CENTER FOR COASTAL STUDIES

Smile, please. Phillip Clapham photographs a humpback from the deck of the *RV Halos*.

MARINE BIOLOGY

Scientists Count a Rising Tide of Whales in the Seas

Call him photographer. As part of a 2-year, seven-nation project called YONAH (Years of the North Atlantic Humpback), biologist Phillip Clapham has been sailing the Gulf of Maine, taking pictures of humpback whales for a catalog based on the unique tails of each individual spotted. To date, the team's book of acquaintances has expanded well beyond their expectations. "It's becoming increasingly clear that there are a lot more humpbacks in the North Atlantic than we thought," says Clapham, a researcher with the Center for Coastal Studies in Provincetown, Massachusetts.

Scientists are making similar observations around the world, as more rigorous census techniques increase the accuracy of population assessments of individual species of whales. "As the years have gone by, we've found almost every single time there were more animals out there than we thought," says Howard Braham, director of the National Marine Mammal Laboratory in Seattle.

In 1986, a global ban on hunting several threatened species was extended to all whales, in part to let scientists take stock of remaining populations. The new population studies, some of which have been reported for the first time in the past few months, suggest that the moratorium may be having a positive effect: With the exception of North Atlantic right whales and southern blue whales, most whales appear to be multiplying. There's now strong evidence that once-depleted stocks of humpbacks and bowheads are growing. In fact, consistently high population estimates of eastern Pacific gray whales for the past several years have prompted the U.S. National Marine Fisheries Service (NMFS) to request their removal from the endangered species list.

The trends remain sketchy, however. Many methods rely heavily on guesswork and extrapolation, and some species are still teetering on the brink of extinction. Researchers also warn that today's higher estimates could partly reflect better methods of locating the animals, and that human activities and natural events such as El Niño may be altering the geographic range of some whales, bringing them within the reach of scientists. What's more, incomplete and inaccurate historical records make it nearly impossible to establish a baseline from which to assess the relative health of current populations.

In spite of these caveats, however, most whale researchers are encouraged by the new estimates. But that's not necessarily good news for the whales. Last year, a scientific committee of the International Whaling Commission (IWC), which imposed the 1986 whaling ban, concluded that the minke whale population, now believed to be about 900,000, is large enough to support small-scale whaling. Environmentalists were outraged, and the IWC declined to accept the committee's recommendation, prompting its chairman, British population biologist Philip Hammond, to resign in protest. In June the Norwegian government decided to ignore the IWC decision and began whaling anyway, a move that drew threats of sanctions from the U.S. government.

A gray area. The controversy surrounding whale censuses tends to obscure the fact that they are more than a tool for politicians to use in deciding whether whaling should be resumed. Censuses can also shed light on such important scientific issues as recovery rates of beleaguered populations and factors affecting their habitat. With methods tailored to the peculiarities of each whale species and multiple years of data collected using comparable counting techniques now available, distinct population trends are at last coming into focus.

That's welcome news in a field in which numbers have often been highly suspect. "Modern whalers have tended to come up with the highest numbers and scientists with conservation groups have used methods to get the lowest numbers. The truth probably lies somewhere in-between," says whale biologist Hal Whitehead of Dalhousie University in Halifax, Nova Scotia. "There are enormous obstacles to getting any reliable numbers."

The new numbers may be more reliable, but they still have many uncertainties. One problem with most estimates is their dependence on statistical probabilities instead of actual counts. For instance, the figure of 21,000 gray whales believed to pass the coast of California is derived from observations of 2900 gray whale pods (which typically contain two animals) migrating in the winter of 1987-88, the most recent census data to be analyzed. Although the population is certainly higher than the actual number counted, it is impossible to know by how much: Taking into account such factors as distance, foggy weather, and fatigued observers, researchers assume they saw about 15% of the whales.

And this estimate is considered one of the most accurate for any whale population. Because of the relative ease of recording migrating whales as they parade past a coastal station, NMFS began counting gray whales as early as 1967. Years spent interpreting population data—conjectures about the number of animals that cruise by at night, for instance, have been validated by monitoring radiotagged whales—have boosted confidence in the estimate, which officially is between 19,200 and 22,700. That compares with the 12,000 to 15,000 believed to exist in 1846, before commercial whaling had begun.

