

COMMONWEALTH



OF AUSTRALIA

Commonwealth Scientific and Industrial Research Organization

Division of Fisheries and Oceanography

REPORT 23

AUSTRALIAN HUMPBACK WHALES 1958

PART 1. ANALYSIS OF CATCHES

PART 2. WHALE MARKING AND RECOVERIES

Prepared for the International Commission on Whaling

By R. G. Chittleborough

Marine Laboratory
Cronulla Sydney
1959

CONTENTS

Page No.

SUMMARY		
PART 1. ANALYSIS OF CATCHES		
I.	INTRODUCTION	1
II.	WEST COAST	1
	(a) Total Catch and Rate of Catching	1
	(b) Sex Ratio	2
	(c) Mean Lengths	4
	(d) Length Frequency Distribution	5
	(e) Puberty	6
	(f) Sexually Immature Whales	7
	(g) Females in Advanced Pregnancy	8
	(h) Age Distribution	9
	(i) Discussion	9
III.	EAST COAST	11
	(a) Total Catch and Rate of Catching	11
	(b) Sex Ratio	11
	(c) Mean Lengths	11
	(d) Length Frequency Distribution	11
	(e) Sexually Immature Whales	11
	(f) Age Distribution	12
	(g) Discussion	12
IV.	NORFOLK ISLAND	13
V.	REFERENCES	14
PART 2. AUSTRALIAN MARKING OF HUMPBACK WHALES		15
I.	INTRODUCTION	15
II.	HUMPBACK WHALES MARKED	15
III.	MARKS RECOVERED	17
IV.	MIGRATIONS OF MARKED WHALES	18
V.	OTHER INFORMATION FROM MARKED WHALES	19
VI.	ACKNOWLEDGMENTS	20
VII.	REFERENCES	21
	APPENDIX	22 & 23

FO 335

SUMMARY

From the analyses of recent catches of humpback whales from the west coast of Australia it is concluded that the Group IV (70°E. - 130°E.) population has diminished very considerably, in spite of lessened hunting pressure since 1955.

In most features the composition of recent catches from the east coast of Australia indicates that the Group V (130°E. - 160°W.) population of humpback whales continues to be in a fairly sound condition. Evidence of some increase in the proportion of young (especially immature) females in recent catches requires further consideration when the catches of succeeding years are analysed.

The composition of the catch made at Norfolk Island in 1958 compared very favourably with the catches of previous years.

Over 1,000 humpback whales in Australian waters have been successfully marked from 1949 to 1958. Recoveries of marks are providing useful information upon migrations and breeding. No interchange between the Group IV and V populations of humpback whales has yet been recorded.

In citing this report, abbreviate as follows:
C.S.I.R.O. Aust. Div. Fish. Oceanogr. Rep. No.23.

FO 335

AUSTRALIAN HUMPBACK WHALES

1958

PART I. ANALYSIS OF CATCHES

I. INTRODUCTION

In this report the catches of humpback whales from Australian whaling stations in 1956, 1957, and 1958, are analysed and compared. Similar data from earlier seasons (1950-56) have already been published (Chittleborough 1958a).

The catches from the west coast of Australia in 1958 represent the only fishing upon the Group IV (70°E. - 130°E.) population of humpback whales in that year, since no humpback whales were taken in the Antarctic Area IV during 1958. In addition to the Group V (130°E. - 160°W.) population of humpback whales caught on the east coast of Australia and at Norfolk Island in 1958, 23 were taken in the Antarctic Area V, 183 from New Zealand, and some from the Tonga Islands.

The only other baleen whales taken in Australian waters during 1958 were two blue whales and three Bryde whales from Carnarvon. Details of the Bryde whales are being published (Chittleborough 1959a).

This report follows the previous procedure (Chittleborough 1958a, 1958b) in that separate analyses are made of the two populations (west and east coasts). Whale marking (Part 2 of this report) has not yet demonstrated any interchange between these two populations.

II. WEST COAST

(a) Total Catch and Rate of Catching

Table 1 shows the quotas, total catch, and average catch per catcher per day for 1956, 1957, and 1958. The station at Carnarvon did not fill its quota in 1958 and the average catch per catcher day was much lower than in previous years. The station at Albany did not fill its quota either in 1957 or in 1958 and in both years the average catch per catcher day was markedly lower than in 1956 or in earlier years (see Chittleborough 1958b).

TABLE 1

CATCHES AND AVERAGE RATES OF CATCHING OF HUMPBACK WHALES AT AUSTRALIAN STATIONS

WEST COAST

Year	Carnarvon			Albany		
	Quota	No. Taken	Av. Catch Per Catcher/Day	Quota	No. Taken	Av. Catch Catcher/D
1956	1000	1000	1.97	120	119 ⁺	1.59
1957	1000	1018*	2.11	120	102	0.66
1958	1000	885 [‡]	1.20	120	82	0.72

EAST COAST

Year	Tangalooma			Byron Bay		
	Quota	No. Taken	Av. Catch Per Catcher/Day	Quota	No. Taken	Av. Catch Catcher/D
1956	600	600	4.69	120	120	2.67
1957	600	600	4.84	121	121	3.66
1958	600	600	4.92	120	120	2.55

NORFOLK ISLAND

Year	Quota	No. Taken	Av. Catch Per Catcher/Day
1956	150	150	2.14
1957	120	120	1.85
1958	120	120	2.14

* By transfer of 18 humpback whales not taken at Albany in 1957.

+ Excluding one fin whale.

‡ Excluding two blue whales and three Bryde whales.

(b) Sex Ratio

Table 2 shows the percentages of females in the catches from 1956 to 1958. At Carnarvon the total catch in 1958 contained a higher proportion of females than in any previous year except 1957. Figure 1 shows the percentages of females in the weekly catches made at Carnarvon in 1951 and in each year from 1956 to 1958. The proportion of females in the weekly catches increased from 1951 to 1957

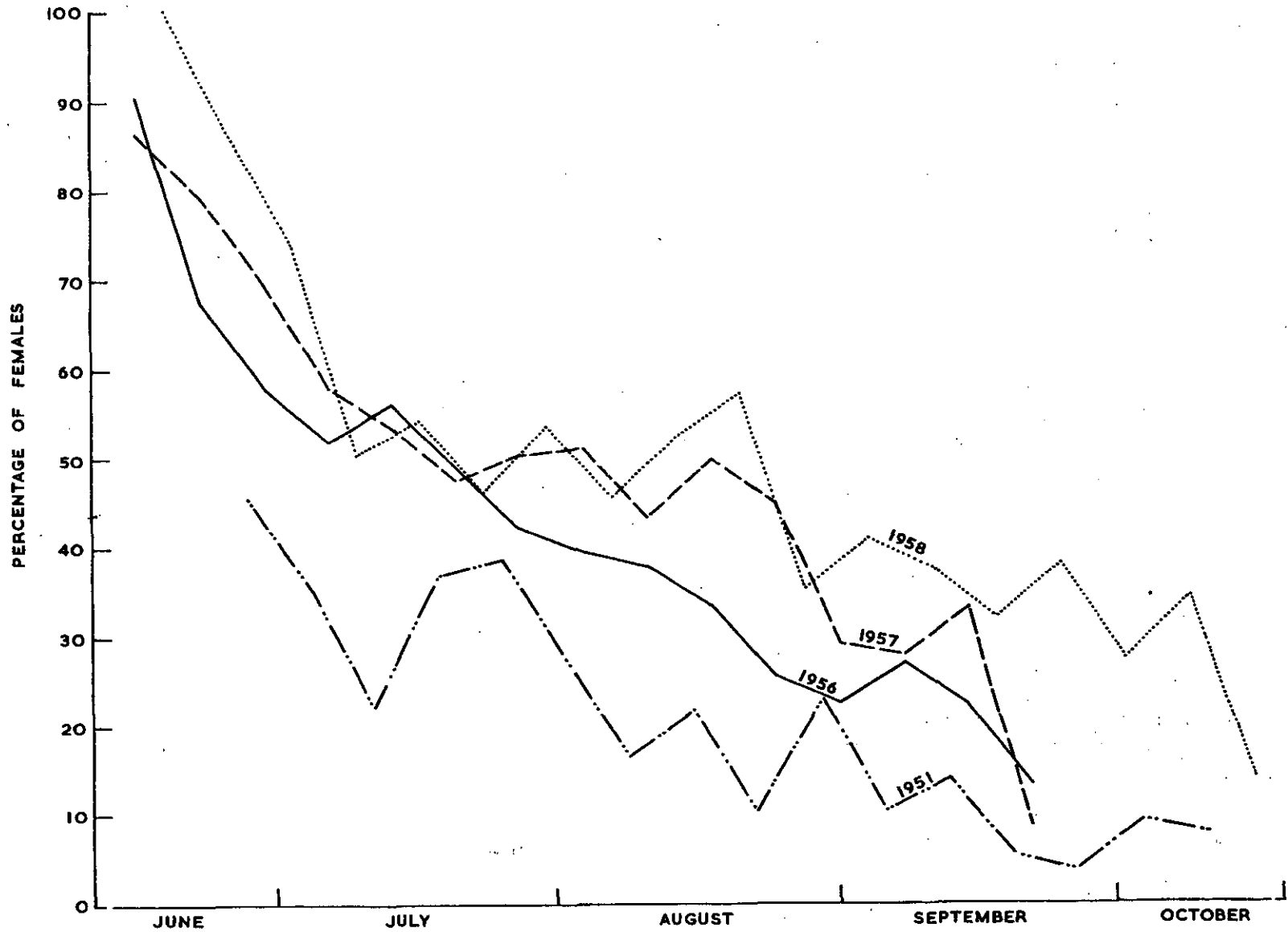


Fig.1. Percentage females in weekly catches at Carnarvon in 1951,1956, 1957, and 1958.

and tended to increase further in 1958. The slight drop in the percentage of females in the total catch of 1958 when compared with that of 1957 was due to the slightly longer catching period in 1958.

TABLE 2

% FEMALES IN RECENT CATCHES OF HUMPBACK WHALES
AT AUSTRALIAN STATIONS

WEST COAST

Year	Carnarvon		Albany		Total West Coast	
	No. Sexed	% Females	No. Sexed	% Females	No. Sexed	% Females
1956	1000	38.3	119	50.4	1119	39.6
1957	1018	48.4	101	42.6	1119	47.9
1958	885	46.6	82	56.1	967	47.4

EAST COAST

Year	Tangalooma		Byron Bay		Total East Coast	
	No. Sexed	% Females	No. Sexed	% Females	No. Sexed	% Females
1956	600	32.2	120	35.0	720	32.6
1957	600	29.7	121	42.1	721	31.8
1958	600	29.0	120	29.2	720	29.0

NORFOLK ISLAND

1956	150	38.7
1957	120	22.5
1958	120	47.5

The percentages of females caught at Albany have fluctuated somewhat from year to year partly due to variations in the period when commercial operations took place (Chittleborough 1958b). However in 1958, catching continued throughout almost the whole of the period when humpback whales were passing this region and the catch contained more females than in the catches of any previous year.

TABLE 3

MEAN LENGTHS OF MALES IN CATCHES
OF HUMPBACK WHALES AT AUSTRALIAN
STATIONS

Year	Carnarvon		Albany		Total West Coa	
	No. Taken	Mean Length (ft)	No. Taken	Mean Length (ft)	No. Taken	Mean Leng (ft)
1956	617	40.52	59	38.53	676	40.35
1957	525	39.89	58	38.78	583	39.78
1958	473	39.48	36	37.57	509	39.35
EAST COAST						
Year	Tangalooma		Byron Bay		Total East Coa	
	No. Taken	Mean Length (ft)	No. Taken	Mean Length (ft)	No. Taken	Mean Leng (ft)
1956	407	40.63	78	40.74	485	40.65
1957	422	40.50	70	39.67	492	40.38
1958	426	40.81	85	41.71	511	40.96
NORFOLK ISLAND						
Year	No. Taken	Mean Length (ft)				
1956	92	41.31				
1957	93	41.24				
1958	63	41.35				

(c) Mean Lengths

Table 3 shows the mean lengths of male humpback whales taken from 1956 to 1958. At Carnarvon the mean length of the males in the catch has decreased steadily from 1956 to 1958. The mean lengths of males taken at Albany have been lower in recent years than the corresponding means from Carnarvon, and the mean length of the males taken at Albany in 1958 was much lower than that in any previous year (1952 to 1958).

