SUNLIGHT SPECTRUM CHANGE IN THE PRESENCE OF PLASTIC IN WATER BODIES

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Plastics are now ubiquitous and are growing pollutants (Fig.1), their negative impact on the environment may not be fully studied. The effects resulting from interactions between wildlife and plastic debris are well known. Typical examples are nutritional deprivation and damage or obstruction of the intestine [1]. Less visible effects of plastic pollution are only being researched in fairly recent years. Surely plastic influences the gaseous exchange between the various environmental compartments, altering their normal functioning. The sea has a thermoregulatory action on the climate thanks to its high thermal capacity due to its high mass. The thermal capacity also depends on the nature of the material and, therefore, on the possibility of exchanging matter and energy. The presence of plastic on the sea surface can alter the delicate balance between abiotic and biotic factors in aquatic life.

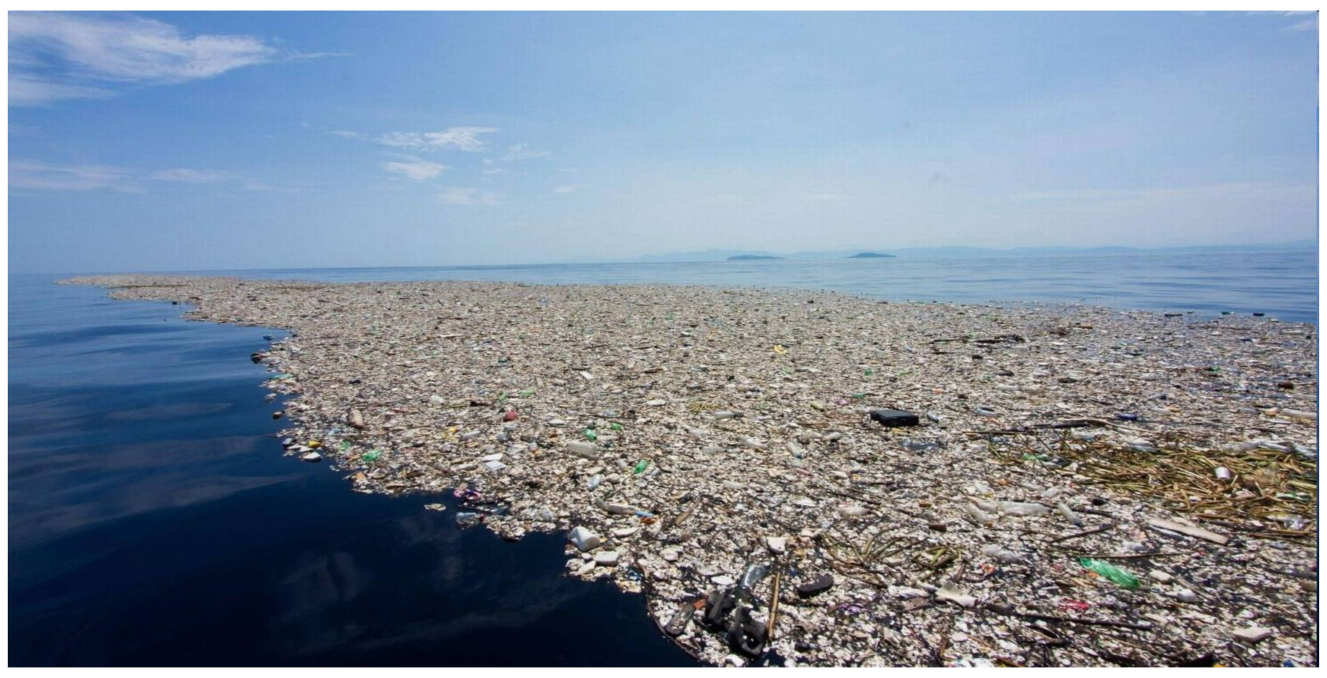

Fig. 1 -The Great Pacific Garbage Patch (a Getty Images from https://www.bbc.co.uk/newsround/47445196)

