THE U.S. NAVY BEARS DOWN ON WHALES—AND THE SCIENTISTS WHO STUDY THEM

BY PETER CANBY

HAL WHITEHEAD AND HIS WIFE, LINDA Weilgart, live on a cove's edge half an hour south of Halifax, Nova Scotia. Their house has views over Tribune Head—a steep granite headland on which a British ship, the *Tribune*, foundered in 1797—and beyond that, the Atlantic Ocean. Below the house is a dock at which Whitehead and Weilgart keep their 40-foot Valiant-class sailboat, *Balaena*, which, over the years, they've sailed most of the way around the world. Whitehead, 54, has an aureole of reddish sandy hair and the ruddy complexion of someone who's not only spent a lot of time on the water but also bikes to his lab at four or five each morning. He explained to me that he and Weilgart bought the house—a ramshackle, recently built structure—because it was the only place they could find at which they could also moor the boat. One of his students told me that once when Weilgart was out of town for a stretch, Whitehead had moved onto *Balaena* and, when asked about it, had seemed puzzled that anyone would actually prefer to live in a house.

A navy ship tests mid-frequency sonar in Washington's Haro Strait, close to a pod of orca whales.

Whitehead is a professor and Weilgart an assistant professor at Dalhousie University in Halifax, an institution an ecologist friend recently characterized for me as "kilo for kilo, the most exciting marine research center in the world." Whitehead is the world's foremost expert on sperm whales. He is known both for a suite of innovative techniques that have allowed him and Weilgart to study these deepwater creatures from *Balaena* and for making (with a colleague, Luke Rendell) the controversial argument that whales not only have "culture" but have used that culture to adapt successfully to the ocean's demanding environments. Because of this, they argue, whales should be included on a short list of the world's most highly evolved creatures.

Whitehead's father was a professor of engineering at

LEFT: PHOTOGRAPH FOR ONEARTH BY CARL WALSH; RIGHT: COURTESY OF KENNETH BALCOMB, CENTER FOR WHALE RESEARCH

One leading scientist compares navy-funded marine-mammal science to tobacco industry-funded studies on lung cancer

Cambridge, and Whitehead himself has an undergraduate degree in mathematics from that same university. This background seems to have bequeathed him a certain intellectual confidence. Because they're so difficult to observe, deepwater whales such as sperm whales are famously difficult to study and all but impossible to experiment on, and Whitehead's ideas about whale culture and whale evolution are built upon meticulously gathered data and complex statistical formulas that are objects of awe for many of his peers. David Lusseau, a postdoc who came to Dalhousie specifically to study with Whitehead, said, "There's animal behavior before Hal and after Hal. Hal has worked up a set of statistical tools to infer general principles from incompletely observed phenomena. No one else has worked up a method for analyzing social structure in all types of animal behavior."

But I had asked to speak to Whitehead and Weilgart on another subject, one I wasn't sure they'd want to talk about publicly. That subject was the vexing problem of the U.S. Navy's increasing tactical dependence on marine sonar and the growing evidence that sonar is damaging, and in some cases fatal, to cetaceans. Navy sonar is very likely the most contentious issue in marine-mammal science today, and it's a subject few marine biologists are willing to touch, perhaps because so many labs and individual scientists are dependent on navy grants. Even though they themselves do not receive navy funds, Whitehead and Weilgart let it be known, when I first asked if they'd be willing to be interviewed on this subject, that they had no desire to become poster children for the navy-sonar issue. Their reaction was hardly unique, as I subsequently discovered when a series of seemingly matter-of-fact calls and e-mails to oceanographers and marine biologists in connection with this article either went unanswered or were answered evasively and incompletely. (It did not help, of course, that the Natural Resources Defense Council [NRDC] has filed lawsuits against the navy to prevent sonar tests that may be damaging to cetaceans.)

