

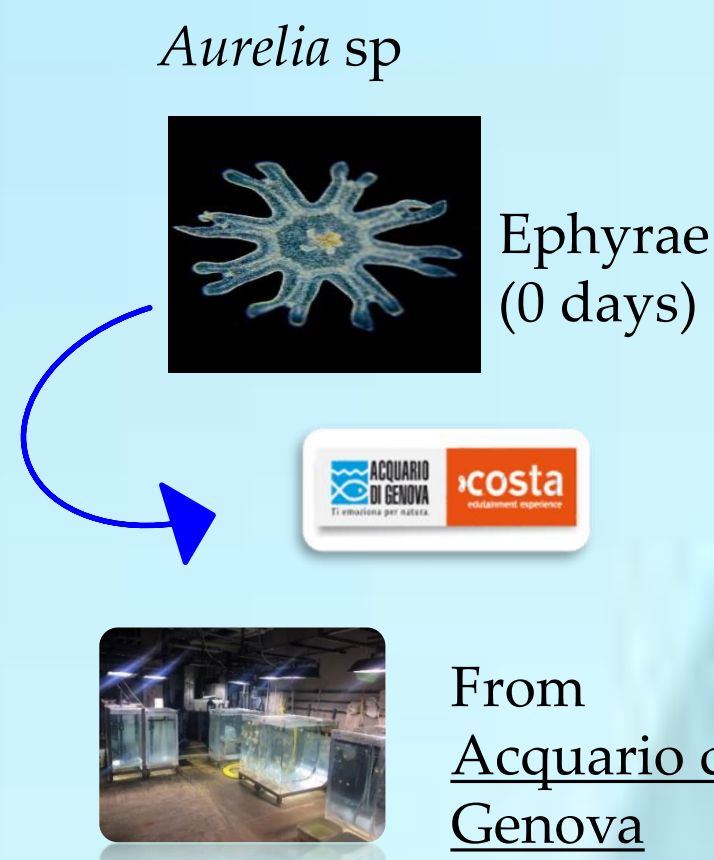
Micro and nanoplastics are ubiquitous in the marine ecosystem, representing an emerging threat due to their small size able to be taken up by many organisms.

The aim of this study was to investigate for the first time the ecotoxicological effects of polyvinylidene difluoride (PVDF), polylactic acid (PLA) microplastics (MPs) and polystyrene nanoplastics (NPs) on ephyra stage of the *Aurelia sp.* jellyfish, recently suggested as valid model organisms in ecotoxicology.

JPI OCEANS RESPONSE

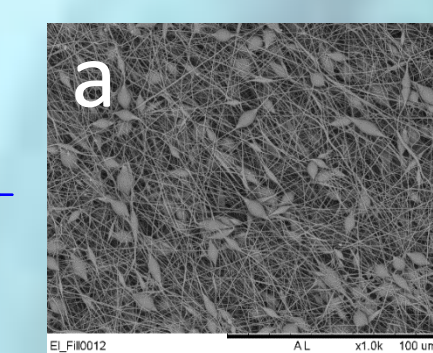
MATERIALS AND METHODS

Model organisms

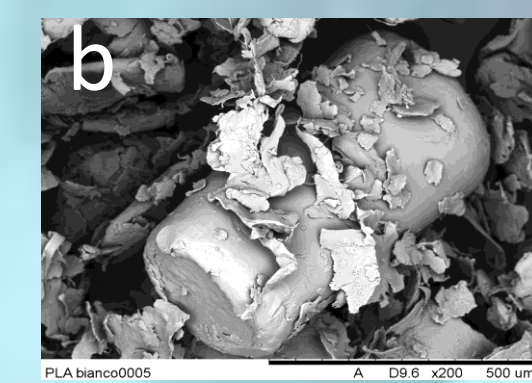


Ephyrae were exposed to environmental and high (0.01-0.1-1-10-100 mg/L) concentrations of:

100 nm visible blue dyed and fluorescent polystyrene (PS) particles purchased from Phosphorex



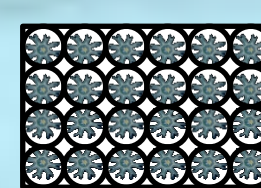
PVDF nanofibers were fabricated via electrospinning method and then ground



PLA for 3D printer were purchased in a local shop and then ground

a, b: SEM images

1 ephyra/each well
8 ephyrae for replica
4 replica



24 hours of exposure

At 20°C in dark condition

Effects investigated

NPs, PVDF and PLA uptake was investigated by using an innovative **holotomographic microscope** (Tomocube Inc., model HT-2)



