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# Abundance Estimates for Humpback Whales and Fin Whales in the Eastern Newfoundland and Southeastern Labrador Areas, August 1981

by

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[1] This series documents the scientific basis for fisheries management advice in Atlantic Canada. As such, it addresses the issues of the day in the timeframes required and the Research Documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

## Abstract

A systematic fixed-wing aerial sampling survey of whales in the northeastern Newfoundland and southeastern Labrador areas produced best estimates of minimum abundance (based on line-transect sighting data) of 663 humpback whales (95% confidence interval of 204-1,123) and 423 fin whales (95% confidence interval of 0-1,222).

## Résumé

Un relevé systématique des baleines effectué par avion au nord-est de Terre-Neuve et au sud-est du Labrador a permis d'établir les meilleures estimations de l'abondance minimum (d'après dénombrement sur transect linéaire) des jubartes (663, intervalle de confiance de 95 %: 204-1 123) et des rorquals communs (423, intervalle de confiance de 95 %: 0-1 222).

## Introduction

As part of its continuing efforts to assess stocks of whales in the Newfoundland-Labrador region and to provide management advice on these stocks to the International Whaling Commission, the Department of Fisheries and Oceans carried out a fixed-wing aerial sampling survey of whales in the near-shore and offshore Newfoundland-Labrador area, from 17 July to 31 August 1981. Aggregations of large baleen whales were encountered on only two occasions: on 1 August off the northeast coast of Newfoundland and on 28 August off southeast Labrador. This report documents the surveys of these two days and provides abundance estimates for humpback whales, Megaptera novaeangliae, and fin whales, Balaenoptera physalus, in these offshore areas. Very few large whales were detected in other zones on different days of the survey. Therefore, the data from these zones have not been analysed as they would result in little improvement of the estimates presented here.

## Materials and Methods

The survey procedures and analytical methods are the same as those adopted for the previous aerial survey of August 1980 (Hay 1982). A twin engine Beechcraft AT-11 aircraft with a glass observation nose bubble was utilized in both the 1980 and 1981 surveys.

The survey design, however, has changed significantly. For the 1980 survey a simple random design was utilized, with flight lines being selected at random without replacement from a potential population of lines spaced at intervals of 1.852 km (1 nautical mile). The resulting sampling intensity (percent of the sea surface sampled) averaged about 10%, assuming a total sampling strip width of 3.7 km (2 nautical miles). Because of the low density of sightings obtained during the 1980 survey which was presumed to be due to low sampling effort coupled with random line selection, a systematic survey with a random start and with about twice as much effort as the 1980 survey was adopted. Each of the large offshore blocks of the 1980 survey was divided into two approximately equal subareas (Fig. 1). Only survey data from zones MW and LW are considered in this report. For both zones, survey lines were spaced systematically at intervals of 18.52 km (10 n. mi.) with the constraint that the northernmost line be placed randomly (i.e. the first line to be flown was selected at random from lines 1, 2, 3, 4 and 5). The result of this survey design was a sampling intensity of about 20% (Table 1), or approximately twice that of the 1980 survey.

Due to adverse weather and time constraints, the southernmost four lines of zone LW were not surveyed. Table 2 gives the lengths and number of primary groups (pods) of humpbacks and fin whales for each sampled line. These are indicated separately for Beaufort wind forces of 0-4 and 0-3, in order that density and abundance estimates could be made using data collected under these differing sea state conditions. For the 1980 survey effort, data collected at Beaufort forces of five and greater were excluded from the analysis, but Scott et al. (1981), for abundance estimates of whales in the northeastern U.S. outer continental shelf, utilized survey data collected at Beaufort wind forces of three and less. Since their data suggest that sightability of large whales decreases with the onset of Beaufort four, density and abundance estimates for Beaufort forces of 0-3 (in accordance with Scott et al. 1981) and for forces of 0-4 (for comparability with 1980 survey results) were calculated in the 1981 aerial survey.

In addition to the truncation of zone LW to six lines as a result of weather and time constraints, this area was further truncated to five and four sampling lines (Table 1) since humpback sightings occurred only on the first four lines and fin whale sightings on the first five lines (Table 2). By truncating the area in this fashion, it was possible to obtain density estimates for these species using only those transects on which sightings occurred, with the aim of reducing the variances of the density and abundance estimates.

