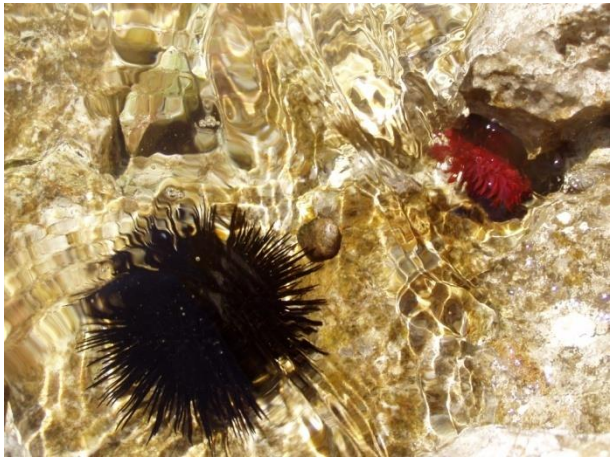

WP5: Port Baseline Survey

FB10: Institute of Oceanography and fisheries, (IOF) Split Croatia

Živana Ninčević Gladan

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Sustav upravljanje balastnim vodama za zaštitu Jadranskog mora (BALMAS)

Glavni cilj: smanjivanje rizika unosa štetnih i patogenih organizama (HAOP) balastnim vodama

Opći podaci o projektu

- IPA Adriatic Cross border cooperation programme 2007-2013
- 6 država na području Jadrana
- 16 PP + 7 associates, vodeći partner Institut za vode Republike Slovenije u suradnji s znanstvenim savjetnikom (dr. Matej David)
- Projektni partneri su javni instituti i organizacije koje se bave zaštitom okoliša, biologijom mora i pomorskim prometom
- Project duration: 1.11.2013 – 30.9.2016 (35 months)
- budget: 7,15 M EUR

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Za postizanje glavnog cilja u okviru projekta BALMAS prikupljeni su slijedeći nizovi podataka:

1. Podaci o pomorskom prometu i GIS karte

- Podaci o lokaciji brodova preko Automatskog Identifikacijskog Sustava (AIS)
- Podatke pribavilo: Zapovjedništvo talijanske obalne straže
- Podaci za razdoblje siječanj 2012 do lipanj 2015
- GIS karte:Institut za vode Republike Slovenije
- Pomorski promet
- Fina mreža tzv stanica veličine 250m (1.439. 457 stanica u Jadranu)
- Broj brodova koji prođe određenu stanicu u zadanom vremenu
- Razlukuju se područja pod većim i slabijim pritiskom

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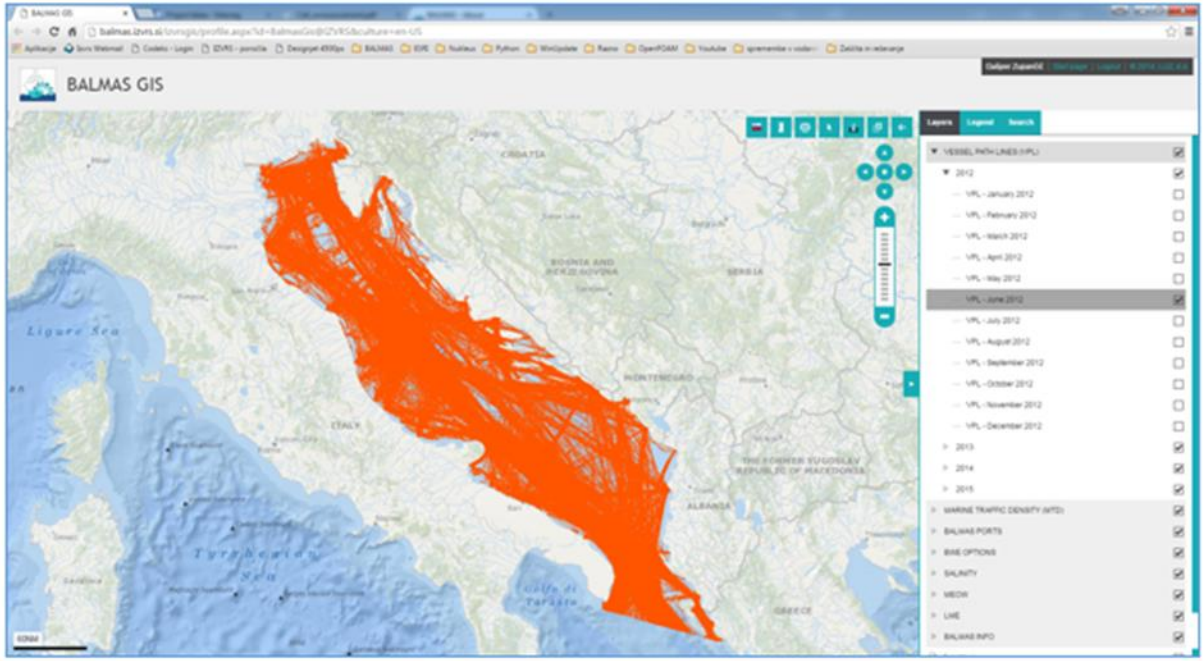
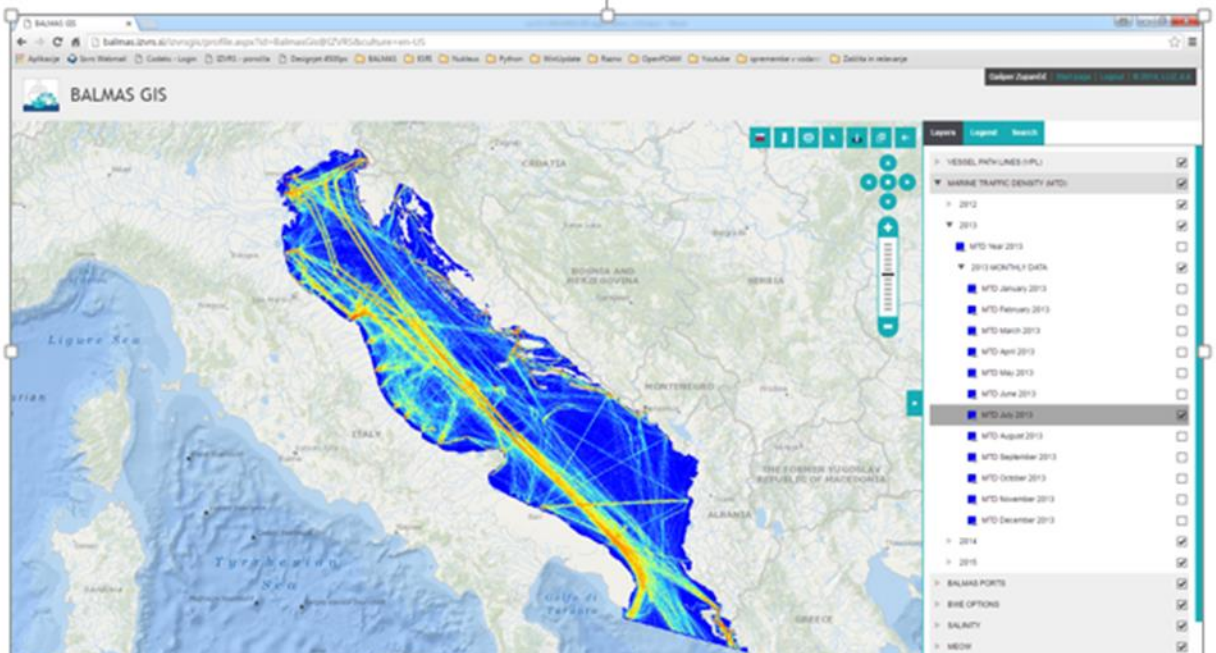


Figure 1: Vessel path lines recorded in June 2012 as displayed by the BALMAS GIS internet application.



2. Podaci o podrijetlu i količini ispuštenih balastnih voda

Dva niza podataka:

- Obrasci za izvještavanje o balastnim vodama
- Obrasci o specifikacijama broda i tereta

Bari: http://212.235.253.114/Nukleus/Bari.htm
Ancona: http://212.235.253.114/Nukleus/Ancona.htm
Venice: http://212.235.253.114/Nukleus/Venice.htm
Trieste: http://212.235.253.114/Nukleus/Trieste.htm
Koper: http://212.235.253.114/Nukleus/Koper.htm
Pula: http://212.235.253.114/Nukleus/Pula.htm
Rijeka: http://212.235.253.114/Nukleus/Rijeka.htm
Šibenik: http://212.235.253.114/Nukleus/Sibenik.htm
Split: http://212.235.253.114/Nukleus/Split.htm
Ploče: http://212.235.253.114/Nukleus/Ploce.htm
Bar: http://212.235.253.114/Nukleus/Bar.htm
Durrës: http://212.235.253.114/Nukleus/Durres.htm

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3. Popis organizama u balastnim vodama (na brodovima)

- Nabaviti opremu i obučiti ljude koji će biti zaduženi za uzorkovanje balastne vode kada Konvencija bude na snazi.
- Osigurati podatke o sastavu organizama u BW

4. Podaci o salinitetu u svjetskim lukama

Procjena rizika o mogućem uspješnom uvođenju HAOP vrste u novo područje zasniva se na dva principa

- Podudaranje okolišnih parametara između luke donora i luke primaoca
- Specifične karakteristike vrste i mogući negativni utjecaj koji može imati u novom okolišu

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5. Podaci o sastavu bioloških zajednica u lukama (Biological Port Baseline Survey, PBS)

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The general goal: provide information about the presence and possible negative effects of HAOP in ports and surrounding areas as hotspots of BW discharges.

- To determine the presence of invasive species in the harbor.
- Provide training and resources to researchers participating in the study as the assessment of the situation and in the future supervision and monitoring of the port.
- Develop and document evidence of invasive species found in the harbor.
- Create the basis for a database on invasive species in the port of Šibenik.
- To provide a basis for future long-term monitoring program for invasive species in the Croatian ports.
- To provide the basis for possible early detection of invasive species at ports and timely notification

In order to obtain comparable results, Protocol for PBS with methods and sampling frequency, the minimum numbers of sampling stations as well as a way of demonstrating results is provided.

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1. DEFINITION OF THE AREA TO BE SURVEYED

First step in developing a design plan is to decide on the extent of survey area. Questions which should be considered in the definition of an area to be surveyed are:

- Where are the areas in the ports where shipping operations might result in the release of BW?
- Where shipping related activities occurred in the past? This may include wrecks, anchorages for sailing ship.
- Where other vectors for NIS as aquaculture and disposal of material dredged from the port are located?
- How diverse are the habitats nearby?
- How easily and safely those habitats can be sampled?
- What is the rate of water exchange between ports and surrounding areas?
- What resources are available?

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2. SAMPLING SITES

2.1. Distribution of sampling sites

Port area	Priority
Commercial shipping facilities	
active berths	1
inactive/ disused wharves	1
channel markers	1
tug and pilot vessel berths	1
Slipways	1
Dredge disposal and spoil ground	2
Breakwaters, groynes etc. for NIS seaweeds priority **1**	3
Adjacent areas outside the port *	
nearby natural habitats**	2
off-shore exposed areas*	2
anchorages	1

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2.2. Number of sampling sites

The field sampling will be conducted in a number of sampling sites, or exact locations, within a port. The number of sites required for an adequate survey will depend on the size and type of port and, ideally, on the biological parameter investigated. As a minimum requirement, **at least three sampling** sites for each biological parameter per port should be selected.

3. Parameters

3.1 Abiotic parameters

Minimum requirements for abiotic parameters are temperature and salinity measurements at each sampling site. In addition, water transparency should be measured using a Secchi disc. In order to ensure a better characterization of environmental conditions in ports, nutrients, oxygen and chlorophyll 'a' concentrations could be measured.

Sediment samples could be taken for analysis of grain size and organic content. Sediment samples will allow characterization of the habitats associated with any introduced epifaunal or infaunal species found.

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3.2 Biotic parameters

- Human pathogens bacteria (Toxicogenic *Vibrio cholera* (serotypes 01 and 0139) *Escherichia coli,* Intestinal *Enterococci*)
- Plankton (phytoplankton, zooplankton, ichthyoplankton)
- Dinoflagellate cysts
- Epibenthos and fish community
- Benthic flora and fauna (seaweeds, seagrass, invertebrates)

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5. FREQUENCY AND TIMING OF SAMPLING

Due to seasonal distribution of marine organisms and life cycles patterns of different life forms, sampling should be performed **at least twice per year**. Dinoflagellate cysts, epibenthos and fish community, fouling organisms, seaweeds and benthic infauna should be sampled in spring and autumn period. **Plankton communities** should be sampled **3-4 times per year (seasonal frequency)**. **Human pathogens** should be sampled **at least four times per year in the water and two times per year in sediments** (simultaneously to the water sampling). Sampling of zooplankton for the search of toxicogenic *Vibrio cholerae (serotypes O1 and O139)* is optional. If the proper sampling (according to PBS Protocol) has been done in last 3 years, obtained data could be used for PBS.

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6. FIELD SAMPLING

Environmental data

GPS location of each of the sampling site should be recorded using the **WGS84** coordinate system. Temperature and salinity at sampling stations should be measured by CTD probe or submersible data logger. Water transparency should be measured using a Secchi disc. Sediment could be collected using dive transects, grabs or cores.

Human pathogens

Water sample of 1000 ml from at approximately 30 cm depth should be taken at each site. Sampling should follow the guidance described in the EU Bathing Water Directive 2006/7/EC. Sediment (surface layer) could be collected using grabs or cores.

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Phytoplankton

Samples should be collected using phytoplankton net (**mesh size 20 µm**) to concentrate sample for qualitative assessment and to estimate the semiquantitative analyses on a scale 1-5 (1=rare, 5=very abundant). **One vertical tow should be done at each site.** In order to ensure adequate sampling, horizontal tows could be performed. Horizontal tows should be performed at approximately 2 m below the surface and should be conducted at speed of approximately 0.30 m s^{-1}. In order to ensure accurate quantitative analyses one sample per each stations could be sampled by bottle sampler or PVC sampler (hose). Samples should be preserved or kept at low temperature and returned to laboratory for incubation and culturing depends of further analyses. Phytoplankton samples should be analyzed according to the Utermöhl method (Utermöhl, 1958).

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Zooplankton

Vertical zooplankton net tows with a mesh size appropriate for the area (a standard 200 µm or smaller if applicable) should be used for collecting zooplankton samples. Only one sample at each station should be collected to ensure for adequate sample. Mesh size depends on the size range of zooplankton in the area and needs to be reported with the data. Tow rate should be adjusted to approximately 1 m s^{-1} and the net should be stopped 1 m above the bottom.

Ichthyoplankton

Ichthyoplankton samples should be collected by vertical net tows with 300 µm mesh size. Three vertical tows, 10 to 15 m apart should be conducted to ensure a qualitatively and quantitatively adequate sample size.

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Dinoflagellate cysts

Surface sediment for dinoflagellate cysts determination should be collected by gravity corer such as Phleger corer or using diver to collect sediment core by hand. Samples could be collected also using Van Ween grabs from which on the vessel corers are taken. At each station a minimum of two replicates should be taken. Recently dredged areas should be avoided. If the germination of cysts is not to be performed, the raw sample should be fixed as soon as possible to avoid the change of composition (ratio of living and empty cysts) by excystment. Formalin or glutaraldehyde should be used as fixing agent (Matsuoka and Fukuyo, 2000).

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Mobile epifauna and fish community

Mobile epifauna, such as crabs, fish and shrimps should be sampled at each site using **traps**. Traps are selective in nature and therefore provide only relative measures of species abundances. However, methodology for sampling epifauna in the port area is very limited and for example using trawls and gillnets is not possible.

Three traps should be deployed at each site for at least 48 hours. Catch should be identified and stored in a cooler. Later in the laboratory, species identification should be performed and specimens should be measured, weighed, prepared and preserved. Fish and larger invertebrates can be frozen, smaller invertebrates preserved.

Trammel net should be used to sample near-shore fishes.

Alternative method

Interviews with local fisherman

Local and overseas experience indicates that conspicuous pest species are often **detected by fishermen**, marine farmers, dive clubs and local communities for sea recreational activities. Thus, it could be very useful to involve local communities in reporting eventual sightings of non-indigenous species. Data collection will be performed trough structured interviews, according to the 'Local Ecological Knowledge' approach (Azzurro et al., 2011).

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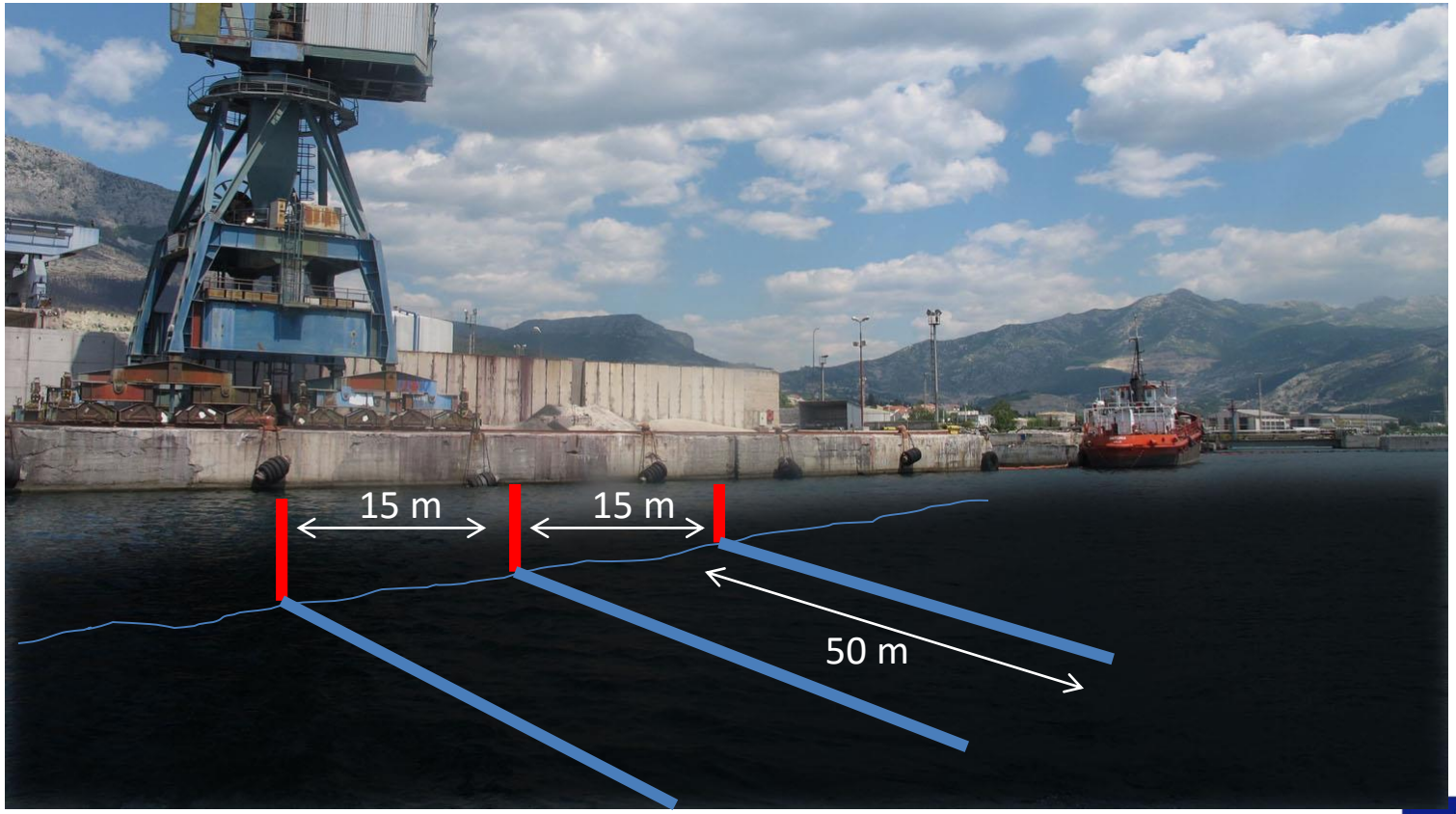
Benthic flora and fauna along vertical transects

RONIOCI: Tri transekta po pristaništu, 10-15 m udaljeni

vertikalno – tvrdi supstrat, horizontalno – meki supstrat



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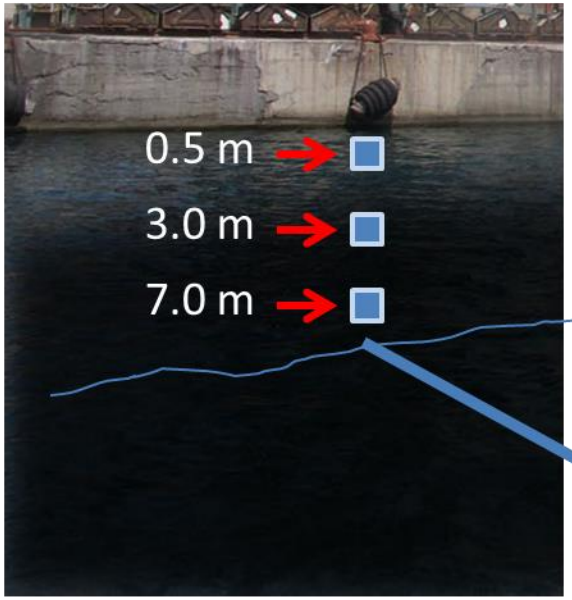
Na svakom transektu:

Vertikalni dio:
Sakupljanje uzoraka s površina 0,1 m^2 (0,25 m x 0,4 m)
Po jedan na -0.5 m, -3.0 m, i -7.0 m – destruktivna metoda
Dodatno: nasumično i ciljano uzorkovanje na svakoj od tri zadane dubine.