BIOLOGICALLY, BEAKED WHALES HAVE BEEN SO LITTLE STUDIED THAT THE CONSERVATION STATUS OF MOST OF THEM IS "DATA-DEFICIENT"

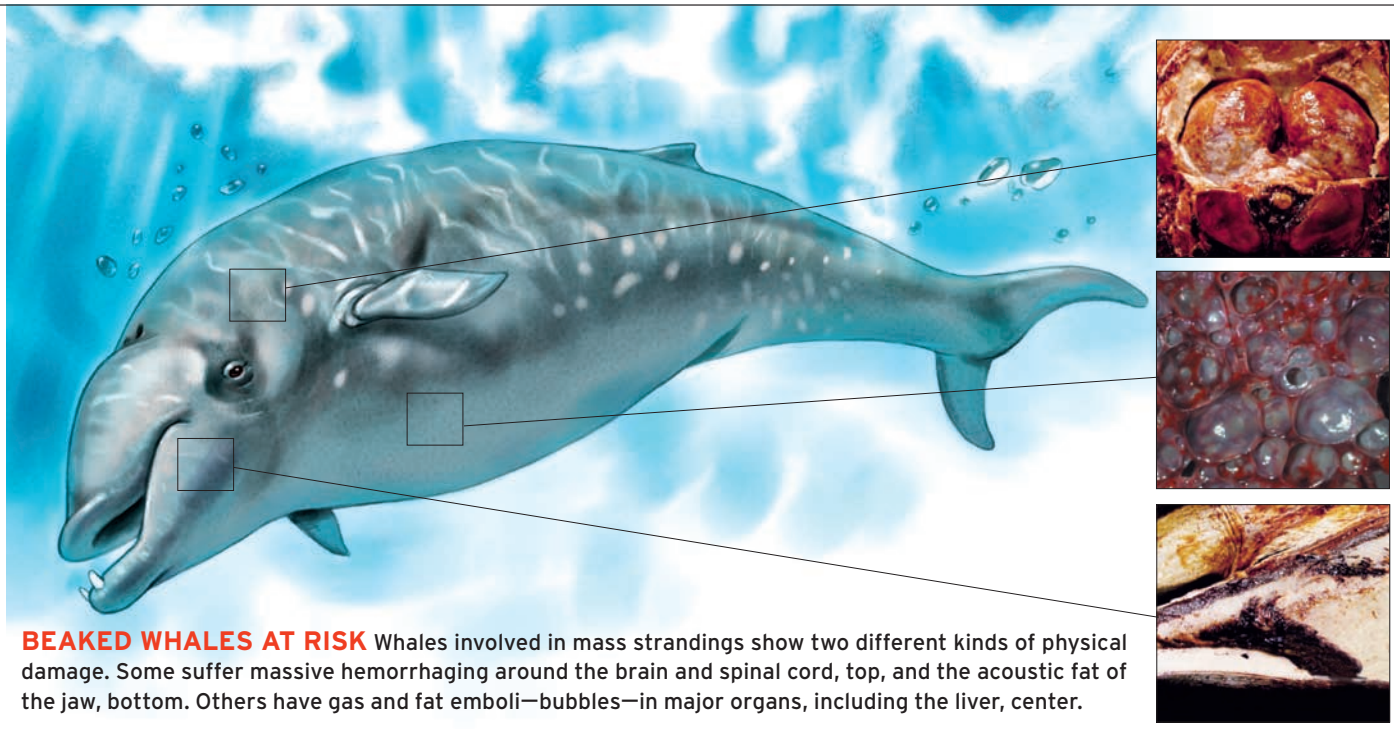
Eventually, however, Whitehead and Weilgart relented—or at least relented partly. They agreed to talk about a related subject on which they've both been outspoken: their belief that the navy's dominant role in funding marine-mammal science has had a corrupting effect on the nature of the research being undertaken. Indeed, Whitehead and Weilgart had already published a 1995 article on the subject in the professional journal *Marine Mammal Science* and a long letter on the same subject in the same journal in 2005. In these pieces they noted that the navy sponsored 70 percent of all marine-mammal research in the United States as well as 50 percent of all research worldwide, and that this had led to a "systematic unwillingness to publicly criticize defense-related projects within the U.S. marine-mammal research community." They likened this situation to "a special information session on lung cancer at a professional meeting of oncologists funded by the tobacco industry."

