

Ringed Seals in James Bay and Hudson Bay: Population Estimates and Catch Statistics

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ABSTRACT. The populations of ringed seals *Phoca hispida* in Hudson Bay and James Bay are estimated on the basis of aerial counts to be 455,000 and 61,000 respectively. If the maximum number of seals, estimated at 21,000, needed to feed the polar bears of Hudson Bay is added to the catch of all trading centres there, estimated at 14,900, the total approximates very closely to the 8 per cent annual sustainable yield of ringed seals in Hudson Bay.

RÉSUMÉ: Population estimée et statistiques des prises de Phoque annelé dans la baie de James et dans la mer d'Hudson. A partir de comptages aériens, l'on estime les populations de Phoque annelé (*Phoca hispida*) dans la baie de James et dans la mer d'Hudson à 455 000 et 61 000 têtes respectivement. Si l'on additionne le nombre maximum de phoques nécessaires à l'alimentation des ours polaires, nombre estimé à 21 000, et la prise totale de tous les centres de traite, estimée à 14 900, le total égale de très près le 8% de phoques annelés disponibles chaque année pour la récolte dans la mer d'Hudson.

РЕЗЮМЕ. Кольчатый тюлень в заливе Джемса и в Гудзоновом заливе. Оценка популяций кольчатого тюленя (*Phoca hispida*), проведенная с воздуха в Гудзоновом заливе и заливе Джемса, составляет соответственно 455 тыс. и 61 тыс. Если к максимальному числу тюленей, необходимому для питания полярного медведя в Гудзоновом заливе и оцениваемому в 21 тыс., добавить добычу всех факторий в этом районе, составляющую приблизительно 14,9 тыс., то общее число животных достаточно точно приближается к 8% годичной постоянной продукции кольчатого тюленя в Гудзоновом заливе.

INTRODUCTION

Knowledge of the numbers and distribution of seals in the large area comprising James Bay and Hudson Bay is very scant. Mansfield (1968) lists the pinniped species present in Hudson Bay and makes brief comments about their distribution and abundance based mainly on extrapolation from the results of studies in other areas. Studies of the Atlantic walrus *Odobenus rosmarus*, involving mainly the counting of hauled-out animals in the Southampton Island area, were conducted by Loughrey (1959), and Mansfield (1958, 1966) completed a study on the biology of this species around Southampton Island and Tikera in Foxe Basin. Mansfield (1967) also made a summary of the distribution of the harbour seal *Phoca vitulina* along the Hudson Bay coast; in Hudson Bay and James Bay it is found mainly in river estuaries. The same seal is also known to travel long distances up rivers and appears to live year-round in many lakes along the eastern and western side of Hudson Bay; a specimen collected in Edehon Lake belonged to the same subspecies as its marine counterparts (Beck *et al.* 1970). Harp seals *Pagophilus groenlandicus* enter Hudson Bay from the east and are to be found in small numbers along its west coast (Brack and McIntosh 1963) but do not make up a significant part of the Inuit seal catch.

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Virtually nothing is known about the distribution or abundance of the ringed seal *Phoca hispida* which is the most common and abundant of marine mammals in these regions. The four original Inuit groups surrounding Hudson Bay, including the Caribou Eskimo of the Keewatin barrens, all relied heavily on this resource in the aboriginal period (Damas 1968). At the present time, seal hunting provides important cash crops from the sale of pelts. Both the ringed seal and the bearded seal *Erignathus barbatus*, which is less abundant and more restricted in its distribution, are important sources of protein for the coastal Inuit and Indian communities. McLaren and Mansfield (1960) were successful in capturing both these species as well as some white whales *Delphinapterus leucas* in a netting experiment near the Belcher Islands. The ringed seal also provides food for the large population of polar bears *Ursus maritimus* occupying the extensive denning areas along the southwest coast of Hudson Bay (Jonkel *et al.* 1970; Stirling and