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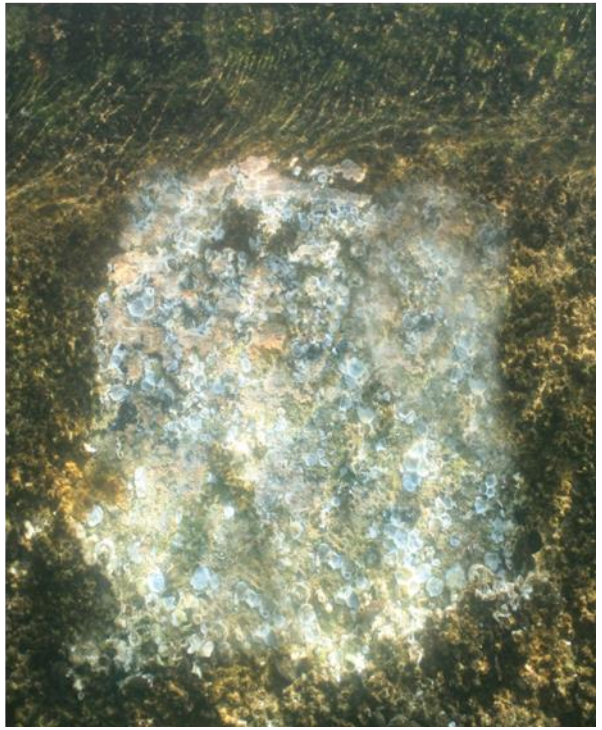
Uzorkovanje na kvadratu (0,25 m x 0,4 m) - destruktivno uzorkovanje



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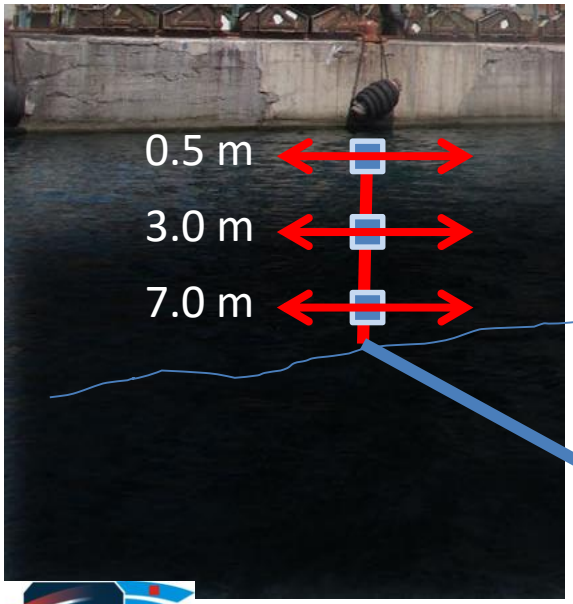
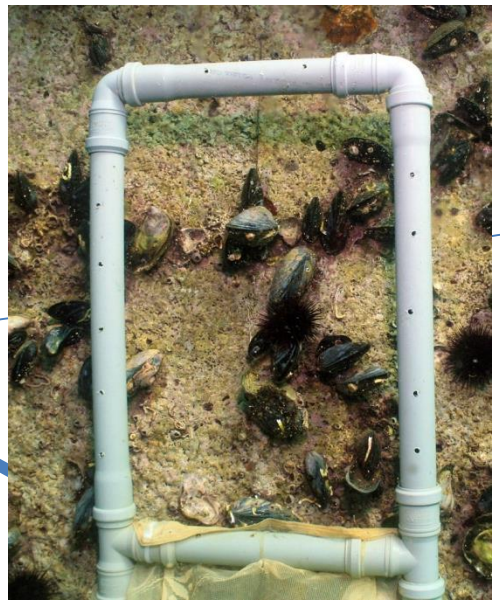
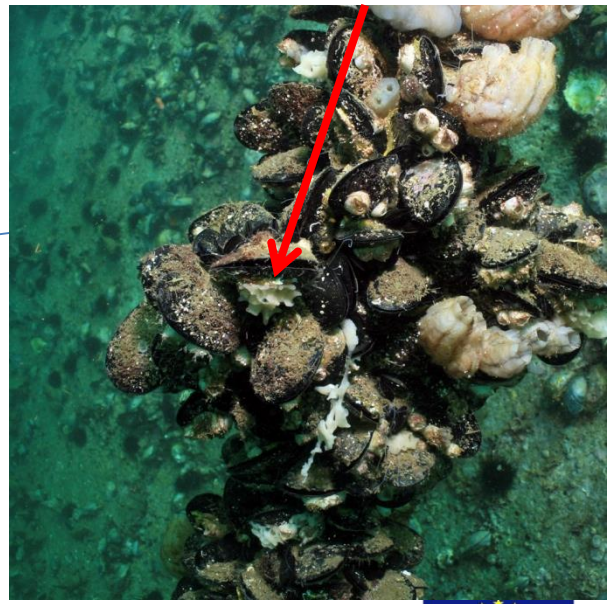
Dodatno: nasumično i ciljano uzorkovanje na svakoj od tri zadane dubine

Posebno bitno za velike vrste male brojnosti!

Paraleucilla magna







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Fotodokumentacija:

Kvadrati

5 m lijevo/desno od uzorkovanih kvadrata uključujući tzv visualni cenzus.

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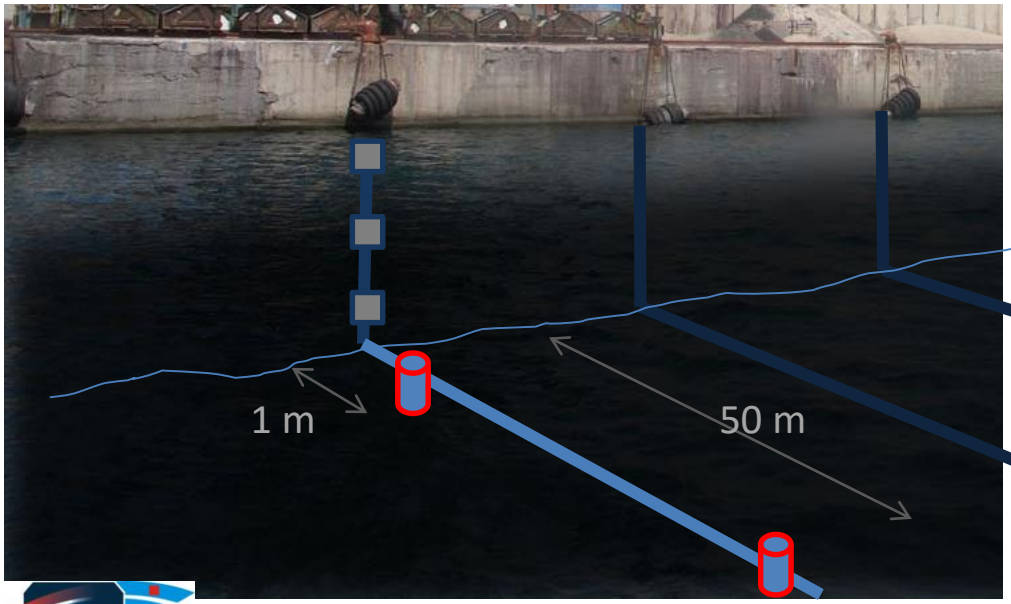
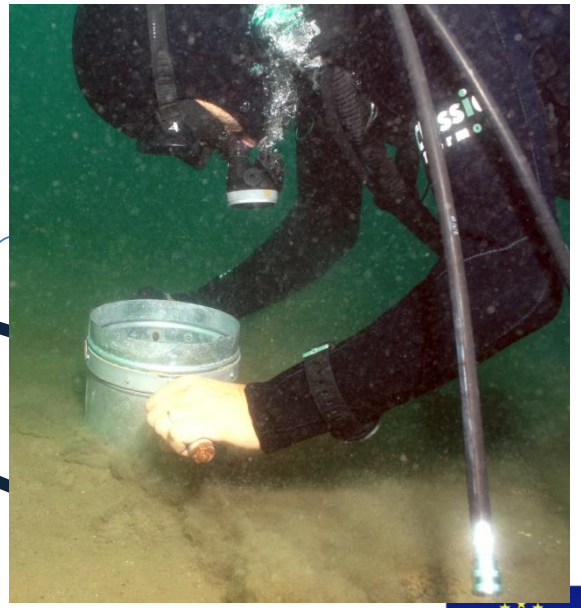
Horizontalno dno (mekani substrat):

50 m transekt okomit na pristan

Uzorkovanje bentoske infaune sa Ø 18 cm ručnim korerom
Po jedan korer treba biti sakupljen da 1 m i 50 m transekta
Uzorci se prebacuju u mrežastu vreću (1mm promjer oka).





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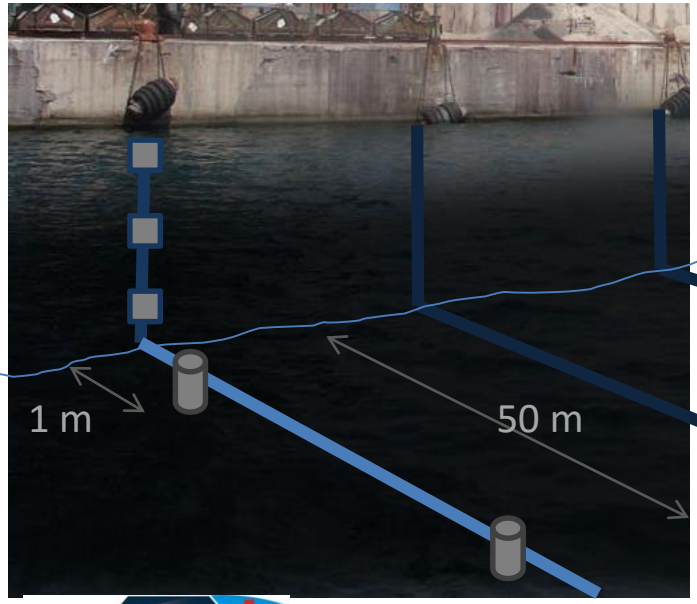
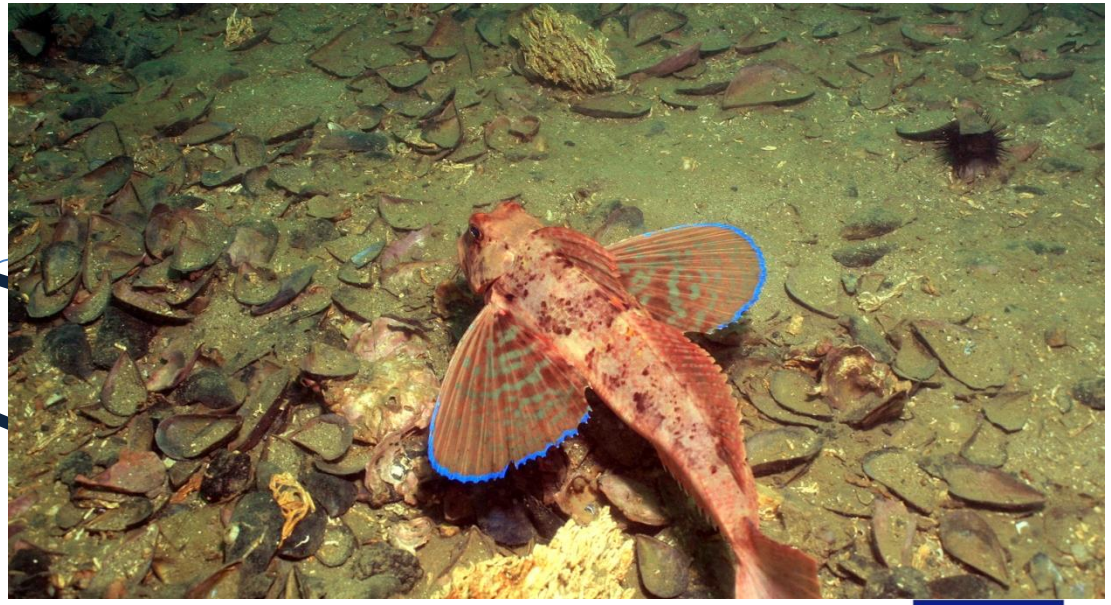
Vizualno pretraživanje, cenzus i sakupljanje po potrebi
Foto i videodokumentacija na transektu





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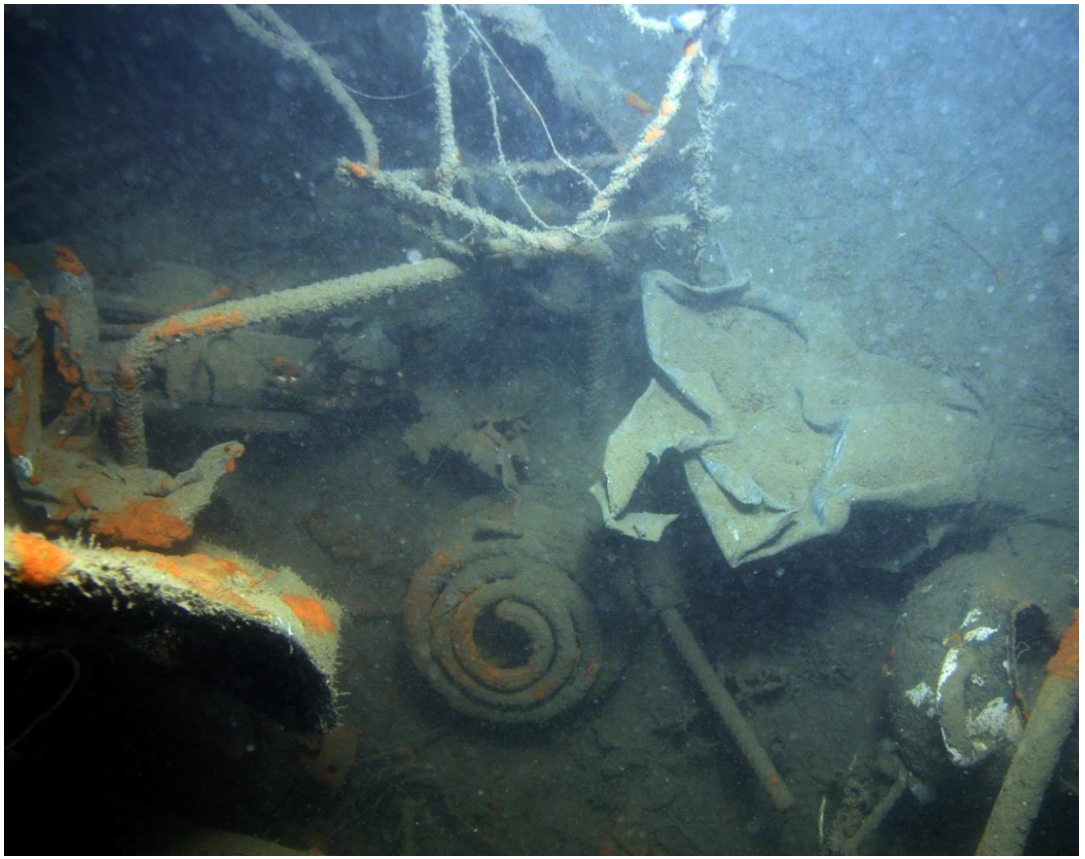
Problemi terenskog rada:

Logistika – promet
Vidljivost
Opasnosti (ribolovni alati, otpad)
Jo-jo ronjenje



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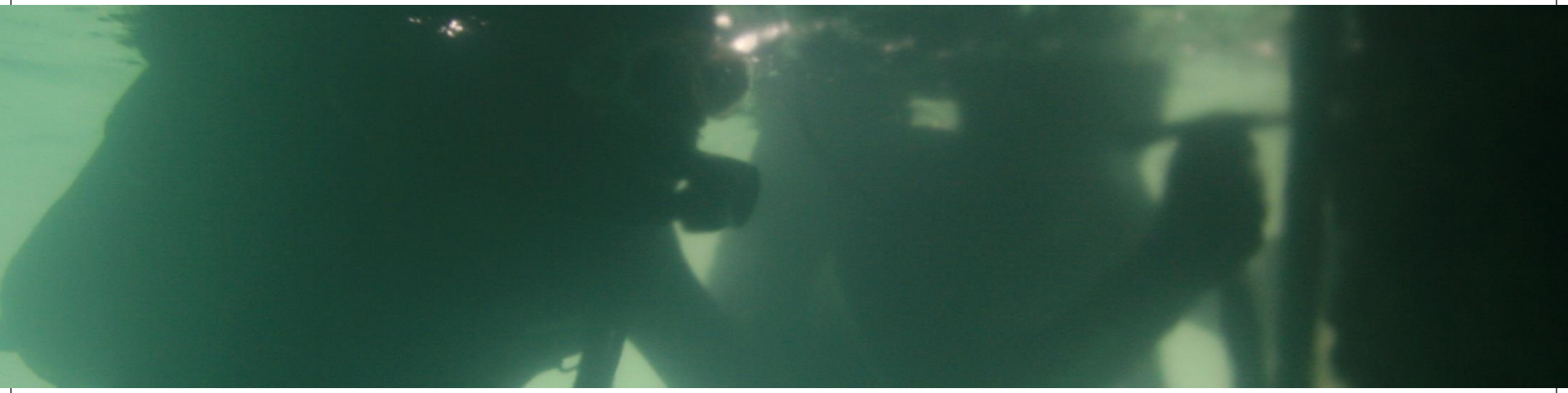

Najviše vremena za istraživanje bentosa luke ne ide na terenski dio istraživanja već na laboratorijsku analizu uzoraka!

