Status of Information on pre-20th Century Sperm Whaling

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Abstract
The results of a workshop designed to develop a program of research on pre-20th century sperm whaling are summarized. Estimates of sperm whale catches are available for the 19th and early 20th centuries on a global basis and for two whaling grounds in the Pacific. No estimates at intermediate spatial scales, or for additional grounds exist. Several tasks were identified to refine the present global estimates, which are possibly underestimates. Further, a program of research based on estimating catches on smaller spatial scales was outlined. Central to this is extraction of geo-referenced information on voyages, including vessel location, catches, and sightings of sperm whales from a stratified sample of the nearly 5,000 extant voyage logbooks. Although American whalers were by far dominant, approaches to determine the intensity of sperm whaling by other nations were also identified.

Introduction
To support the planned IWC Scientific Committee In-Depth Assessment of sperm whales, information on the distribution and intensity of sperm whaling will be required. To address this need, the Census of Marine Life and NOAA sponsored a workshop in July 2002. The report of that workshop (Smith and Reeves 2003) outlined a series of tasks that would be required to adequately prepare the required information (Table 1). Three major analyses were identified: (1) revise global estimates based on aggregated oil production, and based on voyage based oil returns, (2) create voyage-based global estimates, and (3) create voyage-based regional estimates.

These three analyses are at increasing levels of difficulty. The first is straightforward compilation and cross checking of the results of previous data compilations. The second is more difficult in requiring assembling available information on all American voyages, and additional information on non-American catches (e.g. from empire records such as Blue Books). The expectation is that the results of the first two analyses would be similar, and conducting both is partly a cross check of sources.

The third analysis is by far the more difficult and time consuming in requiring extractions of data from a sample of voyage logbooks and assignment of all known voyages to regions. Although difficult, this was the only activity that allowed estimates to be made by regions. Further, the work is straightforward and the methods have been well developed (*e.g.,* Bannister *et al.* 1981, Hope and Whitehead 1991).

The workshop noted that the third activity would necessarily involve interaction with experts on sperm whale population biology and ecology to develop biologically and ecologically appropriate spatial scales for estimating catches. This information is needed because of the large uncertainty about population structure and migration patterns. The reader is referred to Smith and Reeves (2003) for additional details.

Global Sperm Whale Catches Estimated from Aggregate Sperm Oil Production

Best (1983) thoroughly reviewed the data available in published sources for a preliminary assessment of the magnitude of catches from the early 1800s to about 1970. He compiled sperm oil production figures for U.S. and other whaling fleets in the 19th century and reviewed factors affecting them. In addition, he considered various aspects of the open-boat fishery, such as average yields, loss rates, geographical distribution of the catches, and trends in these through time.

In a contract report reviewed by workshop participants, Best (2002) applied some of the lessons learned from his earlier effort and estimated landed catches of sperm whales worldwide for the period 1800-1925. Although he included an adjustment for vessels that were lost, he did not attempt to estimate total removals by adjusting for struck/lost or killed/lost (unprocessed) whales, nor did he attempt to allocate catches to ocean basins or other geographical areas. Reported oil production, by country and by time interval (decade or year), was the basis for all catch estimates. Voyage data from Townsend (1935), Starbuck (1878) and Hegarty (1959) were used to calculate mean yields of sperm oil per whale landed**.**

Several tasks were identified (Table 1) that would result in an improved (i.e., more accurate) series of global catch estimates. This will require the incorporation of data and analyses in addition to those used by Best (1983), but essentially not go beyond revising and expanding Best (1992). Among the key factors that will need to be taken into account are:

- Shore whaling catches at the Azores (and Madeira?), Japan, and any other shore sites.
- Inclusion of new and better data on British sperm whaling, particularly for 1840-56 (e.g., from Chatwin 1997; possibly searching the Public Record Office after consultation with knowledgeable individuals.
- Inclusion of new and better data on German sperm whaling,
- Evaluation of "colonial" production (Best 1983: his Table 3) to confirm that it includes all imports to Great Britain from present-day Canada (e.g., New Brunswick, Nova Scotia, Newfoundland) and Bermuda.
- Evaluation of production attributed to New Zealand, Australia, and Tasmania (Best 1983: his Table 3) to ensure that values are complete and not duplicative with "colonial" production.
- Incorporation of data from Brazil, Chile, and Peru.
- Investigation of Hawaii-based voyages (see Hegarty 1959).
- Application of appropriate loss-rate factors to account for whales struck but not processed (using data from logbooks, including those already available from completed studies by Bannister et al. 1981; Wray and Martin 1983; Hope and Whitehead 1991)
- Inclusion of available data (however incomplete) going back to at least 1760, which has not been as intensively studied and not included in Best (1983).
- Evaluation of completeness of American production data (from Starbuck (1878 and Hegarty 1959).
- Partial correction of Townsend's (1935) catch tabulation by reference to the extant portions of Townsend Abstracts.[1]

