 wagons a year. Today, there are programmes that offer great development opportunities for breeding maricultures, using floating parks – that mainly suit breeding of mussels and other types of shells.

Based on natural opportunities, it is estimated that the capacity of Montenegro for lagoon fish breeding is 3,000 tonnes, and caged breeding 2,000 tonnes a year. More information of fish resources are presented in Section 5.5.6.

Projects and assessments of opportunities and concrete programme focus on exceptional profitability of artificial breeding of marine cultures, and on the other hand on almost limitless market of high-end demand, which is a great challenge for usage of the sea basin.

5.8.8.6 Industry

In the coastal areas, industrial activity is based on following:

1. Machines building in Kotor ("Daido Metal");
2. Production of metalloid minerals – salt is produced in "Bajo Sekulić" in the salt plant of Ulcinj;
3. Production of base chemical products in Buljarica and Bijela;
4. Processing of chemical products in Kotor ("Henkel"-Rivijera");
5. Rubber and Indian rubber processing in Kotor ("Bokeljka");
6. Mill and candy production in Herceg Novi ("Aleksandrija");
7. Production of oil "Primorka" and "Olio-prom" in Bar;
8. Processing of medical herbs and forest products in Bar ("Barbilje") and Risan ("Exportbilje" – currently closed); and
9. Production of beverage in Bar ("Primorka").

5.8.8.7 Oil Industry

The Oil Industry assumes its significant place in the economic development of Montenegro, with important Montenegrin needs. These products are supplied to petroleum installations in Bar and Lipci via sea, and distributed to retailers via road transportation using petrol tankers. Petroleum installations in Bar and Lipci, from a technical point of view, are modern facilities that meet all international standards.

According to the "Energy Development Strategy in Montenegro", which in certain segments is based on geological assessments, oil reserves in Montenegrin offshore are estimated at seven billion barrels, while natural gas reserves are estimated at 425 billion cubic meters.

In terms of oil industry infrastructure, Montenegro has the following:

- Petroleum storage station in Bar on Volujica with tanks capacity of 98,900 m^3 and two berths

- Petroleum storage station in Lipci which includes 5 storage tanks with a capacity 12,200 m^3; around 5,000 m of tubing; berths for shops with up to 6,000 tonnes carrying capacity, draught up to 8 m
- Three yachting services at the coastal zone in Budva, Kotor and Herceg Novi
- Nine gas stations
- Airport petroleum services in Tivat covering 15,000 m^2 within the airport area and comprising of two locations:
    - Bonići for the reception of commodities transported via water for shops with up to 3,000 tonnes and 5.2 m draught capacities. Installations are connected with Bonići 960 m length subsea pipes with a tank capacity 4,840 m^3, and
    - Administrative Building floor area of 100 m^2, including: pumps and vehicle decanters with up to 50 t/h capacity, substation, tank with fire extinguishing facilities, two warehouses and a car base.

Petrol stations and yachting services are structures that meet basic standards in regards to health and safety.

In the coming period of time, these facilities will require substantial technological innovations – in particular in regards to their automation and protection of underground tank space via bundwalls. In particular yachting services which are located at the very coast.

<u>Fiscal Policy of Upstream Hydrocarbon Industry</u>

The legal framework and requirements for exploration and production of hydrocarbon are mainly stipulated through:

- Law on Exploration and Production of Hydrocarbon,
- Rulebook on Conditions for Drilling Boreholes,
- By-law on Method of Calculation and Payment of Fees for Production of Oil and Gas, and
- Bill of Law on Tax for Hydrocarbons.

Revenues which could be generated from hydrocarbon production (the upstream industry) in Montenegro include fees, taxes and other revenues as detailed hereunder.

<u>Fees:</u>

Application fees would range from 30,000 to 50,000 €. The proposed fees for an area of production for a period of 1-7 years is 300 €/km², for 8 years and onward it becomes 3000 €/km². The Royalty rates for production of oil and/or gas are detailed in Table 5.47. The Global, average rate for royalty is 7%.

Table 5.47 Royalty Rates for Production of Hydrocarbon

Production in Barrels	Royalty Rates for Liquid Hydrocarbons (%)	Royalty Rate for Gas (%)
≤ 10,000	5	2
>10,000 – <20,000	7	2
>20,000 – <30,000	10	2
>30,000	12	2

Taxes:

There is an extra tax on income from upstream production of oil and gas. The combination of the extra tax and the general income tax of legal entities results in a cumulative tax of 59% (extra tax rate 50% and general income tax rate of 9%), with defining rules for determining incomes and expenditures for tax purposes which will be regulated with special laws and bylaws.

Other Revenues:

- Fund commissioning expenses – stipulated in the contract;
- Environmental pollution fees.

5.8.8.8 Transportation

The general state of transportation infrastructure in Montenegro is relatively good taking into consideration the landscape of the country (deep canyon valleys and sharp mountain massifs). If the transportation network is assessed as a ratio of total length and area, then it can be considered as rather underdeveloped, because it is falling behind a majority of European countries. The situation is even worse if technical characteristics of the transportation network are considered.

5.8.8.8.1 Road Transportation

The total length of categorized roads in 2013 was 7,965 km. Roads are divided per type of road surface as follows:

- Asphalted road surface: 5,576 km
- Crushed stone pavement: 1,505 km
- Dirt road or uncategorized road: 884 km

The main continental direction is Budva - Podgorica - Bijelo Polje and further towards Serbia and Europe. Moreover, the Adriatic Arterial Road along the coast connects all the coastal settlements.

5.8.8.8.2 Rail Transportation

The existing rail network in Montenegro extends over 250 km, out of which 223.8 km are electric-based and 24.7 km are not, consists of the following three (3) lanes:

1. Bar – Belgrade;
2. Podgorica – Nikšić;

3. Podgorica – Shkodër.

The railroad network in Montenegro is connected with the following industrial tracks:

- Industrial track at the intersection of Kruševo;
- Industrial track at Mojkovac station;
- Industrial tracks at Podgorica station:
  - Aluminium Plant Podgorica, and
  - Zetatrans;
- Industrial tracks in Bar station:
  - Port of Bar JS, and
  - Container Terminal and General Cargoes JS.
- Industrial track at Nikšić station (Iron plant and Boxite mines),
- Industrial track at Danilovgrad station;
- Industrial track at Spuž intersection.

If the geographic position of Montenegro as a transitory country is considered, its railway network, with Belgrade-Bar connection as backbone, can become a substantial part of the Balkan and European railroad network, provided it is reconstructed, upgraded, and maintained.

5.8.8.8.3 Airway Transportation

Montenegro has two (2) main airports located in Podgorica and Tivat for local and international transportation. In addition, there's an airport in Berane, for aerial sport activities and emergency situations.

Podgorica Airport

Podgorica Airport contains a main runway and several smaller ones. The airport is fitted with precise instrumental access, category (CAT I) from 36 directions. The docking platform consists of a platform for commercial transportation and a platform for general aviation. The commercial platform includes six parking positions for class C, D, or E airplanes. The platform for general aviation has three parking positions for planes with the following dimensions: wings span 20 m, hull length 20 m.

The dominant aviation at Podgorica airport are:

- Embraer 195, Foker 100, Airbus 319, Airbus 320, Boeing 737 class C, and
- Airbus 300, Airbus 310, Boeing 757, Boeing 767 class D.

The airport is equipped for landing class E aviation. The biggest airplane that can land is Airbus 330 (series 200) with a maximum weigh at transit of around 230 tonnes.

The passenger terminal building covers an area of 5,500 m^2 and fitted with modern devises for servicing up to 1,040 passenger s and their luggage.

Tivat Airport

Tivat Airport contains a main runway and two smaller ones.

The docking platform consists of a platform for commercial transportation and a platform for general aviation. The commercial platform includes seven parking positions, of which one is for parking class D aviation, and six for class C. The platform for general aviation has 12 parking positions for planes with the following dimensions: wings span 20 m, hull length 20 m aided by aircraft tug tractors.

The passenger terminal building covers an area of 4,056 m^2 and is fitted with modern devices for servicing up to 1,000 passengers and their luggage.

5.8.8.8.4 Marine Transportation

Marine economy, an old Montenegrin tradition which accounted for 24% of the country's GDP in the 80s, is not currently a major contributor to the country's GDP like in the 80s due to the folding of the large shipping companies "Jugooceanija" in Kotor and "Prekookeanske plovidbe" in Bar.

Marine traffic, ports, free zone and supporting shipbuilding-mechanical industry are areas on which development is focused in the Coastal Region. The Port of Bar, Port of Zelenika, Port of Kotor and Shipyard Bijela are the backbones of marine transportation activities in the Mediterranean zone contributing to the development of the Coastal Region and other regions in Montenegro.

Within the coastal zone area, there are smaller ports used by local population: Kalimanj port in Tivat, and Škver port in Herceg Novi,

Waterways

Law on Marine Navigation Safety (OG MNE, No. 62/2013) defines a waterway to be: "Waterway in Internal Sea Waters and Territorial Sea of Montenegro is sea belt sufficiently deep and wide for safe navigation of vessel, which is if required marked." (Article 7, Paragraph 1, Law on Marine Navigation Safety).

Waterways are divided into overseas, coastal and port waterways. The total length of waterways in the coastal zone of Montenegro is 66nmi, or 122.2 km, which is the distance between its final ports, from Sv. Nikola (mouth of the Bojana River) up to Kotor. Out of the total length of the waterway, 50 nmi (92.6 km) is in the open sea, and 16 nmi (29.6 km) within the Boka Kotorska Bay (which will not be affected by the programme). There are a number of navigation safety facilities.

East-Adriatic Waterway goes from Strait of Otranto, along the east shore of the Adriatic to its most northern ports. It goes to the shore, at a distance from 5 to 10 km, from its most jutting points, i.e. within the zones of visibility of navigation safety structures. The width of this waterway is 2 – 4 km. This waterway is for ships whose destination is some of the ports on Montenegrin shore, or ports within its direct vicinity. It is intersected by waterways that connect ports on Montenegrin and Italian shores (Bar-Bari, Bar-Ancona, Kotor-Barletta, and Zelenika-Barletta). These waterways are connected with waterways leading towards Montenegrin shore that are open for international transportation (Bar, Budva, Zelenika and Kotor).

These waterways are international and overseas waterways as they connect ports of countries with coasts on Adriatic Sea, as well as ports of overseas countries. The width of these waterways is not less than 100 m and they are located at 300 m from the shore.

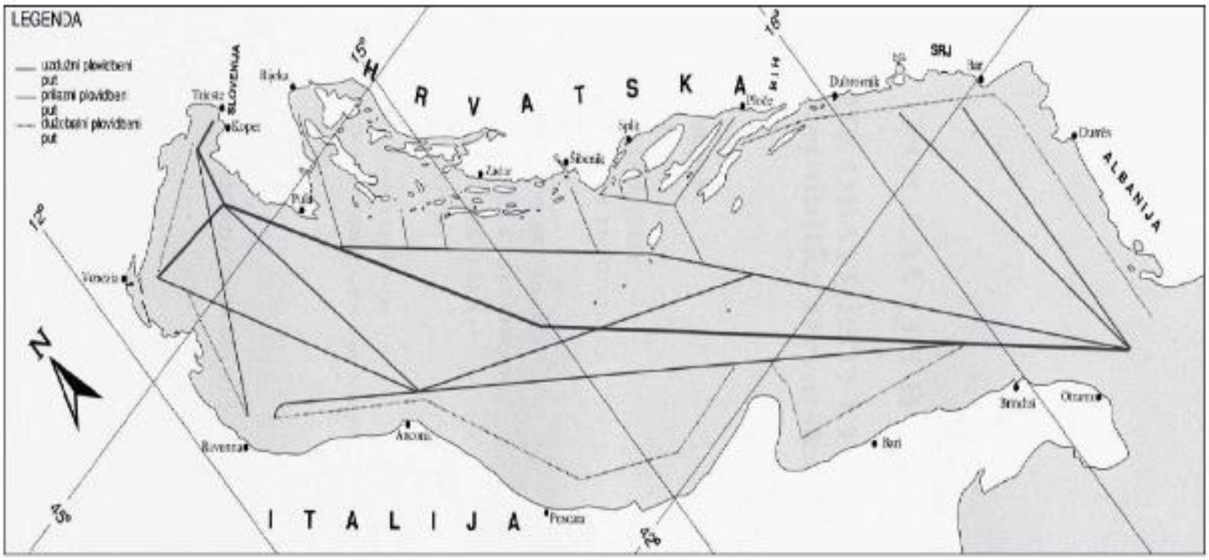


Figure 5.71 Waterway Routes in the Adriatic Sea[1]

LEGEND

Uzdužni plovidbeni put	Longitudinal waterway
Prilazni plovidbeni put	Access waterway
Dužobalni plovidbeni put	Waterway along the coast

Ports

As integral part of the coastal infrastructure, ports are assets used by Montenegro and available for usage under equal terms to all interested legal entities.

The Law on ports (Official Gazette of Mne, no. 51/08, 40/11), envisages that ports of local importance in Montenegro shall be managed by the public enterprise for coastal zone management. The decision on the definition of ports per relevance (Official Gazette of MNE No.20/11), declared the ports of Bar, Kotor and Zelenika as commercial ports and the ports of Škver, Zelenika, Risan, Tivat- "Porto Montenegro", Tivat "Kalimanj" and Budva as ports of local relevance.

❖ **Port of Bar: Luka Bar**

Located at the very entrance into the Adriatic sea, at 42˚05' northern latitude and 19˚05' east longitude, at 976 nautical miles (nm) from the Suez Channel and 1,190 nm to Gibraltar, the Port of Bar, known as Luka Bar, has significant advantages compared to North Adriatic characteristics reflected in:

- Shorter transit-time and saving on marine transportation costs,

[1] (Source: Peljar 1, Adriatic Sea, east shore, HHI, Split, 2007)

- Well connected with the Belgrade-Bar railroad and the road network, thus constituting a significant link in the chain of modern transport,
- Access to Balkan and Central Europe markets,
- Flexible legislative regulations and simplicity of business procedures,
- Long term business operating experience and constant presence in the hinterland market,
- Free zone regime over the entire territory,
- Competitive price policy,
- Application of international coastal safety standards and quality standards.

Figure 5.72 The Port of Bar

The Port of Bar includes the following in terms of structure:

Port Infrastructure

- **Volujica Coast:**
  - **Length: 554.40 m**
  - **Sea basin depth: up to 14 m**
  - **Jetty elevation: + 3.00 m**
  - **Permitted load per area unit: 6 t/m²**
- **The Old Coast:**
  - **Length: 280 m**
  - **Sea basin depth: do 6.20 m**
  - **Jetty elevation: +2.50 m**
- **New petroleum jetty:**
  - **Axis spacing between 2 jetties: 66 m**
  - **Sea basin depth: 13.5 m**
  - **Jetty elevation: +2.50 m**
- **Berth 26 on jetty II:**
  - **Length: 239 m**
  - **Sea basin depth: 10.5 m**
  - **Jetty elevation: +3.00 m**
  - **Permitted load per area unit: 4 t/m²**
- **South shore of jetty III:**
  - **Length: 135 m**
  - **Sea basin depth: 8.10 m**
  - **Jetty elevation: +3.00 m**
  - **Permitted load per area unit: 4 t/m²**
- **Operative shore on jetty V:**
  - **Length: 345 m**
  - **Sea basin depth: do 6.5 m**

Port superstructure:

- Open warehouse on Volujica floor area: 27,000 m²;
- Open warehouse on Jetty III and in the hinterland of jetty III, floor area: 43,453 m²;
- Open warehouse „tor" (in front of the Customs Office): floor area: 20,000 m²;
- Truck parking floor area: 12,550 m²;

- Closed warehouse (floor area 6,300 m^2 and 5,982 m^2);
- Specialized warehouses;
- Coastal port mechanization;
- Truck scale; and
- Administrative structures.

Port Mechanization

In 2013, the Port of Bar offloaded 621,300 tonnes of cargo off 220 ships. Bulk loadings accounted for 293,013 tonnes (47%), liquid loadings accounted for 174,457 tonnes (28%) and general loadings were 153,830 tonnes (25%).

❖ **Port of Kotor**

The Port of Kotor is located directly next to the Adriatic Arterial Road which connects it to places along the coast as well as the towns in the interior.

The available area of activities within the port is segmented into two basic parts: Port and Marine Part. The length of the operative shore of the port segment for Jetty I is 188 m and Jetty II is 150 m. The length of the operative shore of the marine segment is 417.70 m.

The port's pontoon capacity is as follows:

- 2 pontoons type "S" dimensions 12.5 x 2.40 x 0.90 with 8 berths
- 3 pontoons type "S" dimensions 9 x3 x 0.90 with 6 berths

The depth of the sea along the shore ranges from 12.8 m at the top of the operative shore to 3 m at the end of the part of the shore towards Škudra river, i.e. 12.8 meters to 8.6 meters at the other part of the operative shore allocated for international marine transport.

The onshore part of the operative shore of the Port is around 4,000 m^2. The area of the plateau in the 6 m wide belt is the main port functions.

❖ **Port of Zelenika**

The Port of Zelenika operates as a commercial port registered for international marine transport and as a border crossing where foreign nautical vessels (pleasure crafts) undergo needed procedures prior to entering the waters of Montenegro.

Border crossing uses the 134 m long NW jetty of the port which is physically detached from the rest of the port fenced. The jetty of the border crossing contains eight berths for vessels and two power outlets, two motor fuel outlets and water hydrants.

The Port uses the 130 m long SW jetty, which contains nine berths for boats, two power outlets and a water hydrant.

Marinas

Montenegro contains five marinas in Bar, Budva, Kotor, Tivat, and Herceg Novi. The marinas are equipped with all the basic services and contain a few berths without services. There are planned marinas construction in Kumbor, Ulcinj and Luštica.

Jetty

A jetty is a landing stage or small pier at which boats can dock or be moored. Jetties in Montenegro are used for mooring and short stays of tourist vessels and are as follows: Rt Kobila and Kamenari near Herceg Novi, Morinj- Kotor, Airport-Tivat, Port of Budva-Budva and Kacema-Ulcinj.

Bijela Shipyard

Bijela Adriatic Shipyard is the biggest ship-repair shipyard in the Southern Adriatic. The Shipyard covers an area of 120,000 m^2, and a sea basin of 350,000 m^2.

The shipyard is completely equipped for repair and reconstruction of ships and other vessels, regardless of the magnitude of damages and reconstruction scope:

- Two floating jetties, 250 m long and 184 m long;
- An operative shore with a total length 1,120 m;
- Three tugboats;
- Various types of cranes (26 cranes of which 9 are movable, 14 portable and 3 mobile) with bearing capacities ranging between 2.5 and 50 tonnes;
- Needed power facilities;
- Modern communication means; and
- Needed shops and equipment.

In addition, the shipyard is equipped for the production of small vessels such as: barges for various allocations with or without drive power, pontoons, and working platforms.

The shipyard produces as well various sea equipment, such as pylons, pipelines with diameter from 400 mm and onwards and all types of steel structures, including processing equipment.

The Shipyard also includes a training center for training of seamen and workers at the shipyard who are accommodated in the new administrative building. The training center has the most modern equipment for training and meets all the international standards and conditions.

The favorable climate in this region enables all types of works throughout the entire year.

5.8.8.8.5 Flow of Passengers and Goods

Transportation of passengers in 2013 compared with 2012 records and increase in road transport by 8.6%, urban transport by 9.7%, rail transport by 18.1% and airflow of passengers by 14.1%.

Table 5.48 Passengers Transportation Rates

Passenger flow in thousands	2011	2012	2013
Road transport	6,240	5,726	6,220
Urban transport	728	637	699
Railroad transport	692	781	922
Passenger airport flow	1,259	1,358	1,549

In terms of transportation of goods, 2013 records an increase in railroad transportation by 53.6% compared to 2012, road transportation by 71.9%, airflow of goods by 0.3%, and port transport by 5.5%, while marine records a decline by 53%.

Table 5.49 Goods Transportation Rates

Goods flow	2011	2012	2013
Road transport (in thousands of tonnes)	1,247	398	684
Railroad transport (in thousands of tonnes)	1,050	683	1,049
Good airport flow (tonnes)	1,074	766	769

In 2014, there were 350 recorded travels of foreign ships in Montenegro with 306,397 passengers on these boats. Compared with 2013, the number of travels declined by 14.4%, and the number of passengers declines by 2.7%.

The distribution of ships that sailed into Montenegrin territorial waters in 2014 per their origin (based on their flags) is as follows: Malta (40.3%), Bahamas (22.6%), Belgium (6.9%), Bermuda (6.9%), France (4.9%), Greece (4.6%), the Netherlands (4.6%), Panama (4.0%) and others (5.2%).

5.8.8.9 Waste Management

Municipal solid waste is generated in each of the Municipality by the households and by the commercial, industrial or institutional sector, and it is collected by the Public Utility Companies from each of the municipality. In the next table, it is shown the total amount of municipal solid waste collected in Montenegro[1].

Table 5.50 Data on Municipal Waste, Equipment and Machinery

Item	2010	2011	2012
The number of Municipalities which collect waste	21	21	21
Total annual quantity of collected waste - Mg	329,610	297,428	279,667
Estimated population - middle of the year	619,428	620,556	622,008
The collected waste per capita per year in kg	532	479	450
The collected waste per capita per day in kg	1.46	1.31	1.23
Average number of days in the year in which the waste was collected	341	341	338
Communal containers 1.1 m³	7,977	9,028	9,946
Cans 50l	6,404	4,621	3,829
Garbage	95	94	131
Tanks for street washing	16	16	22

[1] Draft Waste Management Plan of Montenegro 2014 – 2020

Based on the provision of the Law on waste (article 10) and "polluter pays principle" waste producers (legal or non-legal entities) are responsible for management of waste that they produce. Collection of household waste is obligation of local Municipalities (article 2 and 10, Law on communal affairs). This obligation is further specified through local Communal ordinances and collection (as a part or communal waste management) is delegated to the registered waste management companies (Municipality owned public utility usually). Based on the Law on waste and extended producers liability, collection (return) of special waste types (batteries and accumulators, waste tires, ELVs, electronic and electrical and packaging) is obligation of the company that produce, import or sell such products (article 11). System of taking, collection and treatment of special waste streams is determined by the Government through specific regulation. The distributor, Public utility or processing company, can do collection of that waste. According to the Law on waste, Government deserves the right to delegate collection of specific waste streams, by Concession act.

For specific waste such as medical, animal and communal sludge, Ministry of Health and Ministry of Agriculture and Rural Development are in charge retrospectively. Registered companies or entrepreneurs, on the conditions defined by mentioned ministries, can do collection of such waste. Different types of waste should be collected separately, and separate collection of paper, metal, plastic, glass and biodegradables is obligation (article 11, Law on waste) and thus, Municipalities are obliged (article 46) to establish separate waste collection systems until 2015. The collection of waste can only be carried out by registered companies or entrepreneurs with adequate equipment and personnel (Law on waste, article 36).

At present, there is only one transfer system in place in Montenegro. Municipal solid waste is mostly collected and directly transported to the disposal sites. Only in the case of Kotor Municipality, the municipal solid waste from Kotor and Tivat is transferred via compaction station and Ro-Ro containers from the material reclamation facility (MRF) after the material segregation (residues) to Mozura sanitary disposal site (SLF).

The European Union was funding the Project "Preparation and Implementation of the National and Local Waste Management Plans". Within this project, a report "Analyses of the environmental effectiveness and the cost effectiveness of separation and recycling of waste" was prepared. The report provided analysis of current state of the waste recycling in Montenegro in terms of quality and quantity, followed by assessment of efficiency and potential, and set out criteria for identification of the most favorable scenario for collection, transport, treatment and re-usage of the waste. In addition, it presented future activities and institutional, legal, technical and financial steps to achieve more quality recycling. In line with requirements specified, the report was referring to the details of waste separation that has been implemented only in few municipalities and to the fact that very small percentage of the waste is recycled in Montenegro. Non-existence of actualized data is serious constrain.

In addition, non-fulfilment of the goals set in the Waste Management Plan for 2011 has been analyzed (only 3% of generated paper and metals are recycled, 2% of plastic while the percentage of recycling glass is negligible) indicating that Montenegro recycles only about 2% of recyclables. The abovementioned showed that the goals set in the Waste Management Plan for 2011 are not near to being reached. Brief overview on the requirements and set of targets (EU and the national ones) for the recycling in next period was provided and compared (Table 5.51) indicating that current national achievement of the targets set can be considered as negligible. Forecast for generation of waste and recyclables was given until 2014[1].

Table 5.51 Target Summaries for Waste Recycling

Recyclables	EU in%	Year / Period	Montenegro target in %	Year / Period	Current Status (2012/13)
Paper / Cardboard	50%	2020	52%	2012	3%
Glass	50%	2020	50%	2012	0.2%
Plastics Packaging			22.5%	2015	
Plastics non-packing	50%	2020			2%
Metal		2020	22%	2012	3%

In present most of municipal solid waste collected in Montenegro is landfilled. There are currently two sanitary landfills under operation one in the Bar Municipality, Mozura Sanitary Landfill, and one in the Municipality of Podgorica, Livade Sanitary Landfill.

In addition to these two sanitary landfills there are 19 non-compliant landfills currently under operation, out of which two are only for construction and demolition waste (Kotor – Dragalj and Budva – Brajici). Out of the rest of the 17 non-compliant landfills, eight are controlled (i.e. fencing, partially levelling of the disposed waste); a nd two of these eight controlled landfills are also engineered (meaning that they have fence, gate, scale and some civil works have been carried out before disposal of waste, like embankment preparation, access road etc.); these two non-compliant engineered landfills are Niksic – Mislov Do and Andrijevica – Suceska.

There are 13 non-compliant landfill currently closed, five of which have been rehabilitated. Currently four projected sanitary landfills, are being at different stages of design and funding, and these are:

- Niksic – Budos
- Herceg Novi – Duboki Do
- Bijelo Polje – Celinska Kosa
- Berane – Vasov do

Hazardous Waste[2]:

In Montenegro, there is no infrastructure for hazardous waste treatment. The only option for an adequate treatment is to export the hazardous waste. For this reason, in accordance with the Law on Waste Management ("Official. Gazette of Montenegro", no. 64/11) and the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, and based on licenses issued by the Agency for the Environment, hazardous waste is exported from Montenegro.

[1] Draft Waste Management Plan of Montenegro 2014 – 2020
[2] Draft Waste Management Plan of Montenegro 2014 – 2020.

In the year 2011 the total amount of hazardous waste exported from Montenegro was 8,030 Mg of the waste with hazardousness codes Y 31,36,21,26.

In the year 2012 the Agency has issued five licenses for the export of hazardous waste. The exported wastes were 1,000 tonnes of slag from primary aluminum production, 1,000 tons of waste mineral oil and 3,800 tons waste lead-acid batteries.

In the next years it is expected that these exports will be much higher. As the level of collection of hazardous waste (according to the specific targets set up in specific legislative acts) will also increase the need to temporary storage and prepare for export (packaging and re-packaging of hazardous waste).

5.8.9 Monitoring Indicators for Economic Activities and Infrastructure

In light of the information and analysis provided on the economic trends and infrastructure in the Programme area, the following indicators are proposed for monitoring of the impacts of the Programme on the socio-economic conditions and infrastructure:

1. Purchasing power of local population
2. GDP contribution from non-oil sectors
3. Percent GDP expenditure on infrastructure works
4. Number of accidents related to subsea infrastructure
5. Generation of hazardous waste (O03)
6. Metric tons of hazardous waste generated by the E&P activities properly managed

Although data on most of these indicators are not presented in the previous sections due to the unavailability of these specific numbers, it is believed that information on the indicators can be calculated based on existing statistics and the monitoring being conducted.

Indicators for monitoring the impacts on Tourism are provided separately in Section 5.8.8.3.

5.8.10 Conclusion

The study seeks to portray the current state of the Coastal Region from a socio-economic aspect with special focus on: population structure, residential capacities, employment, education, criminality, economic activities, and transportation infrastructure. The main conclusions are as follows:

- According to the 2011 census, 24% of the total number of residents of Montenegro live in the Coastal Region;
- The population in the Coastal Region can be characterized as old population, with an average age of 38.4;
- Population density in the coastal region in 2011 was 94.09 residents/km² which is substantially above average for Montenegro (45 residents/km²)
- The Coastal Region is very attractive for migrants. Dominant migrations are from the northern region towards middle and coastal regions, from rural areas to urban settlements;
- Increase in housing fund, expansion of settlements;
- Gap in the labor market between available capacities and labor demand;
- In 2013, 25% of the total active residents (250.4 thousand) is from the Coastal Region;

- 51.6% of the Montenegrin employees are located in the Coastal Region;
- Unemployment rate in the Coastal Region is lower than the unemployment rate in Montenegro and amounts to 8.4% compared with 19.5% for Montenegro;
- Improvement of business ambiance;
- Educational activities adequately organized at all levels of education;
- Concentration of business and tourism-related study programmes;
- Criminality in the coastal region is higher than in other regions of Montenegro. The biggest crime rate was registered in the Budva amounting to 32.4%, while in the Herceg Novi it was substantially lower compared to Budva, but above state average, amounting to 17.0%;
- Montenegrin economy, according to 2013 data is improving; and a GDP growth of 3% has been noted;
- Industrial production growth of 10.6%;
- Inflation rate of 0.3%;
- Low duty fees and liberal system;
- Low tax rates;
- The tourism sector showed a big flexibility in variable market conditions. In 2013, Montenegro had 3.6% more tourists and number of foreign tourists was 4.8% higher;
- Transportation of passengers increased in airports by 14.1%, on the roads by 8.6%, and on rail transport by 18.1%;
- Transport of goods increased via railroad by 53.6%, via road by 71.9%, via airport by 0.3% as well as port transport by 5.5%, while marine transport records declined of 53.0%;
- Retail turnover increased by 11.3%, as well as catering turnover;

Weaknesses of Montenegrin economy are as follows:

- High state debt of 58% of GDP
- Increase in number of closed companies or companies with a loss
- Insufficient loan activity of banks
- High interest rates
- Uneven regional development
- Insufficiently developed infrastructure
- Inflexible labor market and unemployment
- Dependency on direct foreign investment (SDI), low level of greenfield investment and investment in the area of production
- Low level of export
- Dependency on import and unfavorable import structure.

5.9 HEALTH

Nearly all residents of Montenegro are covered with health insurance and in that way exercise their right of public health care in terms of equal access to available care and even quality of health care for all.

Health care system in Montenegro has been substantially reformed for the several past years, which was necessary as Montenegro inherited a massive and inefficient health care system with obsolete technology and inefficient distribution of managers, employees and resources. Reforms were necessary due to high budgetary costs for health, introduction of market economy and decrease in justifiability, quality and accessibility.

Important contribution of reform of health system is the promotion of formulating health public policy. Namely, according to mentioned concept, it is necessary to work on defining health as priority of the overall system so as to ensure participation of every sector in the process of promotion and preservation of population's health. In addition, it is necessary to create a supportive environment to achieve life potential in the best possible way. Uncontrolled usage of natural resources caused clear identification of number of evident and potential health risk factors.

Reform of primary health care system is completed, and it focused on depending on general practice doctors (family medicine) instead of provision of health care through services. Chosen doctors were introduced, who represent transition to family doctors who will be familiar with context of a family so as to provide comprehensive health care to individuals and families of all age groups. Patients can choose certain general practice doctor, gynecologist and pediatrician. The chosen doctor should keep track of his patients and when required refer them to additional levels of secondary health care. Chosen doctors have become actual keepers of health system and health centers, which are primary health institutions at local level. However, even though progress is notable, the goal of health system of Montenegro to meet around 85% of population's health needs at primary level, has not been reached yet, so pressure on hospitals is exceeding.

Besides the previously mentioned health centers on primary level, hospitals (general and specialized) provide medical services to citizens on secondary level of health care, and on tertiary level (clinical centers) in which medical needs of population are provided by relevant health care providers.

In the coastal area of Montenegro where oil and gas exploration and production will take place, health care is provided via six health centers with their outpatient settings on primary level and two general hospitals and two specialized hospitals on secondary level. These health institutions have a total of 118 employees (Table 5.52). It is noted that the share of non-medical workers in the overall structure of employees is higher than at the level of entire Montenegro, which additionally complicates provision of health services to the population at subject territory.

Table 5.52 Staff at Health Institution in the Coastal Area of Montenegro

Name of Institution	Total Staff	Doctors	Higher, Secondary and Lower Attainment – medical workers	Non-Medical Staff
HC Budva	58	17	41	17
HC Kotor	63	19	41	13
HC Tivat	43	13	29	15
HC Herceg Novi	90	33	55	16
HC Bar	124	37	87	18
HC Ulcinj	65	21	44	21
GH Bar	160	43	116	55
GH Kotor	130	37	119	56
Special Hospital Dobrota	94	14	76	29
Special Hospital Risan	118	28	89	37

There is certain inefficiency in staff filling of health sectors, with quarter of non-medical staff of the total number of health sector employees. Even though that percentage is similar to the one in surrounding countries (ex. percentage of non-medical staff in Serbia was 26%[1]), and it was reduced by 3.5% compared with 1991, it seems that there has been a mild increase in non-medical staff (by 0.6% compared with 2003), so this percentage continues to be rather high. In addition, the number of doctors per 100,000 residents in Montenegro (204.5) is still substantially below EU level (321).[2]

One of the significant indicators of the work quality of health institutions is the satisfaction of beneficiaries. Figure 5.73 shows that the beneficiaries are relatively satisfied with health care provided through the system.

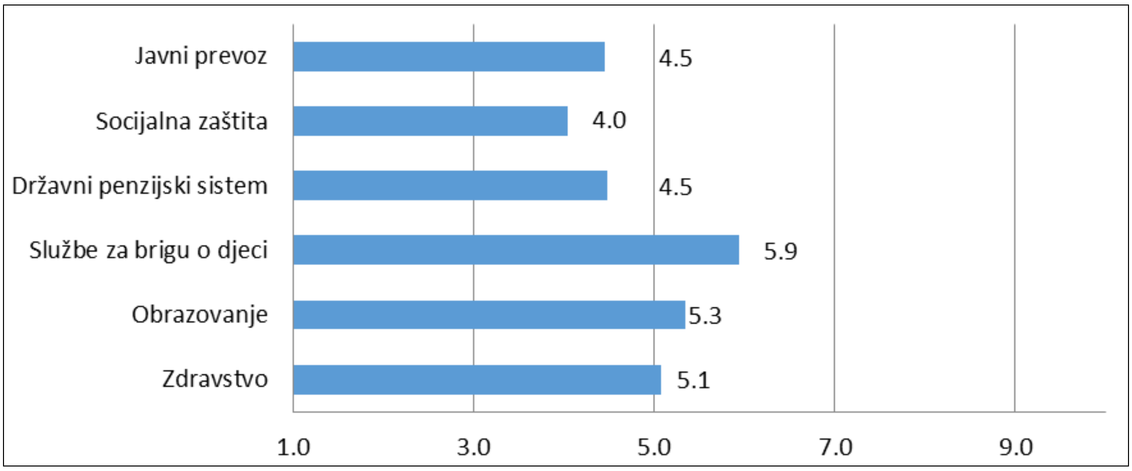


Figure 5.73 Assessment of Quality of Health Care Services by Beneficiaries (1 = Very Low Quality, 10 = Very Good Quality)[3]

Surveys confirm that the conducted reform of health care contributed to creating a better quality relationship with doctor (61.6%) and that it resulted in shorter waiting time for medical

[1] MONTENEGRO: After the Crisis: Towards a Smaller and More Efficient Government, Public Expenditure and Institutional Review, Main Report, World Bank, October 2011, p.86 (CRNA GORA: Nakon krize: Ka manjoj i efikasnijoj vladi, Pregled javne potrošnje i institucija, Glavni izvještaj, Svjetska banka, oktobar 2011.)
[2] Master Plan for Health Development in Montenegro 2010.-2013., p.19
3 Source: Integrity Assessment of the Health Care System in Montenegro, 2011, UNDP, WHO and Ministry of Health

examination (53.5%). It also reduced queuing (18.6%) and enabled better monitoring of patients (16.0%)[1].

Evident impact of risk factors to health resulted in reduction of value of certain sensitive health indicators in the past time, such as expected life duration at birth, with tendency of mild increase (Table 5.53).

Table 5.53 Life Expectancy at Birth in Montenegro

Period	Life Expectancy at Birth		
	Men	Women	Average
1952-1954	58.4	59.9	59.1
1960-1962	62.0	65.4	63.7
1970-1972	68.1	73.1	70.6
1980-1982	71.9	76.4	74.2
1990-1992	71.5	78.6	75.1
2002-2004	71.8	76.7	74.2
2004	71.0	75.2	73.1
2005	70.3	74.9	72.6
2006	70.6	74.8	72.7
2007	71.2	76.1	73.7
2008	71.2	76.1	73.7
2009	71.7	76.1	73.9

Source: Statistical Office of Montenegro (MONSTAT)

However, when it comes to health of children, data reveal that there is a significant improvement in values of sensitive indicators, such as death rate of nurseling. The value of this indicator has reached values planned for the period up to 2015 (7.0) with constant tendency to further decline (Figure 5.74).

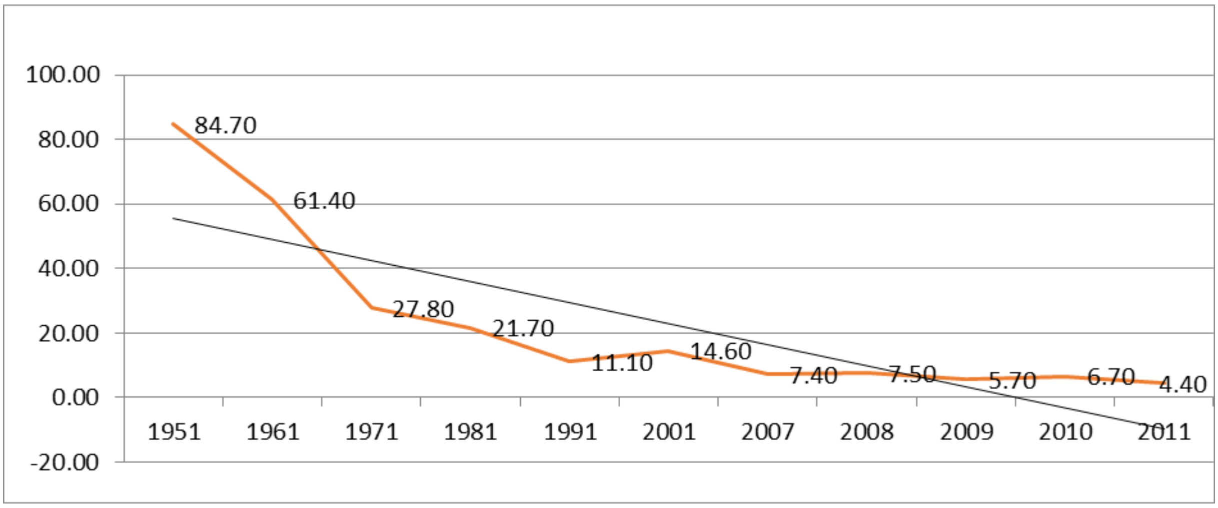


Figure 5.74 Nurseling Death Rate in Montenegro[2]

At primary level, i.e. in health centers and their units during 2012, services of chosen doctors for adults, children and women were registered separately. Five basic diseases were ranked, because diseases are one of the most frequent reasons for visiting the chosen doctors.

1 Source: Integrity Assessment of the Health Care System in Montenegro, 2011, UNDP, WHO and Ministry of Health
2 Source: Statistical Office of Montenegro (MONSTAT)

According to morbidity sample for the chosen doctor, the most often recorded visits were made due to the following diseases[1]:

- At the top of the list are diseases of respiratory system, and dominant disease in this group was acute pharyngitis (laryngitis and tonsillitis).
- At second place of the list of non-hospital morbidity are blood vessel diseases, and dominant disease in this group was primary hypertension (high blood pressure).
- Immediately after this group of disease come symptoms, signs and pathological and clinical and laboratory findings,
- In the fourth place are diseases of muscular-bone system and connective tissue (conditions which are not sufficiently defined).
- In the fifth place are factors that affect health condition and contact with health service.

Chosen pediatricians mostly recorded the diseases[2]:

- Diseases of respiratory system,
- Infectious diseases,
- Symptoms, signs and pathological clinical and laboratory findings,
- Skin diseases and subcutaneous tissue and
- Ear infections and mastoiditis (Figure 5.75).

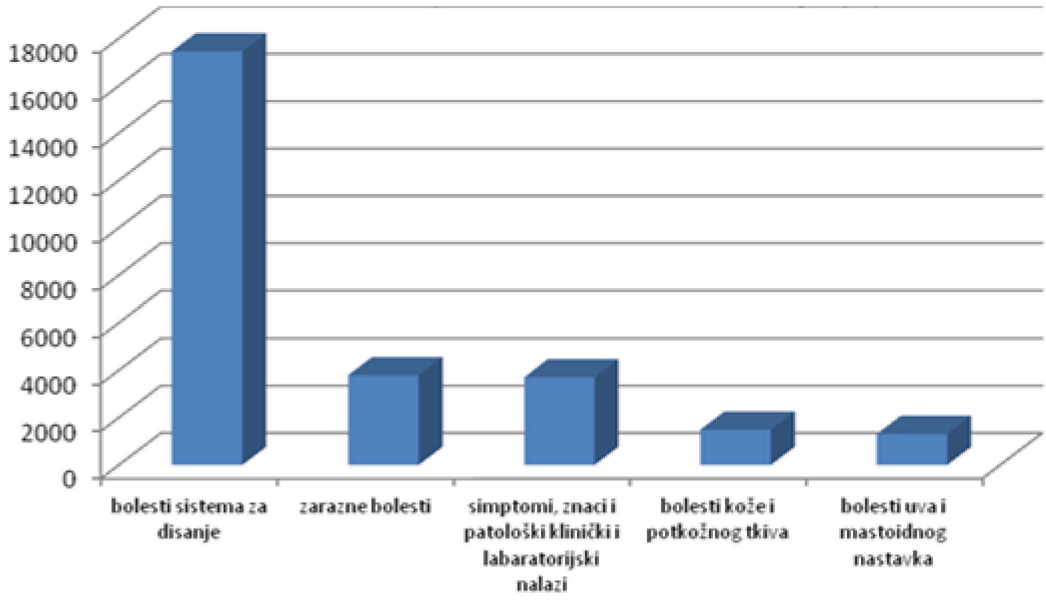


Figure 5.75 List of Diseases at Pediatricians for Children in Target Population

Stationary services (services that entail hospitalization) for people in the coastal area are provided in two general hospitals in Bar and Kotor, followed by two specialized hospitals namely: Specialized Psychiatric Hospital in Dobrota – Kotor and Specialized Hospital for

[1] Source: Statistical Yearbook on Health and Health Care of Population, Institute for Public Health

[2] Source: Statistical Yearbook on Health and Health Care of Population, Institute for Public Health

Orthopedics, Neurosurgery and Neurology (Vaso Ćuković) in Risan. In addition, stationary health center in Ulcinj provides obstetrics stationary services for women in this municipality. Also, private health institutions provide health care services, however there are no data on type and number of services that they provide to users.

The abovementioned institutions have a total of 684 beds for different uses, of which, daily vacancy was 125. Over the past course of time, stationary institutions treated a total of 16,791 beneficiaries, who had 204,158 hospitalization days (Table 5.54).

Table 5.54 Efficiency of Hospitals in the Coastal Area of Montenegro[1]

Institutions	Beds	Treatment days	Released	Percentage of usage	Daily unoccupied beds
General Hospital Bar	169	42173	7377	68.37%	53.46
General Hospital Kotor	144	35641	6168	67.81%	46.35
Specialized Hospital Dobrota	241	95488	1113	108.55%	-20.61
Specialized Hospital Risan	122	30076	1944	67.54%	39.60
Stationary health center Ulcinj	8	780	189	26.71%	5.86
Total	684	204158	16791	67.80%	124.66

The main diseases that cause hospitalization according to the Statistical Yearbook on Health and Health Care of Population are shown in Table 5.55.

Table 5.55 Main Diagnosed Diseases as Cause for Hospitalization

Disease	Diagnosed Cases
Blood vessel diseases (I00-I99)	10,775
Tumors (C00-D48)	7,981
Respiratory system diseases (J00-J99)	7,960
Digestion system diseases (K00-K99)	6,675
Urinary system diseases (N00-N99)	4,757
Muscular-bone system and connective tissue diseases (M00-M99)	4,643
Total	68,198

Table 5.56 presents registered cases of STDs in 2011 and 2012.

Table 5.56 Registered Cases of STDs[2]

STD	Infected population in 2011	Infected population in 2012
Syphilis	0	8

[1] Statistical Yearbook on Health and Health Care of Population, Institute for Public Health
[2] MONSTAT, Statistical Year Book, 2013.

STD	Infected population in 2011	Infected population in 2012
Gonorrhea	4	1
Chlamydiasis genitalis	0	1
Hepatitis virosa acuta	18	25
Total	22	35

As for HIV, Montenegro is a low HIV prevalence country with an estimated HIV prevalence of 0.01%. By the end of 2011, authorities in Montenegro had reported a cumulative total of 128 HIV cases, 62 AIDS diagnoses and 32 deaths among AIDS cases to the WHO Regional Office for Europe and the European Centre for Disease Prevention and Control (ECDC). For the year 2011, they reported 9 new HIV cases, 3 new AIDS cases and 1 death among AIDS cases. The rate of newly diagnosed HIV infections in 2011 was 1.5 per 100 000 population. 8 of the 9 newly diagnosed cases in 2011 were male. By the end of 2011, the cumulative number of reported mother-to-child transmission cases was 3 (0 in 2011).

During 2011, the total number of people tested for HIV was 22,106. Testing in Montenegro has been significantly improved by opening Counselling Centers for confidential counselling and testing/VCT, and now there is a network consisting of seven regional counselling centers in health care centers and one in the Institute for Public Health. HIV testing is anonymous and free of charge for the patient - the cost is covered by the National Health Insurance Fund. In 2011, 1,306 people received VCT services. The number of people receiving antiretroviral therapy (ART) had increased from 13 in 2002 to 40 in 2010. One facility in the county was providing ART as of December 2010.[1]

Problems in Achieving the Promotion and Preservation of Health Goal

The above data show that health is strongly impacted by environmental factors and the existence of exploration and production of hydrocarbon increases the risk factor of environmental health problems. However, with the absence of a health monitoring system, it is difficult to assess incidences and prevalence of diseases from environmental factors.

It is important to pinpoint the health risks at an early stage in order to set up the needed monitoring and evaluation systems to supervise and control all health risk factors related to exploration and production of hydrocarbon and which could impact the community's health.

The main health objective is the promotion and preservation of the current health conditions. The first step in the process would be the identification and monitoring of health problems that could arise from the exploration and production of hydrocarbon, namely: cardiovascular system diseases, respiratory system diseases and cancers, in addition to the possibility of an increase in STD cases.

The main recommendations to monitor health conditions include: Development of a solid database to monitor health trends of the population considering geographic assessment;

[1] Key facts on HIV epidemic in Montenegro and progress in 2011. http://www.euro.who.int/__data/assets/pdf_file/0006/191085/Montenegro-HIVAIDS-Country-Profile-2011-revision-2012-final.pdf?ua=1

Capacity building for public health providers; and Organizing the health sector taking into consideration the health issues that might be raised by the new O&G sector and ensuring financial stability for the sector.

5.9.1 Monitoring Indicators for Health

In light of the data presented in the previous section, the indicators selected to monitor the impacts of the Programme of health are:

1. Number of health-related institutions
2. Population with STDs
3. Population with cardiovascular system diseases, respiratory system diseases and cancers;
4. Percent health care staff trained in new types of health conditions
5. Countries with transboundary cooperation in medical aid
6. Influx people scrutinized with health control measures

Existing database includes information of these indicators, and monitoring shall continue to detect any changes resulting from the implementation of the Programme.

5.10 SUMMARY OF BASELINE CONDITIONS AND LIKELY TREND WITHOUT THE PROGRAMME

The results of the analysis of baseline conditions, including their relation with the Programme, the proposed indicators for monitoring and the likely trend of indicators without the programme are summarized in Table 5.57.

