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**Summer school**

**SUSTAINABLE DEVELOPMENT OF YACHTING AND CRUISE INDUSTRY**

# **Introduction on Marine Biology research and anthropogenic impact**

University of Montenegro  
Institute of Marine Biology

**Lecturer: Dr. Aleksandar Joksimović**  
**Kotor, 22/7/2022**

**Project no. 609675-EPP-1-2019-1-ME-EPPKA2-CBHE-SP**



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Institute of marine biology was founded in 1961

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The main research goal is investigating and protection of Adriatic sea with special interest of South Adriatic area

Institute have 5 different Laboratories and one Center

1. Laboratory for ichthyology and fisheries
2. Laboratory for sea bottom and sea protection
3. Laboratory for marine chemistry and oceanography
4. Laboratory for aquaculture and development center
5. Laboratory for plankton and quality of sea water
6. Center of Adriatic Biodiversity Protection- Boka Akvarium

12 PhD scientist, 6 PhD students, 9 internship and 10 administrative staff

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Research is based through finance on national and international level

More than 140 research projects successfully implemented until today

Present we have 26 research projects

Adriamed – UN FAO

BIO-ICT – CoE World Bank

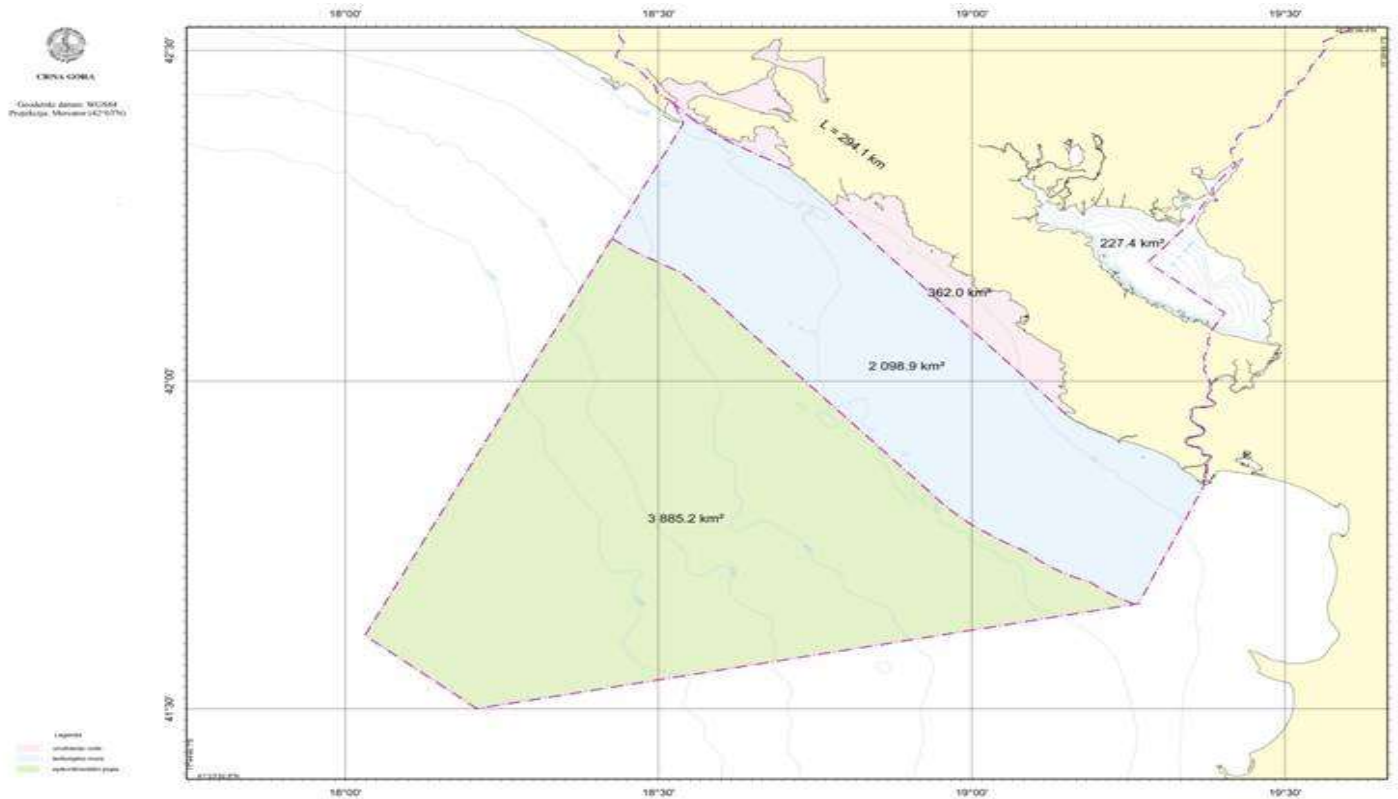
PinnaSPOT – Foundation of Prince Albert II of Monaco

