

P. B. BEST

## Whales Observed in the Indian Ocean

### NOTES ON THEIR DISTRIBUTION

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In 1951 the Meteorological Office kindly offered to co-operate with the National Institute of Oceanography in the collection of records of whales observed at sea by merchant ships and other vessels. Dr. Mackintosh outlined the scheme in *The Marine Observer*<sup>1</sup> and gave an account of the information required, with a description of some of the larger species of whales.\* A short report by the same author, on the first year's observations, appeared later.<sup>3</sup> The main object of this scheme is to obtain new information on the world distribution of the larger whales especially, but also of the smaller cetacea such as the dolphins and porpoises.

#### Data

The first reports were received in April 1952, and by April 1956 some 370 had been received; 65 of them are extracts from meteorological logbooks forwarded by the Meteorological Office, most of the remainder being on the special form provided by this Institute. The great majority of reports contain a number of whale observations and a large number cover more than one voyage. A few observations from aircraft have also been received but are not used in this paper.

The voyages cover the Atlantic, Indian and Pacific Oceans. Preliminary plotting of the observations from all three oceans showed that it would be better in the first instance to concentrate on the results of those from each ocean in turn rather than to attempt to produce a world chart of all the records. The present notes on the observations in the Indian Ocean may be regarded as a preliminary account of some of the results of the first four years.

The boundaries of the area under consideration can be seen in Fig. 1. It extends from 20°E. to 120°E. in the south but in the north the Red Sea is excluded in the west and so are the waters of the East Indian Archipelago in the east (from 100°E. and including all waters east of Sumatra and north of Java). The observations from these areas will be examined at a later date.

A total of 133 reports refer to the Indian Ocean as outlined: 80 of them give sufficient details for the approximate route to be plotted and the ships concerned apparently kept a fairly regular watch for whales. The remaining 53, conveniently referred to as *M* reports (mostly extracted from meteorological logbooks), have been used to reinforce some of the conclusions reached. The observations include 140 sightings of large whales, a large whale being defined as a whale assumed to be about 40 feet or more in length. This definition includes the sperm whale, the humpback whale and all the rorquals (except the minke or lesser rorqual). The reports identify, more or less tentatively, sperm whales, humpback whales and blue, fin and sei whales, but since it is very difficult to distinguish between the last three species at sea, they have been combined under the heading "rorquals" in this study. In addition to specific identifications by the observers, their descriptions of the size and behaviour, etc., of unidentified whales have occasionally enabled an identification to be made, e.g. as a humpback whale, or a rorqual. There remain a number of observations of large whales which cannot be identified. These have been classed as "large whales", possibly including any one or all of the above species. In addition there are many records of dolphins and small whales, but these have not been considered in the present study since they are of little commercial importance though of considerable interest in general marine biology. It is intended to examine their distribution in a future paper.

The track of each vessel from the 80 whale reports has been roughly plotted on a Mercator chart, according to the noon positions of the vessel and the positions at

\* An enlarged edition of these notes was issued by the Institute in July, 1952<sup>2</sup>, for the use of observers in ships.



which any observations were recorded. The chart was next divided into areas ("squares") of  $10^{\circ}$  latitude by  $10^{\circ}$  longitude and into subdivisions of those areas. The distance steamed in each area (to the nearest 100 miles) was calculated and the total mileage was also divided into miles steamed in each of the four three-monthly periods, September-November, December-February, March-May, June-August.

In this preliminary study it has been assumed that a reasonable lookout for whales, consistent with bridge duties, etc., has been kept on all the vessels for which tracks have been plotted. Most of the whale reports state that such a lookout was maintained. It is recognised, of course, that there will be varying degrees of vigilance on different vessels, and some observers doubtless kept a keener watch for cetacea than others. However, it can be supposed that the average degree of vigilance would be fairly constant except perhaps in regions covered by only one or two ships. No allowance has been made for hours of darkness or poor visibility, so that the figures of the total mileage steamed in each area, shown in Fig. 1, indicate the relative rather than the actual intensity of observation in the different areas.

