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Marine Mammal Exploitation: Whales and Whaling

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The utilization of marine mammals for subsistence or profit has a long tradition in human history. Seals, sea lions, walrus and sea otters have been hunted for their fur, meat and oil since Neolithic times. Some of these species were later the target of organized commercial hunting, primarily for their pelts. Other coastal species, such as dolphins, manatees and dugongs have been hunted on an ongoing, if limited, basis by many societies around the world. In general, this exploitation did not differ markedly in scale or method from the hunting or trapping of terrestrial mammals, although in the case of the now extinct Stellar sea cow, the result was nonetheless devastating.

The hunting of whales stands out in the history of human resource exploitation because of its global expanse, its dependence on progressive technical innovation and the sheer scale of the slaughter. From its origins along the shores of the Basque province during the 11th century through to the factory whaling fleets patrolling the Southern Ocean during the 20th century, commercial whalers have exploited an international biological resource for short-term gain, even when this was clearly at the expense of a long-term, sustainable utilization. In acting as though the oceans were an inexhaustible resource, the whaling industry brought about a tragedy of the commons on a grand scale. Time and again, agreement on limits to this exploitation was reached only when it was no longer profitable to hunt depleted species or populations. In the case of illegal whaling by the Soviet Union, even these belated agreements were ignored. With the measures of protection now in effect, some populations of whales are increasing in numbers and a few are approaching their pre-exploitation abundance. Other populations, however, remain precariously small and may be drifting towards extinction.

THE WHALERS' PRINCIPAL PREY

Although directed hunting of cetaceans has often involved smaller species such as dolphins and porpoises, the focus of commercial whaling was the great whales. This includes only one odontocete (toothed cetacean), the sperm whale, a pelagic species that underpinned the expansion of the New England whale fleet in the 18th and 19th centuries.

Beaked whales, including the northern bottlenose whale and Baird's beaked whales, have been the target of more localized hunting at times during the 20th century. All of the other hunted large whales were mysticetes (baleen whales), a group that includes the largest of all animals, the blue and fin whales. There are 11 recognized species of baleen whales, divided into four families. These include the rorquals (blue, fin, sei, Bryde's, minke and humpback whales), the balaenids (the bowhead whale, as well as both northern and southern right whales), the gray whale, and the pygmy right whale. Several unresolved taxonomic issues exist concerning species or subspecies designations in blue, Bryde's, minke, bowhead and right whales.

Most of the baleen whales have a cosmopolitan distribution, but there are four exceptions. The bowhead is a Northern Hemisphere species that spends much of its life in the Arctic and is usually closely associated with sea ice. The Bryde's whale is found in all major oceans, but is the only mysticete whose distribution is concentrated in tropical or subtropical waters year-round. The gray whale is found today only in the North Pacific, although a population existed in the North Atlantic as recently as the 1700s. The cause of its extinction is unknown, and may have been related to either whaling or natural factors, or a combination of the two. Finally, the pygmy right whale, a poorly understood Southern Hemisphere species, is the only mysticete to have never been a regular target of exploitation.

Most baleen whales undertake seasonal migrations from productive high-latitude summering areas, where they feed, to mating and calving grounds in warm waters, where fasting generally occurs. Some migrations, such as those of the humpback and gray whale, are the longest recorded for any mammal. Bowheads never leave high latitudes and, as noted above, Bryde's whales remain in warm water year-round. In other species, migratory patterns vary. Because the oil content of whales was greater during the summer feeding season or during migration from the feeding grounds, whalers tended to focus their hunting at these times. Whales on the return migration from the winter breeding grounds were dry, having lost between one-third and one-half of their renderable oils from fasting.