Global Sperm Whale Catches Estimated from Sperm Oil Returns by Voyage

Statistics on sperm oil returned for a large fraction of American open-boat voyages have been reported (e.g. Starbuck 1878), and a definitive list of American voyages has recently been published (Lund 2001). The goal here is to develop global estimates based on these and other voyage lists.

The specific tasks identified in Table 1 are elaborated below.

- Compile a comprehensive database of sperm oil production, by voyage, including "new" voyages listed by Lund (2001) that were not listed by Starbuck (1878) or Hegarty (1959). This will mean integration of data from not only those sources, but also from Davis et al. (1997), Wood (1837-73), the Whalemen's Shipping List, and possibly other sources. These data should extend back in time to at least 1760 as possible.
- For early years of the American, British, and other sperm whale fisheries, a rationale and procedure need to be developed to account for undocumented or poorly documented catches. For example, there are years in the 1700s for which it is known that a certain number of voyages were undertaken (Starbuck (1878) refers to 80 Nantucket vessels sailing in 1756, 118 in 1766, etc.), yet there is little or no information on the activities or catches of individual vessels, and all too often the aggregate product returns do not distinguish between whale oil and sperm oil. The range of uncertainty in any estimates for these years will be large, but it is nevertheless important to account, somehow, for the fact that removals were taking place.
- Comparison(s) of voyage production data in various sources (e.g., inbound customs-house manifests, Whalemen's Shipping List, Wood (1837-73, Starbuck (1878) and Hegarty (1959), with the goal of determining directions and magnitudes of bias.

[1] The abstracts of voyage logbooks used by Townsend (1935) for vessels beginning with the letters A through J have been located, and are referred to here as Townsend A-J. The other abstracts have not been located. These have now been scanned into computer images.

- Inquiries need to be made concerning sperm whaling by vessels from Brazil, Chile (A. Aguayo; Codero-Oddo, J. 1984. Whale fisheries on the coasts of Chile, between 1825 and 1840 – typed notes in Alexander Turnbull Library, Wellington, NZ, fide R. Richards MS, 1998), and Peru (R. Clarke, K. Van Waerebeek).
- Further refinements of estimates of oil yield per whale. Best (2002) identified and incorporated differences in yield by vessel-types (brig/schooner and bark/ship). The various logbook extractions already completed (e.g., by Bannister et al. (1981), Hope and Whitehead (1991), Wray and Martin (1983), and Reeves (unpublished)) could provide suitable data.

Regional Sperm Whale Catches Estimated from Voyage Logbooks

There was agreement among workshop participants that a voyage-based approach would be necessary for any reconstruction of sperm whale catch history attempting to allocate catches to regional levels. This means that methods need to be developed to ascertain where whaling was conducted on a given voyage, and therefore where sperm whale catches were made and sperm whale products obtained. Numerous tasks were identified that would contribute to the development of such methods (Table 1).

The magnitude of the required spatial scales would greatly affect the difficulty of the work. For example, spatial scales at the ocean basin level would require less work than scales below the ocean basin. However, workshop participants noted that many American voyages whaled in more than one ocean, and almost all of those that did so transited and frequently whaled in the Atlantic both outbound and inbound as well. Thus, logbooks and other sources of specific whaling locations, such as the trade weekly newspaper, the Whalemen's Shipping List, need to be consulted regardless of the spatial scale desired for estimating catches.

Whaling voyage destinations
An initial assessment is needed to determine the temporal and spatial distribution of voyages for which logbook-level data exist. In addition to the extant logbooks in public collections (Sherman et al. 1986; Lund 2001), the Maury abstracts and the Townsend (1935) extant abstracts provide relatively detailed data from more than 250 logbooks that are no longer available. The Maury abstracts are available for more than 570 voyages.

A basic feature of most statistical compilations of voyages (e.g., Starbuck 1878; Hegarty 1959; Sherman et al. 1986) is destination announced by the captain when departing. These are in the form of one or more ocean basins or a more specific region, such as Hudson Bay or Greenland. The information on voyage destination provides an obvious way of stratifying fleet effort and thus, potentially, beginning to break down product returns or whale catches by region. However, it has been noted that the announced destinations are not always consistent with the information on whaling grounds provided by Sherman et al. (1986) for voyages represented by extant logbooks.