Table 5.57 Summary of Baseline Conditions, Data Sources and Relation to E&P Programme

Environmental/ Socio-economic Aspect	Sources of Data/Comments	Baseline Condition	Relation with the E&P Programme	Indicator and Likely Trend without the Programme
Bathymetry	Nautical charts, bathymetric charts, sediment charts (Hydrographic Institute of former Yugoslavia, Split) Covers all Offshore Montenegro No additional data produced since 20 years No digital bathymetry of high-resolution (multi-beam data) is available	Territorial Sea limit is set at 12 nautical miles from baseline. Continental shelf (area limited by depth of 200 m) covers 57% of offshore Montenegro (approximately 50 km from the shore) From 200m to 400m, gentle slope Steep area from 400 to 1000 m (narrow belt of steep slope) South Adriatic valley is found at depth over 1000 m Epi-continental Shelf is defined while Exclusive Economic Zone is not finalized yet	57% of offshore Montenegro is less than 200 m deep; remaining is deeper water; sharp slope after 400 m and then the South Adriatic valley	--
Waves (superficial waves from winds)	Study on "Physical-oceanographic and Hydro-acoustic Properties of Adriatic Offshore"; HIJRM Split 1990. Scientific papers of experts from Hydrographic institute 2 sets of data: (1) 20 years records from observations from ships and (2) equipment deployment	Highest recorded waves in Montenegrin waters of 7.2 meters In front of Dubrovnik: 8.9 meters In former Yugoslavia in northern Adriatic sea: 10.8 m 100-year return wave is 13.5 m (geophysics institute of Croatia) Winter experiences most waves (November to March)	Implications on design of infrastructure, safe movement of vessels	--
Sediments (superficial – 25 cm grab samples)	Study on "Physical-oceanographic and Hydro-acoustic Properties of Adriatic Offshore"; HIJRM Split 1990. Atlas of recent sediments in Adriatic Sea, scale 1: 750 000, HIJRM, Split, 1985.	Main types of sediment are: Mud, muddy sand, sandy mud, fine sand, and coarse sand, rocky	Sediment types are related to biological activity; correlation may be established during SEA study	--
Currents	Study on "Physical-oceanographic and Hydro-acoustic Properties of Adriatic	Main characteristics: winter currents are inwards and summer currents are outward Winter: stronger currents in front of	Current profiles affect the movement of pollution in sea, including from spills	--

Environmental/ Socio-economic Aspect	Sources of Data/Comments	Baseline Condition	Relation with the E&P Programme	Indicator and Likely Trend without the Programme
	Offshore"; HIJRM Split 1990. I. Nožina, M. Tešić, Z. Vučak; Oceanographic properties of Boka Kotorska sea to Bojana River Mouth, Hzdrographic Zear Book, 1980/1981; HIJRM Split Current meters available in Montenegro but no programme for monitoring Current profiles in deeper water not found No organized monitoring since dissolution of former Yugoslavia	Montenegro coast (Eastern Adriatic) and weaker in summer (superficial currents) Winter: northwestern currents in all profiles (superficial) Summer: weaker and towards the coastline	There is potential for transboundary impacts, especially in the winter (towards Northwest) and summer towards the coast and south (Albania)	
Physical characteristics of seawater (T, Salinity and density)	Study on "Physical-oceanographic and Hydro-acoustic Properties of Adriatic Offshore"; HIJRM Split 1990. I. Nožina, M. Tešić, Z. Vučak; Oceanographic properties of Boka Kotorska sea to Bojana River Mouth, Hzdrographic Zear Book, 1980/1981; HIJRM Split Equipment available at hydrometeorological institute but no organized monitoring available due to lack of financial resources Time series: 1949-1990 (however raw data not accessible) Profiles available down to 200 m	Spring: fresh water entry and salinity reduced in superficial part Salinity stabilizes after 20 m depth Most active layer for T is up to 50 meters than T is stable Beneath 50 m seasonal values of seawater density is more stable Exception in Autumn: sea density is slightly lower because of higher water T profile	These characteristics also affect movement of spills and hydrocarbons Thermoclines prevent uprise of pollution from the bottom (around 50 m)	--
Transparency and color	Study on "Physical-oceanographic and Hydro-	Transparency of seawater is affected by sediments from surface water	Pollution in the sea would affect transparency and	Indicator 4.4 (M01): Quality of sea water for swimming

Environmental/ Socio-economic Aspect	Sources of Data/Comments	Baseline Condition	Relation with the E&P Programme	Indicator and Likely Trend without the Programme
	acoustic Properties of Adriatic Offshore"; HIJRM Split 1990. I. Nožina, M. Tešić, Z. Vučak; Oceanographic properties of Boka Kotorska sea to Bojana River Mouth, Hzdrographic Zear Book, 1980/1981; HIJRM Split	Highest transparency in the summer Lowest average transparency is in the autumn Color is related to transparency	color	(microbiological and physical chemical parameters) (**no data on the likely trend**)
Tides	Permanent tide gauge stations of the Hydrometeorological Institute (3 stations) (one since 1964 (south), 2010 (north) and 2013 (central)	Mean Daily amplitude: 23 cm Monthly amplitude 64 cm Highest recorded amplitude: 129 cm caused by tides	Influences movement of pollutants Influences coastal infrastructure but to a limited extent	--
Existing infrastructure and other subsea features	Nautical charts (HI RM SRJ Lepetane) and nautical charts (Hydrographic Institute of Croatia, Split)	Area of disposal of explosives (northern part) Two subsea cables (optical) Several historical wrecks near the coastline	These represent physical constraints to offshore development	- Indicator 15.1: Percent GDP expenditure on infrastructure works (**no data**) - Indicator 16.1: Number of accidents related to subsea infrastructure (**no data**)
Geology	Basic oil-geological properties of exploration area of Montenegro. (JP Jugopetrol – Kotor, Exploration Department, PE NIS NAFTAGAS – NOVI SAD, of Exploration and Technologies, 1994). Kalezić M., Škuletić D., Perović Z., (1976): Geological Composition and Tectonic Assembly of Coastal Area of Adriatic in the territory of Montenegro. Geologic Journal, book VIII. Institute for Geological Explorations of	Offshore Montenegro has a thick sediment complex of Mesozoic and tertiary era and favorable thermobaric conditions for liquid and gas hydrocarbons	Sediments of such thickness with absence of substantial tectonic movement represent potential for substantial generation of hydrocarbons and are comparable to other sediments found in other areas of the world	--

Environmental/ Socio-economic Aspect	Sources of Data/Comments	Baseline Condition	Relation with the E&P Programme	Indicator and Likely Trend without the Programme
	Montenegro, Titograd.			
Geohazards/ seismic activity	Temporary seizmological map for territory of SFRY (part referring to Montenegro) with elements of expected maximal intensitz of earthquake for a return period of 500 years (1987). Map of seismic hazard onshore and offshore of Montenegro (Glavatovic, 2005)	Highest seismic level of 9 MCS; return period of 500 years Maximum magnitude of earthquakes of return period of 100-year is 6.8 in Richter Scale (offshore and onshore) Four basic geotectonic units with massive faults between them	E&P infrastructure should be designed to account for seismic risks to avoid major damage to assets and environmental consequences from loss of containment Injection of produced water could trigger seismic activity; needs to be carefully designed if adopted	--
Geothermal	Geothermal atlas of Europe (1987.)	Heat flow density reaches a maximum of 60 mW/m^2 which is low Data indicates low geothermal potential	Limited potential to "compete" with hydrocarbon resources	--
Phyto-planktons and Zoo-planktons	MEDPOL Project (EPA) Information on state of environment in Montenegro, Agency for Environmental Protection of Montenegro Data available in few locations (Boka Bay and Ada Bojana, Traste) Limited data available deep offshore	Recent research indicates higher organic pollution and increased risks of eutrophication indicated by increase in planktons population	Induced pressure from E&P may lead to increased risks of eutrophication and changes in composition of phyto and zoo-plankton population Risk of invasive species from platforms and vessels	- Indicator 5.1 (B05): Trend of introduction of invasive species (**no data**) - Indicator 4.1 (M02): Trend and geographic distribution of concentration of chlorophyll in vertical water column (**no data**) - Indicator 4.2 (M03): Nutrients / Concentration of nitrates and phosphates and their ratio (**no data**) - Indicator 4.3 (M04): Trophic index (TRIX index) (**stable**)
Phyto and zoo benthos	MEDITS survey, financed by EU since 1995, Montenegro joined since 2008; focus on fish resources; since 2011 all benthic species were covered RAC-SPA publication, 2013 Drakulović Dragana, Importance of phytoplankton	Posedonia Oceanica is most important species of phyto-benthos in Montenegro and is protected by Law of Nature Protection Reproduction of most fish species occur in this habitat Map of these habitats might be available for a large part of Montenegro coast; likely to be part of planned future Marine	Presence of sensitive benthic habitats pose restrictions to E&P activities and requirements of detailed surveys prior to initiation of exploration works	Indicator 6.1 Number of marine protected areas (**increasing**)

Environmental/ Socio-economic Aspect	Sources of Data/Comments	Baseline Condition	Relation with the E&P Programme	Indicator and Likely Trend without the Programme
	as relevant indicator of eutrophication in aquatorium of Boka Kotorska Bay; PhD thesis 2012. Fond IBM Kotor) Pestorić Branka, Dynamics of Zooplankton Communities in Boka Kotorska Bay, PhD thesis 2013. Fond IBM Kotor) UNEP-MAP RAC/SPA, 2008. Development of a network of marine and coastal protected areas (MPAs) in Montenegro. More data available for zoo-benthos in territorial sea and epi-continental area (distribution of zoo-benthos covers an area of 6000 m^2) Need to confirm availability of mapping information for these areas	Protected Areas 25 rare, protected and endangered species of phyto-benthos and zoo benthos Sensitive benthic habitats beyond 500-m are less likely to be encountered Red corals exist in Montenegro but detailed information is not available (endangered protected species)		
Nekton (free water fish)	FAO – ADRIAMED project, estimated biomass of small pelagic fish (anchovy and sardine) (since 2005) Biomass of small pelagic fish estimated each year via 2 methods Montenegro not a member of ICCAT Limited data available for Nekton	Distribution changes on a yearly basis; depends on quantity of phyto-plankton	Relatively limited implication	- Indicator 7.1 (B07): Change in number and area of protected areas and their floor area (**stable**) - Indicator 6.2 (B01): Species Diversity (**no data**)
Seabirds	Vasić, V. (1995): Birds Diversity in Yugoslavia with Overview of Birds of International Species Vizi, O. (1998): Fauna of	Montenegrin part of the sea is located in so called Adriatic migratory corridor which, apart from Gibraltar and Aegean corridors, is the third most important in Europe.	Relatively limited implication	- Indicator 4.5: Number of spills reaching the coast (no data) - Indicator 7.1 (B07): Change in number and area of protected areas and their floor area

Environmental/ Socio-economic Aspect	Sources of Data/Comments	Baseline Condition	Relation with the E&P Programme	Indicator and Likely Trend without the Programme
	Costal Zone of Montenegro	Marine birds nest either in the coastal area and small number of its islands, peninsulas and capes, but mainly in Croatian part of the Adriatic shore, i.e. islands According to BLI, there are 311 species of birds in Montenegro, 12 of them are globally threatened. Among 21 species of seabirds, one is categorized as vulnerable (Clangula hyemalis) and one as endangered (Melanitta fusca). There are 262 migratory birds including protected species.		(**stable**)
Sea mammals, sea turtles and seabirds	IPA NETCET Project (since 2013) (project for the conservation of sea mammals and sea turtles in the Adriatic Sea) PhotoID survey conducted in territorial waters of Montenegro Database of common Dolphin (tursiops truncatis)	Montenegro is a member of ACCOBAMS (protection of mammals in Med, Black and Adriatic seas) Common dolphin is mostly found up to 200 meters depth and closer to the coast; less abundant in deeper sea Striped dolphin is mostly observed by aerial survey and has high abundance in South Adriatic Risso's dolphin also observed in this area as well as Fin whale Two species of sea turtle identified; loggerhead sea turtle and the green turtle; they use Montenegrin water for feeding Massive fatalities recorded in activities of neighboring countries	E&P activities and particularly seismic surveys can lead to behavior changes or auditory trauma to sea mammals and turtles Structures lighting and oil spills could have impacts on sea birds.	- Indicator 8 1: Number of threatened marine mammal species (**no data**) - Indicator 8. 2: Number of injured/killed sea mammals and turtles (**no data**) Indicator 8.3: Number of injured/killed seabirds (no data) - Indicator 8.4: Extent of joint cooperation programmes and projects in the Adriatic Sea (**increasing**)
Marine Protected Habitat	None in Montenegro yet declared but some areas in prepared		MPAs pose restrictions to E&P activities	Indicator 7.1 (B07): Change in number and area of protected areas and their floor area (**stable**)

Environmental/ Socio-economic Aspect	Sources of Data/Comments	Baseline Condition	Relation with the E&P Programme	Indicator and Likely Trend without the Programme
Areas of special significance	CAMP RAC-SPA	Three areas of special significance: Velika plaža, Buljarica and Tivatska solila Proposed sites for the protection of: Boka Kotorska gulf, Mamula up to the ness of Mačka, ness of Trašte up to Platamun (where protected area extends from ness of Žukovac to ness of Kostovica), ZPM Katič, ness of Volujica up to Dobre vode settlement, ness of Komina up to ness of Old Ulcinj (Stari Ulcinj), gulf of Valdanos up to Long Beach (Velika plaža), Seka Đeran and southern area of Long Beach up to delta of Bojana river.	Restricted areas for E&P activities	Indicator 7.1 (B07): Change in number and area of protected areas and their floor area (**stable**)
Fisheries and fish resources (fish, crustaceans and cephalopods)	Ministry of Agriculture and Rural Development (annual monitoring of fishery resources of Montenegrin sea since 1997 and development of annual quotas for fish catch)	Highest abundance of fish resources extracted from 100 to 200 meters depth 0-50 m there is mostly juvenile fish; breeding is most common in this area Biomass decreases after 200 m; bigger fish found after 200 m (red shrimp, Norway lobster, large hake) up to 500 m Hake is a shared resource of all Adriatic sea (Albania, Croatia and Italy) Percent of cephalopods in catches are relatively lower	E&P activities may impact fish catch in important reproduction zones (mostly in the field of posidonia (mostly 0-30 meters); most reproduction occur from May to July; some are reproduced all over the year	- Indicator 9.1 (R01): Biomass state and level of exploitation of fish fund (**decreasing**) - Indicator 9.2 (R02) Aquaculture production (**decreasing**)
Air quality	Information on State of Environment in Montenegro, Agency for Environmental Protection of Montenegro National Strategy for Air Quality Management and Action Plan (2013-2016), Ministry of Sustainable Development and Tourism, 2013. Second National Communication to the UNFCCC (not published yet)	Air quality monitoring network with 8 stations Main sources of air pollution include industry, transportation and domestic heating during winter PM particles is the biggest problem for the air quality in Montenegro Aluminum production is the most important source of PM10 (41%) Concentrations of SO_2, NO_2 and O_3 are within the prescribed threshold limit value. GHG emissions in 2010 were, equivalent to 0.01% of global emissions.	Increased sources of atmospheric emissions from different E&P activities Increased GHG emissions and carbon footprint	- Indicator 1.1 (VA02): Emission of acidifying gases (**increasing**) - Indicator 1.2 (VA03): Emission of ozone precursors (**stable**) - Indicator 1.3 (VA04): Emission of primary suspended particles and precursors of secondary suspended particles (**stable**) - Indicator 2.1: CO2 emissions from E&P activities (**none**) - Indicator 2.2 (KP04): Trends in greenhouse gas emissions (**increasing**)

Environmental/ Socio-economic Aspect	Sources of Data/Comments	Baseline Condition	Relation with the E&P Programme	Indicator and Likely Trend without the Programme
				Indicator 2.3: CO_2 emissions per GDP (**increasing**)
Noise	Information on State of Environment in Montenegro, Agency for Environmental Protection of Montenegro No data on underwater noise	Noise monitoring data indicate increase in noise levels near main roads and in city centers (noise monitoring data indicate that deviations from set boundary values are highest at nighttime); levels are found to exceed applicable standards	E&P activities will pose additional pressure in coastal areas and could lead to further increase in noise levels Increase in underwater noise levels which could negatively affect marine fauna	Indicator 3.1: Percent population exposed to high noise levels (**increasing**)
Population and demographics	MONSTAT	Total population is 625,266 Last census (2011) indicate 149,705 residents in the 6 coastal municipalities most likely to be affected by E&P (Bar, Budva, Herceg-Novi, Kotor, Tivat and Ulcinj) Density: 45 persons per km^2 (national); coastal zone: 94.09 persons per km^2 Tivat alone: 307 persons per km^2 Average population growth between last 2 census (10 years) is 5% 51.2% women versus 48.8% of man Age segregation: men under 30 are more numerous than women under 30 Average age is 38.3 years (regarded as relatively old) 0-19 years: 21.8% 20-65 years (active population): 43-47% depending on municipality 65 and above: about 35% 17% of population with university degree 52% of population has secondary education 28% have only up to elementary education 3 main universities with various faculties (1	Creation of job opportunities Enhanced education Enhanced living standards Increased population pressure Regional Migration seeking for jobs	- Indicator 17.1: Employment rate (slightly increasing) - Indicator 17.2: Population with university degree (**increasing**) - Indicator 17.3: Purchasing power of local population (**no data**) - Indicator 17.4: Percent local labor working for oil and gas companies or service companies (**Labor working in industrial sector (incl. mining, gas and power) are decreasing)**) - Indicator 17.5: Ratio of local and regional nationalities working in the sector (**none**)

Environmental/ Socio-economic Aspect	Sources of Data/Comments	Baseline Condition	Relation with the E&P Programme	Indicator and Likely Trend without the Programme
		State and 2 private) + 7 private faculties There are vocational schools Unemployment: about 20% of active population and 10% in coastal region (about 50,000 persons unemployed, 6,500 in the coastal regions) Minimum wage: 193 EUROs (Labor Law) Inbound migration: 1991 to 2003- highest migration from northern and central to southern region (coastal) Seasonal migration from other Balkan countries in summer Housing: 120,000 apartments available in coastal region; 40% used for permanent residents; 35% for seasonal housing; 20% empty (perhaps unfinished or under renovation)		
Economy	MONSTAT (2012.) and Ministry of Finance	GDP in 2013: 3,327 million EUR GDP/capita: 5,356 EUR Agriculture/ Forestry and Fisheries: 7.4% GDP Small-scale and large-scale trade: 12.3% of GDP Food and accommodation: 6.7% Real Estate: 7.2% Information and Communication: 4.9% Defense and social insurance: 7.8% Processing industry: less than 1% Inflation: about 0.3% Low export and high import; Export in 2013 EUR 375.6 million versus EUR 1,773.4 million Euros for import	Increased revenues from Oil and Gas activities Potential impacts on other economic sectors	Indicator 17.7: GDP contribution from non-oil sectors (**Stable (100%)**)
Crime	MONSTAT	Reported crime rates per 100,000 population in 2012 according UNODC: Assault: 938.2, Theft: 138.0, Sexual violence: 3.9, Robbery: 1.1 Highest crime rate is recorded in Budva	An increase in crime rates could be recorded as O&G personnel become targets of crime	Indicator 17.6: Crime rate increase (**Generally Decreasing -assault decreasing, theft increasing**)

Environmental/ Socio-economic Aspect	Sources of Data/Comments	Baseline Condition	Relation with the E&P Programme	Indicator and Likely Trend without the Programme
Infrastructure (ports, waterways, airports, roads)	Ministry of Transportation Special Purpose Spatial Plan for Coastal Zone of Montenegro, Ministry of Economy, Public Enterprise for Coastal Zone Management of Montenegro, 2007.	Two airports: 1,550,000 arrivals/departures recorded in 2013 Ports include: the port of Bar, the port of Kotor, the port of Zelenika and the port of Risan, and ports for domestic maritime transport, marinas and docks.Total length of marine waterway in our coastal sea is 66 nmi, i.e. 122.2 km, which is the distance between end ports on this route, from St. Nikola (Bojana River Mouth) to Kotor. Total length of this waterway to the open sea decreases to 50 nmi (92.6 km) whilst length of the of waterway in Boka Kotorska Bay is 16 nmi (29.6 km) 3 railroads (Bar to Belgrade, Podgorica to Nikšić and Podgorica to Skadar) Oil storage facilities in Bar (100,000 m^3) and Lipci (12,200 m^3) Lipci: berth for ships Transportation of goods via ports: 1,300,000 tonnes (2013) Road infrastructure not sufficient to cope with higher loads in summer season	Increased demand for infrastructure including airport, port and road capacity	Indicator 15.1: Percent GDP expenditure on infrastructure works (**no data**)
Waste and wastewater management	Information on State of Environment in Montenegro, Agency for Environmental Protection of Montenegro MONSTAT	Domestic waste generation is about 267,563 tonnes per year (2013) Industrial waste generation is 557,635 tonnes per year (2011) of which 6577 tonnes per year of hazardous wastes Nearly 89% of industrial wastes are generated from the electrical, gas and steam sectors Two sanitary landfills for domestic waste and 273 dumpsites No hazardous waste management facility; hazardous waste is exported according to Basel Convention	Increased pressure on waste and wastewater infrastructure	- Indicator 10.1 (O03): Generation of hazardous waste (**decreasing**) - Indicator 10.2 Metric tons of hazardous waste generated by the E&P activities properly managed (**none**)

Environmental/ Socio-economic Aspect	Sources of Data/Comments	Baseline Condition	Relation with the E&P Programme	Indicator and Likely Trend without the Programme
		No waste segregation at the source Only 8.7 million m^3 of wastewater were treated in 2011 per year out of 30.5 million m^3 (MONSTAT) Industrial wastewater is generally treated		
Archaeology	Special Purpose Spatial Plan for Coastal Zone of Montenegro, Ministry for Economic Development of Montenegro, Public Enterprise for Coastal Zone Management of Montenegro, 2007.	357 registered archaeological and cultural monuments More than half are located in the coastal zone Only 2 registered and categorized archaeological sites offshore Another 27 unregistered offshore sites are available Offshore heritage sites are in poor condition; theft of artifacts is also common	E&P activities may pose additional stress on archaeological resources	- Indicator 14.1: Number of incidents/ activities that could result in damage to cultural and archaeological heritage sites (**no data**) - Indicator 14.2: Allocated funds to preserve/ promote cultural and archaeological heritage sites (**increasing**) - Indicator 14.3: Number of discovered underwater archaeological sites and shipwrecks (**increasing**)
Health	MONSTAT Institute of Public Health Ministry of Health	Extra capacity available in general hospitals Capacity of specialized hospitals for mental health, orthopedic and traumatism is more limited and reached capacity Dominant diseases are respiratory related diseases mainly due to smoking, ambrosia allergies and emissions from traffic Prevailing death cause is cardiovascular diseases Highest number of affected population by HIV/AIDS is in coastal zone Transboundary medical services agreement in place with various countries	Increased demand for health services Possible increased rates of morbidity and mortality Safety at work is very important in this industry; need to build safety culture in Montenegro Increase in STD Increased risks of introduction of eradicated diseases Increased rates of health conditions typical to oil industry (such as trauma, psychological, from handling of radioactive wastes, burns)	- Indicator 19.1: Number of health-related institutions (**stable**) - Indicator 19.2: Population with STD (**increasing**) - Indicator 19.3: Countries with transboundary cooperation in medical aid (**no data**) - Indicator 19.4: Influx people scrutinized with health control measures (**increasing**) - Indicator 19.5: Percent health care staff trained in new types of health conditions (**stable**) - Indicator 19.6: population with cardiovascular system diseases, respiratory system diseases and cancers (no data)
Tourism	Master Plan - Tourism	Tourism is priority industry for economic	Perception of polluting	- Indicator 18.1 (T01): Tourist

Environmental/ Socio-economic Aspect	Sources of Data/Comments	Baseline Condition	Relation with the E&P Programme	Indicator and Likely Trend without the Programme
	Development Strategy by 2020 (DEG and Ministry of Tourism) (2001) and its Revision in 2008 MONSTAT Other related strategic plans	development in the country Tourism focuses on coastal area; diversification of tourism products from 3S (sea, sand and sun) to 3E (education, entertainment and ecology) Tendency to reposition from mass tourism to sustainable tourism destination Nearly 1.5 million tourism arrivals in 2013 Majority of overnight stay in coastal zone (97%) Mostly from Russia (28.1%), Serbia (25.1%), Bosnia and Herzegovina (7.5%), Ukraine (5.6%) and Kosovo (3.3%); Germany only 2.3% compared to much higher proportions pre-1990 Increasing trend in number of tourists Numerous challenges related to mass tourism including water supply (improved now), road capacity, security Tourism infrastructure in terms of accommodation is considered sufficient but structure requires change Beach tourism has a long tradition (stone and sandy beaches); 74 beaches Porto Montenegro is the most luxurious tourism investment; yacht and nautical tourism	industry reducing attractiveness of the country as a destination Possible conflict with yacht and nautical tourism Opportunity to increase tourism related to workers and staff from Oil companies` Risk of damaging tourism resources from E&P activities Restriction of oil and gas activities location on-shore to minimize interference with tourism industry	arrivals (**increasing**) - Indicator 18.2 (T04): Number of tourists on cruise lines (**increasing**) - Indicator 18.3: Investment in alternative modes of tourism (**increasing**)

6. STAKEHOLDER ENGAGEMENT AND PUBLIC CONSULTATION

6.1 SCOPING PUBLIC CONSULTATION

The scoping public consultation session was conducted on July 24, 2014 including key stakeholders, NGOs and industry representatives to discuss the contents of the scoping report and obtain necessary inputs for its finalization prior to proceeding with the SEA study.

The affiliation of participants in the consultation was as follows:

- Ministry of Economy
- Ministry of Sustainable Development and Tourism
- Institute for Hydrometeorology and Seismology of Montenegro
- Environmental Protection Agency
- ECRAN (Environment and Climate Regional Accession Network)
- Marine Safety Agency
- Ministry of Agriculture and Rural Development
- Institute for Geological Surveys
- Agency for Inspection Affairs
- Union of Associations of Paraplegics of Montenegro
- Public Enterprise for Coastal Zone Management
- Ministry of Labor and Social Welfare
- Centre for Eco-toxicological Research
- Marine Biology Institute
- Centre for Conservation and Archeology of Montenegro
- MONSTAT (Statistical Office of Montenegro)
- NGO Green Home
- Port Administration of Montenegro
- Institute for Public Health of Montenegro
- Ministry of Interior Affairs, Directorate for Emergency Situations
- Independent Consultants
- Members of SEA Team

During the meeting contents and findings of the Draft Scoping Report were presented, and comments, feedback and recommendations were obtained from the representatives of institutions, as per the fields of their jurisdiction.

Participants were generally satisfied with what has been conducted so far and the manner in which the workshop was prepared and held. The main discussed items and how they were considered in the SEA are presented in Table 6.1.

Table 6.1 Summary of Discussed Issues during Scoping Consultations and their Consideration in the SEA Study

Discussed Issues	Consideration in the SEA Study
The SEA is expected to show where it is allowed to set up oil rigs and where it is not, in accordance with the state of environment and other limiting factors, to identify strategic measures for mitigation of impacts such as to define areas where it will not be allowed to conduct any activities (exclusion zones, i.e. ecologically sensitive areas) or to define time frames when certain activities will not be permitted (i.e. periods relevant for migration of certain species)	Recommendations for sensitivities that shall be avoided during each activity are provided (i.e. underwater archaeological sites, sensitive benthic species.. etc) However detailed surveys shall be conducted during EIA studies to define the presence of such sensitivities in each activity area. Recommendations for the required surveys during EIA studies are provided in Section 12.
Opportunities for further detailed impact assessment after the SEA exist at several stages of subsequent implementation including EIA for Exploration Work Programme of awarded licensees; EIA for Field Development Programme that is prepared in the event of successful appraisal activities; EIA for decommissioning and EIA for any subsequent major variation in Field Development Programme.	Recommendation for required surveys during these subsequent EIA studies are provided in Section 12.
Procedures for cuttings management shall be addressed in the SEA; it is necessary to specify suggested types of mud and clarify limitations in respect to its discharge in the environment.	This issue is addressed in section 7.3.3.3.
Preparation of necessary documentation to inform neighboring countries of potential transboundary impacts is being handled by Ministry of Sustainable Development and Tourism (as per ESPOO convention, notification can be done now or during consultation of SEA report).	Possible transboundary impacts are discussed in Section 10.10.
Montenegro is declared as an Ecological State in its constitution; this shall be included in the legal matrix of the SEA; development of oil and gas sector should not jeopardize this constitutional mandate of the country.	This declaration through the constitution is added to the legal matrix
The Ballast Water Convention has been ratified by Montenegro and shall be included in the legal matrix;	The Ballast water management convention is added to the legal matrix

same for Law on Prevention of Sea Pollution	
Role of inspectors was discussed with representative of Agency for Inspection Affairs, and particularly training to be able to conduct needed inspections at offshore rigs; the SEA shall consider the role of inspectors in the institutional framework and propose a training programme	Institutional framework and capacity building requirements for the implementation of the EMF are provided in Section 11.
Radioactive waste storage facilities with limited capacities are available in Podgorica; no facilities to treat liquid radioactive wastes are available; management of NORM wastes should be carefully addressed in SEA study. It was suggested to trigger amendments to legal remedies in accordance with new oil exploitation industry.	The management and disposal of radioactive waste is discussed in section 7.3.3.2.
Emissions from boats are set out by Annex 6 of the MARPOL convention which was incorporated into Montenegro legislation; it is necessary to create a plan for protection of sensitive receptors in case of an incident.	Appliance of the requirements of Annex VI of MARPOL Convention is included as a proposed mitigation measure.

7. ANALYSIS OF ALTERNATIVES

7.1 INTRODUCTION

Alternatives can be defined as different means or methods to achieve a pre-defined objective. Best practice in the preparation of a strategic environmental assessment study requires that a reasonable range of alternatives project be considered and analyzed.

Project Alternatives are presented, analyzed and compared in this section. Since the selection of some alternatives depends on technical factors that are not defined at this stage of the Programme, advantages and disadvantages of options are provided to facilitate the selection at later stages when the data needed for the selection of options is available.

The Analysis of Alternatives has considered the following:

- Drilling technologies
- Solid Waste management options
- Wastewater management alternatives including management of produced water
- Export options
- Site selection for onshore support facilities

7.2 DRILLING TECHNOLOGIES

After having identified potential drilling locations, an operator would mobilize a rig to start drilling one or more exploratory wells within the boundaries of the awarded block. This aims at proving the existence of hydrocarbons within the identified prospect.

The rig type which will be selected depends upon a number of parameters (Table 7.3), in particular:

- Cost and Availability
- Water depth of location
- Mobility/ transportability
- Depth of target zone and expected formation pressures
- Prevailing weather/ met-ocean conditions in the area of operation
- Experience of the drilling crew (HSE safety record)

The development of the reservoir should take into consideration the footprint of the drilling rig and that of the processing facilities and the associated infrastructure. These would range from bottom founded and platform based rigs, to anchored and dynamically positioned rigs.

As shown in Table 7.1, a direct relation exists between the bathymetry of the basin and the possible rig types that can be used in the different blocks offered for concession award as part of the licensing round corresponding with various water depths (Figure 7.1).

The following types of drilling rigs can be contracted for the offshore drilling (Figure 7.2):

Table 7.1. Possible Rig Types

Approximate Water Depth Range (in meters)	Blocks	Possible Rig Type to be Used
0 -100	1,5,7,25,26, 30	Swamp barges (< 6m of water) Drilling Jackets (calm environment) Jack-up Rigs (5 to 140m of water)
100 -200	4, 10,11,23,24, 29	
200 -1000	2,3, 8, 9,12,13,14,15,27	Fixed Platforms Semi-submersibles Drill ships Dynamically positioned (DP) rigs

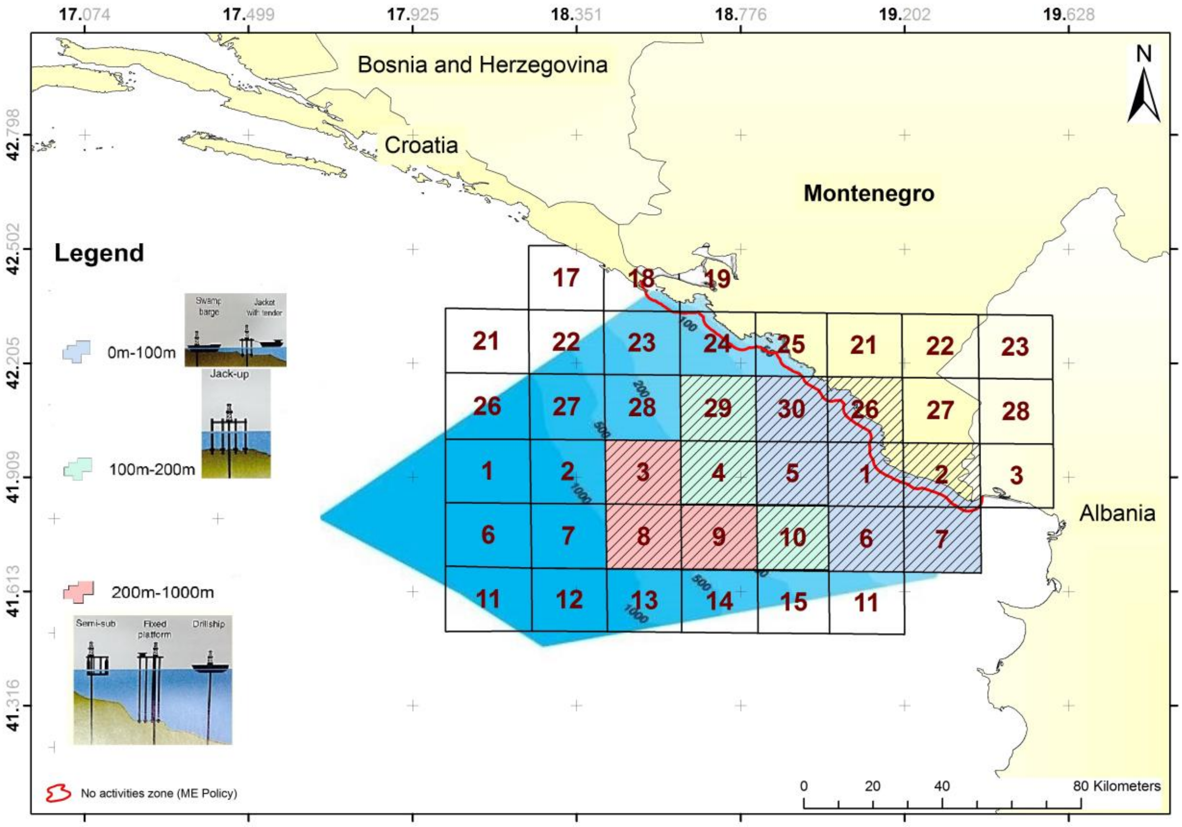


Figure 7.1. Possible Rig Types for the Licensed Exploration Based on Water Depth

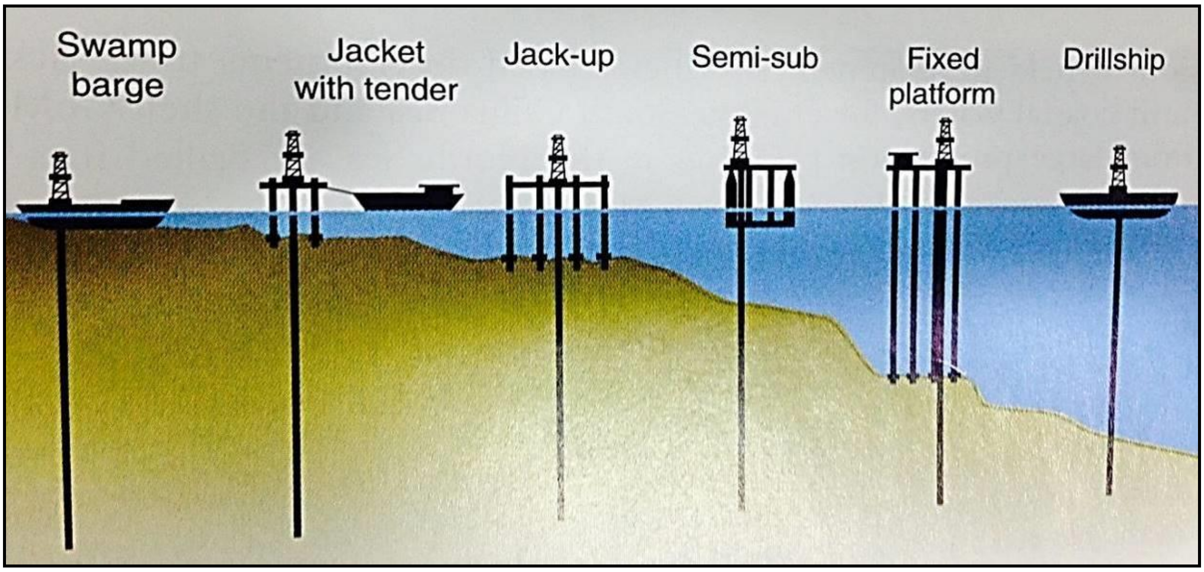


Figure 7.2. Types of Offshore Rigs

Bottom founded and platform based rigs engulfs the following:

7.2.1 Swamp barges

Swamp barges operate in very shallow water (less than 6 meters). They can be towed onto location and are then ballasted so that they 'sit on the bottom'. The drilling unit is mounted onto the barge.

Advantages:

- Operates in very shallow waters

Disadvantages:

- Complete disturbance of the seabed over a very large area

7.2.2 Drilling Jackets

Drilling Jackets are small steel platform structures which are used in areas of shallow and calm water. A number of wells may be drilled from one jacket. If a jacket is too small to accommodate a drilling operation, a jack-up rig is usually cantilevered over the jacket and the operation carried out from there. Once a viable development has been proven, it is extremely cost-effective to build and operate jackets in a shallow environment. In particular, they allow a flexible and step-wise progression of field development activities.

Notes:

The above listed type of rigs will not probably be implemented for Montenegro offshore exploration because the government of Montenegro has set a minimum separation distance from the shore of 3 km. (the red line in Figure 7.1*).*

7.2.3 Jack-up rigs

Jack up rigs are either towed to the drilling location or are equipped with a propulsion system. The three or four legs of the rig are lowered onto the seabed. After some penetration the rig will lift itself to a determined operating height above the sea level. If soft sediment is suspected at seabed, large mud mats will be placed on the seabed to allow a better distribution of weight. All drilling and supporting equipment are integrated into the overall structure. Jack-up rigs are operational in water depths up to about 140 meters and as shallow as 5 meters. Globally, they are the most common rig type, used for a wide range of environments and all types of wells.

Advantages:

- Most commonly used type of rig pointing out the success and the safety against many hazardous possibilities such as high currents.

Disadvantages:

- Stability of the rig depends totally on the seabed sediments; therefore the impact on the seafloor will be moderate to high in the buffer zone of the rig area.

7.2.4 Fixed Platform Rigs

Fixed platforms are built on concrete and or steel legs anchored directly onto the seabed, supporting a deck with space for drilling rigs, production facilities and crew quarters. The structure may be a fixed jacketed platform, spar, tension leg platform (TLP), or gravity structure; whatever it is, the rig sits atop it.

Various types of structure are used, steel jacket, concrete caisson, floating steel and even floating concrete. Steel jackets are vertical sections made of tubular steel members, and are usually piled into the seabed. Concrete caisson structures, pioneered by the Condeep concept, often have in-built oil storage in tanks below the sea surface and these tanks were often used as a flotation capability, allowing them to be built close to shore (Norwegian fjords and Scottish firths are popular because they are sheltered and deep enough) and then floated to their final position where they are sunk to the seabed.

Advantages:

- Such platforms are, by virtue of their immobility, designed for a very long term use.
- Fixed platforms are economically feasible for installation in water depths up to about 1,700 feet (520 m)
- Built up time ranges from 2-3 days for self-erecting rigs, and 2-4 weeks for standard platforms. Conventional standard platform rigs are heavy, and are built to API well spacing standards, so they can work on a wide range of platforms.

Disadvantages:

- Maximized damage to the seabed
- Fixed legs of the platforms onto the seabed for the span of the exploration period

Anchored rigs:

7.2.5 Semi-submersibles

Semi-Submersibles are used for exploration and appraisal in water depths too great for a jack-up. A semi-submersible rig is a movable offshore vessel consisting of a large deck area built on columns of steel. Attached to these heavy-duty columns are at least two barge-shaped hulls called pontoons. Before operation commences on a specified location, these pontoons are partially filled with water and submersed in approximately 16 meters of water to give stability. A large- diameter steel pipe (riser) is connected to the seabed and serves as a conduit for the drill string.

A combination of several anchors and dynamic positioning (DP) equipment assists in maintaining position. Relocation of the semi-submersible vessel is made possible by the utilization of tugboats and/ or propulsion machinery.

Heavy-duty semi-submersibles, like the Deepwater Horizon, can handle high reservoir pressures (15000 psi) and operate in the most severe metocean conditions in water depths down to 3000 meters.

Advantages:

- Minimal impact on the seabed
- Deepwater rigs that can handle high pressure reservoirs and can be controlled by global positioning systems
- Can handle high currents sea
- Operates in water depth around 3000 meters
- The Blowout preventer (BOP) is located at the seabed (Subsea stack)

Disadvantages:

- The style of top-hole drilling used by these rigs has a greater risk from a shallow gas blowout. This would lead to seabed cratering and the loss of the rig.
- Takes around 70 days to be towed from one drill site to the other

7.2.6 Drill ships

A marine riser is lowered from the drillship to the seabed with a blowout preventer (BOP) at the bottom that connects to the wellhead. The BOP is used to quickly disconnect the riser from the wellhead in times of emergency or in any needed situation. Underneath the derrick is a moonpool, an opening through the hill covered by the rig floor. Some of the modern drill ships have larger derricks that allow dual activity operations, for example simultaneous drilling and casing handling.

Drill Ships are used for deep and very deep water work. They can be less stable in rough seas than semi-submersibles. However, modern high-specification drill ships such as Discoverer Enterprise can remain stable, and on target during 100 knot winds using powerful thrusters controlled by a DIP system. The thrusters counter the forces of currents, winds and waves to keep the vessel exactly on target, averaging less than 2 meters off her mark without an anchor.

Advantages:

- Heavy duty drill ships are capable of operating in water depths up to 3700 meters.
- Move quickly under its own propulsion from drill site to the other

Disadvantages:

- Drillship construction cost is much higher than other rigs
- Mobility comes at a high price since the drillship owners can charge higher day rates and get benefit of lower idle times between assignments

7.2.7 Dynamically positioned (DP) rigs

The first vessel to fulfill accepted definition of dynamically positioned rig was the "Eureka" (1961). These rigs were developed for harsh-environment locations where more environmental-friendly methods were needed. They are fitted with a control system and equipped with steerable thrusters fore and aft in addition to main propulsion.

Advantages:

- Eco-Friendly method
- Vessel is fully self-propelled; no tugs are required at any stage of the operation
- Setting-up on location is quick and easy
- Vessel is very maneuverable
- Rapid response to weather changes is possible (weather vane)
- Rapid response to changes in the requirements of the operation
- Can complete short tasks more quickly, thus more economically
- Avoidance of cross-mooring with other vessels or fixed platforms

Disadvantages:

- Higher fuel consumption
- Thrusters are hazards for divers and ROVs
- Can lose position in extreme weather or in shallow waters and strong tides
- Requires more personnel to operate and maintain equipment

In some cases, oil and gas fields are developed from a number of platforms. Some platforms will accommodate production and processing facilities as well as living quarters. Alternatively, these functions may be performed on separate platforms, typically in shallow and calm water. On all offshore structures, however, the installation of additional weight or space is costly. Drilling is only carried out during short periods of time if compared to the overall field life span and it is desirable to have a rig installed only when needed. This is the concept of tender-assist drilling operations.

In tender-assisted drilling, a derrick is assembled from a number of segments transported to the platform by a barge. All the supporting functions such as storage, mud tanks and living quarters are located on the tender, which is a specially built spacious barge anchored alongside.

Advantages:

- It is possible to service a whole field or even several fields using only one or two tender-assisted derrick sets.

Disadvantages:

- In rough weather, barge type tenders quickly become inoperable and unsafe since the platform is fixed whereas the barge moves up and down with the waves.

Major advantages and disadvantages of rig types are presented in Table 7.2.

Table 7.2. Advantages and Disadvantages of the Major Rig Types

Rig type	Advantages	Disadvantages
Bottom founded rigs Platform based rigs	1- Only directly impact the seafloor over a small area immediately around the wellbore 2- The site survey is focused directly upon the well location, the corridor of approach onto location, and any possible stand-off locations 3- Supports as few as 3 or more than 50 well conductors	1- The risk to the rig from a shallow gas blowout is greater 2- Risk to the rig's integrity through loss of seabed support 3- Requires dedicated intrusive geotechnical soil investigations for the analysis of the rig foundation as per the industry guidelines and standards *exp: The Society of Naval Architects and Marine Engineers (SNAME), Technical & Research Bulletin 5-5A, Site Specific Assessment of Mobile Jack-up Units and ISO 19905-1, Petroleum and natural gas industries, Site-specific assessment of mobile offshore units, Part 1: Jack-ups (in development, target publication date September 2011)*
Anchored Rigs	1- Intermediate to High water depth 2- Widely used rigs	1- Impact a large area of the seabed due to anchor chain and/ or wire ropes disturbing the seafloor 2- Perform site survey over a larger area of the seafloor to assess anchoring conditions 3- Cause problems in the case of gas hydrated, Archeological sites and Sensitive environmental sites 4- Needed boat support for anchoring
Dynamically positioned (DP) rigs	1- Impact a small area of the seabed 2- Site survey is focused on the well location and its immediate surroundings 3- Ability to work in any water depths 4- Environmentally friendly method 5-Ability to move to new location rapidly (also avoid bad weather)	1-Can fail to keep position due to equipment failure 2- Higher day rates than comparable moored systems 3- In deep waters the DP rigs requires special program for site surveys

Additional detailed parameters provided in Table 7.3 represent the constraints, hazards or concern to be taken into consideration before the selection of the operational drilling rigs.

Table 7.3. Comparison among Rig Types

Major Rig Types	Rig Type	Cost and Availability	Water Depth	Mobility/ Transportability	Depth of Reservoir/ Pressures	Weather Conditions	Safety	Impacts on the environment
Bottom founded and Fixed platforms	Swamp barges	low	shallow	fast	shallow	calm		• Complete disturbance of the seabed over a very large area
	Drilling Jackets	moderate	shallow to moderate	moderate	shallow to moderate	moderate	fair to high	• Impact on the seafloor will be moderate to high in the buffer zone of the rig area.
	Jack-up Rigs	moderate	shallow to moderate	moderate	deep	moderate	fair to high	• Impact on the seafloor will be moderate to high in the buffer zone of the rig area • Less noise generation than anchored rigs (85 to 127 dB)
	Fixed Platforms	high	deep	slow	deep/ high	hard	good	• Maximized damage to the seabed • Fixed legs of the platforms onto the seabed for the span of the exploration period • Less noise generation than anchored rigs.
Anchored Rigs	Semi-Submersibles	moderate-high	deep to very deep	moderate	deep/ high	moderate to hard	good	• Minimal impact on the seabed • Generates higher noise levels than fixed installation (167 to 171 dB)
	Drill ships	high	deep to very deep	fast	deep/ high	moderate to hard	fair to good	• Minimal impact on the seabed • Noise levels are between 179 to 191dB.
	Dynamically positioned (DP rigs)	very high	deep to very deep	fast	deep/ high	moderate	fair to good	• Vessel is fully self-propelled; no tugs are required at any stage of the operation • Setting-up on location is quick and easy • Vessel is very maneuverable • Higher noise levels and higher fuel consumption • Requires more personnel to operate and maintain equipment

7.3 SOLID WASTE MANAGEMENT OPTIONS

Offshore exploration and production of oil and gas in Montenegro should be coupled onshore with a support system especially when it comes to waste management. Montenegro will be facing considerable problems managing all the types of wastes. The current system of waste collection and disposal is such that it does not provide waste separation and separate treatment of different types of wastes. Most importantly, the disposal of non-hazardous and hazardous waste does not meet the minimum environmental standards. Onshore domestic waste is not any better where the system of waste collection is considered unorganized and not satisfactory.

The collected solid waste whether non-hazardous/Hazardous or domestic wastes need to be separated, treated on site and transported to the onshore facilities.

The database on different sources, quantities and sites where waste is disposed is poor (Whether registered landfills or illegal dumps).Reuse and recycling are found on a very small scale, while energy recovery programs and recovery of raw materials from waste are almost non-existent.

7.3.1 Legal Framework for Waste Management

The main legislative texts and ratified conventions that address waste management in Montenegro are:

1. Law on Waste Management (OG MNE No. 80/05, 73/08, 64/11)
2. Rulebook on the manner of treatment of waste oils (OG MNE No. 48/12)
3. Law on Protection from Ionization Radiation and Radiation Safety (OG MNE No.56/09, 58/09, 40/11)
4. Strategy for Protection against Ionizing Radiation. Radiation Safety and Radioactive Waste Management
5. Solid Waste Strategic Master Plan (2005.)
6. Law on protection of sea from pollution from vessels (OG MNE No. 20/11 of 15.04.2011)
7. Law on Ratification of Barcelona Convention for Protection against Pollution in the Mediterranean Sea (OG MNE, No. 64/07)
8. The Law on Ratification of Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (hereinafter referred to as “the Basel Convention”) (OG SRY”, of 25th December, 1999.)
9. International Convention for the Prevention of Pollution from Ships (MARPOL)

Basic major systemic issues in waste management in Montenegro relates to low awareness of the need to reduce waste generation and provide appropriate treatment and disposal. The *Solid Waste Management Master Plan and the Law on Waste Management* all aim at addressing these issues.

Main challenges in waste management are successful implementation of the Law on Waste Management. This law creates the preconditions which will contribute to the following:

- Prevention of waste generation and the gradual reduction of adverse effects of waste to a minimum;
- Reduction of quantities of generated waste;
- Waste neutralization, recycling and recovering;
- Making use of waste value through the composting and production of energy generation;
- Sustainable development through rational utilization of natural resources; establishment of an integrated and effective system of waste management in a way which is safe for human health and the environment;
- Establishment of a system of regional waste management; and
- Environmentally sound disposal or incineration of waste, remediation of unregulated landfills, etc.

Local laws are very important for the success of the offshore exploration but they should be in harmony with the international laws. The International Maritime Organization (IMO) issued laws on waste management requirements that are expressed in MARPOL 73/78 annex V (Regulations for the prevention of pollution by garbage from ships) which applies to all ships, as well as mobile and fixed installations (including supply ships, platforms, flotels, anchored drilling rigs, etc.). IMO's requirements relating to waste sorting categories are deemed to be a minimum requirement for mobile units and do not come into conflict with any local laws.

All wastes generated from Operations and other activities shall be managed according to the waste Hierarchy Principles described in Figure 7.3.

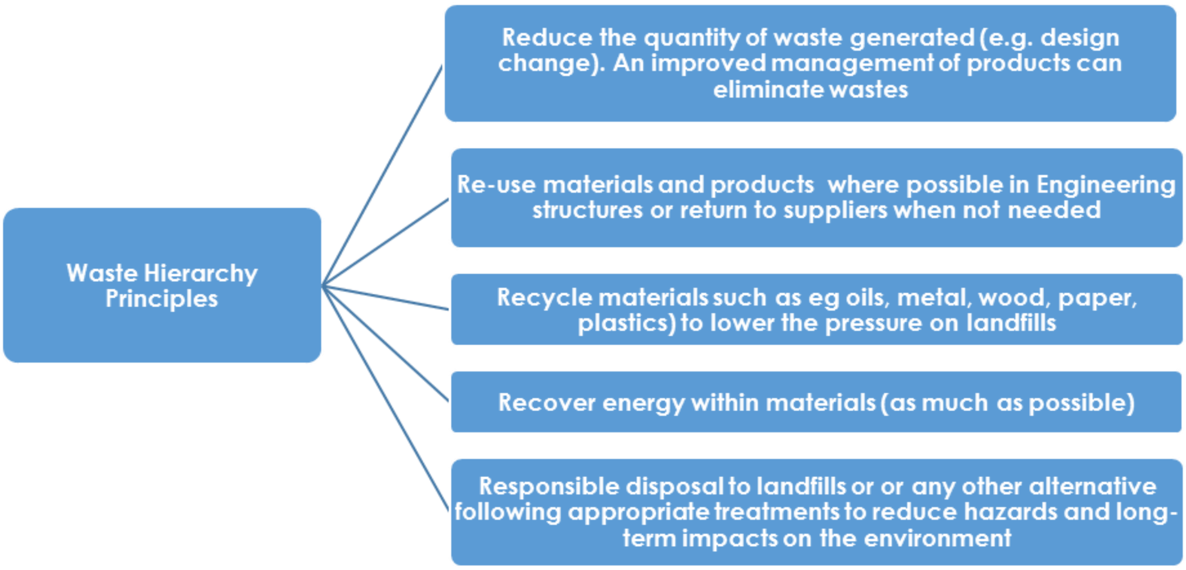


Figure 7.3 Waste Hierarchy Principles

7.3.2 Waste Streams Expected during Different Programme Phases

The solid waste streams expected to be generated during different programme phases are presented in Table 7.4.

The proposed treatment and disposal options for each waste stream is provided in next section.

Table 7.4 Waste Streams Expected during Different Programme Phases

Programme Phase	Waste Streams
Prospecting Phase	Domestic solid waste (food waste, office waste, etc.) and recyclable waste (glass, paper, metals, wood, etc.)
	Hazardous waste (engine oil, lubricants, fuel, batteries, Oil contaminated waste etc.)
Exploration and Appraisal Phase	Domestic solid waste (food waste, office waste, etc.) and recyclable waste (glass, paper, metals, wood, etc.)
	Hazardous waste (engine oil, lubricants, fuel, batteries, Oil contaminated waste etc.) in addition to radioactive waste generated during well testing.
	Drilling cuttings and drilling mud
Development and Production Phase	Domestic solid waste (food waste, office waste, etc.) and recyclable waste (glass, paper, metals, wood, etc.)
	Hazardous waste (engine oil, lubricants, fuel, batteries, Oil contaminated waste etc.)
	Oily sludge (pigging activities and tanks cleaning) which may include NORM.
Hydrocarbon Usage	Domestic solid waste (food waste, office waste, etc.) and recyclable waste (glass, paper, metals, wood, etc.)
	Hazardous waste (engine oil, lubricants, fuel, batteries, Oil contaminated waste etc.)
	Oily sludge (pigging activities and tanks cleaning), which may include NORM
	Inert waste from construction of facilities
Decommissioning Phase	Oily sludge (Pipes and tanks cleaning)which may include NORM
	Inert waste from dismantling of facilities
	Hazardous waste (engine oil, lubricants, fuel, batteries, Oil contaminated waste etc.)

7.3.3 Management of Wastes

7.3.3.1 Non-Hazardous Waste

Non-hazardous waste generated during all Programme phases shall be segregated at source, and the operator shall be responsible for the management, transportation and disposal of waste.

As per Annex V of MARPOL Convention on the Prevention of Pollution by Garbage from Ships Disposal of garbage from ships and fixed or floating platforms is prohibited. Ships must have a garbage management plan and shall be provided with a Garbage Record Book. Discharge of food waste ground to pass through a 25-mm mesh is permitted for facilities more than 12 nmi from land.

The possible management options for the different non-hazardous waste types are presented in Table 7.5.

Table 7.5. Management of Non-Hazardous wastes.

