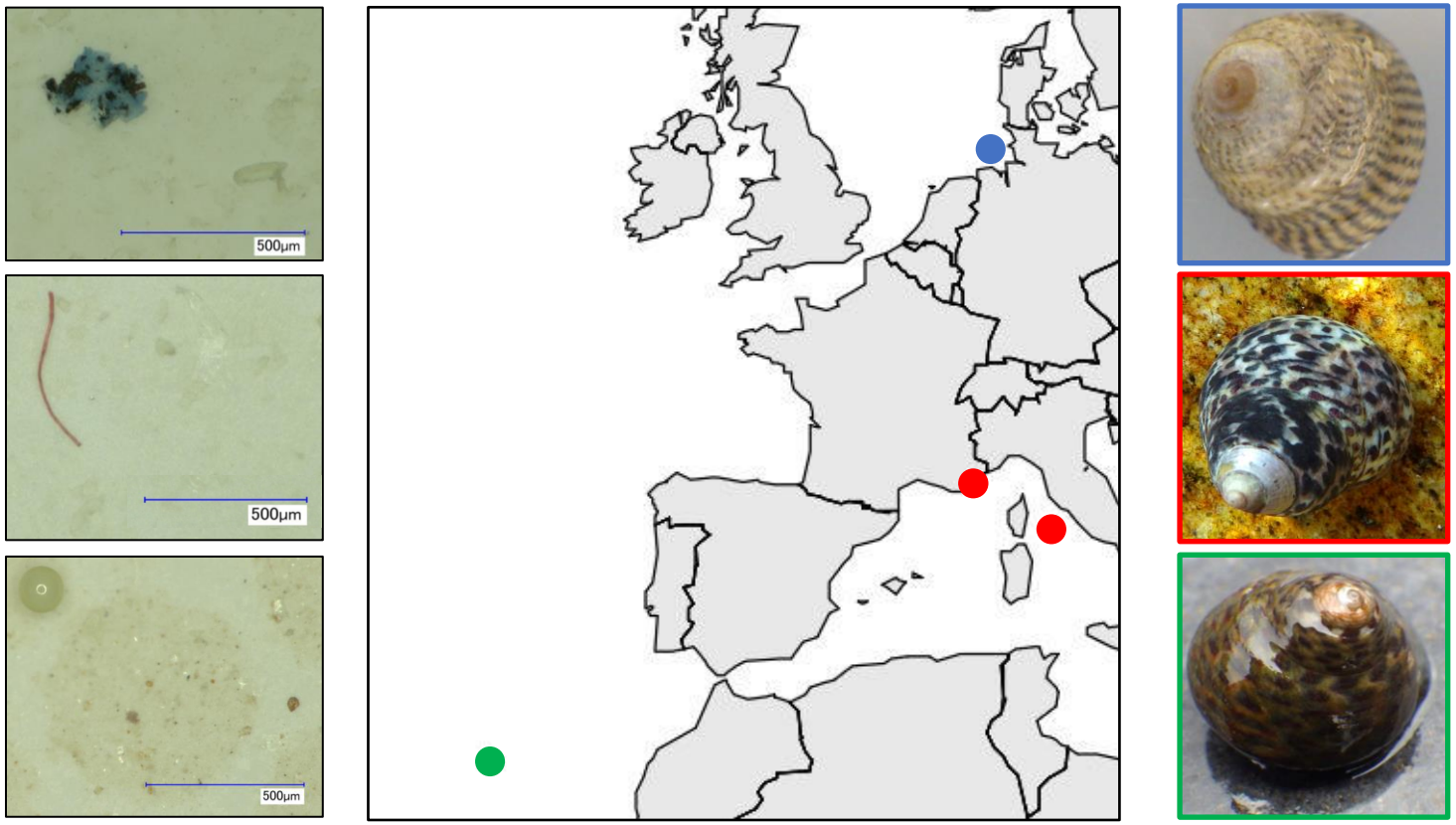
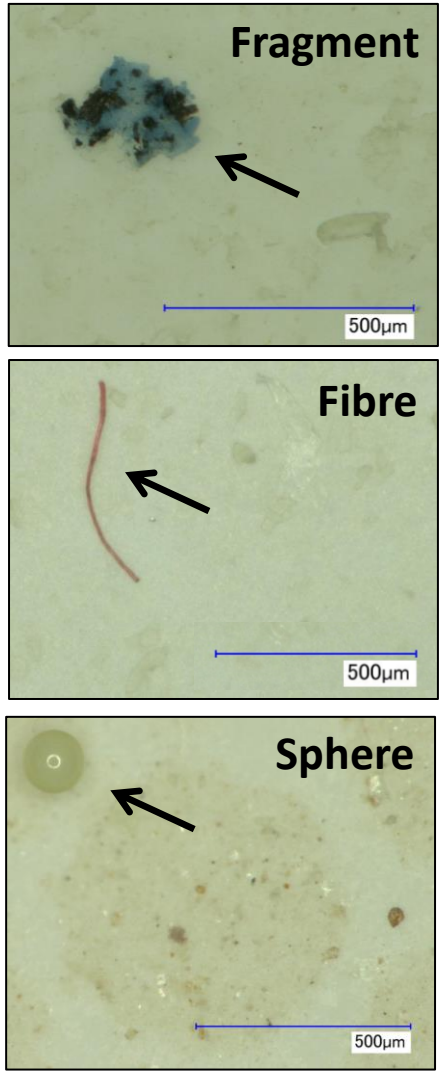
Microplastic load and polymer type composition in European rocky intertidal snails: Consistency across locations, wave exposure and time