Whales are never evenly scattered over the oceans; they are irregularly distributed and different species have more or less extensive seasonal movements. It will be realized that there are limits to the inferences to be made from these observations, for they cover the region unequally and species can seldom be distinguished with certainty. Furthermore, the total number seen is small in the statistical sense, and this means that the pattern of the plotted observations may be due in part to chance as well as to the real distribution of the whales. But if the inferences set out below seem rather cautious at this stage it should be remembered (a) that they are entirely new, for almost no evidence on the general quantities and distribution of whales in the region has yet been published, and (b) that we can expect in time to get more and firmer results out of the same observations when newer data are added to them and when they are taken with other evidence relating to the same region, such as that from returned whale marks, old whaling logbooks, records of catches at whaling stations and improving knowledge of the seasonal rhythms in cetacean distribution.

### Total Whales

It is immediately apparent from an examination of the mileage figures that very much more intensive observation has been carried out to the north of the Equator than to the south. The North Indian Ocean, the Gulf of Aden and its approaches, and the approaches to Ceylon show the greatest mileage steamed. The northern part of the Arabian Sea and the Bay of Bengal have been the least frequented areas. In the South Indian Ocean the areas on the shipping routes from the Red Sea and Ceylon to Western Australia, and from South Africa to Western Australia, have been covered the most and there is very little coverage elsewhere.

The number of sightings of all the large whales made by the vessels for which the mileages steamed have been calculated are shown in Fig. 2. The number of whales seen at each sighting is not indicated but of the 103 sightings plotted, 78 (75 per cent) were of one or two whales only. Thus the number of sightings is roughly proportional to the number of whales seen. The approximate numbers of the different species seen were:

	Rorquals	Sperms	Humpbacks	"Large whales"	Total
Sightings .. .. .	35	33	15	20	103
Number of whales (approx.)	98	82	61	22	263

The chart shows that the sightings are concentrated on the busiest shipping routes as is to be expected. More observations are needed before we can plot for each  $10^{\circ}$  "square" the number of whales of each species per 1,000 miles steaming to give a reliable comparison between the numbers in each "square". It is possible, however, to check the areas in which all large whales appear to be concentrated or scarce if the number of sightings of all species per 1,000 miles steaming,



and the approximate numbers of whales seen, in different areas is calculated. Certain broad features of distribution are then seen to stand out fairly clearly.

Comparing first the parts of the Indian Ocean north and south of the Equator, we have 0.28 sightings/1,000 miles (0.68 whales/1,000 miles) to the north and 0.19 sightings/1,000 miles (0.50 whales/1,000 miles) to the south. From this we can only say that there is no evidence of any great difference in the overall "density" of the populations. The figures do suggest rather more in the northern part, but with the limited number of observations the difference between the two figures may be due to chance.

Next the ocean as a whole may be conveniently divided further into five areas, the boundaries of which are outlined in Fig. 1. These are:

1. The Gulf of Aden and its approaches.
2. The Arabian Sea, which is taken to include the whole area north of the equator and west of 80°E., omitting area 1.
3. The Bay of Bengal, the area north of the equator and east of 80°E.
4. The Central Indian Ocean, from the equator to 30°S. and extending from 50°E. to 100°E.
5. The zone between South Africa and Western Australia, south of 30°S.