Immobility:

% organisms that perform any kind of movement

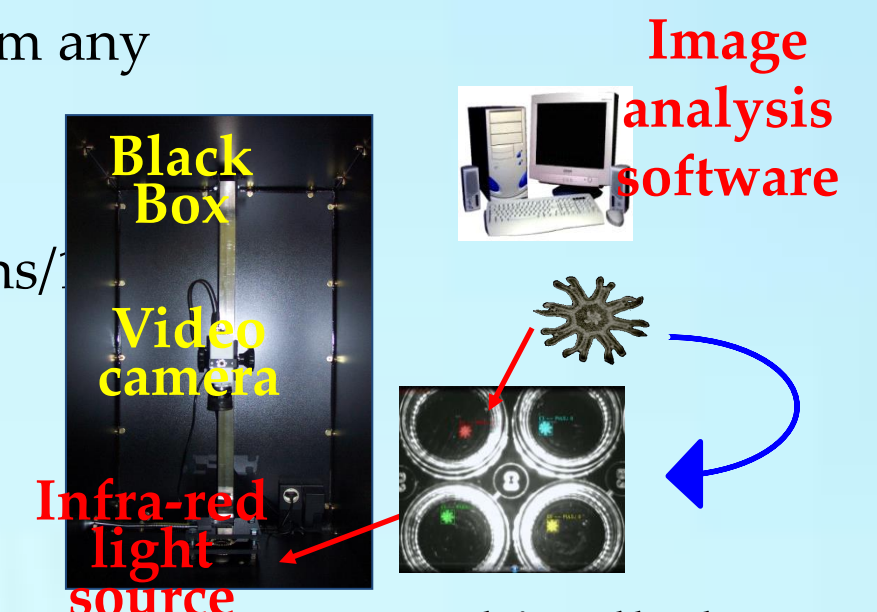
Frequency of pulsations

(Fp)=number of pulsations/minute

$$(\%AFp) = 100 * (Fp_{control} - Fp_{treated}) / Fp_{control}$$

AFp= Alteration of frequency of pulsations

SBR – Swimming Behavioral Recorder – SYSTEM developed at CNR-IAS



RESULTS

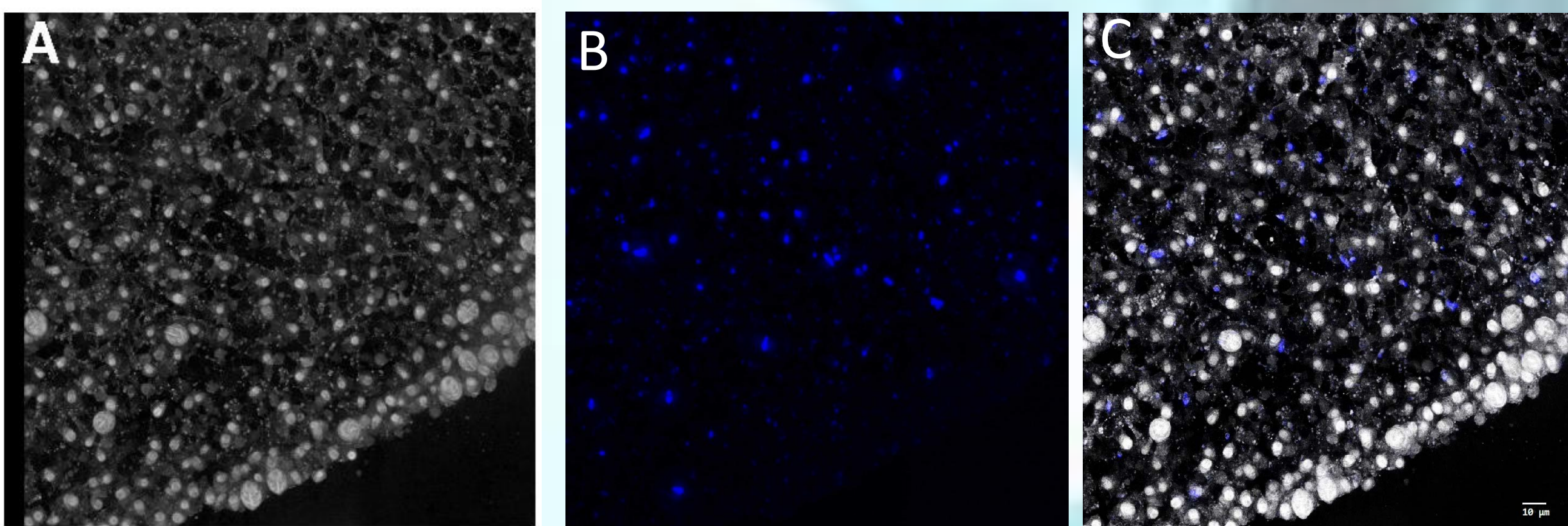
1) Uptake



A 3D **holotomography** map shows different structures based on different **Refractive Index (RI)** ranges with the **fluorescence signal** associated to NPs (RI = 1.58), PVDF (RI = 1.42) and PLA (RI = 1.4)

