CLEANATLANTIC CONFERENCE

Vigo, 21st June

09.00 – 16.30 h
(UTC+2h00, Madrid, Bruselas)

Toxicity of butts and buds

Juan Santos, Camille Lacroix, Aurore Zéler, Jesús Gago, Justine Receveur, Josie Russell and Andy Smith

Interreg Atlantic Area
European Regional Development Fund
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Clean Atlantic

CSIC
Cedre
Cefas

Context

Both are among top beach litter items

OSPAR monitoring (2016-2019): **7.8%** of litter

Cellulose acetate (plastic)

Used to retain toxicants

Not perceived as dangerous for the environment

Several pathways to the ocean: discharge on beaches, transfer via rainwater system, …

BUTTS

BUDS

OSPAR monitoring (2016-2019): **5.3%** of litter

Polypropylene (plastic)

From sewage system

But can also be found on streets (loss during waste collection?) suggesting also transfer via rainwater system

Fate and potential impact on the marine environment?

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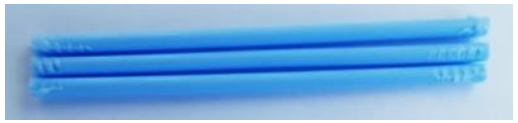
Context

3 types (light, medium, strong) studied



2 types (prices) studied

Both real and artificially-smoked butts

Provide new knowledge and recommandation to support decision making
Contribute to OSPAR Regional action plan - action 48

OSPAR COMMISSION
Protecting and conserving the North-East Atlantic and its resources

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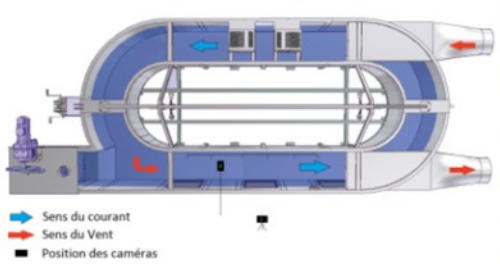
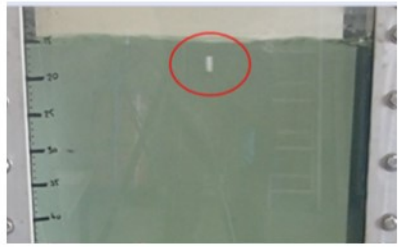
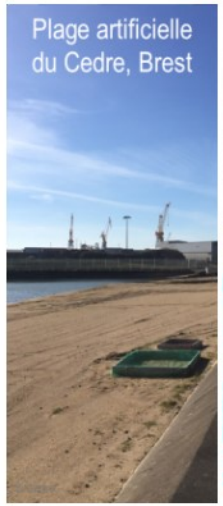
Experimental studies

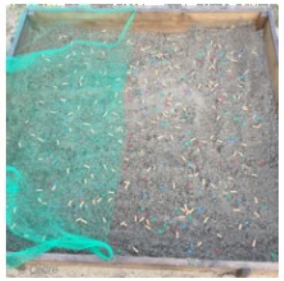
Behaviour (butts and buds)



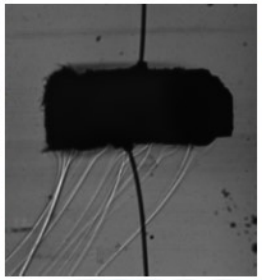


Weathering (butts and buds)

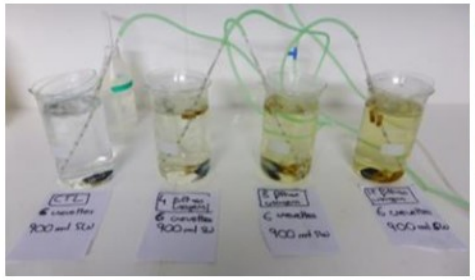


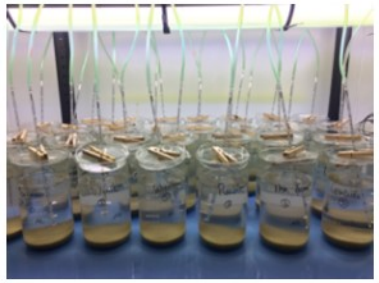


Chemical contamination (butts)



Ecotoxicity (butts)





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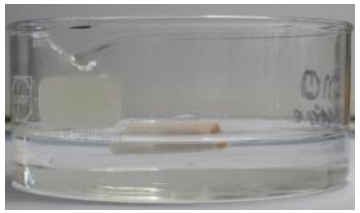
Behaviour in the environment?