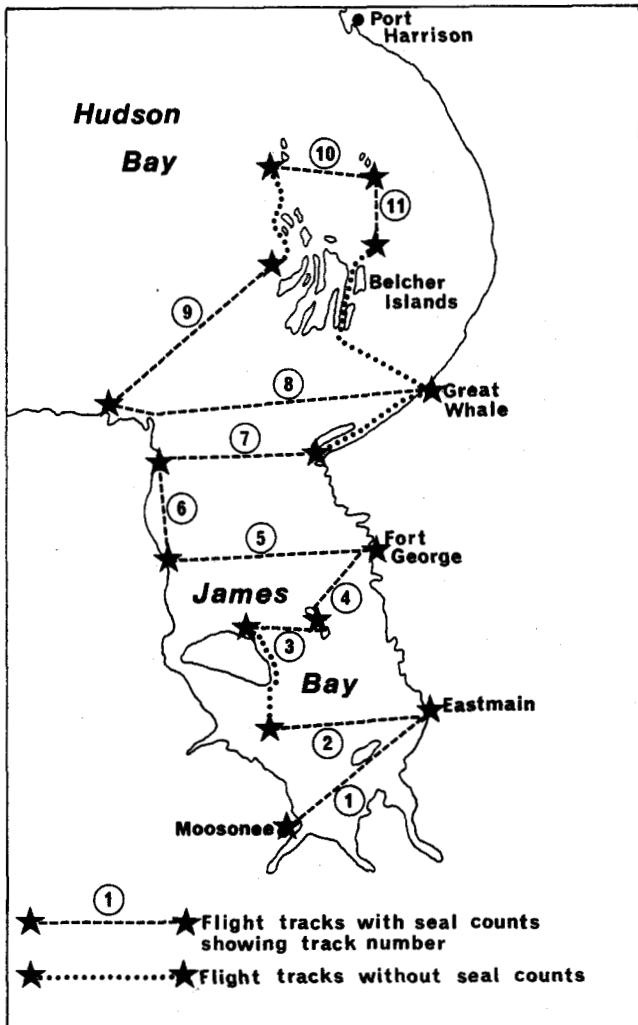


FIG. 1. Locations of flight paths used during the James Bay survey.

Jonkel 1972). The considerable numbers of arctic foxes *Alopex lagopus* harvested by the coastal communities of James Bay and Hudson Bay are also dependent, to a certain extent, on ringed seal pups for food (Smith 1974).

SURVEYS AND RESULTS

Both of the aerial surveys described below were made by means of low-winged twin-engine aircraft — a Beechcraft 18 for the flights over James Bay and a Piper Aztec for those over Hudson Bay. One observer sat in the front right, and the other in the back left, seat.

Continuous transects divided into two-minute quadrats were flown at an altitude of 90 metres (Smith 1973c). Statistical testing was carried out on log-transformed data by means of Student's t-test and linear regression analysis.

James Bay

The survey flights were made on 26 and 27 May 1974, and took a total time of 12.5 hours. Clear, sunny weather prevailed during the entire period. In seven

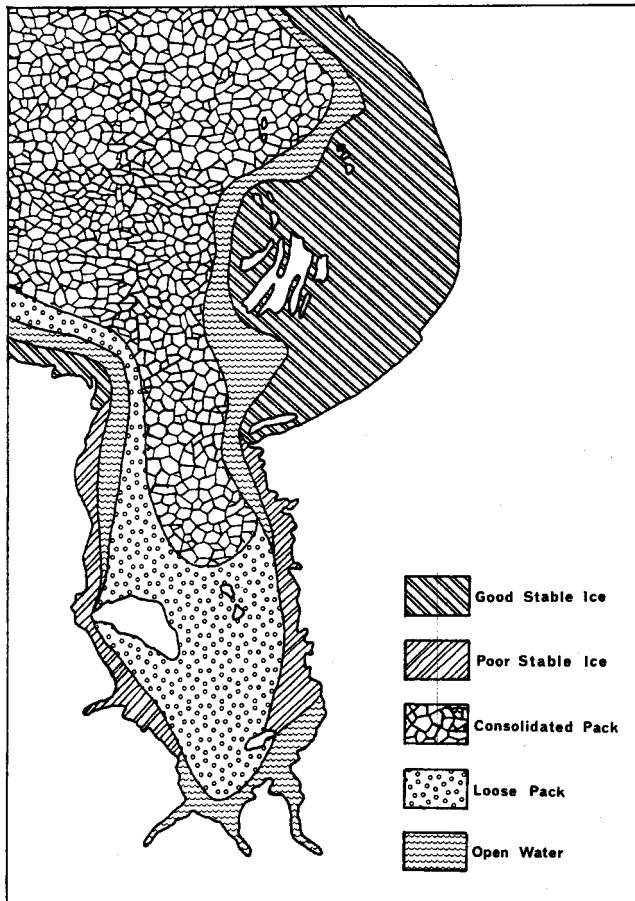


FIG. 2. Ice conditions along the flight paths during the James Bay survey.

of eleven tracks flown, a third observer seated in the rear right seat was employed to check the efficiency of the front right observer. Although the counts of the latter were usually the higher, no significant differences in numbers of seals observed were seen when counts were checked with a t-test. Similarly, no con-

TABLE 1. Data for flight tracks flown in the James Bay aerial survey.

