Estimation of Pup Production of Hooded Seal (*Cystophora cristata*) at Newfoundland During March 1985

by

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Abstract

An aerial survey was conducted in March 1985 to estimate the pup production of hooded seals, Cystophora cristata, offshore of the southern coast of Labrador. An area of 61,289 km^2 was surveyed systematically using aerial photographs. Pup production was estimated at 61,435 with 95% confidence limits of 16,496-119,456. This estimate is negatively biased because no adjustment was made for the number of pups which had already left the ice or were yet to be born. These results confirm those of Hay et al. (1985) which indicated that pup production at the Front is considerably greater than previously thought.

Résumé

Un recensement aérien a été réalisé en mars 1985 pour estimer la production de jeunes phoques à capuchon, Cystophora cristata, au large de la côte sud du Labrador. Une superficie de 61 289 km^2 a été couverte systématiquement au moyen de photographies aériennes. La production de jeunes phoques a été estimée à 61 435 individus avec un intervalle de confiance à 95 % de 16 496 - 119 456. Cette estimation est biaisée négativement parce qu'aucun ajustement n'a été fait pour le nombre de jeunes phoques qui avaient déjà quitté la glace ou qui n'étaient pas encore nés. Ces résultats confirment ceux de Hay et coll. (1985) qui indiquaient que la production de jeunes phoques au Front est beaucoup plus élevée que prévu.

Introduction

Hooded seals, Cystophora cristata, are known to whelp in three major areas in the North Atlantic: at the "West Ice" near Jan Mayen Island, at the "Front" off Newfoundland, and in the Davis Strait. A small number of pups are also born in the Gulf of St. Lawrence (Sergeant 1966, 1976). It is not known if there is interbreeding between these population although seals from the Front, Gulf and Davis Strait areas appear to intermix during the non-breeding season (Sergeant 1978; Kapel 1982).

In Newfoundland hooded seals whelp during March and April on heavy ice floes approximately 60-130 km offshore of the southern coast of Labrador. To estimate pup production for the hooded seals is difficult, however, for a number of reasons. First, it is difficult to locate the pupping areas; at the Front over 50,000 km^2 of suitable ice is present in most years. Also, although a large proportion of the pups are born in concentrated areas, substantial numbers of pups remain scattered outside of the main whelping areas (Hay et al. 1985). Finally, the duration of the lactation period is very short in comparison to the total birthing period (Bowen et al. 1985). Therefore, during any one survey, some pups will have already left the ice while others are yet to be born.

Recently pup production has been estimated by Hay et al. (1985) who found that pup production at the Front was considerably greater than previously thought. The purpose of this study is to estimate pup production of hooded seals at the Front to determine if this recent estimate of production is correct.

Materials and Methods

Survey design

To estimate the current hooded seal pup production at the Front a fixed wing aerial survey was carried out from 17-20 March 1985. East - west transects were flown throughout the survey area from 50°N to 53°N (Fig. 1). These transects were flown from the coast to the ice edge and included the region where historically whelping patches have been found (Hay et al. 1985). During each transect, photographs were taken at 8.0 km intervals. The photographic sequence began when the ice was judged heavy enough to support hooded seals and was terminated when the ice was considered to be too thin. Transects were spaced 18.6 km (10 n mi) apart and aircraft position was recorded at the beginning and end of each photographic sequence to allow calculation of the transect length. Surveys were carried out at an altitude of 229 m and a velocity of 267 km/hr.

Aircraft and camera specifications

A twin engine Piper Aztec (CF-ZAZ) aircraft was used for the survey. Altitude was maintained using a radar altimeter and position was determined by

a Zeiss NT2 Nav Sight/Loran-C 20 navigational system. Vertical photographs (23 cm x 23 cm) were taken using a Zeiss A 15/23 camera equipped with a Universal lens (calibrated focal length = 153.201 mm) and an antivignetting filter (#0111490). Kodak Double - X aerographic black and white film (type 2405) was used for all photographs.

Examination of aerial photographs

The number of attended and solitary pups in each photograph was recorded from black and white prints (23 cm x 23 cm). The reader (DW) has had considerable experience in identifying hooded seals on photographs and encountered few difficulties in identifying pups. Each print was examined with an illuminated hand-lens (7-8X magnification) and a 64 cell acetate grid was overlain on each print to facilitate reading.