Complex behaviour due to its air content, it can either float or sink

→It can reach every marine compartment

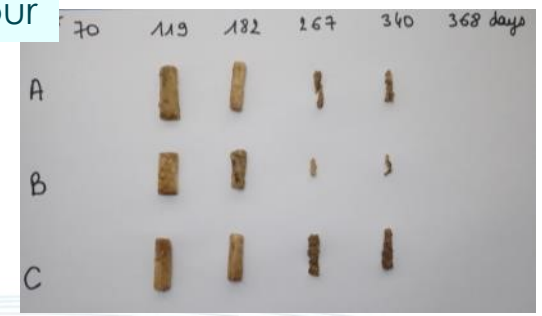


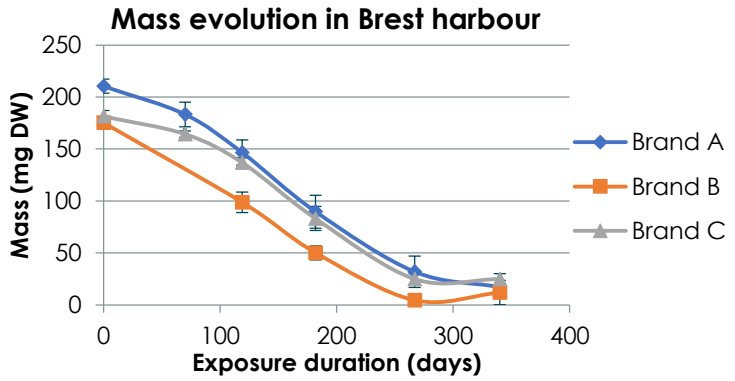
Appear to degrade in seawater but to persist longer on a sandy beach

→Mecanisms involved in degradation remain unknown and the release of small particules cannot be ruled out

Cedre beach

Brest harbour





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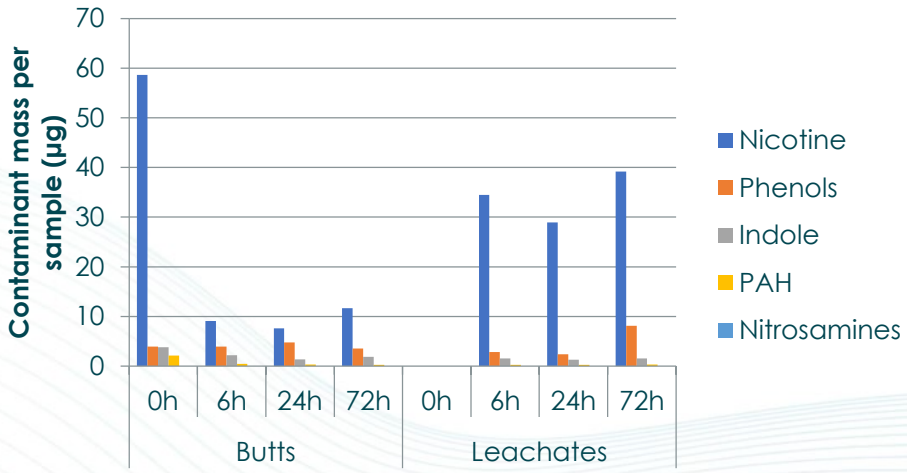
What about chemical contamination?

Complex chemical composition: nicotine, ethylphenol, Cotinine, Nornicotine, N-Formyl-anatabine, N-Acetyl-nornicotine, 4-(Acetylmethylamino)-1-(3-pyridyl)-1-butanone, Tryptophan, PAH

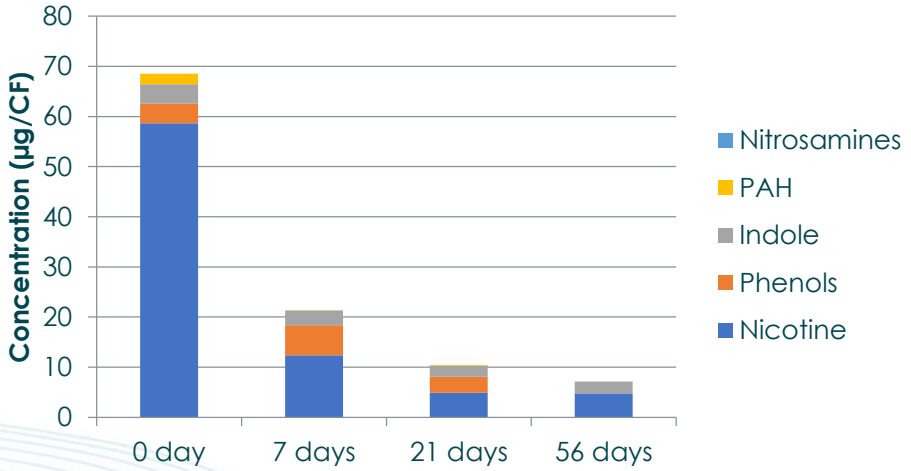
Among contaminants analysed, **nicotine is the most abundant**

