Aeolian Transport of Microplastics in Alpine Environments of North American West Coast Ranges

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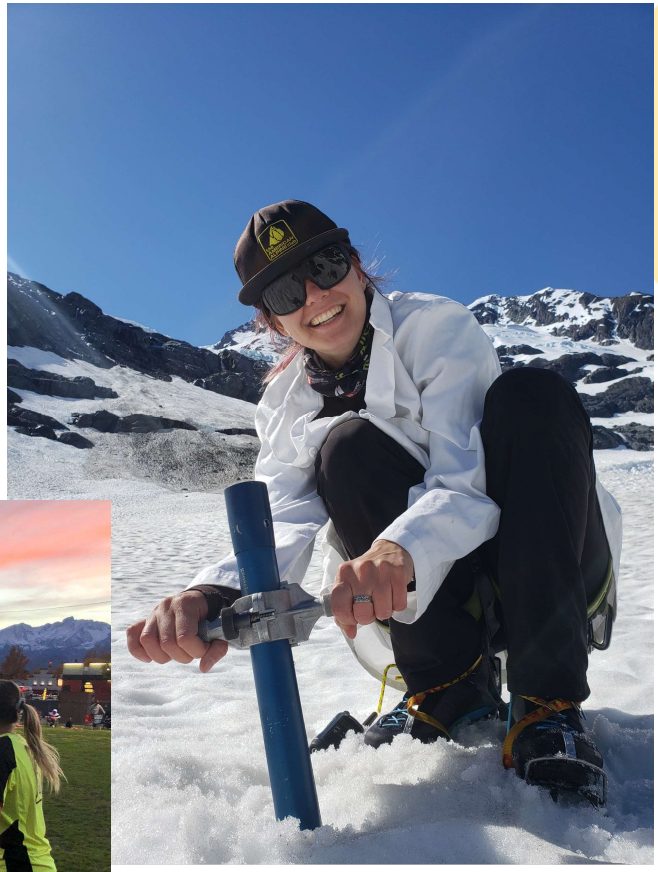
About Myself

- I like to play soccer
- Not a rando
- 4-5 year program where I research terrestrial microplastic
- Distribution
- Toxicology



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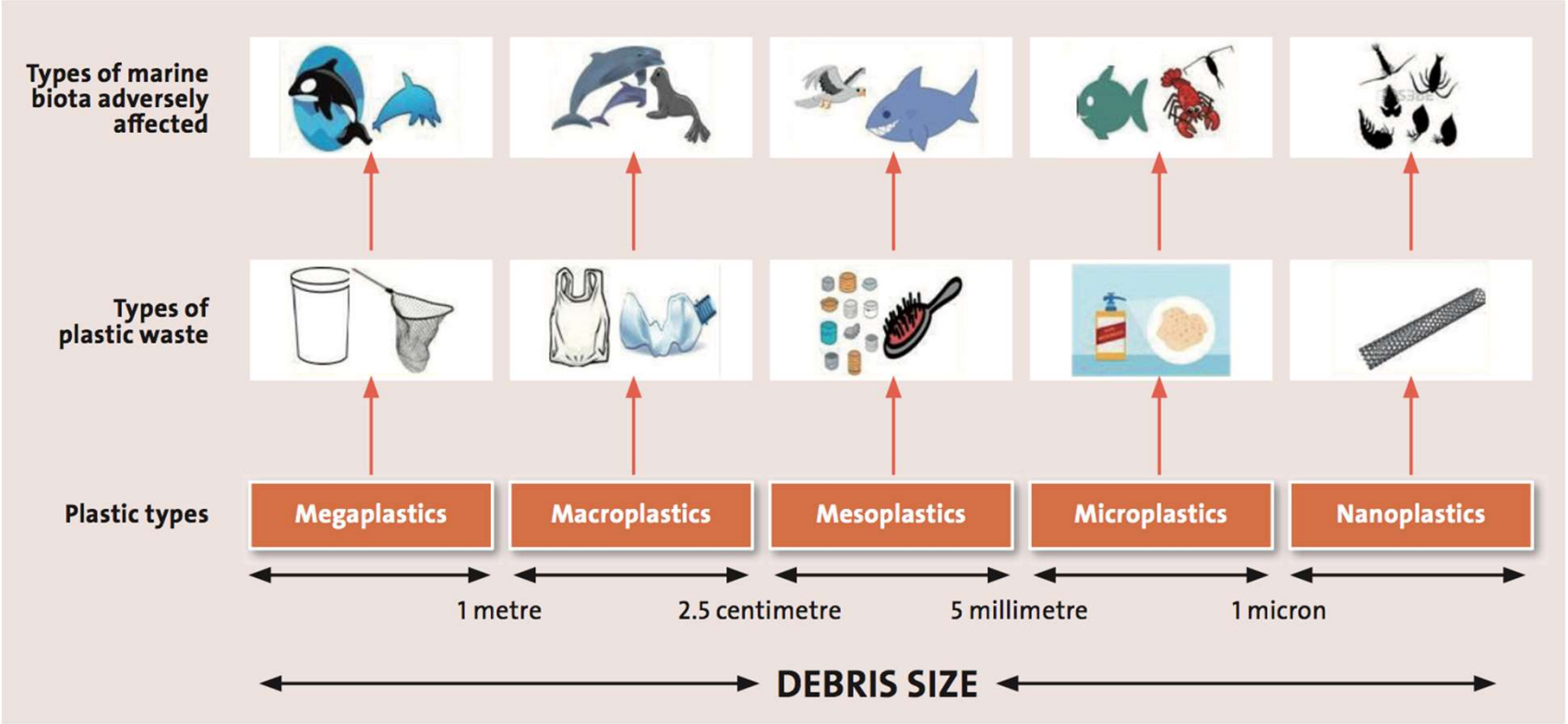
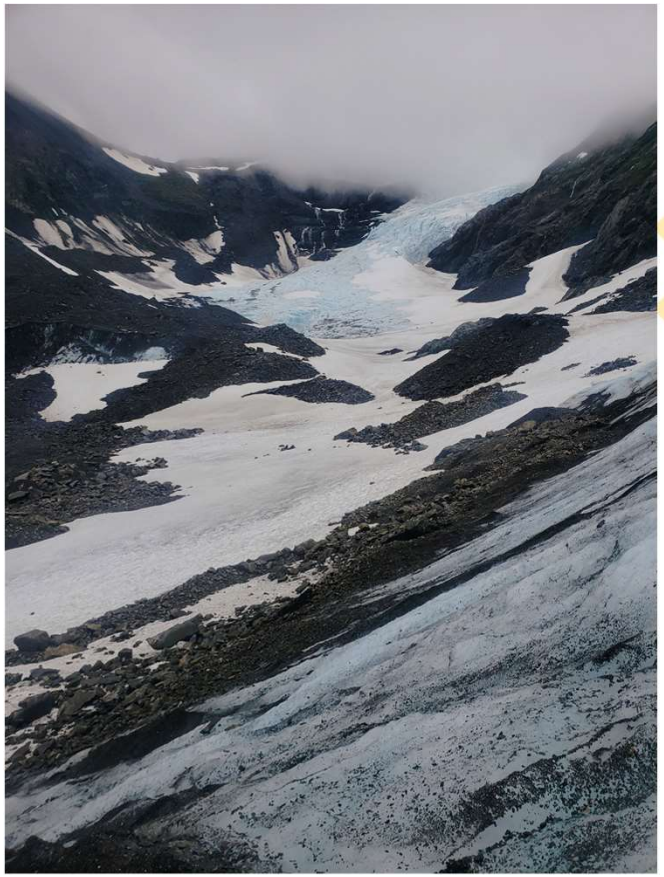
What are microplastics?