The numbers become fuzzier for species that roam far and wide, such as sperm and blue whales. The best hope for researchers is to count those that congregate at a feeding ground or calving lagoon, then extrapolate these findings to a global number. For example, Whitehead's estimate that 4000 sperm whales regularly visit the Galápagos Islands can be converted into a worldwide figure of 400,000 sperm whales using records from 19th-century Yankee whalers showing that about 1% of their catch came from that area. "But that's only a very rough figure," says Whitehead.

Blue whales, the largest animals on Earth, are particularly difficult to count. Members

of this endangered species seem to shun stable groups and sometimes travel alone. Richard Sears, who runs the Mingan Island Cetacean Study in Canada and studies blue whales that feed in the Gulf of St. Lawrence, uses a global figure of 3000 to 10,000, although estimates run as high as 30,000. Those figures compare to a population earlier in the century large enough to yield an annual harvest of 30,000 whales. A census completed in November and being analyzed by Jay Barlow, of NMFS's Southwest Fisheries Science Center in La Jolla, is expected to sharpen the current estimate and, possibly, raise the minimum number. The results will be presented in May at the annual IWC meeting. It follows up on an earlier count done off the coast of Southern California (*Science*, 16 April 1993, p. 287).

The right stuff. Better counting methods have improved the reliability of many estimates. For example, the line-transect survey, originally designed for counting land animals, has now been adapted for minke and other whales. The technique involves flying (or sailing) along a straight line and noting every animal seen and its distance from the line. Last year Joseph Mobley at the University of Hawaii-West Oahu improved previous surveys of north Pacific humpbacks by following new north-south lines and by scanning a larger area around the Hawaiian islands that extends into deep waters. His team has also begun using the global positioning satellite system to measure distance more precisely.

"I'm cautious, but the numbers seem to suggest that the humpbacks are recovering in the same way that gray whales have," says Mobley, who in November presented the results of the new census at the Society for Marine Mammalogy's biennial conference in Galveston, Texas. He calculates that roughly 3400 humpbacks now visit Hawaii—the site favored by most migrating north Pacific humpbacks—compared with an estimated 1400 a decade ago.

Unlike Mobley, Clapham and other YONAH participants try to get as close as possible to every target. Photo identification uses variable markings, such as tail shapes and head callosities, to identify specific individuals of humpback, blue, sperm, fin, and right whales; the probability of seeing the same whale from one year to the next is related to the total size of the population in the area. There are drawbacks, however: It's unlikely all whales in a population are equally seen and counted, Clapham notes, and a whale's markings can change with age.

Still, the method has served to count nearly every right whale in the North Atlantic. Scott Krause of the New England Aquarium in Boston says 325 individuals have been identified over the past 14 years in an area ranging from Iceland to Florida, and very few of the right whales now seen are unfamiliar. Unfortunately, he says, that also suggests no more than 300 are alive today, meaning that one of the best-studied populations of wild animals on Earth is also one of the most endangered. Moreover, this small population is growing very slowly when compared with southern right whales. "They get killed off by boats," says Krause, who figures the north Atlantic's heavy sea traffic accounts for one-third of their mortality.

Prospects appear better for the bowhead whale population near Point Barrow, Alaska. In 1984 Christopher Clark of Cornell University lowered an array of hydrophones into the icy water to listen to the rumbling calls of the bowheads and, by triangulation, located their positions within a 10-mile radius. Three years of bowhead counts by this method have revealed that the population appears to be growing at an annual rate of 3%. The number of whales is now estimated at 7500, up from 1500 in 1976, according to statistician Adrian Raftery, who analyzes bowhead population data at the University of Washington in Seattle. Raftery hopes to clarify the trend with results from last spring's census—the first successful count in 5 years. (Earlier efforts were derailed by bad weather and hydrophones smashed by ice floes, he says.)

