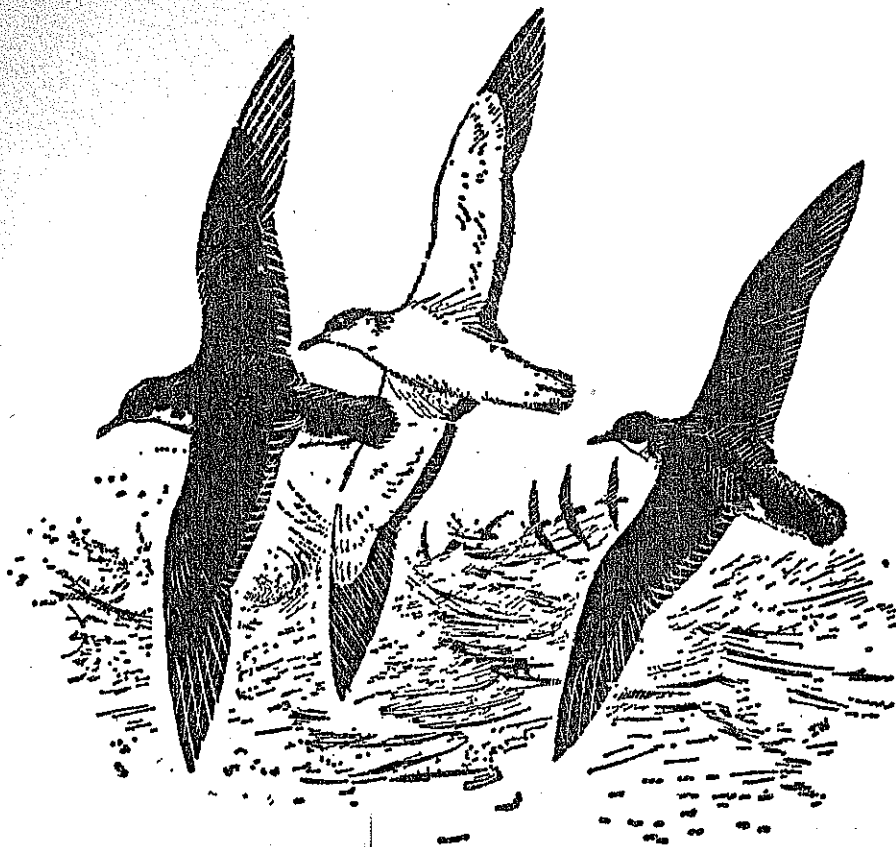


# The Seabird Group



## SEABIRD BULLETIN

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## Seabird Movements in North-west Spain

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### Introduction

1. During three of the last four autumns parties of ornithologists have visited the Estaca de Bares in Galicia to observe seabird movements and have contributed their observations to the Seabird Group. In this paper I examine these records to seek to establish to what extent the movements of seabirds normally occurs along the coast of north Spain rather than across the Bay of Biscay or at sea, and the effect of the weather on such movements.

2. The following dates have been covered:-

- a) September 4-8, 1965 (R.G.Pettitt and M.M.Pettitt).
- b) September 19-26, 1965 (G.Huyskens, P.Maes and H.vander Vloet).
- c) August 21-24, 1967 (Dr.R.G.Gibbs and the University College of North Wales Ornithological Expedition)
- d) August 29 to September 3, 1967 (R.G.Pettitt and J.Ray).
- e) September 14-15, 1967 (J.P.Van der Veghe).  
September 19-22, 1967 (G.Bulteel and H.van der Vloet).
- September 29 to October 6, 1967 (G.Huyskens and P.Maes).
- October 3-6, 1967 (D.L.Clugston, A.A.Bell and C.F.Farnell).
- f) September 8 to October 5, 1968 (G.Bulteel and G.Huyskens to September 24; R.G.Pettitt from Sept.19)

The results of the first three parties have been briefly described in Pettitt (1966), Huyskens (1966) and Gibbs (1967) but in view of the different treatment in these papers the daily totals of seabird species for the whole period of manning will be distributed as a supplement.

3. The Estaca de Bares is the most northerly part of Spain and is near the western end of the 350 mile long straight northern coast. There is no one point which can be described as the 'corner' of north-west Spain round which birds from the Bay of Biscay would pass if tracking south along the west coast of the Iberian peninsula since Corruna Bay occupies this position. The headlands which on the large scale map appear to be best placed for observation of birds passing from Biscay southwards are Cabo Ortegal, Cabo Torinana and Cabo Finistere. A visit by the Pettitts in 1965 (Pettitt 1966) appeared to indicate that Finistere was in the shadow of the land further north-east; at any rate the results of one weeks watching were far less satisfactory than that of the following week on Bares. Torinana has not been used but is most inaccessible. Ortegal is inaccessible, extremely high, has high rocky islets stretching for some distance out from it and would be useless for watching. The Estaca de Bares is an accessible point from which watching can be carried out at about 150 feet and which juts north of the mean line of the Spanish coast. It is not only ideally placed to register the passage of birds along the coast itself but is the best available site for watching passage from the waters of north-west Europe to the south. Figure 1 shows its position in relation to the theoretical minimum distance routes for birds taking a maritime track from the main sea areas to the south. It lies about 45 miles east of the direct route English Channel to the south, and about 60 miles east of the route Lands End or Pembrokeshire to the south. Unless the navigation of the birds was accurate,

a substantial proportion of those on a direct passage from the Channel and the Irish Sea could reasonably be expected to be observable from the Estaca as a result of random navigational error. The point is a little less than 200 miles from the great circle route from the Irish Sea to the east Brazilian coast and birds taking such a route would less likely be seen.

