DGTs, A COMPLEMENTARY TOOL TOWARDS MORE EFFICIENT BIOMONITORING PRACTICES

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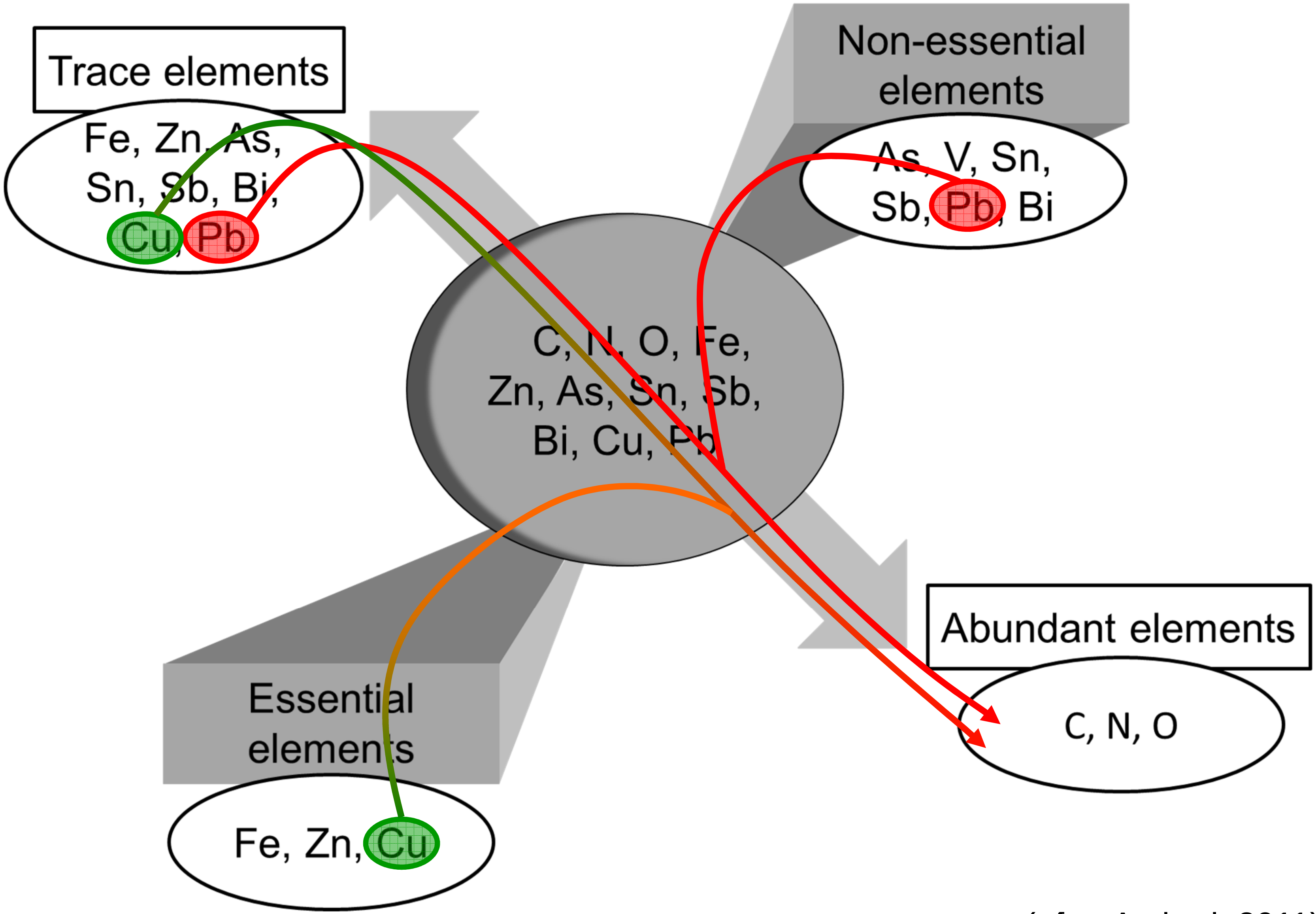
01-10-15

I N T R O D U C T I O N

Trace elements



(after Amiard ,2011)

PRODUCED BY THE FOUNDATION FOR EDUCATION, SCIENCE AND TECHNOLOGY FOR NATIONAL SET WEEK 2003

PERIODIC TABLE of the ELEMENTS

DEPARTMENT OF SCIENCE AND TECHNOLOGY

ALKALI METALS
ALKALI EARTH METALS
TRANSITION METALS
OTHER METALS
OTHER NONMETALS
HALOGENS
NOBLE GASSES
RARE EARTH METALS

H Hydrogen 1 1.01 — Symbol, Element name, Atomic number, Atomic mass

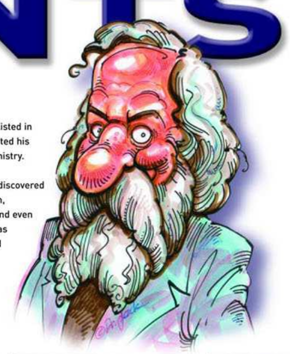
At room temperature the element is:
- Gas
- Liquid
- Natural solid
- Man-made solid (synthetic)

DMITRI MENDELEYEV (1834 – 1907)

The Russian chemist, Dmitri Mendeleyev, was the first to observe that if elements were listed in order of atomic mass, they showed regular (periodical) repeating properties. He formulated his discovery in a periodic table of elements, now regarded as the backbone of modern chemistry.

The crowning achievement of Mendeleyev's periodic table lay in his prophecy of then, undiscovered elements. In 1869, the year he published his periodic classification, the elements gallium, germanium and scandium were unknown. Mendeleyev left spaces for them in his table and even predicted their atomic masses and other chemical properties. Six years later, gallium was discovered and his predictions were found to be accurate. Other discoveries followed and their chemical behaviour matched that predicted by Mendeleyev.

This remarkable man, the youngest in a family of 17 children, has left the scientific community with a classification system so powerful that it became the cornerstone in chemistry teaching and the prediction of new elements ever since.
In 1955, element 101 was named after him: Md, Mendelevium.



Period	IA 1	IIA 2	III B 3	IV B 4	V B 5	VI B 6	VII B 7	VIII 8	VIII 9	VIII 10	I B 11	II B 12	III A 13	IV A 14	V A 15	VI A 16	VII A 17	VIII A 18
1	H Hydrogen 1 1.01																	He Helium 2 4.00
2	Li lithium 3 6.94	Be Beryllium 4 9.01											B Boron 5 10.81	C Carbon 6 12.01	N Nitrogen 7 14.01	O Oxygen 8 16.00	F Fluorine 9 19.00	Ne Neon 10 20.18
3	Na Sodium 11 22.99	Mg Magnesium 12 24.31											Al Aluminium 13 26.98	Si Silicon 14 28.09	P Phosphorus 15 30.97	S Sulphur 16 32.06	Cl Chlorine 17 35.45	Ar Argon 18 39.95
4	K Potassium 19 39.10	Ca Calcium 20 40.08	Sc Scandium 21 44.96	Ti Titanium 22 47.88	V Vanadium 23 50.94	Cr Chromium 24 52.00	Mn Manganese 25 54.94	Fe Iron 26 55.85	Co Cobalt 27 58.93	Ni Nickel 28 58.69	Cu Copper 29 63.55	Zn Zinc 30 65.39	Ga Gallium 31 69.72	Ge Germanium 32 72.61	As Arsenic 33 74.92	Se Selenium 34 78.96	Br Bromine 35 79.90	Kr Krypton 36 83.80
5	Rb Rubidium 37 85.47	Sr Strontium 38 87.62	Y Yttrium 39 88.91	Zr Zirconium 40 91.22	Nb Niobium 41 92.91	Mo Molybdenum 42 95.94	Tc Technetium 43 (98)	Ru Ruthenium 44 101.07	Rh Rhodium 45 102.91	Pd Palladium 46 106.42	Ag Silver 47 107.87	Cd Cadmium 48 112.41	In Indium 49 114.82	Sn Tin 50 118.71	Sb Antimony 51 121.76	Te Tellurium 52 127.60	I Iodine 53 126.90	Xe Xenon 54 131.29
6	Cs Caesium 55 132.91	Ba Barium 56 137.33	Lanthanide Series	Hf Hafnium 72 178.49	Ta Tantalum 73 180.95	W Tungsten 74 183.85	Re Rhenium 75 186.21	Os Osmium 76 190.23	Ir Iridium 77 192.22	Pt Platinum 78 195.08	Au Gold 79 196.97	Hg Mercury 80 200.59	Tl Thallium 81 204.38	Pb Lead 82 207.20	Bi Bismuth 83 208.98	Po Polonium 84 (209)	At Astatine 85 (210)	Rn Radon 86 (222)
7	Fr Francium 87 (223)	Ra Radium 88 (226)	Actinide Series	Rf Rutherfordium 104 (261)	Db Dubnium 105 (262)	Sg Seaborgium 106 (263)	Bh Bohrium 107 (262)	Hs Hassium 108 (265)	Mt Meitnerium 109 (266)									

La Lanthanum 57 138.91	Ce Cerium 58 140.12	Pr Praseodymium 59 140.90	Nd Neodymium 60 144.24	Pm Promethium 61 (145)	Sm Samarium 62 150.36	Eu Europium 63 151.96	Gd Gadolinium 64 157.25	Tb Terbium 65 158.92	Dy Dysprosium 66 162.50	Ho Holmium 67 164.93	Er Erbium 68 167.26	Tm Thulium 69 168.93	Yb Ytterbium 70 173.04	Lu Lutetium 71 174.96
Ac Actinium 89 227.02	Th Thorium 90 232.03	Pa Protactinium 91 231.03	U Uranium 92 238.02	Np Neptunium 93 (237)	Pu Plutonium 94 (244)	Am Americium 95 (243)	Cm Curium 96 (247)	Bk Berkelium 97 (247)	Cf Californium 98 (251)	Es Einsteinium 99 (254)	Fm Fermium 100 (257)	Md Mendelevium 101 (258)	No Nobelium 102 (259)	Lr Lawrencium 103 (260)

Public Understanding of Science Engineering and Technology

FEST Foundation for Education, Science & Technology

Design and production: Loretta Steyn Graphic Design Studio - Pretoria **Illustrations:** Dr. Jack **Technical advisor:** Carl Ahlers - Experilab

Introduction

Direct measurements in water :

- low, punctual and fluctuating concentrations;
- preconcentrations;
- bioaccessible fraction?

↓

Ecotoxicology :

bioindicators = organisms accumulating pollutants to levels representative of their habitat pollution status.

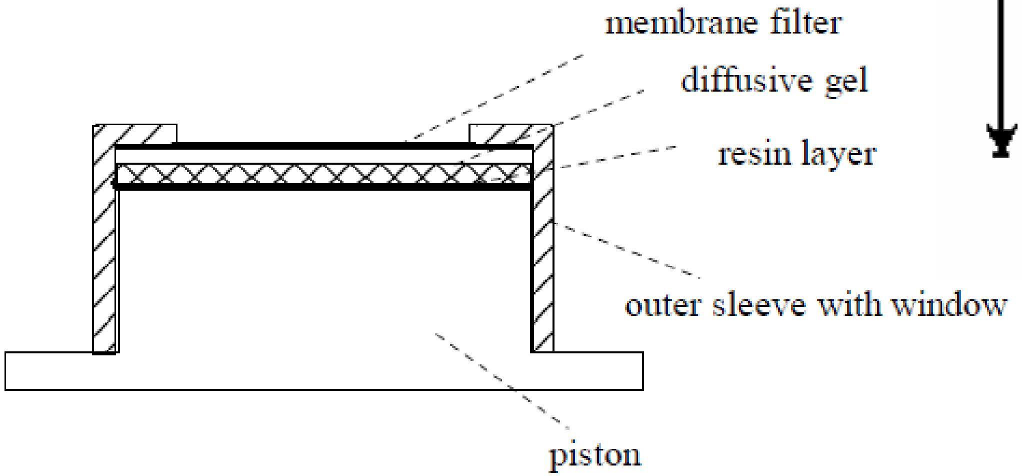
Posidonia oceanica

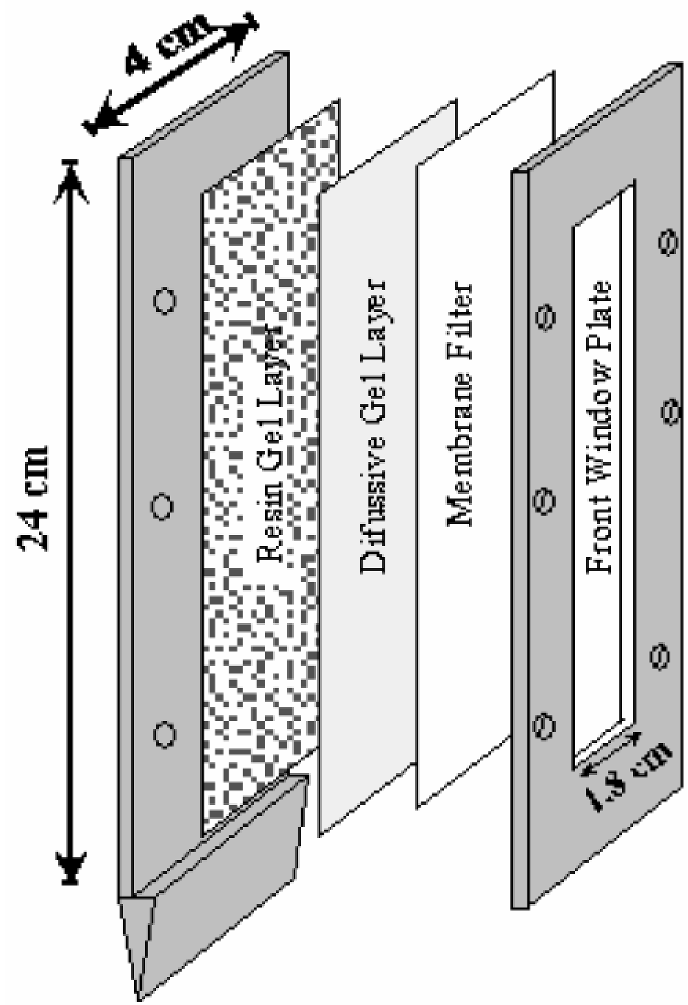
Mytilus galloprovincialis

Introduction

Davison and Zhang (1994). *In situ speciation measurements of trace components in natural waters using thin-film gels.* Nature. 367: 546-548.
(Lancaster University, UK)