Contamination **quickly transfered to the environment**, especially in contact with water

Transfer of contaminants in seawater



Toxicity on artificial beach



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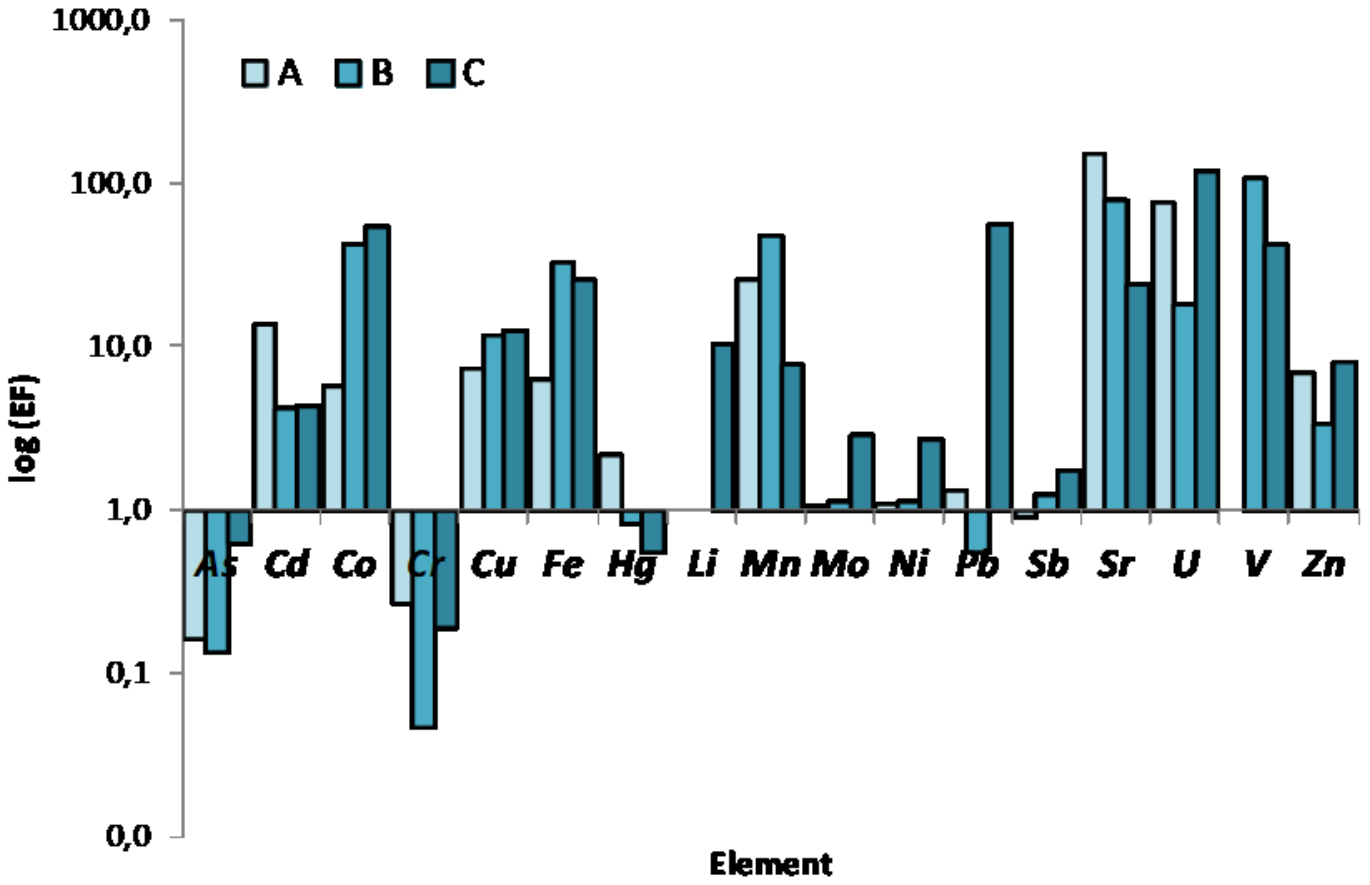
What about chemical contamination?