#### Pattern of movements across the Bay.

4. There are no known breeding areas of substantial numbers of sea birds, other than gulls, within 300 miles of the Estaca de Bares (though some promising islets on the north coast are, so far as we are aware, unexplored for shearwaters). Seabirds pass westward off the head in the months August and October and it is reasonable to assume that the bulk of the movement observed constitutes genuine movement from the areas north of Spain to areas south of Galicia, and of course in some species to the southern hemisphere. The possibility of local circular movements of unattached birds, either on a regular basis like the circulation of feeding parties of shearwaters off the west coast of North America, or because of drifting into the Bay by westerly winds from feeding areas further west, cannot be ruled out, since the topography, like that of Cape Clear, lends itself to recording the movement of birds west rather than east. We are inclined to discount it as a significant feature for most species, since the movements observed coincide with the known dates of departure of birds for their northern breeding areas to the south. Moreover, as the figures for rate of passage in Table 1 show, the number of birds passing, with the exception of the Sooty Shearwater, is never so great as to lead to the suspicion that individuals generally pass the Estaca more than once in the Autumn. Watches at this site in June and July, and at both Finistere and the Estaca in the spring would, however, help to give greater confidence in this judgement. For the purpose of the following analysis it is assumed that the species observed were on passage from northern to southern seas.

5. In order to establish the extent to which different species appeared to take a required track within the Bay and those of which the required track lies across the Bay or by a wholly pelagic route the watching in 1968 was taken and divided between those days on which a passage was liable to be affected by side winds from the Atlantic and those for which it was not. The assumption was made that birds passing the Estaca had made a two day oversea or along the coast, as the case might be, from the British Isles and the adjacent waters and could have been affected by wind drift on either day. Those days in which the wind is recorded in the Daily Weather Report of the British Meteorological Office as reaching a force of more than 13 knots from a direction between south west and north in the sea area bordered by  $5^{\circ}\text{W}$  and  $10^{\circ}\text{W}$  and  $45^{\circ}\text{N}$  and  $50^{\circ}\text{N}$  in either the day in question or the previous day were taken as 'drift' days. There were thirteen such days in 1968, September 14, 15, 16, 17, 20, 21, 22, 23, 24, 27, 28, 29, 30, and fifteen days on which such conditions did not prevail (the remaining days between September 8th and October 5th). A comparison between the passage on the 'drift' days and the 'ordinary' days is set out in Table 2. Manx Shearwaters (*Puffinus puffinus*) were far more numerous on drift than on ordinary days, the mean hourly rate being 5.9 times as great. Similarly, skuas were more numerous on the drift days, the identified Pomarine Skuas (*Stercorarius pomarinus*) being over 22 times as common on drift days, identified Arctic Skuas (*S. parasiticus*) 2.75 times as common, and probably a more valid figure, the total sum of unidentified small skuas and identified Arctic Skuas being 2.57 times as common as on drift days. Bonxies

(*Catharacta skua*) were less concentrated on the drift days (1.83 times. Common or Arctic Terns (*Sterna hirundo* and *macrura*) were 1.66 times as common, but if the unidentified terns were added, most of which were probably 'Commic' as these species more often fly at this range from land than the Sandwich Tern (*Sterna sanvicensis*), the proportion is 2.9 times. Sooty Shearwaters, (*P. griseus*) were nearly twice as common on drift days; identified Balearic Shearwaters (*P. p. mauretanicus*) only 1.54 times, and Cory's (*Procellaria dionedia*) about the same in either conditions. The figure for Gannets (*Sula bassana*) is the same on the drift as on the ordinary days, but juvenile Gannets show a greater tendency to be seen on drift days (1.78 times) whereas those of intermediate years and the adults were more numerous on the 15 ordinary days. The following species were more common on the ordinary days, the first mentioned being the relatively more inclined to move on non-drift days: Black Tern (*Chlidonias niger*) (0.43), Little Tern (*S. albifrons*) (0.47); Sandwich Tern (0.535), Common Scoter (*Melanitta nigra*) (0.67), and the auks (*Alcidae*) (0.76). We have not made similar calculations in respect of 1965 since the two small periods of manning were in separated periods of September, and the drift days fell mainly in one of these periods. The figures for 1967 were also analysed in this way and they are shown in Table 3. They are, however, less valid since, unlike 1968; the drift and ordinary days are not distributed evenly throughout the period of manning. Nine of the ten days of August and early September were days of unbelievably calm weather, whereas seven of the twelve days of late September and early October when movement of some species is at its height were drift days. The drift days were September 3, 19, 20, 22, and October 2, 3, 4, and 5. October 5th was a day of phenomenal movement which distorts the values. Nevertheless the 1967 figures confirm that Manx Shearwaters, Common/Arctic Terns and skuas are more common on drift days, and Common Scoter are not. Sandwich Terns show a higher value for drift days than the others and Sooty Shearwaters have a heavy bias towards the drift days. Juvenile Gannets show a greater tendency to occur in drift days than do those of intermediate years.

