LENFEST OCEAN PROGRAM

RESEARCH SERIES

JANUARY 2010

New study disputes post-whaling population increase for Antarctic minke whales

ARE ANTARCTIC MINKE WHALES UNUSUALLY ABUNDANT?

A SUMMARY OF NEW SCIENTIFIC ANALYSIS:

Ruegg, K., Anderson, E., Baker, C.S., Vant, M., Jackson, J. and S.R. Palumbi. 2010. Are Antarctic minke whales unusually abundant because of 20th century whaling? *Molecular Ecology.*

AN ONGOING DEBATE in the management of Antarctic minke whales concerns whether they are more abundant now than a century ago, before commercial whaling. Some scientists contend that hunting of large whales resulted in an advantage for smaller whales, such as minkes, because of reduced competition for a small crustacean called krill, their main prey. These scientists propose that the Antarctic minke whale population is unusually, or artificially, abundant. Some stakeholders now argue to allow for an increase in minke whale catch, in part to aid in the recovery of other whale species.

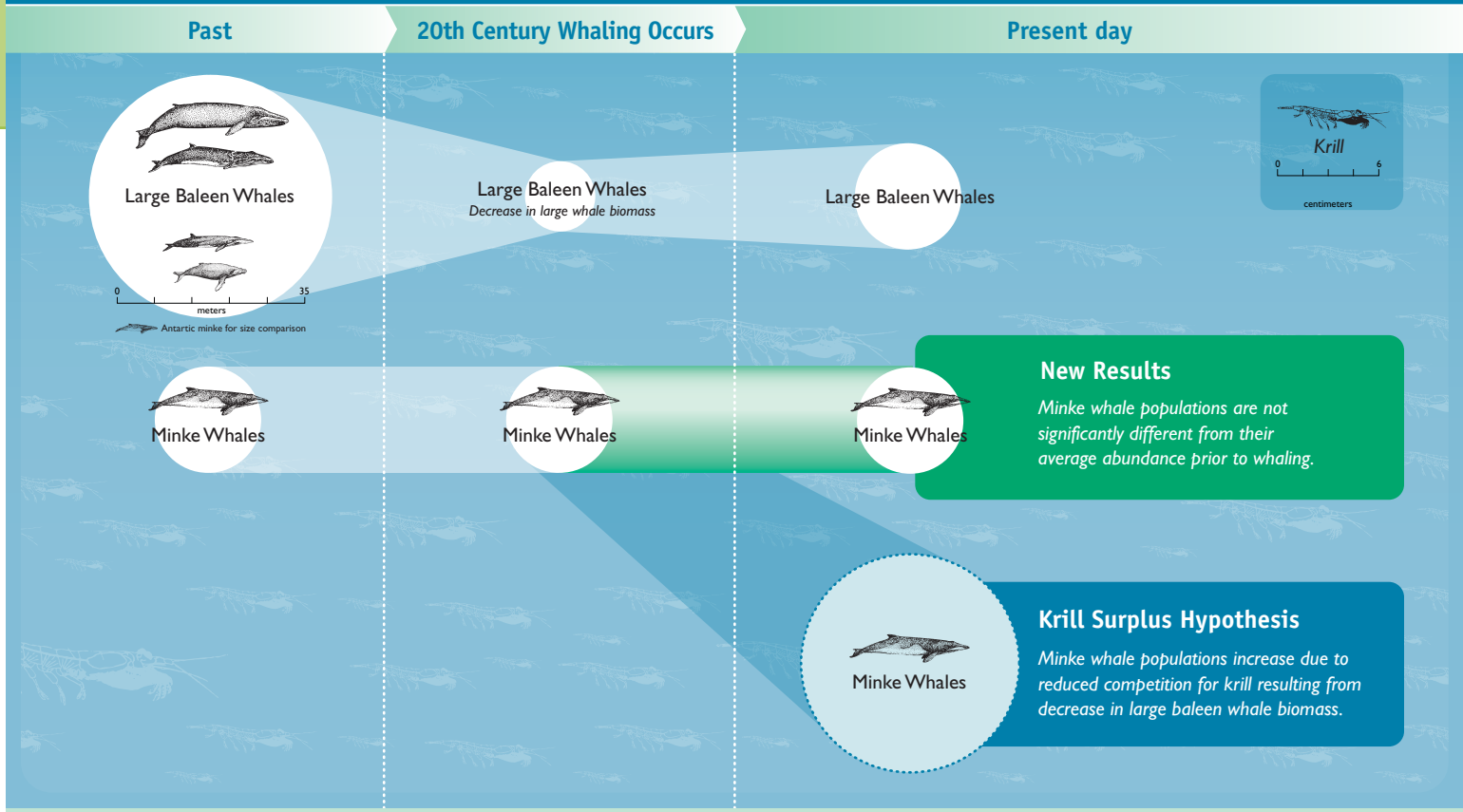
Using analyses of genetic diversity, Kristen Ruegg, Eric Anderson, Scott Baker, Murdoch Vant, Jennifer Jackson and Stephen Palumbi estimate that the long-term population size of Antarctic minke whales falls within the range of estimates from three modern-day surveys of minkes in the Southern Ocean. The study, published in *Molecular Ecology*, does not support the proposition that an unusually large population of minke whales is competing with other whale species for a limited supply of krill. This *Lenfest Ocean Program Research Series* report is a summary of the scientists' findings.

WHALES IN THE ANTARCTIC ECOSYSTEM

In the Southern Ocean, large whales such as blue, humpback, sei and fin whales, share the water with smaller Antarctic minke whales. All of these whales use baleen plates in their mouths to filter feed for krill.

