doc. dr. sc. Romina Kraus

Center for Marine Research

Rudjer Boškovic Institute

Rovinj, Croatia

The project is co-funded by the European Union
Instrument for Pre-Accession Assistance

Let's grow up together
Adriatic IPA
Cross Border Cooperation 2007-2013

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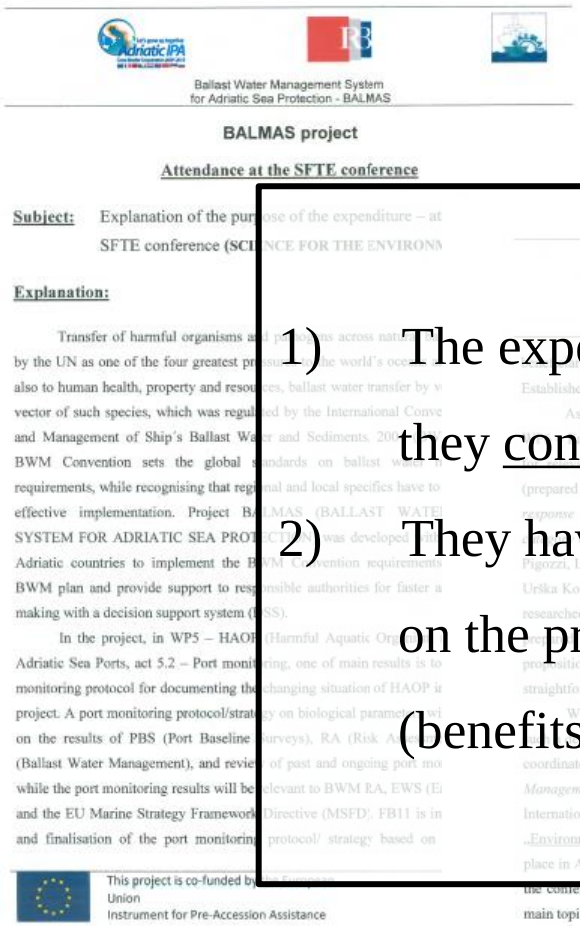
Project:

Ballast Water **M**anagement System

For **A**driatic **S**ea Protection


Ballast Water Management System
for Adriatic Sea Protection - BALMAS

BALMAS project

Attendance at the SFTE conference

Subject: Explanation of the purpose of the expenditure – at SFTE conference (SCIENCE FOR THE ENVIRONM

Explanation:

Transfer of harmful organisms a[illegible]s across nat[illegible] by the UN as one of the four greatest pr[illegible] the world's oce[illegible] also to human health, property and resou[illegible]rces, ballast water transfer by v[illegible] vector of such species, which was regul[illegible]ed by the International Conve[illegible] and Management of Ship's Ballast W[illegible]ter and Sediments. 20[illegible] BWM Convention sets the global s[illegible]tandards on ballast w[illegible] requirements, while recognising that reg[illegible]nal and local specifics have to effective implementation. Project B[illegible]LMAS (BALLAST WATE[illegible] SYSTEM FOR ADRIATIC SEA PROT[illegible]was developed [illegible] Adriatic countries to implement the B[illegible]WM C[illegible]ention requirements BWM plan and provide support to res[illegible]nsible authorities for faster a[illegible] making with a decision support system ([illegible]SS).

In the project, in WP5 – HAOP (Harmful Aquatic Or[illegible] Adriatic Sea Ports, act 5.2 – Port moni[illegible]ring, one of main results is to monitoring protocol for documenting th[illegible]changing situation of HAOP i[illegible] project. A port monitoring protocol/strat[illegible]y on biological paramet[illegible] on the results of PBS (Port Baseline [illegible]surveys), RA (Risk A[illegible] (Ballast Water Management), and revie[illegible] of past and ongoing port mo[illegible] while the port monitoring results will be[illegible]levant to BWM RA, EWS (E[illegible] and the EU Marine Strategy Framework[illegible] Directive (MSFD). FB11 is in and finalisation of the port monitorin[illegible] protocol/ strategy based on

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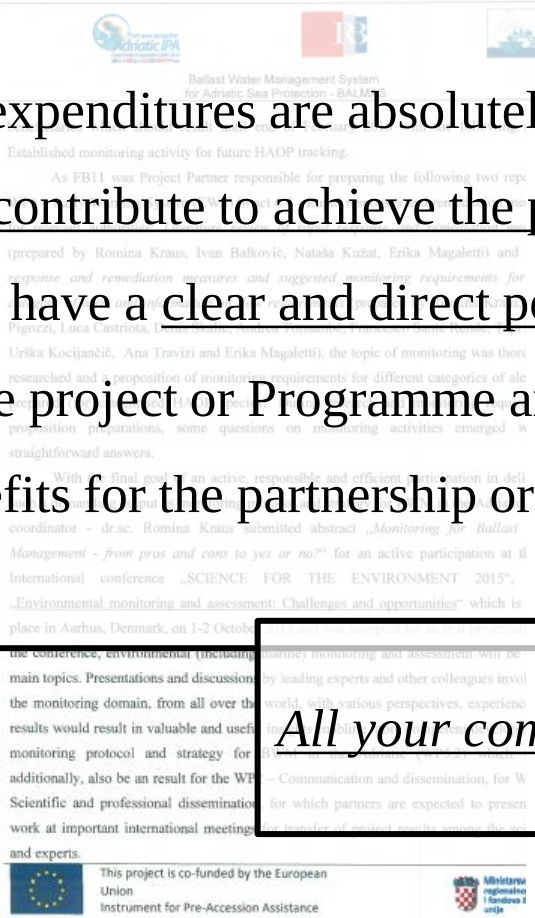
Established monitoring activity for future HAOP tracking.

As FB11 was Project Partner responsible for preparing the following two reps[illegible] (prepared by Romina Kraus, Ivan Balković, Nataša Kužat, Erika Magaletti) and *response and remediation measures and suggested monitoring requirements for* [illegible] Pigozzi, Luca Castriota, [illegible] Urška Kocijančič, Ana Travizi and Erika Magaletti), the topic of monitoring was thor[illegible] researched and a proposition of monitoring requirements for different categories of ale[illegible] proposition considerations, some questions on monitoring activities emerged w[illegible] straightforward answers.

With the final goal [illegible] an active, responsible and efficient participation in dell[illegible] coordinator - dr.sc. Romina Kraus submitted abstract *„Monitoring for Ballast Management - from pros and cons to yes or no?"* for an active participation at th[illegible] International conference „SCIENCE FOR THE ENVIRONMENT 2015", „Environmental monitoring and assessment: Challenges and opportunities" which is place in Aarhus, Denmark, on 1-2 Octo[illegible] the conference, environmental (bio[illegible]marine) monitoring and assessment will be main topics. Presentations and discussion[illegible] by leading experts and other colleagues invol[illegible] the monitoring domain, from all over th[illegible] world, with various perspectives, experienc[illegible] results would result in valuable and usefu[illegible] monitoring protocol and strategy for [illegible] additionally, also be an result for the WP[illegible] - Communication and dissemination, for W[illegible] Scientific and professional dissemination[illegible] for which partners are expected to presen[illegible] work at important international meeting[illegible] and experts.

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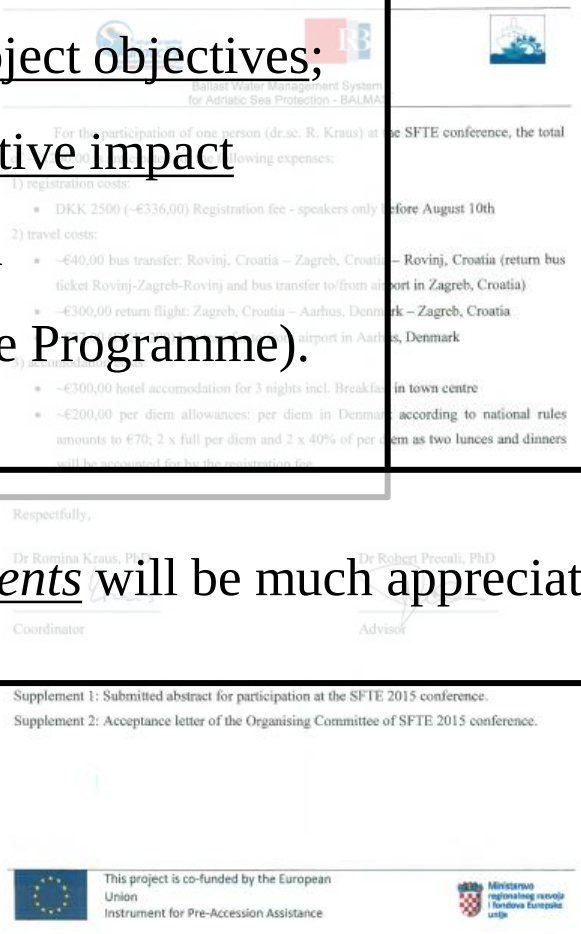
[illegible] participation of one person (dr.sc. R. Kraus) at [illegible] SFTE conference, the total [illegible] following expenses:

1) registration costs:

- DKK 2500 (~€336,00) Registration fee - speakers only [illegible] before August 10th

2) travel costs:

- ~€40,00 bus transfer: Rovinj, Croatia – Zagreb, Croatia – Rovinj, Croatia (return bus ticket Rovinj-Zagreb-Rovinj and bus transfer to/from a[illegible]port in Zagreb, Croatia)
- ~€300,00 return flight: Zagreb, Croatia – Aarhus, Denmark – Zagreb, Croatia
- [illegible] airport in Aar[illegible]s, Denmark
- ~€300,00 hotel accomodation for 3 nights incl. Breakfast in town centre
- ~€200,00 per diem allowances: per diem in Denmark according to national rules amounts to €70; 2 x full per diem and 2 x 40% of per diem as two lunces and dinners [illegible] will be accounted for by the registration fee.

Respectfully,

Dr Romina Kraus, Ph[illegible] Dr Robert Precali, PhD

Coordinator Advisor

Supplement 1: Submitted abstract for participation at the SFTE 2015 conference.
Supplement 2: Acceptance letter of the Organising Committee of SFTE 2015 conference.

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1) The expenditures are absolutely necessary and they contribute to achieve the project objectives;

2) They have a clear and direct positive impact on the project or Programme area (benefits for the partnership or the Programme).

All your comments will be much appreciated!

Monitoring for Ballast Water Management – from pros and cons to yes or no?

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SLOVENIA
CROATIA
ITALY
Rovinj
BOSNIA-
HERZEGOVINA
MONTENEGRO
Adriatic Sea
ALBANIA
Ballast Water Management System
for Adriatic Sea Protection
BALMAS
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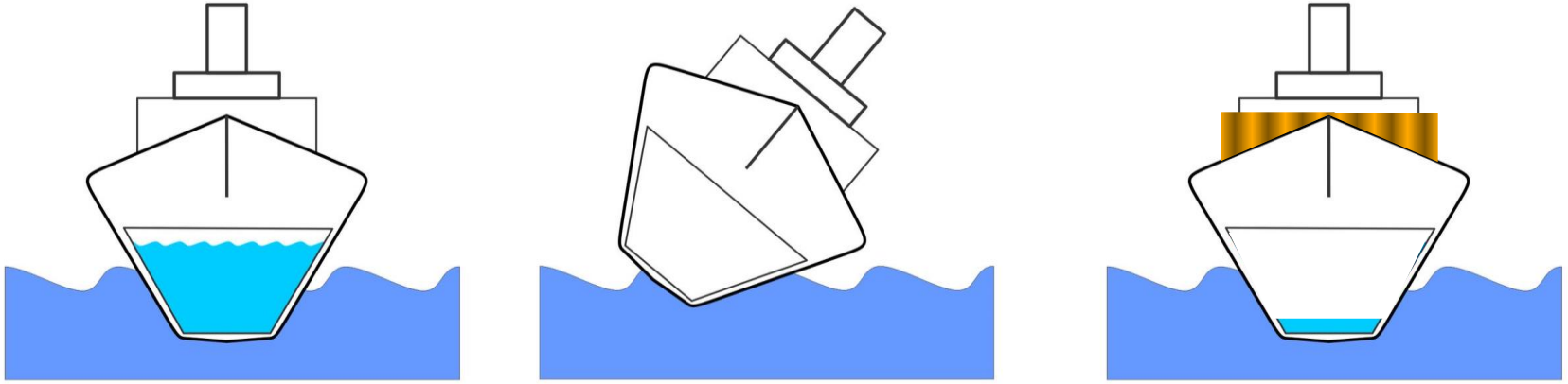
Transfer of harmful aquatic organisms and pathogens (HAOP) / invasive aquatic species (IAS) across natural barriers is recognized as one of greatest pressures to the sea realm, imposing threat to the environment, human health and economy.



