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Summer school

SUSTAINABLE DEVELOPMENT OF YACHTING AND CRUISE INDUSTRY

Importance of monitoring the port's water area in order to estimate the impact of ballast water on marine biodiversity

Lecturer: Dr Dragana Drakulović

Kotor, 22/7/2022

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

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Ballast waters

- Vessels fundamentally rely on ballast water for safe operation as a function of their design and construction.

- When a vessel is not fully laden with cargo, additional weight, i.e. ballast water, is required to compensate for the increased buoyancy.

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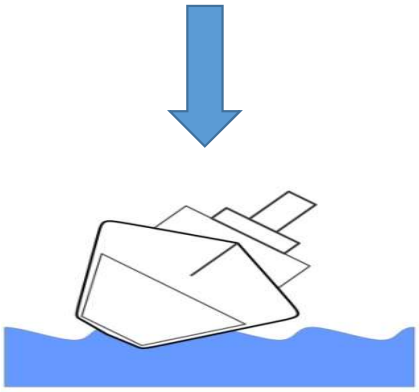
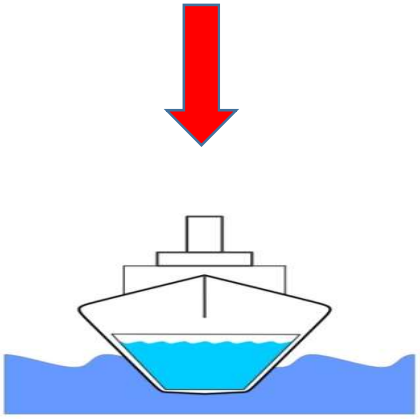
Ballast waters

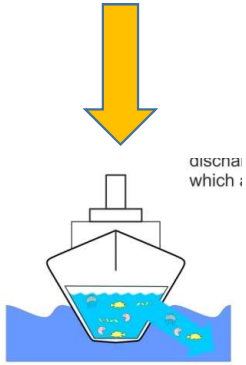
Why ballast water?



To stabilize unloaded cargo-ship.



By discharging the ballast water, organisms in the ballast water are also discharged into the new environment.



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WHAT IS IN THE BALLAST WATER DISCHARGE?

When ballast water is loaded on board the vessel, organisms present in the water are loaded as well. Many of these organisms survive ballasting operations and longer voyages, and then are discharged into the waters of another port.

Ballast water carried by vessels has been recognized as an important vector for the transfer of Harmful Aquatic Organisms and Pathogens (HAOP) and Non-indigenous Species (NIS) across natural barriers. HAOP represent one of the biggest threats to the world's oceans and seas. The transfer of HAOP via ballast water may lead to changes in the state of ecosystems and thus can have a negative impact on human health and on the economy.

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The Adriatic Sea is a unique and highly sensitive ecosystem. The economic development and social existence of the coastal states strongly depend on a clean and preserved Adriatic Sea.

The Adriatic Sea is a seaway mainly used by international shipping transporting goods to or from Europe as hinterland, with intense local shipping as well. Of serious concern is the introduction of harmful aquatic organisms and pathogens (HAOP) by ships' ballast water (BW). The volume of BW discharged into Adriatic Sea ports is over 10 million tons per year and due to impending projects this could soon increase considerably. The presence of HAOP in BW discharged into Adriatic ports has been proven. More than 70 NIS have been recorded in the Adriatic Sea, of which 12 are on the **"100 of the worst"** list, and most of these can be related to BW as vector. Negative HAOP impacts have already been recorded in the Adriatic Sea.

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Monitoring activities in the port areas

- Importance of performing Port Baseline Survey in the aquatorium of the ports
- Importance of establishment of permanent monitoring of marine ecosystem
- Importance of the performing analysis on the board of the vessels

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Monitoring activities in the port areas

BALLAST WATER MANAGEMENT SYSTEM FOR ADRIATIC SEA PROTECTION-BALMAS

The BALMAS project addressed on protection from Ballast Water (BW) pollution in the Adriatic area, risk prevention and protection and enhancement of the marine and coastal environment.

The BALMAS project addressed the problem of BW, which is necessary for safe navigation, but on the other hand represents a prominent vector for the transfer of Harmful Aquatic Organisms and Pathogens (HAOP) across natural barriers. The BALMAS project integrated necessary activities to enable a long-term, environmentally efficient, and financially and maritime transport sustainable implementation of Ballast Water Management (BWM) measures in the Adriatic.

