

COMMONWEALTH



OF AUSTRALIA

Commonwealth Scientific and Industrial Research Organization

Division of Fisheries and Oceanography

REPORT 17

AUSTRALIAN CATCHES OF HUMPBACK WHALES

1957

Prepared for the International Commission on Whaling

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Cronulla, Sydney  
1958

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## SUMMARY

On the western coast of Australia the composition of the catch of humpback whales made at Carnarvon in 1957 was less favourable than that of catches in the previous two years. At Albany the catching rate has declined very considerably since 1955 and the quota was not filled in 1957. Poorer weather conditions along the western coast in 1957 may have had some effect, but the available evidence indicates that the stock of humpback whales hunted on the western coast is continuing to decline. From the examination of females over the period 1951 to 1957, it would appear that in this decreasing population the younger whales are now growing at faster rates than the whales of similar age in the population during the period 1951 to 1954.

On the eastern coast the composition of the catch made at Tangalooma in 1957 was similar to that of previous seasons except that the distribution of the ages of the females appeared (on the evidence of ovulation counts) to have changed considerably. At Byron Bay, much reduced selection of whales in 1957 resulted in a less favourable composition of the catch than in catches of earlier years. The composition of the catch made at Norfolk Island in 1957 compared very satisfactorily with that of the catch in 1956. Present evidence indicates that humpback stocks on the eastern coast of Australia and at Norfolk Island continue to be in relatively sound condition.

In citing this report, abbreviate as follows:  
C.S.I.R.O. Aust. Div. Fish. Oceanogr. Rep. No. 17.

AUSTRALIAN CATCHES OF HUMPBACK WHALES

1957

PREPARED FOR THE INTERNATIONAL COMMISSION ON WHALING

I. INTRODUCTION

In 1957 Australian whaling stations took the numbers of humpback whales permitted on the western and eastern coasts of Australia and at Norfolk Island. The Cheynes Beach Whaling Company did not take its full quota of humpbacks, the remaining number (18) being taken by the Norwest Whaling Company after completing its own quota.

The individual catches of humpback whales made in 1957 at each whaling station operated by Australia were:-

Western Coast

Norwest Whaling Company  
Carnarvon (24°53'S, 113°38'E) 1018

Cheynes Beach Whaling Company  
Albany (35°05'S, 117°56'E) 102

Eastern Coast

Whale Products Pty.Ltd.,  
Tangalooma, Moreton Island  
(27°11½'S, 153°23½'E) 600

North Coast Whaling Pty.Ltd.  
Byron Bay (28°37½'S, 153°38'E) 121

East of Australia

Norfolk Whaling Co.Ltd.  
Norfolk Island (25°S, 167°85'E) 120

In this report the catch returns of these stations are analysed and compared with the catches of earlier seasons. Evidence from ovarian material is also considered. The examination of large collections of ear plugs and baleen samples is still in progress and will be considered in a later paper.

A detailed analysis of catches of humpback whales from the Group IV (70°E - 130°E) and Group V (130°E - 160°W)

stocks from 1950 to 1956 was presented in the previous report to the International Whaling Commission (C.S.I.R.O. Aust. Div. Fish. Oceanogr. Rep. No. 4). With one exception the same methods were followed in the analysis of the catches made in 1957. In the previous report, a length of 36 ft 6 in. was used to estimate the proportion of immature males in catches, although the mean length of males at puberty has been found to be 36 ft 9 in. (Chittleborough 1955a). The length of 36 ft 6 in. was used for convenience since the lengths from Antarctic catches (and some earlier catches in Australian waters) were recorded to the nearest foot. As no humpbacks were taken from the Antarctic Areas IV and V during 1957, it is proposed to use the length 36 ft 9 in. to estimate percentages of immature males in Australian catches. The proportions of immature males in catches of previous years have been recalculated accordingly.

## II. WESTERN COAST

### (a) Carnarvon

(i) Rate of catching.- The average catch of humpbacks per catcher day at the Carnarvon station in the 1957 season was 2.11, slightly above that of the 1956 season (1.97). The catch per catcher day in 1957 might have been expected to have been higher. In 1956 the station had increased its catching fleet and whale quota (by transfer from the station at Point Cloates), but the capacity of the factory at Carnarvon had not been increased in proportion, thus limiting the number of whales which could be handled per day. By the 1957 season the factory capacity had been improved, so a higher daily catching rate was anticipated.

(ii) Sex ratio.- Of 1018 humpback whales taken at the Carnarvon station in 1957, 48.4 per cent. were females; this is greater than in any previous season at that station (see Table 2 of previous report). The catching period has varied somewhat in different seasons, influencing the sex ratio of the total catch to some extent. However, when the sex ratios of different seasons are compared over the same period, as in Figure 1, it is seen that in the 1957 season a higher proportion of females was taken throughout most of the catching period.

(iii).- Mean lengths.- The mean length of 525 males taken at Carnarvon in 1957 was 39.89 ft, and that of 493 females was 41.71 ft. These lengths are below the mean lengths of males and females taken in the previous two seasons at Carnarvon (Table 3 of previous report) but are

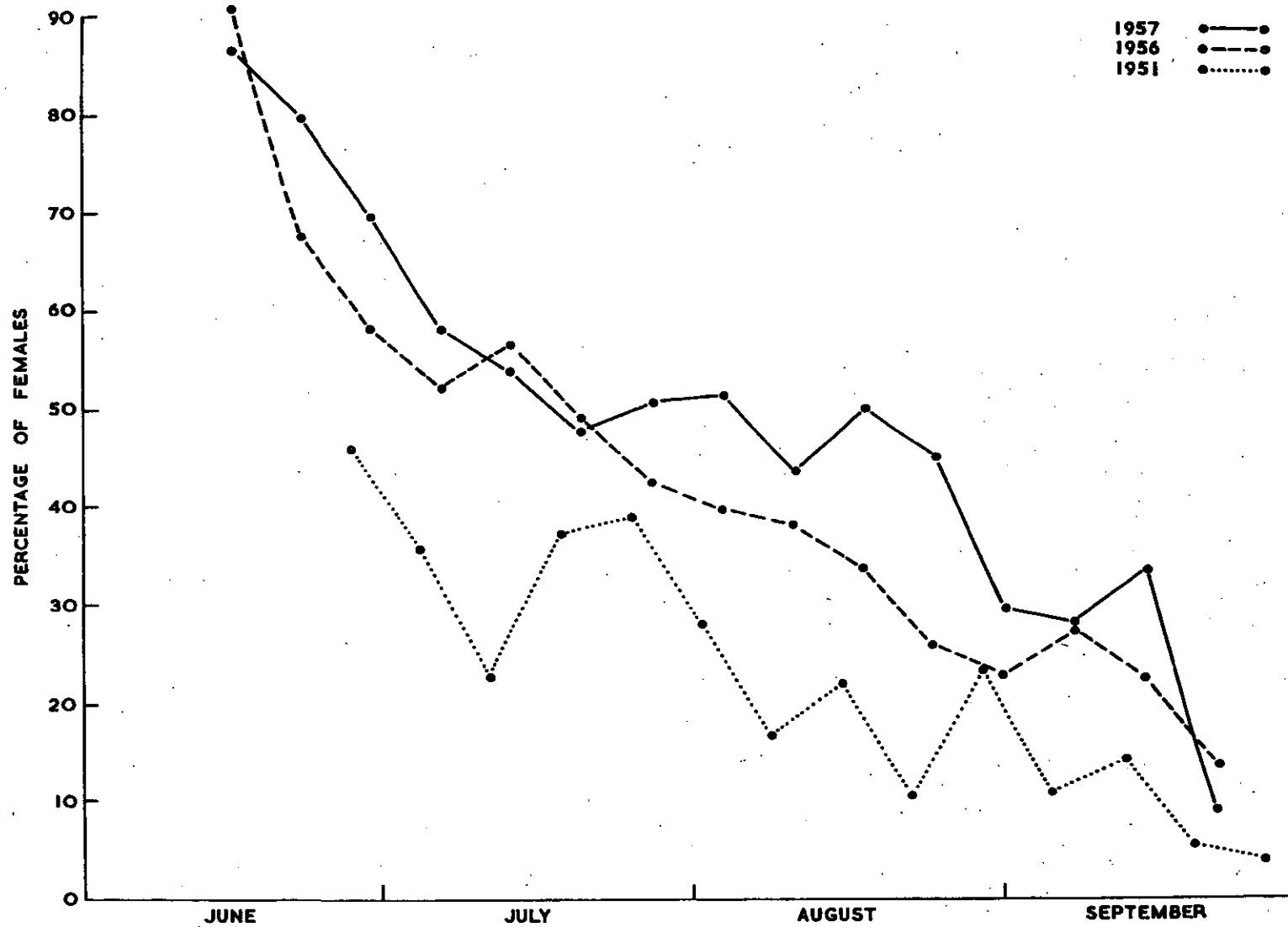


Fig. 1. Weekly sex ratios of catches at Carnarvon in 1957, 1956, and 1951.

generally above the corresponding means of earlier catches at that station.

(iv) Length frequency distribution.- The length frequency distribution of the males taken at Carnarvon in 1957 is compared with that of the 1956 catch in Figure 2A, while Figure 2B shows the corresponding information upon females. For both sexes the catch in 1957 shows an increase in the numbers of individuals within the lower length ranges.

(v) Sexually immature whales.- Classing those males at or below 36 ft 9 in. in length as sexually immature (as discussed in Section I), the following proportions of males were immature in the catches of the past three seasons at Carnarvon:-

1955	3.3%
1956	6.3%
1957	9.0%

Another method of calculating the proportion of immature males in a sample is to regard as immature any male whose combined testes weight is at or below 4 kilograms (Chittleborough 1955a). In previous seasons this method has yielded almost identical results to those using the mean length of 36 ft 9 in. For example, of 395 males examined at Carnarvon in 1951, 36 were at or below 36 ft 9 in. in length and 36 had testes weighing at or below 4 kg. However, at the Carnarvon station in 1957, the results from the two methods were not in close agreement: of 488 males examined, 46 (9.4 per cent.) were immature by length, and 66 (13.5 per cent.) immature by testis weight.

Classing those females at or below 38 ft 6 in. as sexually immature, 15.6 per cent. of the females taken at Carnarvon in 1957 were immature. This is considerably above the proportions of immature females in the catches of the previous two seasons (see Table 6 of the previous report).

