

Resurrecting Leviathan: Reconstructing sperm whale catches in the North Pacific

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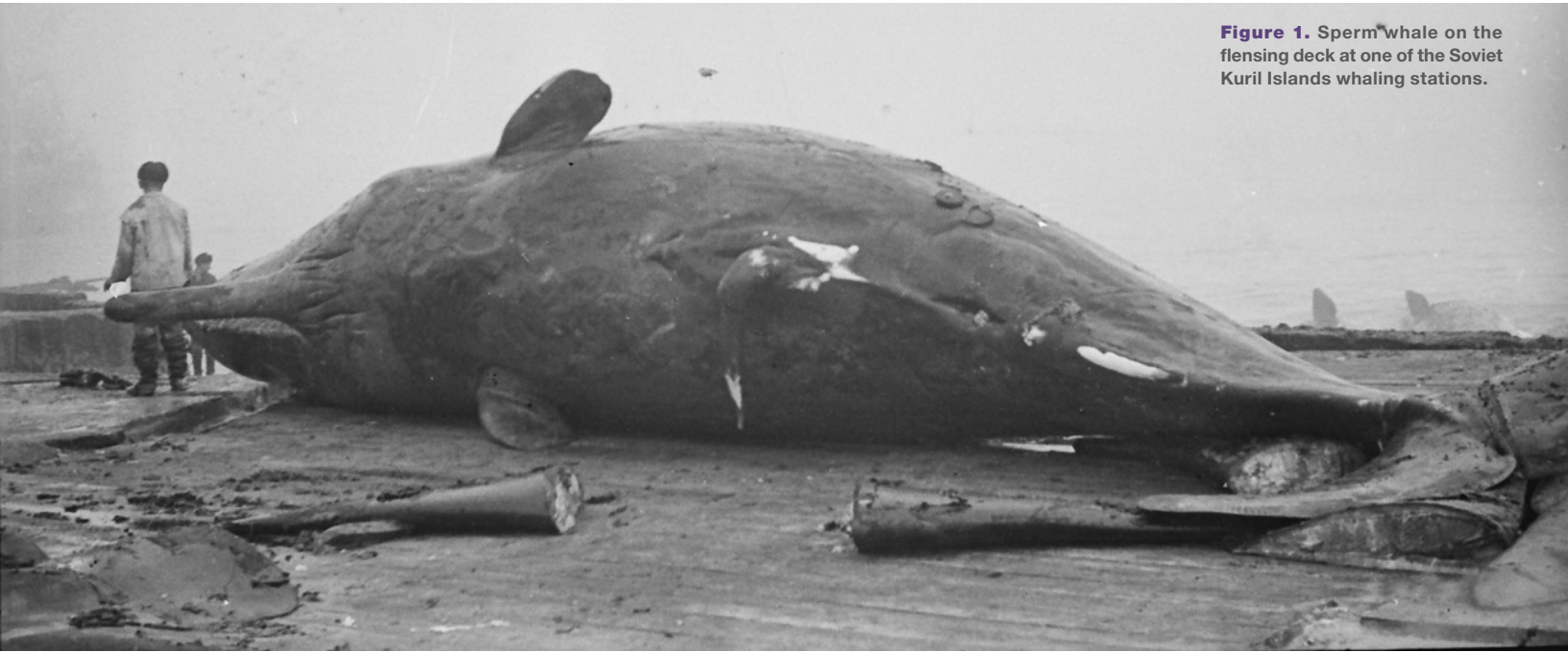


Figure 1. Sperm whale on the flensing deck at one of the Soviet Kuril Islands whaling stations.

To anyone who has ever seen one, the sperm whale (*Physeter macrocephalus*) is among the more bizarre-looking animals on our planet. With its wrinkled skin, giant head, and large teeth arrayed in an oddly underslung jaw, it looks less like a creation of Planet Earth than something put into the world's oceans as a prank by extraterrestrials. Yet this remarkable animal has probably been around for longer than any other living cetacean—perhaps as long as 25 million years—and it is superbly adapted to the pelagic ocean environment in which it expends its long life span. Sperm whales may well be the deepest-diving of all mammals: they can hold their breath for more than 2 hours in extreme cases, and there is good evidence that they can dive to depths of around 10,000 feet. They are a highly socially evolved species, with strong familial bonds evident in groups that travel, forage, and foster their young together. They are found in all the world's oceans and travel thousands of miles on their wanderings.