DGT = diffusive gradients
in thin films





(DGT – for measurements in waters, soils and sediments)

Monitoring

METHODS

Trace elements

direct measurements in the environment:

- water
- sediment
- suspended matter

bioindicators

Mytilus galloprovincialis

Posidonia oceanica

Calvi Bay

S
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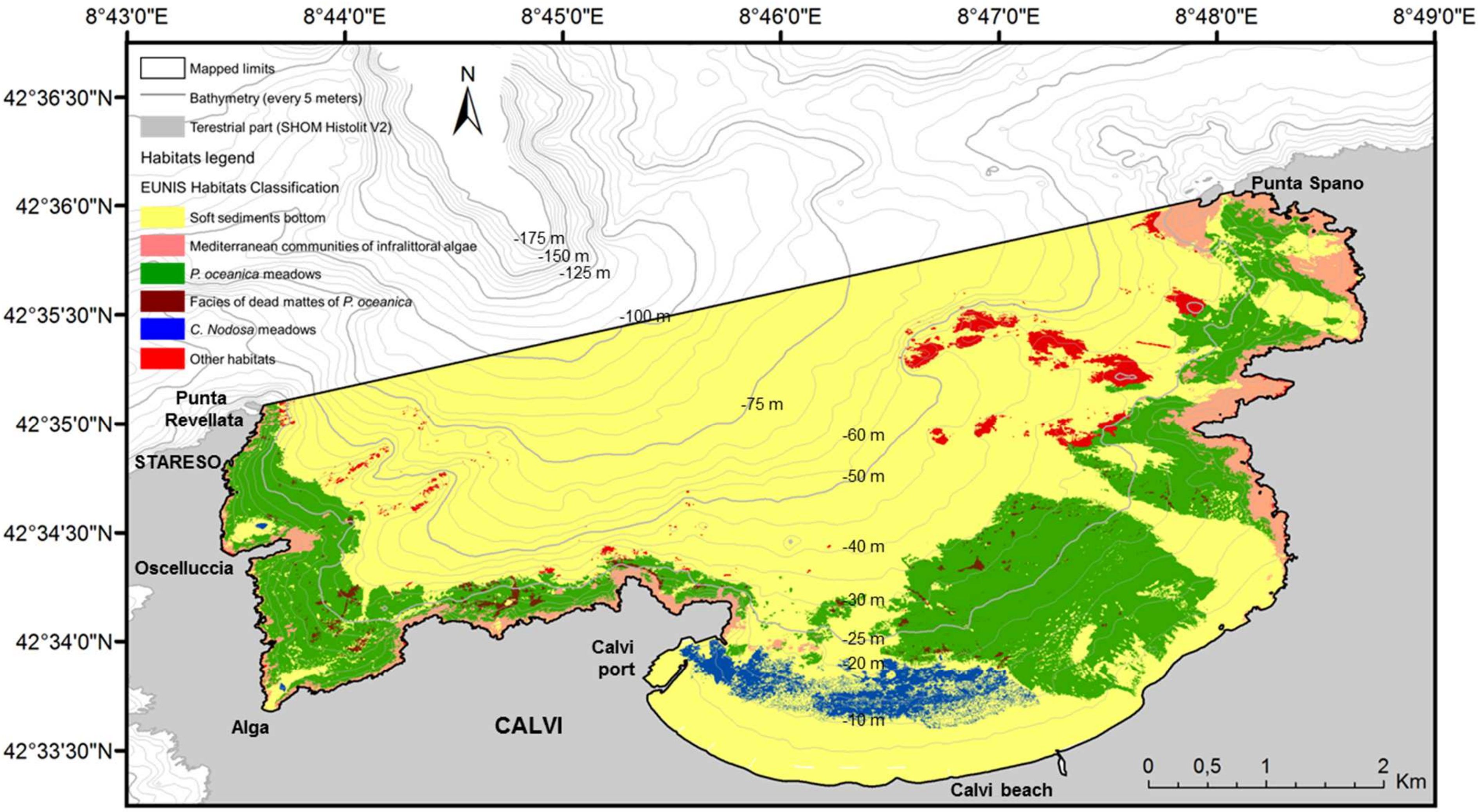
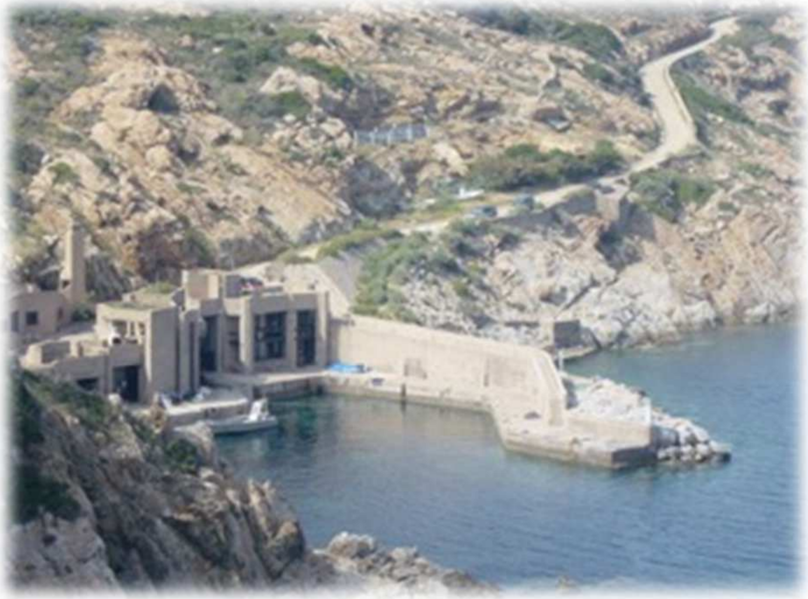
Calvi Bay



8°43'0"E
8°44'0"E
8°45'0"E
8°46'0"E
8°47'0"E
8°48'0"E
8°49'0"E
42°36'30"N
42°36'0"N
42°35'30"N
42°35'0"N
42°34'30"N
42°34'0"N
42°33'30"N
Mapped limits
Bathymetry (every 5 meters)
Terrestrial part (SHOM Histolit V2)
Habitats legend
EUNIS Habitats Classification
Soft sediments bottom
Mediterranean communities of infralittoral algae
P. oceanica meadows
Facies of dead mattes of P. oceanica
C. Nodosa meadows
Other habitats
N
-175 m
-150 m
-125 m
-100 m
-75 m
-60 m
-50 m
-40 m
-30 m
-25 m
-20 m
-10 m
Punta Spano
Punta Revellata
STARESO
Oscelluccia
Alga
CALVI
Calvi port
Calvi beach
0 0,5 1 2 Km

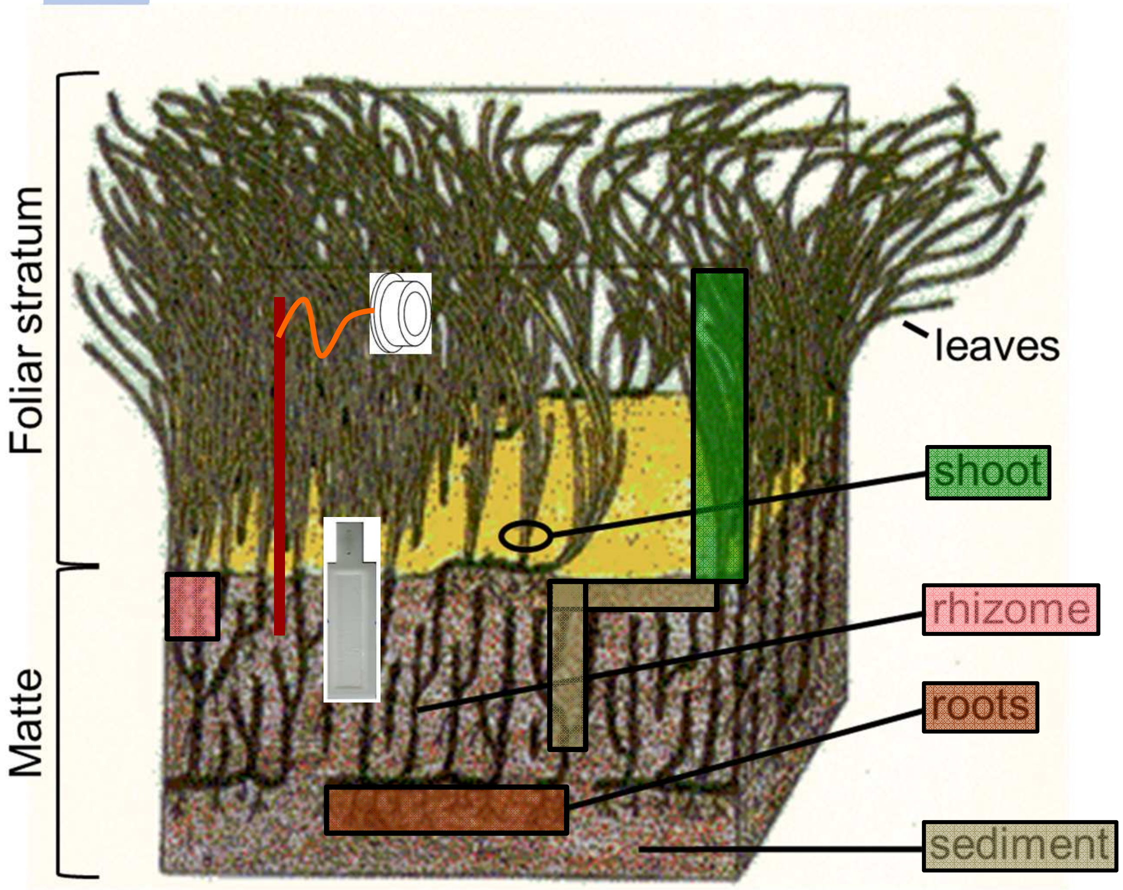
STARESO

S
I
T
E



Posidonia oceanica

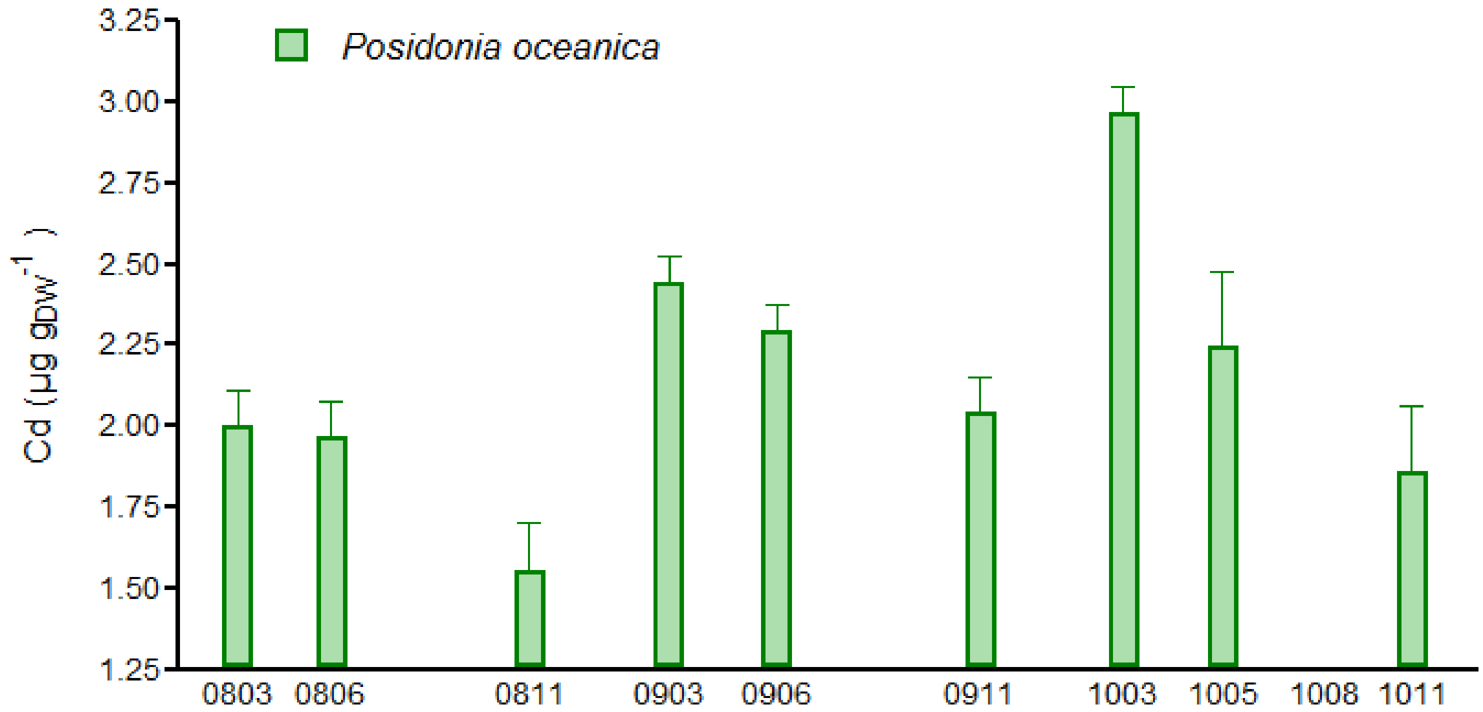
- *Posidonia oceanica*: shoots, rhizomes and roots;
- Foliar stratum;
- Matte.





