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Estimation of theoretical operating time in the Antartic whaling

by

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Introduction

Since the early thirties a catcher's day's work has been used as a unit of effort in studies of the Antarctic whale populations (Hjort et al. 1933). As the whaling can only proceed in daylight, the catching time recorded as catcher's day's work gives no correct measure of the effective catching time. Kurogane and Nemoto (1963) found that the actual operating time was longer than the time from sunrise to sunset, and the difference became shorter with proceeding of the catching season. Variation in the operating time was also observed, with alteration in latitudes. On the other side the operating time of the catcher is reduced by engine break down, close of catching because of overfilled cookers on the factory ships, by scouting trips etc.

Data of actual operating time have not been available from Norwegian catchers, but logbooks from the floating factories and reports given by whaling inspectors include some data which may be used in estimating a theoretical operating time, time with suitable lightconditions for whaling.

Theoretical operating time

In the logbooks kept by the floating factories are recorded for each day the position of the factory together with the number of whales caught, the weather conditions at noon and the catching time for each whale, recorded to the nearest half an hour. However, the time recorded is not always the local time, because the clock onboard the floating factory is not set every day. From a study of the time for the first and last whale caught by an expedition during a season, together with the time for sunrise, sunset, beginning and end of different parts of the twilight a theoretical operating time may be defined.

Twilight is due to the scattering and reflection of the rays of sunlight in the upper air while the sun is less than 18° below

the horizon. The duration of the twilight varies with the declination of the sun and the latitude of the observer. This zone has been divided into three parts: civil, nautical and astronomical twilight. The distinction between them is the moment when the depression of the sun is 6°, 12° and 18° respectively.

As a demonstration the catching season 1946/47 for a Norwegian factory ship has been chosen. This season baleen whaling started the 8th December 1946, and during the season the expedition was mainly catching in the area between 59° and 66°S latitudes. Great daily variations are observed in the catching time for both the first and the last whale caught by the expedition (Fig. 1). This is caused by variations in the abundance of whales in the area, variations in weather conditions and orders of stop catching. On many days the first whale is caught just after sunrise (Fig. 1), and the last whale after the end of nautical twilight. Altogether 92.8 percent of the whales are caught when the sun was over the horizon (Table 1); the whales reported after the end of civil twilight made 2.2 percent. All the whales taken after the end of nautical twilight may have been caught in nautical twilight, because the catching time is recorded to the nearest half an hour. However, about half of the number recorded in nautical twilight may have been caught in civil twilight.

Table 1. Number of baleen whales caught under different light conditions by a Norwegian expedition during the season 1946/47.

	December	January	February	March	April	Total
Daylight	409	713	467	346	56	1991
Civil twilight	27	30	20	27	3	107
Nautical "	1	3	8	24	3	39
Astronomical "			1	3	5	9

In clear weather the light conditions are sufficient for doing work inside houses until the sun is down to about 6° under the horizon (Mohn 1908 and 1911), but in nautical twilight it may be possible only to do such work outside houses which need some light. Whales caught immediately after the end of civil twilight may propably have been sighted before sunset or in early civil twilight. It seems reasonable therefore to suggest a theoretical operating time from sunrise to the end of civil twilight, or at midnight when the light condition during a day is civil twilight or better. For the Norwegian expedition the operating time in December and the first half of January lasts 2 hours longer than the time from sunrise to sunset, which is in accordance with the Japanese investigations (Kurogane and Nemoto 1963).

A diagram suitable for estimating the daily theoretical operating ime, is given in Figure 2. Dates and latitudes are coordinates,

and isolines are drawn for any combination of date and latitude with the same relative part of the day with sufficient lightconditions. This nomograph has been constructed from the data in a nautical almanac (Skaar 1963).

The mean theoretical daily operating time for the expedition decreases from about 21 hours in December 1946 to about 12 hours in April 1947 (Table 2). As a mean for the whole season the whaling may have taken place theoretically about 17.6 hours per day. Accordingly about 73 percent of the time in the whaling area the light conditions were sufficient for catching operations.

Table 2. Theoretical operating time of the Norwegian expedition during the baleen whaling season 1946/47.

Month	Number of hours in the whaling area	Theoretical operating time		
		hours	percent	hours per day
December	576	502	87.2	20.9
January	744	638	85.8	20.6
February	672	480	71.4	17.1
March	744	425	57.1	13.7
April	144	70	48.6	11.7

Estimated by the described method, the daily theoretical operating time of the whale catchers is a biased estimate of the hunting time of each catcher. Catchers operating north and south of the factoryships have respectively shorter and longer operating time than estimated by this method, but since the whales have to be processed within 33 hours after catching, the whale catchers must work within a distance of about 60 nautical miles from the factory. This cause only variations in catching time of a quarter of an hour.