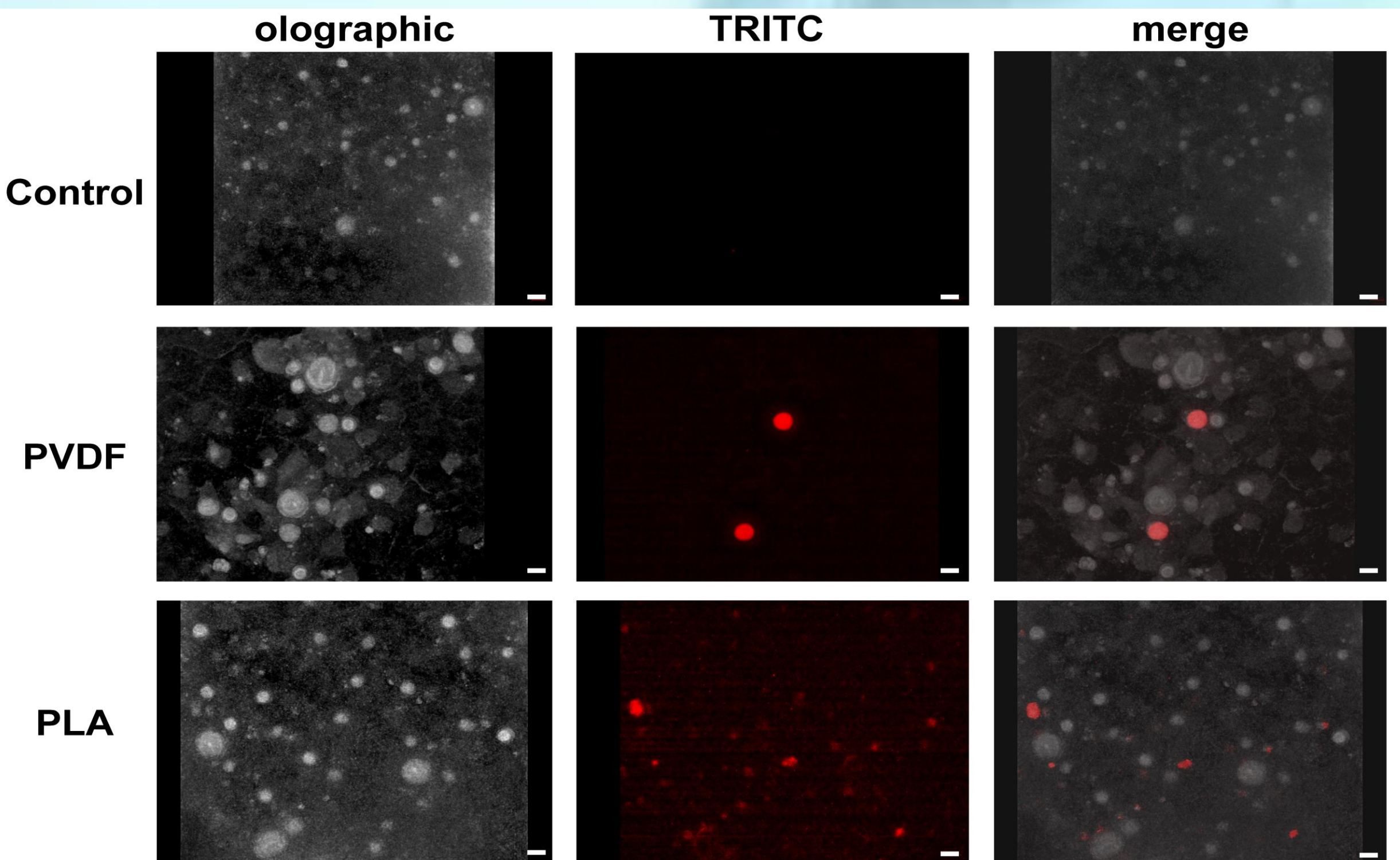


Fluorescent blue NPs (10mg/L) were **inside the ephyra jellyfish body**, (blue colour representing the fluorescence channel visible). C:shows a stitched image of the tomogram (A) and fluorescent (B) images. Bars equal 10 µm.