Seasonal variations of *P. oceanica* [TE]

A P P L I C A T I O N 1



Seasonal variations of *P. oceanica* [TE]

A
P
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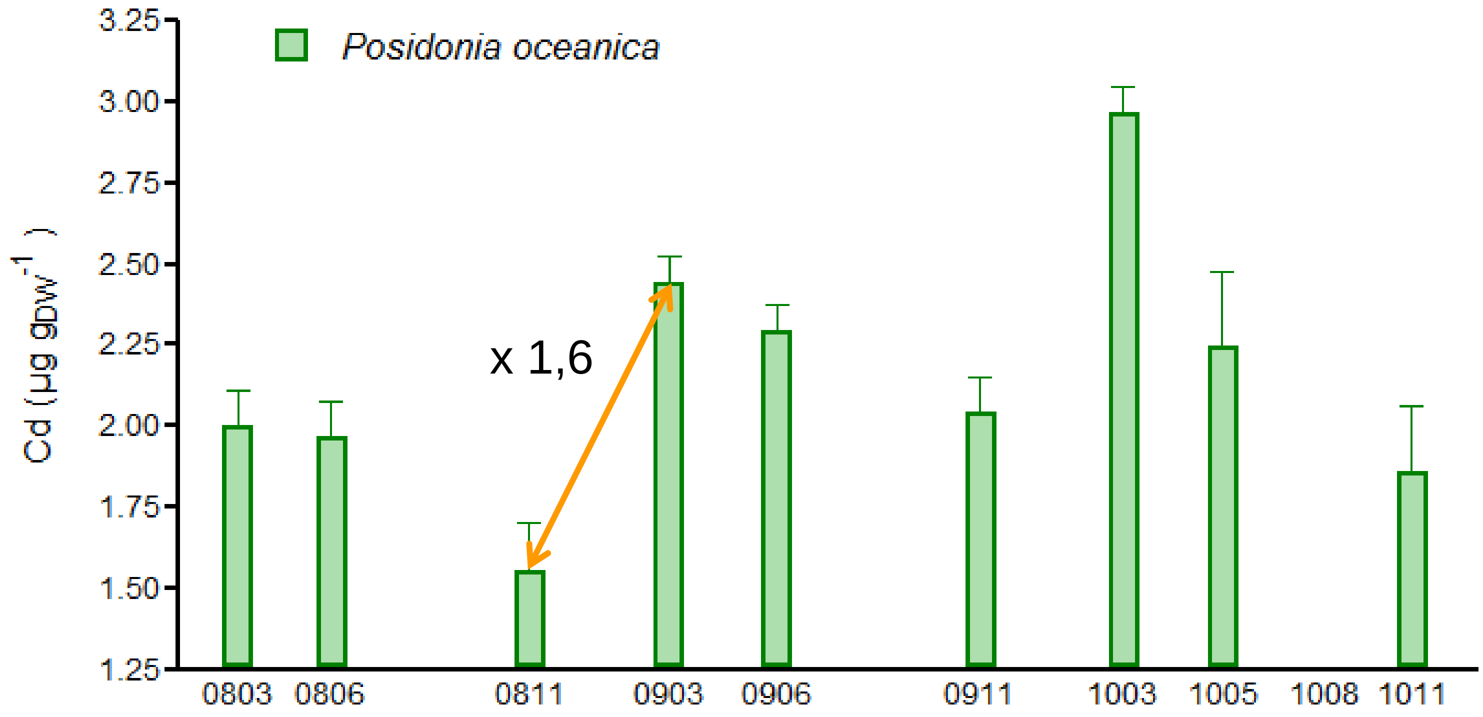
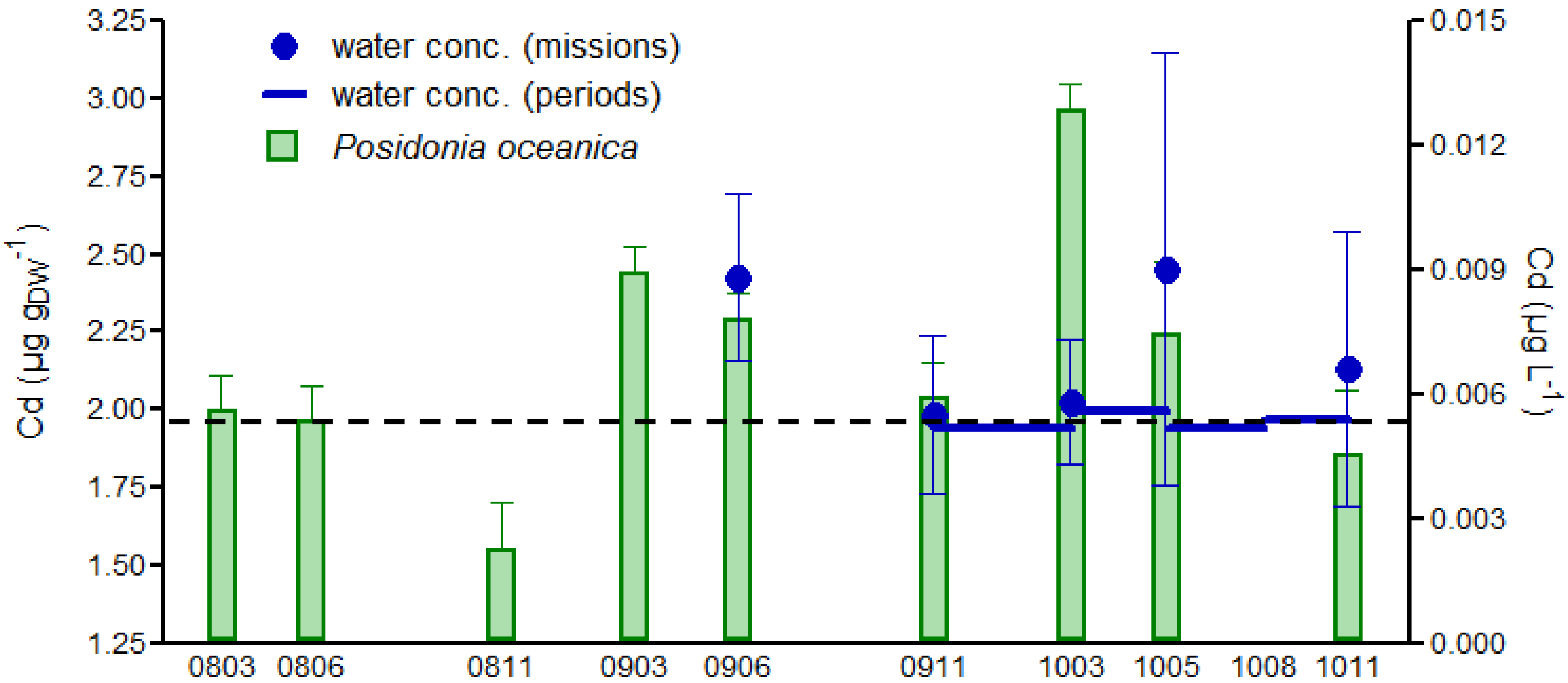
1



Seasonal variations of *P. oceanica* [TE]

A P P L I C A T I O N 1

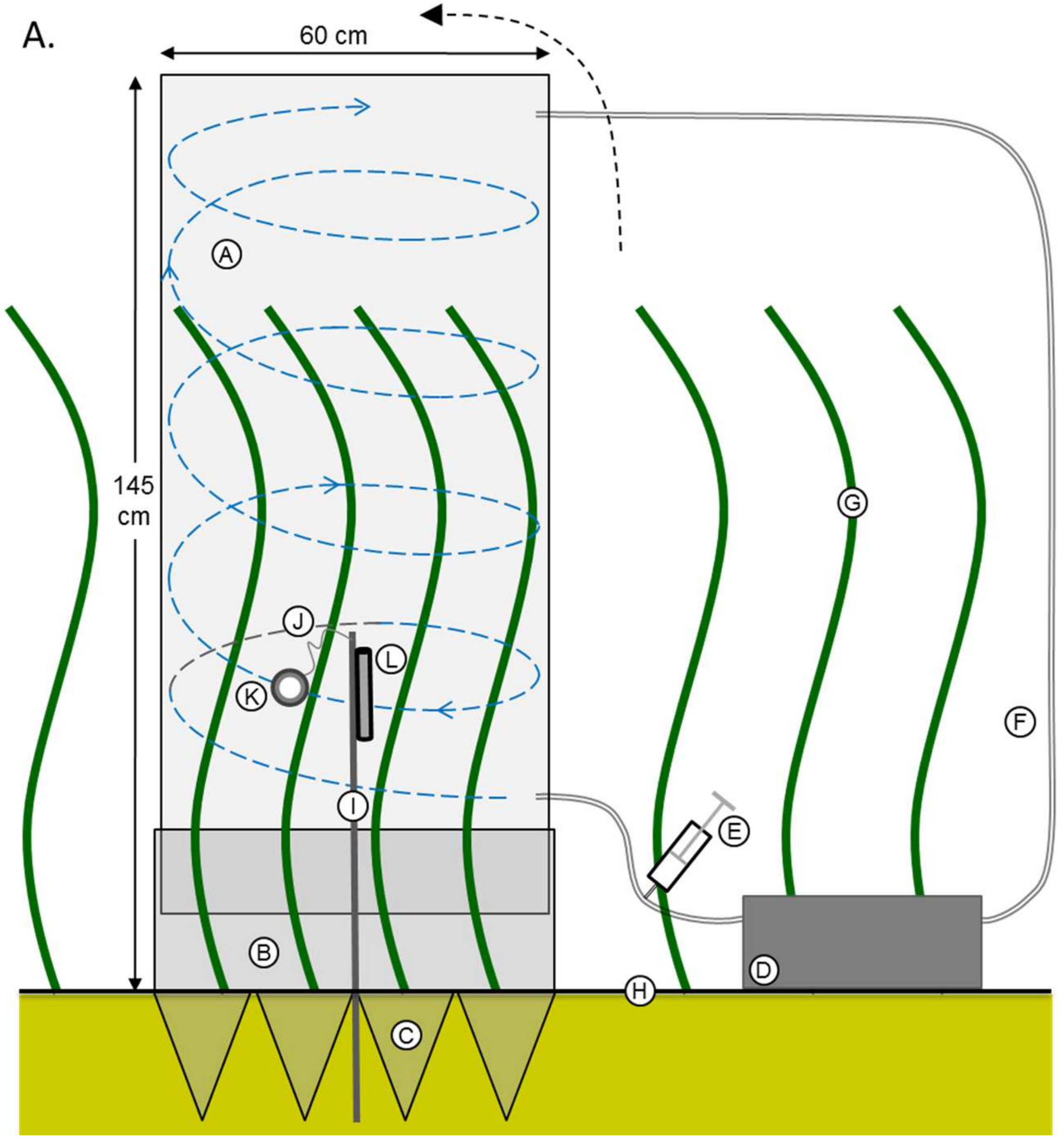
[Cd] *Posidonia oceanica* : 10^6 times > water



In situ contamination of *P. oceanica*

APPLICATION 2

- 5 days of contamination;
- 15 TEs (Pb, Co, Ag, Al, Mn ...);
- 410L bell-shaped mesocosm;
- Contamination every 12 hours (9am-9pm);
- 15 days of decontamination.



In situ contamination of *P. oceanica*

A
P
P
L
I
C
A
T
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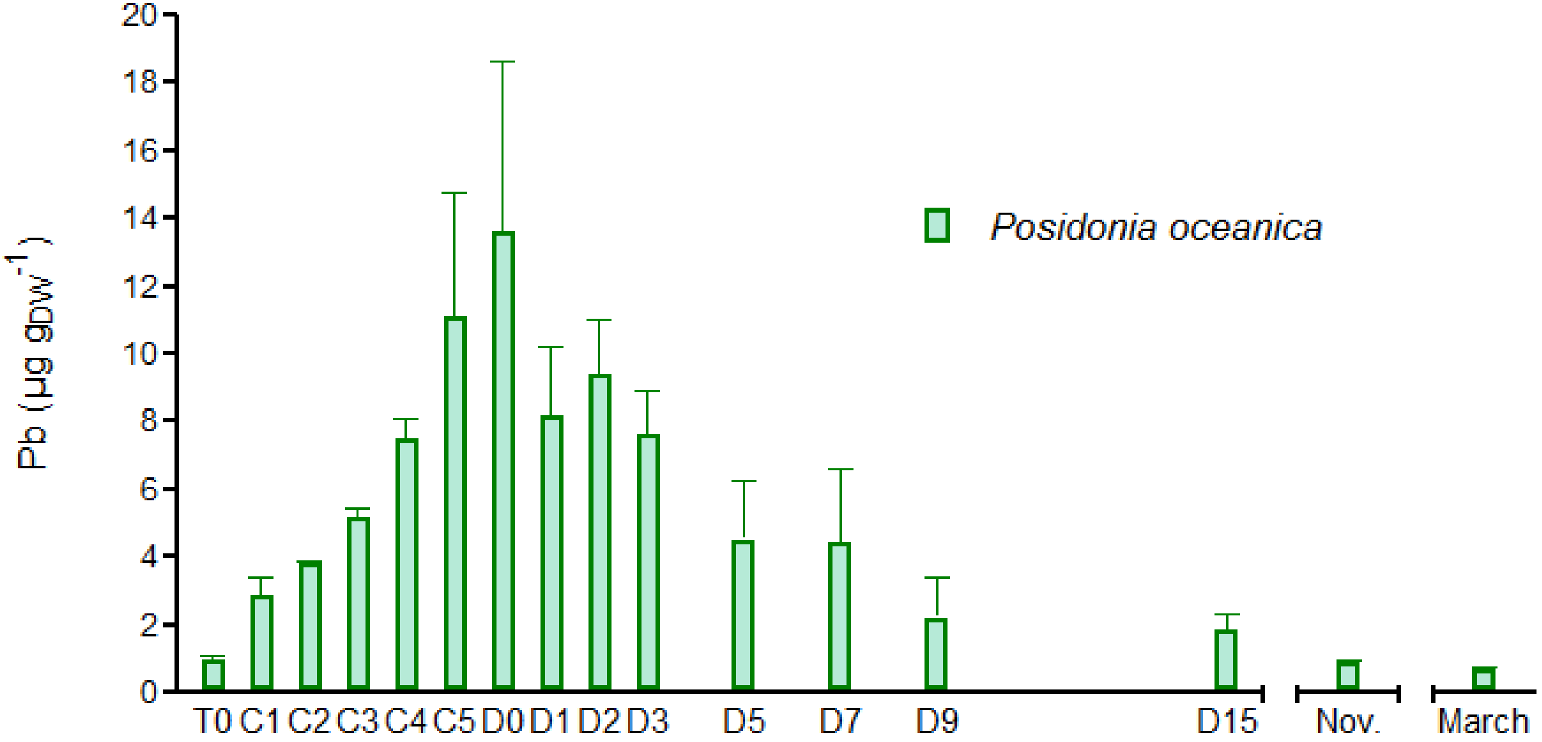
O
N