In the 20th century, whalers removed more than two million large whales from the Southern Ocean. Some scientists suggest that this sharp reduction in large whales meant that more krill were available to minke whales and other krill predators, which artificially boosted their populations roughly between three and eight-fold. This idea, known as the "Krill Surplus Hypothesis," is debated because there is little evidence to judge the pre-whaling population size of minke whales.

FIGURE 1: SCENARIOS OF POSSIBLE WHALE POPULATION DYNAMICS BEFORE AND AFTER WHALING



The "Krill Surplus Hypothesis" suggests that the sharp reduction in large baleen whale populations due to whaling made more krill available for consumption by minke whales, artificially boosting minke whale populations. This new study indicates that minke whale populations are not significantly different from their average population size before the loss of large baleen whales. These results suggest that competition for krill is not a major factor determining minke numbers. The white circles in this figure approximate the general size of the whale populations over time.

ESTIMATING HISTORIC WHALE POPULATIONS USING GENETIC DIVERSITY

Managing exploitation of species in an ecosystem like the Southern Ocean requires knowledge of the influences shaping it, such as whether whaling or sea ice is driving species abundance. Because it is difficult to design a controlled experiment for such a large and complex ecosystem (e.g., post-whaling, animals are not usually removed to find out what happens to the rest of the ecosystem), other types of analyses are necessary to find out why the ecosystem functions the way it does.

Ruegg and her colleagues used an analysis of genetic diversity to estimate the long-term population size of Antarctic minke whales prior to whaling. The scientists extracted genomic DNA from 52 whale meat samples purchased in Japan from minkes killed within four Antarctic management areas. These samples allowed the authors to estimate genetic variation within the Antarctic minke whale population. Large populations tend to have greater genetic variation than small ones, which have more inbreeding. Thus, the amount of genetic variation should correlate with the size of the population; if it does not, the findings may indicate that the current population is either smaller or larger than it once was.

According to Ruegg et al's analyses, the long-term population size of the Antarctic minke whale is estimated at 670,000 individuals. This number falls within the range of several modern sighting survey-based minke whale population estimates conducted under the supervision of the International Whaling Commission, the intergovernmental body responsible for the management of whale stocks.

TOP-DOWN VERSUS BOTTOM-UP CONTROL

Ecosystems can be shaped by how much and what kinds of food consumers eat, as well as the quantity and type of resources available. Ecologists refer to "top-down control" when consumers, such as sharks, tuna and marine mammals, exert the greatest influence on ecosystem dynamics. In this case, a top consumer, such as a large whale, could control how much prey is available for smaller whales and indirectly influence the abundance of the smaller whale species.

An ecosystem can also be shaped by bottom-up influences, or changes in the resource base, such as shifts in nutrient, plant or prey availability. For example, in the Antarctic ecosystem, the amount of sea ice, rather than the number of predators, could regulate how much krill is available.

Managing exploitation of species in an ecosystem like the Southern Ocean requires knowledge of the influences shaping it, such as whaling or sea ice cover.

CONCLUSIONS AND IMPLICATIONS

This population estimate provides evidence that the current number of Antarctic minke whales is not artificially high. This result is inconsistent with the idea that an overly abundant population of minke whales is competing with other whale species for a limited supply of krill. Ruegg et al. speculated about several possible explanations for the absence of a boom in minke whale populations after so many large whales were removed. First, minke whales may have never experienced strong competition for food because krill may have been abundant enough for all predators, both prior to historic whaling and today. Alternatively, minke whales may not eat krill at the same time, in the same areas or at the same depths as larger whales. Lastly, the minke whale population could be limited by factors other than food availability, such as changes in sea ice cover.

Author Scott Baker conducts genetic tests on whale meat purchased in a Japanese fish market.

About the Authors

KRISTEN RUEGG is a postdoctoral researcher at Hopkins Marine Station, Stanford University, Pacific Grove, California, USA.

ERIC ANDERSON is a research scientist at the National Marine Fisheries Service, Southwest Fisheries Science Center, Santa Cruz, California, USA.

C. SCOTT BAKER is the Associate Director of the Marine Mammal Institute at Oregon State University, Professor in the Fisheries & Wildlife Department, Oregon State University, Newport, Oregon, USA and adjunct Professor in the School of Biological Sciences, University of Auckland, New Zealand.

MURDOCH VANT is a research technician at the University of Auckland, New Zealand.

JENNIFER JACKSON is a post-doctoral research associate at the Marine Mammal Institute, Oregon State University, Newport, Oregon, USA.

STEPHEN R. PALUMBI is the Miller Professor of Marine Sciences at Hopkins Marine Lab, Stanford University, Pacific Grove, California, USA.

This study was supported by the Lenfest Ocean Program with additional funding provided by the Marsden Fund of the New Zealand Royal Society.

The Lenfest Ocean Program was established in 2004 by the Lenfest Foundation and is managed by the Pew Environment Group. For more information about the Molecular Ecology paper, please visit www.lenfestocean.org or contact us at info@lenfestocean.org.

These results provide evidence that the current number of Antarctic minke whales is not artificially high.

LENFEST OCEAN PROGRAM

Lenfest Ocean Program: Protecting Ocean Life Through Marine Science

The Lenfest Ocean Program supports scientific research aimed at forging new solutions to the challenges facing the global marine environment.

901 E Street NW, 10th Floor, Washington, DC 20004 • ph: 202.552.2000 • fx: 202.552.2299
email: info@lenfestocean.org • www.lenfestocean.org