A long history of exploitation

None of these characteristics, however, saved sperm whales from human greed. Although sperm whale meat is definitely not good to eat—it is so highly oxygenated that it is truly black rather than dark red—the whale's oil is of extraordinary quality, and for many years whale oil quite literally lit the streets of the industrialized Victorian world. Sperm whale oil maintains its lubricative powers at extremes of temperature, and as a result it was much sought-after for use in everything from watches to heavy machinery. Beginning in the late 18th century, American whalers began seeking out sperm whales farther and farther afield from their home bases in New Bedford, Nantucket, and other New England ports. They were joined in these predatory explorations by vessels from other nations, and sperm whalers were often the first westerners to discover new areas of ocean (and sometimes even new lands). So valuable was sperm whale oil that voyages of 4 or even 5 years, taken to the other side of the world, became common during the height of historical whaling in the 19th century.

Through examination of old whaling logs and other historical records, retired NMFS biologist Tim Smith and colleagues estimated that, between 1712 and 1899, some 300,000 sperm whales were killed worldwide, most by sail-based whalers who chased whales from small open boats and used hand-held harpoons and lances to kill them. Occasionally a sperm whale had the upper hand: the most famous case is that of the Nantucket whaler *Essex*, which was stove and sunk by an angry male sperm whale in the Pacific Ocean in 1820; the crew were subsequently forced to endure months in an open boat and eventually resorted to cannibalism before finally being rescued. But although this incident was dramatic (it inspired Herman Melville's classic novel *Moby Dick*) it was an exceptional event even then; and when the invention in the late 1800s of steam-powered catchers and explosive harpoons ushered whaling into a modern, industrialized era, no whale anywhere was safe.

In collaboration with our colleague Robert Rocha from the New Bedford Whaling Museum, we recently estimated that in the 20th century the global catch of sperm whales was more than 760,000. Just over 400,000 of these animals were taken in the Southern Hemisphere, but the total catch for the North Pacific was almost 315,000.

The great majority of the North Pacific catches were made by two nations: Japan and the former U.S.S.R. Both nations greatly intensified their whaling after the Second World War, with large factory ships plying the waters between Japan and the western coast of North America. The Soviets took about 159,000 sperm whales in the years between 1948 and 1979, of which some 23,000 were killed from shore whaling stations in the Kuril Islands (these formerly Japanese islands and whaling operations had been taken over by the U.S.S.R. as reparations following World War II; Fig. 1). This, and Japan's own large catches from land stations—86,379 sperm whales—is testament to the extraordinary productivity of the marine environment in this region.

A Convention, regulations, and violations thereof...

In 1946, both Japan and the U.S.S.R. signed the International Convention for the Regulation of Whaling, which created the International Whaling Commission (IWC) to manage whale stocks, set catch limits based upon scientific advice, and oversee a wide variety of regulations pertaining to the killing and processing of whales. The IWC was, virtually from the outset, a failure: science was ignored and uncertainty exploited in favor of continued profits; major flaws in the Convention allowed member states to delay, obstruct, or ignore measures intended to make catches sustainable and whaling operations transparent.

However, it was not until the 1990s that the extent of this failure became apparent, with revelations from former Soviet scientists that the U.S.S.R. had conducted a global campaign of illegal whaling which began in 1948 and lasted for three decades. The whaling was conducted secretly and on a massive scale, with size limits, protected species, and other regulations largely ignored; recently, we estimated that the Soviets killed 534,119 whales of all species, of which 178,726 were not reported to the IWC despite the whaling regulations requirements. The catches were driven by a relentless industrial system which demanded that ever-higher production targets be met, regardless of the state of the resource being exploited; success meant bonuses and awards, while failure to hit or exceed targets often brought negative consequences for workers and managers.