Smoked vs non-smoked?

Element (ppm)	A	B	C	AF-1	BF-1	CF-1
As	0,153	0,149	0,131	0,025	0,02	0,08
Cd	0,003	0,003	0,001	0,037	0,014	0,002
Co	0,003	0,001	0,001	0,017	0,046	0,076
Cr	0,808	0,430	0,262	0,215	0,02	0,05
Cu	0,245	0,055	0,051	1,775	0,65	0,63
Fe	7,86	3,97	4,13	49,80	129,9	103,8
Hg	0,003	0,004	0,007	0,005	0,004	0,004
Li	b.d.l.	b.d.l.	0,006	0,085	0,10	0,06
Mn	0,091	0,056	0,176	2,33	2,65	1,35
Mo	0,015	0,012	0,006	0,016	0,013	0,016
Ni	0,160	0,140	0,056	0,175	0,16	0,15
Pb	0,096	0,151	0,012	0,125	0,083	0,684
Sb	0,017	0,014	0,008	0,015	0,017	0,014
Sr	0,061	0,066	0,199	9,25	5,2	4,8
U	0,001	0,001	0,002	0,057	0,01	0,188
V	b.d.l.	0,005	0,005	0,145	0,501	0,208
Zn	0,760	0,900	0,470	5,26	3,05	3,8



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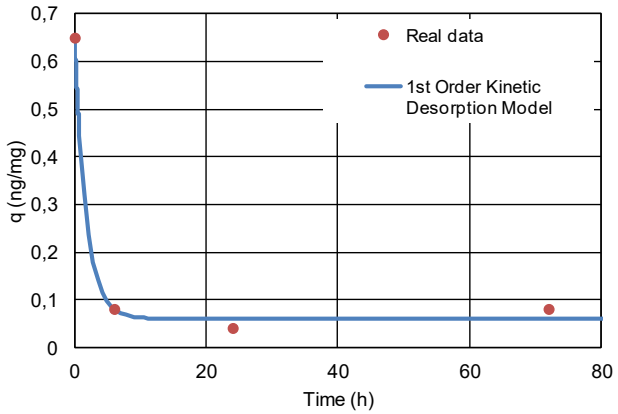
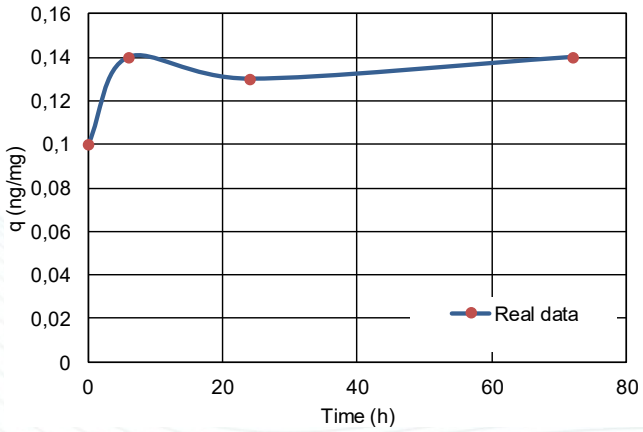
What about chemical contamination?

Metal leaching from smoked butts

All elements



Li and Sr



Element	Brand			% Desorption
	A	B	C	Mean±St. Dev.
As	67	50	88	68±19
Cd	90	64	100	85±18
Co	81	83	88	84±4
Cr	59	-	40	50±13
Cu	**90**	**94**	**89**	**91±3**
Fe	83	80	83	82±2
Hg	79	74	74	75±3
Li	-	-	-	-
Mn	**87**	**88**	**93**	**89±3**
Mo	**33**	-	**38**	**35±3**
Ni	63	38	67	56±16
Pb	-	**2**	**76**	**39±52**
Sb	84	82	86	84±2
Sr	**40**	-	-	**40**
U	79	50	82	71±18
V	74	85	82	80±6
Zn	**88**	**85**	**86**	**86±2**