There are several sources of reliable information on where voyages actually went, among these the various published studies based on logbook examinations (e.g., Bannister et al. 1981; Mitchell and Reeves 1983; Wray and Martin 1983; Reeves and Mitchell 1986; Hope and Whitehead 1991; Reeves et al. 2001, 2002), the published index compiled by Langdon (1978), the extant Townsend (1935) and Maury abstracts, the Dennis Wood abstracts, and the voyage data sheets prepared by docents from logbooks held in whaling museum libraries.[2] Some unpublished data are also available on work sheets prepared by other researchers in previous logbooks-based studies.

It should be possible to ascertain the actual destinations of a large percentage of American voyages by reference to the sources listed above, particularly if all "spoken" voyages are taken into account. It would be useful to have reliable destinations of as many voyages as possible entered into a master database that includes all voyages listed by Lund (2001) and any additional voyages identified subsequent to her compilation.

Review of protocols for logbook data extraction
Logbooks normally contain daily information on where voyages actually went. To achieve consistent data extraction from such sources, which were intended to be industrial, not scientific, records, requires carefully developed protocols. Previous studies (e.g., Bannister et al. 1981; Bockstoce and Botkin 1983; Hope and Whitehead 1991; Smith and Reeves in press) have involved particular protocols for extracting biological and other data from whaling logbooks and related documents. Development of data-extraction protocols was a major feature of the 1977 workshop (IWC 1983), and these were used to good effect in ensuing studies.

[2] The readers, often volunteers, who prepare data sheets for museum files are not always referred to as docents, but this term has been adopted herein for convenience.

Previously used protocols need to be reviewed, however, with the goal of identifying additional types of data that should be extracted as well as identifying data that were collected in previous studies but may not have been sufficiently useful to justify their collection. Determining the optimal data collection protocol will require examination of previously-extracted data. However, several issues have already been identified. One is how to consistently record information on the condition (or fate) of struck whales that are not secured in order to standardize the process of assigning probabilities of survival.

Records of "spoken" vessels proved key to catch estimation in the regional studies by Bannister et al. (1981; and see Tillman and Breiwick 1983) and Hope and Whitehead (1991). Although it will be necessary to reconcile differences in the ways these data were interpreted and analyzed in previous studies, what is important to ensure that all entries related to spoken vessels are extracted in detail from "read" logbooks, or "read" portions of logbooks. This must include recording the vessel's presence in an area as well as its reported amount of whale products on board, etc. (e.g., references to trans-shipment, numbers of whales taken or struck/lost, any indication as to when or where catches were/were not made).

Another issue is whether and how to record weather data. For example, although Bannister et al. (1981) classified days with "thick" weather conditions to be non-whaling days on the Japan Grounds, Hope and Whitehead (1991) found that whales were sometimes taken on such days off the Galápagos. The weather issue might be addressed by comparing catch rates that do and do not involve weather judgments. Such a comparison would make it possible to decide whether the improvement in statistical properties is sufficient to warrant the expenditure of time to continue extracting weather data in future studies.

Design of logbook reading

The nature and availability of logbooks and journals (both generically referred to herein as logbooks) varies widely. Most American whaling logbooks are held in public collections (museums and libraries) in the northeastern United States. A large fraction of them has been microfilmed, which makes interlibrary loan feasible for many, but not all logbooks.

As identification and selection of logbooks for data extraction will be a crucial element of any regional catch-history study, the collation of information on logbook quality is needed. Considerable information of this kind is available from published studies in which the quality of the logbooks that were handled is recorded. Museum cataloging records (e.g., index cards, docent data sheets) frequently provide sufficient information for making judgments about quality and completeness of logbooks. In addition, several researchers during the course of logbook research have made notes on whether or not certain logbooks are legible, complete, detailed, etc. with respect to sperm whale catch and effort.