For North Pacific sperm whales, this huge deception involved not only nations lying about the number of animals taken, but also falsifying the sex and length data for the catches. This was because the IWC had established a minimum legal length for catches of this species at 11.6 m, and many females were smaller than this (in sperm whales, males are much larger than females). Because most of the females killed by the U.S.S.R. were under this length and thus illegally caught, many catches were “transformed” from females to males, and the length adjusted, in official reports to the IWC. For example, in 1970–71 (the year before the IWC finally agreed to place international observers on factory ships) Soviet fleets caught more than 9,000 female sperm whales in the North Pacific, but officially reported fewer than 1,800; in contrast, they killed 5,700 males but reported 12,300.

This gross misrepresentation of the sex ratio of catches led to one of the greater tragedies of this era. Because of the fake catch statistics, the IWC was so concerned that males were under heavy hunting pressure that in 1972 they lowered the minimum size limit from 11.6 m to 9.2 m. The idea was to take pressure off males by allowing more females to be hunted. But in fact it was females that had borne much of the brunt of the catch already, and by lowering the size limit they were now subject to even greater, “legal” hunting pressure.

Reconstructing the true catch

Since the truth about Soviet whaling was revealed, we and our colleague Robert Brownell (Southwest Fisheries Science Center) have worked with former Soviet biologists to reconstruct the true catch of sperm whales and baleen whales. This exercise is essential, because assessments of current whale populations relative to historical abundance levels depend upon possession of an accurate catch series. The Southern Hemisphere catches were corrected in the 1990s, but there remained major gaps in the North Pacific record.

Then, in 2009, one of us (Yulia Ivashchenko) began a doctoral study on this topic and discovered that — contrary to what we had expected — most of the formerly secret Soviet whaling industry reports had not been destroyed but were gathering dust in Russian public archives. These contained the true catch data, unlike the falsified records that were submitted to the IWC. It took many months of sifting through the numerous reports and other materials — Soviet bureaucracy was very good at creating paperwork, much of it irrelevant to our objectives — but with the help of some Russian former whalers it eventually became possible to reconstruct the true catches for most species in the North Pacific (Table 1).

Of the 159,000 sperm whales killed by Soviet whalers after World War II, 25,000 were not reported to the IWC. However, this figure is very misleading because there were also major falsifications of sex and length. In some years and areas, legal-sized females made up less than 2% of the Soviet catch. Catches rose in the 1960s with the introduction of large new factory ships, some of which had more than 20 fast catcher boats. The peak period was between 1963 and 1971 (the last year before an international inspection scheme was introduced by the IWC), when 58,000 sperm whales were killed (Fig. 2). Some 32,000 of these were females, most of them under the legal size limit.

Meanwhile, Japan was also killing large numbers of sperm whales, and we now know that data falsifications were not limited to the U.S.S.R. In 1999 the Japanese scientist Toshio Kasuya published a paper reporting that Japanese shore whaling stations had routinely falsified catch data for sperm whales and other species. The faked data was very similar to those submitted to the IWC by the Soviets, with length and sex misreported for sperm whales. Further details of this were subsequently provided by a retired manager who had worked at the Japanese land stations. Currently, we do not know if these data falsifications extended to the Japanese pelagic (factory fleet) catches, although an analysis in 1983 by British biologist and statistician Justin Cooke suggested that the reported data were suspicious in terms of the length frequencies involved. It may well be that, despite our efforts to correct the Soviet catch, North Pacific whaling data remain compromised.

Table 1. Total catches of whales in the North Pacific by the U.S.S.R., 1948-1979, by species. Note that some catches were over-reported to the IWC to hide illegal whaling or to make catches consistent with reported production data.

