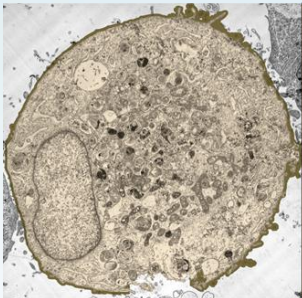
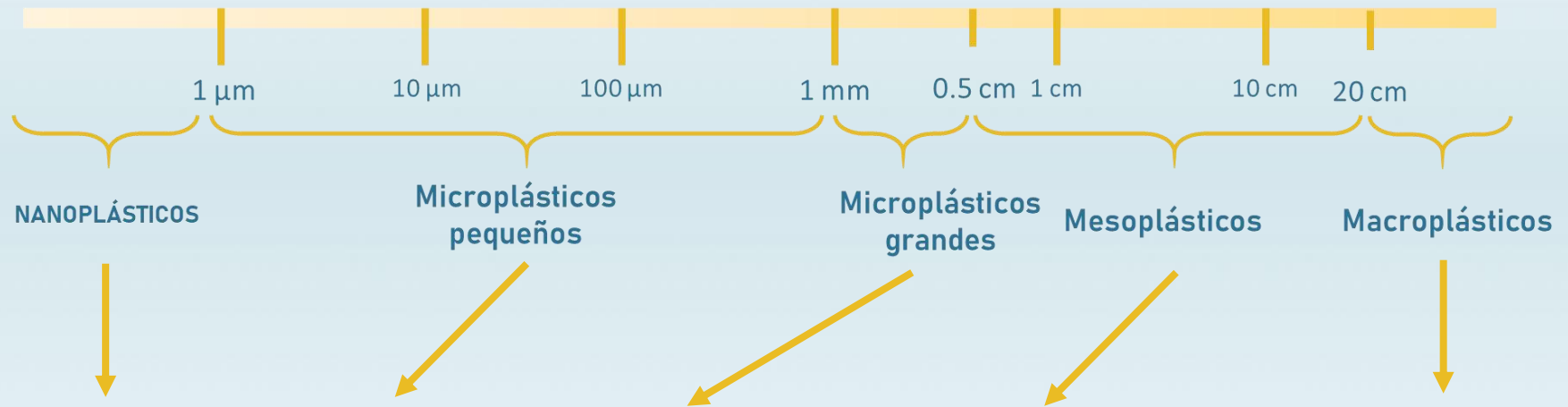


# MICROPLASTICOS Y SUS IMPACTOS. EFECTOS ECOTOXICOLÓGICOS EN ECOSISTEMAS MARINOS

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## ¿TAMAÑO ↔ IMPACTO?



## IMPACTO: propaganda vs ciencia



Fotografía: Chris Jordan

### Plásticos de origen marino:

Niveles máximos: 0.1-1 g por estómago  
*Fulmarus* (Bond et al. 2001)

### Plásticos de origen terrestre:

Niveles máximos: 9-24 g por estómago  
Pollos de albatros (Auman et al. 1997)  
*“ingested plastic probably does not cause direct mortality ... but likely causes physiological stress”*  
*“plastics ... have little or no impact at population level”*

# FACTS

1. **Production of plastics grows steadily**

2. **Plastics from land sources end up in the sea. Roughly 10 million T /year, i.e. 3% of global production.** Jambeck et al. 2015



Jay Directo / Getty Images

# FACTS

1. **Production** of plastics **grows steadily**
2. Plastics from land sources **end up in the sea**. Roughly 10 million T /year, i.e. 3% of global production.
3. Conventional plastics (PE, PP, PS, PVC, PET) are **NOT biodegradable**.

