

Staying on Top

These shoes just did it!

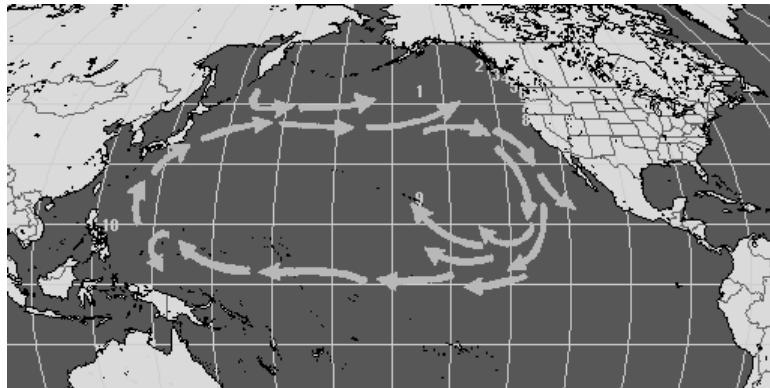


Surface currents in the oceans move in large slow circles called gyres. That explains the story of 60,000 Nike shoes spilled from a storm-tossed cargo ship in the northeastern Pacific in May 1990.

Shoes courtesy of Steve McLeod and Donovan Johnson

The shoes washed ashore one at a time but were wearable after a scrub-down to remove barnacles, algae, and tar. Beachcombers held swap meets to find matched pairs.

Six months to a year later, beachcombers from British Columbia to Oregon began to find shoes. Oceanographers constructed a computer model that predicted the shoes' route. In 1993, shoes were found in Hawaii. If the shoes complete the gyre's circuit, they will turn up in Japan and the Philippines, and in 1996 or 1997 again wash up on North American shores.



The North Pacific gyre has been dropping off shoes around the Pacific since 1990.

- 1 shoe spill, May 27, 1990
- 2 250 recovered, March 26, 1991
- 3 200 recovered, May 18, 1991
- 4 100 recovered, January-February 1991
- 5 200 recovered, November-December 1990
- 6 200 recovered, February-March 1991
- 7 150 recovered, April 4, 1991
- 8 200 recovered, May 9-10, 1991
- 9 several recovered, January-March 1993
- 10 predicted, January-July 1994

SCIENCE FRONTIERS ON-LINE, No. 97 (Jan.-Feb. 1995)

RUBBER DUCKIES CHASE NIKE SHOES ACROSS PACIFIC

Remember that amusing item in SF#84 about the 80,000 Nike shoes that were lost overboard in the Pacific in 1991? These shoes washed ashore months later in Canada and Alaska, carried thousands of miles by prevailing currents. Well, it's happened again. This time, eleven steel containers fell off a cargo vessel in the North Pacific near the International Dateline. The containers released 29,000 bath toys: duckies, turtles, froggies, and beavers. Ten months after the spill (January 10, 1992), the first yellow duckies washed ashore in Canada.

These spills are useful in charting ocean currents but, except for wry Fortean content, are of little import to anomalists. However, there is one prediction of the computer models that is worth noting: Some of these bath toys may make it through the Bering Strait, across the Arctic Ocean, down past Greenland, and onto Atlantic shores. So, keep your eyes open at the beach!

(Anonymous; "Rubber Ducky Armada Crosses Pacific," Science News, 146: 254, 1994. Carlton, Jim; "Tub Toys Are Ducky Ocean Researchers," Wall Street Journal, September 30, 1994. Cr. J. Covey)

YAHOO NEWS JULY 2003

Rubber ducks, which fell from a storm-tossed container ship in the Pacific Ocean in 1992, are believed to be washing ashore somewhere along the New England coast after a decade-long trans-Arctic journey.

