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Email: mcol@pml.ac.uk
Twitter: @SciMatty

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Effects of microplastics in lower trophic organisms

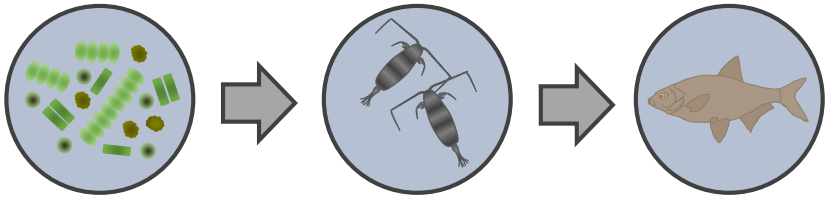
Dr Matthew Cole

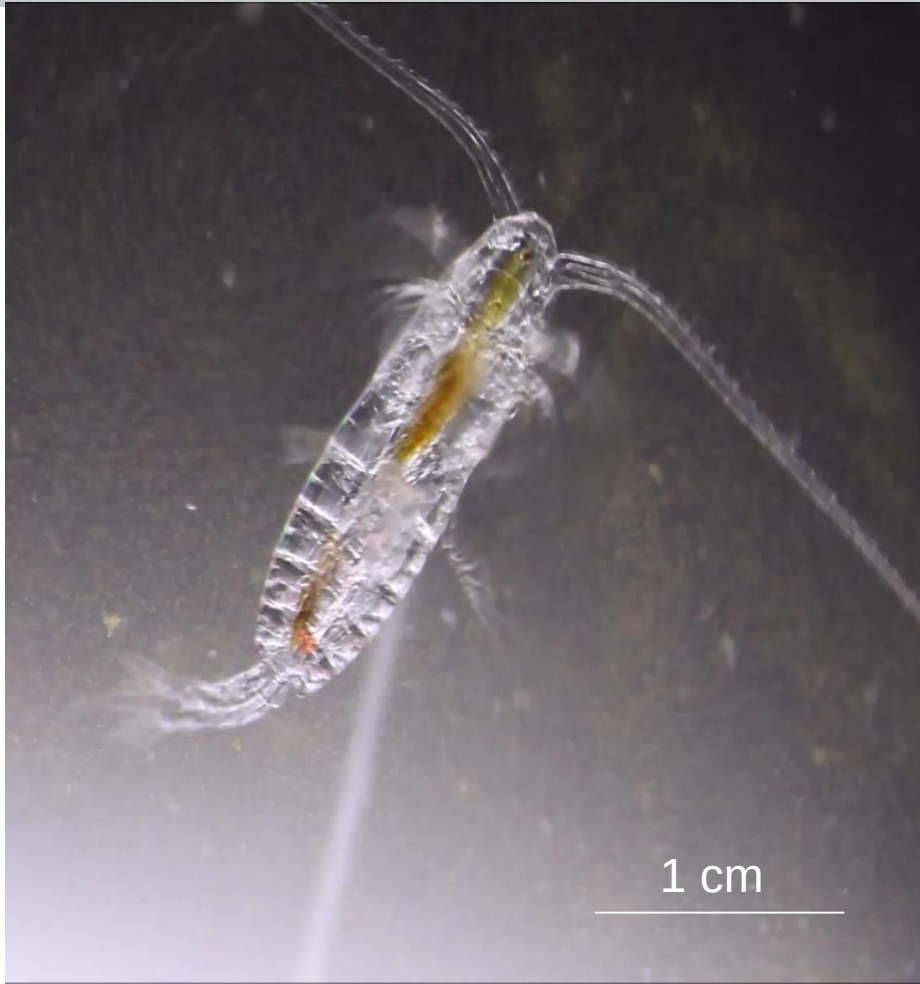
Microplastics

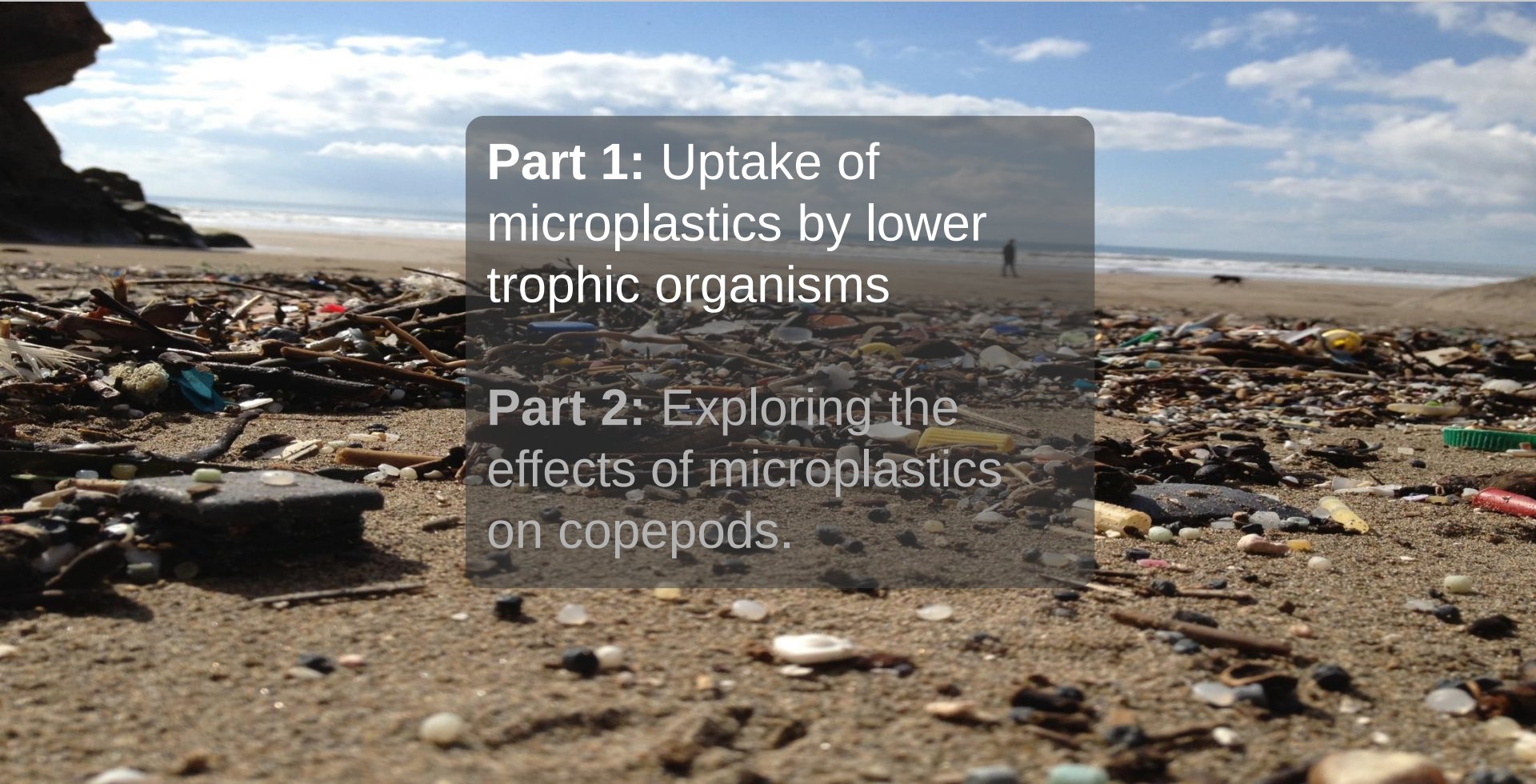
Plankton

Copepods

- Copepods are a type of planktonic animal.
- Filter out crud and algae from water (cleaning water).
- Provide energy to fish, whales and other animals.
- **Vulnerable to microplastic?**



