



# Plastic waste disposal

**Hazardous chemical contamination**

# Greenpeace Research Laboratories



# Plastic is not just a polymer

## Chemicals remaining from manufacture

- Monomers, eg styrene, bisphenol-A (BPA)
- Processing aids, eg PFASs for fluoropolymers
- Catalysts, eg antimony based catalyst in PET

## Additives

- Plasticisers, eg phthalates (DEHP, DBP,...)
- Flame retardants, eg brominated / chlorinated compounds (PBDEs, TDCPP,...)
- Stabilisers; UV stabilisers, thermal stabilisers, organo-metal compounds,..
- Pigments – eg metal compounds

# THE RECYCLING MYTH 2.0

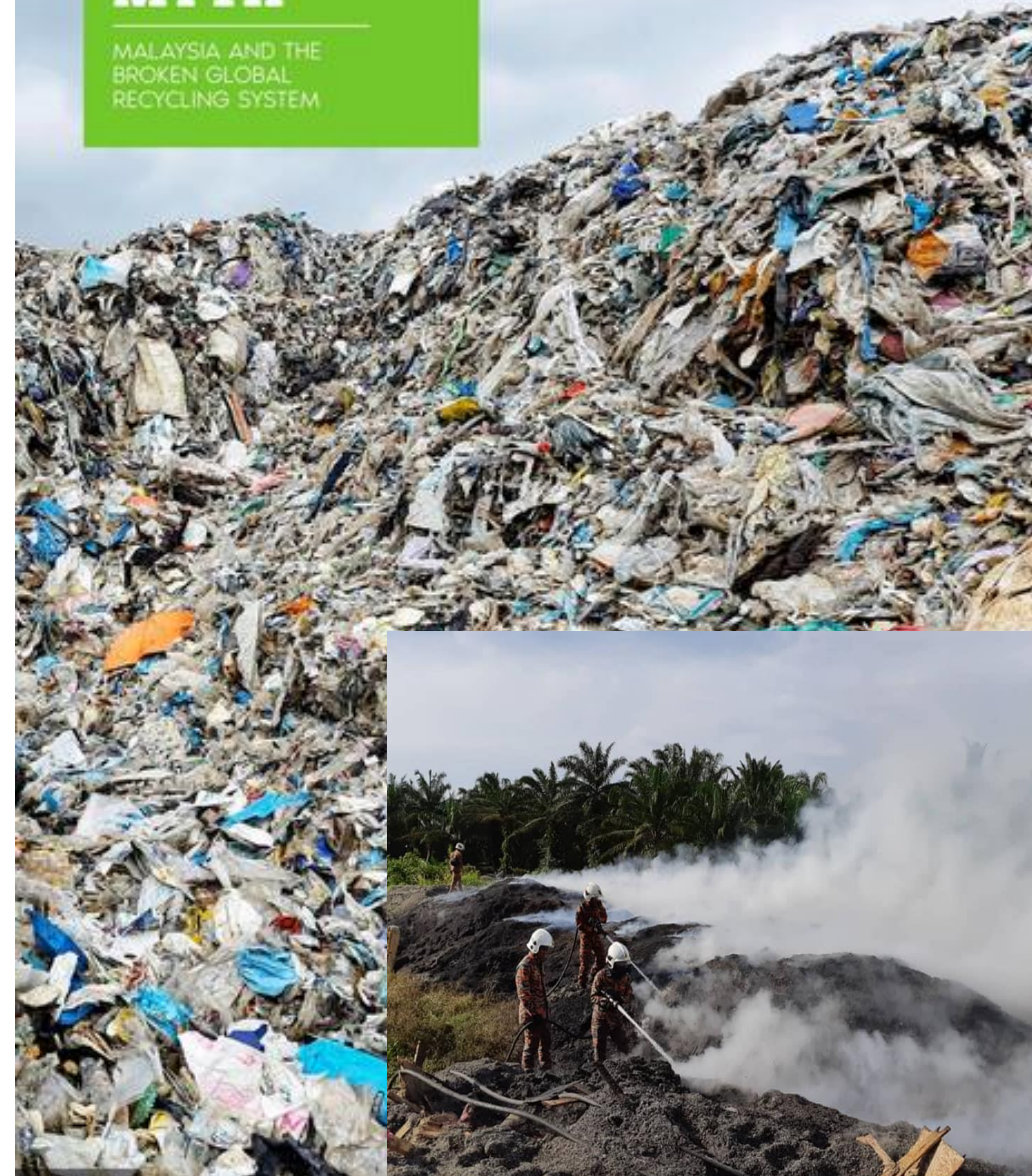
THE TOXIC AFTER-EFFECTS OF  
IMPORTED PLASTIC WASTE IN  
