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OCEAN explorer

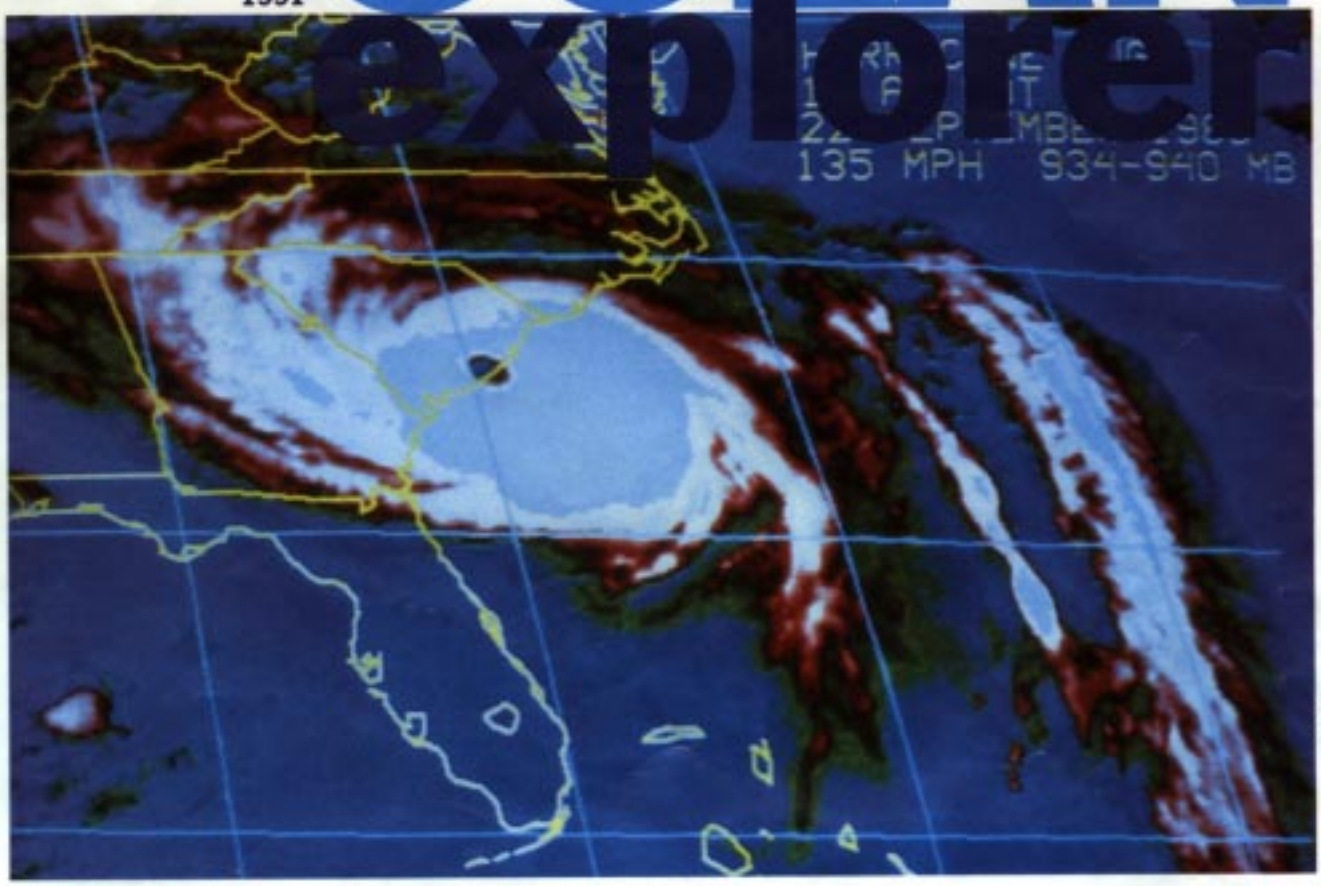


Photo courtesy NOAA

DEVIL STORMS *An Inside Guide to Hurricanes*

On a balmy September afternoon along the west coast of Africa a breeze stirs—the first breath of a monstrous blow that will churn Atlantic waters as it rises and twists in the deadly cyclone pattern of a hurricane.

The conditions are right: the water is warm—80° F (26.5° C) or more. The air is humid. Thunderstorms form over the ocean, and are blown westward by trade winds.