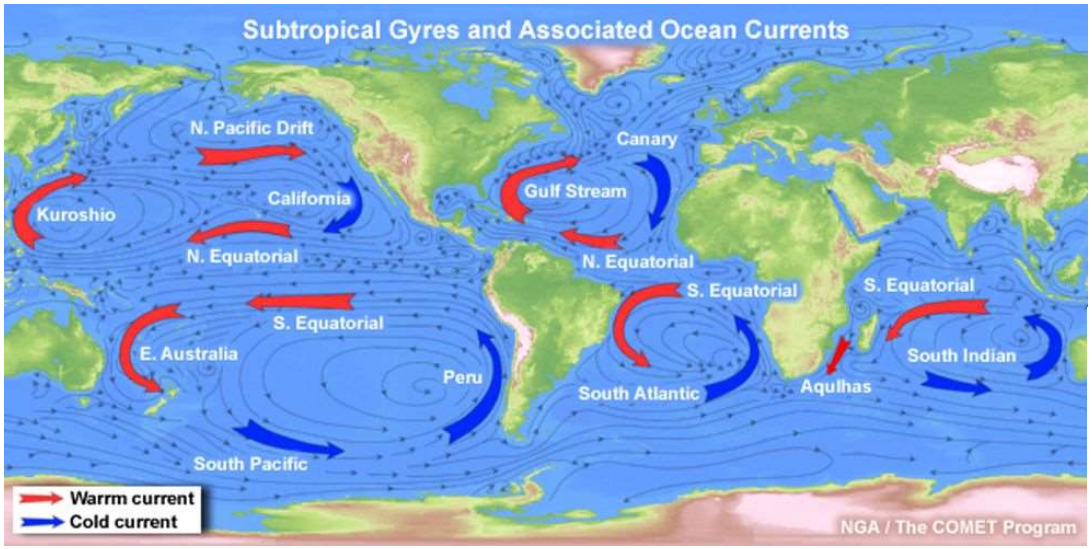
Chatterjee, S.; Sharma, S. Microplastics in Our Oceans and Marine Health. *Field Actions Science Reports. The journal of field actions* **2019**, No. Special Issue 19, 54–61.

Outline of Presentation

- Global Plastics Problem
- Why do we care about microplastics?
- How do we study them?
- Research Questions
- How do we stop our dependency on plastics?



Marine Ecosystem



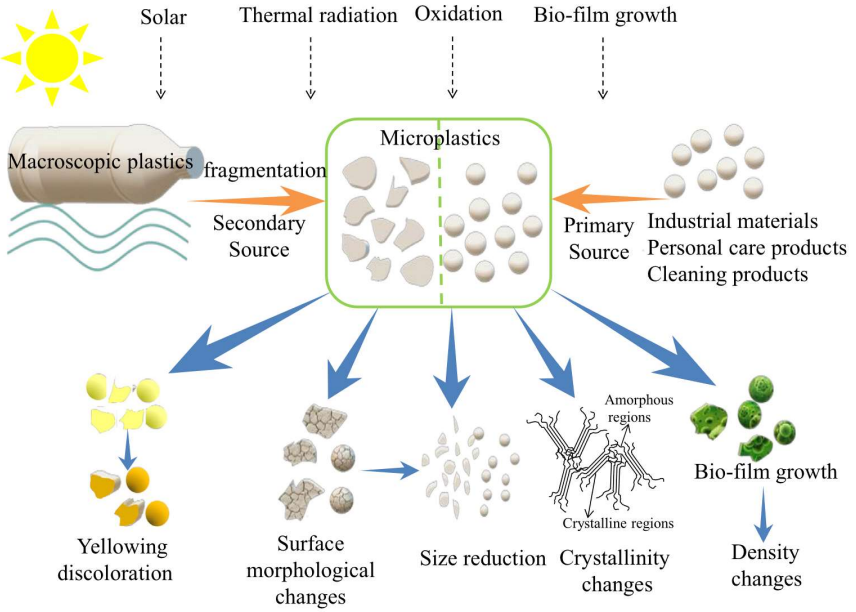


Fig. 1. Properties changes of microplastics after degradation.