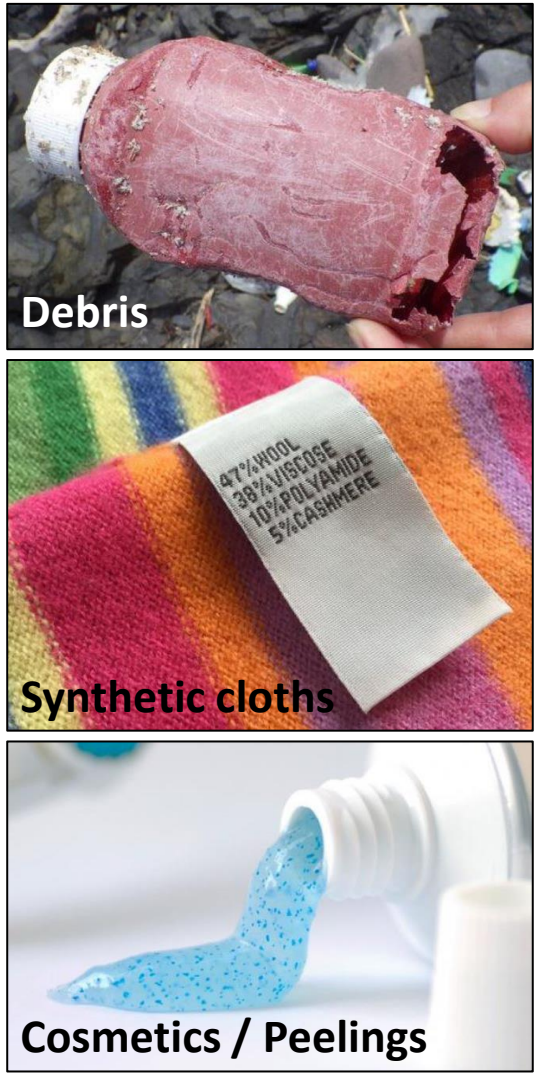


Julius A. Ellrich, Sonja M. Ehlers & Jochen H. E. Koop

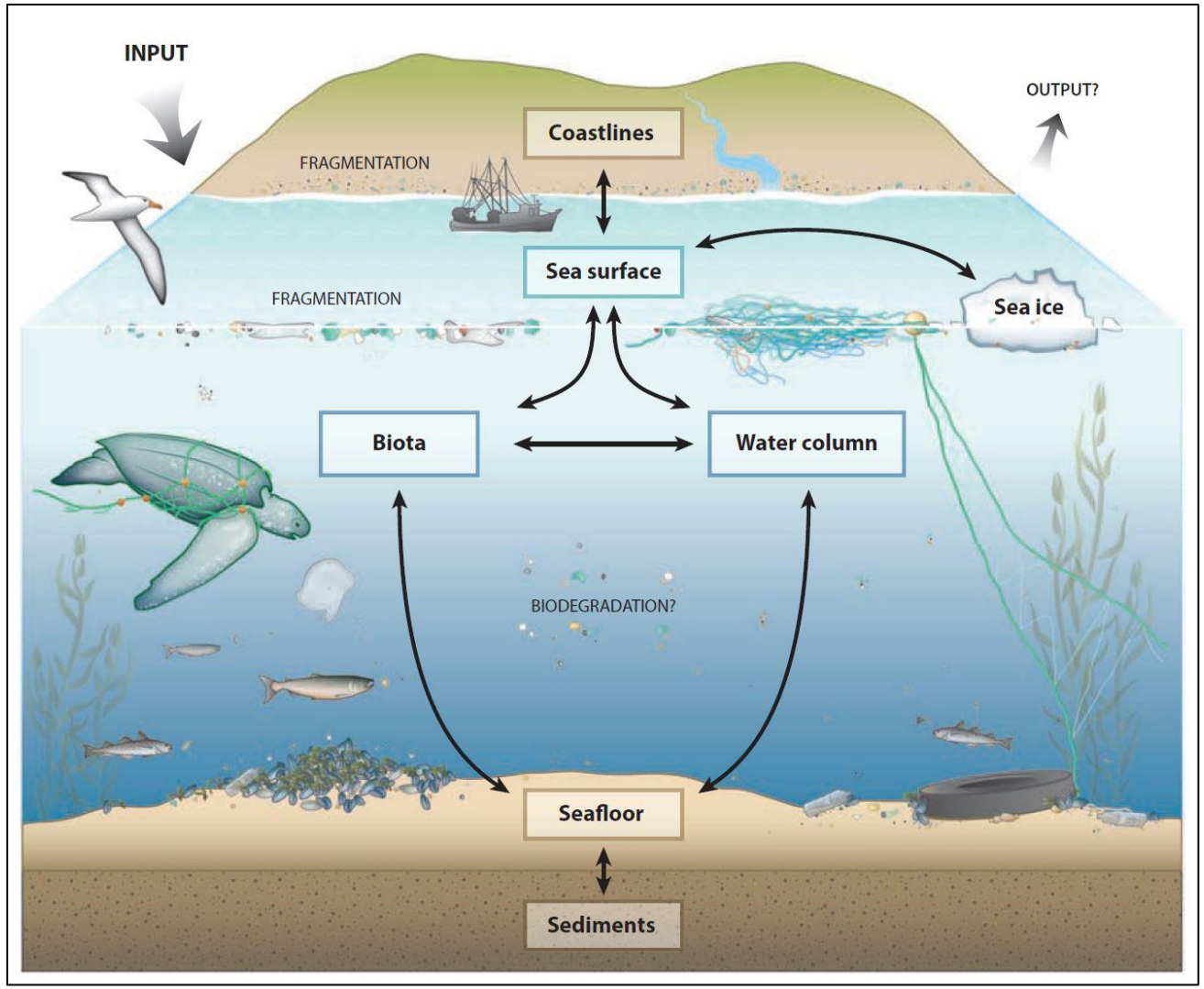
Microplastic (MP) is an emergent pollutant



Microplastic
(plastic < 5 mm, MP)



Microplastic sources



Law 2017

Plastic and MP pollution is common in aquatic habitats

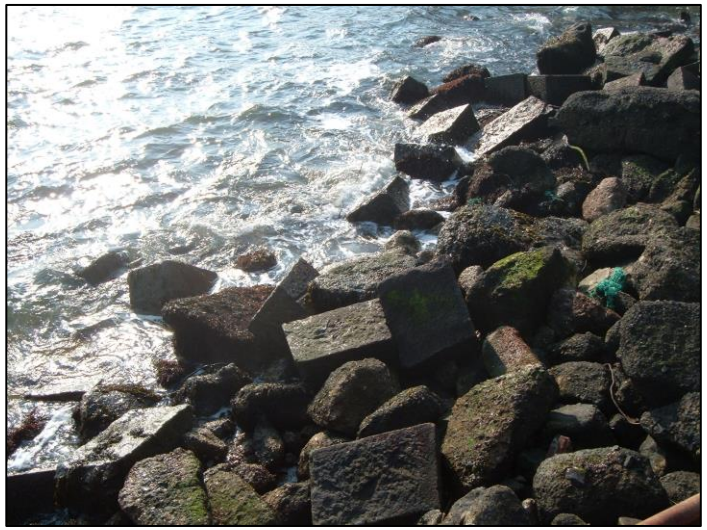
Open ocean

Rivers & estuaries

Ocean floor

Beaches

Plastic pollution is common in rocky intertidal habitats



Helgoland, North Sea

Giglio, Mediterranean

Madeira, Atlantic Ocean

Information on MP in rocky intertidal habitats is extremly scarce.

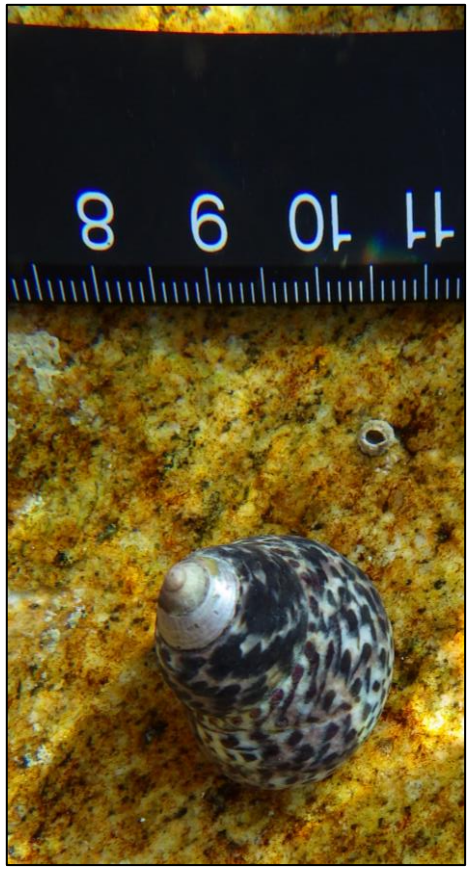
Plastic pollution is common in rocky intertidal habitats

Mussels

Barnacles

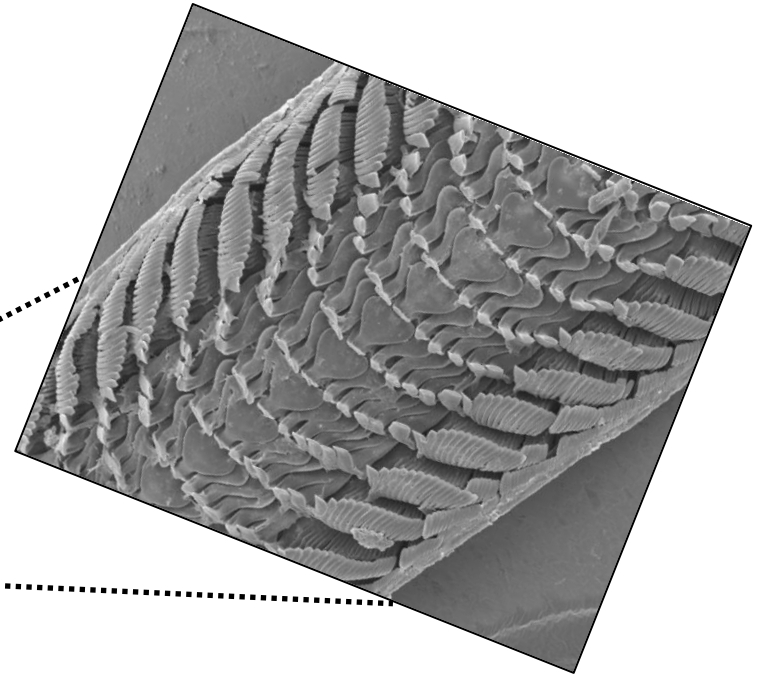
Information on MP in rocky intertidal habitats is almost exclusively limited to filter feeders.