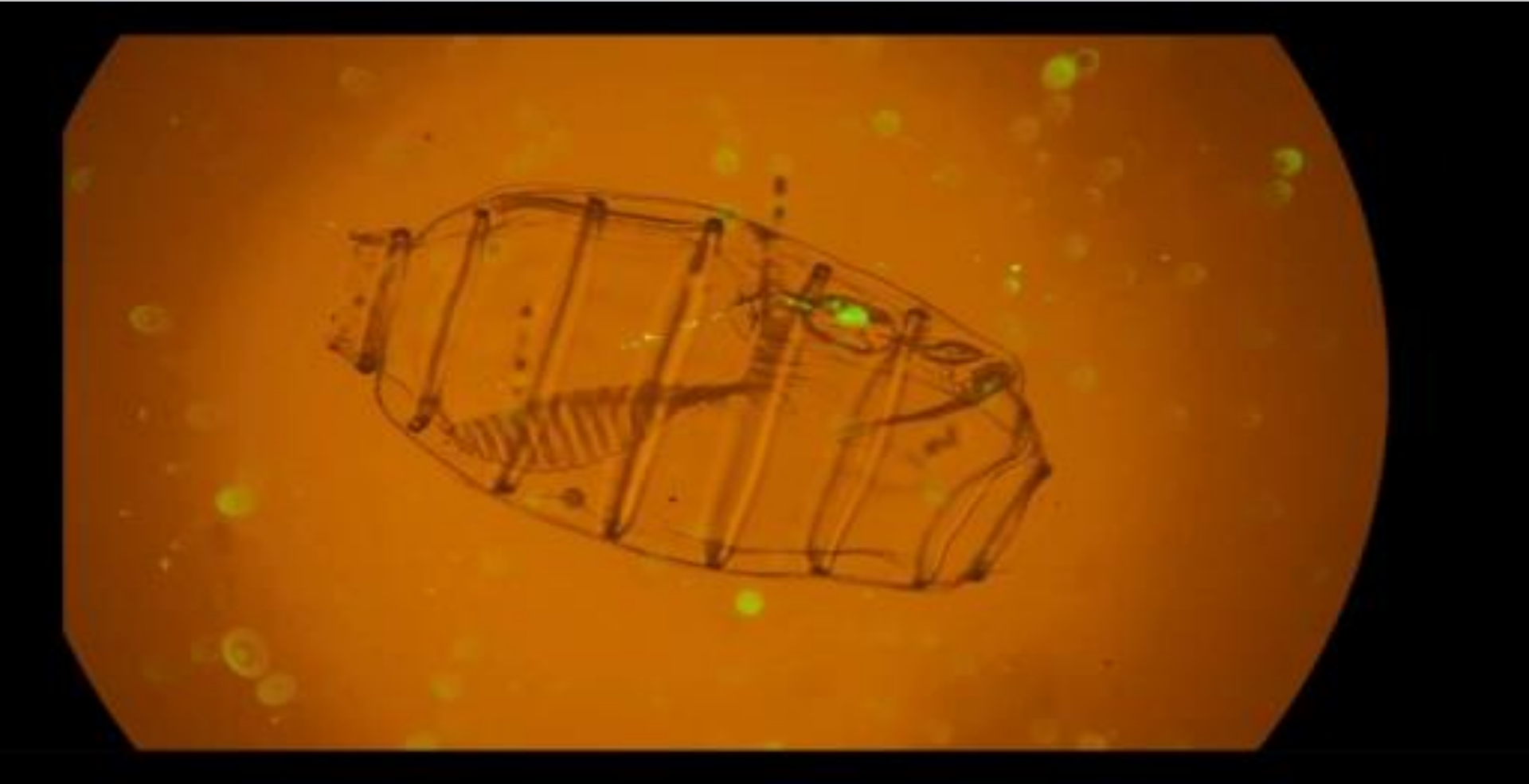




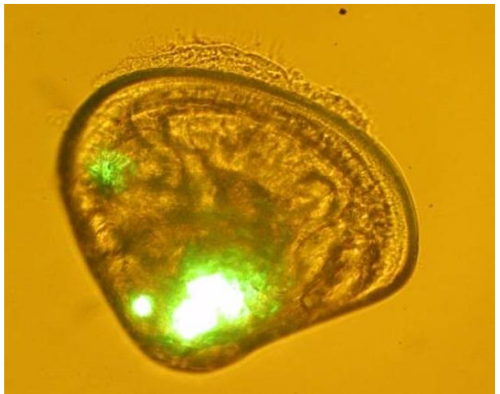
Part 1: Uptake of microplastics by lower trophic organisms

Part 2: Exploring the effects of microplastics on copepods.

Microplastic ingestion



Zooplankton consume microplastics (lab exposures)



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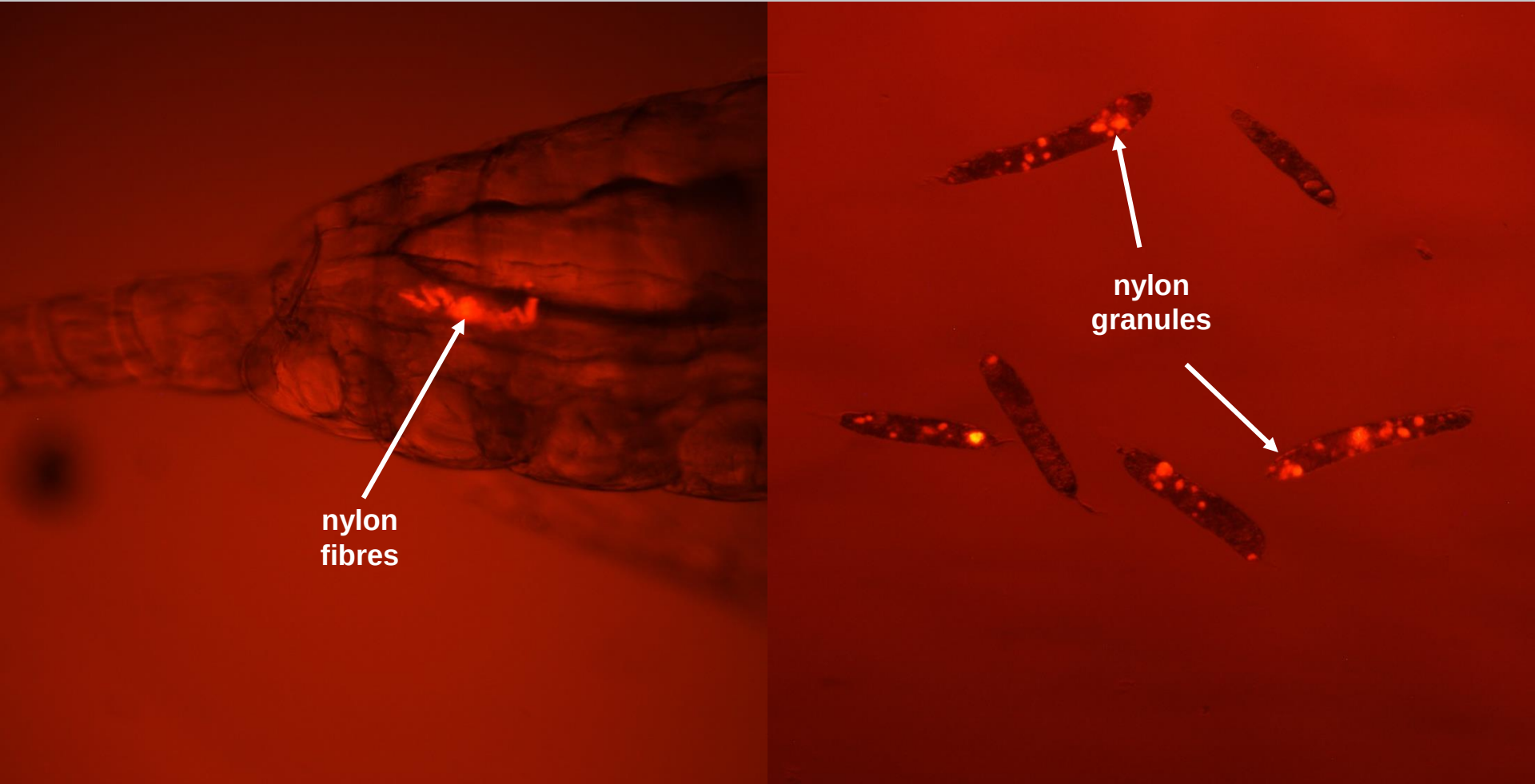
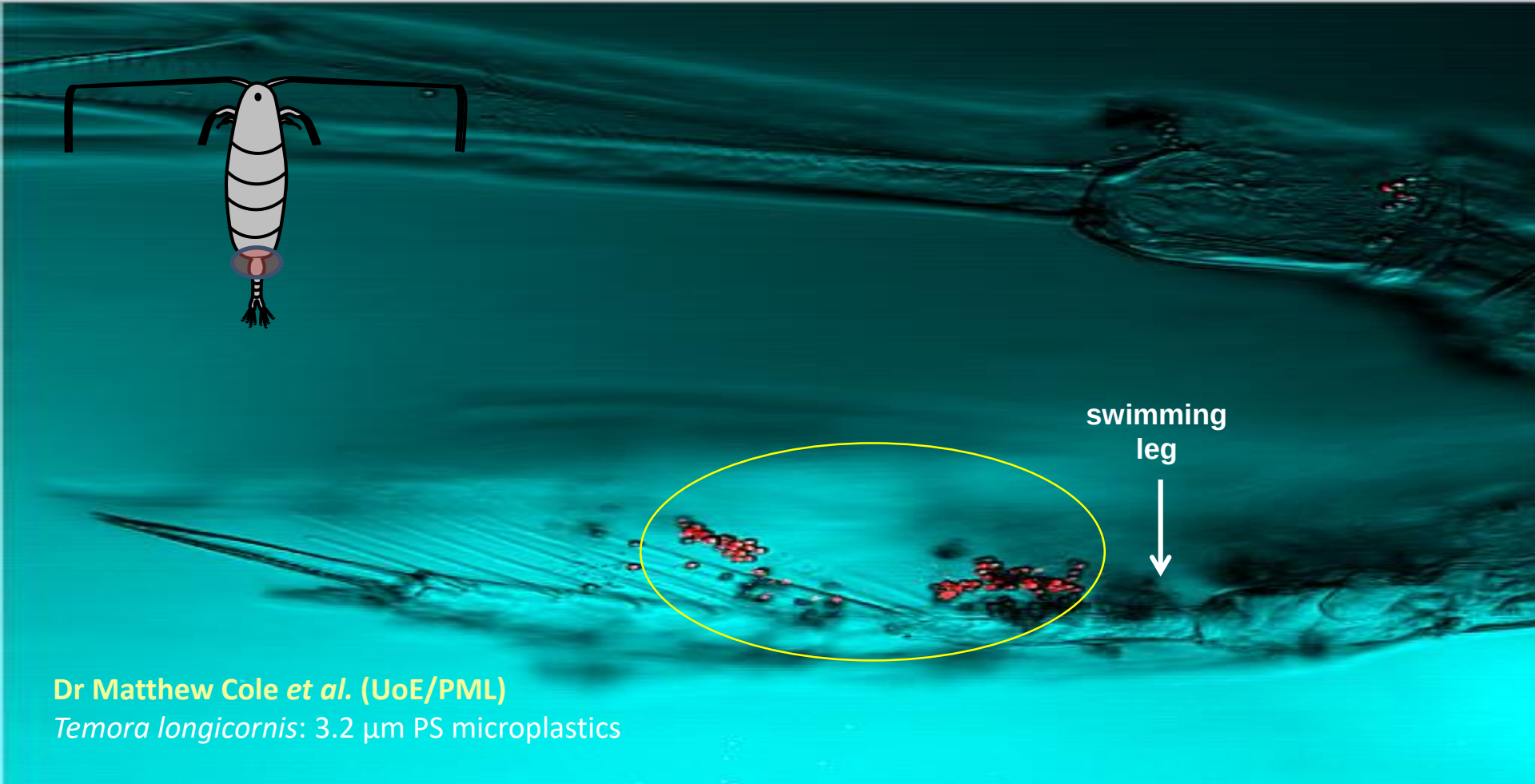


