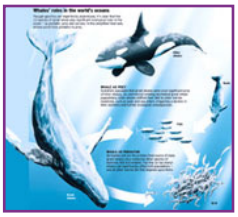
TODAY'S SCENE



Disappearance of great whales would create a huge ecological void

[By Scott LaFee]

From the breaching humpback to the gargantuan blue, the great whales are unmatched by any other animal species in terms of sheer size and spectacle. Their grandeur is both their bane and their blessing.

For centuries, of course, whales were perceived and pursued as a consummate source of food and oil. Commercial hunting decimated them. In just the 60 years from 1920 to 1980, for example, the International Whaling Commission estimates more than 2 million great whales were killed.

But the whales' singular status has also helped save them - at least temporarily. In 1986, an international moratorium on most whaling went into effect. The ban still holds, albeit shakily. Norway, Iceland and Japan are all pressing to expand the harvesting of certain whale species, often under the auspices of "scientific research."

Such claims are derided by conservationists and others, but there is little argument that great whales remain poorly understood.

"The fact is, we just don't know very damn much about them," said Jim Estes, a U.S. Geological Survey research scientist based at University of California Santa Cruz. "I think the implicit view has historically been that whales were just these magnificent, big creatures. Nobody asked the question of what that really meant, whether whales were major players in ocean ecosystems."

In 2003, Estes and colleagues organized an unprecedented scientific symposium to address some of these questions, most notably: Does size really matter? If the great whales were to disappear - a real possibility for some species - what would happen to the world's oceans and remaining inhabitants? "Whales, Whaling and Ocean Ecosystems," a collection of papers inspired by the symposium, has just been published by the University of California Press.

Great whales make difficult research subjects. Despite their size, they are hard to find and follow in the oceans' vastness. Many of the 13 described species spend most of their time in open water, often at great depths. Sperm whales, for example, have been heard by submariners at 8,200 feet, well past the depth of penetrating light. Most species can easily hold their breath for an hour. The maximum may be twice that.

Perhaps the simplest way to consider the ecological significance of great whales, said Estes, is to examine them in three fundamental modes: as prey, as predator and as carcass.

PREY

Conventional thinking depicts food webs and ecosystems as being driven from the bottom up. That is, the fate of the fundamental food source - typically plants - dictates what happens to species further up the food chain. A scarcity of grass means fewer herbivores, which in turn means fewer carnivores feeding upon them.

In the case of great whales, this thinking might not necessarily hold true. Estes and others have proposed that the much-noted declines of sea otters and pinnepeds like the Steller sea lion may be linked to increased predation by killer whales, which began eating the smaller marine mammals after commercial hunting dramatically reduced the numbers of their old prey, the great whales.

This dietary shift, in turn, provoked a cascade of ecological consequences, the researchers contend. With fewer otters to eat them, for example, sea urchins burgeoned in number and eventually overwhelmed kelp forests. Whole local ecosystems collapsed.

Other scientists have dismissed this scenario as too simplistic. They note that the described sequence has not played out in all places, and that evidence of orcas routinely preying upon great whales is scant, anecdotal or inferred.

Estes shrugs at the criticism.

"I'm not saying that this is what has necessarily happened, only that it's a reasonable explanation. These are very complicated ecosystems, and there's very little information about them. Certainly, we need more research and evidence, but I'm reminded of what has happened elsewhere.

"Thirty thousand years ago, the big land animals - mammoths, giant sloths - in North America disappeared. Everybody thought it must have been climate change, but then

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evidence started to turn up suggesting human hunting was a major factor. Now, that's perceived as a real possibility."

In time, he said, the killer whale hypothesis might be, too.

PREDATOR

The importance of great whales as predators depends to some extent upon numbers. Just how many whales existed before the depredations of commercial hunting?

Historical estimates vary widely. Firm numbers don't exist. A 1987 survey by Peter Evans, scientific director of the Sea Watch Foundation, and colleagues estimates that the combined prewhaling population of six great whale species (right, fin, sei, minke, humpback and sperm) approached 4 million individuals.

Others suggest the numbers were far greater. A 2003 study by researchers at Harvard and Stanford universities, which used genetic markers, suggests that for at least some species, prewhaling populations were seven to 12 times higher than previously suspected.

"How abundant is a question more controversial than it should be," said Jeremy Jackson, a research scientist at the Scripps Institution of Oceanography. "The total for all species combined was certainly many millions, so the ecological consequences of the removal of so many behemoths must have been profound."

Jackson and others draw this analogy: Whales were - and are - like bison, whose astounding pre-19th-century numbers (up to 60 million) significantly shaped the nature of the Great Plains.

"Bison urine was a fertilizer that kept the prairies productive," writes Peter Kareiva of the Nature Conservancy. "Bison wallows harbored their own unique plant communities, which were in turn favored by American antelope and other large herbivores."

