THE LENGTHS AND DISTRIBUTION OF ANTARCTIC SEI WHALES

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ABSTRACT

Data from the Bureau of International Whaling Statistics are used to examine the distribution and lengths of sei whales caught by the pelagic fleets in the Antarctic over the period 1931 to 1978. Over this period peak catches occurred in January but from 1931 to 1950 the peak was in March and from 1950 to 1960 the peak was in February. This difference with time is probably due to an earlier preference for blue and fin whales. Maximum lengths found were 61 feet for males and 64 feet for females. Having stratified the data by latitude, longitude and month it was found that for males there was no difference in the mean lengths between the months January to March but for females mean lengths were longer in January than those in February and March. This may reflect the difference in timing of migration of the different age and sexual classes. In all months and longitudinal bands mean lengths of whales of both sexes were greater south of the Antarctic Convergence. These mean differences ranged from 0.5–3.8 feet for males and 0.9–3.9 feet for females. The distribution of larger whales is similar north and south of the Convergence and the difference is caused by most of the smaller whales staying north of the Convergence.

INTRODUCTION

Following the development of the attached, explosive harpoon large rorquals could be caught and numerous sei whales (*Balaenoptera borealis* Lesson) were caught off Finmark, the Faroe Islands and Iceland before the turn of the century (Collett, 1886; Hjort and Rudd, 1929; Tønnessen and Johnsen, 1982). In the Southern Hemisphere sei whales were first taken from the land stations on the Falkland Islands and South Georgia before larger catches were taken by the pelagic fleets. The first record which I can trace of sei whales caught from the Antarctic land stations, is during February or April of 1906 at New Island in the Falkland Islands (Tønnessen and Johnsen, 1982). Catches by the Antarctic Pelagic fleets remained at less than 1,000 per year until 1957/58 although the land stations at South Georgia usually caught more than the pelagic fleets (Ohsumi and Yamamura, 1978). With restrictions on the capture

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of fin whales the fleets took progressively more sei whales and extensive exploitation occurred over the seasons 1963/64 to 1967/68 (Horwood, 1978). Ohsumi and Yamamura record that over the period 1909 to 1978 over 171,000 sei whales were caught from the Southern Hemisphere. Under the regulations of the International Whaling Commission (IWC) sei whales were completely protected from all whaling in the Southern Hemisphere from the start of the 1978/79 whaling season (Anon., 1979).

The distribution of sei whales is seasonal, as is that of the other rorquals, with breeding occurring in the sub-tropical waters and migrations to the polar feeding grounds. The distribution of catches and catch per unit of effort show that in the Antarctic sei whale numbers are highest from January to March and off South Africa are highest in August to October (Bannister and Gambell, 1965; Best, 1967; Budylenko, 1977; Gambell, 1968; Matthews, 1938). Sightings data also confirm this movement (Bannister and Gambell, 1965; Best, 1967; Gambell, 1968; unpublished information provided by Far Seas Fisheries Research Laboratory, Japan; Masaki, 1979). Paiva and Grangeiro (1965, 1970) show a similar winter abundance off Brazil. Marking has shown that sei whales seen in the subtropics do migrate to the Antarctic (Brown, 1977). During the migration, segregation of sexual classes has been observed. Pregnant females leave the warmer waters first, arrive first at the feeding grounds and depart earlier, and older animals generally precede younger ones (Gambell, 1968; Lockyer, 1977).

In the Antarctic, catches of sei whales were predominantly between 40°S and 50°S from longitudes 60°E eastwards to 130°E but at higher latitudes in the rest of the Antarctic (Horwood, 1980a). As shown by Ohsumi (1977) from the North Pacific, Nasu and Masaki (1970) and Kawamura (1974) found the whaling grounds for sei whales to be in temperatures of between 8°C and 18°C, but numerous whales also have been caught south of the Antarctic Convergence (AC). Japanese sighting data show that in some locations sei whales may be found north of 40°S in the whaling season (Masaki, 1980). Within the Antarctic sei whales are not distributed homogeneously and more localized whaling grounds exist. As the whaling season progresses there is a tendency for whaling, and presumably the whales, to be found more to the south (Nemoto, 1959; Kawamura, 1974).

