

## Historical Data Sources on the Morphometry and Oil Yield of the Bowhead Whale

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**ABSTRACT.** Historical data sources on the bowhead whale (*Balaena mysticetus*) provide the means to statistically examine the relationships of body and baleen size and oil yield. These data demonstrate a linear relationship between length of the whale and baleen length, with no apparent differences between males and females. Since baleen length was a standard measure of size, it is possible to compare sizes of whales taken on different whaling grounds with the sizes of living whales today. A quadratic regression provides the best fit for baleen length versus oil yield, but a linear regression is best for baleen weight versus oil yield. Commercial oil returns may be useful in examining the evolution of the whaling industry and aspects of population segregation of the bowhead.

**Key words:** bowhead whale, *Balaena mysticetus*, Baffin Bay – Davis Strait, whaling, morphometry, oil yield

**RÉSUMÉ.** Des données historiques sur la baleine franche (*Balaena mysticetus*) fournissent un moyen pour étudier statistiquement le rapport entre la taille du corps et des fanons et la quantité d'huile. Ces données démontrent une relation linéaire entre la longueur de la baleine et la longueur des fanons, les différences entre mâles et femelles étant apparemment nulles. Vu que la longueur des fanons était une mesure standard de la taille, il est possible de comparer la taille de baleines pêchées à des emplacements différents avec la taille de baleines vivant actuellement. Une régression quadratique donne la meilleure relation entre la longueur de la baleine et la quantité d'huile, mais une régression linéaire représente mieux le rapport entre le poids de la baleine et la quantité d'huile. Les bénéfices commerciaux de l'huile peuvent être utiles dans l'étude de l'évolution de l'industrie baleinière et de certains aspects de la ségrégation de la population des baleines franches.

**Mots clés:** baleine franche, *Balaena mysticetus*, terre de Baffin, détroit de Davis, pêche à la baleine, morphométrie, quantité d'huile

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William Scoresby, Jr. (1820:450) remarked on the difficulty of obtaining an unbiased estimate of the size of the bowhead whale:

Large as the size of the whale certainly is, it has been much over-rated; for such is the avidity with which the human mind receives communications of the marvellous, and such the interest attached to those researches which describe any remote and extraordinary production of nature, that the judgment of the traveller receives a bias, which, in cases of doubt, induces him to fix upon that extreme point in his opinion which is calculated to afford the greatest surprise and interest. . . . When the animal inhabits an element where he cannot examine it, or is seen under any circumstances which prevent the possibility of his determining its dimensions, his decision will certainly be in that extreme which excites the most interest. Thus a mistake in the size of the whale could easily be made.

Scoresby continued: "Of 322 individuals, in the capture of which I have been personally concerned, no one, I believe, exceeded 60 feet in length; and the largest I ever measured, was 58 feet." He went on to compare whale size (from the Greenland Sea) in terms of the length of the baleen, using the "size split," the longest plate of baleen or "whalebone." "Fifteen feet is the greatest length of the whalebone; but 10 or 11 feet is the average size, and 13 feet is a magnitude seldom met with." The "size of the bone" became a standard unit of measure of the whaling industry, although the commercial returns were usually registered in terms of numbers of whales, oil yield and weight of baleen (Ross, 1979). Scoresby (1820) noted that the quantity of oil yielded by a whale was proportional to the length of its longest blade of baleen, expressing this relationship in a table of average oil yields for whales from the Greenland Sea. The graph of this relationship is shown in Figure 1.

Brown (1868:539) suggested that Scoresby had slightly underestimated the maximum size of the bowhead, reporting (second hand) a single example of a 65 foot whale taken at Pond Inlet. This whale, a female, was said to have had baleen 10 feet, 6 inches long. "The longest lamina of whalebone which I have heard of being was 14 feet. I have personally known of another 13 feet 3 inches long; but the average is 12 feet and under. This is the middle split already spoken of, known to the whalers as the 'size-split.'" A "size-fish" was a whale with at least 6 feet of baleen, which was equivalent to a 30-foot body length (Brown, 1868; Lubbock, 1937). Brown also stated that the whalers believed the length of the baleen depended on the size of the head and bore no relationship to the length of the body, and that the baleen of the female whales was broader but shorter than the males'.