During the years 1949 to 1954, the proportion of females classed as immature by length (at or less than 38 ft 6 in.) was in close agreement with the percentage found to be immature after examination of the ovaries (Chittleborough 1955b, p. 324). However, the two methods were not in close agreement in the case of females taken at Carnarvon in 1957. Of 482 females whose ovaries were examined, 79 (16.4 per cent.) were at or less than 38 ft 6 in. in length, while 102 (21.2 per cent.) had not yet ovulated.

(vi) Ovulation counts.- Figure 3 shows the percentage frequency distribution of the total number of ovulations recorded from the ovaries of each of 482 females taken at the Carnarvon station in 1957. The corresponding records from 243 females taken at Carnarvon in 1956 are shown for comparison. Regarding these ovulation counts as reflecting the age distribution of the females in the catches, it is apparent that in 1957 there was a marked increase in the proportion of young females (0 and 1-3 ovulations) in the catch and correspondingly fewer of the older females.

(vii) Review of the catch at Carnarvon in 1957.- The improvement in the composition of catches in 1955 and 1956 following the reduction of the quota on the western coast of Australia (see previous report) was not maintained at Carnarvon in 1957. Several adverse features were apparent in the 1957 catch; i.e., a higher proportion of females, lower mean lengths of both males and females, poorer length frequency distributions, higher proportions of immature males and females, and a poorer age distribution in the females (as indicated by ovulation counts). Most of these unfavourable changes have not reached the low levels of the 1953 and 1954 catches at Carnarvon.

Gunners of catching vessels operating from Carnarvon were urged to maintain in 1957 a similar high level of selection to that which had succeeded in improving the composition of the catches at Carnarvon in 1955 and 1956. It has been suggested that the decline in the composition of the catch in 1957 was caused by adverse weather, making it impossible to maintain a high degree of selection. It has also been suggested that in turbulent weather humpback whales tend to avoid the muddy waters of Shark Bay, so that there were fewer whales available within this bay in 1957.

It is difficult to assess the extent to which adverse weather affected the composition of the catch in 1957, but since the weather was not sufficiently poor to lower the rate of catching below that of 1956, it is unlikely that the poorer composition of the catch in 1957 was entirely due to more adverse weather in that year. The higher proportion of females in the 1957 catch would hardly be due to weather conditions.

#### (b) Albany

(1) General movements of humpback whales in the Albany area.- Humpbacks move along this portion of the Australian coast only during their northbound migration. This affords



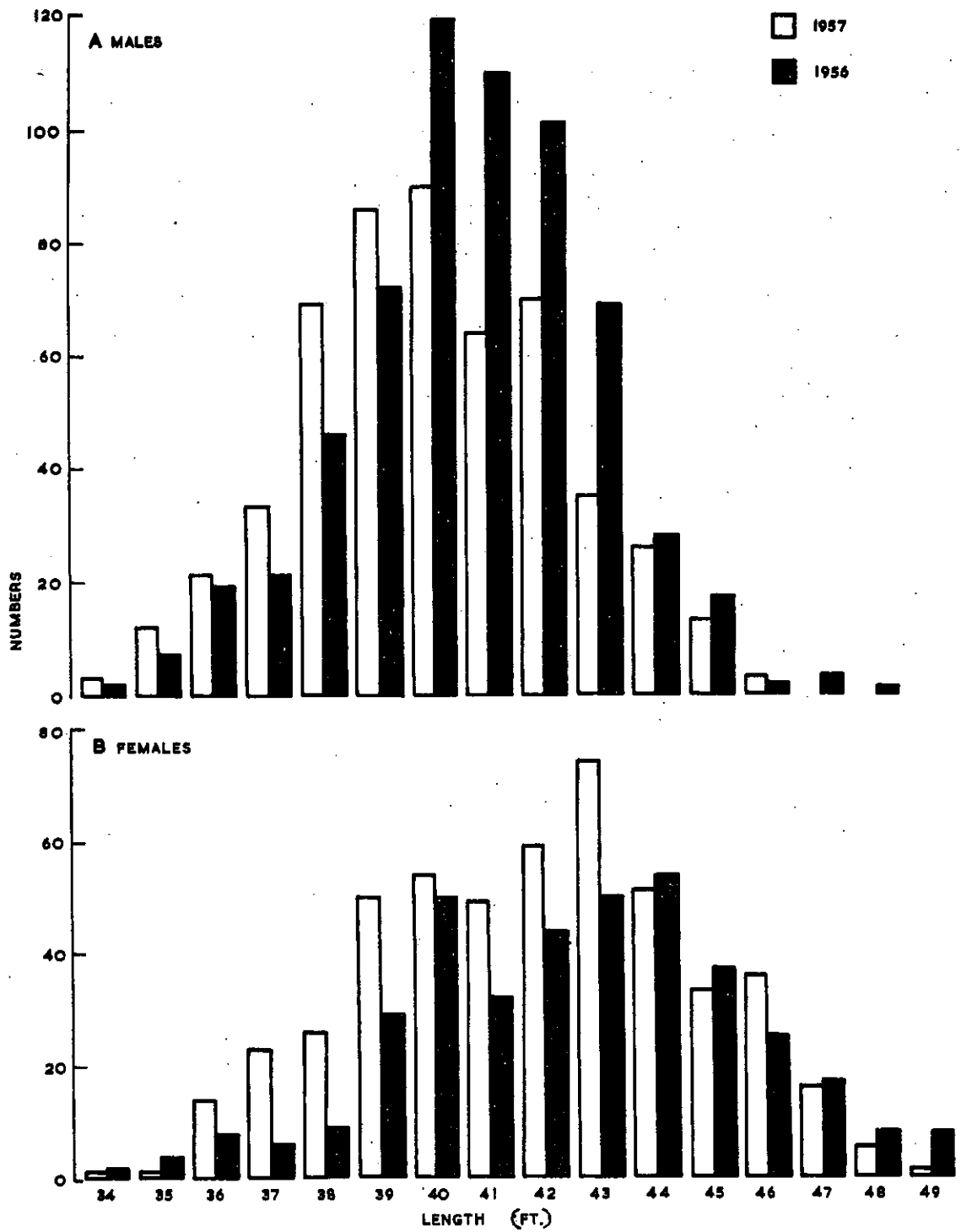


Fig. 2. Length frequency distribution of (A) males and (B) females in catches at Carnarvon in 1957 and 1956.

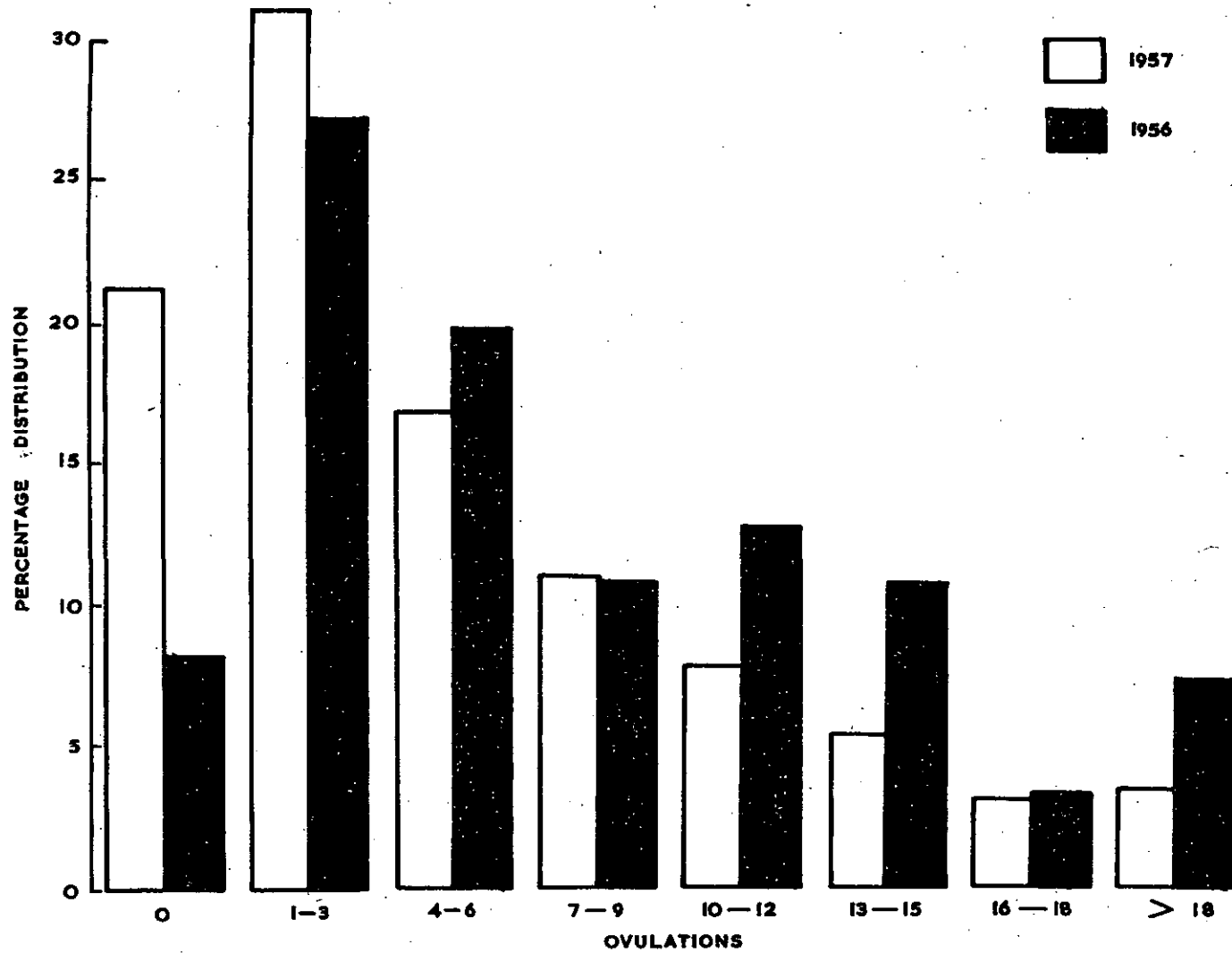


Fig. 3. Percentage frequency distribution of ovulation counts amongst 482 females from the 1957 catch and 243 females from the 1956 catch at Carnarvon.

an opportunity to study the northward migration unhampered by any southbound individuals, the first of which appears toward the end of July in lower latitudes (Chittleborough 1953). Since the Albany station is restricted to a small annual catch, the catches of humpbacks from 1952 to 1957 were pooled in the general analysis of the northward migration.