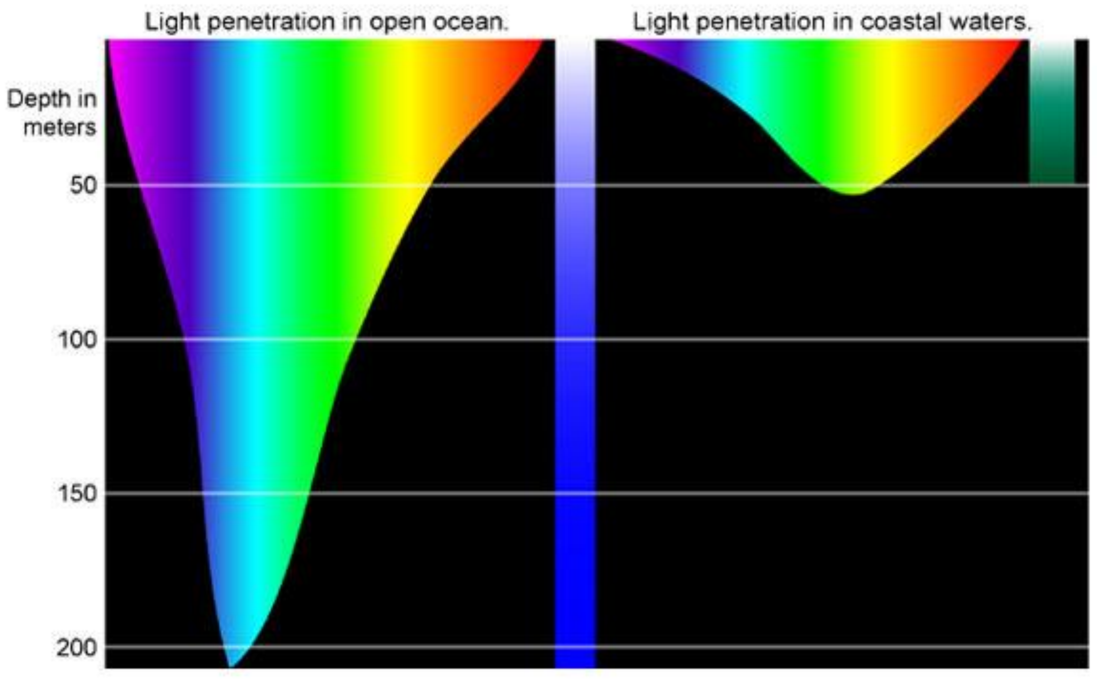

Fig. 2 – Trend of the light penetration in open ocean and coastal waters

Surely light determines the possibility of plant and animal life (biotic); therefore, knowing that the penetration of sunlight (abiotic) into the sea has the trend shown in Fig. 2 [2], we can state that there is colonization along the water column which depends on the available energy and therefore on the light that manages to reach each specific level.

Fig. 3 – Some plastic samples used in the experiments

We here present some preliminary results aiming to evidence the effect of different plastics on the transmission of the sunlight spectrum. Fig. 3 shows a photo of some of the used plastic samples. Opaque plastics completely block the sunlight, while transparent and semitransparent ones alter the spectra in intensity and frequency.