Type	State	Management
Food waste	Solid	Discharge of food waste ground to pass through a 25-mm mesh is permitted for facilities more than 12 nmi from land. For facilities located at less than 12 nmi from land food waste shall be sent to a landfill/on-shore disposal
Glass	Solid	Return to suppliers Recycle Crush and send to Landfill
Grease	Sludge	Landfill/ Add microbes/Enzymes to grease traps Incineration/ Waste to energy/ Bio-diesel/ Bioremediation
Metals	Solid	Reclaim/Re-use/Recycle
Paper and Card	Solid	Recycle Landfill Incinerate/ Waste to Energy
Plastic	Solid	Recycle Landfill Incinerate/ Waste to Energy
Residual mixed waste	Solid	Landfill Incinerate
Wood	Solid	Re-use/Recycle/ Landfill Incinerate/ Waste to Energy

7.3.3.2 Hazardous Waste

Hazardous waste are materials containing substances that are harmful for health and the environment, thus requiring separate handling to prevent pollution, personal injuries, etc. These materials will exhibit one or more of the characteristics such as highly flammable, toxic or corrosive, etc.

Main requirements for handling hazardous waste are:

- Identification
- Proper storage, packaging and labelling
- Prohibition of mixing with other waste, also other types of hazardous waste

After handling the materials, declaration and transport to the licensed waste facilities is the end act. Table 7.6, provides a plan for the management of Hazardous wastes.

Authorities require hazardous waste classification to be done in accordance with both the European Union system for European Waste List codes (EWL) and the prevailing local Montenegrin waste management laws (Law on Waste Management (Official Gazette of the Republic of Montenegro, No 80/05, Official Gazette of Montenegro, No 73/08; 64/11) and the Rulebook on the manner of treatment of waste oils (OG MNE No. 48/12):

- The EWL code classification prepare for source specific classification. Certain EWL codes are specific for waste shipped to shore from offshore oil drilling and production.

- The Montenegrin waste code list is based upon the various chemical properties of different types of waste. This classification will thus be determinative for further waste treatment and disposal (the rulebook on classification of waste and procedures of its processing, recovery and disposal) (Official Gazette of Montenegro 68/09).

Since no hazardous waste management facilities exist in Montenegro, these wastes shall be transported abroad in accordance with local laws and international conventions listed in Section 7.3.1.

The operator will be responsible for the export, including applying for an export permit in their own name. The export regulations are complex and require permits issued by the exporting, transiting and importing countries' environmental authorities. The permits shall specify the type of waste, importing country and chosen transport company. It is prohibited to export hazardous waste to non-OECD countries (Organization for Economic Co-operation and Development member).

Radioactive Waste

Produced water, having been in contact with various rock strata at elevated pressure and temperature, contains many soluble components including Barium and the radioactive intermediates of the Uranium and Thorium decay series. As the water is produced the temperature and pressure decreases creating conditions in which the Barium and radionuclides can co-precipitate inside separators, valves and pipework, forming an insoluble NORM (naturally-occurring radioactive material) scale. Some of the soluble radionuclides and particles of NORM scale will pass through the system and be discharged with the produced water. Similarly, some particulate scale and soluble radionuclides will be entrained with the exported oil or gas pipeline and will be discharged from the onshore terminal.

Wastes are generated during the decontamination process of pipes, vessels, tanks and other components. Small volumes of waste are expected from gas production facilities. However, in some cases, wastes in the form of pyrophoric iron sulfide are also formed at the gas production facility/installation, which may contain NORM.

The presence of NORM at the oil and gas facilities could lead to radiation exposure to workers through external radiation from radioactive isotopes, and internal exposure through inhalation (airborne dust and gas) and possible ingestion of radioactive materials at work sites.

Monitoring of radiation and radioactivity levels at oil and gas facilities during normal operation and maintenance work is very essential. This will ensure the safety of the workers involved, as well as protecting the environment through sound programs of waste management.

Tests of radioactivity shall be performed when opening production and drain systems, for pipelines and tripping out of well tools to determine the existence of radioactive waste. Performing personnel shall be informed of potential dangers and protective measures. A suitable instrument (Geiger counter with probe) shall be made available.

Activity identification (identification of Bq/g levels) shall be performed using quality controlled methods: screening of storage containers; representative samples taken using calibrated handheld test equipment; or laboratory analyses of representative samples. The test results shall be used when filling in the waste declaration form. Specific activity for each nuclide, determined by gamma spectrometry, as well as oil content analysis of each package/barrel, is required for radioactive waste for disposal.

The Pb-210 nuclide content cannot be determined using handheld test equipment. The normal levels of radioactive lead are approx. 10-20 % of the radium level. It is usually well known if a certain installation has abnormally high levels of radioactive lead.

Radioactive waste for disposal shall only be delivered to facilities with specific permits for receiving such waste. Radioactive waste shall be delivered to a waste facility at least once a year.

Since no hazardous waste management facilities exist in Montenegro, radioactive wastes shall be transported abroad in accordance with local laws and international conventions listed in Section 7.3.1.

The waste producer must provide sufficient information regarding the waste's origin, content and properties to ensure proper waste handling. The declaration form must be filled in when delivering the waste. The packaging shall be clearly marked with the declaration number. The labelling must be transport proof.

Routes for disposal (**at existing facilities available outside Montenegro**), include:

- encapsulation and burial of solids, sludge and scales;
- engineered facility for burial of encapsulated or un-encapsulated wastes;
- landfill of treated sludge or slag or ash and scales; and
- other appropriate technologies

Table 7.6. Management of Hazardous Waste

Waste Classification		Transport
Waste Categories	**Description**	**Proper shipping**
Batteries	Cadmium batteries, rechargeable, dry	Open top barrels with clamp tops
	Mercury batteries, button-cell batteries	Open top barrels with clamp tops
	Lead-acid batteries ("car batteries")	Open top barrels with clamp tops
	Unsorted small batteries	Open top barrels with clamp tops
Oil well related waste	Waste from well operations (such as well cleaning, stimulating) not contaminated with crude oil or condensate	Ship Tankers- Open top barrels with clamp tops
Catalytic material	Catalytic material from gas cleansing	Plastic Packaging
	Catalytic material with traces of mercury from gas cleansing	Plastic Packaging
Fluorescent tubes	Fluorescent tubes, UV lamps, energy-saving light bulbs	Ship Tankers- Open top barrels with clamp tops
Solvents	Organic solvents without halogen (e.g. organic solvent mixtures)	Ship Tankers- Tight head barrels with bung holes
Oil contaminated waste	Used lubricating oil fulfilling requirements regarding quality and origin	Ship Tankers- Tight head barrels with bung holes
	Waste oil, mixture	Ship Tankers- Tight head barrels with bung holes
	Other oily water / slop from engine rooms and maintenance / cleansing processes	Ship Tankers- Tight head barrels with bung holes
	Oil contaminated materials - mixture of oily rags, oil filters without metal, filter cloth from cleaning processes, etc.	Ship Tankers- Open top barrels with clamp tops
	Other oil contaminated materials, including hoses with mud or oil content, oily equipment and other oily material	Ship Tankers- Open top barrels with clamp tops
	Fuel residue (e.g. diesel, helifuel, petrol, kerosene)	Ship Tankers- Tight head barrels with bung holes
	Lubricating grease, other grease	Ship Tankers- Tight head barrels with bung holes
Tank cleaning waste	Waste from cleaning tanks previously containing rig slop (machine slop, engine slop, other contaminated water)	-
	Waste from cleaning tanks previously containing drilling slop	

Waste Classification		Transport
Waste Categories	**Description**	**Proper shipping**
	Waste from cleaning tanks previously containing crude oil or condensate	
	Waste from cleaning tanks previously containing water-based drill fluids and brine	
Radioactive waste	NORM waste arising from maintenance, cleaning, decontamination and refurbishment activities in oil and gas facilities/installations.	- Radiation level shall not exceed 5 μSv/h at the surface of each container. - Ends of pipes shall be packed to prevent the spread of contaminated radioactive substances. Valves, pumps and other connected fittings, if not of very large size, shall be entirely packaged. - The relatively large quantities of solid pollutants resulting from sediment mud or solid scaly residues shall be transferred in tanks and separation containers. Big decontaminated substances such as substances with low specific radioactivity shall be transported in barrels or tanks according to industrial parcels. - - No other substances shall be transported in the vehicle transporting substances or equipment contaminated with natural radioactive substances. - When transporting by sea, a suitable container specific for transport shall be used. - Operator shall develop a detailed written transport plan that includes steps to be taken under a state of emergency - Transportation index shall be designated on each barrel. The choice of the appropriate warning sign to be attached to the barrel is determined by measuring equivalent radiation dose (Micro Sievert/hour) at 1 meter from the surface of the barrel, divided by 10, as well as measuring the equivalent radiation dose on the surface of the barrel directly. - Boats used to transport substances or contaminated equipment from offshore platforms, shall use standard marked containers. Contaminated substances that cannot be stored in standard containers shall be protected in a controlled manner to ensure no leak or spill of radioactive substances during transport. - Vessel shall be provided with radioactive warning signs, transportation, guide and other specific stickers for transport, including the following: a. Description of natural radioactive substances (contaminated equipment, and solid scaly residues, mud, waste, and others). b. Size/quantity of transported radioactive substances. c. Transport method. d. Destination. e. Facility where the radioactive waste was collected.

7.3.3.3 *Drilling Mud/ Fluids and Drilling cuttings:*

Drilling mud/fluids are substances that are used to control temperature and pressure in drilled boreholes, to cool and lubricate the drill bit and to remove drill cuttings from boreholes. Drill cuttings are small fragments of subsurface rock of varying size and texture which break and become integrated in drilling fluids/mud during drilling operations. Drilling fluids/mud could be oil-based mud/fluids (OBMs), synthetic-based mud/fluid (SBMs), or water-based mud/fluids (WBMs). Of the three types of drilling fluids/mud, WBMs are likely to cause limited environmental damage than other types of drilling fluids/mud while OBMs are more toxic than the others. It is therefore advisable that WBMs are used for offshore E&P operations to minimize damage to the environment.

An environmental permit should be acquired before the use and discharge of drilling fluids/mud. The application for an environmental permit must include the treatment and disposal programs for drilling fluid/mud and drill cuttings as well as detailed information and an approval letter for the mud system to be used.

There are three main options to manage offshore drilling wastes (Figure 7.4):

- offshore discharge – fluids and/or cuttings are discharged overbroad from the drilling platform after undergoing treatment by solids control equipment designed to remove solids and recover fluids,
- offshore downhole injection –cuttings are ground to fine particle sizes and disposed of, along with entrained fluids, by injection into permeable subsurface formations,
- Onshore disposal – cuttings and the associated fluids are collected and transported for treatment if necessary and final disposal.

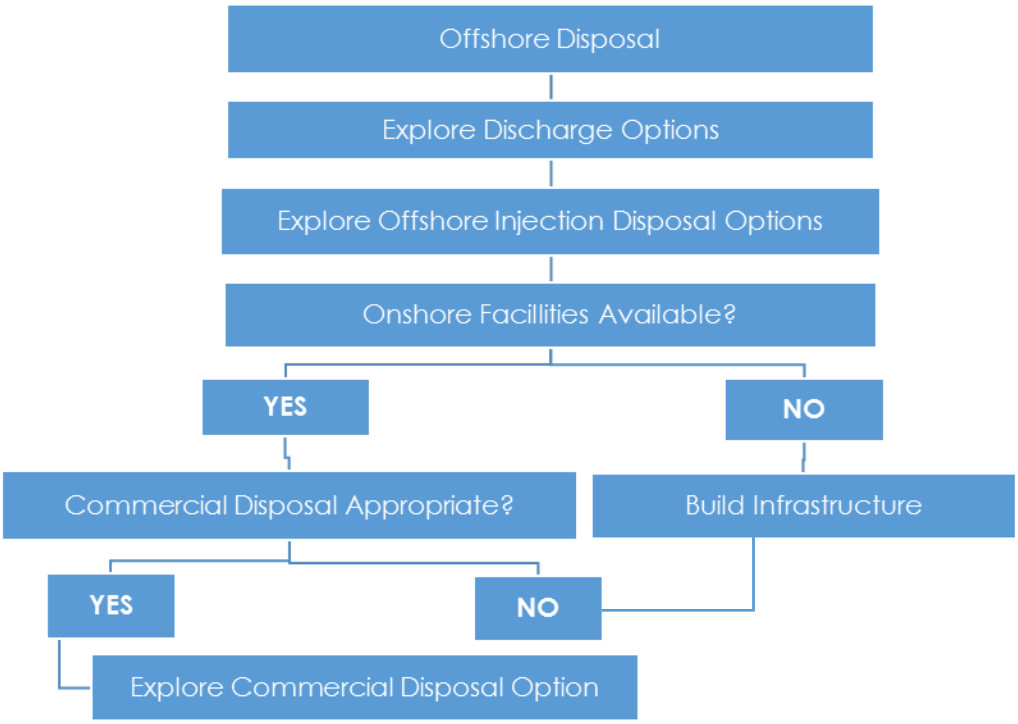


Figure 7.4 Drilling Waste Disposal Options

All options have advantages and disadvantages with regard to environmental impacts, safety, cost, and operational performance.

Drilling fluid are generally recycled on ship after treatment and reused for the drilling of several wells.

There are no standards in Montenegrin laws or conventions signed by Montenegro that relate directly to the quality and quantity of drilling fluids to be used and disposed. However Table 7.7 presents the limits and conditions set by international conventions for the disposal of drilling cuttings and fluids

Table 7.7 Discharge Practices and Standards for Offshore Operations

Legal basis	Discharge in Sea			
	WBF & Cuttings	**SBF Cuttings**	**Oily Cuttings**	**Produced Water (Oil in Water Limit)**
OSPAR Convention	Discharge allowed under PARCOM	10 g/kg	10 g/kg	30 mg/l
Baltic Sea Convention and HELCOM standards	Discharge allowed based on HELCOM Recommendation No. 95/1	Not determined	HELCOM Recommendation No. 95/1	15 mg/l max; 40 mg/l if BAT cannot achieve 15 mg/l
Barcelona Convention (Offshore Protocol)	**Discharge allowed under Barcelona Protocol**	**Not determined**	**100 g/kg**	**40 mg/l 100 mg/l max**
IFC ESH Guidelines for Offshore Oil and Gas Development	Fluids: In compliance with 96 hr. LC-50 of SPP-3% vol. toxicity test first for drilling fluids or alternatively testing based on standard toxicity assessment species. Cuttings: Hg – 1 mg/kg & Cd - 3 mg/kg of dry weight in stock barite. Chloride: less than four time's ambient concentration of receiving water. * Discharge via a caisson at least 15 m below sea surface	NADF cuttings: Oil 1% by weight on dry cuttings. Hg – max 1 mg/kg dry weight in stock barite, Cd - max 3 mg/kg dry weight in stock barite * Discharge via a caisson at least 15 m below sea surface		One day discharge 42 mg/l; 30 day average 29 mg/l

According to OSPAR convention, the discharge of spent oil based drilling mud/fluids and whole fluids/mud into offshore waters is prohibited. However, the discharge of whole drilling mud/fluids, spent drilling mud/fluids, OBMs or SBMs and drill cuttings is permitted in offshore areas with a minimum of 12 nautical miles away from the shoreline and of depth not less than 200 feet provided the specified effluent limitations are satisfied. The discharge of cuttings contaminated with WBMs into offshore waters without treatment is permitted provided the discharge does not contain free oil as determined by a visual sheen on the receiving water surface. No discharge must be made into vulnerable areas (such as sea turtles path) or close to the shore. The discharge of cuttings contaminated with oil from low toxic mineral OBM system into offshore waters is also prohibited unless treated to residual oil content less than 10 g/kg, that is, one per cent of oil-on-cuttings. In addition, the discharge of cuttings contaminated with oil from synthetic/pseudo oil based mud systems into offshore waters is prohibited unless treated to a residual oil content of less than 10 g/kg, that is, one per cent of oil-on-cuttings. Cuttings contaminated with esters may be discharged in offshore waters only when the residual oil content is less than 10 g/kg, that is, one per cent of ester-on-cuttings. Measures such as screening and assessment in compliance with best available technique or best environmental practice should also be adopted for the management of cuttings piles in offshore waters. There is also a mandatory monitoring obligation for operators to sample and analyze mud systems and/ or base oil to determine whether they contain toxic and hazardous substances. Operators are also required to observe the volume, rate, method and frequency of the discharge of fluids/cuttings. A final well report containing the types, composition and quantity of mud/mud additives used, volume of drilling fluids discharged and the volume of drill cuttings produced and discharged must be recorded and very well documented.

According to the Offshore Protocol of Barcelona Convention, water-based drilling fluids and drill cuttings are subject to the following requirements: (a) the use and disposal of such drilling fluids shall be subject to the Chemical Use Plan and the provisions of this Protocol regarding harmful and noxious substances and (b) drill cuttings shall either be disposed of on land or into the sea in an appropriate site or area as specified by the competent authority.

Oil-based drilling fluids and drill cuttings are subject to the following requirements: (a) such fluids shall only be used if they are of a sufficiently low toxicity and only after the operator has been issued a permit by the competent authority when it has verified such low toxicity; (b) disposal into the sea of such drilling fluids is prohibited; (c) disposal of drill cuttings into the sea is permitted only on the condition that efficient solids control equipment is installed and properly operated, the discharge point is well below the surface of the water, and the oil content is less than 100 g/kg of dry cuttings; (d) disposal of such drill cuttings in Specially Protected Areas is prohibited; and (e) in case of production and development drilling, a programme of seabed sampling and analysis relating to the zone of contamination must be undertaken. The use of diesel-based drilling fluids is prohibited. Diesel oil may exceptionally be added to drilling fluids in such circumstances as the Parties may specify.

Given that disposal options at sea may have significant impacts on the marine environment and public health, it was decided by the authorities that discharges at sea from drilling activities including drilling cuttings, drilling fluids and produced water are not allowed. Operators will have to discharge these waste and wastewater streams at available facilities outside Montenegro.

Table 7.8 Options of Drilling Cuttings Management

Waste Type	Options for management	Facilities	Advantages	Disadvantages	Cost	Recommendation
Drilling cuttings	1-Treatment on ship and disposal to water	Treatment facility on ship	1- Less transportation vessels for waste export 2- Less traffic next to the drilling rig	Impacts on benthic communities	Cost-Effective	Disposal shall be at suitable area far from sensitive and important habitats, and according to provisions of Offshore Protocol of Barcelona Convention.
	2-Slurry injected into suitable formations	1-Decontaminated 2-Re-injected	1- Less transportation vessels for waste export 2- Less traffic next to the drilling rig	1-Harms sea bed 2- Injected slurries might migrate through natural fractures or poorly cemented sections of the well then back to seabed.	Cost-Effective	Requires proper selection of injection site.
	Transport to land and treatment	Treatment facility on land	1-Avoid slurrification 2-Minimize lifting operations 3- Minimize impacts on benthic communities	Transportation to land. A treatment plant must be available	High Cost	

7.3.4 Operator Waste Management Plan

The operator must prepare a waste management plan that shall be approved by competent authorities prior to work initiation. The plan should discuss waste reduction, sorting, recovery, recycling and possibly energy recovery. This should be incorporated into the company's HSE policy and it should be filled separate for each waste producing unit (platform/ship/rig) divided based on main activities. The WMP shall include the following:

1- Framework Conditions:
   - Which area/ship/installation(s) the plan applies for
   - Chosen concept for sorting and interim storage of waste (waste categories and sorting station locations), routines for collection and handling of on board waste, routines for shipment to shore
   - Local waste plan audit schedule
   - What has been done to reduce waste destined for landfill and increase the degree of recovery

2- Responsibility
   - Who is responsible for waste management in different areas and locations
   - Who is authorized to purchase or make leasing agreements for equipment
   - Who is responsible for shipping waste to shore, including declaration forms and hazard labels
   - Who is the contact person between the offshore installation and shore

3- Actions:
   - Description of planned actions to achieve established objectives (e.g. waste reducing actions, new waste sorting categories, labelling, further training and information)
   - Use of packaging: The packaging shall not be filled to more than 90 % of the total capacity.

4- Documentation, objective adjustments, corrective actions:
   - The waste producing unit's documentation of implemented actions and achieved results (environmental accounts and waste target figures)
   - Result evaluation to determine whether implemented actions has had the desired effect, or if the objective needs adjustment. Consideration of new actions if the implemented actions have had unsatisfactory effect.

7.3.5 Waste Prevention Actions

Waste prevention is designed to prevent waste being generated at all. Waste prevention is not primarily a question of waste. It has to do with resources, and how better to utilize resources. The waste triangle (Figure 7.5) illustrates that by preventing waste from arising, costs are usually reduced. It also illustrated how low cost and increased environmental benefits are linked.

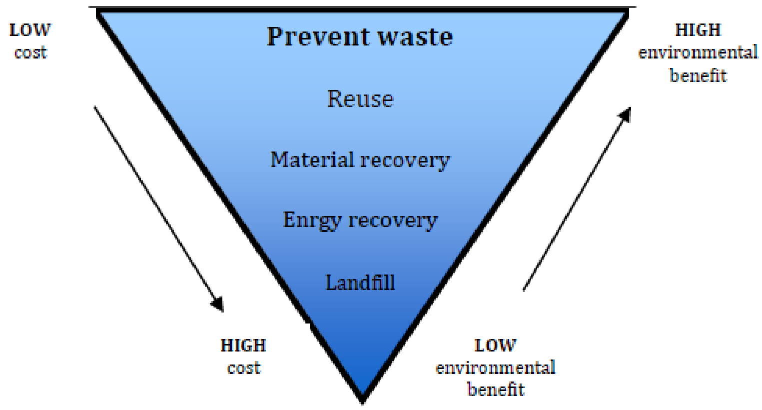


Figure 7.5. Waste Triangle

For improved environmental and economic results, waste reduction should be a focal point during purchase processes. Important considerations are as follows:

- Reduce the consumption of resource intensive products
- Choose products with a long lifetime
- Choose products that can be recovered
- Choose products made of recovered materials
- Choose products with minimal, but still adequate, packaging
- Reduce waste with hazardous substances by selecting alternative products that are less harmful for health and environment

Waste prevention involves being alert to waste that can be generated in the entire value chain. This is not only a question of reduced consumption but must include a change in the pattern of consumption. Improved utilization of resources calls for reduced waste amounts and increased recovery.

Examples include:

- Require the implementation of Best Available Technique/Best Environmental Practice
- Being conscious of waste reduction requirements and the establishment of waste reducing processes in the design or engineering phase (e.g. cuttings, drilling and well fluids)
- Change to chemicals with less environmental impact, evaluate amounts and degree of danger
- Preventive maintenance
- Start-up, shutdown and maintenance procedures that consider waste reduction
- Avoid degassing and drying out of solvents and paints
- Avoid corrosion which will lead to waste production

- Check for damage on received goods
- Proper emptying of packaging such as cans, barrels, bottles, sacks, etc.
- Proper labelling of packaging such as cans, barrels, bottles, sacks, etc.
- For supplier contracts, make contractual demands of return schemes
- For supplier contracts, make contractual demands of suitable reusable packaging
- Avoid small/single packaging, give preference to larger units
- Reduce the use of disposable items such as plastic cups, polyester cups, plastic utensils, cardboard boxes etc.
- Separate food left-overs (remove food waste from packaging. etc. after mess hall meals)

The following examples will reduce the amount of waste sent to final disposition / landfill:

- Reclamation of waste (by-product) to a process or product, e.g. reuse of drilling fluids or used oils to the production flow
- Evaluate pros (possibility of pumping) and cons (increased waste) for slurrification of drill cuttings. Maybe also evaluate new technology for transfer of cuttings from installations to ships to both avoid slurrification and minimize lifting operations
- Reinjection
- Evaluate well design for exploration, e.g. use of "slimhole" drilling to reduce the amount of cuttings and use of drilling fluids
- Make contractual demands of disposition of treated drilling waste
- Improved sorting/categorizing of waste that can be recovered to prevent landfilling and the environmental impact of it

Compacting and/or grinding waste will reduce transport needs and the number of lifting operations both offshore and onshore. Such volume reduction is also favorable regarding storage, handling and general logistics. Waste disposal costs are normally based on weight. Consider personnel safety offshore and onshore when compressing certain waste categories.

7.4 WASTEWATER MANAGEMENT OPTIONS

Routine discharges during different project phases typically include treated sewage and deck drainage. These are subject to MARPOL regulations. In addition, during wells production phase produced water will be generated.

7.4.1 Sewage

Sanitary waste will be treated using a marine sanitation device that produces an effluent with a minimum residual chlorine concentration of 1.0 mg/L and no visible floating solids or oil and grease. Wastewater treatment sludge shall be transported to shore for disposal at an approved facility. Gray water includes water from showers, sinks, laundries, and galleys, safety showers, and eye-wash stations. Gray water does not require treatment before discharge. Service vessels will be equipped with an approved marine sanitation device.

7.4.2 Deck Drainage

Deck drainage is water that reaches the deck of offshore installations through precipitation, sea spray, rainwater or from routine operations such as wash down and fire drills. It may be contaminated with oil and grease that lands on the deck of offshore installations. It is also known as platform drainage or machinery space drainage. Therefore, deck drainage must be collected and treated separately for oil removal by gravity separation or handled by the produced water treatment system before discharge.

In accordance with MARPOL 73/78, all countries that are party of the International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 must comply with the limit of discharge of the deck drainage wastewater. The effluent limitation of oil in water and oily mixtures for machinery space drainage (deck drainage) from offshore installations under MARPOL 73/78 is 15 ppm. Inspection by authorized inspectors should be made to ensure the compliance with the regulations of discharge.

The technologies required for ships generating oily waste water should preferably include the following treatment steps:

- Dewatering and settling tanks for gravity separation of oil;
- Remove free oil and break the oily water emulsions;
- Remove rest hydrocarbons and dissolved toxins;
- If necessary; further treatment to meet the international or modified local environmental discharge requirements.

7.4.3 Produced Water

Produced water is water brought to the surface during routine production operations or injected seawater which is used to increase the pressure in oil wells and maximize oil and gas recovery. It includes formation water, condensed water, brine, injection water and other technological wastes which usually consist of oil, natural hydrocarbons, inorganic salts and technological chemicals. The discharge of produced water accounts for the greater portion of wastes arising from offshore oil and gas exploration and production operations.

Many exploring countries such as Norway, Denmark, the United States of America and the UK require permits for the discharge of produced water, failure to do so can lead to revocation of the petroleum license of the operating company. Therefore, an effective control of the discharge of produced water during the various stages of oil and gas production as well as the transfer of this water to another field for treatment and subsequent re-injection into the reservoir is a must in any exploring country. There are also requirements for sampling, analysis and monitoring of the discharge of produced water. Sampling and analysis of the discharged produced water must be undertaken once a week and reported monthly to ensure compliance with the effluent limitation. Offshore oil and gas operators must also complete a chemical analysis of produced water and monitor the volume, rate, method and frequency of discharge of produced water. Although these requirements are commendable, they depend on the goodwill of offshore operators for compliance.

Possible options for the disposal of produced water include: 1) Discharge to sea and 2) Re-injection.

1. Discharge to sea

If produced water is to be discharged to sea, water shall be treated in a treatment plant on the drilling rig and shall meet the discharge standard set by the authorities. Under the offshore protocol of the Barcelona Convention (Table 7.7), oil content is not to exceed a monthly average of 40 mg/L, or 100 mg/L maximum at any time.

Upon discharge, produced water is diluted rapidly, typically by 30- to 100-fold within tens of meters (OGP, 2005). At distances of 500 to 1000 m from the discharge point, the dilution factor is 1000 to 100 000 or more.

2. Re-Injection of produced water

When the option of re-injection is chosen, confinement of the injected produced water within the target strata is central to the environmental acceptability of the disposal process. Water is injected into the oil-bearing layers or pressure supporting aquifers of the reservoir to provide pressure support and sweep oil out of the pore space and into the production wells. Since injection, either by matrix or fracture injection is more operationally complex than other disposal options; a range of circumstances can occur that will interrupt the injection process. Thus, contingency options should be available:

- Use of alternative, or stand-by injection wells
- Discharge to the sea, in compliance with relevant regulations
- Storage (tankage)
- Well shut-in

In any case, the development of sound contingency plans that meet regulatory requirements is necessary and should be done in parallel with the development of the primary injection plans.

The main concerns during the re-injection process are:

- Compatibility of the injected produced water and injection horizon formation fluids.
- Compatibility of the injected produced water with the lithology and confining zones.

- Heat capacity of injected produced water.

The concentration and particle size distribution of dispersed hydrocarbons and suspended solids are important characteristics that bear upon both water treatment and infectivity as well as the suspended substances such as major cations (NA+, K+, Ca ++, etc.), major anions (Cl-, Br-, etc.), fatty acids, dissolved gases, temperature, pH, total and oil-free suspended solids. This re-injected produced water should undergo specific treatment before it is injected into the confined layers of the exploited reservoir.

Given that both disposal options will have significant impacts on the marine environment and public health, it was decided by the authorities that discharges at sea from drilling activities including drilling cuttings, drilling fluids and produced water are not allowed. Operators will have to discharge these waste and wastewater streams at available facilities outside Montenegro.

Table 7.9 Options of Management of Produced Water

Waste Type	Options for management	Facilities	Advantages	Disadvantages	Cost	Recommendation
Produced Water	1- Treated & Evacuated	Treatment plant on the drilling rig	1-Less transportation vessels for waste export 2-Less traffic next to the drilling rig	Localized Environmental Impacts	Cost-Effective	Disposal away from habitats of sensitive species. Oil content is not to exceed a monthly average of 40 mg/L, or 100 mg/L maximum at any time according to Barcelona Convention.
	2- treated and Re-injected in the reservoir	Treatment on the drilling rig and injection	Pressure on pore space to extract oil	Risk of well shut-in in case of well failure		Recommended in case of low risk

7.5 EXPORT OPTIONS

Crude oil and gas from offshore platforms are evacuated by pipeline or alternatively, in the case of oil, by tanker. Pipeline transport is the most common means of evacuating hydrocarbons, particularly where large volumes are concerned.

Different structures for product transportation are elaborated in Section 3.2.2.4.

If the event of commercial findings of gas offshore Montenegro, export options include the interconnection with the Trans Adriatic Pipeline and the Ionian Adriatic Pipeline. Routes of these pipeline are described in the following sections.

7.5.1 Trans Adriatic Pipeline

The Trans Adriatic Pipeline (TAP) replacing the onshore pipeline project Nabucco is a proposed 870 km long natural gas pipeline that will run from Greece to Italy, via Albania and the Adriatic Sea. The route will link Europe to a new gas source in the Caspian (Shah Deniz II). TAP is owned jointly by BP (20%), SOCAR (20%), Statoil (20%), Fluxys (16%), Total (10%), E.ON (9%), and Axpo Trading (5%). EGL Group, now known as Axpo Trading, and Statoil Hydro established a joint venture (JV), which was followed by an agreement to develop, build and own the TAP project. Construction is expected to commence in 2015 and the pipeline is expected to come online by 2019. The pipeline is designed to carry 10 bcm of gas a year at the initial stage and will have the potential to increase the capacity to 20 bcm annually.

7.5.1.1 <u>Route and design</u>

The Trans Adriatic Pipeline will run for approximately 478 km in Greece, 204 km in Albania, 105 km offshore in the Adriatic Sea and five kilometers in Italy. The Italian section will run for 45 km offshore too. It will be connected to Trans Anatolian Pipeline (TANAP) near the Turkish-Greek border at Kipoi. A connection from the main pipeline of the production facilities in the Montenegrin offshore or land based facilities to the Trans Adriatic pipeline would be a viable export option.

7.5.1.2 <u>Constructing the natural gas pipeline</u>

The onshore pipeline will be constructed and assembled in a conventional way. First, a channel will be dug and then 12 m pipes will be joined to the pipeline string, which is placed lower in the channel. Specialized techniques will be used to cross the roads and rivers.

The offshore pipeline will be laid with the help of an S-type barge, a special vessel. The 12m long pipe will be joined to the pipeline string on the deck of the barge. The vessel will then move forward and the pipe string will be laid to its rear in to the water.

The proposed route contains landfalls in Italy and Albania. Specialized equipment will be used while pulling the pipe towards the shore in these areas, so that the environmental impact will be minimized.

7.5.2 Ionian Adriatic Pipeline

Trans-Adriatic Pipeline has already signed memorandums of understanding and cooperation with developers of the IAP project, including Plinacro (Croatia), BH-Gas (Bosnia and Herzegovina), Geoplin Plinovodi (Slovenia), as well as with the governments of Montenegro and Albania. Thus, TAP continues to work closely with the developers of the Ionian Adriatic Pipeline (IAP) on interconnection and alignment (Figure 7.6).

This pipeline begins in Fier/Albania, passes through Montenegro, Bosnia and Herzegovina to Split in Croatia. The length of pipeline would be 516 km (321 mi). The pipeline would be bi-directional and its capacity would be 5 billion cubic meters (180 billion cubic feet) of natural gas per year.

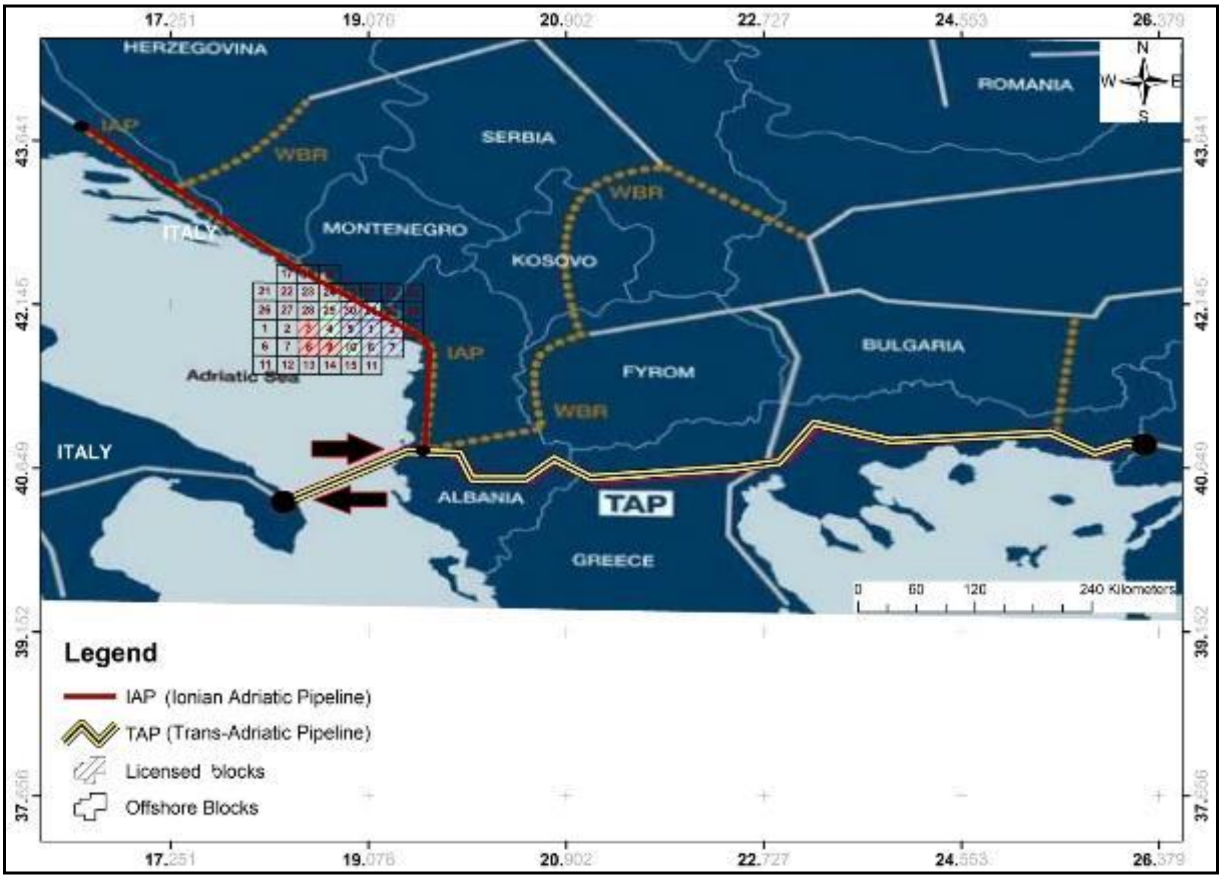


Figure 7.6. Planned Natural Gas Pipelines

The importance of the surrounding countries is crucial for every start up exploring country. The interconnection of pipelines and exporting oil tankers routes in the sea should always be a priority. Montenegro is already surrounded by such productive countries; this phenomenon is known as the energy community ring (Figure 7.7).

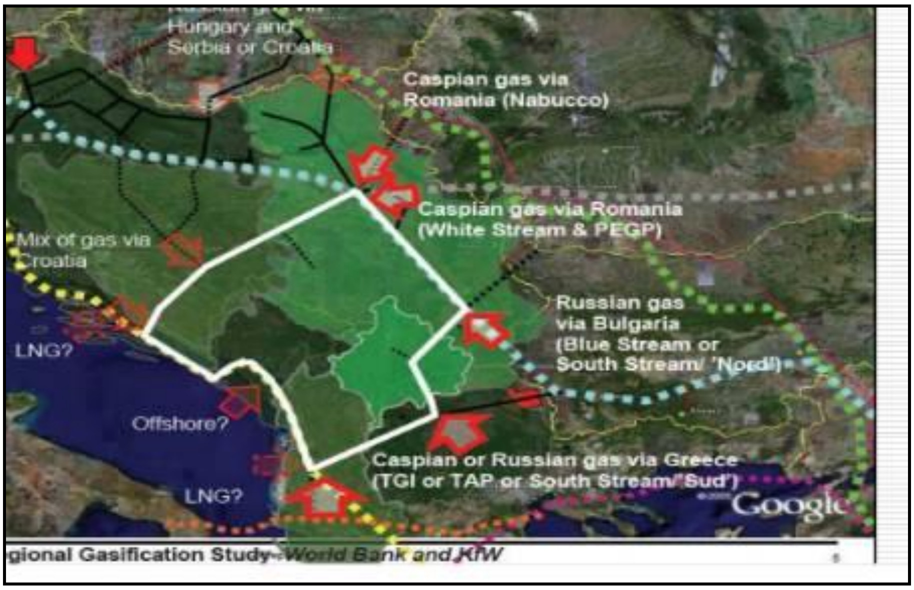


Figure 7.7. Energy Community Ring

7.6 SITE SELECTION FOR ONSHORE FACILITIES

During different Programme phases, there will be a need for on-shore support facilities. The Port of Bar is a good candidate to provide logistics support to the oil and gas operations. The total area of on-shore support facilities including fabrication yards and logistics bases could range from 5 ha (50,000 m^2) in early stages of exploration up to 100 ha (1,000,000 m^2) in the case of multiple platforms operating in the sea. The location of such facilities shall be in line with the spatial land use plans and the facilities shall be subject to EIA studies prior to their deployment.

Site selection of onshore facilities shall undergo careful planning location for onshore facilities at state or municipality levels, and shall consider maintaining a distance of not less than 500 m form the following areas:

- Protected areas, important bird areas and habitats of protected and important species;
- Water courses, such as rivers and lakes;
- Areas of archeological importance and tourist areas;
- Areas of significant landscape features; and
- Populated areas.

It shall be noted also, that regional cooperation can be sought in sharing on-shore facilities. This can be further investigated at next stages of the Programme.

8. SEA FRAMEWORK

The SEA consultants have developed an SEA framework of objectives, indicators and targets based on the inputs obtained from legal and policy analysis, baseline conditions and public consultation.

Table 8.1 summarizes the SEA framework objectives, targets and indicators. The likely trend of indicators with the Programme is also included.

The SEA framework has been used as the main tool to compare E&P Scenarios and to identify potential effects of the Programme on the environment.

Table 8.1 SEA Framework

Sustainability Factors	Objectives	Targets/ Sub-objectives	Indicator	Target	Likely trend without the Programme	Description
Ecosystem Protection (Air)	1. Protect Air Quality	Maintain or reduce concentration of criteria air contaminants in coastal cities	Indicator 1.1 (VA02): Emission of acidifying gases	*Do not increase*	*Increasing*	*Air quality needs to be maintained in all areas of the coastal zone, especially in areas which can be potentially exposed to a greater risk of air pollution* (Regulation on National list of Environmental Indicators, Official gazette of Montenegro No. 19/13)
			Indicator 1.2 (VA03): Emission of ozone precursors	*Do not increase*	*Stable*	
			Indicator 1.3 (VA04): Emission of primary suspended particles and precursors of secondary suspended particles	*Do not increase*	*Stable*	
Climate Change	2. Control GHG emissions	Control CO_2 emissions from E&P activities	Indicator 2.1: CO_2 emissions from E&P activities	*Do not increase*	*None*	*Carbon Dioxide Emissions from E&P (grams of CO_2 per TOE (tons of oil equivalent)* Carbon dioxide emissions per ton of oil equivalent produced represents the ratio of CO_2 emissions to produced hydrocarbons.(Regulation on National list of Environmental Indicators, Official gazette of Montenegro No. 19/13)
		Control CO_2 emissions from all sectors	Indicator 2.2 (KP04): Trends in greenhouse gas emissions	*Contribute to downward trend*	*Increasing*	
			Indicator 2.3: CO_2 emissions per GDP	*Do not increase*	*Increasing*	
Acoustic Environment	3. Maintain quality of acoustic environment	Avoid excessive noise levels in coastal cities	Indicator 3.1: Percent population exposed to high noise levels	*Do not increase*	*No data*	*Percent population exposed to noise levels above standard* *(National regulations on limit values of noise levels in environment and municipal by-laws on defining acoustic zones)* *E&P activities may generate induced activities on the coast that could in turn cause an increase in noise levels.*
Ecosystem Protection (Water)	4. Control induced pollution impacts in	Prevent eutrophication	Indicator 4.1 (M02): Trend and geographic distribution of concentration of chlorophyll in vertical water column	*Do not increase*	*No data**	A measure of eutrophication, which has an important impact on the health of aquatic resources and

Sustainability Factors	Objectives	Targets/ Sub-objectives	Indicator	Target	Likely trend without the Programme	Description
	coastal areas		Indicator 4.2 (M03): Nutrients / Concentration of nitrates and phosphates and their ratio	*Do not increase*	*No data**	ecosystems. High levels correspond to increased risks of eutrophication
			Indicator 4.3 (M04): Trophic index (TRIX index) current index is 4	*Maintain (4)*	*Stable**	Classification of the coastal area was done according to the trophic Index TRIX, which distinguishes four classes according to the degree of eutrophication: oligotrophic – good, mesotrophic - fair, eutrophic – poor and extreme eutrophic - very poor. (Regulation on National list of Environmental Indicators, Official gazette of Montenegro No. 19/13)
		Preserve transparency and color of the sea	Indicator 4.4 (M01): Quality of sea water for swimming (microbiological and physical chemical parameters)	*Maintain*	*No data**	*E&P activities have the potential to negatively affect transparency and color of the sea, which are important physical parameters to be conserved* (Regulation on National list of Environmental Indicators, Official gazette of Montenegro No. 19/13)
		Avoid oil and chemical spills	Indicator 4.5: Number of spills reaching the coast	*Do not increase*	*No data*	*Visual counts of spills reaching the coast Target: 0* *E&P activities have the potential to increase the frequency of spills in the sea.*
	5. Minimize introduction of invasive species	Presence of invasive species	Indicator 5.1 (B05): Trend of introduction of invasive species (currently 9 marine invasive species)	*Do not increase. (downward trend)*	*No data**	E&P activities carry the risk of introducing invasive species into Montenegrin waters with potential impacts on the marine ecosystem; such risks are associated with the arrival of vessels from other continents and waters as well as rigs; ballast water should be consistently emptied at origin as per MARPOL requirements (Regulation on National list of Environmental Indicators, Official

Sustainability Factors	Objectives	Targets/ Sub-objectives	Indicator	Target	Likely trend without the Programme	Description
						gazette of Montenegro No. 19/13)
Biodiversity and habitat	6. Protect habitat areas of protected, rare or endangered phytobenthos and zoobenthos	Protection of *Posidonia Oceanica*	Indicator 6.1 Number of marine protected areas (currently 0)	*Increase*	*Increase(3 sites are proposed and being evaluated)*	m ^{2} of *Posidonia Oceanica* preserved habitat The area of preserved habitat is an indicator of the conservation status of the protected species. Reproduction of most fish species occur in this habitat (Regulation on National list of Environmental Indicators, Official gazette of Montenegro No. 19/13) m ^{2} of *critical habitats* protected Habitats of endangered species should be protected as a means to preserve these species.
		Protect and preserve marine species Protect and preserve endangered species	*Indicator 6.2 (B01): Species Diversity*	Do not decrease	No data **	
	7. Protect sensitive coastal habitats	Avoid disturbance to areas of special significance	Indicator 7.1 (*B07): Change in number and area of protected areas and their floor area*	Do not decrease	Stable*	M^2 of areas of special significance under protection status. Target of the National Biodiversity Strategy is extending the protected nature areas to 10% of the terrestrial territory and to protect 10% of the marine area. This has not been achieved so far.
	8. Protect Sea mammals, sea turtles and seabirds	Avoid increase in the number of threatened sea mammal, turtles and bird species in the country	Indicator 8 1: Number of threatened marine mammal species	Do not increase	*No data*	Percent of mammals threatened The percent of mammals threatened gives an estimate of a country's success at preserving its biodiversity. Preserve the population of threatened species.
			Indicator 8. 2: Number of injured/killed sea mammals and turtles	Do not increase	*No data*	
			Indicator 8. 3: Number of injured/killed seabirds	Do not increase	*No data*	
		Promote regional cooperation in the protection of	Indicator 8.4: Extent of joint cooperation programmes and projects in the Adriatic Sea	*Increase*	*Increasing*	*Number of regional experts supporting monitoring activities in*

Sustainability Factors	Objectives	Targets/ Sub-objectives	Indicator	Target	Likely trend without the Programme	Description
		sea mammals and sea turtles				*Montenegro* *Expertise in the monitoring of sea mammals and turtles is limited in the Adriatic Sea region. Regional cooperation should be promoted to ensure resources are available when needed.*
Fisheries	9. Preserve fisheries	Limit disturbance of reproduction of fish species	Indicator 9.1 (*R01): Biomass state and level of exploitation of fish fund*	Maintain	Decreasing	Annual fish biomass (tons) E&P activities may impact fish catch in important reproduction zones (mostly in the field of *posidonia)* (mostly 0-30 meters). (Regulation on National list of Environmental Indicators, Official gazette of Montenegro No. 19/13)
			Indicator 9.2 (R02) Aquaculture production	Maintain	Decreasing	
Intermodal environmental parameters (Reducing Waste & Consumption Pressures)	10. Develop sustainable measures to manage wastes	Control the generation of hazardous waste	Indicator 10.1 (*O03):* Generation of hazardous waste	*do not increase*	*Decreasing*	Most countries in the world are confronting real difficulties in safely disposing of their hazardous wastes. The more hazardous waste generated, the less likely that a long-term sustainable solution can be found for their proper disposal. In Montenegro, there is no infrastructure for the disposal of hazardous waste, technically and technologically equipped in accordance with European standards. Valid records of the amounts of hazardous waste do not exist in Montenegro at this point. E&P activities will present a new source of hazardous wastes in Montenegro. Sustainable measures for the management of these wastes must be identified before they are generated. Where possible generation of such wastes should be
			Indicator 10.2 *Metric tons of hazardous waste generated by the E&P activities properly managed*	*100%*	*None*	

Sustainability Factors	Objectives	Targets/ Sub-objectives	Indicator	Target	Likely trend without the Programme	Description
						avoided.
Intermodal environmental parameters (Exposure to Natural Disasters)	11. Minimize risks associated with seismic activity (damage to assets and loss of hydrocarbons)	Control population exposure and vulnerability to natural hazards	Indicator 11.1: Environmental Hazard Exposure Index	*Do not increase*	*No data*	*Population-weighted exposure to high levels of environmentally-related natural hazards.* Vulnerability to natural disasters is a function of the exposure to hazards (how often and how severe they are), the sensitivity to such hazards (how big the linkages are to social systems), and the resilience within a society to hazard impacts. This measure provides a useful proxy of the exposure term. E&P might increase population's vulnerability to natural hazards given increased linkages with the social systems.
Transboundary Environmental Pressures	12. Avoid Transboundary Environmental Impacts	Enhance preparedness and responsiveness to avoid transboundary impacts from spills	Indicator 12.1: Availability of spill contingency and response plans	*Availability at all work sites*	*No data*	*Number of plans operational / active fields* E&P activities may result in transboundary environmental impacts primarily because of increased likelihood of spills occurrence. Spill contingency and response plans should be available and operational before any operator initiate works in offshore Montenegro
			Indicator 12.2: Number of incidents of transboundary impacts	*Do not Increase*	*No data*	
Environmental Governance	13. Promote national capacity in managing impacts from E&P activities	Promote effective environmental governance at the national and local level	Indicator 13.1: Environmental officers per active oil and gas fields available and trained to inspect offshore operations	*3 trained staff per active field*	*None*	E&P activities involve may cause various risks to the environment if not properly designed, implemented and inspected; national and local capacity must be develop to enable an effective monitoring and supervision of E&P activities.
Heritage	14. Protect cultural and archaeological	Avoid damage of coastal and offshore heritage	Indicator 14.1: Number of incidents/ activities that could result in damage to cultural and	*Zero*	*No data*	*Number of sites preserved: 29 offshore sites*

Sustainability Factors	Objectives	Targets/ Sub-objectives	Indicator	Target	Likely trend without the Programme	Description
	heritage (S15)	sites	archaeological heritage sites			*There are reportedly 2 registered and categorized offshore archaeological sites; another 27 sites are unregistered; there are in total 357 registered archaeological and cultural monuments in Montenegro more than half of which are located in the coastal zone*
			Indicator 14.2: Allocated funds to preserve/ promote cultural and archaeological heritage sites	*Increase*	*Increasing*	
			Indicator 14.3: Number of discovered underwater archaeological sites and shipwrecks	*Increase*	*Increasing*	
Infrastructure	15. Promote sustainable infrastructure development	Enhance national infrastructure to gradually cope with E&P sector requirements	Indicator 15.1: Percent GDP expenditure on infrastructure works	*Increase*	*No data*	*Investment in infrastructure / GDP x 100* *Development of oil and gas sector will pose additional pressure on country's infrastructure. Infrastructure development must be undertaken in a staged and sustainable manner, taking into consideration opportunities for regional cooperation.*
	16. Preserve subsea infrastructure	Avoid damage of subsea infrastructure	Indicator 16.1: Number of accidents related to subsea infrastructure	*Zero*	*No data*	
Socio-economy	17. Promote sustainable economic development	Promote employment	Indicator 17.1: Employment rate	*Increase*	*Slightly Increasing*	Employment reduces poverty and subsequently reduces pressure on natural resources. *Based on 2011 statistics, unemployment is about 20% of active population and 10% in coastal region (about 50,000 persons unemployed, 6,500 in the coastal regions)*
		Promote education	Indicator 17.2: Population with university degree 3,073 graduates at Montenegro Higher Education Institutions in 2013	*Increase*	*increasing*	*Percent population with university degree (%) 2011 statistics indicate 17% of population has university degree and 28% have only up to elementary education.*
		Enhance living standards	Indicator 17.3: Purchasing power of local population	*Increase*	*No data*	
		Promote local content in labor force	Indicator 17.4: Percent local labor working for oil and gas companies or service companies	*Increase*	*Labor working in industrial*	*Local labor / total labor x 100 (%) Local population should be given priority over foreign population*

Sustainability Factors	Objectives	Targets/ Sub-objectives	Indicator	Target	Likely trend without the Programme	Description
					sector (incl. mining, gas and power) are decreasing	*for where local population can fill positions at either operating companies or service companies*
		Prioritize locals over regional labor force	Indicator 17.5: Ratio of local and regional nationalities working in the sector	*Increase*	*None*	*Local labor/regional labor x100 (%) Economic development may generate further inflow of regional population seeking work in Montenegro. Local population should be given priority.*
		Avoid increase in crime rate	Indicator 17.6: Crime rate increase	*Do not increase*	*Generally Decreasing (assault decreasing theft increasing)*	*Increase in Number of crimes per 1000 population compared to previous year Inflow of oil and gas foreign personnel is often associated with an increase in crime rates.*
		Promote economic diversification in non-oil sectors	Indicator 17.7: GDP contribution from non-oil sectors	*Do not decrease*	*Stable (100%)*	*GDP from non-oil sectors/total GDP x 100 (%)* *Non-oil sectors should be encouraged to avoid Dutch Disease or resource curse.*
Tourism	18. Maintain tourist sector as a prime income-generating sector in Montenegro	Protect tourism attraction and resources	Indicator 18.1 (T01): Tourist arrivals	*Do not decrease*	*increasing*	*E&P activities might undermine tourism attractiveness of Montenegro if assets are not maintained or image of the country as a tourism destination is negatively affected.* *Data available for the period 2000-2012 show an overall increase in tourist arrivals at an annual rate of 9% with the trend of steady increase. The share of domestic and foreign tourists in the total number was stable at around 13% and 87% respectively. The share of coastal towns as the*

Sustainability Factors	Objectives	Targets/ Sub-objectives	Indicator	Target	Likely trend without the Programme	Description
						dominant location for tourist arrivals amounted to 90.4% in the 2012, or 87-91% since 2000. (Regulation on National list of Environmental Indicators, Official gazette of Montenegro No. 19/13)
			Indicator 18.2 (T04): Number of tourists on cruise lines	*Do not decrease*	*increasing*	
		Diversify tourism offers	Indicator 18.3: Investment in alternative modes of tourism	*Increase*	*increasing*	*Millions of USD invested in sustainable tourism modes* *It is important to diversify tourism offers to cope with a changing environment.*
Health	19. Maintain good health status of population	Promote health infrastructure	Indicator 19.1: Number of health-related institutions (in the coastal area, 6 health care centers, 2 GH, 2 specialized hospitals)	*Increase*	*Stable*	*Number of health-care institutions* *Capacity of health-related institutions should be able to cope with potential increase in demand for health services*
		Prevent increase in STD cases	Indicator 19.2: Population with STDs	*Do not increase*	*Increasing*	*Percent population with STD : TBD* *Increase in foreign population might cause an increase in STD (sexually transmitted disease)*
		Promote transboundary cooperation in medical aid	Indicator 19.3: Countries with transboundary cooperation in medical aid	*Increase*	*No data*	*Number of transboundary agreements* *Not all neighboring countries have an agreement with Montenegro for transboundary cooperation.*
		Increase health control of influx people	Indicator 19.4: Influx people scrutinized with health control measures	*Increase*	*Increasing*	*Percent influx people scrutinized with health control measures*
		Increase capacity of health care industry workers	Indicator 19.5: Percent health care staff trained in new types of health conditions	*Increase*	*Stable*	*Percent health care staff capable to handle new health conditions* *Oil and gas industry might introduce*

Sustainability Factors	Objectives	Targets/ Sub-objectives	Indicator	Target	Likely trend without the Programme	Description
		to handle new types of health conditions related to oil and gas sector				*new types of health conditions such as psychological trauma from offshore working environment, offshore related accidents, etc. industry needs to be able to provide expertise to handle this new condition*
		Preserve people's health	- Indicator 19.6: population with cardiovascular system diseases, respiratory system diseases and cancers	*Do not increase*	*No data*	*Environmental pollution may increase the number of* population with cardiovascular system diseases, respiratory system diseases and cancers
Landscapes and visual amenity	20. Preserve landscapes	Prevent developments at the expense of scenic views	Indicator 20.1: landscape visual quality (land use aesthetic /scenic value and terrain/ luminosity)	*Maintain*	*Decreasing*	*Offshore developments might negatively affect the visual amenity of the coast.*
			Indicator 20.2: Acceptability of change in landscape by the public	*70%*	-	Acceptability of change in landscape by the public shall be investigated during public participation meetings.