As advocated by Burnham et al. (1980), the Fourier Series (FS) model was used to determine the densities of humpbacks and fin whales in zones MW and LW. These were calculated using the frequency distribution of right-angle distances of all large whale sightings (humpback, fin, and unidentified large whales) to provide a pooled value for f(o) (the sighting probability density function evaluated for a perpendicular distance of zero) which was then applied to the sighting data for humpbacks and fin whales in each zone. In addition, f(o) was determined from the frequency distributions of perpendicular distance of humpback sightings and fin whale sightings separately and utilized to calculate densities of these species in each zone. Thus, for each zone, there is a pooled value of f(o), a value of f(o) for humpbacks and a value of f(o) for fin whales. Sample sizes in each zone (Table 2) were large enough that pooling of data between zones was not necessary, unlike the situation in the 1980 survey where small sample sizes necessitated the calculation of f(o) using large whale sightings data pooled over the entire survey area and period. Note that, in Table 2, the number of groups of all large whales is sometimes less than the sum of the number of groups of humpbacks and fin whales. This is because a single large whale sighting occasionally comprises a primary group of humpbacks and a primary group of fin whales.

## Results and Discussion

### Group size

Mean pod size and its variance enter into the equations which estimate abundance and its variance. Mean pod sizes and their standard errors for humpbacks and fin whales, in zones MW and LW and for differing sea states, are presented in Table 3. These are similar to estimates of pooled mean pod size for the 1980 aerial survey (Hay 1982), except for fin whales in zone MW where one large primary pod of 25 fin whales was detected. Exclusion of this "outlying" pod produces estimates of mean pod size similar to those estimated for fin whales in the 1980 survey (Table 3). Abundance estimates for fin whales in zone MW were derived using mean pod sizes including and excluding this "outlier". Excluding this outlying pod of 25 fin whales, the maximum primary pod size was seven.

## Estimation of f(o)

The frequency distributions of perpendicular sighting distance for all large whales, humpback whales and fin whales for zones MW and LW are presented in Table 4. It is evident that these distributions are quite different between the two survey zones, especially for humpbacks and all large whales, with the decrease in sighting frequency with distance being initially greater in zone LW than in MW where there is a pronounced "shoulder" in the frequency distributions of perpendicular distance for these taxonomic groups (Table 4).

Table 5 gives the values of f(o) and their standard errors, estimated from these frequency distributions of perpendicular distance using the Fourier series model. The FS model provided good fits to all data sets. Estimates of f(o) for fin whales are lower than for humpbacks and all large whales, due to the higher relative frequency of sightings of fin whales in right-angle distance intervals III and IV, compared to the other taxonomic categories (Table 4). The standard errors of the estimates of f(o) for fin whales are also relatively high, owing to the smaller sample sizes for fin whales (Table 4). Scott et al. (1981) estimate f(o) to be 1.2120 for large whales, slightly higher than the values of f(o) presented in Table 5. They used the Cox-Eberhardt non-parametric method. Fitting the FS model to their Fig. IV-4 yielded a value of f(o) of 1.377 with a standard error of 0.1011.

The estimate of f(o) for all large whales in the 1980 survey (Hay 1982) was 0.9568 $km^{-1}$, which is similar to values of f(o) estimated for this taxonomic group for the 1981 survey (Table 5).

## Sample size

Table 6 shows the total number of primary groups (n) detected, along with its variance (Var(n)), for each species and zone. In zone MW, it is evident that for both species Var(n) is high compared to n, suggesting that pods of both species are highly aggregated (i.e. some transects had many sightings while others had few or none; see Table 2) while aggregation is less evident in Zone LW (Tables 2 and 6). In fact, truncation of zone LW to four lines for humpbacks and five lines for fin whales reduces Var(n) substantially relative to n (Table 6), with consequent considerable impact on the abundance variance estimates (see below). Var(n) was calculated empirically using equation 1.23 of Burnham et al. (1980):

$$\mathrm{Var}(n) = \frac{L \sum_{i=1}^{R} \ell_i \left[ \frac{n_i}{\ell_i} - \frac{n}{L} \right]^2}{R-1}$$

where n is the total number of primary groups, $n_i$ is the number of groups detected on the ith transect, $\ell_i$ is the length of the ith transect, L is the total transect length, and R is the number of transects flown.