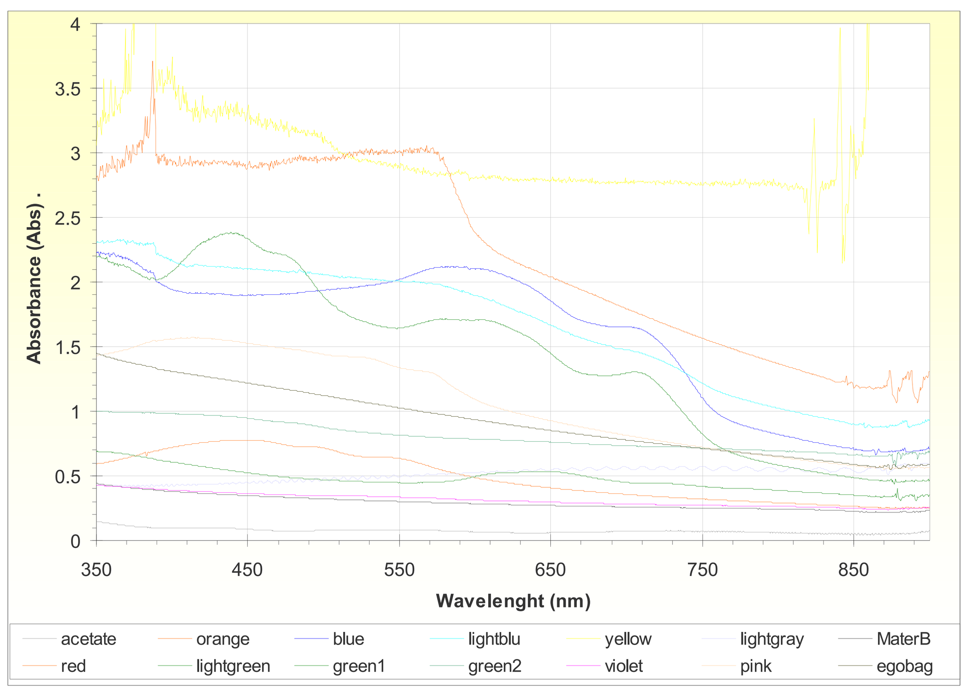

Fig. 4 – Spectra of all 14 samples analyzed from a selection of specimens in Fig. 3

