PLASTICS IN THE OCEAN

By Gary Antonides

Kamilo Beach is an isolated stretch of shoreline on the southern tip of the island chain of Hawaii. Just a few hundred yards from shore, humpback whales rise up from the depths, colorful fish fill the reefs and rare sea turtles swim in to nest on the beach. But http://ensia.com/features/what-will-it-take-to-get-plastics-out-of-the-ocean/ reports that, even in this remote place, toothbrushes, combs, plastic bottles and other garbage wash ashore each day. Old Hawaiian sayings have described the bay as a place where people went looking for loved ones if they got lost at sea. Historically that area has accumulated all manner of things that float in the ocean. Now, the main thing that washes ashore is a lot of plastic. It's happening all around the world.

The reason a remote place like Kamilo can get so swamped by massive amounts of trash is because of ocean currents. Hawaii is located in a huge circular system of ocean currents, the North Pacific Gyre. Within the gyre, trash can get trapped and circulate for years. One region between the islands and California contains such a high density of man-made debris that it has been nicknamed the Eastern Pacific Garbage Patch. The currents vary somewhat, causing the garbage to wash ashore in various places, like Kamilo Beach.

The International Pacific Research Center in Honolulu has taken major steps in understanding how marine debris travels the oceans' currents. They have developed a computer simulation that can project the behavior of floating items at sea. Based on drifter buoys and satellite data, the model indicates how trash accumulates in the oceans.

http://www.oceanhealthindex.org/news/Making_Least_Most_Marine_Trash reports that the world produces 300 million tons of plastic each year, but only about 10% is recycled. The rest is dumped, landfilled or escapes as trash into landscapes, lakes, rivers and the ocean. About 7 million tons end up in the ocean each year, making up roughly 75% of all marine debris. Ocean trash contains

many different types and sizes of plastic, each harmful or even deadly in its own way.

Nanoplastics, the tiniest bits, not even visible to the human eye, come from cosmetics, face washes, toothpaste and other consumer goods as well as the breakdown of larger particles. Some states have been working on banning the use of these particles in personal care products.

Microplastics, in the millimeter size range, come mainly from the breakdown of larger pieces of plastic, but also from plastic pellets (nurdles) used for making plastic products. Microplastics comprise most of the plastic in the ocean.

We cannot get nanoplastics and microplastics out of the ecosystem, and, unfortunately, both enter food webs because they are ingested by filter feeders and small fish. The feeders gain no nutritional value, but do soak up toxins that leach from the particles, and scientists suggest these can be passed on to humans as well as other wildlife.

Most ocean debris ends up in five big subtropical ocean gyres located in the Pacific, Atlantic and Indian Oceans. They rotate clockwise in the Northern Hemisphere and counterclockwise in the Southern. Water samples collected from all these regions show elevated concentrations of plastic particles, and the evidence shows that the marine debris caught in the oceanic gyres continues to grow.

There are many efforts to control the plastics from entering the ocean in the first place. Each September, on International Coastal Cleanup Day, volunteers across the globe roam the shores to collect trash. In 2014, more than half a million participants from 91 countries collected over 16 million pounds of trash in just one day. The top five most commonly found items were cigarette butts, food wrappers, bottle caps, straws, stirrers and beverage bottles. Collectors also found lawnmowers, light bulbs, wigs and even shopping carts.

*Extremely littered beach in northern Norway. Source: ©© **Bo Eide***

The damage and suffering this causes for ocean life is severe. Plastics are found in the stomachs of whales, fish and many other marine animals. Turtles suffocate when they confuse shopping bags with jellyfish, or drown when they get entangled in discarded nets. Seals get stuck in plastic rings from six-packs that slowly cut through their necks. In the middle of the Pacific, albatross chicks die, weakened from eating bottle caps and toys. The Convention on Biological Diversity counts 663 species affected by ocean plastics. Humans are also affected. In 2015, researchers sampled fish and shellfish being sold for human consumption in Indonesian and Californian markets. They found plastic or textile fibers in a quarter of the samples.
A solution is urgently needed, and many schemes for cleaning up the oceans have been proposed. These include marine drones, waterborne kites, huge artificial drains for the gyres, and creating microorganisms to break up the plastics. Experts have tried to convey what a massive challenge it would be to clean up the ocean's trash. The National Atmospheric and Oceanic Administration has estimated it would take 68 ships an entire year to survey just 1 percent of the North Pacific. In another, more hypothetical calculation, ocean activist Charles Moore estimates that to clean all five garbage patches, 1,000 boats would need to filter the water 24 hours a day for 79 years, and that's only if the technology existed.

