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MICROPLASTICS AS ENVIRONMENTAL STRESSOR AND THREAT TO HUMAN AND SEA LIFE

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PRESENTATION OUTLINE

1) Introduction: Microplastics
2) Ways Microplastics get into Ocean
3) Main Sources and Movement Pathways for Microplastics in the Oceans
4) Bioavailability of Microplastics to zooplankton
5) Effects of Plastic Debris on Marine Organisms
6) Effects of Plastic Debris on Man
7) Microplastics as Environmental Stressor
6) What are the Solutions to this Menace: Microplastic Bioavailability in the Ocean
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INTRODUCTION: MICROPLASTICS

- Recently there have been **environmental interests** regarding **“microplastics”.**
- **Microplastics** are microscopic sized plastics having less than 5mm in diameter, which emerge mainly from the production of personal care products and fragments of larger plastics by mechanical degradation or by UV light. e.g mechanical degradation of bottles, food rappers, plastic bags etc. (National Ocean Service, 2017).
- This area of study could be classified under **Biogeochemistry.**

Images for Microplastics

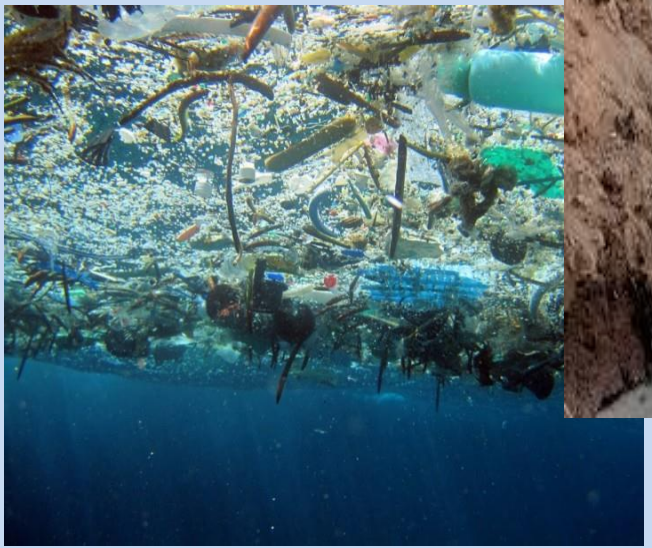
WAYS MICROPLASTICS GET INTO OCEANS

- Microplastics are dumped **indirectly** and **directly** into the oceans e.g industries dumping them directly while rain and wind gets heaped-up plastic household materials outside home into water bodies (Louisa, 2017).