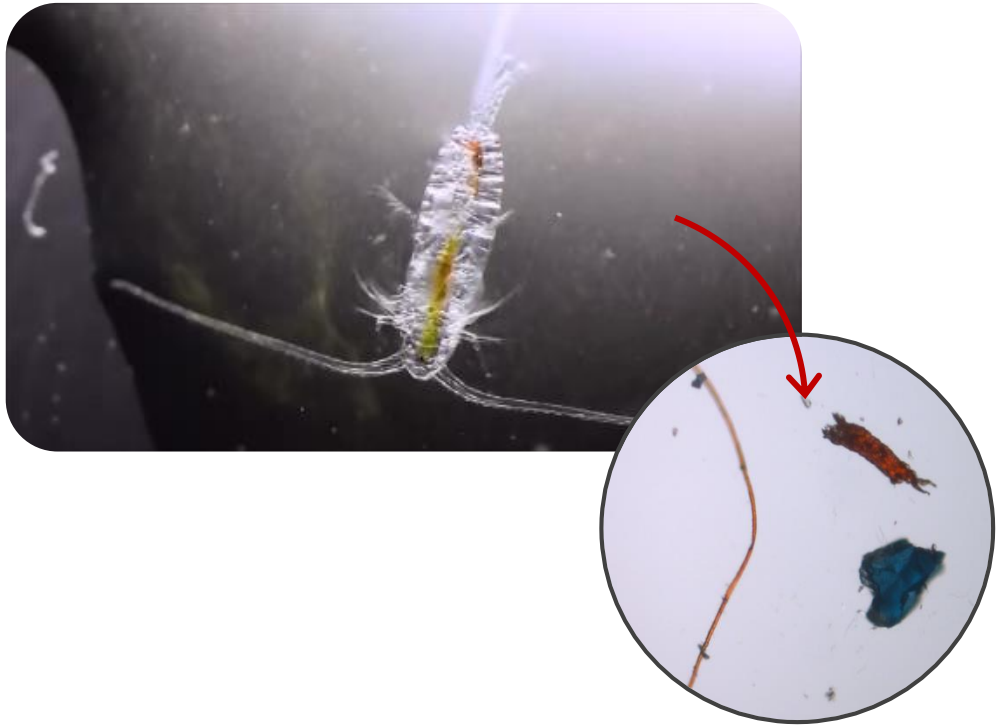
Microplastics stuck to copepod appendages



Dr Matthew Cole *et al.* (UoE/PML)

Temora longicornis: 3.2 µm PS microplastics

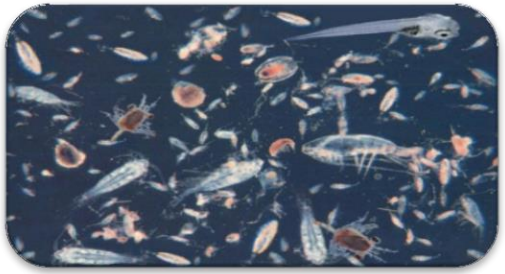
Zooplankton consume microplastics (environment)



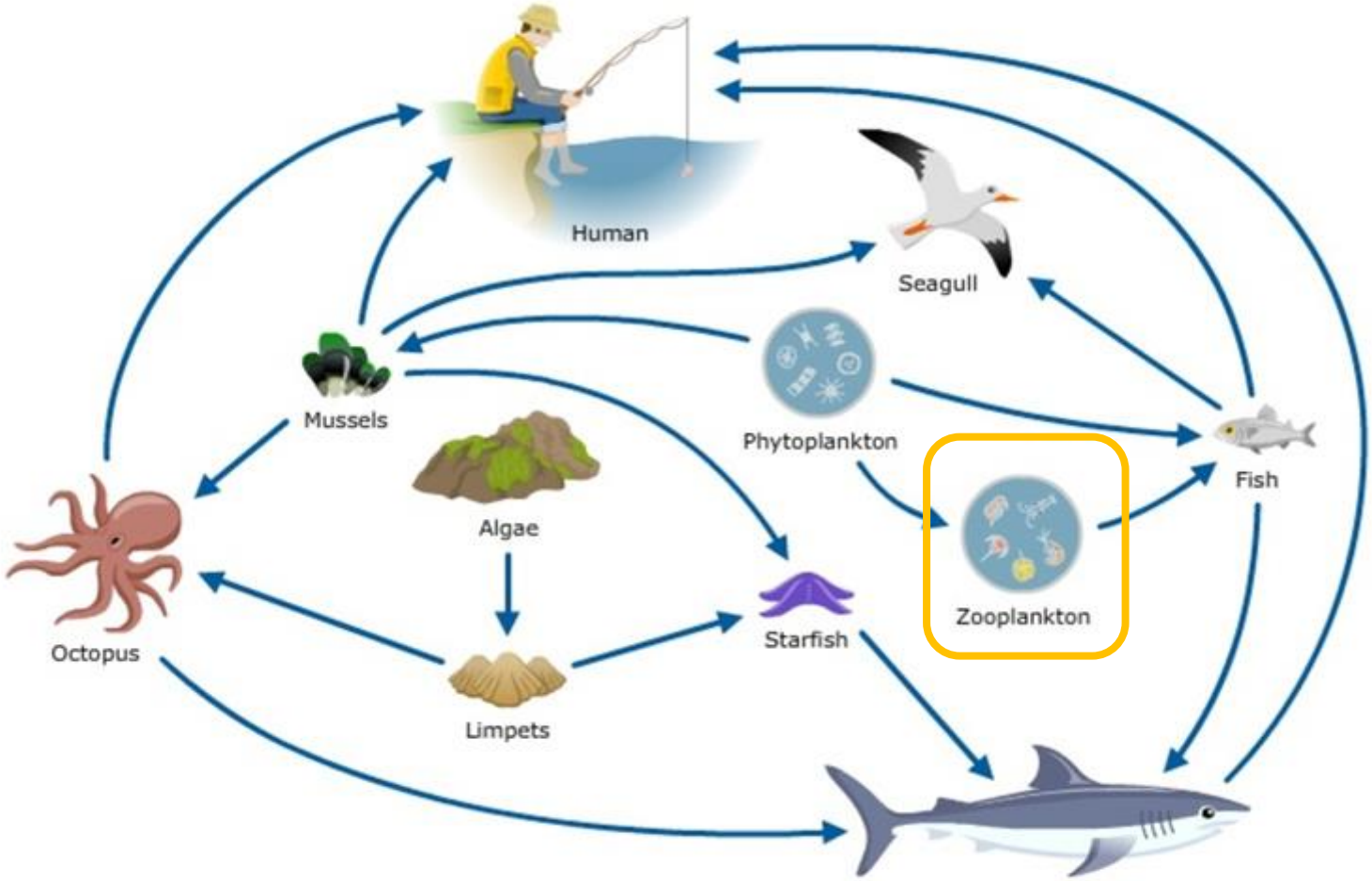
Looking at wild zooplankton in the English Channel:

- Sampling of 12,000 zooplankton revealed average microplastic load of 0.03–24 MP per 10 zooplankton.
- 3% of fish larvae in English Channel contain microplastics.