As they travel, the storms group together, forming one massive system that now spins counterclockwise under its own power, at speeds of up to 225 mph (362 kph). This spin is caused by the Coriolis effect, the normal spinning of water between the equator and the earth's poles. *(see "Devil Storm," p. 4)*

PATRICIA WYNNE

In a Big Blow Where Do Whales Go? (see page 7)

"I Was In Hurricane Hugo" A Teen Tells Her Tale (see page 2)

Eugenia Leath of Charleston, SC.

"I Was In Hurricane Hugo"

Eugenia Leath, 14, of Charleston, South Carolina experienced Hurricane Hugo firsthand.

When Hugo hit, I was 12. My parents were away on a trip. I was at home with a housekeeper and my sisters Suzanne and Daisy, who were 8 and 16 then.

I never was in a hurricane before, so I had no idea how to get ready. We didn't know what kind of food to buy at the store. We bought cookies and stuff that were all eaten in a few days. If I was ever in a hurricane again, I'd buy better food. And bottled water, too. We couldn't drink our water for days after the storm.

Our house is right near the ocean. So we went to stay with some friends that lived a few blocks away. We slept in a room on the top floor of the house. As we got into our beds, the hurricane was getting much closer. It sounded like really loud wind—like a storm, but bigger. We kept the radio on and tried to sleep. Right after midnight, all the windows burst in our faces! It was so scary! We didn't know what to do. So we huddled in the corner in our sleeping bags.

When the eye of the storm came overhead, we went out onto the porch. It was so still, it was eerie. Then we went back inside and fell asleep.

The next day, we went back to our house. The water in the front yard was up to my thighs. All the trees were knocked down. The house wasn't damaged too badly, though there was a flood on one floor that ruined lots of stuff.

Water stood in the yard for two or three days. The house dried out fairly fast, but it smelled so bad! It smelled like rotten food in the refrigerator!

Things took a while to get back to normal. It took a week and a half to get regular food. We were just eating the grossest things. It took three days to get the water back, and two weeks to get the electricity back.

I remember the hurricane when I go to the beach, because I still see a lot of dead trees there. When I go out on the highway, I can still see wrecked shacks, with no people living in them. Those people lost their homes. The hurricane was much harder on poor people than on anyone else.

Photo courtesy NOAA

GEOLOGY AND BIOLOGY

Can a Hurricane Change an Island?

Hurricanes put their imprint on a landscape," says Dr. Graham Giese of Woods Hole Oceanographic Institution, a geologist who has studied coastlines for many years. "In the tropics, only very small adjustments are made in between one hurricane and the next." After Hugo struck in 1989, Graham travelled to the Caribbean island of St. Croix with Dr. David Burdick, now a biologist at the University of New Hampshire.

They wanted to find out how a hurricane changes a beach's shape, and how it changes the kinds of plants that grow there. They studied a beach without any buildings, so they could see nature at work.

Graham and Dave taught each other a lot. "Different parts of nature work together to produce the world around us in ways that aren't immediately obvious," says Graham. Dave showed Graham how beach plants can trap sediments and form the beginnings of new dunes. Graham showed Dave how huge hunks of coastline can move towards land during a hurricane, changing the types of plants that grow in a given spot.

Hugo had built an entirely new coastal system as beaches and dunes moved landward. Sand from the open ocean moved to the beaches. The beaches had retreated to the dunes. The dunes had retreated to the mangrove swamps that lay behind them.

Though this area was changed, it would recover. Nearby, where dunes had been carted away and buildings built, the damage was much greater. Recovery there would be much more difficult, as well.

When a palm tree falls over in a hurricane, sand and sediment trapped in its roots may start a new dune.

METEOROLOGY

Riders on the Storm

Scientists get into Hurricanes

"What I'd like more than anything," figures Jim Edson, who works as a marine meteorologist at Woods Hole Oceanographic Institution, "would be to be able to take wind speed readings while standing on a fixed platform in the middle of the ocean —right in the path of a hurricane."

Up to now, most research on hurricanes in progress has been done from specially-equipped airplanes. "The airplanes we use are flying laboratories," explains Mark Powell. He works in the Hurricane Research Division of The National Oceanic and Atmospheric Administration (NOAA), which has two airplanes to use in hurricanes. "We fly right through the storm, trying to understand its structure." By using onboard computers to collect readings, Mark and others on the plane are able to send information by satellite link to the National Hurricane Center in Miami.

