Whale-sized genetic study largest ever for southern hemisphere humpbacks

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Humpback whales in southern populations are poorly understand in terms of their population structure. The new research will help researchers understand these populations and how they are connected, which in turn will help inform management decisions. Credit: M. Leslie

After 15 years of research in the waters of the South Atlantic and Indian Oceans, scientists from the Wildlife Conservation Society, the American Museum of Natural History, and an international coalition of organizations have unveiled the largest genetic study of humpback whale populations ever conducted in the Southern Hemisphere.

By analyzing DNA samples from more than 1,500 whales, researchers can now peer into the population dynamics and relatedness of Southern Hemisphere humpback whales as never before, and help inform management decisions in the sometimes politically charged realm of

whale conservation.

The results of the massive analysis appear in PLoS One, an interactive open-access journal for scientific and medical research. Other contributors to the study include: Columbia University; University of Pretoria; Environment Study of Oman; Instituto Baleia Jubarta and PURCS (Brazil); University of Cape Town; Marine and Coastal Management (South Africa); Faculdade de Biociências; Agence Nationale des Parcs Nationaux (Gabon); Association Megaptera (France); Université de La Rochelle (France).

"Humpback whales are perhaps the most studied species of great whale in the Northern Hemisphere, but many of the interactions among Southern Hemisphere populations are still poorly understood," said Dr. Howard Rosenbaum, Director of the Wildlife Conservation Society's Ocean Giants Program and lead author of the study. "This research illustrates the vast potential of genetic analyses to uncover the mysteries of how humpbacks travel and form populations in the southern ocean basins."

So little is known about southern ocean basin humpbacks that researchers initially used old whaling records for insights into whale population boundaries.

Researchers collected skin samples from 1,527 whales from fourteen sampling sites from the Southwestern and Southeastern Atlantic Ocean, and the Southwestern and Northern Indian Oceans. The populations are known as Breeding Stocks A (Southwest Atlantic Ocean), B (Southeast Atlantic Ocean), C (Southwest Indian Ocean), and X (Northern Indian Ocean), based on information amassed and designated by the International Whaling Commission, including data from 19th and 20th Centuries commercial whaling.

The scientists collected samples from living whales with biopsy darts fired from crossbows. The darts harmlessly bounce off the marine mammals as they surface to breathe. Samples came also from skin which is continually sloughed off by the animals and collected by the research teams.

The scientists used biopsy darts to harmlessly collect bits of skin (and the genetic material needed for the study) from the whales. The small darts bounce off the backs of surfacing whales and then float, enabling the researchers to recover them. Credit: T. Collins

Once collected, the samples were brought to the lab at the AMNH Sackler Institute for Comparative Genomics and examined through a technique called polymerase chain reaction (PCR), which "amplifies" specific regions of DNA which then can be used to statistically inform researchers about gene flow between populations. The research team specifically focused on mitochondrial DNA, which is passed through maternal lines of a population, in order to measure interchange between groups.

The findings so far have revealed:

1. The highest rate of gene flow between populations is between whales that breed on either side of the African continent (Breeding Stocks B and C), with an estimated one or two reproductively active whales every year swimming from one ocean to join whales in another breeding ground. Authors of the current study previously identified the same individual whale in both Atlantic and Indian Ocean breeding grounds at different times, the first recorded instance of a humpback whale traveling between these two oceans.

2. A lower rate of gene flow between humpbacks breeding on opposite sides of the Atlantic (one population along coastal Brazil and the other along the coast of Southern Africa). While no individual whales have been detected traveling across the Southern Atlantic to both breeding grounds, genetic similarities reveal a slight degree of populations interacting. Interestingly, an examination of humpback whale songs between the two populations are similar, another hint at interchange between the two groups, most likely in the whales' feeding grounds in Antarctic waters.

3. Breeding Stock X, which inhabits the northern Indian Ocean off the Arabian Peninsula, numbers fewer than 200 whales and is the most distinct in terms of genetics and migratory behavior. Unlike the other humpback populations, it is non-migratory and only distantly related to the nearest group of humpbacks (which breed off Madagascar and the eastern coast of Southern Africa). As a small, insular group, the "X" population is unique and therefore a conservation priority.

In addition to examining the population boundaries of humpbacks in the Southern Hemisphere, the study also gives scientists some insight into the mysterious and mercurial nature of marine ecosystems, with

currents, water depth, and other unseen factors serving as shifting conduits and barriers between marine populations and ecosystems.

Researchers from the Wildlife Conservation Society, the American Museum of Natural History, and other organizations have conducted the largest genetic study ever on humpback whales in the Southern Hemisphere. Here, crew members observe several humpbacks off the coast of Madagascar, one of 14 study sites in the south Atlantic and Indian Oceans. Credit: Julie Larsen Maher (c) WCS

On an interesting historical note, Rosenbaum and his co-authors used old whaling records to guide their research on whale populations. One set of charts—titled "The Distribution of Certain Whales as Shown by Logbook Records from American Whale Ships"—was compiled by Charles Townsend of the New York Zoological Society (now WCS) and recorded the locations of more than 50,000 whale captures (including humpback whales) between 1761-1920. According to the charts, many humpback whales were captured in the Gulf of Guinea, Southeastern African and northeastern Madagascar, the same locations where humpbacks congregate today. "Townsend was attempting to identify distribution and possible boundaries between whale populations or 'breeding stocks,'" noted Rosenbaum. "We're still trying to answer the same question with molecular technology in concert with whaling logbook records."

"Understanding the needs of humpbacks and other whale species can be challenging in terms of direct observations of these animals in the wild. Molecular technology gives us a window into the lives of whales that can help us understand the ecological forces shaping their movements and distribution," added Rosenbaum. "We can also use our findings to inform management decisions for a species that is only now beginning to recover from centuries of commercial whaling."

The humpback whale is a baleen whale that grows up to approximately 50 feet in length. The species has distinctively long pectoral fins and a head with knobs on the top and lower jaw. The humpback is also known for its acrobatics (such as full body breaching) and haunting songs, typically sung by males and possibly a mating behavior. The slow-swimming species was hunted commercially until the International Whaling Commission protected the species globally in 1966. Current estimates for humpback whale numbers are widely debated. While they are recovering, total population sizes may only perhaps be a small percent of the original global population.

Source: Wildlife Conservation Society (news : web)