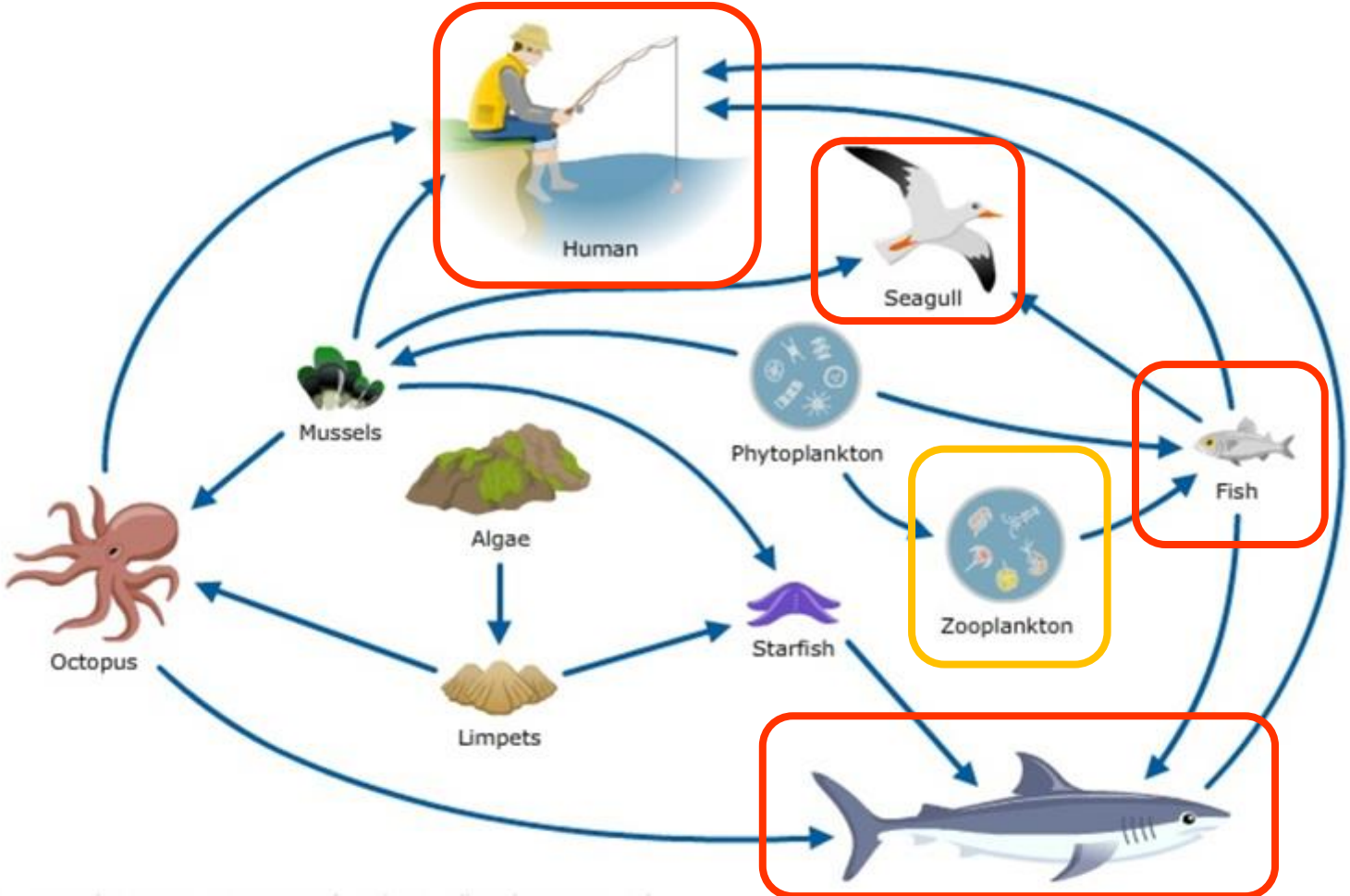
Their small size makes them readily eaten by animals