* *Monitoring is at early stages* according to 2013 State of the Environment Report.

** There are no reliable data sources according to 2013 State of the Environment Report.

9. ANALYSIS OF E&P SCENARIOS AGAINST SEA FRAMEWORK

Several scenarios for Oil and Gas exploration and production based on the findings of seismic surveys, exploratory drilling and production, have been selected for comparison during the scoping stage of the SEA study. The following are the main scenarios considered in developing the SEA study as agreed during the scoping phase:

1. Scenario 0: "Do Nothing" scenario: this scenario considers Business As Usual (BAU) without E&P activities.
2. Scenario 1: Exploration activities will result in finding no commercial deposits: this is a minimalistic scenario whereby activities are limited to exploratory activities and there is no production and development phase (assessment of impacts from this scenario are presented is Section 10.3 'Impacts during Prospecting Phase' and Section 10.4 'Impacts during Exploration Phase'.
3. Scenario 2: Simultaneous commercial findings, this scenario considers multiple simultaneous findings and full production and development activities. This scenario, considers exporting the extracted hydrocarbons.

   In the event of gas findings, gas is typically exported via pipelines. This option considers the construction and operation of subsea pipelines, gas treatment plant and a junction point (tie in) to connect with export pipelines.

   In the event of oil findings, oil is typically exported via tankers in the sea since there are no existing or foreseen oil pipelines that will pass through Montenegro.

   The impacts from this scenario includes the impacts from previous scenario (i.e. exploration) in addition to the impacts presented in Section 10.5 'Impacts during Development and Production Phase' and Sections 10.6.2, 10.6.3, 10.6.4 and 10.6.6.
4. Scenario 3: Scenario 2 combined with hydrocarbon usage scenarios in Montenegro defined in accordance with the 2030 Energy Development Strategy.

   The key strategic commitments of the 2030 Energy Development Strategy to achieve its main priorities include (among others): "Proactive role of the policy of the State of Montenegro in the endeavors to provide access to the systems of natural gas through the international projects (Ionian-Adriatic gas pipeline and others), development of natural gas system (including the construction of regional gas pipelines and plants for utilization of natural gas)"

   This scenario considers the activities of scenario 2 in addition to hydrocarbon usage in Montenegro, which will entail construction of gas treatment plant and pipelines to transport the treated gas to end users.

   The impacts from this scenario include the impacts from previous scenario in addition to the impacts presented in Section 10.6.310.6.5.

Each scenario has been evaluated against the SEA framework to assess the overall environmental and social impacts and to provide a basis that will assist decision makers during the planning process. The analysis followed the criteria presented in Section 2.5.

The scenarios evaluation matrix is presented in Table 9.2.

The evaluation matrix shows that scenario 0 in general has better scores, compared to other scenarios, against indicators related to air quality, water quality, threatened marine mammals and aquaculture production; such indicators will be under pressure and expected to be negatively affected from the programme; while the other scenarios score better against indicators related to protected areas, archaeology and socioeconomics, and this is mainly attributed to the declaration of important marine areas as protected following the recommendations of the SEA which will in turn improve nature-based tourism, also to the marine archeological surveys that shall be undertaken prior to commencement with offshore E&P activities which will allow the preservation and protection of sites that were not discovered before, in addition to tourism enhancement as a result of the influx of foreigners who will be interested in exploring the beauty Montenegro and its tourist offers, and from the involvement of operators with tourism promotion as part of their social responsibility schemes; on the other hand tourism, and other environmental and socioeconomic components might be negatively affected in the event of major accidents, however the assessment considers normal operation conditions. Mitigation measures to reduce the probability and consequence of such accidents are presented in the impact assessment sections.

Scenario 2 and scenario 3 have the highest scores against most of the socioeconomic indicators, mainly due to the economic revenues of hydrocarbon production and usage in the event of commercial findings, and from the provision of direct and indirect job opportunities in addition to the demand of new education specialties related to O&G which is expected to have positive impacts on education.

Despite the positive environmental and socio-economic impact of Scenario 2 and scenario 3, several environmental objectives will be under pressure, thus the proposed environmental management framework (EMF) has to be enforced to reduce these impacts and maximize the benefits from the oil and gas exploration and production.

Table 9.1 summarizes the total number of positive effects, negative effects and neutral effects of each scenario against the indicators.

Table 9.1 Summary of Effects against the Indicators according to Effect Direction

Scenario	Number of Effects		
	Positive effects	Negative effects	Neutral Effects
Scenario 0	9	10	30
Scenario 1	20	28	3
Scenario 2	22	28	1
Scenario 3	22	29	0

Table 9.2 Analysis of Oil and Gas Exploration and Production Scenarios against the SEA Framework

Sustainability Factors	Indicator	Target	Likely Trend of Indicator without the Programme	Scenario 0	Scenario 1	Scenario 2	Scenario 3
Ecosystem Protection (Air)	Indicator 1.1 (VA02): Emission of acidifying gases	Do not increase	Increasing	-1	-2	-3	-4
	Indicator 1.2 (VA03): Emission of ozone precursors	Do not increase	Stable	0	-1	-2	-3
	Indicator 1.3 (VA04): Emission of primary suspended particles and precursors of secondary suspended particles	Do not increase	Stable	0	-1	-2	-3
Climate Change	Indicator 2.1: CO_2 emissions from E&P activities	Do not increase	None	0	-1	-2	-3
	Indicator 2.2 (KP04): Trends in greenhouse gas emissions	Contribute to downward trend	Increasing	-1	-2	-3	-4
	Indicator 2.3: CO_2 emissions per GDP	Do not increase	Increasing	-1	-2	-3	-4
Acoustic Environment	Indicator 3.1: Percent population exposed to high noise levels	Do not increase	No data	0	0	0	-1
Ecosystem Protection (Water)	Indicator 4.1 (M02): Trend and geographic distribution of concentration of chlorophyll in vertical water column	Do not increase	No data*	0	-1	-2	-2
	Indicator 4.2 (M03): Nutrients / Concentration of nitrates and phosphates and their ratio	Do not increase	No data*	0	-1	-2	-2
	Indicator 4.3 (M04): Trophic index (TRIX index) current index is 4	Maintain (4)	Stable*	0	-1	-2	-2
	Indicator 4.4 (M01): Quality of sea water for swimming (microbiological and physical chemical parameters)	Maintain	No data (monitoring is at early stages)	0	-1	-2	-2
	Indicator 4.5: Number of spills reaching the coast	Do not increase	No data	0	-1	-2	-2
	Indicator 5.1 (B05): Trend of introduction of invasive species (currently 9 marine invasive species)	Do not increase. (downward trend)	No data*	0	-1	-2	-2

Sustainability Factors	Indicator	Target	Likely Trend of Indicator without the Programme	Scenario 0	Scenario 1	Scenario 2	Scenario 3
Biodiversity and habitat	Indicator 6.1 Number of marine protected areas (currently 0)	Do not decrease	Stable*	0	+4	+4	+4
	Indicator 6.2 (B01): Species Diversity	Do not decrease	Decreasing	-1	-2	-3	-4
	Indicator 7.1 (B07): Change in number and area of protected areas and their floor area	Increase	Stable	0	+4	+4	+4
	Indicator 8 1: Number of threatened marine mammal species	Do not increase	No data	0	-1	-2	-2
	Indicator 8. 2: Number of killed/injured sea mammals and turtles	Do not increase	No data	0	-2	-3	-3
	Indicator 8. 3: Number of killed/injured seabirds	Do not increase	No data	0	-1	-2	-2
	Indicator 8.4: Extent of joint cooperation programmes and projects in the Adriatic Sea	Increase	No data	0	+2	+4	+4
Fisheries	Indicator 9.1 (R01): Biomass state and level of exploitation of fish fund	Maintain	Decreasing	-1	-2	-2	-2
	Indicator 9.2 (R02) Aquaculture production	Maintain	Decreasing	-1	-2	-3	-3
Intermodal environmental parameters (Reducing Waste & Consumption Pressures)	Indicator 10.1 (O03): Generation of hazardous waste	do not increase	Decreasing	+1	-1	-2	-2
	Indicator 10.2 Metric tons of hazardous waste generated by the E&P activities properly managed	Increase	No increase	-2	+1	+2	+3
Intermodal environmental parameters (Exposure to Natural Disasters)	Indicator 11.1: Environmental Hazard Exposure Index	Do not increase	No data	0	-1	-2	-2

Sustainability Factors	Indicator	Target	Likely Trend of Indicator without the Programme	Scenario 0	Scenario 1	Scenario 2	Scenario 3
Transboundary Environmental Pressures	Indicator 12.1: Availability of spill contingency and response plans	Availability at all work sites	No data	0	+3	+3	+3
	Indicator 21.2: Number of incidents of transboundary impacts	Do not Increase	No data	0	-1	-2	-2
Environmental Governance	Indicator 13.1: Environmental officers per active oil and gas fields available and trained to inspect offshore operations	3 trained staff per active field	None	0	0	+1	+1
Heritage	Indicator 14.1: Number of incidents/ activities that could result in damage to cultural and archaeological heritage sites	Zero	No data	0	-1	-2	-2
	Indicator 14.2: Allocated funds to preserve/ promote cultural and archaeological heritage sites	Increase	Increasing	0	+1	+3	+4
	Indicator 14.3: Number of discovered underwater archaeological sites and shipwrecks	Increase	Increasing	0	+4	+4	+4
Infrastructure	Indicator 15.1: Percent GDP expenditure on infrastructure works	Increase	No data	0	+1	+3	+4
	Indicator 16.1: Number of accidents related to subsea infrastructure	Zero	No data	0	-1	-2	-2
Socio-economy	Indicator 17.1: Employment rate	Increase	Slightly Increasing	+1	+2	+4	+5
	Indicator 17.2: Population with university degree	Increase	increasing	+1	+1	+2	+3
	Indicator 17.3: Purchasing power of local population	Increase	No data	0	+1	+4	+5
	Indicator 17.4: Percent local labor working for oil and gas companies or service companies	Increase	Labor working in industrial sector (incl. mining, gas and power) are decreasing	-1	+1	+3	+4
	Indicator 17.5: Ratio of local and regional nationalities working in the sector	Increase	None	0	+1	+2	+3

Sustainability Factors	Indicator	Target	Likely Trend of Indicator without the Programme	Scenario 0	Scenario 1	Scenario 2	Scenario 3
	Indicator 17.6: Crime rate increase	Do not increase	Generally Decreasing (assault decreasing theft increasing)	+1	-1	-3	-3
	Indicator 17.7: GDP contribution from non-oil sectors	Increase	0	0	+1	+4	+6
Tourism	Indicator 18.1 (T01): Tourist arrivals	Do not decrease	increasing	+2	+3	+4	+4
	Indicator 18.2 (T04): Number of tourists on cruise lines	Do not decrease	increasing	+2	+2	+3	+3
	Indicator 18.3: Investment in alternative modes of tourism	Increase	increasing	+1	+2	+3	+3
Health	Indicator 19.1: Number of health-related institutions (in the coastal area, 6 health care centers, 2 GH, 2 specialized hospitals)	Increase	Stable	0	0	+2	+2
	Indicator 19.2: Population with STD	Do not increase	Increasing	-1	-2	-3	-3
	Indicator 19.3: Countries with transboundary cooperation in medical aid	Increase	Increasing	+1	+2	+3	+3
	Indicator 19.4: Influx people scrutinized with health control measures	Increase	Increasing	+1	+2	+3	+3
	Indicator 19.5: Percent health care staff trained in new types of health conditions	Increase	Stable	0	+1	+2	+3
	- Indicator 19.6: population with cardiovascular system diseases, respiratory system diseases and cancers	Do not increase	No data	0	-1	-2	-3
20. Preserve landscapes	Indicator 20.1: landscape visual quality	Maintain	Decreasing	-2	-3	-4	-5
	Indicator 20.2: Acceptability of change in landscape by the public	70%		0	-2	-2	-2

* *Monitoring is at early stages* according to 2013 State of the Environment Report.
** There are no reliable data sources according to 2013 State of the Environment Report.

10. IMPACT ASSESSMENT AND MITIGATION

10.1 IMPACT IDENTIFICATION

Environmental impacts are any change to the environment, whether adverse or beneficial, wholly or partially resulting from a project's environmental aspects (ISO 14001:2004). The relation between aspects and impacts is one of cause and effect.

The environmental and socio-economic impact identification matrices (Table 10.1, Table 10.2, Table 10.3, Table 10.4 and Table 10.5) were prepared based on the possible Programme activities during prospecting phase, exploration and appraisal phase, development and production phase, hydrocarbon usage and decommissioning phase, and the environmental and socio-economic components selected for study.

Table 10.1 Impact Identification Matrix – Prospecting Phase

PROSPECTING PHASE																	
Component / Activity		Physical Environment			Biological Environment							Socio-Economy and Health					
		Air Quality and Noise	Seawater	Sea bed	Plankton	Nekton	Benthos	Seabirds	Sea Mammals	Sea Turtles	Terrestrial Ecology	Archaeological & Cultural Resources	Infrastructure	Tourism	Fisheries/ shipping	Health	Landscape and Visual Amenity
2D/3D seismic operations	Noise generating activities: airguns/ survey vessel movement	X	--	--	--	X	--	--	X	X	--	--	--	--	X	--	--
	Atmospheric emissions due to energy requirements (combustion) of survey vessels (engines/generators)	X	--	--	--	--	--	--	--	--	--	--	--	--	--	X	--
	Physical presence of survey vessels and towed equipment (including any exclusion zones and lights)/ formation of fouling organisms	--	--	X	--	--	--	X	X	--	--	--	--	--	X	--	X
	Routine vessel discharges and wastes	--	X	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Interaction of equipment on sea bed	--	--	X	--	--	X	--	--	--	--	X	X	--	--	--	--
Accidental events (e.g. loss of cable oil, diesel, equipment)		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X: Potential Impact *--: No impact*

Table 10.2 Impact Identification Matrix – Exploration and Appraisal Phase

EXPLORATION AND APPRAISAL PHASES																	
Component / **Activity**		**Physical Environment**			**Biological Environment**							**Socio-Economy and Health**					
		Air Quality and Noise	**Seawater**	**Sea bed**	**Plankton**	**Nekton**	**Benthos**	**Seabirds**	**Sea Mammals**	**Sea Turtles**	**Terrestrial Ecology**	**Archaeological & Cultural Resources**	**Infrastructure**	**Tourism**	**Fisheries/ shipping**	**Health**	**Landscape and Visual Amenity**
Installation of Drilling Rig		X	X	X	X	X	X	--	--	--	--	X	--	--	--	X	X
Drilling Rig Operation	Wells drilling	X	X	X	--	X	X	--	--	--	--	--	--	--	--	X	--
	Physical presence of the rig	--	--	--	--	X	X	X	X	X	--	--	--	--	X	--	X
	Discharge of drill cuttings	--	X	X	X	X	X	--	--	--	--	X	--	--	X	--	--
	Other effluent discharges	--	X	--	--	X	--	--	--	--	--	--	--	--	--	--	--
	Flaring and power generation (noise and air emissions)	X	--	--	--	--	--	--	--	--	--	--	--	--	--	X	--
Movement of Support Vessel		X	--	--	--	--	--	--	X	X	--	--	--	--	X	--	--
Helicopter Movement		X	--	--	--	--	--	X	--	--	--	--	--	--	--	X	--
On-shore Support Facilities		X	--	--	--	--	--	--	--	--	X	--	X	--	--	--	X
Accidental Events		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X: Potential Impact *--: No impact*

Table 10.3 Impact Identification Matrix – Development and Production Phase

DEVELOPMENT AND PRODUCTION PHASE																	
Component / Activity		Physical Environment			Biological Environment							Others					
		Air Quality	Seawater	Sea bed	Plankton	Nekton	Benthos	Seabirds	Sea Mammals	Sea Turtles	Terrestrial Ecology	Archaeological & Cultural Resources	Infrastructure	Tourism	Fisheries/ shipping	Health	Landscape and Visual Amenity
Platform Installation		X	X	X	X	X	X	--	--	--	--	X	--	--	--	X	X
Pipelines Installation				X			X				--	X	X				
Platform Operation	Presence of Structures	--	--	--	--	X	X	X	X	X	--	--	--	--	X	--	X
	Drilling Discharges	--	X	X	X	X	X	--	--	--	--	X	--	--	X	--	--
	Operational Discharges	--	X	--	--	X	--	--	--	--	--	--	--	--	--	--	--
	power generation (noise and air emissions)	X	--	--	--	--	--	--	--	--	--	--	--	--	--	X	--
Movement of Support Vessel		X	--	--	--	--	--	--	X	X	--	--	--	--	X	--	--
Helicopter Movement		X	--	--	--	--	--	X	--	--	--	--	--	--	--	X	--
On-shore Support Facilities		X	--	--	--	--	--	--	--	--	X	--	X	--	--	--	X
Accidental Events		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X: Potential Impact *--: No impact*

Table 10.4 Impact Identification Matrix – Hydrocarbon Usage

HYDROCARBON USAGE																			
Component Activity	**Physical Environment**					**Biological Environment**							**Others**						
	Air Quality	**Seawater**	**Sea bed**	**Soil and groundwater**	**Surface water**	**Plankton**	**Nekton**	**Benthos**	**Seabirds**	**Sea Mammals**	**Sea Turtles**	**Terrestrial Ecology**	**Archaeological & Cultural Resources**	**Infrastructure**	**Tourism**	**Fisheries/ shipping**	**Health**	**Landscape and Visual Amenity**	**Land Use**
Installation of Subsea Pipelines	--	X	X	--	--	--	--	X	--	--	--	--	X	X	--	X	--	--	--
Construction and Operation of Gas Treatment Plant	X	--	--	X	X	--	--	--	--	--	--	X	X	X	X	--	X	X	X
Construction and Operation of the Junction Point with export pipelines	X	--	--	X	X	--	--	--	--	--	--	X	X	X	X	--	X	X	X
Construction and Operation of Pipelines on land	X	--	--	X	X	--	--	--	--	--	--	X	X	X	--	--	X	--	X
Crude Oil Storage and Export	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X

X: Potential Impact *--: No impact*

Table 10.5 Impact Identification Matrix – Decommissioning Usage

DECOMMISSIONING PHASE																
Component / Activity	Physical Environment			Biological Environment							Others					
	Air Quality	Seawater	Sea bed	Plankton	Nekton	Benthos	Seabirds	Sea Mammals	Sea Turtles	Terrestrial Ecology	Archaeological & Cultural Resources	Infrastructure	Tourism	Fisheries/ shipping	Health	Landscape and Visual Amenity
Dismantling of rig and associated facilities	--	X	X	--	X	X	X	X	X	--	--	--	--	X	X	X
Vessels movement and transportation activities	--	--	--	--	--	--	X	X	X	--	--	X	--	X	--	--
Waste disposal	X	X	--	--	--	--	--	--	--	X	--	X	--	--	X	--

X: Potential Impact *--: No impact*

10.2 SIGNIFICANCE OF ENVIRONMENTAL IMPACTS

Programme-related impacts are characterized using the criteria described in Section 2.7.2.

Significance of impacts during prospecting phase, exploration and appraisal phase and development and production phase are presented in Table 10.6, Table 10.7 and Table 10.8 respectively.

Due to the uncertainty of hydrocarbon usage scenario or possible decommissioning activities at this stage, it was not possible to assess the significance of impacts. Impacts significance will depend on many factors that are not defined at this early stage of the Programme. Possible impacts from different hydrocarbon usage scenario and from decommissioning activities are described in Section 10.6 and section 10.7.

It shall be noted that impact significance rating considers normal operating conditions and not accidental events, since accidental events are very unlikely to occur and their consequence is most likely critical on almost every environmental components; yet possible accidental impacts from each phase of the Programme are described and mitigation measures are proposed in the next sections.

With regard to potential socio-economic impacts, the use of consequence and significance rating of impacts do not apply to them. Socio-economic impacts are qualitatively assessed in Section 10.8.

Possible transboundary impacts that may affect neighboring countries are discussed in Section 10.10.

Table 10.6 Rating of Environmental Impacts during Prospecting Phase

Impact	Environmental Effects Characteristics: Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Consequence rating	Likelihood of occurrence	Significance rating
Impacts on air quality	N	L	VL	ST	C	R	1	L	1L/ Low- Acceptable
Impacts on sea bed	N	L	VL	MT	R	R	1	L	1L/ Low- Acceptable
Impacts on seawater	N	L	VL	ST	S	R	1	L	1L/ Low- Acceptable
Impacts on Plankton and Nekton	N	L	VL	ST	R	R	1	L	1L/ Low- Acceptable
Impacts on Benthos	N	L	VL	MT	R	R	1	L	1L/ Low- Acceptable
Impacts on Seabirds	--	--	--	--	--	--	--	--	--
Impacts on Sea mammals	N	H	L	P	O	I	4	P	4P/ Medium- Acceptable (with EMS in place)
Impacts on Sea Turtles	N	H	L	P	O	I	4	P	4P/ Medium- Acceptable (with EMS in place)
Impacts on archaeological & cultural resources	N	H	VL	P	O	I	4	U	4U/ Medium- Acceptable (with EMS in place)
Impacts on subsea infrastructure	N	M	VL	P	O	R	2	U	2U/ Low- Acceptable
Impacts on fisheries and shipping	N	M	L	ST	C	R	3	L	2L/ Medium- Acceptable (with EMS in place)
Impacts on landscape and visual amenity	N	L	L	ST	C	R	1	L	1L/ Low- Acceptable

KEY

Direction:
B: Beneficial N: Negative
Magnitude:
L: Low M: Moderate H: High
Geographic Extent:
VL: Very Localized: Within the development area.
L: Localized: Within the coastal region.
N: National: Within Montenegro.
G: Global.

Duration:
ST: Short Term. MT: Medium Term. LT: Long Term.
P: Permanent – will not change back to original condition.
Frequency:
O: Occasionally, once per month or less.
S: Sporadic, once per week.
R: Regular, more than once per week intervals.
C: Continuous.
Reversibility:
R: Reversible. I: Irreversible.

Consequence Rating
1- Negligible 2- Minor 3- Moderate
4- Major 5- Critical B- Beneficial

Likelihood of occurrence
A: Almost Certain L: Likely
P: Possible U: Unlikely R: Remote

Significance rating
H: High M: Medium L: Low

Table 10.7 Rating of Environmental Impacts during Exploration and Appraisal Phase

Impact	Environmental Effects Characteristics: Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Consequence rating	Likelihood of occurrence	Significance rating
Impacts on air quality	N	M	L	ST	C	R	2	L	2L/ Medium- Acceptable (with EMS in place)
Impacts on sea bed	N	L	VL	MT	O	R	1	L	1L/ Low- Acceptable
Impacts on seawater	N	M	VL	ST	S	R	2	L	2L/ Medium- Acceptable (with EMS in place)
Impacts on Plankton and Nekton	N	M	VL	ST	R	R	2	L	2L/ Medium- Acceptable (with EMS in place)
Impacts on Benthos	N	M	VL	MT	R	R	2	L	2L/ Medium- Acceptable (with EMS in place)
Impacts on Seabirds	N	M	L	MT	O	I	3	P	3P/ Medium- Acceptable (with EMS in place)
Impacts on Sea mammals	N	M	L	P	O	I	3	P	3P/ Medium- Acceptable (with EMS in place)
Impacts on Sea Turtles	N	M	L	P	O	I	3	U	3U/ Medium- Acceptable (with EMS in place)
Impacts on archaeological & cultural resources	N	H	VL	P	O	I	4	U	4U/ Medium- Acceptable (with EMS in place)
Impacts on subsea infrastructure	N	M	VL	P	O	R	2	U	2U/ Low- Acceptable
Impacts on fisheries and shipping	N	M	L	ST	C	R	3	L	3L/ Medium- Acceptable (with EMS in place)
Impacts on landscape and visual amenity	N	M	L	MT	C	R	2	L	2L/ Medium- Acceptable (with EMS in place)

KEY
Direction:
B: Beneficial N: Negative
Magnitude:
L: Low M: Moderate H: High
Geographic Extent:
VL: Very Localized: Within the development area.
L: Localized: Within the coastal region.
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Duration:
ST: Short Term. MT: Medium Term. LT: Long Term.
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C: Continuous.
Reversibility:
R: Reversible. I: Irreversible.

Consequence Rating
1- Negligible 2- Minor 3- Moderate
4- Major 5- Critical B- Beneficial

Likelihood of occurrence
A: Almost Certain L: Likely
P: Possible U: Unlikely R: Remote

Significance rating
H: High M: Medium L: Low

Table 10.8 Rating of Environmental Impacts during Development and Production Phase

Impact	Environmental Effects Characteristics: Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Consequence rating	Likelihood of occurrence	Significance rating
Impacts on air quality	N	L	L	ST	C	R	1	L	1L/ Low- Acceptable
Impacts on sea bed	N	L	VL	MT	O	R	1	L	1L/ Low- Acceptable
Impacts on seawater	N	M	VL	ST	S	R	2	L	2L/ Medium- Acceptable (with EMS in place)
Impacts on Plankton and Nekton	N	M	VL	ST	R	R	2	L	2L/ Medium- Acceptable (with EMS in place)
Impacts on Benthos	N	M	VL	MT	R	R	2	L	2L/ Medium- Acceptable (with EMS in place)
Impacts on Seabirds	N	M	L	MT	C	I	3	P	3P/ Medium- Acceptable (with EMS in place)
Impacts on Sea mammals	N	M	L	LT	O	I	3	U	3U/ Medium- Acceptable (with EMS in place)
Impacts on Sea Turtles	N	M	L	LT	O	I	3	U	3U/ Medium- Acceptable (with EMS in place)
Impacts on archaeological & cultural resources	N	H	VL	P	O	I	4	U	4U/ Medium- Acceptable (with EMS in place)
Impacts on subsea infrastructure	N	M	VL	P	O	R	2	U	2U/ Low- Acceptable
Impacts on fisheries and shipping	N	M	L	MT	C	R	3	L	3L/ Medium- Acceptable (with EMS in place)
Impacts on landscape and visual amenity	N	M	L	LT	C	R	3	L	3L/ Medium- Acceptable (with EMS in place)

KEY
Direction:
B: Beneficial N: Negative
Magnitude:
L: Low M: Moderate H: High
Geographic Extent:
VL: Very Localized: Within the development area.
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Reversibility:
R: Reversible. I: Irreversible.

Consequence Rating
1- Negligible 2- Minor 3- Moderate
4- Major 5- Critical B- Beneficial

Likelihood of occurrence
A: Almost Certain L: Likely
P: Possible U: Unlikely R: Remote

Significance rating
H: High M: Medium L: Low

10.3 Impacts during Prospecting Phase

This section considers the environmental impacts that may arise from seismic survey activities. <u>It addresses those impacts identified as having the potential to be significant</u>.

10.3.1 Noise Generating Activities

10.3.1.1 <u>Potential Impacts</u>

Sound is readily transmitted underwater and there is potential for the noise produced by the oil and gas industry to cause detrimental effects to marine animals. The use of underwater sound is important for animals such as marine mammals (e.g. seals, whales and dolphins) in order to navigate, communicate and forage effectively. The introduction of additional noise into the marine environment could potentially (through masking effects) interfere with these animals' ability to determine the presence of predators, food and underwater land features and obstructions. It could therefore cause short-term behavioral changes and, in more extreme cases, cause auditory damage. In addition, underwater noise may also cause behavioral changes in other animals such as fish and cephalopods.

Natural sounds in the sea are produced by wind, waves, currents, rain, echo-location and communication noises generated by cetaceans and other natural sources such as tectonic activity.

In addition to the natural occurring sounds there are anthropogenic sounds generated by air traffic, shipping activity, and the oil and gas industry (including drilling, seismic activity, construction and decommissioning, production, and associated vessels).Table 10.9 shows various anthropogenic sources and received levels of sound in the marine environment.

Table 10.9 Sound Sources from Various Maritime Activities (adapted from Evans & Nice, 1996; Richardson et al, 1995)

Activity	Frequency range (kHz)	Average source level (dB re	Estimated received level at different ranges (km) by spherical spreading			
			0.1 km	1 km	10 km	100 km
High resolution geophysical survey; pingers, side-scan, fathometer	10 to 200	<230	190	169	144	69
Low resolution geophysical seismic survey; seismic air	0.008 to 0.2	248	210*	144*	118*	102**
			208	187	162	87
Production drilling	0.25	163	123	102	77	2
Jack-up drilling rig	0.005 to 1.2	85 to 127	45 to 87	24 to 66	<41	0
Semi-submersible rig	0.016 to 0.2	167 to 171	127 to 131	106 to 110	81 to 85	6 to 10
Drill ship	0.01 to 10	179 to 191	139 to 151	118 to 130	93 to 105	18 to 30
Large merchant vessel	0.005 to 0.9	160 to 190	120 to 150	99 to 129	74 to 104	<29
Military vessel	-	190 to 203	150 to 163	129 to 142	104 to 117	29 to 42
Super tanker	0.02 to 0.1	187 to 232	147 to 192	126 to 171	101 to 146	26 to 71

* *Actual measurements in St George's Channel, Irish Sea.*
** *Extrapolated figure as presented by Evans & Nice, 1996.*

In recent years there has been growing awareness of the potential for man-made underwater noise to impact marine animals, particularly marine mammals. Available information on the effects of noise on marine mammals indicates that cetaceans and seals can react differently to the introduction of additional noise into the marine environment. Their reactions are attributable to sound source level, propagation conditions and ambient noise, as well as to animal type, age, sex, habitat, individual variation, and previous habituation to noise (Richardson et al, 1995).

The complexity and uncertainties of marine mammal reactions to underwater noise, and the variability of the strength of noises in the marine environment, mean it is difficult to establish definite areas of influence around an anthropogenic sound source. However, several general zones of noise influence have been identified as follows:

- Zone of audibility: the furthest reaching zone, in which marine mammals can hear anthropogenic noises because they are louder than ambient noise. Although the animal can hear the noise, it is unlikely that the sound will have any deleterious effects at such large distances. The size of this zone can vary greatly as ambient noise fluctuates between the seasons and differs between locations.
- Zone of responsiveness – a more localized area around a sound source, in which animal behavioral responses to noise are observed. The size of the zone is a combination of the sound source level, propagation conditions and ambient noise, in addition to animal age, sex, habitat, individual variation, and previous habitation to noise. In this zone individuals and even entire populations may show almost no signs of disturbance because of habituation or toleration of the sound, or the fact that the noise may be outwith the hearing sensitivities of a particular animal. If noises produce a response then the effects can vary greatly between species and individuals. Marine mammals may become distracted, disturbed, annoyed, or even fearful of these noises which could cause potential physiological upset. Common marine mammal responses to noise are changes to dive behavior, respiration and surfacing rates; quantifiable indicators which can be used to measure animal stress (Richardson et al, 1995). Variation in responsiveness among different individuals, or for one individual at different times, may greatly affect the radius of responsiveness. In general, several physical and biological factors are known, or suspected, to affect the responsiveness, actual or apparent, of a given species of marine mammal to manmade noise. As a result, the maximum radius of responsiveness can vary widely among individuals, locations and over time. Thus the radius of responsiveness, even for a specific type of man-made sound and a particular species, is a variable, not a constant (Richardson et al, 1995).
- Zone of masking – an area in which faint noises produced by the animals are masked by anthropogenic noises of a similar frequency. Any increase in background noise, either man-made or naturally occurring, can interfere with an animal's ability to detect a sound signal, especially if the sound signal is weak relative to the total noise level (Richardson et al, 1995).

  In general, (man-made) pulsed noise has a smaller potential for masking than temporally continuous noise. Furthermore, masking depends on the amount of energy that the call and the (man-made) noise share in the so-called critical frequency bands, which are characteristic of the animal's auditory capacity (Gisiner, 1998).

- Zone of discomfort or hearing loss – an area in which there is a possibility of auditory injury to an animal from underwater sound. The extent of this zone is somewhat speculative because of the scarcity of any direct measurements on marine mammal hearing systems, particularly in the wild. However, it is proposed that continual exposure to significant sound levels, or brief exposure to extremely high noise levels, could create permanent or temporary hearing impairment in marine mammals. Seismic exploration produces noise pulses that are intermittent but considerably more intense than the continuous noise emitted by most industrial noise sources in the ocean. There are few direct 'cause-and-effect' studies into the potential for these pulses to damage the auditory systems of marine mammals per se. However, extensive information on the impacts of anthropogenic sound and zones of discomfort on marine mammals is available (e.g. Richardson et al, 1995; Gordon et al, 2004), including sound produced by seismic vessels. It is generally considered unlikely that marine mammals would remain for any length of time close to any noise source that causes discomfort.

It should be noted that marine mammals may react differently to stationary noise, sudden bursts of noise, and noises that appear to be coming towards them. Studies suggest that most cetaceans will alter their course or display avoidance reactions to a noise that appears to be moving directly towards them. Stationary noises, such as drilling and production noises, outwith an immediate zone of discomfort to the animal, seem to have a lesser effect in disturbing migration patterns and animal feeding, although data and observations are limited (Davis et al, 1990).

Cetaceans

Toothed whales rely on sound for echolocation, foraging and communication. Their auditory sensitivities range from 75 Hz to 150 kHz, with greatest sensitivities around 20 kHz. This means their hearing is most sensitive at frequencies of around 100 times higher than that of baleen whales, and outside the peak energy range (0 to 120 Hz) of seismic air guns. However, air gun arrays can occasionally produce significant sound at frequencies of 1 to 20 kHz, levels that can overlap the hearing range of many toothed whale species at short distances and mask their ability to communicate with each other, for example (Evans, 1998). Beaked whales may be particularly sensitive in this respect (Gordon et al, 2004).

Since the hearing of most toothed whales is largely outwith the sound frequencies of seismic surveys, reactions are rarely recorded. In fact, there have been observations of dolphins bow riding seismic survey vessels. There is concern raised that toothed whales may be affected by the temporal avoidance reaction of fish during seismic survey. If fish are forced to move away from their habitats over a period of a few days or more, it is likely that the toothed whales preying on them will move away too. Evidence of such predator-prey interactions is difficult to obtain and is an area in need of more research before any long-term consequences can be drawn.

There are no direct measurements of hearing sensitivity for baleen whales yet it is presumed that they hear over the approximate frequency range as the sounds they produce. It is therefore assumed that baleen whales have greatest hearing sensitivity ranges between 10

Hz to 10 kHz, with greatest sensitivities usually below 1 kHz (Evans, 1998). It is clear that this hearing range overlaps with the low frequency sounds produced by seismic surveys, which may mask long distance communication between whales over significant distances and prevent the detection of other faint sounds (Evans & Nice, 1996).

Reactions of baleen whales to seismic survey noise occur at received sound pressure levels in excess of 160 to 170 dB Sound pressure levels over 220 dB may cause permanent damage and, in some extreme cases, even death. Studies of bowhead whales and grey whales indicate that reactions vary from subtle changes in surfacing, breathing, and diving behavior to avoidance of the sound source and cessation of feeding and social interaction. Such behavioral responses are generally short lived and occur within 2.5 to 8 km from a seismic sound source (Evans & Nice, 1996). However, it must be stressed that the long-term implication of these noise sources, including cumulative and synergistic impacts, are unknown.

Pinnipeds

Although it is considered that Montenegro does not have living specimens of the critically endangered Mediterranean Monk Seal (*Monachus monachus*), it is assumed that individuals form Greek populations can go through the Strait of Otranto in search of caverns and caves suitable for giving birth.

There have been very few studies of the effects of air gun noise on seals, even though they are known to have good underwater hearing and their feeding grounds often overlap with seismic survey areas (Gordon et al, 2004).

Studied reactions of some seal species included initial fright responses once the air guns were switched on, generally followed by avoidance behavior, i.e. swimming rapidly away from the sound source.

In addition to any direct response reactions, it has recently been shown that moderate levels of underwater noise can induce temporary reduction of hearing sensitivity (temporary threshold shift or TTS) in some marine mammals (including pinnipeds), provided that the exposure duration is relatively long (Kastak et al, 2005). Although such individual exposure events are not likely to have dramatic long-term or fitness consequences (except for cases of extremely high exposure levels resulting in acoustic trauma), they may result in short-term impairment in the ability to communicate, navigate, forage and detect predators. Additionally, behavioral reactions to noise exposure such as startle responses or avoidance may interrupt ongoing behaviors as severe as mother-offspring separation (Kastak et al, 1999).

Turtles

The Mediterranean Sea is home to three species of sea turtles: green sea turtle (*Chelonia mydas*), leatherback sea turtle (*Dermochyls coriacea*) and loggerhead sea turtle (*Caretta caretta*). According to IUCN, loggerhead and green sea turtle are categorized as endangered species while leatherback is categorized as vulnerable.

Loggerhead and green sea turtle are protected by Montenegrin legislation (O.G. MNE, 76/2006).

A small scale behavioral test with a loggerhead turtle and a green turtle in Australia indicated that at seismic sound levels over 155 dB the turtles began to noticeably increase their swimming activity, and above 164 dB they began to show more erratic swimming patterns, possibly indicative of them being in an agitated state (McCauley *et al*, 2000).

Cephalopods

Cephalopods and particularly squids are extremely important components of the food chain for many higher order predators, and have an economic value in Montenegro.

It has been demonstrated that squid sense can respond to marine seismic disturbance through a startle response including the release of ink (McCauley, 2000). Cephalopods have statoreceptor organs that detect noise, and behavioral changes are recorded as a result of seismic activity. In cage trials, squid are recorded as being displaced in the water column by seismic activities – specifically moving closer to the surface (McCauley et al., 2000).

In tests with the squid species Sepioteuthis australis a noticeable increase in alarm response was observed once the air gun level exceeded 156 to 161 dB. No consistent avoidance responses were seen, but there was a general trend for the squid to increase their swimming speed on approach of the air gun, but then to slow down at the closest approach and for them to remain close to the water surface during air gun operations. Squid were the only animals observed during these tests to make use of the sound shadow measured near the water surface (an almost 12 dB difference was consistently observed between hydrophones at 3 and 0.5 m depth in trials. The common fish response to the air gun was the opposite, to go towards the bottom which would take them into the part of the water column with the highest sound levels of air gun (McCauley et al, 2000).

There have been a number of recent examples of correlations between the death of cephalopods (in particular the giant squid) and marine seismic surveys (e.g. Guerra et al., 2004; Andrè et al., 2011). Some of the specimens had lesions in various tissues and organs, but all presented pathologies within the statocysts. Because none of these lesions could be linked to previously known causes of death in the species, the presence of geophysical prospecting vessels in the area suggested for the first time that the deaths could be related to excessive sound exposure (Guerra et al., 2004). Andrè et al. (2011) document morphological and ultra-structural evidence of massive acoustic trauma leading to direct mortality in four cephalopod species subjected to low-frequency controlled-exposure experiments. Exposure resulted in permanent and substantial alterations of the sensory hair cells of the statocysts, the structures responsible for the animals' sense of balance and position.

Seabirds

Few studies have been undertaken to analyze the effects of underwater noise upon seabirds. Stemp (1985) studied the effects of seismic exploration on three seabird species. The conclusions were that seismic air gun sound emissions caused no fatalities and that the variations in bird abundances were less than the normal variation caused by weather and seasonal conditions. Seismic surveying is only likely to disturb birds rafting on the sea surface, within 5 m of the air gun. However, when the seismic vessel approaches groups of birds sitting on the sea surface they are likely fly or swim out of the way of the vessel and, as the air gun is towed behind the vessel, there will be a clear, bird free path in front of the air gun. The vessel bow wave and bird movement away from the boat means that they will be over 5 m away from the operative air gun. In addition, the physical presence of the vessel will itself create no greater disturbance to birds than that created by any other sea vessel in the area.

Fish

The effect of seismic surveys on fish is related to their life cycle stage. Fish eggs and larvae of many fish species drift in or close to the upper sea surface and thus, their spatial movements are determined by ocean and tidal currents. They are therefore potentially at risk to injury from seismic operations because they cannot actively avoid sound sources and their habitat within the upper water layers coincides with the depth at which air guns are towed during survey. Research indicates that larval fish and eggs can be killed within 2 m of a detonating air gun source (Coull *et al*, 1998).

Adult and juvenile fish are rarely affected by seismic operations because they are able to detect and physically avoid the seismic source. For a 248 dB airgun array the potentially lethal range would extend to 8 m from the sound source, although the risk of actual deaths at this sound level remains small (Turnpenny & Nedwell, 1994). The physical damage effects are most pronounced on fish with a swimbladder because the organ is unable to adapt quickly enough to the high intensity seismic pressure waves. If the received sound wave vibrations are too intense the bladder may be damaged or destroyed, the fish may become stunned and disorientated, or trauma can occur to fish hearing (McCauley, 1994).

Fish can detect seismic sound sources at large distances (up to 30 km) yet they seldom react to the sound before it is above a certain threshold. Alarm responses are expected 1 to 5 km from the seismic array, depending upon their threshold and the sound transmission loss (Nakken, 1992). To avoid the sound, adult fish swim away from the sound source. Review work by Turnpenny & Nedwell (1994) indicates that there are two different types of fish avoidance towards seismic sound; demersal fish will dive towards the bottom or into deeper waters and pelagic fish will swim horizontally away from the sound source. Demersal fish may also display a secondary horizontal movement in their diving reaction. In one study on fish avoidance and catch reduction, an array of four air guns operating at 239 dB in 185 m off the coast of Norway, catches of cod declined by 55 to 80% of initial levels within a 9 km radius of the survey area and the effect lasted for 24 h (Løkkeberg, 1991 in Turnpenny & Nedwell, 1994). In another study, an array of 18 air guns operating at 250 dB in 250 to 280 m in the Barents Sea caused a reduction in cod densities and catches of 50% within a 33 km radius and a 70% reduction in catch in the immediate survey zone (Engås *et al*, 1993 in Turnpenny & Nedwell, 1994). This catch reduction lasted for at least 5 days. The effects on the fish themselves appear to be short-lived, possibly only for the actual duration of the exposure, but where fish are displaced over long distances, re-invasion may rely on a diffusion-like process. This would inevitably take longer than the initial directed movement of fish out of the affected area (Turnpenny & Nedwell, 1994). However, such movement is expected to have insignificant effects on stock distribution when natural variability in abundance and distribution are taken into account.

Knowledge of sensitive fish spawning areas and periods could allow more effective planning of seismic activities.

10.3.1.2 Mitigation

Planned Control Measures

No planned control measures were identified.

Proposed Mitigation Measures

- Reducing the noise entering the marine environment is the main measure in minimizing the impacts of seismic survey operations. Therefore, all seismic operations should use the lowest practicable power levels throughout the survey and only discharge pressure waves into the marine environment when necessary and after a suitable '**soft' start** to allow time for marine mammals, turtles and fish to move away before the array reaches full power. The process should begin with the smallest source in an array and build up slowly over 20 to 40 minutes.
- **Visual monitoring** – Beginning at least 30 minutes before startup during daylight hours, visual observers (professional biologists) should monitor a safety (exclusion) zone of 500 meters radius around the survey vessel. Startup of the array cannot begin until the safety zone is clear of marine mammals and turtles for at least 20 minutes.
- **Shutdown of the array** – Visual monitoring of the sea surface should continue while the seismic array is operating during daylight hours, and the array should be shut down if a whale, monk seal, or sea turtle enters the safety zone during visual monitoring.
- **Night-Time operations** – monitoring of a safety zone for marine mammals and turtles is required during the daytime, then a similar procedure should be used at night, or surveys should be limited to daylight hours only.
- The timing and location of cetacean calving and migrations should be considered when planning a seismic survey, and if possible avoided. This will have to be assessed at a later stage during the environmental impact assessment (EIA) phase.
- As fish eggs and larvae are most at risk from the impacts of seismic activities, sensitive fish spawning areas should be avoided at known breeding times.

10.3.1.3 Conclusion

There is a risk of temporary or permanent auditory trauma to marine mammals within a range of a several hundred meters of a typical airgun array, particularly if they swim beneath the array.

The animals most likely to be affected by sound produced from the seismic survey are baleen whales, beaked whales and seals, as it is believed that most toothed whale species are less affected by the sound frequencies used in seismic operations.

The behavioral response shown by fish is to move away from the seismic survey sound sources temporarily. Research indicates that such movements are short lived and that the fish stocks will most likely return to the area after completion of the survey. Research also indicates that larval fish and eggs can be killed within 2 m of a detonating air gun source.

In conclusion, if the mitigation measures proposed here are adopted, the direct, short-term environmental impact of noise, from individual seismic surveys will be minimal.

10.3.2 Atmospheric Emissions

10.3.2.1 Potential Impacts

Exhaust emissions from ships include air pollutants, greenhouse gases and ozone-depleting substances that entail risks to human health and the environment. Ships are fast becoming the biggest source of air pollution in the EU. In 2000, European-flagged ships emitted almost 200 million tons of carbon dioxide (Entec, 2002). This is significantly more than emissions from EU aviation. Sulfur dioxide (SO_2) and nitrogen oxide (NO) are responsible for acid deposition, which can be harmful to the environment, as well as particulate matter harmful to health. NOx and volatile organic compound (VOC) emissions contribute to the formation of ground-level ozone harmful to health and to the environment. NOx emissions contribute to environmentally damaging eutrophication. Carbon dioxide (CO_2) emissions contribute to global warming and climate change.

The impacts of these potential emissions are generally mitigated circumstantially by the open and dispersive environment offshore. Shipping in general is built and operated to standards that preclude significant impacts to the health of their crews, whilst other environmental receptors (e.g. flora and fauna) tend to be sparsely distributed and/or transient in the local area.

At a national level, no data have been seen specifically for shipping emissions to the atmosphere in Montenegro. However, Transport accounted for 7.6% of the total country GHG emissions in 2003; road traffic accounts for almost 90% of energy consumption in the transport sector. Shipping is therefore a minor component of emissions nationally, and the seismic survey emissions contribution to GHG Emissions is most likely to be a very small proportion of this.

10.3.2.2 Mitigation

Planned Control Measures

None have been identified.

Proposed Mitigation Measures

Although Montenegro has not ratified MARPOL Annex VI, it is proposed that the limits and recommendations of the annex be implemented given their relevance to the Programme.

MARPOL Annex VI sets limits on sulfur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances.

Annex VI prohibits deliberate emissions of ozone depleting substances, which include halons and chlorofluorocarbons (CFCs). New installations containing ozone-depleting substances are prohibited on all ships. However, new installations containing hydro-chlorofluorocarbons (HCFCs) are permitted until 1 January 2020.

Annex VI also sets limits on emissions of nitrogen oxides (NOx) from diesel engines. A mandatory NOx Technical Code, which defines how this shall be done, was adopted by the Conference under the cover of Resolution 2.

The Annex also prohibits the incineration onboard ship of certain products, such as contaminated packaging materials and polychlorinated biphenyls (PCBs).

10.3.2.3 Conclusions

Atmospheric emissions will arise from seismic survey vessels involved in the exploration activity.

The resultant emissions will not have any significant localized impacts to health or the environment due to the dispersive nature of the offshore environment. They will contribute to issues such as global warming, acid rain and air pollution, but given their relative scale in relation to existing shipping levels and emissions nationally and at a European level, are considered not to be significant.

While emissions are likely to arise from implementing the seismic surveys, their acceptability overall needs to be considered in the context of the national energy policy, and national policy for the management of greenhouse gases and commitments to the EU and the Kyoto Protocol. Being a Non-Annex 1 Party of The United Nations Framework Convention on Climate Change, Montenegro is required to periodically prepare GHG inventories as a part of its National Report/ Communication to the UNFCCC and must report on the steps it is taking or envisage undertaking to implement the Convention.

10.3.3 Physical Presence

10.3.3.1 Potential Impacts

The coastline of Montenegro includes areas of significant landscape and seascape value, and any impact on lines of sight could be seen as detrimental. Generally however, seismic survey activities will be indistinguishable from other normal shipping and will also be of short duration.

The main interaction of seismic operations with the fishing industry and shipping will be the physical presence of the survey vessel and streamers. Both fishing and seismic vessels have limited maneuverability when towing their gear.

The physical presence of the seismic survey vessel and streamers is identified as having the potential to have a moderate impact and should be considered further.

