Interreg - IPA CBC
Italy - Albania - Montenegro
EUROPEAN UNION
ADRINET

ENVIRONMENTAL RISK MANAGEMENT PLAN

Università degli Studi di Bari Aldo Moro
Comune di Castro
Opština Herceg Novi
UCG Univerzitet Crne Gore
Institut za Biologiju Mora
Agricultural University of Tirana
Këshilli i Qarkut Vlorë

Deliverable D.T1.1.4

Environmental Risk Management Plan (ERMP)

Responsible

PhD Valentina Terio

Participants

PP1 University of Bari Aldo Moro:	**PhD Valentina Terio**
PP4 University of Montenegro:	**PhD Aleksandra Huter,**
	PhD Dragana Drakulović
PP5 Agricultural University of Tirana:	**Assoc. Prof Fatmira Shehu**

December, 2020

Index

1. Introduction

Fishing is an activity that has thousands of years and depends strictly on environmental conditions and natural and human factors. Technologies have developed naturally over time and fishing systems have become more sophisticated, as the understanding of the habits and behaviours of the various species available at sea has gradually increased. Fishing gear has changed over time, becoming increasingly suitable for capturing the most desirable species. This evolution is still ongoing, as technological development continues even if not always looking at sustainability and the environment. In the last times there is a greater awareness of environmental problems on the part of the legislator who is implementing the legislature always with more specific and strict rules and controls.

ADRINET is part of the sixth European Community environmental action program 2002-2012 (6th EAP), which identifies four environmental areas for priority actions: "Climate change", "Nature and biodiversity" - Environment, health and quality of life " and "Resources and natural waste" (EP 2002). One of the seven thematic Strategies representing the next generation of environmental policies is protection and conservation of the marine environment (proposal 24/10/2005).

The project aims to improve a common coastal management system to preserve the biodiversity and marine ecosystems of the selected regions.

In particular to assess the impact of fishing, ADRINET included the analysis of:

- *the type of gear used and the practice (higher impact by dragged gear and particularly dredges),*
- *the geographic location of the activity [and its intensity],*
- *the type of habitat, its status and its environment, and the species and communities present*

ENVIRONMENTAL RISK MANAGEMENT PLAN has been developed within the framework of the Interreg IPA CBC Programme "Italy-Albania-Montenegro 2014-2020., "ADRINET" Adriatic Network for Marine Ecosystem"/ Code. 244

Delopment of the ERMP is only one of the activities of the ADRINET Project. The ERMP has been developed through participatory approach, including, meetings, questionnaires, etc. This is the first time that the ERMP has been prepared in a way that stakeholders were consulted during the process of Management Plan development and not at the end of the process. The approach raised interest among stakeholders who actively participated and contributed to the process.

2. Geographical Location

2.1 Description of the Castro gulf area

All the coast from Otranto to Santa Maria di Leuca forms part of the Natura 2000 – Site of Community Interest (SCI) network under code number IT9150002 (see Figure 1).

It is a site of outstanding natural beauty made of calcareous rocky shores overlooking the sea. The peculiar south-eastern exposure confers the site particular warm-humid microclimatic conditions.

The marine area has hard seabed substrate with high level of diversity and submerged – and partially submerged – sea caves are widely distributed (e.g. the Zinzulusa Cave).

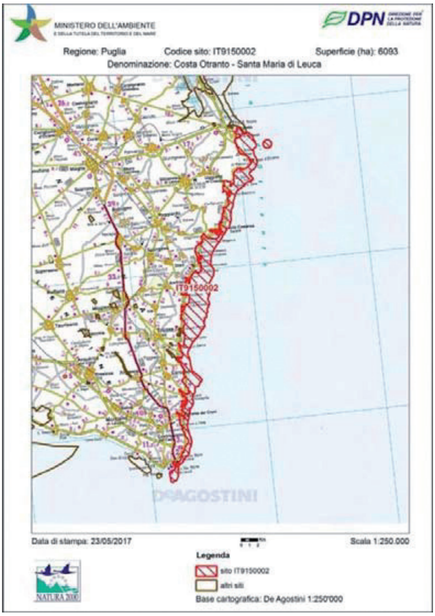


Figure 1 Natura 2000 SCI IT9150002

The presence of endemic and trans-Adriatic species makes the site highly important, as well. The coastal substrate is made of bio-concretions by encrusting algae, Coralligenous and a significant red coral (Corallium rubrum) facies. For the Natura 2000 network, the Coralligenous is part of the Habitat type 1170 "Reefs"; such a category – which consists of a great variety of natural biogenic habitats with different levels of ecological relevance – is extremely challenging to be managed. The population includes – among shellfish – protected species (i.e. date shell – Litophaga lithophaga).

The Coralligenous communities represent the second most important "hot spot" of Mediterranean biodiversity just after Posidonia oceanica beds. Studies have been done in the recent years highlighting the presence in the concerned area of Coralligenous bio- concretions at a depth of between 10 m. and 100-150 m.; the Coralligenous wall may cover a range between 20-25 cm. in the shallow waters down to 2 m. in the deeper water. Such populations play a key role as nursery and spawning area for a relevant number of demersal species, many of them having an extremely high commercial importance.

According to recent studies1 in the mid-19th century, good amounts of red coral were fished from Spartivento Cape to Colonne Cape; important banks were also exploited off Roccella Ionica and Soverato villages, as well as off Rizzuto and Colonne Capes. Other banks were exploited at 4 NM off St. Pietro and St. Paolo Islands4 (Taranto) all the way to Santa Maria di Leuca (Ristola Point, 90 m depth). Today, in the Ionian Sea, small red coral banks are reported at 60-75 m. depth at Santa Caterina, 7 NM off West Gallipoli, at Santa Maria di Leuca, 3 NM off the coast, and at Campomarino, 5 NM off coast, towards East. Other banks are reported close to Porto Cesareo.

No information is available with reference to recent legal fishing activities in the concerned area although size and density of red coral ancient colonies provide the evidence of a progressive exploitation which asks for a urgent need of management and protection measures.

2.2 Description of the Vlora gulf area

The Vlora represents one of the most attractive coastal areas of Albania and is considered as a very important natural, tourist and industrial areas. Vlora Gulf is located on the border between the Adriatic and Ionian Sea. Location is shown in Figure 2. It is a semi-enclosed bay with limited water exchange with the Adriatic Sea via the inlet channel (Rivaro.et al., 2011).