Estimation of abundance

Abundance estimates for humpbacks and fin whales are presented in Tables 7 and 8, respectively. The number of humpback whales in zone MW was estimated to range from 475 to 553; however, confidence intervals were wide (Table 7). Abundance estimates for humpbacks in zone LW range from 635 to 703; 95% confidence intervals narrow markedly when only four lines are used, suggesting that for the estimates using five or six lines, the variance of the number of sightings (Var(n)) is high and is largely responsible for the wide confidence intervals of these estimates (see also Tables 2 and 6). The actual numbers of humpbacks sighted were 125 in zone MW and 174 in Zone LW.

The abundance of fin whales in zone MW ranges from 411-620 when the "outlier" of 25 fin whales is included, and from 285-423 when it is excluded. Confidence intervals are generally wide, especially where the larger mean group size and its higher variance were used (Table 8). In zone LW, fin whale abundance ranges from 272-312, with broad 95% confidence intervals. Elimination of the one line lacking fin whale sightings causes only a slight decrease in the width of the 95% confidence interval (Table 8). The actual numbers of fin whales sighted were 150 in zone MW and 96 in zone LW.

Because the surveys of zones MW and LW were carried out on 1 August and 28 August, respectively, these estimates for each species have not been added. Total minimum abundances for humpbacks (635-703) and fin whales (285-620) are approximately the same as those reported by Hay (1982) for the 1980 survey (738 humpbacks and 478 fin whales). However, the 1980 total minimum estimates are sums of zone estimates over a 22 day period. When corrected for whales missed due to submergence (about 50% go undetected - H. Whitehead, pers. comm.), these estimates are similar to previously published survey-based estimates of the numbers of humpbacks and fin whales summering in the Newfoundland-Labrador area (see Hay (1982) for a summary of recent estimates).

Scott et al. (1981) estimated minimum abundances of 1,102 fin whales during July 1979 and 684 humpbacks during June 1979 in the CETAP study area. They report maximum densities of 0.0292 fin whales/km$^2$ during early July 1979 in the southwestern Gulf of Maine and 0.0187 humpback whales/km$^2$ in this same area during early June 1979. These densities are somewhat lower than densities reported herein for Newfoundland-Labrador, especially in the case of humpback whales (Tables 7 and 8).

It should be emphasized that the estimates presented herein are conservative and have not been corrected for whale submergence times and for varying survey conditions, such as glare, sea state, and observer fatigue. Also, numerous secondary sightings were made but were excluded from the analysis. Although the effects of these survey variables (especially glare and sea state) on the density of sightings have been demonstrated, there have been no attempts to correct estimates of whale abundance for them (Scott et al. 1981). Pending availability of dive time-based correction factors, it is conservatively assumed that 50% of whales go undetected (H. Whitehead, pers. comm.)

## Variability of the estimates

Measures of the components of the variances of the density and abundance estimates, expressed as squared coefficients of variation of sample size, f(o), and mean pod size, are presented in Table 9 for the various surveys. In zone MW, for both species of baleen whale, the variance of sample size (Var(n)) makes up most of the variances of the density and abundance estimates and, while this is generally true for zone LW as well, truncation of zone LW to four lines for humpback whales and five lines for fin whales markedly reduces $(cv(n))^2$, especially for humpback whales. In fact, considering only the four lines of LW on which humpback groups were detected, Var(n) becomes a less important source of variation than Var(g) (Table 9). This results in the considerable narrowing of the 95% confidence intervals about estimates of humpbacks in zone LW (using four lines). However, this confidence interval (approximately 200 to 1,100) is not as narrow as one would want for population estimates for management purposes or to establish short-term trends in abundance. Therefore, it would seem that the only feasible way of reducing variances further would be to increase the number of flight lines (and consequently the sample size) within an aggregation or concentration of whales; this could have the desirable effect of reducing even further the variances due to sample size (n) and pod size (g).

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Table 1. Survey zone information, 1981 aerial survey.

| Survey zone | Geographical area | Date | Area ($km^2$) | No. lines flown | Potential no. lines | Beaufort wind forces | Total line length (km) | Percent[a] sampled |
|---|---|---|---|---|---|---|---|---|
| MW | N.E. Nfld. | 1 Aug. | 15,157 | 7 | 38 | 0-4 | 748.8 | 18.3 |
| | | | 15,157 | 7 | | 0-3 | 637.8 | 15.6 |
| LW | S.E. Labrador | 28 Aug. | 9,031[b] | 6 | 47 | 0-4 | 486.9 | 19.9 |
| | | | 9,031[b] | 6 | | 0-3 | 458.0 | 18.8 |
| | | | 7,553[c] | 5 | | 0-3 | 405.6 | 19.9 |
| | | | 6,040[c] | 4 | | 0-3 | 324.5 | 19.9 |

[a]Assuming a total transect width of 3.7 km (2 nautical miles).