Prominent vector = ballast waters (BW)
(transferred by vessels engaged in the international shipping of goods)

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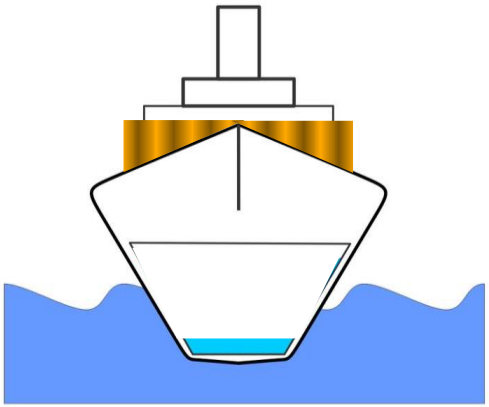

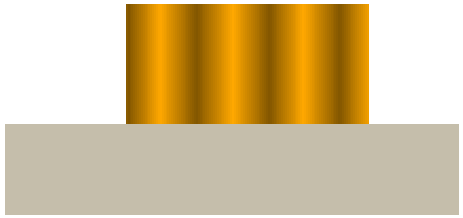

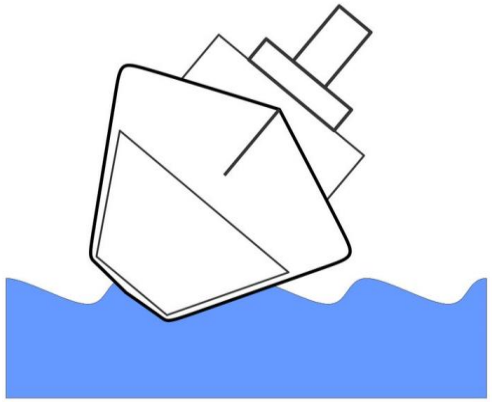

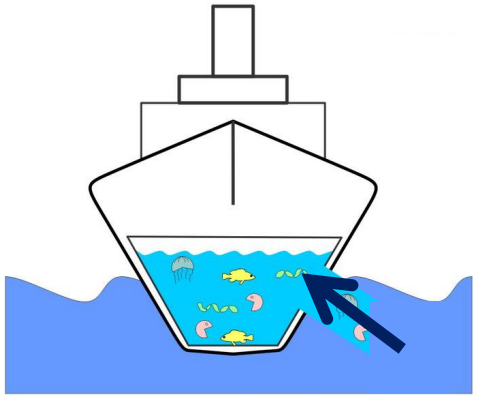

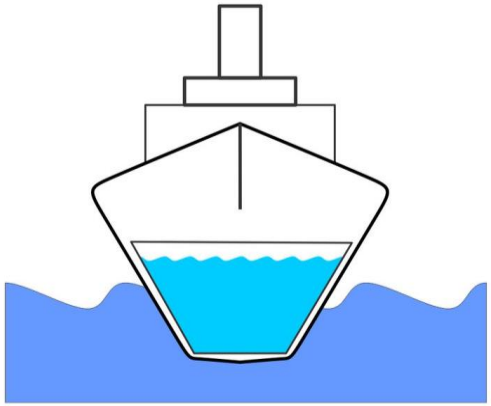

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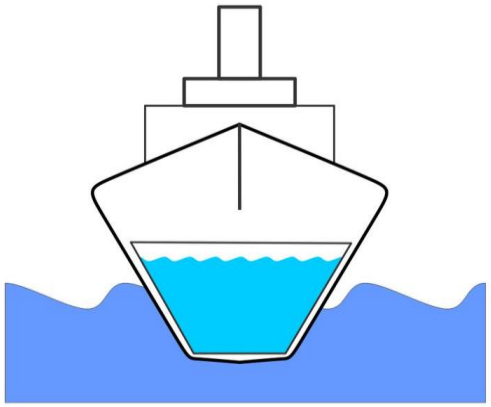

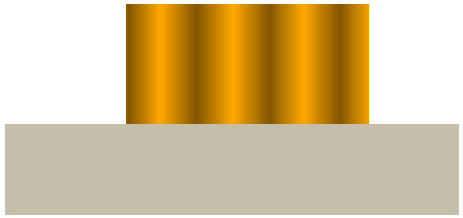

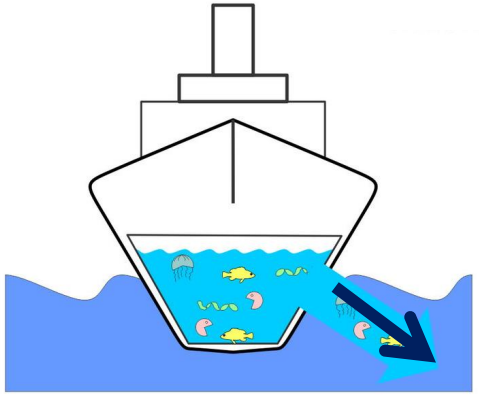

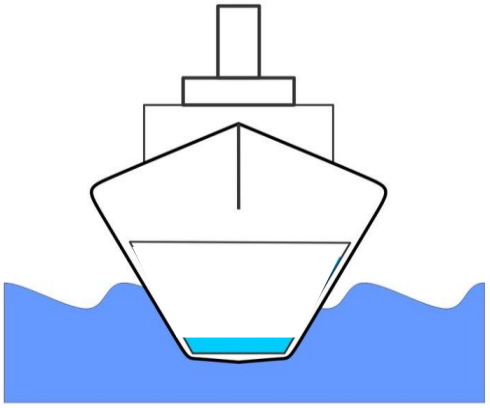

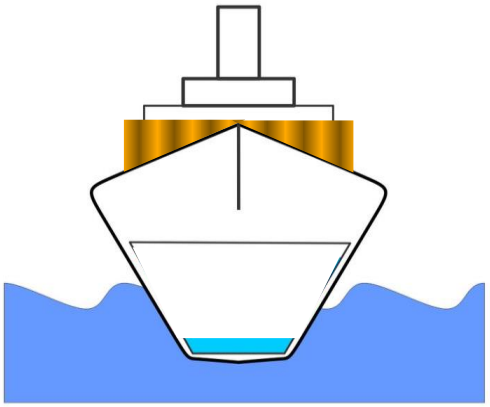

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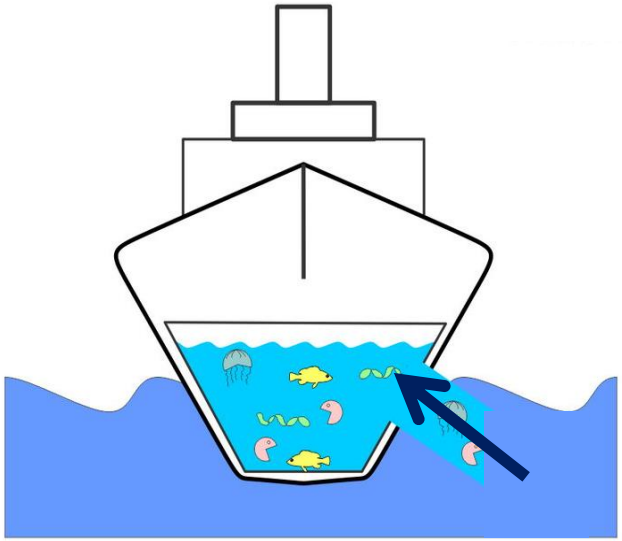

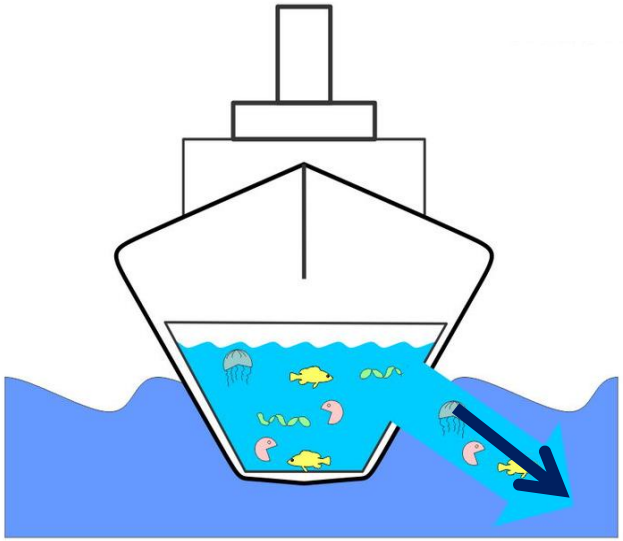

Ballast waters

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International Convention for

the Control and Management of Ship's Ballast Water and Sediments, 2004 (BWM Convention)

includes **implementation of <u>monitoring</u>**

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International Convention for

the Control and Management of Ship's Ballast Water and Sediments, 2004 (BWM Convention)

includes **implementation of <u>monitoring...</u>**

W h y ?

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International Convention for

the Control and Management of Ship's Ballast Water

and Sediments, 2004 (BWM Convention)

includes **implementation of <u>monitoring</u>**

as vital part of **early detection of introduction of HAOP/IAS in ports**

in order to **enable rapid response**

with available methods of eradication, control or containment

for an identified HAOP/IAS species.

Also, to **prevent** ships from loading seawater containing HAOP.

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Monitoring... what?

Provisional list of harmful aquatic organisms relevant for warning ships and environmental authorities, invasiveness, relevance to ballast waters uptake and discharge, demonstrated impact type and information reference.
Colors refer to the **impact category level**
red=strong
orange=medium
yellow=low
green=absent
white = unknown

Abbreviations:
Means of arrival: A=Aquaculture; AQ=aquarium; F=bio Fouling; L=live imports; SM=Suez canal migration; BW=ships ballast water; U=unknown.

NIS= Non Indigenous Species; C=Cryptogenic species; HN=Harmful native species; IAS=Invasive Alien Species.

Groups	Categories levels					
	Total	Strong	Medium	Low	Absent	Unknown
Viruses*	**1**	1	0	0	0	0
Bacteria*	**12**	12	0	0	0	0
MICROALGAE	**113**	113	0	0	0	0
MACROPHYTES	**32**	2	4	13	0	13
Foraminiferans	2	0	0	2	0	0
Poriferans	1	0	0	1	0	0
CNIDARIANS	**34**	19	2	1	0	12
Ctenophores	1	1	0	0	0	0
GASTROPODS	**11**	0	2	8	0	1
BIVALVES	**20**	1	1	9	1	8
Cephalopods	1	0	0	0	0	1
POLYCHAETES	**32**	0	3	15	0	14
Copepods	3	0	1	1	0	1
DECAPODS	**17**	0	1	11	0	5
Amphipods	5	0	0	0	1	4
Isopods	1	0	0	0	0	1
Tanaids	1	0	0	0	0	1
Mysid	1	0	0	0	0	1
Stomatopods	1	0	0	1	0	0
Pycnogonids	1	0	0	0	0	1
Bryozoans	2	0	0	1	0	1
Echinoderms	2	0	0	1	0	1
Ascidians	7	0	2	3	0	2
FISHES	**21**	4	2	13	1	1

Group	ScientificName	Means of Arrival	NIS/ C/IAS/H N	Relevanc e forBW uptake	Impact type	Impact description**	Reference
microalgae	*Alexandrium acatenella* (Whedon & Kofoid) Balech, 1985			yes			
microalgae	*Alexandrium anderzonii* Balech, 1990			yes			
microalgae	*Alexandrium balechii* (Steidinger) F.J.R.Taylor, 1979			yes			
microalgae	*Alexandrium catenella* (Whedon & Kofoid) Balech, 1985	A, BW	IAS	yes	ecosystem, health and social, economic impacts	red tides; paralytic shellfish poisoning (PSP) toxins-producing species responsible for human illnesses and deaths after consumption of infected shellfish; economic damage to aquaculture and the shellfish harvest	DAISIE
microalgae	*Alexandrium cohorticula* (Balech) Balech, 1985			yes			
microalgae	*Alexandrium fundyense* Balech, 1985			yes			
microalgae	*Alexandrium hiranoi* Kita & Fukuyo, 1988			yes			
microalgae	*Alexandrium minutum* Halim, 1960			yes	economic	economic losses to aquaculture	Nehring S (1998) Archive of Fishery and Marine Research 46(3): 181–194
microalgae	*Alexandrium monilatum* (J.F.Howell) Balech, 1995			yes			
microalgae	*Alexandrium ostenfeldii* (Paulsen) Balech & Tangen, 1985			yes			
microalgae	*Alexandrium pseudogonyaulax* (Biecheler) Horiguchi ex Kita & Fukuyo, 1992			yes			