The Gulf of Vlora has an area of 305 km², length of 36 km and width of 10 km. It starts north with the Cape of Triports and ends west with the Cape of Gjuhezes. The Vlora Gulf waterfront is divided into two distinct parts:

The southern part that begins south of the Uji i Ftohte and is called the Ducati Bay, which is narrower and deeper. The northern part called Vlora Gulf, which is wider and shallower.

Figure 2 Map of Vlora Bay

The maximum depth of Vlora Bay is 57 m and is in its southern part. The Vjosa river delta and the Narta lagoon form the northern boundary of the Vlora Bay. The island of Sazan with its rocky shores makes this area one of the safest natural areas of the Adriatic Sea (Corsi I. et al., 2011).

2.3 Description of the Boka Kotorska bay area

Boka Kotorska Bay is a relatively closed ecosystem, which is very sensitive and required special measures to maintain its environmental as well as development status. It is area of high interest for tourism development thus being under pronounced pressures by tourism and related urban development. It creates negative impact on marine ecosystem especially to fish stocks.

Concentration of different activities in this part of the coast is very high, and pollution problems (due to communal wastewater, maritime activities and industry) are expressed, exacerbated by the enclosed nature of the Bay and slow exchange of water with the open sea. The Bay is composed by three major basins (Herceg-Novi, Tivat and Kotor), connected by two narrow straits (Kumbor and Verige) with a maximum depth of 60m. Marine ecosystems are hugely vulnerable, especially in the Bay's narrow part, in the section between Bijela Shipyard and Porto Montenegro Harbor, as well as in Igalo Bay- part of Herceg-Novi Bay.

3. Environmental and ecosystems

The main aims of the EU 2020 Biodiversity Strategy are to halt the loss of biodiversity and the decline of ecosystems. This strategy is in line with the international commitment of the UN Convention on Biological Diversity (CBD, 1992) including the CBD Strategic Plan 2011-2020 and the Nagoya-Protocol 2010 which aim mainly in the conservation of biological diversity and the sustainable use of the components of biological diversity.

So, the main SEA Objectives are: conservation of biodiversity and reduction of loss of biodiversity; increase the size and category of protected areas to protect and restore habitats and thus halt the loss of biodiversity and the degradation of the ecosystem; Improvement and management of nature protection infrastructures; greater public awareness of biodiversity issues.

3.1 Castro bay

The most important resources in the GSA19 are represented by the red mullet (Mullus barbatus) on the continental shelf, hake (Merluccius merluccius), deep-water rose shrimp (Parapenaeus longirostris) and Norway lobster (Nephrops norvegicus) on a wide bathymetric range and by the deep-water shrimps (Aristeus antennatus and Aristaeomorpha foliacea) on the slope. Table 1 shows the data landing of these species.

Table 1 total landingin GSA19

Species	Total landing (in Kilos)
Engraulis encrasicolus	1.094.922
Merluccius merluccius	706.868
Aristaeomorpha foliacea	690.495
Parapenaeus longirostris	647.408
Sardina pilchardus	512.274
Octopus vulgaris	347.141
Boops boops	308.008
Mullus Barbatus	277.858
Lophius Budegassa	178.888
Illex coindetii	176.487
Aristeutis antennatus	103.020
Naphrops norvegicus	87.110
Eledone cirrhosa	49.352
Pagellus Erythrinus	45.547
Lophius piscatorius	33.437
Diplodus annularis	21.960
Helicolenus dactylopterus	13.731
Plesionika spp	13.154
Micrimesistius poutassou	9.337
Phycis blennoides	1.126

Other important commercial species in the GSA19 are the octopus (Octopus vulgaris), the cuttlefish (Sepia officinalis) and common pandora (Pagellus erythrinus) on the shelf, the horned octopus (Eledone cirrhosa), the squids (Illex coindetii and Todaropsis eblanae), the blue whiting (Micromesistius poutassau), the anglers (Lophius piscatorius and Lophius budegassa) on a wide bathymetric range, the greater forkbeard (Phycis blennoides), the rockfish (Helicolenus dactylopterus) and the shrimps Plesionika heterocarpus and Plesionika martia on the slope.

The main target species of the fleet operating in Castro are as follow:

- *Hake (Merluccius merluccius);*
- *Anchovy (Engraulis encrasicolus);*
- *Sardine (Sardina pilchardus);*
- *Mackerel (Scomber scombrus);*
- *Horse mackerel (Trachurus trachurus);*
- *Bogue (Boops boops);*
- *Red mullet (Mullus barbatus);*
- *Sea bream (Diplodus annularis);*
- *Cuttlefish (Sepia officinalis);*
- *Octopus (Octopus vulgaris).*

For some of the above-mentioned species, stocks are overfished (Further information on the state of the fish stock – by species common name and GSA – are available on the Scientific, Technicaland Economic Committee for Fisheries (STECF)); this is the case of the hake (Merluccius merluccius) which is considered as one of the most important commercial species in the area. Furthermore, many other species are generally caught and totally discarded due to their lack of economic value.

3.2 Vlora bay

Vlora Gulf, is represented southeastern edge of Otranto Strait. The coastline of Vlora Gulf-Vjosa River Mouth area has continuously modified its configuration by sedimentation of alluvium transported by Vjosa River water and the swell of the Adriatic Sea. Considering Vlora Bay a specific fishing area, a coastal zone, mostly coastal fisheries are based on the economic and social activities in the area.

In Vlora area, like in all over coasts of Albania during last 30 years of transition occurred a massive demographic movement, chaotic urbanization of the Albanian coast, moving from highest to lowest areas, like marine coastal. This phenomenon brought increased settlement in the coast, biggest pollution; increasing the pressure over the fish resources, illegal mainly. The marine environment along the Adriatic Coast is affected by the considerable pollution of the last 30 years, both by discharge into the sea of polluted river water and by direct discharge of untreated urban and industrial wastewater.

Port of Vlora. Amongst four fishing ports in Albanian Coast, Vlora (90,000 population) has a large dedicated fishing port. This port is located several miles from the main town. Has two total freight quays at 8 meters deep and is the ferry terminal closest to Italy (Brindisi 70 km). There is also a separate fishing port (in Triport), to the north, where 30-40. Commercial fishing boats anchor.