Doi *et al.* (1967) reported on the size distribution of sei whales in the Japanese catch from 60°W eastwards to 170°W (Whaling Areas II–V) over the seasons 1962/63 to 1964/65. They showed that in the catch females were about 4 feet longer than males and that south of 45°S the average length of males in the catch was about 48 feet and the length of females was about 52 feet. North of 45°S the average length of both sexes was much shorter. Similar features were noted by Woolner and Horwood (1980).

The latitudinal segregation by size observed by Doi *et al.* (1967) is not found in the other large rorquals, the catches of which are in higher latitudes. The segregation can be assumed to be of some consequence to the biology of

the Southern Hemisphere sei whale but, in addition, the sampling and interpretation of demographic parameters will be affected by the non-random distribution of the whales. The material reported upon by Doi *et al.* (1967) was collected over a limited number of seasons and longitudinal sectors. This study makes use of the material recorded by the Bureau of International Whaling Statistics (BIWS), from pelagic operations since the 1931/32 season, to describe in greater detail the distribution of sei whales and in particular the distribution of lengths. The spatial and within season distribution by sex and age described above have necessitated analyses by month, latitudinal and longitudinal divisions. Of particular interest is the relative sizes north and south of the AC. The rapid increase in exploitation over the middle 1960s resulted in a substantial change in the mean length of whales in the catch within ten degree latitudinal zones (Woolner and Horwood, 1980), and consequently investigations have been carried out before and after this period.

MATERIALS AND METHODS

The data used are the individual catch records originally collated by the BIWS, Norway. They consist of information about each whale caught by pelagic expeditions in the Southern Hemisphere from the 1931/32 whaling season onwards. Each record is from one whale caught and gives details of expedition, date, position, sex, length and foetal data. The lengths are measured in feet from the tip of the rostrum to the notch between the tail flukes and are recorded to the nearest foot. These records are now held by the Secretariat of the IWC. Pelagic whaling for baleen whales in the latitudes 0°–40°S has not been allowed under the International Convention for the Regulation of Whaling, 1946, and so catch data for sei whales are restricted to the higher latitudes. The statistics give 67,853 male sei whales caught, 63,683 females and one unsexed by the pelagic fleets over the period 1931 to 1978 inclusive.

Woolner and Horwood (1980) described changes in the mean length of sei whales from the 1961/62 season with time. Here we are more interested in the spatial distribution of lengths and the effects of the changes with time need to be removed. This has been done by considering two separate time periods, that before and including the 1961/62 season and that after and including the 1968/69 season. Before 1961/62 exploitation was relatively light and mainly restricted to the South Atlantic region. After 1968/69 exploitation diminished and lengths in the catch were stable in most regions (Woolner and Horwood, 1980).

The most important oceanographic feature at about 45° to 50°S in the sector 60°W eastwards to 130°E is the AC and it is likely to be this feature, with its associated hydrographic and biological characteristics that is responsible for the smaller whales staying to the north. South of the AC the waters are colder and contain different food organisms (Kawamura, 1974). Consequently, we are interested in looking at mean lengths to the north and south of the

AC. The position of the AC has been approximated by the position of the 4°C surface isotherm (Machida, 1974) and this can be seen in the Southern Ocean Atlas as the surface averages from January, February and March (Gordon and Molinelli, 1982). Its position is similar to that described by Mackintosh (1946). Marking of sei whales and the distribution of sei and other whales has indicated that different stocks of sei whales can be found in the Antarctic, but the position is ambiguous with substantial mixing of marked whales. Consequently, the region has been divided into twelve sectors of 30° of longitude. This fine division also makes the recognition of the latitudes north and south of the AC easier since the AC varies from below 40°S to above 60°S. The higher position of the AC from 60°W westwards to 180° corresponds to the region where sei whales were caught in the higher latitudes. The position of these sectors and of the AC is given in Fig. 1.