Wind-Driven Ocean Currents:

Of Shoes And Ships And Rubber Ducks And A Message In A Bottle

Many of us have, at some time, fantasized about being ship-wrecked on a deserted island, knowing that our only hope of communicating with the outside world would be through messages sealed in bottles and tossed into the sea. As we toss the bottle into the water, we would likely pray that our message would travel by wind and ocean currents to some distant beach. There, a beachcomber would find the bottle, alert the world to our plight and send a ship to our rescue.

Scientists too dream of where the winds and currents will take an object floating in the ocean waters. Indeed, many theories of the colonization of the isolated Pacific islands such as Hawaii and Tahiti by humans and plant and animal life have been based upon the ability of winds, ocean waves and currents to transport them from one island to the next. Lizards such as the crested iguana of Fiji likely travelled across many kilometres of ocean from South America clinging to drifting trees before landing on a life-saving beach.

Oceanographers have long used floating objects to discover and study ocean currents. The technique generally employed is to release small bottles known as drift bottles into a specific area of the ocean. Each bottle contains a message asking the finder to return it indicating the date and location where the bottle was found. The path and time of travel can be estimated using the recovery information, the time and place of release and mathematical models of wind and ocean currents.

Curtis Ebbesmeyer, an oceanographer in Seattle, Washington has had a long interest in ocean currents and floating objects. His interest includes the possible historical and cultural significance of objects that may have floated across the Pacific Ocean from China and Japan to the Americas and influenced native cultures. He has even documented the trans-Pacific drift of the rubber wheels from the first aircraft to successfully cross the Pacific solo. They entered the ocean off Japan where the pilot had jettisoned them shortly after takeoff in order to reduce the weight of his aircraft and assure an adequate fuel supply for the flight. The wheels eventually reached shore in Washington State, not many miles from the final landing point of their aircraft.

Ebbesmeyer has used drift bottles and other floating objects to study and model the flow of water across the North Pacific. He has long been in touch with beachcombers along the North American Pacific shores looking for items which might aid him in his research. Fully funded scientific studies of the currents in the Pacific Ocean are few and far between, given the large area to be covered and the variability of wind and currents.

"The ocean currents vary so much year to year that any kind of marker in the ocean that tell you how those currents are going in that year is extremely valuable. There is no routine monitoring service so it's kind of serendipity when you find some large number [of releases] at one spot and one time, particularly in winter," Ebbesmeyer commented. "It's the storms and the winds and the average ocean currents that guide the [objects] to their final destination."

Researchers have often used releases of drift bottles to provide data for studying ocean currents and testing mathematical models. Over the years, Ebbesmeyer has developed a rule of thumb for the recovery of objects released into the ocean currents. As the distance of the release site from the shore increases, the number of bottles recovered onshore decreases. For drift bottles or other mass released objects, 50% or more will be recovered when the release is within several miles of the shore. At release distances of hundreds of miles, recovery rates are generally below 10%. Only a few percent are recovered when objects are released 1000 miles or more from a shore. Therefore, it takes a large release to provide useful information on the movement of objects drifting in the open ocean. In drift-bottle studies, large releases have ranged from 21,600 to 148,400 bottles, but generally the releases have been smaller, under 1000 bottles.

In the past several years, Ebbesmeyer's latest research has used a single message-in-a-bottle, floating running shoes, bathtub toys and hockey equipment along with a computer simulation model known as *OSCURS* (Ocean Surface Currents Simulation) to study the effects of wind, wave and currents of the northern Pacific Ocean.

OSCURS has been designed to simulate wind-driven currents at the ocean surface. It uses mathematical equations to predict the movement of water or other objects in the upper layer of the ocean. It does this through the combination of the influence of long-term, large-scale ocean currents and surface currents produced by daily variations in the wind.

A Message in a Bottle

On June 10, 1990, Richard Strickland of the University of Washington School of Oceanography was kayaking in Barkley Sound off Vancouver Island, Canada when he spied a bottle along the beach. Upon retrieving the bottle, he noticed within it papers inscribed with Chinese characters. Not sure of what he had found, he decided to postpone opening the bottle until he had returned to his laboratory. When he finally opened the Chinese rice wine bottle in December of 1991, it contained six leaflets including one appealing for the release of the well-known Chinese dissident Wei Jingsheng.