Table 2 The more important fish species in the Vlora Gulf

No.	scientific name of the species
1.	Merluccius merluccius
3.	Mullus surmulletus
4.	Sparus auratus
5.	Dicentrarchus labrax
6.	Sardina pilchardus
7.	Boops boops
8.	Parapenaeus longirostris
9.	Exocoetus volitans
10.	Trachurus trachurus
11.	Mugil cephalus

12.	Apogon imberbis
13.	Arnoglossus thori
14.	Octopus.spp
15.	Sepia spp
16.	Loligo spp
17.	Pagellus Erythrinus

The information is mainly used by the National Park of Natural Marine Management Ecosystem Of The Peninsula Karaburuni And Sazan Island (Vlora Region).

Coastal areas today have become industrial and urban discharge collectors, including the Vlora coast. The marine and coastal environment of Vlora constitutes resources of high economic and ecological value for the country. As a result of the mismanagement of these resources, in recent years significant amounts of waste have been discharged directly into the sea or through rivers and atmospheric depositions (Corsi I. et al, 2011).

Figure 3 Direct discharges of waste from the Soda-PVC plant near the Gulf of Vlora.

In 1992 production of the Soda-PVC Plant was stopped (which produced polyvinyl soda and chloride using an outdated technology). This plant lay 4 km north of the city of Vlora, discharging significant amounts of liquid waste directly into the sea with a high content of mercury and other pollutants (Rivaro.et al., 2011). In addition, polluted sludge with a high mercury content was deposited in a damp (about 25 ha) (CISM, 2008).

Another source of pollution is the Vjosa River, which emanates from Greece and flows throughout the southern part of Albania and flows into the northern part of the Vlora Bay, bringing with it relatively high erosion materials of relatively high Ni, Cr content. and numerous urban and terrestrial pollutants (Rivaro.et al., 2011). Because of the low rate of water circulation in the bays, the source of pollution are also the shipping activities, which discharge various pollutants such as fuel, trace metals, nutrients, and organometallic compounds (UNEP, 1990). Finally, the natural composition of the waters is affected by anthropogenic pollution because of urban discharges from surrounding areas (Tursi et al., 2011).

Monitoring the impact of urban discharges on coastal water quality is carried out in the city of Vlora. Under the scheme, the quality of discharge waters at the discharge point (collectors or pumping stations) and their impact on coastal water quality is assessed. In the city of Vlora, urban water is discharged through pumping stations and discharged into the sea in the Soda Forest area (ENVIRONMENTAL REPORT 2017-National Environment Agency)

3.3 Boka Kotorska bay

The Adriatic Sea, forming part of a unified Mediterranean aquatic ecosystem, shares the same modern problems, existing in all Adriatic states. Most of these issues are a consequence of the negative development which had taken place under the influence of human activities. This and environmental degradation, reduced stocks of most fishing resources caused by excessive fishing pressure, have led to a decrease in fishing activities in the Adriatic Sea and the Boka Kotorska Bay.

The investigation on ichtyoplankton composition and abundance has shown presence of a significant number of pelagic species spawning within the Bay. Analysis of plankton material resulted in indentification of spawing of 40 different species from 7 genera and 20 families, providing that the Boka Kotorska Bay is one of the most important spawning areas and feeding grounds for juveniles of a number of pelagic fish species. Also the investigation of ichtyoplankton showed dominance of certain species, such as anchovy (Engraulis encrasicolus), rainbow wrasse (Coris julis), annual seabream (Diplodus annularis), white seabream (Diplodus sargus), pilchard (Sardina pilchardus) and mackerel (Scomber scombrus).

Biological diversity of the Bay and its coastal zone is important for the region. Most phytoplankton species, which is a major prodicer of organic substances, are present in microphytobenthos and periphyton. Their importance is high, since they represent the main source of food for many zooplankton species. The maximum recorded phytoplankton values at some years indicate changes that may lead to eutrophic conditions in the Bay although it is still moderately trophic. According to the TRIX index and Fp ratio, natural eutrophication is still dominant over anthropogenic eutrophication. Based on Institute investigation, phytoplankton abundance in Boka Kotorska Bay reaches up to 10^7 cells/L. Diatoms are the phytoplankton group present throughout the year. Diatoms species are typical for areas with higher eutrophication that prefer nutrient-rich conditions.3.

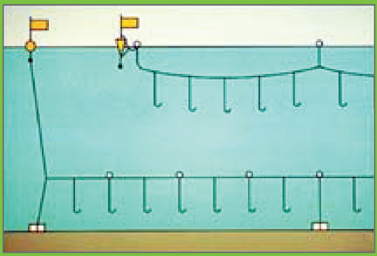
Also 219 species of phytobenthos have been found in this area. The highest number of identified taxa in the Ba belongs to the Atlantic phytogeographic element (31.5 %), followed by the mediterranean (18.9%), cosmopolitan (12.2%) and others. Endemic species of the Adriatic Sea are represented with only one species, Fucus virsoides, with the Bay as its southernmost distribution limit. Four species of seagrass are found, and meadows of Posidonia oceanica and Cymodocea nodosa are numerous, especially in the outher part of the Bay -Herceg Novi Bay.

4. Marine fisheries and activities

Fishery technology has advanced rapidly and decisively since the end of World War II. In addition to the introduction of motors and synthetic fibres, which transformed fishing, there has also been a cultural transformation among fishermen, who have changed their means of work, both in terms of vessels and gear, often with the help of incentives.

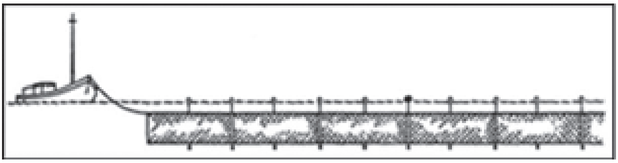
The practice of professional fishing requires a fishing license indicating the fishing system that can be used. Under Ministerial Decree 26/07/95, commonly known as the License Decree, there are 13 possible licenses, one for each of the listed fishing systems. A vessel can have more than one gear allowed in the licence and can therefore use a selection of more than one fishing system from those indicated on the license.

Among the various fishing techniques for this project were chosen: Set Longlines (Standard Abbreviation: LLS), Set Gillnets anchored (Standard Abbreviation: GNS) and Purse seines (Standard Abbreviation: PS). These techniques have been chosen in the most representative ones in the selected fishing area.