Greatfarm, Innobluegrowth – EU IPA funds

MEDITS and MEDIAS fisheries project

Sea water quality on Montenegrin coast

**Project no. 609675-EPP-1-2019-1-ME-EPPKA2-CBHE-SP**



Internal and territorial waters and epicontinental belt of Montenegro

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## *Laboratory for ichthyology and fisheries*

Main activities in this Laboratory is:

Population dynamics of all commercial species in Montenegrin coast

Estimation on abundance and density of all species (fish, crabs and cephalopods)

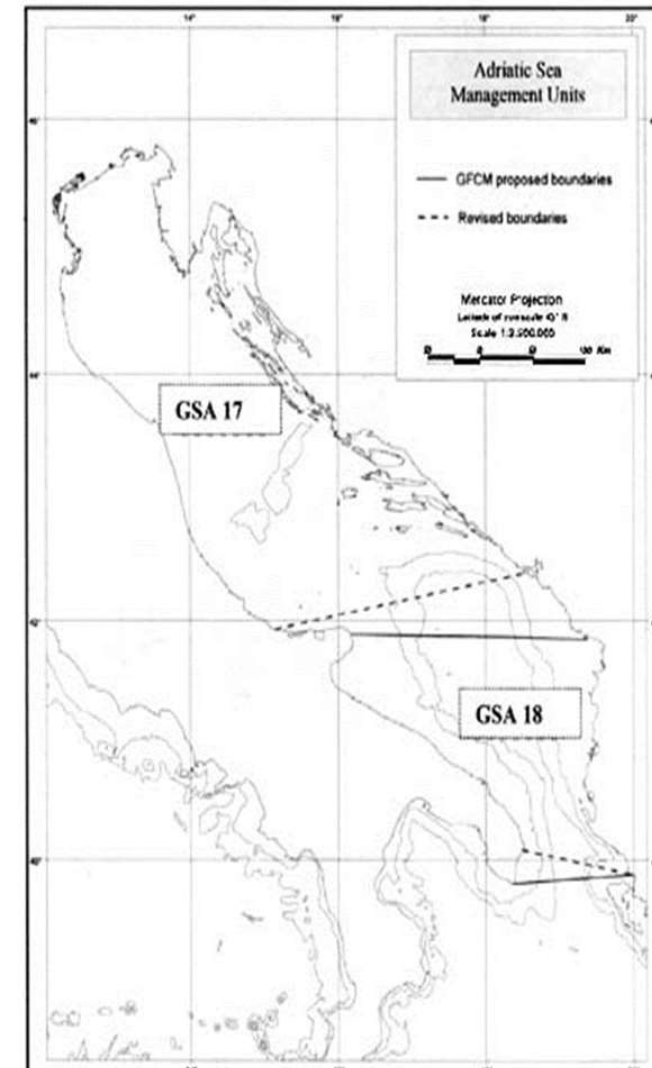
Participation to the MEDITS survey – on GSA 18 level demersal species