## Environmental persistence



**Plastic bottle**  
*450 years*

**All plastic** objects **disposed** in the environment throughout history have the potential to still **remain in the environment**

Around **70% of marine litter is plastic** (Derraik 2002)

# Where is plastic debris going?

## Environmental persistence

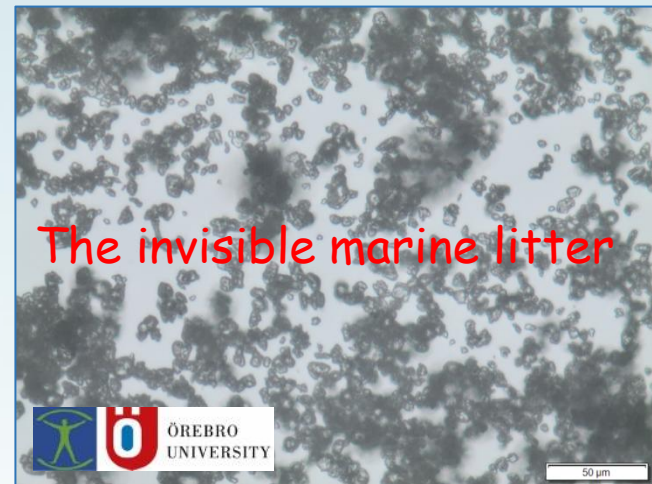
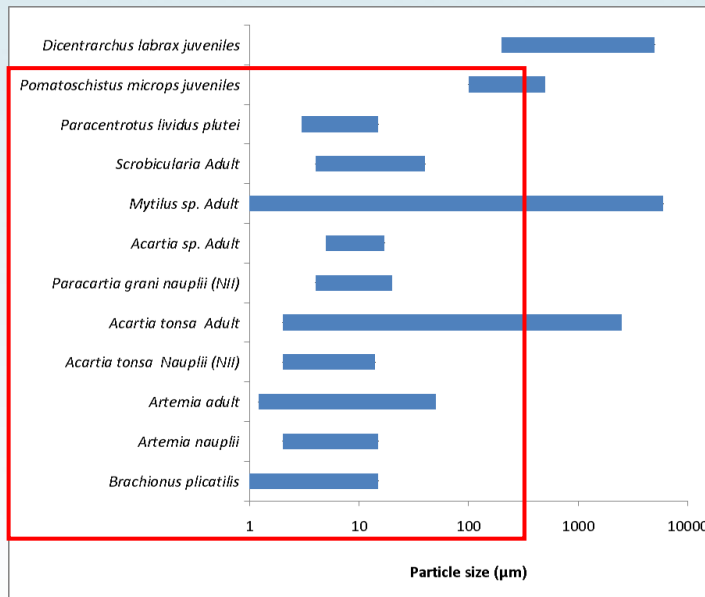


**Plastic bottle**  
450 years

Low energy environments: deep seafloor



High energy environments: exposed coast  
**Secondary microplastics**



Particles < 200-300 µm are **not monitored** using current methods

Conceptos que deberíamos tener claros:

**-Plástico biodegradable:** plástico susceptible de ser reducido a CO<sub>2</sub> o metano por microorganismos del ambiente.

**-Plástico oxodegradable:** plásticos convencionales derivados del petróleo que contienen pequeñas cantidades de catalizadores que facilitan la fragmentación de las cadenas del polímero.

**-Bioplásticos:** plásticos hechos de materiales biológicos renovables tales como el ácido láctico o el almidón, en general susceptibles a la degradación microbológica.



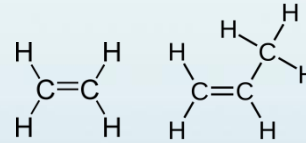
## ¿Cual es la composición de un objeto de plástico?



Petróleo

*cracking*

Oleofina



I. polimerización (grandes compañías petroquímicas)

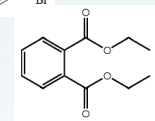
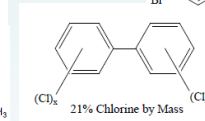
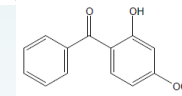
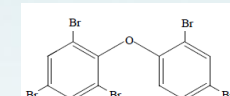
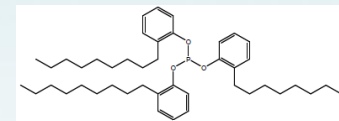


Polímero (PE, PP, PS...)