A set longline (LLS) consists of a mainline and snoods with baited (occasionally unbaited)hooks at regular intervals and which is set, in general, on or near the bottom. The number of hooks, distance of snoods on the main line and length of the snoods depends on the target species, the handling capacity and technology used. Longlines can be set as bottom lines or, less commonly, in mid-water or even not far from the surface. Its length in coastal fisheries can go down too few hundred meters. The fish are attracted by the natural or artificial bait (lures), hooked and held by the mouth until they are brought aboard the operating vessel which periodically hauls the gear. Although this technique is of medium-good selectivity; there is a problem with the accidental capture of turtles, some species of sharks and other endangered species.

Even though longlines may attract and catch a large variety of fish species and sizes, this gear is considered to have medium to good species and size selective properties. The species selectivity of longlines can clearly be affected by the type of bait used, as different species have been shown to have different bait preferences. The size selective properties can partly be regulated by the hook and bait size as many studies have shown a correlation between the size of hook and bait and the size of the fish caught. The longline attracts fish from several hundred meters away, and as large fish have a greater swimming and feeding range than smaller fish, this adds to the size selective properties of longlines. Ghost" fishing may be regarded as a problem with longlining and this gear is not considered to cause significant adverse habitat effects when they are accidentally lost in the deep gorgonians communities.



The gillnet (GNS) is named after its catching principle, as fish are usually caught by "gilling" (i.e. the fish is caught in one of the meshes of the gillnet, normally by the gill region – between the head and the body). Thus, fish capture by gillnets is based on fish encountering the gear during feeding or migratory movements. As fish may avoid the gillnet if they notice the gear, catches are normally best at low light levels or in areas with turbid water. In general gillnets are very size selective, with catches of fish sizes that correspond well to the chosen mesh size. However, due to entangling a small proportion of larger and smaller fish may be taken.

The species selectivity of gillnets is not particularly good and as different fish species grow to different sizes, there is always a possibility of catching juveniles of a large species when using small mesh gillnets for a smaller target species.

Another negative impact of gillnets is the by-catch of sea birds, marine mammals and turtles. Although little information exists on the real effect of such by-catches on the populations of these organisms, it has generated concerns, particularly for pelagic gillnet fishing.

"Ghost" fishing of lost gears is one of the major problems and most criticized aspects in the gillnet fishery. The synthetic fibres do not rot and the gear will fish for a long time. Fixing the floats to the netting with biodegradable material could reduce the problem.

Drift gillnets (GND) consist of a string of gillnets kept more or less vertical by floats on theupper line (-rope) and weights on the lower line (ground-rope) (sometimes the ground-rope is without weights), drifting ith the current, in general near the surface or in mid-water. These nets drift freely with the current connected to the operating vessel. The method of capture is by gilling and driftnets are highly size selective on the targeted species.

The principal negative environmental impact produced by this type of nets is related to the by-catch of non-target species like marine mammals, seabirds and to a minor extent turtles. In general gillnets are a fishing gears with a high degree of size selectivity for fish, efficiently regulated by the mesh size.

It is also a gear with low energy consumption calculated on the relationship of fuel/fish. Various instruments are developed to reduce the negative impact of drift netting on the non-targeted biological resources.

As for purse seine (PS) it is made of a long wall of netting framed with floatlineand lead- line (usually, of equal or longer length than the former) and having purse rings hanging from the lower edge of the gear, through which runs a purse line made from steel wire or rope which allow the pursing of the net. For most of the situation, it is the most efficient gear for catching large and small pelagic species that is shoaling.

Purse seining is a non-selective gear regarding fish size, as the mesh size is chosen to be so small that there should be no risk of mass meshing of fish, even by the smallest size groups of the target species. However, in cases where the fish size in the catch is too small, as estimated from samples taken from the seine, there is usually an opportunity to release the fish. The species selectivity is fairly high and both from the fishers experience and by use of modern sonar equipment it is not too difficult to identify the species before the seine is set.

There is a certain risk of by-mortality in purse seining. Pelagic fishes are in general sensitive to contact with fishing gears which easily leads to loss of scales and resulting mortality. This can be related to the above-mentioned release of unwanted species or sizes of fish, but the main cause of by-mortality in purse seining is the escapement of fish after net rupture due to large catches and/or bad weather. There is extremely low risk of ghost fishing with lost purse seines.

This is the most efficient technique for catching pelagic fish and allowing you to get good quality fish. the main problem is that it is not a selective technique for size and species; so much so that in some cases it is possible to catch tuna or dolphins. it is possible to obtain a partial selectivity based on the experience of the pigeons that can reject unwanted fish.

5. Data collection

Numerous episodes have occurred in recent years highlighting the presence of Persistent Organic Pollutants (POPs) in European seafood products and attention has been focused on the risks these pose to human health. These contaminants are highly mobile (Wania & Mackay, 1996) and, through the grasshopper effect, they tend to concentrate in the remote areas of our planet. A large proportion of the POPs used until now (million tonnes of active ingredients) are found in the coastal and deep-water sediments of our sea. The marine environment has therefore become a final deposit as well as a continuous source for these contaminants, which enter the food chain and reach higher concentrations in organisms through bioaccumulation and biomagnification processes, constituting a threat to species at the higher levels of the food chain, including man.

In this study, PAHs and PCBs were analyzed in water and sediments.

In the catch was evaluated the presence of: heavy metals, in particular cadmium in cephalopods (i.e Octopus spp.) was evaluated; pesticides, in particular organophosphate and carbamate in Boops Boops, and microplastics and antibiotics in Spaurus Aurata and dicentrarchus labrax.

5.1 Methods

5.1.1 PAH and PCB in water and sediments

EPA-Method 1668C for determination of chlorinated biphenyl congeners (CBs) in wastewater and other matrices by high-resolution gas chromatography/high resolution mass spectrometry (HRGC/HRMS).

Water clean-up: Solid-Phase Extraction (SPE),

Quantitative detection: HRGC/HRMS

5.1.2 Trace elements (i. e. Cadmium) in fish

UNI EN 13805: 2014, Foodstuffs – Determination of trace elements – Pressure digestion

Clean up: Pressure digestion apparatus with conventional heating

After the dissection, the fishes' digestive gland were put into an oven to dry set to 90° C. After the gut reached constant weights in the oven they were transferred into digestion flasks. Perchloric acid (4 ml) and 8 ml nitric acid were added and then the digestion flaskswere put on a hot plate set to 120°C (graduallyincreased). The digestion flasks were kept on the hot-plate until all the gut were dissolved. The digests were diluted with distilled water appropriately in the range of standards that were prepared from stock standard solution of the metals.