Participation to the MEDIAS survey - small pelagic species

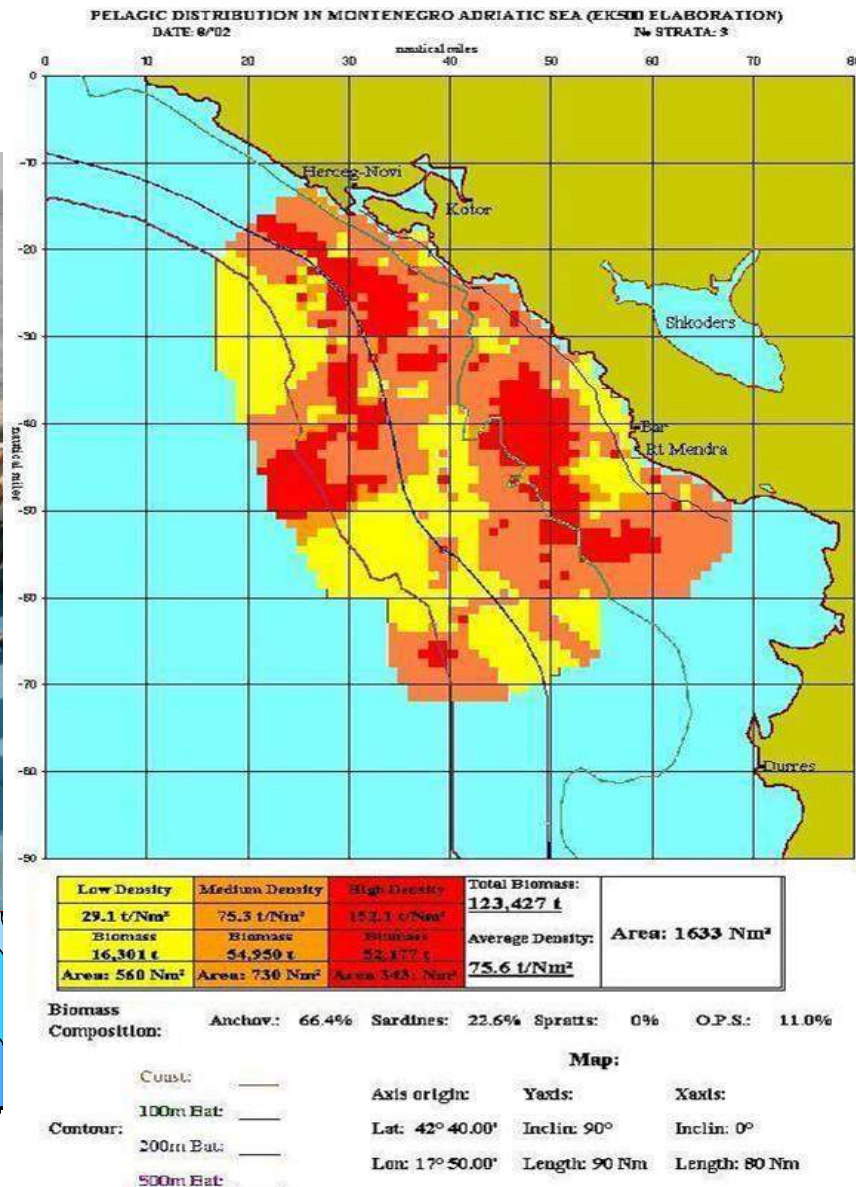
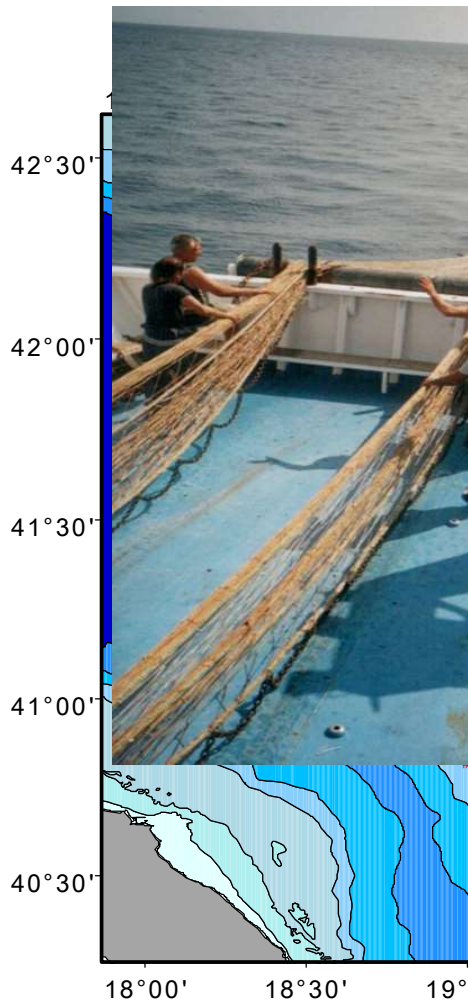
By the Law of marine fisheries and aquaculture Institute is responsible for the monitoring of the fisheries sea of the Montenegro