6. The pattern which emerges from the above analysis is that some species are not much affected by north-westerly winds in the sea areas to the north. It is reasonable to suppose that these birds normally take a coastal course. This is probably the case with Common Scoters, Sandwich Terns, possibly Little Terns. The first two species occur in large numbers, the Sandwich Terns being almost as numerous as the Common or Arctic Terns in spite of the much larger number of the latter birds breeding in Europe. The tendency of these species to move on days where drift from the west would not occur is no doubt explicable by their preference to move on days of better local weather. Gannets of intermediate years and adults (probably not breeding adults at all, since September is rather soon for them to be moving out of Biscay) probably appear less subject to drift because they originate in the Bay of Biscay, either staying there over the summer or routing by it on their way south. Juvenile Gannets probably cross the Bay direct and are thus concentrated by north-westerlies. The species which are more common on drift days but not more than twice as common - Cory's Shearwater and the identified examples of the Balearic Shearwater - are birds which are more commonly occurring on the Spanish coast than north of Biscay. The Sooty Shearwater falls in this middle category on the basis of the 1968 records, though on the basis of those for 1967 it appears to be much dependant on north-westerly conditions. In so far as the 1968 records are more thorough, this analysis supports to some extent the suggestion by Huyskens (1966) that the required track of the Sooty Shearwater is in the Bay of Bis-

cay by a circuitous easterly route, but, as is suggested below, special considerations may apply to this species. The species whose occurrence is heavily dependant on westerly drift, we suggest, take a pelagic course, probably well west of the outlying parts of Spain. This is probably the case for the Manx Shearwater, the smaller skuas, and, to a lesser extent, the Common/arctic Terns.

7. Purely local onshore winds do not provide an explanation of variation of numbers of any species. Several big movements occurred with negligible wind, and we are not of the opinion, as is sometimes suggested, that an effect of the wind in bringing a coasting line of seabirds nearer to the shore and so within binocular range is a significant factor in determining the numbers of birds seen. The Belgian party used massive military binoculars of x20 and x40 magnification and were able to watch at distances possible normally only with a telescope in good light. The commoner species did not normally pass at extreme range but at a favoured distance out which was usually manageably close. The only birds which if seen at all were at extreme range were Great Shearwaters (*Procellaria gravis*) and Sabine's Gulls (*Xema sabini*), and perhaps for those pelagic birds local wind may be the significant factor in determining whether they were recorded. The suspicion especially arises that there may be a coasting movement at beyond binocular range on fine days when movement appears to stop. To test this, on October 5th 1968, a fine day on which a small movement of Sooty Shearwaters and Gannets was taking place in the first hour of watching, R.G.P. took a ten hour yacht trip between Bares and Corruna, taking a track between  $1\frac{1}{2}$  and 8 miles off the coast. On this journey several individual Sooty Shearwaters were seen at about  $1\frac{1}{2}$  to 2 miles out, but never when the boat was further out than this. Sooties moved only close to the shore. 4 Common Terns all seemed to come in from the north as did the one Bonxie and one Arctic Skua. Nine Sandwich Terns followed the coast. The 18 Gannets were partly following the coast and partly coming in from the north or the north-west. No other seabirds were seen. The conclusion to be drawn was that after four or five days of good weather the sea area generally was as empty of birds (other than the littoral zone migrants) as the watches from the shore suggested.

#### Other weather effects.

8. It has been suggested by P.S.Redman (in Pettitt 1965) that Manx Shearwaters and possibly other seabirds were subject to disorientated drift in overcast conditions, and it was under these conditions that these birds occurred in bays rather than on their shortest, more pelagic, route. To establish whether the occurrence of some species at the Estaca was greater after overcast conditions or rain, the average rate of passage for the days when there was local rain was compared with the average rate for the other days, using 1968 data. Because eight of the nine wet days were also days in which the winds had been westerly in the sea area to the north, the days used were eight wet or overcast days of the drift type, (as explained in para.5) and the fair, dry days with broken cloud of the same type. In the case of the Manx Shearwater, on the 'wet' days the average number per hour was 72.8, whereas on the dry days it was only 28.3. The Sooty Shearwater also seemed to occur more on the wet days (43 per hour instead of 27), but there is little difference in the small skuas (7.48 compared with 5.35) while Common Terns (+ identified terns) are fewer (70%) on the wet days than on the dry. Comparing all the 'wet' days with all the dry for four species which are not heavily dependant on west winds, the wet

days have a higher rate with the Sooty (173%) and the Cory (133%) but a lower rate for Common Scoter (44%) and Sandwich Terns (49%). For what the figure is worth, the identified Balearic Shearwaters were 68% as common on the wet drift as on the dry drift days. This analysis supports the validity of Redman's contention and leads us to the conclusion that Manx Shearwaters (at any rate of those of the nominate race) and possibly Sooty Shearwaters are more subject to drift in overcast conditions or rain than when the sky is clear, but that this feature is not detectable in species of other families.

9. It has been suggested by J.H. Phillips and the late S.L. B. Lee (1966), that Manx and Sooty Shearwaters set off on a migration which involves a sea crossing after the passage of a front. To examine the applicability of this suggestion to the movements observed from Bares, the days of 1968 were classified as either 'bad' days - that is wet and overcast, a front passing through, - or first, second and third etc 'good' days - the clear days which follow. The rate of passage on five 'first good days' (September 10, 16, 19, 25, 28 and 29), four 'second good days' (September 11, 17, 20, 26, 30), and three 'third good days' (September 12, 18 and October 1st) is set out in Table 4 together with the average rate over the whole of the manning for comparison. It will be seen that some species show a high value for the first day, higher than the average, and a descending order of values, the third day often being below the average. These species are the Sooty Shearwaters, the Balearic race of the Manx, the Common Scoter, and the Sandwich Tern. The skuas also show a fall from the first to the second day but this is a false value resulting from a single heavy day. The Scoter figure would have been more striking had I reclassified 30 September as a first good day. The front passed early on the 29th but whereas the Sooty Shearwaters started to move that day, Scoters moved only on the next. These species have in common, as is shown in para. 6 above, the habit of following the coast and it is suggested that these movements originate in the Bay, possibly, in the case of the Shearwaters, in feeding areas in the Gulf of Gascony and along the north coast, and the setting off is stimulated by the arrival of good weather and is completed before the good weather is past. This migration release may therefore be more general in seabirds than is suggested by Phillips and Lee, and may not be confined to the shearwaters nor necessarily be connected, as they suggest, with the reluctance of shearwaters to make sea crossings in overcast conditions. A. Gibbs (1968) has pointed out a similar connection between the passage of fronts through the southern North sea and the occurrence of Scoter passing south-west past Cap Gris Nez. Those species which do not manifest this pattern - Manx Shearwater, Common Tern - are birds which we have concluded take a more pelagic course and if stimulated by such conditions into movement are affected by a different set of weather conditions.