Guo, X.; Wang, J. The Chemical Behaviors of Microplastics in Marine Environment: A Review. *Marine Pollution Bulletin* **2019**, *142*, 1–14.

Aquatic Systems

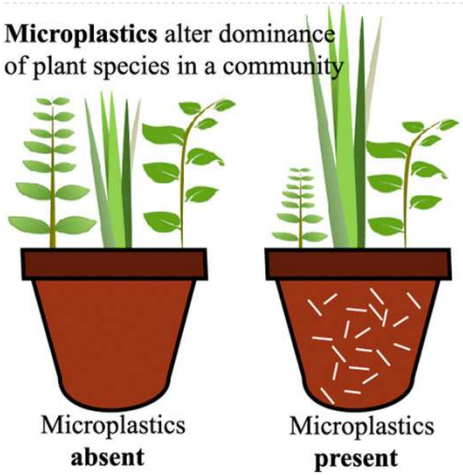
1000 rivers account for 80% of global riverine plastic emissions into the ocean

Meijer, L. J. J.; Emmerik, T. van; Ent, R. van der; Schmidt, C.; Lebreton, L. More than 1000 Rivers Account for 80% of Global Riverine Plastic Emissions into the Ocean. *Science Advances* **2021**, *7* (18).

Terrestrial

Rillig et al. *Scientific Reports* 7, no. 1 (2017): 1–6.
Lozano et al. *Environmental Science & Technology* 54, no. 10 (2020): 6166–73.
Gkoutselis et al. *Scientific Reports* 11, no. 1 (2021): 13214.

Figure 4. Polyethylene (PE-1; 710–850 μm) microplastic particles adhering to the skin of two earthworms. Picture taken during the harvest of the experiment.



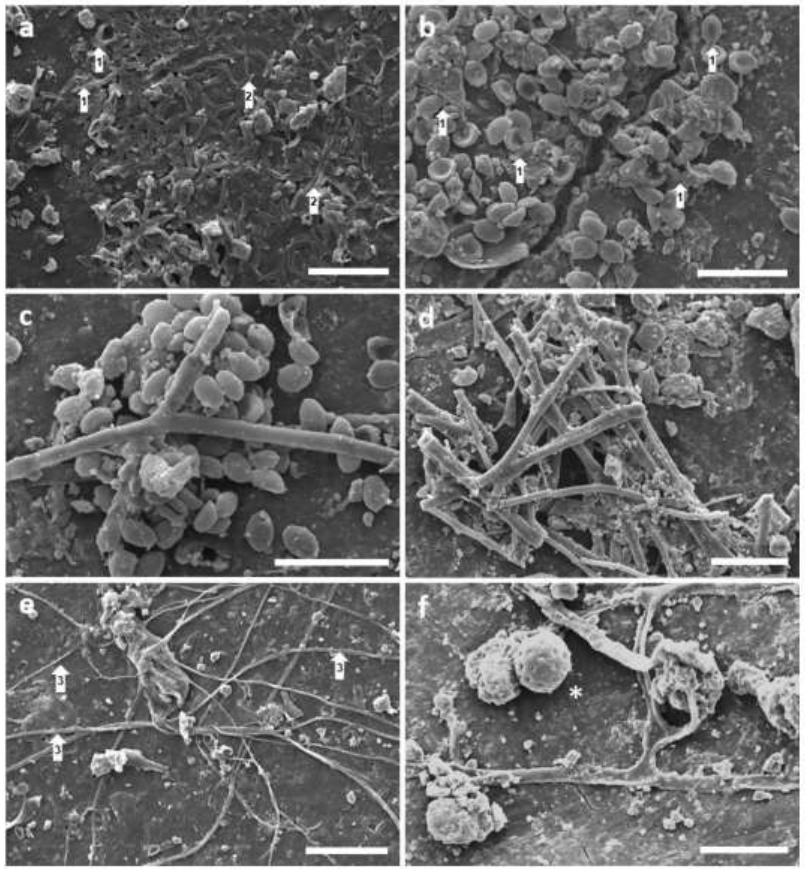
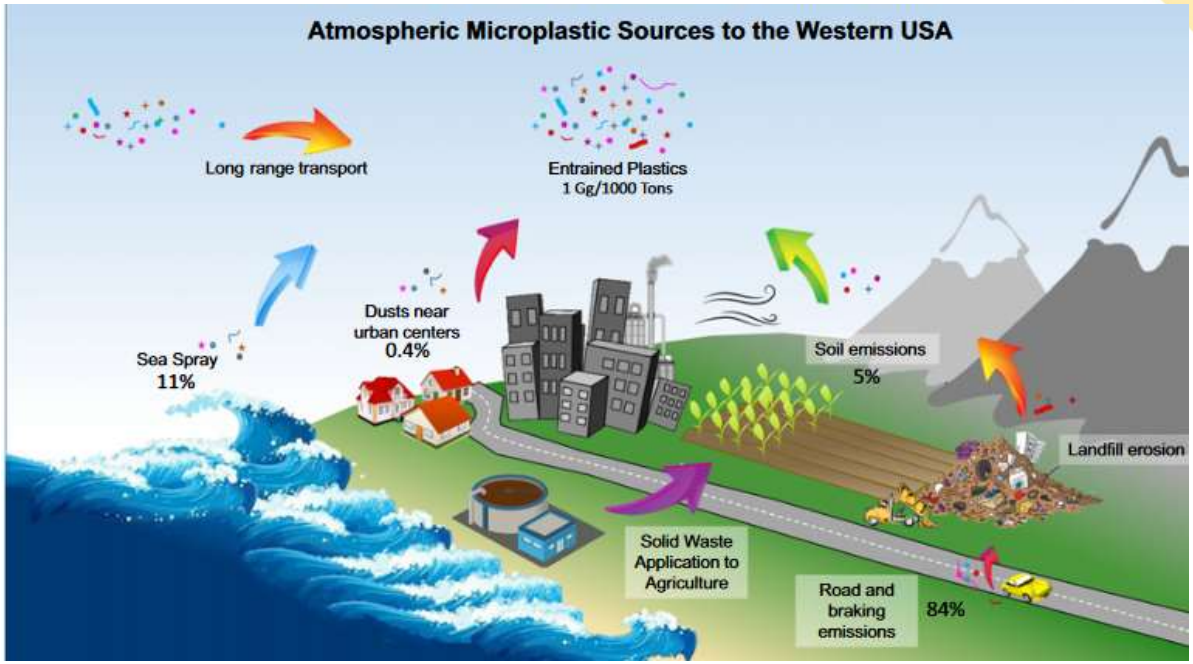