Figure 4 shows the weekly sex ratio of 611 humpbacks taken in the Albany area since 1952, over the majority of the northward migration period. Humpbacks do pass this region in May and September, but not always in sufficient numbers to ensure economic whaling. Figure 4 indicates that females dominate the beginning and end of the northward movement while males are in excess during the height of the movement (at the end of June and in July).

More useful information is obtained if the same weekly catches are divided into the five categories shown in Figure 5. The first group (mature, non-pregnant females) might have been subdivided into those at the end of lactation and those not lactating, but the catch returns were not sufficiently detailed to allow this. Figure 5 indicates that mature, non-pregnant females are more plentiful in the early part of the season. Most of these females are in the latter part of lactation and are accompanied by calves ten to eleven months of age (Chittleborough 1958). Immature whales (representing several age groups) of both sexes appear to be more common during the first half of the northward migration (Fig. 5). The bulk of the mature males appear after the lactating females, and continue in high proportions in catches from the end of June until towards the end of August. Figure 5 shows clearly that females in advanced pregnancy are amongst the last whales to reach the southern coast of Australia. Reaching temperate waters later than other individuals and giving birth shortly afterwards (Chittleborough 1958), relatively few pregnant females are taken at more northerly stations such as that at Carnarvon (see previous report).

It should be pointed out here that the minimum legal length (35 ft) imposes a selective influence so that the catches shown in Figure 5 are not fully representative of the whale stock. Also, an increase in the proportion of immature whales taken does not necessarily prove that these had increased in absolute numbers; it is possible that a temporary lack of larger whales caused more immature whales to be taken.

TABLE 1

RATES OF CATCHING FOR HUMPBACK WHALES  
TAKEN AT ALBANY: 1952-57

Year	Total catch	Number days	Number catching vessels	Average catch per catcher day
1952	51	55	1	0.93
1953	100	77	1	1.30
1954	120	81	1	1.48
1955	126	64	1	1.97
1956	119	75	1	1.59
1957	102	78	2	0.66

(ii) Rate of catching.- Table 1 shows the average catch of humpbacks per catcher day for each season of operations at Albany. Due to lack of information, no allowance could be made for days lost due to adverse weather. The rate of catching increased from 1952 to a maximum in 1955, due presumably to increased efficiency of the station over that period. Since 1955 the catching rate has declined, the fall being especially marked in 1957, when the quota was not filled in spite of a second catching vessel operating in that year.

TABLE 2

HUMPBACK WHALES TAKEN AT ALBANY IN 1957  
SUMMARY OF CATCH COMPOSITION

	Sex ratio*		Mean length (feet)	Sexually immature+ (%)	Pregnant (%) of mature females)
	Number	%			
Males	58	57.4	38.78	17.2	
Females	43	42.6	40.62	23.3	39.4

\* 1 whale not sexed: damaged by sharks

+ Males at or under 36'9"  
Females at or under 38'6"

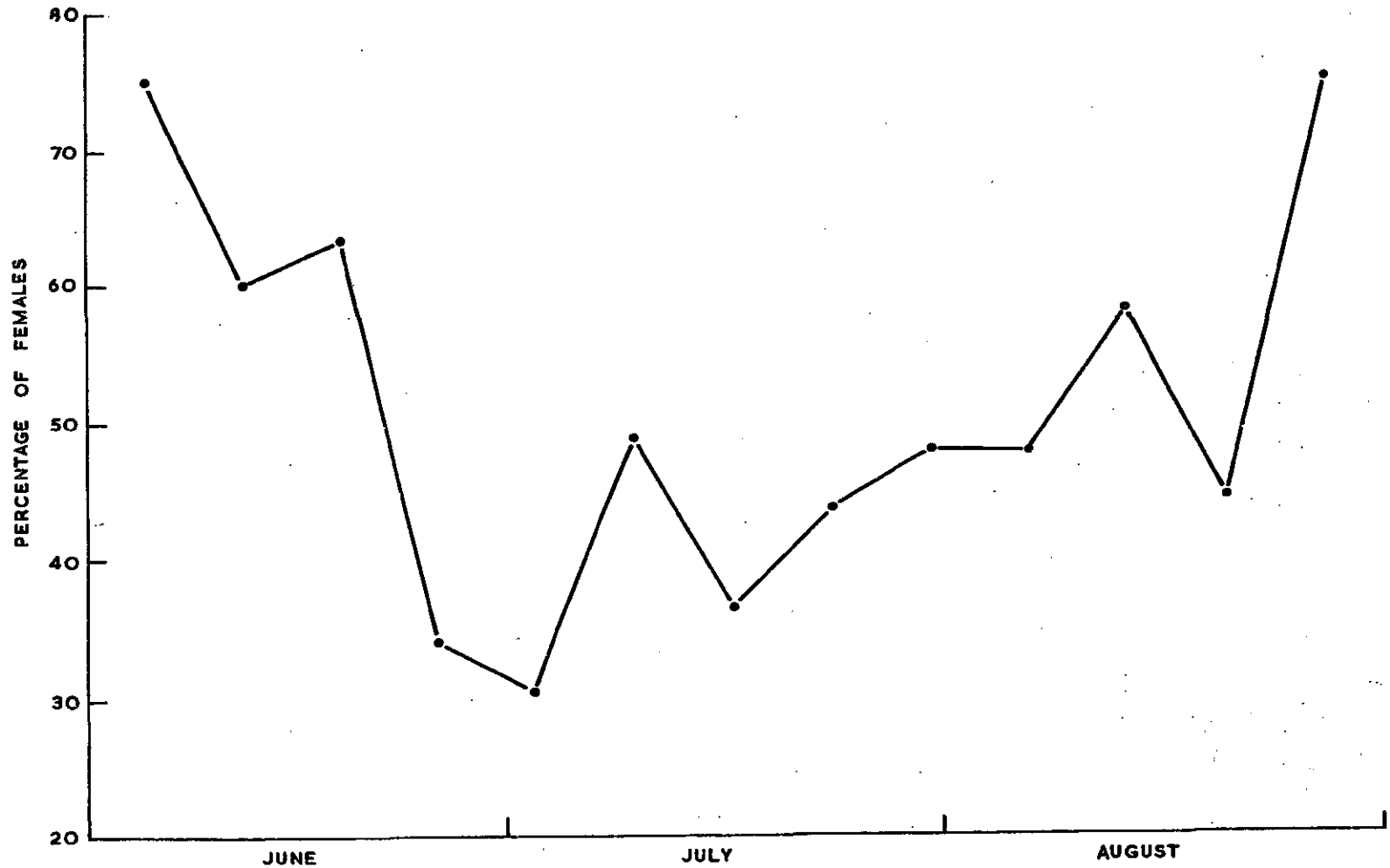


Fig. 4. Weekly sex ratio of 611 humpback whales taken at Albany from 1952 to 1957.

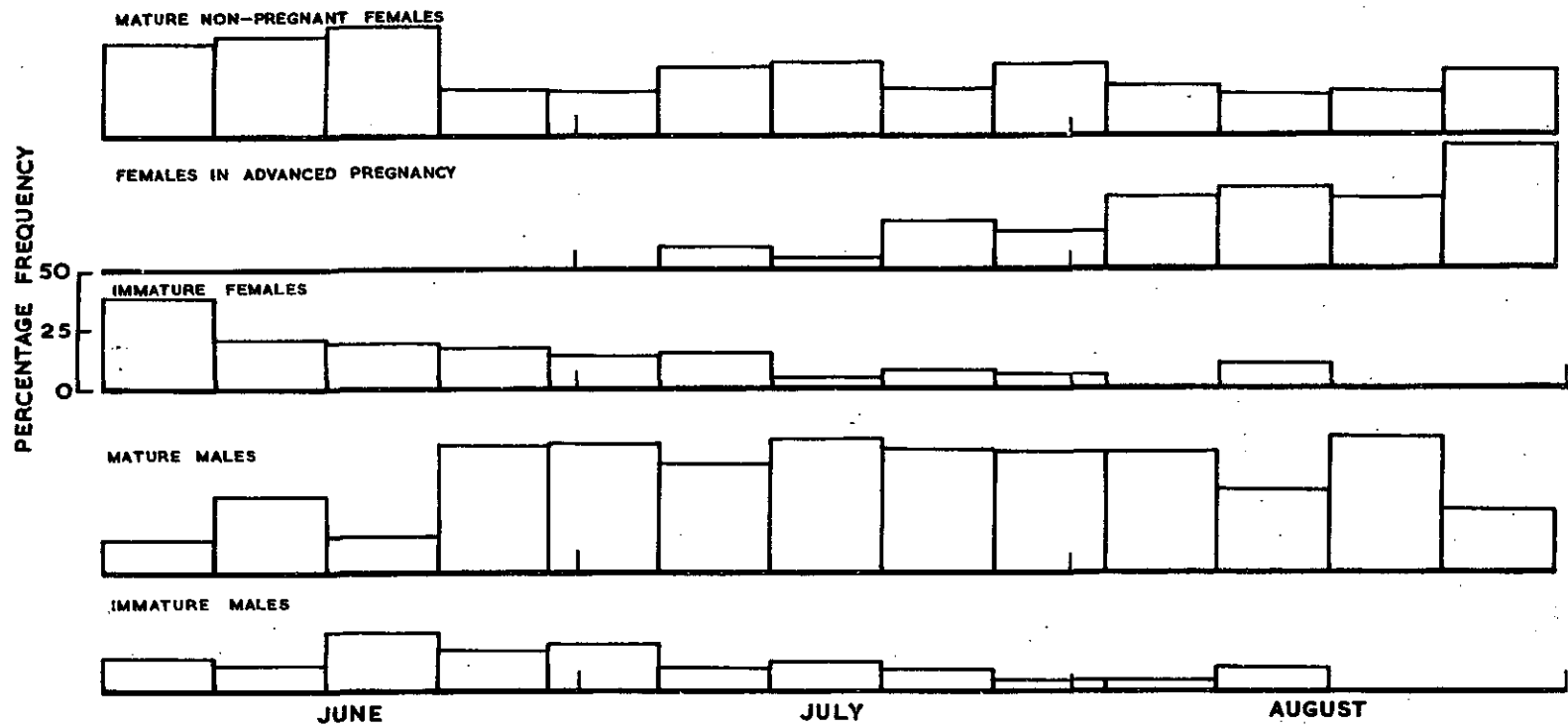


Fig. 5. Composition of weekly catches made at Albany (seasons 1952 to 1957, inclusive) as an indication of the trends during the northward migration of humpback whales.