OPPORTUNISTIC ENCOUNTERS AND SUBSISTENCE HUNTING

Historically, the utilization of large whales took a variety of forms. Many primitive societies took advantage of occasional drift (stranded) whales as a supplement to other sources of nutrition and a source of material (bone and baleen) for tools, utensils and ceremonial items. The Wampanoag of the northeastern coast of the United States (US) and the Maori of New Zealand, for example, frequently availed themselves of beached animals, but did not

actively engage in directed hunting of whales until colonial times. A relatively small number of societies took to sea in pursuit of whales. For these people, particularly the Inuit of the Arctic, whaling was, and continues to be, a central part of both their diet and culture. The origins of this aboriginal whaling probably date back thousands of years. A carving on a sandstone wall in southeastern Korea made about 6000 BC clearly shows a boatload of men harpooning a whale.

Methods of capture varied in directed aboriginal whaling. A variety of cultures in the Pacific region used darts tipped with the poison aconite to kill whales. This must have been a wasteful hunt: given the delayed effect of this poison, the number of animals eventually caught probably represented a small percentage of those actually struck and killed. Early harpoon-based fisheries used shafts tipped with stone points; in some Arctic hunts, sealskin floats were attached to the harpoon line to make the submerged whale easier to follow, and to impede its ability to move and dive, thus hastening the lethal strike with a lance or other weapon. Directed aboriginal whaling relied mainly on slow coastal species such as humpback, right, gray and bowhead whales. A number of cultures exploited the herding instinct of pilot whales by driving them into shallow bays where they could be killed easily; in addition, Arctic peoples often made use of ice entrapments (sassets) to kill entire pods of toothed whales, notably narwhals and belugas.

Examples of aboriginal whale hunts survive today in places as far apart as Indonesia, Greenland and North America. Many native societies that came into contact with the expanding European commercial whale fishery adopted its more efficient methods. By the late 1800s, this included the replacement of hand-thrown implements with guns or explosive harpoons. In some cases, modern subsistence hunting was initiated after contact with commercial whaling (as occurred during the 19th century in the Caribbean island of Bequia and the South Pacific Kingdom of Tonga), or was resumed after a long hiatus (such as with the Makah Indians of the northwestern coast of the US). Japan, which has a long history of opportunistic and directed whaling, developed systematic commercial hunting in the 17th century based on entangling whales in nets. This allowed villages to take species that had previously been difficult to capture by harpooning alone, including gray, right, humpback and fin whales.

EARLY EUROPEAN AND YANKEE WHALING

The earliest sustained commercial whaling, for which reliable records exist, was the Basque right whale fishery in the Bay of Biscay. Market records and tax documents indicate that this enterprise was operating as early as the 11th century in southern France and northern Spain. The Basques were instrumental in the expansion of European whaling

into the New World: their whalers were operating by 1530 in Labrador, where they killed right whales as well as bowheads. Declining catches combined with general European exploration resulted in the opening of new whaling grounds in the Arctic in the early 17th century. This expansion was led by the Dutch and Germans, closely followed by the British and French, with the Basques often employed as harpooners. Bowheads were the principal targets of the Arctic fishery, and exploitation was so intense that the species was effectively extirpated from some areas, notably Spitsbergen. During the same period, colonial settlers in New England began hunting right whales. This pursuit began in earnest in the late 1600s and crashed by 1750, when few whales remained in the coastal waters of the region.

Early European whalers, although using large sailing vessels to find whales, had relied on towing the carcasses to shore for processing, a practice that limited them to coastal or ice-edge species. Despite this limitation, the slow moving right and bowhead whales were depleted (and the gray whale was extinct) in the North Atlantic by the late 18th century and whalers were forced to look to other oceans and species for profit. This expansion was led by the Yankee whalers of New England and aided by technological improvements, including larger vessels fitted with a central brick furnace and large iron pots, referred to as the try-works, used for rendering the oil from the blubber and scraps of the whale. In 1791, Thomas Jefferson, in his role of Secretary of State, wrote of the American whalers, "They followed the whales farther and farther into the ocean, enlarging their vessels to 60, 100 and 200 tons. Having extended their pursuit . . . , they fell in with the spermaceti whale."