II. *compounding* (pequeños fabricantes)

**aditivos** Plastificantes, retardantes de llama, estabilizantes (filtros UV filters, biocidas), antioxidantes, colorantes...

Objeto de plástico



El mismo **polímero** puede mostrar **propiedades ecotoxicológicas** completamente diferentes dependiendo de los **aditivos** químicos que incluya.



## ¿Cual es la composición de un objeto de plástico?

### EL POLÍMERO

70% PVC

97% LDPE

>95% PLA

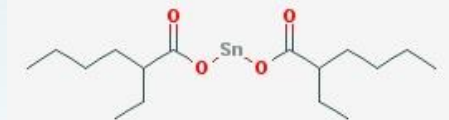


### LOS ADITIVOS

30% DEHP, un disruptor endocrino

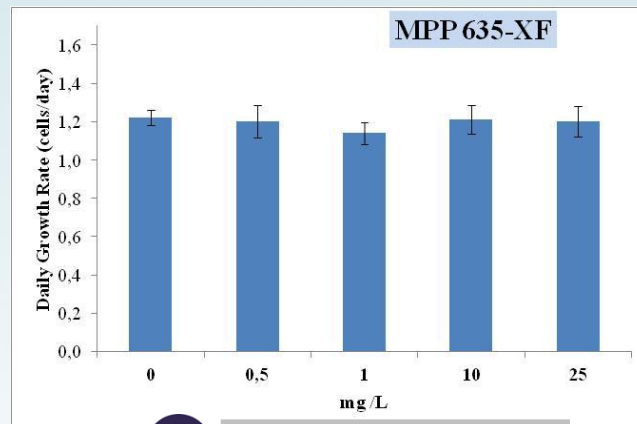
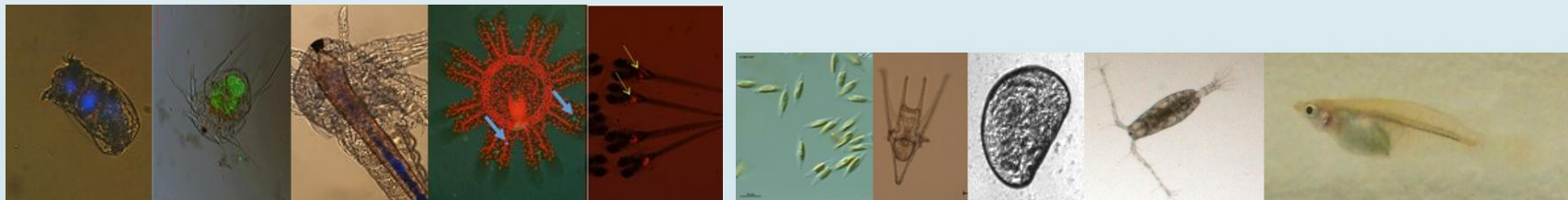
3% Antioxidantes (BHT, HALS), UV estabilizantes (BP, Ni-quenchers), pigmentos (TiO<sub>2</sub>, Cr...)

2% BHT (antioxidante), agente antimicrobiano, Bis(2-ethylhexanoyloxy)-Tin (iniciador)



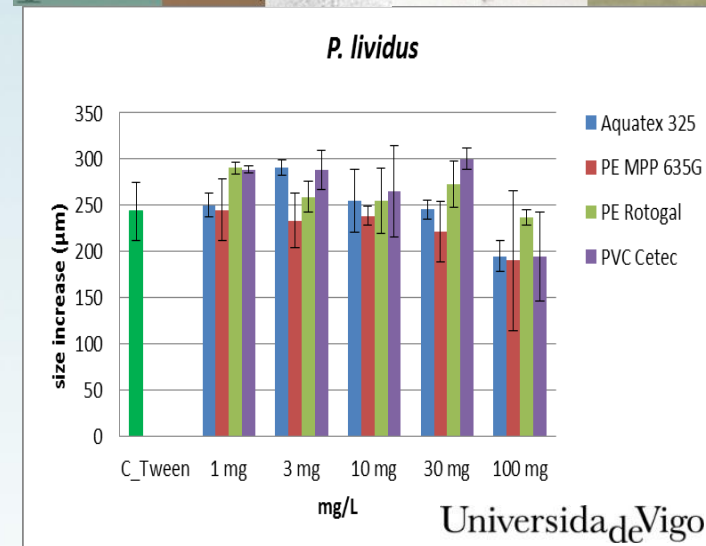
## EL POLÍMERO

**-Microplásticos de PE o PVC virgen carecen de toxicidad incluso tras ser ingeridos en grandes cantidades (LOEC>30 mg/L)**