Further arrangement of the data consists in their presentation by months, since previous studies have indicated a differential migration by age and sexual status. Initial inspection of the data is by groupings of two degrees of latitude within each longitudinal sector.

The data thus have been disaggregated into two time periods, all months, 12 longitudinal and 20 latitudinal zones. ANOVA techniques cannot be applied due to the large number of empty cells and unequal variances and so direct comparison of means has been done using Students-t tests and experiment-wise significance levels.

RESULTS

(a) Maximum sizes

From the 131,537 total sei whales recorded in the pelagic data twelve were 60 feet or over. Two were males of 60 and 61 feet. The largest female was measured as 64 feet and was caught when pregnant by boats of the Sovietskaya Ukraina at 68°S 99°W in 1962.

(b) Catch by month

The percentage catch by month over all seasons since 1931 by the pelagic fleets is given by sex in Table 1. It can be seen that peak numbers occur in January and February with large catches also in December and March. No catches occurred until November and after May. Catches in December before 1961/62 were very few and after 1968/69 tended to be restricted to the more northern latitudes. Consequently, subsequent analyses have looked at sizes only in January, February and March.

(c) Size by month within latitude and longitudinal bands

Mean lengths were extracted by the two time periods, the twelve longitudinal zones, three months and two-degrees of latitudes. Within each

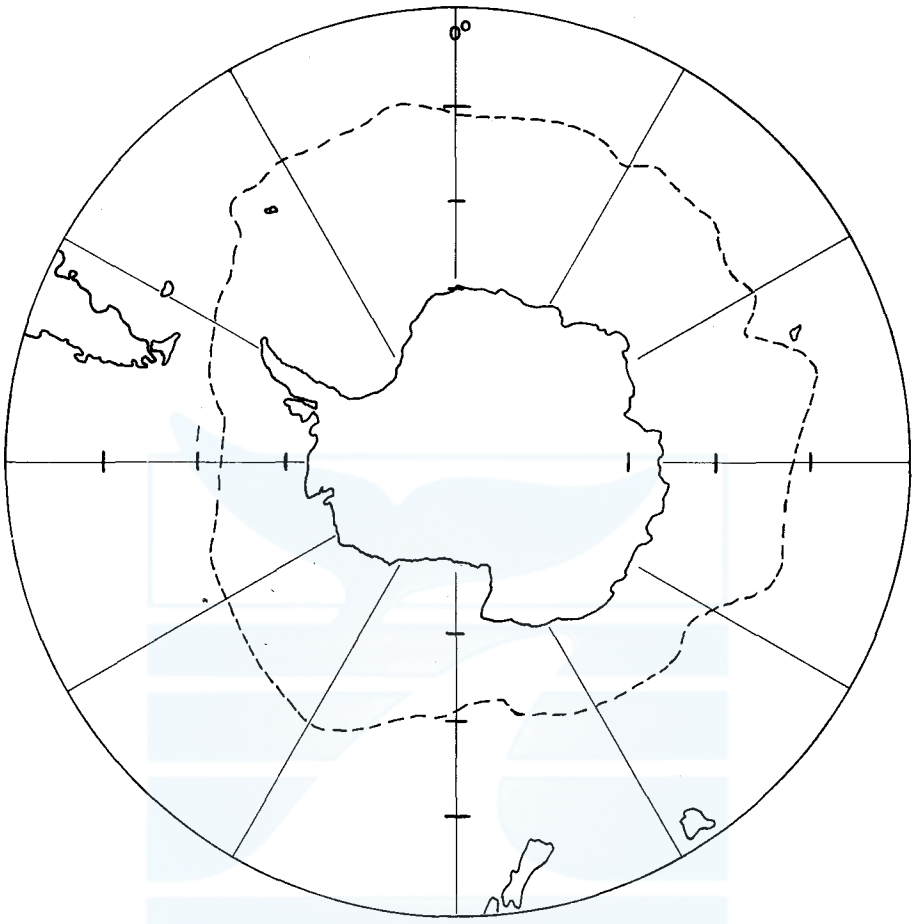

Fig. 1 The Antarctic south of 40°. The dashed line shows the position of the Antarctic Convergence and the radiating lines show the 12 sectors used in the analyses. Ticks are at 50, 60 and 70°S.

