

## Assessing struck-and-lost rates in early modern whaling: examination of first-hand accounts

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### Abstract

In this paper I examine first-hand accounts of modern whaling in 1908-15 and extract 31 occasions where the results of harpoons fired at whales were recorded. For 19 whales killed there were no instances where whales were lost after death or being mortally wounded, giving only a 5% probability of the struck and lost rate having exceeded 13.9%. Published logbook data for 56 whales taken by a North Pacific catcher in 1917 indicate a struck-and-lost rate of 7.1% (90% CL = 3.6, 15.6%). I conclude that the adjustment factor of 30% of the landed catch previously used to account for the mortality of whales struck and lost in the early years of the modern whale fishery is too high, and the upper limit (in 95%-ile terms) should be closer to about 15%. The rate for blue whales may have been higher than for other mysticete species.

### Introduction

Recent attempts to undertake a comprehensive assessment of the current status of whale stocks have almost invariably involved the use of a series of catches as one of the major inputs to the model. The completeness or validity of some of these catch series is uncertain, particularly in the early years of modern whaling before the establishment of a recognized system of reporting. A further source of uncertainty, however, is the size of the unreported mortality; those whales that were killed or mortally wounded but lost before being processed.

Such losses could take place in a number of ways: (a) the whale could be mortally wounded but the line broke or harpoon drew so that the animal escaped, (b) the whale could be killed but lost owing to sinking before it could be retrieved, (c) the whale could be killed and secured but lost later while in flag (e.g. in fog, or from shark damage) or being towed to the factory (through breakage of the chain or tail itself in heavy seas). Since the first Schedule of the IWC came into force (in November 1948), member nations have been supposed to report (under Article VII of the Convention):

“... the number of whales of each species taken, *the number lost*, and the number treated at each factory ship or land station, ...”.

Until 1978 there was no further clarification of what constituted a lost whale, and the sense of the text as written could be taken as referring only to category (c) above, i.e. when the whale had been lost in flag or in tow. In the author's experience this was the interpretation that was most widely adopted, and means that to some extent mortalities may have been under-reported. In 1978 the Schedule was revised to include the provision that all whales struck and lost should be reported, which would seem to include all three types of losses described above. Nevertheless,

this change occurred comparatively late in the catch history of most populations, so effectively most catch histories exclude any allowance for whales struck-and-lost in categories (a) and (b).

Recent assessments of southern humpback whales have used a struck-and-lost ratio of 1.3:1, that is, an assumption that for every whale successfully landed another 30% were struck, lost and died but were not processed, and applied this to all catches taken prior to 1914. As the major phase of exploitation on southern humpback whales on the African coast occurred during this period (Best, 1994), it is obvious that the struck-and-lost rate could be an important factor in this assessment.

In this paper I have examined first-hand contemporary accounts of whaling to obtain empirical evidence of the possible loss rate in early modern whaling. Given the rarity of such accounts, I have not confined my research to African operations, or to those taking humpback whales, on the assumption that all coastal whaling at that time experienced similar technical problems that were largely independent of species or locality.

## **Material and Methods**

Accounts by people accompanying whale catchers on the hunting grounds in the years prior to WWI were sought, to establish whether they included data on the fate of each harpoon fired. Five such accounts were found, including one from 1915 that was included because it covered the region of interest, the west coast of southern Africa (Table 1). Two of the accounts that involve 22 of the observations were made by Roy Chapman Andrews (later to become Director of the American Museum of Natural History) and Robert Cushman Murphy (who later became Lamont Curator of birds at the same museum), and there is no reason to doubt the objectivity of the remaining observers.

## **Results**

A total of 31 shots was recorded, of which six (19.4%) were misses (Table 1). Of the remaining 25 harpoons that hit the whale, 14 (56%) resulted in death without a second harpoon being required (although one animal had to be hand-lanced). Another five harpoons merely wounded the animal and a second (or in one case a third) harpoon was required to kill the animal (although in three of these instances the whale was finally dispatched using a hand lance).

There were only single instances where the line broke or the harpoon drew (both with the same whale), but the whale did not escape. There were no instances of the whale sinking after death and being lost.

Of the 19 whales killed, 17 (89.5%) were taken alongside the catcher after death and only one was put in flag (there was no information for one other animal). It is not surprising therefore that no animals were recorded as lost in flag (and there were no recorded losses during towing).

The lack of observed instances of whales struck-and-lost can be used to infer an upper limit to the actual rate of loss. If there is a probability  $p$  of the whale being struck and lost, and hence  $(1-p)$  of it being struck and killed, then in 19 observations the critical  $p$  in frequentist terms is given by  $(1-p)^{19} = 0.05$ , which gives  $p_{\text{crit}} = 0.146$ . This means that if the true  $p$  was greater than 0.146, there would have been less than a 5% chance of the absence of any struck and lost whales in this sample. Using a Bayesian approach, and assuming a uniform prior over  $[0 ; 1]$  for  $p$  (intending this to be uninformative), there is a 5% posterior probability that  $p$  exceeds  $p_{\text{crit}}$ \*

where  $(1-p_{crit*})^{20} = 0.05$ . From that one can conclude that there is only a 5% probability of the struck and lost rate having exceeded 13.9%.

## Discussion

The lack of any observed losses during this early phase of modern whaling may seem surprising, even given the small sample size. A contributory factor may have been the high proportion of whales that were taken alongside after death and not put in flag, so effectively eliminating any losses due to sinking after death or an inability to re-locate the flagged whale owing to fog or inadequate navigation aids. The reasons for this operational decision are unclear but may have been related to the small size and relatively low power of the catchers at that time, which might have severely limited the number of whales they could tow and so reduced the necessity for putting whales in flag.

