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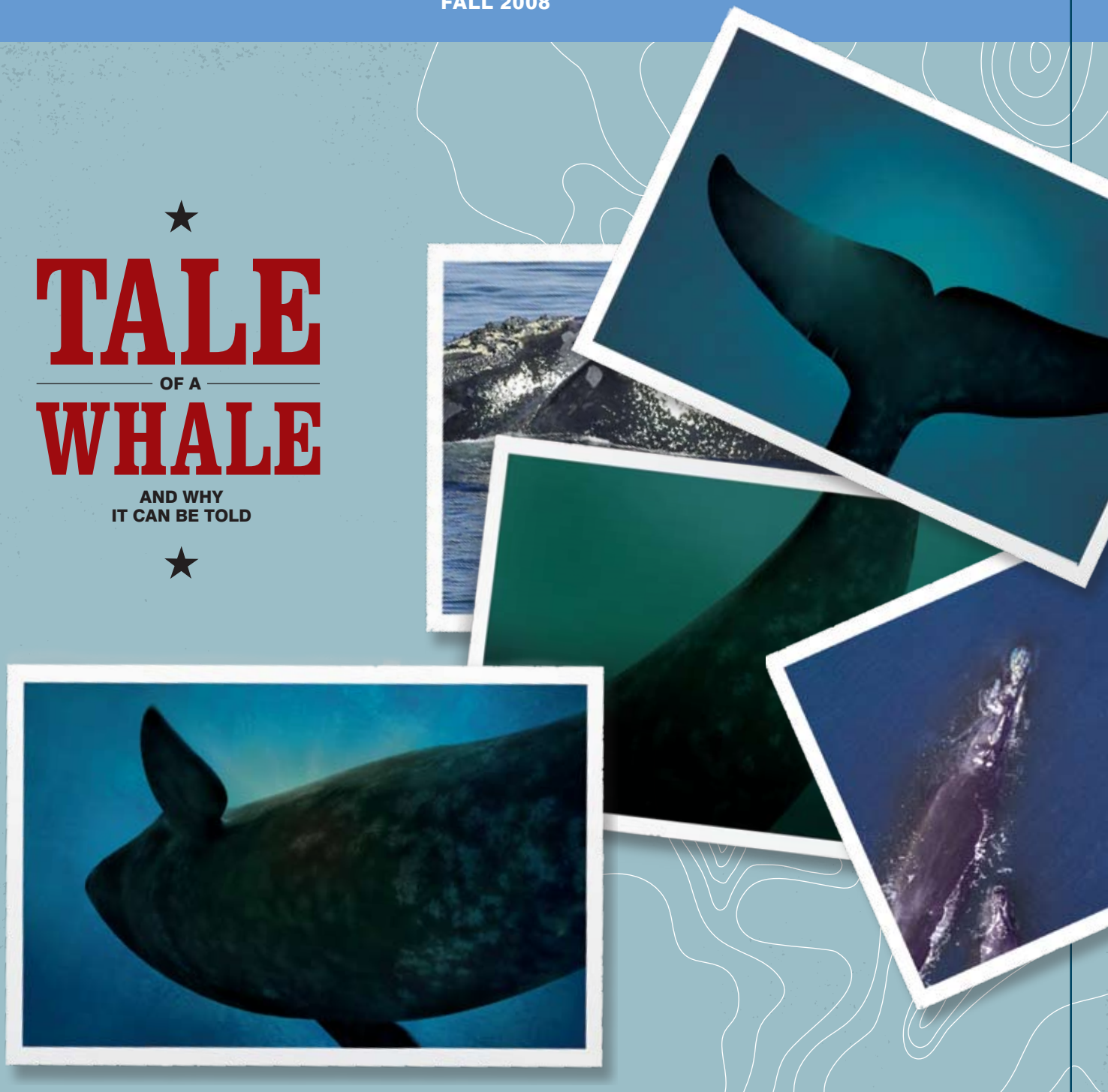
FALL 2008

TALE OF A WHALE

AND WHY
IT CAN BE TOLD



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NATIONAL STANDARDS
The lesson in this issue addresses NAS National Science Content Standards for the characteristics of organisms and NCSS National Social Studies Standards for geography and ecosystems.

STATE STANDARDS
See how the lesson correlates to standards in your state by visiting **smithsonianeducation.org/educators**.

ILLUSTRATIONS
Cover: John Steiner, National Museum of Natural History; Lindsay Hall, New England Aquarium. Inside cover: D. E. Hurlbert, National Museum of Natural History. Page 1: John Steiner (whale model). Page 2: Lindsay Hall. Page 3: Moira Brown, New England Aquarium. Page 4: Karen Carr Studio, Inc. Pages 6–7: New England Aquarium. Page 8: Mary Parrish, National Museum of Natural History. Page 9: Kerry Lagueux, New England Aquarium. Page 12: After a map by Kerry Lagueux, based on data from Scott Kraus and Rosalind Rolland. Back cover: © Feodor Pitcairn Productions, Ltd.