[b]Partial survey.

[c]Subareas of total area surveyed (to attempt to reduce sample size variance - see text).

Table 2. Individual line lengths and sample sizes.

| | Beaufort forces 0-4 | | | | Beaufort forces 0-3 | | | |
|---|---|---|---|---|---|---|---|---|
| | | No. primary groups[a] | | | | No. primary groups[a] | | |
| Transect no. | Length (km) | All large whales | Humpback | Fin | Length (km) | All large whales | Humpback | Fin |
| MW-5 | 95.4 | 0 | 0 | 0 | 95.4 | 0 | 0 | 0 |
| MW-10 | 93.5 | 2 | 2 | 0 | 93.5 | 2 | 2 | 0 |
| MW-15 | 92.2 | 17 | 13 | 7 | 67.0 | 17 | 13 | 7 |
| MW-20 | 103.3 | 12 | 6 | 8 | 50.0 | 8 | 3 | 7 |
| MW-25 | 115.8 | 1 | 0 | 1 | 105.6 | 1 | 0 | 1 |
| MW-30 | 116.5 | 2 | 1 | 0 | 105.4 | 2 | 1 | 0 |
| MW-35 | 132.0 | 3 | 2 | 1 | 120.9 | 3 | 2 | 1 |
| LW-2 | 81.5 | 14 | 10 | 5 | 81.5 | 14 | 10 | 5 |
| LW-7 | 80.2 | 9 | 7 | 2 | 80.2 | 9 | 7 | 2 |
| LW-12 | 81.5 | 14 | 12 | 1 | 81.5 | 14 | 12 | 1 |
| LW-17 | 81.3 | 12 | 7 | 3 | 81.3 | 12 | 7 | 3 |
| LW-22 | 81.1 | 2 | 0 | 2 | 81.1 | 2 | 0 | 2 |
| LW-27 | 81.3 | 0 | 0 | 0 | 52.4 | 0 | 0 | 0 |

[a]Considering only primary groups within 1.852 km of the track-line.

Table 3. Primary group sizes recorded for humpback and fin whales.

| Species | Zone | Beaufort forces | No. of observations | Mean group size | Range | Standard error |
|---|---|---|---|---|---|---|
| Humpback | MW | 0-4 | 28 | 2.2143 | 1-9 | 0.3267 |
| Humpback | MW | 0-3 | 24 | 2.2917 | 1-9 | 0.3636 |
| Humpback | LW | 0-3 | 37 | 2.0000 | 1-11 | 0.2926 |
| Fin | MW | 0-4 | 22 | 3.3636 | 1-25 | 1.0981 |
| Fin[a] | MW | 0-4 | 21 | 2.3333 | 1-7 | 0.3984 |
| Fin | MW | 0-3 | 20 | 3.5500 | 1-25 | 1.2019 |
| Fin[a] | MW | 0-3 | 19 | 2.4211 | 1-7 | 0.4347 |
| Fin | LW | 0-3 | 16 | 2.5625 | 1-6 | 0.4997 |

[a]Excluding one "outlying" primary pod of 25 fin whales.

Table 4. Number of primary groups recorded.

| Zone | Species | Beaufort forces | No. primary groups in intervals[a] I | II | III | IV | V |
|---|---|---|---|---|---|---|---|
| MW | All large whales | 0-4 | 15 | 13 | 4 | 5 | 8 |
| | | 0-3 | 14 | 12 | 3 | 4 | 7 |
| | Humpback | 0-4 | 11 | 8 | 3 | 2 | 4 |
| | | 0-3 | 10 | 7 | 2 | 2 | 3 |
| | Fin | 0-4 | 6 | 5 | 2 | 4 | 4 |
| | | 0-3 | 6 | 5 | 2 | 3 | 4 |
| LW | All large whales | 0-4 | 24 | 13 | 10 | 4 | 4 |
| | | 0-3 | 24 | 13 | 10 | 4 | 4 |
| | Humpback | 0-4 | 18 | 8 | 8 | 2 | 1 |
| | | 0-3 | 18 | 8 | 8 | 2 | 1 |
| | Fin | 0-4 | 6 | 4 | 1 | 2 | 3 |
| | | 0-3 | 6 | 4 | 1 | 2 | 3 |