Species	actual catch	reported catch
Sperm whale	159,286	132,505
Blue whale	1,621	858
Fin whale	14,167	15,445
Humpback whale	7,334	4,680
Sei whale	7,698	11,363
Gray whale	149	1
North Pacific right whale	681	11
Bowhead whale	145	0
Baird's beaked whale	146	148
Killer whale	401	401
Bryde's whale	3,466	3,517
Minke whale	689	686
Total	195,783	169,615

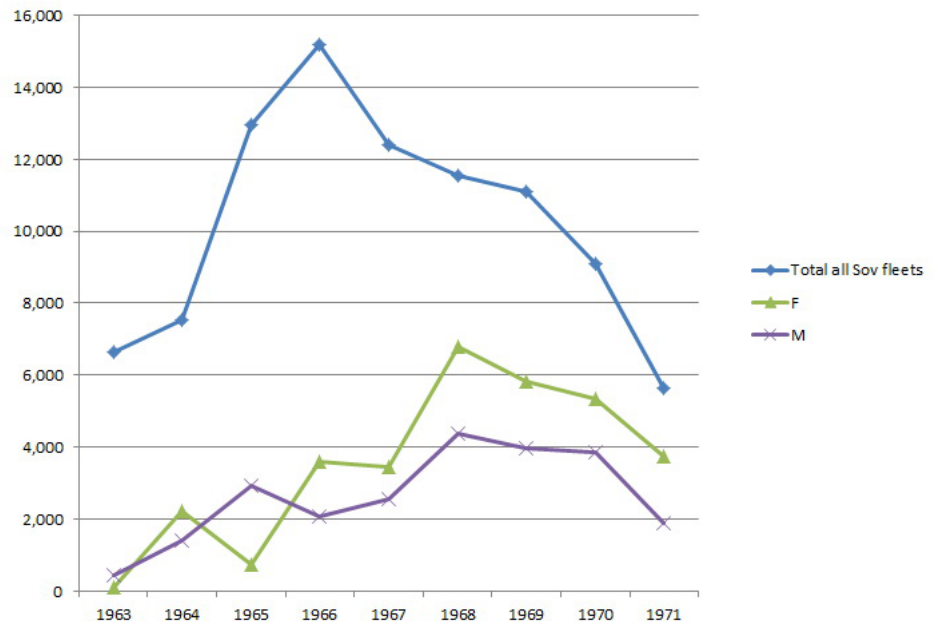
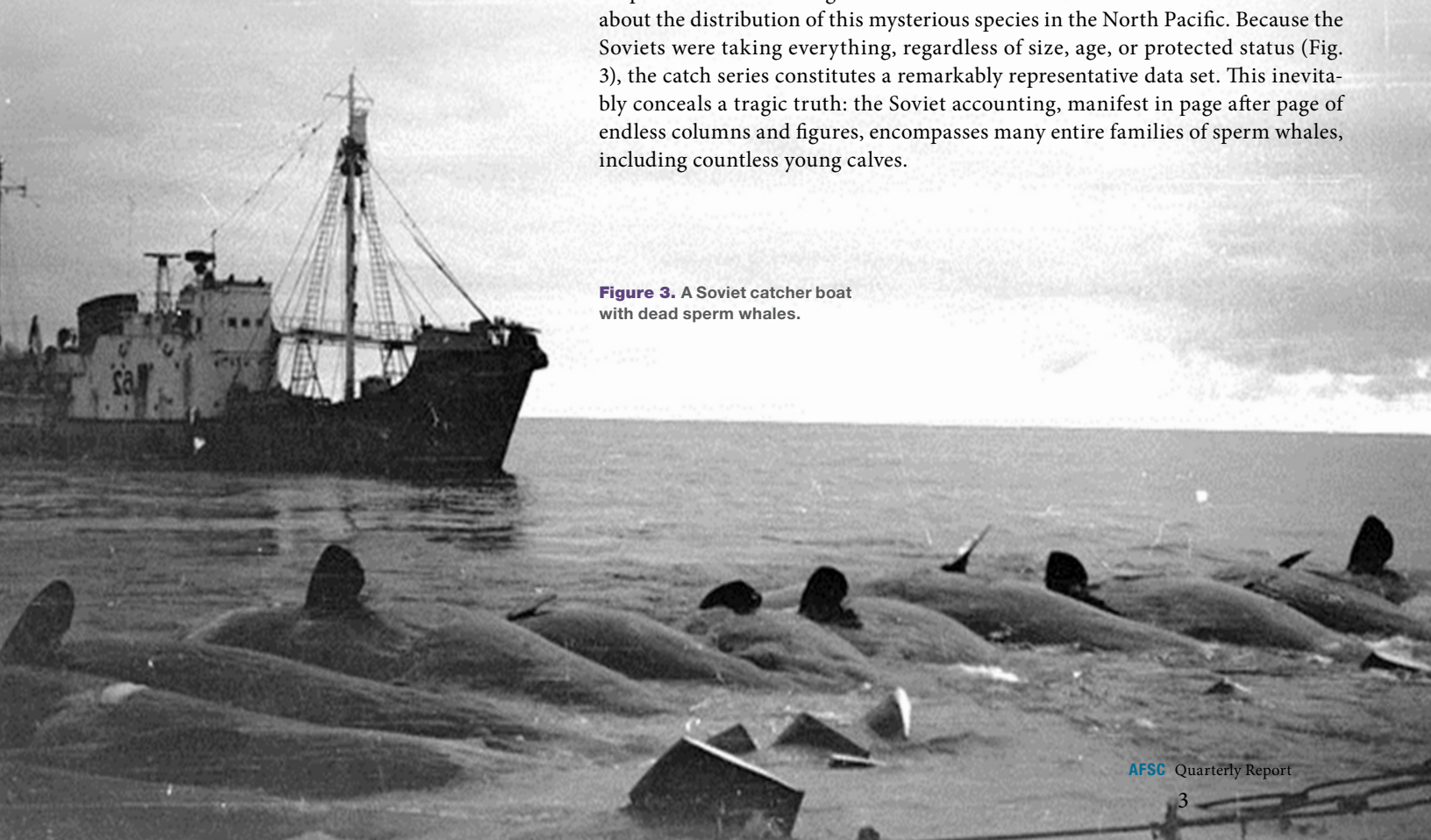