TABLE 1. PERCENTAGE OF THE CATCH BY MONTH FROM THE PELAGIC FLEETS, 1931–78

Month	Male	Female
November	0.0	0.0
December	20.0	17.9
January	32.6	28.0
February	28.7	30.9
March	17.7	21.5
April	1.0	1.6
May	0.0	0.1

time period and longitudinal zone the mean lengths in each two-degree latitudinal block were compared by month to see if mean lengths in January were greater than in February, February greater than March and January greater than March. Cells in which less than six whales were caught were ignored. A plus was given if the earlier month was larger and for each sex the plusses and minuses were summed over the entire Antarctic. The results are summarized in Table 2. A signs test can be applied with a chi-square distribution with one degree of freedom and the pair-wise significance level for each comparison is given in Table 2.

TABLE 2. COMPARISON OF MEAN LENGTHS BY TWO-DEGREES OF LATITUDE WITHIN THE 12 ZONES SUMMED OVER THE ANTARCTIC.
J = JANUARY, F = FEBRUARY, M = MARCH.
A PLUS (+) IS GIVEN IF THE MEAN LENGTH WAS LARGER IN THE EARLIER MONTH

Time	Sex	Months	+	−	Pair-wise probability
≤ 61/62	M	J/F	11	13	> 0.5
≤ 61/62	M	F/M	20	17	> 0.5
≤ 61/62	M	J/M	12	14	> 0.5
≤ 61/62	F	J/F	23	12	0.08
≤ 61/62	F	F/M	22	25	> 0.5
≤ 61/62	F	J/M	18	10	0.09
≥ 68/69	M	J/F	18	15	> 0.5
≥ 68/69	M	F/M	13	17	> 0.5
≥ 68/69	M	J/M	18	8	0.05
≥ 68/69	F	J/F	21	11	0.08
≥ 68/69	F	F/M	15	20	> 0.5
≥ 68/69	F	J/M	22	9	0.02

The signs tests is not powerful but has the advantage of making few assumptions and here the test overcomes any concerns about different sizes between longitudinal zones due to any possible population differences. The results show that in general no differences exist in mean lengths by month of males, but that for females those in January may be larger than those found in February or March. The subsequent analyses retain the segregation by months.

(d) Sizes north and south of the Convergence

Fig. 1 shows the position of the AC as defined by the 4°C isotherm and even after dividing the Antarctic into 30° sectors the AC covers several degrees of latitude in many sectors. For each of the 12 sectors the latitudes taken as

above and below the AC are given below (Table 3); this division thus excludes whales caught within the Convergence.

The larger gaps in some of the sectors, e.g. 5, are because there is some variance between the position of the 4°C isotherm from the Atlas and that given by Mackintosh (1946).

Inspection of the data from the early period showed that the catches were very largely south of the AC and do not provide enough material for

TABLE 3. DEFINITION OF SECTORS

Sector	Longitude	Above AC: north of latitudes	Below AC: south of latitudes
1	0– 30E	48	54
2	30– 60E	48	52
3	60– 90E	50	56
4	90–120E	50	56
5	120–150E	50	60
6	150–180E	52	62
7	0– 30W	48	54
8	30– 60W	50	60
9	60– 90W	58	64
10	90–120W	58	64
11	120–150W	60	62
12	150–180W	60	64

further investigation. The rest of the analysis is based on data obtained during and after the 1968/69 season.