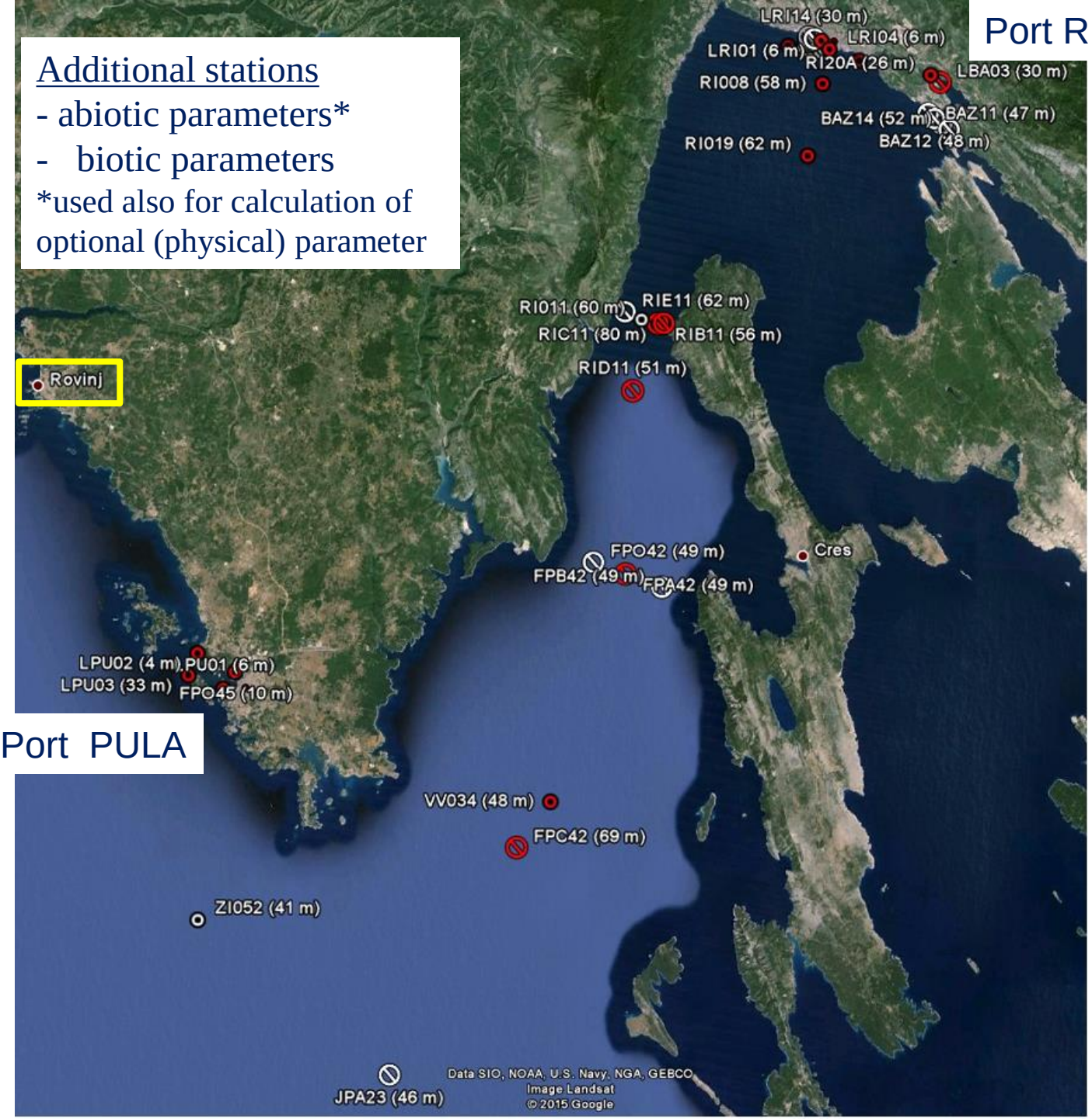
Before monitoring...

PBS (Port Baseline Study)

PARAMETERS (frequency)

Environmental data (temp, psal, nutrients: 0, 5, 10 m & bottom; CTD, Secchi disc; seasonally)
Human patogens – *Escherichia coli*, enterococci & *Vibrio cholerae* strains 01 and 0139 in seawater (seasonally) and in sediments (twice/y)
Phytoplankton – qualitative assessment: vertical & horisontal tow (seasonally)
– quantitative assessment: 0 m, 5 m, 10 m & bottom (seasonally)
Zooplankton – 1 vertical tow (seasonally)
Ichtyoplankton – 3 vertical tows (seasonally)
Dinoflagellate cysts – 4 replicates (3 fixated, 1 raw for germination; twice/y)
Mobile epifauna – traps, visual searches by divers (twice/y)
Fish community – trammel net (twice/y)
Flora & fauna along vertical transects – 3 sampling frames at 3 depths (0,5 m, 3 m, 7 m; twice/y)
Flora & fauna along horisontal transects – 3 inner and 3 outer cores (twice/y)

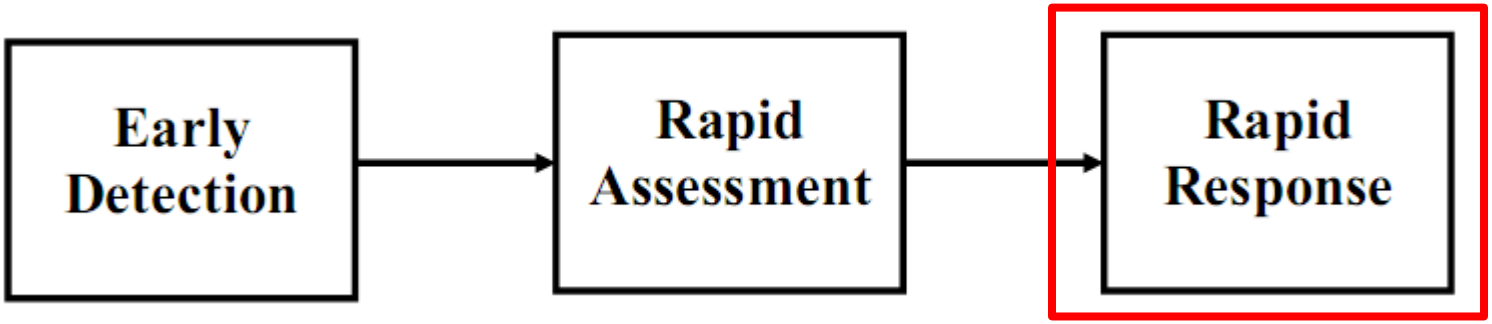
Optional parameters:
Meiofauna – 1 sampling
Circulation pattern – (geostrophic currents; seasonally)
ADCP with CTD – 1 year long (2x 6 months)


Additional stations
- abiotic parameters*
- biotic parameters
*used also for calculation of optional (physical) parameter
Port RIJEKA
LRI14 (30 m)
LRI04 (6 m)
LRI01 (6 m)
RI20A (26 m)
LBA03 (30 m)
RI008 (58 m)
BAZ14 (52 m)
BAZ11 (47 m)
BAZ12 (48 m)
RI019 (62 m)
RI011 (60 m)
RIE11 (62 m)
RIC11 (80 m)
RIB11 (56 m)
RID11 (51 m)
Rovinj
FPO42 (49 m)
Cres
FPB42 (49 m)
FPA42 (49 m)
LPU02 (4 m)
PU01 (6 m)
LPU03 (33 m)
FPO45 (10 m)
Port PULA
VV034 (48 m)
FPC42 (69 m)
ZI052 (41 m)
JPA23 (46 m)
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
© 2015 Google

CHOICE OF SAMPLING SITES

Port	Station	PORT AREA		Priority
		Commercial shipping facilities	Adjacent areas outside port	
Pula	LPU02	active berth		1
	LPU01	active berth		1
	FPO45	channel marker		1
	LPU03	nearby natural habitats		2
Rijeka	LRI01	active berth		1
	LRI04	active berth		1
	JPG28	channel marker		1
	LRI05	nearby natural habitats		2

Schematics of the basic approach against IAS introductions in the host environment



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*Remedial Actions may be envisaged when the species' impacts are classified as '**strong**'. When the detected species belongs to an impact category classified as '**medium**', we may intensify the monitoring efforts in ports and adjacent areas, while continuing routine monitoring activities will be required when species belong to the **moderate** to **low** impact category.*

*The presence of a **human pathogen** or of **indicator microbes** at concentrations above those of Regulation D-2 of the IMO BWM Convention will have to be promptly communicated to the Health Authorities.*

Response strategies and methods

Four main strategies:

Eradication is the most desirable, but often the most difficult approach. Once the establishment of an alien species is accepted as irreversible, control can be divided into **containment**, i.e., keeping species within regional barriers, and **control** in a stricter sense, i.e., suppressing population levels of alien species to below an acceptable threshold. Last option is **no action.**

Response strategies and methods

Response methods:

Mechanical control can be carried out by directly removing individuals of the target species either by hand or using tools.

Chemical treatment offers one of the few options for control of marine invasive species, although its potential is limited. Development, testing and registration of a new compound is a very expensive process, and few products are likely to be developed specifically to address environmental targets.

Biological control is the intentional use of populations of upper trophic level organisms commonly referred to as natural enemies, or naturally synthesized substances against pest species to suppress pest populations (introduction of natural enemies, augmentation of enemies, enhance populations of native predators and parasitoids).

HAB species

L=lab test; F=field test

Alexandrium minutum (L)
Alexandrium tamarense (L)
Alexandrium sp. (L)
Amphidinium carterae (L)
Aureococcus anophagefferens (L)
Chattonella subsalsa (L)
Chatonella marina (L)
Chlorella sp. (L)
Cochlodinium polykrikoides (L+F)
Eutreptiella gymnastica (L)
Gonyostomum semen (L)
Gymnodinium breve (Karenia brevis) (L)
Gymnodinium catenatum (L)
Gymnodinium sanguineum (L)
Gymnodinium spp. (L)
Heterocapsa triquetra (L)
Heterosigma akashiwo (L)
Lingulodinium polyedrum (L)
Microcystis aeruginosa (L)
Nitzschia pungens (L)
Noctiluca scintillans (L)
Prorocentrum micans (L)
Prorocentrum minimum (L)
Pseudonitzschia pungens f. *multiseries* (L)
Pseudonitzschia sp. (L)
Pyrodinium bahamense var *compressum* (L)
Pyrophacus horologium (L)
Scrippsiella trochoidea (L)
Skeletonema costatum (L)
small coccoid cyanobacterium (L)

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Gymnodinium spp. (L)
Heterocapsa triquetra (L)

Red species in the HAO list

Heterosigma akashiwo (L)
Lingulodinium polyedrum (L)
Microcystis aeruginosa (L)
Nitzschia pungens (L)
Noctiluca scintillans (L)
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Eutreptiella gymnastica (L)
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Gymnodinium catenatum (L)
Gymnodinium sanguineum (L)
Gymnodinium spp. (L)
Heterocapsa triquetra (L)

Red species in WP6.3 list of HAO

Red species with available mitigation measure

Heterosigma akashiwo (L)
Lingulodinium polyedrum (L)
Microcystis aeruginosa (L)
Nitzschia pungens (L)
Noctiluca scintillans (L)
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small coccoid cyanobacterium (L)

HAB species

Cochlodinium polykrikoides **(L+F)**

Chemical method – sophorolipid-yellow clay mixture with removal efficiency of 95 % after 30 minutes in field test

(sophorolipid = biosurfactant produced by yeast *Candida bombicola)*

→ can be applied on other HAB

Clay scattering on the area affected by HABs in Korea.