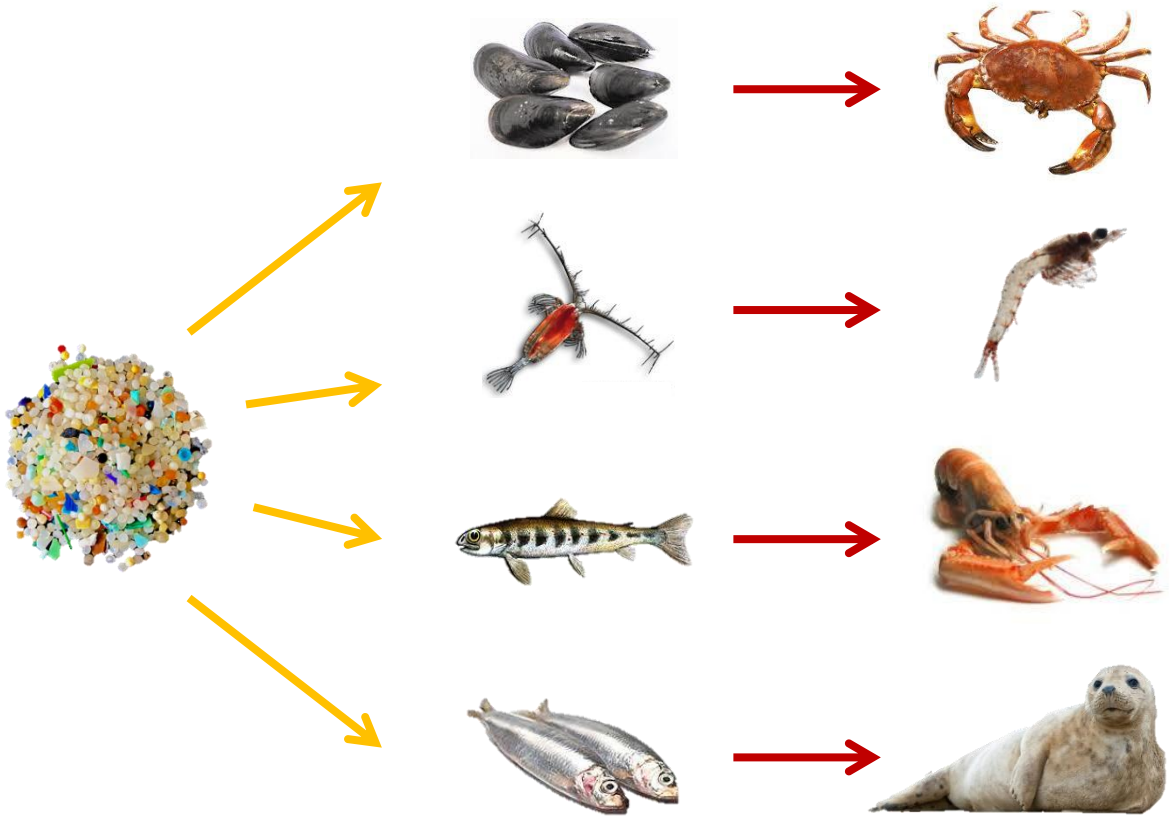
Marine food web



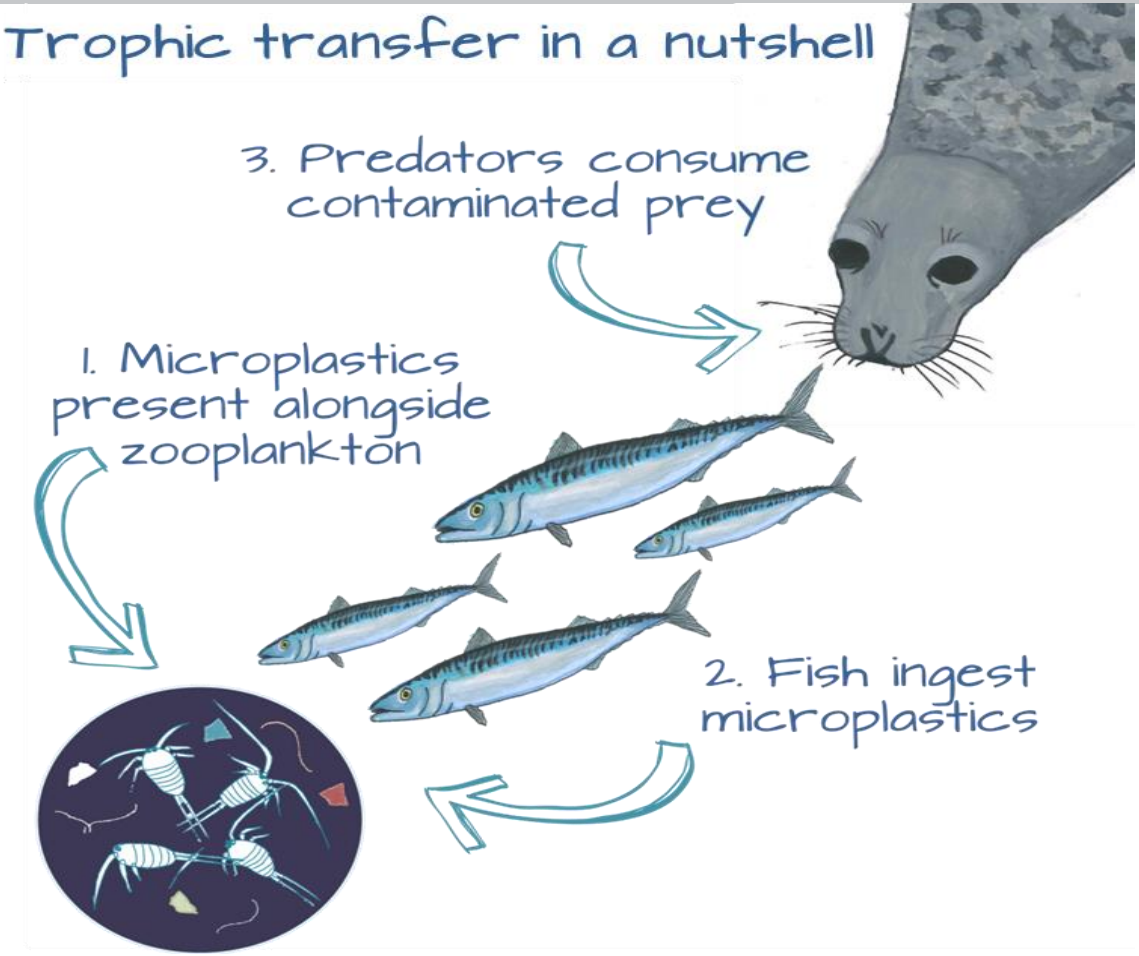
Marine food web



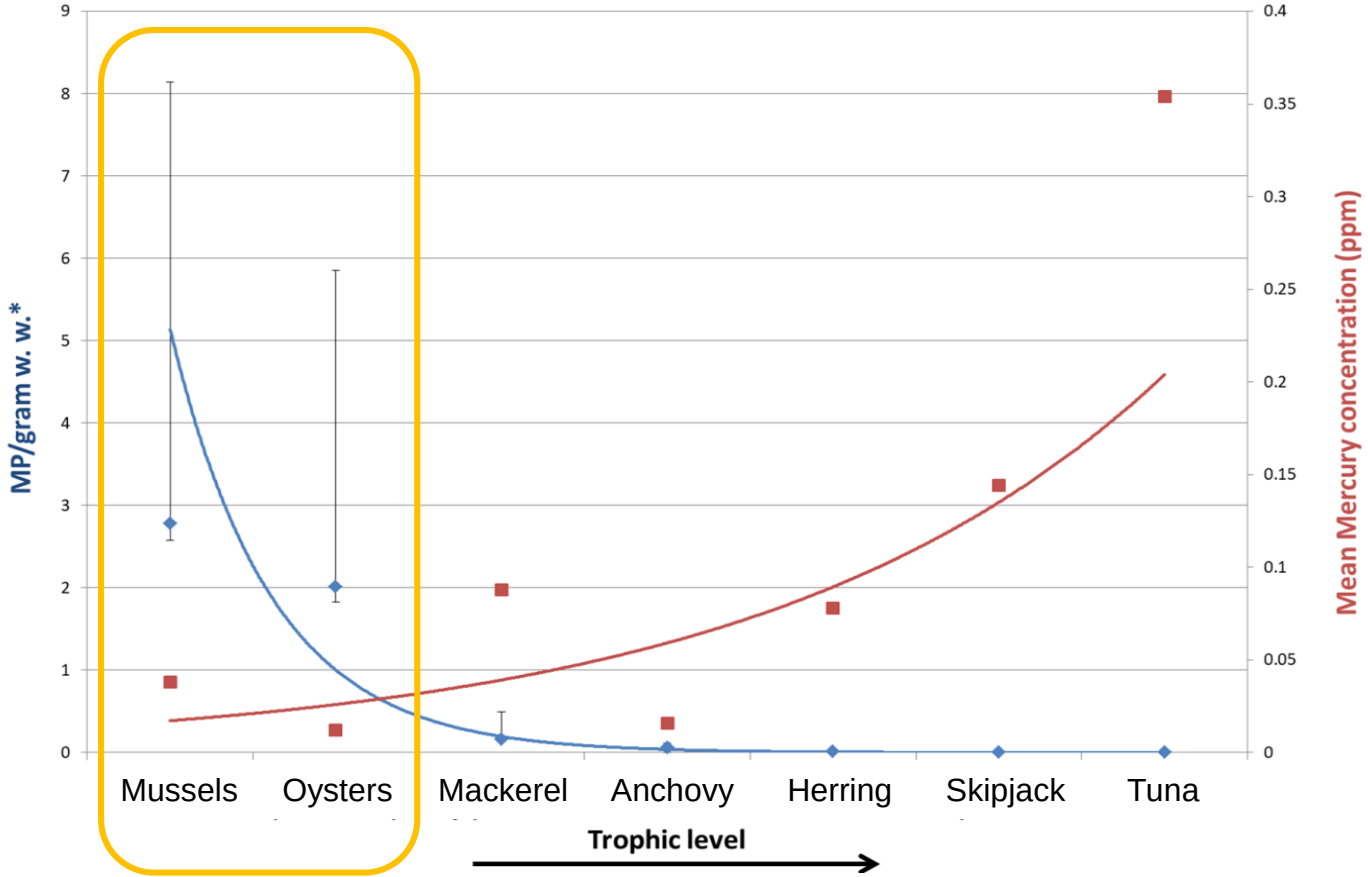
Trophic transfer



PhD: Sarah Nelms



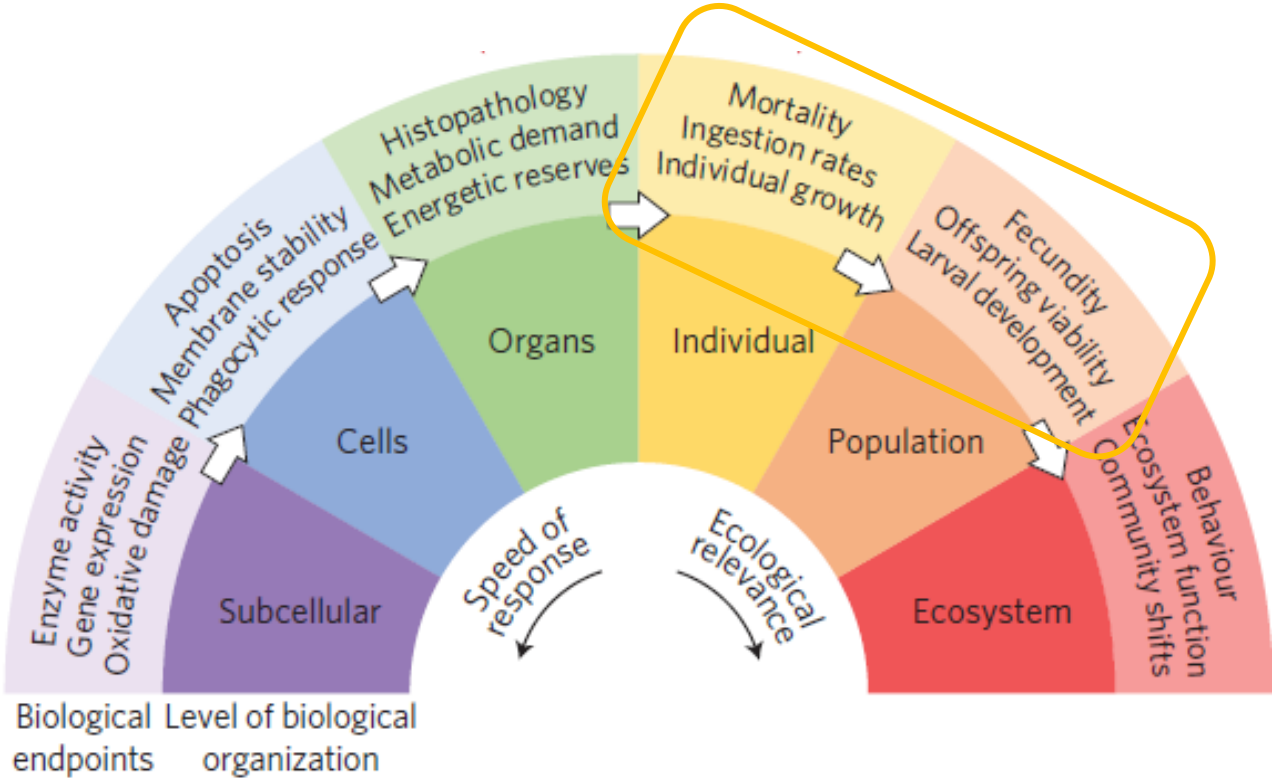
PhD: Chris Walkinshaw



Part 1: Uptake of microplastics by lower trophic organisms.