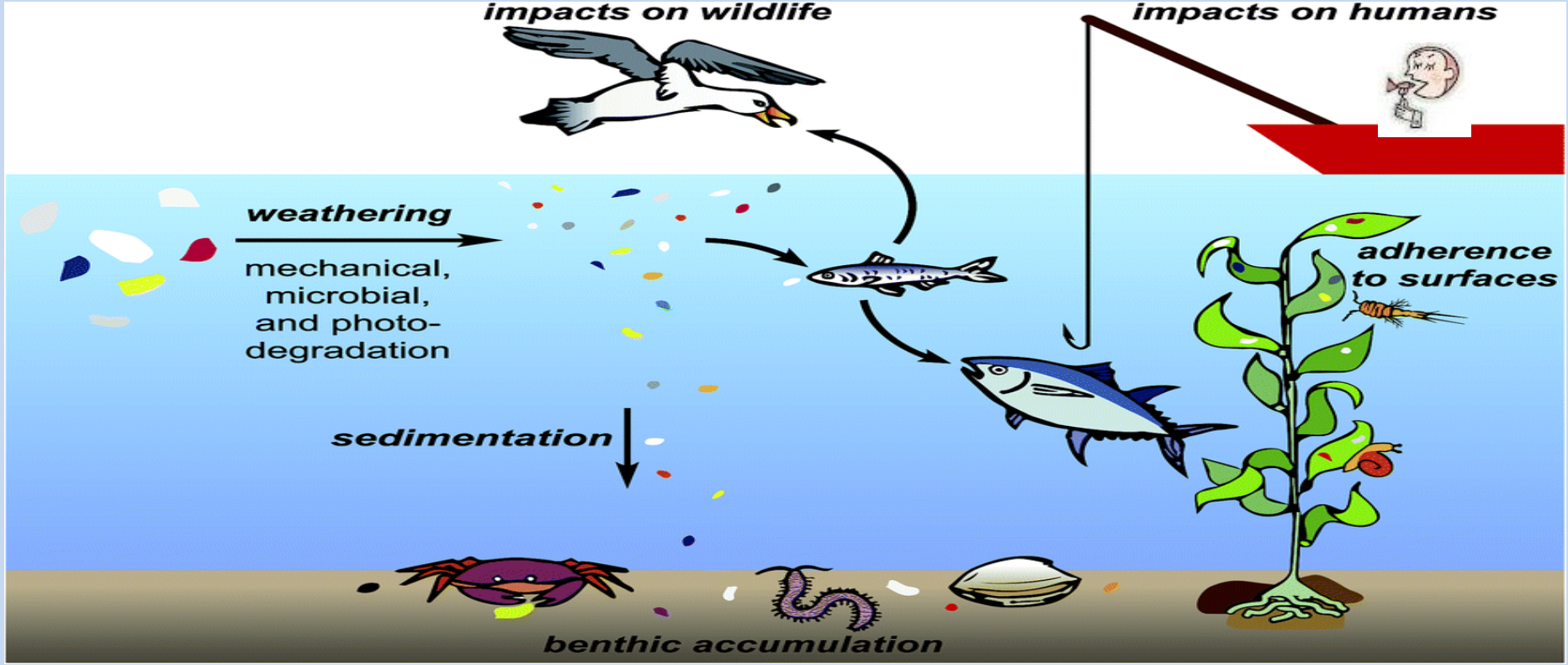
- They have being identified as **debris** and as **sediments** of **marine** and **freshwater** across ecosystems.

- It is difficult to separate the microplastics from other **organic particles** in the sediment.

IMAGES FOR WAYS MICROPLASTICS GET INTO OCEANS



MOVEMENT PATHWAYS FOR MICROPLASTICS IN THE OCEANS



BIOAVAILABILITY OF MICROPLASTICS TO ZOOPLANKTON

- **Zooplankton** encompasses a range of **aquatic animals** that form a **key trophic link** between **primary producers** and the rest of the **marine food web**.

- Microplastics are **bioavailable** to a range of aquatic organisms (zooplanton) which are of low trophic fauna such as algae, amphipods, barnacles, lugworms, mussels, sea cucumbers, echinoderms, bryozoans, bivalves, lobsters, fishes, seabirds and benthic invertebrates, and can be **trophically transferred**.

Sea Turtle Taking in Plastic Product

Picture Showing a Fishes with Microplastics Inside of them

Picture Showing Fishes that Contain an Abnormal Compound that looks Like Egg


HOW LONG UNTIL IT'S GONE?
Estimated decomposition rates of common marine debris items
Plastic Grocery Bag
10 - 20 years
Plywood
1 - 3 years
Disposable Diaper
450 years
Cigarette Butt
1 - 5 years
Foamed Buoy
50 years
Wool Socks
1 - 5 years
Plastic Bottle
450 years
Aluminium Can
200 years
Fishing Line
600 years
Styrofoam Cup
50 years
Tin Can
50 years
Plastic Beverage Holder
400 years
Glass Bottle
undetermined