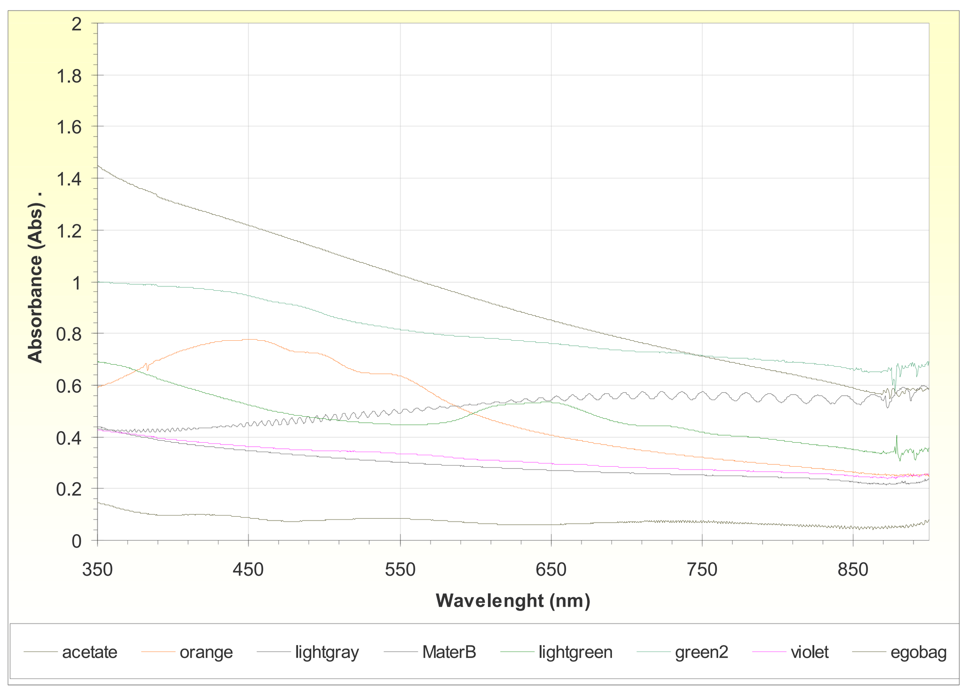

Fig. 5 – Spectra of the 8 most transparent analyzed samples

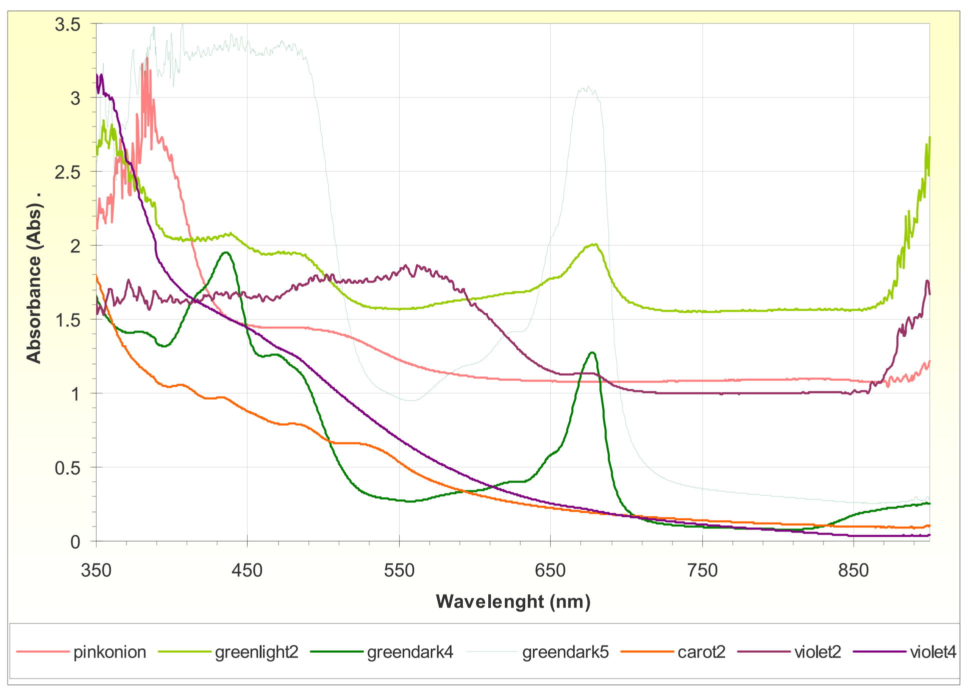

Fig. 6 – Spectra of certain photosynthetic pigments directly extracted in aqueous medium

In order to estimate the size of the problem, films of commonly used plastic were randomly collected, as shown in Fig.3. Fragments of these, *Mesoplastics* [3], were then immersed in tap water to remove those with a possible density greater than 1 that should not remain suspended in the sea or lake water column. By means of support masks, the absorption spectra (Abs) of Fig. 4 and 5 were measured using a Perkin Elmer Lambda 15 against air. With the same instrument, the spectra of Fig. 6 from aqueous phase-only extractions of leaves of various colors were measured, showing the presence of chlorophylls, carotenoids, and other pigments.

A comparison of Fig.4 and 6 show the problem; **the films absorb in the areas of the solar spectrum where photosynthetic pigments are active.** We note that even the films in Fig. 5, which are transparent at first glance, show absorptions even higher than Abs=1, greatly reducing the expected photon influx already shown in Fig. 2.

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2 – Widder E., Carothers K, *Deep Light*, Harbor Branch Oceanographic Institution, 2022, https://oceanexplorer.noaa.gov/explorations/04deepscope/background/deeplight/deeplight.html

3 - Fatema K., Sumon K.A., Moon S.M., Alam M.J., Hasan S.J., Uddin M.H., Arakawa H., Rashid H., *Microplastics and mesoplastics in surface water, beach sediment, and crude salt from the northern Bay of Bengal, Bangladesh coast*, J. Sediment. Environ. 8, 231–246 (2023). https://doi.org/10.1007/s43217-023-00131-z

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