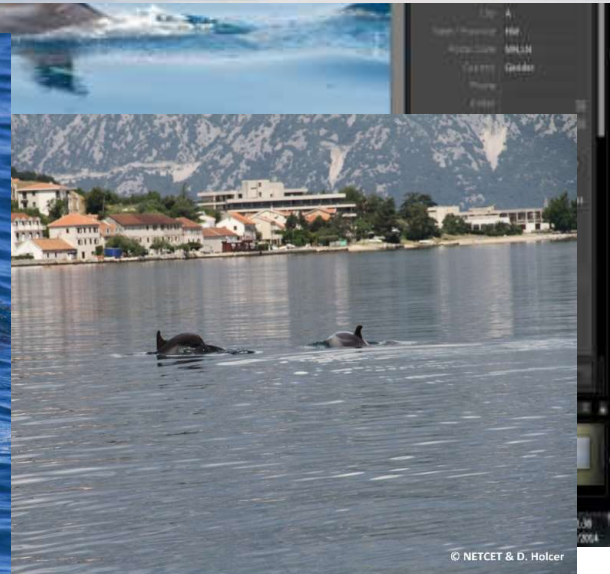
Research on Cetaceans and Sea Turtles

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# DEPM method







## Laboratory for marine chemistry and oceanography

The main activity of employees in this Laboratories are testing / research bio-geo-chemical processes and cycles of different parameters in the water column, sediment and biota of the Montenegrin coast with a view to enhance protection of the marine ecosystem.

Laboratory is involved in:

- analysis of the basic physical-chemical parameters; analysis of nutrients in the sea water;
- examining the presence of heavy metals in sediment and marine organisms and their impact on ecosystem;
- Determination of metals pollution as well as bioaccumulation and geo-accumulation factor;
- examining the physical characteristics of sediments, mineralogy, sedimentary characteristics and ecology of marine sediments;
- Biomonitoring-examination of the degree of pollution of the sea as well as the response of organisms to pollution ie. Monitoring the accumulation of pollutants and their harmful substances in the tissues and organs;
- Laboratory is engaged in oceanographic research, with a focus on the area of the southern part of the Adriatic.



- Chemical parameters:  
salinity, oxygen, oxygen  
saturation, nutritive salts  
(nitrite, nitrate, phosphates,  
silicate, Total Nitrogen and  
Total phosphorus , pH
- Physical parameters:  
temperature, colour,  
transparency, electro-  
conductivity



## HEAVY METALS IN SEDIMENT AND BIOTA



Ekman dredge



Mussels



Lyophilizer



Atomic Absorption  
Spectrophotometer



Dry samples

## Laboratory for plankton and seawater quality

- Study of composition and abundance of autotrophic and heterotrophic picoplankton;
- Picoplankton biomass estimation;
- Study of abundance and composition of mixotrophic and heterotrophic nanoplankton and estimation of its biomass;
- Monitoring of sanitary quality of seawater (presence and abundance of *E. coli* intestinal enterococci and other indicators in seawater);
- Determination of faecal coliforms, streptococci and other indicators in sediment;

Laboratory has accreditation for microbiological (MEST EN ISO 19458:2013) and biological (ISO 5667-9:1992) samplings. Laboratory has accreditation for determination of *E. coli* (MEST EN ISO 9308-1:2015), for intestinal enterococci (MEST EN ISO 7899-2:2011) and determination of phytoplankton (MEST EN 15204:2014).



• Laboratory for plankton and seawater quality is engaged in basic, applied and developmental scientific research in areas of phytoplankton, zooplankton, bacterioplankton and determination of sanitary quality of seawater and sediment, specifically:

- Study of composition and abundance of phytoplankton communities (qualitative and quantitative determination);
- Phytoplankton biomass estimation, determination of chlorophyll concentration as an indicator of phytoplankton biomass estimation;
- Estimation of eutrophication degree based on phytoplankton abundance and composition of species (phytoplankton organisms as ecosystem condition indicators), as well as chlorophyll  $a$ ;
- Determination of potentially toxic and toxic phytoplankton species on mussels and fish farms, and in marine environment in general ;
- Estimation of abundance and composition of zooplankton organisms
- Monitoring of mass appearances of jellyfish and other gelatinous organisms, determination of their abundance and potential harmful effect on the food chain;