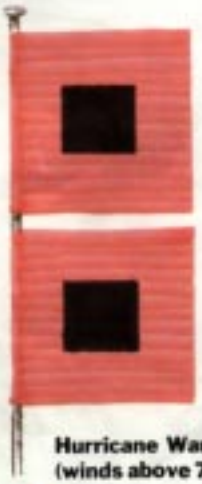
"We now have instruments that allow us to remotely sense winds near the surface. Before, we had to fly very close to the water, which was a lot more risky," says Mark. Knowing the speed of a hurricane wind at the water's surface can help scientists predict the path of a storm surge—a gradually rising mound of water that can cover several miles of coastline with water depths as high as 25 feet.

Which brings us back out to the open ocean, to the fixed platform Jim Edson hopes he'll stand on one day. From air, land and sea, scientists are working hard to find ways to save lives and reduce damage caused by hurricanes.

Small Craft Warning (winds 25 to 38 mph)

Gale Warning (winds 39-54 mph)

Storm Warning (winds 55-73 mph)



Hurricane Warning (winds above 74 mph)

DEVIL STORM: An Inside Guide to Hurricanes

This cutaway view of a hurricane shows the huge storm's raging power

At the hurricane's center is its eye, a low-pressure area where the wind may blow no more than 15 mph (about 25 kph).

The hurricane's eye sucks up water vapor from the ocean surface, making the energy that the storm needs to continue. Around the eye is the eyewall, beneath which the strongest gusts are found—about 225 mph (362 kph). The worst rainstorms of the hurricane are also found just outside its eye.

As long as a hurricane travels over warm water, it will tend to survive. If it reaches land, the hurricane's winds might create a storm surge, a gradually-rising mound of water that