Apparently, this bottle was one of thousands set adrift from the Chinese coastal islands of Quemoy and Matsu as part of a propaganda effort by groups based in Taiwan. The aim of the campaign was to spread the news to citizens of the People's Republic of China of his arrest and detention. Similar propaganda campaigns aimed toward the mainland have been conducted since the end of World War II. It is believed that this series of bottles was released in 1980, most likely in the summer when ocean and wind currents were more favourable for drift to the intended target.

The recovery of the Wei bottle sparked the interest of Curtis Ebbesmeyer. Ebbesmeyer and a team of scientists sought to determine how this bottle may have travelled from its release point off the Chinese coast across the Pacific Ocean to Vancouver Island. First, they had to determine when it may have been tossed into the sea. The content of the messages in the bottle indicated that it could not have been released earlier than October 1979 when Wei was arrested. Allowing time for printing and preparation, 1980 was a more likely time. Favourable winds in the summer which blow toward the mainland would reduce the number of bottles lost to the open ocean. Thus the researchers assumed a summer 1980 release.

Because the *OSCURS* model does not simulate the ocean currents near the Chinese mainland coast, Ebbesmeyer had to estimate the initial movement of the bottle before it reached the open ocean. If the bottle reached the Pacific Ocean south of Japan and was then transported eastward across the Pacific Ocean by the Kuroshio Current (the Pacific counterpart of the Atlantic Ocean's Gulf Stream), it could have reached Vancouver Island in 2 to 3 years. There, it may have travelled around the island for many years before being spotted by Strickland.

An alternate path would have placed the bottle in the general North Pacific circulation gyre, the steady, general flow of current from Japan eastward across the north Pacific by way of Alaska to North America. The gyre then flows southward down the American coast, turns westward to again cross the Pacific before reaching the Asia coast where it turns northward to repeat the circuit. If the bottle was caught in this gyre, it could travel for approximately four and a half years before completing one circuit. Thus, bottle may have been caught in this pathway for one or two circuits of the Pacific before breaking free and eventually reaching Vancouver Island.

One bottle and an unknown release date make interesting detective work but do little for advancing science. Ebbesmeyer requires larger object finds with more exact information on release place and time to verify the mathematical models. Ebbesmeyer and colleague James Ingraham, Jr. of the National Oceanic and Atmospheric Administration (NOAA) in Seattle, Washington have used marine shipping incidents which dumped a large number of objects into North Pacific waters to test *OSCURS* and other models.

The Great Pacific Running Shoe Ultra-Marathon

In late May of 1990, the container vessel *Hansa Carrier* encountered a severe storm in the north Pacific Ocean (~48°N, 161°W) on its passage from Korea to the United States. During the storm, a large wave washed twenty-one shipping containers overboard. Five of these 20-metre containers held a shipment of approximately 80,000 Nike shoes ranging from children's shoes to large hiking boots. It has been estimated that four of the five containers opened into the stormy waters, releasing over 60,000 shoes into the north Pacific Ocean.

The following winter, hundreds of these shoes washed ashore on the beaches of the Queen Charlotte Islands, western Vancouver Island, Washington and Oregon. With the help of beachcombers from British Columbia, Washington and Oregon, Ebbesmeyer was able to determine that hundreds of shoes were recovered. When Oregon newspapers began running the story, the Associated Press picked it up, and the word spread. The publicity resulted in many additional reports of the finding of Nike shoes on Pacific beaches. Dubious about some of the reported finds, Ebbesmeyer decided to confine his study to only those shoes found in groups of 100 or more. Even with this restriction, he accounted for approximately 1300 shoes from the more than 60,000 released.

