



MICROALGAE BIOMASS AS A SUSTAINABLE FOOD SOURCE
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UNIVERSITY OF LISBON
INTERDISCIPLINARY STUDIES
ON SUSTAINABLE ENVIRONMENT AND SEAS



SESSION V - Impact of pollution on microalgae - entry into the food chain

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SESSION V - Impact of pollution on microalgae - entry into the food chain

SUMMARY

The health of the environment is critical for human health

Impact of plastics in the food chain

Impact of microplastics on the microalgae growth

How can microalgae be part of the solution – removal of microplastics

Algal bloom: a negative effect of algae grow

The health of the environment is critical for human health

Oceans have historically provided livelihoods, trade, food, and other resources, known as
“ecosystem goods and services”

Human activities increasingly involve continued and cumulative pressures, producing negative impacts (e.g., pollution, habitat destruction and overfishing), which affect not only ecosystem health, but also human health (Depledge et al., 2019)

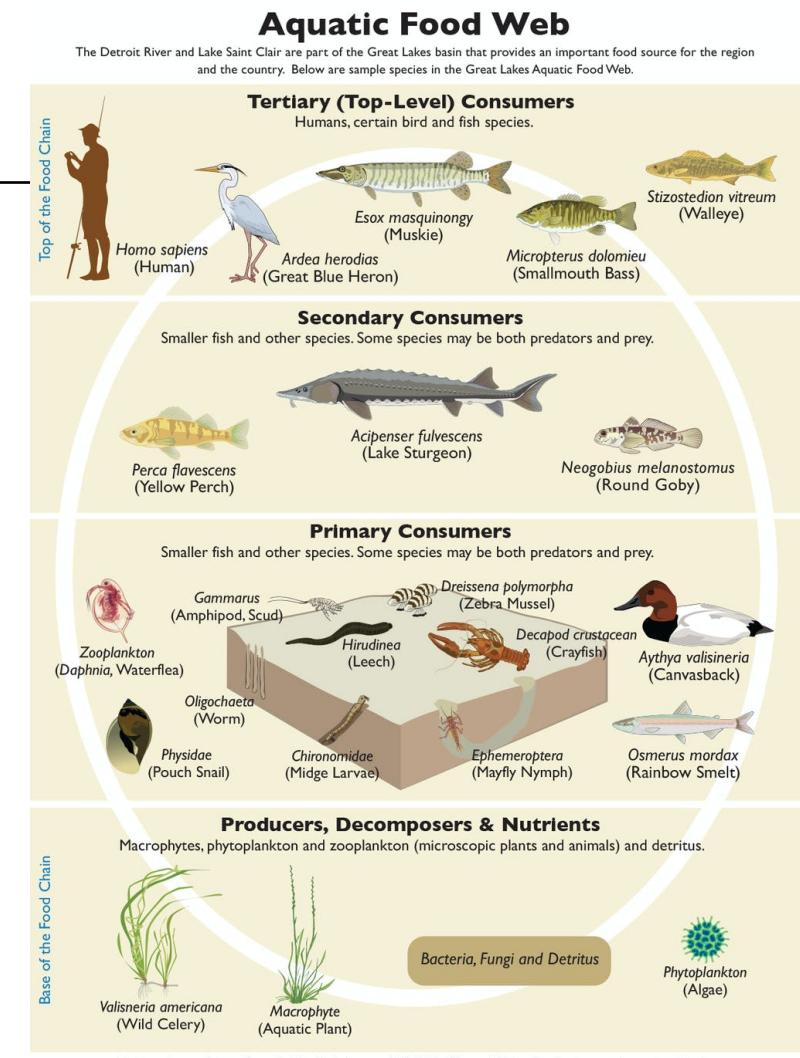
Human health and well-being may be promoted through positive interactions with the coasts with the sustainable use of the natural resources and through the restoration and preservation of **coastal and marine ecosystems**





Plastic pollution is entirely caused by the human production of plastic materials, use and disposal (Pahl et al., 2017).

Plastic is a relatively new material; it has only been used widely since the 1960s, so the amount and the trend of this material escaping into the natural environment globally are astonishing (Jambeck et al., 2015), producing different impacts.



Not to scale. Adapted from the *Life of the Lakes* MICHU 09-400 Michigan Sea Grant, www.miseagrant.umich.edu