Track number	Number of 2-minute quadrats	Mean number per quadrat	Standard deviation	Seals per km ²
1	20	1.85	2.94	.12
2	17	3.53	4.08	.24
3	9	3.44	3.81	.23
4	9	1.80	1.22	.12
5	22	3.13	2.85	.21
6	13	1.76	1.73	.12
7	21	1.85	1.42	.12
8	35	6.85	5.93	.46
9	29	3.20	3.25	.22
10	14	4.42	4.75	.30
11	7	10.00	5.16	.68

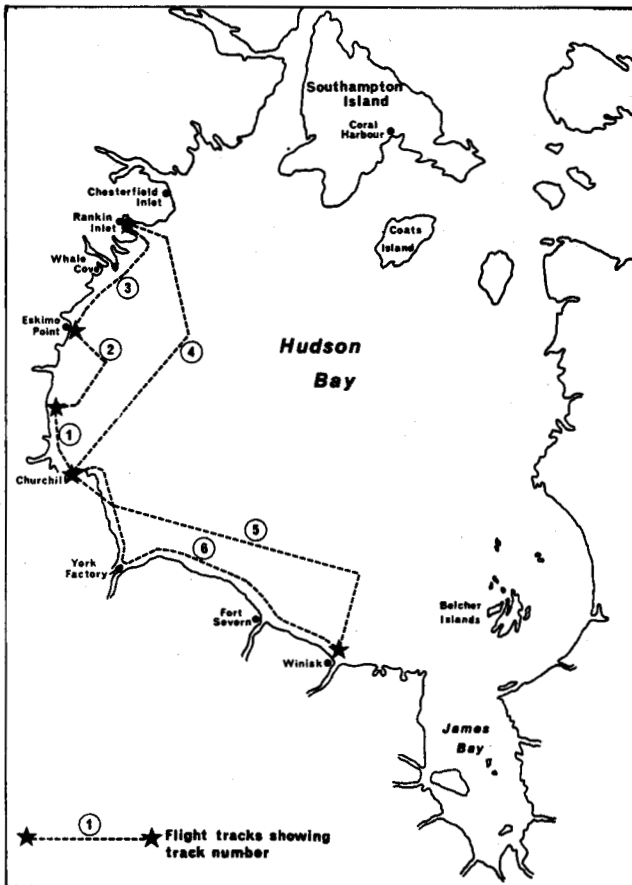


FIG. 3. Locations of flight paths (1-6) used during the Hudson Bay survey.

sistently significant difference was apparent between the counts of the front right observer and those of the observer seated back left.

In Figs. 1 and 2 are shown the locations of the flight paths and ice conditions respectively, and in Table 1 are summarized the data for each flight track. No clear picture emerges of density changing in accordance with distance away from land, except in the case of track number 9 where a positive correlation is apparent. This may, however, be attributable to the particular distribution of ice types along the track (Fig. 2) and therefore not really be indicative of a functional relationship. Very low densities are seen in the cases of all tracks flown in James Bay itself. The highest concentrations were seen from tracks north of James Bay which had the most stable fast ice (e.g. tracks 8 and 11, Figs. 1 and 2).

No concentrations of bearded seals were seen, and only three individuals of this species were sighted during the entire survey. Two animals, tentatively identified as harbour seals, were also recorded.

Hudson Bay

Flights were made on 13, 16, 17 and 20 June, and took a total time of 31 hours. All were based at Churchill, Manitoba. The flight paths are shown in Figs.