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Port Baseline Survey in port of Bar

PORT BASELINE SURVEY PROTOCOL

PBS are used to develop a baseline list of species including both native and non-indigenous (NIS) species present in ports, to develop a list of Harmful Aquatic Organisms and Pathogens (HAOP) and to provide a qualitative basis for monitoring the introduction of new species.

Typically, biota surveys involve sampling several different groups of organisms: hard-bottom organisms, soft-bottom benthos, plankton, and motile epifauna (eg, fish). All of these species groups should be surveyed within a comprehensive sampling protocol.

The proposed sampling protocol within the BALMAS project was applied in 12 ports of the Adriatic Sea: Bari, Ancona, Venice and Trieste in Italy, Koper in Slovenia, Pula, Rijeka, Šibenik, Split and Ploče in Croatia, Bar in Montenegro and Dures in Albania.

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Port Baseline Survey in port of Bar

Water column and sediment

Traps for fish communities

Diving positions for phyto and zoobentos

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Port Baseline Survey in port of Bar

Water column and sediment

Biological parameters in the water column: phytoplankton, zooplankton, ichthyoplankton and microbial pathogens were sampled during four water column sampling campaigns in port of Bar.

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Port Baseline Survey in port of Bar

Water column and sediment

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Port Baseline Survey in port of Bar

Phytoplankton

List of toxic and potentially toxic microalgal taxa (samples are from **Niskin bottle**) found in port of Bar during three campaigns; here are filled maximum abundance from surface, middle and bottom

DATE	February 2015				April 2015				June 2015			
Position	P1	P2	P3	P4	P1	P2	P3	P4	P1	P2	P3	P4
Taxon	cells/l				cells/l				cells/l			
DIATOMS												
Pseudo-nitzschia spp.	12560	5757	6803	33755	10990	14130	3925	4710	8635	13345	17270	14915
DINOFLAGELLATES												
Alexandrium spp.	-	-	-	-	-	-	-	-	200	-	-	-
Dinophysis acuminata	-	-	-	-	-	-	-	-	80	40	-	80
Dinophysis acuta	-	-	-	-	-	-	-	-	80	-	-	-
Dinophysis saccula	-	-	-	-	-	-	-	-	-	40	-	-
Dinophysis tripos	-	-	-	40	-	-	-	-	-	-	-	-
Dinophysis fortii	-	-	-	-	120	-	-	-	-	-	-	-
Gonyaulax spinifera	-	-	-	-	40	-	-	-	80	-	-	-
Lingulodinium polyedra	-	-	-	-	-	-	-	-	280	-	40	-
Phalacroma rotundatum	-	-	-	-	40	-	-	-	-	160	40	40
Prorocentrum minimum	-	-	-	-	1570	-	785	785	-	-	-	-

11 potentially toxic and toxic species

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Port Baseline Survey in port of Bar

All positions during the four investigated seasons were classified as “excellent” according to the EU Bathing Water Directive 2006/7/EC and meet the requirements of the BWM Convention except position P1 in June and October. Seawater quality at site P1 in June and October is considered unsatisfactory according to the requirements of the D2 - BWM convention due to the level of intestinal enterococci, although the water quality is considered sufficient according to the EU Bathing Water Directive 2006/7/EC.

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Port Baseline Survey in port of Bar

Traps for fish communities

Epibenthos and fish community

In April and October 2015, ichthyofauna was sampled at three positions using fish trap.

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Port Baseline Survey in port of Bar

Traps for fish communities

•European conger *Conger conger*, lenght 1.5 m; weight 3 kg

•Crustacean species hermit crab *Dardanus arrosor*, cephalothoracic length 20 mm and weight 6.68 g

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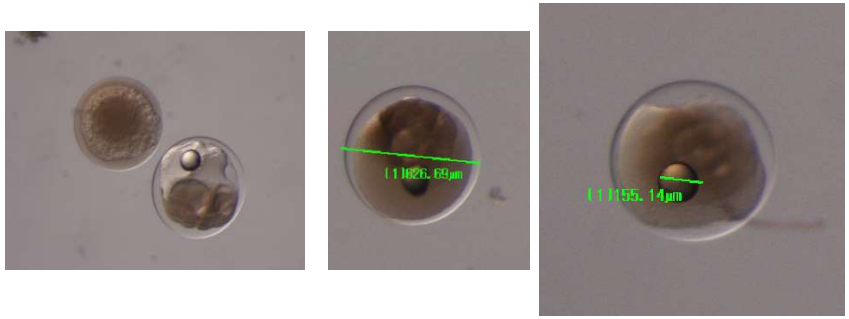
Port Baseline Survey in port of Bar

Ichthyoplankton

early developmental stages of fish

Water column and sediment



With plankton net with mesh size 300µm (200cm in length and diameter 50cm)

The results of the composition and abundance of ichthyoplankton in the port of Bar showed a moderate spawning intensity at all investigated positions.