[a]The right angle distance intervals are:
I - 0 to 0.463 km
II - >0.463 to 0.926 km
III - >0.926 to 1.389 km
IV - >1.389 to 1.852 km
V - >1.852 km

Table 5. Estimates of the sighting probability density function at perpendicular distance zero ($\hat{f}(o)$), and its standard error. The Fourier series line-transect model was used for each set of data.

| Zone | Species | Beaufort forces | $\hat{f}(o)$ | Standard error of $\hat{f}(o)$ |
|---|---|---|---|---|
| MW | All large whales | 0-4 | 0.8837 | 0.1079 |
| | | 0-3 | 0.9184 | 0.1087 |
| | Humpback | 0-4 | 0.9724 | 0.1149 |
| | | 0-3 | 0.9661 | 0.1246 |
| | Fin | 0-4 | 0.7103 | 0.1831 |
| | | 0-3 | 0.7831 | 0.1809 |
| LW[a] | All large whales | | 0.9503 | 0.0826 |
| | Humpback | | 0.9899 | 0.0898 |
| | Fin | | 0.8804 | 0.1827 |

[a]There were no sightings recorded in Beaufort wind force 4 in zone LW.

Table 6. Total number of primary groups observed less than 1.852 km from the track-line, and its variance.

| Species | Zone | No. lines flown | Beaufort forces | Total no. primary groups (n) | Var (n) |
|---|---|---|---|---|---|
| Humpback | MW | 7 | 0-4 | 24 | 186.0 |
| | | | 0-3 | 21 | 223.0 |
| | LW | 6 | 0-4 | 36 | 151.0 |
| | | | 0-3 | 36 | 126.0 |
| | | 5 | 0-3 | 36 | 103.0 |
| | | 4 | 0-3 | 36 | 23.1 |
| Fin | MW | 7 | 0-4 | 17 | 97.4 |
| | | | 0-3 | 16 | 141.0 |
| | LW | 6 | 0-4 | 13 | 17.7 |
| | | | 0-3 | 13 | 14.7 |
| | | 5 | 0-3 | 13 | 11.4 |

Table 7. Abundance estimates for humpback whales.

| Zone | Beaufort forces | No. lines flown | Data source[a] for f(o) | Pods/km² ($D_g$) | S.E.($D_g$) | Whales/km² ($D_w$) | S.E.($D_w$) | No. of whales (N) | S.E.(N) | 95% Confidence limits for N |
|---|---|---|---|---|---|---|---|---|---|---|
| MW | 0-4 | 7 | L | 0.0142 | 0.0082 | 0.0314 | 0.0188 | 475 | 285 | 0 to 1,173 |
| | | | H | 0.0156 | 0.0090 | 0.0345 | 0.0207 | 523 | 313 | 0 to 1,289 |
| | 0-3 | 7 | L | 0.0151 | 0.0109 | 0.0347 | 0.0256 | 525 | 388 | 0 to 1,474 |
| | | | H | 0.0159 | 0.0115 | 0.0365 | 0.0270 | 553 | 409 | 0 to 1,553 |
| LW | 0-4 | 6 | L | 0.0351 | 0.0124 | 0.0703 | 0.0268 | 635 | 242 | 12 to 1,257 |
| | | | H | 0.0366 | 0.0129 | 0.0732 | 0.0280 | 661 | 253 | 11 to 1,311 |
| | 0-3 | 6 | L | 0.0373 | 0.0121 | 0.0747 | 0.0265 | 675 | 240 | 59 to 1,291 |
| | | | H | 0.0389 | 0.0126 | 0.0778 | 0.0277 | 703 | 250 | 59 to 1,346 |
| | 0-3 | 5 | L | 0.0422 | 0.0124 | 0.0844 | 0.0278 | 637 | 210 | 55 to 1,219 |
| | | | H | 0.0439 | 0.0130 | 0.0879 | 0.0290 | 664 | 219 | 55 to 1,272 |
| | 0-3 | 4 | L | 0.0527 | 0.0084 | 0.1054 | 0.0228 | 637 | 138 | 199 to 1,075 |
| | | | H | 0.0549 | 0.0089 | 0.1098 | 0.0239 | 663 | 145 | 204 to 1,123 |

[a]L - f(o) obtained from the distribution of perpendicular distances for sightings of all large whales; H - f(o) obtained from the distribution of perpendicular distances of humpback sightings.