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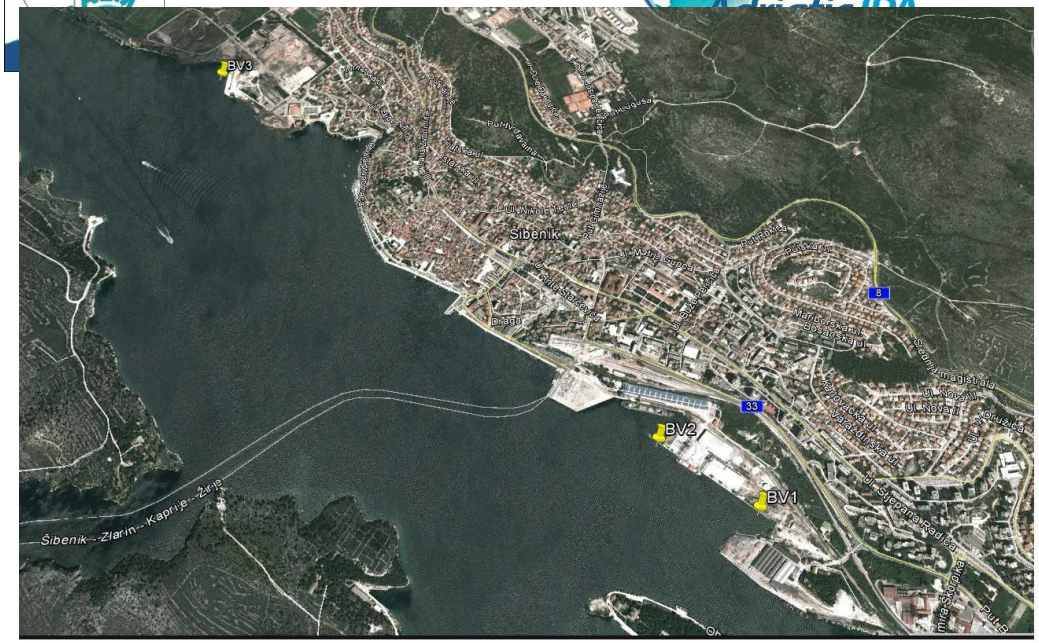
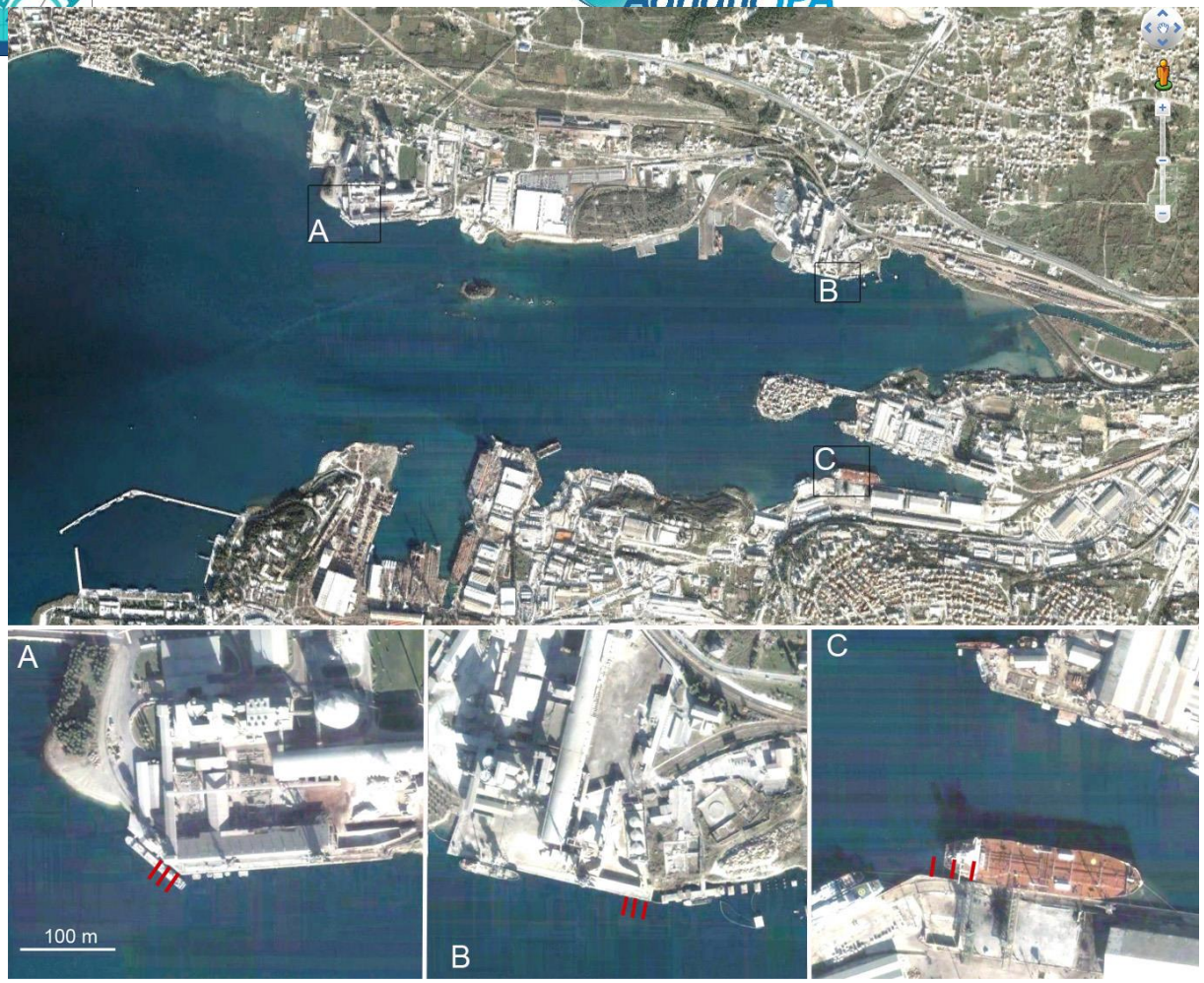


FB10 IOF
Port Šibenik

Date	Biological element
December 2013	Plankton comunities, fish comunities, benthic comunities, dinoflagellate cysts and abiotic parameters
April 2014	Plankton comunities, fish comunities and abiotic parameters Human pathogens
June 2014	Benthic comunities, dinoflagellate cysts
August 2014	Plankton comunities, fish comunities and abiotic parameters Human pathogens

FB10 IOF
Port Split



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Sampling locations for meiofauna and dinoflagellate cysts in the port of Koper

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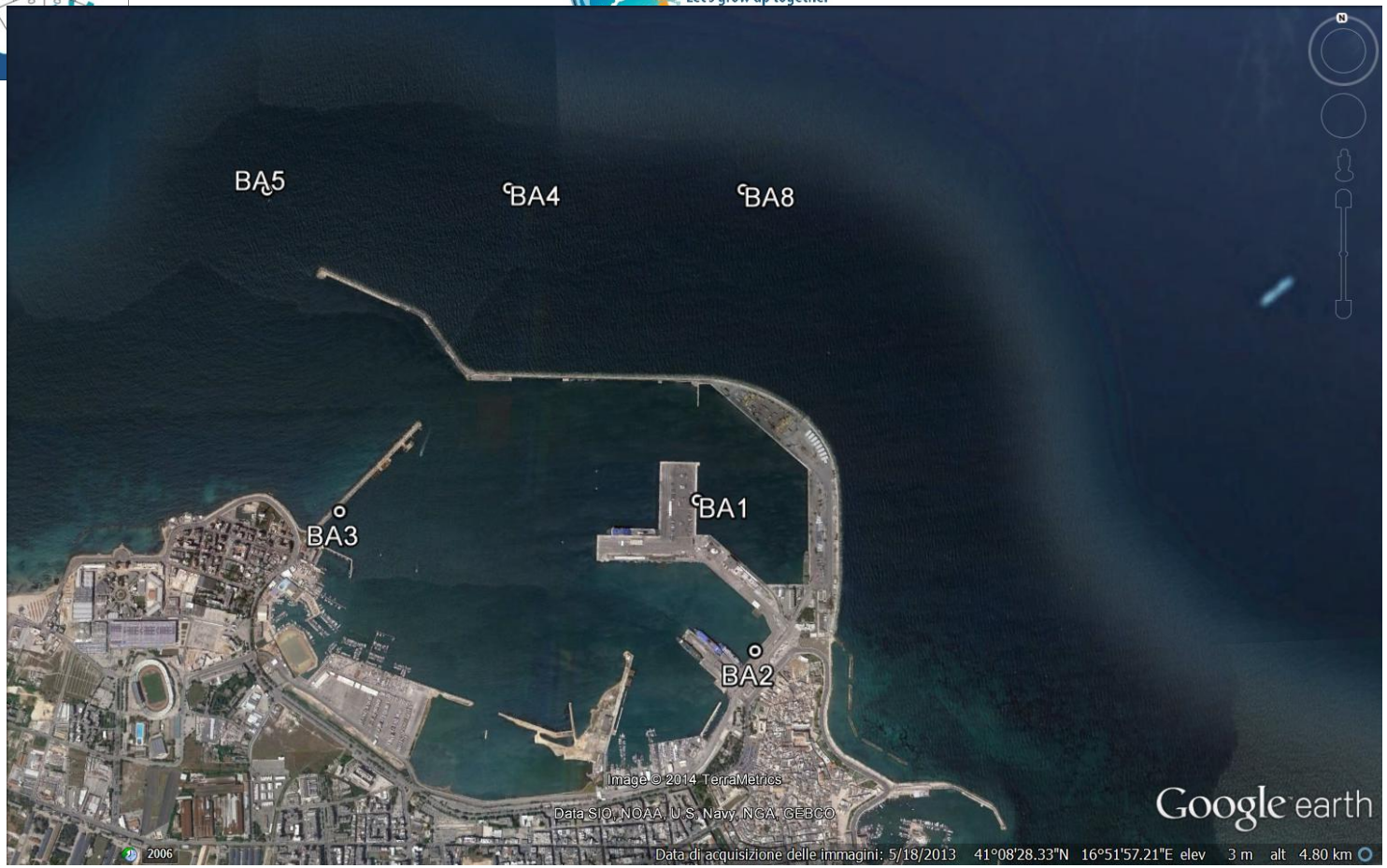

Sampling stations for water column in the port Bari (6 stations)

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FB5 CNR-ISMAR Port Ancona

In October-November 2014 **the fourth** PBS will be carried out

Sampling stations in the Ancona area (6 stations)

Date	Biological element
March 2014	Plankton communities, Human pathogens, abiotic parameters
May 2014	Plankton communities, Human pathogens, abiotic parameters Benthic comunities, fish communities
July-August 2014	Plankton communities, Human pathogens, abiotic parameters

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FB5 CNR-ISMAR Port Venice

In October-November 2014 **the fourth** PBS will be carried out

Sampling stations in the Venice area (9 stations)

Date	Biological element
March 2014	Plankton communities, Human pathogens, abiotic parameters
May 2014	Plankton communities, Human pathogens, abiotic parameters Benthic comunities, fish communities
July-August 2014	Plankton communities, Human pathogens, abiotic parameters

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FB6 – OGS, Port Trieste

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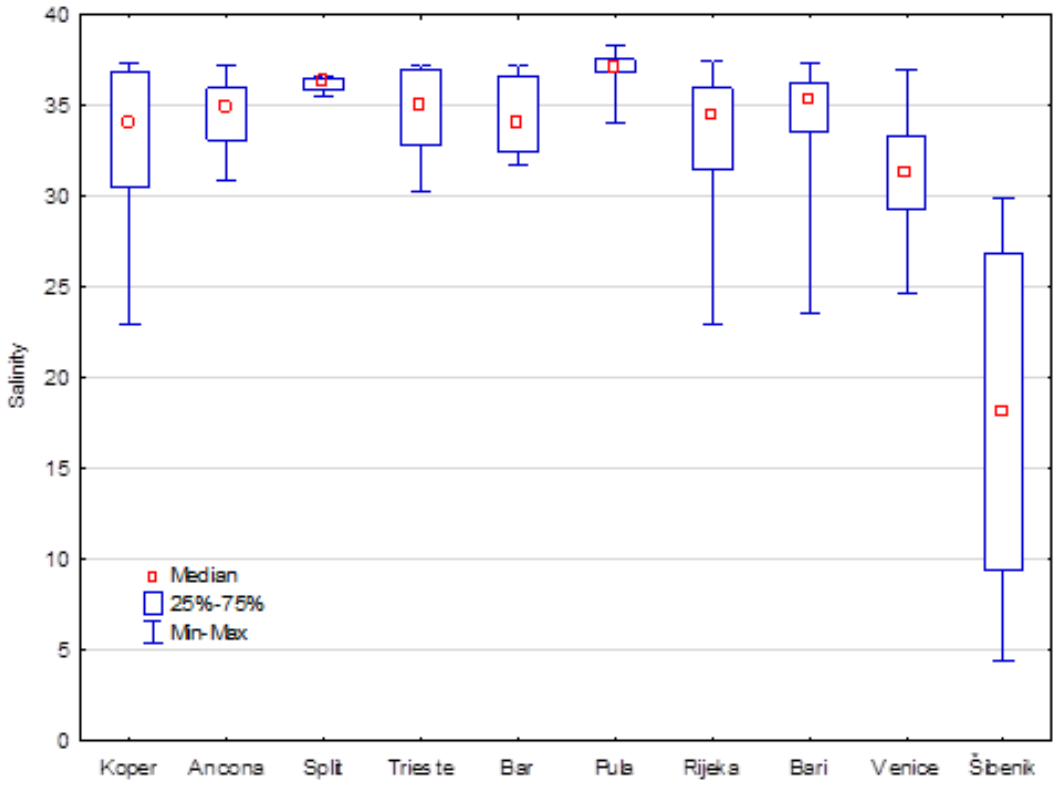

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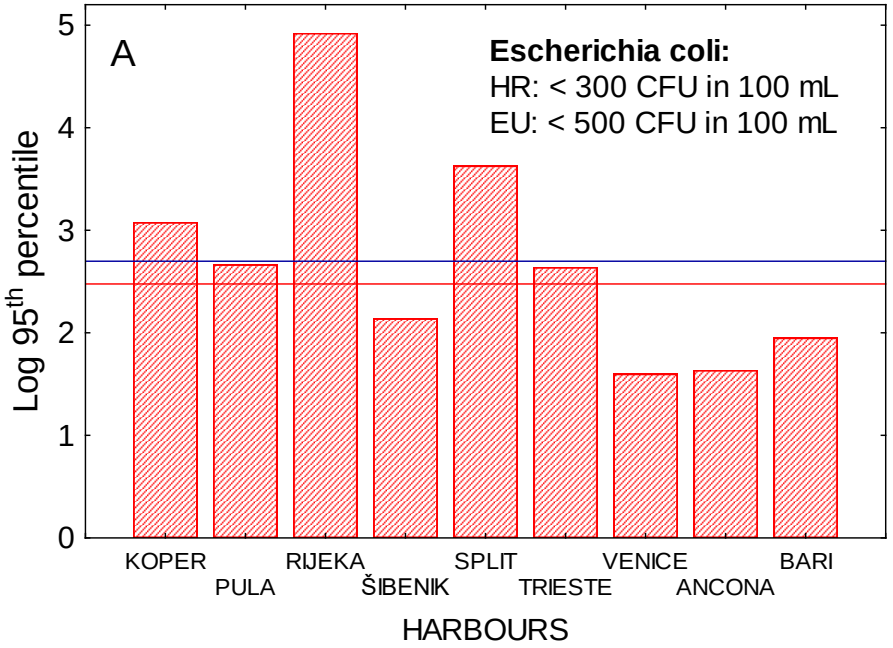

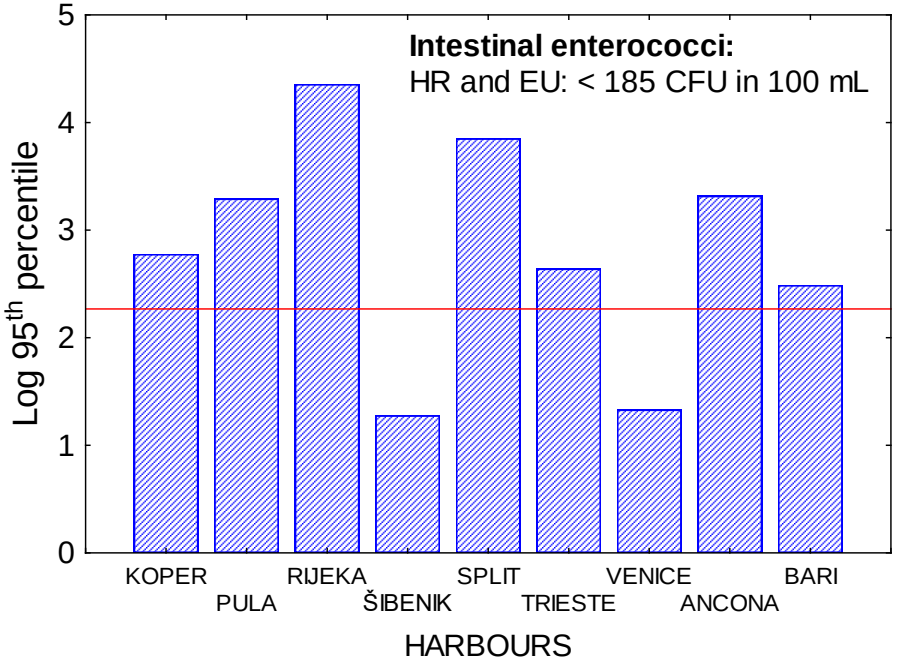

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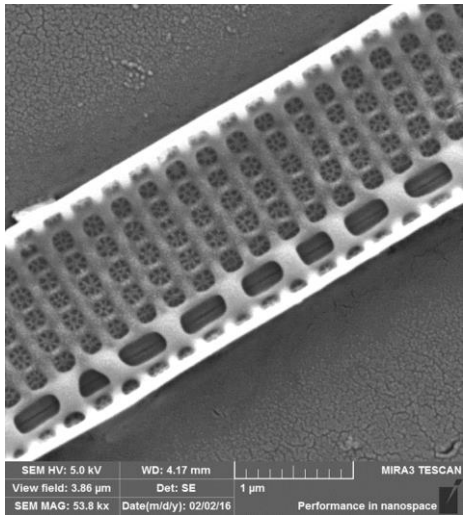
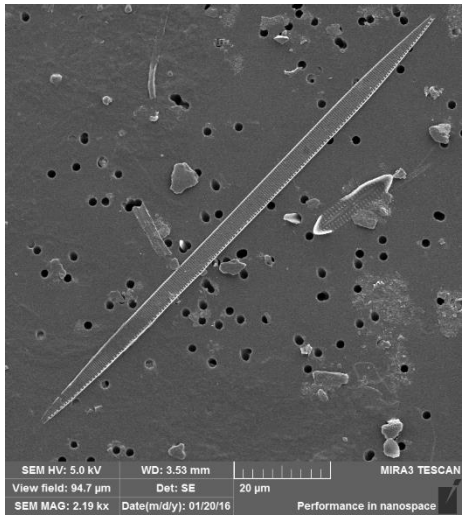
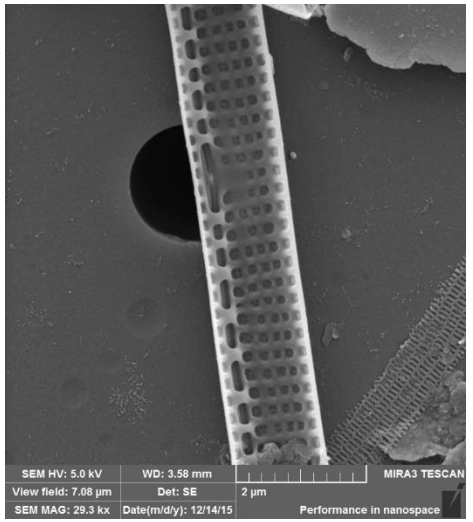
	Bari	Ancona	Venezia	Trieste	Koper	Pula	Rijeka	Šibenik	Split	Ploče	Bar	Durres
DIATOMS												
Pseudo-nitzschia cf. calliantha					+			+	+			
Pseudo-nitzschia delicatissima			+					+	+			
Pseudo-nitzschia pseudodelicatissima								+	+			
Pseudo-nitzschia fraudulenta			+		+			+	+			
Pseudonitzschia galaxiae			+	+								
Pseudo-nitzschia multistriata			+	+								
Pseudo-nitzschia pungens	+	+										
Pseudo-nitzschia subfraudulenta								+	+			
Pseudo-nitzschia spp.	+	+		+	+	+	+	+	+	+	+	







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ADRIATIC +

	Bari	Ancona	Venezia	Trieste	Koper	Pula	Rijeka	Šibenik	Split	Ploče	Bar	Durres
DINOFLAGELLATES												
Alexandrium cf. minutum	+	+			+			+	+			
Alexandrium insuetum					+							
Alexandrium pseudogonyaulax	+	+		+	+							
Alexandrium tamarense								+	+			
Alexandrium spp.	+	+		+	+			+	+		+	
Amphidinium spp.	+							+				
Amphidoma languida	+	+										
cf. Azadinium spp.	+	+										
Cochlodinium sp								+	+			
Dinophysis acuminata	+	+									+	
Dinophysis acuta								+	+		+	
Dinopysis caudata	+	+		+	+			+	+		+	
Dinophysis hastata					+						+	
Dinophysis fortii		+		+	+			+	+		+	
Dinophysis ovum	+	+						+				
Dinophysis sacculus	+	+		+	+			+	+		+	
Dinophysis tripos	+	+		+	+			+				
Dinophysis spp.	+				+							
Gonyaulax spinifera		+						+	+		+	
Karenia cf. mikimotoi	+	+										
Karenia papilionacea	+	+										
Karenia cf. selliformis	+	+										
Karenia spp.	+	+		+				+	+			
Lingulodinium polyedrum	+	+		+	+				+		+	