The daily period with sufficient light condition depends on the visibility. Clouds, rain and snow-drift cause a decrease in light intensity which further cause a reduction in hunting time. However, the visibility may shift during a day, and it is therefore difficult to estimate the real daily hunting time from the available data. On the other side meteorological factors as bad visibility, strong wind and high swell reduce the chances of sighting a whale and complicate the chasing and shooting, which further cause a reduced efficiency of the catchers. With knowledge of weather data, indices of effort can be obtained in terms of standard weather conditions (Gulland and Kesteven 1962).

Summary

The daily hunting time in the Antarctic whaling depends on light conditions. The theoretical hunting time is defined from

sunrise to the end of civil twilight in the evening or at midnight for days when the depression of the sun is less than 6°. A relative daily theoretical operating time can be estimated by a nomograph (Fig. 2) with date and latitude as coordinates.

A Norwegian whaling expedition spent in the season 1946/47 120 days, viz 2880 hours on the whaling grounds in Antarctic (Table 2), and 73 percent of the time had theoretically sufficient light for hunting operations.

References

Gulland, J.H. and Kesteven, G.L. 1962. The effect of weather on catches of whales. International whaling commission. Meeting of Scientific Committee and Three Scientists, Seattle 6th-19th December, 1962. 7 pp. (Mimeo.).

Hjort, J., Lie, J. and Ruud, J.T. 1933. Norwegian pelagic whaling in the Antarctic II. Hvalråd. Skr. (7): 128-152 and 6 pl.

Kurogane, K. and Nemoto, T. 1963. The influence or meteorological factors on the Antarctic whaling. Norsk Hvalfangst-tid. 52,(4): 89-104.

Mohn, H. 1911. Dagslyset i Norge. Grafiske tabeller. Gröndahl & Søns Boktrykkeri, Kristiania, 2 pp. and 8 pl.

" 1908. Dæmringen i Norge. Videnskabsselskabets Skr. 1. Mathematisk-Naturv. Klasse 1908. (5): 1-76.

Skaar, M. 1963. Norsk nautisk almanakk o sjøfartskalender. Nautisk Forlag A/S Oslo, 764 pp.