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TALE OF A WHALE

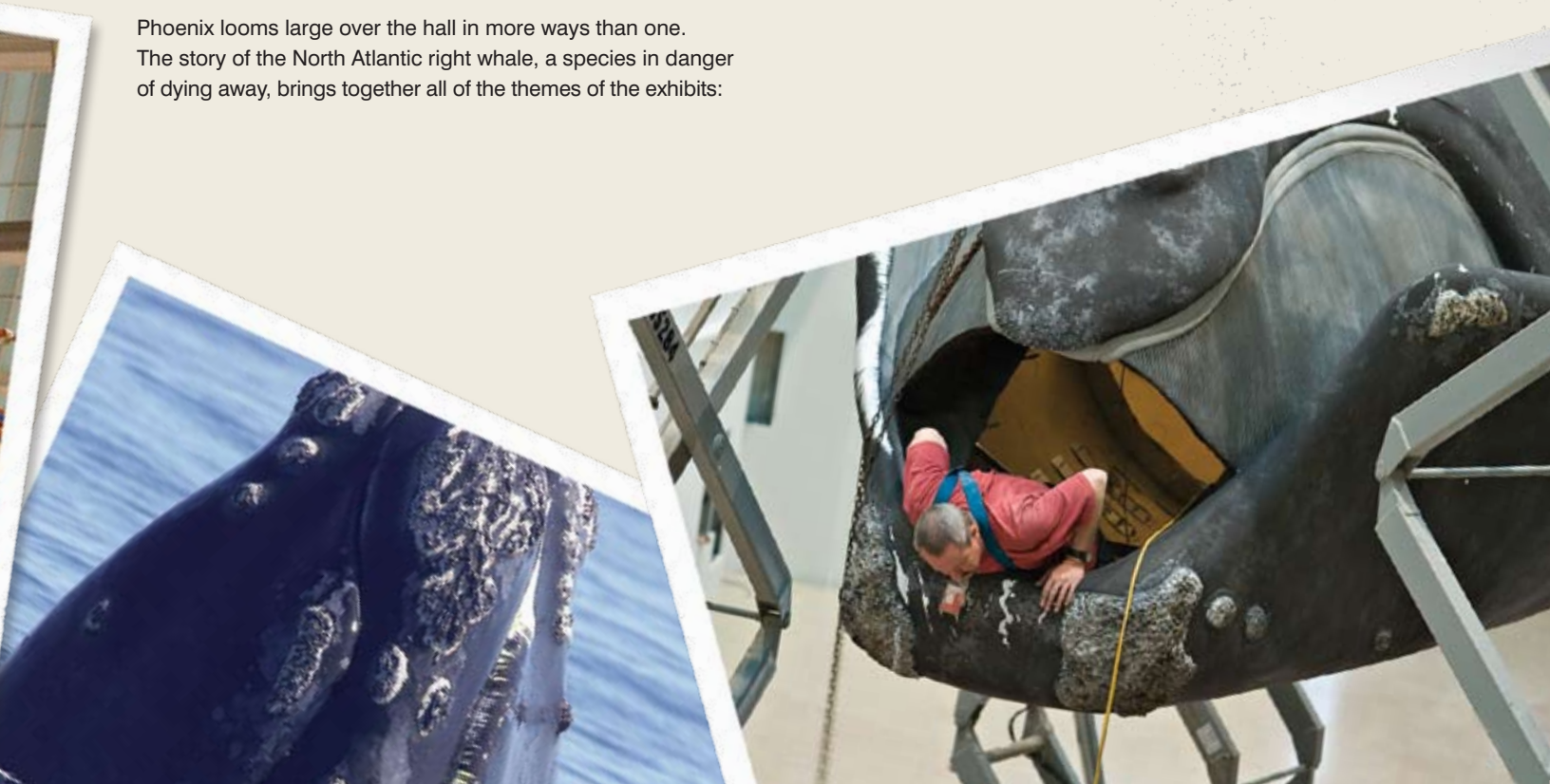
At the center of the new Sant Ocean Hall at the Smithsonian's National Museum of Natural History is a life-sized model of one of the largest creatures that ever lived, the North Atlantic right whale. More than a representation of a species, it is a faithful portrait of an individual whale, a female named Phoenix. Born in 1987, Phoenix is still plying the waters between Florida and Nova Scotia. Like the mythical phoenix, she has risen from an ordeal: in 1997, she became entangled in commercial fishing gear—a common cause of death for right whales—and carried pieces of a heavy line with her for more than a year. She has two scars from the incident, on the lip and the tail, which the model includes in exact detail.

The Smithsonian worked with right whale researchers at Boston's New England Aquarium to create a model that is a physical biography. But how was the biography compiled in the first place? How do you begin to get a handle on a forty-five-foot whale?

Students discover the answers in this issue's lesson. They compare photographs of right whales to find details of individuality. After picking Phoenix out of the lineup, they examine a record of sightings in order to chart her movements along the Eastern Seaboard. By practicing their observation and mapping skills in this way, they do much of the same work as the researchers.