EFFECTS OF PLASTIC DEBRIS ON MARINE ORGANISMS

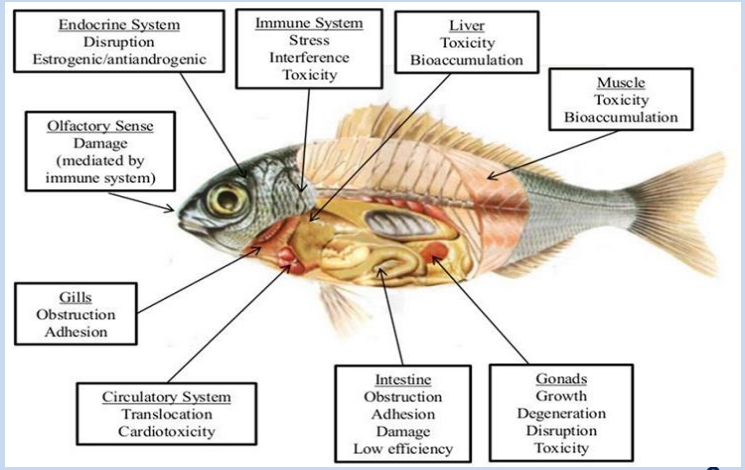
Ecotoxicological and calcification studies has being explored on the effects of microplastics on **marine zooplankton** as case studies for effect on human health and the results has being threatening.

The **effects of plastic debris on marine organisms** as a result of ingestion include:

- gut blockages
- heightened immune response
- loss of lipid reserves
- Disrupting of other normal physiological functions in respect to:

✓ photosynthetic
✓ respiratory
✓ reproductive processes

- other uncertain consequences to the health of the organism.



EFFECTS OF PLASTIC DEBRIS ON MAN

Microplastic itself can move across the **food chain** and pose significant **public health issues** to society.

- The harmful effects potentially **cascades** through **ecosystem's trophic layers**.
- Potential risk to **food insecurity**.
- There has not being too much experiments done in this area as human samples for experimental purposes are difficult, but the various **negative and threatening results** of the effects of microplastics on animals has given so much clue to the effects of microplastics on man mostly as a result of being trophically transferred. These animals used are also **mammals** so it gives most likely result on man.
- The experiments are done by injecting microplastics such as **polyethylene** terephthalate (PET), polyvinylchloride (PVC) etc into mammal (animal) and after a specified period such as three months the effects on the animal's sample body systems such as digestive, reproductive, respiratory etc are done.
- Microplastics are **measured** by analytical laboratory **techniques such as FPA-based Micro-FTIR** (Focal Plane Array-based Micro-Foutier Transform Infrared), or Micro-Raman Spectroscopy.

MICROPLASTICS AS ENVIRONMENTAL STRESSOR

- Most plastics contain **organic polymers**. The vast majority of these polymers are based on chains of carbon atoms alone or with oxygen, sulfur or nitrogen as well. So are the constituents of microplastics. **Some** of the microplastics are **biodegradable and photodegradable** (physical and chemical changes by UV radiation).

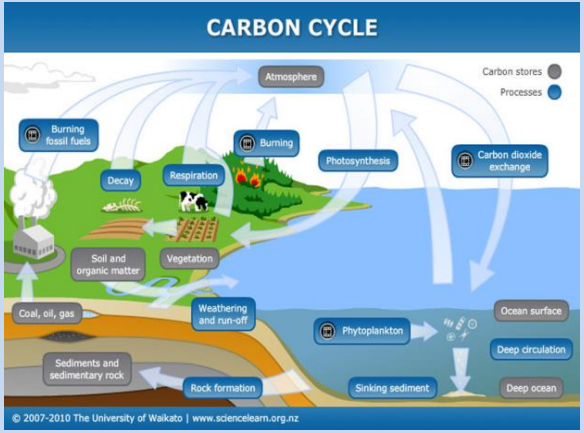
- Therefore, microplastics in the marine habitat because of its constituents are **indirectly** affecting:

✓ how **life is sustained**
✓ how **our planet is threatened**
✓ how the various **chemical cycles** are governed and it **regulates earth's climate and environment**.

