



## SCIENCE & TECHNOLOGY

# Trashing the Oce

An armada of plastic rides the waves, and sea creatures

BY THOMAS HAYDEN

**A**t Taco Bell on Main Street in Ventura, Calif., you can take out the chalupa of your choice—Baja, Nacho Cheese, or Supreme, with ground beef, chicken, or steak. But it will always come in a small plastic shopping bag. The bags arrive preprinted from a factory in Asia—usually. One brilliant summer morning in 2000, the small private research vessel *Alguita* discovered a 10-mile-wide flotilla of the disposable sacks, an estimated 6 million of them destined for Taco Bells around the country, bobbing more than 1,000 miles west of the Ventura store. “We were out in the middle of the Pacific, where you would think the ocean would be pristine,” recalls the *Alguita*’s captain, Charles Moore. “And instead, we get the

Exxon Valdez of plastic-bag spills.”

Most plastic bags end up in landfills, part of the millions of tons of plastic garbage Americans dump each year. But whether jettisoned illegally by ships at sea, washed out from land during storms, or, as in the case of the chalupa bags, accidentally lost overboard from container ships, countless tons of plastic refuse end up drifting on the high seas.

**Lethal litter.** Many Americans know about the hazard posed by six-pack rings, the plastic yokes that can grasp a seagull or otter’s neck as tightly as they do a soda can. But researchers are finding that plastic litter doesn’t just strangle wildlife or spoil the view. “Plastic is not just an aesthetic problem,” says marine biologist David Barnes of the British Antarctic Survey. “It can actually change entire ecosystems.”

The largest pieces of plastic—miles-long discarded fishing nets and lines—

take an obvious toll. These “ghost nets” snare and drown thousands of seals, sea lions, and dolphins a year. Researchers have also watched in horror as hungry turtles wolf down jellyfishlike plastic bags and seabirds mistake old lighters and toothbrushes for fish, choking when they try to regurgitate the trash for their starving chicks. As Barnes is documenting, tiny marine animals riding rafts of plastic trash are invading polar seas, while Japanese researchers are finding high concentrations of deadly chemicals clinging to floating, tapioca-size plastic pellets called “nurdles.” And Moore, back from a three-month North Pacific voyage last week, is tracking it all and discovering that tiny fragments of plastic are entering the food web right near its bottom.

A member of the prominent Los Angeles-area Hancock Oil family, Moore is anything but a typical researcher. He

# ans are suffering

grew up as an avid surfer and sailor in a comfortable waterfront home in Long Beach and ran a furniture restoration business. But in 1995, at the age of 48, Moore sold his business, set up the Algalita Marine Research Foundation, and designed a unique double-hulled sailing research vessel, the Alguita. Both ship and captain found their true calling after a 1997 yacht race to Hawaii.

On his return voyage, Moore veered from the usual sea route and saw an ocean he had never known. Every time he stepped out on deck, "there were shampoo caps and soap bottles and plastic bags and fishing floats as far as I could see. Here I was in the middle of the ocean, and there was nowhere I could go to avoid the plastic." Ever since, Moore has dedicated his time, and a small personal fortune, to seeking it out. "It's an overlooked problem, and this guy is mak-