An important consideration is whether data should be extracted in a consistent fashion from entire logbooks, or alternatively, the pattern of most previous studies should be continued, that is, extracting data only from those portions of logbooks that pertain to a discrete research topic, e.g., a whaling ground (Bannister et al. 1981; Hope and Whitehead (1991), an ocean "basin" (Wray and Martin 1983), a whale population (Bockstoce and Botkin 1983), or a species within a particular region (Mitchell and Reeves 1983; Reeves and Mitchell 1986). While it was generally agreed that the ideal arrangement would be to have all of the desired data extracted from all parts of each logbook that is examined (or "read"), the labor-intensive nature of the data-extraction process may mean that such a comprehensive approach is infeasible from a cost or time perspective. If this proves to be the case, the information may need to be collated on patterns of use of the various whaling grounds to help to determine the portions of voyage logbooks that should be read.

Other tasks related to logbook selection are to examine: (1) the representativeness of the voyages for which logbooks are extant, and (2) systematic differences in the nature of the logbooks held by different institutions. In relation to (1), for example, logbooks from especially successful voyages or to particular regions may be more likely to have been retained and deposited in public collections. In relation to (2), it is plausible that the logbook collections in different institutions have different emphases. For example, voyages from New Bedford, Massachusetts, or from Mystic, Connecticut, voyages may be more likely to be retained at institutions in those cities. This should be checked to determine the importance of ensuring access to a wider range of collections.

Sample sizes

Previous studies have used somewhat arbitrary rules-of-thumb in deciding how many logbooks to consult. For example, the 1977 Sharon workshop recommended a minimum of 100 logbooks, a target used for the Bannister et al. (1981) study. In contrast, Bockstoce and Botkin (1983) extracted data from all relevant logbooks that met their requirements of quality and completeness, regardless of statistical considerations. Mitchell and Reeves

(1983) and Reeves and Mitchell (1986) similarly attempted to identify and examine all available logbooks of voyages that they had reason to believe might contain catch data on West Indies humpback whales and North Atlantic right whales, respectively. Smith and Reeves (in press) designed a sampling scheme, stratified by port and voyage returns, to distribute their logbook data-extraction effort efficiently. Given the global scale of sperm whaling, such a stratified sampling scheme may be particularly useful.

To better understand the relationships between sample size and statistical precision, further analyses of data collected by Bannister et al. (1981), and possibly data from other researchers would be useful. Based on the results of these exploratory analyses, in combination with data on the numbers and distribution of extant logbooks, it should be possible to develop a sampling design with specified levels of statistical precision.

Implementation of data extraction

Implementation of logbook-based regional studies will require large commitments of time from individuals with specialized skills. The intention would be to hire/contract people to carry out the data-extraction tasks. They would need to be trained to ensure that data are recorded accurately and consistently, and their work would need to be checked regularly for quality. It is strongly preferred that the work of data extraction should take place in facilities where consultation and collaboration among researchers can be facilitated and encouraged. This was a major benefit during the study by Bockstoce and Botkin (1983), where all of the data extraction was conducted at the New Bedford Whaling Museum. Such arrangements would give the data extractors access to reference materials and expertise (e.g., librarians and curators), so that as uncertainties and novelties arose, they could be handled in an appropriate and consistent manner.

The extracted data would be entered into relational databases linked to the master list of voyages prepared for the global component of the research program. All databases should be designed to allow the complete suite of data to be archived for later retrieval once analyses are complete.

Table 1. Tasks to develop an understanding of the effects of whaling on sperm whale populations, organized into four projects (Modified from Smith and Reeves 2003, Table 1).	
Project	Task
Global Open-Boat Catch Estimates: Aggregate sperm oil production	Compile available shore whaling catches in all regions
	Incorporate additional British, German & S. American pelagic whaling data
	Evaluate potential double- and under-counting of colonial oil production
	Cross-check Starbuck for bias in aggregate oil production
	Evaluate Townsend data and adjust estimate of average oil yield (bbl/whale) to account for bias
	Compile global aggregate production based estimates of sperm whale catches
Global Open-Boat Catch Estimates: Based on voyage sperm oil returns	Develop integrated database of American voyages.
	Develop method to estimate American catches 1760-1810
	Cross-checking experiments for bias in various data sources
	Extract and compile additional data on catches for S. American whaling.
	Extract and compile on catches for British, German, and other non-American pelagic whaling (e.g., New Brunswick, Bermuda, Hawaii)
	Develop improved methods to stratify oil yield estimates (bbls/whale) from logbook data
	Compile global voyage-based estimates of sperm whale catches
Regional Open-Boat Catch Estimates: Based on data from voyage logbooks	Compile and review published information on spatial and temporal patterns in world open boat sperm whale fisheries, including voyage tracks and itineraries (circuits).
	Determine movement patterns of the whaling fleet
	Augment integrated database of American open-boat voyages with more precise locations of whaling catches from published and museum sources (e.g. Sherman, museum docent records, Townsend)
	Assign as possible non-American pelagic whaling voyages from Project 4.2 to region
	Develop gazetteer database structure to receive data as logbooks are read.
	Computerize previously extracted open-boat logbook data (Bannister et al. 1981, others)
	Refine 1977 logbook data extraction scheme, based on data previously extracted from logbooks.
	Evaluate statistical properties of voyage productivity data previously extracted from logbooks.
	5.4Conduct workshop on sperm whale population biology, ecology and abundance to determine regional population structure.
	Design logbook sampling scheme for oceanic region in priority order, including stratification of logbook selection, evaluation of log quality and completeness, and effect of sample size on statistical precision of catch estimates
	Extract data from stratified random sample(s) of logbooks
	Use extracted logbook data to estimate regional catches
	Estimate size and sex composition of catches for regions
	Compute voyage productivity indices for regions
	Combine regional and global catch estimates for areas corresponding to specific populations or stocks of sperm whales.