MACROPHYTES (8 species)

Ascophyllum nodosum (F) - mechanical (physically removed, successful eradication)

Caulerpa taxifolia *(L+F)*

- mechanical (pumping, limited success, effecting non-target organisms)
- chemical
  - chlorine – successful, effecting non-target organisms
  - copper – poor efficacy
  - freshwater – fair efficacy

CNIDARIA – jellyfish

Mechanical methods – using Pelican boats (400 removed in a day)

Physical destruction – cutting nets use (jellyfish are transported by currents and pushed against these nets and get destroyed then)

Chemical methods *in research* – for polyps destruction (stages which are „seeds" for jellyfish blooms: active substances which induce resistance in target species, impacting also potential predator

Biological methods – intoduction of predator, e.g., ctenophore *Beroe ovata* to control *Mnemiopsis leidyi* (becoming pest itself), butterfish *Peprilus triacanthus* (good results) – altering ecosystem

Robot – *jellyfish terminator* suck up specimens into submerged nets

FISH

Mechanical methods – selective removal by electric fishing and netting methods, successive in suppressing abundance and reducing recruitment

Biological methods – intoduction of natural predator

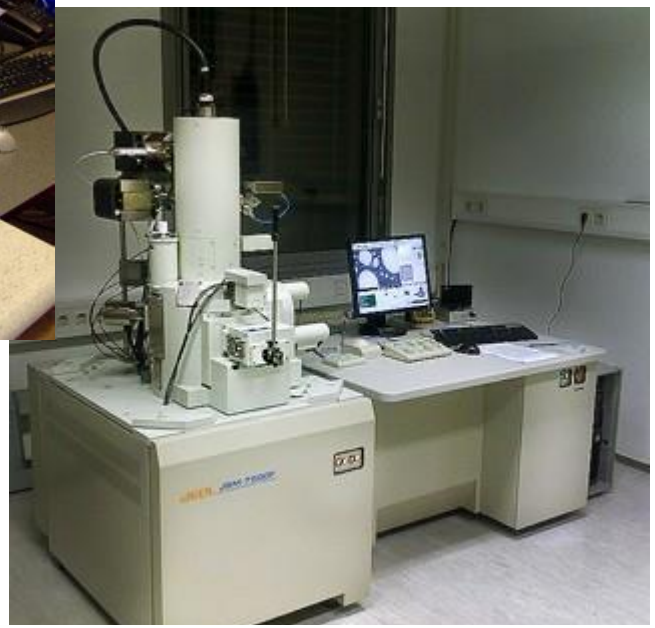
Chemical methods *in research* – pheromones which mediate social behaviour (anti-predator, social and reproductive impacts)

Port	SAMPLES	Date	Station	*E. coli* <250/100mL	Enterococci <100/100mL	*Vibrio cholerae* strain 01	*Vibrio cholerae* strain 0139	Detected species (*Vibrio* = *V.*, *Aeromonas* = *A.*)	Compliance with Croatian legal regulations for BW
Pula	Seawater	9.9.2014	LPU01	61	390	<1	<1	*V. parahaemolyticus* and *V. alginolyticus*	NO
			LPU02	0	4	<1	<1	*V. parahaemolyticus* and *V. alginolyticus*	YES
			LPU03	0	0	<1	<1	*V. alginolyticus*	YES
			FP045	0	14	<1	<1	*V. parahaemolyticus* and *V. alginolyticus*	YES
	Seawater	18.12.2014.	LPU01	454	1540	<1	<1	*V. alginolyticus* (52/100 mL)	NO
			LPU02	0	226	<1	<1	*V. alginolyticus* (3/100 mL)	NO
			LPU03	0	126	<1	<1	*V. alginolyticus* (1/100 mL)	NO
			FP045	0	216	<1	<1		NO
	Sediment	19.12.2014	LPU01	<1	1	<1	<1		Regulative for sediment in Croatia is missing
			LPU02	<1	4	<1	<1	*Vibrio alginolyticus* or *V. metschnikovii*	
			LPU03	<1	<1	<1	<1		
			FP045	<1	<1	<1	<1		
	Seawater	11.2.2015.	LPU01	372	660	<1	<1		NO
			LPU02	172	192	<1	<1		NO
			LPU03	4	15	<1	<1		YES
			FP045	228	276	<1	<1		NO
Rijeka	Seawater	10.9.2014	LRI05	8500	2500	<1	<1	*V. alginolyticus*	NO
			LRI01	400	1100	<1	<1		NO
		11.9.2014	JPG28	28	7	<1	<1	*V. fluvialis*	YES
			LRI04	1400	600	<1	<1	*V. cholerae* non-O1/non-O139	NO
	Seawater	19.12.2014	LRI05	9	14	<1	<1		NO
			LRI01	14500	2600	<1	<1	*Vibrio metschnikovii*	NO
		20.12.2014	JPG28	350	97	<1	<1	*Aeromonas hydrophilla*	NO
			LRI04	1800	560	<1	<1	*Aeromonas hydrophilla*	NO
	Sediment	19.12.2014	LRI05	<1	<1	<1	<1		Regulative for sediment in Croatia is missing
		20.12.2014	LRI01	1	4	<1	<1		
			LRI04	5	28	<1	<1		
	Seawater	12.02.2015.	LRI05	460	160	<1	<1		NO
			LRI01	13000	3200	<1	<1	*Aeromonas hydrophilla*	NO
		13.02.2015.	JPG28	410	100	<1	<1		NO
			LRI04	7500	1800	<1	<1		NO

Light microscopy

Microscope

Electrone microscopy



The project is co-funded by the European Union
Instrument for Pre-Accession Assistance

Sampling of phytoplankton by vertical tow with plankton net in Port Pula

Phytoplankton species observed in vertical and horisontal net

Pula & Rijeka on white
Pula only on yellow
Rijeka only on cyan
Species categorised as strongly relevant (WP6.3) on grey

Phylum CHRYSOPHYTA

Class Chrysophyceae

Dictyocha fibula Ehrenberg

Dictyocha octonaria Ehrenberg

Dictyocha speculum Ehrenberg

Meringosphaera mediterranea Lohmann

Class Prymnesiophyceae (sin. Haptophyceae)

Cocco sp.

Anaplosolenia brasiliensis (Lohman) Deflandre

Calciopappus caudatus K.R.Gaarder & Ramsfjell

Calciosolenia murray Gran

Rhabdosphaera tignifera Schiller

Syracosphaera pulchra Lohmann

Class Bacillariophyceae (sin. Diatomeae)

Amphora sp.

Asteromphalus heptactis (Brébisson) Ralfs

Bacteriastrum biconicum Pavillard

Bacteriastrum delicatulum Cleve

Bacteriastrum furcatum Shadbolt

Bacteriastrum hyalinum Lauder

Bacteriastrum jadranum Godrijan, Maric & Phannkuchen

Bacteriastrum mediteraneum Pavillard

Bacteriastrum sp.

Bleakeleya notata (Grunow) Round

Cerataulina pelagica (Cleve) Hendey

Chaetoceros affinis Lauder

Chaetoceros anastomosans Grunow

Chaetoceros borealis Bailey

Chaetoceros brevis Schütt

Chaetoceros circinalis (Meunier) K.G. Jensen & Moestrup

Chaetoceros compressus Lauder

Chaetoceros constrictus Gran

Chaetoceros contortus F.Schütt

Chaetoceros curvisetus Cleve

Chaetoceros costatus Pavillard

Chaetoceros danicus Cleve

Chaetoceros decipiens Cleve

Chaetoceros didymus Ehrenberg

Chaetoceros diversus Cleve

Chaetoceros gibenii Grunow

Chaetoceros lauderi Ralfs

Chaetoceros messanensis Castracane

Chaetoceros peruvianus Brightwell

Chaetoceros pseudocurvisetus Mangin

Chaetoceros rostratus Lauder

Chaetoceros sp.

Chaetoceros socialis Lauder

Chaetoceros simplex Ostenfeld

Chaetoceros tenuissimus Meuiner

Chaetoceros tortissimus Gran

Cyclotella sp.

Cylindrotheca closterium (Ehrenberg) Reimann et Lewin

Cylindrotheca fusiformis Reimann & J.C.Lewin

Dactyliosolen fragilissimus (Bergon) Hasle

Dactyliosolen mediterraneus (Peragallo) Peragallo

Dactylosolen phuketensis (B.G.Sundström) G.R.Hasle

Detonula pumila (Castracane) Gran

Entomoneis pulchra (Bailey) Reimer

Eucampia cornuta (Cleve) Grunow

Guinardia flaccida (Castracane) Peragallo

Guinardia striata (Stolterfoth) Hasle

Hemiaulus hauckii Grunow

Hemiaulus sinensis Greville

Leptocylindrus danicus Cleve

Leptocylindrus mediterraneus Peragallo

Leptocylindrus minimus Gran

Leptocylindrus sp.

Licmophora sp.

Lioloma pacificum (Cupp) Hasle

Neocalyptrella robusta (Norman ex Ralfs) Hernández-Becerril et Meave del Castillo

Nitzschia longissima (Breb.) Ralfs in Pritch.

Nitzschia sigma (Kützing) W. Smith

Nitzchia sp.

Penate sp.

Pleurosigma sp.

Proboscia alata (Brightwell) Sundström

***Pseudo-nitzschia delicatissima* (Cleve) Heiden (SEM)**

***Pseudo-nitzschia fraudulenta* (Cleve) H.Peragallo**

***Pseudo-nitzschia* spp.**

Pseudosolenia calcar-avis (Schultze) Sundström

Rhizosolenia imbricata Brightwell

Rhizosolenia styliformis Brightwell

Skeletonema sp.

Tabellaria fenestrata (Lyngbye) Kützing

Thalassionema nitzschioides (Grunow) Mereschkowsky

Thalasiosira sp.

Phylum DINOPHYTA

Class Desmophyceae

Prorocentrum compressum (Bailey) Abé ex Dodge

***Prorocentrum micans* Ehrenberg**

Prorocentrum minimum (Pavillard) Schiller

Prorocentrum triestinum Schiller

Class Dinophyceae

***Alexandrium* sp.**

Ceratium arietinum Cleve

Ceratium candelabrum (Ehrenberg) Stein

Ceratium furca (Ehrenberg) Claparède et Lachmann

Ceratium fusus (Ehrenberg) Dujardin

Ceratium hexacanthum Gourret

Ceratium horridum (Cleve) Gran

Ceratium kofoidii Jörgensen

Ceratium macroceras Schrank

Ceratium macroceros (Ehrenberg) Vanhöffen

Ceratium massiliense (Gourret) Jorgensen

Ceratium minutum Jörgensen

Ceratium pulchellum Schröder

Ceratium setaceum Jörgensen

Ceratium sp.

Ceratium trichoceros (Ehrenberg) Kofoid

***Dinophysis caudata* Seville-Kent**

***Dinophysis fortii* Pavillard**

***Dinophysis tripos* Gourret**

Diplopsalis complex

Gonyaulax sp.

***Gonyaulax spinifera* (Claparède et Lachmann) Diesing**

Gymnodinium cucumis Schütt

Gymnodinium sp.

***Ostreopsis ovata* Fukuyo**

Oxytoxum sceptrum (F. Stein) Schröder

Oxytoxum sphaeroideum Stein

Protoperidinium brochii (Kofoid et Swezy) Balech

Protoperidinium depressum (Bailey) Balech

Protoperidinium diabolus (Cleve) Balech

Protoperidinium divergens (Ehrenberg) Balech

Protoperidinium fatulipes (Kofoid) Balech

Protoperidinium globulum (Stein) Balech

Protoperidinium oceanicum (VanHöffen) Balech

Protoperidinium ovum (Schiller) Balech

Protoperidinium pedunculatum (Schütt) Balech

Protoperidinium sp.

Protoperidinium steinii (Joergensen) Balech

Protoperidinium tubum (Schiller) Balech

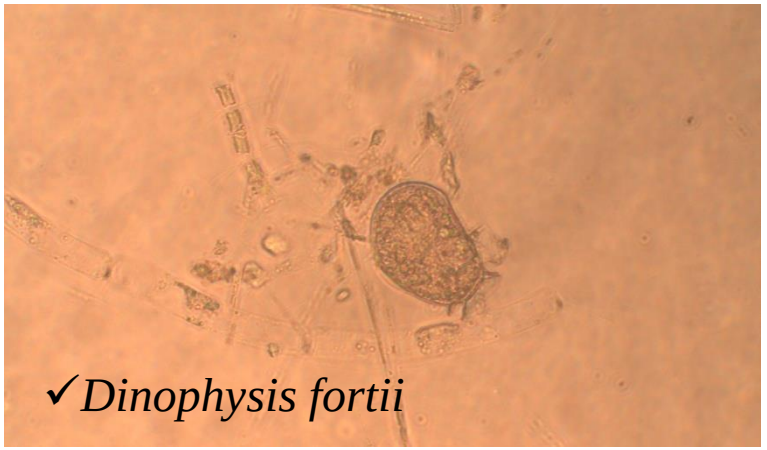
Pseliodinium vaubanii Sournia

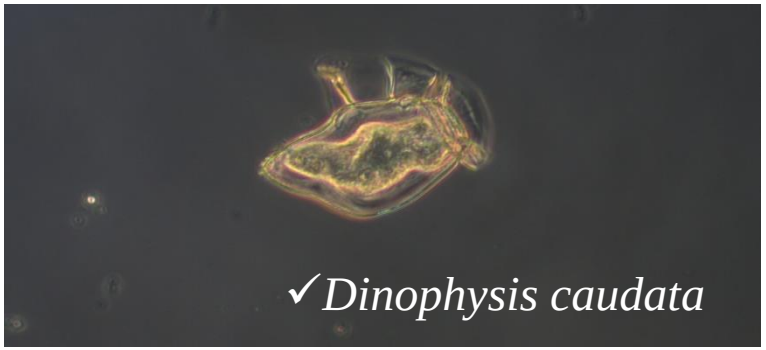
Pyrophacus horologicum Stein

Pyrophacus sp.