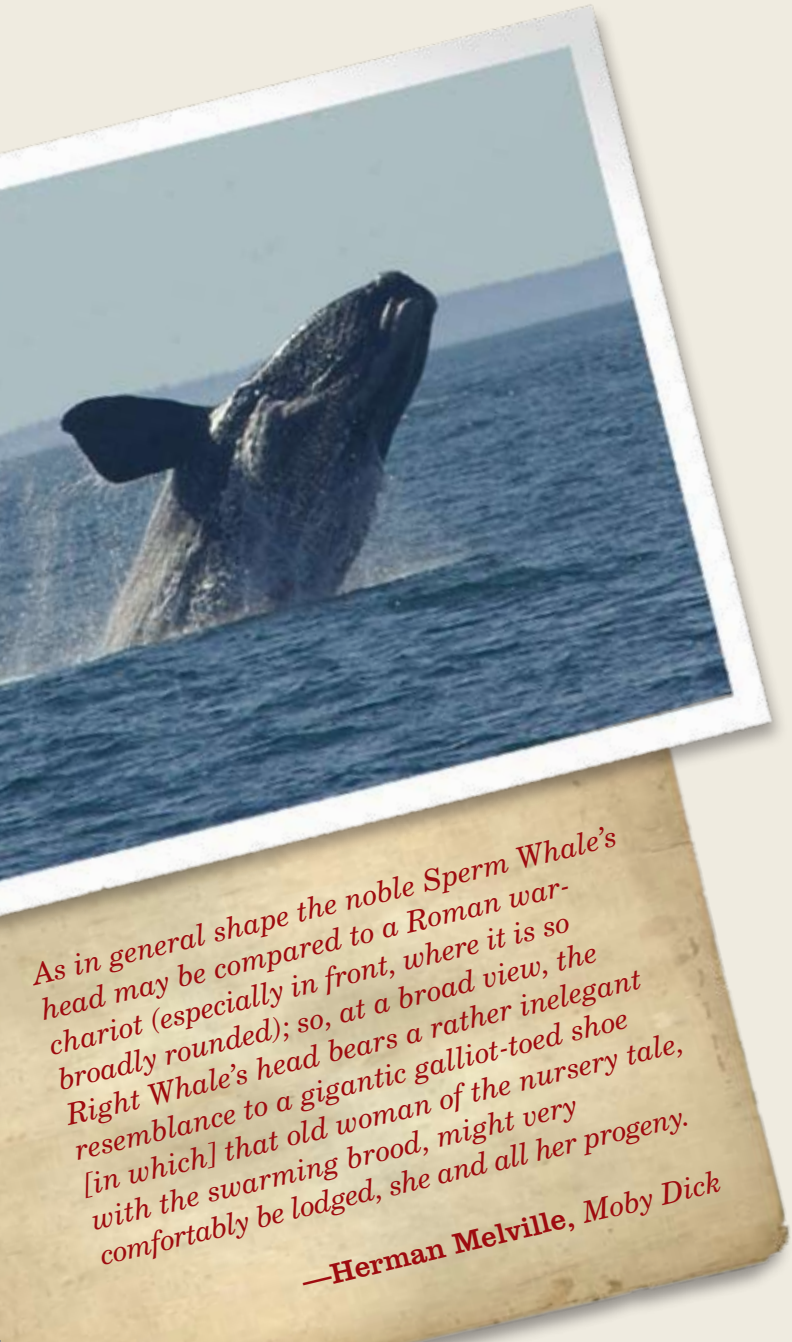
Phoenix looms large over the hall in more ways than one. The story of the North Atlantic right whale, a species in danger of dying away, brings together all of the themes of the exhibits: the ocean's past and its future, the interrelationships of ocean life, and the relationship between the ocean and us. After working on the model, one of the researchers, Marilyn Marx, spotted the real Phoenix out at sea. "Well, there she is, soon to be the most famous right whale around," she thought. "And she's oblivious to the enormous amount of attention that's being focused on her."

If you can't come to see Phoenix at Natural History, you can visit the online version of the exhibits at **ocean.si.edu**.



SNAPSHOTS AND THE BIG PICTURE

Phoenix is officially known as #1705 in the North Atlantic Right Whale Catalog, a database maintained by the New England Aquarium. The four-digit number represents a bit of hopeful thinking about the future. Though an international treaty gave protected status to the world's three species of right whales in 1935, the North Atlantic whales are today on the brink of extinction: there are fewer than four hundred of them.



MAKING A MATCH

The catalog contains nearly half a million photographs of North Atlantic right whales, most from the last thirty years. Researchers identify newly photographed whales by matching the pictures with earlier ones in the catalog. Along with each photo is a record of where and when the whale was sighted. This information allows researchers to track the movements of individual whales, and contributes to a larger understanding of migration patterns, mating habits, and mortality rates.

Glimpsed at sea, the right whale can be distinguished by its lack of a dorsal fin, by the V-shaped spout from its twin blowholes, and by its *callosities*, rough patches of raised tissue on the head. The callosities are what distinguish one individual from another: each whale has a unique pattern of these patches.

When matching photos, the researcher looks for ways to categorize the callosity patterns. The two basic categories are *continuous*, an uninterrupted stretch of callosity along the top of the head, and *broken*, a series of callosity "islands." A system of codes categorizes the arrangement of broken callosities. The code B4, for example, refers to side-by-side symmetrical islands.

The work is made easier by the presence on the callosities of *cyamids*, miniature crab-like crustaceans that are sometimes called "whale lice." These benign parasites have no home other than the callosities of right whales, and a single whale can host thousands of them. The callosities themselves are black, like the rest of the skin, but the cyamids highlight them as bright white or yellow.

A LONG RELATIONSHIP

History has given an irony in the researchers' work: they are trying to get to know a species that, for centuries, we have known all too well. The right whale got its name because it was the "right" whale to hunt. It is a slow swimmer and spends most of its time in easily reached coastal waters. When it dies, its thick layer of fat keeps it floating at the surface.

The fat of one right whale yielded more than a thousand gallons of oil, which was used for lamp fuel, candle tallow, and industrial lubricants. The species had the added value of its *baleen*, or "whalebone," the curtain-like plates through which it strains water from its food. Baleen is composed of keratin, like fingernails. It was ideal for a range of products that required a strong but flexible material: brushes, combs, umbrella ribs, corset stays, skirt hoops, chair caning, carriage springs.

The North Atlantic right whale was the first target of commercial whaling, which began in the Middle Ages in the Bay of Biscay, along the coasts of northern Spain and western France. Basque whalers became so adept at the trade that the species all but disappeared from European coasts, perhaps as early as the sixteenth century. There is evidence that Basque ships crossed the Atlantic in pursuit of the right whale not long after the voyages of Columbus.

New England whaling companies dominated the industry at its height in the early nineteenth century, just before the introduction of petroleum. But by that time the right whale population was nearly depleted from American waters. Whalers were venturing as far as the South Pacific to hunt the deep-water sperm whale, Moby Dick's species, which yielded less oil, though of higher quality.

THE URBAN WHALE

For the sperm whale, it is almost as if whaling never happened: today's population is about 85 percent of the "pre-exploitation" numbers, compared with 4 percent for the three species of right whales. While a right whale of the Southern Hemisphere has begun to rebound, the North Atlantic species has not.