Part 2: Exploring the effects of microplastics on copepods.

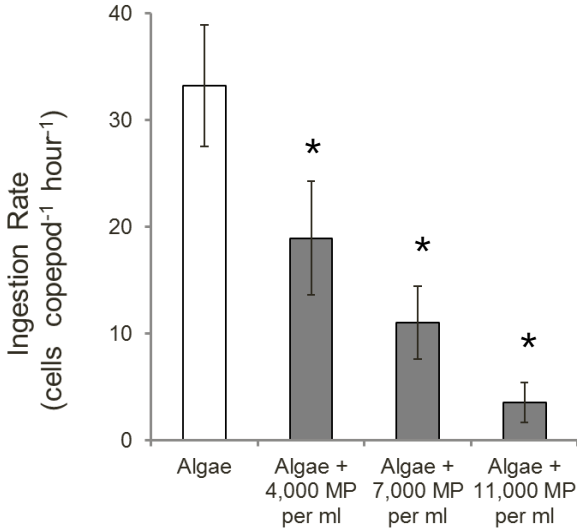
Cascade of biological effects: AOP



Do microplastics pose a risk to copepods?

Microplastics and feeding

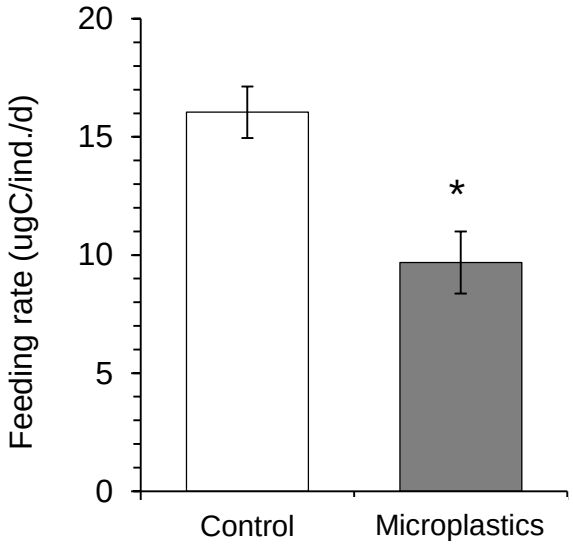
Natural algae + 7 um MP



Adding plastic causes the copepods to eat less food

Microplastics and feeding

Cultured algae + 20 µm MP



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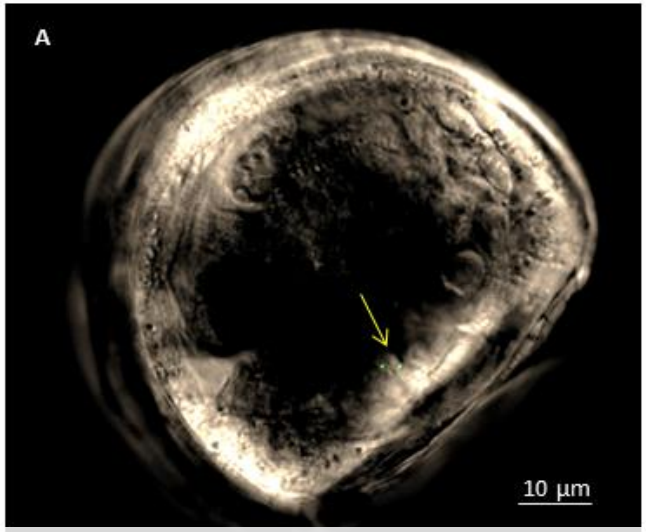
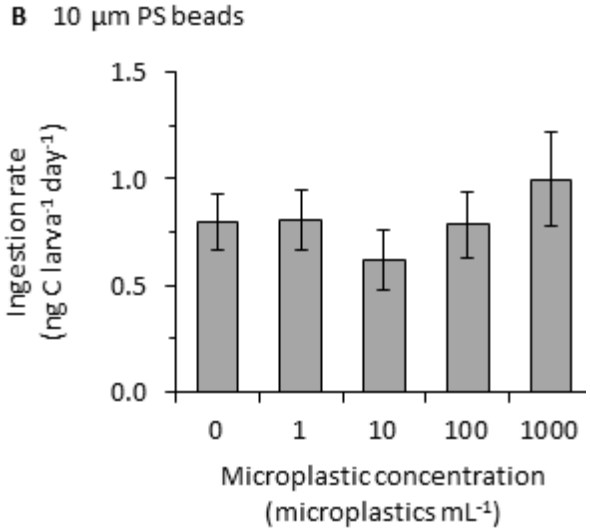
Microplastics and feeding