Figure 1. Fungal colonisation of MP fragments visualised by SEM. White arrows indicate specific structures.

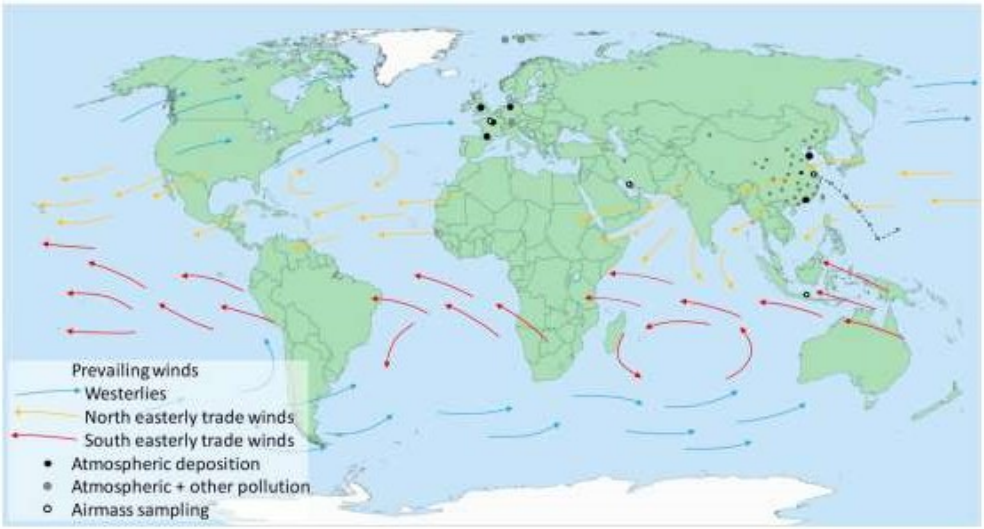
Atmosphere Microplastics

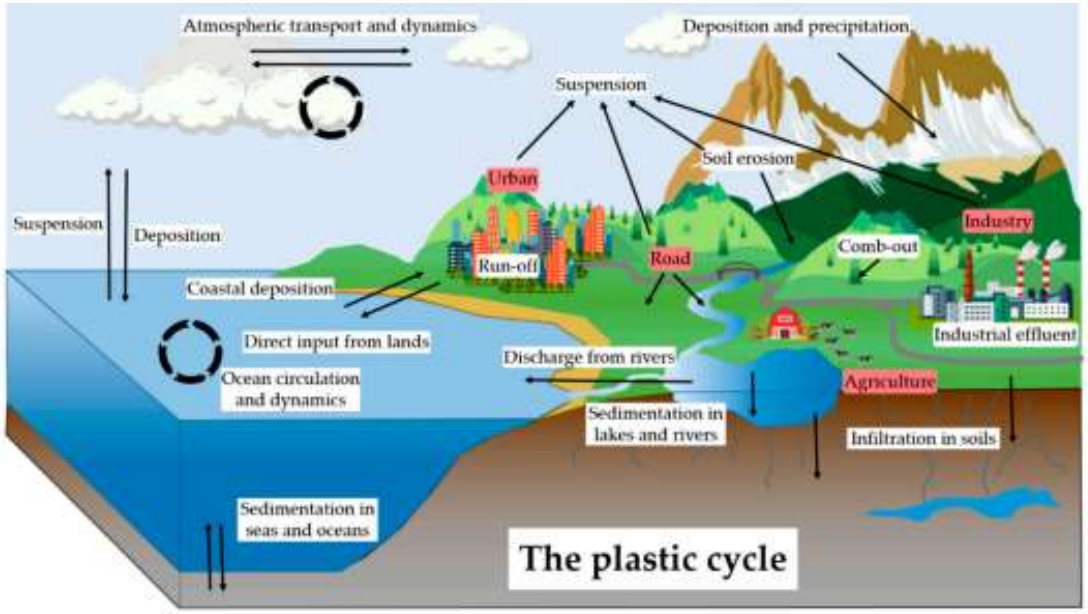
- 4-23 times more MPs in terrestrial environments than in the ocean
- Abundance in concentrations ranges from 0.002-7%
- Many properties, it is not a single substance!
- Polystyrene and polyethylenesulfone are the most common