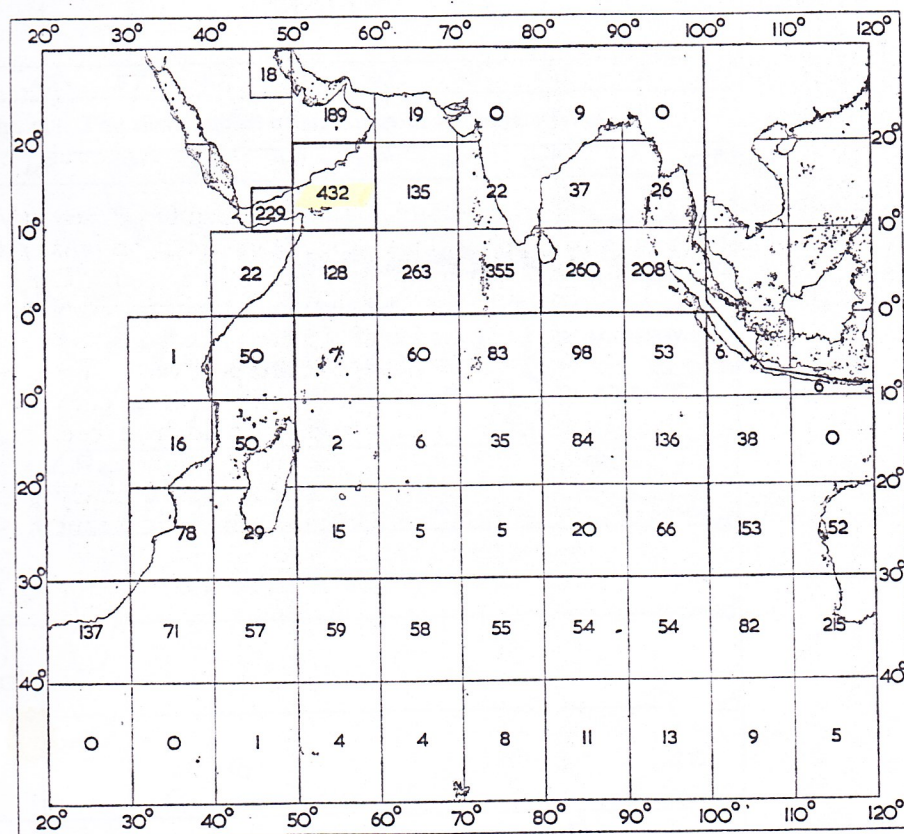


Fig. 1. Chart showing the boundaries of the Indian Ocean, the division into areas and the total mileage steamed in each 10° "square" (in hundreds of miles).

The total distances steamed, the sightings of all species, and the approximate numbers of whales seen, for the whole year in these five areas are set out in Table 1. The highest concentrations of whales occurs in the Gulf of Aden and its approaches. There are fair numbers of whales in the Arabian Sea (but not in the Persian Gulf and its approaches) and in the zone between South Africa and Western Australia. In the Central Indian Ocean, and to a less extent in the Bay of Bengal, there is a very marked scarcity of whales. There is little to be said about the areas on either



Central Indian Ocean, near to the African and Australian coasts. Here observations may be affected through the tendency of some whales, e.g. humpback whales, to keep close to the coast inside the shipping routes, and the sampling is thus less reliable than elsewhere.

Table 1. Sightings and numbers of all large whales in different areas of the Indian Ocean.

	Miles steamed	Number of sightings	Sightings /1000 miles	Number of whales	Number /1000 miles
Gulf of Aden and Approaches ..	66,100	34	0.51	76	1.15
Arabian Sea ..	115,100	24	0.21	64	0.56
Bay of Bengal ..	54,000	7	0.13	20	0.37
Central Indian Ocean	67,500	4	0.06	5	0.07
Africa-Australia ..	89,700	26	0.29	86	0.96

It is interesting to compare the overall density of the whale populations in the Indian Ocean with the density in the Antarctic. Perhaps the best evidence of the latter is given by the results of the voyages of the *Discovery II*. In the course of oceanographic work in the Southern Ocean before the war, *Discovery II* steamed many thousands of miles in the Antarctic. Details of the observations which relate to the years 1933-39 have been given by Mackintosh and Brown.<sup>4</sup> A special constant lookout for whales was kept and the figures, which relate to baleen whales only, eliminate periods of darkness and poor visibility. In the Indian Ocean sector of the Antarctic the density of the whale populations varied from about 70 whales/1,000 miles steamed in summer to about 18 whales/1,000 miles in winter. The corresponding figures for the baleen and "large" whales only, omitting sperm whales, are, for the North Indian Ocean, 0.24 and 0.28 whales/1,000 miles, and for the South Indian Ocean 0.26 and 0.49 whales/1,000 miles respectively. If we assume that half of the total distance steamed in the Indian Ocean was in darkness or poor visibility and that only one-third of the whales which would have been sighted from *Discovery II* (with the special lookout) were sighted by the reporting vessels, the density of the populations of whales in the Antarctic is approximately 47 times as great as that in the North and South Indian Oceans in the summer months and from 6 to 11 times as great in the winter months.