2

seawater average [Pb] : 0.13 µg L^{-1}

contamination level : 5 µg L^{-1}



In situ contamination of *P. oceanica*

APPLICATION 2

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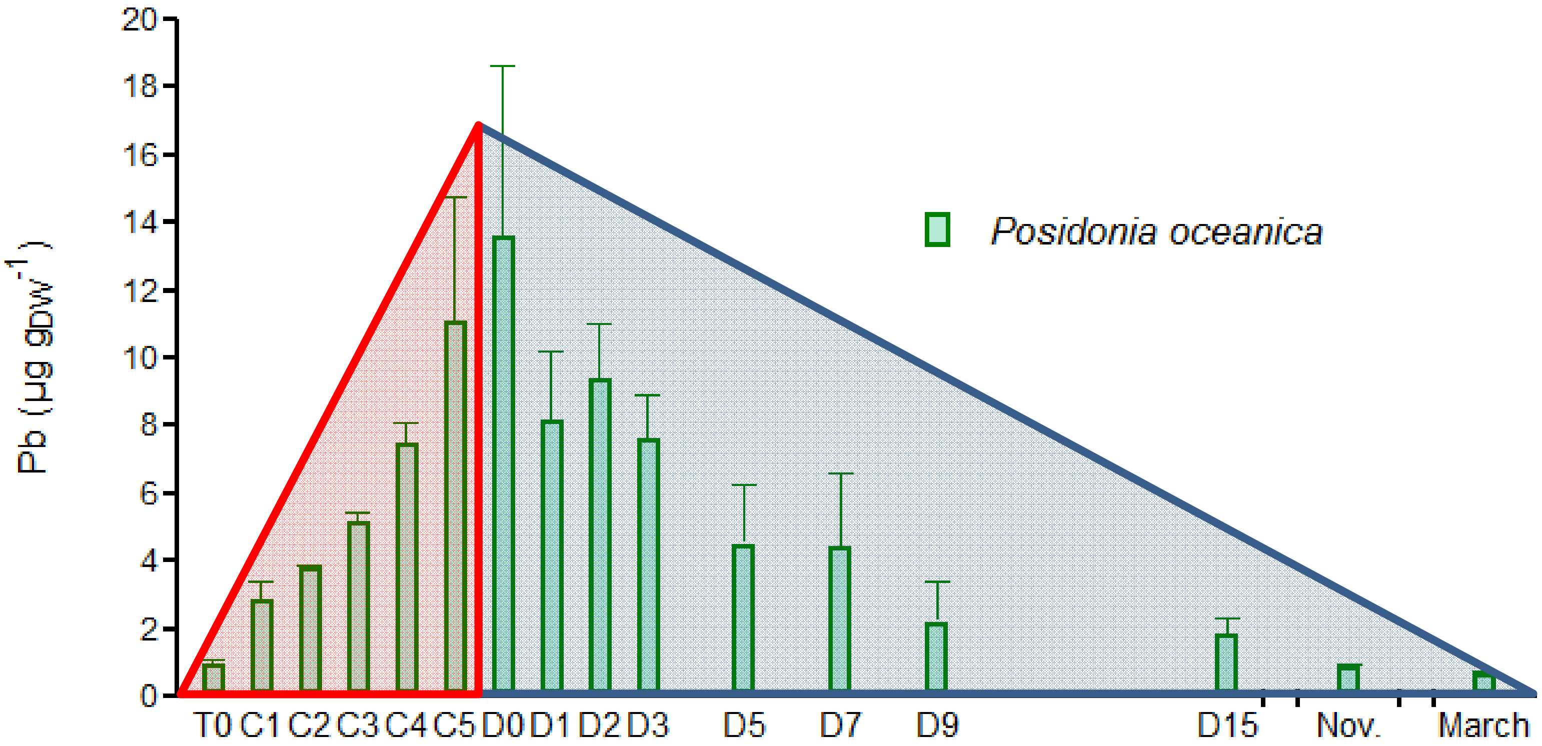
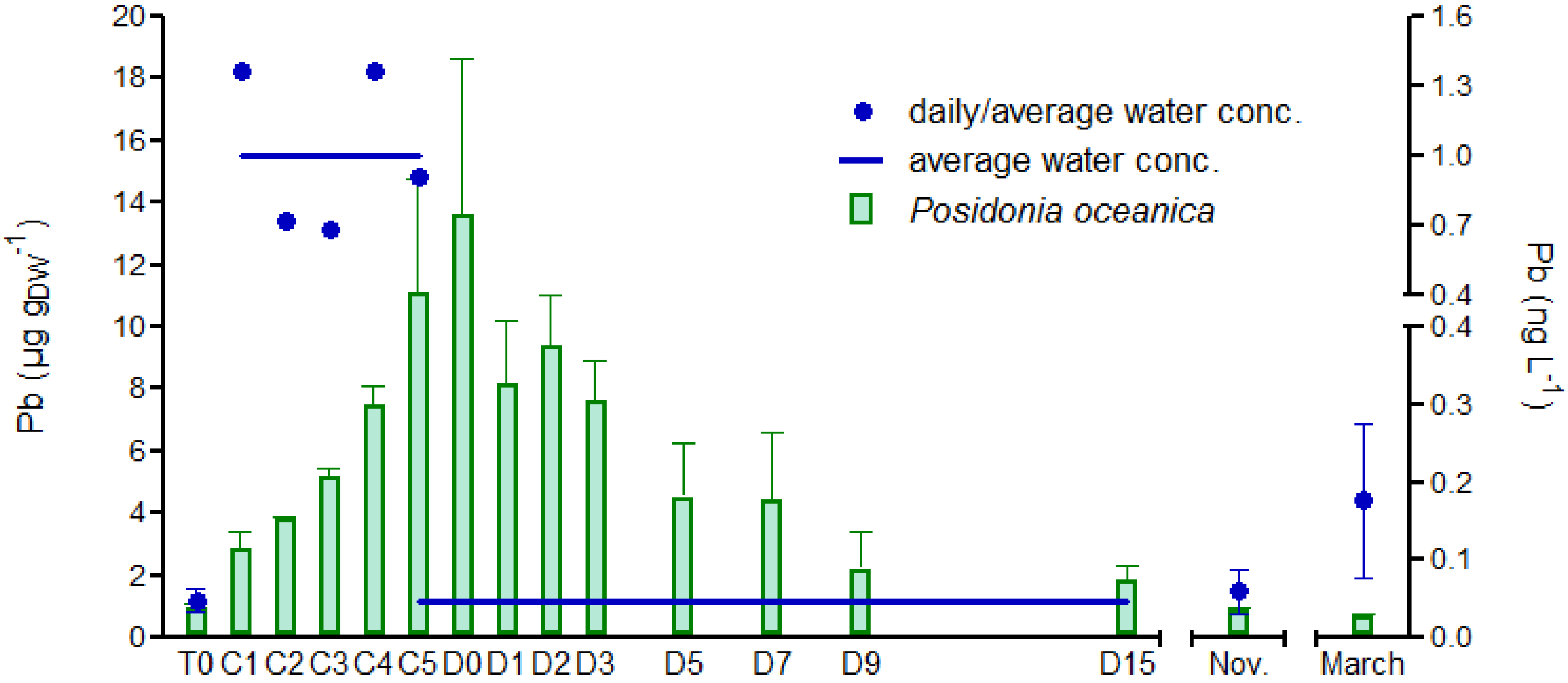


In situ contamination of *P. oceanica*

APPLICATION 2

seawater average [Pb] : 0.05 µg L^{-1} ~~(0.13 µg L^{-1})~~

contamination level : 1.00 µg L^{-1} ~~(5 µg L^{-1})~~

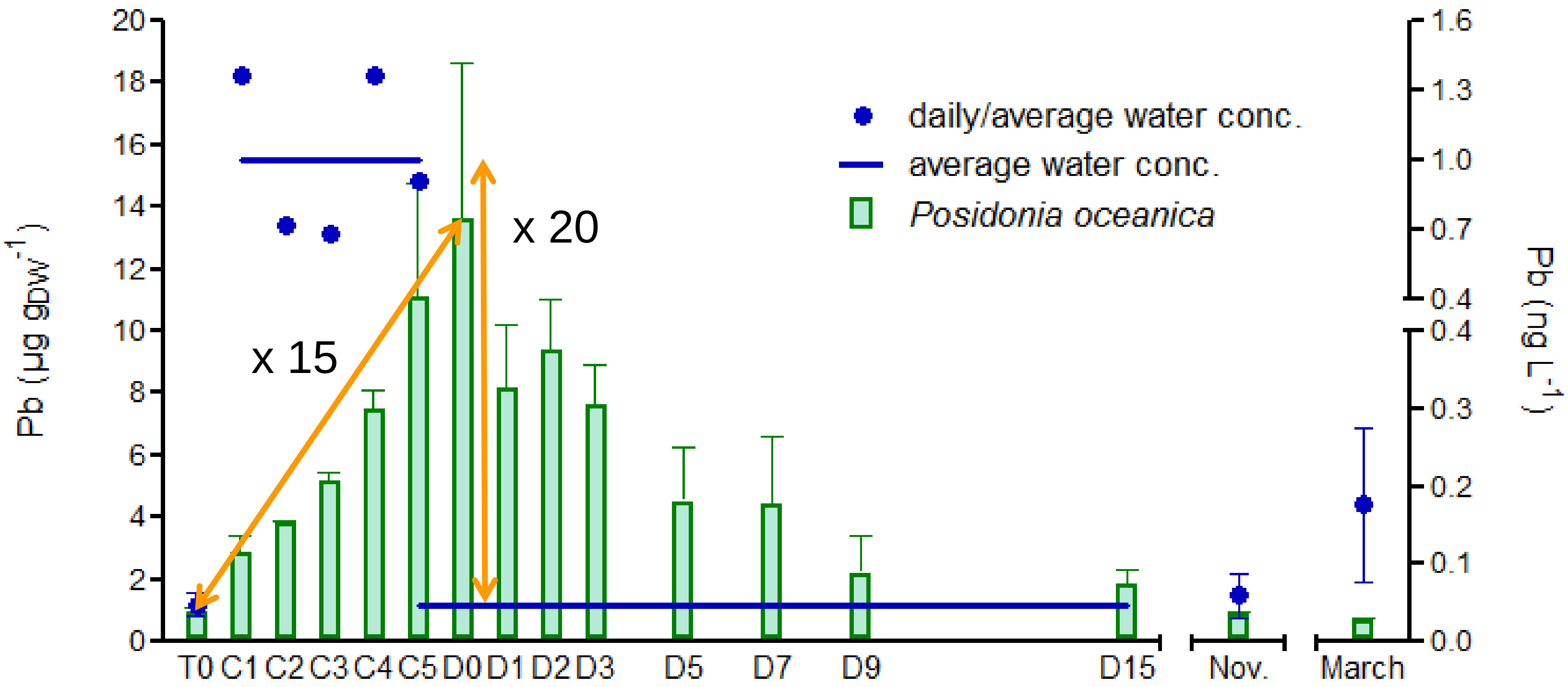


In situ contamination of *P. oceanica*

A P P L I C A T I O N 2

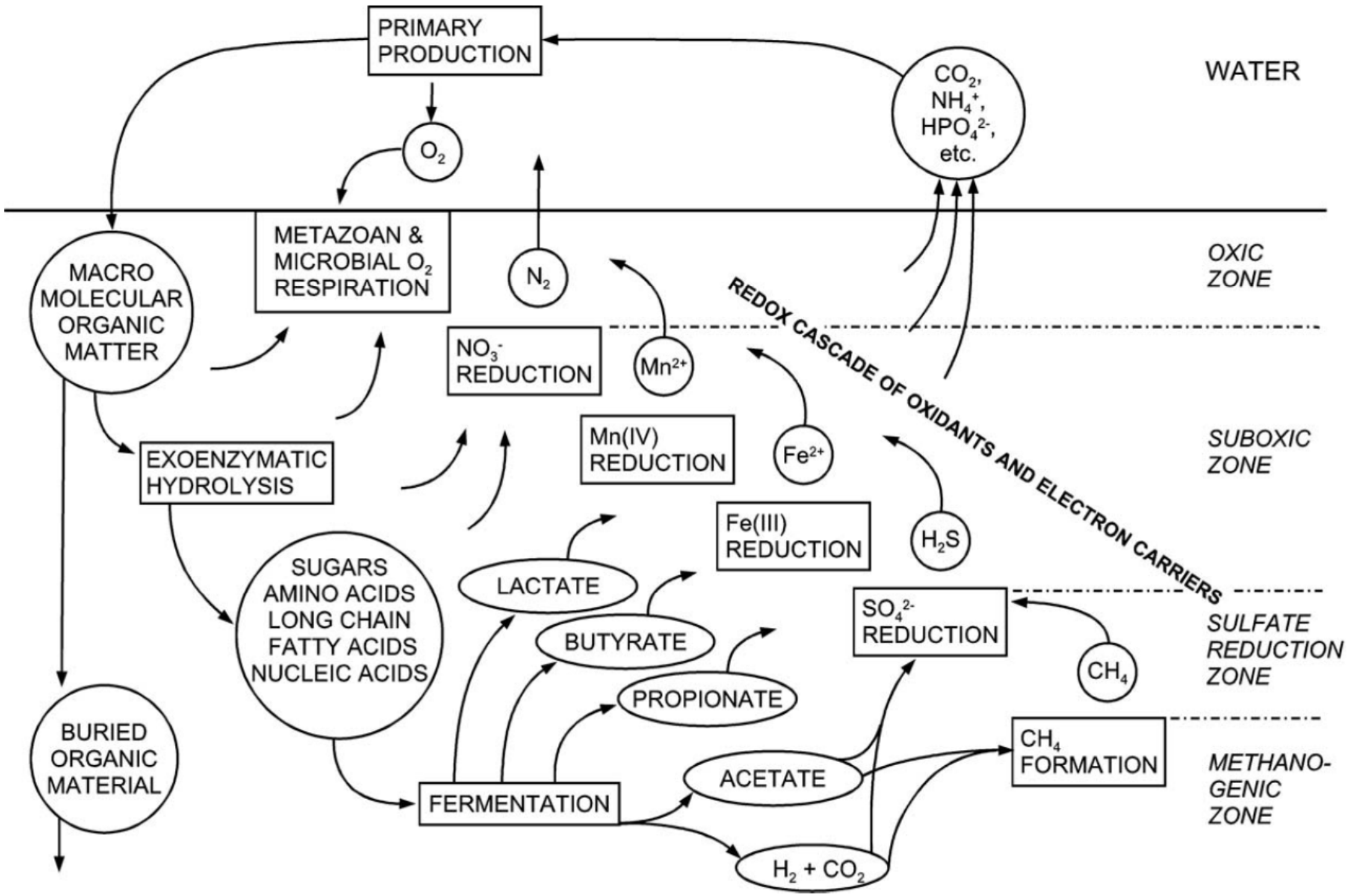
seawater average [Pb] : 0.05 µg L^{-1} ~~(0.13 µg L^{-1})~~