Seismic Survey Vessels and Streamers

Acquisition of 2D seismic data requires the towing of a single streamer of between 3 to 12 km in length at around 5m depth. Surveys operate in a grid shape and therefore need turning area at the end of each line. 3D seismic surveys, however, tow a number of streamers in parallel and the length of streamers are shorter than for 2D seismic, around 3 km in length. In both cases whilst the survey is being undertaken, the survey vessel has limited capability for taking avoiding action in respect of other shipping, and other shipping will therefore need to keep clear of the survey vessel.

Fishing vessels will be unable to fish in the vicinity of a seismic survey and will therefore lose access to grounds in the survey area for the duration of the survey.

10.3.3.2 Mitigation

Planned Control Measures

- It is assumed that survey vessels would use appropriate signals in accordance with International Maritime Law (including communications via radio, lights, and flags) to warn other vessels of the exclusion zone.
- Operators shall identify and map subsea infrastructure and avoid operations in such areas.

Proposed Mitigation measures

- The oil and gas industry operators are required to check in advance with the Ministry of Transport and Maritime Affairs, the Maritime Safety Department and Fisheries Associations that the proposed survey will not be carried out in an area and at a time that would conflict with legitimate shipping and fishing operations, including both floating and stationary gear, with consequential disruption of both such activities, and the required licenses from the relevant authorities shall be obtained.
- In addition, in the case of a survey planned in an area of intensive fishing, discussions with Fisheries Associations shall be initiated as early as possible, and, in any case, at least 45 days before the planned date in order that the implications can be fully considered. A clear communication plan shall be developed and a fair compensation scheme in case of loss of equipment shall be proposed.
- Surface positioning of the survey vessel should be based on augmented global navigation satellite systems (GNSS), e.g. Differentially Corrected GPS (DGPS) or Clock and Orbit Corrected GPS (also referred to as SDGPS or Precise Point Positioning PPP) that typically yield sub-meter positioning accuracy. It is recommended that two fully independent surface positioning systems should be used and would be operated in line with the Guidelines for GNSS (Global Navigation Satellite System) Positioning in the Oil and Gas Industry, issued jointly by OGP (Oil & Gas Producers) and IMCA (International Marine Contractors Association). It describes good practice for the use of global satellite navigation systems (GNSS) in, among other, offshore survey and related activities for the oil and gas industry.

10.3.3.3 Conclusion

Redirection of fishing effort from one area to another nearby area for the duration of a seismic survey is unlikely to affect fishing revenue significantly and any effects to the fishery are considered to be limited. The number of 2D and 3D seismic surveys that may be undertaken and the duration of surveys will determine the significance of impacts from the physical presence. Usually surveys are of limited duration and thus the impacts are not expected to be significant.

10.3.4 Effluent Discharges

10.3.4.1 Potential Impacts

Effluent discharges from survey vessels will include treated sanitary waste, domestic waste, deck drainage, and bilge and ballast water. Impacts will be similar to those of effluent discharges from other ships in the region. For example, effluents may affect concentrations of suspended solids, nutrients, and chlorine, as well as generating biochemical oxygen demand (BOD). These discharges are expected to be diluted rapidly in the sea. Impacts would likely be undetectable beyond tens of meters from the source and are considered to be negligible.

10.3.4.2 Mitigation

Planned Control Measures

- Survey vessels shall comply with the requirements of MARPOL and the Offshore Protocol of Barcelona convention including provisions concerning sewage, food waste, oily waste, and garbage.
- An environmental auditor shall be present on board to ensure compliance with regulations and permit conditions as well as planning logistics corridors responsibly, including timing of trips generated.
- Ships must comply with the requirements of Ballast water management convention, and ballast water shall be discharged in accordance with the regulations of the convention.

Recommended Mitigation

No additional mitigation is recommended.

10.3.4.3 Conclusions

Effluent discharges from survey vessels will be similar to those from other vessels in the region and are expected to have negligible impacts on offshore water quality.

10.3.5 Sea Floor Disturbance

10.3.5.1 Potential Impacts

Some types of seismic surveys involve a small amount of sea floor disturbance. The extent of sea floor disturbance would be minimal, and in most cases impacts would be negligible. However, resources that could be significantly affected include benthic communities, telecommunication cables, and underwater archaeological resources.

There are 25 benthos species (plants and animals) in the study area that are protected according to local / international legislation, however, due to the small area and limited amount of sea floor disturbance during seismic surveys, the significance of the impact is considered to be negligible.

There are two submarine telecommunications cables passing in the Montenegrin waters. These features are susceptible to physical damage from sea floor-disturbing activities. However, operators routinely map and avoid these cables during detailed project planning, and it is assumed that impacts would be avoided.

Montenegro has many underwater archaeological sites that are still in situ and protected by the law, and there are many more that have not yet been explored or discovered. These features are susceptible to physical damage from sea floor-disturbing activities. Mitigation measures shall be provided and applied in order to avoid impacts on these resources.

10.3.5.2 Mitigation

Planned Control Measures

No planned control measures have been identified.

Recommended Mitigation

Locations of sensitive benthic communities and archaeological sites shall be identified and survey routes shall avoid them. A prior approval from related authorities on survey routes shall be obtained.

10.3.5.3 Conclusions

Ocean bottom cable surveys (if any), vertical cable surveys, and VSP surveys may disturb small areas of the sea floor. There is a slight possibility of impacts on benthic communities including deep-water corals, subsea infrastructure, shipwrecks, or other submerged archaeological resources if they are present at the survey location. However, due to the minimal amount of sea floor disturbance during these surveys, no significant impacts are expected.

10.3.6 Accidental Events

Oil may enter the marine environment during seismic operations as a result of accidental streamer rupture or collision with another vessel. The most likely scenario is that of spillages of several hundred liters of kerosene-like oil entering the environment from a streamer parting whilst deployed. However, seismic survey vessels may have numerous streamers deployed containing several thousand liters of oil in each and the potential for larger volume spills cannot be ruled out. Accidental collision with another vessel and complete loss fuel inventory and streamer reservoir would be a worst case scenario.

10.3.6.1 Potential Impacts of a Hydrocarbon Spill

A kerosene spill from streamer failure is the most likely source of a hydrocarbon spill. The quantities of oil spilled into the marine environment would be relatively low in all but a worst case scenario. Any seabirds on the water surface would be potentially at risk from any slicks that form, although the extent of such a slick would be expected to be limited. Marine mammals are considered to be less vulnerable to fouling than seabirds, as they would be expected to move away from any oil pollution. However, marine mammals are believed to be more at risk from inhaling volatile elements in the oil, although these would generally evaporate rapidly from the slick.

The relatively low volumes of oil involved in most streamer accidents and light nature of the oil in the streamers means that it would quickly evaporate and disperse. Complete loss of fuel inventory and streamer reservoir would result in an oil spill of more significant impact.

10.3.6.2 Mitigation

Planned control measures

- Under MARPOL, ships including seismic survey vessels are required to have in place a Shipboard Oil Pollution Emergency Plan (SOPEP). The SOPEP will contain the necessary reporting procedures and actions required to control discharge, and the steps necessary to initiate an external response for any spills.

Proposed mitigation measures

- Selection of a survey contractor with demonstrable planned preventative maintenance procedures will lead to fewer emissions and equipment failures. In addition, training of staff at all levels in environmental awareness will encourage best practice.
- A full risk assessment against accidental events should be performed as part of survey design. Procedural controls, stemming from industry-standard guidelines and best practice procedures, will limit the possibility of accidental events. Quality procedures, incorporating the tenet of continuous improvement, apply and should be considered at the contractor selection stage.

10.3.6.3 Conclusion

The risk of a major accident, such as a collision with another vessel, causing the loss of the streamer oil reservoir and/or diesel fuel from the vessel is considered to be very low. Historical data of such events suggest that small diesel spills of less than one tone and streamer oil spills of several hundred liters or less will represent the most likely oil spill scenario. Impacts from these spills are likely to be very minor.

10.4 IMPACTS DURING EXPLORATION PHASE

This section considers the environmental impacts that may arise from the exploration and appraisal drilling activities. It addresses those impacts identified as having the potential to be significant.

10.4.1 Noise Generation

The issue of seismic survey noise generation is covered in Section 10.3.1. In addition, there is concern over the potential impact of sounds produced by drilling activities on cetaceans and other marine animals that may occur in the exploration area.

10.4.1.1 Noise Associated with the Proposed Operations

Noise Generated during Drilling Operations

Sound levels originating from offshore installations are dependent on the platform type. Semi-submersible installations may generate more radiated sound than fixed installations when using thrusters to maintain position. Little information has been published on which sources and propagation processes are the most significant in generating sound from installations although sound generated during drilling operations by the drill bit itself or the drill string or riser does not appear to be a significant source. [NCE, 2007[1]].

Vessels used to support offshore operations are also a source with sound radiated from propellers/thrusters and internal machinery. The characteristics of the sound generated by shipping are governed by the ship size, mode of propulsion, operational characteristics, speed and other factors [NCE, 2007].

Table 10.9 in Section 10.3.1 compares noises produced by drilling activities with those from other maritime activities.

Individual drilling operations will only occur for a short time. During these drilling operations noise will be generated as the drill moves through the seabed strata, and from machinery vibrations and generator noise. On a semi-submersible rig the drilling machinery and generators are located on solid platforms above the water, where sound is lost as it transmits through the air and the rig flotation structure (Richardson *et al*, 1995).

<u>Noise Generated by Other Activities</u>

Noise will also be produced by supply and standby vessels serving drilling rigs. Noise from these sources originates from ship engines and gears, propellers, and thruster noise if the vessel is operating on DP. Ships moving to site will generally produce more noise than stationary vessels because of propeller cavitation noise. However, if a supply vessel is required to refuel a drilling rig, the boat will have to maintain its position alongside the rig by DP.

In addition, rigs will be visited several times a week for personnel transfers. Low-flying helicopters may increase localized underwater noise levels. From the perspective of an underwater receiver, the noise created by rotor blades and exhaust pipes moves slightly in front of the helicopter in a narrow path and within an arc of 13° from the vertical. The majority of sound will be reflected off the sea surface. Only animals immediately below the aircraft will therefore be affected.

10.4.1.2 Impacts of Noise from Exploration/Appraisal Drilling

The impact of noise generated during the drilling of exploration and appraisal wells depends on ambient noise levels; the strength of the sound source; the sound transmission conditions of the receiving environment, and; the proximity of animals to the noise in relation to their ability to detect such sound frequencies.

As mentioned in Section 10.3.1, sounds in the sea are produced by winds, waves and ocean currents, rain, echolocation and communication noises generated by cetaceans, and other natural sources such as tectonic activity. In addition, there are anthropogenic sounds generated by air traffic and shipping. Different combinations of these noises produce the highly variable ambient (background) noise levels in the Adriatic Sea.

Available information on the effects of noise on marine mammals indicates that cetaceans and pinnipeds can react differently to the introduction of additional noise into the marine

[1] NCE (2007) Review of Existing and Future Potential Treatments for Reducing Underwater Sound from Oil and Gas Industry Activities, Report 07-001, prepared for JIP on E&P Sound and Marine Life, pp185

environment. Their reactions are attributable to sound source level, propagation conditions and ambient noise, in addition to animal type, age, sex, habitat, individual variation, and previous habituation to noise (Richardson *et al,* 1995).

The majority of sounds produced during drilling operations are continuous and of low frequency.

The effects on most toothed whales and pinnipeds to such noises are considered to be minor as their sound sensitivity lies outside the main range of low frequency sounds (sounds below 200 Hz). However, the susceptibility of baleen whale and seal auditory systems to damage from industrial noise may be high, particularly for baleen whales, as it is presumed their hearing sensitivity is good at low frequencies (Davis *et al*, 1990). Continuous sound produced by industrial activities such as drilling may elicit behavioral avoidance in baleen whales at received sound levels of 110 to 130 dB re 1 μPa-m (Evans & Nice, 1996).

Most cetacean species recorded in the exploration area are the toothed whales species. Of the baleen whales, only Fin Whale has been recorded.

Close to the drilling site there is the possibility that low frequency drilling noises may mask marine animal calls if they are made within the same frequencies. In addition, Davis *et al* (1990) suggest that auditory damage would occur if a marine mammal were exposed to sounds greater than 120 dB for prolonged periods of time. To be exposed to such sound levels, the animal would have to be within 220 to 345 m of a semi-submersible drilling rig, or 840 to 2,900 m of a drill ship during drilling activities. It is considered unlikely that marine mammals would remain close to such a noise source for any length of time.

Given the nature and short duration of the noise source, the medium- to long-term risk of such effects currently appears to be comparatively low.

10.4.1.3 Mitigation

Planned Control Measures

No planned control measures have been identified.

Proposed Mitigation Measures

Depending on the type of facility and their moorings, it is known that certain drilling facilities generate more underwater noise than others, with drill ships and semi-submersibles operating on DP being the noisiest. The selection of drilling facility can, therefore, be used to reduce the amount of sound entering the marine environment. However, it is understood that the choice of drilling rig is generally dictated by other factors.

10.4.1.4 Conclusion

Low frequency noises from drilling wells, and all associated vessels, will add to the ambient noise in the exploration area.

As most toothed whales have hearing ranges at medium to high frequencies, they are considered to be relatively unharmed by industrial noise, with the possible exception of beaked whales. Although seals are capable of hearing the low frequency sounds generated by a drilling rig over large distances, they are generally believed not to be adversely affected by drilling rig sounds as their hearing is more sensitive to higher frequency ranges.

Baleen whales are considered to be potentially at risk at close range, since the frequencies used in their communication noises and assumed levels of hearing overlap with the sound spectra of industrial noises.

The impact of the noise generated is difficult to assess due to uncertainties in how noise affects specific marine mammals, and how far the noise will be transmitted in the sea. However, it is estimated that the underwater noise produced could elicit response from some individual marine mammals if they pass within 1 km of a drilling rig. It is not likely that such effects would have any significant impacts at the population level.

10.4.2 Physical Presence of the Drill and the Support Vessels

10.4.2.1 Potential Impacts

Interface with subsea benthic communities, archaeological sites and infrastructure

In order for exploration drilling to take place, a drilling rig is towed into position over the well site by towing vessels and anchored into position by the same vessels performing an anchor handling role. Depending on the type of the drilling rig used, sea floor sediments could be disturbed during installation and removal of drilling rigs. During the drilling operation itself supply vessels will serve the drilling rig and helicopters are expected to be used to carry personnel.

After a drilling rig is removed, anchor scars will likely remain on the bottom for months to years. The anchor scars will eventually disappear as sediments are redistributed by currents and benthic organisms. The main concern with regard to potential impacts is the placement of anchors in areas where protected benthic communities, coral communities and areas of special marine biodiversity importance exist.

There are two submarine telecommunications cables passing in the Montenegrin waters. These features are susceptible to physical damage. However, operators usually map and avoid these cables during detailed project planning, and it is assumed that impacts would be avoided.

Montenegro has many underwater archaeological sites that are still in situ and protected by the law, and there are many more that have not yet been explored or discovered. These features are susceptible to physical damage if not identified and avoided prior to initiation of activities.

Interface with fishing and shipping activities

Interference with other sea users (especially the fishing industry) due to physical presence of the rig, vessels, and subsea equipment, is expected as well. Due to the requirement for a support vessel to be on standby during drilling operations, a vessel will be present for the duration of drilling operations. Supply vessels and helicopters will ferry goods and personnel to and from the drilling rig, leading to a slight increase in vessel activity in the region. This would only take place over the drilling period.

It is proposed that for safety reasons a 500 m exclusion zone will surround the drilling rig whilst on site patrolled by a safety standby vessel, leading to the temporary loss of fishing access, and will require other vessels to avoid the area.

If the well is plugged and abandoned at the end of the drilling programme, the riser will be completely removed to below the sea bed and will therefore pose no threat to ship anchors or over-trawling by fishing vessels. However if the well is suspended, the 500 m exclusion zone will remain in force. The exclusion area is not likely to have any significant commercial impact on fisheries.

Visual impacts

The visibility of the rig from the shore depends on its proximity to the shore and on other factors such as sea and weather conditions. The government of Montenegro has set a minimum separation distance from the shore of 3 km. Yet, rigs installed at greater distances might be seen from the shore and from the coastal mountains especially in clear nights.

Migratory Birds

Birds may use offshore structures for resting, feeding, or as temporary shelter from inclement weather (Russell, 2005). However, evidence indicates that migrating birds can become disoriented when encountering a steady artificial light source at night, likely as a result of a disruption in their internal magnetic compass used for navigation. Birds can become "trapped" when a light source enters their zone of influence at night. This phenomenon can cause birds to circle the light source for hours, increasing the risk of collision with the lighted structure, decreasing fat reserves, and potentially interrupting migration (Weiss et al. 2012, Montevecchi 2006, Longcore and Rich 2004).

10.4.2.2 Mitigation Measures

Planned Control Measures

- It is assumed that the rig and support vessels would use appropriate signals in accordance with International Maritime Law (including communications via radio, lights, and flags) to warn other vessels of the exclusion zone.
- Operators shall map the subsea telecommunication cables to avoid physical damage.

Proposed Mitigation Measures

- A safety Buffer zone of 500 m around the drilling area shall be maintained. The buffer zone will be kept clear of all unauthorized vessels and monitored by radar and visual observation.
- Before conducting any sea floor disturbing activities, surveys shall be conducted to identify the locations of coral communities and protected benthic species. After identification of these locations, operators shall maintain a separation distance of at least 100 m from the location of all proposed sea floor disturbances (including those caused by anchors, anchor chains, and wire ropes).
- Before conducting any sea floor disturbing activities, work sites shall be surveyed by marine archaeologists to identify any underwater archaeological sites and

shipwrecks. Findings and recommendations shall be submitted to the Sector for Cultural Heritage of the Ministry of Culture to specify the required exclusion zone around the identified sites and a permit to conduct the proposed activities at each well site shall be acquired.

- At the time of submitting a well plan for approval, operators shall inform fishermen through the Fisheries Associations. In addition, in the case of a well planned in an area of intensive fishing, discussions with the Fisheries Associations must be initiated as early as possible, and preferably not less than 90 days before planned commencement of drilling.
- At the time of submitting a well plan for approval, operators shall coordinate with the Transport and Maritime Affairs and the Maritime Safety Department to avoid conflict with shipping and fishing operations.
- In the event of a well being suspended, over-trawlable protection should be put in place in areas most used for demersal fishing activities.

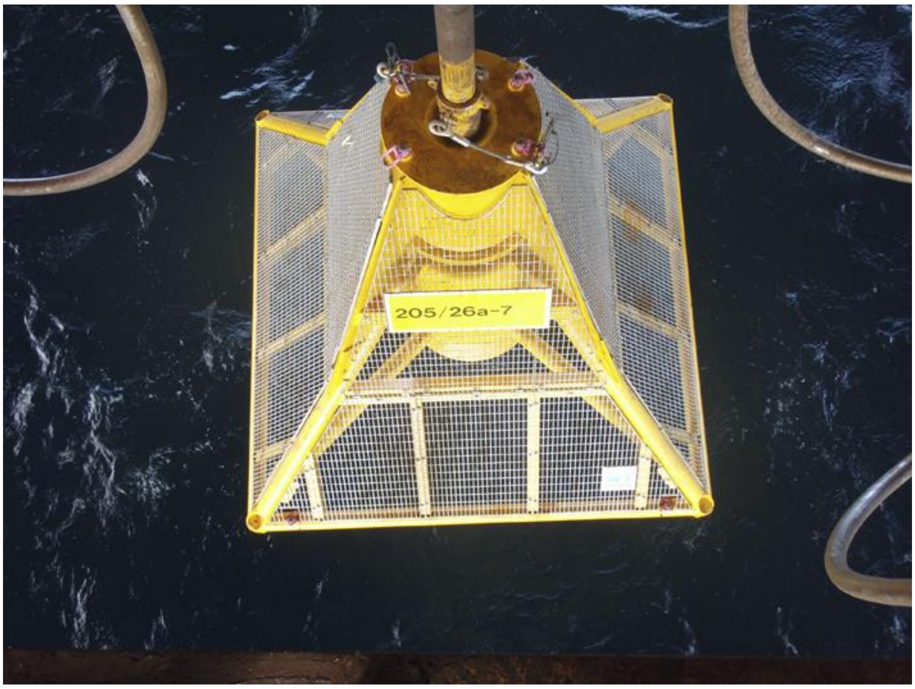

Figure 10.1 Over-trawlable Protection Structure

- Surface positioning of the rig and survey vessel should be based on augmented global navigation satellite systems (GNSS). It is recommended that two fully independent surface positioning systems should be used and would be operated in line with the Guidelines for GNSS (Global Navigation Satellite System) Positioning in the Oil and Gas Industry, issued jointly by OGP (Oil & Gas Producers) and IMCA (International Marine Contractors Association).
- To avoid the impacts on birds especially migratory birds, It is recommended to: 1) use fewer lights as much as practical; 2) use low intensity lights; 3) avoidance of the use of white lights (White lights are the least favorable choice for lighting structures) and 4) Use strobing lights instead of steady lights.

10.4.2.3 Conclusion

The duration of drilling is limited and therefore the impact of the physical presence of the drilling rig and possible suspended wells on fishing and shipping activities is not considered to be significant. The impacts on subsea infrastructure archeological sites and important benthic communities are not expected to be significant as long as these areas are identified prior to drilling and avoided.

10.4.3 Discharge of Drill Cuttings

10.4.3.1 Potential Impacts

During drilling of exploration and appraisal wells, drill cuttings and spent drilling muds require disposal. An introduction to the use and types of drilling muds is provided in 7.3.3.3. Cuttings and particulate material from WBM (water based muds) used to drill the top hole section(s) is always deposited at the sea bed close to the wellhead. A small quantity of the cement used to secure the first set of casings in the borehole is also deposited here.

Cuttings generated from subsequent sections of a well are contaminated with residual drilling muds and associated chemicals following cleaning on the drilling rig. As discussed in Section 7.3.3.3, discharges at sea from drilling activities including drilling cuttings and drilling fluids are not allowed. Operators will have to discharge these waste at available facilities outside Montenegro. Thus local impacts will be negligible and limited to those from the small amounts discharged from the top hole section. However, disposal abroad will require vessels movement to transport the cuttings to the final disposal locations during the exploratory drilling period.

10.4.3.2 Mitigation

Planned Control Measures

Discharges at sea from drilling activities including drilling cuttings and drilling fluids are not allowed. Operators will have to discharge these waste and wastewater streams at available facilities outside Montenegro.

Authorities require hazardous waste classification to be done in accordance with both the European Union system for European Waste List codes (EWL) and the prevailing local Montenegrin waste management laws (Law on Waste Management (Official Gazette of the Republic of Montenegro, No 80/05, Official Gazette of Montenegro, No 73/08; 64/11) and the Rulebook on the manner of treatment of waste oils (OG MNE No. 48/12).

Proposed Mitigation Measures

Operators have to identify final disposal locations and acquire the required permits to transport and dispose drilling cuttings at available treatment and disposal facilities outside Montenegro.

10.4.3.3 Conclusion

Since the discharge of cuttings and drilling fluids at sea is not allowed, and will only be limited to the very small amounts of cement necessary to secure the first set of casings, the impacts on the local environment are considered to be negligible. Transboundary impacts from the disposal of cuttings outside Montenegro have to be addressed during transboundary consultations.

10.4.4 Other Effluent Discharges

Other routine discharges during exploratory drilling typically include treated sewage and domestic wastes (including food waste), deck drainage, and miscellaneous discharges. These are subject to MARPOL regulations.

Sanitary waste will be treated using a marine sanitation device that produces an effluent with a minimum residual chlorine concentration of 1.0 mg/L and no visible floating solids or oil and grease. Wastewater treatment sludge will be transported to shore for disposal at an approved facility. Gray water, includes water from showers, sinks, laundries, and galleys, safety showers, and eye-wash stations. Gray water does not require treatment before discharge. Service vessels will be equipped with an approved marine sanitation device. Food waste, a type of domestic waste, will be ground prior to discharge, in accordance with MARPOL requirements.

10.4.4.1 Potential Impacts

Sanitary and domestic waste from drilling rigs and support vessels may affect concentrations of suspended solids, nutrients, and chlorine, as well as generating BOD. These discharges are expected to be diluted rapidly in the open sea. Impacts would likely be undetectable beyond tens of meters from the source.

Because of the separation and treatment of water from oily areas prior to discharge, deck drainage is not expected to produce a visible sheen or any other detectable impacts on water quality.

Additional miscellaneous discharges typically occur from numerous sources on a drilling rig. Examples include uncontaminated freshwater and seawater used for cooling water and ballast, desalination unit discharges, BOP fluids, and boiler blowdown discharges (USEPA, 1993). These discharges must meet MARPOL requirements and are expected to be diluted rapidly in the open sea. Impacts on water quality would likely be undetectable beyond tens of meters from the source.

10.4.4.2 Mitigation

Planned Control Measures

- Drilling rigs and support vessels must comply with MARPOL requirements including provisions concerning sewage, food waste, oily waste, and garbage.
- Vessels must comply with Ballast Water Management Convention requirements for the management of ballast water and reduce the risk of introduction of invasive species.

Proposed Mitigation Measures

No additional mitigation is recommended.

10.4.4.3 Conclusions

Discharges of effluents such as treated sewage, domestic wastes, deck drainage, and miscellaneous wastes may affect water quality near drilling rigs. The effluents will be similar to those from other vessels in the region, and effects on offshore water quality is not expected to be significant.

10.4.5 Atmospheric Emissions

10.4.5.1 Potential Impacts

The main sources of atmospheric emissions from drilling activity will be from the drilling rig and associated vessels and aircraft support. Drilling rigs typically are powered by diesel engines that emit air pollutants including CO, NOx, SOx, PM, VOCs, and greenhouse gases such as CO_2 and CH_4. Support vessels and helicopters will also emit air pollutants from combustion of diesel fuel (vessels) and aviation fuel. Also in the event that drilling is successful and hydrocarbons are discovered, atmospheric emissions may additionally include those arising from the combustion of produced hydrocarbons during well testing.

Assessing the impacts of these potential emissions at a local level is difficult due to the nature of the offshore environment. As related earlier in Section 10.3.2, impacts are generally mitigated circumstantially by the open and dispersive environment offshore. Drilling rigs and support vessels are in general built and operated to standards that preclude significant impacts to the health of their crews, whilst other environmental receptors (e.g. flora and fauna) tend to be sparsely distributed and/or transient in the local area. And since oil and gas exploration and production activities are not permitted at a distance less than 3 km from the shore, no impacts on coastal or onshore air quality are expected.

10.4.5.2 Mitigation measures

Planned Control Measures

None has been identified.

Proposed Mitigation Measures

- Although Montenegro has not ratified MARPOL Annex VI. It is proposed that the limits and recommendations of the annex be implemented. MARPOL Annex VI sets limits on sulfur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone-depleting substances including halons and chlorofluorocarbons. MARPOL also sets limits on emissions of nitrogen oxides from diesel engines and prohibits the incineration of certain products on board such as contaminated packaging materials and polychlorinated biphenyls.
- The main sources of atmospheric emissions from drilling activity will be from fuel use and potentially from well testing or flaring of produced hydrocarbons. In terms of fuel use, measures can be taken from an early stage to include fuel efficiency in the selection process for drilling rigs, support ships and helicopters, and to use low sulfur fuel for example.

- With regard to well testing, emissions may also be influenced by careful selection of drilling rig and contractors and by the use of maximum efficiency 'green' burners to minimize incomplete combustion, black smoke, and hydrocarbon fallout to the sea. (in the case of oil or condensate wells). The amount of fuel flared can also be minimized by appropriate design of the test programme. If appropriate, well testing systems that do without the need for flaring at all (closed chamber well tests) can be built into the test programme. Volumes of hydrocarbons flared should be recorded.
- It is also recommended that an air dispersion modelling study be prepared as part of the environmental impact assessment study for the drilling activities to better assess the potential of impacts on air quality in the coastal reason, and an estimation of GHG emissions from the drilling activities shall be prepared to assess the impacts on a global level.

10.4.5.3 Conclusions

Atmospheric emissions will arise from exploratory and appraisal drilling activities. The resultant emissions will not have any significant localized impacts to health or the environment due to the dispersive nature of the offshore environment. They will contribute to issues such as global warming and acid rain.

While the emission levels likely to arise from implementing the Programme are relatively small, their acceptability overall needs to be considered in the context of the national energy policy, and national policy for the management of greenhouse gases and commitments to the EU and the Kyoto Protocol.

10.4.6 Accidental Events

10.4.6.1 Introduction

The risk of accidental hydrocarbon and/or chemical spillage to the sea is one of the main environmental concerns associated with oil industry developments. Spilled oil and chemicals at sea can have a number of environmental and economic impacts, the most conspicuous of which are on seabirds and marine mammals. The actual impacts depend on many factors, including the volume and type of oil spilled, and sea and weather conditions. During exploration and appraisal drilling, there is a risk of spillage of oil (fuel/crude), and spillage or leakage of chemicals.

Wildlife related issues to the exploration area include the vulnerability of seabirds, seals and cetaceans offshore, and the presence of several protected species including *Posedonia Oceanica*. Potential economic issues include impacts on coastal fisheries, mariculture and tourism.

10.4.6.2 Hydrocarbon Spills

10.4.6.2.1 The behavior of hydrocarbons at sea

When oil is released into the marine environment it undergoes a number of physico-chemical changes, some of which assist in the degradation of the spill, while others may cause it to persist. These changes are dependent upon the type and volume of oil spilled, and the prevailing weather and sea conditions (Figure 10.2). Evaporation and dispersion are the two main mechanisms that act to remove oil from the sea surface. Following a hydrocarbon spill, evaporation is the initial predominant mechanism of reducing the mass of oil, as the light fractions (including aromatic compounds such benzene and toluene) evaporate quickly. If the spilled oil contains a high percentage of light hydrocarbon fractions, such as diesel, a large part of the spilled oil will evaporate relatively quickly in comparison to heavier (crude) oil. The evaporation process will be enhanced by warm air temperatures and moderate winds and can produce considerable changes in the density, viscosity and volume of the spill.

After the light fractions have evaporated from the slick the degradation process slows down and natural dispersion becomes the dominant mechanism in reducing slick volume. This process is dependent upon sea surface turbulence which in turn is affected by wind speed. Water soluble components of the oil mass will dissolve in the seawater, while the immiscible components will either emulsify and disperse as small droplets in the water column (an oil-in-water emulsion) or, under certain sea conditions, aggregate into tight water-in-oil emulsions, often referred to as 'chocolate mousse'. In practice, usually only one of the two processes will take place (dominate), as they will hardly ever will take place at the same time.

The rate of this emulsification is dependent upon the oil type, sea state and the thickness of the oil slick. Thick (large) oil slicks tend to form water-in-oil emulsions, where thin (smaller) slicks tend to form oil-in-water emulsions that usually disappear by natural dispersion.

When a water-in-oil emulsion (chocolate mousse) is formed, the overall volume of such a water-in-oil emulsion increases significantly, as it may contain up to 70 or 80% water. This chocolate mousse will form a thick layer on the sea surface reducing slick spreading and inhibiting natural dispersion. By diminishing the surface area available for weathering and degradation, these chocolate mousses will be difficult to break up using dispersants. In their emulsified form, with drastically increased volume, they can cause difficulties for mechanical recovery devices as well.

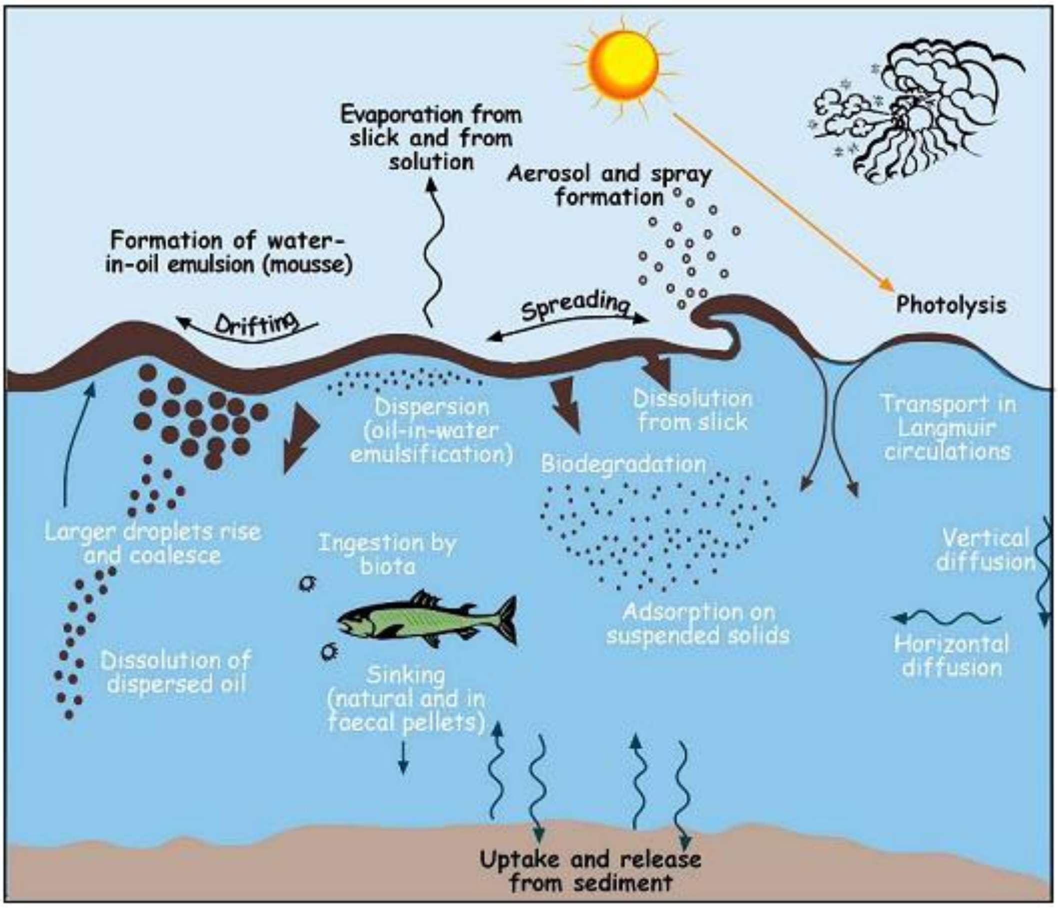

Figure 10.2 Fate and Behavior of Spilled Oil at Sea

Wind and surface current speed and direction are the main parameters involved in affecting where a slick travels. The slick will roughly travel at the same speed and direction as the surface water current. Additionally, the prevailing wind drives a slick downwind at 3 to 4% of the wind speed.

Spill modelling in the oil and gas industry is undertaken as a matter of course as there is usually a requirement, prior to drilling, that an Oil Spill Contingency Plan (OSCP) is prepared.

For crude oil spills, modelling has to be based on the expected characteristics of the crude i.e. heavy/light, which are determined by the reservoir the crude originated from. Therefore site-specific modelling should be undertaken where drilling is expected to take place in an oil bearing formation. The OSCP produced for all drilling operations will specify the level of spill response equipment and facilities present both offshore and onshore.

10.4.6.2.2 Potential impacts of a hydrocarbon spill

Factors important in determining oil spill impacts and recovery rates include the type of oil, the thickness of shore deposits, climate and season, the biological and physical characteristics of the area, the relative sensitivity of species and communities and the type of clean-up response. A summary of impacts arising from oil spills is provided below.

Plankton: Short-term effects have been recorded. However, serious impacts on planktonic organisms have not been observed in the open sea. The main impact is considered to be through initial acute toxicity and long-term effects have been reduced possibly because of high reproductive rates and immigration from outside of the affected area.

Benthos: Effects on the benthos include acute toxicity and possible organic enrichment. Offshore impacts are likely to be minimal, and influenced by water depth and local hydrography. Shallow inshore areas and the shoreline are susceptible to heavy mortalities if coated with fresh crude oil. Recovery times are variable, dependent on many environmental factors, and may be in the region of 1 to 10+ years.

Fish and cephalopods: Adult fish tend to avoid impacted areas however populations moving back into an effected area may take some time to recover. Eggs and larvae in shallow areas may suffer heavy mortalities under fresh slicks, particularly if dispersants are used. There is no evidence that offshore fish populations have been significantly affected.

Spills that affect spawning migration of fish into rivers can affect populations in subsequent years.

Mammals and reptiles: It has been rare for cetaceans to be affected following a spill; they may be able to avoid affected areas and are not believed to be susceptible to the physical impacts of oil and oil emulsion lowering their resistance to the cold. Respiratory problems may be caused by volatile hydrocarbon fractions.

Seals are susceptible to oiling and the contamination of food sources, particularly in the coastal areas around their colonies. Although the Protected Mediterranean Monk Seal is regarded as extinct in Montenegro, it is assumed that individuals form Greek populations can go through the Strait of Otranto in search of caverns and caves suitable for giving birth.

Impacts on marine turtles in the study area are considered to be similar to those for cetaceans. Impacts on eggs and young turtles is not expected since the three existing species do not usually breed in Montenegro, although there has a registry of young green turtle for spring 2013 at Bigovo near Kotor.

Birds: Potential fatalities of offshore species may arise, although this tends to be dependent on species present at the time of the spill. Birds are sensitive to physical fouling of feathers and toxicity by ingestion.

Archaeology: Historic wrecks and archaeological sites in sheltered shallow water on the coast may be at risk from large hydrocarbon spills. The OSCP should take the location of these sites into account when deciding upon response strategies. Impacts on coastal archaeology are associated with smothering and damage from cleanup operations.

Fisheries and mariculture: Fish exposed to oil may become tainted by oil-derived substances. It is of particular concern in caged fish and shellfish culture. Major spills can result in loss of fishing days and exclusion zones and bans on certain species may be enforced and may last several years. Media coverage together with public perception can also damage fisheries.

Tourism: Coastal tourism is vulnerable to the effects of major oil spills. The impact would be influenced by a number of factors including media coverage and public perception.

10.4.6.2.3 Mitigation Measures

Planned Control Measures

- Under Annex 1 of MARPOL Convention, ships (including drilling rigs) are required to have in place a Shipboard Oil Pollution and Emergency Plan (SOPEP). The SOPEP will contain the necessary reporting procedures and actions required to control discharge, and the steps necessary to initiate an external response for any spills.
- Platforms and rigs design and selection shall consider the possible seismic activity in the area they operate at.

Proposed Mitigation Measures

- The crew of the drilling rig/ship should undergo environmental awareness and safety training. All equipment used on the rig/ship should have safety measures built in to minimize the risks of any oil spillage. A two-barrier well control policy should be implemented at all times as a minimum. Primary well control (i.e. mud hydrostatic) and secondary well control (blow-out preventers or BOPs) should be maintained throughout the drilling of a well. A full risk assessment should be performed as part of the planning phase of the well. Safety studies according to authorities requirements should be prepared to demonstrate the acceptability of the risks and that adequate barriers are in place to minimize risks.
- The drilling rig or ship should have built-in safety measures to minimize the risk of an oil spillage, notably blow-out preventers, and fuel-transfer hoses.
- As the highest risk of diesel spillage occurs during re-fuelling (bunkering) operations at sea, all bunkering should take place during suitable weather conditions, preferably in daylight hours, and a continuous watch should be posted during the operations. The bunkering hoses should be segmented and have pressure valves that, in the event of a drop in pressure within the line as a result of loss of diesel, will close, preventing the further release of diesel.
- An OSCP is required. The OSCP shall be designed to assist the decision making process during an oil spill, indicate what resources are required to combat the spill, minimize any further discharges and mitigate its effects.
- Any oil spill must be reported immediately, however small. The level and manner of the required oil spill response will be overseen by the Maritime Safety Department, and determined by the volume and type of oil spilled, and the weather and sea conditions at the time.
- Any oil spill likely to have impacts in waters of neighboring countries shall be reported by the Coast Guard to the relevant authorities in the country likely to be affected.

10.4.6.3 Chemical Spills and Gas Blowout

Chemical spills to the marine environment can have a number of environmental and economic impacts. The chemical inventory on drill rig/ship and supply vessels will include drilling mud formulation and cementing chemicals.

A gas blowout may be caused when a drilling pipe encounters a shallow or a deep pressurized gas zone or an over-pressured rock layer in the subsurface without being prepared to counter the pressure. This allows the gas or the fluid from the rock layer to enter the drilling pipe and up towards the surface. Any gas zone penetrated before a blowout preventer (BOP) has been installed is called a shallow gas blowout.

Shallow gas blowouts occur in approximately one in every 200 wells drilled (UNEP, 1997). While potentially dangerous there are few studies available on gas interactions with the marine environment. Naturally occurring gas blowouts have been linked to gas hydrates and form a potential natural geohazard in the marine environment.

10.4.6.3.1 Impacts of chemical spillage

The environmental implication of a chemical spill is largely dependent on the type of chemical involved, the size and location of the spill and the weather conditions at the time. The actual hazard presented by a spill will depend on the exposure concentration, which is determined by the quantity and rate of spillage and the dilution and dispersion rates. These factors will differ according to whether the spill takes place at the sea surface or sea bed.

The dilution and dispersion of a sea surface spill will depend on the sea state at the time: larger waves will be more effective at dispersing the spill than calm sea states. It will be diluted as it sinks and will be moved by tidal currents and wave activity. Diluted chemicals would be carried with the body of ambient seawater and gradually disperse and degrade. Although it may be detectable within a circle of a tidal motion, it will only be toxic within a very limited area and for a short period of time.

The fate of a spill at seabed level will depend on the properties of the chemical. If the chemical is denser than seawater it may spread over the sea bed and become mixed within the substrate causing potential harm to the benthic community. A lighter chemical will leach into the water column and be dispersed with the currents.

10.4.6.3.2 Impacts of Gas Blowout

Atmospheric emissions may occur as a result of a blowout in an emergency situation. Emissions would be reservoir specific and likely to contain a large proportion of methane (CH_4) with smaller amounts of volatile organic compounds. In the unlikely event of an explosion and hydrocarbons burn then combustion products including carbon dioxide (CO_2) and carbon monoxide (CO) will be emitted. Exact emissions would be well specific but could be considered to be large in a worst case scenario.

10.4.6.3.3 Mitigation Measures

- The potential for shallow gas blowout should be identified and minimized by site survey prior to drilling.
- The BOP is installed to prevent gas blowout once drilling has progressed beyond the riserless stage.
- Gas detection systems are installed on mud shakers to give early indication of any potential for gas blowout.
- Training in safety awareness and response procedures for drilling crews will ensure that the risk of a blowout will be minimized, and be able to make the appropriate response should one occur.

10.4.6.4 Conclusions

The risk of a major crude oil spill or gas blowout during exploration, appraisal and development drilling is considered to be very low. Historical data suggest that small diesel spills from rigs and vessels of less than one tone represent the most likely oil spill scenario. Impacts from diesel spills of this magnitude and frequency (once every 50 to 100 wells drilled) would be Negligible.

10.5 IMPACTS DURING DEVELOPMENT AND PRODUCTION PHASE

10.5.1 Facility and Pipelines Installation

Sea floor-disturbing activities during installation of production facilities will resuspend bottom sediments, crush benthic organisms, and produce turbidity.

The detailed impacts of facility installation will depend on the type of facility selected for a particular project. Physical impacts on the sea bottom may occur in connection with installing pipelines, cables, platforms including platform legs and anchoring.

10.5.1.1 Potential Impacts

Pipeline installation for any particular project is likely to take several weeks to several months, and would crush benthic organisms under the pipeline and anchors and introduce turbidity in the immediate vicinity of the pipe laying operations.

The footprint of the pipeline, or the affected zone around it, is dependent on length, diameter, and the degree of burial or build up of gravel among other factors. Pipeline burial causes the largest impact during the installation phase because of considerable disturbance of the seabed and mobilization of sediment. The volume and distance that suspended sediments disperse depends on particle size, weight and current velocity. The area of impact during pipeline burial is considered to be within 10 – 20 m of the line, but once buried, pipelines usually have insignificant impacts except in the case of pipeline failure and loss of hydrocarbons in the sea.

Benthic communities will be impacted for a variable period of time. In areas of soft sediments, where most pipelines are trenched and buried, the soft bottom fauna re-colonises within a year or two. In areas of harder substrates the recovery of benthic communities may take longer, up to 10 years in deeper colder water areas.

The main concern with regard to potential impacts is the placement of structures in areas where sensitive benthic communities, coral communities and areas of special marine biodiversity importance exist.

There are two submarine telecommunications cables passing in the Montenegrin waters. These features are susceptible to physical damage if not well-mapped and avoided.

Montenegro has many underwater archaeological sites that are still in situ and protected by the law, and there are many more that have not yet been explored or discovered. These features are susceptible to physical damage if not identified and avoided prior to initiation of activities.

10.5.1.2 *Mitigation Measures*

Planned Control Measures

Operators shall identify and map existing subsea infrastructure.

Proposed Mitigation Measures

- Operators proposing to construct production facilities within the license area shall conduct all required surveys to evaluate the presence of coral communities and protected benthic species around each proposed facility location. Operators shall maintain a separation distance of at least 100 m between the location of proposed sea floor disturbances and these communities (if present).
- Before conducting any sea floor disturbing activities, work sites shall be surveyed by marine archaeologists in addition to conducting a remote sensing survey to identify any underwater archaeological sites and shipwrecks. Findings and recommendations shall be submitted to the Sector for Cultural Heritage of the Ministry of Culture to specify the required exclusion zone around the identified sites and a permit to conduct the proposed activities at each well site shall be acquired.

10.5.1.3 *Conclusion*

Installation of production facilities will disturb the sea floor; the extent will depend on the type of the structure. The impacts are likely to persist for several years. The impacts on sensitive benthic communities and coral communities are considered to be significant if these areas are not avoided. Potential damage to shipwrecks or other submerged archaeological resources could be significant if the above listed mitigation measures are not applied.

10.5.2 Physical Presence

Production facilities typically remain in place for long period of time. During this time, the physical presence of the platform, as well as noise and lights from routine operations, may affect marine biota including plankton, fishes, marine mammals, sea turtles, and birds. In addition, the presence of subsea pipelines can create an “artificial reef” effect on the sea floor, attracting epibiota and fishes.

10.5.2.1 *Impacts on Benthic Communities, Plankton and Fishes*

The creation of hard bottom substrate can, over time, give an opportunity for new benthic species to colonize the former sandy/mudflat areas. Pipelines, platform legs and subsea templates may act as shelter for fish and other mobile marine organisms, and provide a habitat for benthic organisms usually associated with hard substrates. This “artificial reef effect” is generally considered as a beneficial impact.

Pipelines will also be colonized by algae and epifauna and will attract fishes. Observations along existing pipelines typically show that epibiota colonise exposed surfaces, and numerous fishes are attracted to submerged structures.

Zooplankton and ichthyoplankton may be attracted to lights associated with offshore structures. Fish larvae are strongly attracted to lights at night (Victor, 1991). Light emissions from operations are likely to have negligible impacts on planktonic communities due to the small area of ocean affected.

10.5.2.2 Impacts on Marine Mammals

Some marine mammals may avoid areas around production platforms due to noise. Others might be attracted to fish populations around the structures. The most likely impacts would be short-term behavioral changes such as diving and evasive swimming, disruption of activities, or departure from the area.

Low frequency noises from the production platform will add to the ambient noise in the area. Baleen whales are considered to be potentially at risk at close range, since the frequencies used in their communication noises and assumed levels of hearing overlap with the sound spectra of industrial noises.

However, noise associated with operation is relatively weak in intensity, and the animals' exposure to these sounds would be transient. Some of the noise (from vessel engines and propellers) would be similar to the existing noise associated with shipping traffic in the region.

10.5.2.3 Impacts on Sea Turtles

Platform lighting mat attract some sea turtles; however it is considered unlikely to appreciably reduce the reproduction, numbers, or distribution of sea turtles (National Marine Fisheries Service, 2001).

Turtle hatchlings are attracted to and can be disoriented by artificial lighting (National Research Council, 1990); but since turtles do not breed in Montenegro, this impact is unlikely to occur.

10.5.2.4 Impacts on Marine Birds

Both positive and negative impacts of offshore structures on birds have been noted. Some birds may be attracted to offshore structures because of the lights and the fish populations that aggregate around these structures. Birds may use offshore structures for resting, feeding, or as temporary shelter from inclement weather (Russell, 2005). However, evidence indicates that migrating birds can become disoriented when encountering a steady artificial light source at night, likely as a result of a disruption in their internal magnetic compass used for navigation. Birds can become "trapped" when a light source enters their zone of influence at night. This phenomenon can cause birds to circle the light source for hours, increasing the risk of collision with the lighted structure, decreasing fat reserves, and potentially interrupting migration (Weiss et al. 2012, Montevecchi 2006, Longcore and Rich 2004).

10.5.2.5 Impacts on Visual Amenity

The visibility of a platform from the shore depends on its proximity to the shore and on other factors such as sea and weather conditions. The government of Montenegro has set a minimum separation distance from the shore of 3 km. Yet, rigs installed at greater distances might be seen from the shore and from the coastal mountains especially in clear nights. This distance shall be confirmed during EIA studies where impact on landscape and visual amenity shall be further confirmed and considered as part of the siting of facilities, where possible.

Platforms typically are visible from shore at distances of 5 to 16 km. On a clear night, lights on top of offshore structures could be visible to a distance of approximately 32 km (MMS, 2007b).

10.5.2.6 Impacts on Fishing and Shipping

The presence of platforms and support vessels may interact with shipping and marine transport. The movement of the support vessel may lead to a slight increase in vessel activity in the region. This would take place over the operation period.

It is proposed for safety reasons that a 500 m exclusion zone will surround the platform, leading to the loss of fishing access, and will require other vessels to avoid the area; however, directing fishing effort from one area to another nearby is unlikely to affect fishing revenue.

10.5.2.7 Mitigation

Planned Control Measures

- It is assumed that the platform and support vessels would use appropriate signals in accordance with International Maritime Law (including communications via radio, lights, and flags) to warn other vessels of the exclusion zone.

Proposed Mitigation Measures

- A safety Buffer zone of 500 m around the platform shall be maintained. The buffer zone will be kept clear of all unauthorized vessels and monitored by radar and visual observation.
- To avoid the impacts on birds especially migratory birds, it is recommended to: 1) use fewer lights as much as practical; 2) use low intensity lights; 3) avoidance of the use of white lights (White lights are the least favorable choice for lighting structures) and 4) Use strobing lights instead of steady lights.
- Surface positioning of the platform and survey vessel should be based on augmented global navigation satellite systems (GNSS). It is recommended that two fully independent surface positioning systems should be used and would be operated in line with the Guidelines for GNSS (Global Navigation Satellite System) Positioning in the Oil and Gas Industry, issued jointly by OGP (Oil & Gas Producers) and IMCA (International Marine Contractors Association).

10.5.2.8 Conclusion

The physical presence of platforms will attract pelagic fishes. Birds may use offshore platforms as stopping places. However migrating birds can become disoriented when encountering a steady artificial light source at night which cause birds to circle the light source for hours, increasing the risk of collision with the lighted structure, decreasing fat reserves, and potentially interrupting migration. Noise and lights may cause minor behavioral changes in marine mammals and sea turtles (e.g., attraction or avoidance). Benthic communities may be affected by sloughing of organic debris from platforms, and by the physical presence of pipelines on the sea floor. The impacts are considered minor.

The presence of platforms and support vessels may interact with shipping, and the 500 m exclusion zone proposed for safety reasons will lead to loss of fishing ground in this area. However these impacts are not expected to be significant.

Visual impacts from the presence of the platform on the quality of landscapes are expected and can be mitigated through adequate siting at significant distances from the shore. The government of Montenegro has set a minimum separation distance from the shore of 3 km; this distance shall be confirmed during EIA studies where impact on landscape and visual amenity shall be further confirmed and considered as part of the siting of facilities, where possible.

10.5.3 Drilling Discharges

10.5.3.1 Potential Impacts

Impacts during development drilling would be qualitatively similar to those during exploratory drilling (discussed in Section 10.4.3). However, because numerous wells would be drilled at each production location, more vessel trips will be required to transport cuttings to the final disposal locations during the drilling period.

10.5.3.2 Mitigation

Planned Control Measures

Discharges at sea from drilling activities including drilling cuttings and drilling fluids are not allowed. Operators will have to discharge these waste and wastewater streams at available facilities outside Montenegro. This will require vessels movement in the sea to transport the cuttings to the disposal locations during the drilling period.