Figure 2. Soviet sperm whale catches (total and by sex, where known) during the peak period of whaling, 1963-1971.

Learning from the past

The only good thing that can be said to have come out of the Soviet illegal catches of sperm whales is the large amount of data now available with which to learn more about the distribution of this mysterious species in the North Pacific. Because the Soviets were taking everything, regardless of size, age, or protected status (Fig. 3), the catch series constitutes a remarkably representative data set. This inevitably conceals a tragic truth: the Soviet accounting, manifest in page after page of endless columns and figures, encompasses many entire families of sperm whales, including countless young calves.

Figure 3. A Soviet catcher boat with dead sperm whales.



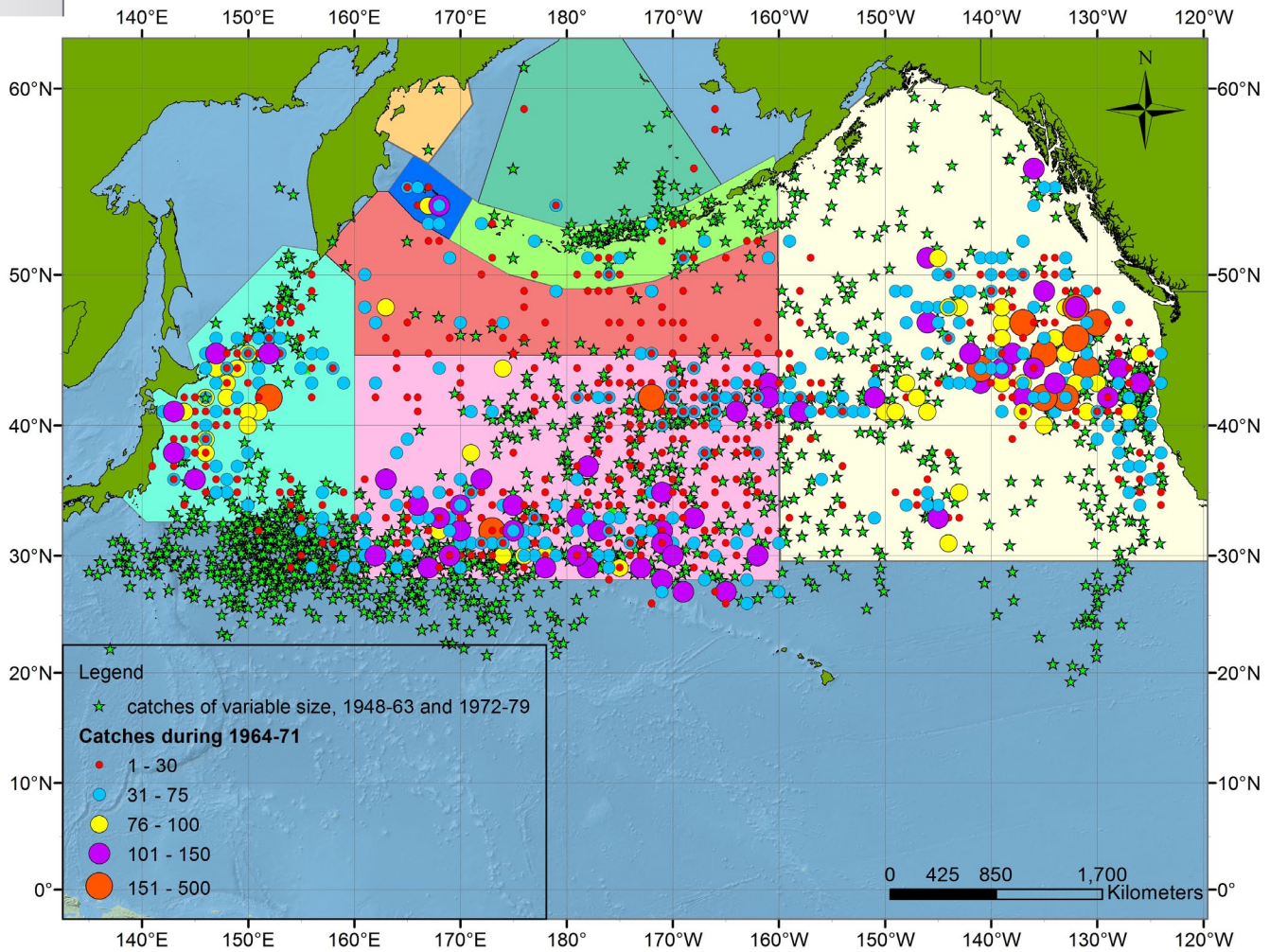


Figure 4. Distribution, where known, of Soviet pelagic sperm whale catches in the North Pacific ($n = 81,035$). Green stars represent catches which are known to be of variable size, but for which numbers often could not be determined; the catch size could be anywhere from one to more than a hundred whales (e.g., the two stars to the west of Kamchatka in the Okhotsk Sea are known to represent more than 200 whales). Catches made by the Kuril Island land stations ($n = 23,090$) are not included.