10. It would be attractive to continue the analysis to test the correlation between the occurrence of Manx Shearwaters off the Estaca with improving conditions in western Ireland and Pembrokeshire or Cornwall, but it is obvious from the irregularity of this species, not merely between one day and the next, but between one year and another, that weather conditions control, to a large extent, whether this species passes close to Spain or not. For this reason, until a much greater amount of material is collected, preferably using the records of other stations, and particularly the weather ships, we consider it premature to attempt such an analysis.

11. In the case of one species, the Common Scoter, a corr-

elation between local wind strength and rate of passage was suspected from observation, and rate of passage in 1968 is plotted against wind strength in Fig. 2. It will be seen that the stronger the wind, the less the passage. Similar connexion between wind strength and passage was expected with the Sandwich Tern, which seemed to move on the same days as the Scoter, but no such correlation emerged, Nor does it with Common Terns.

12. It has been suggested (Parrack 1967) that the regular rolling seas behind a cold front provide good flying conditions for shearwaters and stimulate activity. Notes on sea conditions were not kept by all expeditions, and had they been it would have been difficult to deal with them objectively, but it is worth recording that on the two days where heavy swell was recorded in 1968 (recording of state of sea was made from 20 Sept), September 28th and 29th, there was a substantial movement of Manx Shearwaters (mainly nominate birds), Sooty, and, in the case of 28th, Cory Shearwaters, and of Gannets, but not of birds which do not use the surface of the water for lift. It is also possible that one of the reasons behind the lack of shearwaters on days on which there were no big westerlies (para 5 above) was that the birds did not set off in dead calm conditions when the sea was flat, rather than that they were passing on a broad front well west of the Bay of Biscay. However for the reasons mentioned above it will not be possible to test this suggestion until a parallel series of data from the sea (such as those from Ocean Weathership Kilo) is available for analysis.

#### Notes on Individual Species.

##### Manx Shearwater.

13. Both the nominate and Balearic races of this species occur. All the major movements, other than one on October 5th 1967, appeared to consist mainly of the nominate race.

14. The species was observed throughout the manned periods but its irregularity obscures any trends. The numbers moving in the three days of September 1965, nearly 5,000 in twelve hours, brought the average rate of passage of 1965 to 113.6 an hour, over three times that of the other two years. It is unfortunate that the equivalent period (4-6 September) in the other two years was not covered and it therefore remains a theoretical possibility that a massive movement always occurs during this period as a result of the departure then of the bulk of the British breeding population. This however is unlikely in view of the more gradual reduction in numbers in northern waters, evidenced by the records of the Cape Clear Bird Observatory since 1959 (Cape Clear Bird Observatory Reports), and other seawatch stations in the British Isles. It seems fairly certain that only a small proportion of the movement of our population from the breeding and summering areas to the southern hemisphere is observed from the Estaca and only in special weather conditions. The rate of passage of 1967 and 1968, less than 30 an hour if the identified Balearics are excluded, over daylight hours would account in two months for not more than about 20,000 birds which is only a fraction of the population of Skokholm alone -- estimated at 35,000 pairs in 1964 (Harris 1966).

15. As is suggested in paragraph 5 above, the movement of the Manx Shearwater is heavily dependant on the westerly or north westerly winds in the sea area between the British Isles and Spain, and is accentuated by overcast conditions. The individual movements which account for the greater part of the passage were as follows:-

1. September 4-6 1965, 4,485 birds, mainly nominate, passed in twelve hours of watching in a north westerly air stream behind a deep depression (described in Summers 1967).
2. September 25-26, 1965, 930 in twelve hours watching in a light north west air stream behind a complex depression;
3. September 19-22, 1967, 2,815 in 31 hours watching in a westerly air stream south of a depression (a good proportion of these were mauretanicus);
4. October 5 1967, 1,205 in eleven hours, half being Balearic in a north westerly airstream behind a deep depression, the movement starting with a ceasing of the gales;
5. September 11, 1968, 439 in nine hours, mainly nominate birds, in a westerly airstream south of a depression;
6. September 15-16, 1968, 994 in fifteen hours (mainly nominate birds) in strong NNW winds behind a depression in the Bay;
7. September 22-24, 1968, 1189 in 12 $\frac{3}{4}$  hours in moderately strong NW winds behind a depression in the North Sea.

16. In anticyclonic weather, very few birds of the nominate race were seen at all, either at Bares or at Finistere. This was notably the case during the manned period of August and early September 1967 and during the week spent at Finistere in August by the Pettitts in 1965 (Pettitt 1966). The reason for this lack of birds can hardly be because they crossed direct to the west coast of Spain, by-passing Bares, since the experience at Finistere was the same as at Bares in this type of weather. The explanation must, we consider, be that Manx Shearwaters in calm conditions take a pelagic course immediately on leaving the British Isles. This may be because they take the direct route to the South American coast rather than the coastal one suggested by Perrins (1967), or because they correct for the prevailing westerlies, whether or not they are present.