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**Sin efecto sobre el fitoplancton**

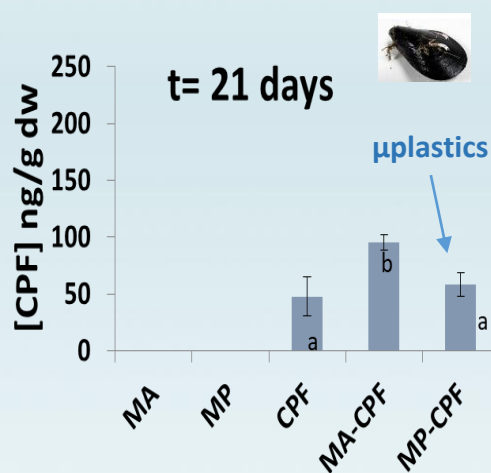
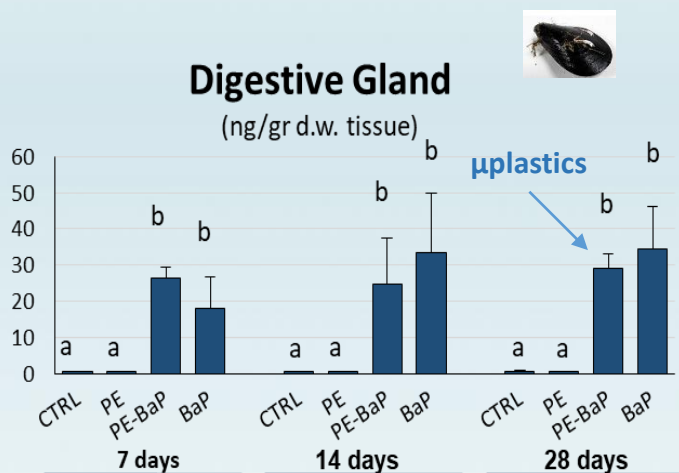


**Sin efecto sobre el zooplancton**

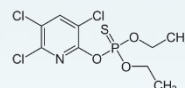
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## EL POLÍMERO

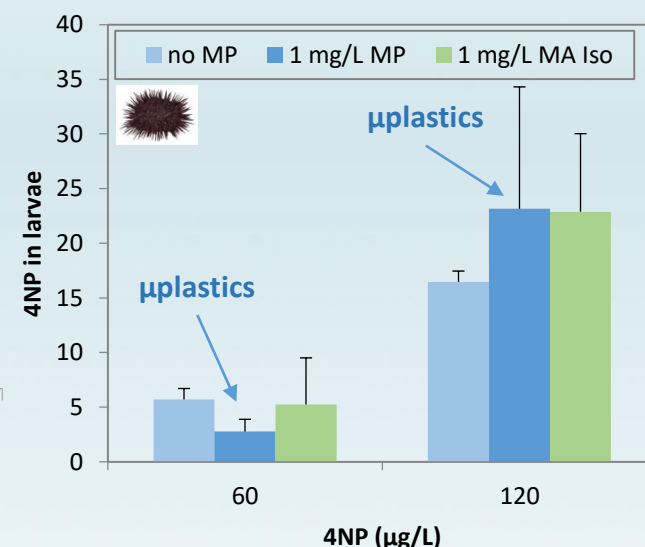
**-Microplásticos de PE no son relevantes como VECTORES de sustancias químicas hidrófobas, y no incrementan su bioacumulación ni su toxicidad comparados con las vías de exposición naturales**