MALAYSIA



<https://www.greenpeace.org/malaysia/publication/3349/the-recycling-myth-2-0/>

## THE RECYCLING MYTH

MALAYSIA AND THE  
BROKEN GLOBAL  
RECYCLING SYSTEM



# Shredded mixed plastic

## Brominated & chlorinated flame retardants:

- PBDEs, BTBPE, DBDPE
- Dechlorane

## Plasticizers:

- phthalate esters: DEHP, DUP

## Other organic chemicals



# Shredded mixed plastic



## Brominated & chlorinated flame retardants:

- **PBDEs**, BTBPE, DBDPE
- Dechlorane

**PBDEs:** Highly persistent chemicals  
Can accumulate in the body  
Developmental neurotoxicity  
Toxic to reproductive and endocrine systems

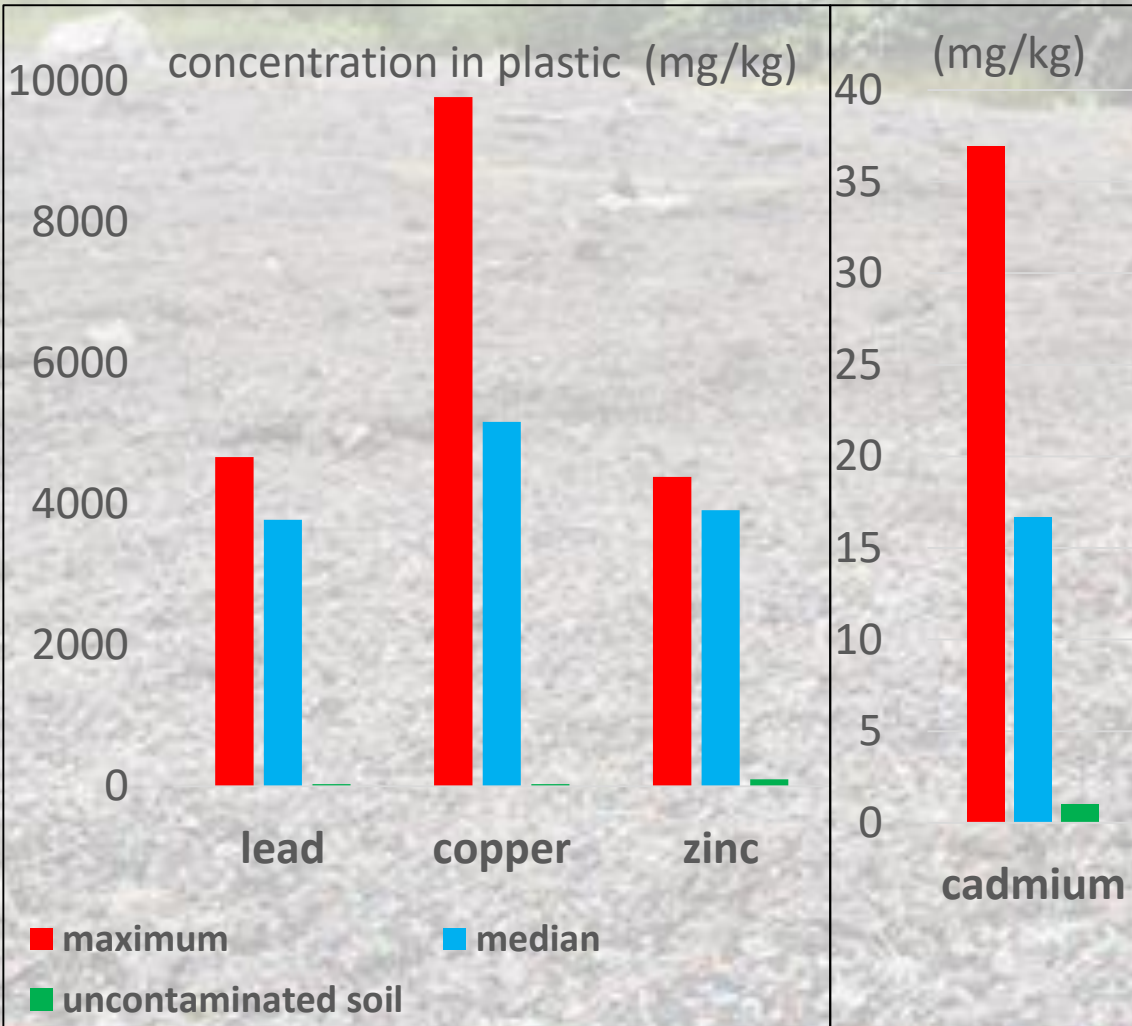
## Plasticizers:

- **phthalate** esters DEHP, DUP

**Phthalates:** Readily leach from plastics  
Some can affect the endocrine system  
/ toxic to reproduction

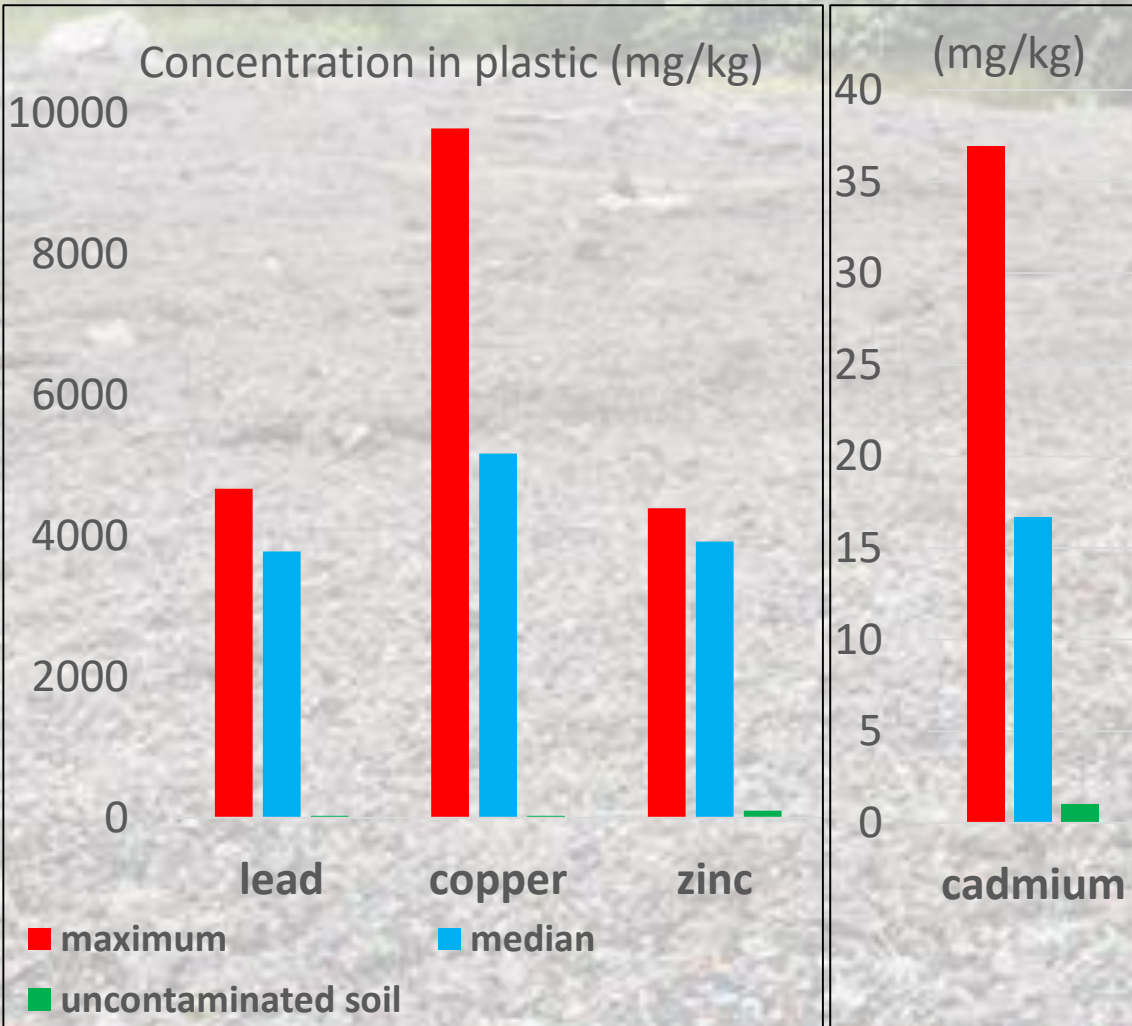
## Other organic chemicals

# Shredded mixed plastic



Also antimony, tin, molybdenum

# Shredded mixed plastic



Also antimony, tin, molybdenum

- Lead:** Can **accumulate** in the body  
Irreversible damage to the **nervous system**,  
(including its development in children)  
Affects the blood system, kidneys and reproduction
- Cadmium** Can **accumulate** in the body  
Damage to the **kidneys** and bones
- Copper** **Gastrointestinal effects** from high levels  
Toxic effects on **aquatic organisms** can occur at very low levels



# Ash & burned plastic

PAHs (polycyclic aromatic hydrocarbons)