TABLE 4

MEAN LENGTHS OF FEMALES IN CATCHES OF HUMPBACK WHALES AT AUSTRALIAN STATIONS

WEST COAST						
Year	Carnarvon		Albany		Total West Coast	
	No. Taken	Mean Length (ft)	No. Taken	Mean Length (ft)	No. Taken	Mean Length (ft)
1956	383	42.38	60	41.95	443	42.32
1957	493	41.71	43	40.62	536	41.62
1958	412	41.51	46	39.65	458	41.33

EAST COAST						
Year	Tangalooma		Byron Bay		Total East Coast	
	No. Taken	Mean Length (ft)	No. Taken	Mean Length (ft)	No. Taken	Mean Length (ft)
1956	193	41.73	42	42.40	235	41.85
1957	178	41.83	51	40.23	229	41.47
1958	174	42.09	35	42.47	209	42.15

NORFOLK ISLAND		
Year	No. Taken	Mean Length (ft)
1956	58	42.09
1957	27	42.47
1958	57	43.40

Table 4 shows the mean lengths of female humpback whales taken at each Australian station from 1956 to 1958. At both Carnarvon and Albany the mean lengths of the females have declined from 1956 to 1958. As in the case of males, the mean lengths of females from Albany have been lower than those from Carnarvon in corresponding years, and in 1958 the mean length from Albany was lower than in any previous year.

(d) Length Frequency Distribution

Figure 2 shows the length frequency distribution of the combined catches of male humpback whales taken on the west coast of Australia for each year from 1956 to 1958. Figure 3 shows corresponding data for the females taken on the west coast. In both sexes the length frequency distribution

skewed towards the smaller individuals over the period from 1956 to 1958.

TABLE 5
MEAN LENGTHS OF PUBERAL FEMALES TAKEN ON THE
WEST COAST OF AUSTRALIA

<u>Year</u>	<u>No. of Puberal Females</u>	<u>Mean Length (ft)</u>	<u>Standard Deviation of Mean</u>
1951-54	77	38.50	0.18
1956	17	40.15	0.74
1957	42	39.49	0.34
1958	59	39.08	0.14

(e) Puberty

Table 5 shows the mean lengths of puberal females taken on the west coast of Australia in various years. The mean length of those taken from 1951 to 1954 is considered to be the most reliable, since during this period gunner selection was less stringent than in later years, allowing more complete sampling of these young females. In more recent years the selection by gunners of larger whales has resulted in a biased sample of puberal females, giving means which are above the true mean length of this class of females. Although the degree of selection applied by gunners cannot be reduced to a mathematical value which can be compared from year to year, there was apparently a similar degree of selection each year from 1956 to 1958. In spite of this the mean length of puberal females declined each year during this period (Table) and the numbers of such females in the catch increased, indicating that the population was declining, forcing gunners to accept more of the smaller individuals.

In order to apply a uniform standard each year, the mean length of 38.50 ft at puberty has been applied when assessing the proportion of immature females in the catch.

Similar apparent variations in the mean length of males at puberty appear to have occurred, due to more careful selection of larger whales in recent years, but comparable histological examination of testes has not been carried out each year. The mean length of 36.75 ft at puberty in males (Chittleborough 1955) has been applied in assessing the proportion of immature males in the catches of each year.

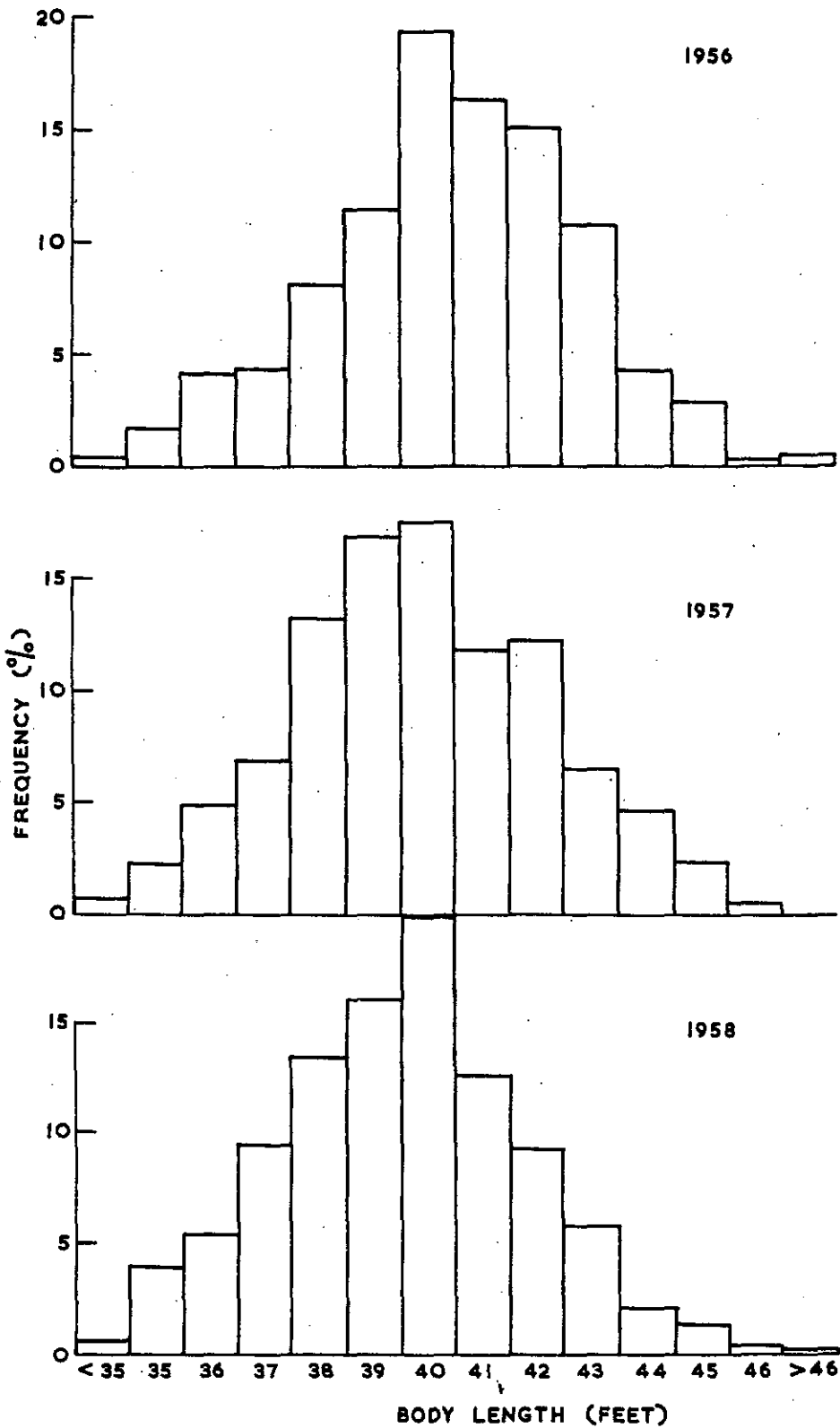


Fig.2. Length frequency distribution of male humpback whales taken on the west coast of Australia from 1956 to 1958.

e
d

5)

FO 335

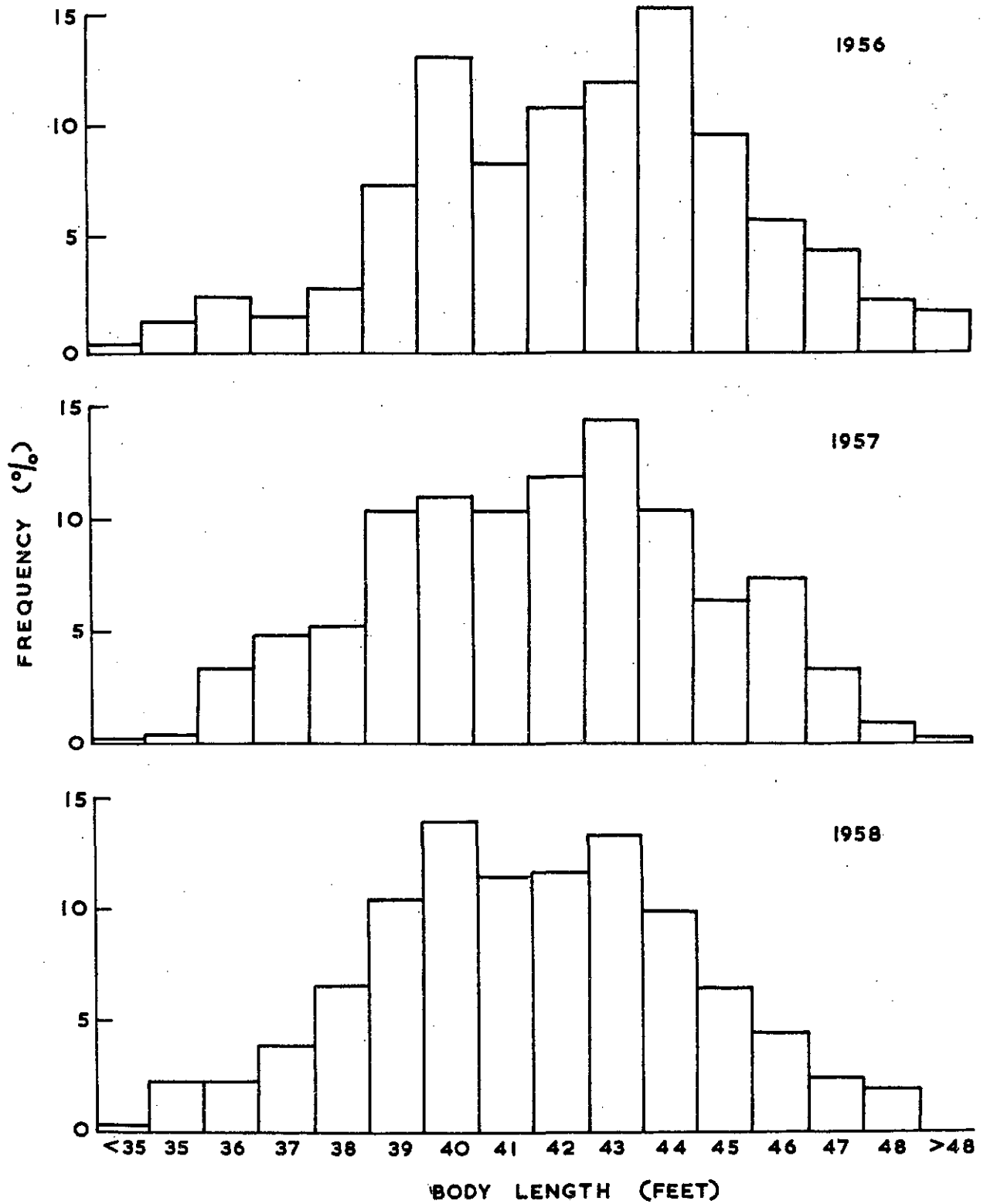


Fig.3. Length frequency distribution of female humpback whales taken on the west coast of Australia from 1956 to 1958.

TABLE 6

PERCENTAGES OF SEXUALLY IMMATURE MALE AND FEMALE
HUMPBACK WHALES FROM AUSTRALIAN CATCHES

WEST COAST

Year	Males				Females			
	By Length		By Examination		By Length		By Examination	
	No. Taken	% $\leq 36'9"$	No. Examined	Testes $\leq 4\text{kg}$ %	No. Taken	% $\leq 38'6"$	No. Examined	Not Ovulated %
1956	676	6.8	110	*	443	10.2	279	8.6
1957	583	9.8	488	13.5	536	16.2	521	21.5
1958	509	13.0	439	18.0	458	17.9	438	21.0

EAST COAST

1956	485	4.7	60	3.3	235	14.9	146	15.8
1957	492	5.5	215	6.1	229	20.1	183	23.5
1958	511	4.1	205	8.3	209	12.4	121	24.0

NORFOLK ISLAND

1956	92	6.5	-	-	58	22.4	48	20.8
1957	93	3.2	-	-	27	14.8	-	-
1958	63	3.2	-	-	57	3.5	-	-

* Small males selected for examination; therefore not representative of catch.