Only a few sectors have sufficient numbers in two-degree latitudinal sectors in one month to enable an inspection of trends from north to south. They are shown in Fig. 2.

From the data on males no trend is obvious in sector 8 in February (Fig. 2a), but sector 9 in January (Fig. 2b) does show a difference between the lengths of whales caught north of 50°S and those caught south of 58°S. Sector 6 in March has the AC covering ten degrees of latitude and most of the data are from within the Convergence but Fig. 2c shows the lengths south of the Convergence to be larger than the others. Sector 3 in February (Fig. 2d) has no values totally south of the AC but the data from the lowest latitudes indicate smaller sizes. This is not seen in the same sector in the previous month (Fig. 2e) and the southernmost point removes the impression of a consistent trend with latitude.

The data from females in sector 8 in January and February (Fig. 2f and g) also show no trend. However, data from sectors 6, 3 and 2 (Fig. 2h, i and j) all show a discontinuity at about the position of the AC, with larger lengths to the south.

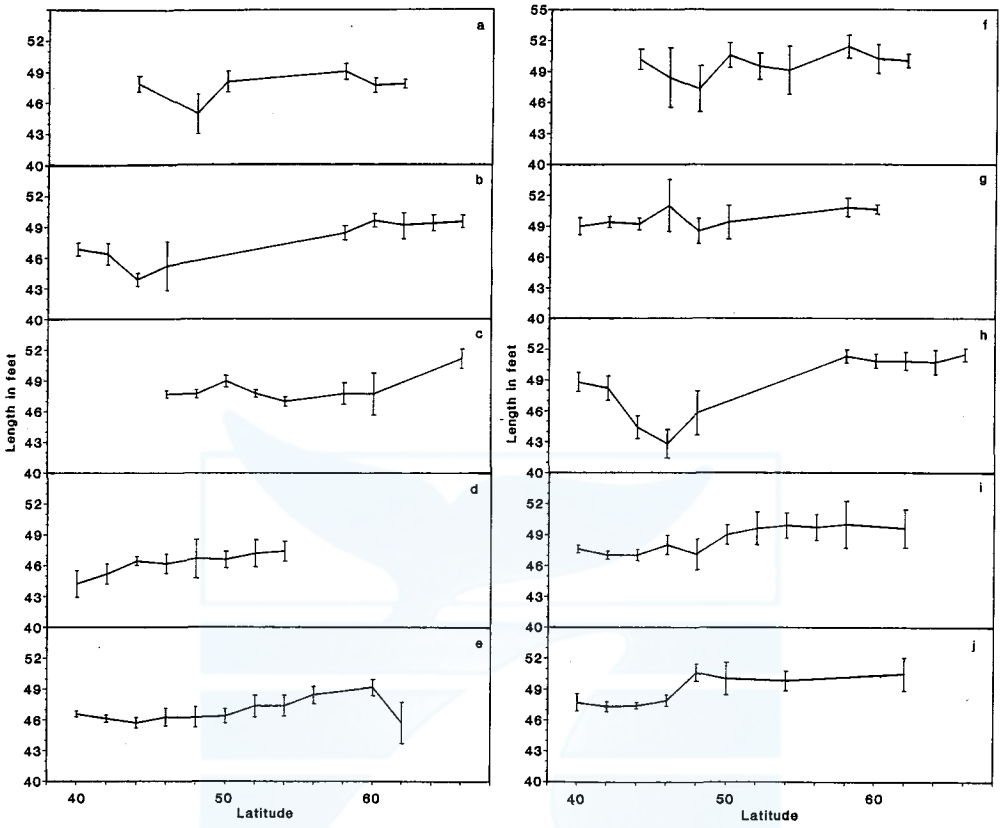

Fig. 2 Mean lengths in feet and ±2 standard errors of lengths by latitude. 40° corresponds to a grouping of whales caught in 40–42°S. Males: a-e. Females: i-j.