- from incomplete combustion
- toxic and persistent

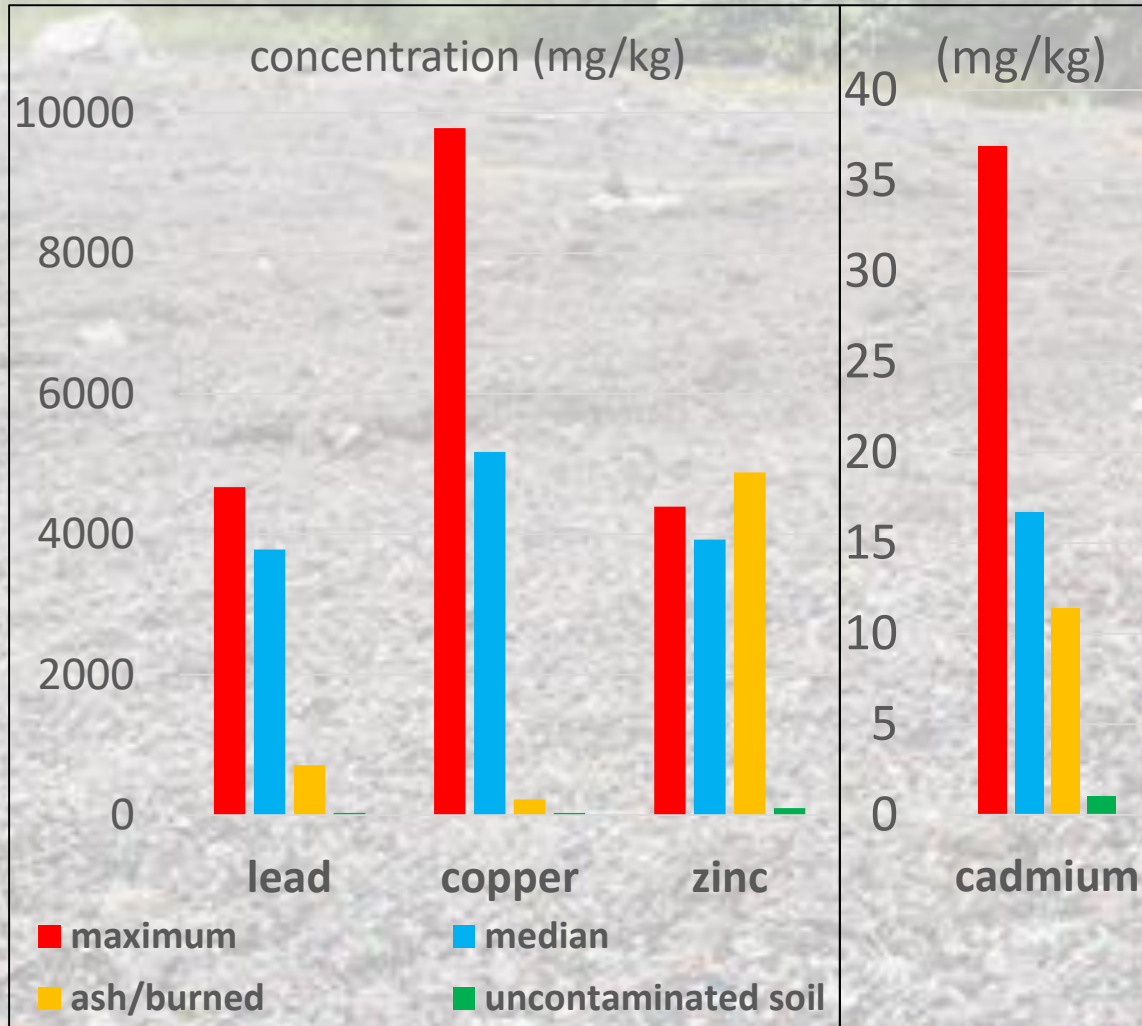
Aliphatic hydrocarbons

- products of plastics thermal decomposition

Other thermal degradation chemicals



# Ash & burned plastic



Also antimony, tin, molybdenum



# Nearby fish pond and water channels

Chemical	Fish pond		Channel to fish pond	Ditch by dumpsite	Other sites
	water	sediment	water	water	water
Antimony	✓	✓	✓		
Nickel	✓	✓	✓		
Copper		✓	✓		
Flame retardant (TPPO)	✓			✓	✓
Styrene trimer	✓			✓	
PAHs		✓			
Plasticizer chemical					✓
Antioxidant degradation chemical					✓

# Summary of findings

- Plastic materials contained a wide range of hazardous chemicals