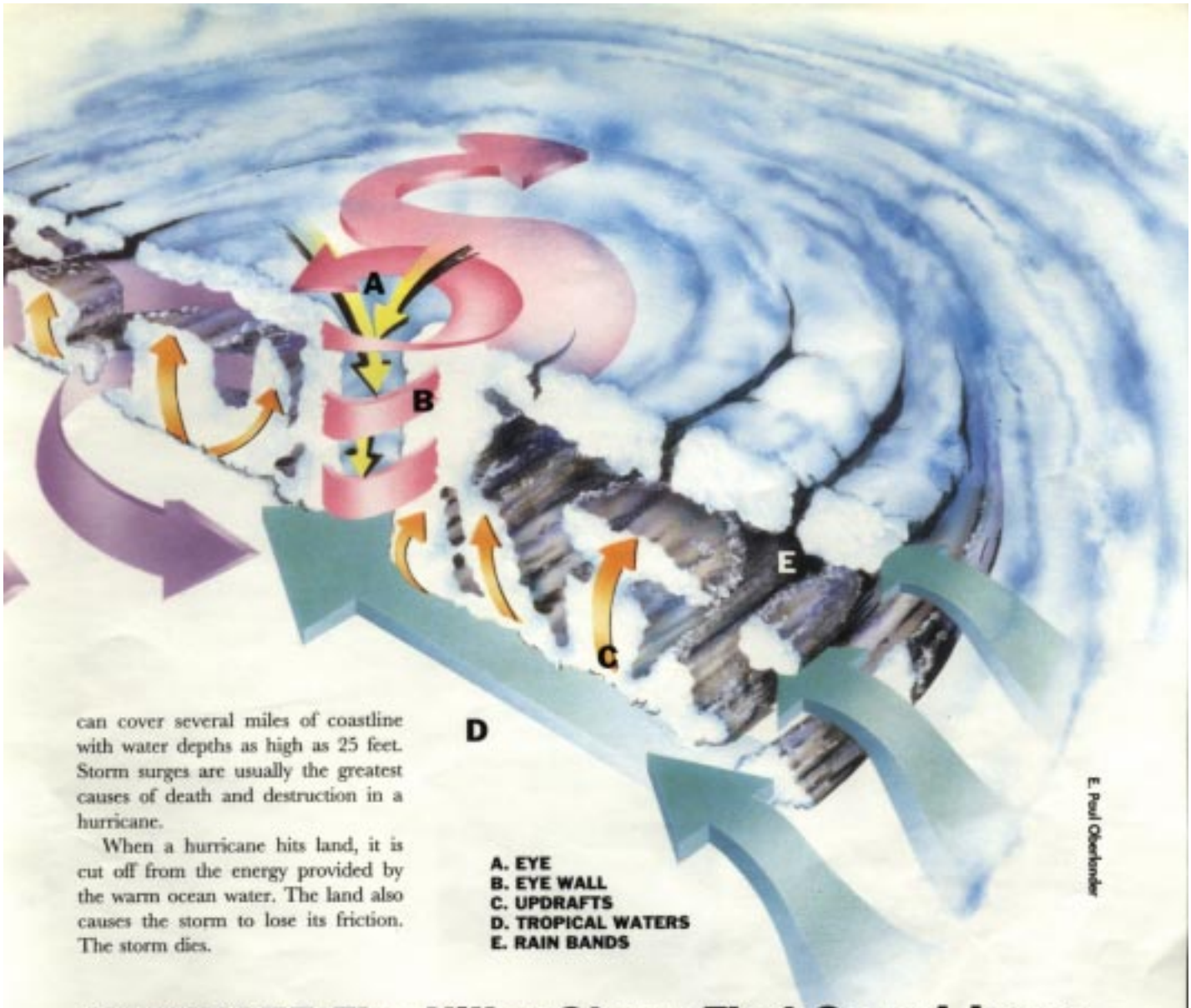
Storm Seeker

The Hercules transport plane show below is one type of plane used for hurricane research.

Seventy-five percent of the ten-hour flight is usually not too different from flying on a regular plane, says meterologist Mark Powell. But when the plane flies its figure-4 pattern close to the ring of thunderstorms around the hurricane's eye, things get a little more . . . difficult.

"My stomach doesn't usually do too well on hurricane flights," Mark admits. But once he gets busy taking readings, he doesn't have much chance to think about it.

E. Paul Oberlander



A. EYE
B. EYE WALL
C. UPDRAFTS
D. TROPICAL WATERS
E. RAIN BANDS

E. Paul Oberlander

can cover several miles of coastline with water depths as high as 25 feet. Storm surges are usually the greatest causes of death and destruction in a hurricane.

When a hurricane hits land, it is cut off from the energy provided by the warm ocean water. The land also causes the storm to lose its friction. The storm dies.

KAMIKAZE: The Killer Storm That Saved Japan

In 1281, a sea storm swallowed the forces of Kublai Khan, bent on the conquest of Japan.

Violent weather has changed history. In 1274 and 1281, typhoons spared Japan from conquest by Kublai Khan, leader of China's Mongol hordes. With his force of 900 ships and 40,000 troops, he attacked Japan at Hakata Bay. The warriors retreated to their ships for the night as a fierce storm brewed. The Mongols put out to sea, only to lose 200 ships and 13,500 soldiers in the ensuing typhoon, called *Kamikaze*—"Divine Wind" by the Japanese.

Khan's forces returned in 1281. This time, they found a high wall had been built where they had planned to attack. They headed for another site. The Emperor of Japan and other high officials prayed for divine help in defeating their enemies.

Unbelievably, a second *Kamikaze* struck, this time sinking 4,000 ships and drowning over 100,000 sailors. Kublai Khan never attacked Japan again.

Letter From The Sea

ENGINEERING

Neil McPhee is an Electronic Technician in the Upper Ocean Process Group of Woods Hole Oceanographic Institution's Department of Applied Physics and Ocean Engineering. He went to sea last summer on the research ship Oceanus, *as a part of a group placing weather-measuring buoys at five different spots in the ocean. (see map, below). While at sea, Neil wrote a letter to* Ocean Explorer. *Here is part of that letter.*

E. Paul Oberlander

We've cruised thousands of miles over the last few weeks, placing buoys that will help us learn about the interaction between air and the sea. The buoys will also help us learn about what happens when the upper and interior layers of ocean water mix together.

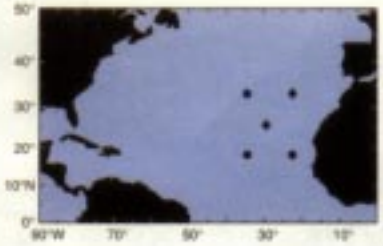
Placing a buoy in the open ocean can be tricky. When we arrive at a spot where we plan to anchor a buoy, we first survey the sea floor to find the best place to drop the buoy's anchor. Then we attach the first section of cable and chain to the buoy. We lift the buoy over the side and release it clear of the ship. For about the next eight hours, lengths of cable and rope (the mooring) are unreeled, and instruments that will take measurements beneath the surface are installed. All this time, the ship is "steaming" slowly at a couple of knots.

