5 GYRES
SCIENCE TO SOLUTIONS

PLASTIC PELLETS

The Plastic Production Leakage Problem

Plastic pellets, also known as nurdles, pose a significant environmental threat as they frequently escape into ecosystems at each stage of the supply chain. These pellets pollute water systems and shorelines globally, attract toxic chemicals, and endanger wildlife that consumes them. Despite being the second largest source of primary microplastics to the environment, no regulation in place prevents pellet leakage or holds polluters accountable. Immediate action is needed to enforce best practices in the supply chain, reduce spillage, and ensure companies are responsible for cleanup.

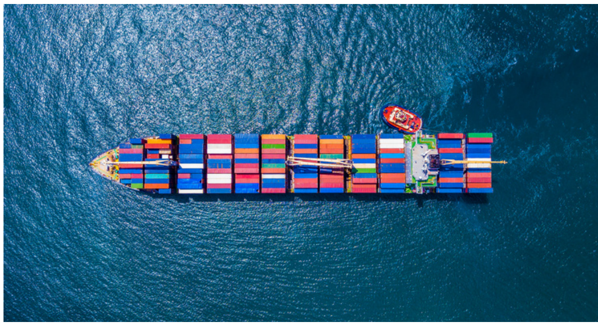
BACKGROUND

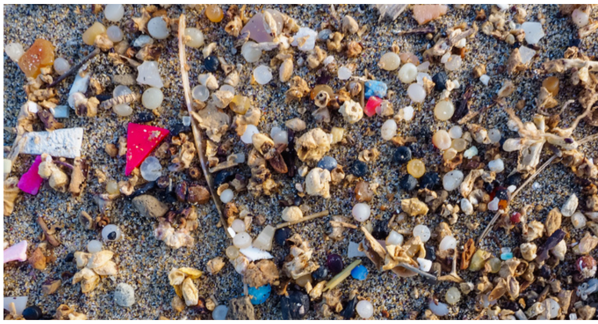
Production & Leakage

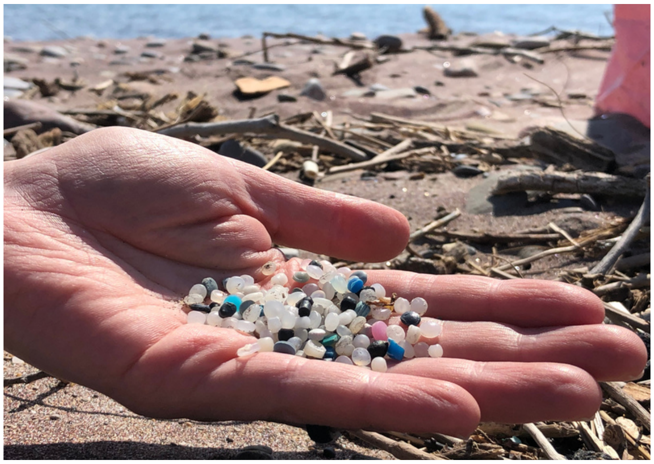
Plastic pre-production pellets, commonly referred to as “nurdles” are cylindrical or spherical plastics (1–5 mm in diameter) used as the building blocks of most plastic products (e.g., bottles, cups, bags, car parts). Produced from oil or natural gas, pellets are transported, via truck, train, or ship, to other facilities to be manufactured into final products. Plastic pellets often spill or “leak” into the environment during production, storage, and transport[1]. Due to their small size and light density, pellets are dispersed widely in fresh and marine waters before eventually settling onto shorelines or the seabed[2].

Estimates suggest an annual leakage of 230,000 tons per year[3], but quantifying total global pellet emissions is challenging. Estimates of leakage from a single production site range from 3 to 36 million pellets annually[1], reflecting inadequate handling and preventative measures during production, loading, and transport[1]. Plastic pellets have been found in waters and shorelines all over the world since the 1970s[4-9].

In the U.S., plastic pellet pollution has been documented on both the East and West coastlines[10,11], as well as the Gulf of Mexico[9] and all the Great Lakes[12]. In the Great Lakes, 42 of 66 sampled beaches were littered with plastic pellets[12]. Major spillage events have occurred, including the MV X-Press Pearl maritime disaster in 2021 off the coast of Sri Lanka, which led to the largest marine plastic spill in history[13], and similar events continue around the world[14-16]. Transport spills also occur on land, including from trucks and trains in the U.S.[17]







IMPLICATIONS
Chemical Pollution & Wildlife

Pellet leakage sites often neighbor polluting industries, such as oil and gas industries[18-19], leading to pellets adsorbing harmful chemicals. Plastic pellets have been shown to contain persistent organic pollutants (POPs) from the environment, including polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and pesticides[11,20]. Harmful pathogens, such as *E. coli* bacteria can also colonize pellets[21]. This allows plastic pellets to act as vectors to transport pollutants and pathogens[22,23]. A study by the International Pellet Watch found that when plastic pellets collected from beaches of 17 countries were tested for chemical sorption, the U.S. pellets had the highest PCB concentrations, followed by western Europe and Japan[11].

Hundreds of organisms are known to ingest plastic pellets[24,25] including fish, turtles, and seabirds[26], with a range of negative effects on metabolism[27], behavior[28], and reproduction[29]. In addition, studies have shown that POPs sorbed to plastic pellets that are ingested by wildlife can become bioavailable, where chemicals released from pellets can impact the organism's health[20,30].

STEPS TO PROGRESS

Current/Ongoing

Voluntary efforts have shown limited success in mitigating pellet pollution. Operation Clean Sweep (OCS), a voluntary program that has been in place for over 25 years, has had limited effectiveness, as OCS facilities are still sources of emissions[31,32].

2019

A Texas federal judge accused Formosa plastics company of violations to the U.S. Clean Water Act after the company allowed billions of plastic pellets to wash into nearby wetlands and waterways. The company went on to pay for cleanup initiatives and vowed to incorporate filters and capture technologies to remove pellets during waste discharge and prevent future pollution[33].

2018

High plastic pellet pollution levels on Mustang and North Padre Islands, TX led to the formation of the citizen science effort, Nurdle Patrol to collect data on nurdle concentrations across the Gulf of Mexico coastline and inform policy responses[9].

2014

The Borealis Group in Austria, one of the most important global plastic producers, set a zero pellet loss objective after the river Danube was shown to have extremely high plastic pellet pollution[34]. Improvements made to address pellet loss were assessed by third party auditors, and more work is ongoing[35].

2011

NOAA and UNEP initiated the Honolulu strategy to reduce impacts of marine debris, with focus on development and implementation of regulations to avoid release of pellets from land-based sources[36].

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