- Improper treatment by burning;
  - Mobilise metals in the plastic
  - Create new hazardous chemicals
- Evidence of plastic related chemicals in the local environment



**Plastic waste**

**Turkey**

# Overview of findings

## Shredded plastic waste

- Plasticisers: phthalates (including DEHP) + others
- Chlorinated flame retardants
- Stabiliser chemicals
- Metals, including cadmium & lead

# Overview of findings

## Ash and soil

Many chemicals that can form during plastic waste combustion:

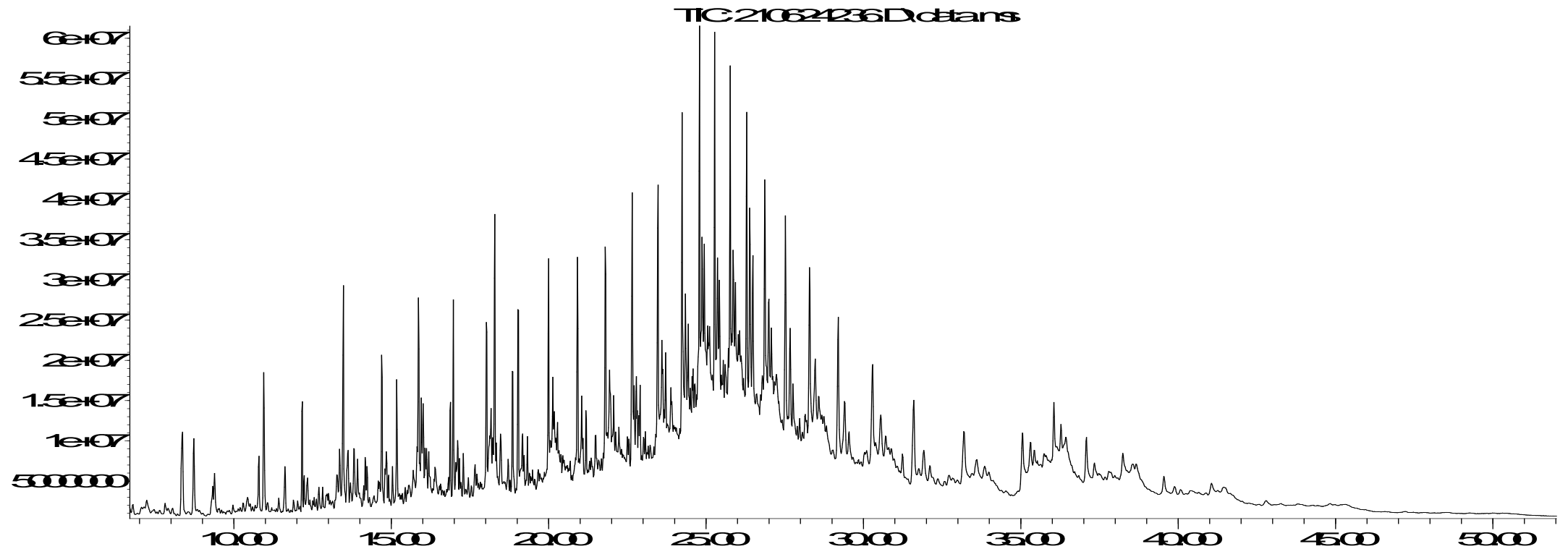
- PAHs, including known human carcinogen (Group 1)
- Many chlorinated chemicals:
  - chlorinated dioxins/furans, PCBs, chlorinated benzenes
- Numerous others