Whalers' logbooks often recorded the size of the catch in terms of the length of the whalebone. Thus we have a date, a location and an index of the size of the whale taken. Reeves *et al.* (1983) occasionally mentioned the length of the whalebone as an index of the size of whales taken in different parts of the whales' range. For example, they reported (p. 57) that the "Abram (1839) took whales with 11 ft 3 in., 9 ft 11 in., 11 ft, 10 ft, 9 ft 2 in., and 9 ft 1 in. baleen while rock-nosing" on the east coast of Baffin Island. (Rocknosing was a specialized fishery directed at large whales during fall along the east coast of Baffin Island.) Although we are led to believe that these five were mostly large whales, we don't know just how long they were. Thus we are unable to compare the sizes of whales taken then with the sizes of living whales today.

Two data sources provide the means to examine statistically the relationships of body and baleen size and oil yield (Fig. 1). The first, the logbook of the *Cumbrian* in 1823, was originally presented by Lubbock (1937) because it was an

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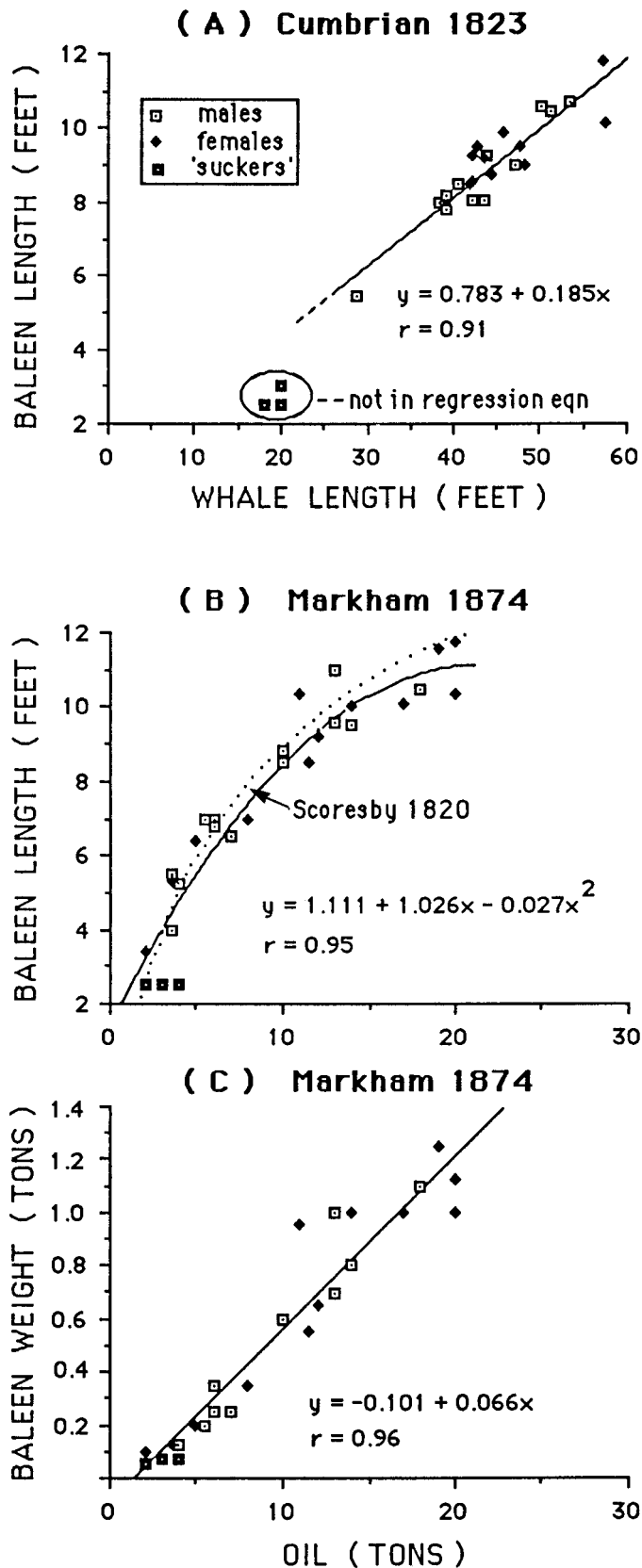


FIG. 1. Length of bowhead baleen in relation to body length (A) and oil produced (B), and weight of baleen in relation to oil produced (C). One long ton (2240 pounds) = 1.016 tonnes; 1 foot = 0.3048 metres.