The navy sonar problem is the controversial edge of a larger problem, the "ensonification" of the seas. John Hildebrand, a professor at the Scripps Institution of Oceanography in La Jolla, California, and a specialist in the effects of anthropogenic (human-generated) sound on marine mammals, is one of the authors of a recently released study that demonstrates that ambient anthropogenic sound in the world's seas has increased tenfold since the early 1960s. He attributes most of this increase to bigger and more powerful ships. But he also blames it on such phenomena as the growing number of seismic surveys by the oil and gas industry (which can be literally deafening to whales and may cause them to strand) and on navy sonars including MFA (mid-frequency active) sonar, deployed on more than 100 fighting ships, and LFA (low-frequency active) sonar, a new type designed to flood entire ocean basins with sound. Beyond the sometimes fatal effect of sonar on individual whales, it's unclear what the cumulative effect of this steep growth of ocean noise will be. The fear is that it will mask the ability of whales to communicate with one another, drive them from long-established migration routes, and prevent them from finding food and even from reproducing. "Our ignorance about marine-mammal behavioral responses to sound is abysmal," Hildebrand wrote in a recent book, "and knowledge of this subject must be improved."

IN THE EARLY 1960S THE WORLD'S navies began increasingly to experiment with "active" sonar, designed to bounce sound waves off approaching submarines. Prior to that, ships had detected submarines by using "passive" sonar, which consisted essentially of listening devices. From the U.S. Navy's first deployment of active sonar, however, tests correlated closely with strandings of certain whale species. There had been strandings before, but with active sonar they became more frequent, occurring in close proximity to naval exercises, with whales left bleeding and dying on nearby shores. But the tests of active sonar were done in secret, and it was rare for scientists to be on the scene and in position to examine freshly stranded whales. In the absence of any studies showing a physical connection between sonar and stranding, the navy refused to accept responsibility.

The problem leaped an order of magnitude when, as the cold war wound down, the navy gradually moved away from its focus on containing Soviet nuclear submarines and toward a readiness for the rapid deployment of American power into the world's coastal zones. In an "operational concept" paper, "Forward… From the Sea," Admiral Jay Johnson, chief of naval operations, articulated the new vision. "Seventy-five percent of the earth's population and a similar proportion of national capitals and major commercial centers lie in the littorals [coastal regions]. These are the places where American influence and power have the greatest impact and are needed most often."

The challenge of the new strategy, however, was that deploying in narrow channels and close inshore left the navy's surface ships vulnerable to a new generation of small, silent submarines. Because these submarines were almost impossible to hear with passive listening devices, in the mid-1980s, U.S. and allied navies steeply ramped up their experimentation with active sonar. The details have been shrouded in secrecy, but one indication of the importance the United States attributes to the sonar buildup is that at a recent International



BEAKED WHALES AT RISK Whales involved in mass strandings show two different kinds of physical damage. Some suffer massive hemorrhaging around the brain and spinal cord, top, and the acoustic fat of the jaw, bottom. Others have gas and fat emboli—bubbles—in major organs, including the liver, center.

Law of the Sea conference in New York City, U.S. delegates quietly let it be known that, along with restrictions on greenhouse gas emissions, regulation of undersea noise was entirely off the table.

The difficulty for cetaceans arose from the navy's conducting its sonar exercises in the deep, steep-walled underwater canyons that lie between certain islands and along the edges of continental shelves—the sort of "acoustically complex environments," in navy terminology, where enemy submarines might set up "choke points" and lie in wait for surface ships. Unfortunately, this same underwater topography is used by a little-known family of deep-diving whales called beaked whales. Biologically, these whales have been so little studied that the conservation status of most of them, according to the World Conservation Union, is "data-deficient." They are perhaps the least understood large mammals in the world. Certain species have never been seen in the wild and are known only from carcasses that have washed up onshore.

As the number of active-sonar exercises grew, beaked whales began stranding in increasing numbers. They were found on beaches near the exercise sites, bleeding profusely from their eyes and ears, suffering from massive internal hemorrhaging or, as was discovered in the aftermath of a series of NATO exercises off the Canary Islands in 2002, from a condition similar to the decompression sickness, also called the bends, experienced by divers who have surfaced too quickly. There were major strandings in Greece in 1996 and 1997, in the Bahamas in 2000, in the Madeiras during that same year, and in the Canaries in 1989 and 2002. What many of these stranding sites had in common was that they were near places where deep underwater trenches abutted island archipelagoes. The preponderance of species stranded were beaked whales—81 percent were Cuvier's beaked whales, the most "cosmopolitan," or widespread, members of the family.