Since there are good reasons for believing that most of the baleen whales are absent from the Antarctic in the winter months it seems curious at first that the density of the Antarctic population in this sector in winter is greater than that of the population in the Indian Ocean, but of course the area of open water in this sector of the Antarctic Ocean in winter is only about one-ninth of that of the Indian Ocean. The whales in the latter will therefore be scattered over a very much greater area of ocean.

When the observations are split up according to species and seasons the data become further reduced and generally not sufficient for conclusions as to seasonal movements. But seasons must be taken into account if only to show, for example, that certain groups of whales were not seen only at one time of year.

### Sperm Whales

Thirty-three sightings of sperm whales were reported (Fig. 3). The approximate number of whales seen was 82. Twenty-three of the sightings were of one or two whales only, and the greatest numbers seen at one time were about 10 and 13 whales.

Twenty-three observations (60 whales) were reported in the North Indian Ocean, 12 of them (38 whales) in the Gulf of Aden and approaches. There are 10 sightings in the South Indian Ocean, only two of them in the Central Indian



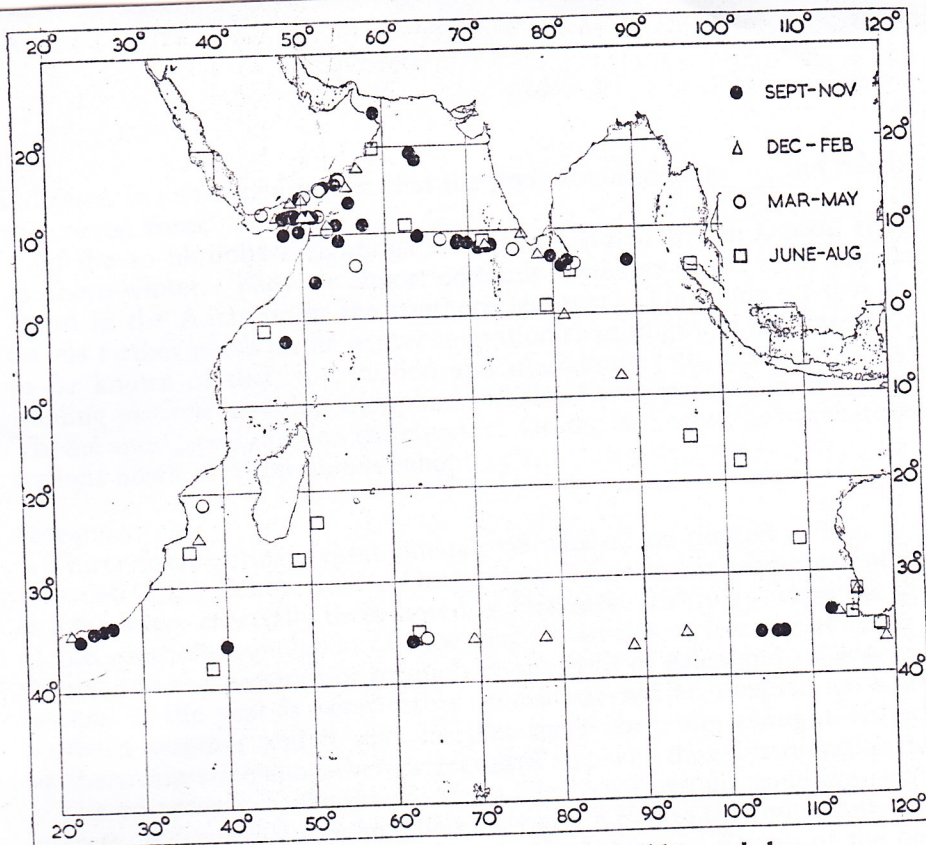


Fig. 2. The distribution of sightings of all large whales.