excellent log with an invaluable set of whale measurements. Indeed, it is probably one of the most complete sets of measurements of the body size of eastern arctic bowheads; the measurements appear to be exacting (to the quarter inch in some cases) and are internally consistent. The year 1823 was a "close season," with a solid ice barrier in Lancaster Sound. Such years were a windfall for the whalers; large numbers of whales were taken, although the oil yield per whale tended to be less because of the prevalence of smaller whales in the Lancaster Sound fishery. However, as Reeves *et al.* (1983:48) show in their expansion of Lubbock's table, the *Cumbrian* succeeded in taking many large whales, "23 in number, yielding probably about 245 tons of oil." The estimate of oil yield was probably based on the number of barrels of blubber and Scoresby's rough conversion of 4 tons blubber to 3 tons boiled oil. Actually, the commercial returns shown for the *Cumbrian* in Lubbock (1937) list 236 tons of oil produced, or 10.3 tons per whale. This yield was better than the average fleet yield of 9.0 tons per whale in that particular ice-barrier year (Table 1).

Although the data from the *Cumbrian* are skewed toward larger whales, they show a strong linear relationship ( $p < 0.001$ ) between the length of the whale and the length of its baleen (Fig. 1A), contrary to Brown's opinion. Also, there does not appear to be any difference in this ratio between males and females. We may now deduce with some confidence from baleen records that the whales taken by the aforementioned *Abram* in 1839 on the rocknosing grounds were very large, some of them approaching 60 feet (18 m). This upper size range agrees well with the size distribution of adult and large subadult whales obtained by photogrammetric techniques on the rocknosing grounds today (Finley, 1990 [this issue]). We can also deduce that 18 bowheads taken by the *Cumbrian* in 1827 (Lubbock, 1937:271) were probably all larger than about 45 feet (13.7 m). Many of these whales were taken during August on the rocknosing grounds along the east coast of Baffin Island. Unfortunately, we do not know the sex of the whales taken by either the *Abram* or the *Cumbrian*.

The second source of data is the journal of Markham (1874), who provided detailed data on 28 bowheads (12 males, 13 females and 3 suckling calves) taken by the *Arctic* in 1873, most of them from the "nursery grounds" in Prince Regent Inlet. Markham provided only the maximum length and total weight of the baleen and tons of oil produced as an indication of the size of the individual whales taken. Although many of the whales taken on the nursery grounds were small (<8 feet of baleen), the *Arctic's* cargo of 285 tons of oil (10.2 tons per whale) was described as the largest ever taken in Baffin Bay (Markham, 1874). This yield was similar to the industry average of 9.9 tons during the period 1861-81, the era of the steam-powered whaleship (Table 1). Markham's data show a strong correlation of baleen-length and baleen weight to the oil-yield from a whale, with the former being nearly congruent with Scoresby's baleen-length to oil-yield curve (Fig. 1: B,C). There is no evidence of a difference between the oil yields of males and females. At the upper end of the regression line are large females (i.e., > 11 feet of baleen, probably > 55 feet [16 m]) that had suckling young. Markham described one of the females, yielding 20 tons of oil, as a "perfect monster." At the lower end of the graphs are three "suckers"

TABLE 1. Oil and baleen yields from bowheads taken in Baffin Bay and the Greenland Sea during the 19th century

Year(s)	Area	Data source	#vessels	#whales	Oil (tons)	Oil yield (tons/whale)	Baleen yield (cwt./whale)
1777	Davis Strait	Scoresby, 1820	1	8	117.5	14.7	—
1814	Davis Strait	Lubbock, 1937	Resolution	44 <sup>a</sup>	299	6.8	—
1814	Spitzbergen	Scoresby, 1820	76	1437	12 132	8.4	—
1806-16	"	"	—	213	1 561	7.3	—
1820	Davis Strait	Lubbock, 1937	7	121	1 545	12.8	—
1821	Baffin Bay	"	11	226.5	2 313	10.2	—
1822	"	"	Active <sup>b</sup>	19	297	15.6	—
1823	Greenland Sea	"	10	121.5	880	7.2	—
1823	Baffin Bay	"	51	872.5	7 832.5	9.0	—
1823	"	"	Cumbrian	23	236	10.3	12.1
1827	"	"	"	18	280 <sup>c</sup>	15.6	—
1827	"	"	14	299.5	3 415	11.4	—
1831	"	"	10	86	1 087	12.6	—
1857	"	"	55	52.5	665	12.7	—
1861-81 <sup>d</sup>	"	"	540	1973	19 433	9.9	9.7
1871	"	Kinnes Lists	Intrepid <sup>e</sup>	24	158	6.6	6.7
1873	"	Markham, 1874	Arctic	28	285 <sup>f</sup>	10.2	10.6
1875	"	Kinnes Lists	Esquimaux <sup>e</sup>	5	40	8.0	10.6
1882	"	"	Mazinthien <sup>e</sup>	11	85	7.7	5.5

<sup>a</sup>Described as the largest catch ever taken by a Scottish whaler, although most were small whales.