Scientists at the New England Aquarium use the term "urban whale syndrome" when explaining the reasons. The North Atlantic habitat lies within fifty miles of the East Coast of the United States and the Canada Maritimes, waters that are heavily trafficked and heavily fished. About half of the recorded deaths have resulted from collisions with ships or entanglements in fishing gear. Then, too, the whales absorb mercury and other toxins from all of the rivers that flow into the Atlantic, which may be a reason for an extremely low reproduction rate.

The nearness of the right whales to our inland lives became dramatically clear in 1994, when one of them swam forty miles up the Delaware River, past downtown Philadelphia. The year-old, thirty-foot male spent days in the river, long enough to get the nickname "Waldo the Wrong-Way Right Whale" in Philadelphia (which temporarily went by the nickname "City of Blubberly Love"). Aquarium scientists flew to Philadelphia to join in an attempt to guide him back toward Delaware Bay. At one point he stranded himself on the New Jersey banks and the scientists were reduced to throwing rocks at him to urge him into deeper water.

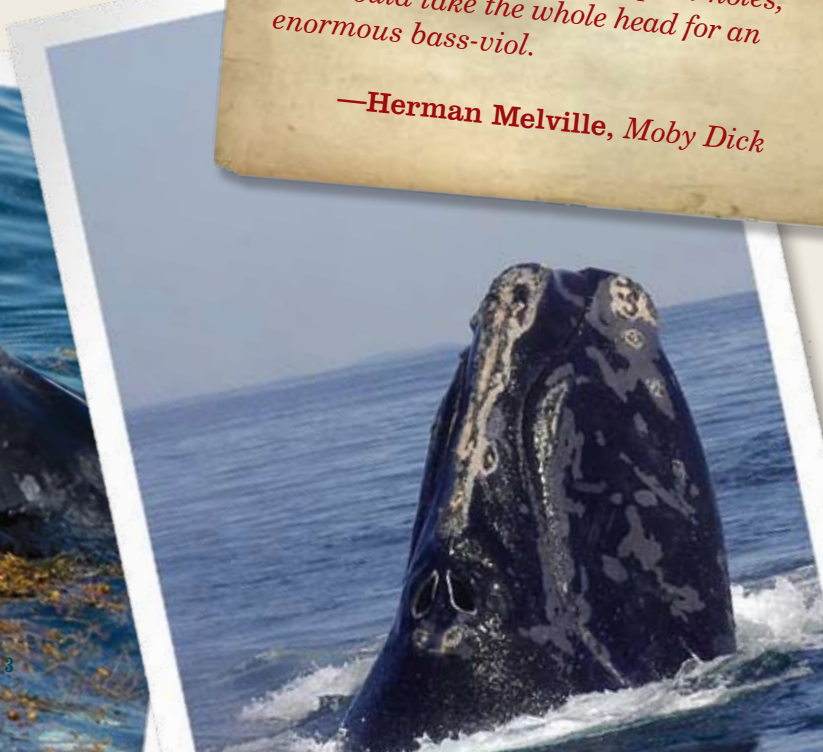
Now named Shackleton, after the Antarctic explorer, the whale returned to the ocean relatively unscathed, but scathed nevertheless. He still carries a scar from a collision with a tugboat.

THE PURPOSE OF THE WORK

Scientists believe that the prevention of two or three accidental deaths each year will make the difference between the decline and growth of the population. Because they can identify the whales' likely locations through the year, they have been able to work cooperatively with government and the shipping and fishing

But as you come nearer to this great head it begins to assume different aspects, according to your point of view. If you stand on its summit and look at these two f-shaped spout-holes, you would take the whole head for an enormous bass-viol.

—**Herman Melville,** *Moby Dick*



BALEEN WHALES

TOOTHED WHALES

industries. In 2000, the U.S. began to require that every ship alert the Coast Guard when it comes into a habitat. More recently, the U.S. and Canadian governments designated three habitats as "areas to be avoided" by ships when the whales are there.

Much remains to be learned about the species, and some mysteries may never be solved. This, perhaps, is what gives the research work its deepest meaning: if the whales pass from the earth, they will take a unique intelligence with them.

"They know things about the ocean that we can't imagine," says New England Aquarium scientist Marilyn Marx. She points to the question of how the enormous creatures find their tiny food, rice-sized plankton called *copepods*. They eat more than a ton a day, and so must locate very dense patches of copepods, which are always on the move. The whales might sense chemical changes in the water when they are near a patch, or they might possess a collective memory of the best places to go—for now, there are only theories. Scientists have used sophisticated instruments to try to find the dense patches on their own, but they still must follow the lead of the whales.

The copepod is a great concern for the scientists. The consumption of contaminated food may be the principal way that the whales absorb toxins. At the same time, global warming and changes in currents may be diminishing the supply.

"We're still blundering around in the ocean," says Scott Kraus, the aquarium's vice president for research, "and in our blundering we're destroying it. Whether it's the lowly jellyfish or a high-profile whale, every animal is important for reasons that we don't even understand."

LESSON

FINDING PHOENIX

On the following page spread are nine photographs of three whales from the North Atlantic Right Whale Catalog. By examining the pictures, students do the most basic work of the whale researchers: they identify an individual—Phoenix, in this case—according to patterns of callosities. They go on to look for patterns of another kind—migration behavior—in a record of Phoenix sightings.

The exercises can be done as a class, in small groups, or individually. Copies of the materials, including larger versions of the photos, can be downloaded from our Web site, **smithsonianeducation.org/educators**.

STEP ONE

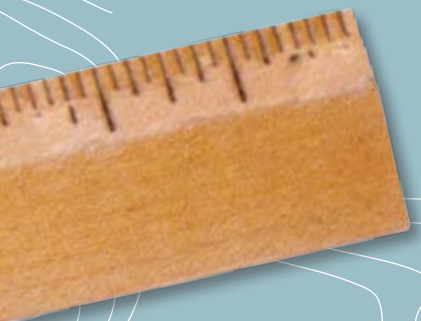
Display pages 6–7 on the board, or print out the photos from our site and display them in the same order. Distribute copies of Handout 1, which should help you to introduce the subject of the right whale and the story of Phoenix.