Knowledge gap: MP in rocky intertidal habitats



Submerged snail
(common topshell)

Grazing snail



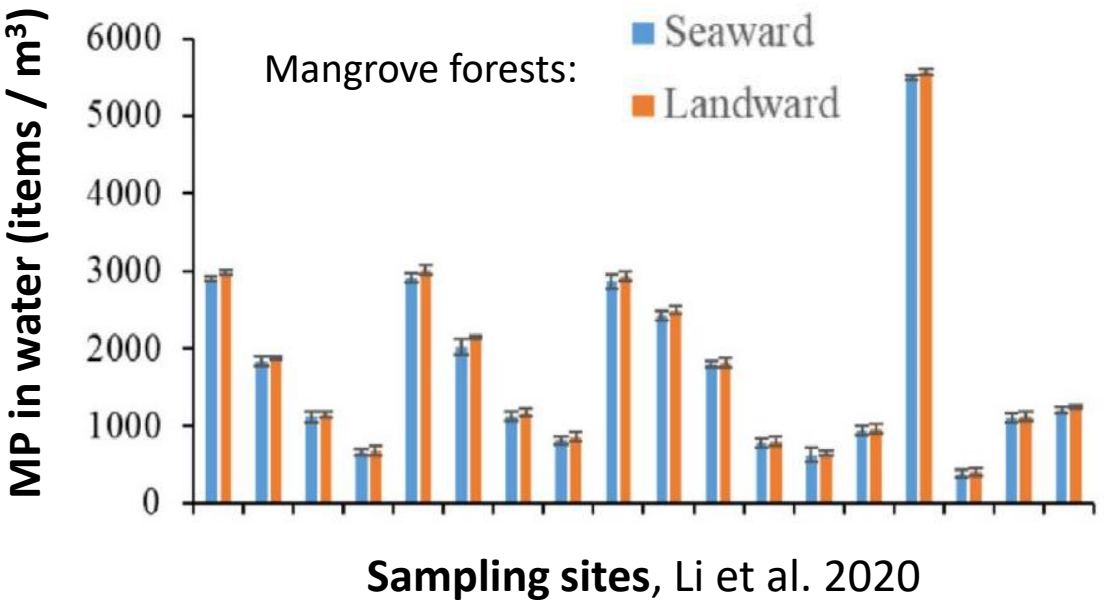
Snail radula

Water sample

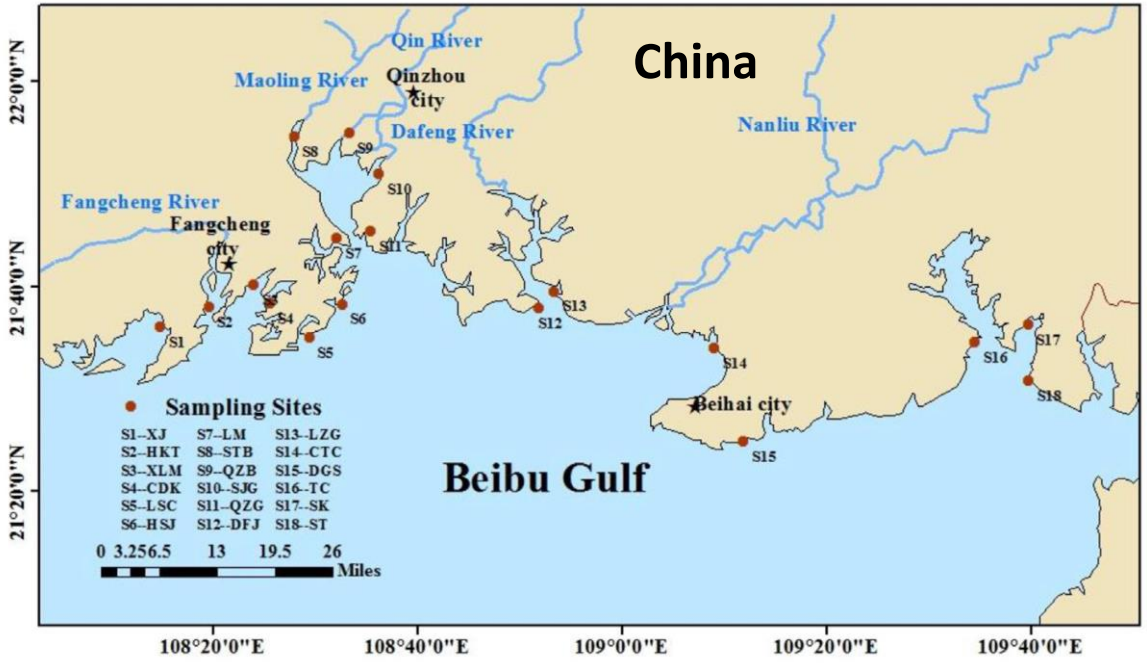
Examination of grazing snails and water samples from rocky intertidal habitats for MPs.

Hypotheses

MP concentrations are similar across wave exposure conditions on sedimentary shores



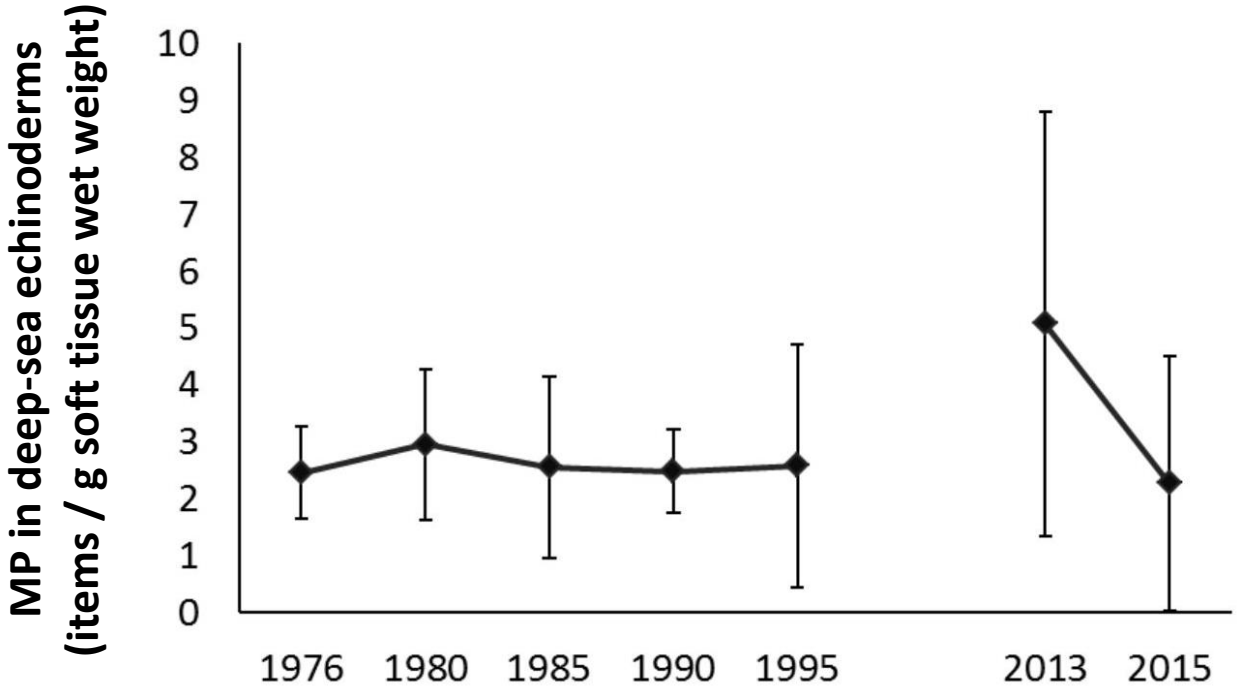
Sampling sites, Li et al. 2020



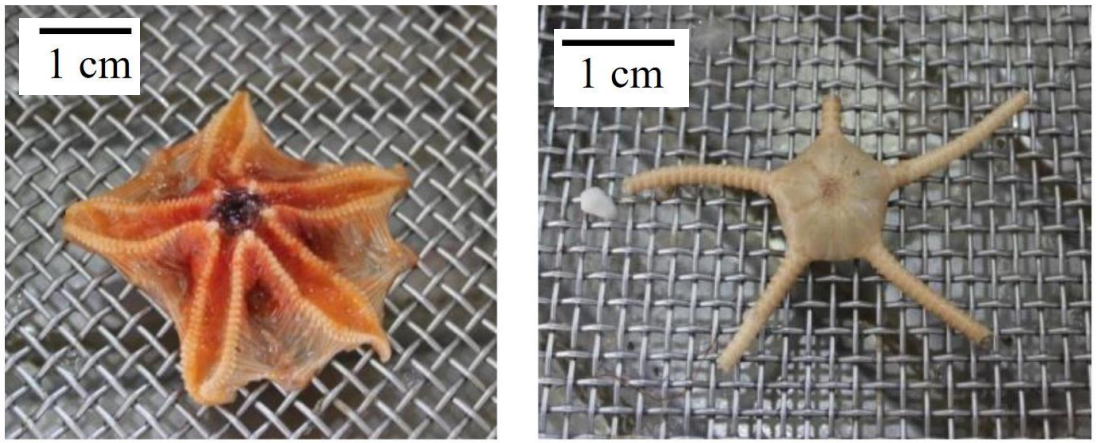
Sampling site locations, Li et al. 2020

Hypothesis 1: Water & snail MP loads are similar across wave exposure in rocky intertidal habitats.