Authorities require hazardous waste classification to be done in accordance with both the European Union system for European Waste List codes (EWL) and the prevailing local Montenegrin waste management laws (Law on Waste Management (Official Gazette of the Republic of Montenegro, No 80/05, Official Gazette of Montenegro, No 73/08; 64/11) and the Rulebook on the manner of treatment of waste oils (OG MNE No. 48/12).

Proposed Mitigation Measures

Operators have to identify final disposal locations and acquire the required permits to transport and dispose drilling cuttings at available treatment and disposal facilities outside Montenegro.

10.5.3.3 Conclusions

Since the discharge of cuttings and drilling fluids at sea is not allowed, the impacts on the local environment are considered to be negligible. Transboundary impacts from the disposal of cuttings outside Montenegro have to be addressed during transboundary consultations.

10.5.4 Operational Discharges

Routine discharges during operation typically include produced water, well workover and completion fluids, treated sewage and domestic wastes, deck drainage and other discharges.

10.5.4.1 Potential Impacts

Produced water is the water found in reservoirs along with the oil or gas. When the oil or gas is extracted, produced water is associated with it. Entrained within the water there are hydrocarbons that are, as far as possible, removed from the water prior to any discharge. As the volume of hydrocarbons found in a reservoir decreases over the life of the field the volume of produced water generally increases. Produced water includes formation water, condensed water, brine, injection water and other technological wastes which usually consist of oil, natural hydrocarbons, inorganic salts and technological chemicals. The discharge of produced water accounts for the greater portion of wastes arising from offshore oil and gas production operations.

As per the policy adopted by the authorities, discharges at sea from drilling activities are not allowed. The operator will have to dispose such discharges including produced water and workover and completion fluids outside Montenegro.

Sanitary and domestic waste from manned production facilities and support vessels may affect concentrations of suspended solids, nutrients, and chlorine, as well as generating BOD. These discharges are expected to be rapidly diluted in the open ocean (MMS, 2007b). Impacts would likely be undetectable beyond tens of meters from the source.

Deck drainage consists of water resulting from rainfall, rig washing, deck washings, tank cleaning operations, and runoff from curbs and gutters, including drip pans and work areas. Offshore production facilities are designed to contain runoff and prevent oily drainage from being discharged. Because of the separation and treatment of water from oily areas prior to discharge, deck drainage is not expected to produce a visible sheen or any other detectable impacts on water quality.

Additional miscellaneous discharges typically occur from numerous sources on an offshore platform. Examples include uncontaminated freshwater and seawater used for cooling water and ballast, desalination unit discharges, BOP fluids, and boiler blowdown discharges (USEPA, 1993). These discharges must meet MARPOL requirements and are expected to be rapidly diluted in the open ocean. Impacts on water quality would likely be undetectable beyond tens of meters from the source.

10.5.4.2 Mitigation

Planned Control Measures

- Discharges at sea from drilling activities including produced water are not allowed. Operators will have to discharge such wastewater streams at available facilities outside Montenegro.
- Offshore platforms and support vessels must comply with MARPOL requirements including provisions concerning sewage, food waste, oily waste, and garbage.

- Vessels must comply with Ballast Convention requirements for the management of ballast water to reduce the possibility of introduction of invasive species.

Proposed Mitigation Measures

- Operators have to identify final disposal locations of drilling discharges including produced water and acquire the required permits to transport and dispose drilling cuttings at available treatment and disposal facilities outside Montenegro.

10.5.4.3 Conclusions

Discharges of Operational effluents may affect water quality near platforms. Effects are expected to be negligible and only within a few tens to hundreds of meters around production facilities.

Transboundary impacts from the disposal of drilling discharges outside Montenegro have to be addressed during transboundary consultations.

10.5.5 Atmospheric Emissions

10.5.5.1 Potential Impacts

The main sources of atmospheric emissions from Operation will be from the power generation at Platform and associated vessels and support aircraft. Platform equipment are typically powered by diesel engines or natural gas that emit air pollutants including CO, NOx, SOx, PM, VOCs, and greenhouse gases such as CO_2 and CH_4. Support vessels and helicopters will also emit air pollutants from combustion of diesel fuel (vessels) and aviation fuel.

Another source of emissions related to oil production is the associated gas brought to the surface which is disposed of at offshore facilities by venting or flaring to the atmosphere. This practice is now widely recognized to be a waste of a valuable resource, as well as a significant source of GHG emissions. However, flaring or venting is also an important safety measure used on offshore oil and gas facilities to ensure gas and other hydrocarbons is safely disposed of in the event of an emergency, power or equipment failure, or other plant upset condition.

Continuous venting of associated gas is not considered current good practice and should be avoided. The associated gas stream should be routed to an efficient flare system, although continuous flaring of gas should be avoided if alternatives are available. Before flaring is adopted, feasible alternatives for the use of the gas should be evaluated to the maximum extent possible and integrated into production design. Alternative options may include gas utilization for on-site energy needs, gas injection for reservoir pressure maintenance, enhanced recovery using gas lift, gas for instrumentation, or export of the gas to a neighboring facility or to market. An assessment of alternatives should be adequately documented and recorded. If none of the options are feasible for the use of associated gas, measures to minimize flare volumes should be evaluated and flaring should be considered as an interim solution, with the elimination of continuous production-associated gas flaring as the preferred goal. Flaring volumes for new facilities should be estimated during the initial commissioning period so that fixed volume flaring targets can be developed. The volumes of gas flared for all flaring events should be recorded and reported.

Assessing the impacts of these potential emissions at a local level is difficult due to the nature of the offshore environment. Impacts are generally mitigated circumstantially by the open and dispersive environment offshore. Platforms and support vessels are in general built and operated to standards that preclude significant impacts to the health of their crews, whilst other environmental receptors (e.g. flora and fauna) tend to be sparsely distributed and/or transient in the local area. Since oil and gas exploration and production activities are not permitted at a distance less than 3 km from the shore, limited impacts on coastal or onshore air quality are expected.

In order to assess the impacts at a global level, the contribution of oil and gas production to the overall GHG emissions in Montenegro, GHG emissions from all facilities and offshore support activities should be quantified annually as aggregate emissions in accordance with internationally recognized methodologies and reporting procedures.

10.5.5.2 Mitigation measures

Planned Control Measures

No planned control measures have been identified.

Proposed Mitigation Measures

- Although Montenegro has not ratified MARPOL Annex VI. It is proposed that the limits and recommendations of the annex be implemented. MARPOL Annex VI sets limits on sulfur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone-depleting substances including halons and chlorofluorocarbons. MARPOL also sets limits on emissions of nitrogen oxides from diesel engines and prohibits the incineration of certain products on board such as contaminated packaging materials and polychlorinated biphenyls.
- Fuel efficiency measures shall be taken in the selection process for platform, support ships and helicopters.
- Before flaring is adopted, feasible alternatives for the use of the associated gas should be evaluated to the maximum extent possible and integrated into production design.
- If flaring is necessary, continuous improvement of flaring through implementation of best practices and new technologies should be demonstrated. The following pollution prevention and control measures should be considered for gas flaring:
    - Use of efficient flare tips, and optimizing the size and number of burning nozzles;
    - Maximizing flare combustion efficiency by controlling and optimizing flare fuel/air/steam flow rates to ensure the correct ratio of assist stream to flare stream;
    - Minimizing flaring from purges and pilots, without compromising safety, through measures including installation of purge gas reduction devices, flare gas recovery units, inert purge gas, soft seat valve technology where appropriate, and installation of conservation pilots;
    - Minimizing risk of pilot blow-out by ensuring sufficient exit velocity and providing wind guards;

- Use of a reliable pilot ignition system;
- Installation of high integrity instrument pressure protection systems, where appropriate, to reduce over pressure events and avoid or reduce flaring situations;
- Minimizing liquid carry over and entrainment in the gas flare stream with a suitable liquid separation system;
- Minimizing flame lift off and/or flame lick; Operating flare to control odor and visible smoke emissions (no visible black smoke);
- Implementation of burner maintenance and replacement programs to ensure continuous maximum flare efficiency;
- Metering flare gas.

• An air dispersion modelling study be prepared as part of the environmental impact assessment study for the operation activities to better assess the potential of impacts on air quality in the coastal reason, and an estimation of GHG emissions from the operation activities shall be prepared to assess the impacts on a global level.

10.5.5.3 Conclusions

Air pollutant emissions from offshore production facilities are expected to have negligible local impacts on air quality due to the dispersive nature of the offshore environment. Due to the distance offshore, no impacts on coastal or onshore air quality are expected.

While the emission levels likely to arise from implementing the Programme are relatively small, their acceptability overall needs to be considered in the context of the national energy policy, and national policy for the management of greenhouse gases and commitments to the EU and the Kyoto Protocol.

10.5.6 Support Activities

During the production phase, offshore service vessels and helicopters will provide support from onshore bases, probably from existing ports and airports.

Existing ports in Montenegro include: the port of Bar, the port of Kotor, the port of Zelenika and the port of Risan, and ports for domestic maritime transport, marinas and docks.

Existing airports in the coastal area include the international airport in Tivat which is not close to the area of the license blocks. The Spatial Plan of Montenegro until 2020 envisaged a secondary airport network including an airport in Ulcinj. The establishment of an airport at Ulcinj will serve the Programme, since the license blocks are in proximity to this coastal city.

10.5.6.1 Impacts on Marine Mammals and Birds

There is a small possibility of a supply boat striking a marine mammal during routine operations. Among marine mammals, whales are the most commonly hit. The risk is similar to that associated with existing vessel traffic in the region.

According to David W. LAIST in a study on collisions between ships and whales (Laist et al., 2001), out of 11 species known to be hit by ships, fin whales (Balaenoptera physalus) are struck most frequently, and sperm whales (Physeter catodon are among the most commonly hit.

Although all sizes and types of vessels can collide with whales, most lethal or severe injuries are caused by ships 80 m or longer and traveling 14 knots or faster (Laist et al., 2001).

Due to the relatively infrequent nature of the support vessel traffic (probably one trip a day), the likelihood of striking a marine mammal is considered low.

Vessel and helicopter traffic could periodically disturb individuals or groups of seabirds (including the two species of endangered and vulnerable ducks). It is likely that individual birds would experience at most a short-term behavioral disruption, and the impact is considered to be minor, unless helicopters fly over the Important Birds Areas in the coastal area (Delta of Bojana River, Rumija mountain, Buljarica area and Tivat Saltpans), refer to Section 5.5.7.

10.5.6.2 <u>Impacts on Fishing and Shipping Activities</u>

Support vessels would normally be expected to follow the most direct route between the platform and onshore support base. Accordingly, significant impacts on fishing are expected to be avoided.

10.5.6.3 <u>Mitigation</u>

<u>Planned Control Measures</u>

No Planned Control Measures were identified.

<u>Proposed Mitigation Measures</u>

- Licensees are required to notify maritime authorities of the planned schedule for the support vessels movement.
- Habitats of seabirds, particularly the habitats of the endangered species (*Melanitta fusca*) and vulnerable species (*Clangula hyemalis*), in addition the important birds areas in the coastal zone, shall be mapped, and avoided by survey vessels and helicopters.

10.5.6.4 <u>Conclusion</u>

Support operations are likely to use existing port facilities and would represent a minor increase in the existing level of operations at these ports. Vessel traffic involves a small risk of striking a marine mammal or turtle. The likelihood of striking a marine mammal or turtle is considered low. Helicopters and vessels crossing coastal habitats may disturb bird colonies; the impacts would be minor, unless helicopters fly over important bird areas.

10.5.7 Accidental Events

The risk of accidental hydrocarbon and/or chemical spillage to the sea is one of the main environmental concerns associated with oil industry developments. Spilled oil and chemicals at sea can have a number of environmental and economic impacts, the most conspicuous of which are on seabirds and marine mammals. The actual impacts depend on many factors, including the volume and type of oil spilled, and sea and weather conditions. During production phase, there is a risk of spillage of oil (fuel/crude), and spillage or leakage of chemicals.

Wildlife related issues to the exploration area include the vulnerability of seabirds, seals and cetaceans offshore, and the presence several protected species including *Posedonia Oceanica*. Potential economic issues include impacts on coastal fisheries, mariculture and tourism.

The impacts from accidental events during operation phase are similar to those during drilling operations (10.4.6) and are not repeated in this section.

10.6 IMPACTS FROM HYDROCARBON USAGE

10.6.1 Introduction

According to the energy policy of Montenegro until 2030, the main priorities of the policy are:

- Security in the energy supply.
- Development of the competitive energy market.
- Sustainable energy development.

The key strategic commitments of the policy to achieve the main priorities include the following (among others):

- Exploration of oil and gas in the Montenegrin undersea and in continental area, as well as of coal in Pljevlja and Berane basin;
- Proactive role of the policy of the State of Montenegro in the endeavors to provide access to the systems of natural gas through the international projects (Ionian-Adriatic gas pipeline and others), development of natural gas system (including the construction of regional gas pipelines and plants for utilization of natural gas);

Based on the above commitments, and in the event of commercial findings of oil/ gas offshore Montenegro, the potential options of end use of exploited hydrocarbons are mainly:

- Treatment and export of gas through pipelines (Ionian Pipeline/ Trans-Adriatic pipeline)

  This option will entail the construction of subsea pipelines, gas treatment plant and a junction point (tie in) to connect with export pipelines.

- Gas treatment and use in Montenegro.

  This option will entail the construction of subsea pipelines, gas treatment plant and pipelines to transport gas to end users in Montenegro such as power plants.

- Oil storage and export.

  In the event of commercial findings of oil offshore Montenegro, the possible option for crude oil usage will be most probably export abroad via tankers since there are no crude oil export pipelines passing in Montenegro, and no oil refineries for refining and local use.

10.6.2 Impacts from Installation of Subsea Pipelines

The construction of subsea pipelines will cause sea floor that will re-suspend bottom sediments, crush benthic organisms, and produce turbidity.

The footprint of the pipeline, or the affected zone around it, is dependent on length, diameter, and the degree of burial or build up of gravel etc. Pipeline burial causes the largest impact during the installation phase because of considerable disturbance of the seabed and mobilization of sediment. The volume and distance that suspended sediments disperse depends on particle size, weight and current velocity. The area of impact during pipeline burial is considered to be within 10 – 20 m of the line, but once buried, pipelines usually have insignificant impacts.

Benthic communities will be impacted for a variable period of time. Due consideration shall be paid during route selection to avoid areas of sensitive and protected benthic species such as the meadows of *Posidonia oceanica.*

Areas of subsea telecommunications cables and underwater archaeological sites shall be mapped and avoided.

10.6.2.1 Mitigation Measures

An environmental impact assessment shall be conducted for the proposed pipelines.

Route selection for subsea pipelines shall consider maintaining a distance of 100 m from sensitive benthic communities, subsea telecommunication cables and underwater archaeological sites. All required surveys shall be conducted prior to route selection.

10.6.3 Impacts from the Construction and Operation of Gas Treatment Plant

Gas processing consists of separating the various hydrocarbons and fluids from the pure natural gas to produce what is known as "pipeline quality" dry natural gas. Major transportation pipelines usually impose restrictions on the makeup of natural gas that is allowed into the pipeline.

Gas from separators generally loses so much pressure that it must be recompressed to be transported. Different types of compressors can be used including Turbine driven compressors which gain their energy by using a small proportion of the natural gas that they compress. The turbine itself serves to operate a centrifugal compressor, which contains a type of fan that compresses and pumps the natural gas through the pipeline. Some compressor stations are operated by using an electric motor to turn the centrifugal compressor. This type of compression does not require the use of any natural gas from the pipe; however, it does require a reliable source of electricity nearby. The compression includes a large section of associated equipment such as scrubbers (to remove liquid droplets) and heat exchangers, lube oil treatment, etc.

The gas treatment plant might have significant impacts on various environmental components including air quality, noise levels, soil, groundwater resources, surface water resources, land use, archeological sites, tourism, socio-economic conditions in addition to visual amenity. The significance of impacts is mainly related to the presence of sensitive receptors near the proposed location, the design of the plant and proposed waste management options.

Significant impacts might occur from accidental events such as fire and explosions, but the likelihood of occurrence of such events is very low and not expected to take place under normal operation conditions.

The site selection of the gas treatment plant is an essential step during design stage. An environmental assessment for the proposed sites shall be conducted before site selection. These facilities will most probably be constructed in the coastal area close to offshore platforms and routes of export pipeline.

10.6.3.1 Mitigation Measures

- Environmental impact assessment shall be conducted for the gas plant, and site and process selection options shall be assessed. A waste management plan shall be submitted as part of the EIA.
- Site selection of Gas treatment plant shall consider maintaining a distance of not less than 500 m form the following areas:
    - Protected areas, important bird areas and habitats of protected and important species;
    - Water courses, such as rivers and lakes;
    - Areas of archeological importance and tourist areas;
    - Areas of significant landscape features; and
    - Populated areas.
- A protection zone of a minimum of 500 m shall be maintained around the gas treatment plant, where unauthorized access shall not allowed.
- Gas plant process design shall consider minimizing atmospheric emissions from venting and flaring.

10.6.4 Impacts from the Construction and Operation of the Junction Point with the Export Pipelines

The junction point shall include metering installation to allow operators to monitor and manage the exported natural gas. These employ specialized meters to measure the natural gas as it flows through the pipeline, without impeding its movement. This metered volume represents a transfer of ownership from a producer to a customer, and is called custody transfer metering. It forms the basis for invoicing the sold product and also for production taxes and revenue sharing among partners.

It may also include pig launcher/ receiver to allow regular inspection and cleaning of pipelines.

One of the sources of impact from this facility would be related to the disposal of accumulated sludge from pigging operations. However limited amounts of sludge are generally generated from gas facilities. Fugitive emissions from leaks from valves and sludge drums are also a source of impact on air quality.

Significant impacts can occur from accidental events that cause loss of containment and fires, but these impacts are not likely to occur under normal operating conditions.

Site selection process shall consider avoidance of sensitive receptors, and shall be based on environmental assessment.

10.6.4.1 Mitigation Measures

- Environmental impact assessment shall be conducted and site and process selection options shall be assessed. A waste management plan shall be submitted as part of the EIA.
- Site selection of the junction point shall consider maintaining a distance of not less than 500 m form the following areas:
    - Protected areas, important bird areas and habitats of protected and important species;
    - Water courses, such as rivers and lakes;
    - Areas of archeological importance and tourist areas;
    - Areas of significant landscape features; and
    - Populated areas.

10.6.5 Impacts from the Construction and Operation of Pipelines on land

Pipelines are expected to be constructed on land in the different hydrocarbon usage scenarios, whether between subsea pipelines and the gas treatment plant, from the gas treatment plant to the export junction point, or to transport the treated gas to end users in Montenegro which are probably power plants.

Impacts from pipelines are mainly expected during construction. Construction activities will entail trenching and removal of topsoil resulting in impacts on soil, habitats of species, land use and land owners. If the pipelines will cross water courses, impacts on water quality, aquatic species and end users of water can occur. Construction might also have impact on archaeological sites in the vicinity of the proposed route. Impacts on air quality and noise are expected from the construction equipment and machineries. However, all these impacts are temporary and limited to the duration of construction activities and not expected to be significant as long as sensitive areas/ receptors are avoided.

Impacts during pipelines operation might arise from pipes regular maintenance and cleaning. Waste generated from pipes pigging shall be properly managed.

Significant impacts might occur from accidental events such as fires and explosions, but the likelihood of occurrence of such events is very low and not expected to take place under normal operation conditions.

10.6.5.1 Mitigation Measures

- An environmental impact assessment study shall be prepared for the proposed pipelines, and route selection options shall be assessed considering avoidance of crossing with sensitive areas/ receptors.
- Modern technologies shall be applied to guarantee the integrity of the pipeline system including provision of pipeline external coating, cathodic protection, and Leak Detection System (LDS) among others.

10.6.6 Impacts from Crude Oil Storage and Export

In the event of commercial findings of oil offshore Montenegro, the possible option for crude oil usage will be mainly export abroad via tankers since there are no crude oil export pipelines passing in Montenegro, and no oil refineries for refining and local use.

Impacts from tankers are similar to those from other shipping vessels in addition to the possibility of oil spills.

These impacts include impacts from air emissions, noise, wastewater disposal, collision with other ships, the possibility of striking marine mammals in addition to the impacts from introduction of invasive species from ballast water.

The main environmental concern associated with tankers movement is oil spills. Spilled oil at sea can have a number of environmental and economic impacts, the most conspicuous of which are on seabirds and marine mammals. The actual impacts depend on many factors, including the volume and type of oil spilled, and sea and weather conditions, the biological and physical characteristics of the area, the relative sensitivity of species and communities and the type of clean-up response. The impacts from oil spills and proposed mitigation are elaborated in Section 10.4.6.

10.6.6.1 Mitigation Measures

Planned Control Measures

- Tankers shall use appropriate signals in accordance with International Maritime Law (including communications via radio, lights, and flags) to warn other vessels of the exclusion zone.
- Tankers must comply with Ballast Water Management Convention requirements for the management of ballast water.
- Tankers must comply with MARPOL requirements including provisions concerning sewage, food waste, oily waste, and garbage.
- Limits and recommendations of MARPOL Annex VI shall be implemented. MARPOL Annex VI sets limits on sulfur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone-depleting substances including halons and chlorofluorocarbons. MARPOL also sets limits on emissions of nitrogen oxides from diesel engines and prohibits the incineration of certain products on board such as contaminated packaging materials and polychlorinated biphenyls.

Proposed Mitigation Measures

- The crew of tanker should undergo environmental awareness and safety training. All equipment used on the tankers should have safety measures built in to minimize the risks of any oil spillage. A full risk assessment should be performed.
- An OSCP is required. The OSCP shall be designed to assist the decision making process during an oil spill, indicate what resources are required to combat the spill, minimize any further discharges and mitigate its effects.
- Any oil spill must be reported immediately, however small. The level and manner of the required oil spill response will be overseen by the Maritime Safety Department, and determined by the volume and type of oil spilled, and the weather and sea conditions at the time.
- Any oil spill likely to have impacts in waters of neighboring countries shall be reported by the Coast Guard to the relevant authorities in the country likely to be affected.

10.7 IMPACTS DURING DECOMMISSIONING PHASE

There are international agreements relating to decommissioning that address removal and deep-sea disposal. For example, the International Maritime Organization (IMO) has developed guidelines and standards for the removal of offshore installations and sets out conditions to protect navigation and maintain safety1. IMO standards state that installations or structures of less than 4,000 tones, excluding the deck and superstructure, and in less than 75 meters of water should be removed entirely at decommissioning. Additionally, no installation or structure should be installed after January 1, 1998 unless the facility is designed to be entirely removed. The standards indicate that exceptions will be considered on a case-by-case basis for installations or structures installed before 1998 that cannot be fully removed for demonstrable reasons of technical or financial feasibility, but these facilities must be partially removed to provide a clear water column depth of 55 meters.

An OSPAR decision recognizes entire removal of the facility from the offshore locations for re-use, recycling, or final disposal on land as the preferred option for the decommissioning of offshore facilities. Alternative disposal options may be considered if justified on the basis of an alternative options assessment. This assessment should consider facility type, disposal methods, disposal sites, and environmental and social impact, including interference with other sea users, impacts on safety, energy and raw material consumption, and emissions.

Article 20 'Removal of Installations' of the Offshore Protocol of Barcelona Convention stipulates that:

1) The operator shall be required by the competent authority to remove any installation which is abandoned or disused, in order to ensure safety of navigation, taking into account the guidelines and standards adopted by the competent international organization. Such removal shall also have due regard to other legitimate uses of the sea, in particular fishing, the protection of the marine environment and the rights and duties of other Contracting Parties. Prior to such removal, the operator under its responsibility shall take all necessary measures to prevent spillage or leakage from the site of the activities.

[1] Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone, 1989 (Resolution A.672 (16))

2) The competent authority shall require the operator to remove abandoned or disused pipelines in accordance with paragraph 1 of this Article or to clean them inside and abandon them or to clean them inside and bury them so that they neither cause pollution, endanger navigation, hinder fishing, threaten the marine environment, nor interfere with other legitimate uses of the sea or with the rights and duties of other Contracting Parties. The competent authority shall ensure that appropriate publicity is given to the depth, position and dimensions of any buried pipeline and that such information is indicated on charts and notified to the Organization and other competent international organizations and the Parties.

In general, decommissioning of offshore fixed or bottom-founded platforms is perceived as technically difficult, costly and posing a number of environmental and safety risks (International Association of Oil and Gas Producers (OGP) 2003). Decommissioning of a floating structure, by their nature, would be relatively easy in comparison as the majority of the infrastructure can simply be disconnected and floated away.

For offshore pipelines, the most common international practice is to abandon the pipeline in place. Prior to abandonment, pipelines are purged until the hydrocarbon levels are undetectable. In some cases, after the pipeline is purged, the pipe may be recovered as scrap. In general, the environmental impacts of abandoning a pipeline in place are minimal, as compared with those of removing it such as emissions and sea floor disturbance (Scandpower Risk Management Inc., 2004).

Before any demolition work starts, it is important to carry out a thorough review of the whole decommissioning process. The operator, preferably with the help of personnel with local knowledge of the specific installation, should identify waste types, hazardous substances and other environmental problems that may arise on the platform. It is useful if experts from the decommissioning facility on land can be present during this process. Any hazardous waste that is accessible offshore must be labelled and safely packaged for transport to shore. Pipelines and other equipment on the platform must be inspected to ensure that no gas or oil is left in the system before pipelines are plugged.

Various marine organisms start to grow on platform legs and other subsea structures after they have been in the sea for only a few months, and the quantity of fouling is much larger after 30–40 years in the sea. Mussels, barnacles, benthic algae and sea cucumbers quickly colonize installations, followed by soft corals and after some years colony-forming stony corals. The species that colonize a particular installation will depend on a number of factors such as recruitment potential, currents, water depth, distance from land and latitude.

Marine fouling should be removed from the installation while it is still offshore if this is technically possible. The open sea usually functions as a satisfactory recipient where the material decomposes naturally. In more enclosed, shallow waters, however, this may result in an excessive load of organic material and oxygen depletion on the seabed. Disposal of the material on land and composting is a possibility, but often results in odor problems[1].

During demolition work onshore, it is important to safeguard worker health and to avoid or minimize radioactive releases to water, air and soil. Employees must use suitable protective clothing during this work. To protect the external environment, it is particularly important to

[1] Decommissioning of Offshore Installations, Climate and Pollution Agency, Oslo, 2011.

avoid the spread of particles. Particles may be deposited on vegetation or in water, and thus enter various stages of the food chain, where they may raise the level of radioactivity in meat and fish used for human consumption.

Naturally occurring radioactive substances in scale, sludge and other deposits on oil and gas platforms may be found in many different parts of the processing equipment, including valves, wellheads, risers, separators, hydrocyclones and piping. They may also be present in subsea systems and pipelines from such systems to the processing installation they are linked to. The same applies to wellhead platforms.

Figure 10.3 Removed Steel Jacket

Decommissioning of offshore installations can cause problems both for the fisheries and for aquaculture industry, including fish farming, but of rather different kinds. For the fisheries, any problems are largely related to the offshore phase of decommissioning, and include restrictions on access to areas.

Risks to the reputation of fish products on different markets could be a problem both for the fisheries and the aquaculture. Reputation is a sensitive factor, and easily influenced in a negative direction. Pollution incidents could have a major impact, especially at local level. Experience shows that it takes a long time to restore a good reputation. There are no special arrangements for compensating for this type of loss other than the normal compensation rules. This issue should therefore be taken into special consideration if permits are to be issued for areas where fisheries and aquaculture are important.

Regarding transport to onshore facilities, transport operations are of short duration and will take place along designated routes. Any negative impacts on the fisheries are therefore expected to be very limited. There may be conflicts with fisheries interests if an installation has to be kept at anchor en route for some time before decommissioning operations can continue. The extent of the problems will depend on the size of the restricted area, how long restrictions last for, and the geographical position.

If explosive charges are used for platform removal, then there is the potential for impacts to fishes, marine mammals, and sea turtles. It is assumed that if explosives are used, the decommissioning plan would include monitoring for the presence of marine mammals prior to any underwater detonations. This monitoring is standard industry procedure and would avoid potential impacts of explosives on marine mammals and turtles (Klima et al., 1988; Gitschlag et al., 2000).

10.7.1.1 Mitigation measures

Planned Control Measures

- Comply with the requirements of the Offshore Protocol of Barcelona Convention regarding removal OF installations.

Proposed Mitigation Measures

- A preliminary decommissioning plan for offshore facilities should be developed that considers well abandonment, removal of oil from flowlines, facility removal, and sub-sea pipeline decommissioning along with disposal options for all equipment and materials. This plan can be further developed during field operations and fully defined in advance of the end of field life. The plan should include details on the provisions for the implementation of decommissioning activities and arrangements for post decommissioning monitoring and aftercare.
- Licensees should be required to follow international best practice for safe structure removal including monitoring for marine mammals and turtles if explosives are to be used.
- Marine fouling should preferably be removed while the installation is still offshore. Oil, scale, structural water and ballast water should if possible be removed while the installation is still offshore Hazardous waste must be suitably packaged, pipelines must be plugged, and good routines must be in place for labelling, packaging and sorting waste.
- Decommissioning facilities (on shore) must be designed to allow safe handling of different types of waste, including hazardous waste such as heavy metals and NORM wastes, with no risk of runoff or infiltration into the soil. In addition, a decommissioning facility should have an effective collection system and an on-site treatment plant for contaminated water, including surface water. Each facility must have a sampling and analysis programme to monitor releases of the most relevant pollutants. The need for an environmental monitoring programme to follow developments in the recipient should also be considered. Other factors that must be closely monitored at decommissioning facilities include noise and releases to air in connection with metal cutting and other operations. Moreover, decommissioning contracts must ensure that the costs of handling hazardous waste are met by the offshore operators.

10.7.1.2 Conclusions

Impacts from decommissioning of platforms are dependent on the type of facility to be removed and on the proposed decommissioning plan. If explosives are used techniques for the removal of offshore production structures has the potential to kill or injure marine mammals or turtles. Impacts from waste disposal can be mitigated with the presence of a proper waste management and disposal plan, and the enforcement of monitoring program. Impacts on fisheries are generally expected to be of short term and reversible.

10.8 SOCIOECONOMIC AND HEALTH IMPACTS

10.8.1 Socioeconomic Impacts

The Oil and Gas exploration and production activities in Montenegro are expected to entail social and economic impacts both positive and negative. These are elaborated in the next sections.

10.8.1.1 Change in Income and Income per Capita

As presented earlier, Montenegro has a high state debt of 58% of GDP. The Programme is anticipated to generate an overall positive impact on national income and income per capita. During Production Phase, hydrocarbon exploitation is anticipated to lead to a reduction in import bills for gas and a rise in exports, thereby leading to an overall net increase in domestic production. It will also have a positive impact at the national level by reducing shortages of petroleum products and securing power resources in the country.

10.8.1.2 Impacts on Existing Economic Activities

During different Programme phases, fishing activities are expected to be affected from the exclusion zones around rigs and platforms, however, these impacts are not expected to be significant since directing fishing efforts from a place to another is not expected to affect fishing revenues.

The presence of seismic vessels, rigs, platforms and support vessels may interact with shipping and marine transport. The movement of support vessels may lead to a slight increase in vessel activity in the region.

These impacts can be mitigated with the coordination between the operator and Transport and Maritime Affairs and the Maritime Safety Department before approval of well plan to avoid conflict with shipping and fishing operations.

However, in the event of accidental oil spill, the effects can be significant of fishing and shipping, that is based on the type of oil, the thickness of shore deposits, climate and season, the biological and physical characteristics of the area, the relative sensitivity fish species and the type of clean-up response.

Risks to the reputation of fish products could be a problem. Reputation is a sensitive factor, and easily influenced in a negative direction. Pollution incidents could have a major impact, especially at local level. Experience shows that it takes a long time to restore a good reputation.

The Programme may have both positive and negative impacts on tourism. Negative impacts may arise in the event of accidental spills or from the degradation of ecosystems. Oil and gas operators are generally very cautious about their reputation and follow very strict procedures to avoid impacts and to benefit the environment and society where they operate; strict implementation of OSCP procedures in a transparent manner will also help minimize such impacts; the oil and gas industry has proven to be able to coexist with highly touristic and pristine areas as long as strict procedures are followed. Positive impacts are expected from the influx of foreigners who will be interested in exploring the beauty Montenegro and its tourist offers, and they may share their experiences with other people, and from the involvement of operators with tourism promotion as part of their social responsibility schemes in order to further conserve the environment in Montenegro and hence support tourism development. Since tourism in Montenegro is mainly nature-based, the proposed mitigation measures in this study to preserve ecosystems, are expected to enhance nature-based tourism, such as declaring areas that are currently being considered for protection as protected, and prohibiting activities in/ approximate to these areas, and specifying an exclusion zone around these areas. Inter-sectorial planning is of great importance to reduce any possible negative impacts on tourism and enhance positive impacts, especially when setting restrictions to work areas, and for the provision of infrastructure that can be used by the tourism sector as well; also, part of the O&G revenues will support the current development of the country including priority sectors such as tourism and environmental protection.

10.8.1.3 Job Creation

As discussed in baseline chapter, Montenegro suffers from a gap in the labor market between available capacities and labor demand.

The implementation of the programme requires both skilled and unskilled labor. It is an opportunity for unemployed people to be hired and for people to receive training. This would contribute to reducing the unemployment rate while improving the quality of life of the local population. After the decommissioning of the Programme, the expertise gained by the trained personnel will also increase their chances of getting jobs at similar projects. The Operator shall develop a 'Recruitment Strategy' which is based on an assessment of the availability and qualification of local labor. This strategy should seek to maximize the recruitment of skilled and unskilled locals. The Strategy should also seek to minimize the potential for conflicts over the local vs. foreigner share in the employment and maximize training opportunities to local labor.

Indirect employment might also be generated through the supply of goods and services from local and national businesses and manufacturing industries of raw material and intermediate inputs.

10.8.1.4 Conflicts Related to Inflow of Foreign Workers

The lack of specialization in oil and gas industry among the local workforce necessitates the hiring of foreign workers. Conflicts caused by the higher ratio of foreigner to local workforce might emerge, especially that the locals would consider the outsider workforce as intruders and their presence as the reason for their loss of livelihood. This situation could potentially create local frustration resulting in emergence of conflicts that would, in the worst case scenario, end up with acts of vandalism or violence.

10.8.1.5 Change in Demand and Supply of Public Services and Infrastructure

Expenditures and demand from the Programme and large workforce will put pressure on the public services and other services, such as hospitals, transport, housing, etc. Also, the transportation of personnel, goods and materials to the work areas will lead to a rise in the demand for transportation and will increase the pressure of ports that will be used by service vessels. Thus the infrastructure that will be used to support the proposed activities shall be specified and its adequacy to cater for the requirement of proposed activities shall be assessed during the EIA Studies of each phase of the Programme. If new infrastructure services are to be established to support the Programme activities, the planning process shall be conducted in collaboration with other sectors in the coastal region, such as tourism and transport, to optimize the use of the new infrastructure to achieve benefits to other sectors as well.

10.8.1.6 Inflation

Current inflation rate in Montenegro is 0.3%. The increase in demand for goods and services to supply the Programme is expected to create a rise in the overall level of prices. The presence of foreign workforce could lead a new host of services and a larger range of goods being offered in the local markets to satisfy the demand. It is expected that local businesses would want to offer their goods and services at higher prices for the foreign workforce. Such impacts can be mitigated with proper control and monitoring from the competent authorities.

10.8.1.7 Mitigation Measures

- Following the Norwegian model, it is proposed that the majority of the revenues from oil and gas activities shall be deposited in a special fund (sovereign wealth fund) to be used for the needs of future generations. Other revenues will support the current development of the country and will be used to support priority sectors in Montenegro such as tourism and environmental protection.
- Operators are required to check in advance with the Ministry of Transport and Maritime Affairs, the Maritime Safety Department and Fisheries Associations that the proposed activities will not be carried out in an area and at a time that would conflict with legitimate shipping and fishing operations, including both floating and stationary gear, with consequential disruption of both such activities, and the required licenses from the relevant authorities shall be obtained.
- In addition, in the case of a survey planned in an area of intensive fishing, discussions with Fisheries Associations shall be initiated as early as possible, and, in any case, at least 45 days before the planned date in order that the implications can be fully considered. A clear communication plan shall be developed and a fair compensation scheme in case of loss of equipment shall be proposed.
- At the time of submitting a well plan or operation plan for approval, operators shall coordinate with the Transport and Maritime Affairs and the Maritime Safety Department to avoid conflict with shipping and fishing operations.

- Operators are required to notify maritime authorities of the planned schedule for the support vessels movement.
- An OSCP for the different Programme phases is required. The OSCP shall be designed to assist the decision making process during an oil spill, indicate what resources are required to combat the spill, minimize any further discharges and mitigate its effects.
- Any oil spill must be reported immediately, however small. The level and manner of the required oil spill response will be overseen by the Maritime Safety Department, and determined by the volume and type of oil spilled, and the weather and sea conditions at the time.
- The Operator shall develop a clear 'Recruitment Strategy' which is based on an assessment of the availability and qualification of local labor. This strategy should seek to maximize the recruitment of skilled and unskilled locals. The Strategy should also seek to minimize the potential for conflicts over the local vs. foreigner share in the employment and maximize training opportunities to local labor.
- The intent to hire locals shall be highlighted in media outlets, and universities so as to manage expectations.
- The Operator shall prepare and implement a 'Procurement and Supply Strategy' with the aim to maximize benefits to the local, provincial and national economies.
- Infrastructure services that will be used to support the proposed Programme activities shall be specified and its adequacy to cater for the requirement of proposed activities shall be assessed during the EIA Studies of each phase of the Programme. If new infrastructure services are to be established to support the Programme activities, the planning process shall be conducted in collaboration with other sectors in the coastal region, such as tourism and transport, to optimize the use of the new infrastructure to achieve benefits to other sectors as well.
- The competent authorities shall monitor and control the level of prices to avoid inflation.
- As part of their Corporate Social Responsibility Scheme, oil and gas Operators are recommended to investigate opportunities for funding social and health infrastructure projects, and promote tourism, education and scientific research.

10.8.2 Health and Safety Impacts

10.8.2.1 Public Health

Oil and gas exploration and production may entail public health issues especially in the event of accidents.

In the event of blowouts at a rig, various types of air pollutants will be emitted to the air and may cause adverse health problems such as lung and heart disorders, cancers, asthma, and reproductive problems. Since operations are not permitted within 3 Km from the shore, the possibility of these pollutants reaching the shore is dependent on the amount of gases released, weather conditions and wind direction.

Oil causes a variety of public health problems either through direct exposure to oil during a spill or through indirect exposure. Slow leaks of oil and other contaminants from oil drilling and shipping can lead to contamination of fish caught recreationally or commercially. Consumers eating contaminated fish are exposed to these chemicals as well.

Public health and safety problems are common in the event of an oil spill. Acute health effects from the evaporation of volatile oil components can include headaches, nausea, vomiting, eye irritation, worsened asthma symptoms, upper respiratory tract irritation, vertigo, leg and back pains and psychological ailments[1].

Spills can also have psychosocial effects in the communities where they occur. For example, those exposed to the *Exxon Valdez* oil spill and the cleanup efforts which followed were 3.6 times more likely to have generalized anxiety disorder and 2.1 times more likely have developed post-traumatic stress disorder than those who were not exposed.[2]

Besides the direct impacts, food (fish and shellfish) and water supplies can become contaminated as the result of a spill[3].

10.8.2.1.1 Mitigation Measures

- Discharges to air and sea shall be according to international standard limits presented in previous sections.
- Mitigation measures presented in Section 10.3.6, 10.4.6 and 10.5.7 shall be implemented to mitigate the impacts from accidental events.

10.8.2.2 *<u>Workers Health</u>*

Workers in the offshore oil and gas industry might be subject to several health and safety issues including:

Environmental health issues can mainly arise from exposure to high levels of noise and vibration, air pollutants and radioactive materials.

Personal health issues include water quality, food hygiene, legionnaire's disease and other outbreaks of infection. Whilst generally well controlled by the industry, these issues continue to have the potential for widespread illness and loss of life.

Psychological health issues

The offshore environment is potentially stressful because the workforce lives and works in one restricted location for a significant period of time without a break. A wide range of hazardous duties are carried out in a confined space and in an environment which has the potential for the rapid escalation of hydro-carbon-related incidents. Life offshore has been described as dangerous, arduous and socially isolating[4]. The offshore employees may suffer adverse

[1] Palinskas, L., et al. (1993) Community patterns of psychiatric disorders after the Exxon Valdez oil spill, Am. J. Psychiatry, 150:1517-1523.
[2] D O'Rourke and S Connolly 97. (2003) Just oil? The distribution of environmental and social impacts of oil production and consumption, Annual Review of Environment and Resources. 17:587-617.
[3] Exxon Valdez Oil Spill Trustee Council. Human Uses-Subsistence, http://www.evostc.state.ak.us/ recovery/status_human_subsistence. cfm
[4] Safety and related issues pertaining to work on offshore petroleum installations Tripartite Meeting on Safety and Related Issues Pertaining to Work on Offshore Petroleum Installations, Geneva, 1993, document no. TMPOI/1993.

impacts in many ways that could lead to psychological ill-health, alcohol problems, drug abuse, cumulative stress trauma litigation and other[1].

Risks of hazards

Major hazard risks that can cause injuries or death to workers include:

- **Fire and explosion:** Fire and explosion can result from the ignition of any released hydrocarbon. Typical sources of hydrocarbon releases (HCRs) are the well, the pipeline riser, other pipe lines and pipe work and associated process plant. Releases can occur from either failure of the asset itself due to corrosion, abrasion or fracture, or because of failures of maintenance e.g. poor practice when breaking and re-making joints, or insufficient operational controls. HCRs can also result from damage due to other failures e.g. dropped objects during crane operations.

  Floating production installations have a higher rate of HCRs in comparison to fixed installations. Operators of these installations need to act to make sure they eliminate HCRs.

- **Loss of stability /Loss of station:** Floating installations are also of concern because they can lose stability and buoyancy following collisions, loss of control of ballast systems and environmental action. They can also lose station through failures of anchors and tethers or engine problems.

- **Structural failure:** It includes structural failure of a major element of an offshore structure due to corrosion, fatigue, overloading or impact from, for example, vessels or dropped objects.

Offshore workers are also exposed to a range of hazards associated with **manual handling, use of chemicals, slips and trips**. The accident rates offshore are currently about half that of onshore construction and onshore industrial activities and are slightly lower than onshore wholesale/retail activities[2].

Mechanical handling and crane operations present a significant risk to people. Crane operations and dropped objects that could damage plant are also potential major hazard precursor events. These remain one of the most prevalent causes of reportable dangerous occurrences offshore.

Risks associated with **diving** and diving-related operations include a dropped diving bell or sudden decompression of a saturation system.

10.8.2.2.1 Mitigation Measures

- All these risks prevail across the offshore industry. Effective management and control remains central to the continued safety of every offshore installation. It is also essential that where control measures fail, measures to mitigate risks are in place, for example, gas detection systems and fire deluge arrangements. Escape, Evacuation and Rescue measures (EER) should also be in place for occasions when other

[1] Stress prevention in the offshore oil and gas exploration and production industry, Dr. Valerie J. Sutherland, Professor Cary L. Cooper Manchester Institute of Science and Technology, 1996.
[2] Oil & Gas UK Health & Safety Report 2013.

combined measures have failed. Systems should not just be in place but tested to ensure plant and equipment works when required. It is crucial that personnel are competent and understand how to interpret warnings and take necessary action.

- Hazard identification and risk assessment studies must be prepared for each facility to ensure operators have identified all risks and put appropriate control measures in place before offshore installations come into operation. Safety studies should be a mandatory requirement to demonstrate that offshore facilities are safe in their specific operating environment. Risks of seismic activity and possible impacts from changes in sea level as a result of climate change (refer to Section 5.3.4) have to be considered.
- Operator HSE plan and Emergency Response Plan shall be prepared according to best practice.
- Qualified paramedic shall be present onboard all the time to address health issues and concerns of staff.
- HSE Officer must be present onboard to ensure HSE plan is well applied, and workers abiding to it.
- Personal exposure limits to radiation shall be periodically measured, and proper PPE shall be worn. Flares shall be designed in a way to ensure workers are exposed to safe levels of heat radiation.
- Noise levels shall be maintained below IFC occupational noise levels.
- Industrial hygiene measures include general housekeeping and maintenance of all areas on the drilling vessel.
- The living environment must provide suitable conditions in which workers can relax and recuperate from the demands of the job, and which includes:
  - the ability to get adequate sleep; that is, undisturbed sleep of a quality and quantity necessary to restore physical and mental equilibrium;
  - a balanced and adequate diet;
  - leisure and recreational activities; and
  - feeling safe and secure.

10.9 CUMULATIVE IMPACTS

Cumulative impacts occur as a result of a number of activities, discharges and emissions combining or overlapping, potentially creating a significant impact. Potential cumulative impacts could arise as a result of impacts resulting from O&G activities interacting or combining with those from other activities taking place Offshore Montenegro. These may include, for example, marine scientific research, commercial fishing, and shipping. Possible cumulative impacts include:

- Cumulative noise of seismic and drilling activities with other users of the sea:

Other users the sea may include merchant shipping, fishing and marine scientific research. Table 10.9 shows some indicative sound levels of various users of the sea. This table shows that, in general, sound levels of all these users are attenuated to below levels expected to cause any effects on marine mammal or fish behavior within 1 km from the source (with the exception of seismic surveys).

With a 500 m exclusion zone in place around each drilling rig, the interaction of underwater drilling noise with those noises generated by other users of the sea is unlikely to cause a significant cumulative effect, due to the transitory and temporary nature of the various other activities. In addition, any other vessel in the vicinity, with the exception of those vessels servicing the rig itself, will be passing, and any cumulative effect will be of short duration.

Due to the high sound levels generated by seismic surveys, underwater sounds are more likely to interact with other users of the sea at some level. However, any interaction with passing vessels is expected to be of short duration, and no significant cumulative impacts are expected to arise as a result of such encounters.

- Disturbance to sea bed

Other activities taking place offshore Montenegro which lead to physical disturbance of the sea bed include commercial fishing for demersal or benthic species and telecommunications cable installation. However, there are no available data quantifying the area of seabed affected by fishing activity and telecommunications cable installation, and it is likely that the additive effect resulting from implementing of the Programme would be relatively small.

- Atmospheric emissions

Other sources of atmospheric emissions include merchant shipping and fishing vessels with no fixed sources of air emissions offshore Montenegro. Air pollutant emissions from all offshore sources are expected to have negligible cumulative local impacts on air quality due to the dispersive nature of the offshore environment. At a national level, no data have been seen specifically for shipping emissions to the atmosphere in Montenegro. However, Transport accounted for 7.6% of the total country GHG emissions in 2003; road traffic accounted for almost 90% of energy consumption in the transport sector. Shipping is therefore a minor component of emissions nationally. Thus the cumulative impacts on air quality are not considered to be significant.

- Discharges to Sea

Sources of discharges to sea at the distance of more than 3 km from the shore include routine discharges of fishing and shipping vessels which shall be compliant with MARPOL regulations similar to the discharges from O&G activities since discharges to sea of produced water, drilling cuttings and drilling fluids are not allowed. These sources even when combined are expected to have negligible impacts on offshore water quality.

10.10 TRANSBOUNDARY IMPACTS

ESPOO Convention defines a transboundary impact as: "Any impact not exclusively of a global nature, within an area under the jurisdiction of a Party caused by a proposed activity the physical origin of which is situated wholly or in part within the area under the jurisdiction of another party".

Article 15, clause 9 of the SEA Law of Montenegro ("Official Gazette of MNE", No. 80/05, „ OG of MNE, No. 73/10, 40/11) requires that the potential significant transboundary impacts on the environment shall be defined; also Article 18 on Transboundary Impacts stipulated that when there is the possibility of transboundary impacts, the competent state environmental protection authority shall initiate the procedure of exchange of information on transboundary impacts set forth by Article 23 of the SEA Law. Article 23 describes the procedures and requirements for the exchange of information on transboundary impacts.

Also the Guidelines on Strategic Environmental Impact Assessment (SEA directives) (2001/42) of European Parliament and the Convention on Environmental Impact Assessment in a Transboundary Context (1991) - "ESPOO Convention" requires informing the country that is expected to be affected by transbounday impacts.

Neighboring countries that are most likely to be affected from the Programme are mainly Croatia and Albania. Albania is likely to be affected by the transboundary impacts since some of the license blocks are located adjacent to maritime boundaries between Montenegro and Albania. Croatia might be affected from oil spills since the direction of surface currents is towards the north in the Adriatic Sea.

As discussed in previous sections, most of the impacts from the programme are localized within the immediate vicinity of facilities and unlikely to affect neighboring countries. However, the following activities have the potential to cause transboundary impacts:

- Noise from seismic activities will be limited in scale and of very short duration; however, in view of the possibility that seismic survey vessels may enter waters of neighboring countries (i.e. Albania), noise may have impacts on marine mammals in the neighboring country within a range of a several hundred meters of a typical airgun array, particularly if they swim beneath the array.
- Seismic vessel activity may have the potential to interact with shipping travelling through the seismic activity area from ports of other countries, thus a notification shall be given to maritime affairs in foreign countries that have ships planning to travel through the activity area during the time of the activity.
- Accidental oil/chemical spills are the main concern of transboundary impacts. Any oil/chemical spill likely to have impacts in waters of a neighboring country shall be reported to the relevant authorities in that country. Factors important in determining oil spill impacts and recovery rates include the type of oil, the thickness of shore deposits, climate and season, the biological and physical characteristics of the area, the relative sensitivity of species and communities and the type of clean-up response.
- The possibility of transboundary impacts from a shallow gas blowout would be reservoir specific. Atmospheric emissions could potentially have transboundary effects, although they would be dependent on the type and volume of gas released into the atmosphere in addition to the accident location.
- Disposal of discharges from drilling activities and hazardous waste outside Montenegro might have impacts on waste management infrastructure in the country where wastes are to be disposed. Such impacts shall be discussed during Transboundary Consultations.

11. ENVIRONMENTAL MANAGEMENT FRAMEWORK

11.1 SUMMARY OF PROPOSED MITIGATION MEASURES

Mitigation refers to the "elimination, reduction or control of the adverse effects of the policy, plan or program, and includes restitution for any damage to the environment caused by such effects through replacement, restoration, compensation or any other means". Priority is given to impact avoidance, followed by minimization and then compensation.

As seen in the previous assessment sections, without any controls or mitigation, the proposed Programme has the potential to impact the environment in a number of ways. The mitigating measures first proposed for avoidance and/or reduction of the key environmental impacts assessed in Section 10 are brought together below.

11.1.1 Prospecting Phase

11.1.1.1 Noise Generating Activities

Planned Control Measures

No planned control measures were identified.

Proposed Mitigation Measures

- Reducing the noise entering the marine environment is the main measure in minimizing the impacts of seismic survey operations. Therefore, all seismic operations should use the lowest practicable power levels throughout the survey and only discharge pressure waves into the marine environment when necessary and after a suitable '**soft' start** to allow time for marine mammals, turtles and fish to move away before the array reaches full power. The process should begin with the smallest source in an array and build up slowly over 20 to 40 minutes.
- **Visual monitoring** – Beginning at least 30 minutes before startup during daylight hours, visual observers should monitor a safety (exclusion) zone of 500 meters radius around the survey vessel. Startup of the array cannot begin until the safety zone is clear of marine mammals and turtles for at least 20 minutes.
- **Shutdown of the array** – Visual monitoring of the sea surface should continue while the seismic array is operating during daylight hours, and the array should be shut down if a whale, monk seal, or sea turtle enters the safety zone during visual monitoring.
- **Night-Time operations** – monitoring of a safety zone for marine mammals and turtles is required during the daytime, then a similar procedure should be used at night, or surveys should be limited to daylight hours only.
- The timing and location of cetacean calving and migrations should be considered when planning a seismic survey, and if possible avoided. This will have to be assessed at a later stage during the impact assessment phase.
- As fish eggs and larvae are most at risk from the impacts of seismic activities, sensitive fish spawning areas should be avoided at known breeding times.