The transects were plotted on a hydrographic chart (1:500,000) of Mercator projection. The total area surveyed was determined by planimetry.

Statistical methods

The number of hooded seal pups present was estimated by multiplying the area surveyed by the average density of seals, as determined from the spot photographs. Confidence limits for the density estimates were obtained using a bootstrap resampling procedure; a histogram was produced of the mean density of 2000 random draws of the observed data with replacement (Effron 1979). Because information on the developmental stages of the pups surveyed was not available no adjustments were made for the flux of pups.

Results

Table 1 provides a summary of the results of the photo-transects. The locations of the spot photographs in which hooded seal pups were found are shown in Fig. 1. A whelping patch, centered at 52°20'N, 53°00'W, was located on 17 March 1985 (Fig. 2). A second large whelping concentration was located on 23 March 1985, centered near 51°45'N, 52°45'W (Fig. 2). Due to inclement weather and time constraints, a detailed wing aerial photographic survey of either patch was not completed.

A total of 54 pups were seen on 463 photographs, giving an observed density of 1.002 pups/km^2. The survey area was 61,289 km^2. The estimated pup production was 61,435 with 95% confidence limits of 16,496-119,456 (Fig. 3).

Discussion

Our results confirm those of Hay et al. (1985); hooded seals pup production at the Front is considerably greater than previously estimated. Estimates of pup production ranged from 27,000 to 31,000 for the period 1966-71, based on the survival index method (Benjaminsen and Øritsland 1975,

Sergeant 1976, Winters and Bergflødt 1978). Hay and Wakeham (1983a), using a Leslie analysis, estimated an annual production of about 8,000 to 16,000 pups in the Front region from 1977 to 1982, however, these estimates are negatively biased to an unknown extent for reasons given by the authors. A minimum estimate of 5000 pups was derived from an incomplete aerial survey conducted in March 1983 (Hay and Wakeham 1983b). In 1984 an aerial survey for hooded seals which was believed to be complete was conducted at the Front and in the Davis Strait (Hay et al. 1985) and the results were adjusted for the flux of pups on the ice. Their estimated pup production of 62,100 hooded seals at the Front is similar to our estimate of 61,400.

Our results are likely to be negatively biased as they are uncorrected for the number of pups that had left the ice or had not been born on the days the survey was flown. Such a correction for the birthing ogive may be large and is necessary for accurate population estimates (Hay et al. 1985). Although the bias was minimized because the survey was conducted when the maximum number of pups were likely present on the ice, this bias may be as large as 45% (Hay et al. 1985) and should be considered in future surveys.

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Table 1. Summary of results of spot-photo surveys of hooded seals carried out at the Front during March 1985. (Total area surveyed = 61,289 km^2; single photo area = 0.1163 km^2; interval between photos = 8.0 km; survey altitude = 229 m.)

Transect no.	Length (km)	Number photos taken	Number of hooded seal pups counted			Frequency of photos with number of pups equal to							
			With mother	Solitary	Total	0	1	2	3	4	9	14	15
1	242.2	30	15	4	19	27	1	-	1	-	-	-	1
2	183.9	25	9	1	10	23	1	-	-	-	1	-	-
3	186.4	22	5	1	6	19	2	-	-	1	-	-	-
4	165.6	26	0	1	1	25	1	-	-	-	-	-	-
5	222.3	27	1	0	1	26	1	-	-	-	-	-	-
6	244.0	31	0	0	0	31	-	-	-	-	-	-	-
7	261.0	32	0	0	0	32	-	-	-	-	-	-	-
8	239.9	28	0	1	1	27	1	-	-	-	-	-	-
9	106.1	14	0	0	0	14	-	-	-	-	-	-	-
10	116.4	17	0	0	0	17	-	-	-	-	-	-	-
11	139.5	18	0	0	0	18	-	-	-	-	-	-	-
12	118.3	17	0	0	0	17	-	-	-	-	-	-	-
13	136.8	19	0	0	0	19	-	-	-	-	-	-	-
14	206.0	27	0	0	0	27	-	-	-	-	-	-	-
15	282.2	34	2	0	2	33	-	1	-	-	-	-	-
16	128.7	17	0	0	0	17	-	-	-	-	-	-	-
17	146.0	18	14	0	14	17	-	-	-	-	-	1	-
18	275.9	35	0	0	0	35	-	-	-	-	-	-	-
19	132.2	16	0	0	0	16	-	-	-	-	-	-	-
20	121.0	10	0	0	0	10	-	-	-	-	-	-	-
TOTALS	3654.4	463	46	8	54	450	7	1	1	1	1	1	1