MICROPLASTICS AS ENVIRONMENTAL STRESSOR CONT'D

- The chains of carbon microplastic contain becomes available for **carbon cycle** either to **microbes** and **phytoplankton** or it **sinks** and is buried in **seafloor sediments and strata**. Ultimately after tens to hundreds of millions of years, volcanoes return some to the air as gas and the heat-trapping properties affect **Earth's climate**.
- The nitrogen microplastic contains also becomes available for **nitrogen cycle** so is the **sulphur**.
- Microplastics also contain **calcium** in combined form as Calcium carbonate ($CaCo_3$) and as Calcium inosilicate ($CaSiO_3$). In which deposition of the Calcium carbonate in ocean causes **ocean calcification**, leading to **ocean acidification** (putting marine life in danger), then to **ocean warming** which drives **climate change**.
- The **oxygen** constituent buried over long period when exposed on land causes a reaction called **oxidative weathering** which very slowly over millions of years affect **climate**.

Ocean Volcano



Carbon Cycle

WHAT ARE THE SOLUTIONS TO THIS MENACE: MICROPLASTIC BIOAVAILABILITY IN THE OCEAN

SOLUTIONS BY REGULATORS, SCIENTISTS, GOVERNMENT AND MANUFACTURING INDUSTRIES

Microplastics are **tiny** and may not be easily noticed as a treat to both sea and human life, therefore there is an **urgent need to combat it**.

The **potential risk** to food security, and thereby human health, has led:

- **regulators** to call for
- ✓ **better understanding**
- ✓ **education** and
- ✓ **public awareness** of the fate and effects of microplastic debris on marine life.

- to the call for urgent actions by
- ✓ **scientists (researching more)**
- ✓ **government (putting right policies in place)** and the
- ✓ **manufacturing industries** on the need for the reduction of the production and activities resulting in the availability and spread of microplastic into the marine environment.

- To the need to **strengthen international and regional cooperation** in this area among:
- ✓ **decision-makers**
- ✓ **researchers** and
- ✓ **academias** to raise awareness in addressing water-related issues.

WHAT ARE THE SOLUTIONS TO THIS MENACE: MICROPLASTIC BIOAVAILABILITY IN THE OCEAN CONT'D

PUTTING IN PLACE APPRORIATE PROHIBITIONS , LAWS AND BANS

The following should be done:

- For **Countries**: **prohibiting** or disincentivizing **land-based materials causing marine litter** such as the use of microbead plastics for toothpaste.
- For **Manufacturing**: **National law and sub-national law** should be put in place.
- At **Retail Level**: **National Law and sub-national law** should be put in place

WHAT ARE THE SOLUTIONS TO THIS MENACE: MICROPLASTIC BIOAVAILABILITY IN THE OCEAN CONT'D

WHAT TO DO AS AN INDIVIDUAL

- Report plastics pollutions e.g by using hashtag **#plasticspollution** with the photo, date and location.
- Cut **down on plastics** by staying clear of plastic products. Look for natural alternatives or reuseable containers. Don't buy cleansers and cosmetics with microbeads.
- **Clean-up plastic pollution**. When possible use a pool or aquarium skimmer to **remove plastics debris from the water** and throw the debris in the garbage.
- Gathering of **wax worm** to degrade heap-up plastics. The worms live in honeycombs, where they feed on wax. 100 wax worms degrade 92 milligrams of a plastic shopping bag. At this rate, it will take 100 worms nearly a month to completely break down an average of 5.5gram plastic bag.