Scrippsiella sp.

- ✓ *Pseudo-nitzschia delicatissima* (SEM)
- ✓ *Pseudo-nitzschia fraudulenta* (SEM)
- ✓ *Pseudo-nitzschia* spp.
- ✓ *Prorocentrum micans*
- ✓ *Alexandrium* sp.
- ✓ *Dinophysis caudata*
- ✓ *Dinophysis fortii*
- ✓ *Dinophysis tripos*
- ✓ *Gonyaulax spinifera*
- ✓ *Ostreopsis ovata*





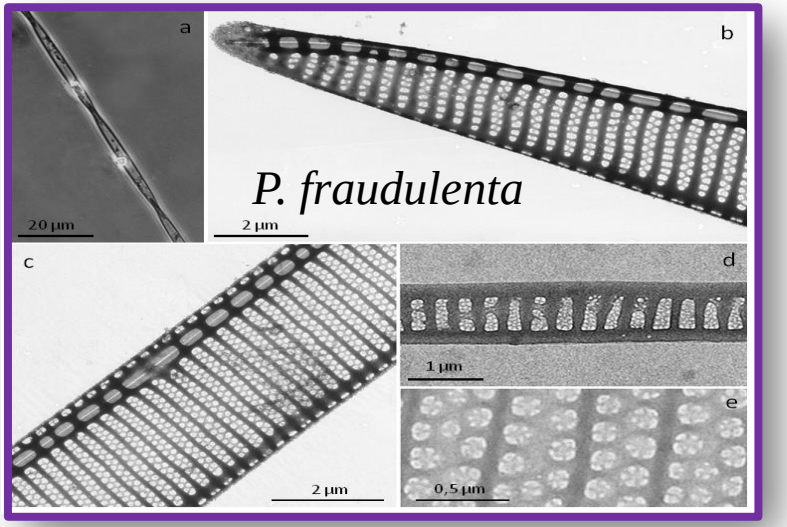
Phytoplankton species observed in ports Pula and/or Rijeka in summer samples & categorised as strongly relevant

- ✓ *Pseudo-nitzschia delicatissima* (SEM)
- ✓ *Pseudo-nitzschia fraudulenta* (SEM)
- ✓ *Pseudo-nitzschia* spp.
- ✓ *Prorocentrum micans*
- ✓ *Alexandrium* sp.
- ✓ *Dinophysis caudata*
- ✓ *Dinophysis fortii*
- ✓ *Dinophysis tripos*
- ✓ *Gonyaulax spinifera*
- ✓ *Ostreopsis ovata*

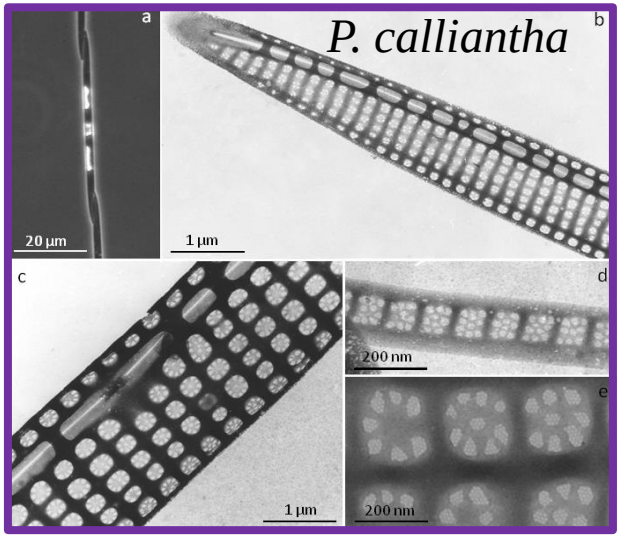
List of *Alexandrium* and *Pseudo-nitzschia* species categorised as strongly relevant in the list

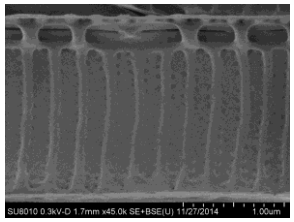
- *Alexandrium acatenella*
- *Alexandrium andersonii*
- *Alexandrium balechii*
- *Alexandrium catenella*
- *Alexandrium cohorticula*
- *Alexandrium fundyense*
- *Alexandrium hiranoi*
- *Alexandrium minutum*
- *Alexandrium monilatum*
- *Alexandrium ostenfeldii*
- *Alexandrium pseudogonyaulax*
- *Alexandrium tamarense*
- *Alexandrium tamiyavanichii*
- *Alexandrium taylori*

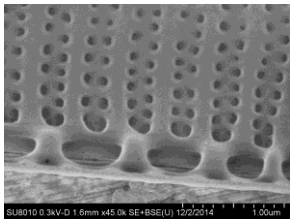
- ❖ *Pseudo-nitzschia australis*
- ❖ *Pseudo-nitzschia calliantha*
- ❖ *Pseudo-nitzschia cuspidata*
- ❖ *Pseudo-nitzschia delicatissima*
- ❖ *Pseudo-nitzschia fraudulenta*
- ❖ *Pseudo-nitzschia galaxiae*
- ❖ *Pseudo-nitzschia multiseries*
- ❖ *Pseudo-nitzschia multistriata*
- ❖ *Pseudo-nitzschia pseudodelicatissima*
- ❖ *Pseudo-nitzschia pungens*
- ❖ *Pseudo-nitzschia seriata*
- ❖ *Pseudo-nitzschia turgidula*

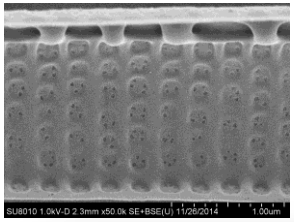


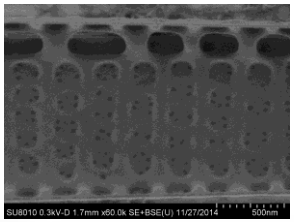
Pseudo-nitzschia spp.

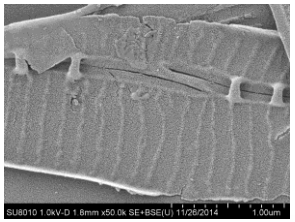


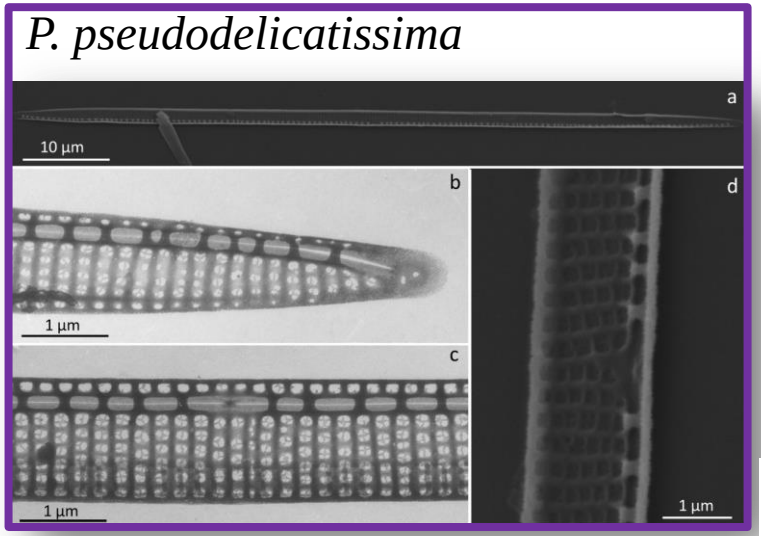


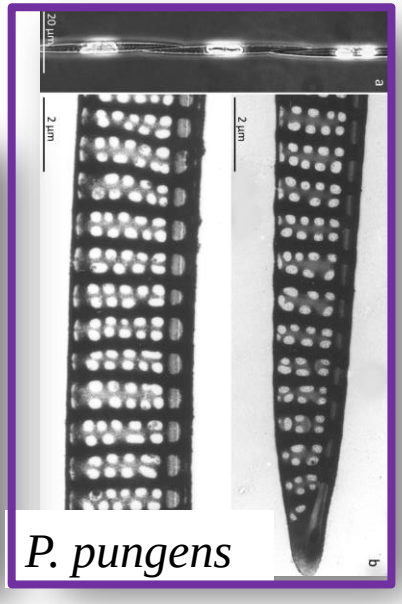


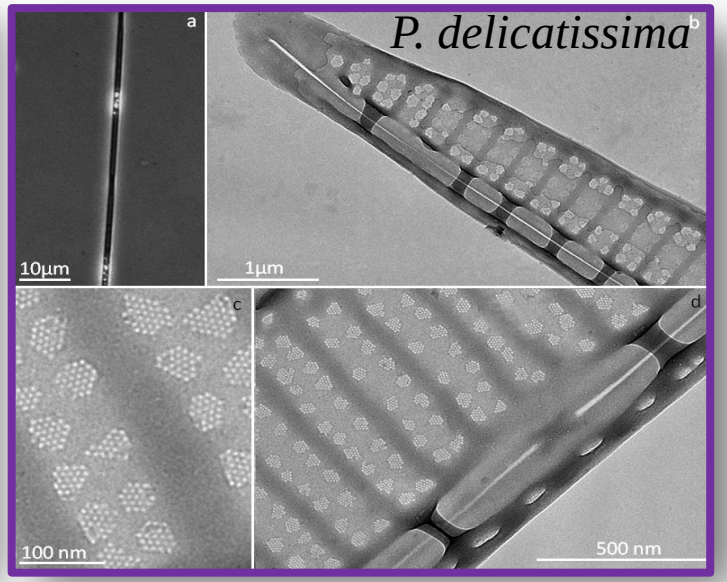






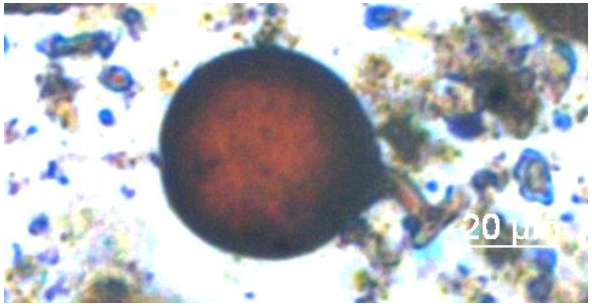




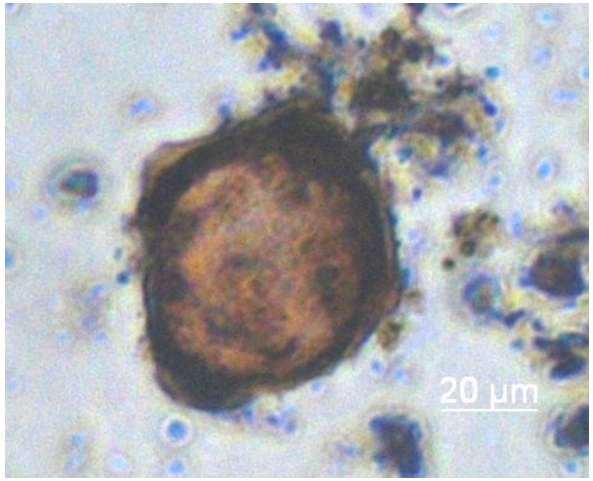


Dinoflagellate cysts observed during Rijeka PBS in 2011 (species identification has to be confirmed)