STEP TWO

Distribute Handout 2 and guide students as they try to match up the photos of the three whales. They can label the photos by filling out the handout's graph. Correctly completed, the graph would look like this:

1	3	1
2	2	2
3	3	1

On the handout, students describe the whales' distinguishing marks before they become familiar with terms used by researchers. Let them know that the researchers, in initial reports, sometimes jot down impressions in nonscientific language.



STEP THREE

Distribute Handout 3, which contains a guide to callosity patterns. Students now try to incorporate the researchers' terms into more detailed descriptions of the three whales.

STEP FOUR

Distribute Handout 4. By studying the sketch of Phoenix on the handout, students try to identify her among the photos of the three whales. They then try to find one of her scars. She is # 3 and the scar is visible as a white streak on the right lip in the "headshot" photo.

STEP FIVE

Distribute Handouts 5 and 6, which contain a map of the whales' habitat and a chart of recent sightings of Phoenix. By marking the map with the dates of the sightings, students should be able to see that Phoenix has spent warm months in the north and winter months in the south. When they learn that Phoenix and her offspring were all born in the south during the winter, they speculate on the reasons.

Scientists know that the whales feed in northern waters because copepods and other plankton are most plentiful there. But they don't yet know why females travel south to give birth and nurse in warmer water. The southern coasts have a great disadvantage as a birthing ground: sharks are more common there.

Any student hypothesis, then, will be worthwhile. There are no wrong answers because science does not yet have the right answer.

EXTENSION

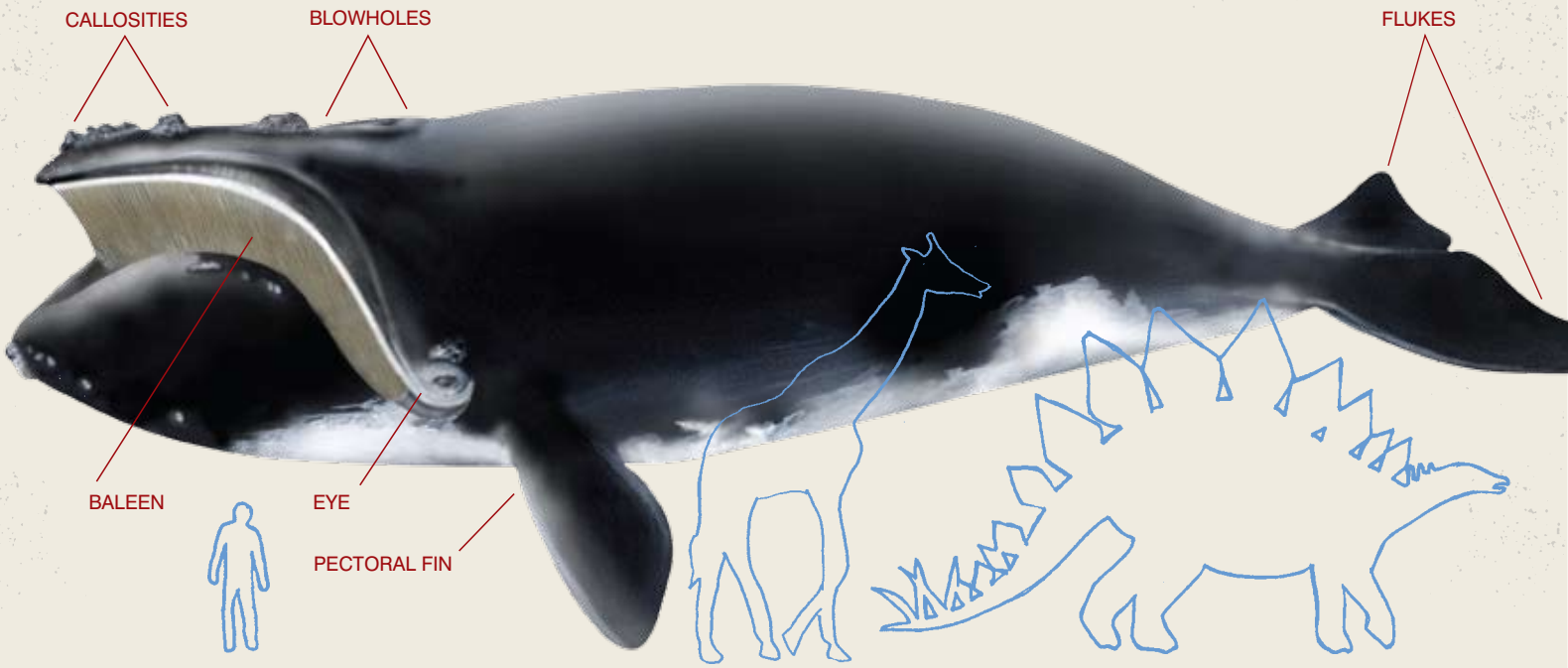
Visit the New England Aquarium's Web site at **neaq.org**. Click on "Animals and Exhibits" and then "North Atlantic Right Whale." You will find an online version of the catalog, a delightful whale-matching game, and information on how the class can "adopt" a right whale.