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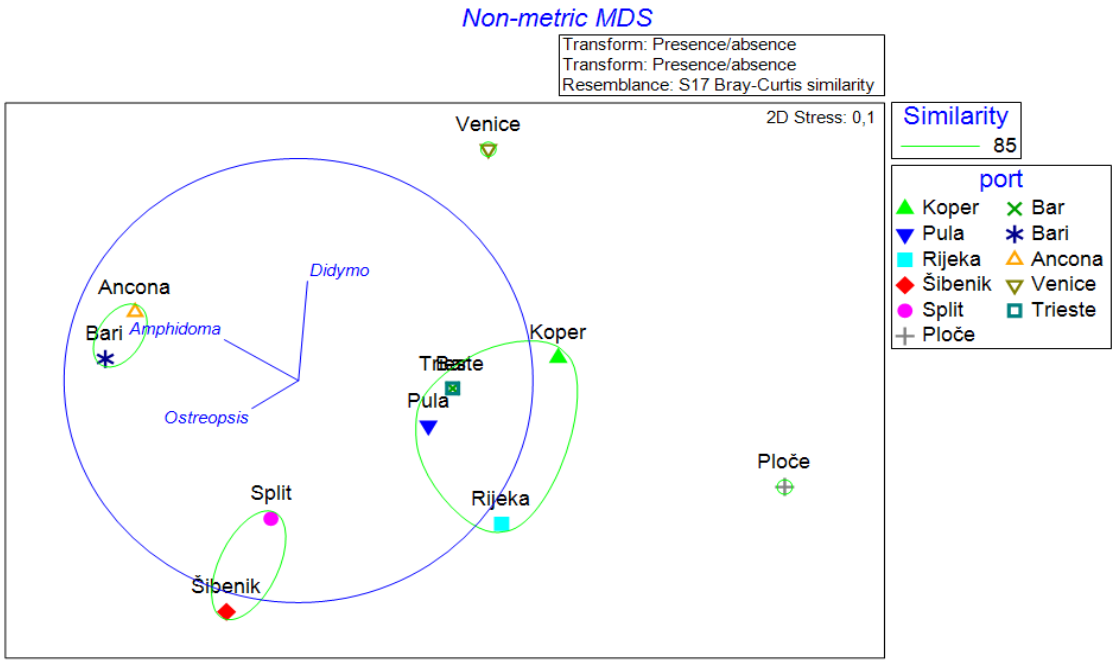

Differences between sampling ports, based on presence and/or absence of recorded phytoplankton species and their taxonomy groups are shown on n-MDS ordination (Figure 3.3.1). According to cluster analyses, three groups of sampling ports separated at a 85% of similarity: 1) Ancona and Bari; 2) Trieste, Koper, Pula, Rijeka and Bar; 3) Split and Šibenik, while ports Ploče and Venice were separated from the others. Contrary to the common species that were recorded in most of the sampling ports, species such as Didymospenia geminate that was recorded exclusively in Venice; Amhidoma languida recorded in ports Ancona and Bari and Ostreopsis spp. recorded in Bari, Split and Pula contributed to the differences between mentioned ports.

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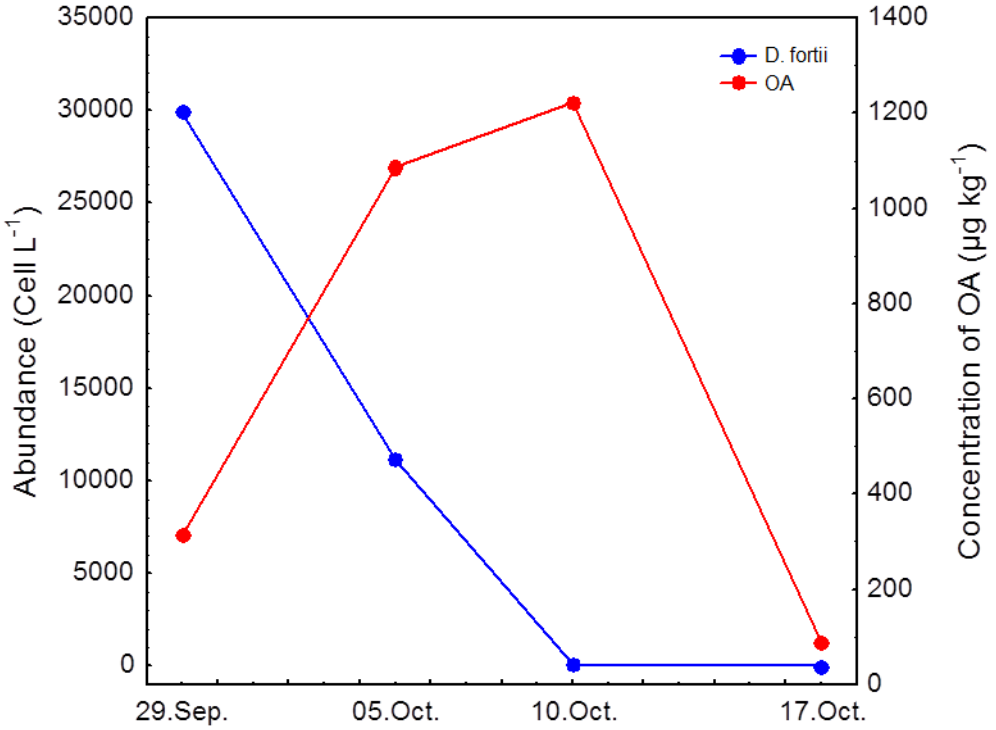
Dinophysis acuta
Dinophysis fortii

Recorded: December, 2013
Abundance:rare



Abundances of *D. fortii* in water samples and concentrations of okadaic acid (OA) in shellfish samples obtained from Lim Bay, 2006. (Ninčević Gladan et al., 2011)

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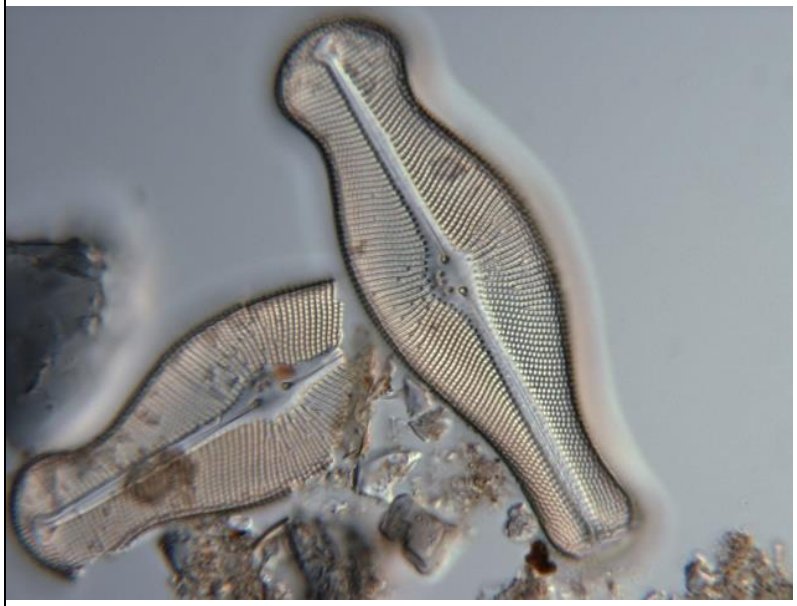
Species: *Didismosphenia geminata* (Lyngbye) M.Schmidt, 1899	***Location:*** Port of Venice

Species impact*:* Diatom *Didismosphenia geminata* produces nuisance growths in freshwater rivers and streams. It is native to the northern hemisphere, and considered an invasive species in Australia, Argentina,New Zealand,and Chile. Species produce large amounts of stalk material to form thick brown mats on stream bottoms. Didymo threatens aquatic habitat, biodiversity and recreational opportunities, but it is not considered a significant human risk.



Diatom *Didismosphenia geminata* cells and brown mats on bottom

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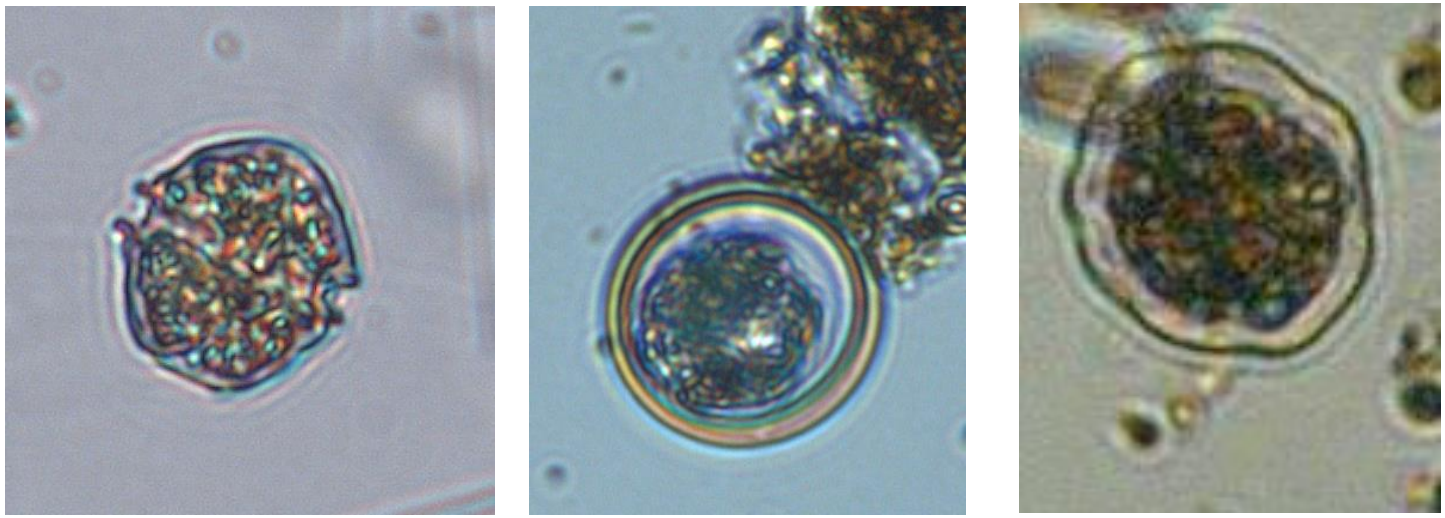
Species: Alexandrium minutum, Halim 1960	**Location:** Ports of Venice, Ancona, Bari, Trieste, Koper, Šibenik, Split

Species impact*:* Dinoflagellate *A. minutum* have been reported over a very large geographical area including the Mediterranean sea.. It is red tide species and producer of paralytic shellfish poisoning toxins, which can seriously threathen a human helth.



Dinoflagellate *Alexandrium minutum* vegetative cell and cysts

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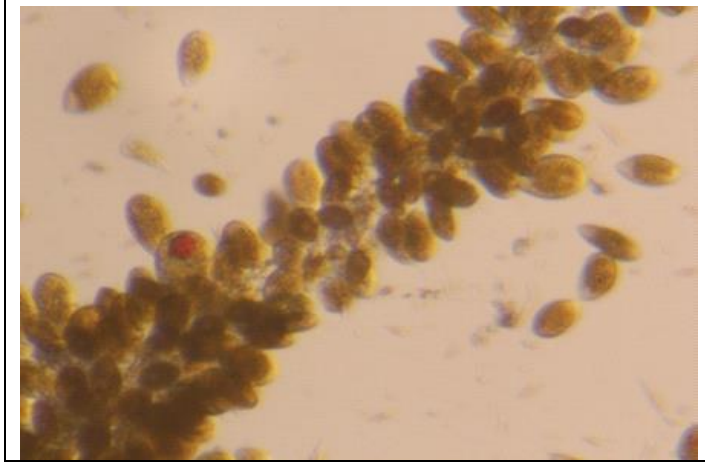
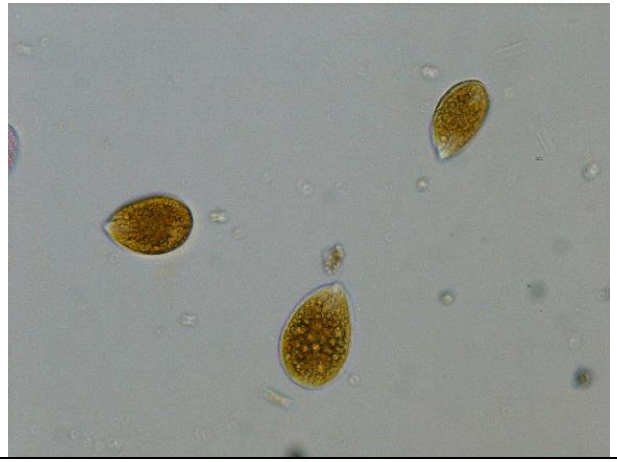
Species: Ostropsis ovata Fukuyo, 1981	Location: in the vicinity of Port of Split, Bari

Species impact: Dinoflagellates of the genus Ostreopsis are known to cause food poisoning in tropical coastal areas following the accumulation of palytoxin (PLTX) and/or its analogues (PLTX group) in crabs, sea urchins or fish. Ostreopsis spp. occurrence is presently increasing in the northern to north western Mediterranean Sea (Italy, Spain, Greece and France), probably in response to climate change. Since the late 1990s, a respiratory syndrome has been repetitively observed in humans concomitant with *Ostreopsis* spp. blooms (mainly O. cf. ovata) in the Mediterranean area. Sindrom is known as „algal sindrom“ and it is assosiated with forming aerosols whicch contain Ostreopsis cell and toxins.





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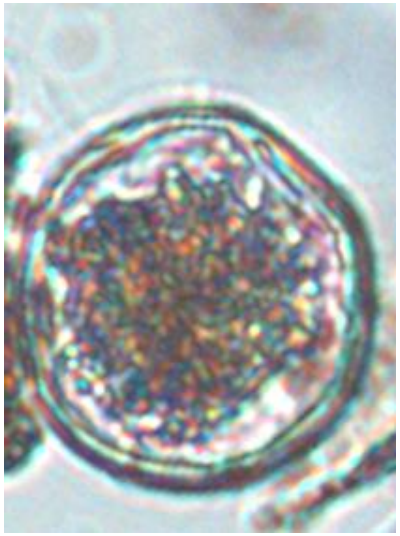
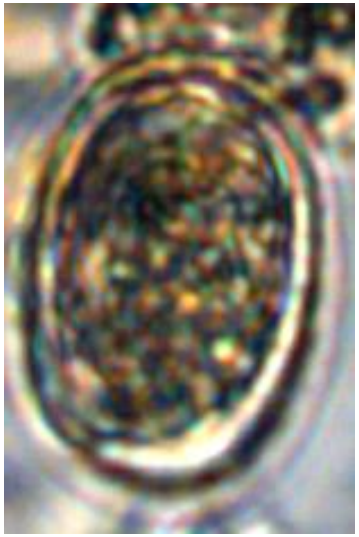
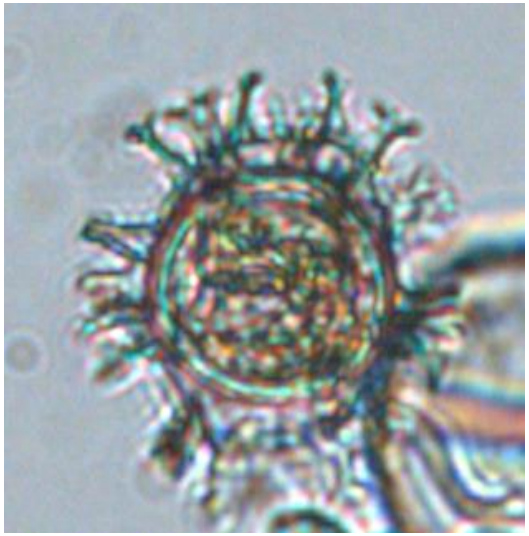
Ciste dinoflagelata



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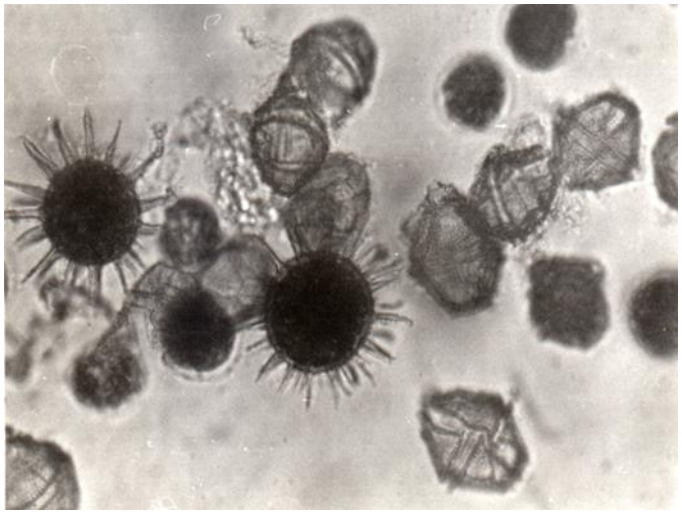

	SL-1	SL-2	SK-1	SJ-1
Gonyaulacales				
Alexandrium minutum	4	40	250	20
Alexandrium tamarense	4		10	
Gonyaulax spinifera		90	160	20
Gonyaulax sp. (scrippsae)		60	250	30
Lingulodinium polyedrum	100	950	10374	320
Prorocentrales				
Prorocentrum minimum	20	10	60	
Gymnodiniales				
Cohlodinium sp. (polykrikoides)	20			
Gyrodinium inpudicum			20	
Peridiniales				
Diplopsalis sp.	48	40	130	
Protoceratium reticulatum	12	20	120	30
Protoperidinium compressum	16			
Protoperidinium conicum		40	40	
Protoperidinium conicoides			10	
Protoperidinium leonis	4			
Protoperidinium pentagonum	4		30	20
Protoperidinium sp.1			10	
Protoperidinium sp.2			20	
Protoperidinium spp.		20	90	10
Scrippsiella trochoidea		20	40	30
Zygabikodinium lenticilatum	10		10	
Neidentificirane				
Dinophyta sp.1			50	10
Dinophyta sp.2		10		
Dinophyta sp 3				