(f) Sexually Immature Whales

Table 6 shows the percentages of sexually immature male and female humpback whales in catches from 1956 to 1958. Where possible the percentages of immature individuals have been assessed by two methods, using body length and examination of gonads. In recent years more individuals have been found to be immature by the examination of gonads than by applying the mean lengths of males and females at puberty. In the last report it was suggested that this might be due to the more rapid rate of growth of young individuals in recent years, but it is probable that efforts by gunners toward more stringent selection of larger whales have been largely responsible for this difference.

On the west coast of Australia the percentage of immature males and females in the catches has increased each year from 1956 to 1958. The percentage of immature females (as shown by examination of ovaries) taken in 1958 would have been higher but for the fact that the longer catching period in that year enabled some females to ovulate for the first time.

TABLE 7

FEMALES IN ADVANCED PREGNANCY IN CATCHES OF MATURE FEMALES AT AUSTRALIAN STATIONS

West Coast			East Coast		
Station & Year	Est.No.of Mature Females	% in Advanced Pregnancy	Station & Year	Est.No.of Mature Females	% in Advance Pregnanc
Carnarvon			Tangalooma		
1956	348	7.2	1956	161	5.0
1957	416	6.0	1957	148	8.8
1958	347	6.9	1958	152	16.4
Albany			Byron Bay		
1956	50	26.0	1956	39	12.8
1957	33	39.4	1957	35	0
1958	29	13.8	1958	31	9.7
			Norfolk Island		
			1956	45	0
			1957	23	4.3
			1958	55	1.8

(g) Females in Advanced Pregnancy

Table 7 shows the percentages of mature females which were in advanced stages of pregnancy when killed. Apart from differences due to the geographic positions of the stations and fluctuations caused by variations in the period of whaling operations from year to year, these data show no important trends.

(h) Age Distribution

(i) Males.- The laminations within the cores of the ear plugs afford the best method of age determination in male humpback whales as discussed by Chittleborough (1959b). Examination of a large sample of ear plugs collected on the west coast of Australia during 1958 is still in progress, but Figure 4 shows the distribution of ages of sexually mature males, taken on the west coast in 1957 and of similar samples from the east coast in 1957 and 1958. Sexually immature males were excluded from the data shown in Figure 4 in order to minimize possible differences in gunner selection between the two areas.

Figure 4 shows that the majority of the mature males sampled on the west coast in 1957 were relatively young individuals, whereas the samples from the east coast both in 1957 and 1958 contained more of the older whales. The distribution of ages within samples taken on the west and east coasts of Australia in 1957 is considered further by Chittleborough (1959b).

(ii) Females.- As the examination of ear plugs also collected from female humpback whales taken on the west coast in 1958 has not yet been completed, the condition of the ovaries and numbers of previous ovulations will be used as an index of age (see Chittleborough (1959b)).

Figure 5 shows the frequency distribution of the numbers of ovulations within samples of females from the west coast in 1956, 1957, and 1958. From 1956 to 1958 increasing proportions of relatively young individuals and correspondingly fewer of the older females have been taken.

Figure 6 shows the mortality curves calculated from the sexually mature females shown in Figure 5, following the procedure of Chittleborough (1959b). These curves become steeper from 1956 to 1958, indicating that amongst the mature females sampled, the age distribution has steadily swung towards younger mature females.

(1) Discussion

In the comparison of the catches of humpback whales taken on the west coast of Australia in 1958 with the catches of previous years, the following adverse trends are apparent:-

(1) Failure at both whaling stations to complete the allotted quotas.

555 OF
FO 335

- (ii) Low rates of catching.
- (iii) An increase in the proportion of females taken (when the same catching periods are compared).
- (iv) A decrease in the mean lengths of both males and females in the catches.
- (v) Length frequency distribution skewed towards lower length ranges in the catches of both sexes.
- (vi) Increasing proportions of immature individuals.
- (vii) Amongst the sexually mature whales taken, the age distribution swung towards higher proportions of young whales.

If the weather conditions during the 1958 season had been more adverse than in previous years, some (but not all) of these features might be explained. The relationship between weather conditions and the catch of whales is being studied, but from the preliminary assessment the weather conditions at Carnarvon did not differ significantly in the 1957 and 1958 catching periods. Also most of these trends have been progressive over the past three years, making it less likely that weather conditions were responsible.

It has been shown (Chittleborough 1958a) that from 1949 to 1954 the condition of the Group IV population of humpback whales deteriorated, apparently as a result of commercial catching. From 1955 the quotas allotted on the west coast of Australia were reduced, and with the exception of 824 taken in 1956, no humpback whales were taken in Antarctic Area IV from 1955 to 1958.

In spite of the reduced annual catch from this population since 1955, analysis of recent catches from the west coast of Australia indicates that this stock is continuing to decline. The apparent decline has appeared in the face of relatively stringent selection of the whales available from 1955 to 1958. The male portion of the population has declined even more markedly than the female (Chittleborough 1959b). In its present

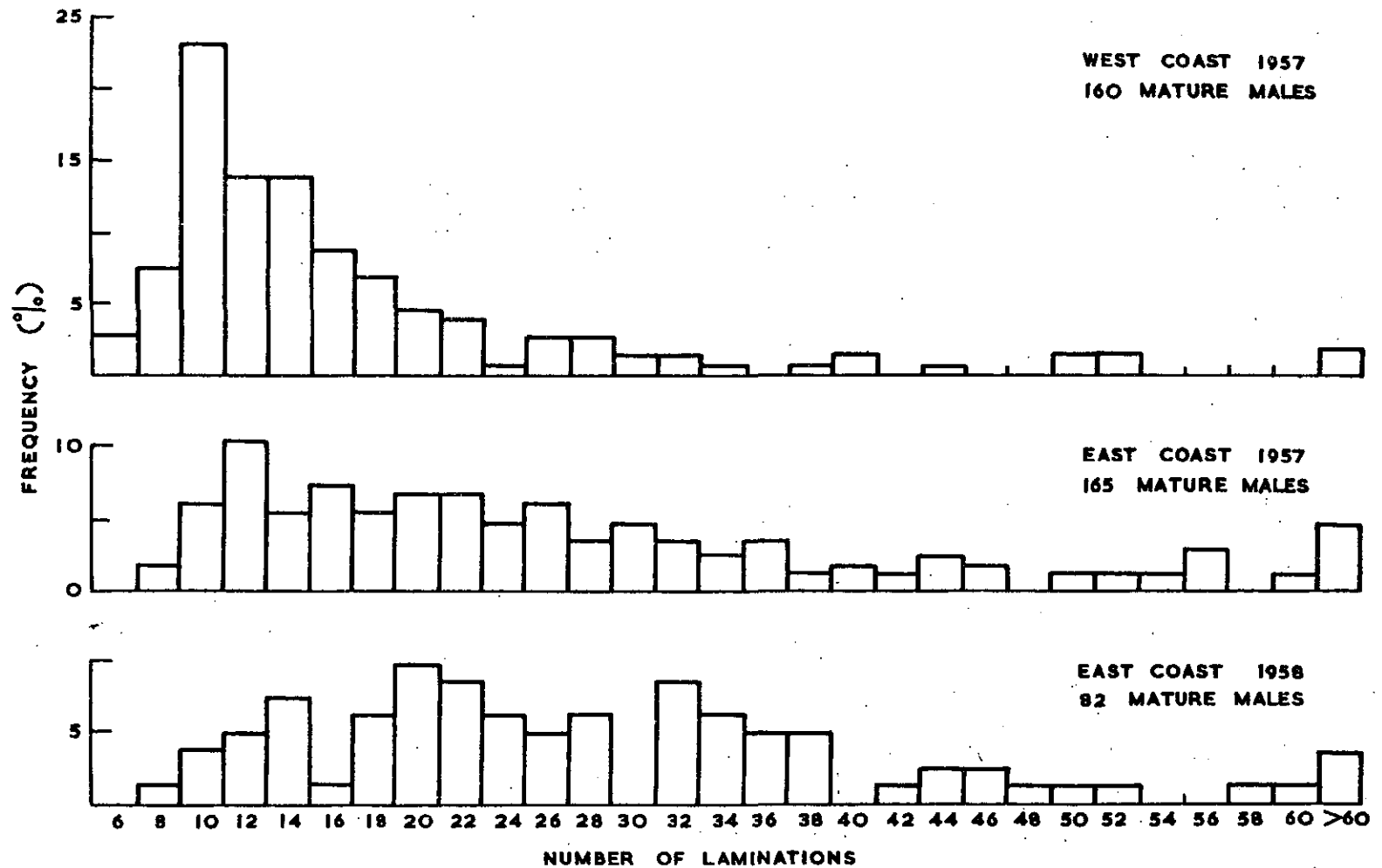


Fig.4. Age distribution (based on ear plug laminations) within samples of sexually mature males from the west coast of Australia in 1957 and from the east coast in 1957 and 1958.

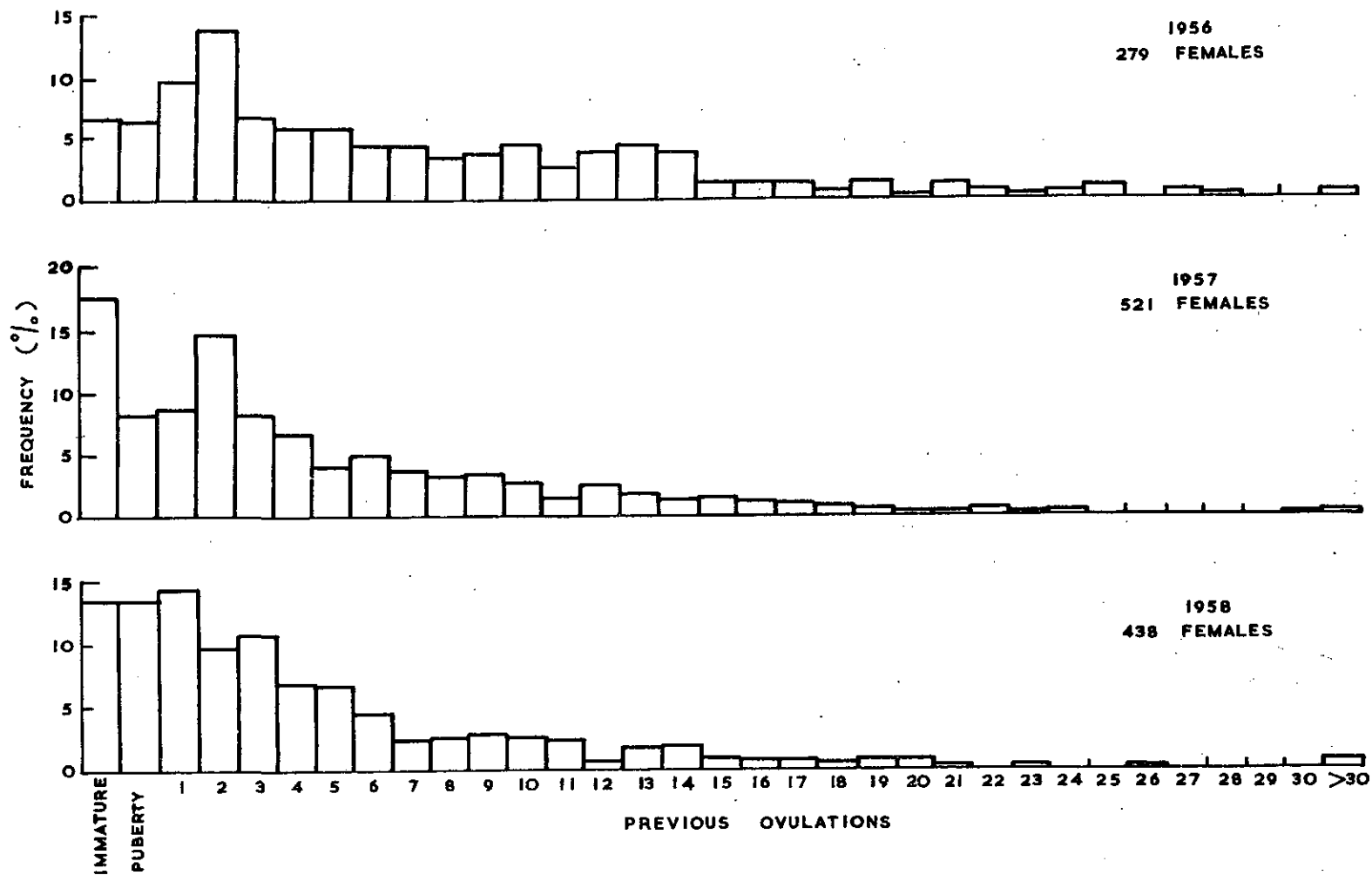


Fig.5. Distribution of numbers of ovulations within samples of female humpback whales examined on the west coast of Australia in 1956, 1957, and 1958.