MP loads in deep-sea echinoderms have been constant across time



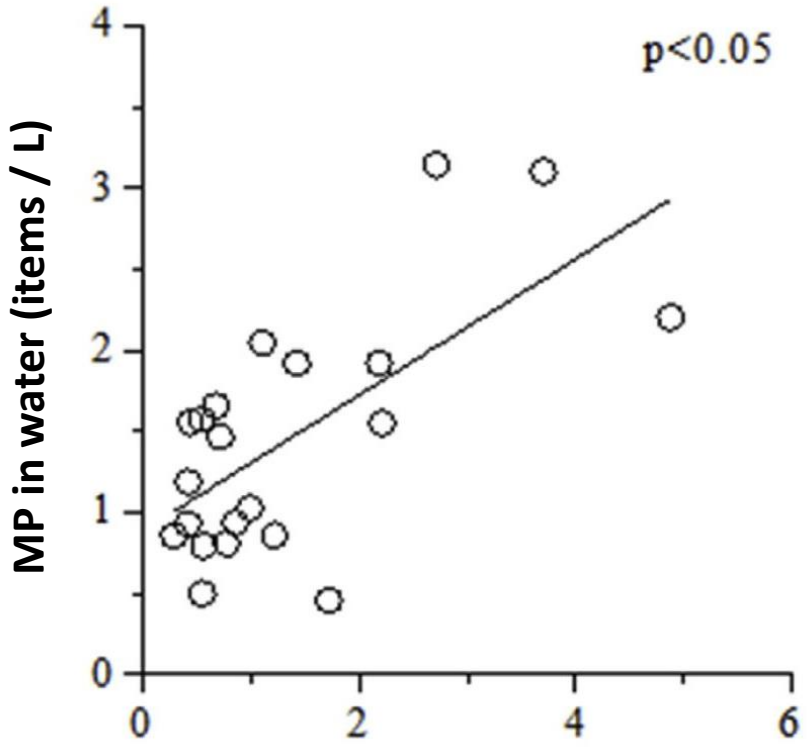
Years, Courtene-Jones et al. 2019



Deep-sea echinoderms:
Hymenaster pellucidus & *Ophiomuseum lymani*,
pictures: Courtene-Jones 2019

Hypothesis 2: Snail MP loads in rocky intertidal habitats have been constant across time.

MP loads in freshwater clams increase with water MP loads



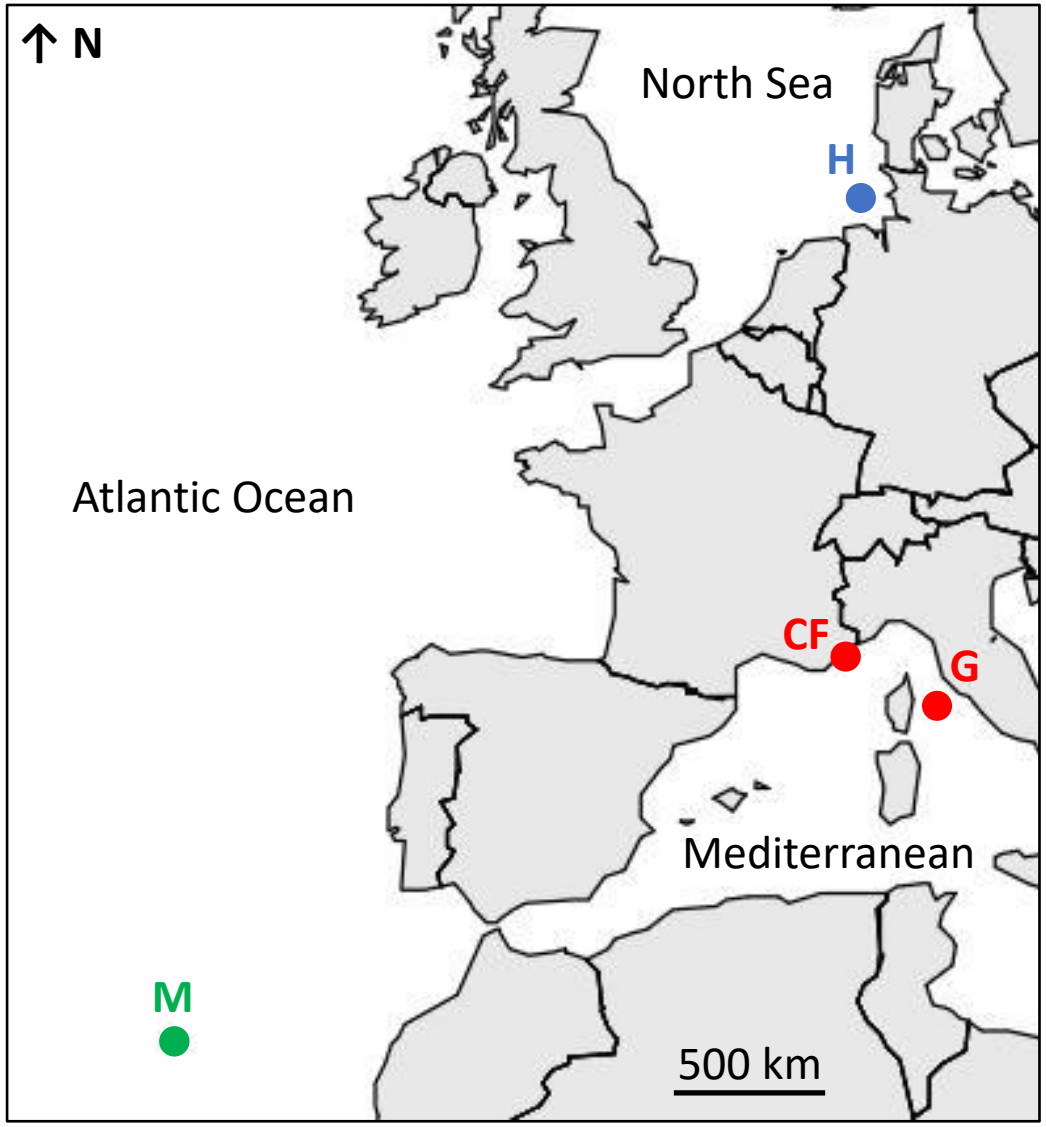
MP in clams (items / g clam),
Su et al. 2018

Freshwater clams (*Corbicula fluminea*),
picture: BfG 2018

Hypothesis 3: Water-snail MP load relationship in rocky intertidal habitats is positive.

Material & Methods

Snail & water sampling



Helgoland, **C**ap **F**errat, **G**iglio, **M**adeira

Steromphala cineraria

Phorcus turbinatus

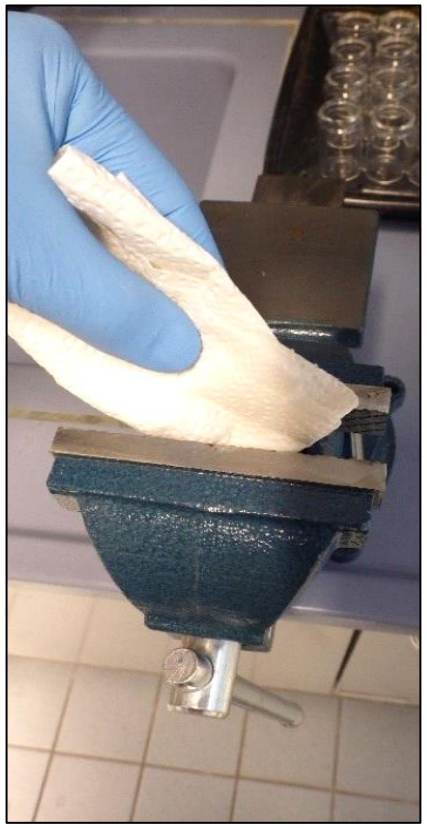
Phorcus sauciatus

2007-2009 & 2019-2020

n= 130 snails in total (10 / habitat)

n= 24 water samples in total (3 / habitat)

Snail & water sample processing



Snail shell cracking with a bench vice

Snail / snail soft tissue

Balance to measure snail soft tissue wet weight

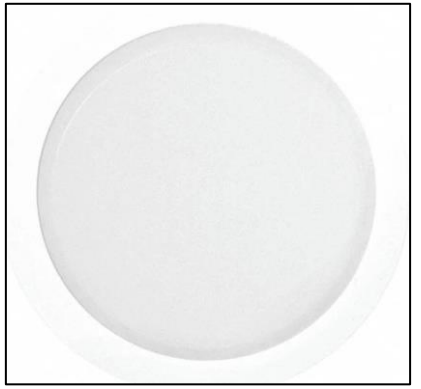
Water sample (2 L bottle)