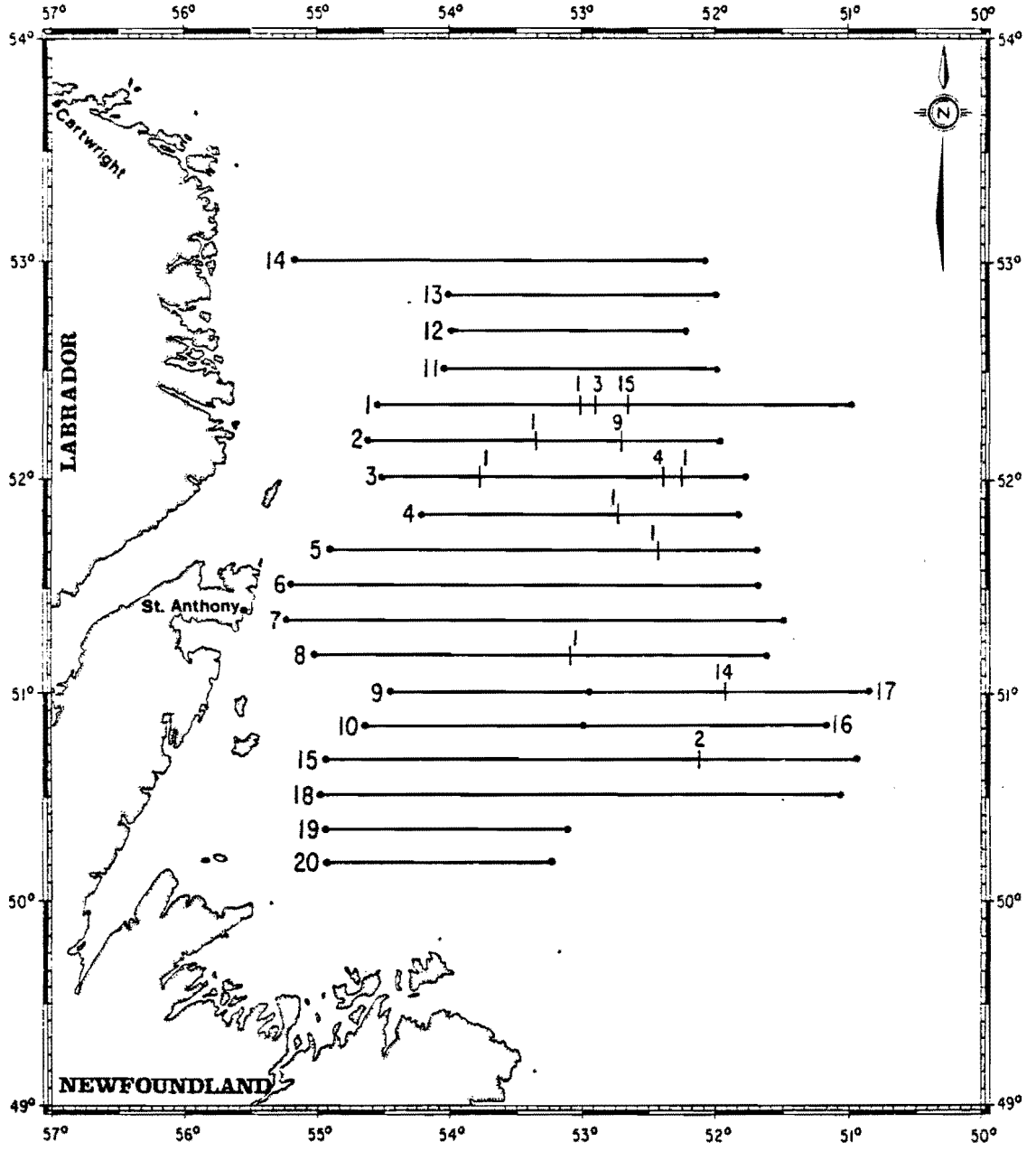

Fig. 1. Photo-transects flown at the Front from 17-20 March 1985. Transects are identified by number at the end of the lines. Vertical bars indicate spot photos containing hooded seal pups. Numbers above the bars indicate the number of pups present.

