

Plastic Trash on the Ocean

“It’s not a pretty sight.”

by Paul Hess

The main message from the albatross is this: No place, no creature, remains apart from you and me anywhere in the whole world. Seeing a parent albatross gagging up a toothbrush made me realize humanity has no borders. We’ve woven the albatross and many other creatures into our culture. That creates an obligation, and the opportunity to make a better world. We should do this not just for albatrosses, but also for ourselves.

—Carl Safina, *Eye of the Albatross* (Henry Holt and Co., 2002)

Humans are mighty. We can trawl every seamount, climb every mountain, and perturb the atmosphere itself. Everything on earth, from the deepest oceanic abyss to the highest mountain, is touched by human influence. But seeing that influence just floating out here in the middle of nowhere makes our power painfully obvious, and the consequences of the industrial age plain. It’s not a pretty sight.

—Miriam Goldstein, Chief Scientist, SEAPLEX expedition, written at sea on 20 August 2009

As happens in the face of all significant threats to the environment, plastic pollution in the sea has drawn three responses from people who care: scientific research, educational efforts, and commitments to conservation. Scientists are documenting the discovery, ubiquity, and dangerous consequences of discarded plastics that circle in great gyres around the oceans. Environmental educators are increasingly reaching out to schools and communities to arouse public concern. Growing numbers of nonprofit organizations are focusing on possibilities for mitigating the plastics’ biological damage.

The internet is a vast resource for knowledge about oceanic debris and how it is being studied. A basic introduction is the “Marine Debris 101” section of the National Oceanic and Atmospheric Administration’s website <marinedebris.noaa.gov>, which also describes projects funded by NOAA and partnered with other governmental agencies and organizations. Search the web for “ocean plastics,” “North Pacific gyre,” and “Great Pacific Garbage Patch” to find many organizations that are studying the oceanic debris and hoping to mitigate its dangers to marine life. Websites such as the five highlighted in the following pages offer not only an extensive array of information but also an invigorating spirit of inspiration.

During an August 2009 SEAPLEX expedition to the North Pacific Gyre, researchers encountered a large fishing net entangled with rope, plastic, and marine life.

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Algalita Marine Research Foundation (AMRF)

algalita.org

Returning to the U.S. mainland from Hawaii after a yacht race in 1997, Captain Charles Moore was aghast at what he saw in the immense whirling vortex of the North Pacific Gyre: “Every time I came on deck to survey the horizon, I saw a soap bottle, a bottle cap, or a shard of plastic waste bobbing by. Here I was in the middle of the ocean, and there was nowhere I could go to avoid the plastic.”

Various studies during the 1980s had begun to assess the danger of plastics to seabirds that eat the floating debris by accident or mistake it for food. But something else troubled Moore. Plastics in the ocean degrade both chemically and mechanically, fragmenting into smaller and smaller pieces. He wondered how the resulting micro-particles might affect small filter-feeding organisms and even zooplankton, the base of the marine food chain.

Moore’s concern led him to focus AMRF on the study of this phenomenon and to attract the public’s attention to the problem. Aboard the Oceanographic Research Vessel *Alguita*, his first systematic sampling of water from the gyre in 1999 showed an average density ratio of six parts plastic to one part zooplankton. Surveys in 2007–2008 produced samples with ratios up to 46 parts plastic to one part zooplankton. More samples trawled from the gyre in 2009 are being analyzed for comparison with those from the 1999 survey.

In 2004 AMRF’s Pacific focus had turned also to near-shore plastics entering the ocean from southern California’s rivers. Conducting a state-funded study, AMRF researchers estimated that 2.3 billion pieces of plastic weighing 30 tons were coming down the Los Angeles and San Gabriel rivers during just three days of sampling. AMRF estimates that up to 80 percent of marine debris worldwide comes from land-based discharges, and the flood of plastic off the U.S. west coast continues in full force. On an outing after recent rains in southern California, the researchers saw a coastal picture just as gloomy as in the gyre. The *Alguita* blog for 10 February 2010 summarizes the observers’ reaction: “It was very disappointing to find windrows thick with plastic pollution outside the harbor.”

Meanwhile, in the “5 Gyres Project” described below, two AMRF researchers tell of finding disappointments in the Atlantic Ocean as well.

In his newest AMRF annual report, Moore emphasizes the challenges ahead: “Our research, while exposing dire threats to the ocean’s beauty and health, relies on the public’s love for the greatest of all the habitats for life in our entire solar system.

We accept as true the oft-quoted adage, ‘We protect what we love.’ We’ve got a lot of protecting to do.”

5 Gyres Project

5gyres.org

Besides the North Pacific Ocean, the South Pacific, North Atlantic, South Atlantic, and Indian oceans have gyres of their own, where the extent of plastic pollution has not been surveyed systematically.