Despite a year in the ocean, much of the footwear was in fine shape and wearable after a washing. Unfortunately, the shoes were not tied to one another so that matching pairs did not always reach the beach together. Each shoe, however, had an identifying serial number, and with information obtained from the manufacturer, Ebbesmeyer was able to determine that the shoes were indeed from the *Hansa Carrier*.

The accident turned into a scientific gold mine. With information on the locations where the shoes were found, Ebbesmeyer and Ingraham were able to use the spill to test and calibrate their ocean current model. In the past when researchers have released a multitude of drift bottles to provide data for testing models, only about one or two percent of the drift bottles are typically recovered. Thus, the accidental release of approximately 61,000 shoes and the recovery of approximately 1600 shoes (2.6%) provided data as good as any pre-planned study.

Ebbesmeyer and Ingraham used the *OSCURS* model to determine where and how the shoes may have drifted after the containers were swept overboard. The model suggested that the main landfall would have been around the northern tip of Vancouver Island and the central coast of British Columbia approximately 249 days after the spill. The first reports of shoe landfall came from Vancouver Island and Washington approximately 220 days after the spill. A large number of shoes were recovered in the Queen Charlotte Islands and northern Oregon suggesting that when the shoes neared the North American coast, some were diverted north and others south by coastal currents.

In the summer of 1992, shoes were reported arriving at the northern end of the Island of Hawaii. After reaching North America, these shoes may have continued southward along the California coast and then been pushed off the coast by currents moving westward to Hawaii.

Have You Seen My Rubber Ducky?

Ebbesmeyer's next serendipitous study of the ocean currents in the North Pacific came in late 1992 when a large number of brightly coloured bathtub toys were reported on the beaches near Sitka, Alaska. These toys had been part of a shipment of containers headed from Hong Kong to Tacoma, Washington. In January, 1992, the container ship carrying the toys among its cargo encountered severe storm conditions near the International Date Line (44.7°N, 178.1°E). Twelve containers went overboard as the ship rolled about 40 degrees in the heavy seas. One of these 20-metre containers held a shipment of 29,000 bathtub toys.

"They're toys for two-year olds, and they're called *Floatees*, and they're meant to go into the bathtub with the kids," recounts Ebbesmeyer. "Each package has a green frog and a blue turtle and a yellow duck and a red beaver."

When the container emptied the toys into the ocean, they were packed in a plastic housing glued to a cardboard backing. After about a day in the water, the glue deteriorated releasing the four toys into the sea. And, being floating toys, they began to float pushed by wind, wave and currents across the Pacific.

The first landfall of these toys was reported on November 16, 1992. There on the beach of Baranof Island just south of Sitka, Alaska, six toys were found. A few days later, another 20 were found north of the initial site. A further 400 toys were discovered by beachcombers between November 1992 and August 1993 long an 850-kilometre stretch of shore between the city of Cordova, Alaska and Coronation Island in the southeastern Gulf of Alaska.

Ebbesmeyer expanded the search for the toys in newsletter articles and notices to lighthouse keepers and beachcombers on the Queen Charlotte Islands, Vancouver Island and in Washington

State. No landfall of toys was reported south of Coronation Island, so Ebbesmeyer assumes most drifted north after reaching the Sitka region.

Ebbesmeyer and Ingraham again used the *OSCURS* model to simulate the drift of the toys. They pinpointed the release time and location with the help of the vessel's log book. The wind speed and direction were derived from information provided by the U.S. Navy's Fleet Numerical Oceanography Center. They refined the model calculations by adjusting the Gulf of Alaska section of the model to agree with the movement of a satellite-tracked drifter released in 1978. They tuned the model to account for the effects of wind on the floating toys. This allowed the model to more accurately predict the toys' first reported landfall. In earlier simulations without this adjustment, the toys would not have reached the Alaska coast by mid-November 1992 but would have taken an extra six months to reach the North American shore, likely further south of the actual landfall.