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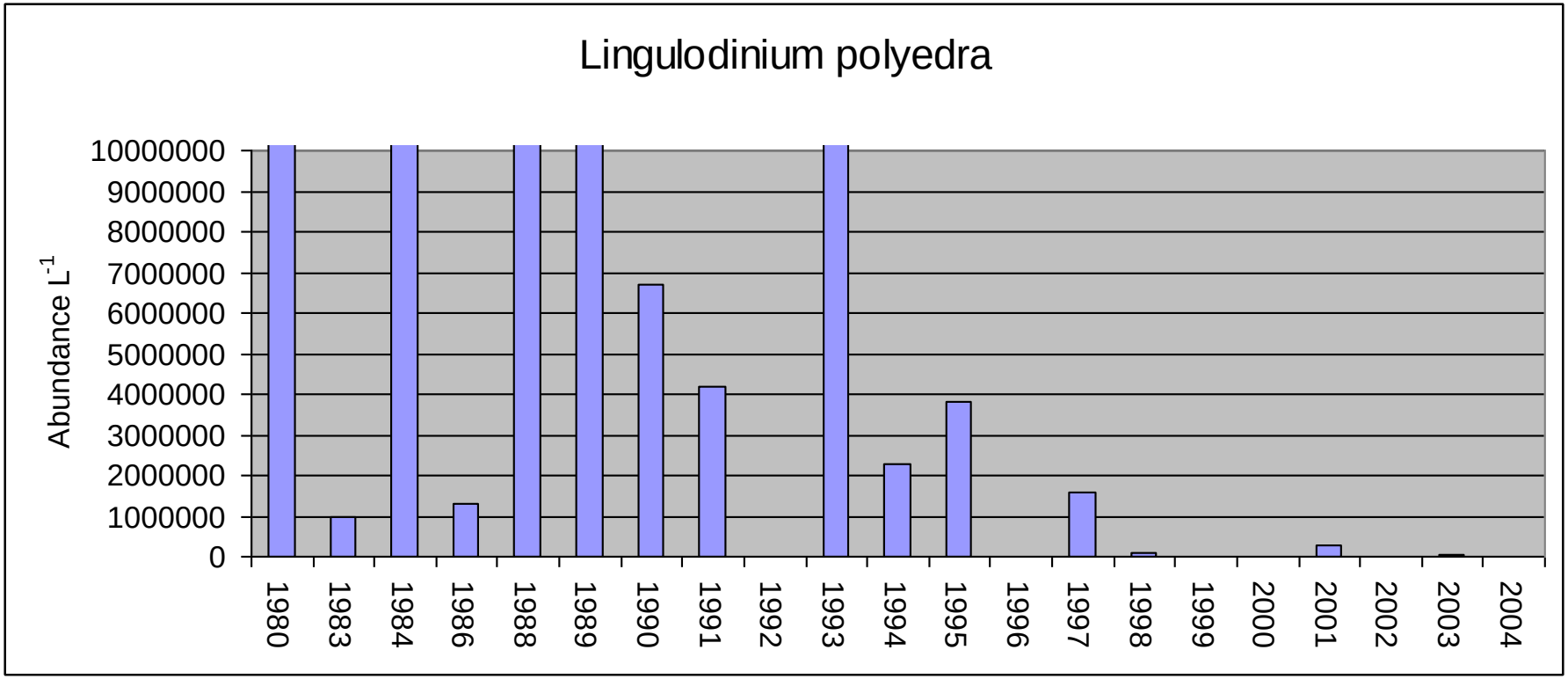

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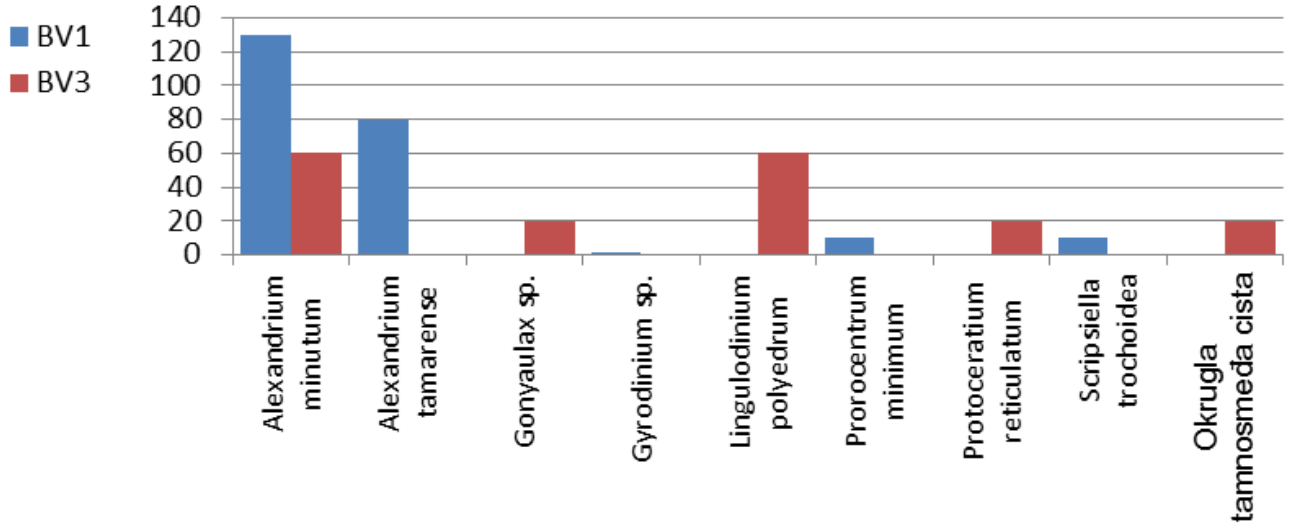

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BALMAS REZULTATI

ANALIZA ZOOPLANKTONSKE ZAJEDNICE			
LUKA	**BROJ TAKSONA**	**BROJ NIS**	
KOPER	81	1	*Pseudodiaptomus marinus*
PULA	114	0	
RIJEKA	118	1	*Parvocalanus crassirostris*
ŠIBENIK	133	2	*Parvocalanus crassirostris, Pseudodiaptomus marinus*
SPLIT – SJEVERNA LUKA	89	0	
PLOČE	50	0	
BAR	52	0	
BARI	96	2	*Paracartia grani, Acartia tonsa*
ANCONA	85	2	*Paracartia grani, Acartia tonsa*
VENEZIA	---	1	*Pseudodiaptomus marinus*
TRST	85	1	*Pseudodiaptomus marinus*

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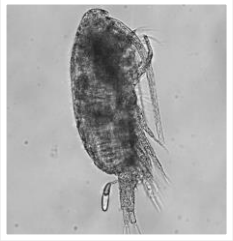
BALMAS REZULTATI

Pseudodiaptomus marinus	*Parvocalanus crassirostris*	*Acartia tonsa*	*Paracartia grani*
Trst	Rijeka	Ancona	Ancona
Venecija	Šibenik	Bari	Bari
Koper			
Šibenik			



AUTOHTONI AREAL			
Sj. zap. Pacifik	Zap. Atlantik	Zap. Atlantik	Ist. Atlantik
	Indo-Pacifik	Indo-Pacifik	

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Pseudodiaptomus marinus

- Obalno-estuarijska vrsta, dimenzije 1,1-1,8 mm, hrani se detritusom
- Stanovnik hiperbentosa, optimalan salinitet 30-37, ali tolerira i niži
- Autohtona vrsta u vodama oko Japana (Hokkaido)
- Širenje areala započelo već 1950-ih, danas cirkumglobalne distribucije

- Unešen u vode uz zap. obalu Sj. Amerike, Havajsko otočje, Sjeverno more, Mediteran (jezero Faro na Siciliji, Napuljski zaljev) i Jadransko more, Tršćanska luka, De Olazabal i Tirelli, 2011)

Reference	Site
NATIVE REGION	
Sato (1913)	Inland Sea of Japan, Japan
Uye *et al.* (1982)	Fukuyama harbour, Japan
Liang & Uye (1997b)	Tomo Bay, Japan
INVADED REGIONS	
Jones (1966)	Ala Wai Canal, Oahu, Hawaii
Grindley & Grice (1969)	Port Louis harbour, Mauritius
De Olazabal & Tirelli (2011)	Rimini and Trieste, Italy
Brylinski *et al.* (2012)	Gravelines and Calais harbour, France
Sabia (2012)	Lake Faro, Italy

Sabia *et al.*, 2015

Sabia *et al.*, 2015

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Parvocalanus crassirostris

- Obalno-estuarijska vrsta diskontinuiranog staništa
- Dimenzije 0,5 mm, hrani se fitoplanktonom i protozoima
- Kozmopolitski rasprostranjen u zaklonjenim obalnim lokalitetima
- Tolerira raspon saliniteta 3-55 i temp. do 30^{o}C
- U Mediteranu je Lesepsijski migrant u Levantinskom bazenu
- Zabilježen u SZ Mediteranu i SI Egejskom moru

- Stanje populacije u lukama Šibenik i Rijeka za sada nije na zabrinjavajućoj razini, ali je potrebno pratiti buduću dinamiku širenja i utjecaj na lokalnu autohtonu zajenicu

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Acartia tonsa

- Dimenzija 1-1,5 mm, stanovnik je obalnih voda i laguna, tolerira niži salinitet, ali zahtijeva okoliš bogat hranjivim česticama
- Hrani se filtracijom i predatorski, pa se lako prilagođava hranidbenom potencijalu okoliša
- Proizvodi jako otporne trajne stadije, tzv. “spavajuća jaja” koja mogu preživjeti u izrazito nepogodnim uvjetima olakšavaju prijenos balastnim vodama

- Stanje populacija u Mediteranu se prati već od 1985. godine, kada je unešena balastnim vodama brodova
- Prvi nalaz u u Jadranu 1989. god. (Farabegoli et al. 1989)
- Negativan utjecaj na lokalne populacije očituje se kroz kompeticiju s drugim vrstama istog roda

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Paracartia grani

- Autohtoni areal u vodama oko Norveške
- Unešena u Mediteran krajem 1970-ih.
- Od tada se širenje povezuje s utjecajem balastnih voda brodova
- Povezana s razvojnim ciklusom parazitske praživotinje *Marteilia refringens* koja izaziva oboljenje marteilozu kod kamenice (*Ostrea edulis)*
- moguća je i translokacija preko akvakulture, česta na uzgajalištima školjkaša

- U Jadranu prvi put zabilježena u sjevernom dijelu (De Olazabal et al. ., 2006)

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ZAKLJUČCI

- Nezavičajne zooplanktonske vrste u Jadranu su uglavnom termofilne vrste cirkumglobalne distribucije, koje su već zabilježene u Mediteranu
- Autohtona područja su Indo-Pacifik, te sjeverozapadni i istočni Atlantik, ali putevi širenja u Jadranu vjerovatno uključuju sekundarnu translokaciju između jadranskih luka
- Kroz projekt BALMAS omogućeno je dobivanje detaljnih podataka o sastavu zooplanktonske zajednice u lukama, identifikacija nezavičajnih vrsta te praćenje eventualnog širenja ovih vrsta putem predviđenog budućeg monitoringa.
- Ova saznanja omogućit će ostvarenje ciljeva vezanih uz MSFD (Okvirnu direktivu o marinskim vodama), u sklopu deskriptora D1 (bioraznolikost), D2 (invazivne vrste) i D4 (hranidbena mreža)

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Trieste

- A total of 24 taxa were collected with both gears
- In particular, trammel net caught 19 taxa, including 12 fish, 5 crustaceans and 2 mollusks (17 taxa exclusively)
- The most representative species were *Chelon labrosus*, *Pagellus erythrinus* for fish, *Maja crispata* for crustaceans and *Hexaplex trunculus* for molluscs, respectively.
- Traps caught 7 taxa: 2 fish, 3 crustaceans and 2 molluscs (5 taxa exclusively)
- The most representative species were *Gobius niger* for the fish community, *Pagurus prideaux* for crustaceans and *Nassarius reticulatus* for molluscs

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ADRIATIC +

Venice

Rhithropanopeus harrisii

- A total of 37 taxa were collected with both gears, **including an invasive alien species: the crustacean *Rhithropanopeus harrisii***.
- In particular, trammel net caught 34 taxa, including 20 fish, 12 crustaceans, 4 mollusks and 1 echinoderm (27 exclusively).
- The most representative species were *Liza ramada*, *Carcinus aestuarii*, *Hexaplex trunculus* and *Asterina gibbosa*.
- Traps caught 10 taxa: 3 fish, 4 crustaceans and 3 molluscs (3 exclusively). The most representative species were *Gobius niger*, *Carcinus aestuarii* and *Nassarius nitidus*

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Ancona

Crassostrea gigas

- A total of 35 taxa were collected with both gears, **including an invasive alien species: the mollusc *Crassostrea gigas***.
- In particular, trammel net caught 25 taxa, including 14 fish, 14 crustaceans, and 7 mollusks (25 exclusively).
- The most representative species were *Liza ramada*, *Maja crispata* and *Hexaplex trunculus*.
- Traps caught 17 taxa: 5 fish, 9 crustaceans and 3 molluscs (10 exclusively).
- The most representative species were *Sarpa salpa*, *Liocarcinus vernalis, Pagurus eremita* and *Nassarius nitidus*.

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Bari





- A total of 26 taxa were collected with both gears.
- In particular, trammel net caught 16 taxa, including 12 fish, 1 crustacean and 3 mollusks (14 taxa exclusively with this gear).
- The most representative species were *Diplodus annularis*, *Maja crispata* and *Hexaplex trunculus*.
- Traps caught 12 taxa: 5 fish, 4 crustaceans and 3 molluscs (10 exclusively). The most representative species were *Serranus hepatus*, *Squilla mantis* and *Nassarius nitidus*.

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Koper

- Alltogether 432 specimen and 27 species were caught in winter sampling(23 fish, 3 crustaceans (Carcinus aestuarii, Cragon Cragon, Squilla mantis) and 1 gastropod (**Bursatella leachii**) **which is the only NIS species** among the catch. *Bursatella leachii* was obtained in only one location, on the seagrass meadow in front of St. Katarina. 9 specimen were caught and additional few were seen to drop from the net back into the sea.
- The most abundant species were *Atherina boyeri* with relative abundance of 41 %, *Engraulis encrasicolus* (29 %), *Carcinus aestuari (*11 %) *and Sarpa salpa* (6 %).
- Summer sampling within the lagoon of Škocijanski zatok was omitted, because of the difficulties with setting the nets. Altogether 484 specimen and 19 taxa were caught. The most abundant species were crustacean *Maja* sp. (35 %) and fish species *Engraulis encrasicholus* (25 %) and *Atherina boyeri* (25 %). No NIS species were caught.
- Within the monitoring programme 35 taxa were determined, among them 21 fish species. The highest biomass was reported for *Sardina pilchardus* (96 % of total biomass). No NIS species were detected

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Bar

- In trap, in April 2015, two species were caught. One was fish European conger *Conger conger* (Linnaeus, 1758) with total length of 1.5 m and weight of 3 kg and other was crustacean species hermit crab *Dardanus arrosor* (Herbst, 1796) with cephalothoracic length of 20 mm and weight of 6.68 g.
- In trap, in October 2015 six species were caught (*Muraena helena*, *Pagellus bogaraveo*, *Conger conger*, *Diplodus vulgaris, Serranus cabrilla*, *Phycis phy*cis).

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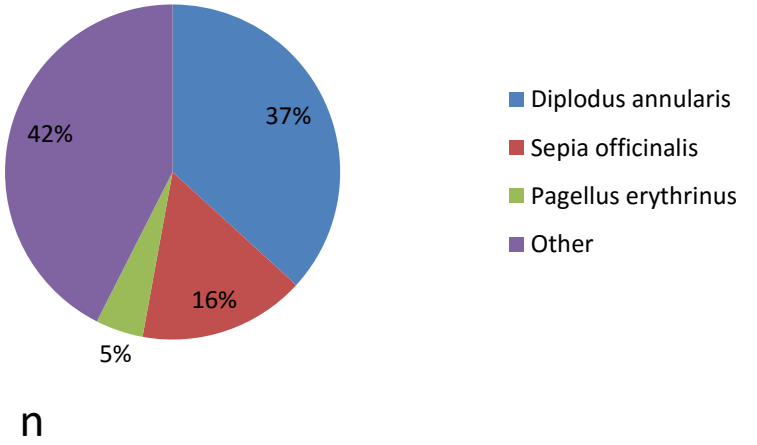
ADRIATIC +

Kaštela bay

APRIL 2014.

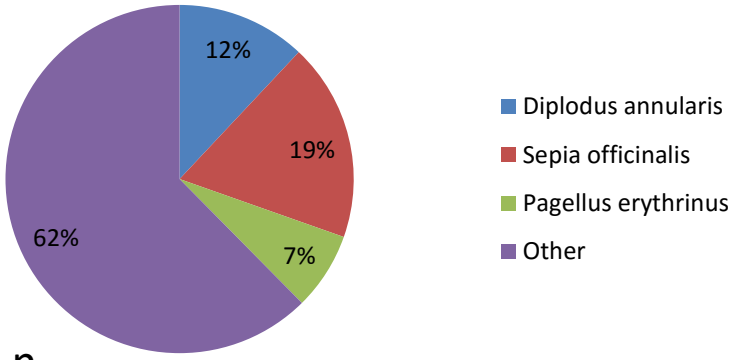
- 14 species of fish and cephalopods (n=77; 6,9 kg)
- 13 species of various invertebrates
- Crabs: *Squilla mantis* and *Maja crispata* dominant
- *Hexaplex trunculus* dominant
- **In traps:** 6 species of fish and 2 species of invertebrates



n

AUGUST 2014.

- 23 species of fish and cephalopods (n=111; 13,4 kg)
- 15 species of various invertebrates
- Crabs: *Squilla mantis* and *Maja crispata* dominant
- *Hexaplex trunculus* dominant
- **In traps:** 5 species of fish and 2 species of invertebrates



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NO ALIENS !!

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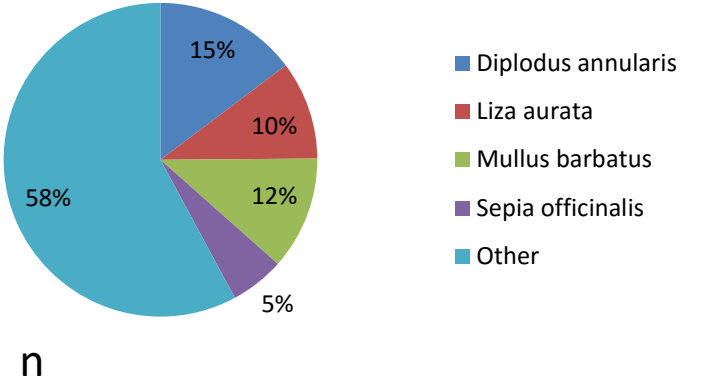
Šibenik port

APRIL 2014.

- 19 species of fish and cephalopods (n=114, 16 kg)
- 19 species of various invertebrates
- Crabs: *Squilla mantis* dominant
- *Hexaplex trunculus* dominant
- **In traps:** 3 species of fish and 3 species of invertebrates



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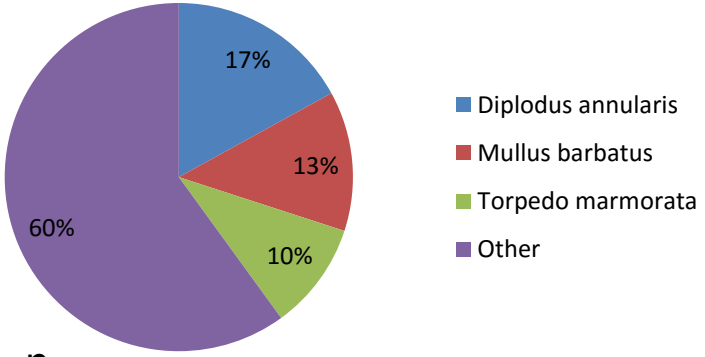
AUGUST 2014.

- 20 species of fish and cephalopods (n=90, 9,9 kg)
- 10 species of various invertebrates
- Crabs *Melicertus kerathurus* dominant
- *Hexaplex trunculus* dominant
- **In traps:** 3 species of fish



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NO ALIENS !!

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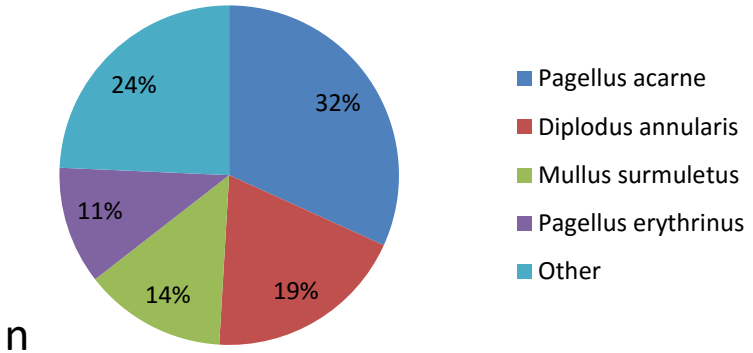
Pula port

APRIL 2016.