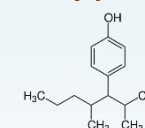
**chlorpyrifos**



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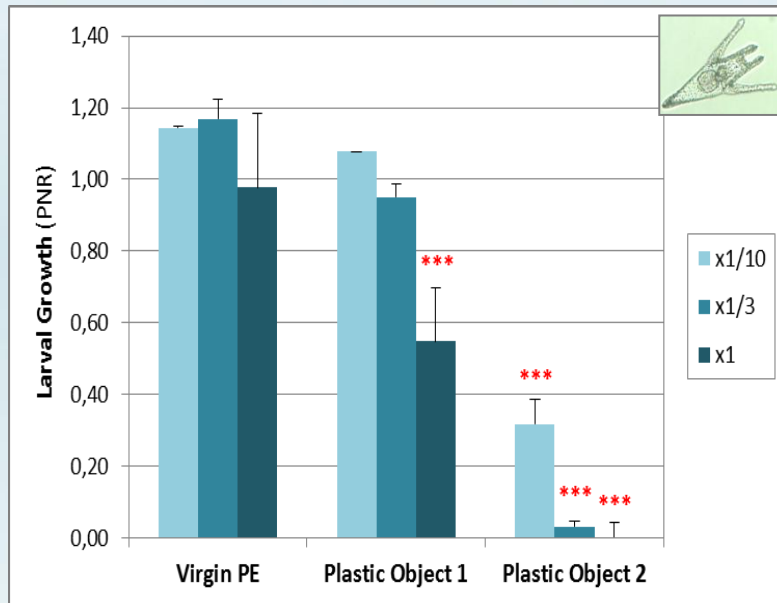
**4-nonylphenol**



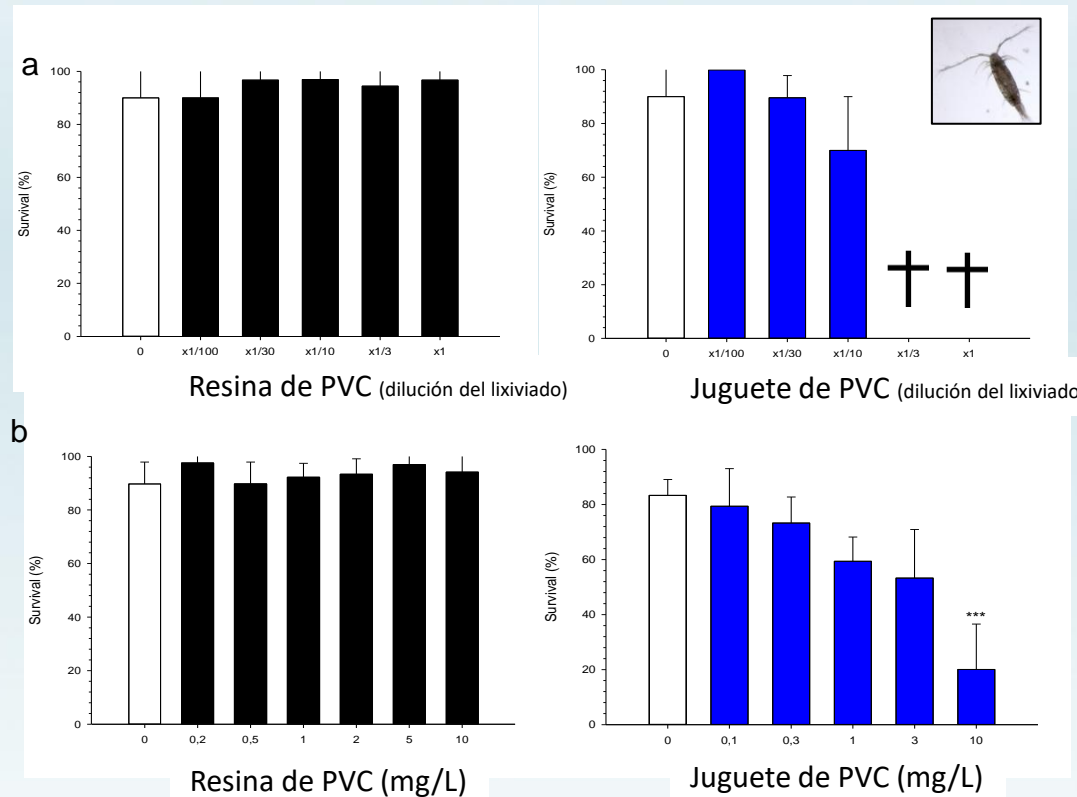
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## LOS ADITIVOS

