

# The Waste-butterfly effect

## Definition:

Describes a cumulative effect that a small force can have in the world over time. Waste has such an effect on the oceans. Throwing a plastic bottle on the ground can have an unsuspected effect on the environment for decades or even centuries.



**80%**

of the plastic load comes from land sources

LOAD OF PLASTIC ADDED TO THE OCEAN PER YEAR

**4.800.000 - 12.700.000 TONS**



equals the weight of 34.200 - 90.700 blue whales out of pure plastic



Our oceans are constantly moving, following a global pattern of circulation called the global conveyor belt. This conveyor belt is a result of interaction between surface- and deep water currents, called thermohaline circulation. This global current moves water between the south and north, and everywhere in between, making it possible for pollution, and especially plastic to travel great distances.

## SDG 14.1

“By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution”



## TODAY:

**88-95%**

of the global plastic load is caused the 10 biggest rivers

## Call for actions:

- Enforced governmental action
- Collective private action
- Better education to clarify the consequences of waste
- Focus on macroplastic
- Stop the plastic input (e.g. raking treatment plants for the biggest rivers)
- Joint Implementation as a global unit



A bottle from Japan, that was found at the beach clean up 2019 on Skogsøyna, Norway



## References

Jambeck et al. (2015); Schmidt et al. (2017); Figure: Broecker (1991); NOAA Ocean Service Education; United Nations: Sustainable Development Goals  
The exact sources can be found in the enclosed paper.

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## **About the Waste Butterfly Effect in the Oceans: Examining Plastic Marine Pollution**

The butterfly effect describes a cumulative effect that a small force can have in the world over time. Waste has such an effect on the oceans. If a plastic bag is thrown away in Norway, it might end up in the stomach of a whale in the Philippines (BBC 2019). Rivers are one of the largest sources of ocean plastic (UNDP, 2019). The distribution of mismanaged waste is due to ocean currents. Every year, about 9 million tons of plastic get into the ocean (NG, 2019). The urgency of this is acknowledged in the SDG 14.1 (UN, 2019). After all, over 70 percent of the Earth is covered in water (Worldatlas, 2018). The “high seas” are subject to international law since the first UNCLOS conference (ILC, 1956). This shows that states were already then aware of their shared responsibility regarding the ocean. Working together is actually the foundation goal of the SDGs, goal 17 states that “strong global partnerships and cooperation” are needed for envisioning and enforcing the SDGs (UN, 2019).

### **Ocean Currents**

What makes ocean pollution a global problem is the fact that it does not only affect the people polluting, or just the people living where it is being polluted. It can affect people miles and miles away. Our oceans are constantly moving around the world, following a global pattern of circulation called the global conveyor belt. This belt is the result of the Earth’s rotation, prevailing winds, uneven heating of the earth’s surface by the sun, the configurations of land and oceans, tides, and changes in water density (Miller & Spoolman, 2016; NOAA, 2017). All these factors affect the interaction of surface- and deep ocean currents, also called thermohaline circulation. The global conveyor belt moves water between the south and north, and everywhere in between, making it possible for pollution, and especially plastic to travel great distances.

Even in places far away from densely populated areas we find plastic. In fact, sometimes even more than usual. Global patterns of ocean circulation have resulted in five subtropical gyres. These are large rotating currents creating vortexes in the ocean. Here plastic is accumulated, often in even higher concentrations than other areas (NOAA, 2018). Not even in these remote areas life is free from plastic.