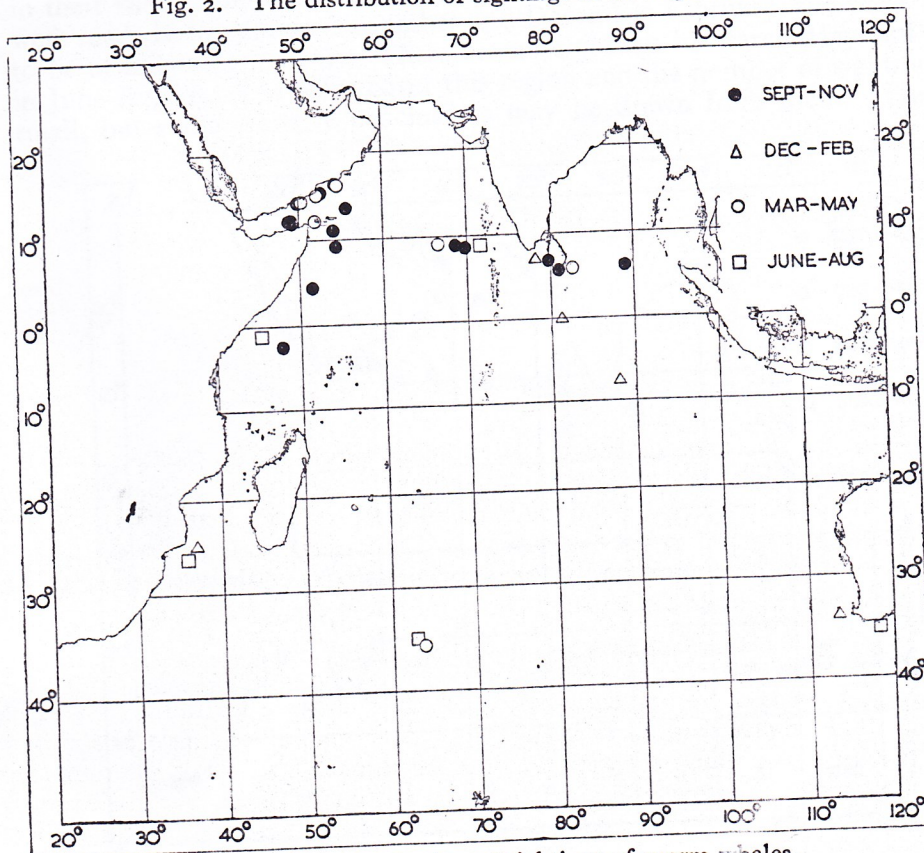


Fig. 3. The distribution of sightings of sperm whales.



Ocean area. It seems that even in the North Indian Ocean sperm whales do not outnumber the rorquals and humpbacks (31 sightings of 89 whales).

The seasonal distribution of sperm whales shown in Fig. 3, and reinforced by sightings plotted from the *M* reports, agrees very well with the distribution of this species determined by Townsend (1935)<sup>5</sup> on his charts plotted from the logbook records of nineteenth-century American whalships. The only striking difference is that he does not record any sperm whales taken on the "Coast of Arabia" ground in the period March-May, whereas Fig. 3 shows several records for this period in this area. It is possible that very few whalers visited the area at this time. In an earlier paper<sup>6</sup> he states that the whaling in the Arabian Sea (lat. 15°N.) was chiefly in December and January.

Townsend,<sup>5</sup> speaking of the distribution of sperm whales generally, states that his charts show "a seasonal oscillation of most of the sperm whales between north and south latitudes, or at least toward or away from the equator". He goes on to say: "There is much evidence that there is an extensive southward movement of sperm whales as the northern winter season comes on. A reverse movement is indicated for the winter season south of the equator." The sightings of the individual species in the four three-monthly periods, expressed as sightings per 1,000 miles steaming (Table 2), show that north of the equator in the sightings of sperm

Table 2. Numbers of sightings of individual species per 1,000 miles steaming.