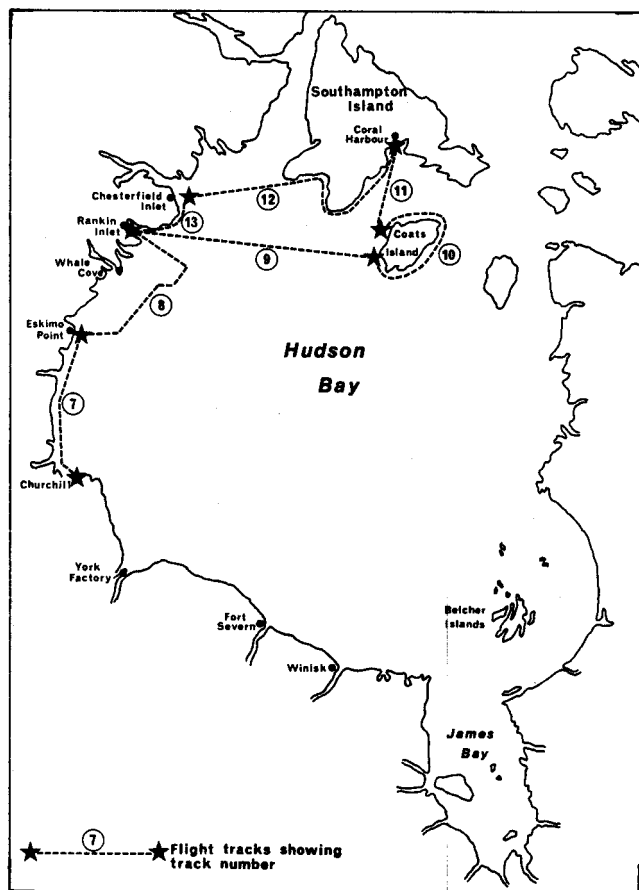


FIG. 4. Locations of flight paths (7-13) used during the Hudson Bay survey.

TABLE 2. Data for flight tracks flown in the Hudson Bay aerial survey.

Track number	Number of 2-minute quadrats	Mean number per quadrat	Standard deviation	Seals per km ²
1	10	24.30	24.54	1.64
2	35	5.74	6.56	.39
3	42	16.76	13.18	1.13
4	65	5.08	5.04	.34
5	89	5.40	5.07	.36
6	89	2.94	6.50	.20
7	39	8.67	7.47	.58
8	40	0.78	0.97	.05
9	36	2.92	2.43	.20
10	36	3.31	4.73	.22
11	15	1.40	1.35	.09
12	40	5.53	6.14	.37
13	13	39.38	49.45	2.59

3 and 4, and the data for each track are summarized in Table 2. In Fig. 5 are shown the distributions of ice types in the areas flown.

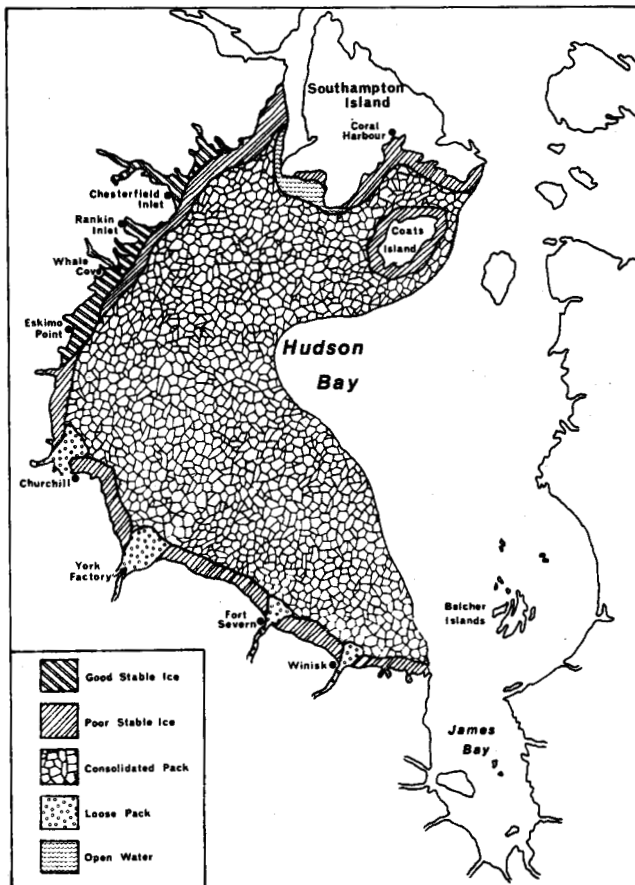


FIG. 5. Ice conditions along the flight paths during the Hudson Bay survey.

The highest densities recorded, from 0.58 to 2.59 seals per km², were all in tracks flown within 16 km of, and paralleling, the shore line and containing stable fast ice. The average density of seals was therefore 1.48 per km² over the coastal fast ice from Churchill to Chesterfield Inlet. In the case of track 6, flown parallel to the coast from Winisk to Churchill, the density of seals was very low. The condition of the ice along this coastline was very poor, often broken with large areas of brown, overturned ice. The ice in this area is evidently more unstable than along the western coastline of Hudson Bay and breaks up earlier.