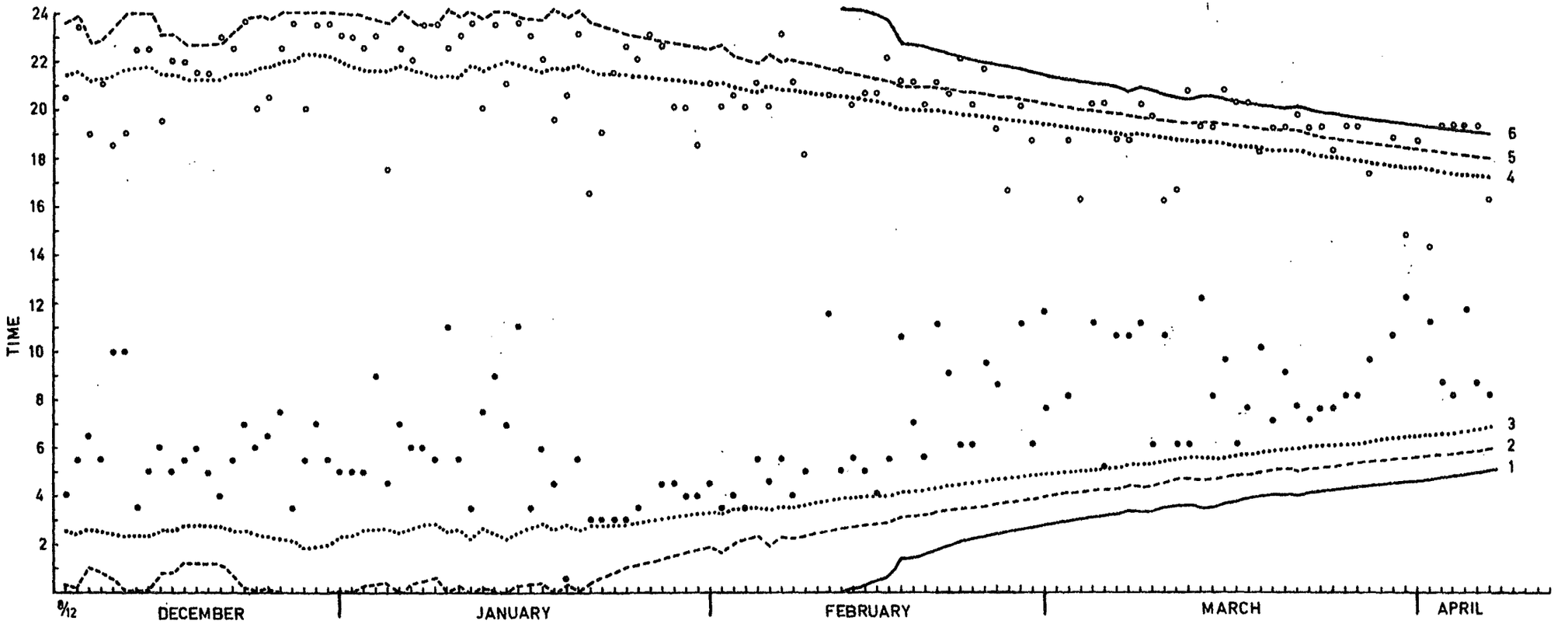

Figure 1. Time of first and last whale caught each day by a Norwegian whaling expedition 1946/47 together with time for sunrise, sunset and for the beginning and end of civil and nautical twilight.
1. Start of nautical twilight. 2. Start of civil twilight. 3. Sunrise. 4. Sunset.
5. End of civil twilight. 6. End of nautical twilight.

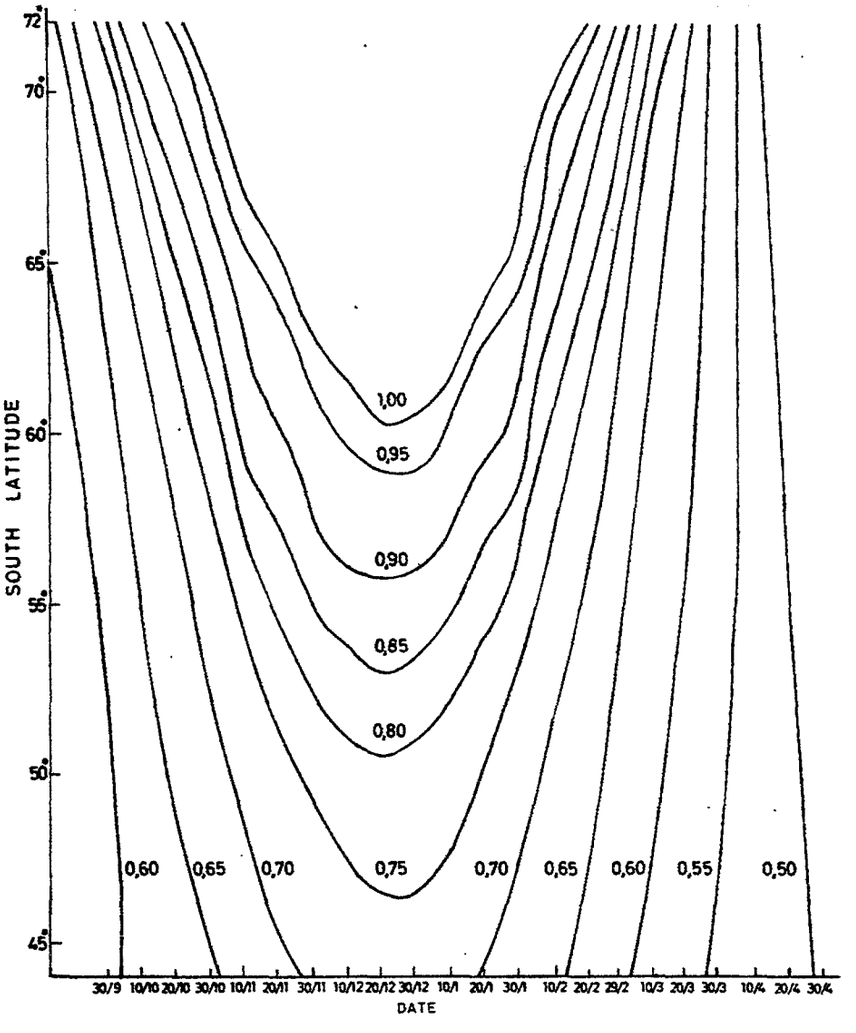

Figure 2. Nomograph for estimation of theoretical operating time. Contours are showing the theoretical operating time from any combination of date and latitude. Number given on each curve is the relative part of days with light conditions sufficient for hunting.