Water sample in a drying cabinet

Snail & water sample processing

Chemical digestion
(KOH & H_2O_2)

Pressure filtration
(Model 16249, Sartorius)



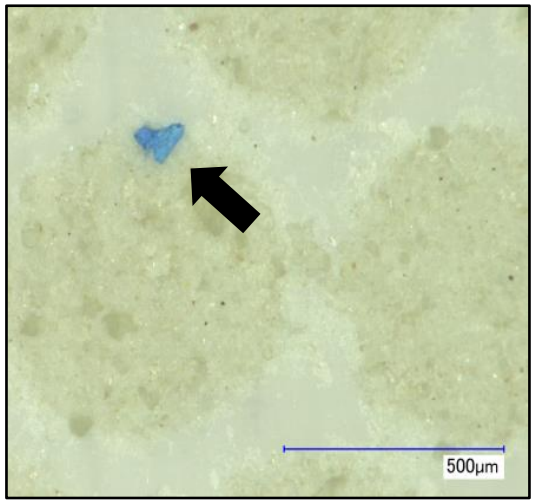
Aluminum oxide
membrane (AOM) filters

Sealed AOM filter
(drying: 50 °C, 48 h)

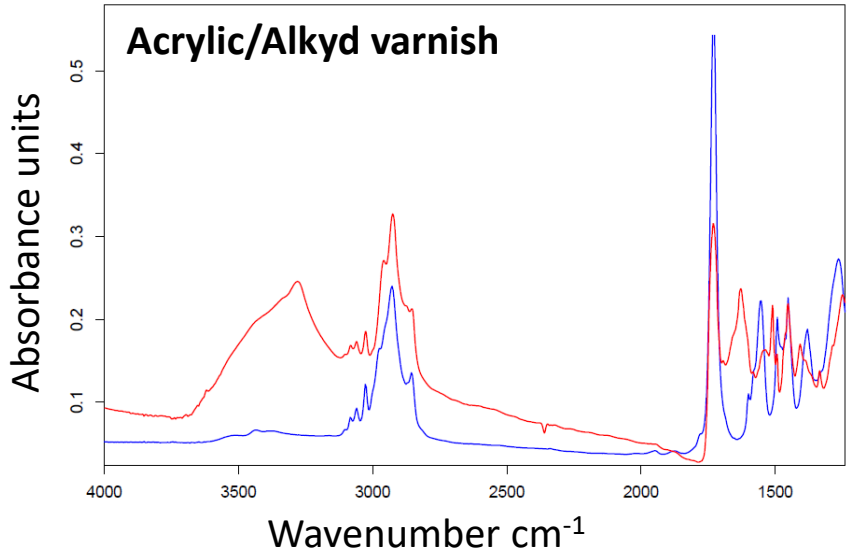
Polymer identification

Micro-Fourier-transform infrared spectroscopy (µFTIR):

µFTIR (Hyperion 2000, Bruker, Ettlingen, Germany)



Particle under examination



Reference

Measurement

µFTIR-spectrum of examined particle

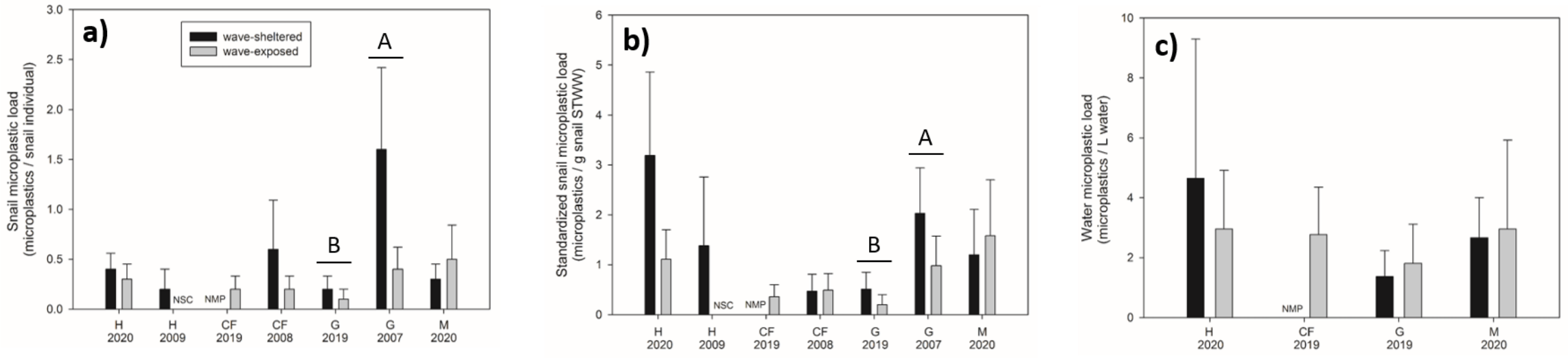
n= 362 individual & manual µFTIR measurements in total

Results & Discussion

MP loads

Snails (n= 50 MPs in total)

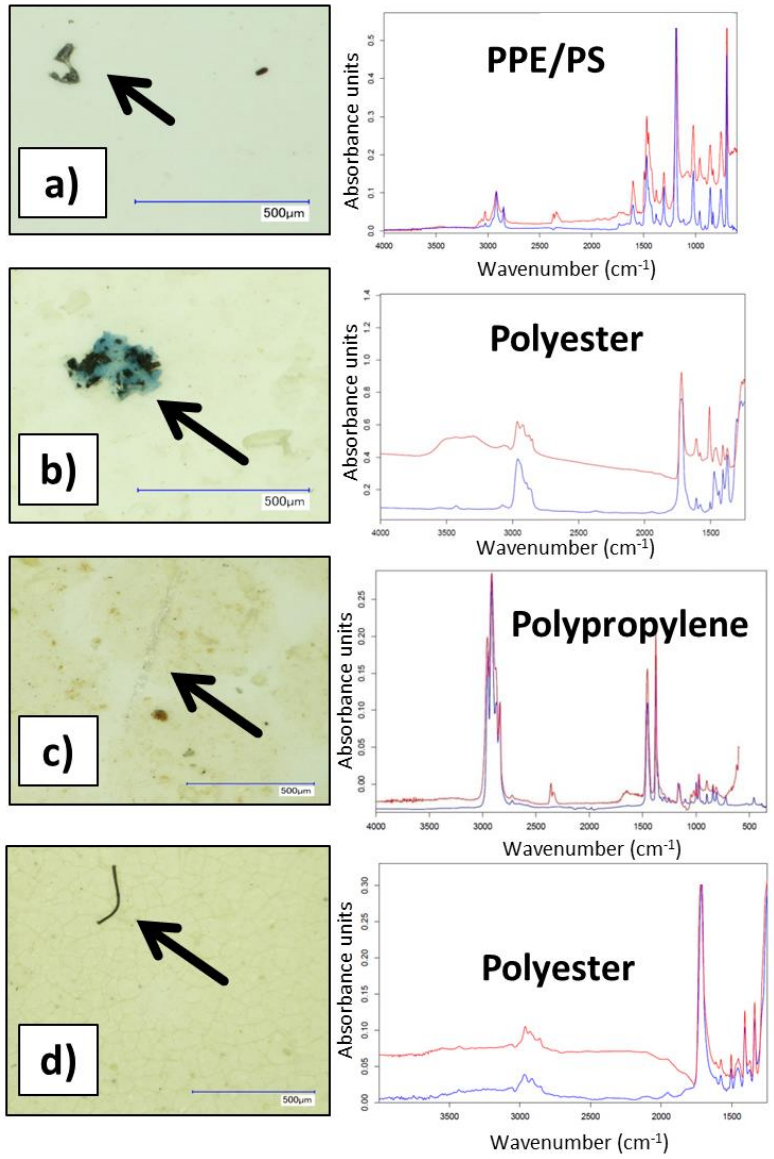
Water (n= 24 MPs in total)