The buoy is attached to the mooring by a cable. As the cable unreels, the mooring is left further and further behind the ship until it is just a dot on the horizon.

Finally, we attach an eight thousand pound anchor to the end of the buoy's cable. It takes over a half hour for this anchor to fall three miles to the ocean floor.

After everything settles out, we make sure the buoy's instruments are working by "listening" to the radio signals sent from the buoy to the Argos satellites. These satellites will send us readings from the buoys when we get back to Woods Hole.

We had a good trip. Not everything went as planned, but the challenge of changing and fixing things at sea is what makes oceanography so special.



PATRICIA WYNNE

To Find Out More About Hurricanes

Books

Brindze, Ruth. *Hurricanes: Monster Storms From the Sea.* NY: Atheneum, 1973.

Cosgrove, Brian. *Eyewitness Books: Weather.* NY: Alfred A. Knopf, 1991.

Hebert, Paul J. and Case, Robert A. *The Deadliest, Costliest, and Most Intense United States Hurricanes of this Century and Other Frequently-Requested Hurricane Facts.* Springfield, VA: National Technical Information Service, 5285 Port Royal Road, Springfield VA 22151. Price: $2.75 a copy. Ask for book by title, and add March, 1990 and NEW NHC 31.

Magazines

"Kublai Khan's Lost Fleet," *National Geographic*, Nov. 1982.

"Hurricane!" by Ben Funk, *National Geographic*, Sept. 1980.

Free Books and Pamphlets

(write to: NOAA Weather Service, National Hurricane Ctr., 1320 South Dixie Highway Rm 631 Coral Gables, FL 33146)

STORM SURGE AND HURRICANE SAFETY (with North Atlantic Tracking Chart)

"HURRICANE!" A Familiarization Booklet

OWLIE SKYWARN'S WEATHER BOOK

NATURAL HAZARD WATCH AND WARNING with safety rules for Tornadoes, Hurricanes, Floods, Flash Floods, Thunderstorms, Lightning, Winter Storms.

MESSAGE IN A BOTTLE

Dear *Ocean Explorer,*

What's the difference between a hurricane, a typhoon, a tornado, and a cyclone?

Ela Stevenson
Edinburgh, Scotland

Dear Ela,

A cyclone is any circulation of wind around a low-pressure center, no matter how big or how strong. Hurricanes, typhoons, and tornadoes are different types of cyclones.

Hurricanes and typhoons are alike, except that hurricanes occur in the Atlantic Ocean and typhoons occur in the Pacific Ocean. Hurricanes and typhoons are big storms—they can be as big as 500 miles (about 800 km) in diameter. Their winds can range in speed from 120 miles (193 km) per hour to over 240 miles (387 km) per hour.

Tornadoes are much smaller than hurricanes. They often form over land. Tornadoes happen when cooler, drier air passes over warm, moist air. Tornadoes and thunderstorms sometimes also travel with hurricanes, creating huge, terrible systems.

Dear *Ocean Explorer,*

How are hurricanes named?