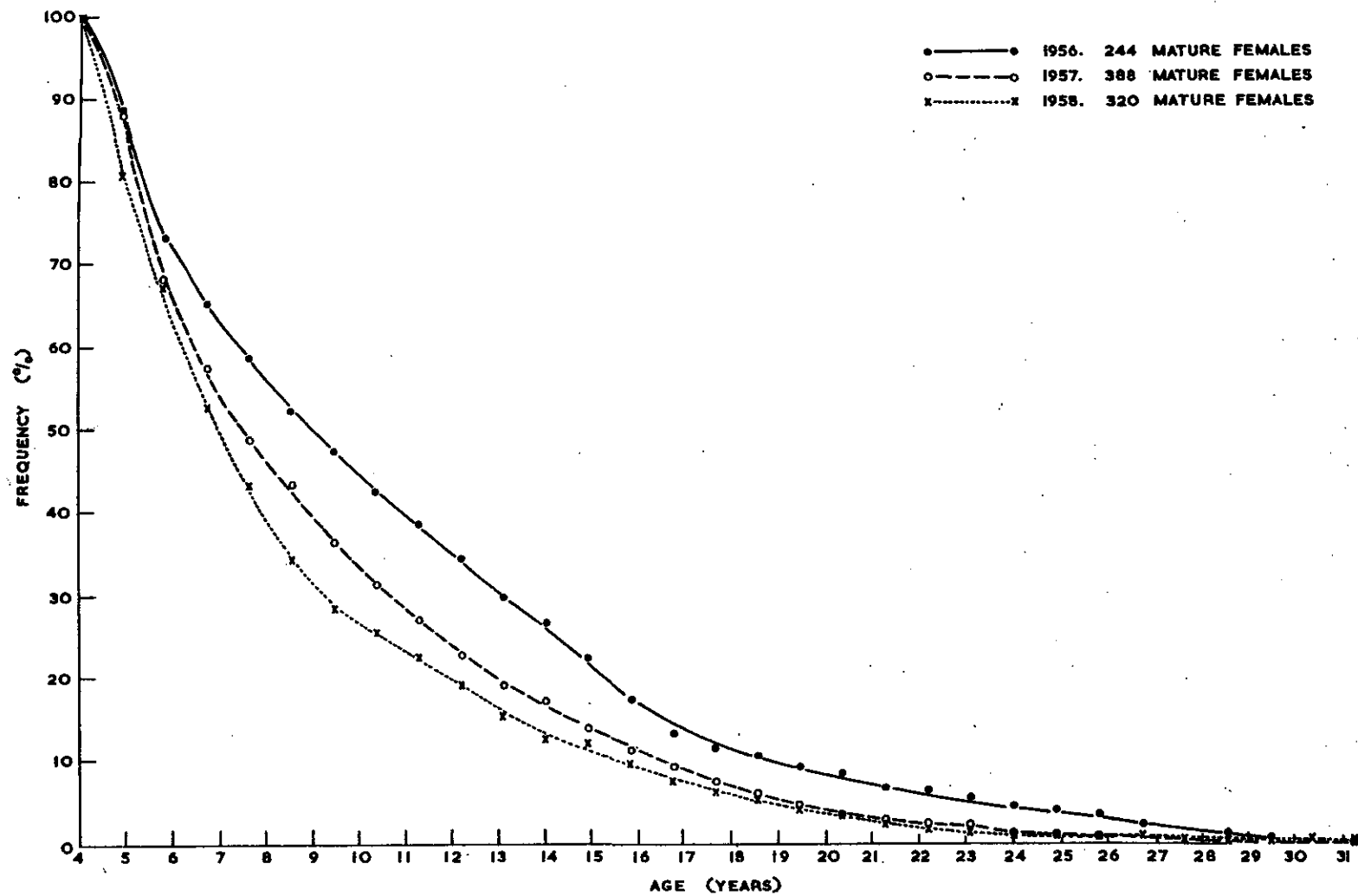


Fig.6. Mortality curves for samples of mature females from the west coast of Australia from 1956 to 1958.

condition it is very doubtful whether the stock will support a total annual catch (from Antarctic Area IV and the west coast of Australia) of 500 whales without decreasing the population further.

III. EAST COAST

(a) Total Catch and Rate of Catching

On the east coast of Australia quotas of humpback whales have been filled each year and the average catch per catcher day has been relatively stable in recent years (Table 1). At Tangalooma the average catch per catcher day increased slightly from 1956 to 1958. At Byron Bay the average catch per catcher day was higher in 1957 than in 1956 and 1958, possibly due to less stringent selection of whales in 1957 (see Chittleborough 1958b).

(b) Sex Ratio

The percentages of females in catches from the east coast in 1958 (Table 2) were slightly lower than in previous years and much lower than in catches from the west coast.

(c) Mean Lengths

The mean lengths of both males (Table 3) and females (Table 4) taken by both stations on the east coast of Australia in 1958 were higher than in previous years.

(d) Length Frequency Distribution

Figure 7 shows the length frequency distribution of the combined catches of male humpback whales taken on the east coast for each year from 1956 to 1958. Figure 8 shows corresponding data for females taken on the east coast. In both sexes the length frequency distribution has been relatively constant over this period. Slightly higher proportions of the smaller individuals were taken in 1957; this was the result of less selective catching at Byron Bay in that year.

(e) Sexually Immature Whales

On the basis of body length, the proportions of immature males and females in the catch from the east coast in 1958 were less than in previous years (Table 6). However, from the examination of gonads the percentages

of immature males and females were higher in 1957 or 1956. In the case of the males this percentage is still relatively low, but the percentages of immaturity (from the examination of ovaries) were relatively high in 1957 and 1958.

(f) Age Distribution

(i) Males.- Figure 4 shows the distribution within samples of sexually mature male humpback whales on the east coast of Australia in 1957 and 1958, using ear plug laminations per year as the criterion of age. The sample collected in 1958 contained fewer young males (less than eight years-of-age), more between 8 and 15 years-of-age, and slightly fewer of the older males than the sample from the catch made in 1957.

Figure 9 shows the mortality curves for the male humpback whales examined on the east coast in 1957 and 1958, derived as given by Chittleborough (1959b). The curves follow similar paths, the differences possibly being due to the smaller sample collected in 1958.

(ii) Females.- Figure 10 shows the frequency distribution of the numbers of ovulations within samples of female humpback whales examined on the east coast in 1957, and 1958. Both in 1957 and 1958 there were fewer immature and recently matured females than in 1956. On the other hand, in 1957 there were slightly more of the older females than in either 1956 or 1958.

Figure 11 shows the mortality curves calculated for the sexually mature females shown in Figure 10, following the procedure of Chittleborough (1959b) (1.1 ovulation per year). These curves show no regular trends from 1956 to 1958, the slope of the curve in the 1958 sample generally lying between those of 1956 and 1957. The number of females sampled each year on the east coast have been lower than corresponding samples from the west coast (Figs. 11 & 6). It is possible that the differences in mortality curves obtained from the east coast in 1957 and 1958, were due to the relatively small numbers sampled.

(g) Discussion

In the comparison of catches from the east coast of Australia in 1958 with those of previous years, no features indicated continued stability within this

an in
 ge was
 females
 both

 ages
 taken
 two
 The
 males
 years-
 the

 e male
 1958,
 curves
 ttribut-

 s-
 of
 956,
 e
 On the
 latively

 rom
 ing
 s per
 to
 lly
 mature
 much
 cf.
 n the
 1957,
 females

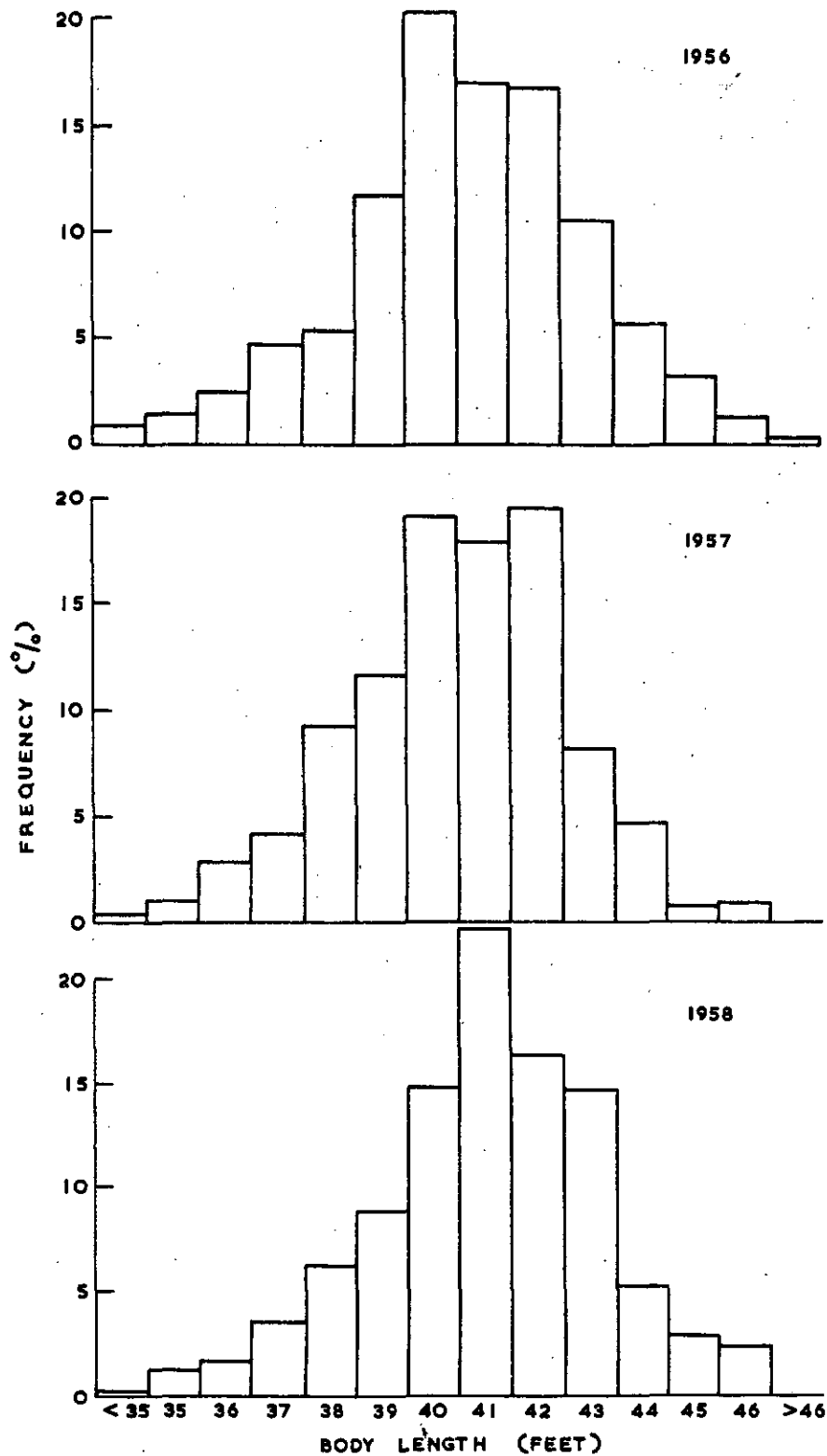


Fig. 7. Length frequency distribution of male humpback
 whales taken on the east coast of Australia
 from 1956 to 1958.

of
 ck.

of immature males and females were higher in 1958 than in 1957 or 1956. In the case of the males this percentage was still relatively low, but the percentages of immature females (from the examination of ovaries) were relatively high both in 1957 and 1958.