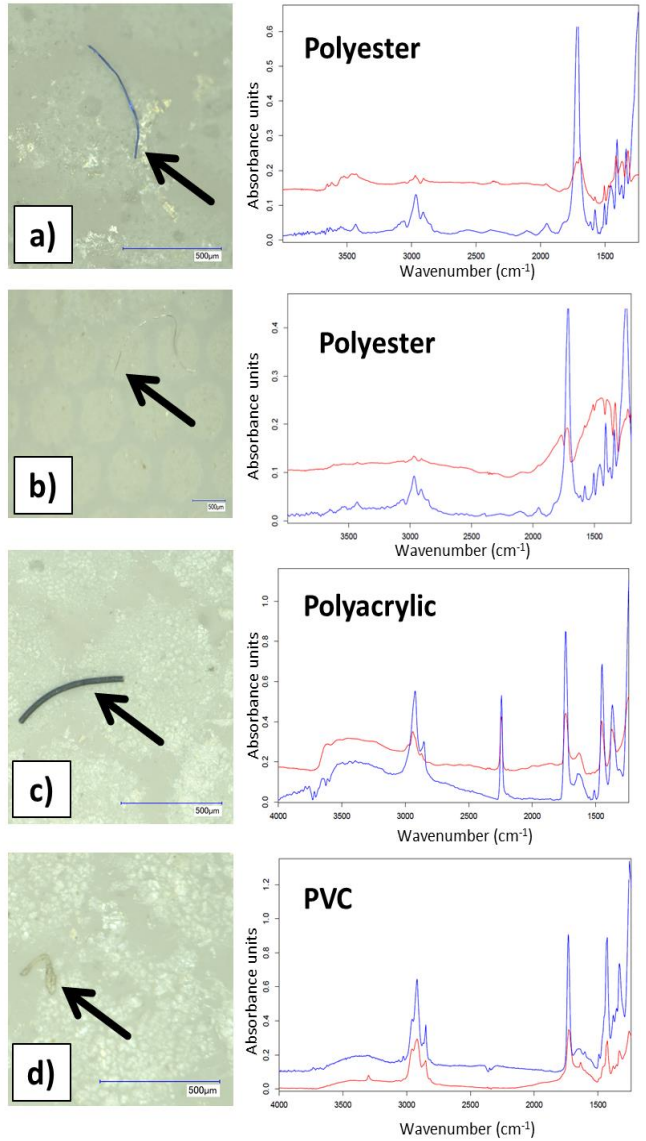
MP loads were consistent across locations, wave exposure & time.
Thus, MPs are common in rocky intertidal habitats.

MP polymer types & shapes

Polymer types in snails (n= 9 in total)



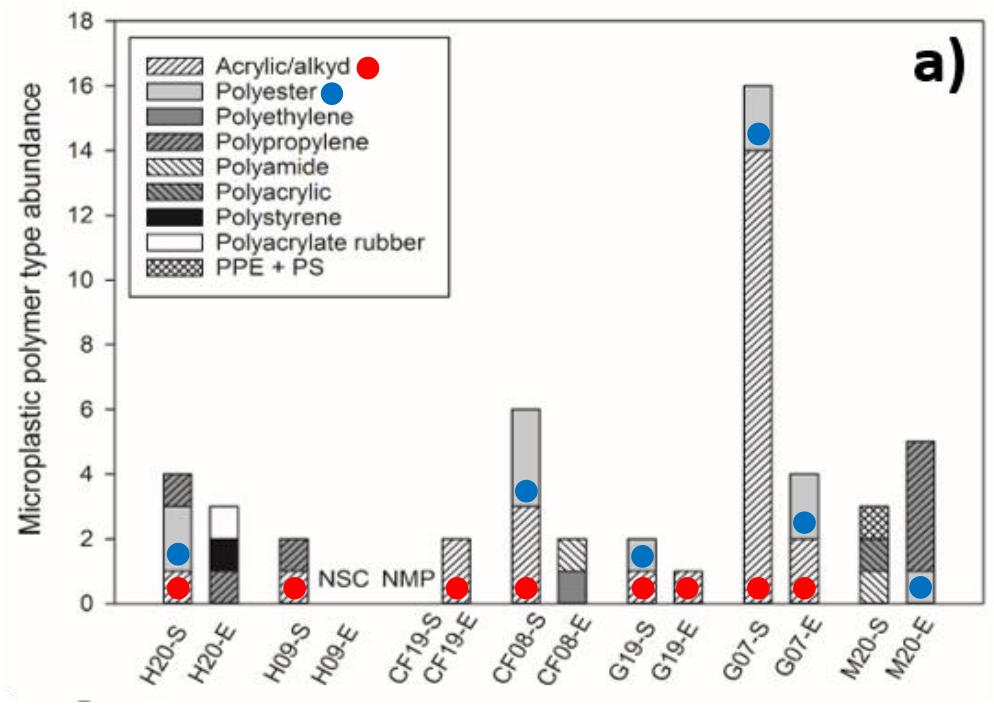
Polymer types in water (n= 6 in total)



Snails & water samples contained various polymer types & shapes.

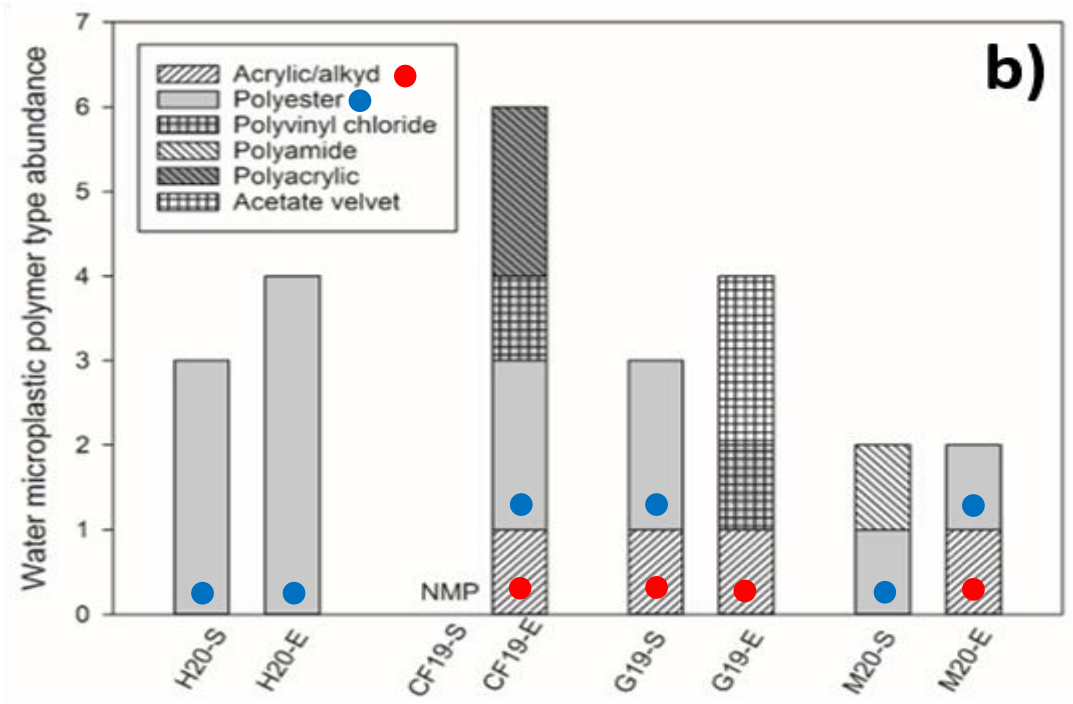
MP polymer type composition

Snails (n= 9 polymer types in total)