The first long-distance survey of the North Atlantic is being conducted in 2010. A pioneering voyage in collaboration with the Algalita Marine Research Foundation in January and February proved that huge quantities of plastic are floating in this ocean as well. Project directors Marcus Eriksen and Anna Cummins crossed from the U.S. Virgin Islands to the Azores on the racing sloop *Sea Dragon*, owned and donated for the researchers’ use by the ocean voyaging company Pangaea Explorations. The leaders’ blog on 31 January summarized what they found as they approached the center of the Sargasso Sea:

“Since leaving Bermuda, our trawls have looked nearly identical to those we collected on our first leg: clumps of sargassum peppered with small particles of plastic—whites, blues, grays, and the occasional pastel—which gives staring out to sea a



SEAPLEX scientists sampled small fish along with floating plastic in the North Pacific Ocean Gyre. © Jim Leichter, Scripps Institution of Oceanography, University of California-San Diego.

bittersweet tone. In this seemingly pristine landscape, impossibly clear waters stretching thousands of miles in all directions, our random samples all contain plastic.”

Just as in the North Pacific Gyre, micro-particles of plastic were discovered in the stomachs of fish. An important question that Algalita scientists are studying is what impact these particles may have on the fish themselves and on fish-eating creatures—including humans.

An expedition directed by Eriksen and Cummins will cross the South Atlantic Gyre in August 2010 along a transect from Rio de Janeiro to Cape Town, South Africa, where even less is known about the extent of plastic pollution. Next, Pangaea Explorations <panexplore.com> is planning a voyage to sample plastics in the South Pacific Gyre from September to December 2010.

Oikonos—Ecosystem Knowledge oikonos.org

This research and educational organization’s twin goals are to promote awareness and understanding of human impacts on marine ecosystems and to improve biodiversity conservation on imperiled islands.

Of particular interest on the website are photographs of boluses—large pellets of indigestible material regurgitated by albatross chicks just before they are ready to leave the nest site to spend several years at sea. Marine biologist Carol A. Keiper, an Oikonos board member, explains that the boluses normally contain indigestible items such as squid beaks and fish bones. Now, she says, every bolus also contains plastic fragments and whole plastic items such as bottle caps, baby pacifiers, children’s toys, toothbrushes, and fishing line that were fed to the chick for months by the parents. Especially dramatic is the photograph of a dead Laysan Albatross chick on Kure Atoll lying next to its stomach contents. The stomach weighed 370 grams, of which 270 grams were plastic.

Michelle Hester, president of Oikonos, offers an overall perspective: “No one has been able to quantify what proportion of chicks are killed by plastic. It is difficult because the mortality is usually indirect, for example from dehydration, which cannot be proven in the field with current funding levels.” But she adds that “in several colony studies, every single albatross chick was fed some degree of plastic trash by the parents.”

A webpage headlined “Ocean Stewardship: Education and Outreach” offers free, downloadable teaching tools for school and community programs. These include interactive projects permitting students to examine actual boluses to see what they contain. Collecting the boluses from far-flung nesting islands requires a major effort by Oikonos, the Hawaii Division of

Forestry and Wildlife, the University of California–Santa Cruz, the National Oceanic and Atmospheric Administration, and the U.S. Fish and Wildlife Service. The California Coastal Commission and the Cordell Bank National Marine Sanctuary provide further materials and assistance.

Is Oikonos achieving its goal? The website quotes a California middle school student’s reaction after a program on plastics and albatrosses: “Thank you so much for teaching us about how much plastic is in the ocean and how many birds eat plastic. I knew that it was bad, but I didn’t know it was this bad. I was amazed! Because of your presentation, I feel I need to help these birds too.”

Project Kaisei projectkaisei.org

The first thing to notice on this organization’s home page is a tall ship, sails full blown, and making good speed. It is the brigantine *Kaisei* (Japanese for “Ocean Planet”), a gloriously unlikely research vessel, which sailed through the North Pacific Gyre on a 1,700-mile cruise in August 2009. The voyage was a companion to the SEAPLEX cruise described below, and the two expeditions’ participants reported finding plastic in every sample of ocean water they netted on transects along 3,500 miles of the gyre. Items of especially great concern to Kaisei researchers are the tiny plastic fragments that degrade into micro-particles and will remain permanently in the gyre

SEAPLEX researchers in the North Pacific dispatched a small boat from the Research Vessel *New Horizon* on 10 August 2009 to capture plastic debris. Among the items they found were three plastic bottles carrying sea creatures.

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if they cannot be removed somehow.

Doug Woodring, co-founder of Project Kaisei, expressed a strong reaction in his blog while at sea on 18 August 2009: “What this shows us is that man has extended its reach to the far reaches of the world, in this case the ocean, in the form of another environmentally tarnished footprint. We only saw two boats on the entire time in the gyre, and one was the Kaisei. Even planes barely fly overhead. This is the ‘quiet zone’ in terms of human activity, because there is no one out here working, polluting, or wasting things, yet we have still managed to leave our mark in the form of debris. It has come from all of us.”