At the beginning of the 19th century, New England whalers were venturing into the Southern Hemisphere in pursuit of right and sperm whales. In 1835, the first North Pacific right whales were killed in the Gulf of Alaska, and soon after, the fishery expanded to the western side of the ocean and the Okhotsk Sea. By 1849, right whales were sufficiently scarce in areas of the North Pacific to cause many whalers to switch their focus to the Bering and Beaufort Seas, where newly discovered stocks of bowheads were being plundered. Later in the 19th century, and continuing into the 20th century, shore stations on the west coast of North America sprang up, taking abundant humpback and gray whales for a few years before local depletion caused the stations' closure.

MODERN WHALING AND THE SOUTHERN OCEAN

During the 1860s, two resourceful whalers (one Norwegian, the other American) independently introduced an innovation that was to change forever the methods of whaling. The harpoon gun (fired from the shoulder or mounted in

more powerful form on the bows of catcher boats) permitted whalers to dispatch whales more swiftly than had ever been possible with hand-thrown harpoons and lances. This invention, together with the equally revolutionary replacement of sail with steam power, rendered even the fastest rorquals fair game, and ushered in the modern era of industrial whaling. Additional improvements in efficiency resulted from use of the compressor to inflate carcasses that would otherwise sink and be lost. Finally, in 1925 the introduction of the factory ship freed whalers from any remaining dependence on land stations for processing and thus permitted independent, fully mechanized whaling on the high seas.

The technical advances of modern whaling coincided with the discovery of the richest whaling grounds on Earth. In 1904, a Norwegian whaler ventured into the Southern Ocean near the island of South Georgia and noted with astonishment, "I see them in hundreds and thousands." Every species of baleen whale except the bowhead, gray and Bryde's existed in vast numbers in the extraordinarily productive feeding grounds of the Antarctic. With this discovery, the stage was set for a slaughter that has few parallels in the history of wildlife exploitation. Between 1904 and 1980, approximately two million whales were killed in the Southern Hemisphere.

Although catch reports to international agencies for this period showed rapid declines in most species, the full extent of this exploitation was not revealed until 1994 when a group of Russian scientists presented the true catch records of several Soviet factory ships. From shortly after World War II until the late 1970s, the Soviet vessels systematically falsified their records, vastly under-reporting the true catches of some species. For humpback whales, the reported catch was 2710 but the true catch was 48477. For the southern right whale, which had been depleted in the 19th century and protected by international agreement since the 1930s, the reported catch was four but the true catch was 3354. Accounting for these newly available records shows that the true extent of modern whaling in the Southern Hemisphere included over 200 000 humpbacks, 350 000 blue whales, almost 400 000 sperm whales and a staggering 725 000 fin whales. Although we will never know the true abundance prior to whaling, it is probable that between 80 and 95% of the pristine populations of these species were killed during this period.

THE MORATORIUM AND STATUS OF STOCKS

The International Whaling Commission (IWC) was established 1947 in recognition of "the interest of the nations of the world in safeguarding for future generations the great natural resources represented by the whales stocks." Unfortunately, this admirable objective was not quickly or easily

achieved. Although whale stocks were already in decline, and a few species had been protected by previous international agreements, the IWC made little effort and had little power to impose catch limits. By the 1960s even the seemingly boundless stocks of rorquals in the Southern Hemisphere, particularly the humpback and blue whales, had all but disappeared. In 1972, the United Nations recognized the need for urgent action and called for a moratorium on whaling to allow the recovery of stocks. Not until 10 years later, however, did the IWC admit failure of its past management and agree to the need for a moratorium. This moratorium took effect in 1986, banning all commercial whaling and providing time to formulate an adequate management plan for any future hunting. Following several years of development and debate, the IWC agreed to a Revised Management Procedure based on a computer model to determine levels of allowable catch for any future hunting.