Quantitative detection: Metal concentrations were measured using a Perkin Elmer AS 3100 flame atomic absorption spe ctrophotometer.

5.1.3 Pesticides (Organophosphates and carbamate) assessment in fish

AOAC Official Method 2007.01, Pesticide Residues in Foods by Acetonitrile Extraction and Partitioning with Magnesium Sulfate

Clean up: the QuEChERS (quick, easy, cheap, effective, rugged, and safe) method has been used: a single-step buffered acetonitrile (MeCN) extraction and salting out liquid– liquid partitioning from the water in the sample with $MgSO_4$, were carried out.

Dispersive-solid-phase extraction (dispersive-SPE) cleanup is done to remove organic acids, excess water, and other components with a combination of primary secondary amine (PSA) sorbent and $MgSO_4$; then the extracts were analyzed by mass spectrometry (MS) techniques after a chromatographic analytical separation.

Quantitative detection: Gas Chromatography/Mass Spectrometry and Liquid Chromatography/Tandem Mass Spectrometry

5.1.4 Microplastic in Sparus aurata and Dicentrarchus labrax

Clean up: method proposed by Roch S. and Brinker A. "Rapid and Efficient method for the detection of microplastic in the gastrointestinal tract of fishes".

Qualitative detection: dissecting microscope.

5.1.5 Antibiotics in Sparus aurata and Dicentrarchus labrax

Screening Methods: Premi®Test 25, R-Biopharm AG; Antimicrobial Array Randox

6. RESULTS

6.1 Castro

6.1.1 PAH and PCB in water and sediments

Table 3. PAH and PCB in water and sediments

Parameters	Analysis	Unit	Castro bay
Polichlorine bifenils (PCB)	PCB 28	mg/kg	<LOD
	PCB 52	mg/kg	<LOD
	PCB 77	mg/kg	<LOD
	PCB 81	mg/kg	<LOD
	PCB 169	mg/kg	<LOD
	PCB 101	mg/kg	<LOD
	PCB 156	mg/kg	<LOD
	PCB 118	mg/kg	<LOD
	PCB 126	mg/kg	<LOD
	PCB 128	mg/kg	<LOD
	PCB 138	mg/kg	<LOD
	PCB 153	mg/kg	<LOD
	PCB 180	mg/kg	<LOD
Polyclyc aromatic hydrocarbo ns-PAHs	Naphtalene	mg/kg	<LOD
	Fluorene	mg/kg	<LOD
	Phenanthren	mg/kg	<LOD
	Anthracene	mg/kg	<LOD
	Fluoranthene	mg/kg	<LOD
	Pyrene	mg/kg	<LOD
	Benzo(a) Anthracene	mg/kg	<LOD
	Chrysene	mg/kg	<LOD
	Benzo(b)fluor anthene	mg/kg	<LOD
	Benzo(a) Pyrene	mg/kg	<LOD
	Indeno(1.2.3- cd)pyrene	mg/kg	<LOD
	Dibenzo(a.h) anthracene	mg/kg	<LOD
	Benzo(g.h.i) perylene	mg/kg	<LOD

6.1.2 Trace elements (i. e. Cadmium) in Loligo spp and Sepia spp

Table 4. Cadmium in Loligo spp and Sepia spp

Number of sample	Samples types*	Parameters	Unit of measure	Average Results	Maximum allowed limit in flesh
	Digestive gland	Cd	mg/kg	1,5±0,008	1,0
	Cephalopods-Sepia spp				

* Cadmium was evaluated on digestive gland to assess the real marine bioaccumulation in cephalopods target organs. Considering that digestive gland contains Cd-binding ligands as metallothionein, is most probably reveal this contaminant and link these data to the water pollution.

6.1.3 Pesticides (Organophosphates and carbamate) assessment in Mullus Barbatus

Table 5. Organophosphates and carbamate assessment in Mullus Barbatus

	Samples types	Parameters	Unit of measure	Results
90	Mullus barbatus	Organophosphat pesticides		
		Chlorfenvinphos	mg/kg	< LOD
		Chlorpyriphos	mg/kg	< LOD
		Carbamates		
		Aldicarb	mg/kg	< LOD
		Methiocarb	mg/kg	< LOD
		3-hydrocarbofuran	mg/kg	< LOD
		Carbaryl	mg/kg	< LOD
		Oxamyl	mg/kg	< LOD
		Carbofuran	mg/kg	< LOD
		Methomyl	mg/kg	< LOD
		Carbosulfan	mg/kg	< LOD
		Indoxacarb	mg/kg	< LOD
		Iprovalicarb	mg/kg	< LOD
		Pirimicarb	mg/kg	< LOD
		Propamocarb	mg/kg	< LOD

6.1.4 Microplastic in Spaurus Aurata and Dicentarchus Labrax

Table 6. Microplastic in Spaurus Aurata and Dicentarchus Labrax

SPECIES		Nr. of analyzed samples	Microplastic Stomach	Intestine
species selected for study by ADRINET	Spaurus aurata	90	6	3
	Dicentrarchus labrax	70	4	3

6.1.5 Antibiotics in Spaurus Aurata and Dicentarchus Labrax

Table 7. Antibiotics in Spaurus Aurata and Dicentarchus Labrax

Nr. of samples	Sample types	Substance (Antibiotic)	Unit of measure	Results
60	Spaurus aurata	Thiamphenicol	Ppb	It was not found
		Streptomycin	Ppb	It was not found
		Tylosin	Ppb	It was not found
		Quinolone	Ppb	5.63±0,3
		Ceftiofur	Ppb	It was not found
		Tetracyclines	Ppb	1,02±0,2
60	Dicentrarchus labrax	Thiamphenicol	Ppb	It was not found
		Streptomycin	Ppb	It was not found
		Tylosin	Ppb	It was not found
		Quinolone	Ppb	2,24±0,6
		Ceftiofur	Ppb	It was not found
		Tetracyclines	Ppb	2,38±0,4