The navy's reluctance to concede a causal relationship between its exercises and the strandings grew increasingly strained, however, as physical evidence of the nature of the damage to stranded whales gradually emerged. Kenneth Balcomb, an independent whale biologist and former navy underwater-surveillance officer, happened to be living in the Bahamas in 2000 when five navy ships conducted anti–submarine warfare exercises in the narrow channel between Grand Bahama and Grand Abaco Island, leading to the stranding of 17 cetaceans—including nine Cuvier's beaked whales and three Blainville's beaked whales—and the deaths of at least eight of them. Balcomb had been studying this particular population of beaked whales, and it had seemed to him as if he were studying a population of dinosaurs. "Few whale biologists even today," he told me, "have ever seen a beaked whale." After the whales died, he severed the heads of several and froze them. The navy then flew the heads to a lab in Boston for analysis. There, Balcomb and Darlene Ketten, a biologist funded by the National Oceanic and Atmospheric Administration (NOAA), the federal agency with jurisdiction over marine mammals, conducted necropsies that clearly showed fatal hemorrhaging of the delicate tissues around the whales' brains and ears. Balcomb attributed this to "resonance phenomena" caused by the navy sonar.

This was the first physical evidence of sonar-related injuries to whales and bad news for the navy. When he first came across the stranded whales, Balcomb had effectively reported up the chain of command by calling Robert Gisiner, the marine-mammals program director for the Office of Naval Research (ONR) and the man who makes funding decisions for much of the navy's marine-mammals science. But at some point during the Boston necropsies Balcomb began to suspect that the navy might bury the incident. He insisted on both videotaping the necropsies for himself and keeping copies of the CAT scans. When, after a number of months, the navy and NOAA were still sitting on the evidence of cranial hemorrhaging, Balcomb decided to take the radical step of breaking the code of silence surrounding navy-funded projects.

His announcement of his findings was hugely controversial, and in December 2001, a year and a half after he had spoken out, the navy

and NOAA jointly issued an interim report on the stranding, in which they acknowledged that navy sonar was "the most plausible source" of the "acoustic or impulse trauma" that led to the deaths of the whales. Balcomb believes that the navy took this unprecedented step only because he had the evidence, but even in its preliminary report (a final one has never been released) the navy did not concede much. While acknowledging the brain hemorrhaging, the navy argued that this had not in itself been fatal and suggested that the whales had actually died from "cardiovascular collapse" after stranding, a conclusion Balcomb strongly disputes and for which he says there is no evidence. Balcomb likens the stranding to "fishing with dynamite."

Two years after the Bahamas incident, a different kind of physical evidence emerged when a team of Spanish veterinarians arrived at a stranding of 14 beaked whales on the Canary Islands, not long after a NATO naval exercise. The whales were "severely shocked and dying rapidly" and bleeding profusely from their mouths and eyes. In the Bahamas, Balcomb and Ketten had focused on the heads of the whales, but the Spanish team was able to make more detailed full-carcass examinations. Like Balcomb and Ketten, they found "massive" hemorrhaging around the animals' brains, but they also found hemorrhaging of the blood vessels of many of the whales' other organs, including their kidneys, liver, and lungs. They were able to discern gas and fat bubbles in the blood vessels, consistent with those found in divers who contract the bends. The Spanish veterinarians suggested that the animals might have altered their normal surfacing routine and shot to the surface in response to the intense sonar to which they'd been exposed.

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By 2003, these and other strandings had led to a public outcry sufficient for Congress to direct the Marine Mammal Commission, an agency within the federal government, to create an "advisory committee on acoustic impacts on marine mammals." The committee included all interested parties—the navy, the oil and gas industry, the shipping industry, academics, and environmentalists. Perhaps in recognition of the dysfunctional relationship among these groups, the committee convened under the direction of a conflict-resolution organization. The plan was to hammer out a consensus report that would serve as a guide to Congress in making decisions on marine-acoustic issues.