(a) February, 30–60°W (b) January, 60–90°W
(c) March, 150–180°E (d) February, 60–90°E
(e) January, 60–90°E (f) February, 30–60°W
(g) January, 30–60°W (h) March, 150–180°E
(i) January, 60–90°E (j) February, 30–60°E.

It is possible to aggregate the data over latitudes north and south of the Convergence (as defined above), but retaining the segregation by month and sector. The mean lengths so obtained and the differences of the means are given in Table 4.

Data have only been used if six or more lengths were obtained both north and south of the AC and consequently many gaps are found in the table. In all cases (35) the mean value was greater south of the Convergence. In the light of this further tests are hardly required but for completeness Student's t-tests were done.

In all cases the variance of the lengths was greater in the north, a feature

TABLE 4. MEAN LENGTH OF WHALES NORTH OF THE AC AND IN BRACKETS DIFFERENCES IN THE MEAN LENGTH IN FEET OF SEI WHALES CAUGHT SOUTH AND NORTH OF THE AC BY MONTH AND LONGITUDINAL SECTOR IN THE SEASONS OF 1968/69 AND AFTER. ALL VALUES ARE GREATER IN THE SOUTH. AN ASTERISK INDICATES THAT LESS THAN 6 WERE CAUGHT EITHER NORTH OR SOUTH OF THE CONVERGENCE

Sector	Month		
	January	February	March
(a) FEMALES			
1	*	*	*
2	*	47.5 (2.94)	*
3	47.3 (2.50)	46.7 (2.75)	47.1 (2.80)
4	48.0 (2.67)	47.4 (2.08)	*
5	*	*	*
6	*	*	47.0 (3.87)
7	*	*	*
8	49.2 (1.43)	49.1 (1.23)	*
9	49.5 (1.44)	50.0 (0.87)	*
10	*	47.7 (2.96)	*
11	49.6 (0.91)	49.4 (1.53)	48.6 (2.32)
12	*	49.0 (1.64)	47.2 (3.85)
(b) MALES			
1	*	*	*
2	*	46.1 (2.23)	*
3	46.3 (1.71)	46.1 (1.30)	*
4	46.8 (1.36)	45.5 (1.88)	*
5	47.3 (0.68)	*	*
6	*	*	45.6 (3.79)
7	*	*	*
8	47.2 (0.55)	47.1 (0.84)	44.5 (2.50)
9	47.7 (3.33)	47.4 (0.74)	*
10	*	46.5 (1.01)	*
11	47.9 (1.23)	47.8 (0.50)	47.7 (0.99)
12	*	47.1 (0.95)	46.6 (2.24)

seen in the data of Doi *et al.* (1967), and consequently tests involving unequal variances and unequal sample sizes have been used (Snedecor and Cochran, 1980). An example of the distribution of lengths from the 60°–90°E sector in January is given in Table 5. The t-values are given in Table 6. Very few values are not significant at a pair-wise significance level of P = 0.01. If the males and females are treated as two independent groups then a better test is to look at the experiment-wise significance rates and these are shown in Table 6. A large number are significant even on this basis.

TABLE 5. LENGTH FREQUENCY DISTRIBUTION OF FEMALES CAUGHT FROM THE 1968/69 SEASON AND AFTER IN JANUARY AND IN THE 60–90°E SECTOR

	Length																			
	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58
North of AC	1	1	29	41	47	43	65	52	80	85	84	85	91	84	76	25	12	6	1	0	1
South of AC	0	0	0	0	1	2	2	3	4	2	7	5	11	13	14	7	0	3	0	0	0

TABLE 6. STUDENT'S T-VALUES OF COMPARISON OF MEAN LENGTHS NORTH AND SOUTH OF THE AC. THE DEGREES OF FREEDOM BASED ON UNEQUAL VARIANCES ARE GIVEN IN BRACKETS. SIGNIFICANCE LAVELS OF $P \leq 0.02$ ASSESSED ON AN EXPERIMENT-WISE BASIS FOR MALES AND FEMALES SEPARATELY ARE GIVEN BY $^+$ (EQUIVALENT TO $P \leq 0.001$ FOR PAIR-WISE TESTS)