Metals, including cadmium & lead

# Complexity: numerous chemicals

## Ash from plastic burning site

Abundance



Time →



# Summary of findings

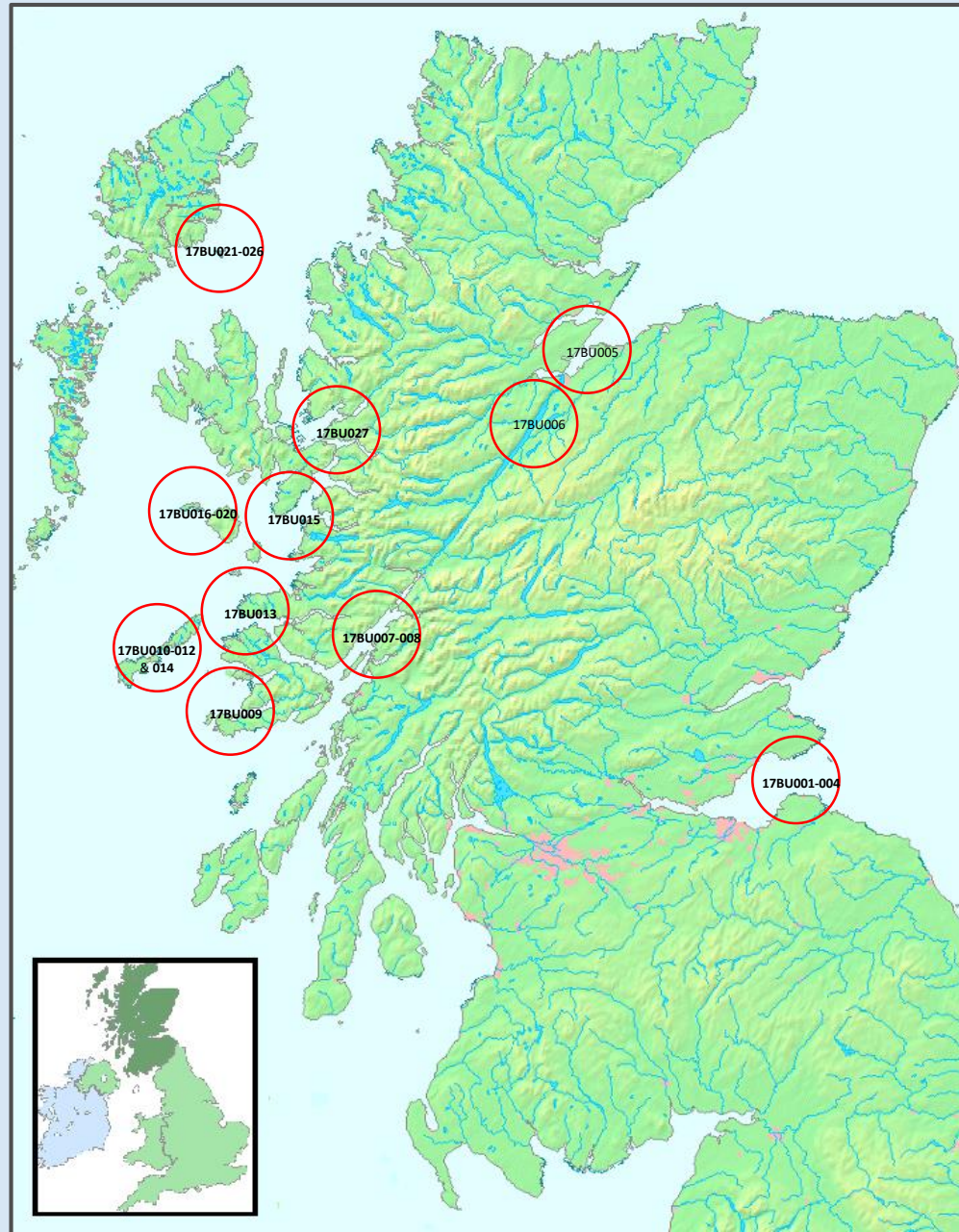
## Shredded plastic waste:

- similar to case in Malaysia

## Ash & local environment (soil):

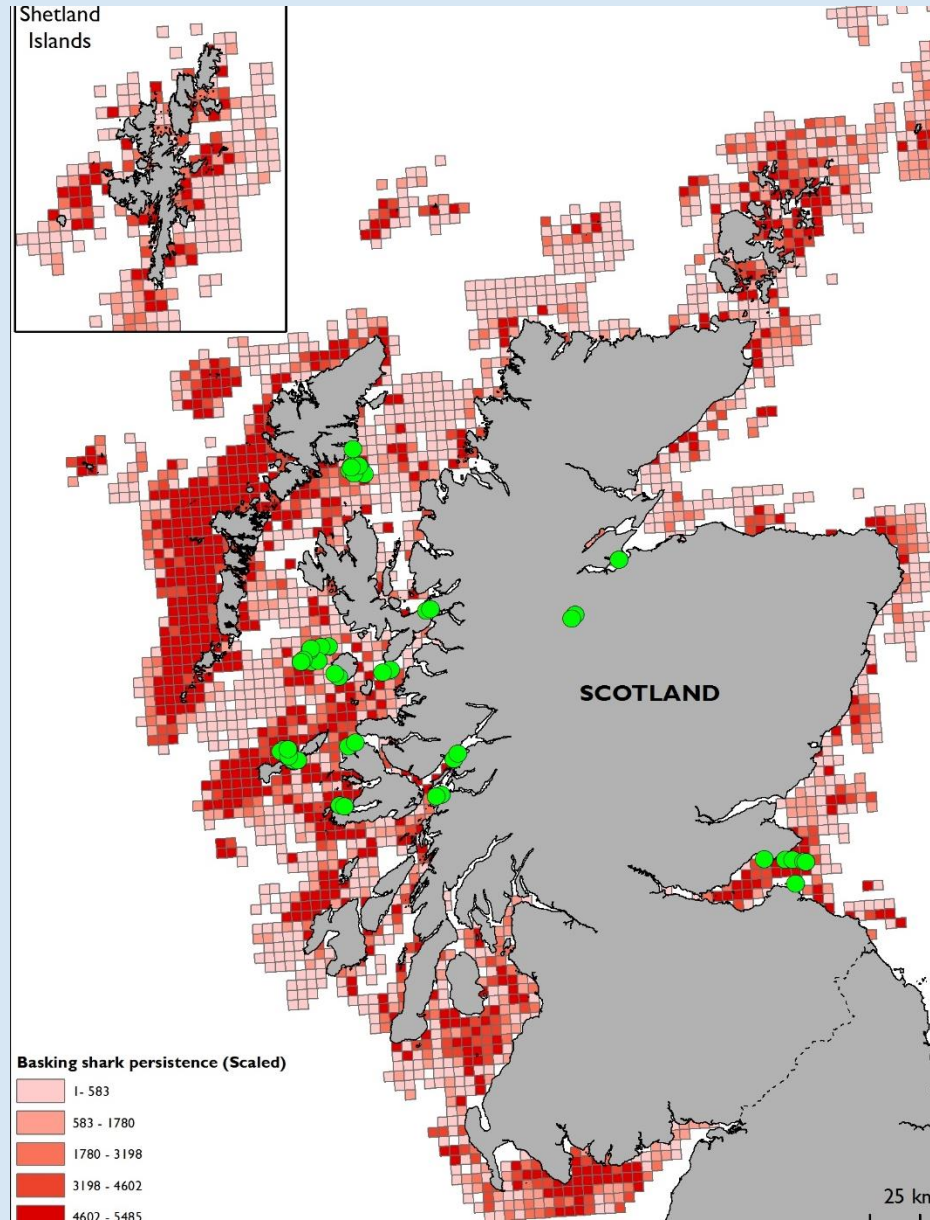
- extensive contamination of soil
- Including **P**ersistent, **B**ioaccumulative, **T**oxic chemicals