Lozano and Rillig. Environ. Sci. Technol. 2020, 54, 6166−6173
Brahney et al. PNAS 2021 Vol. 118 No. 16

The Global Plastic Cycle





Brahney et al. PNAS 2021 Vol. 118 No. 16
Zhang et al. *Earth-Science Reviews* 203. 2020. 103118.
Bianco et al. *Sustainability* 12, no. 18 (2020): 7327.
Zhou et al. *Journal of Hazardous Materials* 411 (2021): 125178.

Ecotoxicology of Microplastics

Matthews et al." *Comparative Biochemistry and Physiology Part C: Toxicology & Pharmacology* 247 (2021): 109056.

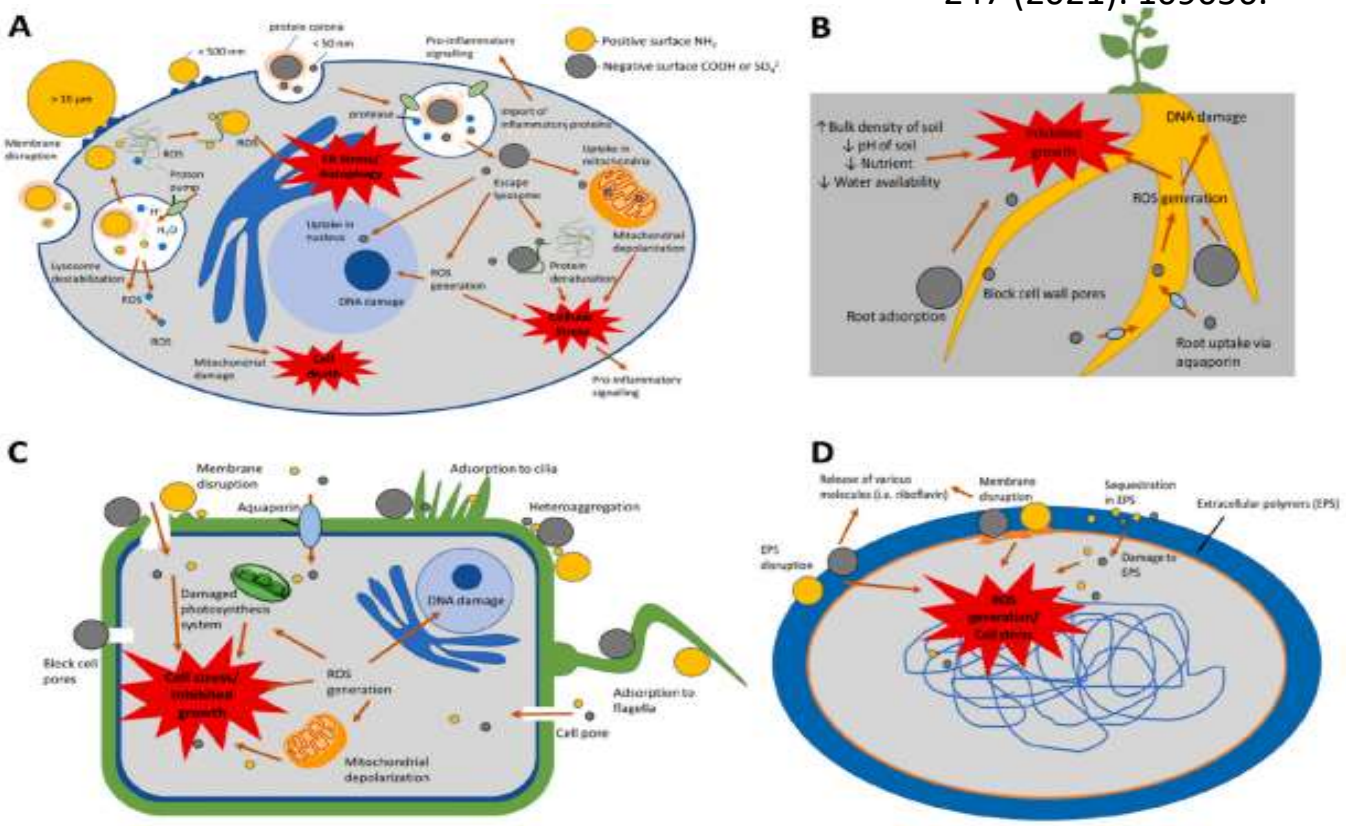


Fig. 1. Key toxicity mechanisms of micro- and nanoplastics (MNPs). Cellular mechanisms mainly depend on MNP size, surface characteristics, polymer types, and