Ebbesmeyer and Ingraham calculated a number of possible drift trajectories of the toys for the next two years. Some took the flotilla of toys southward to the vicinity of Hawaii. The most likely trajectories, however, took them into the Gulf of Alaska gyre moving westward along the Alaskan coast toward the Bering Sea.

And what of the future for this colourful plastic navy? Ebbesmeyer's calculations suggest that by January of 1994, they should have arrived in the southeastern Bering Sea. Some of the toys would likely be transported into the Bering Sea and then northward through the Bering Strait into the Arctic Ocean. Others may turn south toward eastern Asia and be caught in the Kuroshio Current perhaps eventually heading to Hawaii.

After five years or so in the Arctic Ocean and ice, the northern flotilla is predicted to emerge into the North Atlantic Ocean destined for the beaches of Greenland, Iceland, Norway, Ireland and Great Britain. While Ebbesmeyer and colleagues look for other information to improve their ocean models, they eagerly await the reports in the year 2000, an invasion of yellow ducks and red beavers and green frogs and blue turtles hitting the beaches of Europe.

Ebbesmeyer sees such accidents as fortunate events for the study and modelling of ocean currents and surface drifting. More information is needed to study the flow of surface waters in the world's oceans. In addition, seasonal current variations or variations during El Niño episodes are poorly understood. By improving the mathematical models which predict the motion of objects in ocean currents and waves, the movement of oil spills and missing vessels or people can be better predicted. This would greatly facilitate clean-up or rescue by determining the path to be followed by a floating object.

Ebbesmeyer and other oceanographers eagerly await the next oceanic escape of rubber ducks or shoes or.... If you live on the coast of one of the oceans or other large water bodies, have a beachcomber's eye for any large deposits of commercial items. They may become part of the next great ocean experiment.

Alaska Science Forum

September 2, 1992

If the Shoe Fits Article #1099

by Carla Helfferich

This article is provided as a public service by the Geophysical Institute, University of Alaska Fairbanks, in cooperation with the UAF research community. Carla Helfferich is a science writer at the Institute.

Oceanographers are opportunists, and they admit it. For example, their reports often credit a "ship of opportunity" as a research platform. The term appropriately describes a suitable vessel slated to be in the right place at the right time (and with an owner willing) to serve some oceanographer's purpose.

Opportunity may even drive science, as shown by the work of Seattle-based researchers Curtis Ebbesmeyer and W. James Ingraham. They have taken advantage of a unique spill of opportunity---the world's greatest inadvertent launch of shoes.

In spring 1990, the container vessel Hansa Carrier encountered some rotten weather as she chugged westward across the North Pacific. On May 27, storm waves swept 21 containers from her decks. Five of those 40-foot containers held a shipment of Nikes---shoes for running, hiking, jogging; for men, women, children. Forty thousand pairs of shoes hit the sea at once.

No one knows how many of those shoes sank with their containers and how many broke free and floated away. But, since the shoes were not fastened into pairs, an oceanographer's best-case scenario offered 80,000 current tracers set loose in the Pacific at 48 degrees north latitude, 161 degrees west longitude.

By the end of 1990, beachcombers reported hundreds of shoes arriving on the Washington shore. By May 1991, a Seattle newspaper claimed thousands of shoes had landed along the coast. The oceanographers set about recruiting field workers of opportunity---the beachcombers who were gathering shoes and arranging swap meets to find mates for still-wearable if well-soaked Nikes.

Their most enthusiastic recruit was Oregon artist Steve McLeod, who quickly became chief shoe scout. Ebbesmeyer and Ingraham credit McLeod's contacts for providing about half their data. The other half came from what they describe as "media-spurred reports." Reporters found the project irresistible, and the Associated Press picked up the story and disseminated it widely. Not just any stranded Nike made an acceptable data point. Since there are many reasons for a shoe to be found at sea, the oceanographers limited their study to verified flotillas of washed-up shoes. They officially recorded only reports of a hundred or so Nikes found together at a time.