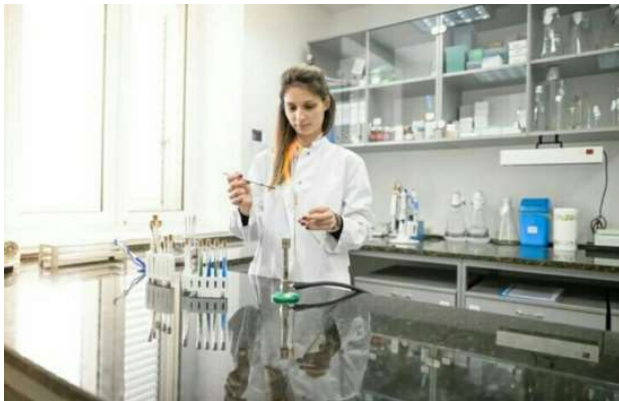




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Main responsibilities of the laboratory for aquaculture are research and innovation in the field of marine aquaculture.  
That implies following:

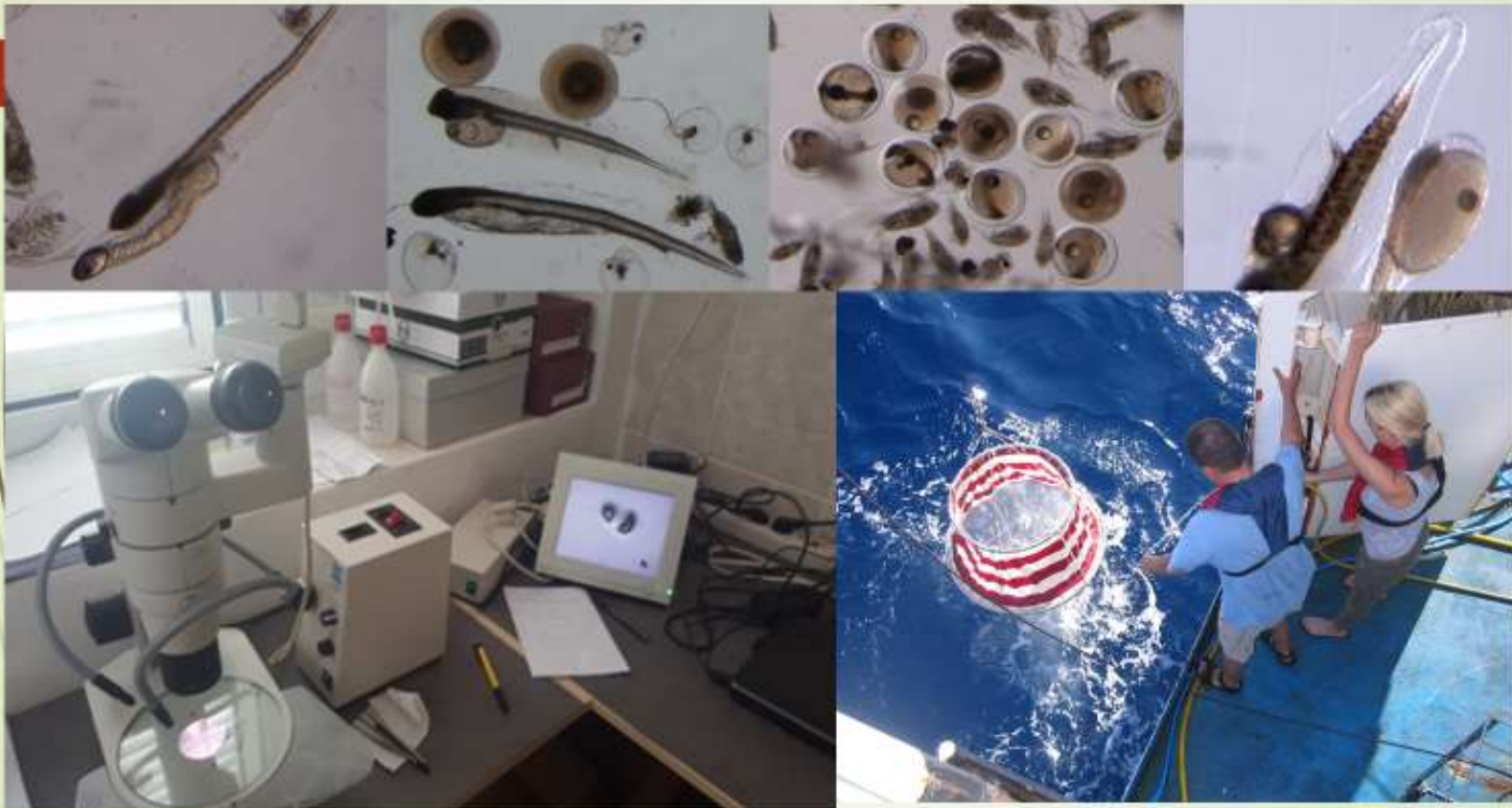
- ▶ study and improvement of technology of cultivation of edible shellfish and finfish in the area of the Montenegrin coast;
- ▶ analysis and site selection for fish and shellfish farming process in accordance with FAO principles AZA (Allocated Zones for Aquaculture);
- ▶ research in the field of integrated multi-trophic aquaculture (IMTA);
- ▶ estimation of biomass and spatial distribution of edible shellfish
- ▶ introduction of new native species in the farming process (diversification of production);
- ▶ advising of producers, as well as permanent monitoring and bio-monitoring of water quality on fish and shellfish farms