The committee met regularly over a two-year period, "haggling over every sentence, every phrase, fighting over every line and compromising over every word," as one member put it. At the end of that time, according to several participants, the committee was struggling with a late draft of the consensus report when the navy suddenly ceased cooperating. Frank Stone, of the office of the chief of naval operations, talked to the panelists by speakerphone and told them the navy no longer agreed with a single line of the draft consensus report. Asked to comment on the collapse of the process, Rear Admiral James Symonds, director of navy environmental programs, said, "It is inaccurate to attribute the lack of consensus among the committee to any one member."

In the end the panel issued a set of sharply differing caucus reports. Linda Weilgart, who'd been an alternate member of the advisory committee, was the principal author of the environmental caucus report. In a comment filed separately, she noted that "we are not just talking about a small-scale effect on a few individual [whales]. There is every reason to believe that impacts could be large scale and considerable."

NOT LONG AFTER I ARRIVED IN Halifax, I spent the morning at Whitehead's kitchen table discussing how he felt the financial structures of marine-mammal science—particularly in the United States—had become distorted. He and Weilgart are paid, he told me, through their Dalhousie salaries and through grants from the Canadian Natural Sciences and Engineering Research Council, which gives them a five-year budget for general programs rather than specific projects. ("It encourages efficiency in research rather than in grant writing," Whitehead noted dryly.) In the United States, where he and Weilgart have advocated the creation of an independent council for marine mammals, the situation is quite different. Part of the job description of many of his colleagues, Whitehead told me, was to bring in, beyond their salaries, $200,000 a year in research grants. Universities, he said, have become dependent on this money; it has become a factor in granting tenure and therefore in career success. "A lot of my colleagues spend 50 percent of their time chasing money, and this can become corrupting, especially in a situation such as exists now in which the navy and the oil and gas industry provide so many of the grants."

It's hard to deny the navy's need for sonar—its ships are highly vulnerable to silent submarines—and there is no doubt that the navy is concerned with whales, if only because high-profile strandings tend to cause public relations problems and calls for restrictions on sonar testing. But it doesn't follow that the navy is the best institution to dominate the funding of academic research on marine mammals. The navy's research, according to its critics, obsessively focuses on hearing thresholds—on "controlled exposure experiments" to determine how loud and how close to whales its sonar can be operated before it affects the animals' behavior or causes temporary or permanent hearing loss. "The navy's been doing hearing-loss research for 15 years," Balcomb told me.

There's an aspect of navy marine-mammal research, moreover, that's closer to engineering than to pure science. A navy spokesman characterized the work funded by Robert Gisiner as "figuring out how to make sonar work." (Gisiner wouldn't comment for this article.) Sara Wan, a member of both the California Coastal Commission and the federal advisory committee on acoustic impacts on marine mammals, observed to me that navy research grants are project driven. In this kind of situation, she said, the questions you ask are going to determine the answers you get. "The navy is driven to look at the effects of its sonar because it wants to use its sonar."

Any argument that the navy took a disinterested approach to the outcome of its research became harder to make in 2002, when NRDC, in the course of filing suit against a proposed deployment of low-frequency sonar, discovered a series of e-mails between Gisiner and Joseph Johnson, the navy's environmental manager for its low-frequency sonar system. The exchange concerned a negative appraisal filed in a publicly accessible environmental-impact state-

ment by a group of scientists. Johnson e-mailed Gisiner to ask if they were navy-funded. When Gisiner said they were, Johnson responded that their comments were "negative and…out of the box. If they are funded by the navy, the proper way to bitch is via the sponsor (you)." To which Gisiner replied, "I pretty much told them as much in a scorching phone call. I think they had some inkling that they might be about to take our money and make themselves look good to the enviros too."

As we spoke on these matters, Whitehead nodded toward my coffee mug, which was purple with bold gold script spelling out the acronym ECOUS. "That's Environmental Consequences of Underwater Sound," he said, "a May 2003 conference in San Antonio at which I gave a paper on the funding issue written by Lindy, Luke Rendell, and myself. The conference seemed to be in honor of Bob Gisiner. Speech after speech toasted him for his years of work as head of the marine-mammal section of the Office of Naval Research until, toward the end of the final day, I stood up and blasted his office for the ways in which it distorted marine-mammal research. Among other things, we accused them of being narrow-minded and focused on hearing damage and asked why it was that the gas and fat emboli thesis had been developed without navy funding. When I finished, you could have heard a pin drop."