	September- November	December- February	March- May	June- August
NORTH OF EQUATOR				
Sperm .. ..	0.184	0.017	0.220	0.015
Rorquals .. ..	0.098	0.117	0.073	0.060
Humpback .. ..	0.061	0.033	0.073	0.015
"Large whales" .. ..	0.074	0.033	0.073	0.015
SOUTH OF EQUATOR				
Sperm .. ..	0.020	0.073	0.025	0.067
Rorquals .. ..	0.139	0.091	—	0.034
Humpback .. ..	0.020	—	—	0.067
"Large whales" .. ..	0.060	0.055	—	0.051

whales, and to a very much smaller extent in humpback whales and "large whales", there is a preponderance of sightings in September-November and in March-May. South of the equator the sperm whale sightings are at a maximum in December-February and June-August, although the difference between the four seasons is much less marked than in the northern hemisphere. This distribution of the observations (which also applies to the actual numbers of whales seen) suggests that sperm whales are represented to the north of the equator mainly in the northern autumn and spring and to the south of it in the southern summer and winter, as if there were a double migration. More observations may show whether this is in fact the case or whether the apparent distribution is due to chance.

### Humpback Whales

Only 15 records of humpback whales, referring to some 61 animals, were made (Fig. 4). The 10 observations north of the equator were all of single whales or very small parties, seven being the greatest number recorded. Two of the four records from the coast of Western Australia refer to parties of about 12 whales in each. Large numbers of humpback whales are known to be present off the Australian coasts in the southern winter and the fact that only four sightings were reported



indicates, as mentioned earlier, that the present observations do not reliably sample the coastal areas.

Of the 10 humpback sightings seen in the North Indian Ocean, six are in the southern winter. They are almost certainly members of the same population as is found in the Antarctic in the southern summer. They suggest that this species travels farther north on its winter migration than might be expected from what is so far known of their distribution and migrations. On the west coast of Africa whaling stations catching humpback whales have operated in the past from St. Thomé and Cape Lopez on the equator. On the east coast, however, there were no stations north of Mozambique, about 15°S.

### Rorquals

Thirty-five sightings (approximately 98 whales) are plotted in Fig. 4. None are recorded in the Central Indian Ocean area. The number seen north of the equator is interesting, especially those noted in December-February when the greater part of the southern population of blue and fin whales at least must be in Antarctic waters, and the presence of rorquals in the Gulf of Aden and its approaches at all seasons of the year is noteworthy. Evidently not all rorquals go south for the southern summer and it may be that more than was thought either miss the southern migration altogether, or get out of step with the main migration movements.

The 12 records in the South Africa-Western Australia zone are also of special interest. Baleen whales sighted here may give a clue to the routes followed by them in their annual migrations to and from the Antarctic. Eleven of the observations were made in September-November and December-February, and these are likely to be of migrating animals. There are no sightings in March-May, and only one in June-August. Few ships cover this region and the number of sightings is very small, but some tentative conclusions may be drawn from them. The mileage