For offshore tracks in areas containing fast ice or consolidated pack made up of large ice pans (tracks 2, 4, 5 and 12) the average density of seals was 0.37 per km². For other offshore areas with greater amounts of broken ice and open water, densities were much reduced, averaging only 0.11 seals per km². For the coastline around Coats Island there was a low density of only 0.22 seals per km². The ice there had been considerably folded by pressure and formed into large ridges. The area was therefore unsuitable for hauling-out, and since the ice in it was evidently unstable it would not be very suitable as a breeding habitat either.

Regression analysis was made of seal densities in relation to distance from land for tracks 4, 5 and 9. No significant correlations were obtained.

No concentrations of any other pinniped species were observed during this survey, and only six bearded seals were sighted.

TABLE 3. Summary of data on seal pelts traded in the Hudson Bay and James Bay regions during the years 1941-72.

	Maximum number traded in one year	Number of years with records	Average number traded
<i>Northern Hudson Bay</i>			
Coral Harbour	1819	14	1091
Repulse Bay	1689	25	625
<i>Western Hudson Bay</i>			
Chesterfield Inlet	950	17	271
Eskimo Point	873	20	277
Rankin Inlet	1441	11	407
Whale Cove	2000	5	1072
<i>Southern Hudson Bay</i>			
Fort Albany	3	4	1
Fort Severn	None	—	—
<i>Eastern Hudson Bay</i>			
Belcher Islands	1648	10	1361
Port Harrison	3977	29	1001
Poste-de-la-Baleine	3446	14	1275
Povungnituk	1395	23	419
Richmond Gulf	None	—	—
<i>James Bay</i>			
Attawapiskat	71	9	25
Eastmain	None	—	—
Fort George	235	6	73
Moosonee	None	—	—
Paint Hills	96	4	37
Rupert's House	18	3	12
	19662		7947

DISTRIBUTION AND SIZE OF CATCHES

Information on the size of catches from localities in Hudson Bay and James Bay is presented in Table 3. Most of the information comes from the records of seal pelts bought by the Hudson's Bay Company. It therefore provides an underestimate of total kill, because of the exclusion of skins used domestically and ones lost through sinking. Smith (1973a) increases by 26 per cent the figure of seals traded to obtain an estimate of total kill in two villages in the eastern Arctic. Annual catches of seals vary greatly because of many factors, including weather and ice conditions, the price of pelts, and the local opportunities for employment. Because of this, the average figures for pelts traded are not very useful as indicators of potential harvest, but taken together with data for the number of years when skins have been traded, they do indicate the localities which have been dependent on this resource for part of their cash income. Smith (1973 a, b) shows there to be a strong correlation between the numbers of seal pelts traded and the prices paid for them. The maximum figures shown in Table 3 might therefore be taken as better indicators of the size of the potential harvest for each community. These catches could be expected to increase with advances in hunting technology and growth of Inuit and Indian populations. The increase might however be somewhat offset in the future because of fewer people depending on hunting as a full-time occupation.

Variation in size of catch from one community to the next is probably due mainly to local conditions affecting the availability of the seal to the hunter and does not reflect large differences in absolute numbers present in different localities. Thus, it is pointed out by Brack and McIntosh (1963) that the site of Whale Cove on the west coast of Hudson Bay was chosen because the floe edge is usually 1.6 — 4.8 km from the village, and so it is a good seal hunting location.

McLaren (1961) states that Hudson Bay is a persistently poor place for seal hunting compared with other localities in the Arctic. He estimates the expectation of good weather there is always less than 10 per cent. He notes, however, that conditions improve towards the north of the Bay, a fact which is reflected in the larger catches from Coral Harbour and Repulse Bay (Table 3).

The largest catches in Hudson Bay come from the east coast, which includes the Belcher Islands, Port Harrison and Great Whale River (Poste-de-la-Baleine) communities. Earth Resources Technology Satellite (ERTS) pictures show that this area, from Cape Dufferin to Cape Jones and extending 160-320 km from the coast, contains the most stable offshore ice in Hudson Bay. This fact probably makes it a good breeding habitat for the ringed seal, so that the number of locally-produced seals available to the nearby hunting communities is increased. Because of high winds in Hudson Bay, hunting during the open-water season is less productive than it is when there is ice. The stable expanse of ice in this area, together with the shelter afforded by the many nearshore islands for hunting from canoes, makes it the best seal hunting area in Hudson Bay.

