

## Microplastics FAQ

From Jenessa Gjeltrema who runs the Gjeltrema lab at UC Davis that is dedicated to understanding the health effects of microplastics on animals, populations, ecosystems, and the planet and is helping with some of the research being conducted by the TERC team to investigate the presence of microplastics at the lake.

1. How long does it take in the Tahoe environment, both in the water and on the shores, for specific plastics to turn into micro plastic?

There are many factors that go into how rapidly larger plastics break down physically into smaller plastics within the environment. These factors include the characteristics of the plastic (what type of plastic it is, what additives are mixed in), exposure to environmental factors that can promote breaking including UV light exposure that can make the plastic more brittle, temperature fluctuations that may contribute to repeated shrinking and expansion of the plastic, physical contact (waves, contacting abrasive surfaces like rocks or sand, being crushed by tires on a highway), and what kinds of bacteria/organisms colonize the surface of the plastic. While I am aware of a few studies looking into such factors, I am not aware of any that have been performed specifically with the Tahoe Lake environment in mind. Others may chime in with information or projects they are aware of.

2. How long does it take in the Tahoe environment, both in the water and on the shores, for specific plastics to biodegrade completely?

Different plastics take varying lengths of time to break down chemically in the environment. Estimates of the process ranges from a few years to millions of years, and different environmental conditions impact the timeline significantly. Most of the current knowledge stems from studies conducted for marine or terrestrial environments, which may or may not accurately estimate biodegradation in the environmental conditions at lake Tahoe. I am not a waste management expert - so speaking to one about this topic specifically may be helpful. I've attached a paper to help you see how complex the estimation of biodegradation timelines can be.

3. What types of impacts do these plastics have in Tahoe and the wildlife in the Tahoe the basin? Bears, birds, and fish specifically. Is there's any evidence of adverse effects in bears?

We are just beginning to evaluate the potential health effects that plastics and microplastics may have on wildlife, and unfortunately, our understanding of this subject is rudimentary at best. Lack of standardized practices, reporting, and validation of techniques/methodologies as this field of research develops has limited our ability to draw concrete conclusions in many cases. With that being said there are a variety of potential ways that microplastics can potentially impact health of animals:

1. Physical effects: Pieces of plastic get stuck on or inside the animal, affecting its health

- a. Example: animal eats plastic instead of normal diet, leading to weight loss and malnutrition
  - b. Example: animal eats plastic, which can get stuck in their gastrointestinal tracts, leading to obstruction/rupture.
  - c. Example: pieces of plastic get stuck in gills, leading to decreased gill function or interruption of normal ecological lifecycle processes (like displacing larval stages of invertebrates, such as mussels, that develop in fish gills)
  - d. Can serve as a 'raft' that introduces invasive species to new areas
2. Direct toxic effects: Additives and plasticizers are often added to plastics to change their characteristics (like making them more pliable, rigid, or anti-bacterial). These can leach out of the plastic, causing toxic effects.
  3. Vector of hazardous agents: Persistent environmental pollutants as well as pathogens can potentially be absorbed by or stick to plastics (almost like a sponge), and then serve as a method of delivery of these agents to an animal when ingested/inhaled, etc.
  4. Transfer to organs: Small plastics have been found in internal organs of some animals (like the liver) and have been associated with inflammation.

4. Because sites on the beach use sand bags and tarps and it seems this material breaks down into fibers and microplastics relatively quickly this specifically is regarding Polypropylene. Is there an excess of this found in the lake water and on the beaches. I've found.

We are currently working on a project that evaluates what sizes and kinds of microplastics are found and where these microplastics end up in the Tahoe Lake environment. We do not yet have results to share, but may have some in the not-so-distant future as our collection of samples will be starting soon.

6. I'm super interested in this project, how can I get involved? i.e. Citizen science, writing officials, get involved with campaigns etc...

There are lots of ways for people to get involved, including personal actions to reduce plastic use, local policy initiatives, clean-ups, donations to research programs (crowd-funding reputable projects), helping with education programs, and volunteering to assist with research projects, etc. The TERC team would probably be best to help guide you to local resources for how your readers can make an impact.