contamination level : 1.00 µg L^{-1} ~~(5 µg L^{-1})~~



Porewater TE concentrations

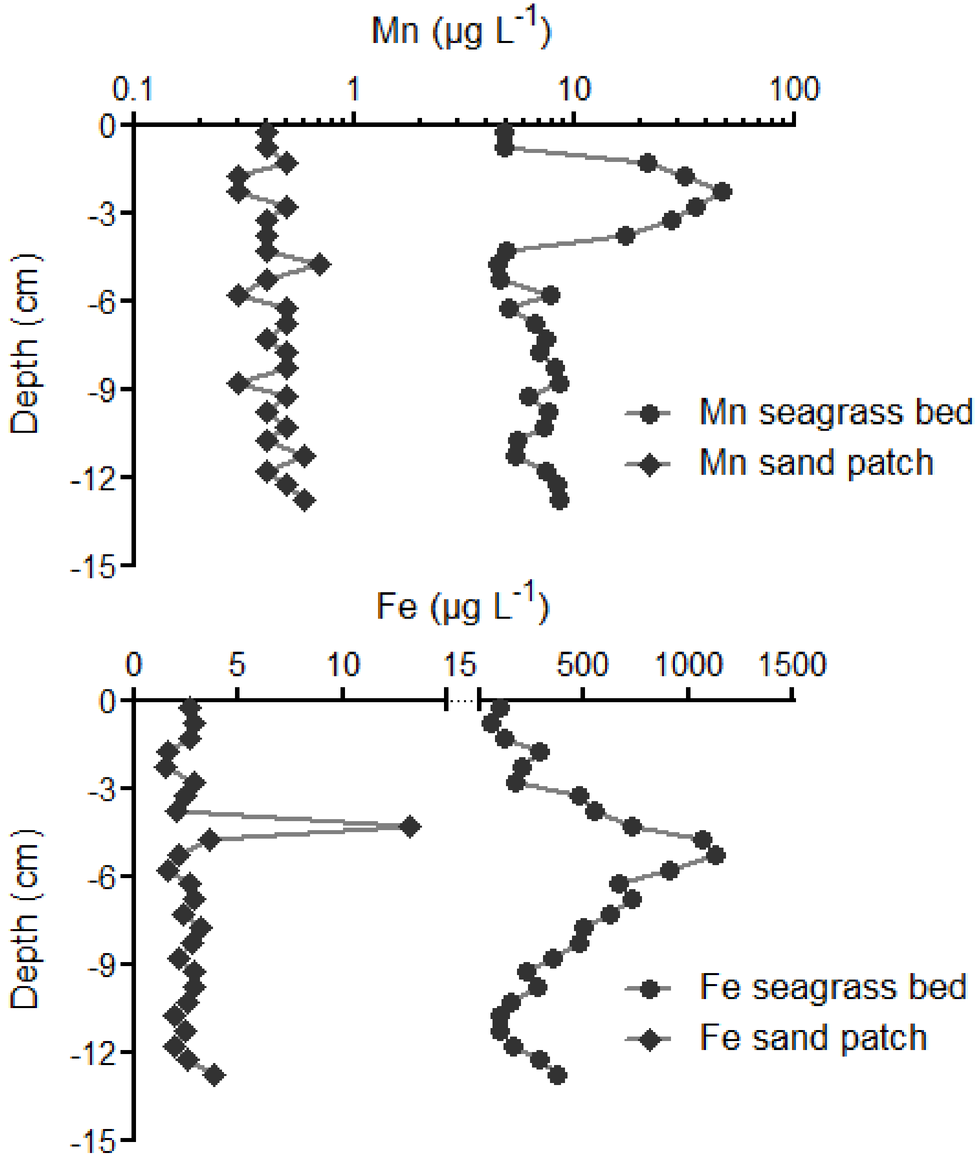
APPLICATION 3



(Jørgensen, 2006)