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Port Baseline Survey in port of Bar

Diving positions
for phyto and zoobentos

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Port Baseline Survey in port of Bar

Among the invertebrate species, introduced or non-native species have also been recorded :

Shell *Arcuatula senhousia*

Polychaetes *Hydroides dirampha* and *Palola valida*

Bryozoa *Bugula neritina*

Ascidia *Styela plicata*

Diving positions for phyto and zoobentos

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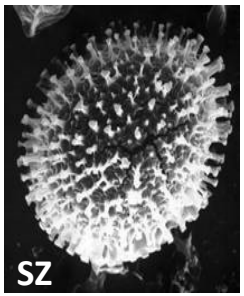
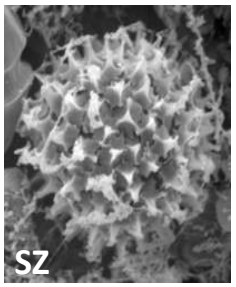
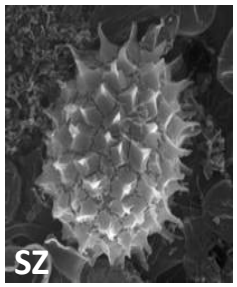
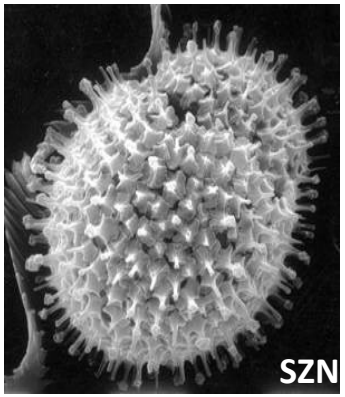
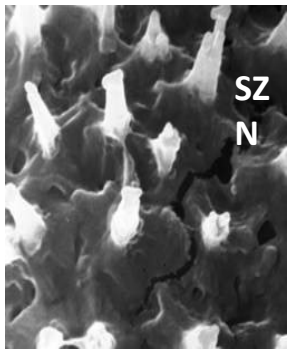
Dinoflaglelates cysts

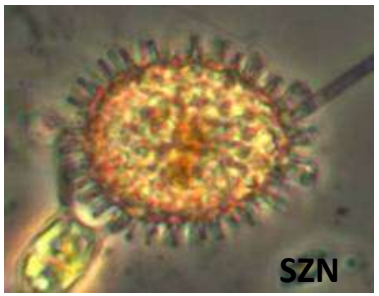


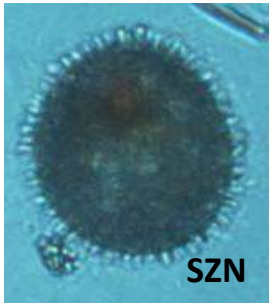


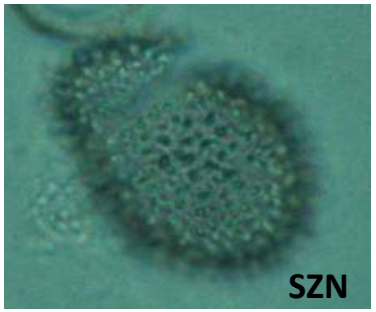












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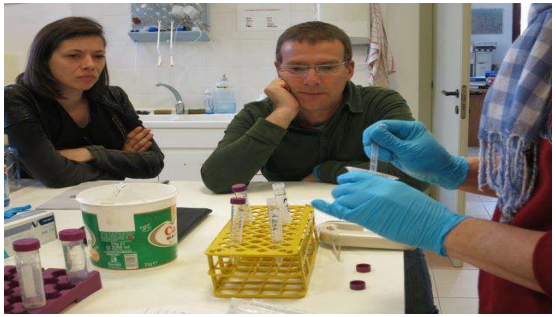
Workshop in Venice



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

Ballast water sampling for compliance monitoring and enforcement of the BVM Convention carried out in ports and on vessels, containing reviews, models and test results: BWS method and sampling

Workshop of BWS in port of Bar

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

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Ballast water sampling for compliance monitoring and enforcement of the BVM Convention carried out in ports and on vessels, containing reviews, models and test results: BWS method and sampling