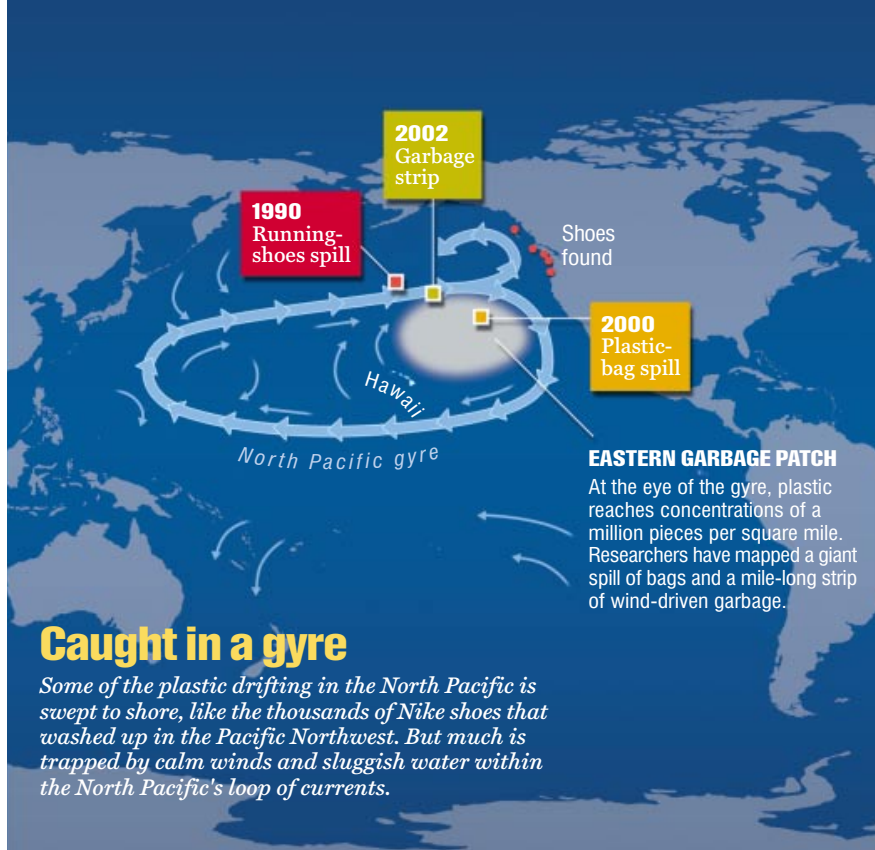
ing a really important contribution," says oceanographer Dale Kiefer of the University of Southern California.

With little scientific training, Moore formed alliances with professional scientists, including chemists, biologists, and a private oceanographer, Curtis Ebbesmeyer, himself a well-known flotsam hunter. Ebbesmeyer's most famous case involved a 1990 containership spill that dumped 80,000 Nike running shoes into the North Pacific. The errant runners washed up on beaches from British Columbia to California, helping him trace the currents that carried them.

The Alguita's mission started in earnest in 1999. Moore and his all-volunteer crew—attracted by the chance for meaningful adventure and Moore's reputation as an excellent chef—returned to the garbage-strewn region he had happened on two years earlier and skimmed

er maps—that protects Southern California's enviable weather by pushing storms north or south. The H is the eye of a circle of currents thousands of miles wide called the North Pacific gyre. The high's weak winds and sluggish currents naturally collect flotsam, earning it the unfortunate nickname of the "Eastern Garbage Patch." Similar wind and current patterns exist in all the major oceans, and all presumably suffer from similar contamination.

Because most plastics are lighter than seawater, they float on the surface for years, slowly breaking down into smaller and smaller fragments—which often end up in the ocean's drifting, filter-feeding animals, like jellyfish. Early in his voyages, Moore collected baseball-size gelatinous animals called salps and found their translucent tissues clogged with bits of monofilament fishing line and nurdles (more romantically referred to as "mermaid tears" by



## Caught in a gyre

*Some of the plastic drifting in the North Pacific is swept to shore, like the thousands of Nike shoes that washed up in the Pacific Northwest. But much is trapped by calm winds and sluggish water within the North Pacific's loop of currents.*

### EASTERN GARBAGE PATCH

At the eye of the gyre, plastic reaches concentrations of a million pieces per square mile. Researchers have mapped a giant spill of bags and a mile-long strip of wind-driven garbage.

ROB CADY—USN&WR



**ADRIFT.** Floating on the high seas (far left), plastic can tempt animals like this albatross, dead with flotsam in its belly.

the surface with fine collecting nets. Across hundreds of miles of ocean, they counted roughly a million pieces of plastic per square mile, almost all of it less than a few millimeters across.