### **Effects on Nature**

Dealing with the impact on the waste-butterfly effect in the nature, plastic, which is mostly not biodegradable, can remain thousands of years in the oceans (WWF, 2018). This causes environmental pressure, destroying the ecosystem and biodiversity, disturbing the food chain (Brink et al., 2016). The most impact is caused by the microplastic with particles less than 5mm (WWF, 2018). These fragments absorb a high proportion of organic contaminants, which make them toxic when ingested (WWF, 2019). Lethal and non-lethal impacts are the consequences when the chemical molecules of plastics get into the ocean, penetrating cells and interacting chemically with them (Brink et al., 2016). Globally, 17% of about 700 marine wildlife species are listed by IUCN as “threatened” or “critically endangered”, such as seals, turtles, birds and dolphins. 344 species have been trapped in plastic in the year of 2018. Marine wildlife often mistake plastic for food because of its smell. Therefore, “seabirds fall into olfactory traps, fish mistake plastic as krill and sea turtles confuse bags for jellyfish” (WWF, 2018, 17). Large pieces of plastic such as bags, cans or nets cause injuries, lesions and deformities to animals, hindering them from escaping predators, swimming or feeding. Becoming an easy prey, drowning or dying from hunger thus are consequences of plastic pollution (WWF, 2018).

### **Where the Plastic comes from**

There are three ways plastic can enter the sea: transport by wind, tides and through waterways such as rivers or wastewater (Jambeck et al., 2015). Around 80% of the plastic comes from land sources and the remaining 20% come from marine sources (e.g. fishing gear) (Li et al., 2016). In 2010, 275 million tons of plastic were produced and 8 million tons - which equals 3% of the global annual plastic waste - ended up in the ocean (Jambeck et al., 2015). The reasons of mismanaged waste entering the sea are inadequately disposed waste and littered waste, which is dumped in an inappropriate location. While industrialized regions like North America or Europe produce way more plastic per person than developing areas like Sub-Saharan Africa - due to their waste management system - their contribution of plastic entering the sea is negligible. Contrastingly, India, Guinea or Cameroon, mismanage over 80% of the waste and therefore risk the plastic entering the sea (Jambeck et al., 2015). In 2015, 86% of the global plastic river input came from Asia and the top 20 polluting rivers accounted for 67% of the global annual river input (Lebreton et al., 2017).

### **Concluding Remarks on the Effects of Plastic**

It all comes down to the mismanagement of the stakeholders that have to work together. Not only the governments' and nations', but also the personal conscience of the individuals has to be altered. Many citizens dump plastic in the ocean, unaware of its effects. Some land owners have access to water and use it ignorantly. Similarly, recreational users utilize ocean life; such as beach guests swimming and polluting the ocean with toxins in their sunscreen, again, unaware of the effects. Journalists inform the public, selecting the most dramatic information influencing the public opinion common misconceptions.

Scientists provide us with the information and research needed for governments and institutions to implement laws and regulations that benefit, instead of harming the environment. Based on this knowledge, the conservationist works to protect the ocean and marine life. This is what the governments ought to do as well; working together (SDG. 17), creating restrictions on plastic consumption and installing waste management systems and thus affecting individual conscience about the plastics' effects on the world. After all, it is a global issue that includes all spheres of society, and must be tackled locally and collectively.

### **References**

BBC (2019) "Dead Philippines whale had 40 kg of plastic in stomach" Lest 08.04.2019,  
<https://www.bbc.com/news/world-asia-47608949>

Christian Schmidt, C.; Krauth, T.; Wagner, S. (2017) "Export of Plastic Debris by Rivers into the Sea" Read 18.05.19  
<https://pubs.acs.org/doi/abs/10.1021/acs.est.7b02368>

Figure on Poster: The great ocean conveyor belt of global ocean currents as described in Broecker (1991); Read 08.05.19  
<https://pubs.usgs.gov/pp/p1386a/gallery2-fig31.html>

Geyer, R.; Jambeck, J. R.; Wilcox, C.; Siegler, T. R.; Perryman, M.; Andrady, A.; Ramani, N.; Law, K. L. (2017) "Production, use, and fate of all plastics ever made." Read 18.05.19  
<https://science.sciencemag.org/content/347/6223/768/>

Jambeck, J. R.; Geyer, R.; Wilcox, C.; Siegler, T. R.; Perryman, M.; Andrady, A.; Ramani, N.; Law, K. L. (2015) "Plastic waste inputs from land into the ocean." Read 18.05.19

<https://science.sciencemag.org/content/347/6223/768>

Kiprop, Victor . “How much of the Earth is covered in Water?”, Worldatlas 14.11.2018

<https://www.worldatlas.com/articles/how-much-of-the-earth-is-water.html>

Li, W. C.; Tse, H. F.; Fok, L. (2016) “Plastic waste in the marine environment: A review of sources, occurrence and effects” Read 18.05.19

<https://www.sciencedirect.com/science/article/pii/S0048969716310154>

Miller, G. T., & Spoolman, S. E. (2016). *Environmental Science* Boston, MA 02210: Cengage Learning.