Ballast water (BW) samples were taken from one GC ship arrived in the port of Bar on 26th July 2016. The origin of ballast waters is from Marsaxlokk port, from Malta. The holding time of BW in tank prior sampling was three days.
Sample number, ship types, holding time in tank prior sampling and origin of the ballast waters

The ship was chosen for sampling and it was sampled with the "*in-tank*" method according to the access point - manholes, as proposed in the BWS Protocol for Compliance Monitoring and Enforcement of the BWM Convention and Scientific Purposes" (David and Gollasch 2014)

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Ballast water sampling for compliance monitoring and enforcement of the BVM Convention carried out in ports and on vessels, containing reviews, models and test results: BWS method and sampling

This type of sampling will be part of a regular inspection and it is of great importance that those institutions that will be involved in the whole process acquire the necessary practice in the handling of equipment.

Salinity test with refractometer

Sampling with the spot sampler

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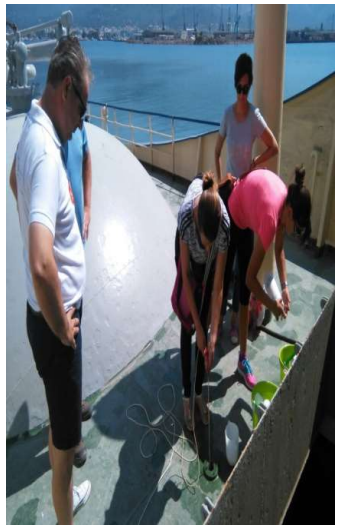
Ballast water sampling for compliance monitoring and enforcement of the BVM Convention carried out in ports and on vessels, containing reviews, models and test results: BWS method and sampling

On board was made indicative, quick analysis showed Low Risk, which indicates that there is no danger for the discharge of ballast. In the laboratories of the Institute of Marine Biology and in the laboratory of Faculty of Sciences in Podgorica it was made a detailed analysis of biological parameters, and qualitative and quantitative determination of organisms.

Ballast Water Handheld Fluorometer



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Ballast water sampling for compliance monitoring and enforcement of the BVM Convention carried out in ports and on vessels, containing reviews, models and test results: BWS method and sampling

Detailed analyses of bilogical parameters

Depth (m)	Indicator microbes 100 CFU/		Viable Phytoplankton (cells/ml)	Viable Zooplankton (items/m^3)	D-2 Compliance
	E. coli	Enterococci			
i	absent	absent	8	167	NO
0.5	-		2		
2	-		3		

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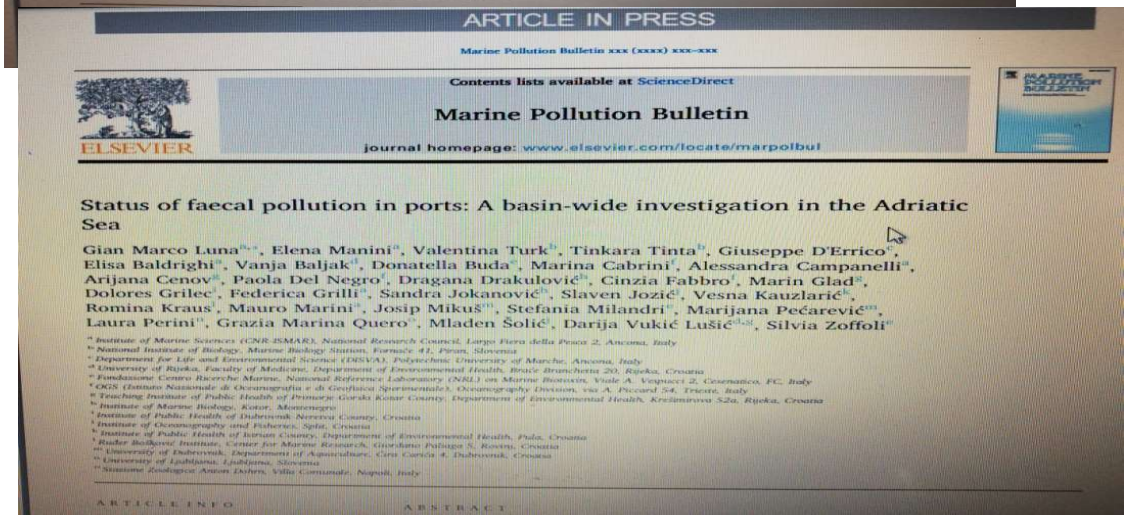

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Status of faecal pollution in ports: A basin-wide investigation in the Adriatic Sea

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https://youtu.be/KhwDnzPoy18

https://youtu.be/gakAIgFJvSg

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Thank you for your attention!

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