Tab 7. *Result are reported as mean ± DS in ppb*

6.2 Vlora results

6.2.1 PAH and PCB in water and sediments

Table 8. PCB in 2 Water samples

Parameters	Analyte	Unit of measure	Results
Bifenils PCB	PCB_28	µg/L	< 0.05
	PCB_52	µg/L	< 0.05
	PCB_101	µg/L	< 0.05
	PCB_138	µg/L	< 0.05
	PCB_153	µg/L	< 0.05
	PCB_180	µg/L	< 0.05

Table 9: PCB in 2 Sediments samples

Parameters	Analyte	Unit of measure	Results
PCB	PCB_18	mg/kg	< 0,002
	PCB_28	mg/kg	< 0,002
	PCB_52	mg/kg	< 0,002
	PCB_44	mg/kg	< 0,002
	PCB_101	mg/kg	< 0,002
	PCB_138	mg/kg	< 0,002
	PCB_153	mg/kg	< 0,002
	PCB_180	mg/kg	< 0,002
	PCB_194	mg/kg	< 0,002

6.2.2 Trace elements (i.e. Cadmium) in Loligo spp and Sepia spp

Table 10. Cadmium in Loligo spp and Sepia spp

Nr Samples	Parameters	Analyte	Unit of measure	Results
51 sepia.spp	Heavy metals	Pb	mg/kg	<0.06
		Cd	mg/kg	<0.02
		Hg	mg/kg	<0.1
3 sepia.spp	Heavy metals	Pb	mg/kg	<0.06
		Cd	mg/kg	<0.02
		Hg	mg/kg	0.12
23 Loligo spp	Heavy metals	Pb	mg/kg	<0.06
		Cd	mg/kg	0.12
		Hg	mg/kg	<0.1
9 Loligo spp	Heavy metals	Pb	mg/kg	<0.06
		Cd	mg/kg	<0.02
		Hg	mg/kg	<0.1

6.2.3 Pesticides (Organophosphates and Carbamate)

Table 11. Organophosphates and Carbamate) in fish

Parameters	Analyte	Unit of Measure	Results
Organochlorine	Aldrin	mg/kg	< 0.01
Organochlorine	Dieldrin	mg/kg	< 0.01
Organophospho rus	Chlorpyrifos	mg/kg	< 0.01
Organophospho rus	Chlorpyrifos-methyl	mg/kg	< 0.01
Organophospho rus	o,p´-DDT	mg/kg	< 0.01
Organochlorine	p,p´-DDT	mg/kg	< 0.01
Organochlorine	p,p´-TDE (DDD)	mg/kg	< 0.01
Organochlorine	p-p´-DDE	mg/kg	< 0.01
Organochlorine	Diazinon	mg/kg	< 0.01
Organochlorine	Endrin	mg/kg	< 0.01
Organochlorine	Heptachlor	mg/kg	< 0.01
Organochlorine	Heptachlor epoxide	mg/kg	< 0.01
Organochlorine	Hexachlorobenzene	mg/kg	< 0.01
Organochlorine	Hexachlorocyclohexane (HCH), alpha-isomer	mg/kg	< 0.01
Organochlorine	Hexachlorocyclohexane (HCH), beta-Isomer	mg/kg	< 0.01
Organochlorine	Hexachlorocyclohexane (HCH), delta-isomer	mg/kg	< 0.01
Organochlorine	Lindane (Gamma-isomer I Hexachlorocyclohexane (HCH))	mg/kg	< 0.01
Organochlorine	Methoxychlor	mg/kg	< 0.01
Organochlorine	Mirex	mg/kg	< 0.01
Organophospho rus	Pirimiphos-methyl	mg/kg	< 0.01

6.2.4 Microplastic in Spaurus Aurata and Dicentarchus Labrax

Table 12. Microplastic in Spaurus Aurata and Dicentarchus Labrax

SPECIES		Nr. of analyzed samples Stomac	Microplastic		%
			Intestine		
species selected for study by ADRINET	Spaurus aurata	30	4	2	20%
	Dicentrarchus labrax	20	3	2	25%
other species analyzed	Mullus Barbatus	20	3	2	25%
	Triglia Lucerna	20	1	1	10%
	Solea Soolea	20	2	2	20%
	Trachurus Mediterraneus	20	7	4	55%
	Pagellus Erythrinus	20	1	1	10%
	Sardina Pilcardus	20	2	1	15%
	Total	150	16	11	23%

6.2.5 Antibiotics in Spaurus Aurata and Dicentarchus Labrax

Table 13. Antibiotics in Spaurus Aurata and Dicentarchus Labrax

Nr. of samples	Sample types	Substance (Antibiotic)	Unit of measure	Results
45	Spaurus aurata	Sulfonamide	ug/kg	It was not found
		Sulfamethazine	ug/kg	It was not found
		Oxytetracycline	ug/kg	It was not found
		Quinolone	ug/kg	It was not found
		Chloramphenicol	ug/kg	It was not found
		Nitrofurazone (SEM)	ug/kg	It was not found
		Furaltadone (AMOZ)	ug/kg	It was not found
		Furazolidone (AOZ)	ug/kg	It was not found
23	Dicen-trarchus labrax	Sulfonamide	ug/kg	It was not found
		Sulfamethazine	ug/kg	It was not found
		Oxytetracycline	ug/kg	It was not found
		Quinolone	ug/kg	It was not found
		Chloramphenicol	ug/kg	It was not found
		Nitrofurazone (SEM)	ug/kg	It was not found
		Furaltadone (AMOZ)	ug/kg	It was not found
		Furazolidone (AOZ)	ug/kg	It was not found