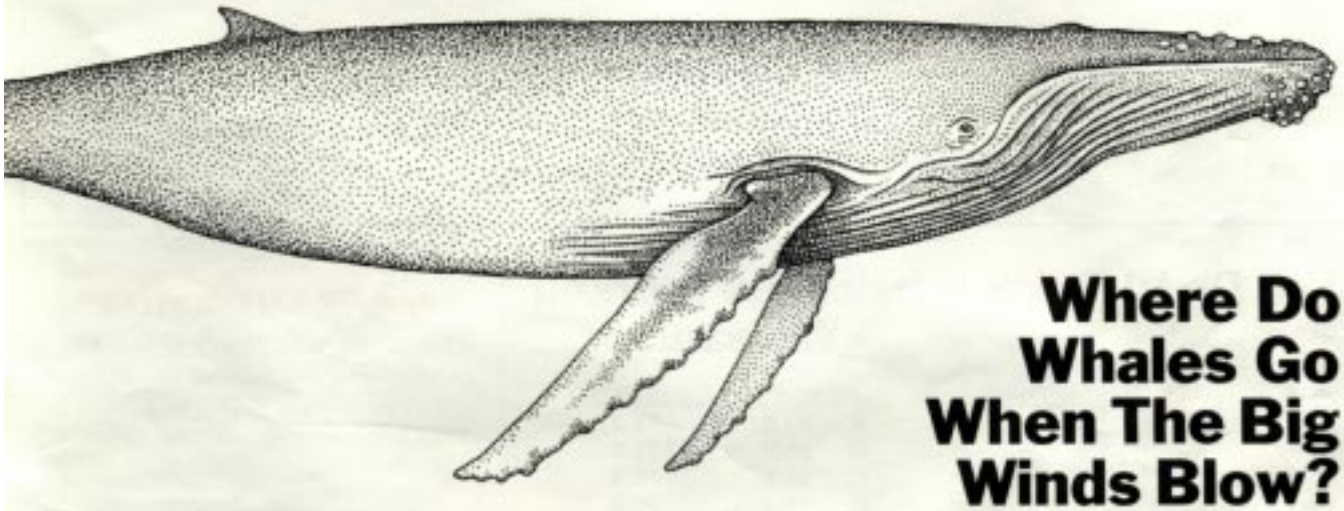
Eddie Lee
Montpelier, VT

Dear Eddie,

If winds from a storm at sea begin to blow more than 39 miles (62 km) per hour in a circular pattern, the storm is named by officials at the National Hurricane Center in Florida.

Here are the names for 1991: Ana, Bob, Claudette, Danny, Erika, Fabian, Grace, Henri, Isabel, Juan, Kate, Larry, Mindy, Nicholas, Odette, Peter, Rose, Sam, Teresa, Victor, Wanda.

SEND QUESTIONS TO: Editor Ocean Explorer, c/o Woods Hole Oceanographic Associates, Woods Hole MA 02534 . . . Thanks to Taylor Baldwin, Marion MA; Ben Gillespie, Westport, MA; Katie Hodgson, New Bedford, MA; and Alex Porcaro, Washington, DC. Each suggested we call the newsletter Ocean Explorer . . .
COMING IN NOVEMBER:
Tales of Arctic and Antarctic.



Where Do Whales Go When The Big Winds Blow?

Bill Watkins, has never been at sea in a hurricane. But the marine biologist, who has studies whales at Woods Hole Oceanographic Institution, has been at sea in force 12 winds (hurricane-force winds of more than 75 mph (120 km) with waves greater than 35 feet (10.8 m) high. What did he notice?

"Whales don't seem harried in any way when the seas get high," says Bill. "They come up and take a breath in the trough between the waves." When the sea is slightly rough, whales seem playful at the surface. "Though Caribbean sperm whales avoid ships and noisy man-made things, they don't seem to move out of the way when a hurricane comes," says Bill. "Their world is a water world."

Bill has seen smaller marine mammals body surfing. Maybe if the waves were hurricane-size, a whale might try a ride.

When the sea is flat calm, the opposite happens. Whales surface quickly to breathe, and drop back down almost instantly. Why? "The surface of flat water is a perfect reflector," says Bill. "As whales come up from underneath, they see themselves reflected exactly. If they make any noise, that noise is reflected back exactly to them." This might frighten them, Bill suggests.