Epi-fluorescence of PVDF and PLA (red color representing the fluorescence channel) are localized **inside the gelatinous body**, after 24h exposure. Bars equal 30 µm.

For **both polymers** the uptake occurred only at the **highest concentration (100 mg/L)**.



2) Ecotoxicological End-points

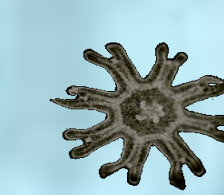
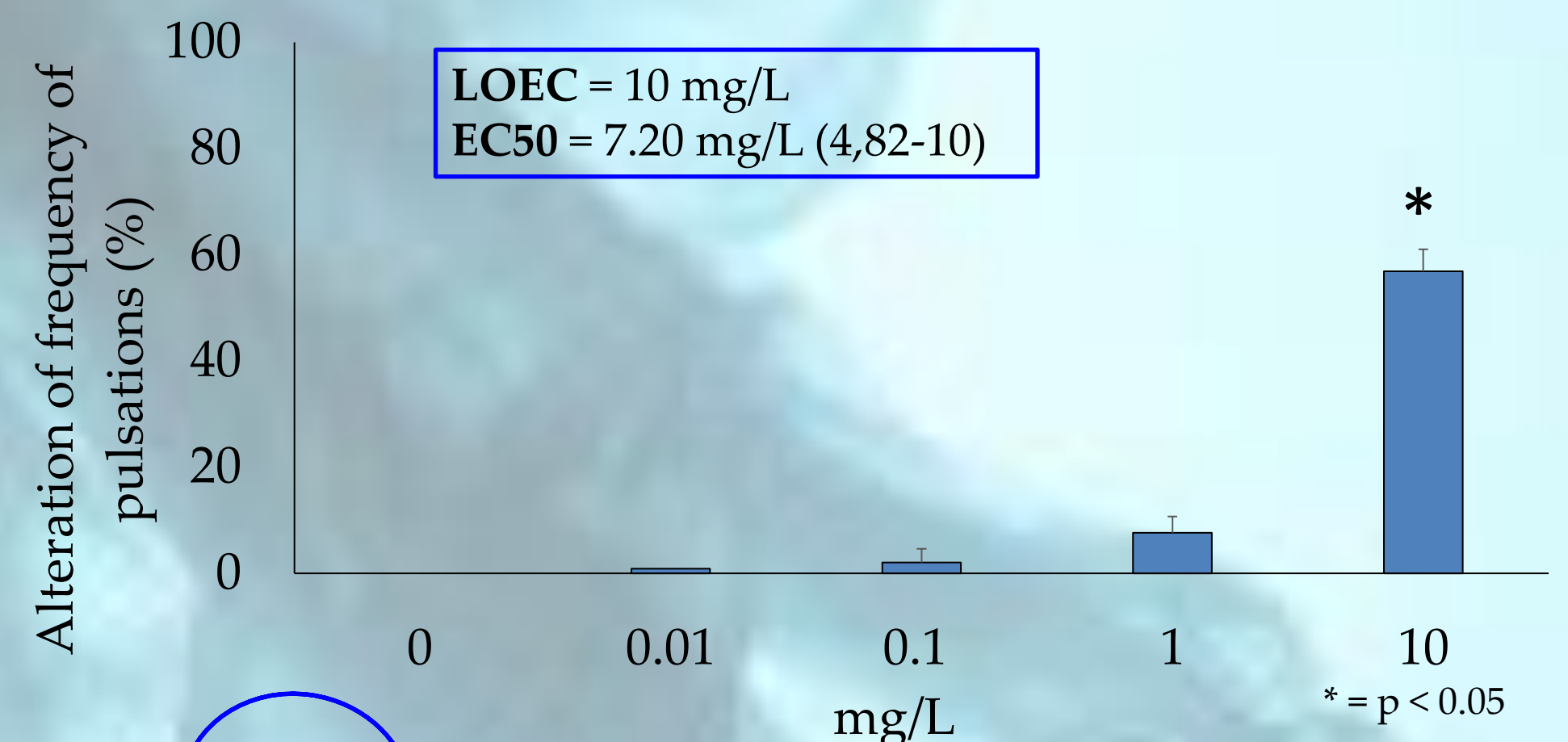


Ephyrae (0 days)

Polystyrene NPs did not affect immobility

Aurelia sp. ephyrae at any concentrations (<10% effect, data not shown).

NPs impaired jellyfish behaviour in term of **Alteration of Frequency of pulsation** after 24 hour exposure in a dose-dependent manner.