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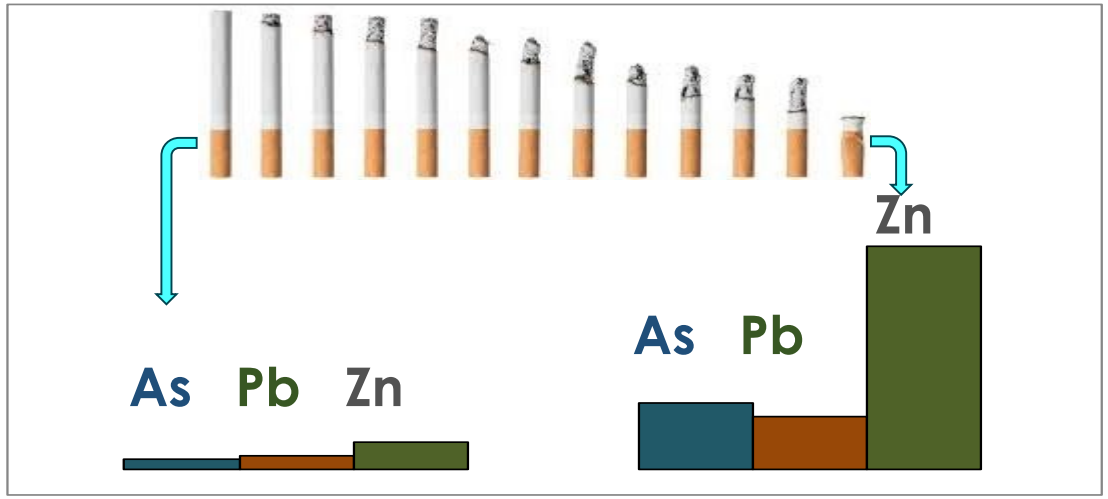
What about chemical contamination?



Clean water

Desorption

As Pb
Zn

Contaminated water

Adsorption

Zn As As Pb
Pb Zn As Zn
Pb Zn

As Pb As As Pb
Zn Pb Zn

Desorption

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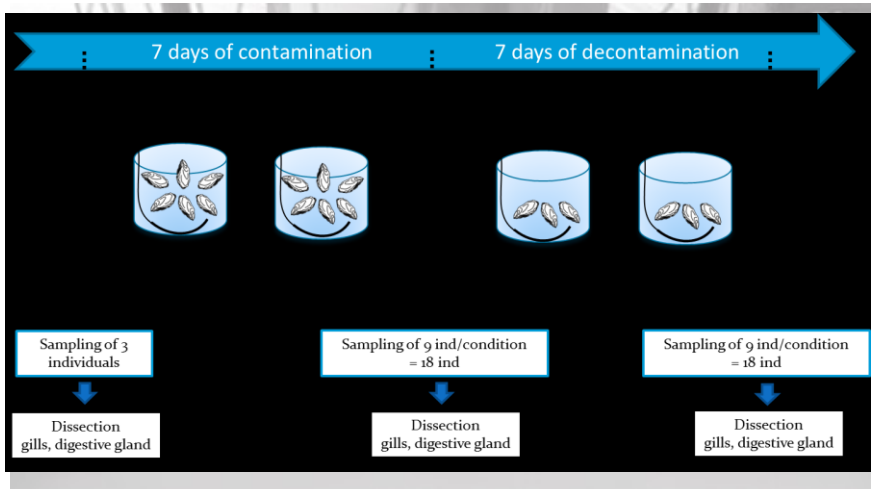
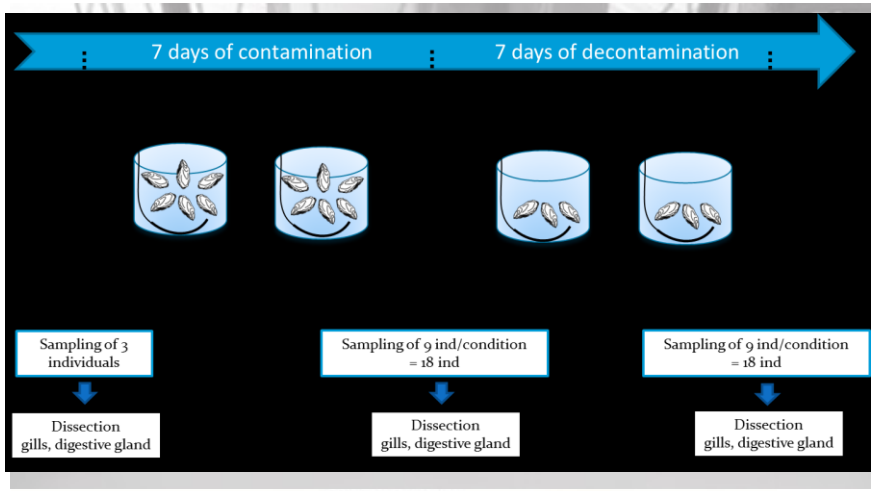
Toxicity