Sector	January	February	March
(a) FEMALES			
1	–	–	–
2	–	7.6 (48)$^+$	–
3	7.0 (93)$^+$	4.5 (42)$^+$	3.3 (10)
4	6.7 (23)$^+$	3.4 (83)	–
5	–	–	–
6	–	–	10.7 (247)$^+$
7	–	–	–
8	5.7 (329)$^+$	2.2 (65)	–
9	2.9 (23)	1.9 (43)	–
10	–	3.9 (21)$^+$	–
11	1.7 (49)	5.5 (262)$^+$	4.9 (119)$^+$
12	–	5.5 (367)$^+$	5.1 (35)$^+$
(b) MALES			
1	–	–	–
2	–	5.7 (22)$^+$	–
3	5.6 (86)$^+$	2.9 (30)	–
4	3.0 (16)	3.7 (79)$^+$	–
5	1.3 (6)	–	–
6	–	–	13.5 (286)$^+$
7	–	–	–
8	2.5 (152)	1.9 (64)	2.8 (11)
9	8.8 (22)	2.2 (52)	–
10	–	4.1 (48)	–
11	3.7 (34)$^+$	2.8 (292)	2.6 (48)
12	–	4.5 (254)$^+$	3.4 (27)

DISCUSSION AND CONCLUSION

The lengths of sei whales in catches are affected by the location of the catches.

For instance, this study has shown that there are differences north and south of the Antarctic Convergence and Gambell (1968) found that more immature whales were caught off South Africa than off South Georgia. This presents a problem in describing lengths in the population. However, large numbers of sei whales have been caught from many localities and the aggregation of the data from the Southern Hemisphere is likely to yield a better description of the length at age in the population than presentation of the data from single regions. Even so there has been selection for the larger of the young animals and that has forced the construction of 'ideal age-length keys' (Ohsumi and Masaki, 1978). The age length keys have given maximum mean lengths (L_∞) of 48 to 49 feet for males and about 51 feet for Southern Hemisphere sei whales.

The maximum length of each of the whale species is useful to know, at least for identification purposes. Zemski (1980) reported that the maximum sizes of sei whales were 19 m (62 feet) in the Southern Hemisphere and 18 m (59 feet) in the Northern Hemisphere. The BIWS pelagic catch data show 12 whales caught of 60 feet or over. The largest male was 61 feet and the largest female 64 feet. The International Whaling Statistics (IWS, 1967, 1968) show that off Kamchatka a 59 foot male and 62 foot female were caught. Thompson (1928) reported males of 62 and 64 feet in catches from Scottish whaling stations and mentioned that Haldane's notes recorded a male of 65 feet. Thompson (1928) observed, in his section on right whales (p.7), that he suspected that at least some of the lengths of right whales were measured along the arc of the body. No such comment is made about sei whales but it is probable that he was referring to length measurements of all whales. Martin (1983) remarked that the Scottish length measurements were much bigger than any known reliably documented measurement from the North Atlantic. The 12 whales from the BIWS data were recorded over the period 1956–64 and although Clark (1983) has indicated that there might have been differences in measurement by different countries of up to 5 per cent, the techniques of standard measurement were established by this time and the lengths can be accepted. We can conclude that maximum lengths of sei whales are 61 feet for males and 64 feet for females with a possibility that larger ones have existed.