(f) Age Distribution

(i) Males.- Figure 4 shows the distribution of ages within samples of sexually mature male humpback whales taken on the east coast of Australia in 1957 and 1958, using two ear plug laminations per year as the criterion of age. The sample collected in 1958 contained fewer young mature males (less than eight years-of-age), more between 8 and 19 years-of-age, and slightly fewer of the older males than in the sample from the catch made in 1957.

Figure 9 shows the mortality curves for the mature male humpback whales examined on the east coast in 1957 and 1958, derived as given by Chittleborough (1959b). The two curves follow similar paths, the differences possibly being attributable to the smaller sample collected in 1958.

(ii) Females.- Figure 10 shows the frequency distribution of the numbers of ovulations within samples of female humpback whales examined on the east coast in 1956, 1957, and 1958. Both in 1957 and 1958 there were more immature and recently matured females than in 1956. On the other hand, in 1957 there were slightly more of the relatively old females than in either 1956 or 1958.

Figure 11 shows the mortality curves calculated from the sexually mature females shown in Figure 10, following the procedure of Chittleborough (1959b) (1.1 ovulations per year). These curves show no regular trends from 1956 to 1958, the slope of the curve in the 1958 sample generally lying between those of 1956 and 1957. The numbers of mature females sampled each year on the east coast have been much lower than corresponding samples from the west coast (cf. Figs. 11 & 6). It is possible that the differences in the mortality curves obtained from the east coast in 1956, 1957, and 1958, were due to the relatively small numbers of females sampled.

(g) Discussion

In the comparison of catches from the east coast of Australia in 1958 with those of previous years, most features indicated continued stability within this stock.

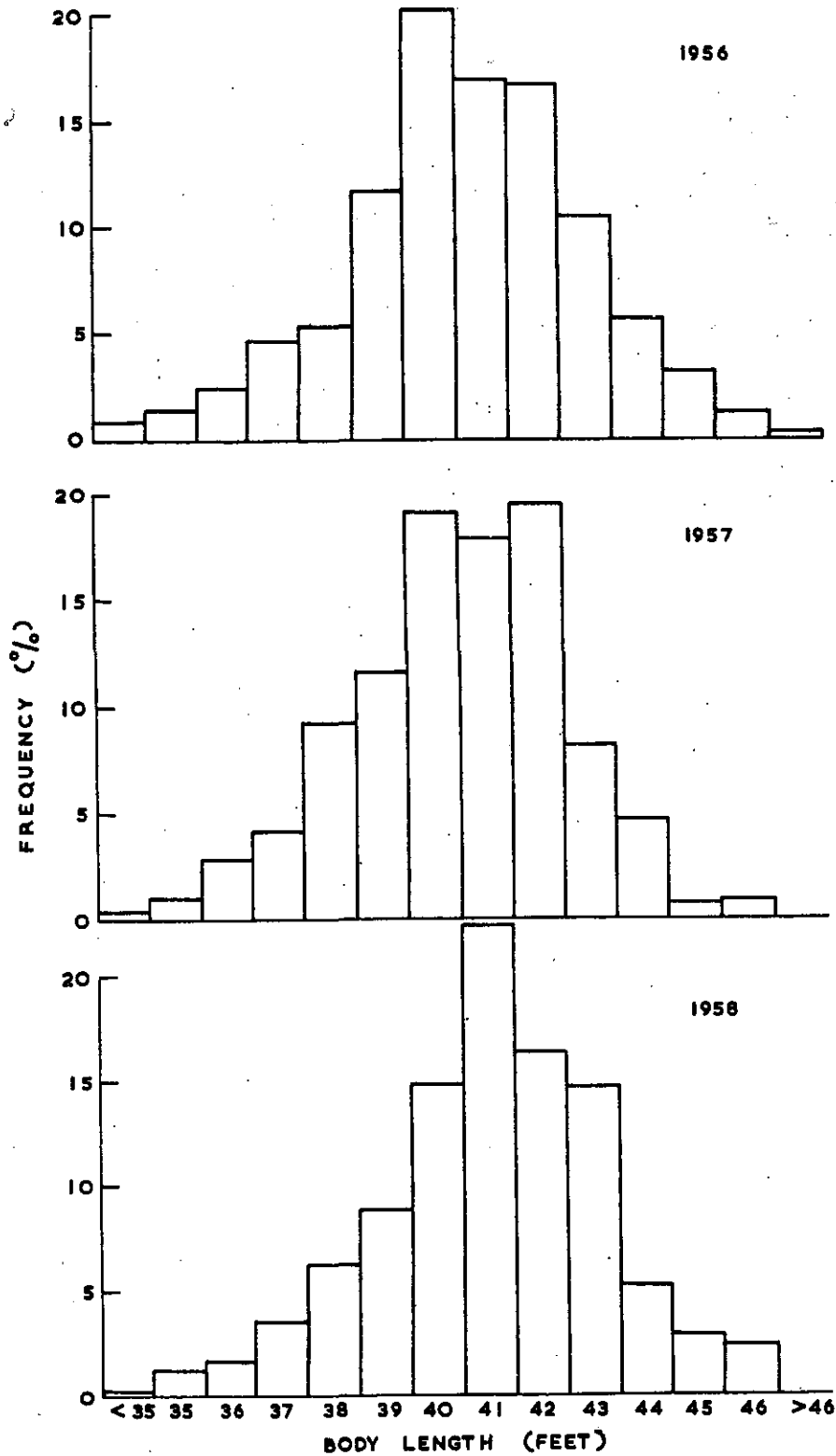


Fig.7. Length frequency distribution of male humpback whales taken on the east coast of Australia from 1956 to 1958.

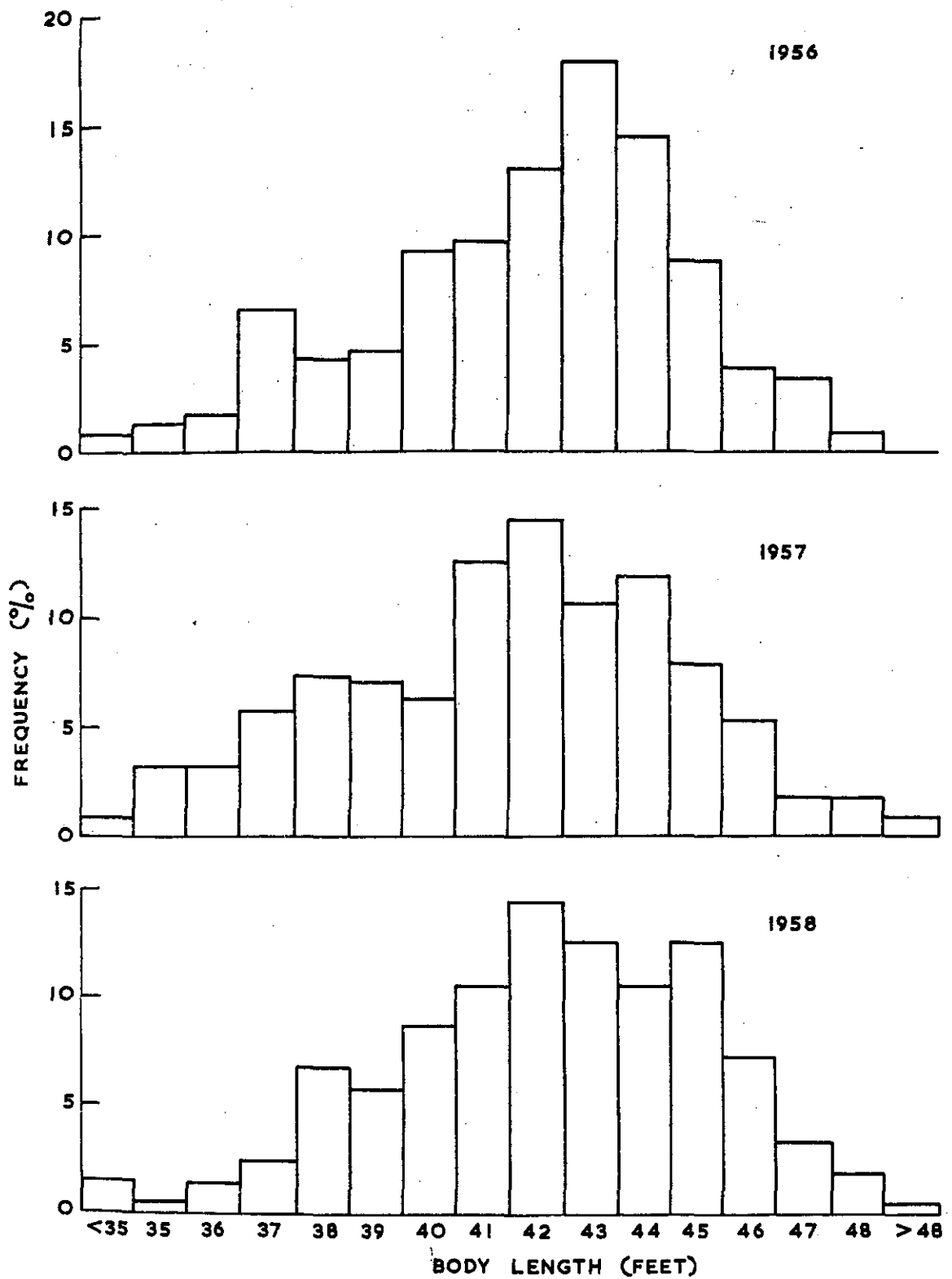


Fig.8. Length frequency distribution of female humpback whales taken on the east coast of Australia from 1956 to 1958.