Surely, the scientists argue, the one-time multitudes of great whales exerted a similar ecological influence on their environment. The exact nature of those contributions is only now coming into focus, example by example.

Case in point: Gray whales are suction feeders that inhale enormous amounts of water and sediment to extract amphipods, tubeworms, shrimp and small fish. In doing so, they release abundant nutrients and organic material into the water column, which feed countless other species.

CARCASS

When a whale dies and sinks to the bottom of the ocean (which most do), it becomes a rare and extraordinary feast for sea-floor inhabitants. Nutrients in the deep ocean are scarce. A fresh, dead whale is a food parcel without parallel: Many tons of protein-and fat-rich tissue and bone, all in one gigantic helping.

"Whale falls are similar to the collapse of a big tree in the forest versus a fallen twig," said Craig Smith, a professor of oceanography at the University of Hawaii at Manoa. "A fresh detrital whale has emergent properties related to size and quality. It is so large and so energy-dense that it creates special circumstances that persist over a long period."

Finding whale falls to observe is a chance affair. Researchers estimate that approximately 69,000 great whales die and sink to the bottom each year, but fewer than 100 whale falls have been studied in depth.

Nonetheless, scientists have broadly described the stages of decomposition in a whale fall - and the novel habitats that arise from that flesh and bone.

The first stage draws transient scavenger species like sleeper sharks, hagfish and crabs attracted by the abundant soft tissue. Depending upon the size of the dead whale, this stage may last from months to years. A 160-ton blue whale carcass, for example, might feed assorted scavengers for seven to 11 years.

Next is the "enrichment-opportunist" stage: Dense colonies of bacteria and invertebrates - mollusks and crustaceans - begin to feed on the lipid-laden skeleton and in the surrounding sediment, which has become enriched by whale tissue fallout. Some of these species are whale-fall specialists. They exist nowhere else. The length of this stage also depends on the size of the whale. A 5-ton whale might last less than two years; a 35-ton whale more than five.

The third stage involves organisms - mussels, amphipods, snails - that extract energy from chemical processes rather than from light. They feed upon sulfide emissions from lingering fats decomposing. As in stage two, many are specialists, found only here or in places like sea vents and ocean-floor seeps. Such a community can last a long time. A single large whale skeleton, said Smith, might sustain it for 40 to 80 years.

In the final stage, the whale is literally a skeleton of its former self. Its picked-clean bones now serve only as a kind of biological reef to which suspension feeders like clams attach themselves, the better to extract scarce nutrients from the water.

FALLING NUMBERS

Probing the breadth and depth of whale ecology is a race against time. While a few species such as the Pacific gray and bowhead appear to be on the road to recovery, other species like the North Atlantic Right (less than 400 individuals remain) teeter on the verge of extinction.

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These whales - and whales in general - confront a host of obstacles to their continued survival: a revival of commercial hunting, climate change, habitat destruction, pollution, errant fishing nets, collisions with ships and, perhaps, damaging noise from human activities.

Estes notes that no great whale species has yet gone extinct on a global scale, but that may not be true much longer. If and when it happens, the ecological repercussions will probably not be immediately obvious, but they may be profound - if not for humans, then for other species.

When commercial whalers in the 19th century radically reduced the number of gray whales migrating up and down the California coast, other species suffered from their loss, sometimes in surprising ways.

One such species was the California condor, which had historically fed upon the occasional dead beached whale. It was a feast no less welcome than whale falls are to abyssal sea life.

With most grays falling to harpoons rather than nature, the birds lost a key source of food. It was just one more factor that helped push the condor to the brink of extinction.

SIDEBAR

The great whale

Blue (Balaenoptera musculus)

Average length: 80-85 feet. Average weight: 100-120 tons.

North Atlantic right

(Eubalaena glacialis)

45-55 feet. 40-80 tons.

North Pacific right

(E. japonica)

45-60 feet. 40-80 tons.

Southern right (E. australis)

45-55 feet. 40-80 tons.

Fin (B. physalus)

62-73 feet. 45-75 tons.

Bowhead (Balaena mysticetus)

45-50 feet. 50-60 tons.

Sperm (Physeter macrocephalus)

36-50 feet. 20-45 tons.

Gray (Eschrichtius robustus)

45-48 feet. 14-35 tons.

Humpback (Megaptera novaeangliae)

40-46 feet. 25-30 tons.

Sei (B. borealis)

45-58 feet. 20-25 tons.

Bryde's (B. edeni)

50-60 feet. 16-18 tons.

Antarctic minke (B. bonaerensis)

30-35 feet. 9 tons.

Common minke (B. acutorostrata)

25-30 feet. 9 tons.