6.3 Boka Kotorska bay Results

6.3.1 PAH and PCB in sediments

Table 14. PAH and PCB in sediments

Parameters	Analysis	Unit	Port of Herceg Novi	Shipyard Bijela
Polichlorine bifenils (PCB)	PCB 18	mg/kg	<0.002	0.0032±0.0004
	PCB 31	mg/kg	<0.002	0.004±0.001
	PCB 28	mg/kg	<0.002	0.0021±0.0002
	PCB 52	mg/kg	<0.002	0.11±0.01
	PCB 44	mg/kg	<0.002	0.034±0.004
	PCB 101	mg/kg	<0.002	0.21±0.02
	PCB 149	mg/kg	<0.002	0.23±0.02
	PCB 118	mg/kg	<0.002	0.13±0.01
	PCB 153	mg/kg	<0.002	0.24±0.02
	PCB 138	mg/kg	<0.002	0.28±0.03
	PCB 180	mg/kg	<0.002	0.15±0.02
	PCB 194	mg/kg	<0.002	0.021±0.003
Polyclyc aromatic hydrocarbons-PAHs	Naphtalene	mg/kg	<0.005	0.13±0.04
	2- Methylnaphtalene	mg/kg	0.014±0.004	0.064±0.018
	1- Methylnaphtalene	mg/kg	0.007±0.002	0.034±0.009
	Acenaphtylene	mg/kg	<0.005	0.016±0.003
	Acenaphtene	mg/kg	0.031±0.006	0.095±0.017
	Fluorene	mg/kg	0.030±0.005	0.096±0.016
	Phenanthren E	mg/kg	0.31±0.05	1.09±0.16
	Anthracene	mg/kg	0.076±0.009	0.26±0.03
	Fluoranthene	mg/kg	0.41±0.06	1.53±0.23
	Pyrene	mg/kg	0.33±0.05	1.23±0.19
	Benzo(a)anthracene	mg/kg	0.22±0.03	0.89±0.12
	Chrysene	mg/kg	0.17±0.03	0.75±0.12
	Benzo(b)fluor anthene	mg/kg	0.27±0.04	1.06±0.16
	Benzo(k)fluor anthene	mg/kg	0.098±0.024	0.38±0.09
	Benzo(a)pyrene	mg/kg	0.21±0.03	0.77±0.10
	Indeno(1.2.3- cd)pyrene	mg/kg	0.14±0.02	0.50±0.08
	Dibenzo(a.h) anthracene	mg/kg	0.029±0.007	0.11±0.03
	Benzo(g.h.i) perylene	mg/kg	0.11±0.02	0.43±0.08
	ΣPAHs	mg/kg	2.5±0.4	9.4±1.6

6.3.2 Trace elements (i.e. Cadmium) in Sepia spp

Table 15. Cadmium in Sepia spp

Number of sample	Samples types	Parameters	Unit of measure	Results	Maximum allowed limit
80	Ceohalopods-Sepia spp	Cd	mg/kg	0,088±0,009	1,0
		MEST EN 14084:2009*	mg/kg	0,020±0,002	1,0
			mg/kg	< 0,02	1,0
			mg/kg	0,20±0,02	1,0
			mg/kg	0,045±0,005	1,0
			mg/kg	< 0,02	1,0
			mg/kg	< 0,02	1,0
			mg/kg	< 0,02	1,0
			mg/kg	< 0,02	1,0
			mg/kg	< 0,02	1,0
			mg/kg	< 0,02	1,0
			mg/kg	< 0,02	1,0
			mg/kg	< 0,02	1,0
			mg/kg	< 0,02	1,0
			mg/kg	< 0,02	1,0
			mg/kg	< 0,02	1,0
			mg/kg	< 0,02	1,0
			mg/kg	< 0,02	1,0
			mg/kg	< 0,02	1,0

6.3.3 Pesticides (Organophosphates and Carbamate) in fish

Table 16. Organophosphates and Carbamate) in fish

	Samples types	Parameters	Unit of measure	Results	Method
30	Mulus barbatus	Organophosphate pesticides			
		Chlorfenvinphos	mg/kg	< 0,01	DIN EN 15662
		Chlorpyriphos	mg/kg	< 0,01	DIN EN 15662
		Chlorpyriphos-methyl	mg/kg	< 0,01	DIN EN 15662
		Diazinon	mg/kg	< 0,01	DIN EN 15662
		Dichlorvos	mg/kg	< 0,01	DIN EN 15662
		Ethion	mg/kg	< 0,01	DIN EN 15662
		Fenitrothion	mg/kg	< 0,01	DIN EN 15662
		Fenthion-sulfone	mg/kg	< 0,01	DIN EN 15662
		Fenthion (sum of fenthion and its oxigen analogue, their sulfoxides and sulfone expressed as parent)	mg/kg	< 0,01	DIN EN 15662
		Methidathion	mg/kg	< 0,01	DIN EN 15662
		Phosmet	mg/kg	< 0,01	DIN EN 15662
		Malathion (sum of malathion and malaoxon expressed as malathion)	mg/kg	< 0,01	DIN EN 15662
		Phosalone	mg/kg	< 0,01	DIN EN 15662
		Pirimiphos-methyl	mg/kg	< 0,01	DIN EN 15662
		Profenofos	mg/kg	< 0,01	DIN EN 15662
		Pyrazophos	mg/kg	< 0,01	DIN EN 15662
		Triazophos	mg/kg	< 0,01	DIN EN 15662
		Tolcloflos-methyl	mg/kg	< 0,01	DIN EN 15662
		Acephate	mg/kg	< 0,01	DIN EN 15662
		Azinphos-methyl	mg/kg	< 0,01	DIN EN 15662
		Dicrotophos	mg/kg	< 0,01	DIN EN 15662
		Dimethoate+Omethoate (sum of dimethoate and omethoate expressed as dimethoate)	mg/kg	< 0,01	DIN EN 15662

		Fosthiazate	mg/kg	< 0,01	DIN EN 15662
		Methamidophos	mg/kg	< 0,01	DIN EN 15662
		Monocrotophos	mg/kg	< 0,01	DIN EN 15662
		Oxydemeton-methyl	mg/kg	< 0,01	DIN EN 15662
		Paraoxon-methyl (sum of parathion-methyl and paraoxon- methyl expressed as parathion-methyl)	mg/kg	< 0,01	DIN EN 15662
		Parathion	mg/kg	< 0,01	DIN EN 15662
		Trichlorfon	mg/kg	< 0,01	DIN EN 15662
		Carbamates			
		Aldicarb	mg/kg	< 0,01	DIN EN 15662
		Aldicarb sulfone	mg/kg	< 0,01	DIN EN 15662
		Methiocarb	mg/kg	< 0,01	DIN EN 15662
		3-hydrocarbofuran	mg/kg	< 0,01	DIN EN 15662
		Carbaryl	mg/kg	< 0,01	DIN EN 15662
		Oxamyl	mg/kg	< 0,01	DIN EN 15662
		Propoxyr	mg/kg	< 0,01	DIN EN 15662
		Aldicarb sulfoxide	mg/kg	< 0,01	DIN EN 15662
		Carbofuran	mg/kg	< 0,01	DIN EN 15662
		Methomyl	mg/kg	< 0,01	DIN EN 15662
		Benfuracarb	mg/kg	< 0,01	DIN EN 15662
		Carbosulfan	mg/kg	< 0,01	DIN EN 15662
		Furathiocarb	mg/kg	< 0,01	DIN EN 15662
		Thiodicarb	mg/kg	< 0,01	DIN EN 15662
		Fenoxycarb	mg/kg	< 0,01	DIN EN 15662
		Indoxacarb	mg/kg	< 0,01	DIN EN 15662
		Iprovalicarb	mg/kg	< 0,01	DIN EN 15662
		Pirimicarb	mg/kg	< 0,01	DIN EN 15662
		Propamocarb	mg/kg	< 0,01	DIN EN 15662