REFERENCES

Bannister, J.L., S. Taylor and H. Sutherland. 1981. Logbook records of 19th century American sperm whaling: a report on the 12-month project, 1978-79. Rep. Int. Whal. Commn 31:821-833.

Best, P.B. 1983. Sperm whale stock assessments and the relevance of historical whaling records. Rep. Int. Whal. Commn (Special Issue) 5:41-55.

Best, P.B. 2002. Estimating the landed catch of sperm whales in the nineteenth century. Contract report, Northeast Fisheries Science Center, Woods Hole, MA.

Bockstoce, J.R. and D.B. Botkin. 1983. The historical status and reduction of the Western Arctic bowhead whale (Balaena mysticetus) population by the pelagic whaling industry, 1848-1914. Rep. Int. Whal. Commn (Special Issue) 5:107-142.

Chatwin, D. 1997. 'A trade so uncontrollably uncertain': a study of the English southern whale fishery from 1815 to 1860. M.A. thesis, Australian National University, Canberra. 156 pp.

Davis, L.E., Gallman, R.E., and Gleiter, K. 1997. In Pursuit of Leviathan. Technology, Institutions, Productivity, and Profits in American Whaling, 1816-1906. University of Chicago Press, Chicago.

Hegarty, R.H. 1959. Returns of Whaling Vessels Sailing from American Ports. A Continuation of Alexander Starbuck's 'History of the American Whale Fishery' 1876-1928. Old Dartmouth Historical Society, and Whaling Museum, New Bedford, Massachusetts. 58pp.

Hope, P.L. and H. Whitehead. 1991. Sperm whales off the Galápagos Islands from 1830-50 and comparisons with modern studies. Rep. int. Whal. Commn 41:273-86.

IWC. 1983. Report on activities of the International Workshop on Historical Whaling Records. Rep.int. Whal.Commn (Special Issue 5):1-13.

Langdon, R. (ed.). 1978. American Whalers and Traders in the Pacific: A Guide to Records on Microfilm. Pacific Manuscripts Bureau, Research School of Pacific Studies, Australian National University, Canberra.

Lund, J.N. 2001. Whaling Masters and Whaling Voyages Sailing from American Ports: A Compilation of Sources. New Bedford Whaling Museum, New Bedford, MA; Kendall Whaling Museum, Sharon, MA; and Ten Pound Island Book Co., Gloucester, MA.

Mitchell, E. and R.R. Reeves. 1983. Catch history, abundance, and present status of northwest Atlantic humpback whales. Rep. Int. Whal. Commn (Special Issue) 5:153-212.

Reeves, R.R., P.J. Clapham and S.E. Wetmore 2002. Humpback whale (*Megaptera novaeangliae*) occurrence near the Cape Verde Islands, based on American 19th century whaling records. J. Cetacean Res. Manage. 4:235-253.

Reeves, R.R. and Mitchell, E. 1986. American pelagic whaling for right whales in the North Atlantic. Rep. Int. Whal. Commn (Special Issue) 10:221-54.

Reeves, R.R., Swartz, S.L., Wetmore, S.E. and Clapham, P.J. 2001. Historical occurrence and distribution of humpback whales in the eastern and southern Caribbean Sea, based on data from American whaling logbooks. J. Cetacean Res. Manage. 3:117-29.

Rice, D.W. 1989. Sperm whale Physeter macrocephalus Linnaeus, 1758. Pp. 177-233 in S.H. Ridgway and R. Harrison (eds.), Handbook of marine mammals, vol. 4. Academic Press, London.