# Microplastics in coastal waters



# Basking sharks

Important foraging areas



<b>chemical group</b>	<b>common uses</b>	<b>health concerns</b>	<b>frequency</b>
<b>12 phthalate esters, incl.:</b> <ul style="list-style-type: none"> <li>• DEHP</li> <li>• DiBP</li> <li>• BBP</li> <li>• DINP</li> </ul>	<ul style="list-style-type: none"> <li>• additives in flexible plastics and printing inks</li> </ul>	<ul style="list-style-type: none"> <li>• many phthalates are toxic to reproduction and can interfere with hormone systems</li> </ul>	<ul style="list-style-type: none"> <li>• 3 samples</li> <li>• 6 samples</li> <li>• 1 sample</li> <li>• 2 samples</li> </ul>
<b>4 pesticides, including:</b> <ul style="list-style-type: none"> <li>• chlorpyrifos-ethyl</li> <li>• flufenacet</li> <li>• tebuconazole</li> <li>• buprofezin</li> </ul>	<ul style="list-style-type: none"> <li>• insecticide (organophosphate)</li> <li>• herbicide</li> <li>• fungicide</li> <li>• insecticide</li> </ul>	<ul style="list-style-type: none"> <li>• toxic to nervous &amp; immune systems</li> <li>• toxic to aquatic plants and algae</li> <li>• possibly toxic to reproduction</li> <li>• possibly toxic to nervous system</li> </ul>	<ul style="list-style-type: none"> <li>• 5 samples</li> <li>• 1 sample</li> <li>• 1 sample</li> <li>• 1 sample</li> </ul>
<b>3 organophosphates, incl.:</b> <ul style="list-style-type: none"> <li>• TCEP</li> <li>• TPP</li> <li>• TPPO</li> </ul>	<ul style="list-style-type: none"> <li>• fire retardant</li> <li>• fire retardant, plasticiser</li> <li>• chemical manufacture</li> </ul>	<ul style="list-style-type: none"> <li>• toxic to reproduction &amp; carcinogenic</li> <li>• toxic to nervous system</li> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• 1 sample</li> <li>• 1 sample</li> <li>• 1 sample</li> </ul>
<b>2 UV stabilizers, including:</b> <ul style="list-style-type: none"> <li>• UV P</li> <li>• UV 326</li> </ul>	<ul style="list-style-type: none"> <li>• reduce degradation of plastics</li> </ul>	<ul style="list-style-type: none"> <li>• possible hormone disruptor</li> <li>• toxic to aquatic animals</li> </ul>	<ul style="list-style-type: none"> <li>• 4 samples</li> <li>• 3 samples</li> </ul>
<b>1 polycyclic musk</b> <ul style="list-style-type: none"> <li>• Galaxolidone</li> </ul>	<ul style="list-style-type: none"> <li>• breakdown product of fragrance enhancer in personal care products</li> </ul>	<ul style="list-style-type: none"> <li>• not known</li> </ul>	<ul style="list-style-type: none"> <li>• 4 samples</li> </ul>
<b>1 perfluorinated chemical</b> <ul style="list-style-type: none"> <li>• PFOS</li> </ul>	<ul style="list-style-type: none"> <li>• water/grease-proofing of fabrics and other textiles</li> </ul>	<ul style="list-style-type: none"> <li>• toxic to liver and to development</li> </ul>	<ul style="list-style-type: none"> <li>• 1 sample</li> </ul>
<b>5 heavy metals, including:</b> <ul style="list-style-type: none"> <li>• lead</li> <li>• copper</li> <li>• chromium</li> <li>• manganese</li> <li>• cadmium</li> </ul>	<ul style="list-style-type: none"> <li>• plastic stabilizers, pigments</li> <li>• antifoulants, biocides, electronics</li> <li>• pigments, metal plating</li> <li>• steel, pigments, cosmetics</li> <li>• batteries, pigments</li> </ul>	<ul style="list-style-type: none"> <li>• toxic to nervous system and kidneys</li> <li>• toxic to algae</li> <li>• some forms are carcinogenic</li> <li>• toxic to nervous system at high doses</li> <li>• toxic to kidneys</li> </ul>	<ul style="list-style-type: none"> <li>• 3 samples</li> <li>• 5 samples</li> <li>• 5 samples</li> <li>• 4 samples</li> <li>• 1 sample</li> </ul>

A photograph of a beach covered in plastic waste and hazardous chemical contamination. The foreground is a dark, pebbly beach littered with numerous small pieces of colorful plastic debris. In the middle ground, there are larger pieces of plastic waste, including what appears to be a red and white striped object. The background consists of dense green vegetation, including palm trees and other tropical plants. The overall scene depicts a significant environmental problem of plastic pollution and chemical contamination in a natural coastal area.

# Plastic waste disposal

**Hazardous chemical contamination**