Lack data of PHA in water and sediments Microplastic in Spaurus Aurata and Dicentarchus Labrax Antibiotics in Spaurus Aurata and Dicentarchus Labrax.

6.3.4 Antibiotics in Spaurus Aurata

Nr. of sample	Sample types	Substance (Antibiotic)	Unit of measure	Results
40	***Sparus aurata L.***	**Penicillin:**		
		Ampicillin	µg/kg	< 7.5
		Penicillin G	µg/kg	< 7.5
		Cloxacillin	µg/kg	< 10
		Amoxicillin	µg/kg	< 7.5
		Penicillin V	µg/kg	< 10
		Oxacillin	µg/kg	< 10
		Dicloxacillin	µg/kg	< 15
		Nafcillin	µg/kg	< 10
		Fluoroquinolone:	µg/kg	
		Enrofloxacine	µg/kg	< 10
		Ciprofloxacin	µg/kg	< 10
		Danofloxacin	µg/kg	< 10
		Marbofloxacin	µg/kg	< 10
		Flumequine	µg/kg	< 10
		Tetracycline:	µg/kg	
		Tetracycline+4-epitetracycline	µg/kg	< 20
		Oxytetracycline+4-epioxytetracycline	µg/kg	< 20
		Chlortetracycline+4-epichlortetracycline	µg/kg	< 20
		Doxycycline	µg/kg	< 20
		Σ Sulfonamide	µg/kg	< 8
		Ampicillin	µg/kg	< 7.5
		Penicillin G	µg/kg	< 7.5
		Cloxacillin	µg/kg	< 10
		Amoxicillin	µg/kg	< 7.5
		Penicillin V	µg/kg	< 10
		Oxacillin	µg/kg	< 10
		Dicloxacillin	µg/kg	< 15

		Nafcillin	µg/kg	< 10
		Fluoroquinolone:	µg/kg	
		Enrofloxacine	µg/kg	< 10
		Ciprofloxacin	µg/kg	< 10
		Danofloxacin	µg/kg	< 10
		Marbofloxacin	µg/kg	< 10
		Flumequine	µg/kg	< 10
		Tetracycline:	µg/kg	
		Tetracycline+4-epitetracycline	µg/kg	< 20
		Oxytetracycline+4-epioxytetracycline	µg/kg	< 20
		Chlortetracycline+4-epichlortetracycline	µg/kg	< 20
		Doxycycline	µg/kg	< 20
		Σ Sulfonamide	µg/kg	< 8

7. Conclusion

The data provided by the ADRINET project are in contrast with data reported by Italian environmental Ministry regarding the Northern and Central Adriatic Sea. The absence of main pollutants in the waters and in the sediments, suggestions that environmental conditions of this part of the Mediterranean Sea are positive.

The quality of the water and the sediments therefore translates into the lower risk of chemical contamination of the catch.

To explain the quality of waters of the Southern Adriatic Sea compared to Northern and Central Adriatic Sea, it is possible make various hypothesis:

- *the absence of large rivers that can bring in their water industrial discharges and chemical compounds;*
- *the absence of drills,*
- *Sea currents coming from the Ionian Sea and consequent mixing of the waters.*

The most alarming data is the presence of plastic dispersed in the sea and then found in high percentage in the intestine of some fishery products. This is a global problem of environmental contamination because it conditions the survival of the marine ecosystem. For that purpose, ADRINET project aim for collects and analyses data from Italy, Montenegro and Albania and suggests common strategies to preserve marine ecosystem.

8. REFERENCE

- *Corsi I., Tabaku A., Nuro A., Beqiraj S., Marku E., Perra G., Tafaj L., Baroni D., Bocari D., Guerranti C., Cullaj A., Mariottini M., Shundi L., Volpi V., Zucchi S., M. Pastore A., Iacocca A., Trisciani A., Graziosi M., Piccinetti M., Benincasa T., and Focardi S. (2011): Ecotoxicological Assessment of Vlora Bay (Albania) by a Biomonitoring Study Using an Integrated Approach of Sublethal Toxicological Effects and Contaminant Levels in Bioindicator Species. Journal of Coastal Research: Special Issue 58: pp. 116 – 120.*
- *CISM (2008): "Progetto di asistenca tecnica alla realizzazione ed alla gestione di un centro internacionale di scienze del mare in Albania", vol I TOMO II*
- *Management plan National park of marine natural Ecosystem of the Karaburuni peninsula And Sazan island- 2015*
- *Tursi A.; Corselli C.; Bushati S., and Beqiraj S., (2011): The Vlora project. In: Tursi, A. and Corselli, C. (eds.), Coastal Research in Albania: Vlora Gulf, Journal of Coastal Research, Special Issue No. 58, pp. 1–5*
- *Rivaro P.; Cullaj A.; Frache R.; Lagomarsino C.; Massolo S.; De Mattia M.C., and Ungaro N., (2011): Heavy metals distribution in suspended particulate matter and sediment collected from Vlora Bay (Albania): A methodological approach for metal pollution evaluation. In: Tursi, A. and Corselli, C. (eds.), Coastal Research in Albania: Vlora Gulf, Journal of Coastal Research, Special Issue No. 58, pp. 54–66*
- *Wania, F. and Mackay, D. (1996) Tracking the Distribution of Persistent Organic Pollutants. Environmental Science & Technology, 30, 390A-396A. http://dx.doi.org/10.1021/es962399q*