(iii) Composition of catch in 1957.- Table 2 shows some statistics of the catch of humpbacks at Albany in 1957. When compared with corresponding values from earlier seasons (see previous report) these features do not show regular trends. Although the composition of the catch has been variable from one season to another, it apparently has not been possible to maintain a high degree of selection in this area. This might be due to more adverse weather than in the Carnarvon area, or to a more limited number of whales available.

(iv) Review of the catch at Albany.- Some features of the catch at Albany in 1957 may be related to the period of catching. For example, the later start in 1957 tended to reduce the proportion of females taken. Also the later catching increased the proportion of mature females which were in advanced pregnancy (see Figure 5).

The only statistic showing a regular trend is the catch per catcher day (Table 1). It is highly unlikely that the decline in the average catch per catcher day since 1955 is solely due to adverse weather in 1956 and extremely adverse weather in 1957 (when the humpback quota was not filled). It would appear that humpbacks hunted in the Albany area are near the fringe of a population (Group IV). If this population has been considerably reduced, one might expect that a station situated towards the border of the stock's range would be first to notice the decreased numbers of whales available.

#### (c) Relative Growth Rate of Western Coast Humpbacks

(i) Sexually immature females.- As shown earlier in this report, in the analysis of the catch made at Carnarvon during 1957, higher proportions of whales were classed as sexually immature as a result of gonad examination than by use of the mean lengths at puberty (see Section II (a) (v)). The large collections of ovaries from humpbacks taken on the western coast since 1951 have enabled this discrepancy to be investigated in the case of females.

Table 3 shows the numbers and percentages of females classed as immature by length (at or below 38 ft 6 in.) and by examination of ovaries (no ovulations) in the samples from catches made from 1951 to 1957 on the western coast. The "reliability" of the length method for immaturity is shown by expressing the proportion classed as immature by means of length as a percentage of the true proportion found to be immature after examination of ovaries.

TABLE 3

FEMALE HUMPBACK WHALES FROM THE WESTERN  
COAST OF AUSTRALIA SEXUALLY IMMATURE  
BY LENGTH AND BY OVARIES

Year	Number of females examined	At or under 38'6"		Not yet ovulated		A x 100 B
		No.	%(A)	No.	%(B)	
1951	89	19	21.4	15	16.9	127
1952	277	54	19.5	52	18.8	104
1953	245	74	30.2	72	29.4	103
1954	150	44	29.3	38	25.3	116
1956	279	20	7.2	24	8.6	83
1957	482	79	16.4	102	21.2	78

In Figure 6 the "reliability" values are shown for the samples from each year. In samples from the western coast from 1951 to 1954, classing those females at or below 38 ft 6 in. as immature, resulted in slightly higher proportions of immature females than were actually present. However, in 1956 and 1957 the position was reversed, the classification by length resulting in lower proportions than the true values.

More stringent selection of larger whales could result in only the larger of the immature females (over 38 ft 6 in.) being taken. Hence the proportion of immature females as calculated on a basis of a length of 38 ft 6 in. would fall below the true proportion of immature females in a carefully selected catch. This reasoning might largely explain the result shown in Table 3 for 1956, when a high degree of selection succeeded in improving the general composition of the catch. But as discussed above, it was not possible to maintain a high degree of selection in 1957, yet Table 3 and Figure 6 show that in that year the proportion of females classed as immature on a length of 38 ft 6 in. continued to drop even further below the true proportion of immature females in the sample.

In the 1957 catch the ovaries of 482 females were examined: 81 of these were found to be sexually immature, 42 were at puberty, and 359 were sexually mature. The distributions of the immature and mature females are shown in Figure 7, grouped within six inch intervals of body length. Figure 7 also shows the corresponding records for females



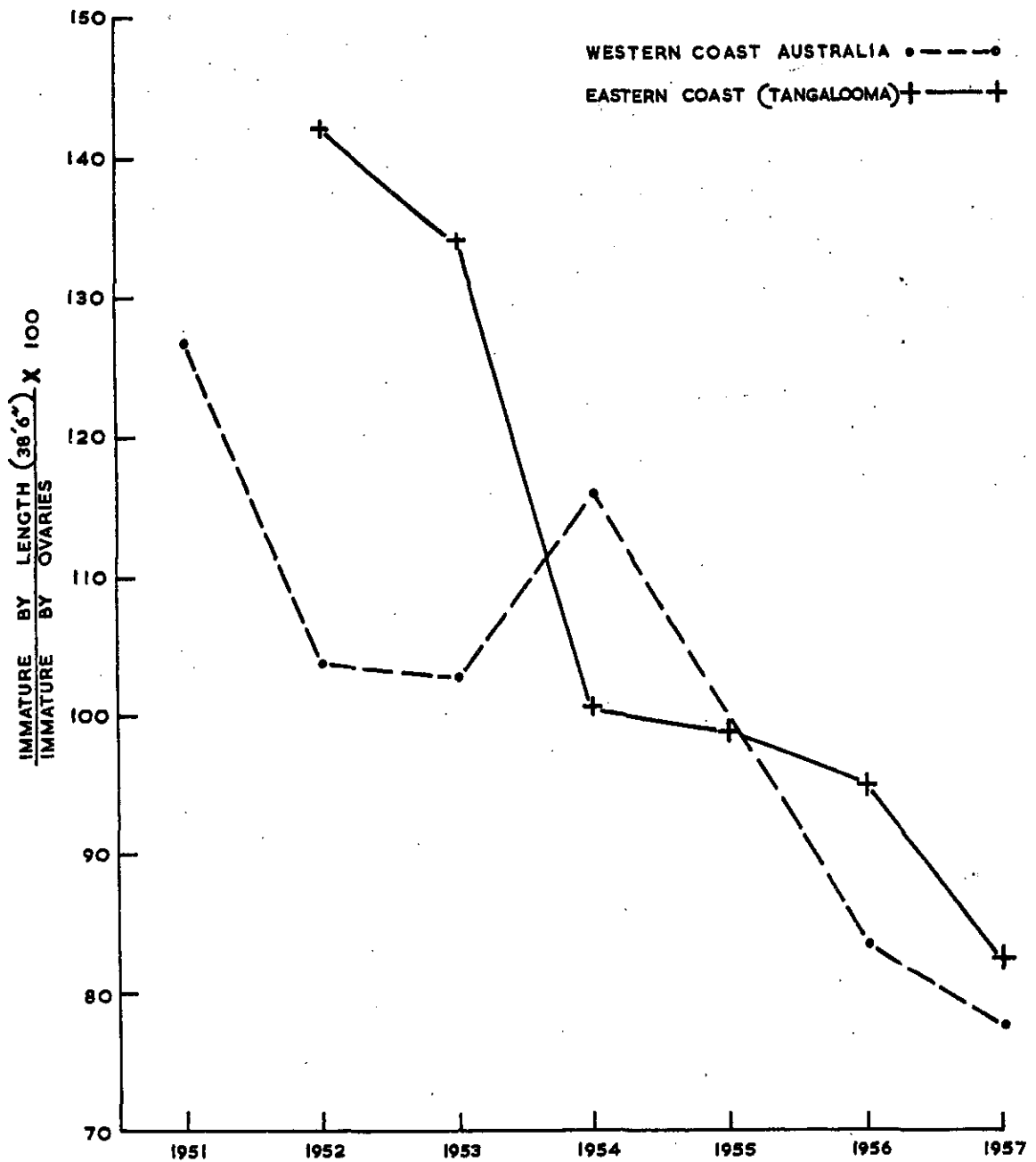


Fig. 6. Relationship between the proportion of females classed as immature on a basis of length (at or below 38 ft 6 in.) and the true proportion found to be immature after examination of ovaries.

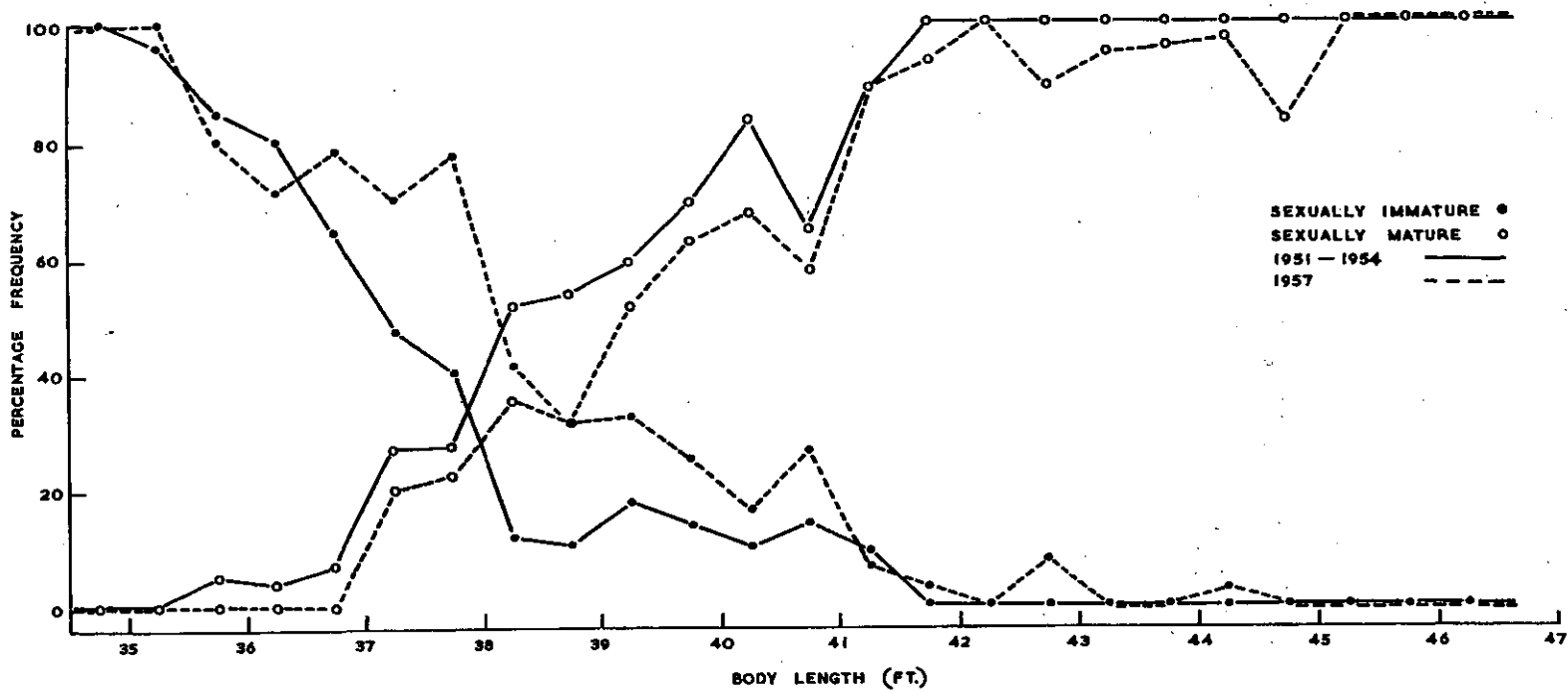


Fig. 7. Percentages of immature and mature females within 6 in. intervals of body length: western coast, 1957 and 1951-4 samples.

examined between 1951 and 1954 reported by Chittleborough (1955b). For reasons of clarity, pubertal females have been omitted from this figure, but are considered below.