A look at the catch data shows the breadth of the Soviet whaling effort, which swept most of the North Pacific (Fig. 4). Because sex data are available for many of the catches, we can also examine the distribution of males and females (Fig. 5). By and large, this is as one would expect based upon previous studies: sperm whales are known to be strongly segregated by sex, with mature males foraging in high latitudes and family groups of females and juveniles inhabiting tropical or sub-tropical waters.

However, there are some surprises in the data. Oleutorskiy Bay (which lies at roughly lat. 55°–60°N on the western side of the Bering Sea) seemed to have been occupied by mixed groups that contained a surprisingly high proportion of females. This, and similar catches of family groups from the Commander Islands, contradict traditional assumptions that female sperm whales are largely confined to lower latitudes and adds to recent discussion of similar catches and sightings. It seems that females at least occasionally travel to higher-latitude habitats, presumably in response to favorable oceanographic conditions and the occurrence of prey.

Of further interest is an apparent division of catch composition in the central Aleutians around long. 180° in the vicinity of Amchitka Pass, with family groups to the west and mature males to the east. This division somewhat parallels the situation with present-day transient-type (mammal-eating) killer whale (*Orcinus orca*) populations: a recent study conducted at the Alaska Fisheries Science Center’s National Marine Mammal Lab and led by zoologist Kim Parsons has shown a sharp division in the genetic structure of this species across Amchitka Pass. The reason for this rather pronounced division in sperm and killer whale populations is not clear.