17. Balearic Shearwaters are one of the few birds which give indications of an easterly movement. A large proportion of the movement was very close inshore, in both directions, and may well have been feeding movements. Three movements are worthy of particular comment:

1. September 20-22, 1967, (see para. 15 above);
2. October 5th, 1967, when 557 moved in eleven hours.
3. September 25th, 1968, when 147 passed west in 8 $\frac{1}{2}$  hours.

All these movements took place at the same time as those of the Sooty Shearwater, a species with which this sub-species shares two characteristics mentioned earlier, the relatively small dependence on north westerly winds and the tendency to move on good days after the passage of fronts. Like it, the race obviously regularly comes to feed in the Bay. The larger movements late in September and October may well represent an evacuation of the Biscay seas by this sub-species for its winter quarters which are still unknown.

#### Sooty Shearwater.

18. The remarkable feature of the movement of the Sooty Shearwaters observed from the Estaca was the sheer numbers involved. The rate of passage in 1967 was 41.7 per hour. If, as seemed likely, this average were maintained over two months in the daylight hours alone, 30,000 birds would have passed. This number is of the same order as that suggested by Phillips (1963) as the number summering in the North Atlantic. The averages for 1965 (13.4 per hour) and 1968 (25.8) are likely to have been lower than that for 1967 because in 1965 the period in which the largest numbers moved, late September and early October, was not



covered, while in 1968 manning may have stopped before the major movements occurred.

19. The major movements are depicted graphically in Fig. 3 These were:

1. September 22-23, 1965, 878 in  $16\frac{1}{2}$  hours in calm weather;
2. September 26th, 1965, 180 in 7 hours after a passage of fronts on 24th and 25th;
3. September 19-21, 1967, 1665 in  $31\frac{1}{2}$  hours in the westerly and northerly winds of two pressure systems which passed in the nights 18/19 and 20/21;
4. October 1st, 1967, a movement of 2,106 in 11 hours in fairly neutral conditions;
5. October 5th, 1967, 2877 in 11 hours following the passage of a depression through British waters;
6. September 11-12, 1968, a movement of 836 with Manx Shearwaters;
7. September 15-16, 1968, a movement of 719 in 14 hours, again with Manx Shearwaters;
8. September 22 and 25, 1968, the first one of 340 birds, one of the very rare extreme movements, the second an obvious movement of 872 in  $8\frac{1}{2}$  hours along the coast on the first good day after a spell of wet and stormy weather;
9. September 27-28, 1968, a movement of 901 in 14 hours.

20. There are three possible explanations of the size of the passage. First, the number of birds which come to the North Atlantic may be bigger than suspected by Phillips. Secondly, a very large proportion of the birds which come to the North Atlantic may track through the Bay of Biscay. Thirdly, the birds may be recorded more than once during the same autumn. We have explained (paragraph 4 above) that we do not consider that for Sooty Shearwaters or any other species a purely local circular movement was occurring, but in view of the scale of the Sooty Shearwater movement we do not feel that a circular movement on a grand scale can be ruled out. Examination of the weather maps for the period of the two major movements in 1967 and one in 1968 reveals an interesting situation. The movement on 19th September occurred in neutral weather following the passage of a front. At this time a second depression with an associated warm front was giving southerly winds two hundred miles west of Bares, and westerly gales off the Irish coast. At the time of the movement on October 1st 1967 there were strong south westerly winds and rain to the west of Spain on 25th September with overcast and light south west winds. It is at least possible that some of the birds leaving in the three big movements on these dates entered these systems and were deflected at first northwards and later eastwards by the westerly winds or gales which followed, being driven on to the continental or British coasts again, and passed through the Bay on the abatement of the north westerlies on September 21st 1967, October 5th 1967 and September 28th, 1968 respectively. Conditions which could have caused such a deflection of passage did not exist after the big movement of 28th September 1968, the winds tending to deflect birds south east on to the west coast of Spain, and it may be significant that there was no further major movement of Sooty Shearwaters during the rest of the manned period of 1968. This suggestion presupposes that the circulation in the Bay was inadvertent but it is a further possibility that the Sooty Shearwater regularly circulates the Bay of Biscay and the adjacent seas in this way during the autumn using the regular alternation of south westerly and north westerly winds which are a feature of sea areas through which successions of depressions pass. In view of the fact that the whole of the Sooty Shearwater movement is a circ-

ular one of the oceans using the prevailing winds it is by no means inconceivable that there may be a regular circulation in more limited sea areas using regular weather systems. It may even be the case that such a local circulation may have resulted from the use of fronts to provide favourable feeding conditions suggested by Parrack (1967). By this hypothesis the shearwaters would have left the Bay with the passage through of the fronts and the passing of the immediately post-frontal conditions, in which upwelling produced favourable conditions, and headed west out of the calm waters. They then entered the next frontal zone and remained behind it until they were led to the coasts, and began this circulation again. Insufficient evidence is at present available to us to comment on the validity of these suggestions but it is recommended that work in future years should be devoted to testing them by collecting a series of simultaneous observations in September and October from Finistere, Bares and the coasts of Ireland and France and comparing these with observations from the Weathership Kilo and any sea crossings (such as the Southampton - Bilbao and the Boulogne - Vigo runs) to establish first the reality and then the reason for such conditions. At present these suggestions can do little but challenge the straight forward interpretation of the data, which is that at least 30,000 Sooty Shearwaters pass along the north coast of Spain annually.