1


2


3

THE NORTH ATLANTIC RIGHT WHALE…



- ★ WEIGHS NEARLY 2,000 POUNDS AT BIRTH AND CAN GROW TO MORE THAN 55 FEET AND 160,000 POUNDS
- ★ IS BORN WITH ROUGH PATCHES OF SKIN, CALLED *CALLOSITIES,* ON THE HEAD
- ★ HAS A LIFE SPAN OF AT LEAST 70 YEARS AND MIGHT LIVE PAST 100
- ★ CAN GIVE BIRTH TO A SINGLE OFFSPRING, OR *CALF,* EVERY 3 TO 5 YEARS
- ★ LIVES MOSTLY ON *COPEPODS,* CRUSTACEANS THE SIZE OF GRAINS OF RICE
- ★ MUST EAT MORE THAN 2,200 POUNDS OF THIS FOOD EACH DAY
- ★ HAS *BALEEN* INSTEAD OF TEETH
- ★ CATCHES FOOD BY SWIMMING WITH THE MOUTH OPEN AND USING THE BALEEN TO STRAIN THE COPEPODS FROM THE WATER

TO SCIENTISTS, THE CALLOSITIES ARE LIKE FINGERPRINTS…

BECAUSE EACH WHALE HAS A UNIQUE PATTERN OF THEM. SCIENTISTS CAN IDENTIFY INDIVIDUAL WHALES BY THE PATTERNS, THOUGH THEY DON'T KNOW WHAT THE CALLOSITIES ARE *FOR*. THOUSANDS OF HARMLESS PARASITES, CALLED "WHALE LICE," LIVE ON THE CALLOSITIES. BUT WHAT ARE THE WHALES GETTING OUT OF IT? LIKE MUCH ABOUT THE LIVES OF THESE GIANTS, IT'S STILL A MYSTERY.

HANDOUT 2

YOU'RE A MARINE BIOLOGIST WHO STUDIES THE NORTH ATLANTIC RIGHT WHALE…

AND YOU'VE JUST RETURNED FROM A RESEARCH TRIP.
YOU SPOTTED THREE WHALES AND GOT NINE GOOD PHOTOS OF THEM.

You have a clear "headshot" of each whale. You've labeled these as 1, 2, and 3.

But it's not so easy to tell who's who in the other six pictures. You need to spend some time examining the pictures to identify Whale 1, Whale 2, and Whale 3. When you've made the matches, you label the other pictures as 1, 2, or 3.

1		
2		
3		

YOU WRITE A BRIEF REPORT ON WHY YOU THINK YOU MATCHED THE PICTURES TO THE "RIGHT" RIGHT WHALES.

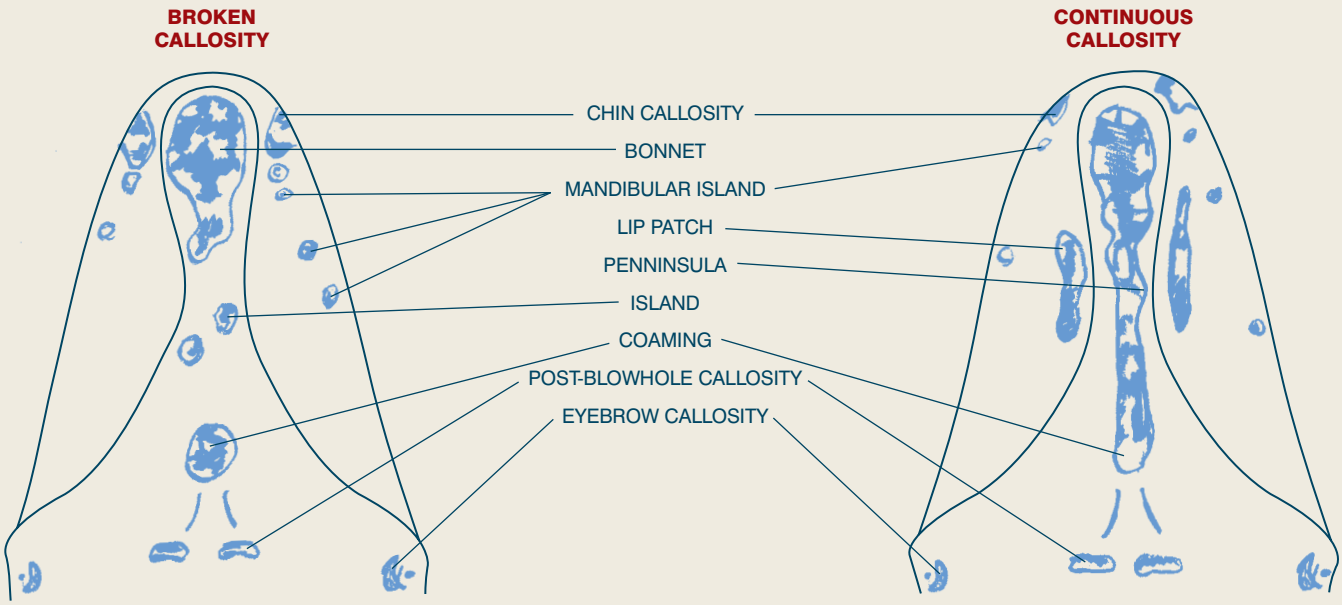
HANDOUT 3

YOU NOW CONSULT YOUR CALLOSITY PATTERN CHART…

TO WRITE MORE DETAILED DESCRIPTIONS OF THE THREE WHALES.

You start with the two most basic categories of callosities. Does the whale have a continuous callosity—a long, unbroken streak at the top of the head? Or are the callosities broken into isolated spots?

You describe the locations of the spots, or islands, and also look for peninsulas, or bumps on the head.



WHALE 1

WHALE 2

WHALE 3

YOU GET A CALL FROM ANOTHER SCIENTIST…

WHO HAS BEEN SEARCHING FOR A WHALE NAMED PHOENIX. THE SCIENTIST ASKS IF THERE IS A CHANCE THAT PHOENIX WAS ONE OF THE WHALES YOU SPOTTED ON YOUR TRIP.

You go to the North Atlantic Right Whale Catalog and find a sketch of Phoenix. You compare this to your photos.

DO YOU THINK THAT PHOENIX IS ONE OF YOUR WHALES?

_____

WHY OR WHY NOT?