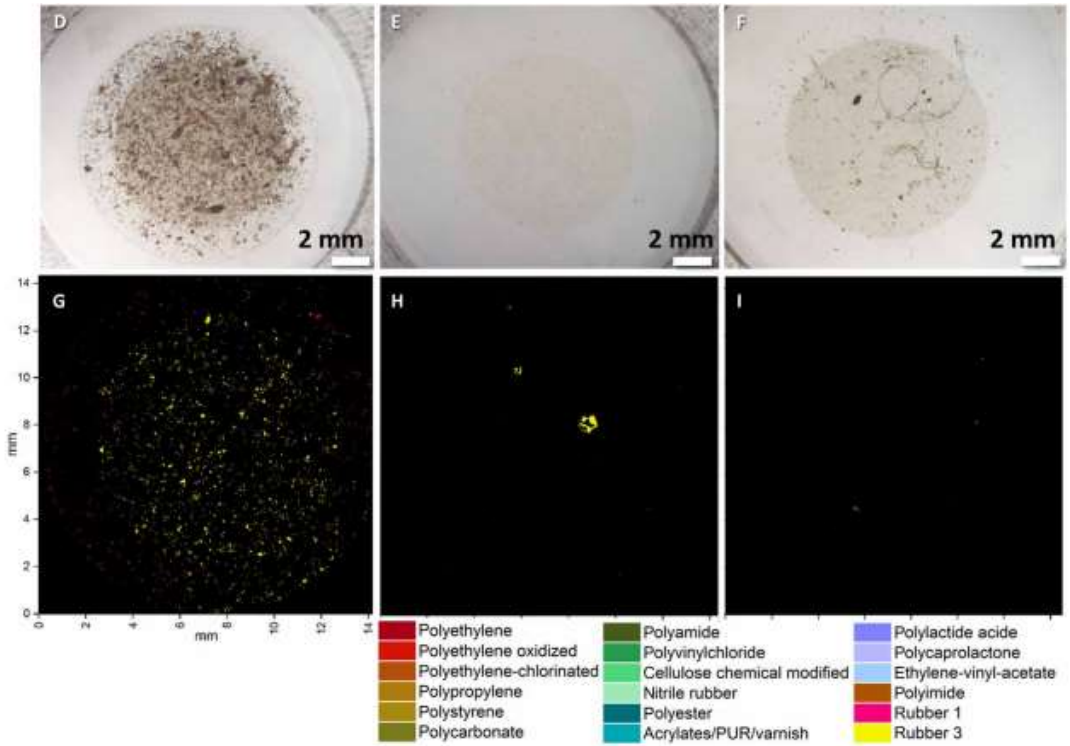
Charge, size, surface roughness, chemical composition, surface area, mass, etc.

Research Questions (4-5 years)

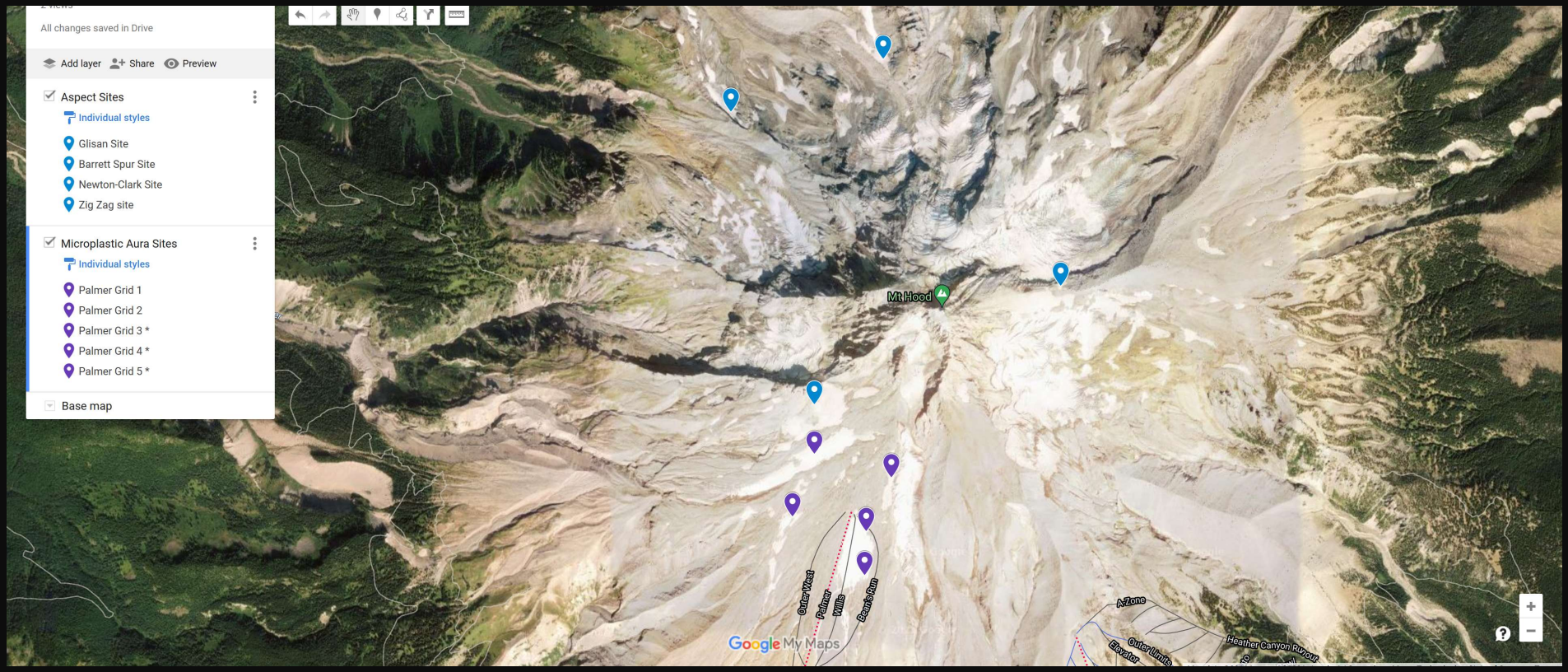
- What kind of microplastics are depositing in alpine environments via atmospheric transport?
- Does aging of microplastics increase toxicity?
- How does mixing of microplastic exposure affect toxicity?
- What is the significance of POP adsorption to microplastics at the ecosystem scale in comparison POP adsorption to organic materials?