Harmer (1931) and Matthews (1938) showed that over the years 1913 to 1931 peak catches of sei whales at South Georgia occurred in March with reasonable numbers caught in February and April. Gambell (1968) reported peak catches at South Georgia from 1963 to 1965 to be in January and peak catch per effort in the same month. Catches were high from January to March. Gambell (1968) argued that although the wave of migrations of blue and then fin whales past South Georgia affected the desirability of sei whales to the industry the late influx of sei whales was real and this is supported by the low percentage of sei whales with diatom infestation at South Georgia from January to March. The pelagic data over the years 1931 to 1978 show peak catches in January and February with less in December and March and very few in other months. Japanese sightings data from 1965 also confirm

that peak abundances occur about January in the latitudes 40°–50°S but with a year-to-year variation that shows the general abundance of sei whales to occur between December and March. At higher latitudes peak sightings occur later. The impression is of sei whales starting to arrive in large numbers in the waters south of 40°S about December and generally remaining until March with a few penetrating further south later in the season. The more southern penetration of sei whales as the season progresses has been noted by Kawamura (1974). Nemoto (1959) considered that relatively large catches of sei whales in 1957 and 1958 in the Antarctic were associated with higher water temperatures in those years and that higher surface water temperature later in the summer allows sei whales further south. The sensitivity of sei whales to cold water and cold weather is well documented (Ingebrightsen, 1929; Nemoto, 1959; Mitchell and Kozicki, 1974).

Laws (1977) suggested that the changes in peak abundance from the 1927–31 period to that in the late 1950s could be due to a relaxation of interspecific competition or some environmental change but Matthews (1938) pointed out that absence of catches in January may well be because of the much greater demand for fin whales. Subsequent catches described by Gambell (1968) and the large majority of the pelagic catches described here were taken earlier in the season but were taken after fin and blue whales had been substantially depleted. Consequently, we cannot tell if the timing of migration has altered. Further inspection of the catch data by ten-year blocks revealed that before 1950 pelagic catches peaked in March, over the period 1950 to 1960 they peaked in February and only later were the large catches taken in January. One factor suggesting that the change is not real is that the catches described by Harmer (1931) and Matthews (1938) and early pelagic catches were over only three months whereas we now see sei whales in substantial numbers over four months. A three-month feeding season is very short. However, temperatures in the Antarctic Peninsula during the late 1920s were the coldest of the century (Horwood, 1980b) and subsequent warming or relaxation of competition may have allowed sei whales to arrive earlier in the season, but even so the late pelagic catches peaking late in the season continued until 1960 and a change in selection by the industry is the likely explanation.

The results given in Table 2 show that for males there is no evidence that migration to or residence in the waters south of 40°S is related to length. For females, however, the average lengths are greater in January than in February or March. This would indicate that larger females arrive earlier. The early migration of older females is documented by Gambell (1968) and Lockyer (1977) but the sexual status of the whales is also important with immature and pregnant females preceding lactating females. Lockyer (1977) shows (her Figure 3) that there is a high incidence of pregnant and mature sei whales in mid-January. The larger whales found in January thus may be the older mature whales which are joined later by the smaller, younger whales. Reasons for this may be that the larger whales can tolerate the slightly colder temperatures

found in January or that their sexual condition needs a longer feeding season.

The figures showing the distribution of lengths of whales with latitude do not generally show sharp discontinuities associated with the AC. In some localities the changes are more pronounced than others, such as 30°–90°E, but usually only slight trends can be seen. In contrast, when the lengths are grouped north and south of the Convergence large differences in the mean lengths are found. In January to March in both sexes and in all longitudinal zones, where enough data existed, whales were longer south of the Convergence. In males the means difference ranged between 0.55 to 3.79 feet and in females from 0.87 to 3.85 feet. An example of the distribution of lengths is given in Table 5 and its character is similar to that observed by Doi *et al.* (1967). The difference is generated by the distribution of larger sizes being about the same both north and south of the Convergence but with many smaller whales to the north. This was reflected in the variance of the lengths being always greater in the north. The reason for the segregation is not known. As previously described, sei whale distribution is known to be sensitive to surface temperature. This may be a direct thermal effect in that they do not like cold water or an effect moderated through their food supply. In the Antarctic it is possible that only the larger whales can tolerate the colder waters to the south of the Convergence or that the distribution of the prey species, known to be different south of the Convergence (Kawamura, 1974), can only be harvested by the larger animals.

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