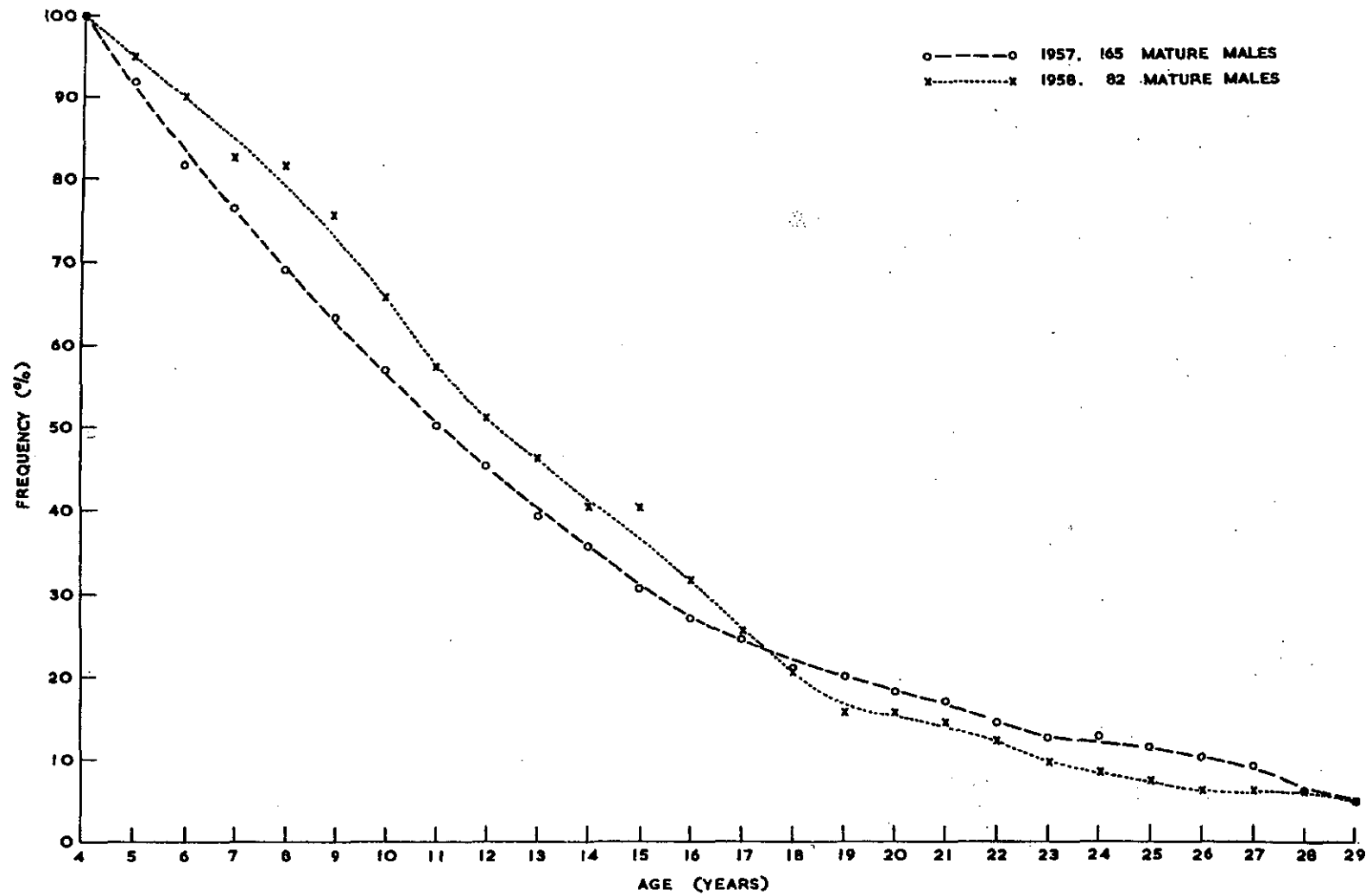


Fig.9. Mortality curves for samples of mature males taken on the east coast of Australia in 1957 and 1958.

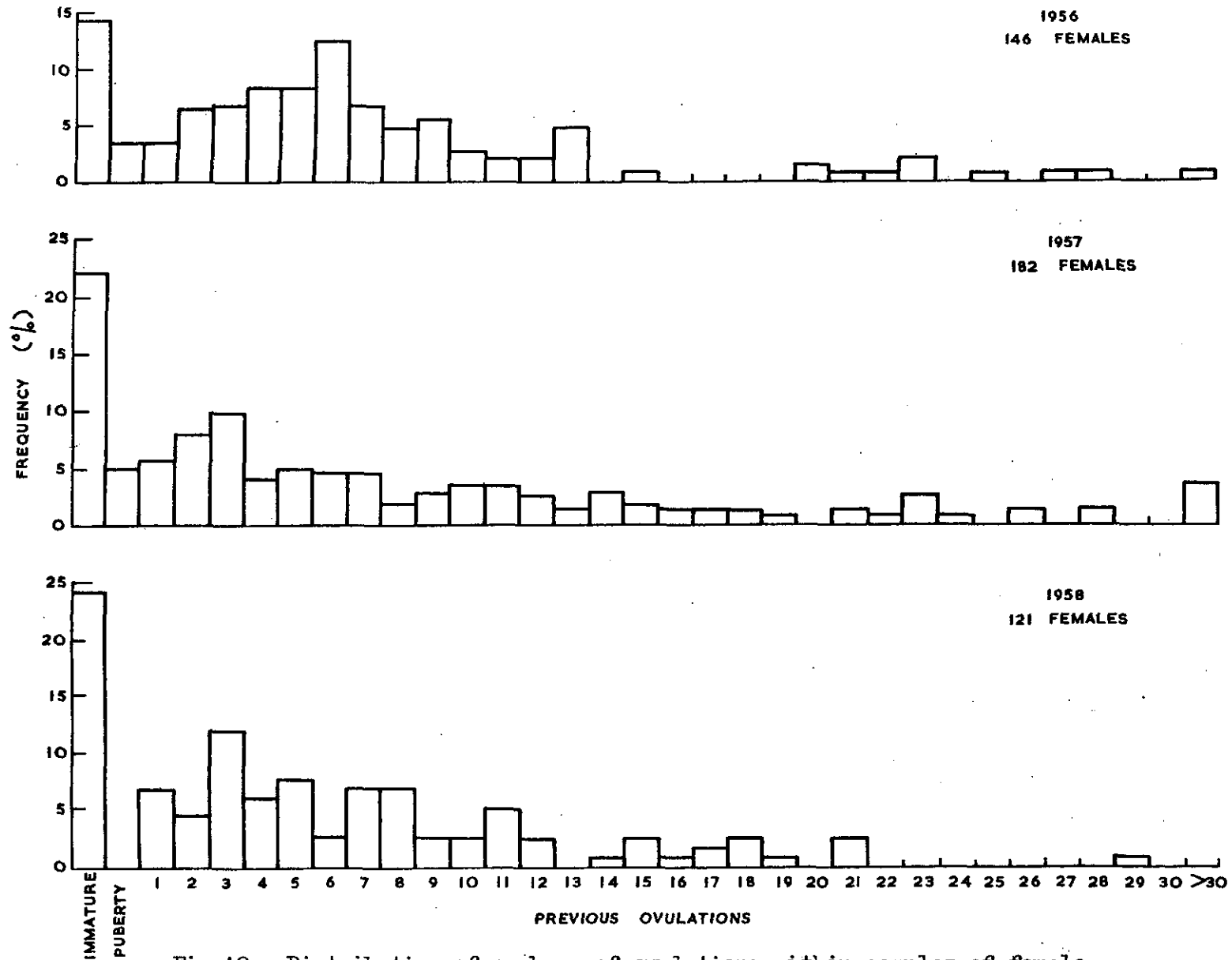


Fig.10. Distribution of numbers of ovulations within samples of female humpback whales examined on the east coast of Australia in 1956,1957, and 1958.

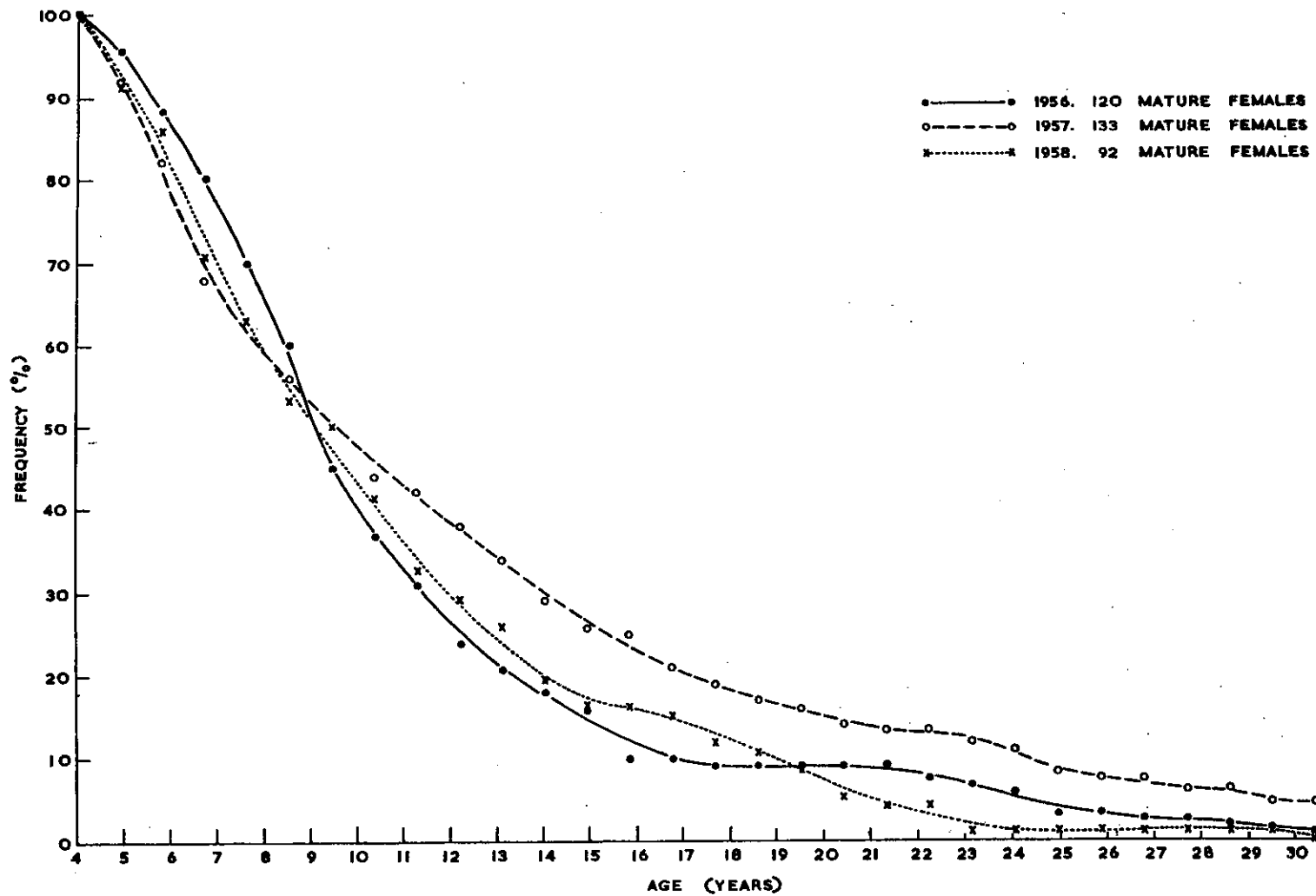


Fig.11. Mortality curves of samples of mature females from the east coast of Australia from 1956 to 1958.

In some aspects there was even an improvement (e.g. an increase in the mean length of males and females and a slight fall in the percentage of females taken in 1958). However, there was some evidence of an increase in the proportion of young (especially immature) females in the catches. This should be re-examined when the catches of succeeding years are being analysed.

IV. NORFOLK ISLAND

In the comparison of the catch made at Norfolk Island in 1958 with the catches of 1956 and 1957, it was found that the catch per catcher day (Table 1) remained relatively constant, the percentage of females (Table 2) increased (mainly due to the period of catching in 1958), the mean length of the males (Table 3) was very slightly above, and that of the females (Table 4) considerably above the corresponding values in 1956 and 1957, while the proportions of immature males and females (Table 6) were both very low. Very few (1.8%) of the sexually mature females taken in 1958 were in advanced stages of pregnancy (Table 7). This was to be expected since catching did not commence until August 3, so that the majority of the whales were taken after the usual time of parturition (Chittleborough 1958c).

The composition of the catch made at Norfolk Island in 1958 compared favourably with earlier years, indicating continued stability in this part of the Group V population of humpback whales.

V. REFERENCES

- Chittleborough, R.G. (1955).- Aspects of reproduction in the male humpback whale, Megaptera nodosa (Bonnaterre). Aust. J. Mar. Freshw. Res. 6 (1): 1-29.
- Chittleborough, R.G. (1958a).- An analysis of recent catches of humpback whales from the stocks in Groups IV and V. Norwegian Whaling Gazette. 47 (3): 109-37.
- Chittleborough, R.G. (1958b).- Australian catches of humpback whales 1957. C.S.I.R.O. Aust. Div. Fish. Oceanogr. Rep. No.17.
- Chittleborough, R.G. (1958c).- The breeding cycle of the female humpback whale, Megaptera nodosa (Bonnaterre). Aust. J. Mar. Freshw. Res. 9 (1): 1-18.
- Chittleborough, R.G. (1959a).- Balaenoptera brydei Olsen on the west coast of Australia. Norwegian Whaling Gazette. (Submitted for publication).
- Chittleborough, R.G. (1959b).- Age determination in the humpback whale. Aust. J. Mar. Freshw. Res. (Submitted for publication).

PART 2. AUSTRALIAN MARKING OF HUMPBACK WHALES

I. INTRODUCTION

The objects and importance of whale marking in general are wellknown (Mackintosh 1952; Chittleborough and Godfrey 1957), and Dawbin (1956a) has stressed the importance of marking humpback whales, Megaptera nodosa (Bonaterre) in the southern Pacific Ocean.