APPLICATION 3

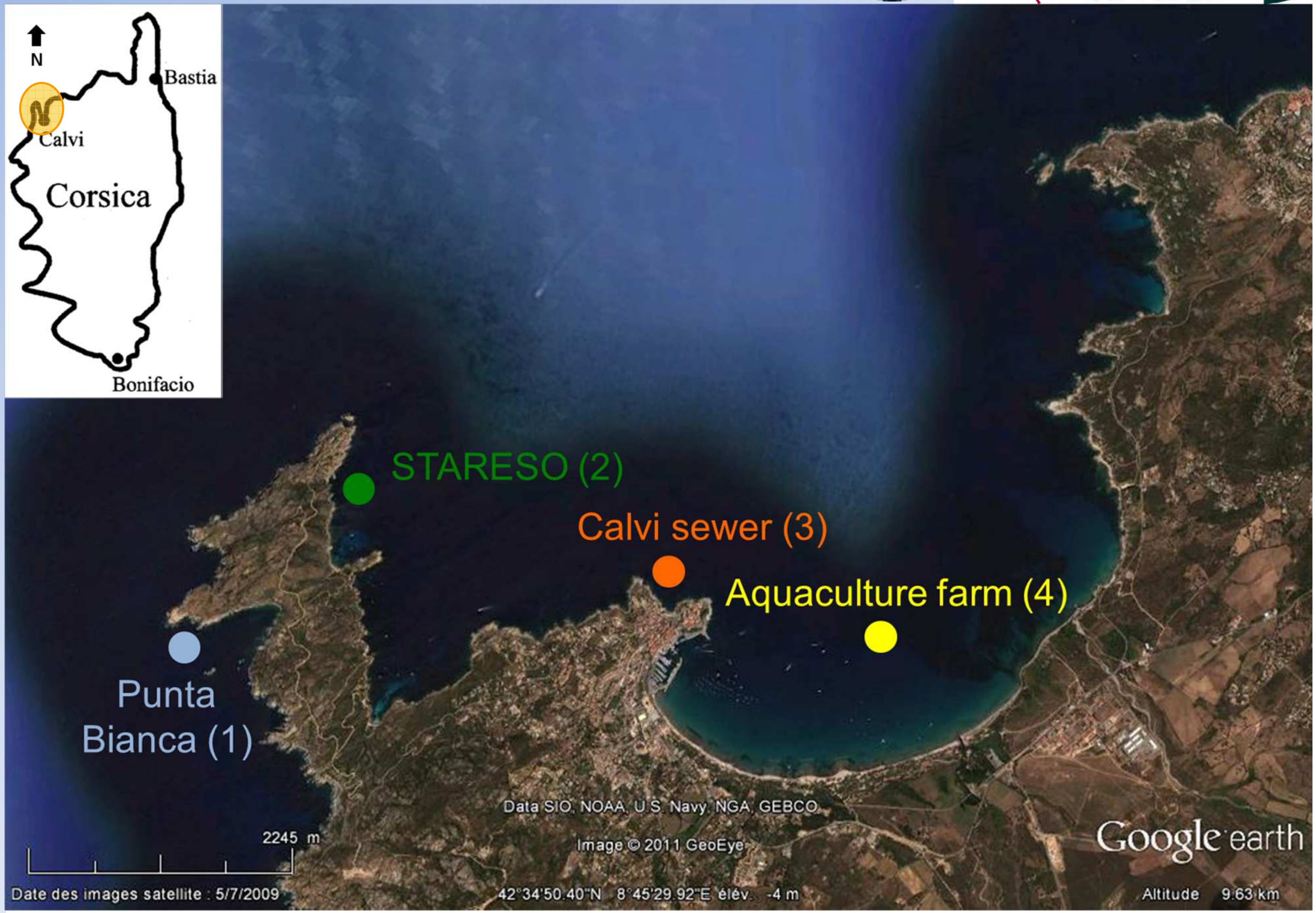
Porewater TE concentrations

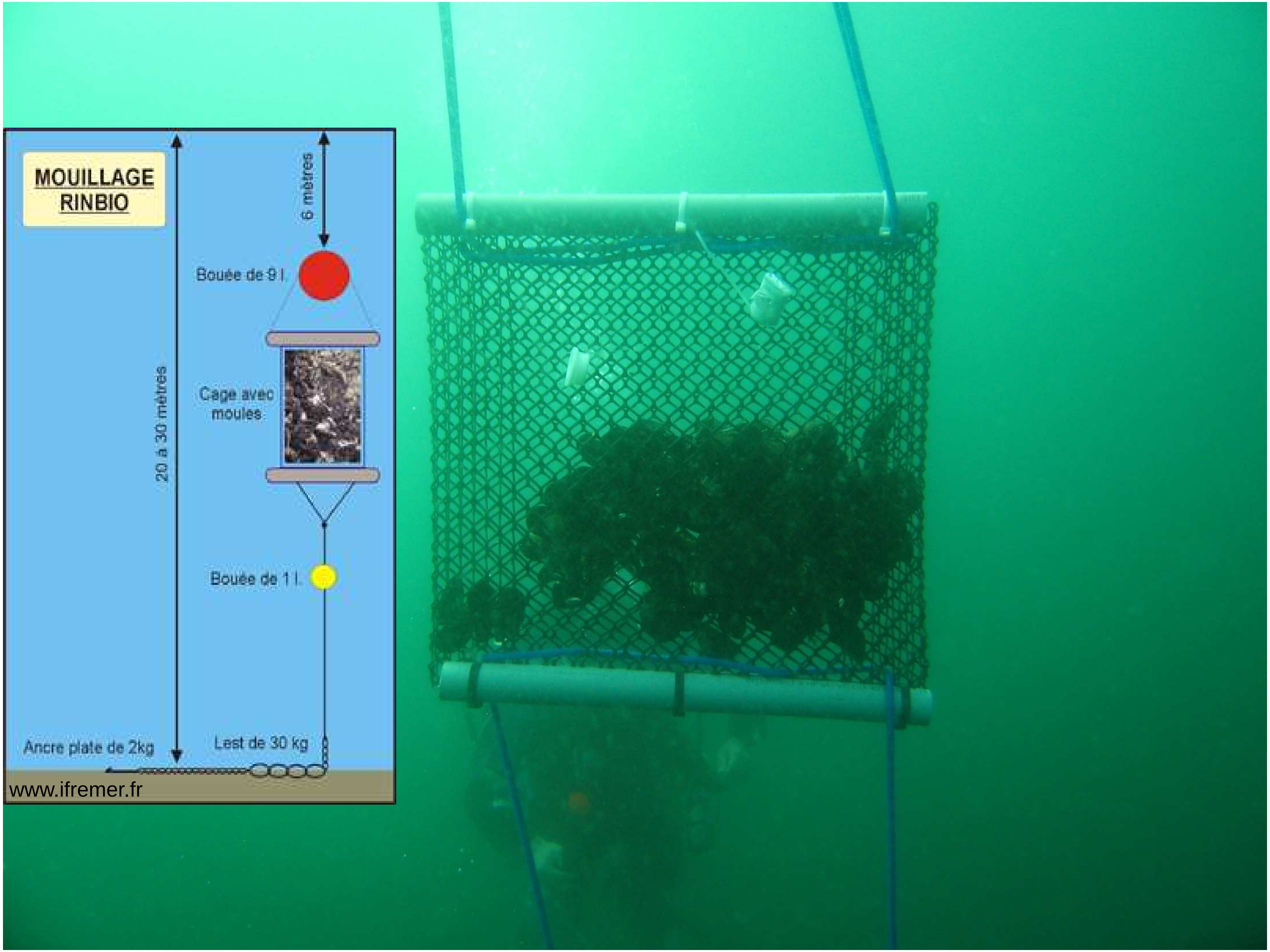


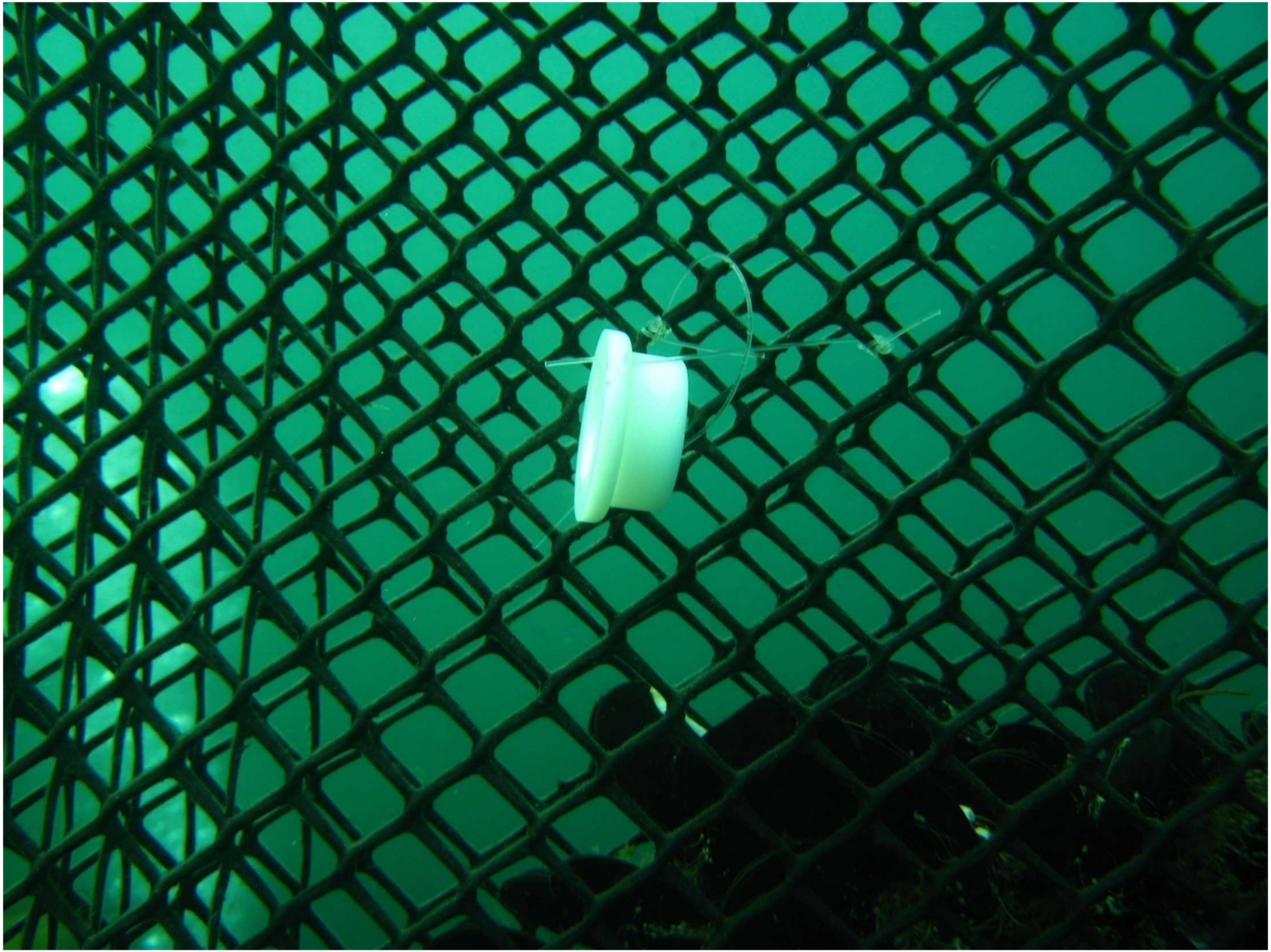
Rem.: concentrations in the resine eluats after ICP-MS measurements.

Mussel caging: TE bioaccumulation

APPLICATION 4



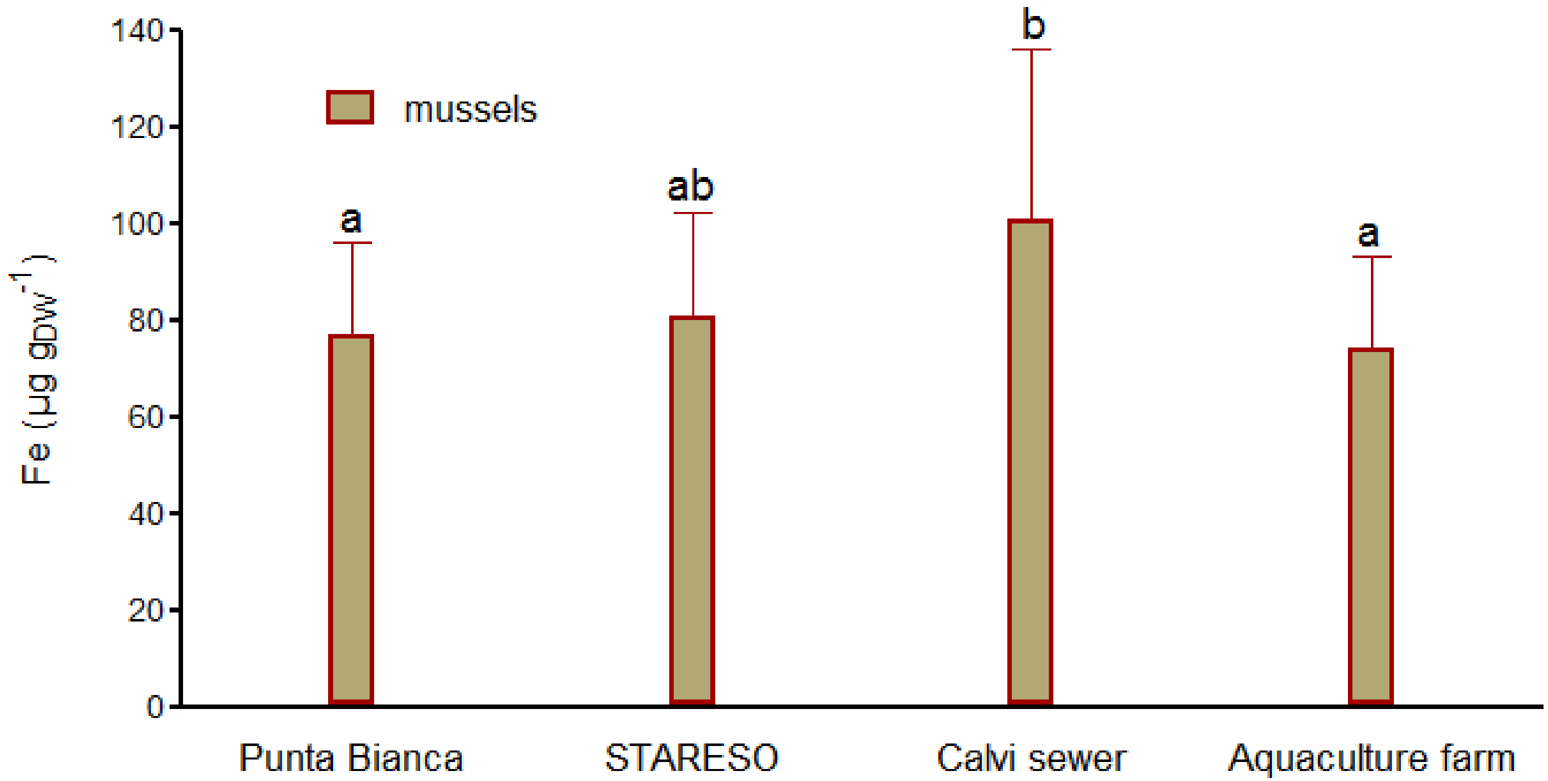

MOUILLAGE RINBIO
6 mètres
Bouée de 9 l.
Cage avec moules
20 à 30 mètres
Bouée de 1 l.
Ancre plate de 2kg
Lest de 30 kg
www.ifremer.fr



Mussel caging: TE bioaccumulation

APPLICATION 4

Calvi sewer / Aquaculture farm: mussels = 1.36



Mussel caging: TE bioaccumulation

APPLICATION 4

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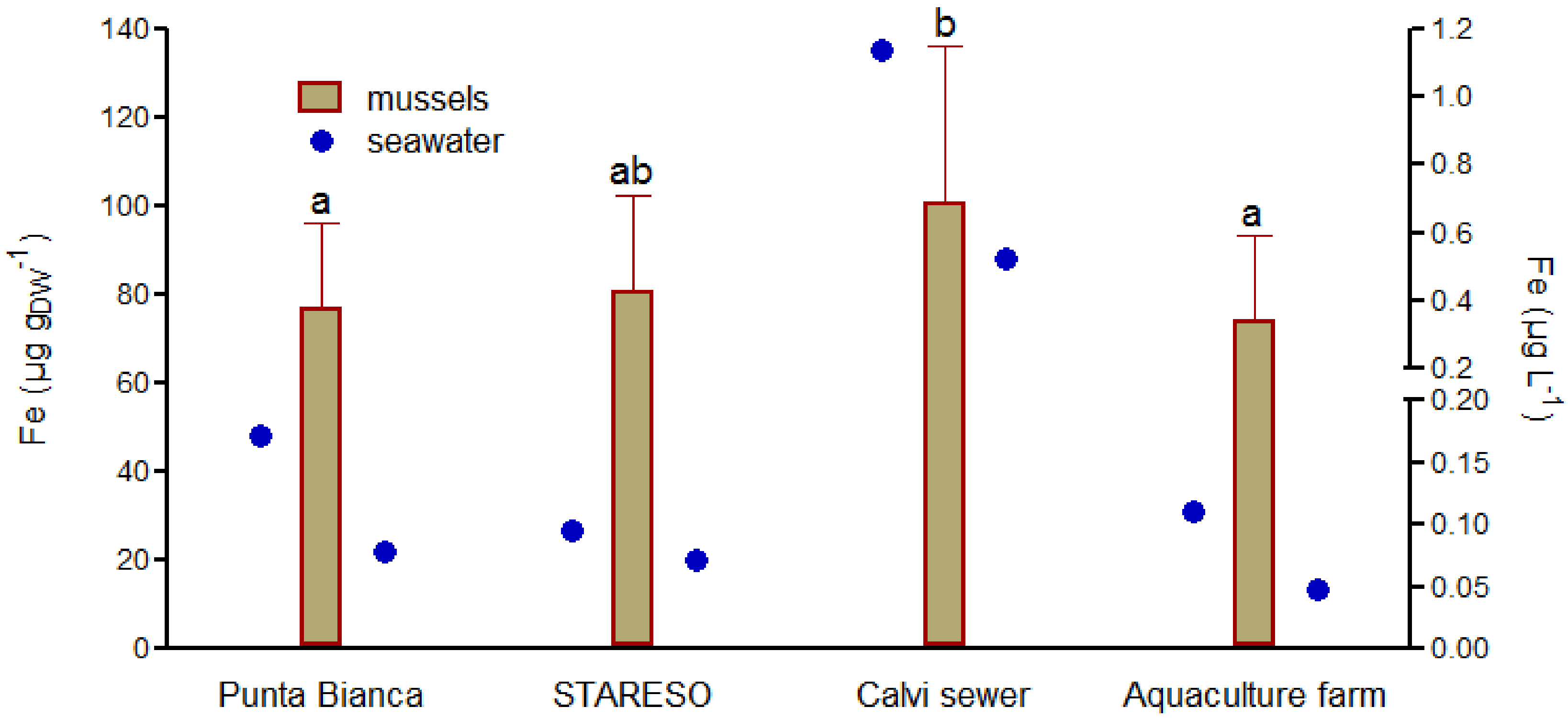
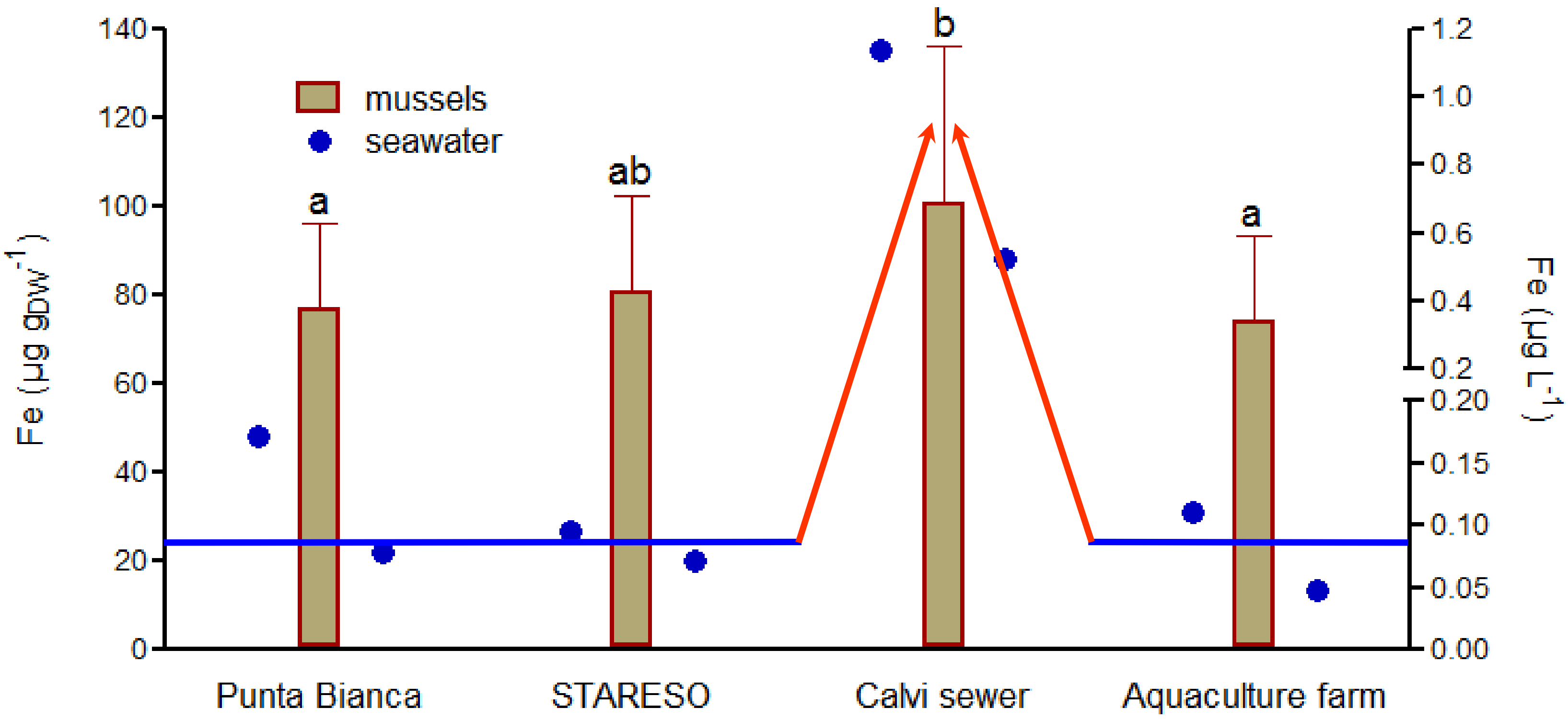