National Geographic 2019 “Ocean Circulation and the Butterfly Effect”, Read 18.05.19

<https://www.nationalgeographic.org/media/ocean-circulation-and-butterfly-effect/>

“Mismanaged municipal plastic waste” - in the National Geographic 2019, “What happens to the plastic we throw out” Read 18.05.19

<https://www.nationalgeographic.com/magazine/2018/06/the-journey-of-plastic-around-the-globe/?beta=true>

NOAA (2017). *Currents*. Read 18.05.19 Retrieved from

<https://oceanservice.noaa.gov/education/kits/currents/09references.html>

NOAA (2018). *What is the Great Pacific Garbage Patch?*. Read 18.05.19 Retrieved from

<https://oceanservice.noaa.gov/facts/garbagepatch.html>

Ocean Pollution. (2015). Ocean Stakeholders & Their Interests; Read 18.05.19

<https://oceanpollutionaghs2015.weebly.com/ocean-stakeholders--their-interests.html#>

ten. Brink, P.; Schweitzer, J.-P.; Watkins, E.; Howe, M. (2016) “Plastics Marine Litter and the Circular Economy. A briefing by IEEP for the MAVA Foundation.” Read 10.05.2019

[https://ieep.eu/uploads/articles/attachments/15301621-5286-43e3-88bd-bd9a3f4b849a/IEEP\\_ACES\\_Plastics\\_Marine\\_Litter\\_Circular\\_Economy\\_briefing\\_final\\_April\\_2017.pdf?v=63664509972](https://ieep.eu/uploads/articles/attachments/15301621-5286-43e3-88bd-bd9a3f4b849a/IEEP_ACES_Plastics_Marine_Litter_Circular_Economy_briefing_final_April_2017.pdf?v=63664509972)

UNCLOS Report 1956: Read 18.05.19

[http://legal.un.org/ilc/texts/instruments/english/commentaries/8\\_1\\_8\\_2\\_1956.pdf](http://legal.un.org/ilc/texts/instruments/english/commentaries/8_1_8_2_1956.pdf)

[http://govinfo.library.unt.edu/oceancommission/documents/full\\_color\\_rpt/03a\\_primer.pdf](http://govinfo.library.unt.edu/oceancommission/documents/full_color_rpt/03a_primer.pdf)

United Nations 2014 Sustainable Development Goals:

<https://sustainabledevelopment.un.org/content/documents/11803Official-List-of-Proposed-SDG-Indicators.pdf>

<https://www.undp.org/content/undp/en/home/sustainable-development-goals/goal-14-life-below-water.html>

WWF- World Wide Fund for Nature (2019) “Solving Plastic Pollution through accountability” Read 10.05.19,

[http://d2ouvy59p0dg6k.cloudfront.net/downloads/solving\\_plastic\\_pollution\\_through\\_accountability\\_eng\\_spread\\_2.pdf](http://d2ouvy59p0dg6k.cloudfront.net/downloads/solving_plastic_pollution_through_accountability_eng_spread_2.pdf)

WWF– Worldwide fund for Nature (2018) “Out of the plastic trap. Saving the Mediterranean from plastic pollution” Read 10.05.19

[http://d2ouvy59p0dg6k.cloudfront.net/downloads/a4\\_plastics\\_med\\_web\\_08june\\_new.pdf](http://d2ouvy59p0dg6k.cloudfront.net/downloads/a4_plastics_med_web_08june_new.pdf)