Figure 7 shows that within the range of lengths at maturity, there were in 1957 higher proportions of immature females in most intervals of body length than in the sample collected from 1951 to 1954. This would imply that in the more recent sample, females tended to attain greater lengths before maturing.

(ii) Pubertal females.- The mean length of 77 pubertal females examined on the western coast from 1951 to 1954 (Chittleborough 1955b) was 38.50 ft (standard deviation of mean 0.18). The mean length of 42 pubertal females from the same area in 1957 was 39.49 ft (standard deviation of mean 0.34). The mean of the second sample is significantly higher than that of the first since  $t = 2.87$  on 117 degrees of freedom.

(iii) Sexually mature females.- Using the number of ovulations as an index of relative age, a growth curve may be constructed for the mature females in a sample (see Chittleborough 1955b). Such a growth curve may then be compared with a similarly constructed curve from a sample of another population or a sample taken from the same population at some other time.

Table 4 shows the mean lengths of females grouped according to the number of ovulations which had occurred prior to the season of killing, for the females sampled in 1957 from the western coast. Figure 8 shows these values as a growth curve for this sample and also the corresponding curve for the sample collected from 1951 to 1954 (as given by Chittleborough 1955b, Table 4). From Figure 8 it would appear that the growth rate of the younger mature females (up to 3 ovulations) in the 1957 sample was greater than that of the corresponding females in the 1951-54 sample. The growth curves of the older mature females were almost identical.

Table 5 shows the results of "t" tests upon each of the first four groups of females from the two samples shown in Figure 8. This shows that each of the first three points (0, 1, and 2 ovulations) of the 1957 growth curve are significantly above the corresponding points on the growth curve from the earlier sample. At three previous ovulations the test of significance was inconclusive.

TABLE 4  
HUMPBACK WHALES: WESTERN COAST  
RELATION BETWEEN BODY LENGTH AND RELATIVE AGE, USING NUMBERS  
OF OVULATIONS AS AN INDEX OF RELATIVE AGE

Total ovulations prior to season of killing	1956			1957		
	Number of females	Mean length (ft)	Standard deviation of mean	Number of females	Mean length (ft)	Standard deviation of mean
0*	17	40.15	0.74	42	39.49	0.34
1	27	40.15	0.34	39	40.53	0.32
2	38	41.36	0.27	69	41.39	0.23
3	19	41.64	0.46	40	41.76	0.33
4	16	41.64	0.48	30	42.31	0.34
5	16	42.36	0.46	21	42.86	0.43
6	12	43.40	0.56	24	43.02	0.40
7	12	43.53	0.62	20	43.26	0.52
8	9	44.69	0.43	15	44.39	0.40
9	10	42.70	0.49	16	43.85	0.33
10	12	43.78	0.68	13	43.74	0.27
11-12	18	44.18	0.34	20	43.96	0.47
13-14	23	44.89	0.45	17	44.70	0.55
15-17	9	44.56	0.55	16	45.30	0.41
18-21	10	45.42	0.62	9	45.32	0.51
22-50	13	45.87	0.60	10	44.68	0.33

\*Pubertal

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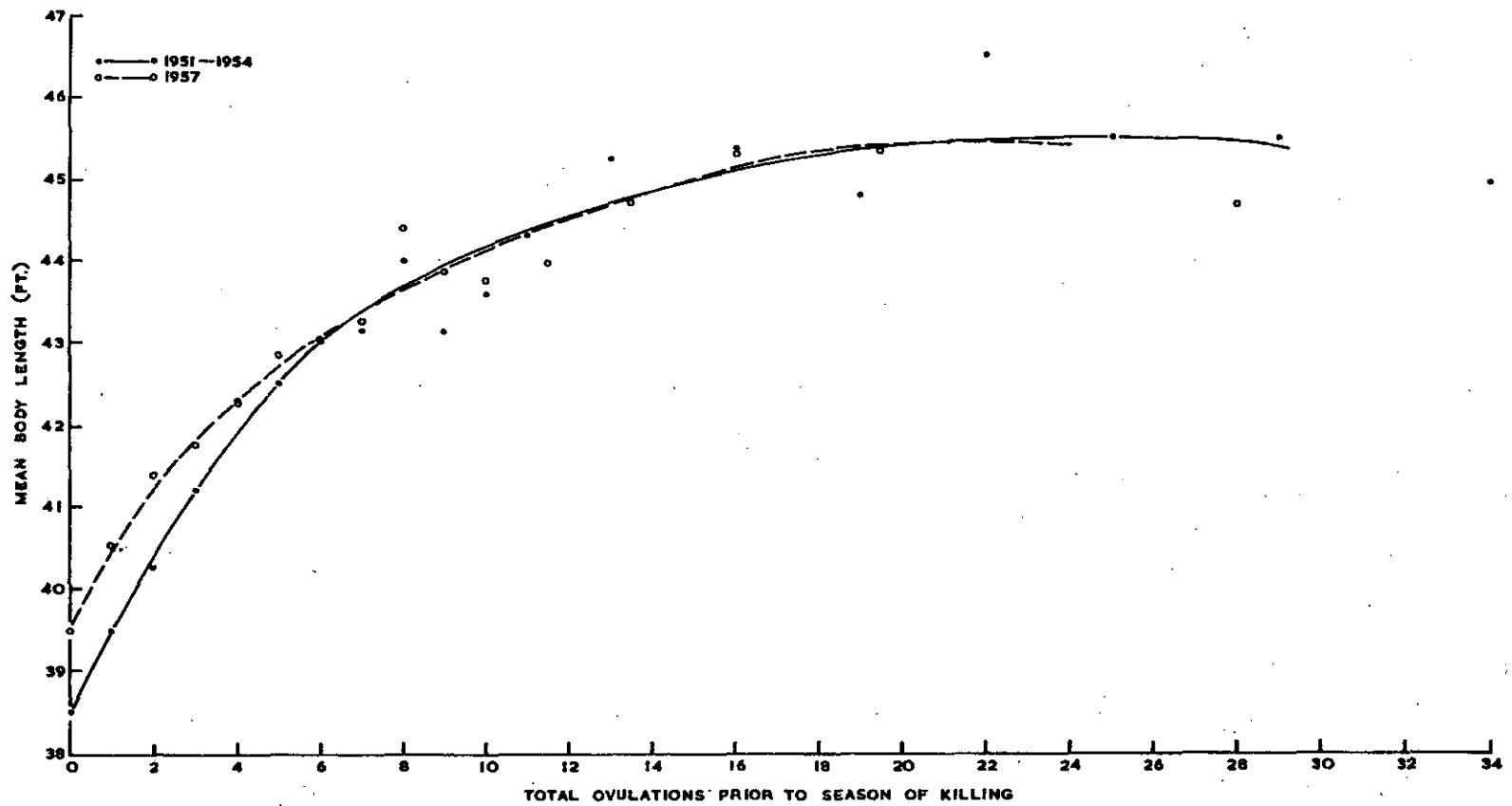


Fig. 8. Growth curves of females as indicated by ovulation counts. Western coast, 1957 and 1951-54 samples.

TABLE 5

COMPARISONS BETWEEN THE LENGTHS OF SPECIFIED CLASSES OF FEMALES IN SAMPLES FROM CATCHES MADE ON THE WESTERN COAST IN THE PERIOD 1951-54, AND THE CORRESPONDING DATA COLLECTED IN 1957

Class of females	"t" test: 1951-54 and 1957	
	t	degrees of freedom
0 (Pubertal)	2.87	117
1 previous ovulation	3.21	111
2 previous ovulations	3.62	136
3 previous ovulations	1.28	90

(iv) Evidence from other years.- It is of some importance now to consider any similar evidence collected from the western coast in 1955 or 1956. Insufficient numbers of ovaries were examined in the 1955 season to allow comparable calculations to be made, but reasonable numbers of females were examined in 1956. These are shown in Table 4 in comparable form to the data from other years. Owing to the smaller numbers within each sub-group, the mean lengths in 1956 samples were more variable than those of the 1951 to 1954, or the 1957 samples. But the first four points (pubertal, 1, 2, and 3 ovulations) in the 1956 material (Table 4) were above those of the 1951-54 material (Table 4 of Chittleborough 1955b). Table 6 shows that in the 1956 sample, both the first (pubertal) and third (2 ovulations) classes of females were significantly longer than the corresponding classes in the sample of 1951 to 1954; the "t" test on the second class (1 ovulation) was inconclusive, and the fourth class (3 ovulations) did not differ significantly in the two samples.

TABLE 6

COMPARISONS BETWEEN THE LENGTHS OF SPECIFIED CLASSES OF FEMALES IN SAMPLES OF CATCHES MADE ON THE WESTERN COAST IN THE PERIOD 1951-54, AND THE CORRESPONDING DATA COLLECTED IN 1956

Class of females	"t" test: 1951-54 and 1956	t	degrees of freedom
0 (Pubertal)	3.24	92	
1 previous ovulation	1.95	99	
2 previous ovulations	3.14	105	
3 previous ovulations	0.79	69	

(v) Discussion:- The evidence given above may be summarized as follows:-

Of the females sampled in 1957, immature individuals tended to attain greater lengths, pubertal females were significantly longer, and young mature females (1 and 2 previous ovulations) were also significantly longer than corresponding females sampled from catches made in 1951-54. Some similar trends were found in the sample collected in 1956.