Microplastics in Snow

- Snow presents a feasible way to ma analyze microplastics in terrestrial environments
- Varnish was the most frequent and abundant polymer types
- Chronic inhalation
- Direction of the cycle



Bergmann, Melanie, Sophia Mützel, Sebastian Primpke, Mine B. Tekman, Jürg Trachsel, and Gunnar Gerdts. "White and Wonderful? Microplastics Prevail in Snow from the Alps to the Arctic." *Science Advances* 5, no. 8 (August 1, 2019): eaax1157. https://doi.org/10.1126/sciadv.aax1157.


All changes saved in Drive
Add layer
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Glisan Site
Barrett Spur Site
Newton-Clark Site
Zig Zag site
Microplastic Aura Sites
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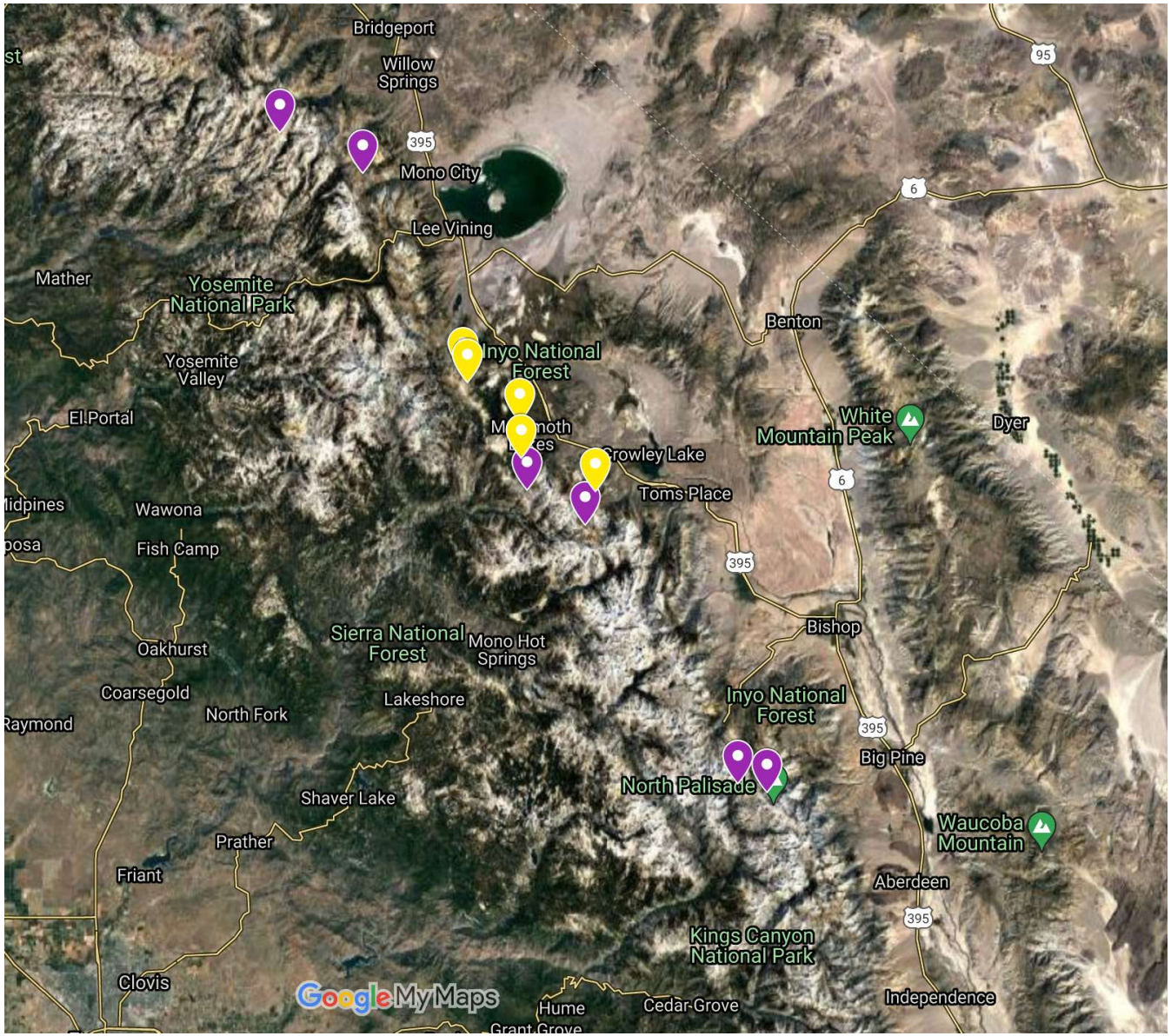
Palmer Grid 1
Palmer Grid 2
Palmer Grid 3 *
Palmer Grid 4 *
Palmer Grid 5 *
Base map
Mt Hood
Outer West
Palmer
Wilis
Beanie Rim
A-Zone
Outer Limits
Elevator
Heather Canyon Ryzour
Google My Maps