The perception of high loss rates in early modern whaling may have been fuelled by the observations of whales frequently found floating dead at sea. It is clear from contemporary accounts, however, that many of these early operations did little more than process the blubber and then jettison the carcass. According to Strong (1914), for instance, an estimated 3,150 out of 4,250 whales killed off Angola and Gabon in 1912 were “thrown away”. Although a local Portuguese regulation stipulated that disused carcasses were to be stranded in specified areas, this was seldom done and carcasses were just allowed to drift away.

Published figures for whales lost in modern whaling are highly variable, probably time- and case-specific, and rarely defined. Tønnessen and Johnsen (1982), for instance, refer to loss rates of at least 30% in the North Atlantic during the period 1868-1904 but add that the loss of whales was subsequently almost eliminated. In 1935 they mention that an estimated 18-20% of harpooned whales were lost owing to the line breaking, but seemingly these were mostly the largest and heaviest blue whales. Immediately after WWII there were problems with poor quality whale lines, resulting in average loss rates of 20-25% in the Antarctic (and as much as 42-43% for a land station in Portugal). In none of these cases is it clear whether a lost whale included some or all of the categories mentioned above.

Reeves *et al.* (1985) provide some of the only empirical evidence of loss rates in modern whaling, from their study of catcher logbooks at the Akutan and Port Hobron land stations between 1917 and 1939. Here 45 whales were lost during the securing of 2,426, or a loss rate of 1.9% of the landed catch: this figure assumes that death eventually occurred in 50% of the whales where the harpoon drew (or where the cause of the loss was unknown), and in 75% of those where the line or shackle parted. In the 1917 season, or that closest to the period of interest, the logbook data (for the *Unimak* of 146 tons displacement) indicate 56 whales secured and five lost, two during heaving in after death, two when the line broke, and one for unspecified reasons. Using Reeves *et al.*'s definitions, four of these would be counted as additional mortalities, resulting in a struck-and-lost rate of 7.1% (90% CL = 3.6, 15.6%).

Is there any evidence that this rate could vary between species? The *Unimak*'s logbook reported the successful harpooning of 10 blue, 37 fin, 8 humpback and 1 sperm whale, and the loss of 3 blue, 1 fin and 1 sperm whale. Combining these observations with those in Table 1, and ignoring the single sperm whale record, reported loss rates become 23.1% for blue whales, 2.4% for fin whales, and 0% for sei and humpback whales. The rate for blue whales is significantly higher than that for all of the other mysticetes combined (Fisher exact test, one-tailed  $p = 0.026$ ).

Both the observations in Table 1 and the data from the *Unimak* suggest that the upper limit for the struck-and-lost rate in the early years of the modern whale fishery was likely to be below the value of 30% previously used in assessments, and in terms of an upper 95%-ile probably closer to about 15%.

## Acknowledgements

I am indebted to Randy Reeves (Okapi Wildlife Associates) for consultation and advice, and to Doug Butterworth (Department of Mathematics and Applied Mathematics, University of Cape Town) for assisting with the computations.

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Table 1: First-hand observations of the fate of harpoons fired at large whales, 1908-1915

No.	Date	Locality	Catcher	Tonnage	Species	Result	Fate	Source	Remarks
1	31-May-08	Vancouver Island	<i>Orion</i>		Hump	Kill, secure	Taken alongside	Andrews (1916)	
2	1908	Frederick Sd, Alaska	<i>Tyee</i>	151 DT	Hump	Miss		“	
3	“	“			Hump	Kill, secure	Flagged	“	
4	“	“			Hump	Kill, secure	Taken alongside	“	
5	“	“			Fin	Hit, wound		“	
6	“	“				Hit, wound	Taken alongside	“	Killed with lance
7	1908	Frederick Sd, Alaska	<i>Tyee</i>		Hump	Hit, wound	?	“	Killed with lance
8	“	“			Fin	Kill, secure	Taken alongside	“	Cow
9	“	“			Fin	Kill, secure	Taken alongside	“	Calf
10	1909	Aikawa, Japan	<i>Hogei Maru # 5</i>		Sei	Hit, wound		“	
11	“	“				Kill, secure	Taken alongside	“	Killed with lance
12	“	“			Sei	Kill, secure	Taken alongside	“	
13	1909	Aikawa, Japan	<i>Hogei Maru # 5</i>		Sei	Kill, secure	Taken alongside	“	
14	“	“			Sei	Hit, wound		“	
15	“	“				Kill, secure	Taken alongside	“	
16	1909	Aikawa, Japan	<i>Rekkusu Maru</i>		Blue	Hit, line broke		“	
17	“	“				Hit, h'poon drew		“	
18	“	“				Kill, secure	Taken alongside	“	
19	Jul-09	Saldanha Bay, SA	<i>Frigg</i>		Hump	Miss		Pilkington (1909)	
20	“	“				Hit, wounded		“	

21	“	“				Hit, wounded	Taken alongside	“	Killed with lance
22	Nov 08/09	Durban, SA	?	65	Finback	Miss		“	
23	“	“			Finback	Miss		“	
24	“	“			Hump	Kill and secure	Taken alongside	Durand (1911)	
25	26-Nov-12	South Georgia	<i>Fortuna</i>		Hump	Kill, secure	Taken alongside	Murphy (1947)	
26	“	“			Hump	Kill, secure	Taken alongside	“	
27	“	“			Blue	Kill, secure	Taken alongside	“	
28	“	“			Hump	Miss		“	
29	3 Sep 1915	Porto Alexandre, Angola	<i>COJ (?)</i>		Blue	Miss		Rochester (1915-16)	
30	“	“			Blue (?)	Kill, secure	Taken alongside	“	
31	“	“			Fin	Kill, secure	Taken alongside	“	

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