La toxicidad de los microplásticos es debida a los **aditivos**



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Los productos comerciales son mucho más tóxicos que los polímeros vírgenes

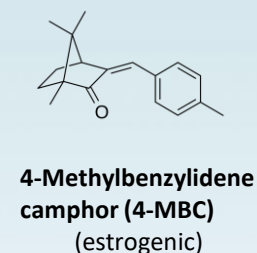
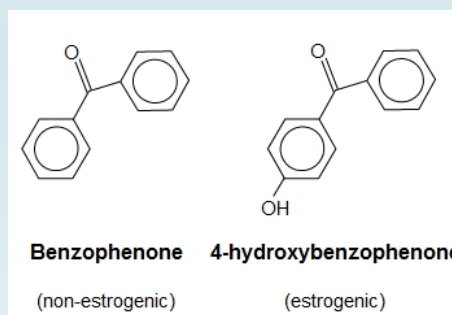
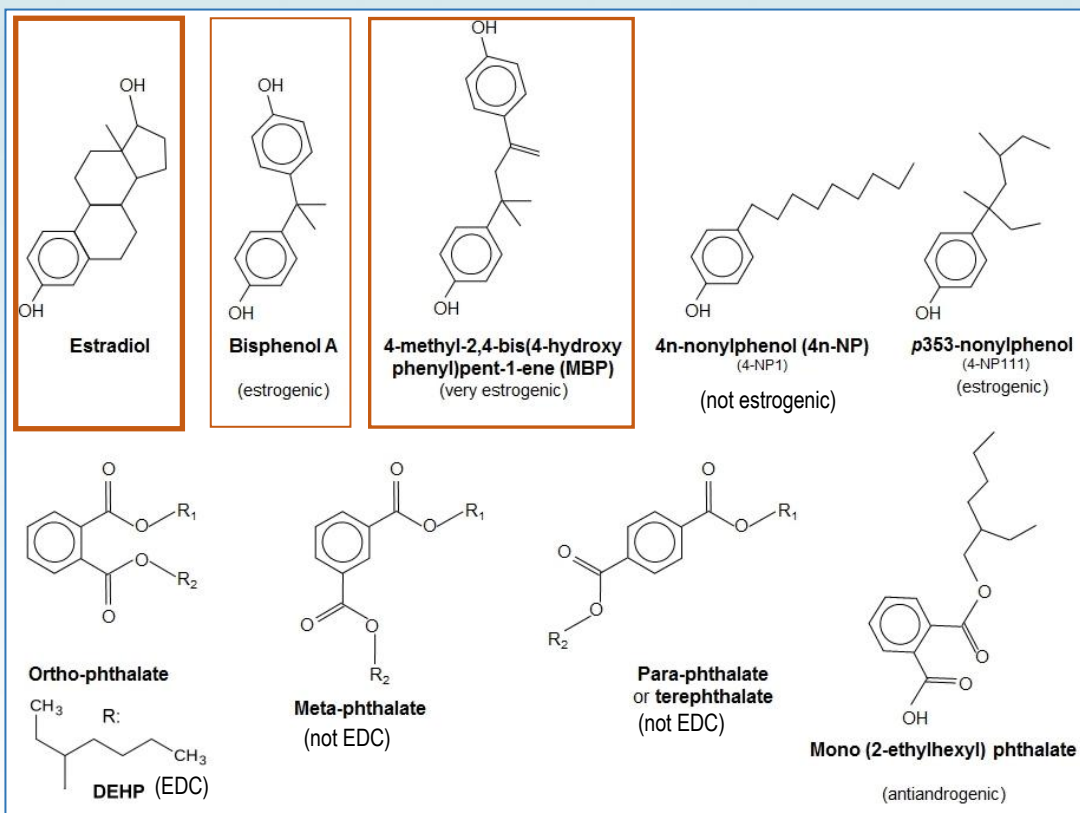
## LOS ADITIVOS