We also compared the Soviet data to positions of 19th century American catches plotted from whaling logbooks by renowned zoologist Charles Haskins Townsend. The Soviets covered a much larger proportion of the North Pacific than Yankee whalers could; nonetheless, some of the sperm whale distribution was very similar to the historical catches, notably in the “Japan Ground” (in the pelagic western Pacific, associated with the Kuroshiro Extension Current) and the “Coast of Japan Ground.” The habitats that were important to sperm whales 150 years ago remain so today.

The status of sperm whales today is largely a mystery in most places. Unlike some baleen whales, sperm whales are extraordinarily challenging to study: their offshore distribution and lengthy dive times make them very difficult to access and investigate. There is little doubt that the huge Soviet and Japanese catches of this species wrought considerable damage to the sperm whale populations of the North Pacific. That these catches included so many mature females, of a species that has a reproductive rate that is generally lower than that of many baleen whales, undoubtedly exacerbated the situation and inhibited the chances of a swift recovery.

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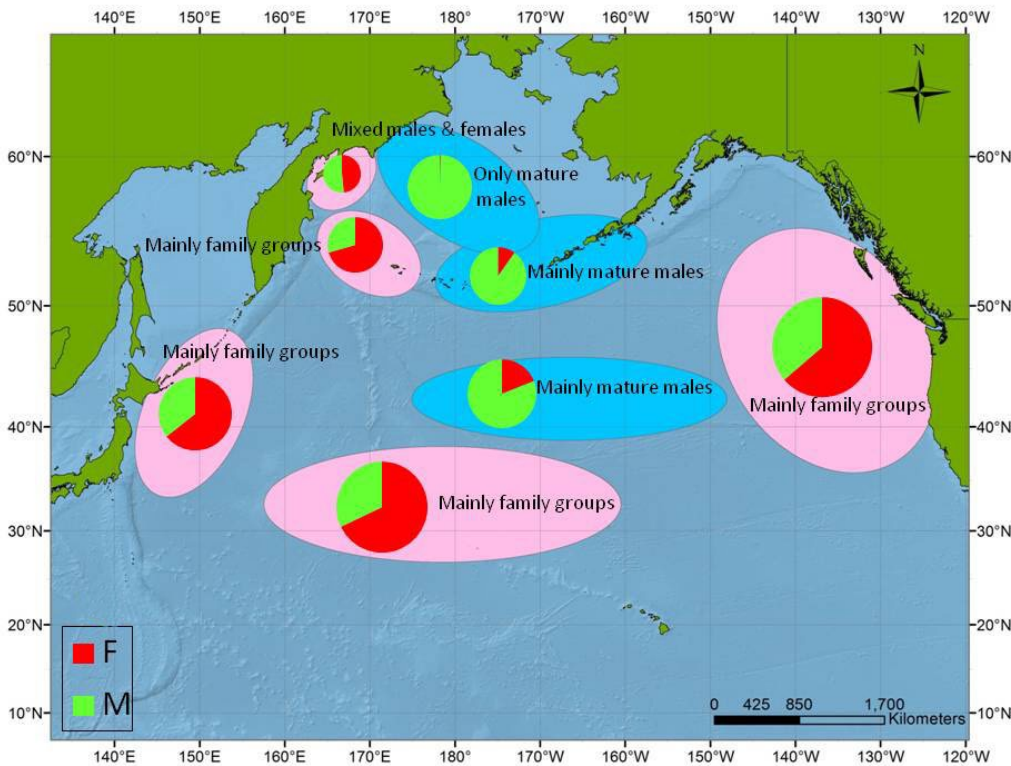


Figure 5. Composition of Soviet catches of sperm whales (F = female, M = male), by area. The size and shape of the ellipses are not intended to represent exact regions but rather to highlight general areas of concentration.

Today, we are attempting to wring as much information as possible from the illegal whaling data. It is our hope that the Soviet bureaucrats' obsession with detail can now be put to use in the service of a better understanding of how to conserve this remarkable species.

Further reading

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