_____

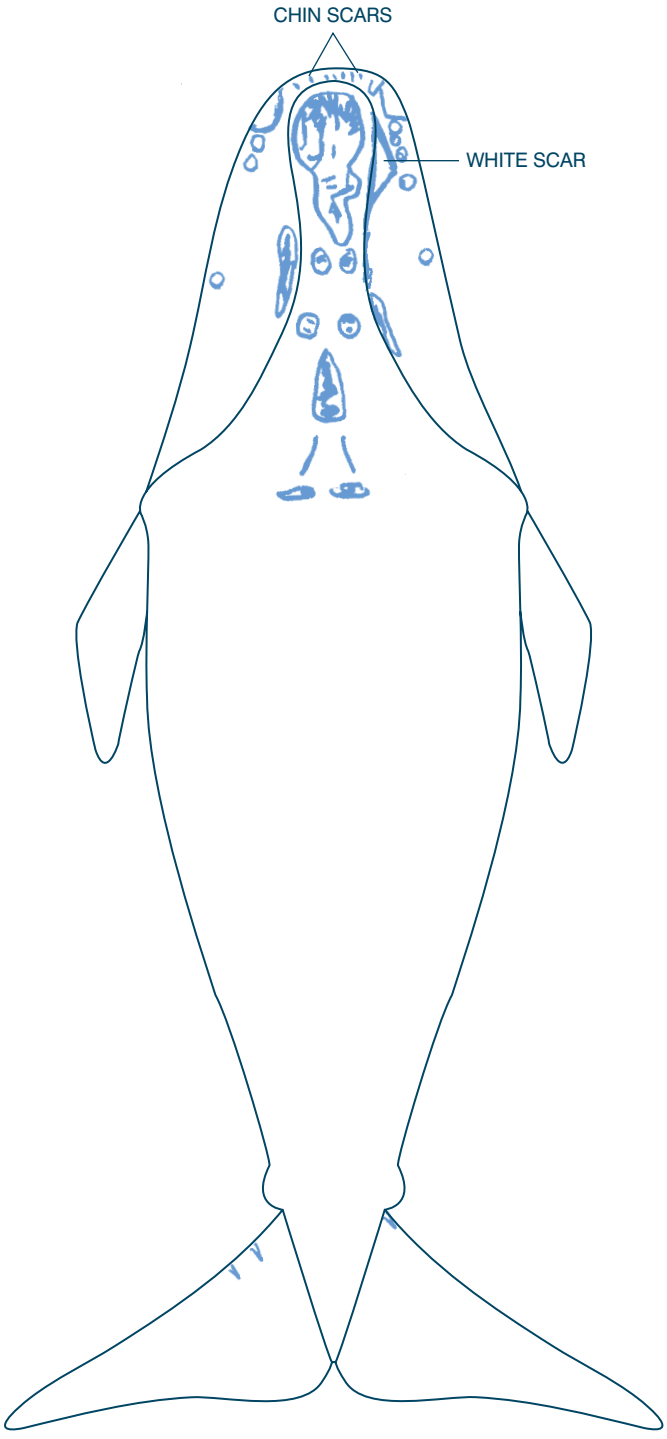
_____

_____

_____

_____

_____



You learn that Phoenix has a special story. She was first spotted as a calf near the coast of Florida in 1987. At the age of ten, a year after giving birth herself, she got tangled up in a commercial fishing line. This is one of the leading causes of early death for the whales.

Phoenix carried pieces of the line with her for many months. Two years later, scientists were happy to see that she had somehow freed herself. She had scars from the accident—on her lip and her tail—but otherwise seemed healthy. She has gone on to have two more calves and to become a grandmother.

Scientists were able to follow Phoenix's story by doing the same kind of work you've done—studying photographs of whales to identify individuals.

IF YOU THINK YOU'VE FOUND PHOENIX, CAN YOU FIND A SCAR FROM THE ACCIDENT IN ONE OF THE PHOTOS?

HANDOUT 5

THE NORTH ATLANTIC RIGHT WHALE MAJOR HABITAT AREAS

★

- CANADIAN CONSERVATION AREAS
- UNITED STATES CRITICAL HABITAT AREAS
- PRIMARY RIGHT WHALE SIGHTING LOCATIONS
- OCCASIONAL RIGHT WHALE SIGHTING LOCATIONS

0 200 400
KILOMETERS

0 150 300
NAUTICAL MILES

HANDOUT 6

NOW YOU, TOO, ARE PART OF PHOENIX'S STORY…

BECAUSE YOUR SIGHTING WILL SOON GO INTO THE RIGHT WHALE CATALOG.

You return to the catalog and look up the records of Phoenix sightings in the last few years. You chart her movements by putting down the month of each sighting in the correct area on your map.