Since whale marking on the Australian coast was commenced on a small scale in 1949 a considerable number of humpback whales has been marked and some useful recoveries made. In this report the results up to 1958 are summarized. This marking, which forms part of the programme of research upon the humpback whale, is being continued.

With the exception of five fin whales, Balaenoptera physalus L., and one pilot whale Globicephala melaena (Traill), which have been marked, whales marked in Australian waters are humpback whales.

II. HUMPBACK WHALES MARKED

After excluding all marks which either missed or ricocheted off whales, and also duplicate hits into the same whale, the numbers of humpback whales marked each year are recorded in Table 1. Whales from which the mark was recorded as protruding should not be regarded as successfully marked, as these marks would probably fall out within a short time. Marks recorded as "possible hits" have been recovered from whales in later years, and even one recorded as a ricochet and one as missing the target, have later been found in whales. For this reason it is proposed to consider that one third of the possible hits resulted in successfully marked whales. By this means it is estimated from the results given in Table 1 that up to 1958 a total of 1019 humpback whales have been marked. Of these 786 were marked off the east coast of Australia, 16 off Norfolk Island, and 217 off the west coast of Australia.

CC 03

TABLE 1

HUMPBACK WHALES MARKED IN AUSTRALIAN WATERS
1949-1958

Year	East Coast			West Coast		
	Fully Marked	Possible Mark	Mark Protruding	Fully Marked	Possible Mark	Mark Protruding
1949				15	1	4
1950	4					
1951						
1952	4					
1953	14		2			
1954	59	7	4	20	1	1
1955	161	19	3	53	16	1
1956	364	12	11	6		
1957	51	12	3	70	10	4
1958	109	9	4	41	7	2

NORFOLK ISLAND

1956	14	3	
1957	1	2	

When marking whales, it has been the practice to record an estimated length for each whale marked. However, from the lengths measured at the time of recapture (Appendix I) it is evident that estimates of length at sea are of little real value unless the individual was especially small when marked.

At least 90 humpback whales were marked on the east coast of Australia with marks modified as described by Chittleborough and Godfrey (1957). Whenever possible females with young calves were marked; at least 67 lactating females and 37 calves have been marked. It was hoped that modified marks would prove less harmful to calves than the standard marks, but one calf marked with a modified mark was found dead some days later, approximately 250 miles south of the position when marked. From information supplied by the fishermen who returned this mark, it appeared that the mark had entered rather low in the body and pierced

the intestines. It is expected that this would occur rarely.

Young calves proved difficult to mark, having surprising endurance, presenting a relatively small target for a shorter time than adults, and frequently surfacing on the side of the female away from the vessel.

When possible, preference was given to the marking of young whales, especially "yearlings" which reach Australian coasts in June (Chittleborough 1958). However, other work often made it necessary to defer marking until later in the year.

III. MARKS RECOVERED

Details of all marks recovered from humpback whales taken in Australian waters from 1951 to 1958 are shown in Appendix I. In 67 per cent. of these recoveries it has been possible to identify the whale which had carried the mark, while the remainder of the marks were recovered from the cookers or in other parts of the factory. Ruud and Øynes (1954) also found that approximately one third of recovered marks were found in the cookers. One whale on the east coast of Australia was marked three times and shot by a catching vessel later in the same day. The mark which had been recorded as protruding was recovered during flensing operations, but the two marks which had penetrated deeper were found some days later when residues were being removed from the cookers.

In addition to the recoveries listed in Appendix I, two Australian marks have been recovered in other regions. Mark No. A188 was fired into a humpback whale off the west coast of Australia and recovered six months later in Area IV of the Antarctic (Brown 1956), while mark No. 16471 was fired off the east coast of Australia and recovered twelve months later in New Zealand (Dawbin 1959).

Table 2 shows the intervals which had elapsed between firing and recovery of Australian marks. Although the number of marks recovered is not yet very large, similar numbers were taken after one, two, and three years, indicating that the whales make the winter migration every year. Recoveries have been very erratic; for example, although far more humpback whales were marked in 1956 than in 1955 (Table 1), the annual recovery rate has been lower from the former group than from the latter.

TABLE 2
INTERVALS BETWEEN RELEASE AND RECOVERY OF MARKS:
HUMPBACK WHALES MARKED IN AUSTRALIAN WATERS

Year Marked	Interval until Recovered					
	0 yrs	½ yr	1 yr	2 yrs	3 yrs	9 yrs
1949				1		1
1950						
1951						
1952						
1953	1				1	
1954	1		1	3		
1955	6	1	3	2	10	
1956	1		1	2		
1957	1		1			
1958	1					
Total	11	1	6	8	11	1

IV. MIGRATIONS OF MARKED WHALES

Figure 1 shows the migrations of humpback whales as indicated from recent recoveries of marks in Australian waters and of one Australian mark recovered in the Antarctic. The four Russian marks recovered at Carnarvon in 1958 are not shown as details of their firing have not yet been received. Migrations are indicated by straight lines: obviously the actual paths would have been influenced by coastlines and food supply. The probable migrations of individuals marked in temperate waters and recaptured one or more years later in temperate waters are shown by broken lines.

It can be seen from Figure 1 that no interchange between the Group IV (longitude 70°E. to 130°E.) and the Group V (longitude 130°E. to 170°W.) populations has yet been recorded.

The movements of marked whales between the west coast of Australia and Antarctic Area IV confirm the known migration of humpback whales in this population (Rayner 1940).

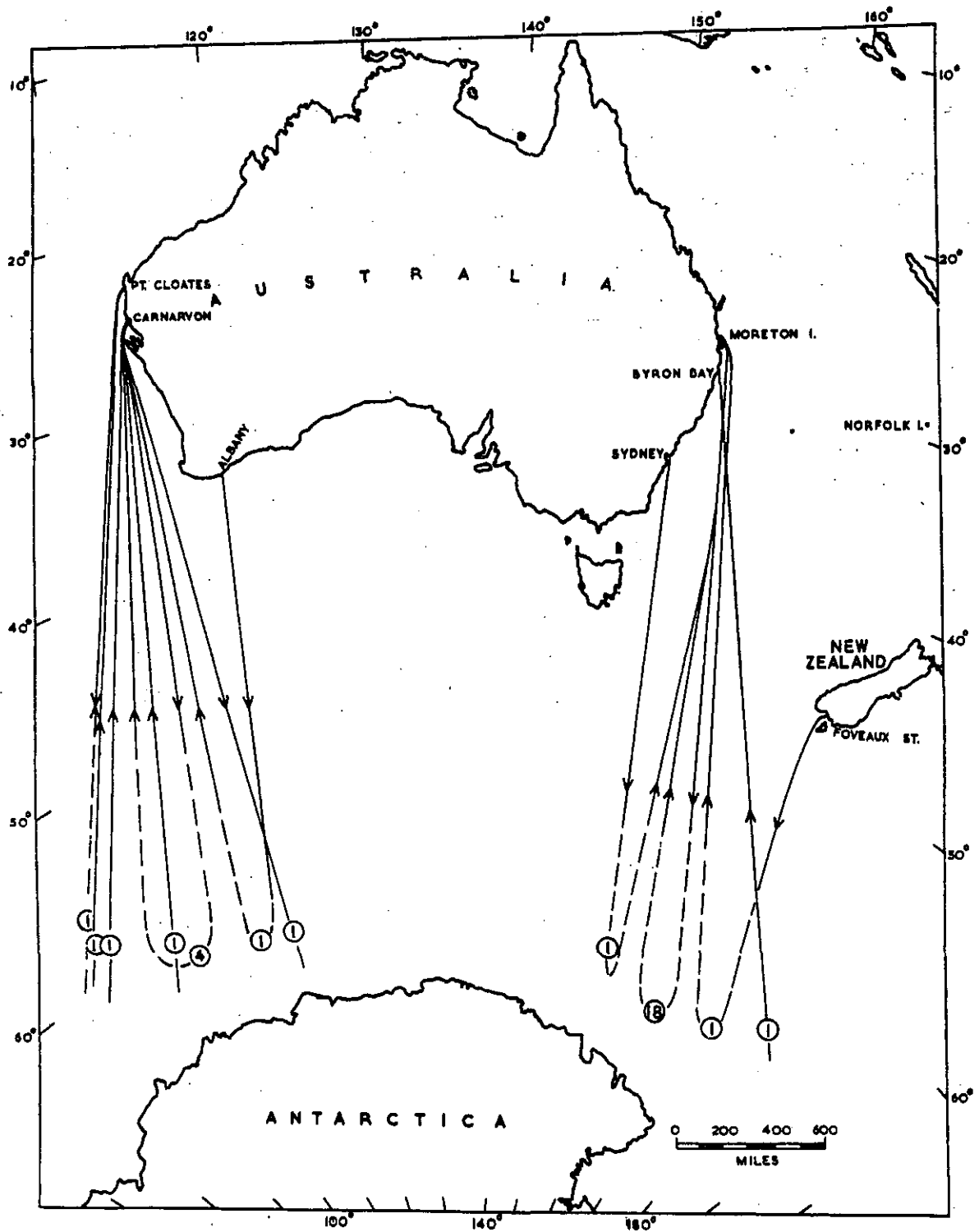


Fig.1. Migrations of humpback whales.

Another link between humpback whales of Antarctic Area IV and the west coast of Australia was established in a unique manner. On January 29, 1954 a member of a whaling expedition threw into the Southern Ocean a dentifrice tin containing a message bearing his name and address. The position of the vessel was then close to 64°S., 92°E. On June 27, 1954 this tin and message was recovered from the intestines of a humpback whale which was being processed at the land station near Albany, Western Australia.

The recovery in June, 1958 from the east coast of Australia of a mark from a humpback whale marked in Antarctic Area V gives the first confirmation of the postulated migrations of humpback whales within the Group V stock (see Mackintosh 1942).

Nineteen marks recovered on the east coast of Australia had been fired into humpback whales along the same coastline one to three years earlier, while one whale marked in Foveaux Strait, New Zealand, during a southward migration was killed nine months later on the east coast of Australia. It would appear that within the Group V population individuals tend to follow the same migration path each year, but that after mingling in the one Antarctic feeding area, some individuals change from one migration route to another.

Further information upon the migrations and dispersal of humpback whales of the Group V population has been obtained from the widespread marking programme organized by W.H. Dawbin (1959). More detailed information upon this aspect may be anticipated as increasing numbers of marks are recovered from this population.

V. OTHER INFORMATION FROM MARKED WHALES

Although short-term recoveries of marks within a few days of marking are usually of little value, they may sometimes yield information upon the rate of movement of whales. For example, mark No. A137 was fired into a humpback whale on the east coast of Australia in 1953 during the northward migration, and when recovered six days later had travelled at least 520 miles, giving an average speed of 3.6 knots. Mark No. A236 was fired into another humpback whale in similar circumstances in 1958 and recovered seven days later after travelling at least 430 miles northward, giving an average speed of just over 2.5 knots. These rates of travel are similar to those reported by Chittleborough (1953) for humpback whales kept under direct observation for short

periods during undisturbed northward migrations. However Dawbin (1956b) by comparing the times when the bulk of the humpback whales pass separate points on a migration route, has indicated that the average rate of progression of migrating humpback whales is close to 1.3 knots.

Nine humpback whales marked on the east coast of Australia during June and early July (during the northbound migration) of either 1955 or 1956, were killed in the same locality in 1958 in the same months, but in all cases the dates of killing were a few days later than the dates of marking in the earlier years. The differences between the dates varied from five to fifteen days, with a mean of 8.8 days. This could indicate that the northward migration in 1958 was slightly later than in 1955 or 1956. Dawbin (1956b, Fig. 4) has clearly shown annual variations in the time of the northward migration of humpback whales passing through Cook Strait, New Zealand.

Recoveries of marks from female whales which had been marked in previous years when accompanied by a calf can yield useful information upon the rate of ovulation and breeding of females if the whales have been adequately examined when the marks were recovered. Two such recoveries have been made on the Australian coast and are described elsewhere (Chittleborough 1959).