<sup>b</sup>Described as the best-fished ship of the entire fleet for that year.

<sup>c</sup>Described by Lubbock (1937:271) at the time as "the largest cargo in the annals of Arctic whaling."

<sup>d</sup>Excludes abnormal year, 1876, and estimate for beluga oil in 1868, '69, '75, '77, '78.

<sup>e</sup>Vessel that visited Isabella Bay (Finley, 1990).

<sup>f</sup>Described as the largest cargo of oil ever obtained in Baffin Bay.

with only 2.5 feet of bone; these three data points are also registered in the *Cumbrian* graph by assuming that suckling calves are about 24 feet (6 m) long (Davis *et al.*, 1983).

We now have the means with which to interpret oil and whalebone yields as evidence of the changing fortunes of the whaling industry in relation to different ice conditions and changing technology. This subject cannot be fully explored here without additional archival research, but to begin with we can examine the data presented by Lubbock (1937) for various years near the beginning and the end of the Baffin Bay bowhead fishery. First, we can compare oil yield in a "close season," 1823 (8.9 tons per whale) with normal seasons, 1827 and 1831 (11.4 and 12.6 tons per whale; Table 1). The lower yield in 1823 agrees with views expressed by Lubbock (1937) and Reeves *et al.* (1983) that the fleet had encountered large numbers of young whales along the Lancaster Sound ice edge; the average yield corresponds to whales with less than 8 feet of baleen (i.e., <40 feet [9 m], the size of small subadult whales). Similarly, the average industry yield (9.9 tons per whale) from 1861 to 1881, following the introduction of steam power, suggests that the dying industry was consuming smaller whales. The oil cargo of three ships that visited Isabella Bay between 1871 and 1882 (Finley, 1990) averaged only 7.1 tons per whale, representing small whales. During this decade many ships, emboldened by steam power, penetrated into the Prince Regent Inlet "nursery grounds" (Ross, 1985). Unfortunately the logbooks of the ships that visited Isabella Bay have not been located, but since they were steam powered, one may speculate that they were among the vessels that entered Prince Regent Inlet.

Judging from the average fleet oil yield of 7.3 tons per whale obtained in the decade 1806-16, near the end of the Greenland Sea fishery, it too was dependent on small whales (Table 1). In 1814, the "greatest cargo ever brought into Great Britain [up to 1820] in one vessel from the whale fishery, was procured near Spitzbergen, by Captain Souter in the *Resolution* of Peterhead. It consisted of 44 whales, which produced 299 tons of oil" (Scoresby, 1820:123). This represents <7 tons of oil per whale, indicative of whales that were much smaller than those taken in Davis Strait in 1777, near the beginning of British whaling, which yielded 14.7 tons of oil per whale (Table 1).

It would be interesting to know whether 8 large whales (average 10 feet 11 inches baleen) taken by the *Cumbrian* in the "south-west" grounds in the spring of 1827 yielded more oil than the 10 large whales (average 10 feet 4 inches baleen) taken in the rocknosing grounds in late summer, when feeding is most intensive. The 18 bowheads produced 280 tons of oil (15.6 tons per whale), believed at the time to be the largest cargo in the annals of arctic whaling (Lubbock, 1937).

Because of the bowheads' rarity and the absence of a bowhead hunt in the Baffin Bay-Davis Strait area, statistics on body size are difficult to obtain. Over the past two years, at least three carcasses of bowheads have been reported in the Eastern Arctic, but very little information was obtained on these whales. In most cases, the baleen was removed and the carcass was left to the usual crowd of polar bears. We examined several strips of baleen obtained from a whale found dead from unknown causes in Cumberland Sound in October 1987. The maximum length of the whale's baleen was 2.97

m (9 feet 9 inches), indicating that it was a large adult about 14.5 m (48 feet) in length. Reliable statistics would be useful in assessing aspects of the mortality of this endangered species. Even a piece of baleen may be useful for the simple size conversions discussed here, and it may also prove to be useful for aging and other biological interpretations if analyzed by isotopic techniques (Schell *et al.*, 1989).

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