John Azzaro, communications liaison for the voyage, had a similar reaction in his final blog entry just after returning to port in San Francisco on 31 August 2009: “Mission accomplished, or mission just begun? Once our eyes have been opened to the shocking reality of toxic man-made marine debris, how can we turn our attention away from this pressing reality?”

Indeed the journey has just begun. Project Kaisei has the hopeful subtitle “Capturing the Plastic Vortex.” In that spirit, a new expedition will cross the gyre in the summer of 2010 to test the potential feasibility of capturing the plastics and recycling them into some kinds of useful byproducts.

SEAPLEX

sio.ucsd.edu/Expeditions/Seaplex

This acronym represents the Scripps Environmental Accumulation of Plastic Expedition, a scientific cruise in August 2009 by doctoral students and research volunteers from the Scripps Institution of Oceanography at the University of California–San Diego. In collaboration with Project Kaisei, the expedition surveyed the distribution and abundance of floating plastics along a 1,360-mile track across the North Pacific Gyre.

Participants aboard the research vessel *New Horizon* focused on much more than threats to seabirds. Led by chief scientist Miriam Goldstein, they collected thousands of samples of plastic debris and marine creatures to assess the impact of the plastics on birds, small fish, invertebrates, and zooplankton. Back at the Scripps Institution, the researchers are investigating potential impacts, and they hope also to determine whether the plastics are carrying invasive species and organic pollutants around the ocean.

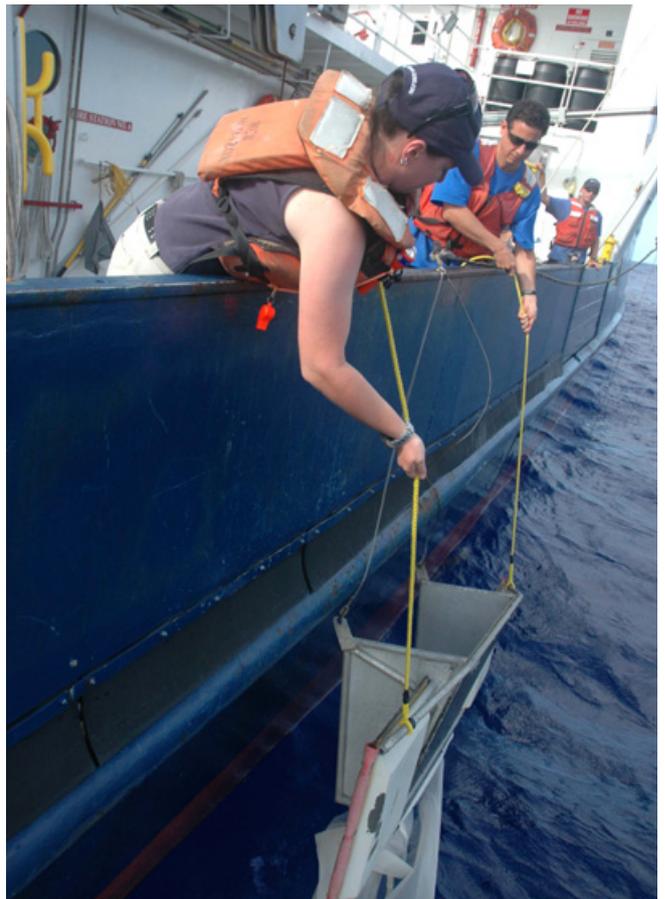
Expedition members tell the scientific story fascinatingly and describe their personal reactions movingly in a daily blog on the website. Miriam Goldstein, the expedition’s chief scientist, concludes her blog with a memorable plea:

“When I was growing up near the Gulf of Maine, my parents cautioned us to never turn our backs to the ocean. They meant

that we shouldn’t get caught by surprise by a big wave or a rip tide, but I think this advice should extend to the lovely parts of the ocean as well as the scary parts.

“The ocean is the cradle of life on Earth, filled with infinite variability, and we’ve only explored a tiny fraction of it. There are so many mysteries to explain, so many depths to plumb. Even the humblest seaside tidepool contains animals barely known to science.

“So to all who followed along with SEAPLEX, and who are intrigued by the big, wet, and blue: Please don’t turn your backs to the ocean. Perhaps someday missions like SEAPLEX will become obsolete, and ocean science will be done for the sheer joy of discovery instead of the necessity of understanding what our species has wrought.”



Miriam Goldstein (left), chief scientist on the SEAPLEX expedition to the North Pacific Gyre, and Mario Aguilera, assistant director of communications at Scripps Institution of Oceanography, deploy a net to sample the sea surface for floating organisms and plastic debris on 9 August 2009. © Jim Leichter, Scripps Institution of Oceanography, University of California–San Diego.