Catches from James Bay are generally small, the largest of them coming from Fort George and Paint Hills on the east coast and Attawapiskat on the west coast. The small catches primarily reflect the fact that the Indians are not tra-

ditionally sea mammal hunters. The earlier break-up and later freeze up also probably result in a lower density of seals in the area and make hunting conditions less favourable.

DISCUSSION

Concerning the smallness of the densities of seals seen in flights made over the ice of James Bay (tracks 1-7, Fig. 1), it is probable that the figures derived from them are underestimates, because of the advanced break-up of the ice in this area. Very rough estimates of the numbers of seals present in this area are presented in Table 4 on the basis of extrapolations of densities derived for the nearshore and offshore types of ice in the Hudson Bay region.

TABLE 4. Estimates of numbers of ringed seals in Hudson Bay and James Bay.

Category of ice (Fig. 6)	Area (km ²)	Percentage suitable as breeding habitat	Seals per km ²	Flight tracks used for density estimates	Total estimated number of seals
<i>Hudson Bay</i>					
Stable ice to 10 miles offshore	107,290	90-100	2.97	1,2,7,13 (Table 2)	286,587
Stable offshore ice	178,511	90-100	0.83	8,9,10,11 (Table 1)	133,024
Unstable offshore ice	160,298	30-50	.73	2,4,5 (Table 2)	35,611
Total (nearest thousand)					455,000
Sustainable yield (8%)					36,417
<i>James Bay</i>					
Stable ice to 10 miles offshore	21,712	80-100	2.97	1,2,7,13 (Table 2)	51,551
Unstable offshore ice	67,091	20-30	0.73	2,4,5 (Table 2)	9,858
Total (nearest thousand)					61,000
Sustainable yield (8%)					4,912

McLaren (1958) estimated that there were 218,300 seals in the area of Hudson Bay bounded by lines from Repulse Bay to Cape Wolstenholme in the north and from Cape Henrietta Maria to Cape Jones in the south. The estimate was based on computations of different densities for three categories of land fast ice and does not take account of the large areas of slowly shifting pack ice. C. Jonkel (personal communication) has, however, reported that there were significant numbers of seals in the very centre of Hudson Bay during March 1972. Estimates by the present author of the ringed seal population take account of the offshore ice area. From his personal observations both in the eastern and western Canadian Arctic (Smith 1973c), he has shown that areas of offshore ice contain breeding animals. This finding is supported by the work of Fedoseev (1971) on the populations of ringed seals *Phoca hispida ochotensis* in the Sea of Okhotsk. There, low densities of breeding seals were found in irregular distributions which corresponded to the areas of "white ice" — that is, relatively stable, slowly moving masses made up of large ice pans.

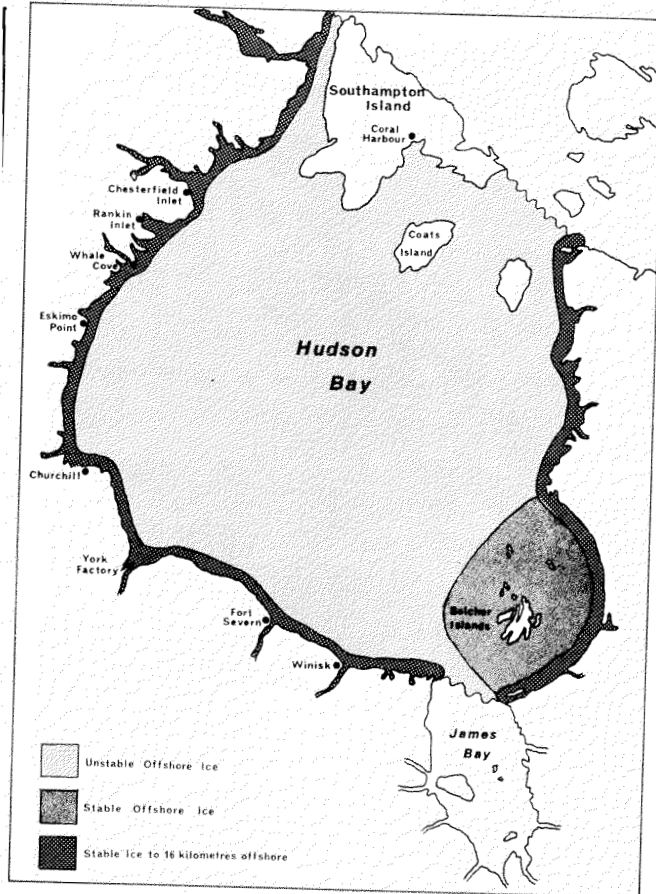


FIG. 6. Broad categories of ice containing differing intensities of seals in Hudson Bay.