Bridgeport
Willow Springs
395
Mono City
Lee Vining
Mather
Yosemite National Park
Yosemite Valley
El Portal
Inyo National Forest
Benton
White Mountain Peak
Dyer
Crowley Lake
Toms Place
6
95
Wawona
Fish Camp
Oakhurst
Sierra National Forest
Mono Hot Springs
Bishop
Coarsegold
North Fork
Lakeshore
Raymond
Inyo National Forest
Big Pine
North Palisade
Shaver Lake
Waucoba Mountain
Prather
Friant
Aberdeen
Kings Canyon National Park
Clovis
Google My Maps
Hume
Cedar Grove
Independence
Grant Grove

Experimental Design

Sampling

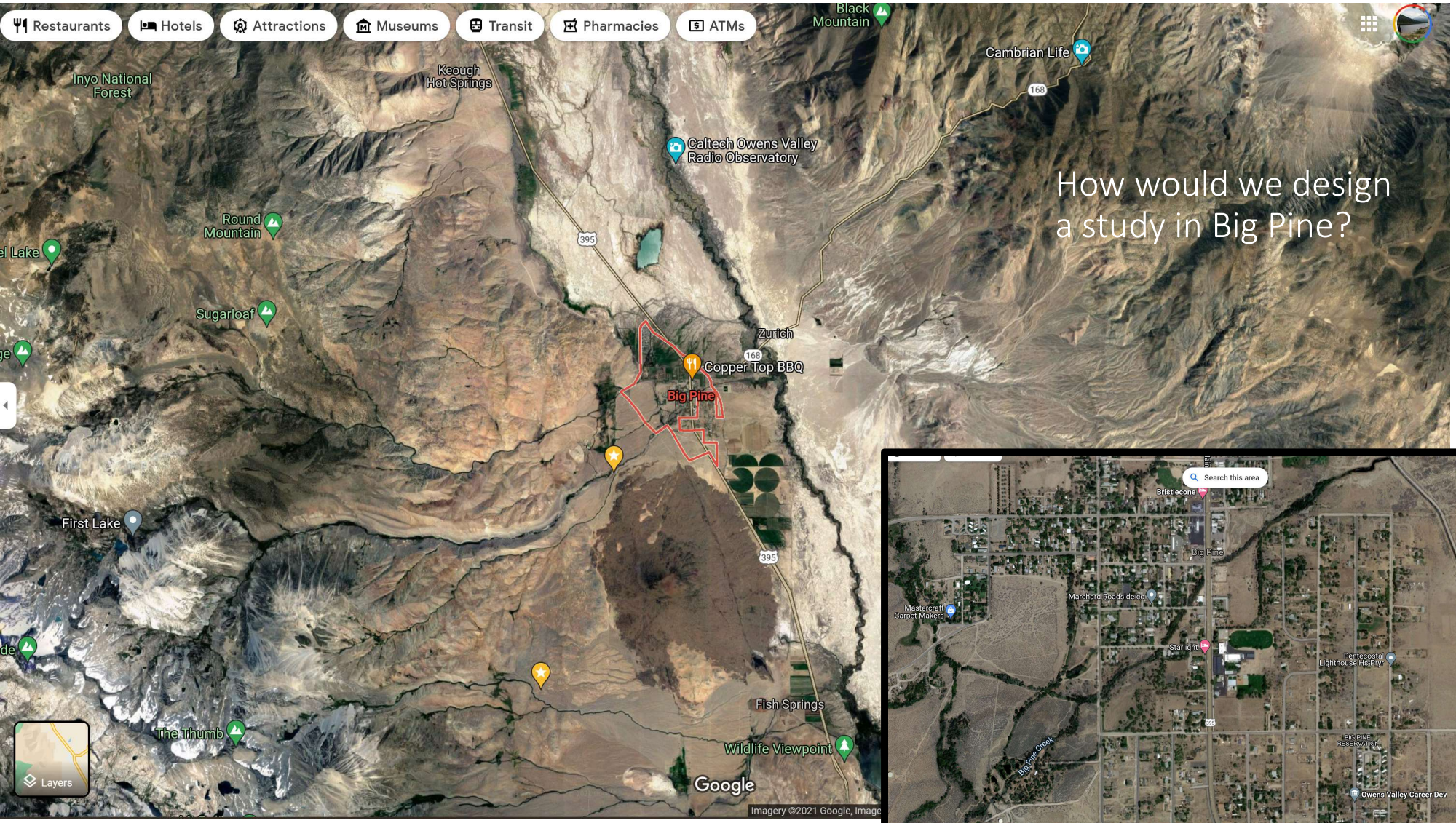
- Digest sample
- Filter melt water through aluminum oxide or cellulose filter
- Use all plastic-free equipment and use blanks

Imaging/Characterization

- FTIR/Raman Spectroscopy
- Confocal or optical microscope after dying sample with Red Nile dye
- CNM, x-ray diffraction at the synchrotron

Additional experimental studies: UV aging, plant uptake, MP flux in sludge, adsorption, acid environment aging

Where are there possible sources of contaminatio


Restaurants
Hotels
Attractions
Museums
Transit
Pharmacies
ATMs
Black Mountain
Cambrian Life
Inyo National Forest
Keough Hot Springs
Caltech Owens Valley Radio Observatory
How would we design a study in Big Pine?
Round Mountain
Sugarloaf
Zurich
Copper Top BBQ
Big Pine
First Lake
Fish Springs
The Thumb
Wildlife Viewpoint
Layers
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Imagery ©2021 Google, Image
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Big Pine
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Starlight
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Thank you!

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the AMERICAN ALPINE club