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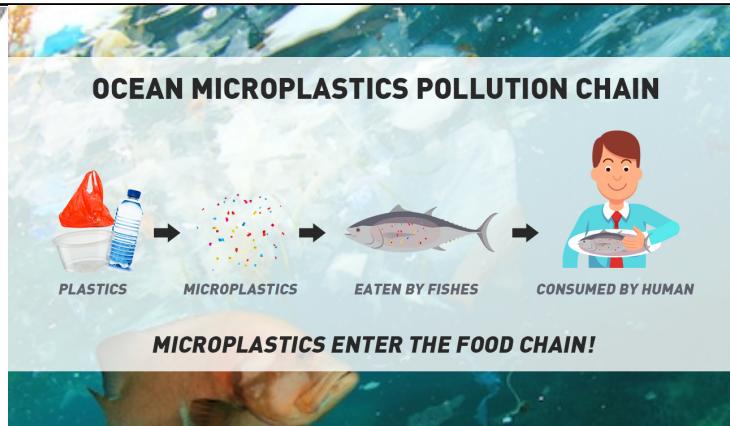
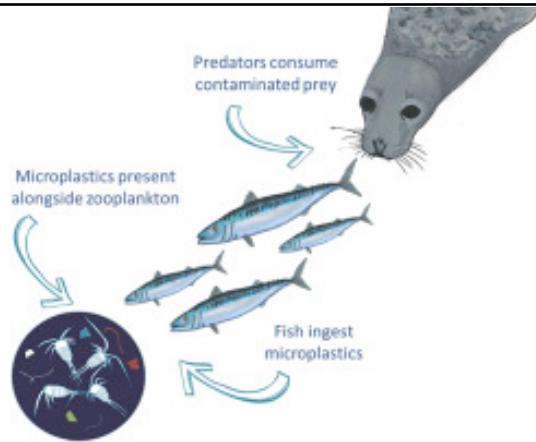


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Size matters!!!!

Microplastics and microalgae are similar in size - a decisive step towards entering the food chain





Review

Effects of microplastics on microalgae populations: A critical review



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Few studies about the toxic effects of microplastics on microalgae populations

Microalgae, one of the most important primary producers in aquatic ecosystems, could suffer from microplastic contamination, leading to larger impacts on aquatic food webs.



Impact of plastics in microalgae population

<https://www.sciencedirect.com/science/article/abs/pii/S0048969719306187>

Microplastics seem to have limited effects on parameters such as growth, chlorophyll content, photosynthesis activity and reactive oxygen species (ROS), **current environmental concentrations are not expected to induce toxicity.**

But, microplastics could disrupt population regulation mechanisms, by reducing the availability or absorption of nutrients (bottom-up) or reducing the population of predator species (top-down).

Microplastics' properties can also **influence the effects on microalgae, with smaller sizes and positive surface charges having higher toxicity.**

More research is needed to better understand the effects of microplastics on microalgae, such as adaptation strategies, effects on population dynamics and microplastics properties influencing toxicity.



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Effect of plastic exposure on marine *Prochlorococcus* – the most abundant photosynthetic organism on Earth and is a vital contributors to global primary production and carbon cycling

<https://desdaughter.com/chemicals-leaching-from-plastic-pollution-impairs-the-base-of-the-marine-food-web/>



ARTICLE

<https://doi.org/10.1038/s42003-019-0410-x>

OPEN

Plastic leachates impair growth and oxygen production in *Prochlorococcus*, the ocean's most abundant photosynthetic bacteria

Sasha G. Tetu¹, Indrani Sarker¹, Verena Schrammeyer², Russell Pickford³, Liam D.H. Elbourne¹, Lisa R. Moore¹ & Ian T. Paulsen¹

Leachate exposure strongly impairs *Prochlorococcus* *in vitro* growth and photosynthetic capacity and results in genome-wide transcriptional changes.

The strains showed distinct differences in the extent and timing of their response to each leachate. Consequently, **plastic leachate exposure could influence marine *Prochlorococcus* community composition and potentially the broader composition and productivity of ocean phytoplankton communities.**



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Cunha et al. (2019). Marine vs freshwater microalgae exopolymers as biosolutions to microplastics pollution, Environmental Pollution, Vol.249: 372-380, <https://doi.org/10.1016/j.envpol.2019.03.046>.



Marine vs freshwater microalgae exopolymers as biosolutions to microplastics pollution*



César Cunha ^a, Marisa Faria ^a, Natacha Nogueira ^{b,c}, Artur Ferreira ^d, Nereida Cordeiro ^{a,c,*}

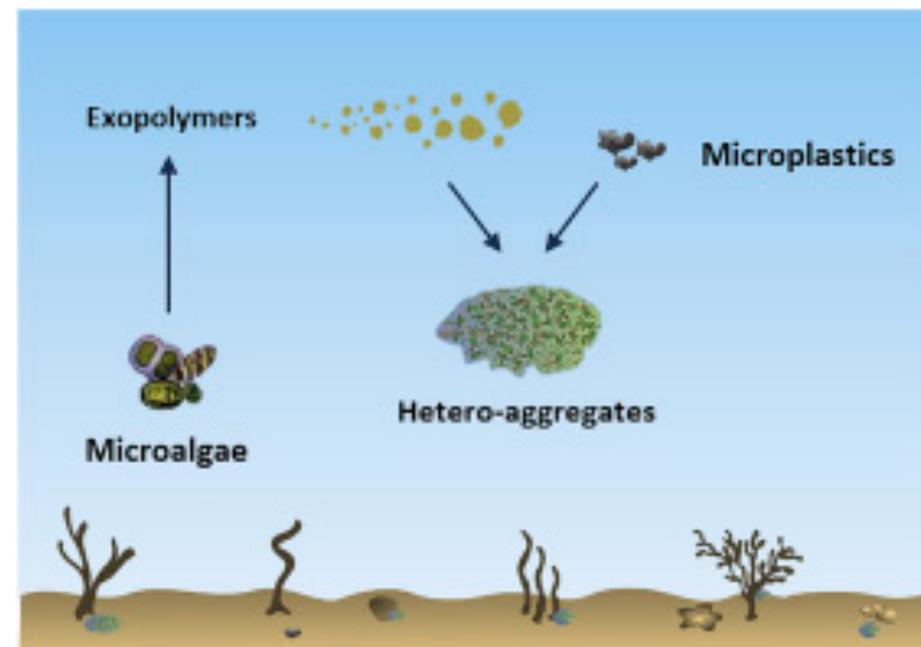
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Microalgae can excrete exopolymer substances (EPS) with a potential to form hetero-aggregates with microplastic particles, flocculate microplastics, contributing to their vertical transport and consequent deposition.