**Trash heap.** The Alguita was sampling water beneath a climate feature called the North Pacific subtropical high—the big "H" on weather



**ON THE LOOKOUT.** Charles Moore, captain of the private research vessel *Alguita*, pursues the Pacific's floating plastic.

beachcombers). A hundred billion pounds of these pellets are produced each year, to be formed into everything from CD cases to plastic pipe. But each one is a perfect plankton's-eye-view replica of a fish egg. "You rarely find any particles smaller than a millimeter in the water," says Moore. "They're all in the jellies."

That's not likely to be good for the filter feeders or the things that eat them, notes Moore, and not just because a meal of plastic doesn't yield much nutrition. A 2001 paper by Japanese researchers reported that plastic debris can act like a sponge for toxic chemicals, soaking up a millionfold greater concentration of such deadly compounds as PCBs and DDE, a breakdown product of the notorious insecticide DDT, than the surrounding seawater. That could turn a bellyful of plastic from a mere stomachache to a toxic gut bomb that can work its way through the food web.

**Unhappy hunting.** In Moore's latest voyage to the garbage patch, he got a close-up view of what happens when life meets floating garbage. The *Alguita's* crew found plastic trash bobbing in a thick line from horizon to horizon—everything from tiny particles to 5-inch-thick towing lines, Japanese traffic cones, and yellow quart bottles of American crankcase oil. "We followed the debris for more than a mile, and we never found the end of it," Moore told *U.S. News* by satellite phone. The research team had stumbled across what oceanographers call a Langmuir cell, a wind-driven circulation pattern where two masses of water are

pushed together, forcing some of the water to sink where they meet; anything that floats stays on the surface.

Normally that means living things. These convergences are favorite hunting grounds of seabirds and other predators, which pick zooplankton, fish eggs, jellyfish, and other delicacies out of the long, frothy windrows. Alien-seeming gelatinous creatures usually float just below, spinning fantastic webs of mucus to sieve out every last particle. Not this time, says Moore. "We found all the refuse of civilization, but there were no zooplankton at all." He's at a loss to explain why.

The *Alguita* team did see albatrosses and tropic birds circling above the line of trash. With little else to choose, they were apparently eating plastic. The birds seemed to be picking and choosing "the reds and pinks and browns. Anything that looks like shrimp," Moore says. Earlier in the trip, the *Alguita* had visited the French Frigate Shoals, off Hawaii, home to endangered monk seals and seabird rookeries. In the birds' gullets, researchers found red plastic particles.

Lines of trash like this one may also help explain the woes of the monk seals, which are usually killed by large masses of nets, more than any one fishing vessel is likely to lose or cut loose at a time. The *Alguita's* crew plucked several of these net balls from the Langmuir windrow. The converging currents evidently brought nets together and tangled them into makeshift deathtraps as they rolled in the sinking water.

Expect the trashing of the oceans to con-

tinue. An international convention called MARPOL bans the dumping of plastics at sea, but enforcement on the open ocean is nonexistent. Accidental losses are forgiven, notes Moore, and shippers don't even have to report them. "That means do-gooders like me don't even get a chance to clean up after the polluters," says Moore.

Rob Krebs of the American Plastics Council notes that people value plastics for exactly what creates problems at sea: their durability. Manufacturers are not to blame for the trash, he says. "The responsibility is with the people who control the material, not those who produce it." Moore agrees that greater efforts to prevent spills will help. But, he adds, "there's no reason why a six-pack ring or a peanut butter jar should have to last for 400 years." Manufacturers have tried for years to perfect biodegradable packaging, and at least one company, EarthShell, may finally be making some headway. Government agencies like the National Park Service are already using EarthShell's biodegradable plates and packaging, and hundreds of McDonald's restaurants have experimented with its clamshell boxes.

Moore, meantime, says he'll keep hunting marine plastic as long as his money holds out. After all, there is a link between his own advantages and the plastic flotsam he has been tracking. Oil made his grandfather's fortune—and oil is the raw material for most plastics manufacturing. "In a way, part of all this is remediation for the consequences of my grandfather's life," he says. "I guess maybe I need to make amends." |