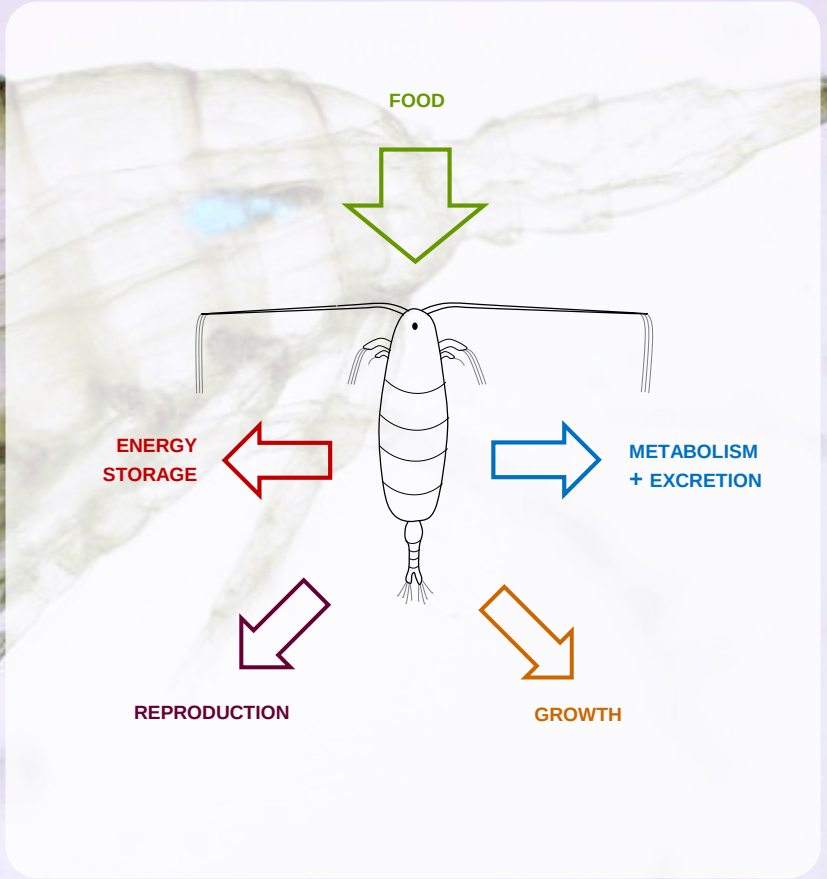


Cultured algae + 10 um MP

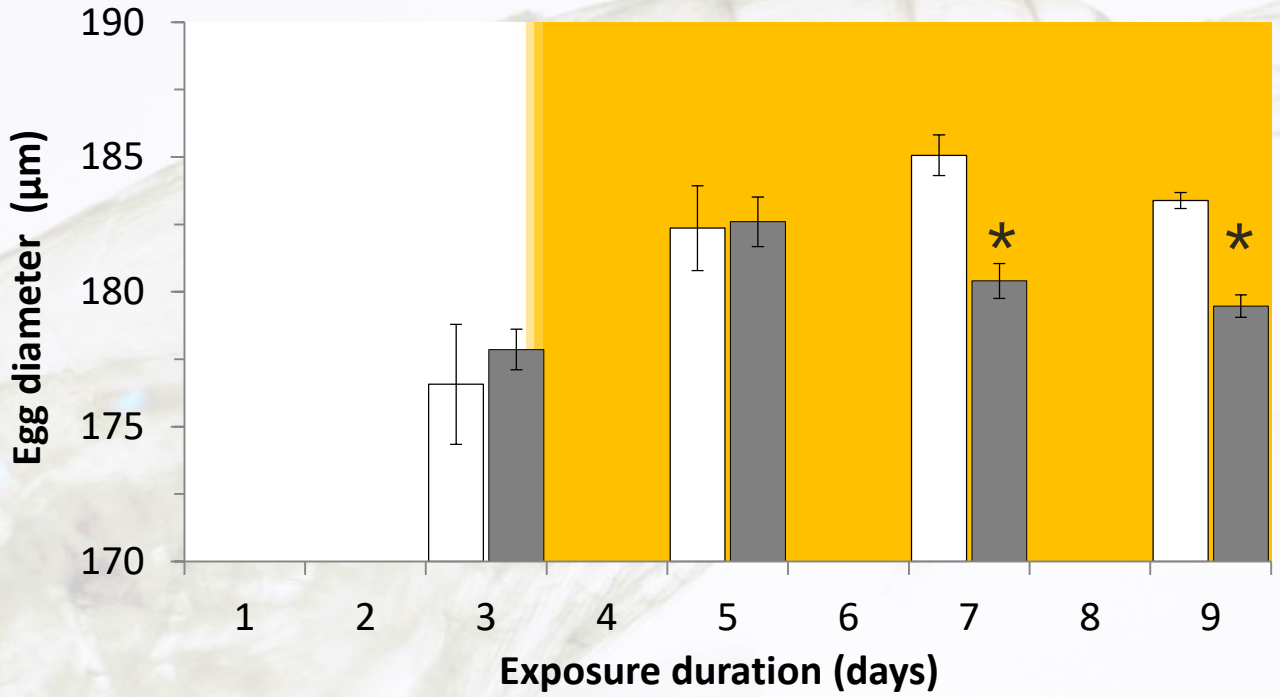


Oyster larvae shown to ingest NANO and MICROplastics... but no impact to their feeding

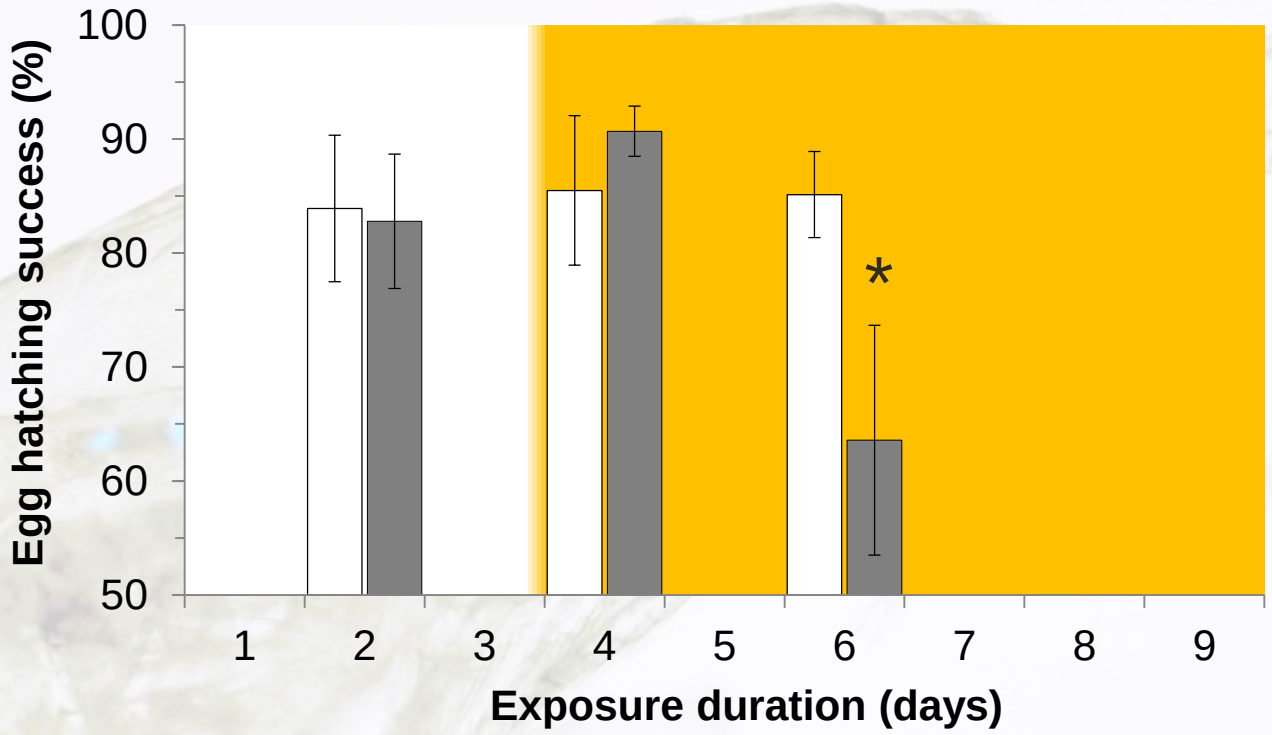
Energetic budget:
Feeding provides energy for key function of an organism



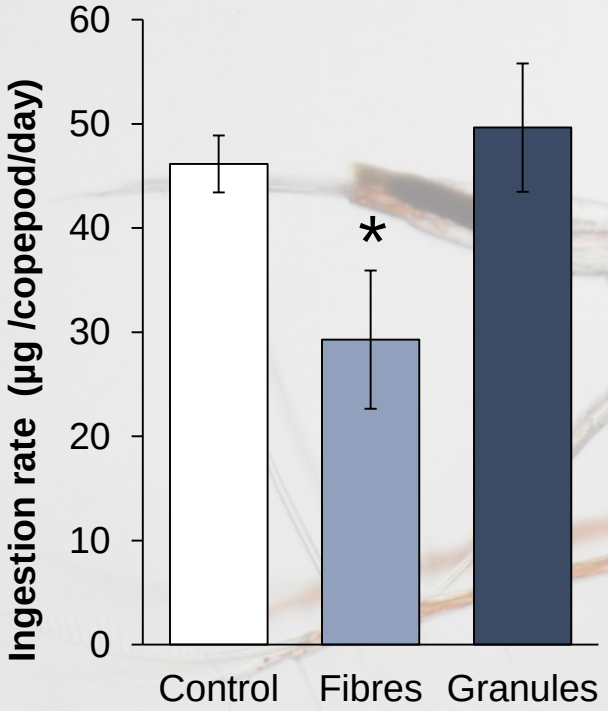
Calanus helgolandicus egg size



Calanus helgolandicus egg hatching success



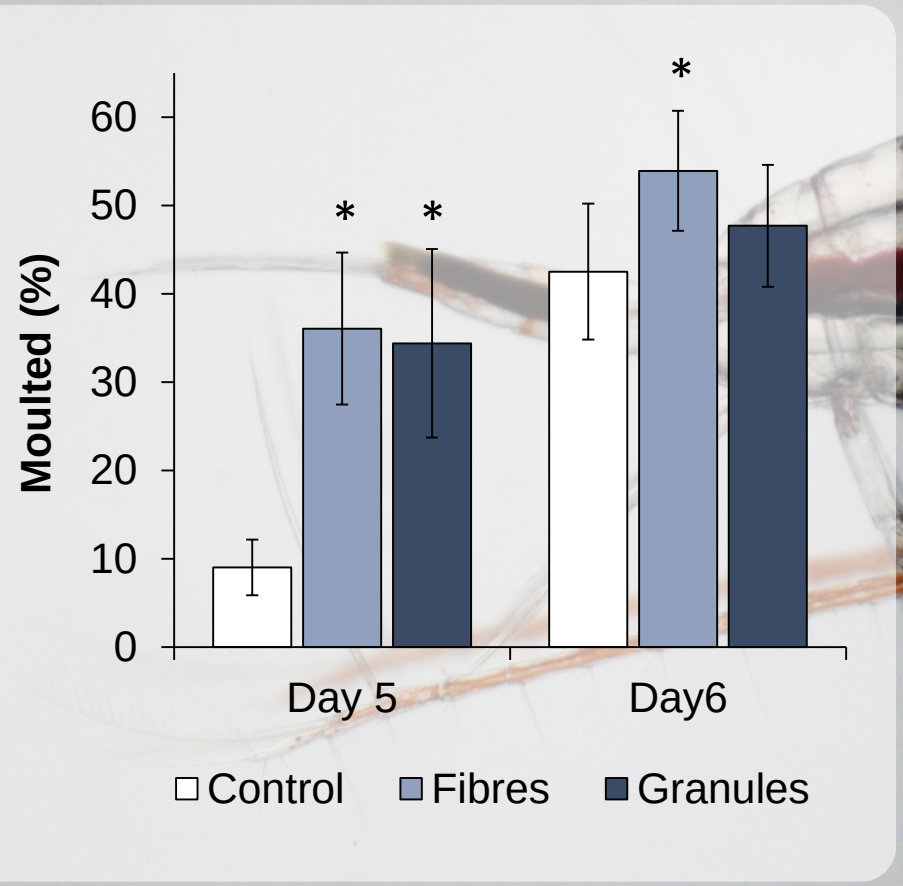
Juvenile *Calanus finmarchnicus* feeding



Copepods exposed to microfibres showed substantial decline in feeding

Cole *et al.* (2019) *Environmental Science & Technology*

Juvenile *Calanus finmarchnicus* development



Microplastic exposed copepods moulted significantly earlier than controls.