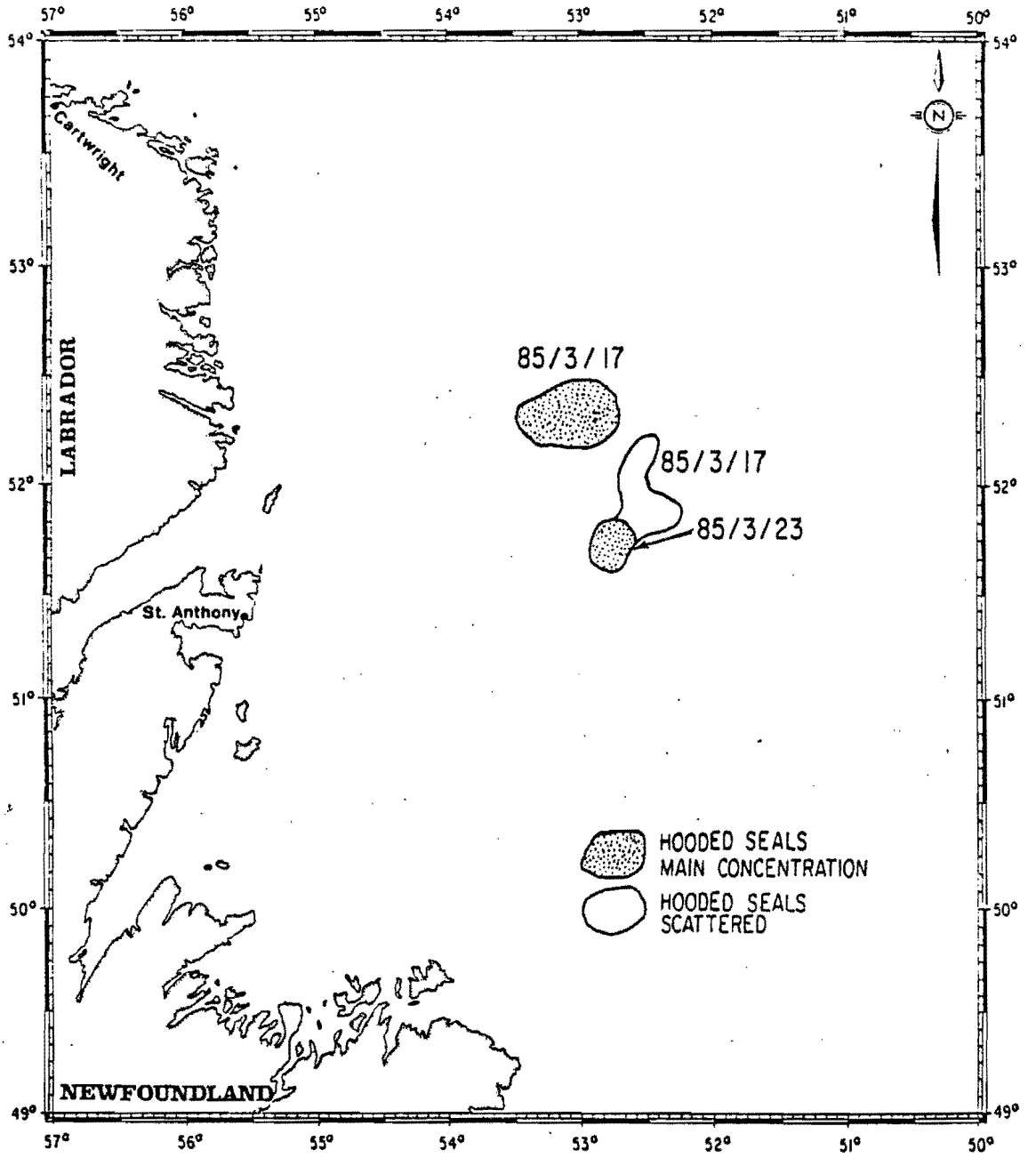

Fig. 2. Distribution of hooded seals at the Front during March 1985. Animals located on 17 March were seen during the fixed-wing aerial survey. The concentration of seals located on 23 March was spotted by a helicopter sighting survey.