## Developmental research:

- research on determination, diversity, spatial distribution and abundance of early life stages of fishes and shellfishes
- Analyses of composition, type and spatial distribution of marine litter
- Analyses and preparation of project proposals for different international calls: IPA; Horizon 2020, Interreg, Adrion etc.







## Laboratory for benthos and protection of the sea

In this laboratory there are 2 scientist (dr Vesna Mačić and dr Slavica Petović) and technician (Branislav Lazarević). Our small group is performing research on fitobenthos (macroalgae and seagrasses) and different groups of invertebrates (echinoderma, mollusks, sponges, etc.).

Most of our work is performed by SCUBA diving as a most direct and notdestructiv way of survey.





- Our work is mostly concentrated to the Boka Kotorska Bay but also to the other parts of the coast of Montenegro. We are working on biodiversity with special attention to the protected and endangered species. Furthermore we are working on habitat mapping, inventory of invasive species, and creation of the MPA (Marine Protected Area).



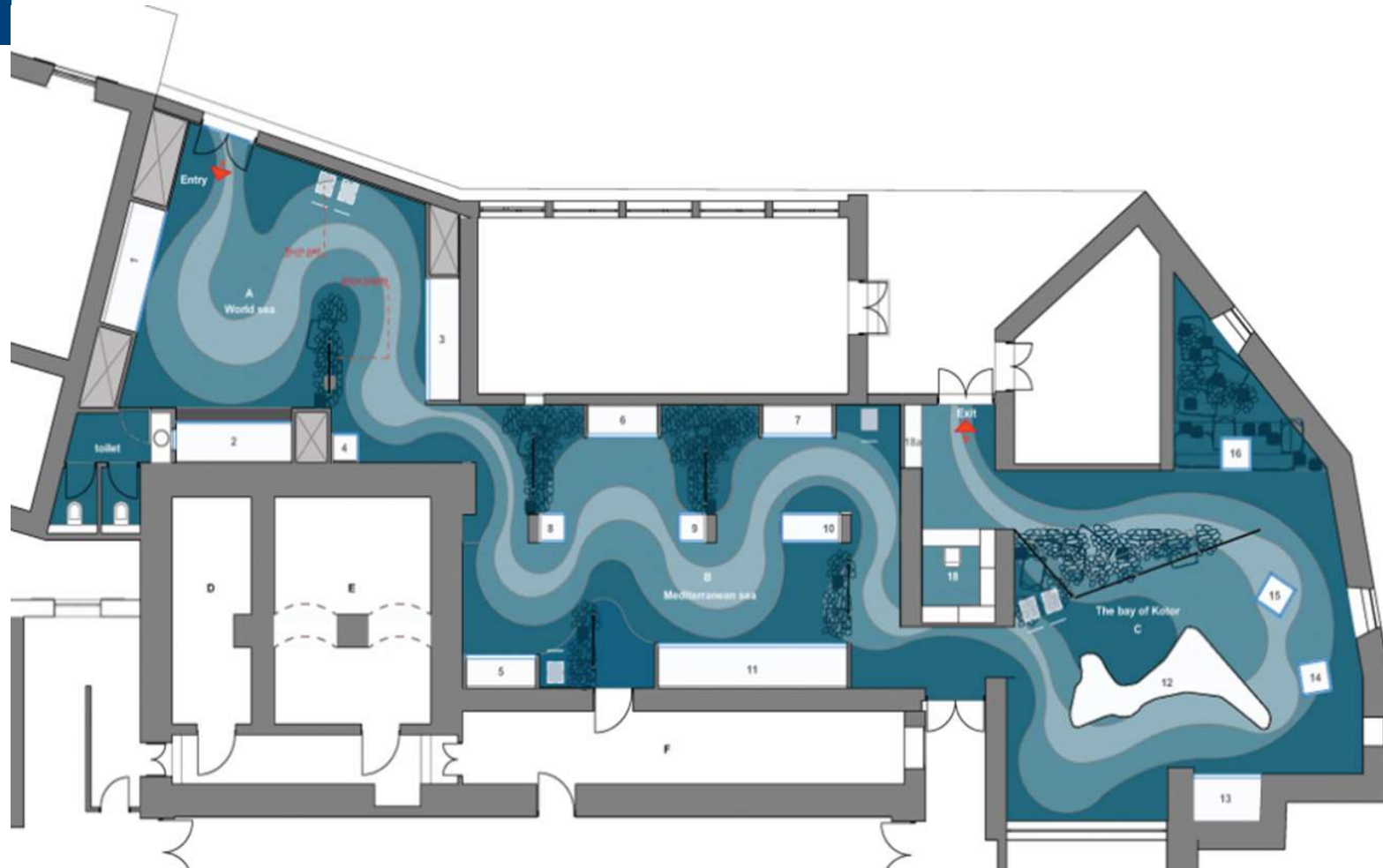
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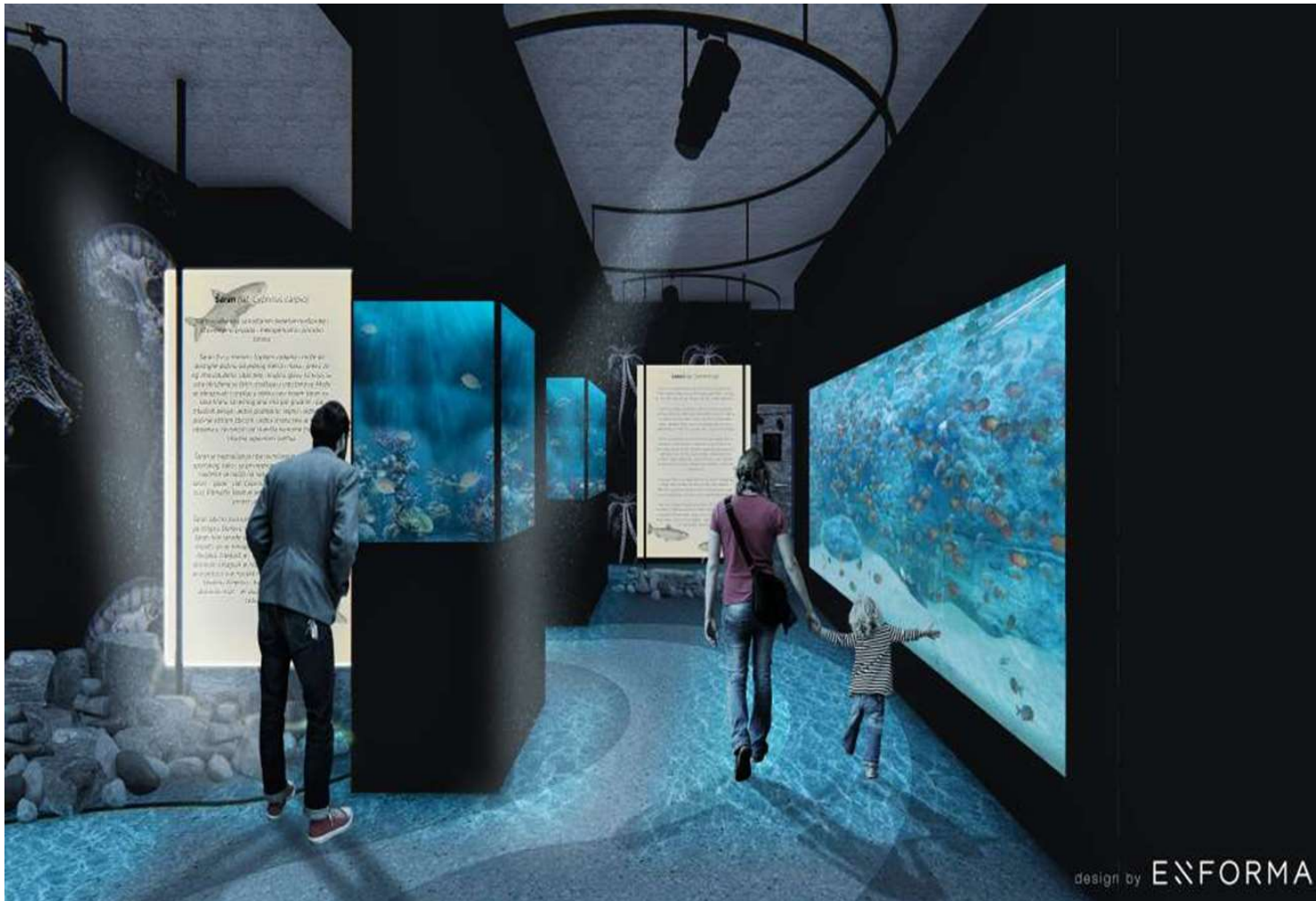