With those limitations, the oceanographers accepted only 1300 shoes as genuine current tracers from the shoe spill. This approximately 1.6 percent return would certainly seem paltry to the Nike company, or to its insurers, but is quite respectable in comparison with returns from more customary releases. For example, drift bottles tossed overboard at Ocean Station Papa (a point that the seaborne shoes would have passed on their way to North America) provided recoveries no higher than 6.2 percent and usually closer to 2 percent.

Although Alaska's Cold Bay was probably the town closest to the spill, no shoes headed there. Going with the flow, the shoes rode eastward in the current, diverging north and south only when they came close to North America. Nikes from the spill reached Canada's Vancouver Island by January 1991, and on March 26 of that year 250 shoes were found in the Queen Charlotte Islands. Apparently the Nikes were bound our way, but Ebbesmeyer and Ingraham reported no group of at least 100 shoes stranded on Alaska's coastline.

Probably the shoes sailed on by, held well offshore in the Alaska Current. Still, it's worth keeping watch. Apparently some shoes are still floating along in the circling waters. As Ebbesmeyer and Ingraham were readying their shoe-spill article for publication, they got word that more Nikes had turned up---on the north shore of the Big Island of Hawaii.

American Institute of Physics web site.

(On the website you can listen to a recording of this script.)

Rubber Ducks Go Swimming

(SFX: storm noises)

THE STORM WAS ROUGH, THE SEAS WERE HIGH, AND THE TANKER GOT TOSSED AROUND AS IT CROSSED THE PACIFIC OCEAN. SUDDENLY, 12 LARGE CONTAINERS OF PRECIOUS CARGO SWEPT OVERBOARD. TWENTY-NINE THOUSAND RUBBER TOYS FLIPPED INTO THE SEA, (SFX: Ernie's rubber duckie song) SET FREE TO RIDE THE WAVES AROUND THE WORLD.

Ebbesmeyer: "They're nice little critters, they're green frogs, little blue turtles, red beavers and yellow ducks. they're made to float in the bathtub."

OCEANOGRAPHER CURTIS EBBESMEYER SAYS THIS TIME THE TOYS GOT A MUCH TOUGHER RIDE--SOME SAILED OVER TO JAPAN, OTHERS TO ALASKA, AND ELSEWHERE ALONG AMERICA'S WEST COAST. EBBESMEYER, ALONG WITH HIS COLLEAGUE JAMES INGRAHAM HAVE BEEN RECORDING WHERE THE LITTLE TOYS FINALLY HIT THE SHORE IN AN EFFORT TO TRACK THEIR PATH AND, THEREFORE, THE OCEAN CURRENTS IN THE PACIFIC.

Ebbesmeyer: "They fell overboard about January 10th, 1992, and about Thanksgiving of 92, they started showing up at Sitka, Alaska and beachcombers were finding them by the hundreds and putting them in their hottubs and having all kinds of fun with them."

EBBESMEYER SAYS THAT EVERY WEEK HE HEARS FROM PEOPLE WHO'VE SPOTTED ANOTHER YELLOW DUCK OR GREEN FROG LYING ON THE BEACH, AND BY COMBINING THAT INFORMATION WITH COMPUTER MODELS, HE AND JIM INGRAHAM MAPPED OUT THE TOYS PATH. THE TOYS ARE HEADING UP INTO THE BERING SEA--WHICH ISN'T GOOD NEWS SINCE IT MEANS THAT THE TOYS OR OTHER PLASTIC DEBRIS THAT GETS DUMPED INTO THE PACIFIC COULD END UP TRAPPED IN THE ARCTIC OCEAN. SUCH INFORMATION ABOUT THE CURRENTS SHOULD HELP US CONTAIN OTHER--POSSIBLY MORE DANGEROUS--SPILLS IN THE FUTURE. IF YOU GO TO THE BEACH ON VACATION AND FIND ONEOF THESE TRAVELLING TOYS, HE WANTS TO HEAR FROM YOU. SEND A PHOTOGRAPH OF THE TOY TO: CURTIS EBBESMEYER, EVANS HAMILTON, INC. 731 NORTH NORTHLAKE WAY, SEATTLE, WA, 98103.