7 days of contamination
7 days of decontamination
Sampling of 3 individuals
Sampling of 9 ind/condition = 18 ind
Sampling of 9 ind/condition = 18 ind
Dissection gills, digestive gland
Dissection gills, digestive gland
Dissection gills, digestive gland

Toxicity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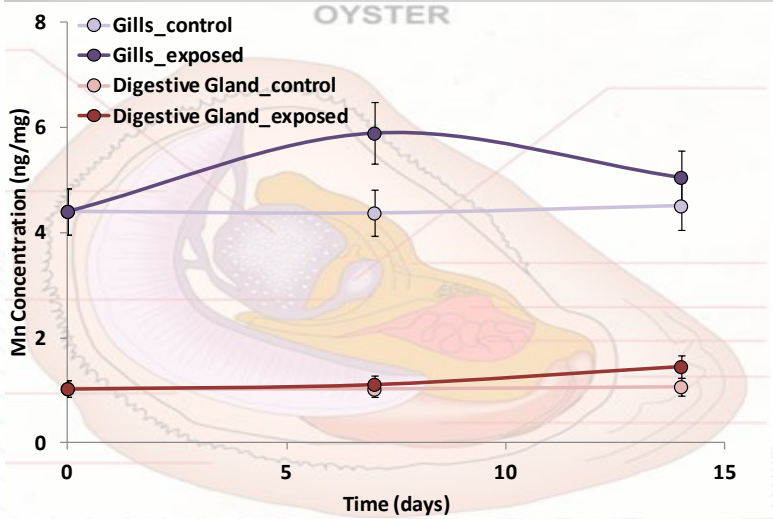
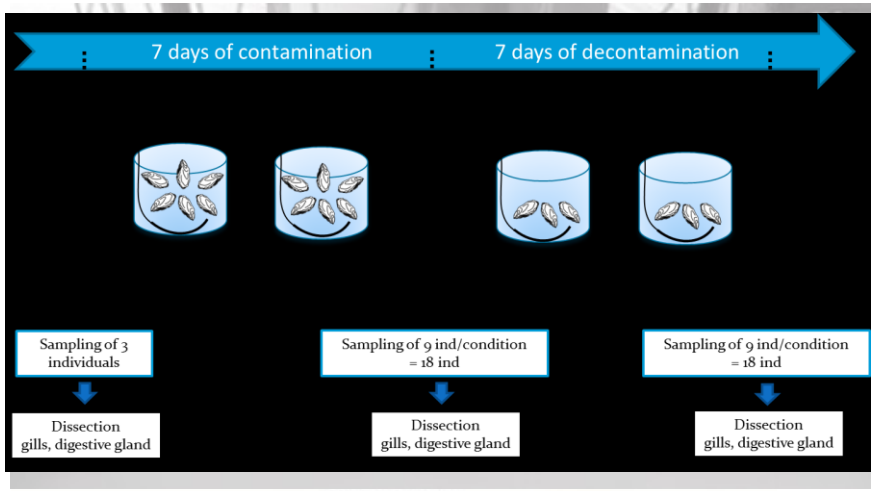
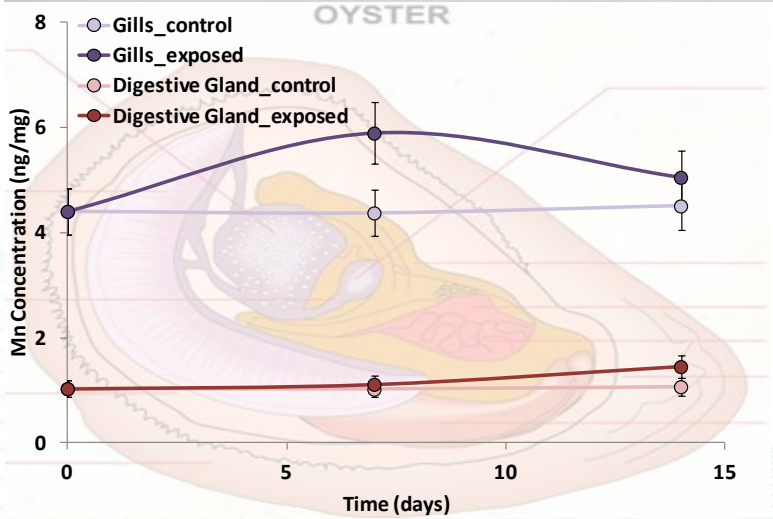