Boyan Slat, a young Dutch inventor, presented his idea to filter the open ocean in 2012. Instead of sending out boats to go after the trash he would take advantage of the rotating currents of the gyres. If a filtering platform could be fixed to the seabed underneath the North Pacific garbage patch, one could get the trash out while the water flowed through it. Some experts say that Slat's project could cause more harm than good by threatening delicate zooplankton and other animals living near the sea surface. They also point out how difficult it would be to fix the structure to the seabed.

For many decades, environmental organizations have tried to raise awareness of how all this debris impacts marine life. But what finally alarmed many citizens were reports of massive trash islands in the ocean, one reportedly "twice the size of Texas." In fact, plastic is distributed quite widely over the vast oceans. The garbage patches are not solid islands, but regions where high concentrations of small plastic pieces are dispersed in the upper part of the water column, hardly visible from above.

For a long time, with good reason, the development of plastics was perceived as a big success story. Synthetic materials have advanced human civilization, wealth and comfort in uncountable ways. Their development started in 1907 when the Belgian-born chemist Leo Baekeland developed Bakelite, the first synthetic plastic polymer. Bakelite was moldable, heat-resistant and nonconductive, so it was soon used for a multitude of products, from electrical insulators and casings for telephones and radios to toys, poker chips and firearms. Most plastic applications were industrial until the 30's and 40's when it was used increasingly in consumer products including telephones, furniture, and dishware. Global plastic production rose from 1.9 million tons in 1950 to close to 330 million tons in 2013. And the numbers continue to grow. Now plastic products can be found from the surface of oceans to deep-sea sediment, in lakes and rivers, even frozen in Arctic ice. They are ubiquitous, and we find ourselves forced to think about the consequences. Unfortunately, plastics are not the only new technology wholeheartedly adopted without an appreciation of the long term consequences.

While efforts to find a viable method to clean existing ocean plastic are laudable, it is more important to stop more trash from entering the oceans in the first place, which means keeping it out of the rivers and streams that empty in the oceans. Cleanup projects and research are being undertaken worldwide, but here we will mention only two commendable local efforts.

In Baltimore, John Kellett worked near the city's heavily polluted harbor for many years and realized that much of the plastic reaching the harbor came from Jones Falls, a stream that accumulates trash as it winds through residential neighborhoods. With local partners, Kellett constructed a device that would skim garbage from the surface of the stream
before it could float downstream. Utilizing a waterwheel to take advantage of the Jones Falls current and solar panels, the Inner Harbor Water Wheel was deployed in 2014 and has become a prominent city landmark. Resembling a giant nautilus, it has orange booms that cover the 35-meter-wide (40-yard-wide) mouth of Jones Falls and directs items floating on the surface to a conveyor belt, where they are collected before they can reach the harbor. The trash is then emptied into a large container and hauled off.

Photo by Inhabitat (Flickr/Creative Commons)

Kellett estimates that about three-quarters of the trash that would have floated into the inner Baltimore harbor is now being caught. *National Geograpic, April 2016* reports that 12 dumpsters were filled in 48 hours after a severe storm last year. Kellet is being praised by experts for his efforts to catch trash closer to the source. He has received a number of requests to deploy his technology in other places around the world, including the trash filled Guanabara Bay in Brazil where Olympic events will be hosted this year. He sees good potential to scale it up for midsize rivers and harbors, but he points out that if there were better education, legislation and technology, the trash might not show up in the rivers and travel to the ocean in the first place.

Those who live near Annapolis may remember Matt Rutherford the sailor who, in 2012, was the first person to circumnavigate the Americas non-stop and solo. Since then he has founded the non-profit Ocean Research Project (ORP), teaming with NASA, Smithsonian, and 5 Gyres to study climate change, ocean acidification and marine plastics in one of the most remote regions of the world

http://oceanresearchproject.org/2652-2/ reports that last summer he and Nicole Trenholm sailed their specially equipped 42' schooner to uncharted fjords off western Greenland to conduct first-of-its-kind scientific research in one of the most remote and least-understood places on the planet. The 100-day expedition gathered scientific data on some of the critical environmental challenges of our time, including climate change, ocean acidification and marine plastics.

For one of their projects, ORP will use finely webbed nets to collect, for one of the first times in an Arctic environment, small pieces of plastic refuse. Samples of these microplastics will be analyzed for their composition, any harmful toxins and various micro-bacteria. This research will support international models that show the characteristics of marine debris in various climactic regions. Trenholm, a former NOAA scientist, said the marine debris research builds upon previous ORP surveys.

CEPA's Fall newsletter will include an article that focuses on the many effects of plastics on marine life.