A mass stranding in the Canary Islands in 2002 provided strong evidence of damage from sonar.

Whitehead later gave me a copy of the speech, and it was indeed brutal. In their paper, he, Rendell, and Weilgart argued that ONR-funded marine-mammal research was not just "narrow-minded" but also "arrogant" ("only we [the navy] can understand the complexities") and "frequently wrong." They pointed out that dissent was regularly squelched and that as a result of "direct ONR funding of most major U.S. marine-mammal bioacoustics labs," marine-mammal science was suffering from a credibility gap as well as a "massive and archetypal case of conflict of interest."

WHILE WHITEHEAD AND I WERE speaking, Weilgart returned with the youngest of their three children, 12-year-old Sonja. After lunch the four of us took *Balaena* out for a sail. Weilgart took the helm as Whitehead raised the sails. Weilgart is a tall, slim woman with long, dark hair. As she steered us out of their cove, she told me that her parents were Austrian-German refugees, and that in Vienna her uncle's family had picnicked with the Freuds. Her father had fled Vienna just before World War II and she herself had grown up in Iowa, where her father taught psychology and her mother German at Luther College in Decorah. Her father spoke 14 languages but had spent much of his career developing a single international lingua franca made of 20 symbols that he hoped would be less open to political manipulation than the German of his youth.

Because of her family's experience, the funding issue has been particularly resonant for Weilgart. "As scientists," she said, "it affects us more because we see the chilling influence on our colleagues. It's a difficult position to put scientists in. You want to believe what you read and—imperfect as the whole process of science may be—we don't want scientists to lose their credibility. It's central to the whole democratic process."

Weilgart and Whitehead have collaborated on studies of sperm whales off Sri Lanka, off the Galapagos, and in the South Pacific. Over time they have refined a model of sperm whale social structure using photo identifications of individual whales, DNA studies of sloughed skin, and acoustic recording, concluding that, much like elephants, sperm whales live in extended matrilineal groupings that persist for decades. They've also discovered a vocabulary of distinctive click-like "codas" with which whales in these groups communicate. Their breakthrough came during a sabbatical year in 1992–1993. They took their two children—Benjamin, then age 5, and Stefanie, 6 months (Sonja had not yet been born)—and sailed across the Pacific and back collecting data. They concluded that each sperm-whale population group not only had its own coda vocabulary—taught to successive generations—but also distinctive behavioral norms. It was the data from this trip that led Whitehead and Luke Rendell to make their whale culture argument.

As we sailed outside Halifax harbor, Whitehead alluded to something he'd brought up several times: that he'd grown up at a time when being a whale scientist meant cutting up carcasses on the deck of a whaling ship. When he'd proposed undertaking his first offshore studies of sperm whales from a sailboat near Sri Lanka, he'd been assured it couldn't be done. He seems to have taken this as a challenge. Through the exercise of pure science, he and Weilgart have not only defied the strictures of their field but also inferred startlingly insightful conclusions.

Despite the end of the era of mass whale slaughter, the general degradation of the oceans has left whales under assault as never before. At a moment when scientists are, for the first time, becoming aware of the complexities of whale societies, those societies are being threatened by a growth of ocean noise that could prevent whales from locating one another and finding food. The point is that very little is known about the broader effects of sound on whales, and even as large amounts of research money are going toward fine-tuning the effects of sonar or, increasingly, conducting oil and gas seismic surveys, far too little is devoted to the kind of basic science in which Whitehead and Weilgart are engaged. As Sara Wan put it to me, "We have enough information to know we have a problem. We need to have a better understanding of whales to know what we're doing, to know we're not putting them at risk. Their numbers are still dangerously low."

The day after our sail, just before I left, Whitehead sat me down and seemed to want to be sure I was paying attention: "Our research," he said, "is not just intended to describe the biological processes of whales, or how what we do affects them, but also to affect the ways in which we view whales and to understand how that in turn affects the moral universe in which we live."

VIDAL MARTIN (SECAC)