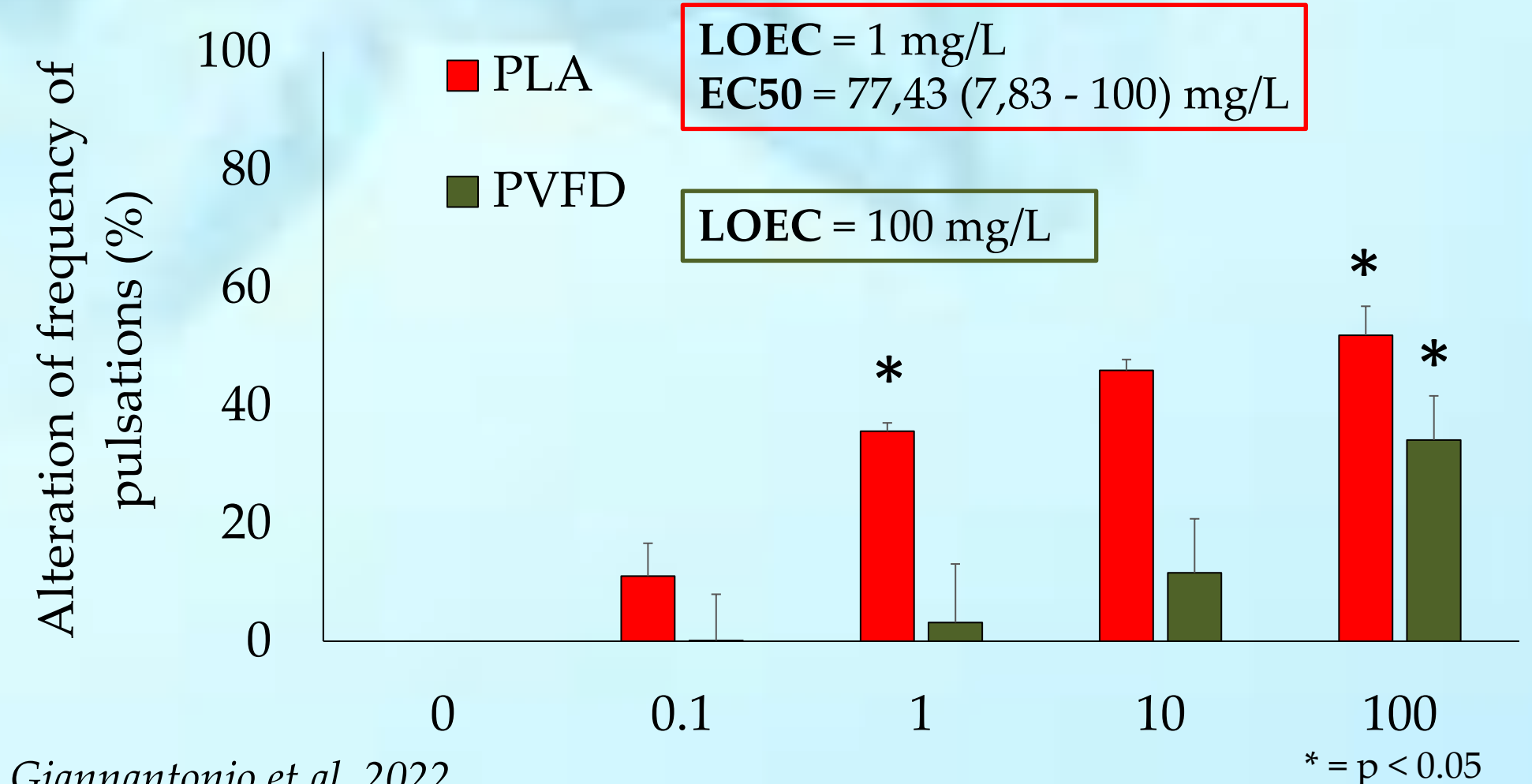


Ephyrae (0 days)

PLA and PVDF did not affect immobility *Aurelia sp.* ephyrae

at any concentrations (<10% effect, data not shown).

MPs impaired jellyfish behaviour in term of **Alteration of Frequency of pulsation** after 24 hour exposure



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CONCLUSIONS

These findings provide new evidence on **NP uptake** in marine jellyfish ephyrae and the **adverse consequences on behavioral dysregulation**. In addition, the uptake of **PLA and PVDF significantly altered the Frequency of pulsation** only after exposure to **high concentrations** of these materials, with a potential impact on the marine ecosystem since **jellyfish are key components of the food web**.