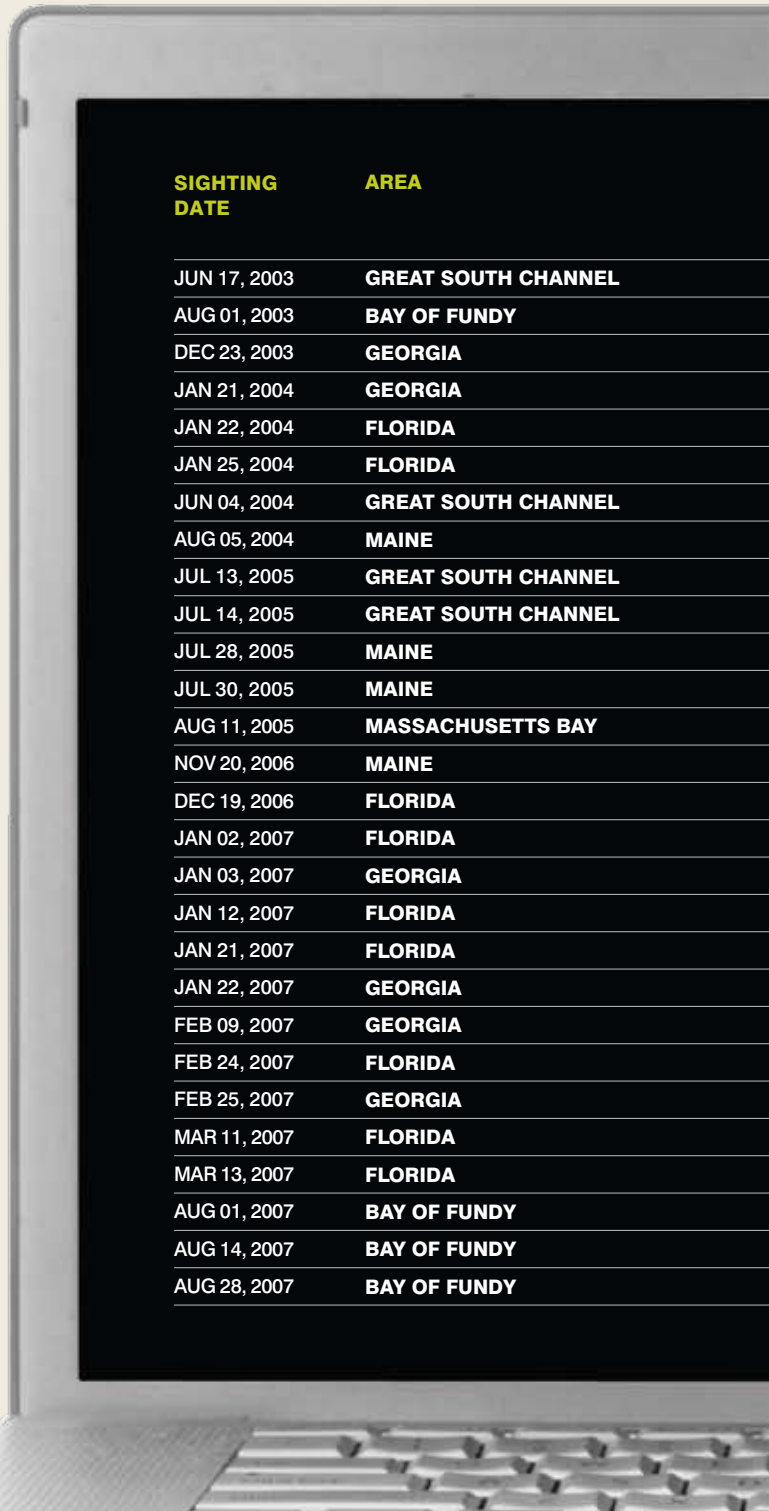
DO YOU NOW SEE ANY PATTERNS ON THE MAP? IF SO, WHAT ARE THEY?

Your next research trip is in August. You would like to see Phoenix again.

WHERE WOULD BE A GOOD PLACE TO GO?

In the catalog, you find the records for two of Phoenix's calves, named Smoke and Fuse. Both were first sighted as newborns in southern waters during the winter months—the same place and time of year as the first sighting of the newborn Phoenix in 1987.

DO YOU THINK IT'S A COINCIDENCE? IF NOT, WHAT IS YOUR THEORY FOR THIS?



SIGHTING DATE	AREA
JUN 17, 2003	GREAT SOUTH CHANNEL
AUG 01, 2003	BAY OF FUNDY
DEC 23, 2003	GEORGIA
JAN 21, 2004	GEORGIA
JAN 22, 2004	FLORIDA
JAN 25, 2004	FLORIDA
JUN 04, 2004	GREAT SOUTH CHANNEL
AUG 05, 2004	MAINE
JUL 13, 2005	GREAT SOUTH CHANNEL
JUL 14, 2005	GREAT SOUTH CHANNEL
JUL 28, 2005	MAINE
JUL 30, 2005	MAINE
AUG 11, 2005	MASSACHUSETTS BAY
NOV 20, 2006	MAINE
DEC 19, 2006	FLORIDA
JAN 02, 2007	FLORIDA
JAN 03, 2007	GEORGIA
JAN 12, 2007	FLORIDA
JAN 21, 2007	FLORIDA
JAN 22, 2007	GEORGIA
FEB 09, 2007	GEORGIA
FEB 24, 2007	FLORIDA
FEB 25, 2007	GEORGIA
MAR 11, 2007	FLORIDA
MAR 13, 2007	FLORIDA
AUG 01, 2007	BAY OF FUNDY
AUG 14, 2007	BAY OF FUNDY
AUG 28, 2007	BAY OF FUNDY

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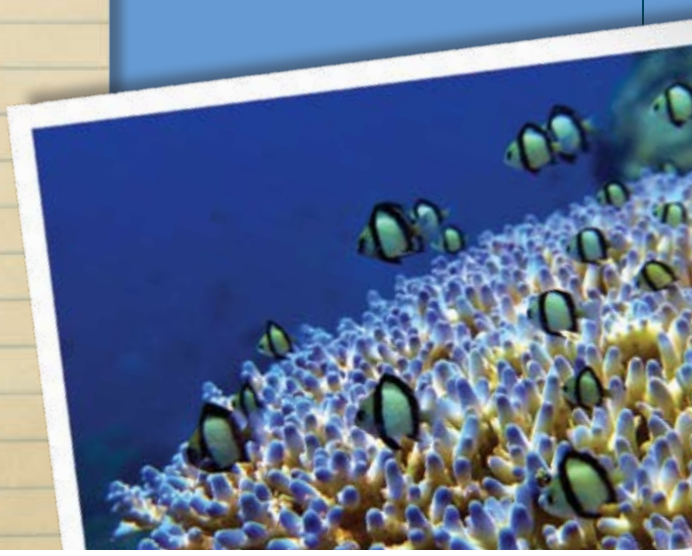

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