It is hoped that later recoveries of marks from whales marked when young will enable present methods of age determination to be checked. Some such recoveries have been reported from New Zealand (see Dawbin 1959).

VI. ACKNOWLEDGMENTS

The National Institute of Oceanography (England) has been most helpful in the supply of whale marks for this work and in the exchange of information upon marks fired or recovered in the Antarctic. The assistance of the State Fisheries Department of Western Australia in making one of its vessels available for marking on the west coast is gratefully acknowledged. Australian whaling companies have been co-operative in the return of marks recovered. State and Commonwealth Whaling Inspectors have also been helpful in furnishing details of marks recovered.

VII. REFERENCES

- Brown, S.G. (1956).- Whale marks recently recovered. Norwegian Whaling Gazette, 1956, (12): 661-4.
- Chittleborough, R.G. (1953).- Aerial observations on the humpback whale, Megaptera nodosa (Bonnaterre). Aust. J. Mar. Freshw. Res., 4 (2): 219-26.
- Chittleborough, R.G. (1958).- The breeding cycle of the female humpback whale, Megaptera nodosa (Bonnaterre). Aust. J. Mar. Freshw. Res., 9 (1): 1-18.
- Chittleborough, R.G. (1959).- Age determination in the humpback whale. Aust. J. Mar. Freshw. Res. (In press).
- Chittleborough, R.G., and Godfrey, K. (1957).- A review of whale marking and some trials of a modified whale mark. Norwegian Whaling Gazette, 1957 (5): 238-48.
- Dawbin, W.H. (1956a).- Whale marking in South Pacific waters. Norwegian Whaling Gazette, 1956 (9): 485-508.
- Dawbin, W.H. (1956b).- The migrations of humpback whales which pass the New Zealand coast. Trans. Roy. Soc. N.Z. 84 (1): 147-96.
- Dawbin, W.H. (1959).- Report on whale marking in New Zealand and South-west Pacific Islands. (In preparation).
- Mackintosh, N.A. (1942).- The southern stocks of whalebone whales. 'Discovery' Rep. 22: 197-300.
- Mackintosh, N.A. (1952).- The marking of whales. Norwegian Whaling Gazette, 1952 (5): 236-40.
- Rayner, G.W. (1940).- Whale marking: progress and results to December 1939. 'Discovery' Rep. 19: 245-84.
- Ruud, J.T., and Øynes, P. (1954).- Trials with whale marks conducted on board floating factories in the season 1954. Norwegian Whaling Gazette, 1954 (7): 383-93.

APPENDIX

MARKS RECOVERED FROM HUMPBACK WHALES IN AUSTRALIAN WATERS
1951-58

Mark number	Release			Recovery		
	Date	Position	Remarks	Date	Position	Remarks
A15	1.8.49	23°31'S. 113°27'E.	Female with calf	5.7.58	25°31'S. 112°45'E.	Female 43 ft 6 in. 10 corpora albicantia
A20	2.8.49	22°37'S. 113°36'E.	Adult Female with young calf	5.10.51	22°38½'S. 113°39'E.	Female 42 ft 3 in.
A32	16.7.55	24°40'S. 113°25'E.		18.7.55	25°00'S. 113°23'E.	Male 40 ft
A99	17.8.54	35°02'S. 118°08'E.		22.9.56	25°59'S. 113°00'E.	Female 40 ft 3 corpora albicantia Found in grax pump
A120	11.6.53	35°20'S. 150°30'E.		6.8.56	Moreton I. 27°11'S. 153°24'E.	
A137	7.7.53	35°10'S. 150°45'E.	Approx. 39 ft	13.7.53	27°0'S. 153°26'E.	Male 43 ft
A236	4.7.58	34°0'S. 151°16'E.		11.7.58	27°05'S. 153°29'E.	Female 45 ft 8 in.
5136	29.1.36	60°01'S. 88°55'E.		26.7.53	22°38'S. 113°39'E.	? Female 46 ft 7 in. 14 corpora albicantia
5202	1.1.36	61°00'S. 90°32'E.	Recorded as ricochet	8.10.51	Carnarvon	Found in cooker
11690	6.10.54	Off Moreton I. approx. 27°S. 153½°E.	Approx. 38 ft	23.7.55	27°08'S. 153°28'E.	Female 41 ft
11692	6.10.54	Off Moreton I.	Approx. 42 ft	18.10.54	Byron Bay. 28°37'S. 153°38'E.	Found in cookers
11730	7.10.54	Off Moreton I.	Approx. 40 ft	19.6.56	27°05'S. 153°29'E.	Male 39 ft
11738	8.10.54	Off Moreton I.	Approx. 38 ft	13.6.56	27°04'S. 153°29'E.	Female 39 ft 10 in.
11746	23.6.55	Off Moreton I.	Approx. 40 ft	16.6.56	27°15'S. 153°33'E.	Male 38 ft 9 in.
11752	23.6.55	Off Moreton I.	Approx. 38 ft	28.6.58	26°58'S. 153°28'E.	Male 40 ft
11770	27.6.55	Off Moreton I.	Approx. 40 ft	7.8.58	Moreton I.	Found in separator tank
11774	27.6.55	Off Moreton I.	Approx. 40 ft	6.7.57	26°59'S. 153°26'E.	Male 38 ft 9 in.
11786	28.6.55	Off Moreton I.	Approx. 36 ft	4.7.58	27°06'S. 153°30'E.	Male 40 ft 10 in.
11788	28.6.55	Off Moreton I.	Approx. 41 ft	Aug. 1958	Moreton I.	Found in cooker
11804	28.6.55	Off Moreton I.	Approx. 40 ft	13.7.58	28°38'S. 153°42'E.	Male 45 ft 8 in.
11808	29.6.55	Off Moreton I.	Approx. 40 ft	4.7.58	27°01'S. 153°29'E.	Male 39 ft 6 in.
11834	5.7.55	Off Moreton I.	Approx. 38 ft	20.6.56	27°03'S. 153°30'E.	Male 39 ft 5 in.
11835	5.7.55	Off Moreton I.	Approx. 40 ft	12.7.58	28°37'S. 153°41'E.	Male 40 ft 10 in.

11. Nicholls, A.G. (1957).- The population of a trout stream and the survival of released fish. (For limited circulation: not available for exchange).

APPENDIX CONT.

Mark Number	Release			Recovery		
	Date	Position	Remarks	Date	Position	Remarks
11840	5.7.55	Off Moreton I.	Approx. 35 ft Recorded as possible hit	18.7.58	Moreton I. 27°11'S. 153°24'E.	Found in cookers
11853	7.7.55	Off Moreton I.	Approx. 39 ft	7.7.55	27°02'S. 153°30'E.	Male 39 ft
11884	14.7.55	Off Heron I. 23°30'S. 151°56'E.	Approx. 40 ft	10.8.56	Moreton I.	Male 40 ft 7 in.
11903	27.7.55	24°54'S. 113°17'E.	Approx. 40 ft	20.10.58	Carnarvon	Found in cooker at end of season
11909	2.8.55	25°30'S. 113°03'E.	Approx. 34 ft	14.6.57	Carnarvon 24°53'S. 113°38'E.	Male 38 ft
11963	18.7.55	Off Moreton I.	Approx. 40 ft	1.8.58	26°59'S. 153°26'E.	Male 43 ft 8 in.
11986	24.7.55	Off Moreton I.	Approx. 37 ft	24.7.55	26°57'S. 153°30'E.	Female 37 ft 8 in. Mark protruding
11987	24.7.55	Off Moreton I.	Same whale as 11986	Aug. 1955	Moreton I.	Found in cookers
11988	24.7.55	Off Moreton I.	Same whale as 11987	Aug. 1955	Moreton I.	Found in cookers
12127	26.7.55	Off Moreton I.	Approx. 40 ft	31.7.55	Byron Bay	Found in cooker
13781	Feb. 1955	63°14'S. 98°10'E.		24.6.57	25°35'S. 113°15'E.	Male 38 ft
14309	13.9.56	Off Norfolk I. 25°S. 167°85'E.	Approx. 38 ft	13.9.56	Norfolk I.	Male 36 ft 5 in.
16392	21.9.57	Shark Bay c. 25°S. 113°15'E.	Adult with calf	8.9.58	Carnarvon	Found in cooker
16729	3.7.56	Off Moreton I.	Approx. 38 ft	10.7.58	27°09'S. 153°31'E.	Male 46 ft 2 in.
16866	9.7.56	Off Moreton I.	Recorded as miss	16.7.58	Moreton I.	Found in cooker
17236	5.11.57	Foveaux Str. N.Z. 47°S. 168½°E.	Approx. 40 ft	5.8.58	27°06'S. 153°29'E.	Female 42 ft 10 in.
19504	18.9.57	Off Moreton I.	Calf under 20 ft	9.1.10.57	31°49'S. 152°45'E.	Washed ashore
19934	27.12.57	65°49'S. 179°45'E.		27.6.58	28°38'S. 153°43'E.	Male 43 ft 6 in.
1007				4.9.58	Carnarvon	Found in cooker
U.S.S.R. 1027				8.9.58	Carnarvon	Found in cooker
U.S.S.R. 1030				4.9.58	24°39'S. 112°57'E.	Female 40 ft 9 in. I corpus luteum
U.S.S.R. 1165				8.9.58	Carnarvon	Found in cooker
U.S.S.R. }		Information not yet available				

DIVISION OF FISHERIES AND OCEANOGRAPHY

REPORTS

1. Thomson, J.M. (1956).- Fluctuations in catch of yellow-eye mullet Aldrichetta forsteri (Cuvier and Valenciennes) (Mugilidae).
2. Nicholls, A.G. (1957).- The Tasmanian trout fishery. I. Sources of information and treatment of data. (For limited circulation: not available for exchange).
3. Nicholls, A.G. (1957).- The Tasmanian trout fishery. II. The fishery of the north west rivers. (For limited circulation: not available for exchange).
4. Chittleborough, R.G. (1957).- An analysis of recent catches of humpback whales from the stocks in Groups IV and V. Prepared for the International Commission on Whaling.
5. F.R.V. "Derwent Hunter" Scientific Reports of Cruises DH3/56, DH4/56, DH5/56.
6. Cowper, T.R., and Downie, R.J. (1957).- A line fishing survey of the fishes of the south-eastern Australian continental slope.
7. Davis, P.S. (1957).- A method for the determination of chlorophyll in sea-water.
8. Jitts, H.R. (1957).- The ^{14}C method for measuring CO_2 uptake in marine productivity studies.
9. Hamon, B.V. (1957).- Mean sea level variations on the east Australian coast.
10. Nicholls, A.G. (1957).- The Tasmanian trout fishery. Part III. Rivers of the north and east. (For limited circulation: not available for exchange).
11. Nicholls, A.G. (1957).- The population of a trout stream and the survival of released fish. (For limited circulation: not available for exchange).

12. F.R.V. "Derwent Hunter" Scientific Report of Cruise DH6/56.
13. Chau, Y.K. (1957).- The coastal circulation of New South Wales from drift card results 1953-56.
14. Kott, Patricia (1957).- Zooplankton of East Australian waters 1945-54.
15. F.R.V. "Derwent Hunter" Scientific Report of Cruises DHL/57 - DH4/57.
16. Rochford, D.J. (1958).- The seasonal circulation of the surface water masses of the Tasman and Coral Seas.
17. Chittleborough, R.G. (1958).- Australian catches of humpback whales 1957. Prepared for the International Commission on Whaling.
18. Australian documents for U.N.E.S.C.O. Conference on the oceanography of the Tasman and Coral Seas.
19. F.R.V. "Derwent Hunter" Scientific Report of Cruises DH5/57 - DH8/57.
20. F.R.V. "Derwent Hunter" Scientific Report of Cruises DH9/57 - 12/57.
21. F.R.V. "Derwent Hunter" Scientific Report of Cruises DHL3/57 - 16/57.
22. Robins, J.P.- F.R.V. "Marelda" Scientific Report of Cruises July 1957 - May 1958.
23. Chittleborough, R.G.- Australian catches of humpback whales, 1958.