Rijeka

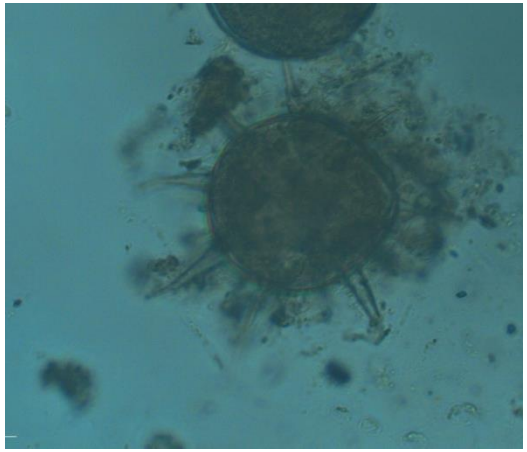


***Gymnodinium catenatum* H. W. Graham**

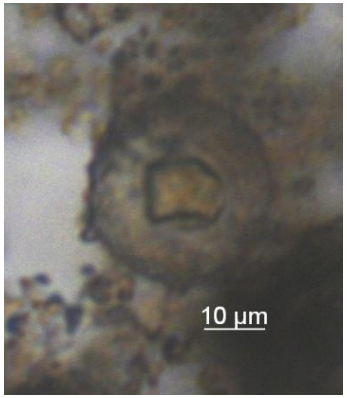


***Protoperidinium americanum* (Gran & Braarud) Balech**

Other ports in Kvarner Bay

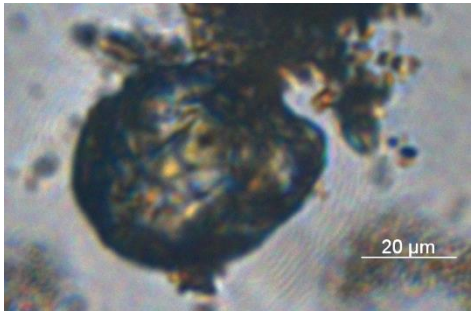


***Linguloidinium polyedrum* (F. Stein) J. D. Dodge**



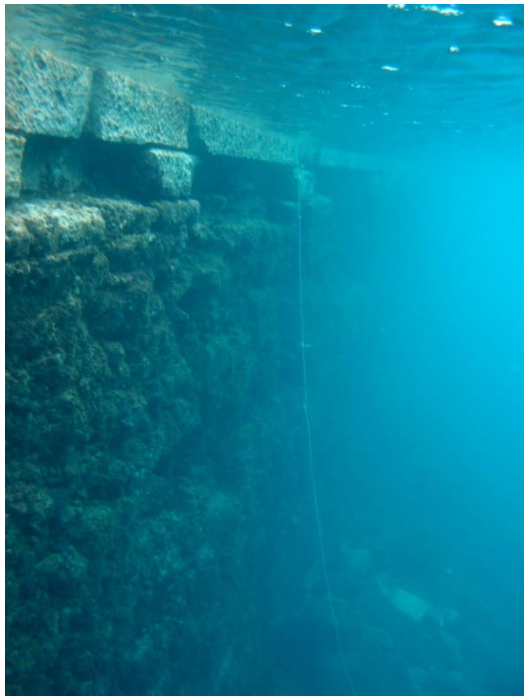
***Protoperidinium conicoides* (Paulsen) Balech**

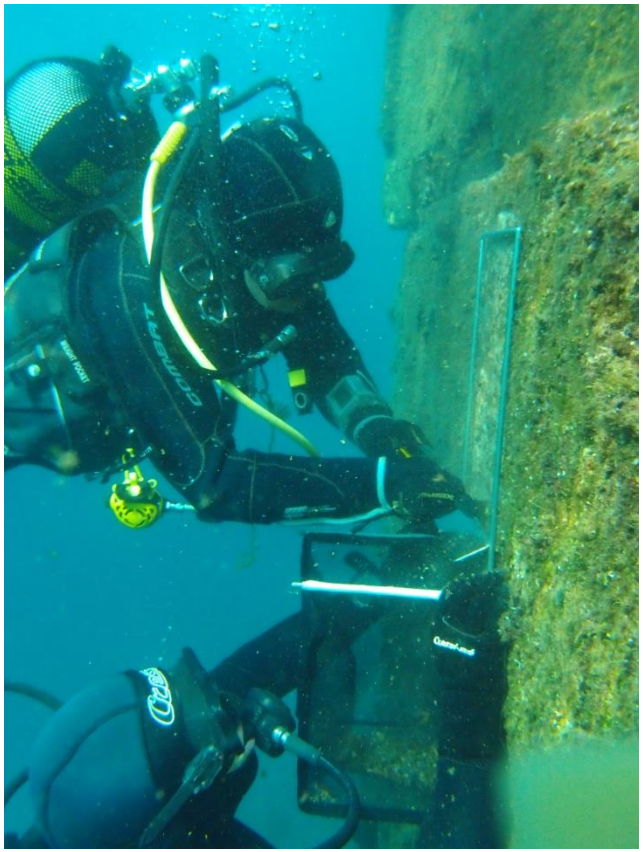
***Protoperidinium minutum* (Kofoid) Loeblich III**

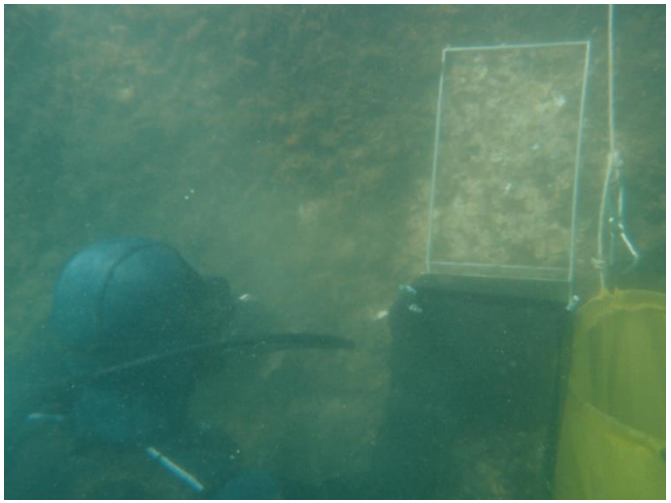


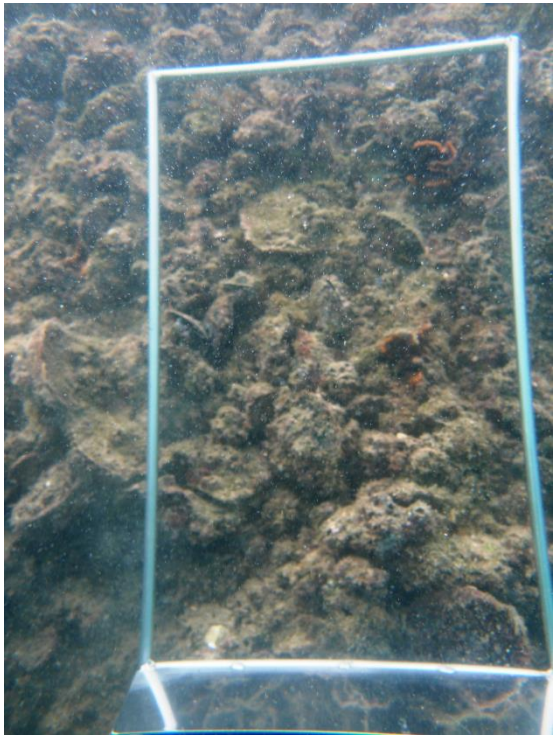
***Scrippsiella cristallina* J. Lewis**

Sampling flora and fauna from the vertical transect

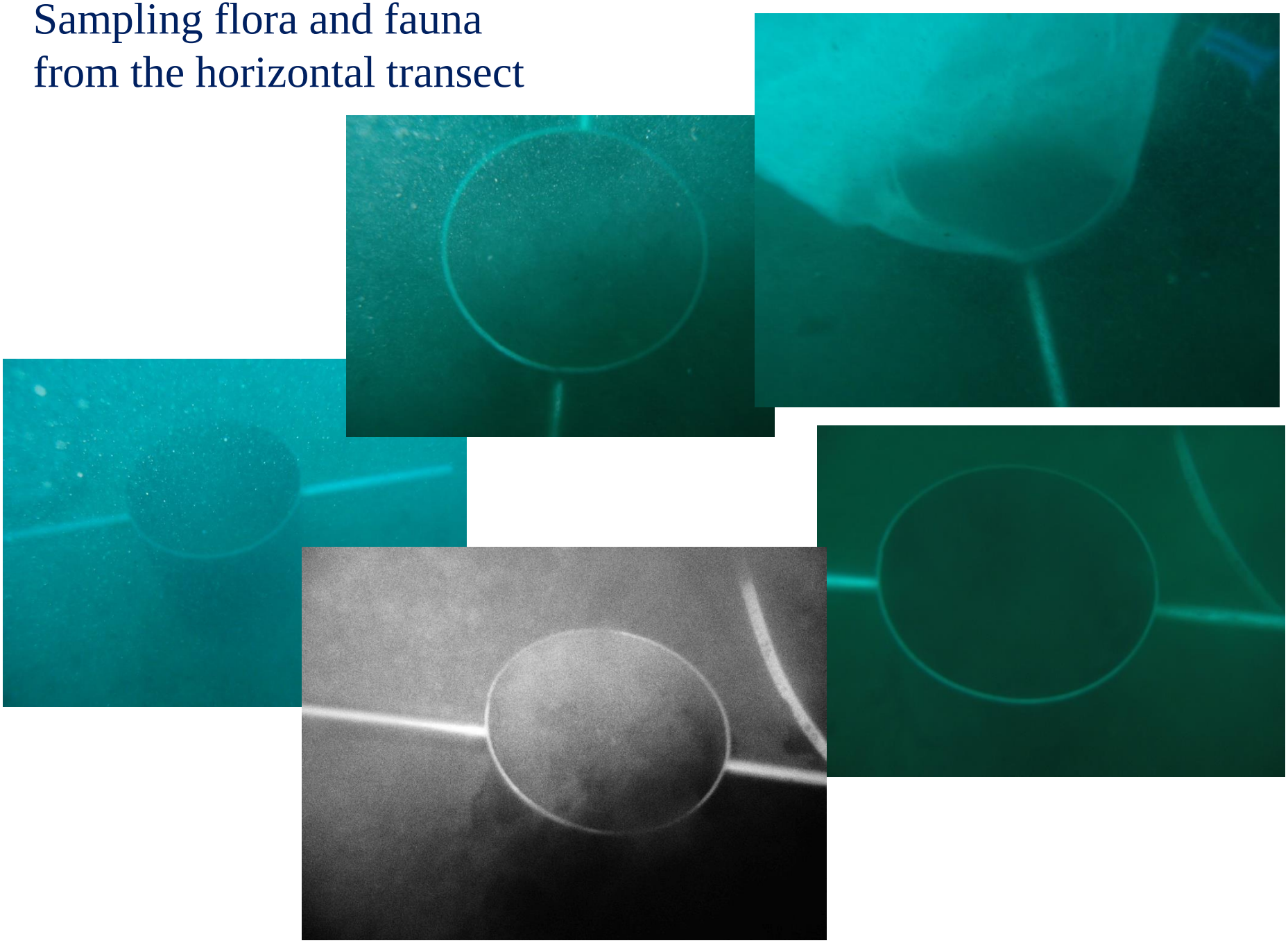








Sampling flora and fauna from the horizontal transect



Working hours for separation flora & fauna at H&V transects

Station	Samples processed / n	Sampling time
LPU02	7/12	1 morning
LPU01	3/12	1 morning
LPU03	3/9	1 morning
LRI01	3/12	1 morning
LRI04	3/12	1 morning
LRI05	3/9	1 morning

Sampling time for 2 ports, autumnal samples: 6 mornings

Working hours for separation flora & fauna at H&V transects

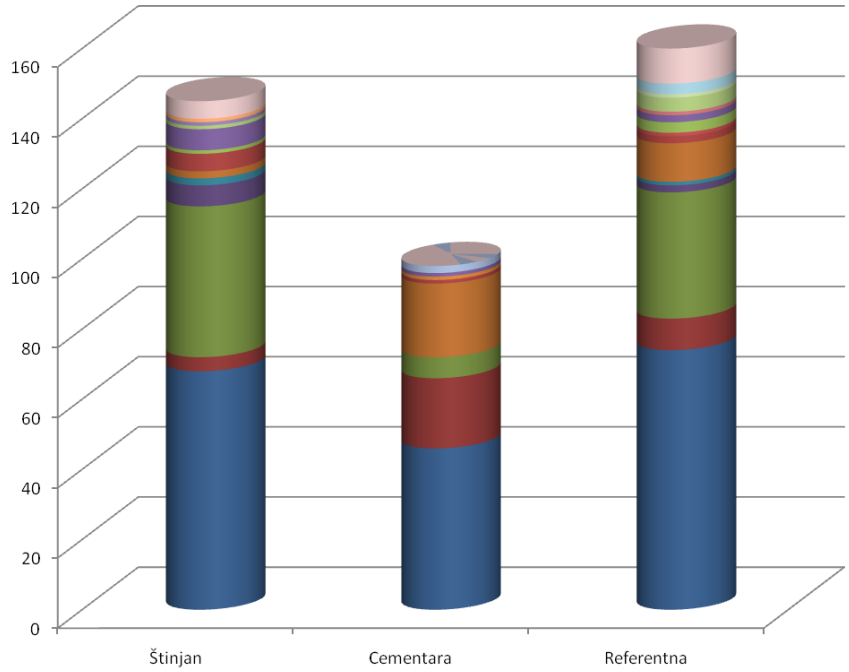
Station	Samples processed / n	Sampling time	Separation from detritus
LPU02	7/12	1 morning	Several hours
LPU01	3/12	1 morning	Several hours
LPU03	3/9	1 morning	Several hours
LRI01	3/12	1 morning	Several hours
LRI04	3/12	1 morning	Several hours
LRI05	3/9	1 morning	Several hours