- 17 species of fish and cephalopods (n=204; 28,6 kg)
- 3 species of various invertebrates
- *Pagellus acarne* most numerous species (n=68)
- **In traps:** empty



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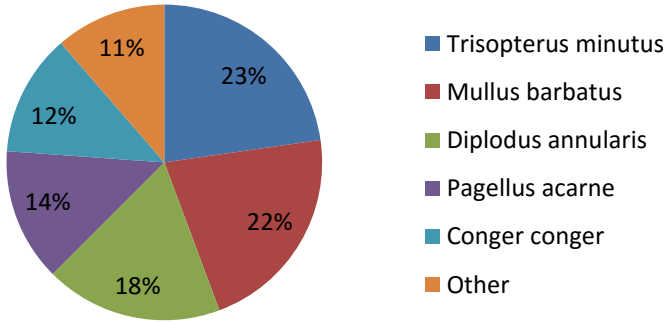
Rijeka port

- 16 species of fish and cephalopods (n=108; 38,6 kg)
- 5 species of various invertebrates
- *Trisopterus minutus* most numerous species (n=20)
- *Conger conger* - large biomass (15,7kg)
- **In traps:** empty



n

NO ALIENS !!

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• Specimens of *Elates ransonnetii (1)* caught in Kaštel Sućurac in **2010** and *Paranthias furcifer (2)* and *Holacanthus ciliaris (3)* caught in Trogir shipyard **2011.**

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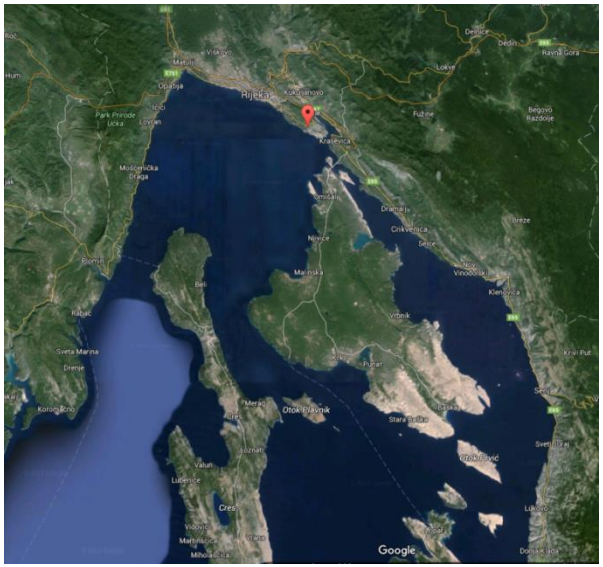

Oplegnathus fasciatus

- Specimen caught on 23. November 2015

- 1 Nm from Urinj (tanker terminal and oil refinery) in trap for Norway lobster

- Fourth record for the Mediterranean (2 specimen photographed in Malta in 2009)

- One specimen from Trieste bay – July, 2015

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SUMMARY:

- 45 species of **fish**
- 3 species of **cephalopods**
- 16 species of **crabs** (*including Paguridae sp.)*
- at least 25 species of various invertebrates

NO ALIEN FISHES BUT:

- **crustacean *Rhithropanopeus harrisii* (Venice)**
- **mollusc *Crassostrea gigas (Ancona)***
- **Gastropod *Bursatella leachii* (Koper)**

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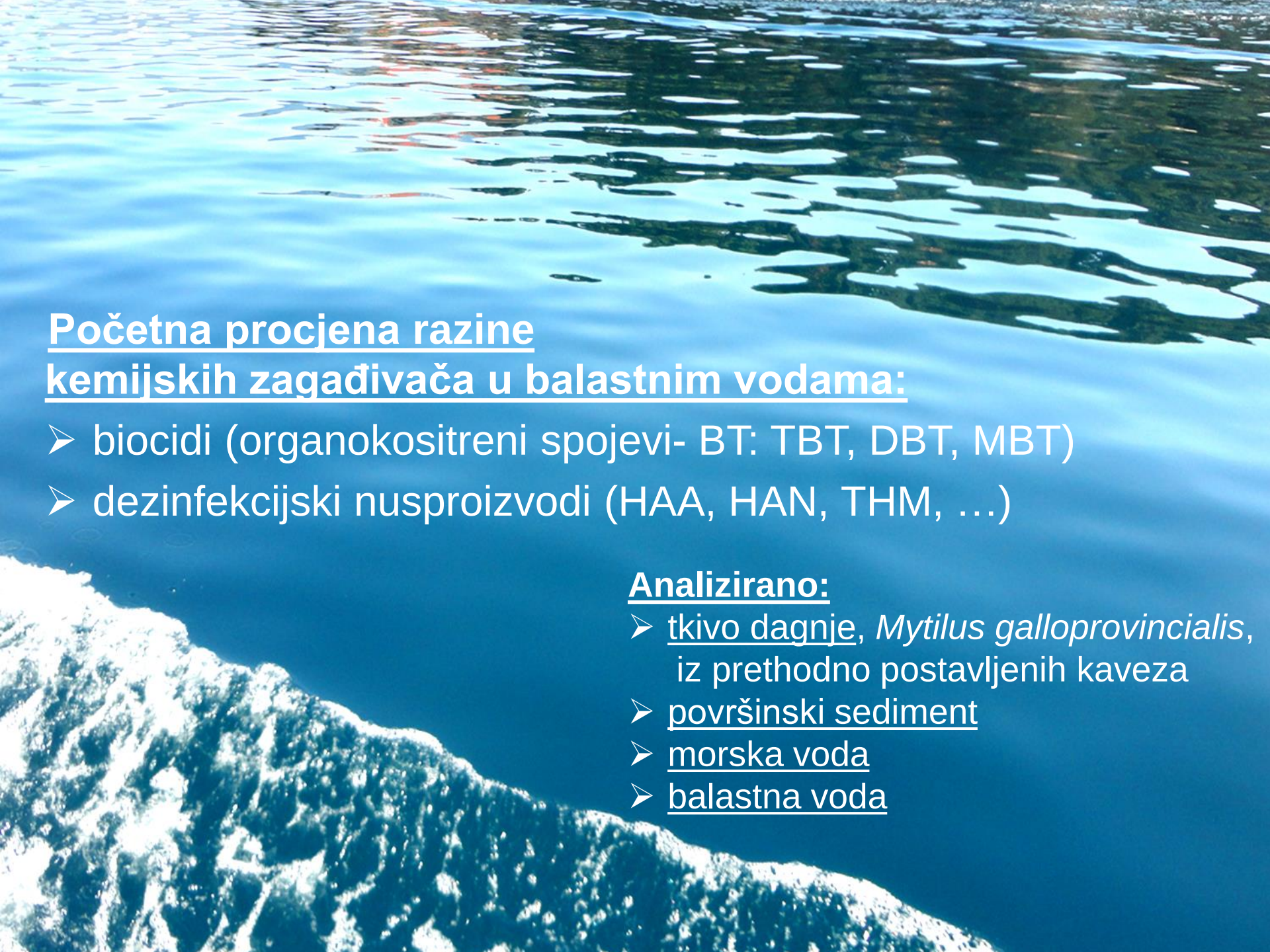
Balastne vode:

- nositelji sedimenata, bentoskih i planktonskih organizama
- štetnih vodenih organizama i patogena (Harmful Aquatic Organisms and Pathogens- HAOP)
- invazivnih vrsta (prijetnja endemskim vrstama u Sredozemnom moru)
- **različitih kemijskih zagađivača**



Početna procjena razine kemijskih zagađivača u balastnim vodama:

- biocidi (organokositreni spojevi- BT: TBT, DBT, MBT)
- dezinfekcijski nusproizvodi (HAA, HAN, THM, …)

Analizirano:

- tkivo dagnje, *Mytilus galloprovincialis*, iz prethodno postavljenih kaveza
- površinski sediment
- morska voda
- balastna voda

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REZULTATI

Organokositreni spojevi (TBT, DBT i MBT)

- dagnje
- površinski sediment
- morska voda
- balastna voda

Dezifekcijski nusproizvodi (DBP)

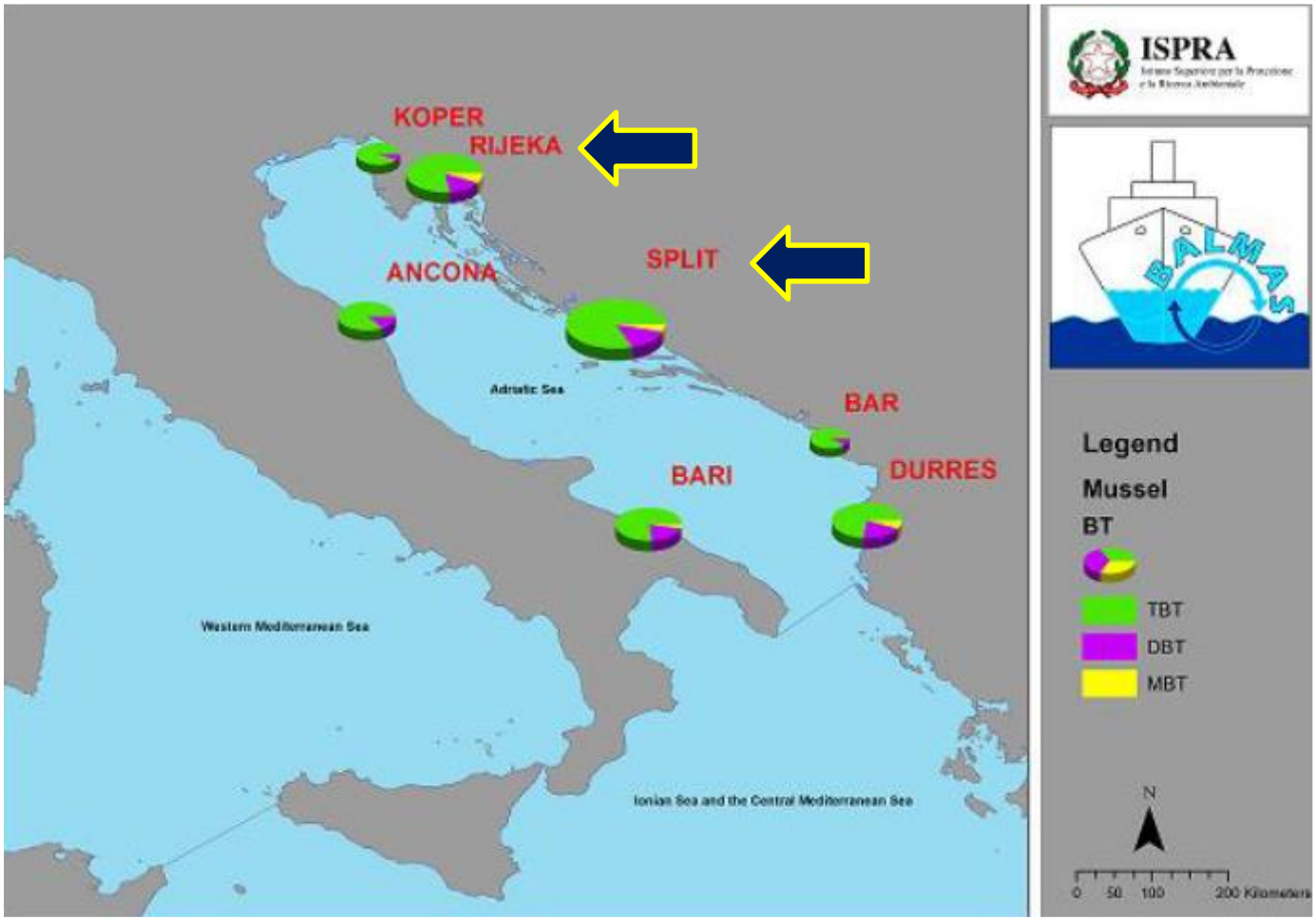
- dagnje
- površinski sediment
- morska voda
- balastna voda

Organokositreni spojevi *(Butyltin compounds- BT)**:***

- **tributil kositar** (tributyltin- TBT)
- **dibutil kositar** (dibutyltin- DBT)
- **monobutil kositar** (monobutyltin- MBT)

- dagnje
- površinski sediment
- morska voda
- balastna voda

- od 1970-ih, TBT korišten kao antivegetativni premaz za trupove brodova
- zabrana primjene organokositrenih protuobraštajnih sredstava u svijetu od 2008. (AFS konvencija, 2001.; IMO, 2001.)
- ovi zakoni za TBT nisu primijenjenjivani za balastne tankove
- pokazalo da transport TBT-a nije ograničen samo na trupove brodova, već i balastna voda može djelovati kao vektor mnogo većeg kapaciteta te doprinijeti ponovnom akumuliranju TBT onečišćenja u ušćima, pomorskim lukama i obalnim regijama



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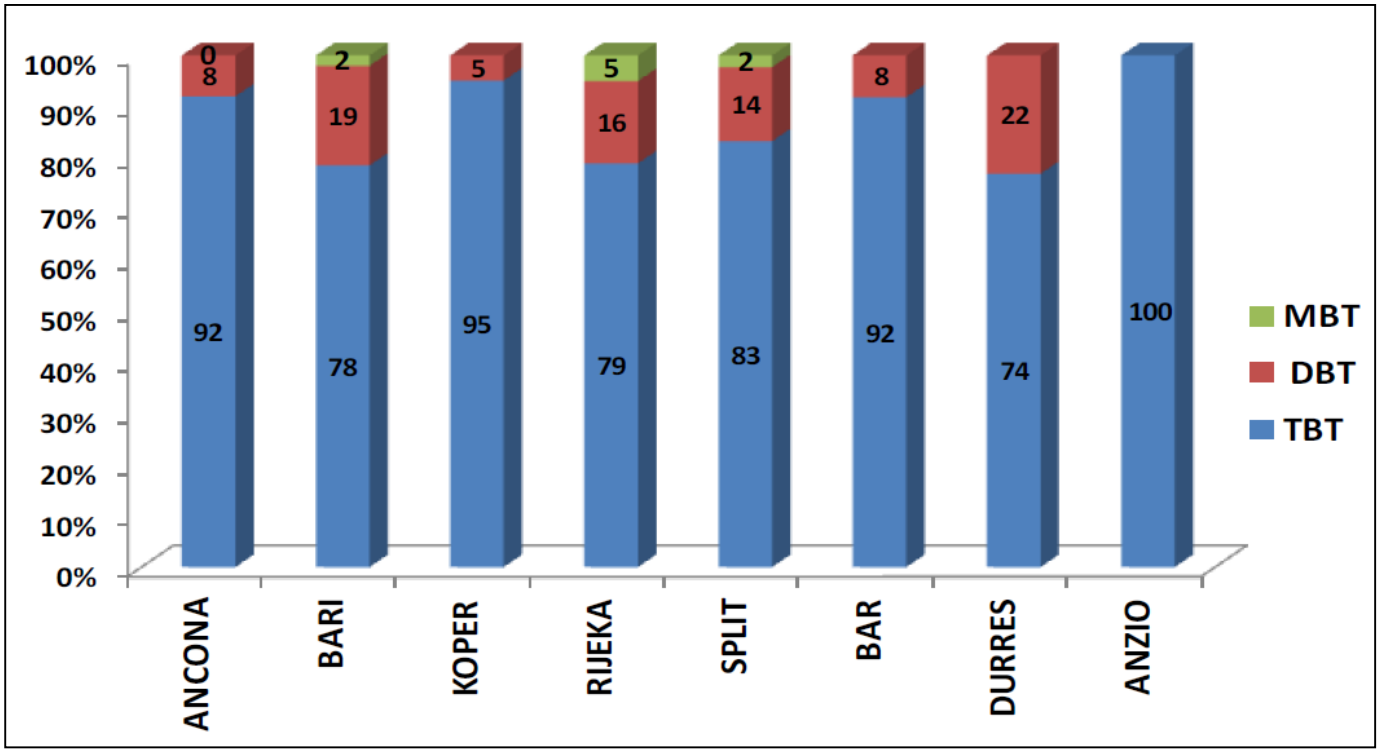

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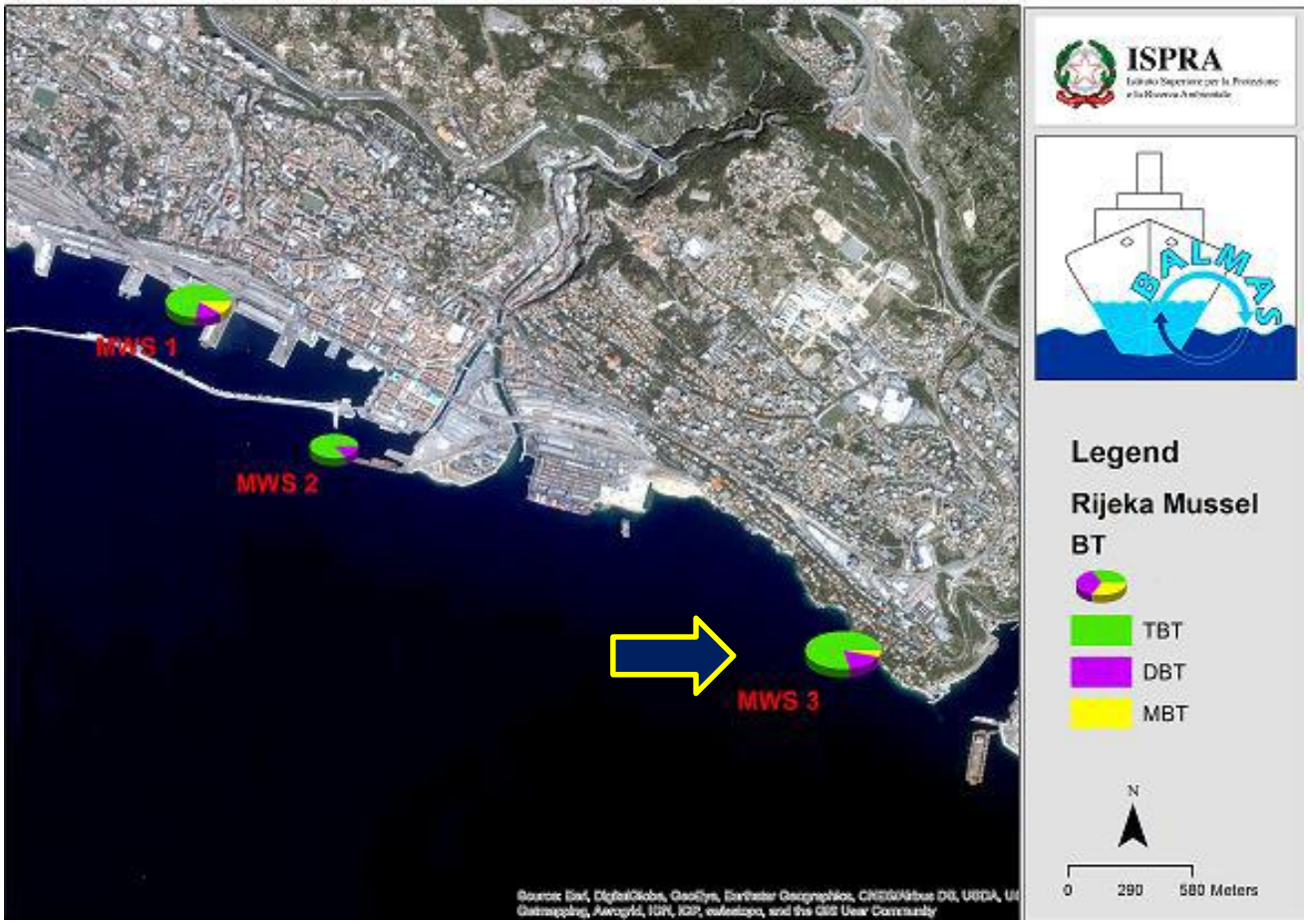