#### Great Shearwater.

21. This species was only seen on four days of 1967 (Sept. 14th, October 4th to 6th) and one day of 1968. In all cases the birds were seen at extreme range. It is likely at least in the case of the birds of October 1967 that they were driven into the Bay by the severe north westerly winds which concentrated sea-birds of all sorts in the area on October 5th.

22. It is well known from the paucity of records from the shore in the British Isles that observation from the land is an ineffective way of establishing the occurrence and movements of this pelagic species, and watching from Spain is clearly no different. In early October 1967, this bird was numerous in the Bay of Biscay. D.L. Clugston crossed the Bay on October 1st in the M.V. Patricia on the journey Southampton to Bilbao and saw several thousand Great Shearwaters, and well over a thousand on the return journey on October 17th. On the other hand the relatively large numbers seen from the shore in 1967 compared with 1968 may well be a true indication of the scarcity of Great Shearwaters in the more easterly weather of October 1968. R.G.P. crossed the Bay in the M.V. Patricia from Bilbao on October 8th 1968 and saw only two Great Shearwaters in spite of watching the greater part of the day.

#### Cory's Shearwater.

23. This species occurred both close in, in what seemed to be leisurely feeding flights, and in some extreme range movements. The sightings of this species are likely to be controlled to such a large extent by local weather conditions and the size of optics used that we would prefer not to attempt an analysis from the records of this station in isolation. Certainly no pattern is obvious, nor do the movements of the bird coincide with those of either Manx or Sooty Shearwaters. The population of this species which summer in the Bay of Biscay might in theory have been observed leaving for the wintering quarters off South Africa, but there was no indication of such a movement in the period of manning.

### Gannet.

24. Gannets showed more regularity than any other species. The numbers built up over September and early October (Fig.3) and there were in these months no days when the daily average fell markedly short of the average for the period in question or, except for one day in 1967, any which greatly exceeded it. Long periods during the day when no birds were seen occurred in very fine days but on these days large movements in the early morning usually made up the daily numbers to average. The bulk of the birds in early September were birds of the year, but the numbers of birds of the intermediate years (referred to in the tables as sub-adult) increased over the period of watching and at the end of September were about equal. Adult birds, or birds which had some insignificant signs of immaturity that they could only be distinguished at very close range appeared a little later. The rate of passage of birds in these categories for each day of observation in 1968 is set out in Table 5.

25. As is mentioned in paragraph 5 above the apparent regularity obscures the effect of north westerly winds on juvenile birds. These birds occurred in substantially greater numbers on days on which north westerly conditions had been prevailing in the sea areas north of Spain, whereas the sub-adult and 'adult' birds, possibly because they preferred dry or calm conditions for moving, were seen more on the other days. Juvenile Gannets tended to move further out than sub-adult birds and were less numerous in the early morning, increasing relatively to the other ages as the day went on. The sub-adult birds on the other hand showed a considerable tendency to move soon after dawn and then to show a drop at about 9 am local time, a characteristic of many seabird day migrants which follow the coast. Indeed the Gannet, in spite of the more general spread of juveniles over the day, was one of the few species which exhibited a strong diurnal rhythm. This rhythm is depicted in Figure 5.

26. It is suggested that the juvenile birds usually tracked fairly directly from their natal areas across the Bay. The rate of passage, in 1968 assuming a two month migration over the daylight hours alone, would give a total of 29,400 birds passing, a substantial proportion of the offspring of the breeding pairs of this side of the Atlantic (82,000 pairs in 1949). It is suggested, therefore, that the course is generally further east than that of the shearwaters and the skuas. The sub-adult birds probably originate immediately in the Bay. Most of the adults probably do the same. An exception to this must be suggested for the massive movement of Gannets which occurred, with other species, on October 5th 1967. On this day a total of 3,279 Gannets passed in 11 hours, of which a much larger proportion of adults (954) than usual were observed. These and the smaller number of sub-adults which moved with them did not show the usual diurnal pattern but were fairly evenly distributed over the day, like the juveniles and other species which made a long overseas crossing. We suggest that this movement represented a changing of sea areas by breeding adults of the British Isles and possibly even of Iceland, made visible by north westerly winds which stretched as far as Greenland, a movement which is observed from the Irish stations Tory and Mullet at this time of the year in westerly conditions. Unlike that of the sub-adults and the adults (probably non-breeding ones) seen earlier, it probably is normally by a more open sea route.

### Common Scoter.

27. Common Scoter moved throughout the manned periods, especially on calm days, and their movements seemed precipitated

by the passing of fronts (paragraph 9 above). All passage was fairly close to the shore and in view of the lack of dependence on north west wind systems it is suggested that the bulk of the birds which pass from northern Europe to the wintering area in west Spain and Morocco follow the coast and are observed from the Estaca. This suggestion is borne out by the fact that the number of birds passing per hour shows a considerable similarity in the case of the two years 1967 (84) and 1968 (96.1) when a long manning was achieved.

28. Detailed figures of passage at Cap Gris Nez for the years 1965-67 are now available (Gibbs, 1968) for comparison. This station is thought to observe the greater part of the movement of this species through the English Channel as a result of the tendency of the Scoter to move west along the southern shore. In 1967 an average of 45 per hour passed Cap Gris Nez in ten hours of watching in late August, and 121 an hour in 79 hours of watching in September 1967. The equivalent figures for September 1966 was 136. Unless there are other streams which join beyond Cap Gris Nez, such as the Icelandic population (which one might expect to winter in Ireland rather than further south) or birds which pass from Europe west of the British Isles (again unlikely in view of the paucity of Scoter records at Irish sea watching stations) these figures suggest that the bulk of the birds which pass through the English Channel are destined for wintering areas south of Galicia.