Before attempting to relate these results to the condition of this stock of humpback whales, it should be stressed that there has been no change over the years concerned in the method of examining ovaries or of measuring the whales. The females were examined on the flensing deck without selection towards any particular size group or physiological condition, and the numbers examined are considered sufficient to be representative of the catches of females.

The changes in the lengths of the younger classes of females in the catches of recent years may be the result of:-

- (1) Selection upon a rapidly increasing population
- (2) Whales now maturing later than in earlier years
- (3) Changes in the selection of whales by gunners
- (4) An increase in the rate of growth of young whales

Each of these possibilities will be considered in turn.

(1) Selection upon a rapidly increasing population.-  
If in recent years the numbers of whales within the younger year classes had increased very rapidly, more could be taken from these classes. Careful selection could then result in only the larger individuals being taken, so that the mean length of a sample from a particular year class would show an apparent increase.

Trends in recent catches from this stock of humpback whales rule out the possibility that this population is rapidly increasing.

(2) Whales now maturing later than in earlier years.-  
If the growth rate had remained constant, but individuals now tended to mature at slightly later ages than previously, immature whales would now tend to be longer and pubertal and young mature whales would be of slightly increased average lengths in the catches of more recent years. This possibility can be checked by means of baleen and ear plug material, but as yet there is no supporting evidence for such a theory.

With the fin whale, Hylén, Jonsgård, Pike, and Ruud (1955) give some evidence contrary to the above theory. Figure 1 of their paper indicates that both males and females were tending to mature at earlier ages in 1952 and 1953 than in previous years.

(3) Changes in the selection of whales by gunners.-  
As discussed in the previous report, from 1951 to 1954 the "selection factor" remained relatively constant from year to year. After the 1954 season the quota allotted to the western coast was reduced. Consequently the larger whales were selected much more carefully in 1955 and 1956, with corresponding improvement in the composition of the catches.

More stringent selection, applied successfully in 1956, could explain the apparent increase in the rate of growth of young whales in the 1956 catch. For example, by attempting to take only those whales over forty feet in length, the pubertal females sampled would include only the larger females in this class, so that the mean length of pubertal females in the 1956 sample would be expected to be abnormally high, and not truly representative of pubertal females.

However, as discussed earlier in this report, the catch on the western coast in 1957 was not selected as



stringently as in 1956; in fact the analysis of catch returns would indicate that the selection factor in 1957 was comparable with that applying in the period 1951-54. In spite of lessened selection, the apparent growth rate of young females was again significantly greater than in the initial years.

(4) An increase in the rate of growth of young whales.- This appears to be the only satisfactory explanation for the changes which were demonstrated in the females sampled during 1957. If the growth rate increased, it is unlikely that it would become evident abruptly (as in the 1957 catch), but rather would appear earlier in a minor degree. A real increase in growth rate may have appeared in the 1956 catch, but was overshadowed by the effects of the much more stringent selection of the larger whales which was applied successfully in that year.

Some confirmatory evidence for an increase in the rate of growth of whales in a decreasing or depleted stock may be deduced from Matthews' (1937) report upon humpback whales taken at South Georgia and South Africa between 1924 and 1930. Although the numbers of humpbacks examined were small (31 males and 31 females), the estimated average lengths of males and females at sexual maturity (39.37 ft and 41.00 ft, respectively) exceeded the corresponding lengths reported by Chittleborough (1955a and 1955b) by similar amounts (i.e., 2.62 ft in the males and 2.50 ft in the case of females). The humpbacks reported by Matthews would hardly have been selected very carefully, since by that time the humpback stocks in those regions had been so severely reduced that this species formed a very insignificant part of the catches (Ruud 1952).

It would appear that the humpbacks reported by Matthews were from a population in which the numbers had been severely reduced and the rate of growth of remaining individuals was greater than in the population on the western coast of Australia between the years 1951-54.

### III. EASTERN COAST

#### (a) Tangalooma

(i) Rate of catching.- In 1957 the average catch per catcher day was 4.8, which compares favourably with an average of 4.7 in the 1956 season.

(ii) Sex ratio.- Of a total of 600 humpbacks taken in 1957, 29.7 per cent. were females. This falls within the

range of earlier seasons (see Table 9 of the previous report).

The percentages of females in weekly catches throughout the season (Fig. 9) were similar in 1957 to those of 1956, although slightly lower proportions of females were taken towards the end of the catching period in 1957 than in the previous season.

(iii) Mean lengths.- The mean length of 422 males taken in 1957 was 40.50 ft, while that of 178 females was 41.83 ft. These means are very similar to those of the 1955 and 1956 catches (Table 10 of the previous report).

TABLE 7

HUMPBACK WHALES: EASTERN COAST AND NORFOLK ISLAND  
LENGTH FREQUENCIES IN 1957 CATCHES

Length (ft)	Males			Females		
	Tanga- looma	Byron Bay	Norfolk Island	Tanga- looma	Byron Bay	Norfolk Island
31				1		
32						
33	2					
34				1		
35	5		2	3	4	
36	10	4	1	3	4	
37	15	5	5	11	2	2
38	35	11	4	11	6	2
39	43	14	3	8	8	
40	82	12	14	11	3	2
41	77	11	15	24	5	2
42	92	4	19	28	5	5
43	34	6	18	21	3	4
44	20	3	7	20	7	1
45	3		4	16	2	4
46	4			10	2	4
47			1	4		
48				4		
49				1		1
50				1		
Total	422	70	93	178	51	27

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(iv) Length frequency distribution.- Table 7 shows the distribution of lengths for catches of males and females from Tangalooma in 1957. The length frequency distributions from catches in 1956 and 1957 are compared in Figure 10. In both sexes the distributions are very similar for the two seasons, although in 1957 there were fewer males and females in the length range from 43 ft to 45 ft inclusive.

(v) Sexually immature individuals.- Of the total catch of males (422) in 1957, 5.2 per cent. were at or below 36 ft 9 in. in length, so were classed as sexually immature. Of 215 males sampled, 6.1 per cent. had a total testis weight of at or less than 4 kg, so were classed as immature by this method.

Of the total catch of females (178) in 1957, 16.9 per cent. were at or less than 38 ft 6 in., so were classed as immature. Of 132 sampled, 20.5 per cent. had not yet ovulated, so were immature.

(vi) Pregnancy.- Of 148 females classed as sexually mature (by length) 13 or 8.8 per cent. were in advanced pregnancy. This is a similar proportion to earlier catches at this station (Table 15 of the previous report).

(vii) Ovulation counts.- Figure 11 shows the distribution of ovulation counts amongst females sampled at Tangalooma from 1952 to 1957. The sample from the 1957 catch shows marked changes from samples of previous years. In 1957 there has been a move towards younger females (0 and 1-3 ovulations) dominating the sample, while the proportion of relatively old females (more than 18 ovulations) also increased considerably.

TABLE 8

NUMBERS OF FEMALES EXAMINED EACH SEASON  
AT TANGALOOMA

Year	Total catch of females	Females examined	
		Number	Percentage
1952	150	105	70.0
1953	191	122	63.9
1954	178	148	83.1
1955	171	115	67.3
1956	193	97	50.3
1957	178	132	74.2

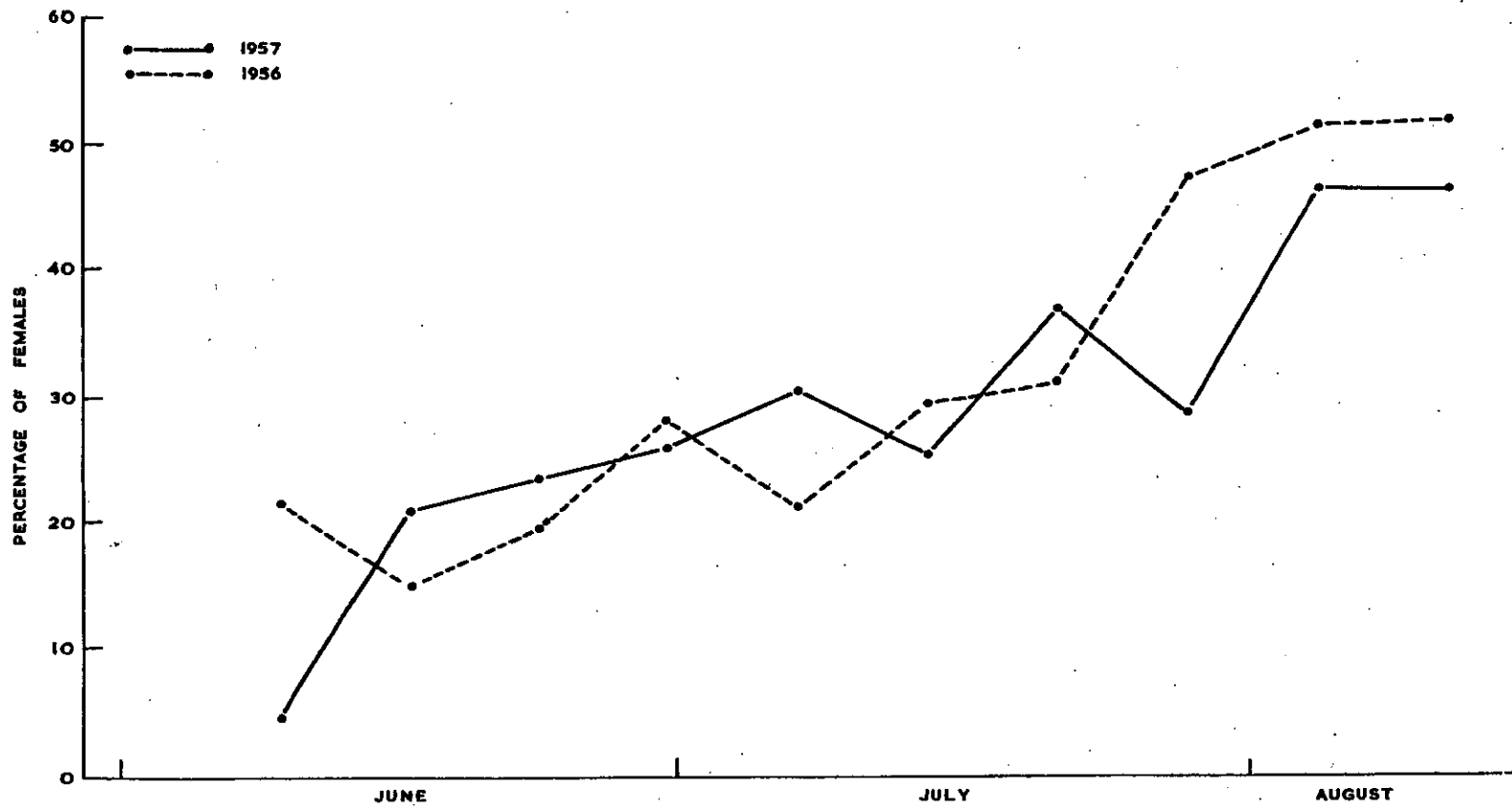


Fig. 9. Weekly sex ratios of catches at Tangalooma in 1957 and 1956.