**Bisfenol A:** monómero del policarbonato y resinas epoxy

**Orto-ftalatos:** plastificantes

**Benzofenonas y 4-MBC:** filtros UV y estabilizantes de luz

## Compuestos Disruptores Endocrinos (EDC)



## A message for EU policy makers

Currently we cannot know the composition in additives of any plastic object, only the polymer is indicated (PE, PP, PET...). Even in plastics in contact with food or children toys.

### Food labeling:

**INGREDIENTS:** WATER (75%), **SUGARS (12%)** (GLUCOSE (48%), FRUCTOSE (40%), SUCROSE (2%), MALTOSE (<1%), STARCH (5%), **FIBRE E460 (3%), AMINO ACIDS** (GLUTAMIC ACID (19%), ASPARTIC ACID (16%), HISTIDINE (11%), LEUCINE (7%), LYSINE (5%), PHENYLALANINE (4%), ARGININE (4%), VALINE (4%), ALANINE (4%), SERINE (4%), GLYCINE (3%), THREONINE (3%), ISOLEUCINE (3%), PROLINE (3%), TRYPTOPHAN (1%), CYSTINE (1%), TYROSINE (1%), METHIONINE (1%)), **FATTY ACIDS (1%)** (PALMITIC ACID (30%), OMEGA-6 FATTY ACID: LINOLEIC ACID (14%), OMEGA-3 FATTY ACID: LINOLENIC ACID (8%), OLEIC ACID (7%), PALMITOLEIC ACID (3%), STEARIC ACID (2%), LAURIC ACID (1%), MYRISTIC ACID (1%), CAPRIC ACID (<1%), ASH (<1%), PHYTOSTEROLS, E515, OXALIC ACID, E300, E306 (TOCOPHEROL), PHYLLOQUINONE, THIAMIN, **COLOURS** (YELLOW-ORANGE E101 (RIBOFLAVIN), YELLOW-BROWN E160a), **FLAVOURS** (3-METHYLBUT-1-YL ETHANOATE, 2-METHYLBUTYL ETHANOATE, 2-METHYLPROPAN-1-OL, 3-METHYLBUTYL-1-OL, 2-

### Clothing labeling:



### Plastic labeling:



## EU regulations restricting composition of plastic objects:

### -Articles that can be placed in the mouth of **children**:

- ≤ 0.1% for ED phthalates (Dir. 2005/84/EC)
- ≤ 0.1 mg/L (migration limit) for BPA (Dir. 2014/81/EU)
- ≤ 5 mg/Kg TCEP, TCPP, TDCP (Dir. 2014/81/EU)

### -Plastics in contact with **food**:

- migration limits for ca. 900 chemicals from 0.05 to 60 mg/Kg (Reg. 10/2011)

### -Packaging:

- <100 ppm for the sum of Hg, Cd, Pb and CrVI (Dir. 94/62/EC)

**Information relevant for the consumer: contents on chemical additives.**

Agradecimientos:

Thanks!



**ECIMAT**  
*Centro Singular de Investigación Mariña*

**JPI  
OCEANS**



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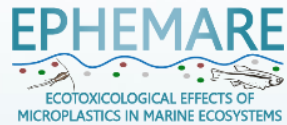


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## Conclusions:

- Plastic **particles < 200-300  $\mu\text{m}$**  in the sea, those more readily incorporated into food webs, are **not currently monitored**
- Ecological effects depend on particle size and plastic composition, particularly **plastic additives**, potentially **toxic**
- ERA studies are limited by the absence of **statistics** available about production or use of many **plastic additives**
- We lack **standard methods to detect EDCs** with marine organisms
- The **compositon of plastic** consumer products, included those in contact with food or toys, is **not disclosed**.