29. Because the manning dates do not coincide well for 1965 and 1967, no comparison has been made between the individual movements at Cap Gris Nez and Bares, but this would be a worthwhile exercise for 1968, and for later years if simultaneous manning can be achieved.

30. At Bares the movement of Scoters seemed to be highest in the morning and evening, though because movements stopped quite suddenly and were followed by days of little activity this pattern was rarely exhibited in any single day. Indeed a very common pattern was for a movement to take place on one evening and the following morning. The birds flew low over the water on most days. The one exception was October 4th when a bank of fog and low cloud lay over the coast beneath clear skies. Scoters were passing much of the morning at a considerable height just above the level of the cloud tops, sometimes descending to the sea where the clouds were absent. They nevertheless followed the line of the coast with some accuracy, and there was no suggestion that they came in from across the Bay. When the clouds disappeared the behaviour of the Scoters returned to normal. We do not consider, however, that many Scoters were unseen through flying over the top of clouds. In conditions of heavy clouding, which presumably extended to some height, the birds seemed to fly low over the sea as on the fine days.

31. During 1967 it was noted that the proportion of black birds declined steadily. On September 8th, 75% were adult males. By the 19th the proportion was about 50%; on the 27th it was 26% and on the 28th, 12%.

32. Only one Velvet Scoter (*M. fusca*) was seen with the Common Scoters. The movement of this species no doubt occurs later in the autumn, as in the case of Cap Gris Nez.

#### Arctic, Pomarine, and Long-tailed Skuas.

33. Some care is necessary in comparing the numbers of skuas on days on which the Belgians were present and other days, because the smaller skua often moved at such a distance out that they were beyond the range of normal optics. Even with this

limitation, however, it is obvious that the passage of these birds is very dependant on the weather, and the major movements were all in conditions in which north-westerly winds had deflected them, possibly from very far afield. The major movements were as follows:

1. September 19th, 1967, 105 unidentified skuas in 1 hour;
2. September 21st, 1967, 335 unidentified, 9 Arctic and 4 Pomarines in  $10\frac{1}{2}$  hours;
3. September 30th, 1967, 408 unidentified, 13 Pomarine, 6 Arctic and 2 Long-tailed in 11 hours;
4. October 4th and 5th, 1967, 1196 in 21 hours, including 71 Arctic and 135 Pomarines;
5. September 15th and 17th, 1968, 192 Arctic, 10 Pomarine and 156 unidentified birds in  $23\frac{1}{2}$  hours.

The unidentified skuas were considered to be mainly Arctic rather than Pomarine. The weather situation in the day before the largest movement is shown in figure 76. It is suggested that on this occasion birds were deflected from as far away as the Icelandic seas by the strong winds behind the low pressure systems.

34. The larger number of small skuas occurred in the last hours of daylight. In days of lesser movement the birds often only seen in these two hours unless small numbers were seen associating with tern flocks. In the evening small parties were on occasions seen flying fairly high in some semblance of formation, a feature noted by R.G.P. at Tory Island. On the days of heavy movement birds were moving most of the day but again there was a build up in the last hours. For example, on 5th October 1967, 76 passed between 1500 and 1600 GMT., 118 between 16 and 1700 and 258 between 17 and 1800. As the Hilbre party left the site and looked back over the sea, skuas could be seen passing in an almost constant stream with parties of up to a dozen birds. It is suggested that the major part of the passage of small skuas takes place at night, and possibly in this area, overland. This was borne out by the discovery during the stay of the Hilbre party of an injured Arctic Skua below the lighthouse one morning and another flying over the fields nearby.

35. Long-tailed Skuas (*S. longicaudus*) were recognised only once, on 30th September 1967.

#### Bonxie.

36. Unlike the smaller skuas, Bonxies were not heavily dependant on westerly conditions, which contrasts with experience at Tory Island and Cape Clear (Observatory Reports). It is suggested that this is because Bonxies, whose winter range does not extend so far south of Spain, do not pass on orientated journeys near the Bay of Biscay in any numbers. Those birds seen are probably mainly birds which winter in this part of the sea and their occurrence at Bares is therefore largely random.

#### Lesser Black-backed Gull.

37. The numbers of this species passing were rarely noted partly because it was difficult in times of heavy passage to spend time to distinguish the passing of immature Lesser Black-backed Gulls amongst the host of immature Herring Gulls associated with the local fishing industry. However, adults of both the nominate and British races passed west on most days. It was noticed that on days of very bad visibility the numbers were greater. In complete cover and drizzle on September 24th, 179 passed in one hour along the cliff edges. On clear days very few passed.

Sabine's Gull. (*Xema sabini*).

38. Sabine's Gulls were seen on three days of 1967 and one of 1968. As it is known that these birds are regular in the sea areas north west of Spain it is clear that observations from the land are of little value in interpreting movements of the species.

Conclusions.

39. We conclude

1. Sandwich Terns, Gannets of the intermediate years, Sooty Shearwaters and Common Scoters, regularly take an inshore course through the Bay of Biscay;
2. Manx Shearwaters of the nominate race, Common or Arctic Terns, Roseate Terns, Arctic and Pomarine Skuas, Juvenile Gannets and Lesser Black-backed Gulls take a more pelagic course;
3. The birds taking a pelagic course are brought into the area by simple drift on north west or west winds;
4. Manx Shearwaters of the nominate race are drifted more in overcast conditions than in clear;
5. Manx Shearwaters leaving the British Isles neither regularly enter the Bay of Biscay, nor take a course following the European coast but adopt a pelagic course from the start;
6. A circular movement round the Bay of Biscay using the passage of depressions may well be used in the case of the Sooty Shearwater;
7. Migration release by the advent of clear or calm weather is shown in the case of Sooty Shearwaters, the Balearic race of the Manx, Common Scoter and Sandwich Terns.