OYSTER
Gills_control
Gills_exposed
Digestive Gland_control
Digestive Gland_exposed
Mn Concentration (ng/mg)
0
2
4
6
8
0
5
10
15
Time (days)

Toxicity



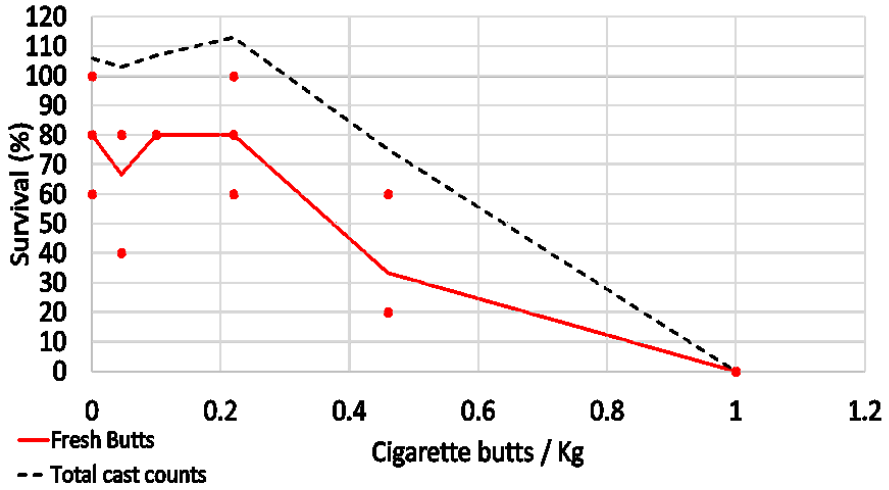


	Baseline value (ng/mg)		Potential accumulation (ng/mg)	
	Gill	Digestive Gland	Gill	Digestive Gland
As	4,6	5,16	0,01	0,01
Cd	0,61	0,68	0,00	0,00
Co	0,04	0,04	0,01	0,01
Cr	0,15	0,13	0,02	0,03
Cu	16,33	16,96	0,18	0,23
Fe	50	53	17	22
Hg	0,05	0,06	0,00	0,00
Li	0,13	0,11	0,00	0,00
Mn	4,5	4,6	0,46	0,58
Mo	0,09	0,08	0,00	0,00
Ni	0,59	0,68	0,02	0,03
Pb	4,9	5,8	0,06	0,07
Sb	0,005	0,005	0,003	0,004
Sr	6,3	4,1	1,0	1,3
U	0,05	0,06	0,01	0,02
V	0,16	0,19	0,06	0,07
Zn	472	499	0,80	1,0

Toxicity

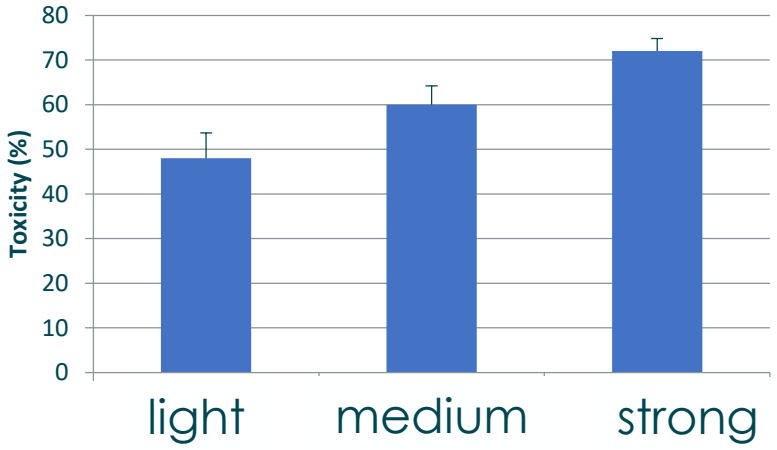
In a short period of time, one CF can contaminate water or sediment at a level that may affect marine organisms

10 Day Arenicola mortality test



Endpoint	Fresh Cigarette butts/kg sediment	Statistical methods
EC_{50} Mortality	**0.424** (0.340 – 0.528)	Spearman-Karber

Microtox© test



24h leachates Seawater Concentration of 8 CF/L

EC50: 3,4 – 5,6 CF/L

CF present a risk for water and sediment quality and associated organisms

CF are harmful for the marine environment

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What did we learn on cigarrete butts?