How ducks quacked it

Rubber ducks can track ocean currents, says Paul Simons
The Guardian , Thursday November 29, 2001

Millions of toy ducks adorn bathrooms the world over - even the Queen has a collection of them. But now our yellow friends are being recruited to track the world's ocean currents and the vast problem of marine trash.

On January 10, 1992, a container ship en route from Hong Kong to Tacoma, Washington state, hit a storm in the middle of the Pacific. The cargo containers on deck swayed so violently that a dozen tore free, spilled overboard and at least one burst open. Cargoes fall off vessels every day, except that several months later dozens of toy ducks, as well as blue turtles, red beavers, and green frogs washed ashore in southern Alaska.

News of the toys soon reached oceanographers Curt Ebbesmeyer and Jim Ingraham in Seattle, who study how sea currents and winds push flotsam around the globe. They put notices in local newspapers along the north-west coast asking for more sightings, and over the following year received reports of hundreds of the plastic toys along Alaska's coastline.

However, the sightings were useless without knowing when and where the spillage had occurred, and that took considerable detective work. "Container shippers are reluctant to talk about losses," explains Ebbesmeyer.

"We spent months tracking down the ship's owners, talking to lawyers and executives, telling them we just wanted to know what the ocean was doing."

The owners finally revealed that 29,000 plastic bath toys had been shed about 2,000 miles off the Alaskan coast. This rubber duck armada gave the oceanographers a huge test of their computer models of winds and currents. As predicted, some of the toys steered south and circled the entire north Pacific ocean in just three years, while many more sailed up into the Bering Sea between Alaska and Russia and some made it into the Arctic ocean where they were trapped in ice.

Over the next decade a few survivors are expected to be spat out from there into the north Atlantic and might get washed up on our beaches, more than 9,000 miles from the start of their odyssey. The plastic ducks project was rare but not unique.

Over the years, Ebbesmeyer and Ingraham have chalked up some impressive investigations tracking 100,000 toy cars and balloons, 34,000 hockey gloves, 5m Lego pieces and 61,000 Nike trainers (these floated for years but were still wearable once they were cleaned up). Their all-time record distance was a second world war life jacket, tracked from Australia to France; they have also been amazed at how fast trash can drift, up to 25 miles per day. Fascinating as these projects are, they also have a darker side.

"Very little transoceanic trash has actually been documented, so these studies provide clear evidence that plastic blows across all the world's seas," Ebbesmeyer says.

Floating junk is reaching crisis proportions. Some 10,000 containers are accidentally lost overboard every year, adding to the rubbish deliberately dumped: at least 4.8m metal, 450,000 plastic and 300,000 glass containers thrown into the sea every day. Fishing nets, fishing lines, plastic bags, plastic sheeting, bottles, gallon drums are just the tip of a vast floating rubbish heap.

The rubbish is washed up on beaches, and much of it survives in the sea and coasts for decades. All of which spells disaster for wildlife, and ultimately us. Around one million birds and 100,000 marine mammals and sea turtles die every year from getting tangled up or eating plastics. Plastic trash does not degrade but simply becomes ground down into ever smaller particles that become eaten by plankton and so on through the food chain until eventually we consume it. The lesson of the seas is that what goes round, comes round.

Amateurs play a crucial part by sending in beachcombing reports from all over the world, although they need to hear more from Britain. "I think a lot of Pacific debris washes to your shores, but beachcombers have not yet learned to recognise it yet," explains Ebbesmeyer. At present, they want news of the plastic bath toys (stamped with the logo "The First Years"), Nikes with serial numbers beginning "90", sandals with a colourful lightning bolt through the sole, and messages in bottles.