## *Center for Adriatic Biodiversity Conservation –Boka Akvarium*

- Setting up a public aquarium on the principle of economic self-sustainability, its regular maintenance and taking care of its functionality in accordance with the best principles and rules of keeping animal species in captivity
- Establishment of a Center for the rescue of sea turtles and other endangered species
- Organization of educational workshops, courses and training for children and young people of all ages
- Organization of the outdoor exhibition "Museum of the Sea" and its regular maintenance
- Connecting with colleagues from the country and region, for the purpose of exchanging experiences, working together, developing project applications, implementing joint international projects, writing joint scientific papers, organizing scientific conferences, promoting marine sciences.

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## The main ecological problem in Adriatic sea

- Overexploitation of fisheries resources
- Huge marine traffic
- Illegal activities in fisheries and diving
- Waste water
- Marine litter
- Alien species



ECONOMY





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## *Oceans and seas*

Ocean (Okeanos, Greek god of the sea) (Trevi Fountain, Rome), The oceans cover almost three-quarters of the Earth's surface and constitute by far the largest and most complex biome. They are home to the largest and smallest animals, from tiny zooplankton to the mighty blue whale. Between these two extremes, the oceans contain an incredible wealth of life.

The world's oceans contain about 1.35 billion cubic kilometers of seawater, but this huge amount is not uniform, but differs by several physical properties, among which are temperature, salinity, pressure and light level.

Today it is generally accepted that the Earth has 5 oceans and the greatest depth is in the Pacific Ocean (Marian Trench), about 11,000 meters.

Around the edges of these oceans are smaller areas called seas and sunken bays. Some seas such as the Sargasso are still vaguely defined, but others such as the Mediterranean or the Adriatic Sea are almost entirely surrounded by land or island arcs.



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## *Oceans and seas*

Oceans produce 70% of our oxygen, absorb heat and redistribute that heat around the world and thus have a dominant influence on the world's weather system.

The length of the Adriatic Sea is 783 km, the average width is 248 km, at Bar 355 km, the average depth is 239 m, and the area is 138,595 km<sup>2</sup>, which is about 4.6% of the total area of the Mediterranean. The volume is about 34,977 km<sup>3</sup>.

The Adriatic Sea is northernmost part of the Mediterranean is divided into the northern, middle and southern parts, and the depth increases from the north to the south of the Adriatic Sea (South Adriatic basin, 1,228 m).

In the Adriatic, the depth decreases from the littoral, over the shelf (up to 200 m), to the continental shelf (bathyal-abysal). The length of the coastline of the Montenegrin part is 294.1 km, of which 105.7 km belong to the Bay of Kotor and 11 km are islands. Inland waters, territorial waters (up to 12 NM) and then the epicontinental belt alternate from the coast to the open sea.

In the seas and oceans, marine organisms that swim in free water are nektonic, planktonic float and are carried by sea currents and nektons that perform their activities on the bottom of the sea

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## *Oceans and seas*

During the summer months in the Adriatic there is a known thermocline, a layer of water in which the temperature changes sharply with depth.

Due to human activity, the seas and oceans are permanently polluted, and the biggest problem today is plastic waste. In addition, heavy metals are also present as pollutants, especially in sediment and animal tissues, the most dangerous of which is mercury.

We are also witnessing climate changes, changes in average temperatures, and as a consequence, we have the appearance of invasive species, foreign, introduced species, which are becoming more and more numerous.

A big challenge for us and future generations is how to preserve biodiversity, i.e. biological diversity on the planet, i.e. in the sea and oceans.



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*Let's ask ourselves if we deserve the name Homo sapiens???*

<https://www.youtube.com/watch?v=bN5HTVioDqE&t=120s>

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# Thank you for your attention!

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