1. Most of the **CBs are enriched in metals** after being smoked (up to 150 times).

2. Once in the sea, **metals** are **released to seawater** (up to 91% desorption).

3. **Once in the environment**, while **butts** are degraded, they tend to **accumulate metals**, some of the metals are more accumulated when butts are released in the sand, others while butts are degraded in the harbor.

4. **No increases** were **observed** with respect to metal levels **in oyster tissues** after exposure to smoked CBs. Although metals are released from the smoked, the potential quantity of metal than can be adsorbed by the tissues is well below the usual content of metals in the tissues. The exceptions are Mn and Sr.

5. **This does not indicate that metals in butts cannot affect metal concentration in marine bivalves**. In fact, if the stock solution would have been prepared **desorbing the metals for the aged butts** in the harbor or in the beach, metal levels in **oyster tissues would have probable been increased.**

6. **Future research** and experiments could be conducted in this line, as not only plastics, but also butts are changing the natural biogeochemical cycle of metals and their exposure to marine biota.

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What did we learn on plastic cotton bud sticks (PCBS)?

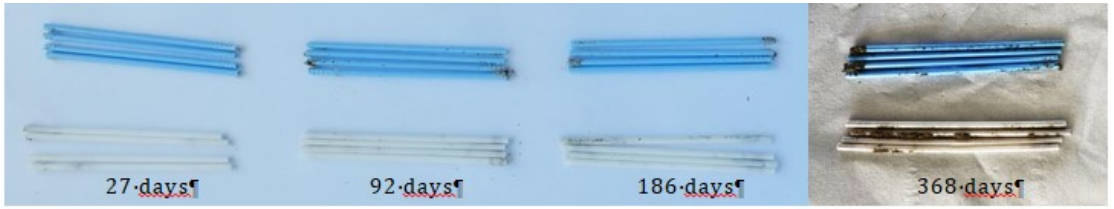
Float in seawater, especially when cotton tips have disappeared

→It can disperse in the marine environment

Degrade slowly but differences were observed between brands

→After one year, in Brest marina, no degradation was observed (no mass loss)

→After, one year on Cedre beach, no degradation was observed though one brand became very brittle and degraded into small fragments



PCBS evolution on Cedre artificial beach

Species can develop on PCBS

As other plastic, PCBS can be harmful (species transport, contamination, ingestion, …**)**

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Conclusion and recommandations

- Both (butts and buds)appear to be harmful but for different reasons

=> for cotton bud sticks, it is due to its plastic composition

=> for cigarette filter, main risk is related to its chemical contamination

Cotton buds sticks are waste difficult to manage (their size makes them difficult to retain) and it appears difficult to prevent discharges

PCBS must be banned and replaced by alternative biodegradable material (wood, paper, cardboard)

⇒Measure already taken at the EU level via the Directive 2019/904 and in the UK

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Conclusion and recommandations

- **Contact between cigarette filters and the environment (expecially water) should be prevented!**
- **Clean-up and biodegradable filter are not satisfactory solutions**

→ Do not prevent transfer of contaminants in the environment

- **Potential solutions:**
  - **<u>Collection and elimination or recycling</u>**
  - **<u>Awareness raising to prevent the discharge in the environment</u>**
  - **<u>Public policy to develop fines and other measures</u>**

→ Most of these actions are already existing and should be developed

More information

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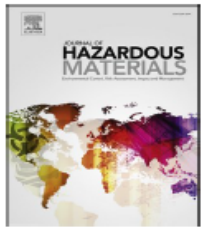

Check for updates

The role of cigarette butts as vectors of metals in the marine environment: Could it cause bioaccumulation in oysters?

Juan Santos-Echeandía [a,*], Aurore Zéler [b], Jesús Gago [a], Camille Lacroix [b]

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[b] Centre of Documentation, Research and Experimentation on Accidental Water Pollution (Cedre), 715 rue Alain Colas, CS 41836, Brest Cedex 2 29218, France

Final reports will be available on CleanAtlantic website
Work will contribute to the elaboration of OSPAR background document for action 48

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Thank you!

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