Sampling time for 2 ports, autumnal samples: 6 working days

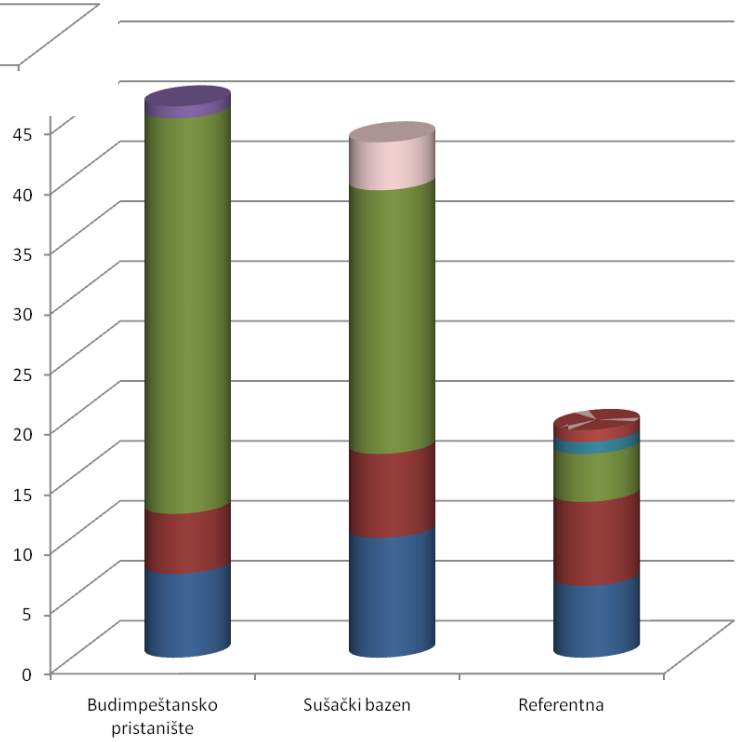
Working hours for separation flora & fauna at H&V transects

Flora & fauna along horisontal transects
3 inner and 3 outer cores (twice/y)
separation time for 2 ports, autumnal samples: 2 months

Flora & fauna along vertical transects
3 sampling frames at 3 depths (0,5 m, 3 m, 7 m; twice/y)
separation time for 2 ports, autumnal samples: 6 months

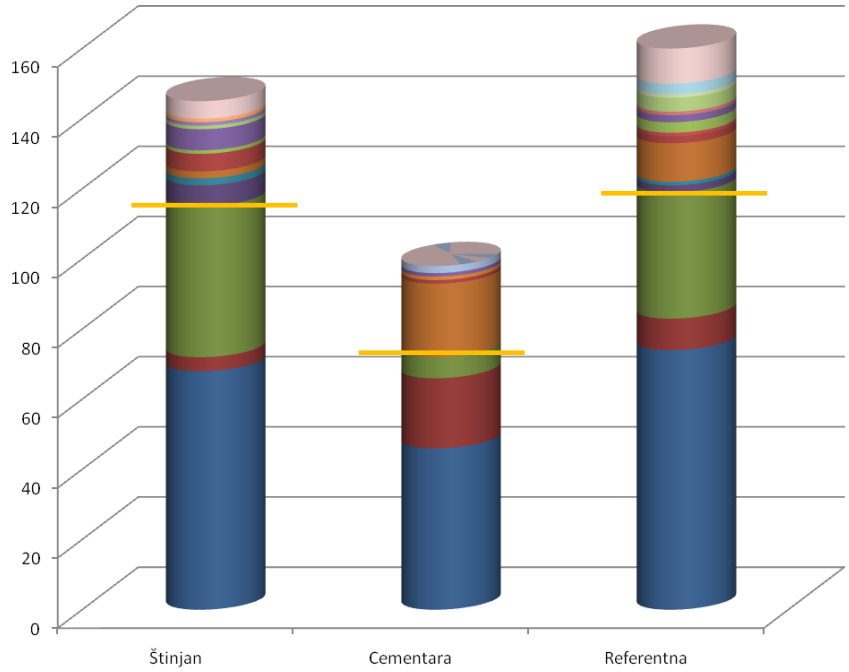


LPU02 LPU01 LPU03

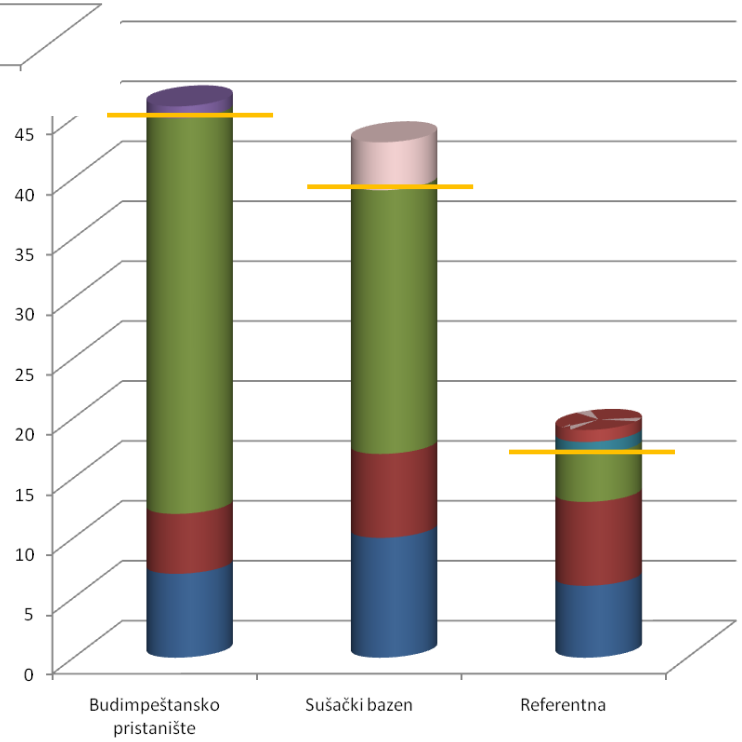


LRI01 LRI04 LRI05

Varia indet.
Polyplacophora
Anthozoa
Cirripedia
Euphausiacea
Echinoidea
Isopoda
Porifera
Sipuncula
Tanaidacea
Cumacea
Holothuroidea
Amphipoda
Decapoda
Ophiuroidea
Scaphopoda
Bivalvia
Gastropoda
Polychaeta



LPU02 LPU01 LPU03



LRI01 LRI04 LRI05

Taxon observed TAXON FB11 expert +

Taxon NOT observed TAXON FB11 expert -

Taxon/Impact		strong	medium	low	absent	unknown	total
	FORAMINIFERA	-	-	2	-	-	2
1	PORIFERA	-	-	1	-	-	1
2	CNIDARIA	19	2	1	-	12	34
	CTENOPHORA	1	-	-	-	-	1
3	GASTROPODA	-	2	8	-	1	11
	BIVALVIA	1	1	9	1	8	20
	CEPHALOPODA	-	-	-	-	1	1
4	POLYCHAETA	-	3	15	-	14	32
5	COPEPODA	-	1	1	-	1	3
	DECAPODA	-	1	11	-	5	17
	AMPHIPODA	-	-	-	1	4	5
	ISPOPODA	-	-	-	-	1	1
	TANAIDACEA	-	-	-	-	1	1
	MYSIDACEA	-	-	-	-	1	1
	STOMATOPODA	-	-	1	-	-	1
	PYCNOGONIDA	-	-	1	-	1	2
6	BRYOZOA	-	-	1	-	1	2
7	ECHINODERMATA	-	-	1	-	1	2
	ASCIDIACEA	-	2	3	-	2	7
	TOTAL	**21**	**12**	**55**	**2**	**54**	**144**

	Taxon/Impact	strong	medium	low	absent	unknown	total
	FORAMINIFERA	-	-	2	-	-	2
1	PORIFERA	-	-	1	-	-	1
2	CNIDARIA	19	2	1	-	12	34
	CTENOPHORA	1	-	-	-	-	1
3	GASTROPODA	-	2	8	-	1	11
	BIVALVIA	1	1	9	1	8	20
	CEPHALOPODA	-	-	-	-	1	1
4	POLYCHAETA	-	3	15	-	14	32
5	COPEPODA	-	1	1	-	1	3
	DECAPODA	-	1	11	-	5	17
	AMPHIPODA	-	-	-	1	4	5
	ISPOPODA	-	-	-	-	1	1
	TANAIDACEA	-	-	-	-	1	1
	MYSIDACEA	-	-	-	-	1	1
	STOMATOPODA	-	-	1	-	-	1
	PYCNOGONIDA	-	-	1	-	1	2
6	BRYOZOA	-	-	1	-	1	2
7	ECHINODERMATA	-	-	1	-	1	2
	ASCIDIACEA	-	2	3	-	2	7
	TOTAL	21	12	55	2	54	144

PULA

Gastropoda (8)

Antalis dentalis
Fustiaria rubescens
Calyptraea chinensis
Hyala vitrea
Natica dillwynii
Nassarius incrassatus
Nassarius reticulatus
Turritella communis

RIJEKA

Gastropoda (10)

Acteon tornatilis
Alvania discors
Bela fuscata
Bittium reticulatum
Crisilla depicta
Epitonium clathrus
Gibbula adansoni
Nassarius incrassatus
Raphitoma linearis
Runcina sp.

PULA & RIJEKA

Gastropoda (17)

Acteon tornatilis
Alvania discors
Antalis dentalis
Bela fuscata
Bittium reticulatum
Calyptraea chinensis
Crisilla depicta
Epitonium clathrus
Fustiaria rubescens
Gibbula adansoni
Hyala vitrea
Nassarius incrassatus
Nassarius reticulatus
Natica dillwynii
Raphitoma linearis
Runcina sp.
Turritella communis

List of harmful aquatic organisms relevant for warning ships and environmental authorities:

Pintada radiata

	Taxon/Impact	strong	medium	low	absent	unknown	total
	FORAMINIFERA	-	-	2	-	-	2
1	PORIFERA	-	-	1	-	-	1
2	CNIDARIA	19	2	1	-	12	34
	CTENOPHORA	1	-	-	-	-	1
3	GASTROPODA	-	2	8	-	1	11
	BIVALVIA	1	1	9	1	8	20
	CEPHALOPODA	-	-	-	-	1	1
4	POLYCHAETA	-	3	15	-	14	32
5	COPEPODA	-	1	1	-	1	3
	DECAPODA	-	1	11	-	5	17
	AMPHIPODA	-	-	-	1	4	5
	ISPOPODA	-	-	-	-	1	1
	TANAIDACEA	-	-	-	-	1	1
	MYSIDACEA	-	-	-	-	1	1
	STOMATOPODA	-	-	1	-	-	1
	PYCNOGONIDA	-	-	1	-	1	2
6	BRYOZOA	-	-	1	-	1	2
7	ECHINODERMATA	-	-	1	-	1	2
	ASCIDIACEA	-	2	3	-	2	7
	TOTAL	21	12	55	2	54	144

PULA
Bivalvia (13)

Acanthocardia deshayesii
Axinulus croulinensis
Corbula gibba
Dosinia lupinus
Gari fervensis
Kurtiella bidentata
Mysia undata
Pitar rudis
Plagiocardium papillosum
Tapes (Tapes) rhomboides
Tellina distorta
Tellina donacina
Thyasira fexuosa

RIJEKA
Bivalvia (45)

Abra alba
Abra nitida
Abra tenuis
Acanthocardia echinata
Acanthocardia sp.
Anomia ephippium
Axinulus croulinensis
Azorinus chamasolen
Bornia sebetia
Bryopa aperta
Clausinella fasciata
Corbula gibba
Flexopecten hyalinus
Gari fervensis
Gouldia minima
Hiatella arctica
Hiatella rugosa
Kellia suborbicularis
Kurtiella bidentata
Laevicardium crassum
Laevicardium oblongum
Loripes lacteus
Lucinoma borealis
Modiolarca subpicta
Modiolus barbatus
Myrtea spinifera
Mysia undata
Mytilus galloprovincialis
Nucula nitidosa
Nuculana illirica
Nuculana pella
Parvicardium ovale
Phaxas pellucidus
Pitar rudis
Plagiocardium papillosum
Pseudochama gryphina
Rocellaria dubia
Saxicavella jeffreysi
Sphenia binghami
Tapes (Tapes) rhomboides
Tellina distorta
Tellina donacina
Tellina serrata
Thyasira fexuosa
Timoclea ovata