Examination by the present author of ERTS pictures of ice conditions in Hudson Bay during March and April leads him to divide the ice into three main categories: stable ice within 16 km of shore from headland to headland; stable offshore ice concentrated on the east coast in the area of the Belcher Islands from Cape Dufferin to Cape Jones; and less stable offshore ice made up of slowly shifting, large pans, 30 per cent of which is, on an estimate, suitable for breeding habitat (Fig. 6).

During the same period, the western and southern coasts of Hudson Bay have a fringe area of constantly open water along the shore fast ice which appears to be approximately 16 km wide. The offshore ice along this coastline is made up of consolidated pack ice, with large pans towards the middle of the Bay and the eastern coast. The south coast of Southampton Island also has an open water fringe along a coastal band of fast ice of up to 16 km in width. The southern end of Roes Welcome Sound as far north as Whale Point is an area of much open water and apparent ice movement. Farther north towards Repulse Bay the ice appears to be more stable. The entire coastlines of Coats Island and Mansel Island have open water and apparently little stable ice. The northeastern coast of Hudson Bay from Cape Wolstenholme to Cape Dufferin, including the

Ottawa Islands area, is made up of moving offshore ice containing large pans interspersed by long open leads. The east coast area from Cape Dufferin to Cape Jones has noticeably more stable ice containing few large leads, and includes the Belcher and Sleeper Islands.

Estimates of the numbers of ringed seals in Hudson Bay and James Bay are shown in Table 4. The percentage of ice suitable for breeding habitats in each of the three categories is a minimal estimate obtained by visual inspection of ERTS photographs. In all three ice categories the lower estimate is used to calculate the total number of seals. The density of seals for each category is derived from the mean values of the densities obtained from observations on the individual flight tracks of the surveys. The mean values were doubled to take into account the estimated 50 per cent of seals in the water during the aerial counts (Smith 1973c). Total populations of 455,000 and 61,000 ringed seals are estimated for Hudson Bay and James Bay respectively.

Both McLaren (1958) and Smith (1973a) estimated maximum sustainable yields for ringed seals to be approximately 8 per cent, on the basis of catch statistics. Estimates for maximum sustainable yields of ringed seals for Hudson Bay and James Bay are therefore 36,400 and 4,900 respectively. The highest number of seal pelts traded in one year, from all Hudson Bay stores, was 11,828 in 1963. Correcting this figure for losses due to sinking and skins not traded, Smith (1973a) gives a maximum catch of 14,900 seals. The maximum kill for James Bay is estimated as 280 seals.

Concern has been expressed about the possible overexploitation of the seal stock of Hudson Bay when the catches of the Inuit, the arctic fox and the large population of polar bears are combined. The large population of approximately 600 bears occupying the denning area of southern Hudson Bay has been estimated to consume something between 5,000 (N.A. Oritsland, University of Guelph, Ontario, personal communication) and 21,000 (Stirling 1974) ringed seals annually, on the assumption that the bears hunt on the sea ice for half the year. If the maximum estimated catch by polar bears of 21,000 is added to the maximum catch by humans of 14,900, the total is very close to the present estimated sustainable yield for Hudson Bay of 36,400 (see above). It must be stressed, however, that the catch figure has been maximized, and the figure for sustainable yield is definitely an underestimate. On the other hand, the estimated 600 bears in the Cape Churchill area are no doubt a small fraction of the bears to be found in James Bay and Hudson Bay. No accurate estimates have been made, but the total number of polar bears there could be as high as 2,000-3,000 (C. Jonkel, personal communication). The extent of the loss of seals to foxes is completely unknown. Catches by humans in the James Bay area are so low that even an unusually high rate of mortality due to predators can be tolerated.

The accuracy of population estimates based solely on aerial census data is not generally good enough for the purpose of estimating even minimum sustainable yields. Many factors act to introduce bias into estimates of the actual numbers of seals present in a census area (Pastukhov 1965; Smith 1973c). The actual error in survey counts themselves is sometimes greater than the correction factors applied to estimate the true population size (Fedoseev 1971).