Location, year & wave exposure

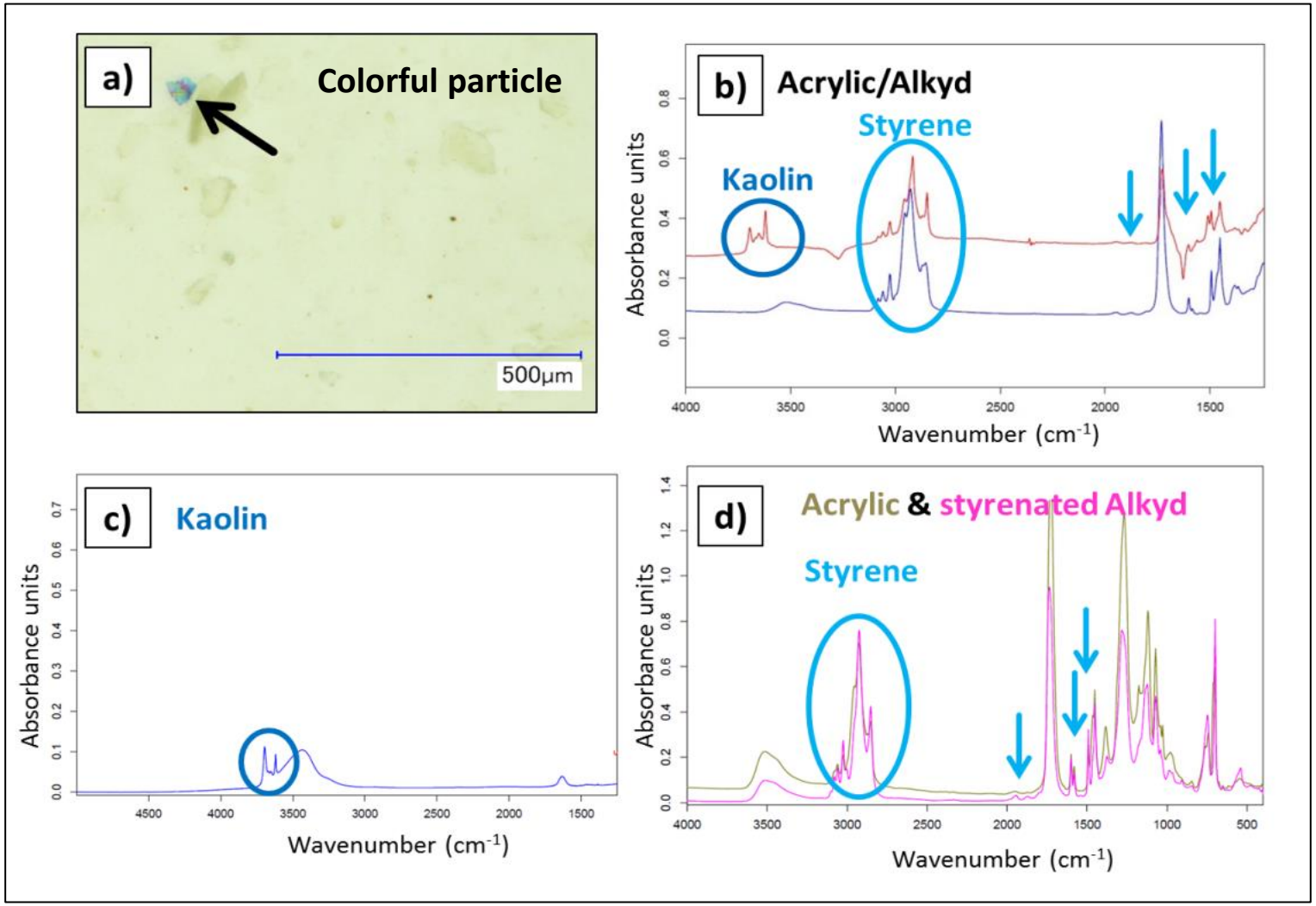
Water (n= 6 polymer types in total)



Location, year & wave exposure

Acrylic/Alkyd polymers (followed by Polyester) dominated polymer type composition.

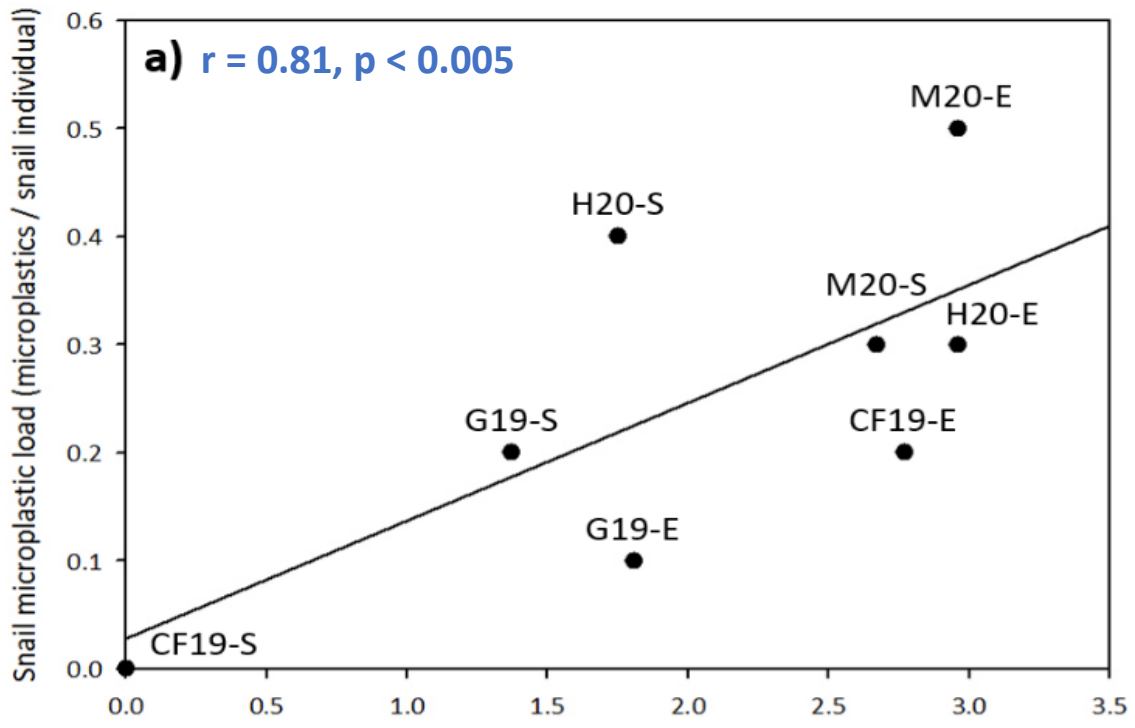
Acrylic/Alkyd polymers

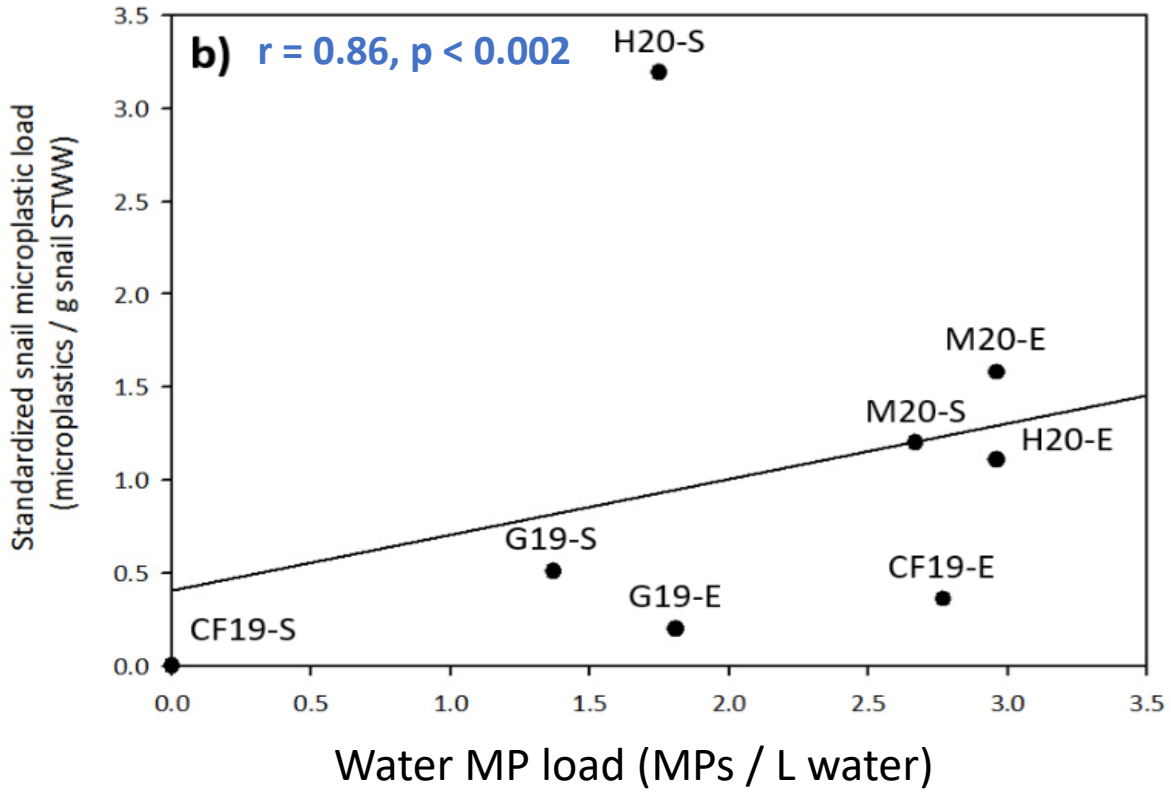


Acrylic/Alkyd polymers derived from paint chips.

Paint chips may derrive from boats in nearby harbors.