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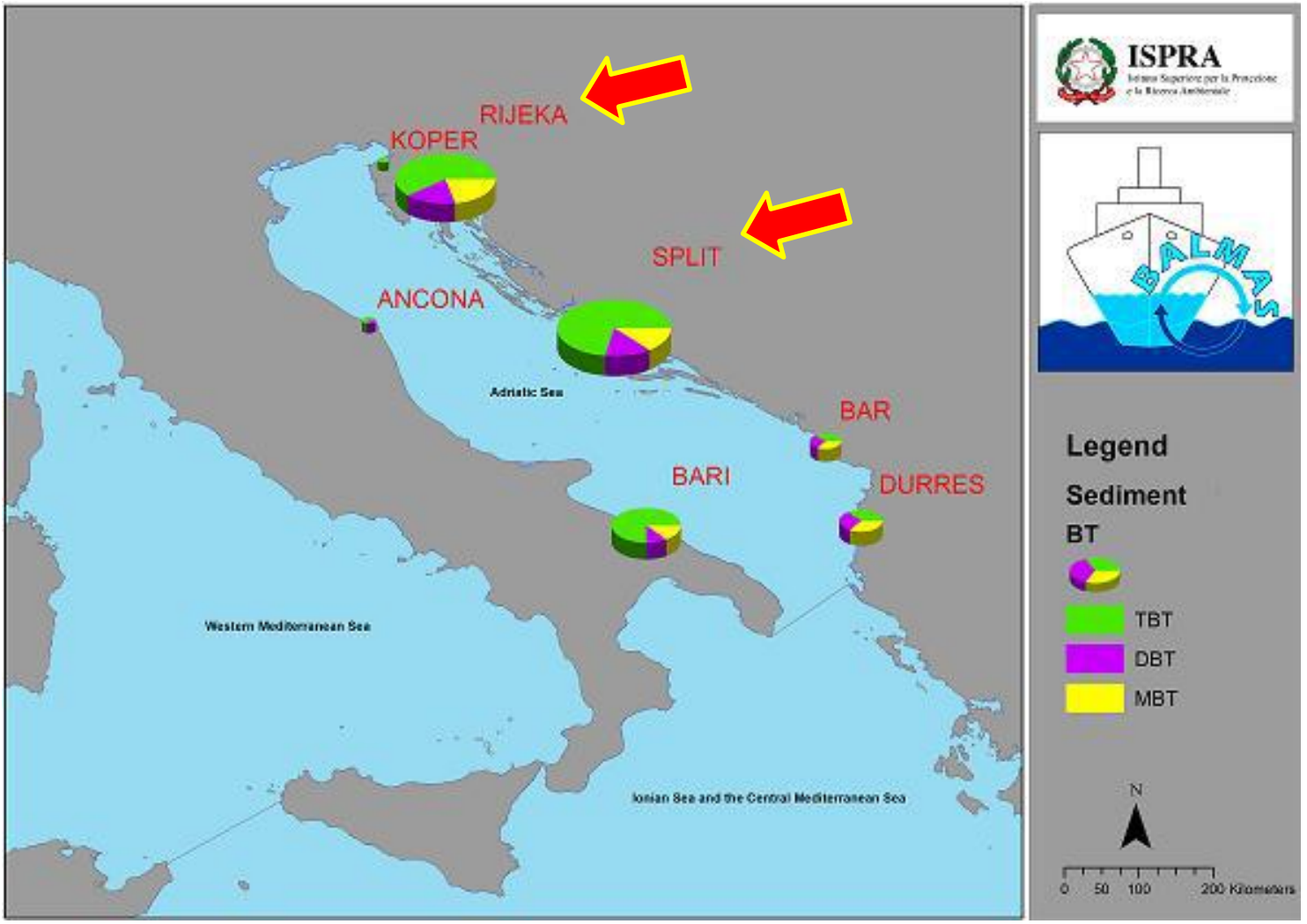
PORT	SAMPLING SITE	ORGANOTIN COMPOUNDS (ng Sn g^{-1} d.w.)			TOTAL ORGANOTINS
		TBT	DBT	MBT	∑BT (ng Sn g^{-1} d.w.)
ANCONA	AN_1	63	12	<4	75
ANCONA*	AN_3*	16	<4	<4	16
BARI	BAR_1	71	17	5	93
BARI	BAR_2	23	6	<4	29
KOPER	KO_1	26	5	<4	31
KOPER	KO_2	28	<4	<4	28
KOPER*	KO_3*	21	<4	<4	21
RIJEKA	RI_1	61	14	9	84
RIJEKA	RI_2	40	7	<4	47
RIJEKA*	RI_3*	89	19	5	112
SPLIT	SP_2	171	28	9	208
SPLIT*	SP_3*	54	10	<4	64
BAR	BA_1	21	4	<4	25
BAR	BA_2	18	<4	<4	18
DURRES	DU_1	62	19	7	88
DURRES*	DU_3*	37	11	<4	48
ANZIO**	AZ_1**	3	<4	<4	3



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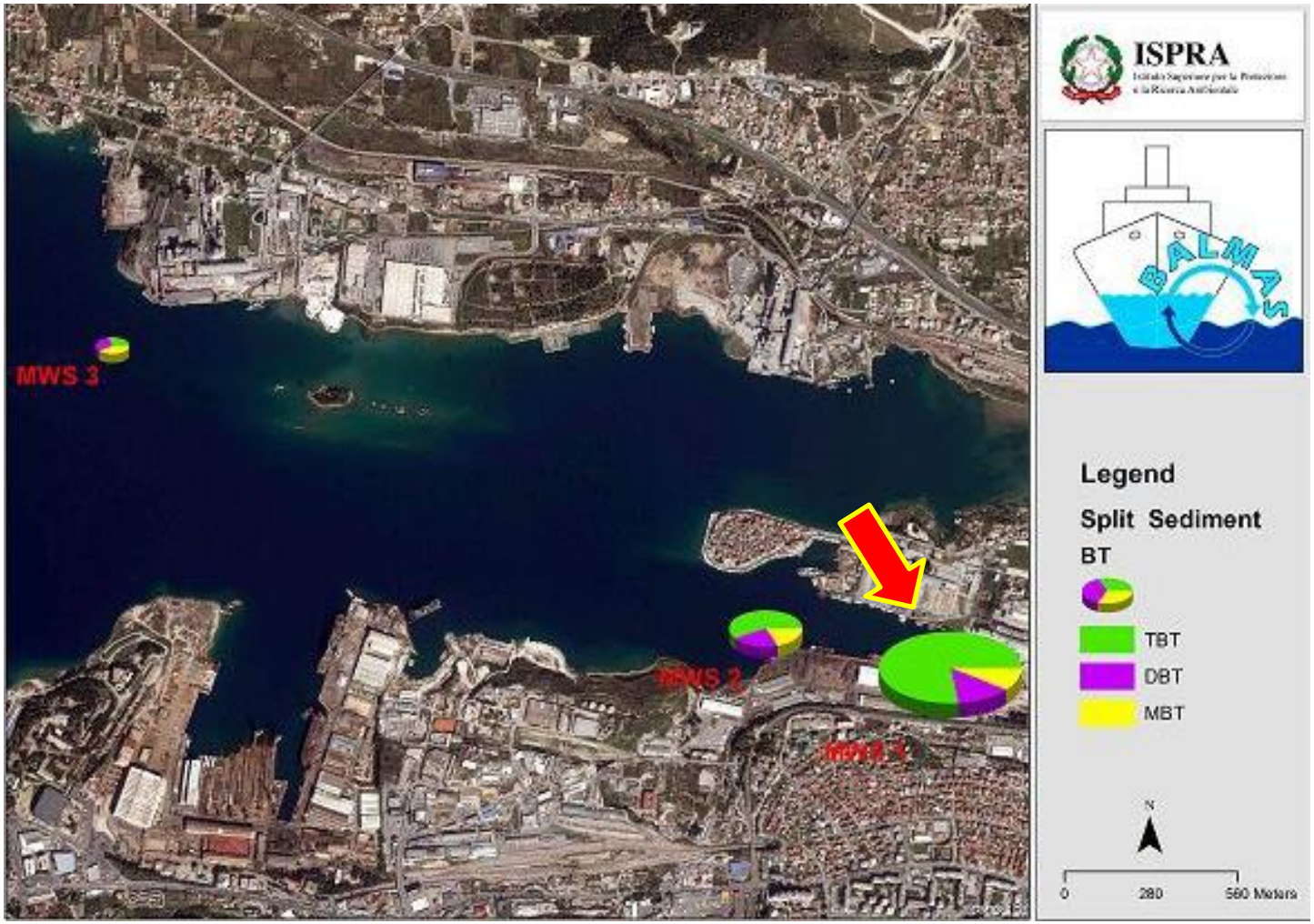

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Dezinfekcijski nusproizvodi (DBP)

- skupine spojeva prirodnog i antropogenog porijekla
- industrijska aktivnost, biocidi na bazi klora

Nepostojani organski spojevi (VOC):

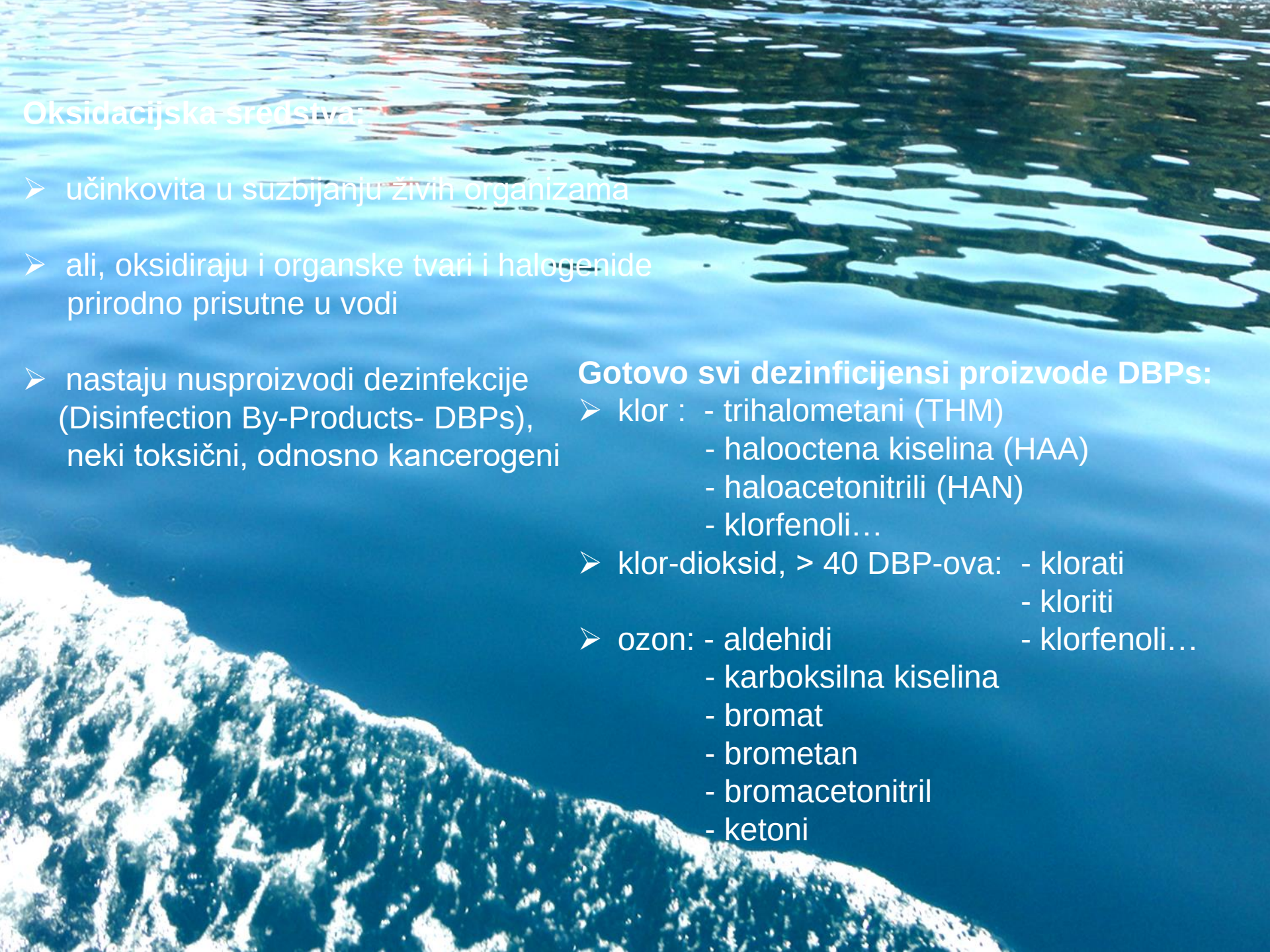
- nepostojani klorirani nusproizvodi dezinfekcije (Volatile chlorinated disinfection by-products- VDBPs)
- trihalometani (Trihalomethanes- THMs)
- haloacetonitrili (Haloacetonitriles- HANs)

- halooctene kiseline (Haloacetic Acids- HAAs)

Većina odobrenih sustava pročišćavanja
dezinficiraju vodu koristeći jake oksidanse
kao što su klor i ozon, ili koriste UV zračenje

Ukupni oksidansi prisutni u vodi tretiranoj s BWMS
(Ballast Water Management Systems)
se često skupno nazivaju ‘ukupni rezidualni oksidansi’
(Total Residual Oxidants- TRO)

Maksimalno dopuštena koncentracija
u ispuštenim balastnim vodama, MADC
(Maximum Allowable Discharge Concentration)
0,2 - 0,1 mg/L Cl_2 (IMO, 2014.)



Oksidacijska sredstva

- učinkovita u suzbijanju živih organizama
- ali, oksidiraju i organske tvari i halogenide prirodno prisutne u vodi
- nastaju nusproizvodi dezinfekcije (Disinfection By-Products- DBPs), neki toksični, odnosno kancerogeni

Gotovo svi dezinficijensi proizvode DBPs:

- klor : - trihalometani (THM)
  - halooctena kiselina (HAA)
  - haloacetonitrili (HAN)
  - klorfenoli…
- klor-dioksid, > 40 DBP-ova: - klorati
  - kloriti
- ozon: - aldehidi
  - karboksilna kiselina
  - bromat
  - brometan
  - bromacetonitril
  - ketoni
  - klorfenoli…

Site	Ancona		Bari		Koper			Rijeka			Split		Bar		Durres	
Sampling station	AN_1	AN_3	BAR_1	BAR_2	KO_1	KO_2	KO_3	RI_1	RI_2	RI_3	SP_2	SP_3	BA_1	BA_2	DU_1	DU_3
	ng kg^{-1} wet weight															
Chloroform	<10	<10	62	<10	<10	<10	<10	14	<10	75	13	12	<10	12	<10	<10
Bromodichloromethane	<10	<10	<10	<10	<10	13	12	<10	<10	<10	<10	<10	<10	<10	17	38
Carbon tetrachloride	<18	<18	<18	<18	<18	<18	19	<18	<18	<18	<18	<18	<18	<18	<18	<18
Dibromochloromethane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Bromoform	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
THMs	<LOQ	<LOQ	62	<LOQ	<LOQ	13	31	14	<LOQ	75	13	12	<LOQ	12	17	38
1,1,1-trichloroethane	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
1,2-dibromoethane	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15
Trichloroethene	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Tetrachloroethene	<20	<20	145	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
1,1-dichloro-2-propanone	<20	<20	205	<20	<20	<20	<20	35	<20	77	<20	<20	94	44	<20	<20
1,1,1-trichloro-2-propanone	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
1,2,3-trichloropropane	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
1,2-dibromo-3-chloropropane	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
VDBPs	<LOQ	<LOQ	350	<LOQ	<LOQ	<LOQ	<LOQ	35	<LOQ	77	<LOQ	<LOQ	94	44	<LOQ	<LOQ
Dichloroacetonitrile	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Trichloroacetonitrile	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
HANs	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ
VOCs	<LOQ	<LOQ	412	<LOQ	<LOQ	13	31	49	<LOQ	152	13	12	94	56	17	38

Site	Ancona		Bari		Koper			Rijeka			Split		Bar		Durres	
Sampling station	AN_1	AN_3	BAR_1	BAR_2	KO_1	KO_2	KO_3	RI_1	RI_2	RI_3	SP_2	SP_3	BA_1	BA_2	DU_1	DU_3
	ng g^{-1} wet weight															
MCAA	1.1	0.6	1.6	0.7	0.8	1.3	1.2	1.1	1.3	0.3	0.3	0.3	0.4	1.2	0.6	0.4
MBAA	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
DCAA	2.8	1.2	1.6	2.0	1.5	2.7	2.1	1.6	2.7	0.5	1.5	1.4	2.4	2.4	2.4	2.2
TCAA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
BCAA	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
BDCAA	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
DBAA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
CDBAA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
TBAA	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total HAAs	3.9	1.8	3.2	2.7	2.3	4.0	3.1	2.7	4.0	0.8	1.8	1.7	2.8	3.6	3.0	2.6
Dalapon	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.4	<0.2

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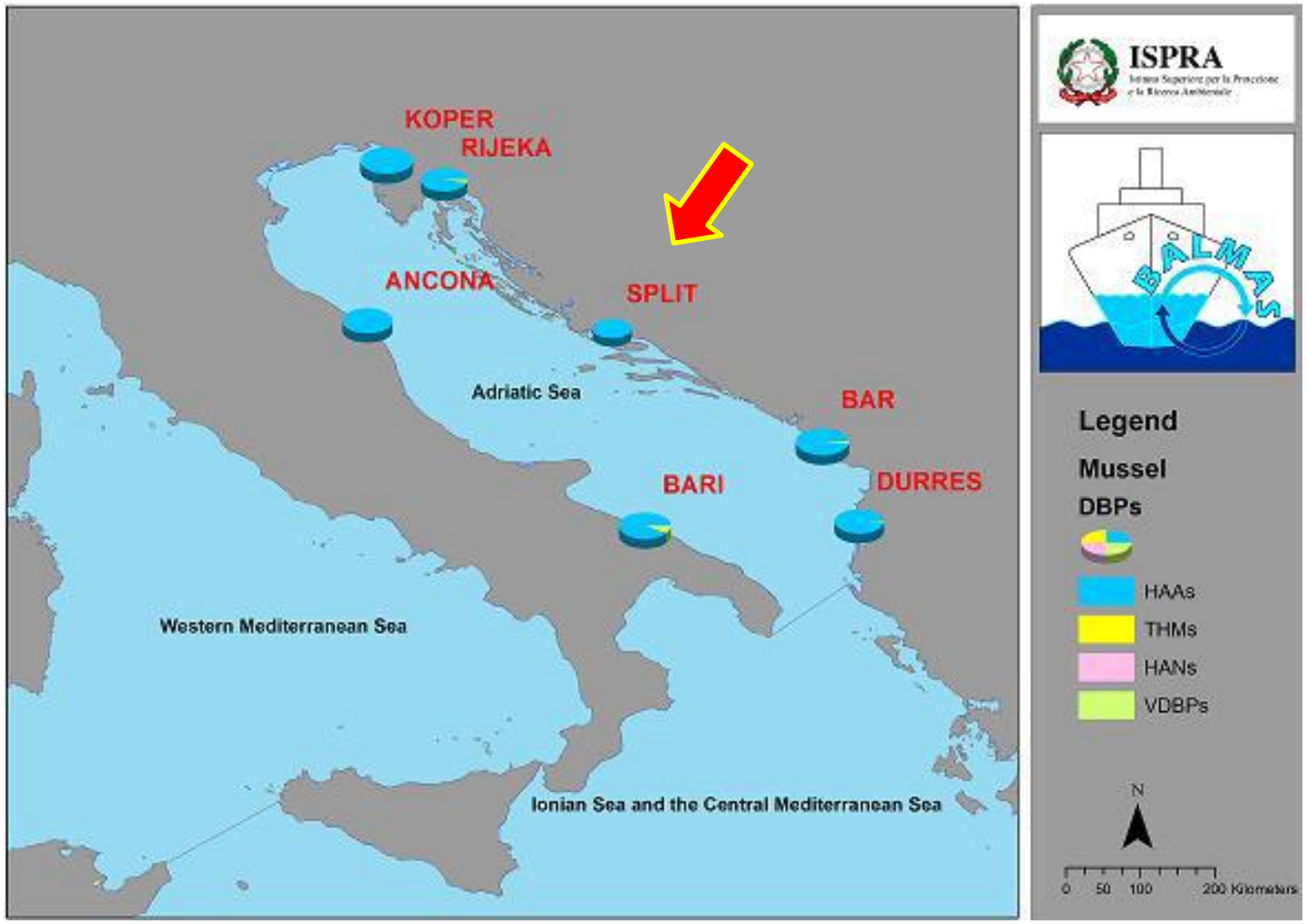