Table 8. Abundance estimates for fin whales.

| Zone | Beaufort forces | No. lines flown | Data source[a] for f(o) | Pods/km² ($D_g$) | S.E.($D_g$) | Whales/km² ($D_w$) | S.E.($D_w$) | No. of whales (N) | S.E.(N) | 95% Confidence limits for N |
|---|---|---|---|---|---|---|---|---|---|---|
| MW | 0-4[b] | 7 | L | 0.0100 | 0.0060 | 0.0337 | 0.0228 | 511 | 346 | 0 to 1,359 |
| | | | F | 0.0081 | 0.0051 | 0.0271 | 0.0194 | 411 | 294 | 0 to 1,130 |
| | 0-3[b] | 7 | L | 0.0115 | 0.0087 | 0.0409 | 0.0337 | 620 | 511 | 0 to 1,870 |
| | | | F | 0.0098 | 0.0076 | 0.0349 | 0.0296 | 529 | 448 | 0 to 1,625 |
| | 0-4[c] | 7 | L | 0.0100 | 0.0060 | 0.0234 | 0.0144 | 355 | 219 | 0 to 891 |
| | | | F | 0.0081 | 0.0051 | 0.0188 | 0.0124 | 285 | 188 | 0 to 744 |
| | 0-3[c] | 7 | L | 0.0115 | 0.0087 | 0.0279 | 0.0215 | 423 | 327 | 0 to 1,222 |
| | | | F | 0.0098 | 0.0076 | 0.0238 | 0.0190 | 361 | 288 | 0 to 1,064 |
| LW | 0-4 | 6 | L | 0.0127 | 0.0043 | 0.0325 | 0.0126 | 294 | 114 | 1 to 586 |
| | | | F | 0.0118 | 0.0045 | 0.0301 | 0.0130 | 272 | 117 | 0 to 573 |
| | 0-3 | 6 | L | 0.0135 | 0.0041 | 0.0346 | 0.0126 | 312 | 114 | 20 to 604 |
| | | | F | 0.0125 | 0.0045 | 0.0320 | 0.0131 | 289 | 119 | 0 to 594 |
| | 0-3 | 5 | L | 0.0152 | 0.0042 | 0.0390 | 0.0131 | 295 | 99 | 20 to 570 |
| | | | F | 0.0141 | 0.0047 | 0.0362 | 0.0139 | 273 | 105 | 0 to 565 |

[a]L - f(o) obtained from the distribution of perpendicular distances for sightings of all large whales; F - f(o) obtained from the distribution of perpendicular distances of fin sightings.

[b]These estimates include the "outlying" pod of 25 fin whales.

[c]These estimates exclude the "outlying" pod of 25 fin whales.

Table 9. Components of variance of the density estimates, expressed as squared coefficients of variation of sample size (n), f(o), and pod size ($\bar{g}$).

| Zone | Species | No. lines flown | Beaufort forces | $(cv(n))^2$ | $(cv(f(o)))^2$ | $(cv(\bar{g}))^2$ |
|---|---|---|---|---|---|---|
| MW | Humpback | 7 | 0-4 | 0.3229 | 0.0140 | 0.0218 |
| | | | 0-3 | 0.5057 | 0.0166 | 0.0252 |
| | Fin | 7 | 0-4 | 0.3370 | 0.0664 | 0.0292[a] |
| | | | 0-3 | 0.5508 | 0.0534 | 0.0322[b] |
| | All large whales | 7 | 0-4 | - | 0.0149 | - |
| | | | 0-3 | - | 0.0140 | - |
| LW | Humpback | 6 | 0-4 | 0.1165 | 0.0082 | 0.0214 |
| | | | 0-3 | 0.0972 | 0.0082 | 0.0214 |
| | | 5 | 0-3 | 0.0795 | 0.0082 | 0.0214 |
| | | 4 | 0-3 | 0.0178 | 0.0082 | 0.0214 |
| | Fin | 6 | 0-4 | 0.1047 | 0.0431 | 0.0380 |
| | | | 0-3 | 0.0870 | 0.0431 | 0.0380 |
| | | 5 | 0-3 | 0.0675 | 0.0431 | 0.0380 |
| | All large whales | - | - | - | 0.0076 | - |

[a]Excluding the pod of 25 fins; including this pod, $(cv(\bar{g}))^2 = 0.1066$.