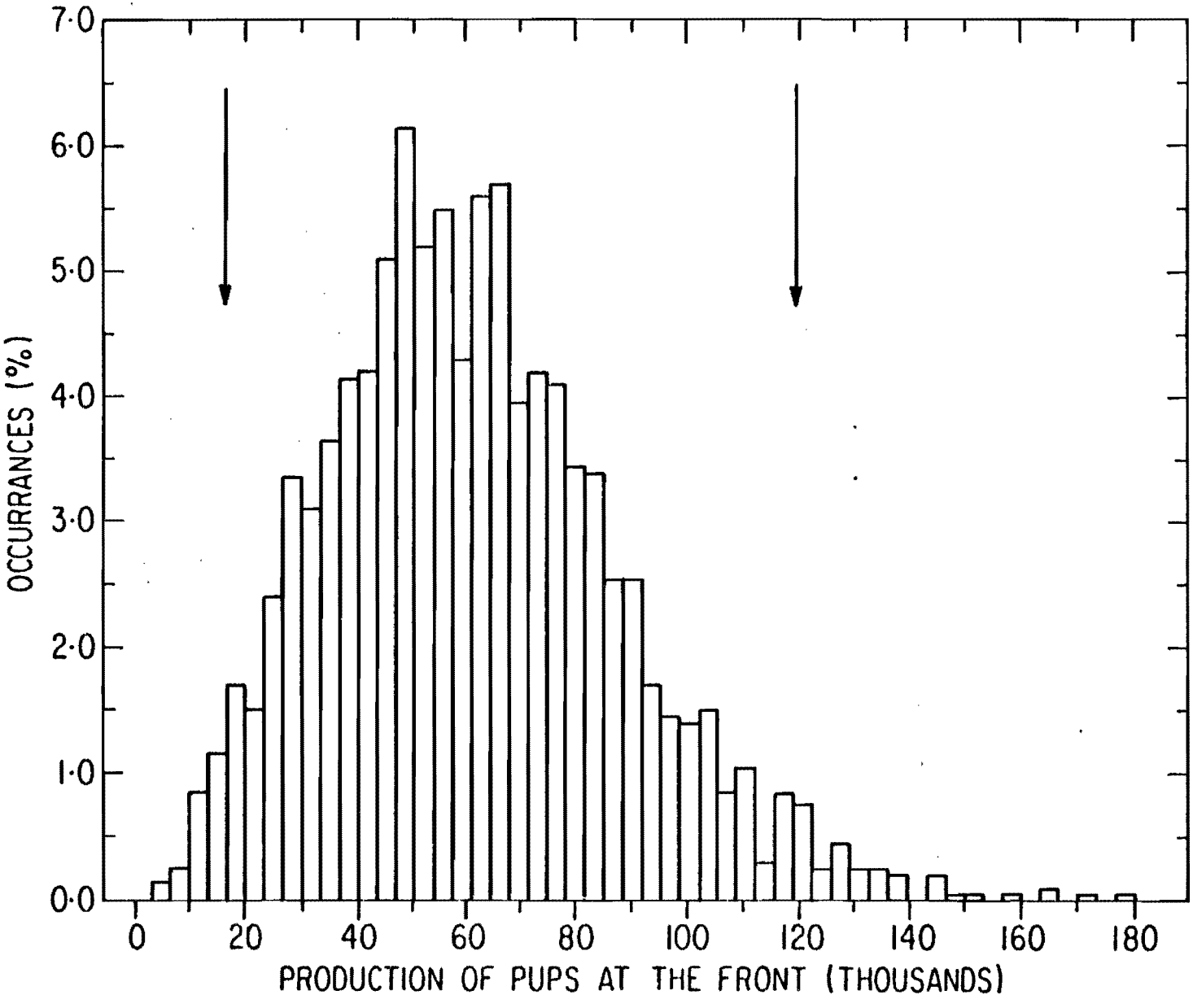

Fig. 3. Histogram of 2000 bootstrap simulations of the data collected during an aerial survey of hooded seals at the Front during March 1985. The 95% limits are indicated by arrows.