PULA & RIJEKA
Bivalvia (49)

Acanthocardia deshayesii
Abra alba
Abra nitida
Abra tenuis
Acanthocardia echinata
Acanthocardia sp.
Anomia ephippium
Axinulus croulinensis
Azorinus chamasolen
Bornia sebetia
Bryopa aperta
Clausinella fasciata
Corbula gibba
Corbula gibba
Dosinia lupinus
Flexopecten hyalinus
Gari fervensis
Gouldia minima
Hiatella arctica
Hiatella rugosa
Kellia suborbicularis
Kurtiella bidentata
Laevicardium crassum
Laevicardium oblongum
Loripes lacteus
Lucinoma borealis
Modiolarca subpicta
Modiolus barbatus
Myrtea spinifera
Mysia undata
Mytilus galloprovincialis
Nucula nitidosa
Nuculana illirica
Nuculana pella
Parvicardium ovale
Phaxas pellucidus
Pitar rudis
Plagiocardium papillosum
Pseudochama gryphina
Rocellaria dubia
Saxicavella jeffreysi
Sphenia binghami
Tapes (Tapes) rhomboides
Tellina distorta
Tellina donacina
Tellina donacina
Tellina serrata
Thyasira fexuosa
Timoclea ovata

List of harmful aquatic organisms relevant for warning ships and environmental authorities:

Hydroides dianthus
Hydroides elegans
Leiochrides australis

Not on List: *Phycopomatus enigmaticus*

	Taxon/Impact	strong	medium	low	absent	unknown	total
	FORAMINIFERA	-	-	2	-	-	2
1	PORIFERA	-	-	1	-	-	1
2	CNIDARIA	19	2	1	-	12	34
	CTENOPHORA	1	-	-	-	-	1
3	GASTROPODA	-	2	8	-	1	11
	BIVALVIA	1	1	9	1	8	20
	CEPHALOPODA	-	-	-	-	1	1
4	POLYCHAETA	-	3	15	-	14	32
5	COPEPODA	-	1	1	-	1	3
	DECAPODA	-	1	11	-	5	17
	AMPHIPODA	-	-	-	1	4	5
	ISPOPODA	-	-	-	-	1	1
	TANAIDACEA	-	-	-	-	1	1
	MYSIDACEA	-	-	-	-	1	1
	STOMATOPODA	-	-	1	-	-	1
	PYCNOGONIDA	-	-	1	-	1	2
6	BRYOZOA	-	-	1	-	1	2
7	ECHINODERMATA	-	-	1	-	1	2
	ASCIDIACEA	-	2	3	-	2	7
	TOTAL	21	12	55	2	54	144

PULA
Polychaeta (63)

Ampharete acutifrons
Amphitrite cf. *variabilis*
Amphitritides gracilis
Aonides oxycephala
Aphelochaeta marioni
Aponuphis grubii
Aricidea sp.
Brada villosa
Chaetozone setosa
Clymenura sp.
Dipolydora flava
Dipolydora giardi
Eteone longa
Euclymene lumbricoides
Euclymene oerstedii
Euclymene palermitana
Euclymene sp.
Eunice vittata
Exogone sp.
Galathowenia oculata
Gallardoneris sp.
Glycera unicornis
Harmothoe antilopes
Hilbigneris gracilis
Laonice cirrata
Lumbrineris coccinea
Magelona minuta
Malmgreniella darbouxi
Marphysa sanguinea
Megalomma sp.
Mellina palmata
Micronephthys stammeri
Nematonereis unicornis
Notomastus latericeus
Notomastus sp.
Ophiodromus flexuosus
Owenia fusiformis
Paraehlersia ferrugina
Pectinaria auricoma
Pectinaria koreni
Pherusa plumosa
Phyllodoce lineata
Phyllodoce sp.
Pilargis verrucosa
Pista cristata
Podarkeopsis arenicolus
Poecilochaetus fauchaldi
Polycirrus medusa
Polycirrus sp.
Praxillella affinis
Prionospio cirrifera
Prionospio malmgreni
Pseudopolydora paucibranchiata
Sabellaria spinulosa
Scolelepis tridentata
Scoletoma impatiens
Sigambra tentaculata
Spiochaetopterus costarum
Spiophanes bombyx
Spiophanes kroyeri
Sternaspis scutata
Syllis garciai
Terebellides stroemi

RIJEKA
Polychaeta (48)

Ampharete lindstroemi
Aricidea sp.
Armandia cirrhosa
Autolytus sp.
Caulleriella killariensis
Ceratonereis hirconicola
Chaetozone carpenteri
Ditrupa arietina
Dodecaceria concharum
Euclymene oerstedii
Eunice vittata
Galathowenia oculata
Glycera alba
Glycera unicornis
Heteromastus filiformis
Hydroides helmatus
Hydroides pseudouncinatus pseudouncinatus
Lepidonotus clava
Levinsenia gracilis
Lysidice ninetta
Lysidice sp.
Marphysa bellii
Mellina palmata
Monticellina dorsobranchialis
Nephthys hystricis
Nephthys incisa
Nereis perivisceralis
Nereis pulsatoria
Nereis rava
Perinereis cultrifera
Platynereis dumerilii
Platynereis nadiae
Polyophthalmus pictus
Pomatoceros triqueter
Scoletoma fragilis
Scoletoma impatiens
Serpula concharum
Serpula vermicularis
Sternaspis scutata
Syllis armillaris
Syllis garciai
Syllis gerlachi
Syllis gracilis
Syllis rosea
Terebellides stroemii
Thelepus cincinnatus
Vermiliopsis infundibulum
Vermiliopsis striaticeps

PULA & RIJEKA
Polychaeta (103)

Ampharete acutifrons
Ampharete lindstroemi
Amphitrite cf. *variabilis*
Amphitritides gracilis
Aonides oxycephala
Aphelochaeta marioni
Aponuphis grubii
Aricidea sp.
Aricidea sp.
Armandia cirrhosa
Autolytus sp.
Brada villosa
Caulleriella killariensis
Ceratonereis hirconicola
Chaetozone carpenteri
Chaetozone setosa
Clymenura sp.
Dipolydora flava
Dipolydora giardi
Ditrupa arietina
Dodecaceria concharum
Eteone longa
Euclymene lumbricoides
Euclymene oerstedii
Euclymene palermitana
Euclymene sp.
Eunice vittata
Exogone sp.
Galathowenia oculata
Gallardoneris sp.
Glycera alba
Glycera unicornis
Harmothoe antilopes
Heteromastus filiformis
Hilbigneris gracilis
Hydroides helmatus
Hydroides pseudouncinatus pseudouncinatus
Laonice cirrata
Lepidonotus clava
Levinsenia gracilis
Lumbrineris coccinea
Lysidice ninetta
Lysidice sp.
Magelona minuta
Malmgreniella darbouxi
Marphysa bellii
Marphysa sanguinea
Megalomma sp.
Mellina palmata
Micronephthys stammeri
Monticellina dorsobranchialis
Nematonereis unicornis
Nephthys hystricis
Nephthys incisa
Nereis perivisceralis
Nereis pulsatoria
Nereis rava
Notomastus latericeus
Notomastus sp.
Ophiodromus flexuosus
Owenia fusiformis
Paraehlersia ferrugina
Pectinaria auricoma
Pectinaria koreni
Perinereis cultrifera
Pherusa plumosa
Phyllodoce lineata
Phyllodoce sp.
Pilargis verrucosa
Pista cristata
Platynereis dumerilii
Platynereis nadiae
Podarkeopsis arenicolus
Poecilochaetus fauchaldi
Polycirrus medusa
Polycirrus sp.
Polyophthalmus pictus
Pomatoceros triqueter
Praxillella affinis
Prionospio cirrifera
Prionospio malmgreni
Pseudopolydora paucibranchiata
Sabellaria spinulosa
Scolelepis tridentata
Scoletoma fragilis
Scoletoma impatiens
Serpula concharum
Serpula vermicularis
Sigambra tentaculata
Spiochaetopterus costarum
Spiophanes bombyx
Spiophanes kroyeri
Sternaspis scutata
Sternaspis scutata
Syllis armillaris
Syllis garciai
Syllis gerlachi
Syllis gracilis
Syllis rosea
Terebellides stroemii
Thelepus cincinnatus
Vermiliopsis infundibulum
Vermiliopsis striaticeps

Monitoring requirements suggestions for BW in the Adriatic

The project is co-funded by the European Union
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Table 2

Suggested sampling frequency requirements for monitoring of presence–absence and population dynamics (abundance and/or biomass) of NIS of different taxonomic groups and varying life cycle lengths.

Organism group	Presence/ absence	Population dynamics
Pathogens and other disease agents	Seasonal	Variable
Phytoplankton	Seasonal	Frequent, depending on biosecurity requirements
Zooplankton	Seasonal	Monthly (bi-weekly)
Benthic vegetation	Seasonal/ annual	Seasonal/annual
Zoobenthos	Annual	Annual
Fish	Annual	Annual at specific times (*e.g.* reproduction)

From: **Dose of truth—Monitoring marine non-indigenous species to serve legislative requirements** by Lehtiniemi, M., Ojaveer, H., David, D., Galil, B., Gollasch, S., McKenzie, C., Minchin, D., Occhipinti-Ambrogi, A., Olenin, S., Pederson, J. Marine Policy 54 (2015) 26–35.

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<u>Recommendations for monitoring frequency would be as follows</u>:

A. For **microorganisms** (viruses, bacteria, microalgae) – on **weekly** basis (also in accordance with BW Control and Management in developing countries recommendations).

B. For **macroflora** and **fauna** (i.e., all other groups) – **seasonally** or at least **twice a year** (as suggested for monitoring of IAS in Mediterranean Marine Protected Areas).

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Groups	Categories levels						Taxonomist present in at least 1 country
	Total	Strong	Medium	Low	Absent	Unknown	
Viruses*	**1**	1	0	0	0	0	
Bacteria*	**12**	12	0	0	0	0	
MICROALGAE							+
MACROPHYTES							+
Foraminiferans							
Poriferans							
CNIDARIANS							
Ctenophores							
GASTROPODS							+
BIVALVES							+
Cephalopods							
POLYCHAETES							
Copepods							
DECAPODS							
Amphipods							
Isopods							
Tanaids							
Mysid							
Stomatopods							
Pycnogonids							
Bryozoans	2	0	0	1	0	1	
Echinoderms	2	0	0	1	0	1	
Ascidians	7	0	2	3	0	2	
FISHES	**21**	4	2	13	1	1	

MICROORGANISMS – plankton

- relatively fast results (days – weeks)
- experts offten available
- available methods
- but no/poor remedy measures

therefore...

Monitoring?
Frequency? Purpose?

Groups	Categories levels						Taxonomist present in at least 1 country
	Total	Strong	Medium	Low	Absent	Unknown	
Viruses*	**1**	1	0	0	0	0	
Bacteria*	**12**	12	0	0	0	0	
MICROALGAE	**113**	113	0	0	0	0	+
MACROPHYTES							+
Foraminiferans							
Poriferans							
CNIDARIANS							
Ctenophores							
GASTROPODS							+
BIVALVES							+
Cephalopods							
POLYCHAETES							
Copepods							
DECAPODS							
Amphipods							
Isopods							
Tanaids							
Mysid							
Stomatopods							
Pycnogonids							
Bryozoans	2	0	0	1	0	1	
Echinoderms	2	0	0	1	0	1	
Ascidians	7	0	2	3	0	2	
FISHES	**21**	4	2	13	1	1	

MACRO FLORA and FAUNA

- long separation period
- various experts
- no efficient remedy measures

therefore...

Monitoring?
Frequency? Purpose?

In addition to detecting IAS/HAB species, a method which should be highly advised to be included in standard monitoring efforts is a rapid bacterial bioluminescence assay with *Vibrio fisheri* (Microtox standardised test)

a useful and rapid bacterial bioluminescence assay with *Vibrio fisheri* (Microtox standardised test)

Determination of seawater toxicity in Shuaiba Industrial Area, Arabian Gulf, Bay of Brest, France, Bay of Mexico, Albufera National Park, Spain, Aegean Sea, Greece, as well as at 24 sampling sites along Adriatic coast, Croatia, during 12 years of continuous monitoring.

The project is co-funded by the European Union
Instrument for Pre-Accession Assistance

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Let's grow up together
Adriatic IPA
Cross Border Cooperation 2007-2013

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