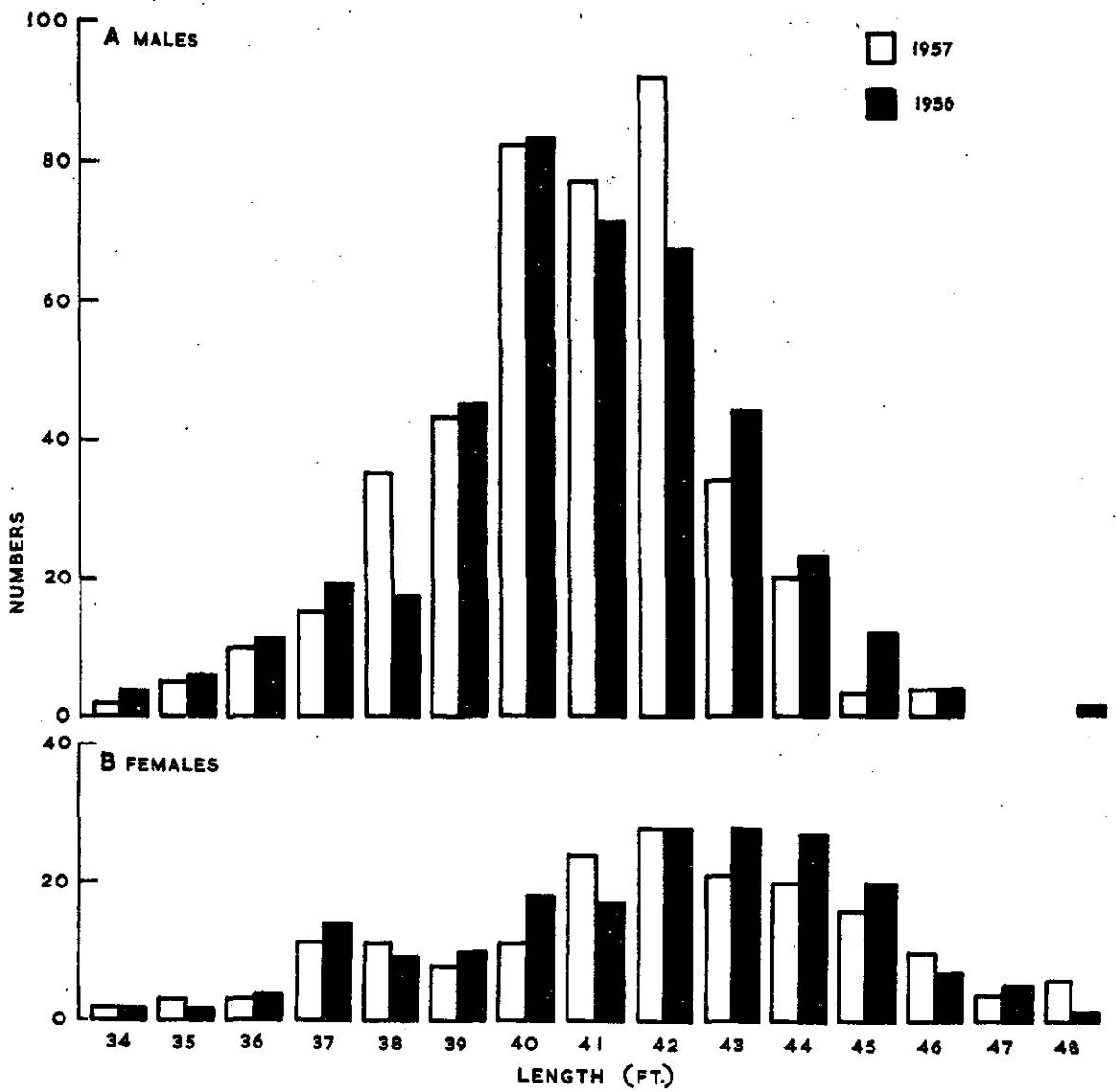


Fig. 10. Length frequency distribution of males and females in catches at Tangalooma in 1957 and 1956.

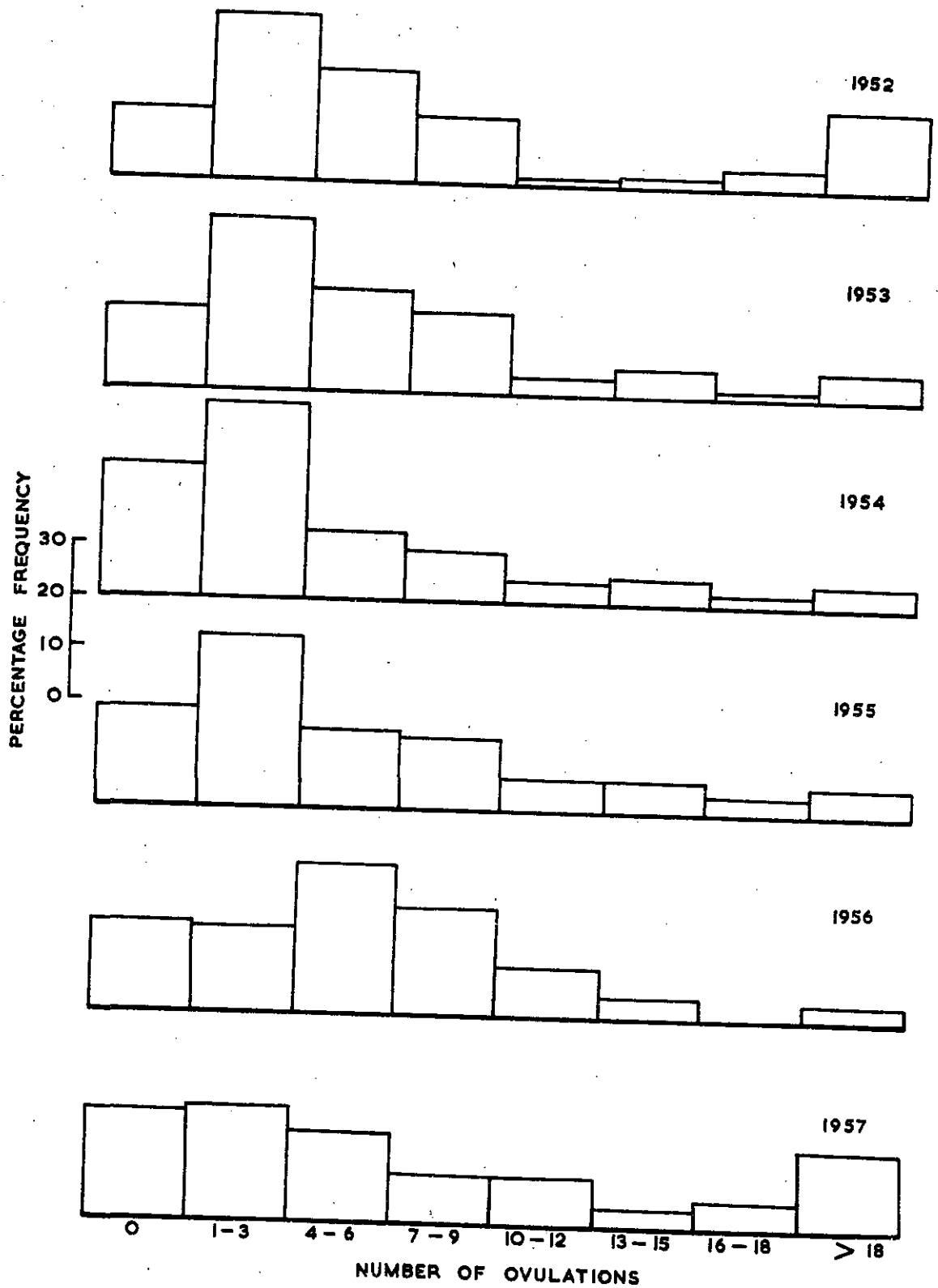


Fig. 11. Percentage frequency distribution ovulation counts amongst females sampled at Tangalooma from 1952 to 1957.

Table 8 shows that the numbers of females sampled each year were reasonably representative of the total catches of females. If the catches made each year were fully representative of the females (above the minimum legal lengths) in the stock, the swing towards younger females in the catch of 1957 could be the result of previous heavy fishing upon this stock. On the other hand, the abrupt increase in the proportion of relatively old females in the 1957 sample is hardly in accordance with excessive catching in recent years.

(viii) Review of the catch at Tangalooma.- In most features the composition of the catch in 1957 compares favourably with catches of previous seasons. However, using the number of ovulations in females as an index of relative age, there has been a considerable change in the age distribution of females from the catch of 1956 to that of 1957.

From a population which had been hunted relatively lightly for some years (i.e. prior to 1952), one might expect the initial catches to contain an accumulation of older whales, but that such whales would be of minor importance in catches of succeeding years. Figure 11 shows this occurred in catches of females at Tangalooma from 1952 to 1956. The abrupt increase in the proportion of older females in the 1957 catch is then surprising. Evidence from future seasons is necessary to assess the significance of this apparent change.