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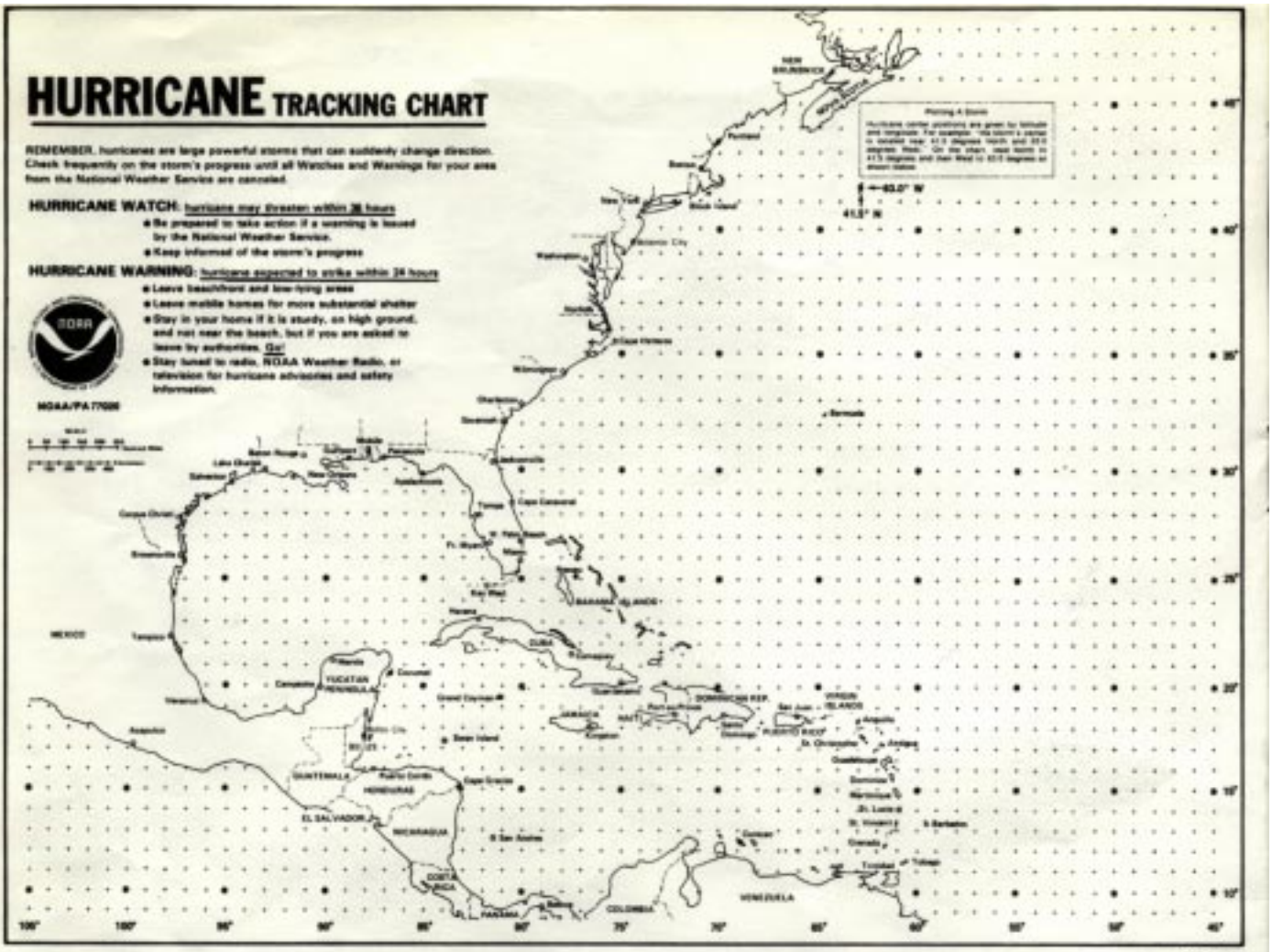

You Do It! Track Hurricanes Yourself

When a hurricane travels through the ocean, those studying it plot its course, to try to predict where it will strike land.

To plot a storm, its center positions are given by latitude and longitude, for example, "The storm's center is near 40.5 degrees North and 67 degrees West".

Make photocopies of this chart. Use one when you hear of a hurricane in progress.

To find out the current location of a hurricane in progress, you may call the Hurricane Hotline at the National Weather Service at (900) 820-6622. The call costs 50 cents for the first minute and 30 cents for each additional minute.

If you want to practice placing coordinates on the chart, plot the course of Hurricane Bob. What islands did it strike? Where did it hit the mainland?

BOB POSITIONS

	Lat. (°N)	Long. (°W)
A.	25.6	74.3
B.	25.7	74.9
C.	25.9	75.4
D.	26.4	75.8
E.	27.1	76.2
F.	27.8	76.5
G.	28.4	76.9
H.	29.0	77.1
I.	29.7	77.0
J.	30.5	76.9
K.	31.5	76.6
L.	33.0	76.1
M.	34.6	75.3
N.	36.5	74.5
O.	38.9	73.0
P.	41.2	71.6
Q.	41.4	71.4
R.	43.8	69.6
S.	45.6	67.6
T.	47.0	65.5
U.	48.4	61.9
V.	49.8	58.3

HURRICANE SAFETY STEPS

When a Hurricane Watch is issued for your area, the National Oceanic and Atmospheric Administration (NOAA) hopes you will take these safety steps:

1. Leave low-lying areas.
2. Moor your boat securely or evacuate it.
3. Protect your windows with boards or tape.
4. Secure outdoor objects or bring them indoors.
5. Fuel your car.
6. Save several days' water supply.
7. Leave mobile homes for more substantial shelter.
8. Know your house's level above sea level.
9. Know the storm surge history for your area.
10. Stay indoors during the hurricane.