Sherman, S.C., Downey, J.M., Adams, V.M. and Pasternack, H. 1986. Whaling Logbooks and Journals 1613-1927: An Inventory of Manuscript Records in Public Collections. Garland Publ., New York and London.

Smith, T.D. and Reeves, R.R. in press. Estimating American 19th century whaling catches of humpbacks in the West Indies and Cape Verde Islands. Caribbean Journal of Science: (IWC Sci. Comm. Doc. SC/54/H 15.)

Smith, T.D. and R.R. Reeves, R.R. (eds). 2003. Design of a Program of Research on Sperm Whale Catch History: Results of a Workshop. Available from the Census of Marine Life, History of Marine Animal Populations website: http://www.cmrh.dk/hmapindx.html.

Starbuck, A. 1878. History of the American Whale Fishery from its Earliest Inception to the Year 1876. Report of the U.S. Fish Commission 4, 1875-6, Appendix A.

Tillman, M.F. and J.M. Breiwick. 1983. Estimates of abundance for the western North Pacific sperm whale based upon historical whaling records. Rep. Int. Whal. Commn (Special Issue) 5:257-69.

Townsend, C.H. 1935. The distribution of certain whales as shown by logbook records of American whaleships. Zoologica 19:1-50, 4 charts.

Wood, D. 1837-73. Abstracts of whaling voyages. New Bedford Free Public Library, New Bedford, MA.

Wray, P. and K.R. Martin. 1983. Historical whaling records from the western Indian Ocean. Rep. int. Whal. Commn (Special Issue) 5:213-41.

The sperm whale was commercially hunted in the 18th and 19th centuries for its spermaceti oil, blubber (also for oil), and meat. The Marine Mammal Protection Act of 1972 protects sperm whales in U.S. waters. The only recent quantitative analysis of sperm whale population trends suggests that a pre-whaling global population of about 1,100,000 has been reduced by 67% due to whaling activities. The International Whaling Commission manages sperm whale populations under the International Convention for the Regulation of Whaling, and Schedule of the Convention lists Sperm Whale seasons, sperm whale ? Sperm Whale[1] Conservation status: Vulnerable[2]. File:Sperm whale 12.jpg. Size compared to an average human.Â Over most of the period from the early 18th century until the late 20th century, the sperm whale was hunted to obtain spermaceti and other products, such as sperm oil and ambergris . Spermaceti found many important uses, such as candles , soap , cosmetics and machine oil. Due to its size, the sperm whale could sometimes defend itself effectively against whalers.Â [20] The sperm whale has 18 to 26 teeth on each side of its lower jaw which fit into sockets in the upper jaw. [20] The teeth are cone-shaped and weigh up to 1 kilogram (Template:Convert/LoffAonSoff) Template:Convert/test/A . In the 20th century the concept of whale harvesting began to grow as well as the introduction of factory ships which could be used to hunt, capture and transport whales much more effectively. As technology and the demand of whale goods increased stocks of whales began to significantly decrease causing many species to become endangered. By the late 1930â€™s 50,000 + whales were being killed annually. The large decline in whale populations led to growing concerns among groups and organizations that began to worry about various species of whale becoming endangered and possibly even facing extinctio Between 1990 and 1962, the same number of sperm whales had been killed by industrial methods as had been taken during 18th and 19th centuries. Much of this was down to larger, faster ships and exploding harpoons. Whaling expert said the new number could still be 'an underestimate'.Â Humans have killed 2.9 million whales over the last century in what has been described as 'the largest hunt in human history'. The figure is believed to be the first global estimate of the number of whales killed by industrial harvesting from twentieth-century hunting. Scientists estimate that between 1900 and 1999, 276,442 whales were killed in the North Atlantic, 563,696 in the North Pacific and 2,053,956 in the Southern Hemisphere. Scroll down for video. Whaling changed irrevocably around the 17th century, when advances in technology and increased demand for whale products combined to elevate the practice to a major industry. A Norwegian whaling pioneer named Svend Foyn is credited with heralding modern commercial whaling by developing two key innovations: the steam-powered whaling ship, first launched in 1863, and the harpoon cannon, created in 1868, which shot a harpoon that actually exploded inside the whale once it landed.Â Sperm whalesâ€”which are toothedâ€”were also sought for the oil that could be extracted from the spermaceti organ in its head cavity. An average-size sperm whale could produce around 25 to 40 barrels of oil.