Again, this isn't directly tied to reduced feeding…

Cole *et al.* (2019) *Environmental Science & Technology*

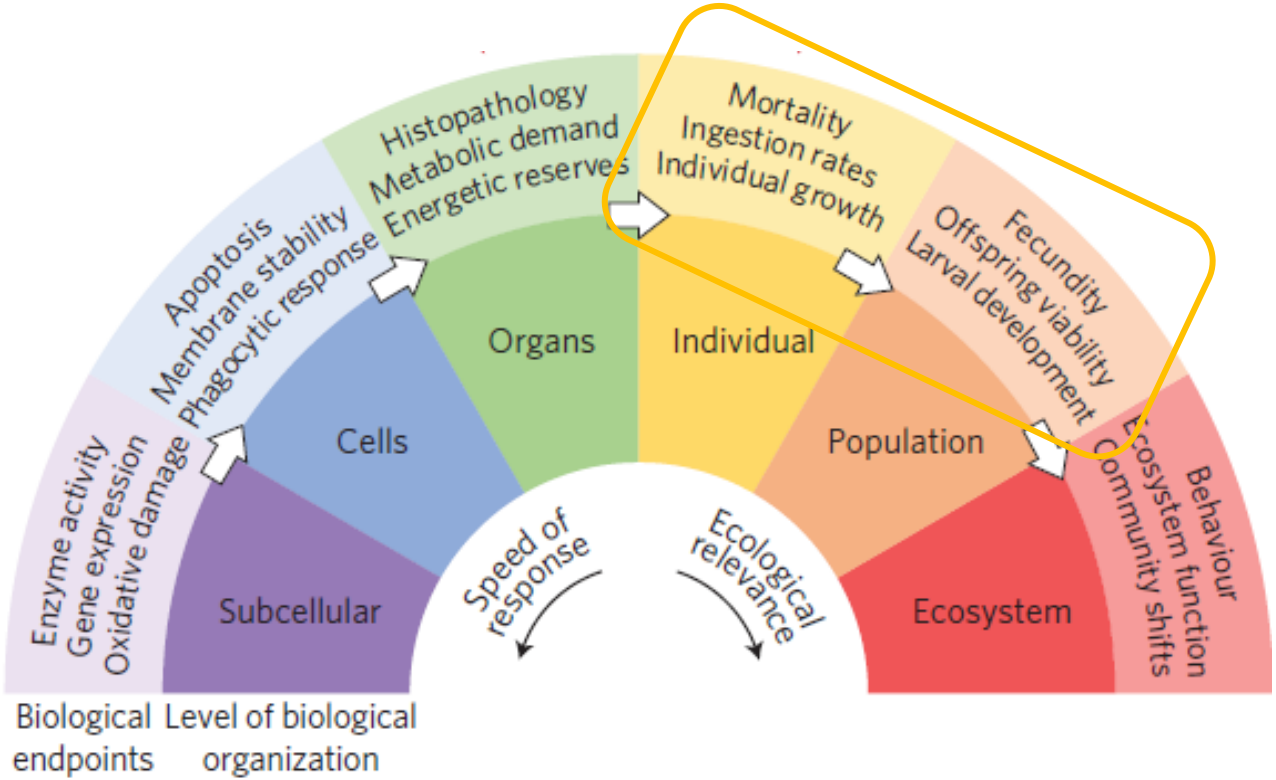
Cause and effect

Plastics are complex: made up of a polymer matrix and numerous additives and monomers

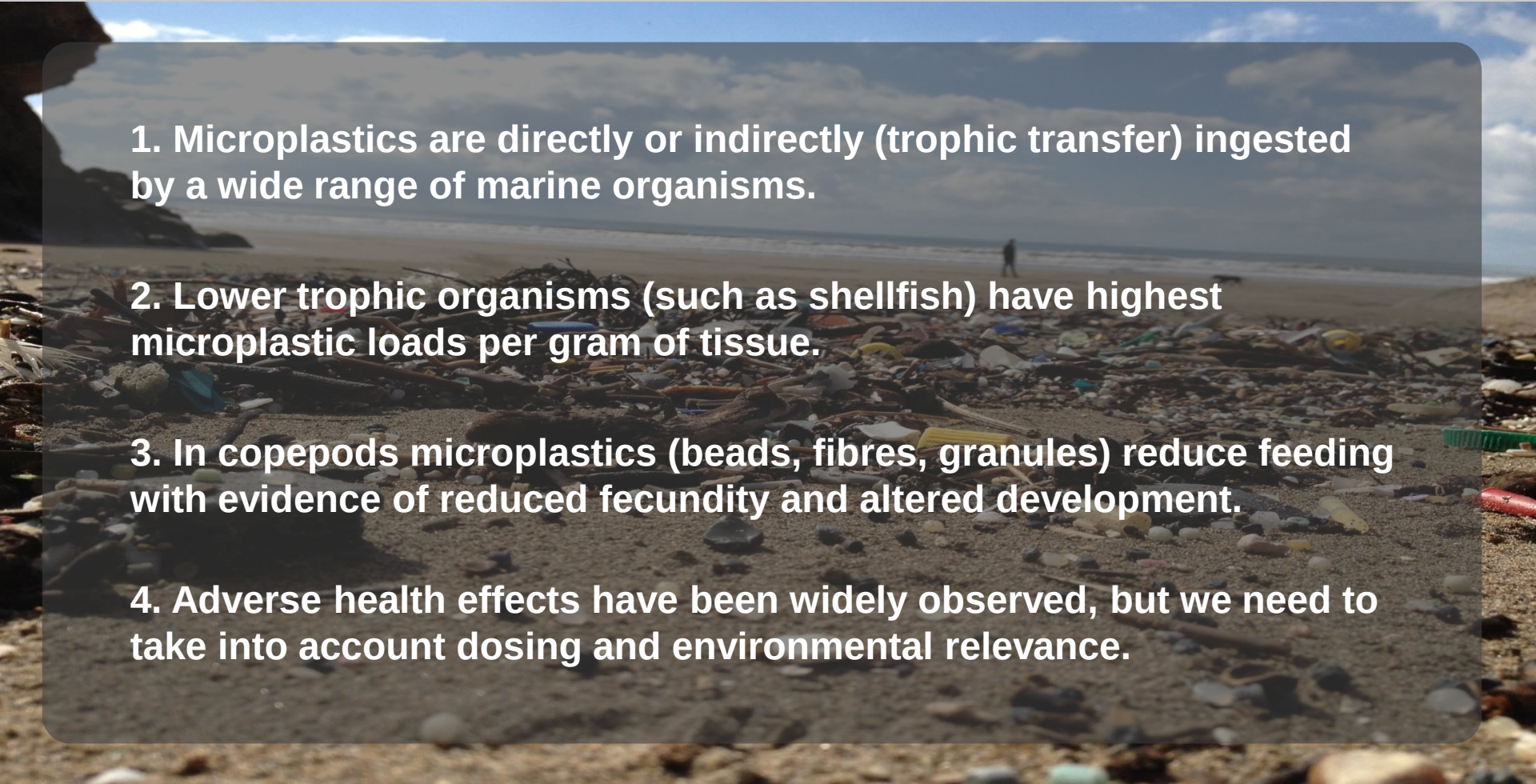
Chemicals associated with microplastics may cause toxicity or endocrine disruption???

Cole *et al.* (2019) *Environmental Science & Technology*

Cascade of biological effects: AOP



Our current understanding



1. Microplastics are directly or indirectly (trophic transfer) ingested by a wide range of marine organisms.

2. Lower trophic organisms (such as shellfish) have highest microplastic loads per gram of tissue.

3. In copepods microplastics (beads, fibres, granules) reduce feeding with evidence of reduced fecundity and altered development.

4. Adverse health effects have been widely observed, but we need to take into account dosing and environmental relevance.

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