Additional information concerning the daily patterns of movement (Shustov 1969; Smith 1973a, c), the extent of immigration into the area from outside centres of production (Smith 1974), and the location of prime breeding habitat near seal hunting communities, is necessary for sound management. Detailed population studies for each important sealing community, based on catch statistics, result in useful estimates of sustainable yields. Since catch curves provide estimates of total mortality, the sustainable yields derived take account of both the natural and the hunting mortalities, and therefore are applicable to areas such as Hudson Bay, where a large population of natural predators exists.

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REFERENCES

- BECK, B., SMITH, T. G. and MANSFIELD, A. W. 1970. Occurrence of the harbour seal *Phoca vitulina* (Linn.) in the Thlewiaza River, N.W.T. *Canadian Field Naturalist*, 84: 297-300.
- BRACK, D. M. and MCINTOSH, D. 1963. Keewatin mainland area economic survey and regional appraisal. *Canada, Department of Northern Affairs and Natural Resources, Industrial Division, Report*.
- DAMAS, D. 1968. The Eskimo. In: Beals, C.S. (ed.), *Science, History and Hudson Bay, Vol. 1*, Ottawa: Department of Energy, Mines and Resources, pp. 141-72.
- FEDOSEEV, G. A. 1971. The distribution and numbers of seals on whelping and moulting patches in the Sea of Okhotsk. In: *Research on Marine Mammals; Canada, Fisheries Research Board, Translation Series* no. 3185, pp. 135-58.
- JONKEL, C. J., KOLENOSKY, G. B., ROBERTSON, R. J. and RUSSELL, R. H. 1970. Further notes on polar bear denning habits. *IUCN News Series*, 23: 142-58.
- LOUGHREY, A. G. 1959. Preliminary investigation of the Atlantic walrus *Odobenus rosmarus* (Linn.). *Canada, Canadian Wildlife Service, Management Bulletin*, series 1, no. 14.
- MANSFIELD, A. W. 1958. The biology of the Atlantic walrus *Odobenus rosmarus* (Linn.) in the eastern Canadian Arctic. *Canada, Fisheries Research Board, Manuscript Report Series* no. 653.
- . 1966. The walrus in Canada's Arctic. *Canadian Geographical Journal*, 72: 88-95.
- . 1967. Distribution of the harbour seal *Phoca vitulina* (Linn.) in Canadian arctic waters. *Journal of Mammalogy*, 48: 249-57.
- . 1968. Seals and walrus. In: Beals, C. S. (ed.), *Science, History and Hudson Bay, Vol. 1*, Ottawa: Department of Energy, Mines and Resources, pp. 378-81.
- MCLAREN, I. A. 1958. The economics of seals in the eastern Canadian Arctic. *Canada, Fisheries Research Board, Arctic Unit, Circular* no. 1.
- . 1961. A preliminary analysis of weather suitable for seal hunting from boats in the eastern Canadian Arctic. *Canada, Fisheries Research Board, Manuscript Report Series (Biological)* no. 716.

- and MANSFIELD, A. W. 1960. The netting of sea mammals: a report on the Belcher Islands experiment, 1960. *Canada, Fisheries Research Board, Arctic Unit, Circular* no. 6.
- PASTUKHOV, V. D. 1965. A contribution to the methodology of quantitative counting of the Baikal seal. *Proceedings of Symposium on Marine Mammals, Moscow, 1969; Canada, Fisheries Research Board, Translation Series* no. 3408.
- SHUSTOV, A. P. 1969. Daily dynamics of seal rookeries in the Sea of Okhotsk. *Canada, Fisheries Research Board, Translation Series* no. 2402.
- SMITH, T. G. 1973a. Population dynamics of the ringed seal in the Canadian eastern arctic. *Canada, Fisheries Research Board Bulletin*, no. 181.
- 1973b. Management research on the Eskimo's ringed seal. *Canadian Geographical Journal*, 86: 118-25.
- . 1973c. Censusing and estimating the size of ringed seal populations. *Canada, Fisheries Research Board, Technical Report* no. 427.
- . 1974. Biology of the Beaufort region. *Northern Perspectives* (Canadian Arctic Resources Committee), 2 (2): 10, 12.
- STIRLING, I. 1974. Midsummer observations on the behaviour of wild polar bears *Ursus maritimus*. *Canadian Journal of Zoology*, 52: 1191-8.
- and JONKEL, C. J. 1972. The great white bears. *Nature Canada*, 1: 15-18.