Mussel caging: TE bioaccumulation

APPLICATION 4

Calvi sewer / Aquaculture farm: mussels = 1.36
water ~ 10



Mussel caging: TE bioaccumulation

APPLICATION 4

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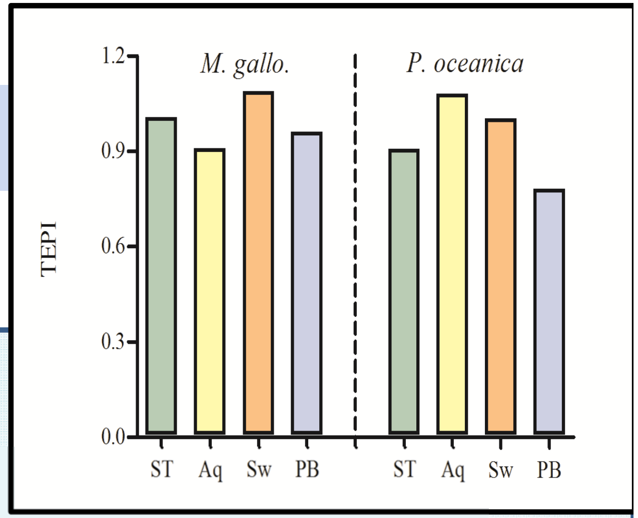

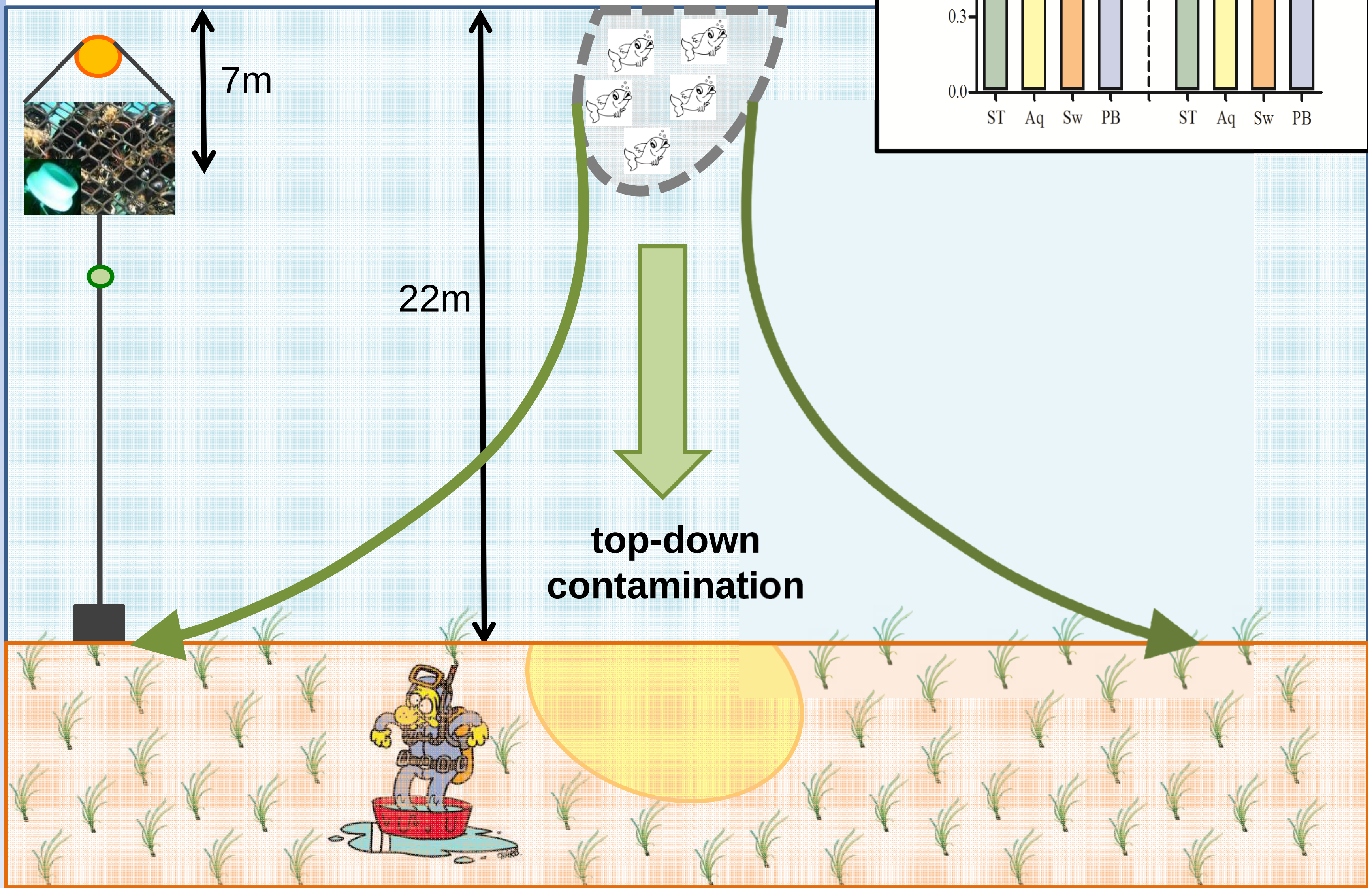

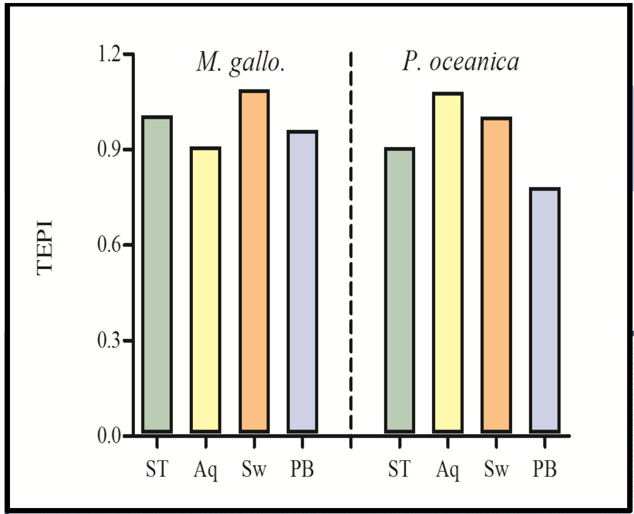

Mussel caging: TE bioaccumulation

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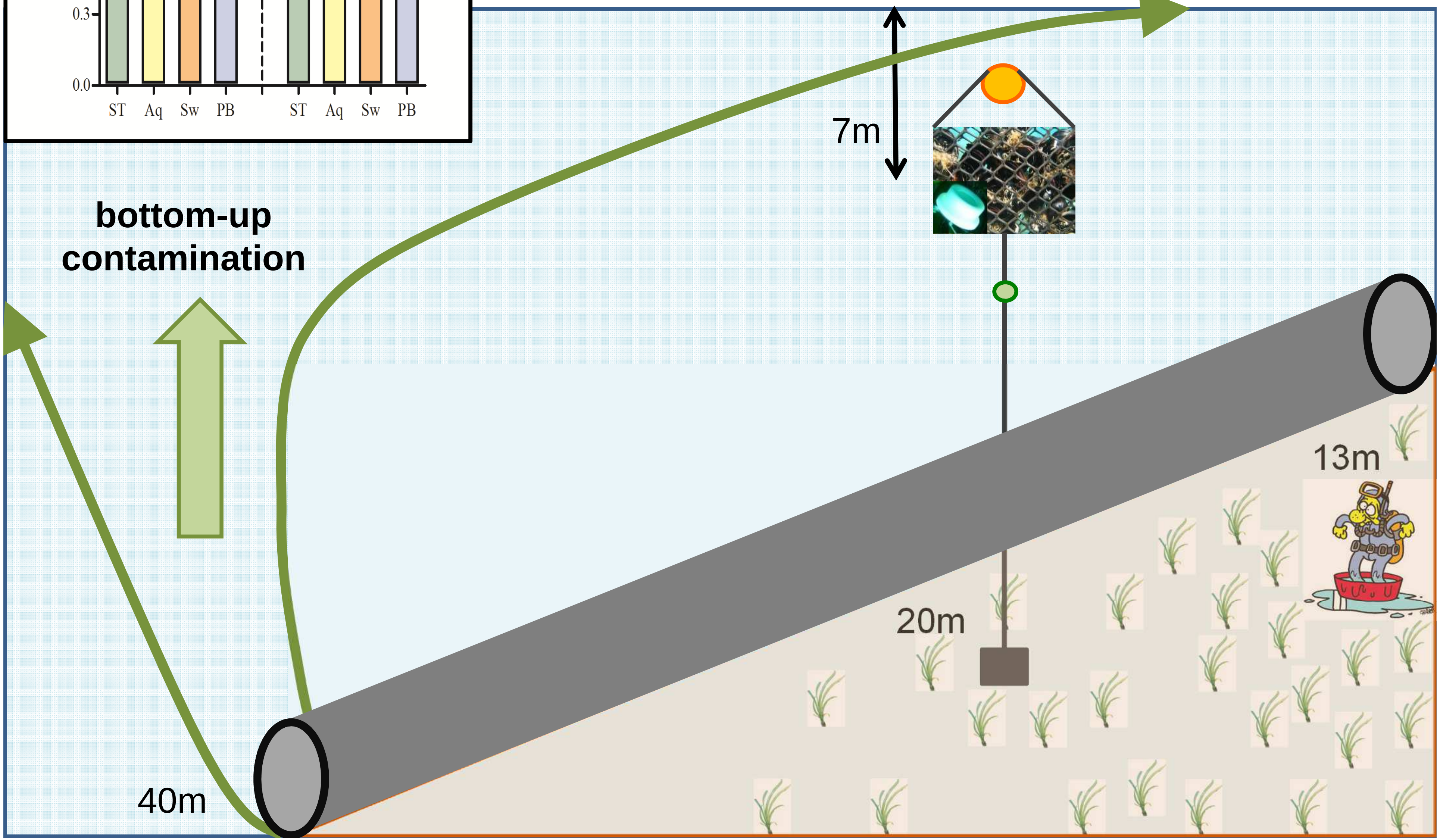
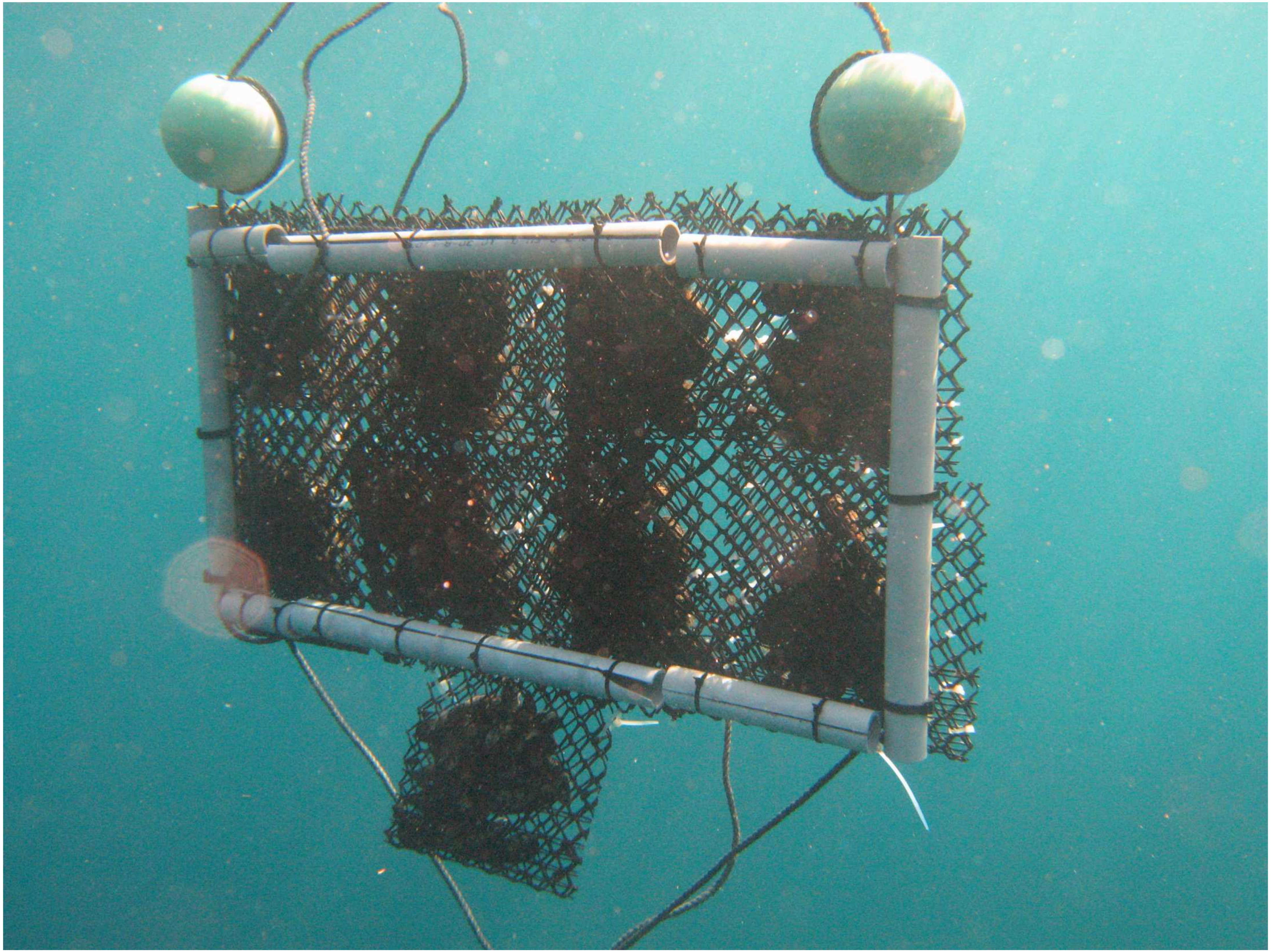