In 1957 a lower number of females was classed as sexually immature by using a mean length of 38 ft 6 in. at puberty, than was actually recorded after examination of the ovaries (see part (v) of this section). Figure 6 shows the relationship between the proportion of immature whales as calculated by length (at or below 38 ft 6 in.) and the true proportion (by examination of ovaries) for each season at Tangalooma from 1952 to 1957. Initially (1952 and 1953) the division by length resulted in much higher proportions of immature females than were actually present in the catches, but Figure 6 shows that by 1957 the position was reversed; the proportion found by length was considerably below the true proportion of immature females present. It might be suggested that this trend indicates that larger whales had been selected more carefully each year, especially from 1954 onwards. However, while it has been suggested in the last report that a higher degree of selection has been applied since 1955, there is no evidence that gunners have succeeded in selecting larger whales more carefully each year from 1952 to 1957.

The trend shown in Figure 6 for females taken at Tangalooma could be explained if the younger whales in this population are now growing at a faster rate than were whales of similar ages in earlier years. Present material is insufficient to examine this possibility.

(b) Byron Bay

(i) Sex ratio.- 42.1 per cent. of the catch in 1957 (121 humpbacks) were females.

Since the annual catch at this station is small, it is necessary to pool the catches made since 1954 to follow changes in the sex ratio over the catching period. Figure 12 shows the sex ratio at intervals of 10 days for the net catch of 481 humpbacks taken from 1954 to 1957. Weekly sex ratios of catches made at Tangalooma in 1952 and 1957 are also shown for comparison. The trends at the two stations over the corresponding period are very similar, though the peak in abundance of females in August is higher at Byron Bay than at Tangalooma.

With a small quota, the sex ratio of the annual catch at Byron Bay is largely dependent upon the period of whaling operations.

(ii) Mean lengths.- The mean length of 70 males taken in 1957 was 39.67 ft, while that of 51 females was 40.23 ft. In both sexes the mean lengths in 1957 were considerably below corresponding means in previous years (see Table 10 of last report).

(iii) Length frequency distribution.- Table 7 shows that in the 1957 catch at Byron Bay the distributions of lengths for both males and females were poorer than for the same season at Tangalooma.

(iv) Sexually immature whales.- Classifying males at or below 36 ft 9 in. in length as immature, 7.1 per cent. of the males in the 1957 catch were immature. This is higher than the corresponding value in 1956 (2.6 per cent.) but is still reasonably low.

31.4 per cent. of the females taken in 1957 were at or below 38 ft 6 in. in length, agreeing with the ovarian examination (31.4 per cent. immature). This is much higher than in any previous season (Table 13 of the last report).

(v) Pregnancy.- No females in advanced pregnancy were taken in 1957. The majority of the catch was taken in



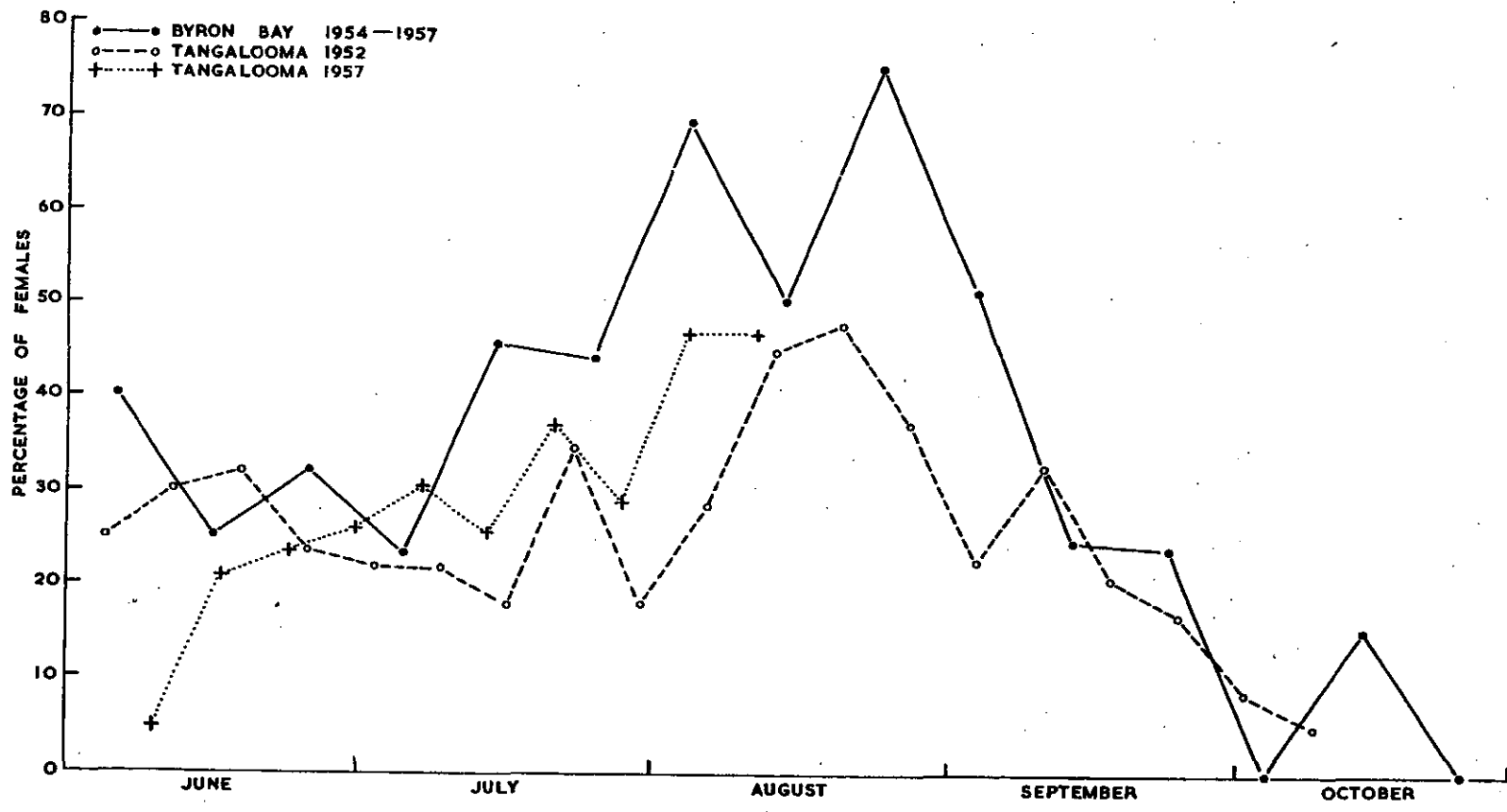


Fig. 12. Sex ratio intervals of 10 days, for the net catch at Byron Bay from 1954 to 1957. Also the weekly sex ratio of catches at Tangalooma in 1952 and 1957.

September, by which time most of the calves have been born (Chittleborough 1958).

(vi) Review of the catch at Byron Bay.- The composition of the catch at Byron Bay in 1957 showed a decline in mean lengths, poorer length frequency distributions, and higher proportions of immature males and females than in previous seasons.

The company which operates the stations at Norfolk Island and Byron Bay intended in 1957 first to fill the quota allotted to Norfolk Island and then to transfer operations to Byron Bay. However, it was found necessary to suspend whaling at Norfolk Island temporarily in mid-August, fill the quota at Byron Bay, and return to complete operations at Norfolk Island. It would appear that in order to conclude catching at Byron Bay swiftly, whales were much less rigidly selected than in previous years.

(c) Norfolk Island

(i) Rate of catching.- In the first part of the season (June 15 to August 16), 82 whales were taken in 52 days; i.e. an average of 1.58 per day. In the second part of the season (September 30 to October 12), 38 whales were taken in 13 days; i.e. an average of 2.92 per day. A similar degree of selection was apparently applied over both periods, so it appears that humpbacks were more plentiful in the second period.

(ii) Sex ratio.- Combining the catches of 1956 and 1957, Table 9 shows the monthly sex ratio amongst 270 humpbacks taken at Norfolk Island. In 1957 the proportion of females in the catch (22.5 per cent.) was lower than that of the 1956 catch (38.7 per cent. females), due mainly to the different periods of whaling operations in the two seasons.

TABLE 9

SEX RATIO IN MONTHLY CATCHES - NORFOLK ISLAND 1956-57

Month	Total catch		Net catch	Females	
	1956	1957		Total	%
June	-	8	8	1	12.5
July	-	51	51	7	13.7
August	16	23	39	15	38.5
September	57	2	59	34	57.6
October	77	36	113	28	24.8

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(iii) Mean lengths.- The mean length of 93 males taken at Norfolk Island in 1957 was 41.24 ft, very close to that of the males taken in 1956. The mean length of 27 females taken in 1957 was 42.47 ft, slightly above that of females taken in 1956 (see Table 10 of previous report).

(iv) Length frequency distribution.- Table 7 shows the distribution of the lengths of males and females taken at Norfolk Island in 1957. The length frequency distributions of both sexes compare favourably with catches at Tangalooma and Byron Bay in 1957 and with catches at Norfolk Island in 1956 (Tables 11 and 12 of previous report).

(v) Sexually immature whales.- 3.2 per cent. of the males taken in 1957 were at or less than 36 ft 9 in., and so were classed as immature. This is less than the corresponding proportion (7.6 per cent.) in the 1956 catch.

14.8 per cent. of the females taken in 1957 were classed as immature (at or less than 38 ft 6 in.); again less than in 1956 (22.4 per cent. immature).

(vi) Pregnancy.- One female in advanced pregnancy was taken in 1957. None were taken in 1956.

(vii) Review of the catch at Norfolk Island.- The composition of the catch at Norfolk Island in 1957 compared favourably with that of the catch in 1956. Some features even showed some improvement in 1957; for example, the mean length of the females was above the high level recorded in 1956, while the proportions of immature males and females decreased in 1957. The period of whaling operations varied in the two years; this would be expected to have some effect upon the composition of the catches.

#### IV. CONCLUSIONS

From the evidence available it is concluded that the stock of humpback whales hunted on the western coast of Australia is continuing to decline, in spite of the lower quotas allotted since 1955. It would appear that, in this dwindling population, the younger whales are now growing at faster rates than the whales of similar age in the population during the period 1951 to 1954.

The evidence from catches on the eastern coast of Australia and at Norfolk Island indicates that these stocks continue to be in relatively sound condition.

## V. ACKNOWLEDGMENTS

The co-operation of the whaling companies, enabling data to be collected from their respective stations, is gratefully acknowledged.

Inspectors of the Commonwealth Fisheries Office and the Western Australian Fisheries Department gave valuable assistance in the collection of material, in addition to compiling the catch returns analysed in this report.

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