Today, some whales are recovering from overexploitation, although few have begun to approach their pre-exploitation abundance. The California gray whale is an exception: after nearly a century of protection, it is now thought to number 26 000 individuals, equaling or exceeding pre-exploitation abundance. Some humpback and southern right whale populations appear to be experiencing strong growth, despite the massive damage inflicted upon them in the 20th century. Nonetheless, a number of exceptions exist involving populations that remain dangerously small. Among the most critically endangered are the North Pacific and North Atlantic northern right whales, bowhead whales of the eastern Arctic, western Pacific gray whales and most blue whale populations. In addition, some local populations appear to have been almost entirely extirpated; examples include the humpbacks and blue whales that once fed in huge numbers around South Georgia, New Zealand humpback whales, Spitsbergen bowheads, Gibraltar fin whales, North Atlantic right whales, and blue whales off Japan.

The reasons for the variability in recovery of stocks are unknown but could include a loss of cultural tradition or fidelity to specific migratory destinations. Recent behavioral and genetic studies indicate the importance of a calf's early experience in determining migratory traditions. If these traditions are lost by local extinction, the pattern of recovery will be patchy. Another possibility is the as yet poorly understood consequences of past illegal or pirate whaling. With the exception of the former Soviet scientists' data, which are still being evaluated, most illegal whalers kept poor catch records. Finally, even low levels of ongoing illegal hunting could be depressing recovery in some stocks. Molecular genetic surveys of whale meat markets of Japan and Korea show that protected species and stocks are still available more than a decade after the moratorium.

ENVIRONMENTAL CHANGE AND THE FUTURE

The ecological impacts of whaling have been much debated, especially for the Antarctic ecosystem where whales were the dominant predator. The principal prey for virtually all mysticetes in the Southern Ocean is krill (euphausiid crustaceans). Even a moderate size whale, such as a humpback, probably requires more than a ton (900 kg) of krill a day for much of the 90–120 day feeding season. By some estimates, the depletion of whales has liberated more than 150 million tons of krill a year into the Antarctic marine ecosystem. This is several times more biomass than taken each year in all the fisheries of the world (estimated to be 60–70 million tons in 1980). Although there is evidence that populations of other predators (such as penguins and some pinnipeds) have expanded as a result of increased krill availability, it is unlikely this has replaced the role of whales. In particular, these other predators do not migrate and the incidental transport of nutrients to tropical waters by formerly abundant whale populations is now vastly reduced. Data on possible density-dependent effects in surviving whale populations are more equivocal, and there is little evidence to support the hypothesis that the recovery of some whale populations is inhibited by interspecific competition from others.

Humans do not as yet colonize the oceans; consequently, unlike many terrestrial mammals, competition for habitat space is not strictly an issue for whales. However, cetaceans are increasingly threatened with human competition for food resources, as well as with habitat degradation from pollution, noise, ship traffic and proliferation of fishing gear. The North Atlantic right whale population, depleted by whaling prior to the 20th century, is now struggling due to mortality from collisions with ships and entanglement with fishing nets in the busy coastal waters of the northeastern US and Canada. The impacts of global climate change on whales (and thus on whaling) are more difficult to assess but could constitute a serious threat in the Southern Hemisphere. Studies have shown that increased ultra violet radiation from ozone depletion can inhibit growth of phytoplankton on which krill feed. Independently, global warming may be influencing the ecological dynamics of invertebrates in the Antarctic marine system. In some areas, salps (tunicates), which are not a dietary component of whales, seem to be displacing krill. Interestingly, data on whales and whaling also provide an indication of global climate change. Whaling records (collected since 1937) appear to show an abrupt southerly movement of the sea-ice edge between the mid 1950s and early 1970s. This suggests a decline of some 25% in the area covered by sea ice, and could imply changes in Antarctic deep-water formation and, consequently, biological productivity. The actual impact of these changes on the recovery of whales remains to be seen.

Like all other life on Earth, however, whales are now unwitting participants in a great and uncontrolled experiment in global ecology and climate change which began with the onset of the industrial revolution.

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