[b]Excluding the pod of 25 fins; including this pod, $(cv(\bar{g}))^2 = 0.1146$.

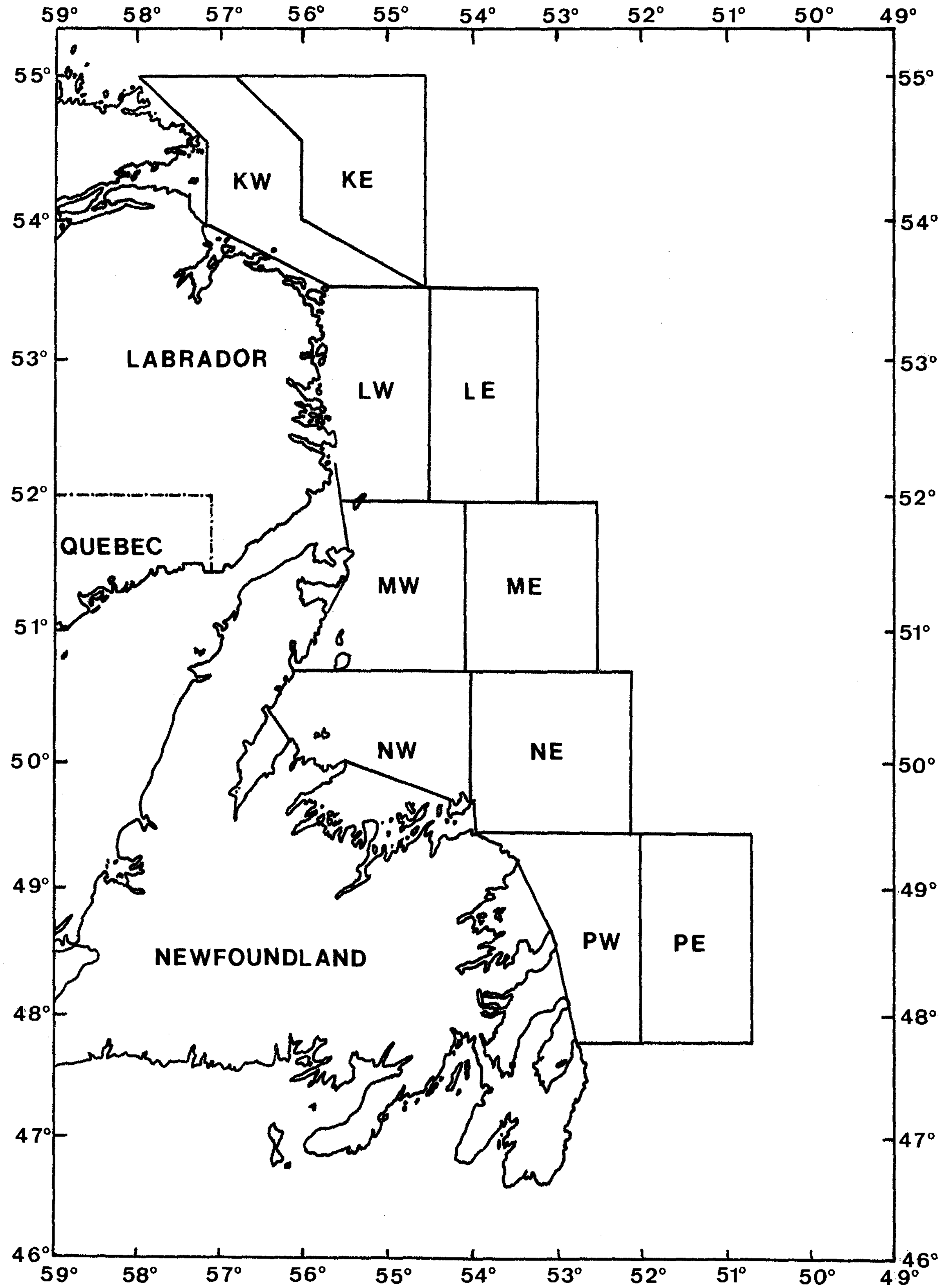


Fig. 1. The study area. Only zones MW and LW are considered in this report.