11.1.1.2 Atmospheric Emissions

Planned Control Measures

No planned control measures have been identified.

Proposed Mitigation Measures

Although Montenegro has not ratified MARPOL Annex VI. It is proposed that the limits and recommendations of the annex be implemented given their relevance to the Programme.

MARPOL Annex VI sets limits on sulfur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances.

Annex VI prohibits deliberate emissions of ozone depleting substances, which include halons and chlorofluorocarbons (CFCs). New installations containing ozone-depleting substances are prohibited on all ships. However, new installations containing hydro-chlorofluorocarbons (HCFCs) are permitted until 1 January 2020.

Annex VI also sets limits on emissions of nitrogen oxides (NOx) from diesel engines. A mandatory NOx Technical Code, which defines how this shall be done, was adopted by the Conference under the cover of Resolution 2.

The Annex also prohibits the incineration onboard ship of certain products, such as contaminated packaging materials and polychlorinated biphenyls (PCBs).

11.1.1.3 Physical Presence

Planned Control Measures

- It is assumed that survey vessels would use appropriate signals in accordance with International Maritime Law (including communications via radio, lights, and flags) to warn other vessels of the exclusion zone.
- Operators shall identify and map subsea infrastructure and avoid operations in such areas.

Proposed Mitigation measures

- The oil and gas industry operators are required to check in advance with the Ministry of Transport and Maritime Affairs, the Maritime Safety Department and Fisheries Associations that the proposed survey will not be carried out in an area and at a time that would conflict with legitimate shipping and fishing operations, including both floating and stationary gear, with consequential disruption of both such activities, and the required licenses from the relevant authorities shall be obtained.
- In addition, in the case of a survey planned in an area of intensive fishing, discussions with Fisheries Associations shall be initiated as early as possible, and, in any case, at least 45 days before the planned date in order that the implications can be fully considered. A clear communication plan shall be developed and a fair compensation scheme in case of loss of equipment shall be proposed.
- Surface positioning of the survey vessel should be based on augmented global navigation satellite systems (GNSS), e.g. Differentially Corrected GPS (DGPS) or Clock and Orbit Corrected GPS (also referred to as SDGPS or Precise Point Positioning PPP)

that typically yield sub-meter positioning accuracy. It is recommended that two fully independent surface positioning systems should be used and would be operated in line with the Guidelines for GNSS (Global Navigation Satellite System) Positioning in the Oil and Gas Industry, issued jointly by OGP (Oil & Gas Producers) and IMCA (International Marine Contractors Association). It describes good practice for the use of global satellite navigation systems (GNSS) in, among other, offshore survey and related activities for the oil and gas industry.

11.1.1.4 Effluent Discharges

Planned Control Measures

- Survey vessels shall comply with the requirements of MARPOL and the Offshore Protocol of Barcelona convention including provisions concerning sewage, food waste, oily waste, and garbage.
- An environmental auditor shall be present on board to ensure compliance with regulations and permit conditions as well as planning logistics corridors responsibly, including timing of trips generated.
- Ships must comply with the requirements of Ballast water management convention, and ballast water shall be discharged in accordance with the regulations of the convention.

Recommended Mitigation

No additional mitigation is recommended.

11.1.1.5 Sea Floor Disturbance

Planned Control Measures

No planned control measures have been identified.

Recommended Mitigation

Locations of sensitive benthic communities and archaeological sites shall be identified and survey routes shall avoid them. A prior approval from related authorities on survey routes shall be obtained.

11.1.1.6 Accidental Events

Planned control measures

- Under MARPOL, ships including seismic survey vessels are required to have in place a Shipboard Oil Pollution Emergency Plan (SOPEP). The SOPEP will contain the necessary reporting procedures and actions required to control discharge, and the steps necessary to initiate an external response for any spills.

Proposed mitigation measures

- Selection of a survey contractor with demonstrable planned preventative maintenance procedures will lead to fewer emissions and equipment failures. In addition, training of staff at all levels in environmental awareness will encourage best practice.

- A full risk assessment against accidental events should be performed as part of survey design. Procedural controls, stemming from industry-standard guidelines and best practice procedures, will limit the possibility of accidental events. Quality procedures, incorporating the tenet of continuous improvement, apply and should be considered at the contractor selection stage.

11.1.2 Exploration Phase

11.1.2.1 Noise Generation

Planned Control Measures

No planned control measures have been identified.

Proposed Mitigation Measures

Depending on the type of facility and their moorings, it is known that certain drilling facilities generate more underwater noise than others, with drill ships and semi-submersibles operating on DP being the noisiest. The selection of drilling facility can, therefore, be used to reduce the amount of sound entering the marine environment. However, it is understood that the choice of drilling rig is generally dictated by other factors.

11.1.2.2 Physical Presence of the Drill and the Support Vessels

Planned Control Measures

- It is assumed that the rig and support vessels would use appropriate signals in accordance with International Maritime Law (including communications via radio, lights, and flags) to warn other vessels of the exclusion zone.
- Operators shall map the subsea telecommunication cables to avoid physical damage.

Proposed Mitigation Measures

- A safety Buffer zone of 500 m around the drilling area shall be maintained. The buffer zone will be kept clear of all unauthorized vessels and monitored by radar and visual observation.
- Before conducting any sea floor disturbing activities, surveys shall be conducted to identify the locations of coral communities and protected benthic species. After identification of these locations, operators shall maintain a separation distance of at least 100 m from the location of all proposed sea floor disturbances (including those caused by anchors, anchor chains, and wire ropes).
- Before conducting any sea floor disturbing activities, work sites shall be surveyed by marine archaeologists to identify any underwater archaeological sites and shipwrecks. Findings and recommendations shall be submitted to the Sector for Cultural Heritage of the Ministry of Culture to specify the required exclusion zone

around the identified sites and a permit to conduct the proposed activities at each well site shall be acquired.

- At the time of submitting a well plan for approval, operators shall inform fishermen through the Fisheries Associations. In addition, in the case of a well-planned in an area of intensive fishing, discussions with the Fisheries Associations must be initiated as early as possible, and preferably not less than 90 days before planned commencement of drilling.
- At the time of submitting a well plan for approval, operators shall coordinate with the Transport and Maritime Affairs and the Maritime Safety Department to avoid conflict with shipping and fishing operations.
- In the event of a well being suspended, over-trawlable protection should be put in place in areas most used for demersal fishing activities.
- Surface positioning of the rig and survey vessel should be based on augmented global navigation satellite systems (GNSS). It is recommended that two fully independent surface positioning systems should be used and would be operated in line with the Guidelines for GNSS (Global Navigation Satellite System) Positioning in the Oil and Gas Industry, issued jointly by OGP (Oil & Gas Producers) and IMCA (International Marine Contractors Association).
- To avoid the impacts on birds especially migratory birds, It is recommended to: 1)use fewer lights as much as practical; 2) use low intensity lights; 3) avoidance of the use of white lights (White lights are the least favorable choice for lighting structures) and 4) Use strobing lights instead of steady lights.

11.1.2.3 Discharge of Drill Cuttings

Planned Control Measures

- Discharges at sea from drilling activities including drilling cuttings and drilling fluids are not allowed. Operators will have to discharge these waste and wastewater streams at available facilities outside Montenegro.
- Authorities require hazardous waste classification to be done in accordance with both the European Union system for European Waste List codes (EWL) and the prevailing local Montenegrin waste management laws (Law on Waste Management (Official Gazette of the Republic of Montenegro, No 80/05, Official Gazette of Montenegro, No 73/08; 64/11) and the Rulebook on the manner of treatment of waste oils (OG MNE No. 48/12).

Proposed Mitigation Measures

Operators have to identify final disposal locations and acquire the required permits to transport and dispose drilling cuttings at available treatment and disposal facilities outside Montenegro.

11.1.2.4 Other Effluent Discharges

Planned Control Measures

- Drilling rigs and support vessels must comply with MARPOL requirements including provisions concerning sewage, food waste, oily waste, and garbage.
- Vessels must comply with Ballast Water Management Convention requirements for the management of ballast water and reduce the risk of introduction of invasive species.

Proposed Mitigation Measures

No additional mitigation is recommended.

11.1.2.5 Atmospheric Emissions

Planned Control Measures

None has been identified.

Proposed Mitigation Measures

- Although Montenegro has not ratified MARPOL Annex VI. It is proposed that the limits and recommendations of the annex be implemented. MARPOL Annex VI sets limits on sulfur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone-depleting substances including halons and chlorofluorocarbons. MARPOL also sets limits on emissions of nitrogen oxides from diesel engines and prohibits the incineration of certain products on board such as contaminated packaging materials and polychlorinated biphenyls.
- The main sources of atmospheric emissions from drilling activity will be from fuel use and potentially from well testing or flaring of produced hydrocarbons. In terms of fuel use, measures can be taken from an early stage to include fuel efficiency in the selection process for drilling rigs, support ships and helicopters, and to use low sulfur fuel for example.
- With regard to well testing, emissions may also be influenced by careful selection of drilling rig and contractors and by the use of maximum efficiency 'green' burners to minimize incomplete combustion, black smoke, and hydrocarbon fallout to the sea. (in the case of oil or condensate wells). The amount of fuel flared can also be minimized by appropriate design of the test programme. If appropriate, well testing systems that do without the need for flaring at all (closed chamber well tests) can be built into the test programme. Volumes of hydrocarbons flared should be recorded.
- It is also recommended that an air dispersion modelling study be prepared as part of the environmental impact assessment study for the drilling activities to better assess the potential of impacts on air quality in the coastal reason, and an estimation of GHG emissions from the drilling activities shall be prepared to assess the impacts on a global level.

11.1.2.6 Accidental Events

Hydrocarbon Spills

Planned Control Measures

- Under Annex 1 of MARPOL Convention, ships (including drilling rigs) are required to have in place a Shipboard Oil Pollution and Emergency Plan (SOPEP). The SOPEP will contain the necessary reporting procedures and actions required to control discharge, and the steps necessary to initiate an external response for any spills.

Proposed Mitigation Measures

- The crew of the drilling rig/ship should undergo environmental awareness and safety training. All equipment used on the rig/ship should have safety measures built in to minimize the risks of any oil spillage. A two-barrier well control policy should be implemented at all times as a minimum. Primary well control (i.e. mud hydrostatic) and secondary well control (blow-out preventers or BOPs) should be maintained throughout the drilling of a well. A full risk assessment should be performed as part of the planning phase of the well.
- The drilling rig or ship should have built-in safety measures to minimize the risk of an oil spillage, notably blow-out preventers, and fuel-transfer hoses.
- As the highest risk of diesel spillage occurs during re-fuelling (bunkering) operations at sea, all bunkering should take place during suitable weather conditions, preferably in daylight hours, and a continuous watch should be posted during the operations. The bunkering hoses should be segmented and have pressure valves that, in the event of a drop in pressure within the line as a result of loss of diesel, will close, preventing the further release of diesel.
- An OSCP is required. The OSCP shall be designed to assist the decision making process during an oil spill, indicate what resources are required to combat the spill, minimize any further discharges and mitigate its effects.
- Any oil spill must be reported immediately, however small. The level and manner of the required oil spill response will be overseen by the Maritime Safety Department, and determined by the volume and type of oil spilled, and the weather and sea conditions at the time.
- Any oil spill likely to have impacts in waters of neighboring countries shall be reported by the Coast Guard to the relevant authorities in the country likely to be affected.

Chemical Spills and Gas Blowout

- The potential for shallow gas should be identified and minimized by site survey prior to drilling.
- The BOP is installed to prevent gas blowout once drilling has progressed beyond the riserless stage.
- Gas detection systems are installed on mud shakers to give early indication of any potential for gas blowout.
- Training in safety awareness and response procedures for drilling crews will ensure that the risk of a blowout will be minimized, and be able to make the appropriate response should one occur.

11.1.3 Development and Production Phase

11.1.3.1 Facility and Pipelines Installation

Planned Control Measures

Operators shall identify and map existing subsea infrastructure.

Proposed Mitigation Measures

- Operators proposing to construct production facilities within the license area shall conduct all required surveys to evaluate the presence of coral communities and protected benthic species around each proposed facility location. Operators shall maintain a separation distance of at least 100 m between the location of proposed sea floor disturbances and these communities (if present).
- Before conducting any sea floor disturbing activities, work sites shall be surveyed by marine archaeologists in addition to conducting a remote sensing survey to identify any underwater archaeological sites and shipwrecks. Findings and recommendations shall be submitted to the Sector for Cultural Heritage of the Ministry of Culture to specify the required exclusion zone around the identified sites and a permit to conduct the proposed activities at each well site shall be acquired.

11.1.3.2 Presence of Structures

Planned Control Measures

- It is assumed that the platform and support vessels would use appropriate signals in accordance with International Maritime Law (including communications via radio, lights, and flags) to warn other vessels of the exclusion zone.

Proposed Mitigation Measures

- A safety Buffer zone of 500 m around the platform shall be maintained. The buffer zone will be kept clear of all unauthorized vessels and monitored by radar and visual observation.
- To avoid the impacts on birds especially migratory birds, it is recommended to: 1) use fewer lights as much as practical; 2) use low intensity lights; 3) avoidance of the use of white lights (White lights are the least favorable choice for lighting structures) and 4) Use strobing lights instead of steady lights.
- Surface positioning of the platform and survey vessel should be based on augmented global navigation satellite systems (GNSS). It is recommended that two fully independent surface positioning systems should be used and would be operated in line with the Guidelines for GNSS (Global Navigation Satellite System) Positioning in the Oil and Gas Industry, issued jointly by OGP (Oil & Gas Producers) and IMCA (International Marine Contractors Association).

11.1.3.3 Drilling Discharges

Planned Control Measures

- Discharges at sea from drilling activities including drilling cuttings and drilling fluids are not allowed. Operators will have to discharge these waste and wastewater streams at available facilities outside Montenegro. This will require vessels movement in the sea to transport the cuttings to the disposal locations during the drilling period.
- Authorities require hazardous waste classification to be done in accordance with both the European Union system for European Waste List codes (EWL) and the prevailing local Montenegrin waste management laws (Law on Waste Management (Official Gazette of the Republic of Montenegro, No 80/05, Official Gazette of Montenegro, No 73/08; 64/11) and the Rulebook on the manner of treatment of waste oils (OG MNE No. 48/12).

Proposed Mitigation Measures

- Operators have to identify final disposal locations and acquire the required permits to transport and dispose drilling cuttings at available treatment and disposal facilities outside Montenegro.

11.1.3.4 Operational Discharges

Planned Control Measures

- Discharges at sea from drilling activities including produced water are not allowed. Operators will have to discharge such wastewater streams at available facilities outside Montenegro.
- Offshore platforms and support vessels must comply with MARPOL requirements including provisions concerning sewage, food waste, oily waste, and garbage.
- Vessels must comply with Ballast Convention requirements for the management of ballast water to reduce the possibility of introduction of invasive species.

Proposed Mitigation Measures

- Operators have to identify final disposal locations of drilling discharges including produced water and acquire the required permits to transport and dispose drilling cuttings at available treatment and disposal facilities outside Montenegro.

11.1.3.5 Atmospheric Emissions

Planned Control Measures

NO planned control measures have been identified.

Proposed Mitigation Measures

- Although Montenegro has not ratified MARPOL Annex VI. It is proposed that the limits and recommendations of the annex be implemented. MARPOL Annex VI sets limits on sulfur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone-depleting substances including halons and chlorofluorocarbons. MARPOL also sets limits on emissions of nitrogen oxides from diesel engines and prohibits the incineration of certain products on board such as contaminated packaging materials and polychlorinated biphenyls.

- Fuel efficiency measures shall be taken in the selection process for platform, support ships and helicopters.
- Before flaring is adopted, feasible alternatives for the use of the gas should be evaluated to the maximum extent possible and integrated into production design.
- If flaring is necessary, continuous improvement of flaring through implementation of best practices and new technologies should be demonstrated. The following pollution prevention and control measures should be considered for gas flaring:
  - Use of efficient flare tips, and optimizing the size and number of burning nozzles;
  - Maximizing flare combustion efficiency by controlling and optimizing flare fuel/air/steam flow rates to ensure the correct ratio of assist stream to flare stream;
  - Minimizing flaring from purges and pilots, without compromising safety, through measures including installation of purge gas reduction devices, flare gas recovery units, inert purge gas, soft seat valve technology where appropriate, and installation of conservation pilots;
  - Minimizing risk of pilot blow-out by ensuring sufficient exit velocity and providing wind guards;
  - Use of a reliable pilot ignition system;
  - Installation of high integrity instrument pressure protection systems, where appropriate, to reduce over pressure events and avoid or reduce flaring situations;
  - Minimizing liquid carry over and entrainment in the gas flare stream with a suitable liquid separation system;
  - Minimizing flame lift off and/or flame lick; Operating flare to control odor and visible smoke emissions (no visible black smoke);
  - Implementation of burner maintenance and replacement programs to ensure continuous maximum flare efficiency;
  - Metering flare gas.
- An air dispersion modelling study be prepared as part of the environmental impact assessment study for the operation activities to better assess the potential of impacts on air quality in the coastal reason, and an estimation of GHG emissions from the operation activities shall be prepared to assess the impacts on a global level.

11.1.3.6 *Support Activities*

Planned Control Measures

No Planned Control Measures were identified.

Proposed Mitigation Measures

- Licensees are required to notify maritime authorities of the planned schedule for the support vessels movement.

- Habitats of seabirds, particularly the habitats of the endangered species (*Melanitta fusca*) and vulnerable species (*Clangula hyemalis*), in addition the important birds areas in the coastal zone, shall be mapped and avoided by survey vessels and helicopters.

11.1.3.7 *Accidental Events*

Refer to Section 11.1.2.6.

11.1.4 *Impacts from Hydrocarbon Usage*

11.1.4.1 *Impacts from Installation of Subsea Pipelines*

An environmental impacts assessment shall be conducted for the proposed pipelines.

Route selection for subsea pipelines shall consider maintaining a distance of 100 m from sensitive benthic communities, subsea telecommunication cables and underwater archaeological sites. All required surveys shall be conducted prior to route selection.

11.1.4.2 *Impacts from the Construction and Operation of Gas Treatment Plant*

- Environmental impact assessment shall be conducted for the gas plant, and site and process selection options shall be assessed. A waste management plan shall be submitted as part of the EIA.
- Site selection of Gas treatment plant shall consider maintaining a distance of not less than 500 m form the following areas:
  - Protected areas, important bird areas and habitats of protected and important species;
  - Water courses, such as rivers and lakes;
  - Areas of archeological importance and tourist areas;
  - Areas of significant landscape features; and
  - Populated areas.
- A protection zone of a minimum of 500 m shall be maintained around the gas treatment plant, where unauthorized access shall not allowed.
- Gas plant process design shall consider minimizing atmospheric emissions from venting and flaring.

11.1.4.3 *Impacts from the Construction and Operation of the Junction Point with the Export Pipelines*

- Environmental impact assessment shall be conducted and site and process selection options shall be assessed. A waste management plan shall be submitted as part of the EIA.
- Site selection of the junction point shall consider maintaining a distance of not less than 500 m form the following areas:

- Protected areas, important bird areas and habitats of protected and important species;
- Water courses, such as rivers and lakes;
- Areas of archeological importance and tourist areas;
- Areas of significant landscape features; and
- Populated areas.

11.1.4.4 Impacts from the Construction and Operation of Pipelines on land

- An environmental impact assessment study shall be prepared for the proposed pipelines, and route selection options shall be assessed considering avoidance of crossing with sensitive areas/ receptors.
- Modern technologies shall be applied to guarantee the integrity of the pipeline system including provision of pipeline external coating, cathodic protection, Leak Detection System (LDS)… etc.

11.1.4.5 Impacts from Crude Oil Storage and Export

Planned Control Measures

- Tankers shall use appropriate signals in accordance with International Maritime Law (including communications via radio, lights, and flags) to warn other vessels of the exclusion zone.
- Tankers must comply with Ballast Water Management Convention requirements for the management of ballast water.
- Tankers must comply with MARPOL requirements including provisions concerning sewage, food waste, oily waste, and garbage.
- Limits and recommendations of MARPOL Annex VI shall be implemented. MARPOL Annex VI sets limits on sulfur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone-depleting substances including halons and chlorofluorocarbons. MARPOL also sets limits on emissions of nitrogen oxides from diesel engines and prohibits the incineration of certain products on board such as contaminated packaging materials and polychlorinated biphenyls.

Proposed Mitigation Measures

- The crew of tanker should undergo environmental awareness and safety training. All equipment used on the tankers should have safety measures built in to minimize the risks of any oil spillage. A full risk assessment should be performed.
- An OSCP is required. The OSCP shall be designed to assist the decision making process during an oil spill, indicate what resources are required to combat the spill, minimize any further discharges and mitigate its effects.
- Any oil spill must be reported immediately, however small. The level and manner of the required oil spill response will be overseen by the Maritime Safety Department,

and determined by the volume and type of oil spilled, and the weather and sea conditions at the time.

- Any oil spill likely to have impacts in waters of neighboring countries shall be reported by the Coast Guard to the relevant authorities in the country likely to be affected.

11.1.5 Impacts during Decommissioning Phase

Planned Control Measures

- Comply with the requirements of the Offshore Protocol of Barcelona Convention regarding removal of installations.

Proposed Mitigation Measures

- A preliminary decommissioning plan for offshore facilities should be developed that considers well abandonment, removal of oil from flowlines, facility removal, and sub-sea pipeline decommissioning along with disposal options for all equipment and materials. This plan can be further developed during field operations and fully defined in advance of the end of field life. The plan should include details on the provisions for the implementation of decommissioning activities and arrangements for post decommissioning monitoring and aftercare.
- Licensees should be required to follow international best practice for safe structure removal including monitoring for marine mammals and turtles if explosives are to be used.
- Marine fouling should preferably be removed while the installation is still offshore. Oil, scale, structural water and ballast water should if possible be removed while the installation is still offshore Hazardous waste must be suitably packaged, pipelines must be plugged, and good routines must be in place for labelling, packaging and sorting waste.
- Decommissioning facilities (on shore) must be designed to allow safe handling different types of waste, including hazardous waste such as heavy metals and NORM wastes, with no risk of runoff or infiltration into the soil. In addition, a decommissioning facility should have an effective collection system and an on-site treatment plant for contaminated water, including surface water. Each facility must have a sampling and analysis programme to monitor releases of the most relevant pollutants. The need for an environmental monitoring programme to follow developments in the recipient should also be considered. Other factors that must be closely monitored at decommissioning facilities include noise and releases to air in connection with metal cutting and other operations. Moreover, decommissioning contracts must ensure that the costs of handling hazardous waste are met by the offshore operators.

11.1.6 Socioeconomics and Health

11.1.6.1 Socioeconomics

- Following the Norwegian model, it is proposed that the majority of the revenues from oil and gas activities shall be deposited in a special fund (sovereign wealth fund) to be used for the needs of future generations. Other revenues will support the current development of the country and will be used to support priority sectors in Montenegro such as tourism and environmental protection.

- Operators are required to check in advance with the Ministry of Transport and Maritime Affairs, the Maritime Safety Department and Fisheries Associations that the proposed survey will not be carried out in an area and at a time that would conflict with legitimate shipping and fishing operations, including both floating and stationary gear, with consequential disruption of both such activities, and the required licenses from the relevant authorities shall be obtained.
- In addition, in the case of a survey planned in an area of intensive fishing, discussions with Fisheries Associations shall be initiated as early as possible, and, in any case, at least 45 days before the planned date in order that the implications can be fully considered. A clear communication plan shall be developed and a fair compensation scheme in case of loss of equipment shall be proposed.
- At the time of submitting a well plan or operation plan for approval, operators shall coordinate with the Transport and Maritime Affairs and the Maritime Safety Department to avoid conflict with shipping and fishing operations.
- Operators are required to notify maritime authorities of the planned schedule for the support vessels movement.
- An OSCP for the different Programme phases is required. The OSCP shall be designed to assist the decision making process during an oil spill, indicate what resources are required to combat the spill, minimize any further discharges and mitigate its effects.
- Any oil spill must be reported immediately, however small. The level and manner of the required oil spill response will be overseen by the Maritime Safety Department, and determined by the volume and type of oil spilled, and the weather and sea conditions at the time.
- The Operator shall develop a clear 'Recruitment Strategy' which is based on an assessment of the availability and qualification of local labor. This strategy should seek to maximize the recruitment of skilled and unskilled locals. The Strategy should also seek to minimize the potential for conflicts over the local vs. foreigner share in the employment.
- The intent to hire locals shall be highlighted in media outlets, and universities so as to manage expectations.
- The Operator shall prepare and implement a 'Procurement and Supply Strategy' with the aim to maximize benefits to the local, provincial and national economies.
- As part of their Corporate Social Responsibility Scheme, oil and gas Operators are recommended to investigate opportunities for funding social and health infrastructure projects, and promote tourism, education and scientific research.

11.1.6.2 *Health and Safety*

Public Health

- Discharges to air and sea shall be according to international standard limits presented in previous sections.
- Mitigation measures presented in Section 10.3.6, 10.4.6 and 10.5.7 shall be implemented to mitigate the impacts from accidental events.

Workers Health

- All these risks prevail across the offshore industry. Effective management and control remains central to the continued safety of every offshore installation. It is also essential that where control measures fail, measures to mitigate risks are in place, for example, gas detection systems and fire deluge arrangements. Escape, Evacuation and Rescue measures (EER) should also be in place for occasions when other combined measures have failed. Systems should not just be in place but tested to ensure plant and equipment works when required. It is crucial that personnel are competent and understand how to interpret warnings and take necessary action.
- A hazardous identification and risk assessment studies must be prepared for each facility to ensure operators have identified all risks and put appropriate control measures in place before offshore installations come into operation.
- Operator HSE plan and Emergency Response Plan shall be prepared according to best practice.
- Qualified paramedic shall be present onboard all the time to address health issues and concerns of staff.
- HSE Officer must be present onboard to ensure HSE plan is well applied, and workers abiding to it.
- Personal exposure limits to radiation shall be periodically measured, and proper PPE shall be worn.
- Noise levels shall be maintained below IFC occupational noise levels.
- Industrial hygiene measures includes general housekeeping and maintenance of all areas on the drilling vessel.
- The living environment must provide suitable conditions in which workers can relax and recuperate from the demands of the job, and which includes:
  - the ability to get adequate sleep; that is, undisturbed sleep of a quality and quantity necessary to restore physical and mental equilibrium;
  - a balanced and adequate diet;
  - leisure and recreational activities; and
  - feeling safe and secure.

11.2 ENVIRONMENTAL AND HUMAN HEALTH MONITORING

Clause 10 of Article 15 of the SEA Law stipulates that the SEA should contain a description of the environmental status monitoring programmes, including human health, during the implementation of the plan or programme.

Monitoring of environmental parameters is critical to assess the status of the environment during Programme implementation and for identifying effectiveness of mitigation measures that were formulated to address the potential environmental and socio-economic effects identified in this SEA Study. With the knowledge of baseline conditions, the monitoring programme will serve as an indicator for any deterioration in environmental conditions due to implementation of the Programme.

Monitoring and reporting of the state of the environment in Montenegro is the responsibility of the Environmental Protection Agency (EPA). EPA is an independent body and the operative implementation authority of the Law on Environmental Protection, it was established in 2008. The EPA outsources the monitoring to several organizations such as the Center for Eco-toxicological Research (CETI), Nature Protection Institute, Public Institute for Development and Research into Occupational Health and Safety (PIDROHS) that monitors environmental noise and the Institute of Marine Biology.

The environmental and socioeconomic indicators proposed in the development of the SEA Framework are the basis of monitoring the changes in the environmental and socio-economic parameters. Parties responsible for the monitoring of these indicators are specified in Table 11.1.

Montenegro adopted a list of 55 national environmental indicators. However the available data allow calculating only 36 of the adopted indicators. The first indicator-based state of environment (SoE) report was produced in 2013 and adopted by the Government in 2014. The SoE is based on the 36 indicators from the adopted list of 55 national indicators.

The monitoring indicators proposed below are composed of indicators from the list of national environmental indicators in addition to other indicators proposed by the SEA Study Team.

In order to affectively monitor any environmental and socio-economic impacts from the Programme, the EPA and other competent authorities shall start the data collection and monitoring of environmental and socio-economic parameters which are not being monitored currently (see Table 11.1) prior to Programme implementation, so that changes in baseline conditions can be detected.

Also, the licensing authority should ensure that an appropriate activity level monitoring programme be devised for evaluating the environmental impacts and efficacy of mitigation measures relating to the key potential environmental issues that were identified as significant. This should be carried out in consultation with the environmental authorities and specialists. Operators will be required to monitor their activities as per the a monitoring programme approved by the licensing authority. Monitoring records shall be submitted to the competent authorities.

Table 11.1 Indicators to be Monitored and Monitoring Responsibility

Sustainability Factors	Monitoring Indicator	Currently Monitored?	Monitoring Responsibility
Ecosystem Protection (Air)	Indicator 1.1 (VA02): Emission of acidifying gases	Yes	EPA -Centre for Eco-toxicological Research (CETI)
	Indicator 1.2 (VA03): Emission of ozone precursors	Yes	EPA -Centre for Eco-toxicological Research (CETI)

Sustainability Factors	Monitoring Indicator	Currently Monitored?	Monitoring Responsibility
	Indicator 1.3 (VA04): Emission of primary suspended particles and precursors of secondary suspended particles	Yes	EPA -Centre for Eco-toxicological Research (CETI)
Climate Change	Indicator 2.1: CO_2 emissions from E&P activities	No	EPA
	Indicator 2.2 (KP04): Trends in greenhouse gas emissions	Yes	EPA
	Indicator 2.3: CO_2 emissions per GDP	Yes	EPA
Acoustic Environment	Indicator 3.1: Percent population exposed to high noise levels	No	Public Institute for Development and Research into Occupational Health and Safety (PIDROHS)
Ecosystem Protection (Water)	Indicator 4.1 (M02): Trend and geographic distribution of concentration of chlorophyll in vertical water column	Yes	EPA -Centre for Eco-toxicological Research (CETI)
	Indicator 4.2 (M03): Nutrients / Concentration of nitrates and phosphates and their ratio	Yes	EPA -Centre for Eco-toxicological Research (CETI)
	Indicator 4.3 (M04): Trophic index (TRIX index) current index is 4	Yes	EPA -Centre for Eco-toxicological Research (CETI)
	Indicator 4.4 (M01): Quality of sea water for swimming (microbiological and physical chemical parameters)	Yes	EPA/ The Institute of Marine Biology.
	Indicator 4.5: Number of spills reaching the coast	No	EPA/ Marine Safety Agency
	Indicator 5.1 (B05): Trend of introduction of invasive species (currently 9 marine invasive species)	Yes	EPA/ Nature Protection Institute- Institute of Marine Biology
Biodiversity and habitat	Indicator 6.1 Number of marine protected areas (currently 0)	Yes	EPA/ Nature Protection Institute
	Indicator 6.2 (B01): Species Diversity Indicator 7.1 *(B07): Change in number and area of protected areas and their floor area*	Yes Yes	*EPA/ Nature Protection Institute- Institute of Marine Biology* EPA/ Nature Protection Institute
	Indicator 8 1: Number of threatened marine mammal species (currently 13 Cetartiodactyla and One (1) seal)	Yes	EPA/ Nature Protection Institute- Institute of Marine Biology
	Indicator 8. 2: Number of injured/killed sea mammals and turtles	No	EPA/ Nature Protection Institute- Institute of Marine Biology

Sustainability Factors	Monitoring Indicator	Currently Monitored?	Monitoring Responsibility
	Indicator 8. 3: Number of injured/killed seabirds	No	EPA/ Nature Protection Institute
	Indicator 8.4: Extent of joint cooperation programmes and projects in the Adriatic Sea	Yes	EPA
Fisheries	Indicator 9.1 (*R01): Biomass state and level of exploitation of fish fund*	Yes	Agriculture and Rural Development(MARD)/ Department of Agriculture and Fisheries/ the Institute of Marine Biology
	Indicator 9.2 (R02) Aquaculture production	Yes	Agriculture and Rural Development(MARD)/ Department of Agriculture and Fisheries/ the Institute of Marine Biology
Intermodal environmental parameters (Reducing Waste & Consumption Pressures)	Indicator 10.1 (*O03):* Generation of hazardous waste	Yes	Ministry of Sustainable Development and Tourism of Montenegro (MSDT) Dept. Waste Management and Community Development Centre for Eco-toxicological Research (CETI)
	Indicator 10.2 *Metric tons of hazardous waste generated by the E&P activities properly managed*	No	Ministry of Sustainable Development and Tourism of Montenegro (MSDT) Dept. Waste Management and Community Development
Intermodal environmental parameters (Exposure to Natural Disasters)	Indicator 11.1: Environmental Hazard Exposure Index	No	EPA/ Ministry of Interior Affairs, Directorate for Emergency Situations
Transboundary Environmental Pressures	Indicator 12.1: Availability of spill contingency and response plans	Yes	EPA
	Indicator 12.2: Number of incidents of transboundary impacts	No?	EPA
Environmental Governance	Indicator 13.1: Environmental officers per active oil and gas fields available and trained to inspect offshore operations	No	EPA/ Ministry of Labor and Social Welfare
Heritage	Indicator 14.1: Number of incidents/ activities that could result in damage to cultural and archaeological heritage sites	No	Ministry of Culture - Center for Conservation and Archaeology of Montenegro
	Indicator 14.2: Allocated funds to preserve/ promote cultural and archaeological heritage sites	Yes	Ministry of Culture - Center for Conservation and Archaeology of Montenegro

Sustainability Factors	Monitoring Indicator	Currently Monitored?	Monitoring Responsibility
	Indicator 14.3: Number of discovered underwater archaeological sites and shipwrecks	Yes	Ministry of Culture - Center for Conservation and Archaeology of Montenegro
Infrastructure	Indicator 15.1: Percent GDP expenditure on infrastructure works	Yes	Ministry of Economy
	Indicator 16.1: Number of accidents related to subsea infrastructure	No?	Ministry for Information Society and Telecommunications
Socio-economy	Indicator 17.1: Employment rate	Yes	EPA/ Ministry of Labor and Social Welfare
	Indicator 17.2: Population with university degree	Yes	Ministry of Education
	Indicator 17.3: Purchasing power of local population	Yes	EPA/ Ministry of Labor and Social Welfare
	Indicator 17.4: Percent local labor working for oil and gas companies or service companies	Yes	EPA/ Ministry of Labor and Social Welfare
	Indicator 17.5: Ratio of local and regional nationalities working in the sector	No	EPA/ Ministry of Labor and Social Welfare
	Indicator 17.6: Crime rate increase	Yes	Ministry of Justice-Police Directorate
	Indicator 17.7: GDP contribution from non-oil sectors	Yes	EPA/ Ministry of Labor and Social Welfare
Tourism	Indicator 18.1 (T01): Tourist arrivals	Yes	Ministry of Sustainable Development and Tourism of Montenegro (MSDT)
	Indicator 18.2 (T04): Number of tourists on cruise lines	Yes	Ministry of Sustainable Development and Tourism of Montenegro (MSDT)
	Indicator 18.3: Investment in alternative modes of tourism	No	Ministry of Sustainable Development and Tourism of Montenegro (MSDT)
Health	Indicator 19.1: Number of health-related institutions (in the coastal area, 6 health care centers, 2 GH, 2 specialized hospitals)	Yes	Ministry of Health - Institute for Public Health (IPH)
	Indicator 19.2: Population with STD	Yes	Ministry of Health - Institute for Public Health (IPH)
	Indicator 19.3: Countries with transboundary cooperation in medical aid	No	Ministry of Health
	Indicator 19.4: Influx people scrutinized with health control measures	No	Ministry of Health - Institute for Public Health (IPH)

Sustainability Factors	Monitoring Indicator	Currently Monitored?	Monitoring Responsibility
	Indicator 19.5: Percent health care staff trained in new types of health conditions	No	Ministry of Health - Institute for Public Health (IPH)
	Indicator 19.6: population with cardiovascular system diseases, respiratory system diseases and cancers	Yes	Ministry of Health - Institute for Public Health (IPH)
Preserve landscapes	Indicator 20.1: Landscape visual quality	No	EPA/ Ministry of Sustainable Development and Tourism of Montenegro (MSDT)
	Indicator 20.2: Acceptability of change in landscape by the public	No	EPA/ The Ministry of Sustainable Development and Tourism of Montenegro (MSDT)

11.3 INSTITUTIONAL FRAMEWORK

Figure 11.1 provides an overview of the institutional framework required to implement the recommendations of this SEA. The figure maps out the various stakeholders and authorities that have a role in the implementation of the Environmental Management Framework (EMF).

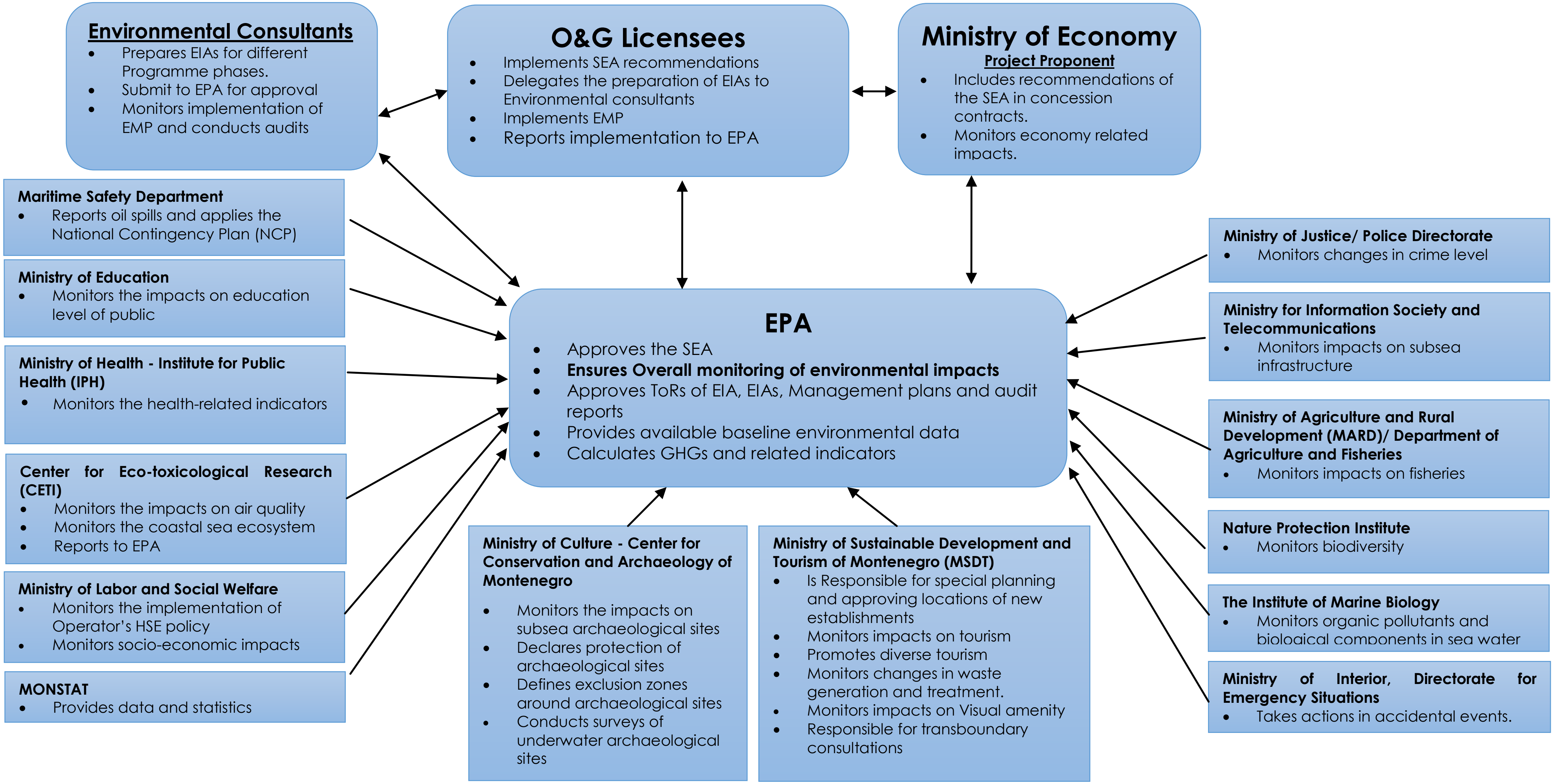

Figure 11.1 Institutional Framework for EMF Implementation

11.4 TRAINING AND CAPACITY BUILDING

Implementation of this EMF requires further capacity building for stakeholders in order to adequately foster it. It is proposed that main stakeholders be trained to become fully familiar with the outcomes of the SEA and this EMF to be able to implement it. Several methods are proposed to effectively raise the capacity of stakeholders to implement the requirements of this SEA:

- Training workshops focusing on improving the understanding of local stakeholders about the oil and gas industry, its lifecycle and associated hazards and understanding the requirements of this SEA
- Study tours to offshore platforms and oil and gas facilities, so stakeholders acquire practical know-how on how to conduct activities (such as inspections, sampling or audits) at such facilities
- Provision of necessary monitoring and inspection equipment to stakeholders depending on their needs
- Introduction of specific programmes in universities and technical schools to prepare the local workforce to serve the oil and gas industry and to maximize local benefits in terms of employment and education

11.5 AUDIT AND INSPECTION

EPA shall conduct regular audits to ensure that this EMF is being properly implemented and to allow improvements to be made with time.

12. CONCLUSIONS AND RECOMMENDATIONS

Purpose of this Strategic Environmental Assessment (SEA) Report is to assess the environmental, social and health impacts Hydrocarbon Exploration and Production (E&P) Activities in Offshore Montenegro, in addition to developing measures for effectively addressing the identified impacts at an early stage of the planning cycle.

The conclusions from the assessment of the potential effects of implementing the draft plan are summarized below.

12.1 CONCLUSIONS

12.1.1 Noise Generation

<u>During seismic surveys:</u> It is generally accepted that the sound caused during seismic surveys has the potential to adversely affect marine organisms but the significance of these effects is the subject of a large number of research studies, notably on marine mammal behavioral responses. While many studies have reported changes in behavior, no universal conclusions have been drawn as to whether they are biologically important [OSPAR Commission, 2009]. Similarly, no conclusive evidence of a link between sounds of seismic surveys and the mortality of any marine mammals has been established. Studies investigating sound-induced effects on other species are relatively scarce. Fish can be particularly vulnerable especially in their early, larval, stages but it appears that seismic-induced effects do not hinder recruitment to fish populations [OSPAR Commission, 2009].

The animals most likely to be affected by sound produced from the seismic survey are baleen whales, beaked whales and seals, as it is believed that most toothed whale species are less affected by the sound frequencies used in seismic operations.

In order to minimize any possible impacts on marine mammals, it is recommended that seismic operations should use the lowest practicable power levels throughout the survey and only discharge pressure waves into the marine environment when necessary and after a suitable 'soft' start to allow time for marine mammals, turtles and fish to move away before the array reaches full power. The process should begin with the smallest source in an array and build up slowly over 20 to 40 minutes. Beginning at least 30 minutes before startup during daylight hours, visual observers should monitor a safety (exclusion) zone of 500 meters radius around the survey vessel. Startup of the array cannot begin until the safety zone is clear of marine mammals and turtles for at least 20 minutes. Visual monitoring of the sea surface should continue while the seismic array is operating during daylight hours, and the array should be shut down if a whale, monk seal, or sea turtle enters the safety zone during visual monitoring. Monitoring is required during the daytime and nighttime, or surveys should be limited to daylight hours only. It is very important that the timing and location of cetacean calving and migrations should be considered when planning a seismic survey, and if possible avoided. As for fish eggs and larvae which are most at risk from the impacts of seismic activities, sensitive fish spawning areas should be avoided at known breeding times.

An Environmental Impact Assessment (EIA) study should be conducted for seismic survey activities whereby exact timing, locations and possible impacts shall be determined and additional mitigation measures identified if required.

During drilling and production, low frequency noises from drilling wells, and all associated vessels, will add to the ambient noise in the exploration area. As most toothed whales have hearing ranges at medium to high frequencies, they are considered to be relatively unharmed by industrial noise, with the possible exception of beaked whales. Although seals are capable of hearing the low frequency sounds generated by a drilling rig over large distances, they are generally believed not to be adversely affected by drilling rig sounds as their hearing is more sensitive to higher frequency ranges. Baleen whales are considered to be potentially at risk at close range, since the frequencies used in their communication noises and assumed levels of hearing overlap with the sound spectra of industrial noises.

The impact of the noise generated is difficult to assess due to uncertainties in how noise affects specific marine mammals, and how far the noise will be transmitted in the sea. However, it is estimated that the underwater noise produced could elicit response from some individual marine mammals if they pass within 1 km of a drilling rig or a platform. It is not likely that such effects would have any significant impacts at the population level.

The selection of drilling facility or a production platform can be used to reduce the amount of sound entering the marine environment. However, it is understood that the choice of drilling rig is generally dictated by other factors.

12.1.2 Discharge of Cuttings and Disturbance to Sea Bed

The discharges of drill cuttings, muds and cement from the top sections of the wells, which are deposited close to the sea bed at the wellheads, are expected to cause impacts at each well site. To avoid such impacts, a policy of not allowing discharges at sea from drilling activities will be adopted; operators will be obliged to discharge cuttings and drilling fluids outside Montenegro. It is important that similar policies be adopted in other countries of the Adriatic to be able to control cumulative impacts.

Disturbance to sea bed is expected during different project phases. Ocean bottom cable surveys (if any), vertical cable surveys, and vertical seismic profile (VSP) surveys may disturb small areas of the sea floor during seismic surveys. During drilling, production and hydrocarbon usage, installing rigs, platforms and pipelines is expected to disturb sea bed. Sea bed-disturbing activities may have impacts on benthic communities including deep-water corals, subsea infrastructure, shipwrecks, or other submerged archaeological resources.

In order to avoid or at least minimize these impacts, operators are required to conduct detailed surveys of the seabed prior to selection of well locations and start of operations. Results of these surveys are presented in the EIA study to support selection of wells and other facilities and to demonstrate that disturbance to seabed has been minimized to the extent possible.

12.1.3 Atmospheric Emissions

Atmospheric emissions will arise from seismic survey vessels, drilling and production activities and from gas treatment onshore.

The resultant emissions offshore will not have any significant localized impacts due to the dispersive nature of the offshore environment. Gas treatment onshore may have impacts on sensitive receptors in the vicinity of the treatment plant; thus site selection is essential to avoid significant adverse impacts on surrounding communities.

The overall air emissions from the different Programme phases will contribute regionally and globally to issues such as global warming, acid rain and air pollution. The acceptability overall needs to be considered in the context of the national energy policy, and national policy for the management of greenhouse gases and commitments to the EU and the Kyoto Protocol. Being a Non-Annex 1 Party of The United Nations Framework Convention on Climate Change, Montenegro is required to periodically prepare GHG inventories as a part of its National Report/ Communication to the UNFCCC and must report on the steps it is taking or envisage undertaking to implement the Convention.

12.1.4 Physical Presence

The number of 2D and 3D seismic surveys that may be undertaken and the duration of surveys will determine the significance of impacts from the physical presence during that phase. Usually surveys are of limited duration and thus the impacts are not expected to be significant. However, to further reduce these impacts, it is recommended that oil and gas industry operators are required to check in advance with the Ministry of Transport and Maritime Affairs, the Maritime Safety Department and Fisheries Associations that proposed surveys will not be carried out in an area and at a time that would conflict with legitimate shipping and fishing operations, including both floating and stationary gear, with consequential disruption of both such activities, and the required licenses from the relevant authorities shall be obtained. In addition, in the case of a survey planned in an area of intensive fishing, discussions with Fisheries Associations shall be initiated as early as possible, and, in any case, at least 45 days before the planned date in order that the implications can be fully considered. A clear communication plan shall be developed and a fair compensation scheme in case of loss of equipment shall be proposed.

The duration of drilling is limited and therefore the impact of the physical presence of the drilling rig and possible suspended wells on fishing and shipping activities is not considered to be significant.

The physical presence of platforms will attract pelagic fishes. Birds may use offshore platforms as stopping places. However migrating birds can become disoriented when encountering a steady artificial light source at night which cause birds to circle the light source for hours, increasing the risk of collision with the lighted structure, decreasing fat reserves, and potentially interrupting migration. Noise and lights may cause minor behavioral changes in marine mammals and sea turtles (e.g., attraction or avoidance). Benthic communities may be affected by sloughing of organic debris from platforms, and by the physical presence of pipelines on the sea floor. Generally, these impacts are not expected to be significant. To avoid the impacts on birds especially migratory birds, It is recommended to use fewer lights as much as practical; use low intensity lights; avoidance of the use of white lights (white lights are the least favorable choice for lighting structures) and use strobing lights instead of steady lights.

Visual impacts from the presence of the platform and rigs on the quality of landscapes are expected and can be mitigated through adequate siting at significant distances from the shore. The government of Montenegro has set a minimum separation distance from the shore of 3 km; this distance shall be confirmed during EIA studies where impact on landscape and visual amenity shall be further confirmed and considered as part of the siting of facilities, where possible.

There will also be a need for on-shore support facilities. The Port of Bar is a good candidate to provide logistics support to the oil and gas operations. The total area of on-shore support facilities including fabrication yards and logistics bases could range from 5 ha (50,000 m^2) in early stages of exploration up to 100 ha (1,000,000 m^2) in the case of multiple platforms operating in the sea. The location of such facilities shall be in line with the spatial land use plans and the facilities shall be subject to EIA studies prior to their deployment.

12.1.5 Accidental Events

Possible accidental events include:

- During seismic surveys: collision with vessels, causing the loss of the streamer oil reservoir and/or diesel fuel from the vessel.
- During exploratory drilling: crude oil spill, chemical spill or gas blowout.
- During Operation: crude oil spill and chemical spill.
- During Hydrocarbon usage: oil spill from tankers (collision with vessels), loss of containment in pipelines and fires/explosions in gas treatment plants.

The probability of such impacts is very small. The actual impacts depend on many factors, including the volume and type of oil spilled / gas fired, and sea and weather conditions, the biological and physical characteristics of the area, the relative sensitivity of species and communities and the type of clean-up response.

The crew of the drilling rig, production platform or gas treatment facility should undergo environmental awareness and safety training. All equipment used should have safety measures built in to minimize the risks of any oil spillage. The installations should have built-in safety measures to minimize the risk of an oil spillage, notably blow-out preventers, and fuel-transfer hoses. Platforms and rigs design and selection shall consider the possible seismic activity in the operation area.

An approved Oil Spill Contingency Plan (OSCP) is required in advance of approval for drilling. This is designed to assist the decision-making process during an oil spill, indicate what resources are required to combat the spill, minimize any further discharges and mitigate its effects. The operator shall consider in the OSCP the possible spill scenarios, the methods to prevent such scenarios, as well as the material and equipment needed to effectively respond to each scenario. Prior to start, the operator shall demonstrate its readiness to implement the OSCP.

In the event of environmental damage, environmental liability shall be determined according to Law No. 27/2014 on environmental liability and the Environmental Liability Directive – Directive 2004/35/EC based on the principle of polluter pays.

