## OUT IN THE PACIFIC PLASTIC IS GETTING DRASTIC

## THE WORLD'S LARGEST "LANDFILL" IS IN THE MIDDLE OF THE OCEAN

There is a large part of the central Pacific Ocean that no one ever visits and only a few ever pass through. Sailors avoid it like the plague for it lacks the wind they need to sail. Fisherman leave it alone because its lack of nutrients makes it an oceanic desert. This area includes the "horse latitudes," where stock transporters in the age of sail got stuck, ran out of food and water and had to jettison their horses and other livestock. Surprisingly, this is the largest ocean realm on our planet, being about the size of Africa-over ten million square miles. A huge mountain of air, which has been heated at the equator, and then begins descending in a gentle clockwise rotation as it approaches the North Pole, creates this ocean realm. The circular winds produce circular ocean currents which spiral into a center where there is a slight down-welling. Scientists know this atmospheric phenomenon as the subtropical high, and the ocean current it creates as the north Pacific central or sub-tropical gyre.

Because of the stability of this gentle maelstrom, the largest uniform climatic feature on earth is also an accumulator of the debris of civilization. Anything that floats, no matter where it comes from on the north Pacific Rim or ocean, ends up here, sometimes after drifting around the periphery for twelve years or more. Historically, this debris did not accumulate because it was eventually broken down by microorganisms into carbon dioxide and water. Now, however, in our battle to store goods against natural deterioration, we have created a class of products that defeats even the most creative and insidious bacteria. They are **plastics**. Plastics are now virtually everywhere in our modern society. We drink out of them, eat off of them, sit on them, and even drive in them. They're durable, lightweight, cheap, and can be made into virtually anything. But it is these useful properties of plastics, which make them so harmful when they end up in the environment. Plastics, like diamonds, are forever!

If plastic doesn't biodegrade, what does it do? It "photo-degrades" – a process in which it is broken down by sunlight into smaller and smaller pieces, all of which are still plastic polymers, eventually becoming individual molecules of plastic, still too tough for anything to digest. For the last fifty-odd years, every piece of plastic that has made it from our shores to the Pacific Ocean, has been breaking down and accumulating in the central Pacific gyre. Oceanographers like Curtis Ebbesmeyer, the world's leading flotsam expert, refer to it as the great Pacific Garbage Patch. The problem is that it is not a patch, it's the size of a continent, and it's filling up with floating plastic waste. My research has documented six pounds of plastic for every pound of plankton in this area.

My latest 3-month round trip research voyage just completed in Santa Barbara this week, (our departure was covered by SBNP) got closer to the center of the Garbage Patch than before and found levels of plastic fragments that were far higher for hundreds of miles. We spent weeks documenting the effects of what amounts to floating plastic sand of all sizes on the creatures that inhabit this area. Our photographers captured images of jellyfish hopelessly entangled in frayed line, and transparent filter feeding organisms with colorful plastic fragments in their bellies.

As we drifted in the center of this system, doing underwater photography day and night, we began to realize what was happening. A paper plate thrown overboard just stayed with us, there was no wind or current to move it away. This is where all those things that wash down rivers to the sea end up. On October 10, during our return trip to Santa Barbara, we discovered something never before documented-a Langmuir Windrow of plastic debris. Circular ocean currents with contrary rotation create long lines of material, visible from above as streaks on the ocean. Normally these are formed by planktonic organisms or foam, but we discovered one made of plastic. Everything from huge hawsers to tiny fragments were formed into a miles long line. We picked up hundreds of pounds of netting of all types bailed together in this system along with every type and size of debris imaginable. Sometimes, windrows like this drift down over the Hawaiian Islands. That is when Waimanalo Beach on Oahu gets coated with blue green plastic sand, along with staggering amounts of larger debris. Farther to the northwest, at the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve, monk seals, the most endangered mammal species in the United States, get entangled in debris, especially cheap plastic nets lost or discarded by the fishing industry. Ninety percent of Hawaiian green sea turtles nest here and eat the debris, mistaking it for their natural food, as do Laysan and Black Footed Albatross. Indeed, the stomach contents of Laysan Albatross look like the cigarette lighter shelf at a convenience store they contain so many of them.

It's not just entanglement and indigestion that are problems caused by plastic debris, however. There is a darker side to pollution of the ocean by ubiquitous plastic fragments. As these fragments float around, they accumulate the poisons we manufacture for various purposes that are not water-soluble. It turns out that plastic polymers are sponges for DDT, PCBs and nonylphenols -oily toxics that don't dissolve in seawater. Plastic pellets have been found to accumulate up to one million times the level of these poisons that are floating in the water itself. These are not like heavy metal poisons which affect the animal that ingests them directly. Rather, they are what might be called "second generation "toxics. Animals have evolved receptors for elaborate organic molecules called hormones, which regulate brain activity and reproduction. Hormone receptors cannot distinguish these toxics from the natural estrogenic hormone, estradiol, and when the pollutants dock at these receptors instead of the natural hormone, they have been shown to have a number of negative effects in everything from birds and fish to humans. The whole issue of hormone disruption is becoming one of, if not the biggest environmental issue of the 21st Century. Hormone disruption has been implicated in lower sperm counts and higher ratios of females to males in both humans and animals. Unchecked, this trend is a dead end for any species.

A trillion trillion vectors for our worst pollutants are being ingested by the most efficient natural vacuum cleaners nature ever invented, the mucus web feeding jellies and salps (chordate jellies that are the fastest growing multicellular organisms on the planet) out in the middle of the ocean. These organisms are in turn eaten by fish and then, certainly in many cases, by humans. We can grow pesticide free organic produce, but can nature still produce a pesticide free organic fish? After what I have witnessed first hand in the Pacific, I have my doubts.

I am often asked why we can't vacuum up the particles. In fact, it would be more difficult than vacuuming up every square inch of the entire United States, it's larger and the fragments are mixed below the surface down to at least 30 meters. Also, untold numbers of organisms would be destroyed in the process. Besides, there is no economic resource that would be directly benefited by this process. We have not yet learned how to factor the health of the environment into our economic paradigm. We need to get to work on this calculus quickly, for a stock market crash will pale by comparison to an ecological crash on an oceanic scale.

I know that when people think of the deep blue ocean, they see images of pure, clean, unpolluted water. After we sample the surface water in the central Pacific, I often dive over with a snorkel and a small aquarium net. I have yet to come back after a fifteen minute swim without plastic fragments for my collection. I can no longer see pristine images when I think of the briny deep. Neither can I imagine any "beach cleanup" type of solution. Only elimination of the source of the problem can result in an ocean nearly free from plastic, and the desired result will only be seen by citizens of the third millennium AD. The battle to change the way we produce and consume plastics has just begun, but I believe it is essential that it be fought now. The levels of plastic particulates in the Pacific have at least tripled in the last ten years and a tenfold increase in the next decade is not unreasonable. Then, sixty times more plastic than plankton will float on its surface.

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