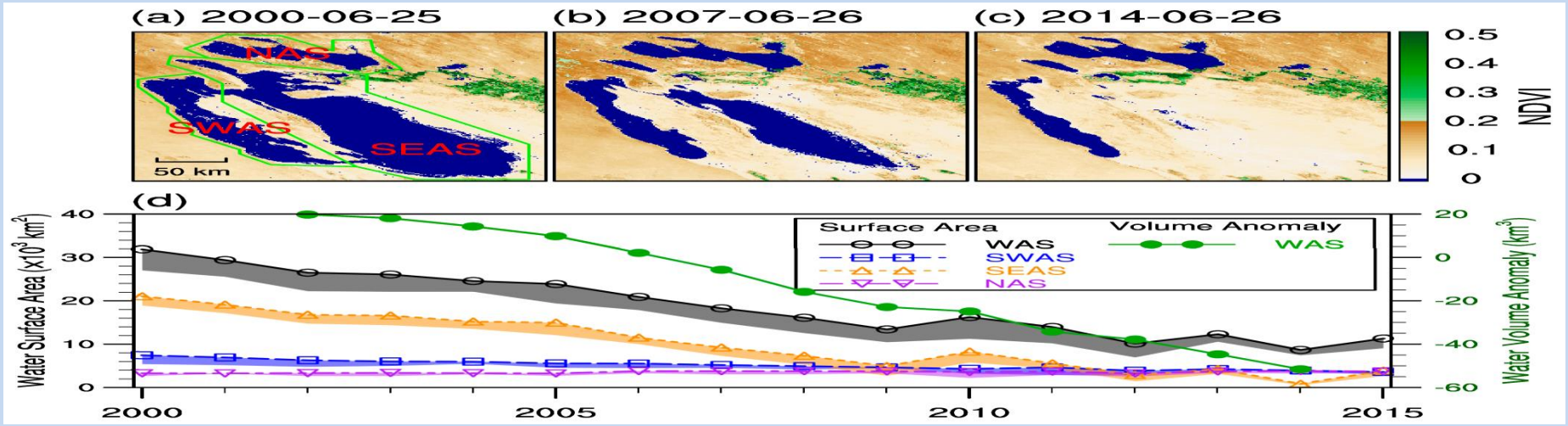
Wax worms

The worms in honeycombs feeding on wax

WHAT ARE THE SOLUTIONS TO THIS MENACE: MICROPLASTIC BIOAVAILABILITY IN THE OCEAN CONT'D

SOLUTIONS USING SPACE BASED TECHNOLOGIES

- Space based **technologies**, **applications** and **services** such as **satellite remote sensing** through space observations could be used to study plastic and microplastic related pollutions in the oceans for **better water management** for the benefit of humankind and the environment (Bagchi and Bussa, 2011).
- This is because this technology is able to address the challenge on **global scale**.



Picture Shows Example of Satellite Image and Data of Marine Environment

WHAT ARE THE SOLUTIONS TO THIS MENACE: MICROPLASTIC BIOAVAILABILITY IN THE OCEAN CONT'D

SOLUTIONS USING SPACE BASED TECHNOLOGIES CONT'D

- **Satellites** provide researchers and policy-makers with **vital information about the Earth's water system**, enabling the prevention/preparedness to response/post-recovery through:

✓ Monitoring
✓ Prediction
✓ modelling and
✓ implementation of mitigation and adaptation measures.

- Satellites **provides information before and after disaster**, as well as ensures **timely response** to emergencies such as flood, drought, tsunami, hurricane etc.

CONCLUSION

- Stopping the mentality that everything ends up in the ocean. The oceans give back to us what we give to it.

- It's very clear that microplastics if not controlled today from the marine world pose as **environmental stressor** tomorrow by affecting **Earth's climate**. Lets protect the future of the generations yet unborn.
- Let us all (regulators, educators, academias, scientists, researchers, policymakers, government, manufacturing industries) press more in educating the public, researching on the effects of microplastics, putting right policies in place against the negative acts on microplastics and doing the right thing by not making the oceans a dumping place.
- **Space based technology** indeed needs to be looked into more as a solution to the world's water management as it gives us solution on a **global scale**, as the microplastics menace affect the whole planet at the long run.

- Seeing this picture, is it achievable to have an Empty Ocean, clean and free from microplastics by **2048**?

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THANK YOU FOR YOUR ATTENTION