12.1.6 Socioeconomic Impacts

The Oil and Gas exploration and production activities in Montenegro are expected to entail social and economic impacts both positive and negative. These include:

- Change in income and income per capita: During production phase, hydrocarbon exploitation is anticipated to lead to a reduction in import bills for gas and a rise in exports, thereby leading to an overall net increase in domestic production. It will also have a positive impact at the national level by reducing shortages of petroleum products and securing power resources in the country.
- Impacts on existing economic activities including fishing, shipping and marine transport from the physical presence and movement of vessels. As discussed earlier these impacts are not expected to be significant with proper mitigation and communication.
- The Programme may have both positive and negative impacts on tourism:
    - Negative impacts may arise in the event of accidental spills or from the degradation of ecosystems. Oil and gas operators are generally very cautious about their reputation and follow very strict procedures to avoid impacts and to benefit the environment and society where they operate; strict implementation of OSCP procedures in a transparent manner will also help minimize such impacts; the oil and gas industry has proven to be able to coexist with highly touristic and pristine areas as long as strict procedures are followed.
    - Positive impacts are expected from investments that oil and gas companies will make as part of their corporate social responsibility in order to further conserve the environment in Montenegro and hence support tourism development; it is also expected that the industry will increase the influx of foreigners who will be interested in exploring the beauty of Montenegro and its tourist offers, and they may share their experiences with other people; last but not least, and as discussed above, part of the O&G revenues will support the current development of the country including priority sectors such as tourism and environmental protection.
- Job creation: The implementation of the programme requires both skilled and unskilled labor. It is an opportunity for unemployed people to be hired and for people to receive training. This would contribute to reducing the unemployment rate while improving the quality of life of the local population. Indirect employment might also be generated through the supply of goods and services from local and national businesses and manufacturing industries of raw material and intermediate inputs. A key policy of the government of Montenegro is to require that oil and gas companies train Montenegrins so that they can gradually join the work force and support the sector, hence reducing the currently high unemployment rate.
- Conflicts related to inflow of foreign workers: The lack of specialization in oil and gas industry among the local workforce necessitates the hiring of foreign workers. Conflicts caused by the higher ratio of foreigner to local workforce might emerge, especially that the locals would consider the outsider workforce as intruders and their

presence as the reason for their loss of livelihood. This situation could potentially create local frustration resulting in emergence of conflicts that would, in the worst case scenario, end up with acts of vandalism or violence. Operators shall develop a clear 'Recruitment Strategy' which is based on an assessment of the availability and qualification of local labor. This strategy should seek to maximize the recruitment of skilled and unskilled locals. The Strategy should also seek to minimize the potential for conflicts over the local vs. foreigner share in the employment, and the intent to hire locals shall be highlighted in media outlets, and universities so as to manage expectations.

- Change in demand and supply of public services and infrastructure: Expenditures and demand from the Programme and large workforce will put pressure on the public services and other services, such as hospitals, transport, housing, etc. Also, the transportation of personnel, goods and materials to the work areas will lead to a rise in the demand for transportation and will increase the pressure of ports that will be used by service vessels. Operators shall prepare and implement a 'Procurement and Supply Strategy' with the aim to maximize benefits to the local, provincial and national economies.
- Inflation: The increase in demand for goods and services to supply the Programme is expected to create a rise in the overall level of prices. The presence of foreign workforce could lead a new host of services and a larger range of goods being offered in the local markets to satisfy the demand. It is expected that local businesses would want to offer their goods and services at higher prices for the foreign workforce.

As part of their Corporate Social Responsibility Scheme, oil and gas Operators are recommended to investigate opportunities for funding social and health infrastructure projects, and promote tourism, education and scientific research.

12.1.7 Health and Safety Impacts

<u>Public Health</u>

Oil and gas exploration and production may entail public health issues especially in the event of accidents.

Oil causes a variety of public health problems either through direct exposure to oil during a spill or through indirect exposure. Slow leaks of oil and other contaminants from oil drilling and shipping can lead to contamination of fish caught recreationally or commercially. Consumers eating contaminated fish are exposed to these chemicals as well. Public health and safety problems are common in the event of an oil spill. Acute health effects from the evaporation of volatile oil components can include headaches, nausea, vomiting, eye irritation, worsened asthma symptoms, upper respiratory tract irritation, vertigo, leg and back pains and psychological ailments such as anxiety disorder and post-traumatic stress disorder.

In the event of blowouts at a rig, various types of air pollutants will be emitted to the air and may cause adverse health effects. However, since operations are not permitted within 3 Km from the shore, the possibility of these pollutants reaching the shore is dependent on the amount of gases released, weather conditions and wind direction.

Impacts of offshore oil and gas activities on public health are however generally expected to be low under normal operation conditions as discharges to air and sea need to follow strict national and international standard limits and policies and given the limited exposure of the general population.

Workers Health

Workers in the offshore oil and gas industry might be subject to several health and safety issues including:

Environmental health issues can mainly arise from exposure to high levels of noise and vibration, air pollutants and radioactive materials. To mitigate these impacts Operator HSE plan and Emergency Response Plan shall be prepared according to best practice and HSE Officer must be present onboard to ensure HSE plan is well applied, and workers abiding to it, and personal exposure limits to radiation shall be periodically measured, and proper PPE shall be worn. Noise levels shall be maintained below IFC occupational noise levels.

Personal health issues include water quality, food hygiene, legionnaire's disease and other outbreaks of infection. Whilst generally well controlled by the industry, these issues continue to have the potential for widespread illness and loss of life. A qualified paramedic shall be present onboard all the time to address health issues and concerns of staff. Industrial hygiene measures includes general housekeeping and maintenance of all areas on the vessel.

Psychological health issues due to the potentially stressful offshore environment as the workforce live and work in one restricted location for a significant period of time without a break. The offshore employees may suffer adverse impacts in many ways that could lead to psychological ill-health, alcohol problems, drug abuse, cumulative stress trauma litigation and other. The living environment must provide suitable conditions in which workers can relax and recuperate from the demands of the job, and which includes:

- the ability to get adequate sleep; that is, undisturbed sleep of a quality and quantity necessary to restore physical and mental equilibrium;
- a balanced and adequate diet;
- leisure and recreational activities; and
- feeling safe and secure.

Risks of hazards such as fires and explosion, Loss of stability /Loss of station, Structural failure and Risks associated chemicals handling and diving and diving-related operations.

Effective management and control remains central to the continued safety of every offshore installation. It is also essential that where control measures fail, measures to mitigate risks are in place, for example, gas detection systems and fire deluge arrangements. Escape, Evacuation and Rescue measures (EER) should also be in place for occasions when other combined measures have failed. Systems should not just be in place but tested to ensure plant and equipment works when required. It is crucial that personnel are competent and understand how to interpret warnings and take necessary action.

Hazard identification and risk assessment studies must be prepared for each facility to ensure operators have identified all risks and put appropriate control measures in place before offshore installations come into operation.

12.1.8 Cumulative Impacts

Cumulative impacts occur as a result of a number of activities, discharges and emissions combining or overlapping, potentially creating a significant impact. Potential cumulative impacts could arise as a result of impacts resulting from O&G activities interacting or combining with those from other activities taking place Offshore Montenegro. These may include, for example, marine scientific research, commercial fishing, and shipping. Possible cumulative impacts include:

- Cumulative noise of seismic and drilling activities with other users of the sea:

Other users the sea may include merchant shipping, fishing and marine scientific research. With a 500 m exclusion zone in place around each drilling rig, the interaction of underwater drilling noise with those noises generated by other users of the sea is unlikely to cause a significant cumulative effect, due to the transitory and temporary nature of the various other activities. In addition, any other vessel in the vicinity, with the exception of those vessels servicing the rig itself, will be passing, and any cumulative effect will be of short duration.

Due to the high sound levels generated by seismic surveys, underwater sounds are more likely to interact with other users of the sea at some level. However, any interaction with passing vessels is expected to be of short duration, and no significant cumulative impacts are expected to arise as a result of such encounters.

- Disturbance to sea bed

Other activities taking place offshore Montenegro which lead to physical disturbance of the sea bed include commercial fishing for demersal or benthic species and telecommunications cable installation. However, there are no available data quantifying the area of seabed affected by fishing activity and telecommunications cable installation, and it is likely that the additive effect resulting from implementing of the Programme would be relatively small.

- Atmospheric emissions

Other sources of atmospheric emissions include merchant shipping and fishing vessels with no fixed sources of air emissions offshore Montenegro. Air pollutant emissions from all offshore sources are expected to have negligible cumulative local impacts on air quality due to the dispersive nature of the offshore environment. At a national level, no data have been seen specifically for shipping emissions to the atmosphere in Montenegro. However, Transport accounted for 7.6% of the total country GHG emissions in 2003; road traffic accounted for almost 90% of energy consumption in the transport sector. Shipping is therefore a minor component of emissions nationally. Thus the cumulative impacts on air quality are not considered to be significant.

- Discharges to Sea

Sources of discharges to sea at the distance of more than 3 km from the shore include routine discharges of fishing and shipping vessels which shall be compliant with MARPOL regulations similar to the discharges from O&G activities since discharges to sea of produced water, drilling cuttings and drilling fluids are not allowed. These sources even when combined are expected to have negligible impacts on offshore water quality.

12.1.9 Transboundary Impacts

Neighboring countries that are most likely to be affected from the Programme are mainly Croatia and Albania. As discussed in previous sections, most of the impacts from the Programme are localized within the immediate vicinity of facilities and unlikely to affect neighboring countries. However, the following activities have the potential to cause transboundary impacts:

- Noise from seismic activities will be limited in scale and of very short duration; however, in view of the possibility that seismic survey vessels may enter waters of neighboring countries (i.e. Albania), noise may have impacts on marine mammals in the neighboring country within a range of a several hundred meters of a typical airgun array, particularly if they swim beneath the array.
- Seismic vessel activity may have the potential to interact with shipping travelling through the seismic activity area from ports of other countries, thus a notification shall be given to maritime affairs in foreign countries that have ships planning to travel through the activity area during the time of the activity.
- Accidental oil spills are the main concern of transboundary impacts. Any oil spill likely to have impacts in waters of a neighboring country shall be reported to the relevant authorities in that country. Factors important in determining oil spill impacts and recovery rates include the type of oil, the thickness of shore deposits, climate and season, the biological and physical characteristics of the area, the relative sensitivity of species and communities and the type of clean-up response.
- The possibility of transboundary impacts from a shallow gas blowout would be reservoir specific. Atmospheric emissions could potentially have transboundary effects, although they would be dependent on the type and volume of gas released into the atmosphere in addition to the accident location.
- Disposal of discharges from drilling activities and hazardous waste outside Montenegro might have impacts on waste management infrastructure in the country where wastes are to be disposed. Such impacts shall be discussed during Transboundary Consultations.

Since significant transboundary impacts might occur in the events mentioned above, transboundary consultations with neighboring countries shall be conducted as per the SEA Law of Montenegro (No. 80/05), EU Directive 2001/42/EC (SEA Directive) and the Law on Ratification of Convention on Environmental Impact Assessment in a Transboundary Context (ESPOO Convention) (OG MNE, No. 08/08-27).

12.2 RECOMMENDATIONS

Recommendation/ mitigation measures for each phase of the Programme are presented in section 11.1. In addition the following is to be followed prior to any Oil and Gas activity:

1- It is recommended to establish an "Environmental Management Unit/ Committee" responsible for Oil and Gas Exploration and Production under the jurisdiction of the EPA, this unit shall have representatives from all concerned stakeholders (presented in Section 11.3). The Unit shall be responsible for preparations of ToRs for EIA studies; review and approval of EIA studies; monitor compliance of Operators with the environmental management plans; shall receive and review periodic reports from the Operator on discharges to air, water, in addition to waste generation, management and disposal reports; shall be responsible for monitoring of impacts from O&G activities on the environment through the monitoring of the proposed indicators in this SEA (Table 11.1); and shall advise on any required corrective actions or further monitoring. It is recommended that members of civic society be represented in this committee to ensure transparency and full representation.

2- It is recommended to ratify the Offshore Protocol of Barcelona Convention, which will form a legal obligation for licenses to abide with.

3- It is recommended that the National Contingency Plan (NCP) be reviewed and updated in light of the Oil and Gas Exploration and Production. The plan shall support individual OSCP to be developed by future operators for their individual blocks.

4- Marine areas that are currently being considered for protection shall be declared as protected, and Licensees shall not be permitted to conduct activities in/ approximate to these areas. An exclusion zone shall be specified around these areas (not less than 500 m).

5- Underwater shipwrecks and archeological sites shall be surveyed, mapped and an exclusion zone around these sites shall be specified based on their importance prior to start of any activity by an operator.

6- Environmental impact assessment studies shall be prepared for each proposed E&P activity according to the Law on Environmental Impact Assessment (Official Gazette of the Republic of Montenegro, No 80/05, Official Gazette of Montenegro, No 40/10, 73/10, 40/11 and 27/13). The current SEA provides a substantial amount of information that will provide a base for the subsequent EIA studies, however, the assessment is conducted at a high level and shall be subject to detailed assessment during EIA studies as more information becomes available on the techniques to be used (i.e. type of seismic surveys, type of drilling rigs, type of production platforms and the usage of extracted hydrocarbons). During the course of the EIAs, the following shall be conducted for the proposed activity:

   - Surveys of benthic species including coral communities. Exclusion zones shall be defined around areas of sensitive/ protected species.
   - Survey of mammal species, turtles and seals which could be present in the study area during the time of the proposed activity.

- Defining and mapping birds' migration routes and time of migration, and habitats of marine birds.
- Survey of underwater shipwrecks and archeological sites (if not conducted at earlier stage).
- Survey of water quality and bottom sea sediments quality.
- Defining important fishing areas within the area of the proposed activity.
- Defining and mapping water ways crossing the area of the proposed activity.
- Survey of underwater noise levels; and conducting an underwater noise modelling study (for seismic activities) to define the zones around noise sources in which sea mammals, turtles and seals would be at risk.
- Conducting air dispersion modelling studies for drilling, production activities and for gas treatment plants.
- Specifying land based infrastructure that will be used to support the proposed activity (such as ports and airports). The adequacy of existing infrastructure to cater for the requirement of proposed activity shall be assessed.
- Preparation of a waste management plan that considers the recommendations presented in Section 7.4.
- The site selection of proposed land based activities (especially for gas treatment plants and pipelines during hydrocarbon usage phase) shall be based on an analysis of alternatives, and shall avoid and keep a distance from:
    - o Protected areas, important bird areas and habitats of protected and important species;
    - o Water courses, such as rivers and lakes;
    - o Areas of archeological importance and tourist areas;
    - o Areas of significant landscape features; and
    - o Populated areas.

7- It is recommended to adopt and enforce the policies proposed by the authorities to ensure that oil and gas activities are conducted in a sustainable and environment friendly manner, which include:

- not allowing discharges at sea from drilling activities (drilling cuttings, drilling fluids and produced water);
- obliging oil and gas operators to dispose of hazardous solid wastes resulting from their activities at existing facilities available outside Montenegro;
- not allowing unnecessary emissions to the air;
- enforcing strict procedures to be followed by oil and gas operators to avoid accidents and chemicals/hydrocarbon releases in the Adriatic Sea, including the

preparation and prior approval of a spill contingency and response plan before starting any activities.

8- Since significant transboundary impacts might occur during accidental events, transboundary consultations with neighboring countries shall be conducted as per the SEA Law of Montenegro (No. 80/05), EU Directive 2001/42/EC (SEA Directive) and the Law on Ratification of Convention on Environmental Impact Assessment in a Transboundary Context (ESPOO Convention) (OG MNE, No. 08/08-27).

9- Potential Areas for Environmental Regional Cooperation include:

- Environmental Policies of Joint Interest (discharge of muds and cuttings, produced water, protection of cetaceans and marine habitats);
- Shared infrastructure (waste management, on-shore support facilities);
- Transboundary environmental impacts and emergency response; and
- Environmental training and sharing of know-how and expertise.

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14. APPENDICES

APPENDIX A : LEGAL AND POLICY ANALYSIS

No.	Regulations/Strategies/Plans	Key Requirements	Implications to the Programme
1.	Constitution of Republic of Montenegro ("Official Gazette of MNE", No. 1/07)	Constitution defines Montenegro as ecological country.	During EP activities, everyone is obliged to protect nature and cultural heritage of general interest.
2.	Law on Environment („Official Gazette of MNE", No. 48/08, 40/10, 40/11)	The Law sets out: environmental principles and sustainable development principles, subjects and instruments for environmental protection, public participation in environmental matters and other issues important for environment.	During activities it is mandatory to adhere to the law to protect all the segments of environment.
3.	Law on Strategic Environmental Impact Assessment ("Official Gazette of MNE", No. 80/05, „ Official Gazette of MNE, No. 73/10, 40/11)	The Law sets out conditions, manner and procedure for assessing environmental impacts of certain plans and programmes, by integrating environmental protection principle, approval and realization of plans and programmes that have substantial impact on environment.	Programme of offshore hydrocarbon exploration and production is subject to an SEA.
4.	Law on Environmental Impact Assessment ("Official Gazette of MNE" No. 80/05, Official Gazette of MNE" No. 40/10, 73/10, 40/11, 27/13)	The Law sets process for assessment of impacts of projects which can have significant environmental impacts.	EIA is required for every separate project for EP activities with potential for significant environmental impacts. This will include at least seismic surveys, exploratory and production drilling activities, full development programme and decommissioning activities.
5.	Law on Liability for Environmental Damage ("Official Gazette of MNE" No. 27/14)	Law sets out process for determining liability for environmental damages as well as implementation of prevention measures.	During EP activities, there could be damages in the environment; the Law sets out two principles which need to be adhered to during EP activities: - Polluter payer and - Mandatory insurance.
6.	Law on Chemicals (OG MNE No. 07/11, 18/12)	The Law sets out classification, packing and labelling chemicals, import and export of hazardous chemicals as well as other issues of importance for protection of human lives and health and environment from harmful impacts of chemicals.	Pursuant to EP activities, it is strictly mandatory to adhere to this Law.
7.	Law on Inspection Supervision (OG MNE No. 76/09)	The Law sets out principles of inspection supervision.	Inspection needs to be performed to ensure regular controls during E&P activities.
8.	Law on Integrated Prevention and Control of Environmental Pollution (OG MNE No. 80/05, OG MNE No. 54/09, 40/11)	Sets out prevention and control of environmental pollution by issuing integrated permit for facilities and activities that may have negative impact on human health, environment and material resources.	Depending on development scenario, permits will need to be secured in accordance with this law.
9.	Law on Coastal Zone (OG MNE No. 14/92, 27/94, OG MNE	The law sets out management of the coastal zone and	Given that EP activities are carried out in the

No.	Regulations/Strategies/Plans	Key Requirements	Implications to the Programme
	No. 51/08 and 21/09)	seabed, its usage, improvement and protection.	coastal zone, provisions of this law need to be adhered to.
10.	Law on Waste Management (OG MNE No. 80/05, 73/08, 64/11)	The Law sets out basic legal framework for waste management and conditions for application of National Strategic Master Plan for Solid Waste Management.	Given that EP activities generate waste, provisions from this law need to be adhered to.
11.	Law on Noise Protection in Environment (OG MNE No. 28/11, 28/12, 01/14)	This law sets out measures for prevention or reduction in harmful impact of noise on environment.	E&P will lead to increase in noise levels so it is necessary to implement measures set out by this law to prevent or mitigate harmful impacts.
12.	Law on Air protection (OG MNE No.air10, 40/11)	This law sets out manner of monitoring air quality, protection measures, air quality assessment and improvement as well as air quality planning and management.	E&P can lead to negative impacts on air quality, so it is necessary to abide by this law particularly in terms of emissions monitoring and reporting and preventive and control measures to minimize impacts on air quality.
13.	Law on Utilities (OG MNE No.12/95)	This law sets out utilities and principles, general conditions and manner of conducting utility activities.	Utilities need to be provided in accordance with this law.
14.	Law on Protection from Ionisation Radiation and Radiation Safety (OG MNE No.56/09, 58/09, 40/11)	This law sets out protection of environment and human lives and health from harmful impacts of ionization radiation, performance of radiation activity, transport of sources of ionization radiation and radioactive materials, management of radioactive waste, procedures in case of accidents or other environmentally important issues for protection from ionization radiation and radiation safety.	EP activities can result in usage of ionization radiation during their implementation so it is necessary to abide by the provisions from this law. E&P activities may also generate NORM Wastes (Naturally Occurring Radioactive Materials), which will need to be managed in accordance with the provisions of this law.
15.	Law on Protection Against Non-Ionizing Radiation (OG MNE No.35/13 of 23.07.2013)	This Law sets out protection of human lives and health which operate with sources of non-ionization radiation or in the process of work are located in the field of non-ionization radiation (professionally exposed persons) and protection against harmful impact of non-ionization radiation and other issues of importance for protection from non-ionization radiation.	During EP, there can be usage of non-ionization radiation activities, so it is necessary to adhere to the provisions of this law.
16.	Law on Nature Protection (OG MNE No. 51/08, 21/09, 40/11, 62/13, 06/14)	This law sets out principles of nature protection and preservation. Pursuant to article 8 planning, development and usage of space and natural resources and assets, can be performed solely based on spatial planning and design documents, maps and programmes for management and usage of natural resources and assets in mining, energy production, traffic, maritime affairs, water management, agriculture, forestry, hunting, fisheries, tourism and other activities that impact the nature in accordance with measures and conditions for nature protection set out for the purpose of	EP activities may negatively affect fauna and also sensitive ecosystems depending on the location of the activities. Measures should be considered to avoid or minimize such impacts through careful planning, site selection and establishment of adequate emergency response plans.

No.	Regulations/Strategies/Plans	Key Requirements	Implications to the Programme
		preservation of nature values. Plans, maps, programmes and projects shall include measures and requirements for nature protection set out by Law.	
17.	Law on National Parks (OG MNE No. 56/09)	This law establishes company for national parks management.	E&P should be carried on in a way not to impact national parks Primarily through the careful selection of locations of the activities.
18.	Law on Exploration and Production of Hydrocarbon (OG MNE No. 41/10 and 10/11)	Law on Exploration and Production of Hydrocarbon (OG MNE No. 41/10 and 10/11) is aligned with EU Directive (94/22/EK). With its approval, Montenegro allowed for the future production of hydrocarbon to be conducted in a transparent manner and in accordance with best international practices.	During EP, the law needs to be adhered to.
19.	Law on Energy (OG MNE No. 28/10 of 14.05.2010, 40/11, 42/11, 6/13)	This law sets out energy activities and conditions and manner of their execution. This law includes liabilities stemming from second energy package (2003/54/EC and 2003/55/ EC for Electric Power and Gas) of EU legislation, as well as specific liabilities in accordance with Directive of Renewable Sources (2001/77/EC and 2009/28/ EC, except in regards to bio fuel), on cogeneration (2004/8/ EC) and in part in oil and oil product reserves (2009/119/ EC).	During EP, the law needs to be adhered to.
20.	Law on Spatial Development and Construction (OG MNE No. 51/08, 40/10, 34/11, 40/11, 47/11, 35/13, 39/13)	This laws sets out system for spatial development of Montenegro, manner and terms of construction as well as other issues of relevance from spatial development and construction of structures.	During EP, the law needs to be adhered to.
21.	Law on Sea (OG MNE No. 17/07, 06/08, 42/07)	This Law sets out marine and submarine space of Montenegro, i.e.: internal marine waters, territorial sea, exclusive economic zone, epicontinental shelf, ban on sailing into, stopping and ship exile.	E&P activities are clearly related to this law and should abide by it.
22.	Law on protection of sea from pollution from vessels (OG MNE No. 20/11 of 15.04.2011)	This law enabled application of Barcelona and MARPOL convention, as well as other rulebooks and recommendations from International Marine Organisation and Mediterranean organisations within UN System.	Necessary adherence to provisions of this law aimed at preventing or reducing pollution of the marine environment from vessels. E&P activities involves several types of vessels including at least survey vessels, logistics support vessels, and waste transportation vessels.
23.	Law on Ports (OG MNE No. 51/08, 27/13)	This law sets out: legal status, division of ports, management, fees, concessions, order, inspection supervision and other issues relevant for ports in Montenegro.	During EP, the law needs to be adhered to. E&P activities shall require the utilization of ports.
24.	Law on Marine Safety (OG MNE No. 62/13, 06/14)	This laws sets out requirements for marine structures, crew and vessels that sail within territorial sea of Montenegro for the safety of marine sale and other issues which secure safety of marine sale.	EP marine structures, crew and related vessels should adhere to the requirements of this Law.
25.	The Law on Geological Explorations (OG MNE No. 28/93,	This law sets out requirements and manner of execution of geological explorations.	During E&P, provisions of this law need to be adhered to.

No.	Regulations/Strategies/Plans	Key Requirements	Implications to the Programme
	27/94, 42/94, 26/07 and 28/11)		
26.	Law on Olive Tree Growing (OG MNE No. 15/92, 59/92).	This law sets out manner and requirements for olive tree growing.	Depending on the EP development scenario, E&P provisions of this law need to be adhered to especially if onshore activities could impact areas where olive trees are grown.
27.	Law on Roads (OG MNE No. 42/04, 21/09 and OG MNE No. 54/09, 40/10, 73/10, 36/11, 40/11)	This law sets out legal status, development, maintenance, protection, management and funding of public roads	Depending on the EP development scenario, provisions of this law need to be adhered to.
28.	Law on Tourism (OG MNE No. 61/10, 40/11, 53/11)	Sets out manners and conditions under which tourist and hospitality activities are conducted, sets out tourism promotion and measures for development of Montenegrin tourist offer.	Ministry of Economy should ensure that E&P activities are in line with the provisions of this Law and do not negatively affect tourist offer in Montenegro.
29.	Law on Protection of Cultural Assets (OG MNE No. 49/10)	This law sets out types and categories of cultural assets, manner of establishing protection, regime and protection measures.	During EP activities, it is necessary to adhere to this law.
30.	Law on Marine Culture and Fishery (OG MNE No.56/09, 40/11)	Sets out affairs regarding marine fishery and marine culture as biological resources.	Fish and other marine organisms, as well as biodiversity of sea are protected from environmental endangerment and excessive usage. During EP activities, it is necessary to adhere to this law.
31.	Law on Railways (OG MNE No.27/13, 43/13)	This law sets out terms and manner of managing railway infrastructure and manner of conducting transportation in railroad traffic.	Depending on E&P development scenario, during EP activities, it is necessary to adhere to this law.
32.	Law on Agriculture and Rural Development (OG MNE No.56/09, 18/11, 40/11)	This Law sets out development of agriculture and rural areas.	Depending on E&P development scenario, during EP activities, it is necessary to adhere to this law. Ministry of Economy should ensure that E&P activities do not negatively affect agriculture and rural development.
33.	Law on Agricultural Land (OG MNE No.15/92, 59/92 and 4/93, 27/94, 73/10, 32/11)	Land, as asset of general interest, has special protection and is used under conditions and in a manner set out by this law. All types of land that can be used for agricultural production are regarded as agricultural land. Agricultural land can be temporarily or permanently used for non-agricultural purposes.	Depending on E&P development scenario, during EP activities, it is necessary to adhere to this law. No E&P activities should be undertaken on land classified as agricultural land unless as stipulated in the provisions of this law.
34.	Law on Waters (OG MNE No. 27/07)	This laws sets out status and manner of managing all types of water resources and water structures, as well as other issues of relevance for management of water resources.	During EP activities requiring the utilization of water resources, provisions of this law shall apply.
35.	Law on Ratification of Convention on Biological Diversity (OG SRY-International Agreements, No.11/01-28")	Objectives of this convention are preservation of biological diversity and sustainable management of its components.	Provisions of the Convention are incorporated in national legislation on nature protection in respect to the section that could be important for the implementation of EP activities.

No.	Regulations/Strategies/Plans	Key Requirements	Implications to the Programme
36.	Law on Ratification of Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) (OG MNE – International Agreements, No.06/08-147")	Objective is to preserve onshore, offshore and bird migratory species within the area of their spread.	Provisions of the Convention are incorporated in national legislation on nature protection in respect to the section that could be important for the implementation of EP activities. Special provisions should be taken to avoid impacts on migratory bird species during E&P activities.
37.	Law on ratification of the Convention on the Conservation of European Wildlife and Natural Habitats (Berne Convention) (OG MNE No.7)	Its objective is to preserve wildlife and its natural habitats. Special stress is on endangered or vulnerable species including endangered and vulnerable migratory species.	Provisions of the Convention are incorporated in national legislation on nature protection in respect to the section that could be important for the implementation of EP activities.
38.	Law on Ratification of Convention on Wetlands (Ramsar Convention) (OG SFRY, No. 09/77-675)	Promotes approach per ecosystems whereas water ecosystems are observed as a whole. Ramsar convention attaches special attention to population of migratory birds which raises questions in regards to connections between central areas.	Provisions of the Convention are incorporated in national legislation on nature protection in respect to the section that could be important for the implementation of EP activities.
39.	Law on Ratification of Convention Concerning the Protection of the World Cultural and Natural Heritage (OG SFRY", No.56/74-1771)	Protects cultural and natural heritage of extreme world value by means of, amongst others, registering every location of world heritage (World Heritage Sites).	Provisions of the Convention are incorporated in national legislation on nature protection in respect to the section that could be important for the implementation of EP activities.
40.	The Law on Ratification of the European Convention on Areas (OG MNE No. 006/08-135)	Objective of the Convention is to promote protection of areas, management, planning and organisation of European cooperation on areas.	Provisions of the Convention are incorporated in national legislation on nature protection in respect to the section that could be important for the implementation of EP activities.
41.	Law on Ratification of Convention on International Trade in Endangered Species of Wildlife (CITES Convention) (OF SRY" – International Agreements, No. 11/01-3)	The Convention refers to trade in endangered species. All the species from CITES list are on regime of import CITES permits for import and CITES export permits for export.	Provisions of the Convention are incorporated in national legislation on nature protection in respect to the section that could be important for the implementation of EP activities.
42.	Law on Ratification of Framework Convention on UN Climate Changes (OG SRY", No.02/97-71)	Sets framework for international action against negative impacts of climate change. The Convention recognises climate system as common resource whose stability can be endangered by industrial and other sources of GHG and CO2 emissions.	EP activities result in emission of CO2 and other GHG.
43.	Law on Ratification of Kyoto Protocol linked to UN Framework Convention on Climate Change (OG MNE No.17/07 of 27.03.2007)	Is operationalization of the UNFCCC Convention by establishing mandatory target values for reduction of GHG for developed countries.	EP activities result in emission of CO2 and other GHG.
44.	Law on Ratification of Vienna Convention for the Protection of the Ozone Layer (OG SRY, No. 01/90-3)	The Convention refers to protection of ozone layer that protects the Earth from harmful radiations.	During EP activities, it is necessary to adhere to this law.
45.	Law on Ratification of Montreal Protocol on Substances that Deplete the Ozone Layer (OG SRY No.16/90-3)	It is based on general framework, objectives and principles established with the Convention and it refers to the same differences between industrialized countries and developing countries.	During EP activities, it is necessary to adhere to this law.
46.	Law on Ratification of The Convention on Long-range Transboundary Air Pollution (OG SFRY", No. 11/86-3)	Objective of the Convention is to limit and gradually decrease and prevent air pollution including transboundary	During EP activities, it is necessary to adhere to this law. E&P activities are likely to generate

No.	Regulations/Strategies/Plans	Key Requirements	Implications to the Programme
		air pollution.	substantial air emissions leading to long-range transboundary air pollution.
47.	Law on Ratification of Stockholm Convention on Persistent Organic Polluters	Objective is to develop inventory of chemicals on the list of Stockholm Convention.	During EP activities, it is necessary to adhere to this law. POPs most relevant to E&P activities are dioxins and furans and possibly PCBs
48.	Law on Ratification of Convention on Environmental Impact Assessment in a Transboundary Context (ESPOO Convention) (OG MNE, No. 08/08-27)	Provisions of this Convention do not affect the right of the parties to implement national laws, regulations, administrative provisions or accepted legal practices that protect information whose distribution would be harmful for industrial and commercial secrecy or national safety. However it does set procedures for EIA studies where transboundary impacts are likely to occur.	E&P activities are likely to cause transboundary impacts, particularly in the event of spills. EIAs of such activities should comply with the provisions of this law.
49.	Law on Ratification of Protocol on Strategic Environmental Impact Assessment in Transboundary Context (OG MNE, International Agreements, No. 2/2009-19)	Objective of this Protocol is to provide high degree of environmental protection including health, by setting clear, transparent and efficient procedures for strategic environmental impact assessment;	SEA is issued for E&P. It should comply with the necessary provisions to account for transboundary impacts.
50.	The Law on Ratification of Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (hereinafter referred to as "the Basel Convention") (OG SRY", of 25th December, 1999.)	Aiming to implement the Convention, set of laws and by-laws on waste management were passed.	Hazardous waste can be generated during E&P activities, so it is necessary to adhere to the law provisions particularly for such wastes that require treatment and disposal outside Montenegro.
51.	Law on Ratification of Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, usually known as the Aarhus Convention (Aarhus Convention) (OG MNE – International Agreements, No. 03/09 of July 31st, 2009)	Objective of the Convention is right to access to information, public participation in decision-making in environmental matters, in accordance with provision of this convention.	Free access to information needs to be ensured during all E&P activities.
52.	Law on Ratification of Barcelona Convention for Protection against Pollution in the Mediterranean Sea (OG MNE, No. 64/07)	Objective is to implement all relevant measures in accordance with provisions of this Convention and valid protocols of member states, to prevent, reduce, suppress and to eliminate pollution in the Mediterranean in the greatest possible extent and thus protect and promote marine environment in that area so as to contribute to its sustainable development.	EP activities may result in pollution of marine environment; it is necessary to implement protection measures.
53.	Law on Ratification of Protocol Concerning Cooperation in Preventing Pollution from Ships and, in Cases of Emergency, Combating Pollution of the Mediterranean Sea (OG MNE, No. 64/07)	The objective is to prevent pollution from vessels.	EP activities may results in pollution of marine environment thus it is necessary to implement protection measures.
54.	Law on Ratification of Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources and Activities (OG MNE No. 64/07)	Objective is the prevent sea pollution from land-based sources of pollutions.	Depending on EP development scenario, marine environment could be polluted from the land-based sources. Protection measures need to be put in place.
55.	Law on Ratification of Protocol Concerning Specially	Objective is protection of biodiversity by passing action plans.	During EP activities, it is necessary to adhere to

No.	Regulations/Strategies/Plans	Key Requirements	Implications to the Programme
	Protected Areas and Biological Diversity in the Mediterranean (OG MNE No.. 64/07)		this law and approved plans.
56.	Law on Ratification of Protocol on Integrated Coastal Zone Management in the Mediterranean	Objective is to set framework for integrated Mediterranean coastal area management and implementation of necessary measures to strengthen regional cooperation for that purpose.	During EP activities, it is necessary to adhere to this law.
57.	Law on Ratification of Agreement on the Conservation of Cetaceans in the Black Sea Mediterranean Sea and Contiguous Atlantic Area – ACCOBAMS (OG MNE No. 007/08-2)	Objective is to protect wales and dolphins and to undertake concrete measures and conduct monitoring.	During EP activities, it is necessary to adhere to this law. E&P offshore activities are likely to negatively affect Cetaceans.
58.	Law on Ratification of European Landscape Convention (Florence Convention)	The Convention is aimed at the protection, management and planning of all landscapes and raising awareness of the value of a living landscape	During EP activities, it is necessary to consider the impacts on landscape from drilling rigs and platforms
59.	Law on Ratification of IMO Ballast Water Management Convention	The Convention includes technical standards and requirements in the regulations for the control and management of ships' ballast water and sediments.	During EP activities, it is necessary to adhere to the requirements of the convention.
60.	Rulebook on Closer Content and Manner of Keeping Records of Environmental Polluters (OG MNE No. 43/10)	This Rulebook sets content and manner of keeping records of environmental polluters.	During EP activities, it is necessary to adhere to this Rulebook. Operators need to maintain records of emissions according to the requirements of the Rulebook.
61.	Rulebook on the manner of treatment of waste oils (OG MNE No. 48/12)	This Rulebook sets procedures for treatment of waste oils in accordance with technical technological requirements for waste oil treatment.	During EP activities, it is necessary to adhere to this Rulebook
62.	Rulebook on Development and Production of Hydrocarbon in Montenegro (OG MNE No. 07/14)	This rulebook sets closer content of DP hydrocarbon.	During EP activities, it is necessary to adhere to this Rulebook
63.	Rulebook on Condition for Drills and Construction of EP hydrocarbon plant (OG MNE No. 07/14)	This rulebook sets manner of drills registration, preparation and content of plans and programmes for drills, reporting on operating and collecting and submitting samples.	During EP activities, it is necessary to adhere to this Rulebook
64.	Rulebook on Closer Manner and Required Documentation for Issuing Permits on Permitted Air Pollutant Emissions (OG MNE No. 25/13, 61/13)	Permit on Permitted Emissions of air polluters is issues based on documents and manner set out by this rulebook.	During EP activities, it is necessary to adhere to this Rulebook
65.	Rulebook on Requirements for Environmental Protection during operating with hydrocarbons (OG MNE No. 60/12)	Sets out measures for operating with hydrocarbons, for the purpose of environmental protection, in addition to legal environmental protection measures, other regulations, norms and standards	During EP activities, it is necessary to adhere to this Rulebook
66.	Rulebook on Manner and Procedure of Measuring Emission from Standards Sources (OG MNE No. 39/13)	This Rulebook sets manner for metering emissions from stationary sources.	During EP activities, it is necessary to adhere to this Rulebook
67.	Rulebook on Manner and Conditions for Air Quality Monitoring (OG MNE No. 21/11)	This rulebook sets out terms and manner of air quality monitoring.	During EP activities, it is necessary to adhere to this Rulebook

No.	Regulations/Strategies/Plans	Key Requirements	Implications to the Programme
68.	Rulebook on limit values of the environmental noise level, manner of determining noise indicators and acoustic zones and methods of estimating harmful noise impacts (Official Gazette of the Republic of Montenegro (OG MNE No. 60/11)	This rulebook sets limit values of noise in the environment.	During EP activities, it is necessary to adhere to this Rulebook
69.	Rulebook on Quality of Sanitary-Technical Requirements for Discharging Waste Waters into Recipient and Mains, manner and procedure for testing waste water quality, minimal number of tests and content of the report on determined water quality (OG MNE No. 45/08 od 31.07.2008, 09/10)	This rulebook closer sets out quality of sanitary-technical requirements for discharging waste waters in recipient.	During EP activities, it is necessary to adhere to this Rulebook
70.	Decision on Protection of Endemic, Rare and Endangered Flora and Fauna Species (OG MNE No. 56/06)	This Decision places under protection 415 species of plants and 430 animal species including all types of bats because those are either rare or endangered species.	It is necessary to adhere to protection measures for the species elicited in this Decision.
71.	Spatial Plan of Montenegro by 2020	One of general goals of the Plan is rational usage of natural resources through sustainable development of the coastal area with application of sustainable development principles.	SPMNE envisages development of E&P activities. According to information from SPMNE, geological explorations for gas and oil are reflective of perspectivity of the offshore of Montenegro. Overall oil potential is 12,5 x 10^9 tonnes.
72.	Special Purpose Spatial Plan for Coastal Zone	The plan contains guidelines for development, usage and protection of coastal zone areas of Montenegro, taking into account specificity and constraints in the space.	The Plan's objective is to ensure rational usage of natural and manned resources in the coastal zone area and their long-term protection and sustainability. During EP, it is necessary to adhere to provisions of the plan given that EP activities may result in substantial impacts on usage and protection of the areas.
73.	Solid Waste Strategic Master Plan (2005.)	System for waste management infrastructure is based on a network of sanitary landfills fitted out in accordance with EU standards with remediation of temporary dumps. Hazardous waste management is based on establishing Centre for Hazardous Waste treatment and adequate landfills. Part of the system considers export of certain types of waste.	EP activities generate types of waste included in the plan. It is necessary to adhere to measures and activities identified in the Master Plan. Status of establishment of the Solid Waste infrastructure needs to be known for Operators to plan for the management of E&P related wastes and whether to rely on domestic infrastructure or export of wastes
74.	National Strategy for Sustainable Development of Montenegro (2007.)	The Strategy sets out general goals: - Speed up economic growth and developmetn and reduce regional development inequalities; - Reduce poverty; ensureequal approach to services and resources; - Ensure efficient control and reduction of	Strategy sets out sustainable development of montenegro based on three pillars of sustainable development: economic, social development and environmental protection and natural resources which can be impacted by EP

No.	Regulations/Strategies/Plans	Key Requirements	Implications to the Programme
		pollution, sustainable management of natural resources; - Improve public participation and management system; mobilise all actors with development of capacities on all leveles; and - Preserve cultural diversity and identities.	activities.
75.	National Strategy on Biodiversity from 2010 to 2015.	Principles underlying the Strategy are: – Protection of biodiversity is key segment for nature conservation in Montenegro through an ecosystem[1]; – Biological diversity is one of key values and one of key resources for further development of Montenegro. – Further development of Montenegro depends on capacities and productivity of the ecosystem[2]; – Other, especially, economic development sectors in Montenegro are responsible for inclusion of biodiversity and nature conservation in their policies, strategies, programmes and plans; – Biological diversity of Montenegro is part of global – world biodiversity which is why efforts on its conservation are being harmonized with relevant international contracts and regional and global initiatives; – Nature and biological diversity conservation rest on deployment of all parts of Montenegrin society; – Process of extraordinary of regular passing of Strategy (after 5-year period) shall ensure its previous consideration by those target groups and actors relevant for its implementation. The action plan sets out 54 measures. One of these is: »Instilment of measures and conditions for biodiversity and nature conservation in documents for commercial areas «.	During EP activities, may result in substantial impact on biodiversity, thus it is necessary to adhere to the strategy
76.	Strategy for Regional Development of Montenegro from	Objective of the strategy is trying to harmonize regional	EP activities may result in different impacts on

[1] http://www.cbd.int/ecosystem/
[2] CBD, Decision No. V/6, annex, section C, paragraph 12, Description, Principles and Operative Guidelines for Economic Approach

No.	Regulations/Strategies/Plans	Key Requirements	Implications to the Programme
	2010-2014.	development policy with EU regional development policy. Three strategic goals have been defined: more moderate development of all units of local self-government and region, rapid development of less developed self-governments and regions, regional development and environmental protection.	regional development. It is necessary to adhere to measures and activities identified in the strategy for adequate implementation of planned activities
77.	Mining Strategy 2009 – 2013.	Just like Strategy for Agriculture and Strategy for Fisheries Development of Montenegro (2006) it is passed on grounds of EU legislative framework and takes into account requirements for strengthening capacities for implementation of Common EU Fisheries Policy. The strategy promotes development of marine fisheries to sustainable development through promotion of legislation, resources monitoring system and gradual compliance with EU international standards in control of fisheries.	EP activities may impact the fisheries. It is necessary to adhere to this Strategy to adequately protect fish catches in the areas of exploration/exploitation hydrocarbon.
78.	Strategy for Protection Against Ionizing Radiation. Radiation Safety and Radioactive Waste Management	Strategy aims to ensure protection against ionizing radiation and safe management of radioactive waste.	E&P activities may result in ionization radiation and generation of NORM wastes. Measures and activities stipulated under the Strategy should be defining for EP activities with explicit adherence to relevant Law
79.	Energy Development Strategy of Montenegro by 2030 – white book with Strategic Environmental Impact Assessment	Strategy is based on approved Energy Policy, existing international responsibilities of Montenegro and EU Energy Policy guidelines. Montenegro accepts all responsibilities from the Agreement on Energy Community as key document for realization of reforms in energy sector. Montenegro shall seek to fulfil all measures for successful realization of EU Acquis Communautaire for energy, environment, competition and renewable sources.	The strategy sets development of EP in offshore. According to presented data, potential oil reserves amount to approx. 7 bln barrels, and potential reserves of natural gas 425 bln m^3. Commercial cost effectiveness of so far found gas and oil in offshore of Montenegro can be determined by means of new drills on appropriate structures. It is estimated that substantial production could be realized on this space under condition that greater scope of exploration reveals commercial deposits.
80.	National Strategy for Employment and Human Resource Development 2012-2015;	Objective of the Strategy is to increase employment, knowledge, skills, and competences through formal education, informal education and training, promotion of social inclusion and reduction of poverty.	During EP activities, there will be potential for substantial increase in employment. It is possible to expect inflow of labor force from other countries. During EP, it is necessary to envisage training of local labor force in greater scope.
81.	Montenegro Tourism Development Strategy 2020, Podgorica 2008.	Master Plan is based on projections that Montenegro shall have around 20 mln overnight stays in 2020 which would mean quadruple increase in capacities compared with 2005. Of the total number of expected overnight stays in 2020,	The Strategy does not identify EP activities. E&P can impact further tourism development in terms of landscape and other impacts. Accidents could have substantial impact on

No.	Regulations/Strategies/Plans	Key Requirements	Implications to the Programme
		three quarters are expected to be realized at the coast of Montenegro. The Plan also stresses the need to protect ecologically sensitive zones as well as importance of application of density limitations in tourism for development of high-quality tourist offer.	further development of tourism.
82.	National Air Quality Management Strategy	The objective is to protect the environment and human health from negative impacts of air pollution.	The strategy sets general and specific measures for air protection that need to be implemented during EP activities. Depending on the scenario, the strategy treats emissions from oil origin liquid fuels as substantial source of gas emission in the air, especially non-methane fumes and benzene.
83.	Commission sets out new safety standards for offshore oil and gas operations (http://ec.europa.eu/energy/oil/offshore/standards_en.htm)	The new regulatory framework aims at reducing the occurrence of major accidents related to offshore oil and gas operations and to limit their consequences. Consequently, it will increase the protection of the marine environment and costal economies against pollution. It establishes minimum conditions for safe offshore exploration and exploitation and improves the response mechanisms in the event of a major accident. The new law will apply to existing and future installations and operations. Offshore oil and gas operations will only be conducted by operators appointed by licensees or licensing authorities. The directive contains provisions ensuring the independence and objectivity of the competent authority. To prevent conflicts of interest, member states should ensure a clear separation between regulatory functions relating to offshore safety and environment and regulatory functions relating to economic development, including licensing and revenues management. In addition, the directive also provides rules for transparency and sharing of information, cooperation between member states, emergency response plans and transboundary emergency preparedness and response.	During EP activities, it is necessary to adhere to these provisions.

APPENDIX B : INTERNATIONAL CONVENTIONS AND PROTOCOLS RATIFIED BY MONTENEGRO

No.	Name of Convention / Protocol	Status
1	Convention on Biological Diversity	Ratified / Adopted via succession
2	Cartagena Protocol on Convention on Biological Diversity	Ratified / Adopted via succession
3	Convention on migration species	Ratified / Adopted via succession
4	Convention on preservation of European wildlife and natural habitats (Bern Convention)	Ratified
5	RAMSAR Convention on Wetlands	Ratified / Adopted via succession
6	Convention on World Cultural Heritage Protection	Ratified / Adopted via succession
7	European Landscape Convention	Ratified
8	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES convention)	Ratified / Adopted via succession
9	UN Convention on fight against spreading of desert belt in countries affected by serious drought and/or deserts, especially in Africa	Ratified
10	Framework UN Convention on Climate Changes	Ratified / Adopted via succession
11	Kyoto Protocol on UN Framework Convention on Climate Changes	Ratified
12	The Vienna Convention for the Protection of the Ozone Layer	Ratified / Adopted via succession
13	Montreal Protocol on Substances that Deplete the Ozone Layer	Ratified / Adopted via succession
14	Amendments to Montreal Protocol on Substances that Deplete the Ozone Layer, London, 29th June 1990	Ratified / Adopted via succession
15	Amendments to Montreal Protocol on Substances that Deplete the Ozone Layer, Copenhagen, 25 November 1992	Ratified / Adopted via succession
16	Amendments to Montreal Protocol on Substances that Deplete the Ozone Layer, passed on Ninth Meeting of Signatories, Montreal, 17 September, 1997	Ratified / Adopted via succession
17	Amendments to Montreal Protocol on Substances that Deplete the Ozone Layer, Beijing, 3 December 1999	Ratified / Adopted via succession
18	Convention on Long-Range Transboundary Air Pollution (CLRTAP)	Ratified / Adopted via succession
19	Protocol with Convention on Long-range Transboundary Air Pollution for Funding Cooperation for Monitoring and Evaluation of Long-Range Transfer on Pollutants in Air in Europe (EMEP)	Ratified / joined via succession
20	Protocol on Heavy Metals (Aarhus , 1998)	Not ratified (ratification ongoing)
21	Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Goteborg, 1999)	Not ratified (ratification ongoing)
22	Protocol on Persistent Organic Pollution	Not ratified (ratification ongoing)

No.	Name of Convention / Protocol	Status
23	Stockholm Convention on Persistent Organic Pollutants (POPs)	Ratified
24	The Convention on Environmental Impact Assessment in a Transboundary Context	Ratified
25	Amendments to the Convention on Environmental Impact Assessment in a Transboundary Context, Sophia, 27 February 2001	Ratified
26	Amendments to the Convention on Environmental Impact Assessment in Transboundary Context, Cavtat, 4 June, 2004	Ratified
27	Protocol on Impact Assessment in Transboundary Context	Ratified
28	Convention on Transboundary Effects of Industrial Accidents	Ratified
29	Kiev Protocol on Pollutant Release and Transfer Registers (PRTR), Kiev, 21 May 2003	Not ratified / succession performed with regards to the signature
30	The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal	Ratified / joined via succession
31	Amendments to Basel Convention on Control of Transboundary Movement of Hazardous Wastes and their Disposal, Geneva, 22 September, 1995	Not ratified / succession performed with regards to the signature
32	Basel Protocol on Liability and Compensation for Damage resulting from Transboundary Movement of Hazardous Wastes and their Disposal	Not ratified
33	Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters – Arhus Convention	Ratified
34	Convention for the Protection Of The Mediterranean Sea Against Pollution (Barcelona Convention)	Ratified
35	Protocol Concerning Cooperation in Preventing Pollution from Ships and, in Cases of Emergency, Combating Pollution of the Mediterranean Sea (Protocol on Prevention and Emergency)	Ratified
36	Protocol on Protection of Mediterranean Sea against Pollution from Land-Based Sources (LBS protocol)	Ratified
37	Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean	Ratified
38	Protocol on Prevention of Pollution of Mediterranean Sea against Transboundary Movement of Hazardous Wastes and their Disposal (Protocol on Hazardous Waste)	Ratified
39	Protocol for the Prevention and Elimination of Pollution in the Mediterranean Sea by Dumping from Ships and Aircraft or Incineration at Sea	Not ratified
40	Protocol for Protection of the Mediterranean Sea again Pollution Resulting from Exploration and Exploitation of the Continental Shelf and the Seabed and its Subsoil	Not ratified
41	Protocol on Integrated Coastal Zone Management in the Mediterranean	Ratified
42	Convention on Protection and Use of Transboundary Watercourse and International Laws – Water Convention	Not signed / Not ratified
43	IAEA Vienna Convention on Civil Liability for Nuclear Damages	Ratified / Adopted via succession
44	Protocol to Amend Vienna Convention on Civil Liability for Nuclear	Not ratified

No.	Name of Convention / Protocol	Status
	Damage	
45	IAEA Convention of Physical Protection of Nuclear Material	Ratified / Adopted via succession
46	Amendment to Convention on Physical Protection of Nuclear Material	Not ratified
47	IAEA Convention on Early Notification on Nuclear Accidents	Ratified / Adopted via succession
48	Convention on Supplementary Compensation for Nuclear Damage	Not ratified
49	IAEA Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency	Ratified / Adopted via succession
50	The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management	Not ratified
51	International Convention on Suppression of Acts of Nuclear Terrorism	succession performed with regards to the signature / Serbia and Montenegro failed to provide ratification instrument
52	Non-Proliferation - Agreement to Limit the Spread of Nuclear Weapons	Ratified / Adopted via succession
53	Comprehensive Nuclear-Test-Ban Treaty (CTBT)	Ratified / Adopted via succession
54	Agreement to Ban of Nuclear Weapons Tests in Atmosphere, Space and Under Water	Ratified / Adopted via succession
55	Treaty Banning Nuclear Tests in the Atmosphere, in Outer Space and Under Water	Ratified / Adopted via succession
56	Ballast Convention	Ratified

APPENDIX C : STAKEHOLDERS ENGAGEMENT AND CONSULTATION PLAN

APPENDIX D : SCOPING REPORT

APPENDIX E : LIST OF SEA PREPARERS

Ricardo Khoury	Team Leader / SEA Expert
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