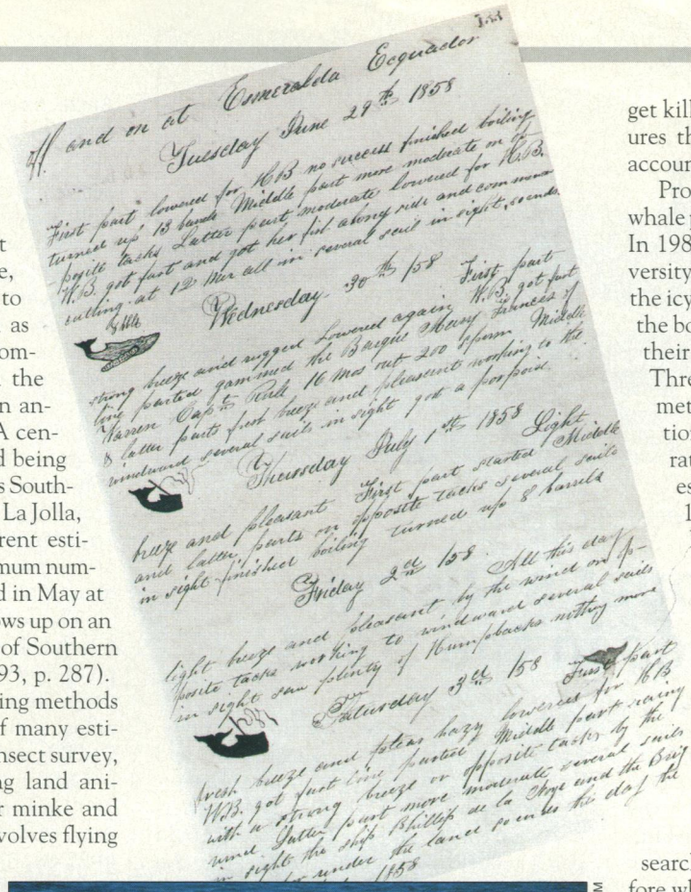
Spotty records. Unfortunately, even innovative new census techniques can't help researchers learn how many whales lived before whaling took its toll. That takes historical records. But those records are spotty at best, particularly for species hunted several centuries ago, says Randall Reeves, a geographer who runs Okapi Wildlife Associates in Hudson, Quebec.

Reeves tries to calculate the number of whales that once lived in an area by adding up how many were killed just before a population plummeted. This painstaking process involves poring over old ship logs, converting yields of baleen and oil to numbers of whales, and reconstructing time gaps. But even existing data—recorded in a variety of languages and units of measurement—is sometimes suspect, thanks to whalers who may have exaggerated sizes, misidentified species, and hidden the true location of their hunting grounds.

Despite their shortcomings, such historical records give researchers a rough idea of how many whales a given region might once have supported. Records for beluga whales in the St. Lawrence River and estuary, for example, suggest a population of at least 5000 a century ago; today, only about 500 live in the heavily polluted area.

But even as Reeves fleshes out the faint outline of a time before the mass harvesting of these huge creatures, whaling nations are using data from his colleagues of increasing populations to justify a resumption of the hunt. The irony is not lost on researchers. "The more whales there are," says Britain's Hammond, "the greater the chance that a revised management plan will allow a catch."

–Karen Schmidt



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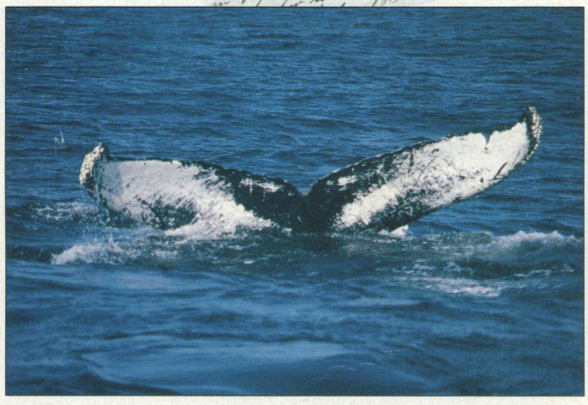

SCOTT KRAUSE, NEW ENGLAND AQUARIUM

One man's tale. Top, daily entries from a journal kept by Josiah Robinson of the whaling bark *William Lee* during a 3½-year Pacific cruise in the 1850s; above, the tail of a humpback whale in the Bay of Fundy.