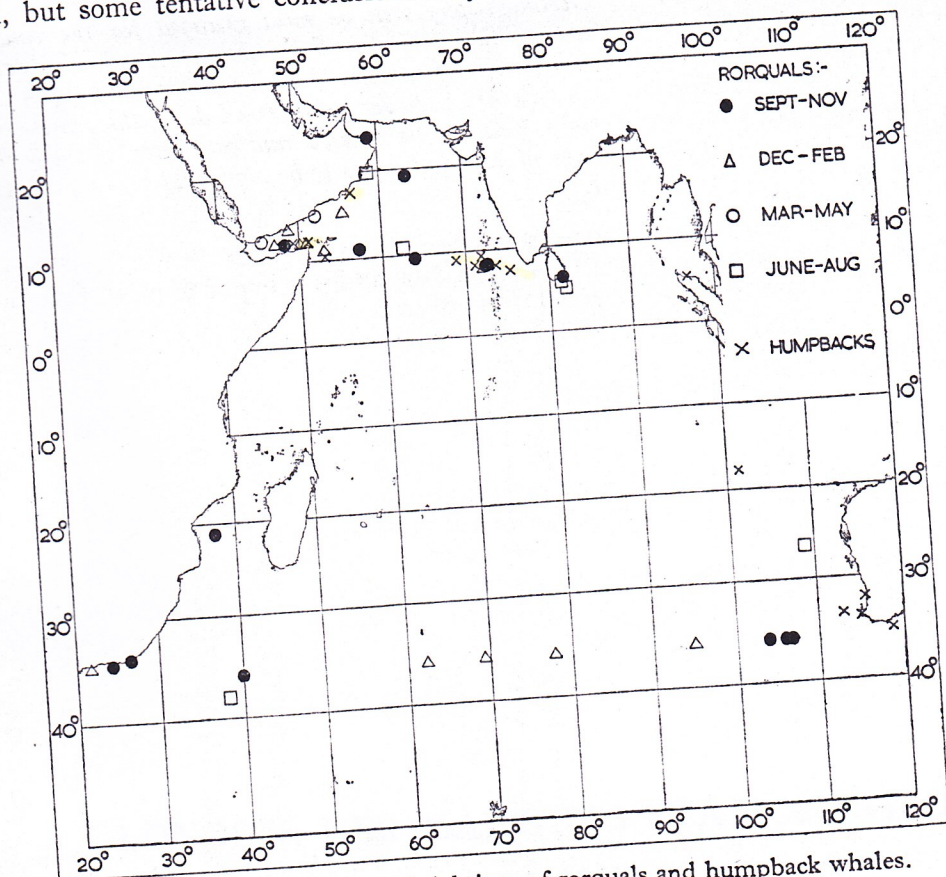


Fig. 4. The distribution of sightings of rorquals and humpback whales.



steamed in the zone in each of the three periods from September to May is approximately equal, but it is doubled in the period June-August. It seems likely, therefore, that there really are very few rorquals in this area at this time. The distance steamed in each of the 10° "squares" between 40°E. and 100°E., from 30° to 40°S., is approximately equal during the period September-February so that the distribution of the sightings suggests that in the rorquals in this sector of the Southern Ocean, migration is along a broad front rather than restricted to one or two narrow routes. It will be very interesting to see if the accumulation of further records from this zone will confirm this.

### Conclusions

The main conclusions reached may be summarised here. There is apparently no great difference in the overall density of the large whale populations per unit area north and south of the equator. The highest concentrations of whales in the Indian Ocean occur in the Gulf of Aden and its approaches, the Arabian Sea and in the zone between South Africa and Australia. The least concentration is found in the Central Indian Ocean.

In summer the concentration of baleen whales in the Antarctic is very many times greater than in the Indian Ocean but there is much less difference in winter. The number of sperm whales in the ocean as a whole seems not to outnumber that of the different species of baleen whales combined.

Humpback whales and rorquals are found unexpectedly far north, on the supposition that they all belong to the southern hemisphere populations. Rorquals have been observed right across the 30° to 40°S. zone between South Africa and Australia where ships might be expected to intercept them occasionally during their migrations.

*The National Institute of Oceanography will be most grateful for the continued co-operation of mariners who are willing to make whale observations.\* Reports are required from all oceans and of all species of whales. If full records can be given, with the vessel's noon position for each day (or every second or third day), these will be most valuable as they allow the vessel's track to be plotted and estimates of the mileages steamed by vessels and the coverage of different areas to be made. However, all records are useful and will be examined.*

The whale reports which have accumulated from the Atlantic and Pacific Oceans are now being examined, along with other data, and it is hoped to published further preliminary reports on the results in due course.

### Acknowledgments

The National Institute of Oceanography is indebted to the Director of the Meteorological Office, Sir Graham Sutton; the Marine Superintendent, Commander C. E. N. Frankcom; his staff, and the Port Meteorological Officers for their help in organising and operating the scheme, and for the extracts of whale observations from the meteorological logbooks of vessels.

We wish to thank all masters of vessels and observers who have sent in the whale reports upon which these notes are based, and to record our appreciation of the trouble they have taken to make useful observations for us. Observations have been received from a total of 92 ships.

The author is indebted to Dr. N. A. Mackintosh for helpful advice and criticism and to Mr. A. Style for his valuable assistance in the preparation of the figures.

\* Special forms for this purpose and all necessary instruction can be obtained from any Port Meteorological Officer in United Kingdom ports. Further supplies of these forms will be sent to the ship by the National Institute of Oceanography.



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