How can we reduce MPs/NPs in the environment

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The GoJelly project

This is a EU H2020 innovation project that explores both jellyfish and microplastics as problems that can be turned into resources (potentially), including:

- Food for humans
- Aquaculture feed
- Cosmetics, pharma
- Fertilizer for aquaculture
- A filter for capturing MPs & NPs
The GoJelly project

• Turning a nuisance – JellyFish (JF) - into a resource

(similar to plastics – it is not waste; it’s a resource)

• JF mucus was shown to capture nano-gold particles (Patwa et al., 2015)

• So… can JF mucus be used to capture MPs too?

• To effectively reduce flux of MPs to the environment, want to go to where some of these MPs originate - WWTPs

• Goal: create a mucus-based filter to capture MPs and NPs in WWTP effluents
Japan
Power plant turbines cooling system screens compromised by massive jellyfish numbers

Israel
summer 2019
The GoJelly project

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MPs in Karmiel WWTP - Findings

- WWT removes more particles than fibers, and removal efficiency decreases with particle size.

- A typical WWTP with capacity similar to the Karmiel plant (300K people) releases about 460,000,000 MPs / day, so there is incentive to address this.
challenge

• so there are a lot of particles being released from WWTPs into the environment....

• What can we do about it?
What is being done?

1. **Standard Coagulation/flocculation** – does not remove all MPs

2. **Fionn Ferreira** – **ferrofluids** (oil and magnetite powder) and magnets to extract MPs from water (https://www.thejournal.ie/irish-student-science-award-microplastics-4745270-Jul2019/)

3. **Filtering** wastewater (EU CLAIM project) using 1.5mm, 70µm & 30µm filters to capture polymers & then photocatalytic (Tofa et al., 2019) degradation of the polymers. Took 175 h for cracks and spots to appear in LDPE. http://www.claim-h2020project.eu/technologies/

4. **Problem:** Because there is no regulation re WWTP removal of MPs / NPs, there is little incentive to develop solutions ...
AuNP capture by JF mucus (Patwa et al. 2015)

A. aurita and P. noctiluca mucus

Diagram:

- Aqueous phase contaminated with nanoparticles (QDs, gold NPs)
- Nanoparticles trapped in the mucus
- Decontaminated supernatant
Aurelia mucus captures AuNPs

*Aurelia* sp. mucus added to AuNP. Different ratios of mucus & AuNP. Tubes 4 and 8 - AuNP controls.
JF mucus to capture MPs / NPs

Some of the challenges:

- Supply of **mucus** to enable testing – JF availability
- Mucus **shelf-life**: how long can we work with it?
- **Freeze-dried** mucus – not optimal, unfortunately
- **Which** polymers to focus on? PE, PP, PS, nylon, acrylic, others?
- **type of MP** to test – anything not available commercially, needs to be custom-made
- **How** to test MP capture - developing **methods** that work
- Capture is best with **NPs** – not MPs
Summary

- Mucus from different jellyfish (& probably different biota) has different particle capture abilities (Aurelia mucus is best)
- Particle capture is instantaneous & highly efficient
- Nano-size particles are captured better than MPs
- For commercial application, need to generate a sustainable synthetic matrix for MP/NP capture
- After capturing the plastics, need to develop procedure to separate mucus in order to re-use/compost mucus and re-use the MPs
- Regulation (& Policy) re MPs discharge would make this R&D a lot easier
Thanks to:

- Partners from:
  - Sintef Ocean
  - Braude College
  - my team at the Univ of Haifa
  - the whole GoJelly consortium
- the European Union