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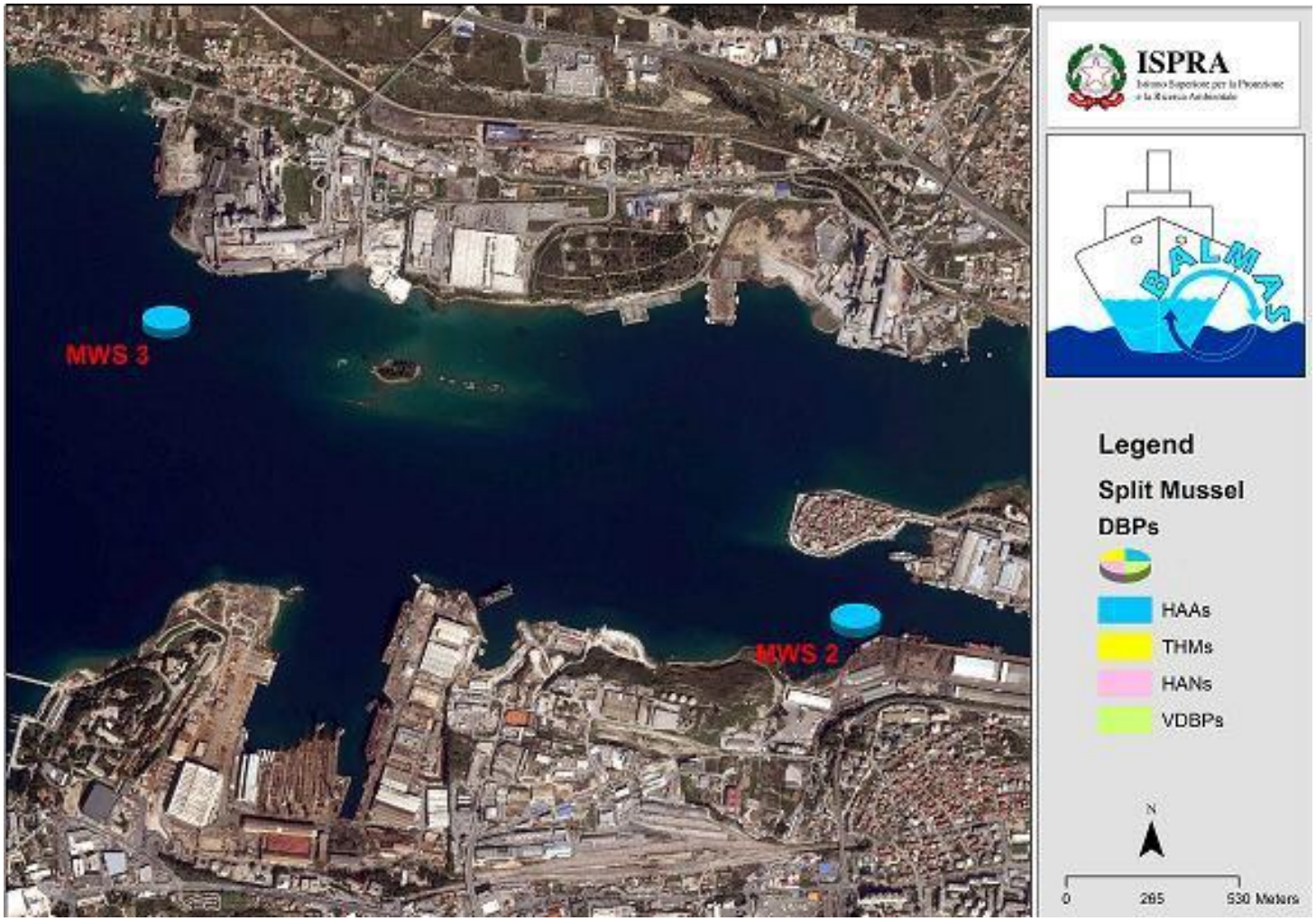

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Site	Ancona			Bari			Bar			Durres		Koper			Split			Rijeka		
	ng g^{-1} wet weight																			
Sampling station	AN_1	AN_2	AN_3	BAR_1	BAR_2	BAR_3	BA_1	BA_2	BA_3	DU_1	DU_2	KO_1	KO_2	KO_3	SP_1	SP_2	SP_3	RI_1	RI_2	RI_3
MCAA	0.27	0.19	0.36	0.15	0.52	0.40	0.09	0.13	0.17	0.08	0.12	0.10	0.74	0.16	0.31	0.14	0.52	0.15	<0.06	0.1
MBAA	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
DCAA	<0.06	<0.06	<0.06	0.07	0.12	0.13	0.15	<0.06	0.11	0.06	<0.06	<0.06	0.11	0.07	0.12	0.11	0.11	0.09	<0.06	0.10
TCAA	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	0.03	<0.02	0.03
BCAA	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.06	0.05	<0.04	<0.04	0.05	0.05	<0.04	0.05
BDCAA	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
DBAA	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	0.02	0.04	0.02	<0.02	<0.02	0.04	0.06	0.03	<0.02	0.04	0.07	0.03	0.05
CDBAA	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
TBAA	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Total HAAs	0.27	0.19	0.36	0.24	0.64	0.53	0.29	0.15	0.34	0.16	0.12	0.10	0.97	0.34	0.46	0.25	0.72	0.39	0.09	0.38
Dalapon	<0.04	<0.04	<0.04	0.04	0.04	0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04

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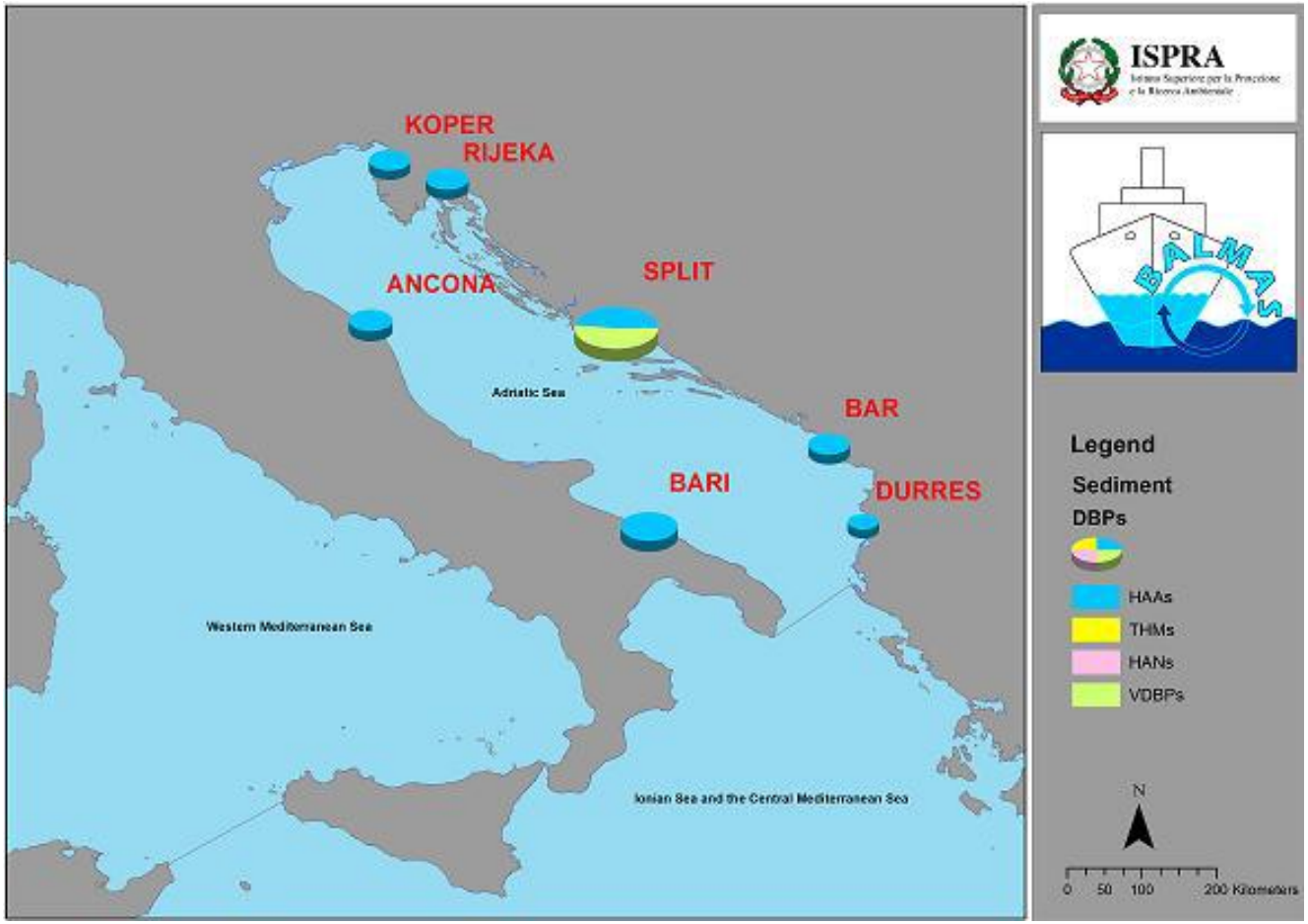

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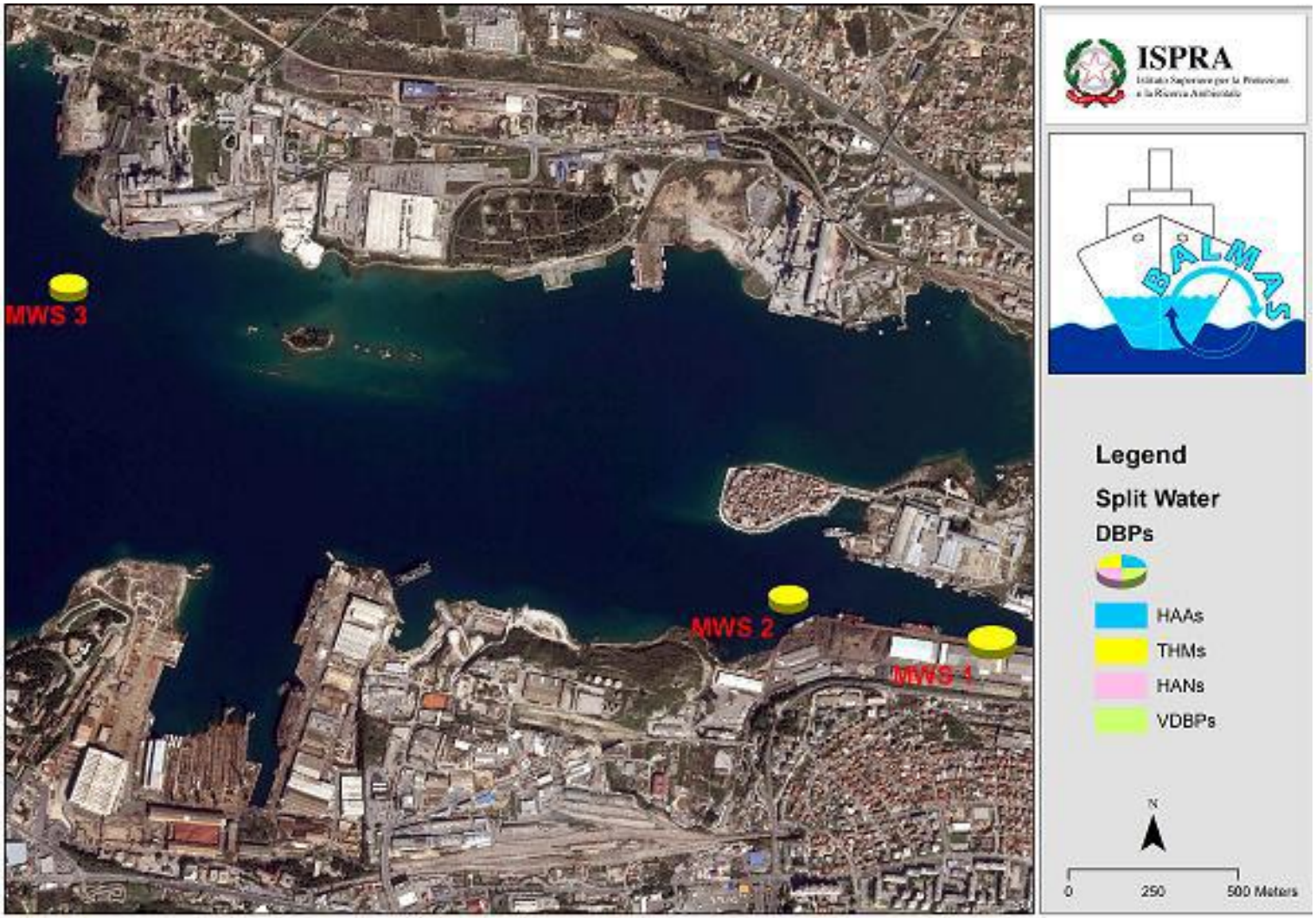

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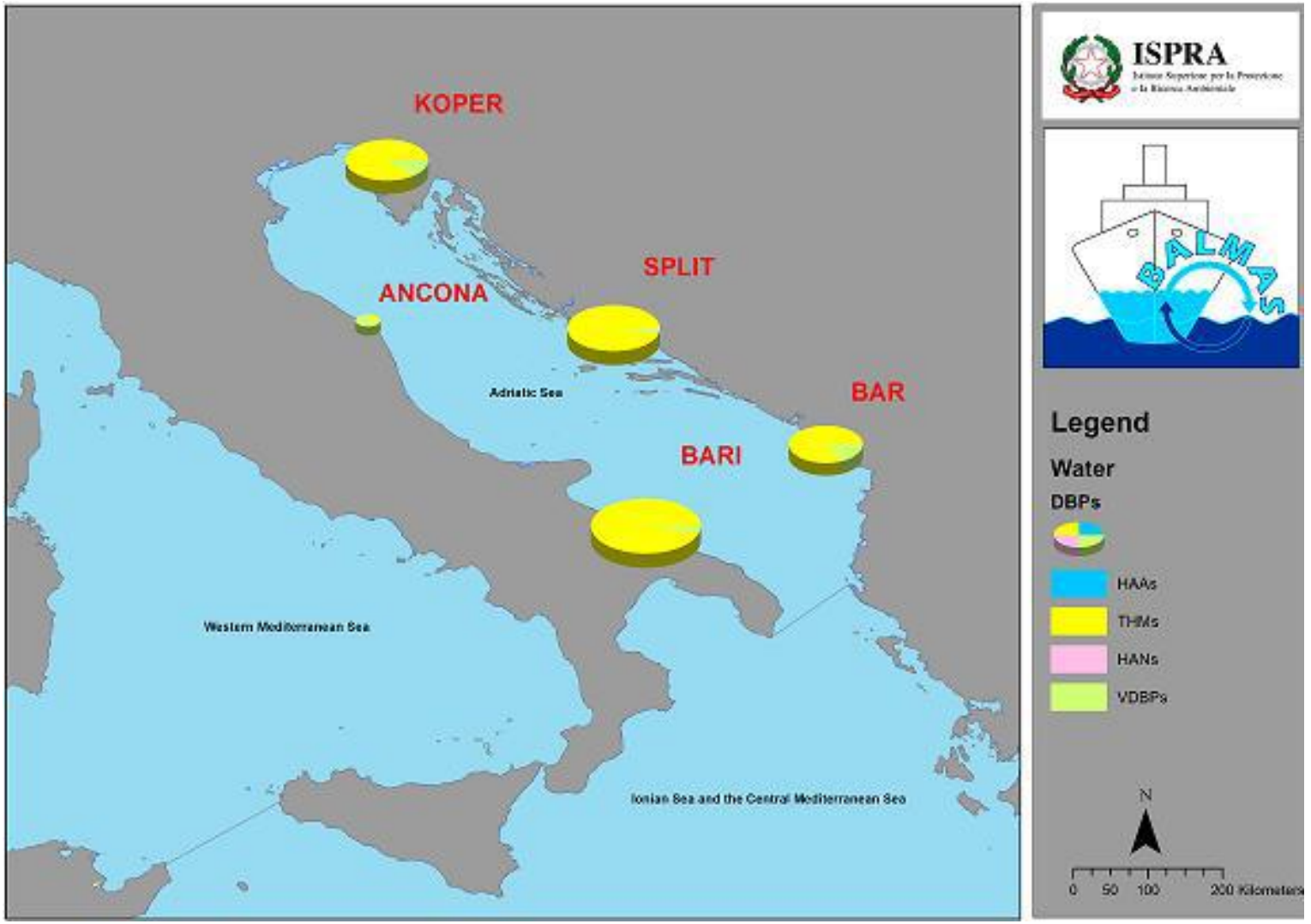

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Site	Ancona			Bari			Bar			Koper			Split		
Sampling station	MS1	MS2	MS3	MS1	MS2	MS3	MS1	MS2	MS3	MS1	MS2	MS3	MS1	MS2	MS3
							ng L^{-1}								
Chloroform	<10	<10	<10	27	<10	<10	<10	<10	18	<10	<10	<10	95	71	79
Bromodichloromethane	10	14	<10	45	<10	<10	<10	<10	34	<10	<10	15	246	154	122
Carbon tetrachloride	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15
Dibromochloromethane	<10	<10	<10	98	67	66	54	62	69	31	54	42	302	195	165
Bromoform	<10	<10	<10	637	666	899	235	454	65	326	723	95	139	106	111
THMs	10	14	<LOQ	735	733	965	289	516	186	357	777	152	782	526	477
1,1,1-trichloroethane	<15	<15	<15	<15	19	<15	25	20	31	39	24	31	26	<15	17
1,2-dibromoethane	<15	<15	<15	38	<15	<15	17	16	37	<15	<15	<15	<15	<15	<15
Trichloroethene	<10	<10	<10	22	<10	<10	12	10	15	<10	<10	13	<10	<10	<10
Tetrachloroethene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
1,1-dichloro2propanone	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
1,1,1-trichloro2propanone	<50	56	56	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
1,2,3-trichloropropane	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
1,2,3-tribromo3chloropropane	<50	<50	<50	<50	<50	<50	<50	<50	<50	53	<50	<50	<50	<50	<50
VDBPs	<LOQ	<LOQ	<LOQ	60	19	<LOQ	54	46	83	39	24	44	26	<LOQ	17
Dichloroacetonitrile	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Trichloroacetonitrile	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Dibromoacetonitrile	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
HANs	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ
VOCs	10	14	<LOQ	795	752	965	343	562	269	396	801	196	808	526	494

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BW CODE	BW1	BW2	BW3	BW4	BW5	BW6	BW7	BW8	BW9	BW10
	ng L^{-1}									
Chloroform	22	20	19	18	20	19	19	18	28	27
Bromodichloromethane	<10	14	<10	<10	16	15	<10	<10	19	<10
Carbon tetrachloride	<15	<15	16	<15	<15	<15	<15	<15	<15	<15
Dibromochloromethane	<10	<10	<10	<10	<10	<10	<10	<10	15	<10
Bromoform	12	14	13	<10	11	13	<10	13	22	18
THMs	34	48	48	18	47	47	19	31	84	45
1,1,1-trichloroethane	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15
1,2-dibromoethane	18	18	18	<15	18	18	<15	<15	<15	18
Trichloroethene	11	11	12	10	<10	<10	<10	<10	11	14
Tetrachloroethene	<10	<10	<10	<10	<10	<10	<10	<10	<10	41
1,1-dichloro2propanone	65	<20	84	<20	<20	<20	22	29	<20	<20
1,1,1-trichloro2propanone	<40	<40	<40	<40	<40	<40	<40	<40	<40	<40
1,2,3-trichloropropane	<20	23	20	23	23	23	23	<20	22	27
1,2-dibromo3cloropropane	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
VDBPs	94	52	134	33	23	41	45	29	33	100
VOCs	128	100	182	51	70	88	64	60	117	145

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U budućnosti…

- rezultati studije procjene stanja u lukama predstavljaju početnu procjenu za istraživane kemijske spojeve
- s obzirom na Međunarodnu konvenciju o nadzoru i upravljanju brodskim balastnim vodama i talozima (IMO, 2004.), savjetuje se nova procjena kemijskog zagađenja u navedenim lukama
- potreban je sustavni monitoring organokositrenih spojeva u balastnim vodama različitih tipova brodova i procjena mogućeg utjecaja na morski okoliš
- preporuča se procjena razine drugih zagađivala iz skupine DBP-ova
- buduće studije bi se mogle bazirati na drugačijim metodama (pasivni uzorkivači) radi boljeg razumijevanja ponašanja ovih zagađivala u okolišu
- proširiti projekt i na druge luke u Sredozemnom moru, jer je ono more koje je vjerojatno najopterećenije brodskim prometom na svijetu

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