Algal bloom: a negative effect of algae grow

An algal bloom is the **rapid increase of the algae population in aquatic ecosystem** (fresh and marine waters). They thrive where there is an **abundance of phosphorus and nitrogen** (nutrients), usually caused by runoff of nutrients (animal waste, fertilizers, sewage) from the land.

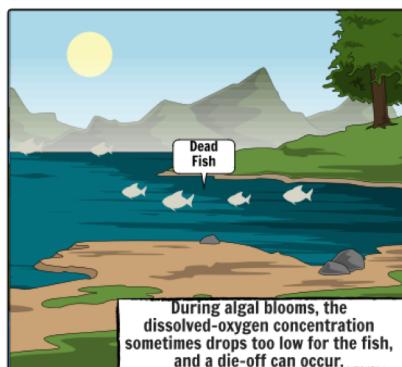
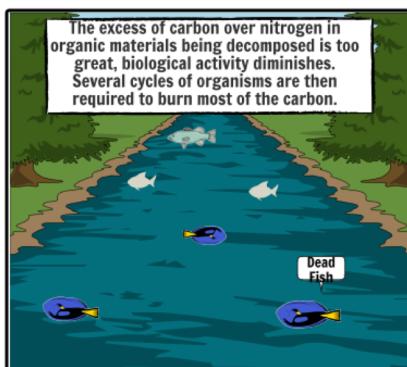
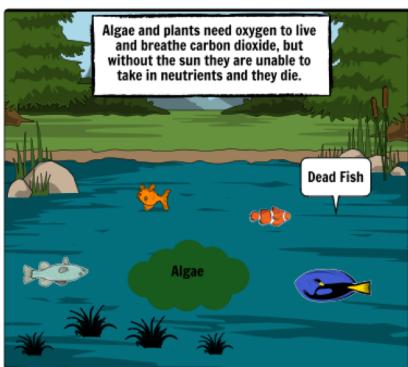
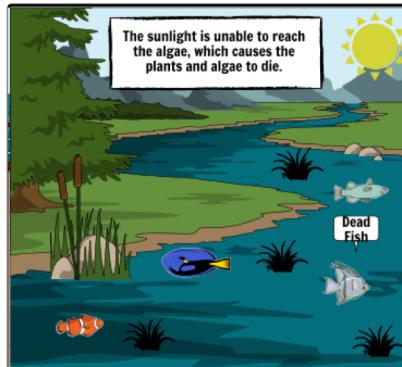
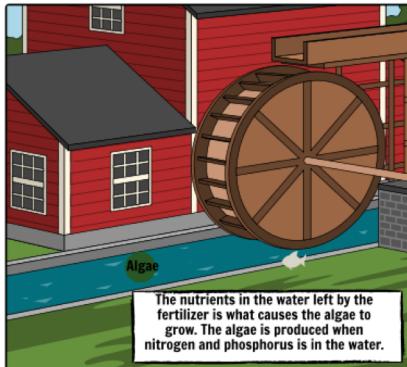
Algal blooms are known to be mainly composed of **bio-toxins** and are characterized by a **distinct discoloration of water** due to a large number of pigmented algae cells. Colors range from green, red, brown, and yellow. The major types of algal blooms are cyanobacteria (blue-green algae) and red tides (red algal blooms).



Algal bloom is one of the most common forms of **eutrophication**, which **depletes the supply of oxygen**, leading to the death of animal life.



Algal bloom: a negative effect of algae grow



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Messages to take home

Pollution of seas and rivers has a high impact on the food chain

The entry of plastics into the food chain has negative implications for all links in the chain

Microalgae have a similarity in terms of size with microplastics, facilitating their entry into the food chain.

The presence of microplastics has an influence on the growth of microalgae

The phenomena of algal bloom also results from extreme pollution situations and have a negative effect on seas and rivers.



The background of the image is an underwater scene. At the surface, there is a large, partially melted plastic bag and several plastic bottles. Below the surface, a green sea turtle swims gracefully. In the background, a school of small fish swims away. The water is a deep blue, and the overall atmosphere is somber, highlighting the issue of plastic pollution in the ocean.

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