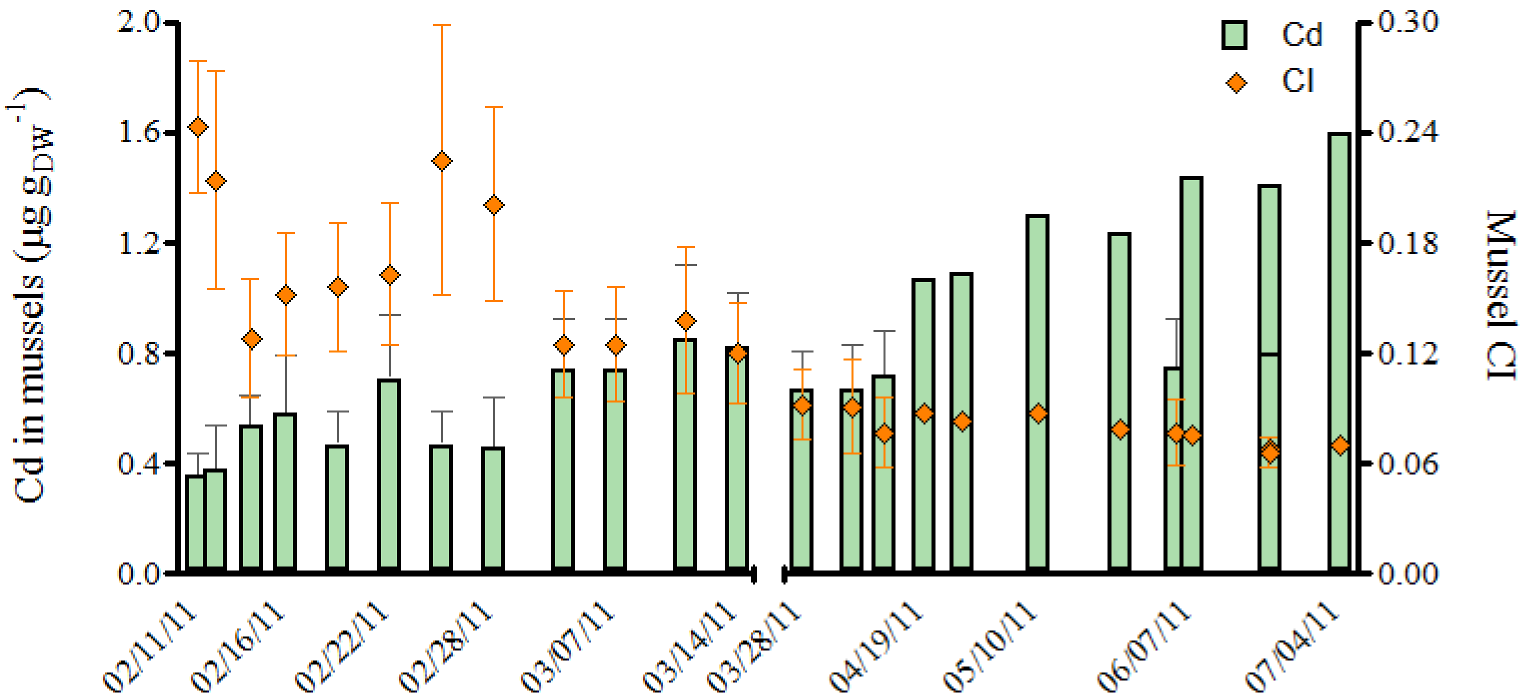
TE kinetics in caged mussels

APPLICATION 5



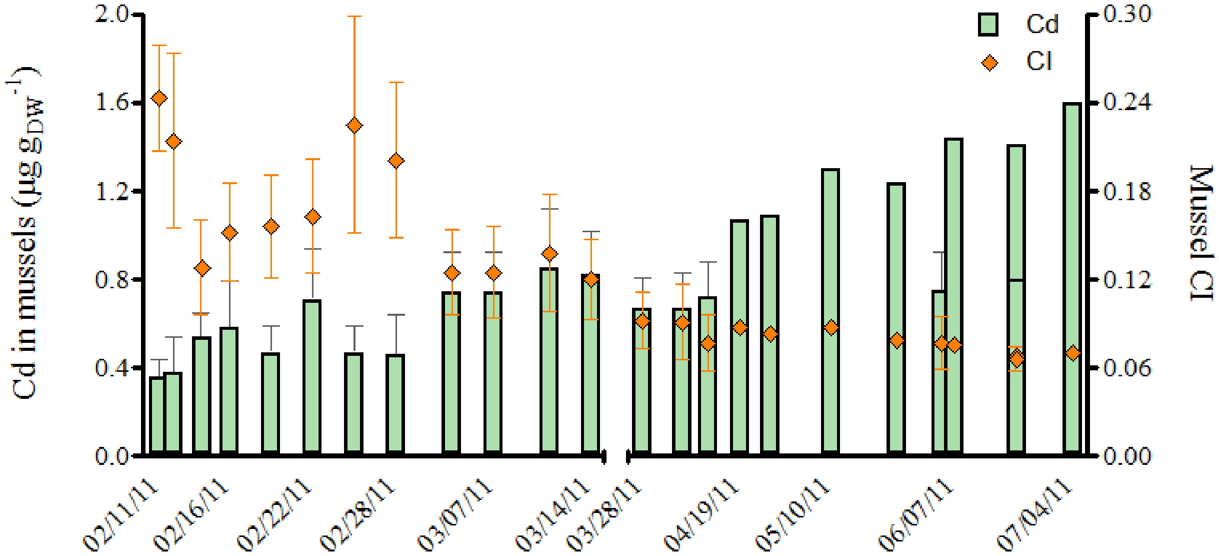
TE kinetic in caged mussels

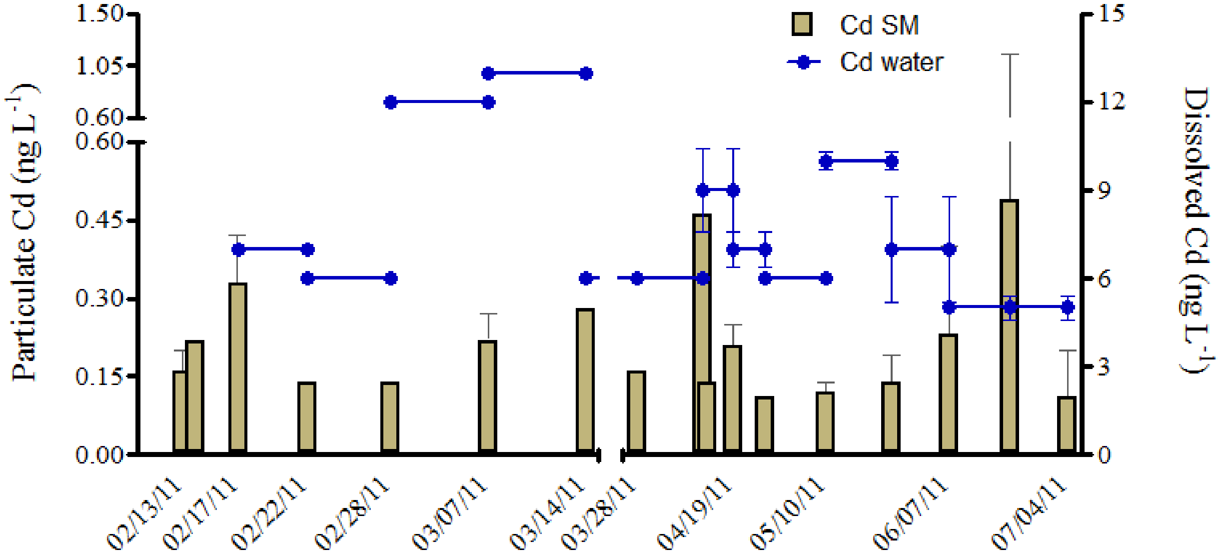
APPLICATION 5



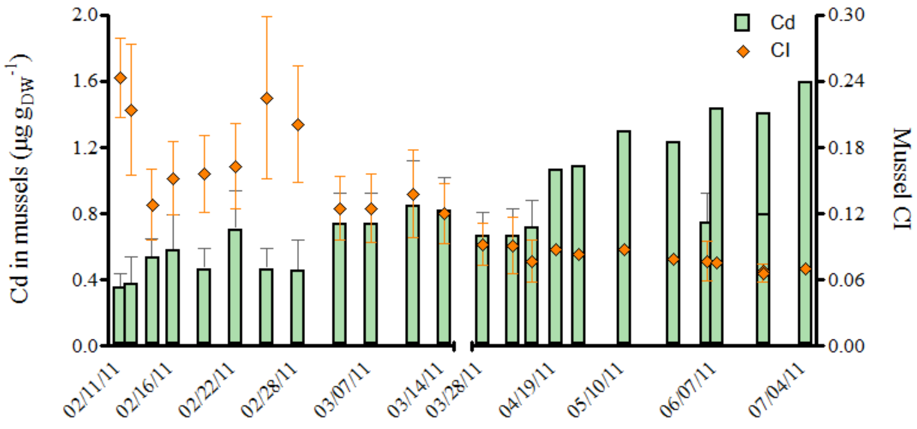
TE kinetic in caged mussels

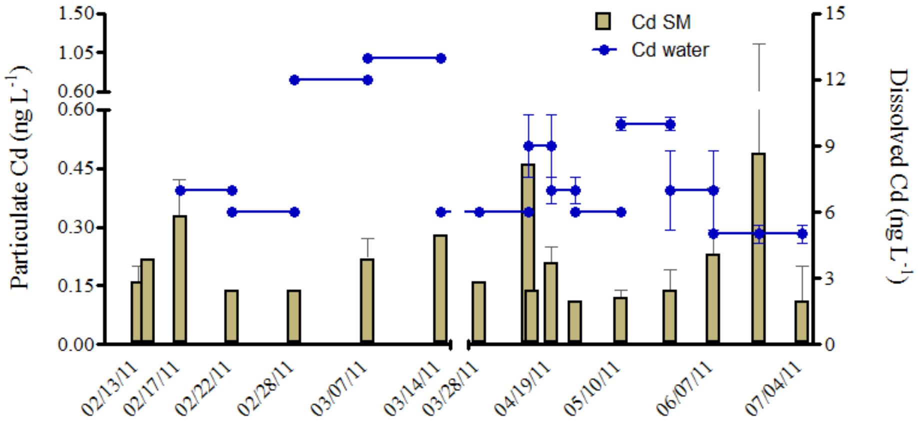
APPLICATION 5

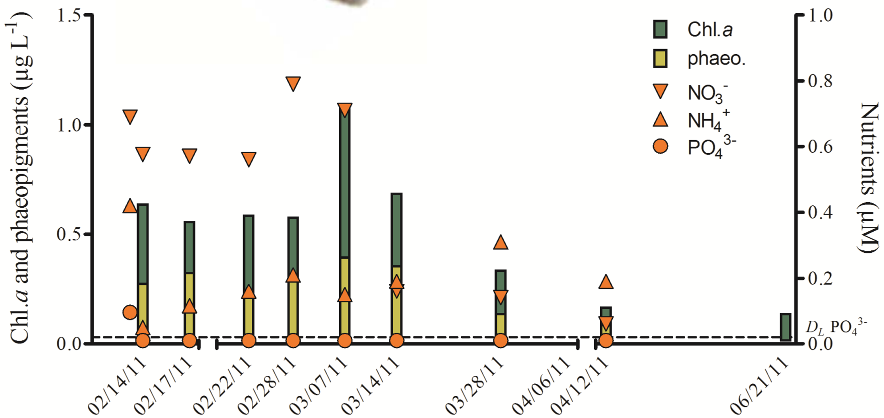


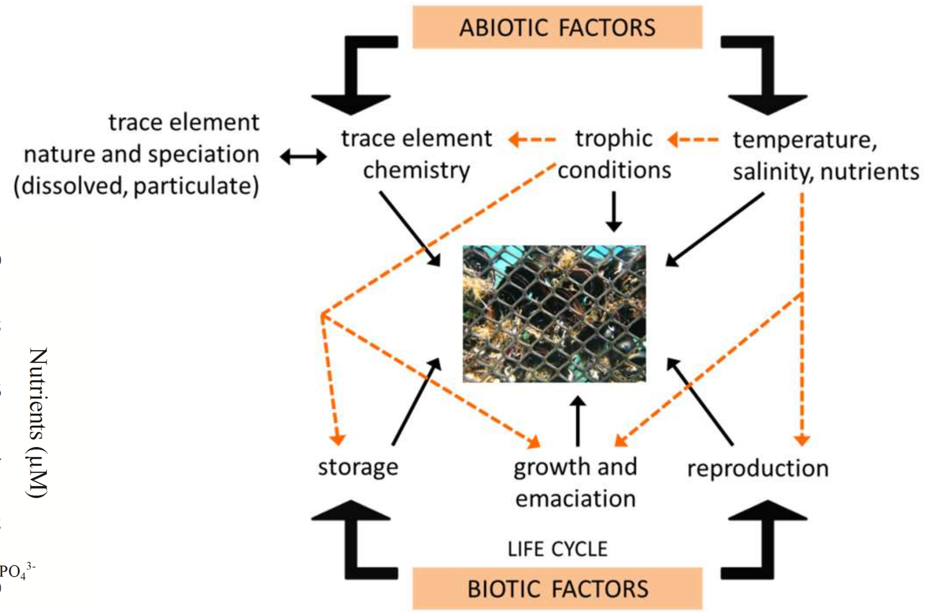


TE kinetic in caged mussels









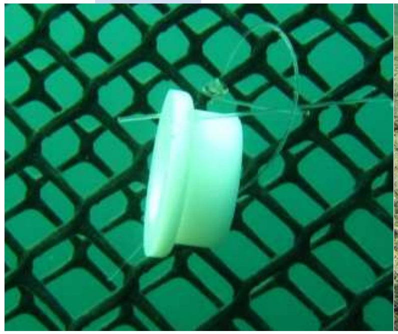
(modified after Casas, 2005)

DGTs vs bioindicators

CONCLUSIONS

- Different and complementary information;
- Organism ecology in their chemical environment;
- Average TE concentrations over deployment time;
- Scheduled monitoring campaigns.

→ Combined use in ecological, ecotoxicological and ecosystemic approaches of marine coastal environment functioning.



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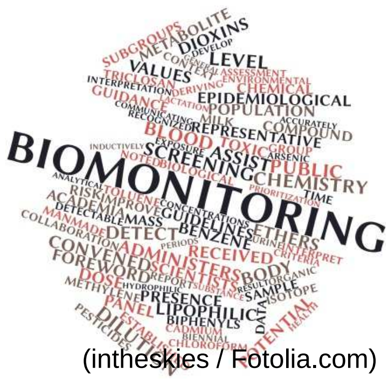

(intheskies / Fotolia.com)

Thank you for your attention

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01-10-15