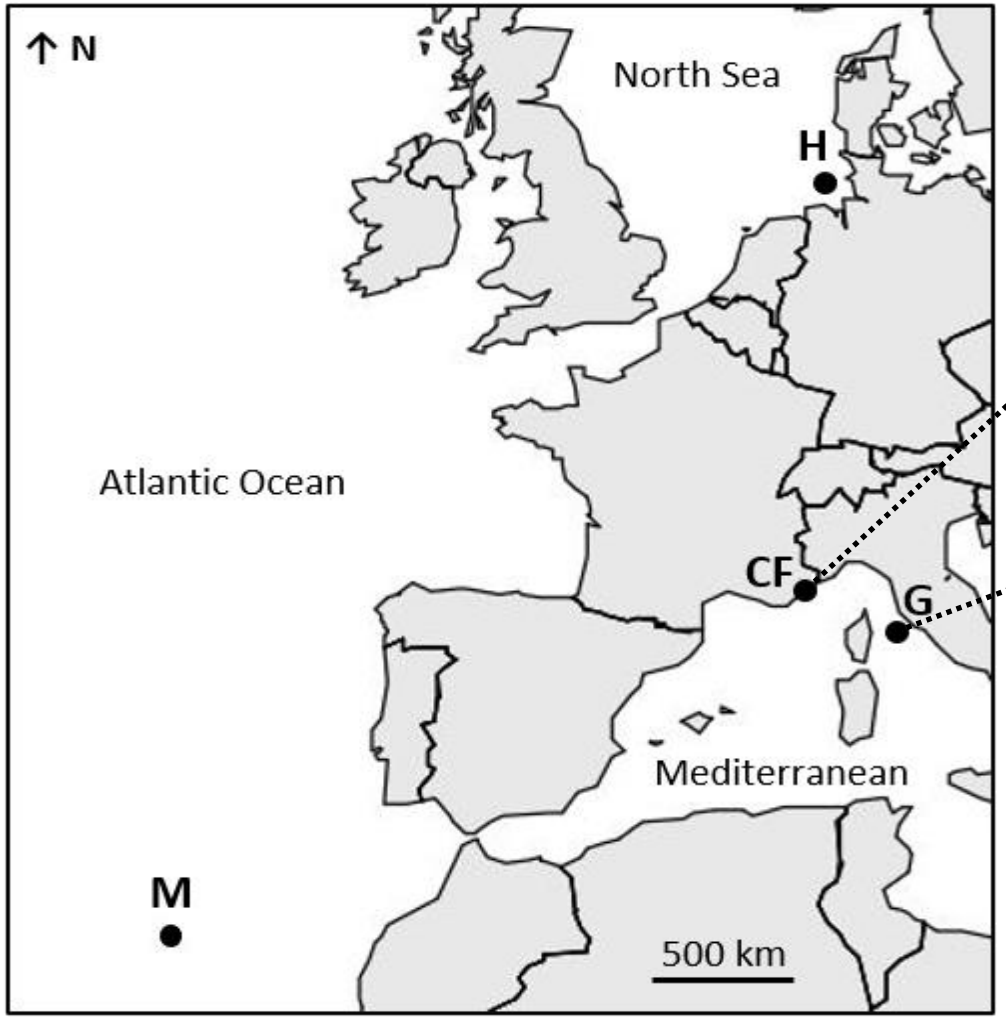
Water – snail MP load relationships

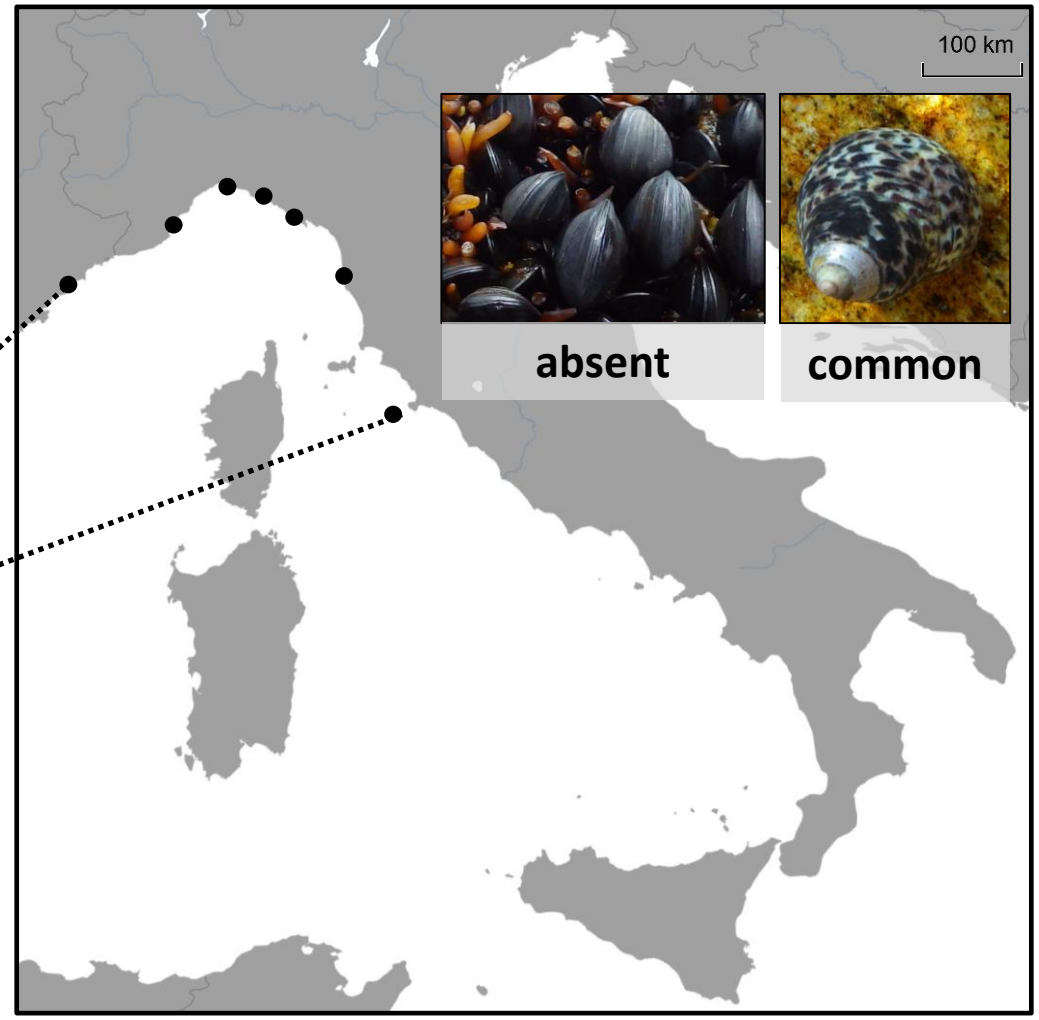




Snails are useful bioindicators for water MP loads.

Absent mussels VS common snails





Snails are useful bioindicators for water MP loads.

Summary

- First comprehensive MP study in European rocky intertidal habitats
- MPs are common in rocky intertidal habitats
- MP load and polymer type composition are similar across locations, wave-exposure and time
- MPs from rocky intertidal habitats are dominated by paint chips that may derive from ships
- Snails are useful bioindicators for water MP loads
- MP data can be used as baseline to monitor future MP dynamics in rocky intertidal habitats

Thank you very much!

This presentation is based on the article:

Ehlers, S. M., Ellrich, J. A. & Koop, J. H. E. (2021) Microplastic load and polymer type composition in European rocky intertidal snails: Consistency across locations, wave exposure and years. Environmental Pollution 292: 118280. Doi: 10.1016/j.envpol.2021.118280

www.juliusaellrich.weebly.com www.sonjamehlers.weebly.com

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Courtene-Jones, W., Quinn, B., Ewins, C., Gary, S. F., Narayanaswamy, B. E. (2019) Consistent microplastic ingestion by deep-sea invertebrates over the last four decades (1976 - 2015), a study from the North East Atlantic. *Environmental Pollution* 244: 503-512. Doi: 10.1016/j.envpol.2018.10.090

Law, K. L. (2017) Plastics in the marine environment. The Annual Review of Marine Science 9: 205-229. Doi: 10.1146/annurev-marine-010816-060409

Li, R., Zhang, S., Zhang, L., Yu, K., Wang, S. & Wang, Y. (2020) Field study of the microplastic pollution in sea snails (*Ellobium chinense*) from mangrove forest and their relationships with microplastics in water/sediment located on the north of Beibu Gulf. *Environmental Pollution* 263: 114368. Doi: 10.1016/j.envpol.2020.114368

Su, L., Cai, H., Kolandhasamy, P., Wu, C., Rochman, C. M. & Shi, H. (2018) Using the Asian clam as an indicator of microplastic pollution in freshwater ecosystems. *Environmental Pollution* 234: 347-355. Doi: 10.1016/j.envpol.2017.11.075