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TABLE 1

Average rate of passage west per hour of the commoner  
species 1965, 1967 and 1968

	(1) 1965	(2) 1967	(3) 1968
Manx Shearwater.	113.65	37.6	31.6
Identified nominate		10	
"    Balearic		9.15	3.52
Great Shearwater		.081	.02
Cory's Shearwater	6.2	1.17	10.5
Sooty Shearwater	13.4	41.7	25.8
Gannet	35.7	44.8	77.2
Juvenile		29.8	40.8
sub-adult		5.3	24.2
adult		7.0	9.12
Common Scoter	44.5	84	96.1
Arctic Skua	.13	.86	2.04
Bonxie	.24	.45	.19
Pomarine Skua		.84	.3
Pomarine/Arctic Skua	2.4	9.4	2.37
Black Tern	@	1.29	1.57
Common or Arctic Tern	@	49	20.2
Little Tern		.156	.5
Sandwich Tern	10.7	17.3	18.8
Common + unidentified Terns		53.4	29.38
Auks	.06	.5	.168

@ - average not computed as these species were ignored on certain busy days.

All averages are the averages of the hourly rate for the manned days.

\* \* \* \* \*

Two months passage at this rate in daylight hours.

( (2) or (3), whichever is greater x 720)

	000's
Manx Shearwater	27.1
nominate	7.2+
Balearic	6.58
Great Shearwater	.058
Cory's Shearwater	7.56
Sooty Shearwater	29.9
Gannet	55.6
juvenile	29.4
sub-adult	17.4
adult	6.6
Common Scoter	69.2
Arctic Skua	1.47
Bonxie	.324
Pomarine Skua	.605
Pom/Arctic Skua	6.8
Black Tern	1.13
Common/Arctic Tern	35.2
Sandwich Tern	13.6
Common/Arctic Tern + unidentified.	38.5
Auks	.36



TABLE 2

A comparison between the rate of passage on thirteen days of northwesterly weather and fifteen other days, 1968.

	(a)	(b)	Ratio (a) (b)
	<u>Av. rate/hour.</u> <u>NW days</u>	<u>Other days.</u>	
Manx Shearwater	61.8	10.5	5.9
Balearic race	4.06	2.64	1.54
Cory's Shearwater	11.2	9.9	1.14
Sooty Shearwater	36.8	18.9	1.94
Gannet	80.2	75.2	1.06
juvenile	52	29	1.78
sub-adult	21.4	26.8	.8
adult	7.35	10.8	.68
Common Scoter	79.5	118.	.67
Bonxie	.25	.137	1.83
Arctic Skua	3.2	1.18	2.75
Pomarine Skua	.735	.033	22.8
Arctic or Unidentified	6.7	2.6	2.57
Black Tern	.91	2.11	.43
Common or Arctic Tern	23.7	14.3	1.66
Commic and unidentified	39.1	17.8	2.19
Little Tern	.298	.632	.47
Sandwich Tern	12.5	24.3	.535
Auks	.146	.2	.76

\* \* \* \* \*

TABLE 3

Comparison between the average rates of passage on eight northwesterly days and sixteen other days, 1967.

	(a)	(b)	Ratio (a) (b)
	<u>Av. rate/hour</u> <u>NW days</u>	<u>Other days</u>	
Manx Shearwater	72.7	18.7	3.88
Sooty Shearwater	71.2	7.95	8.95
Gannet	82.2	38.5	2.04
juvenile			2.3
sub-adult			1.82
adult			3.1
	for the fourteen days in September and October only		
Common Scoter	75	87	.863
Small skuas	32	7.6	4.07
Common or Arctic Tern	97.6	25.6	3.62

\* \* \* \* \*

TABLE 4

A comparison of the rate of passage of certain species on the days following frontal weather, 1968.

	Rate per day			Average all days
	1st good day.	2nd g.d.	3rd g.d.	
Manx Shearwater	28.8	30	10.5	31.6
Balearic	6.06	4.85	1.6	3.52
Cory's Shearwater	9.1	21.3	4.54	10.5
Sooty Shearwater	49.9	23.5	14.4	25.8
Gannet juvenile	57.4	25.09	36.2	40.8
sub-adult	25.6	15.9	32.8	24.2
adult	7.2	8.01	17.1	9.12
Common Scoter	107	64.4	31.5	96.1
Small skuas	7.31	4.87	2.55	4.71
Commic Tern	23	49	5.76	20.2
Sandwich Tern	25.3	15.5	16.26	18.8

There were six 'First good days', four 'second good days' and three 'third good days'.

\* \* \* \* \*

TABLE 5

average rate of passage per hour of Gannets of three plumage phases, 1968.

Date.	Sept. 8	9	10	11	12	13	14	15	16	17	18
Juvenile	24.7	14	12.2	15.3	17.2	10.6	11.3	33.4	25.4	22	42.5
Sub-adult	4.2	4.7	.8	3.5	2.1	2	2.1	2.7	3.06	6.5	18
Adult	0	.3	.1	.1	.3	.25	.3	1	1.3	1.77	.4

Date.	Sept. 19	20	21	22	23	24	25	26	27	28	29
Juvenile	10.3	22.9	20.6	26.6	53.7	123	47	17.8	50	139	99
Sub-adult	18.4	19.8	20.4	17.9	26	29.5	90	30	38.5	15.2	66
Adult	1.6	3.8	2.1	2.5	6.8	11	10	4.4	11	15.2	15.4

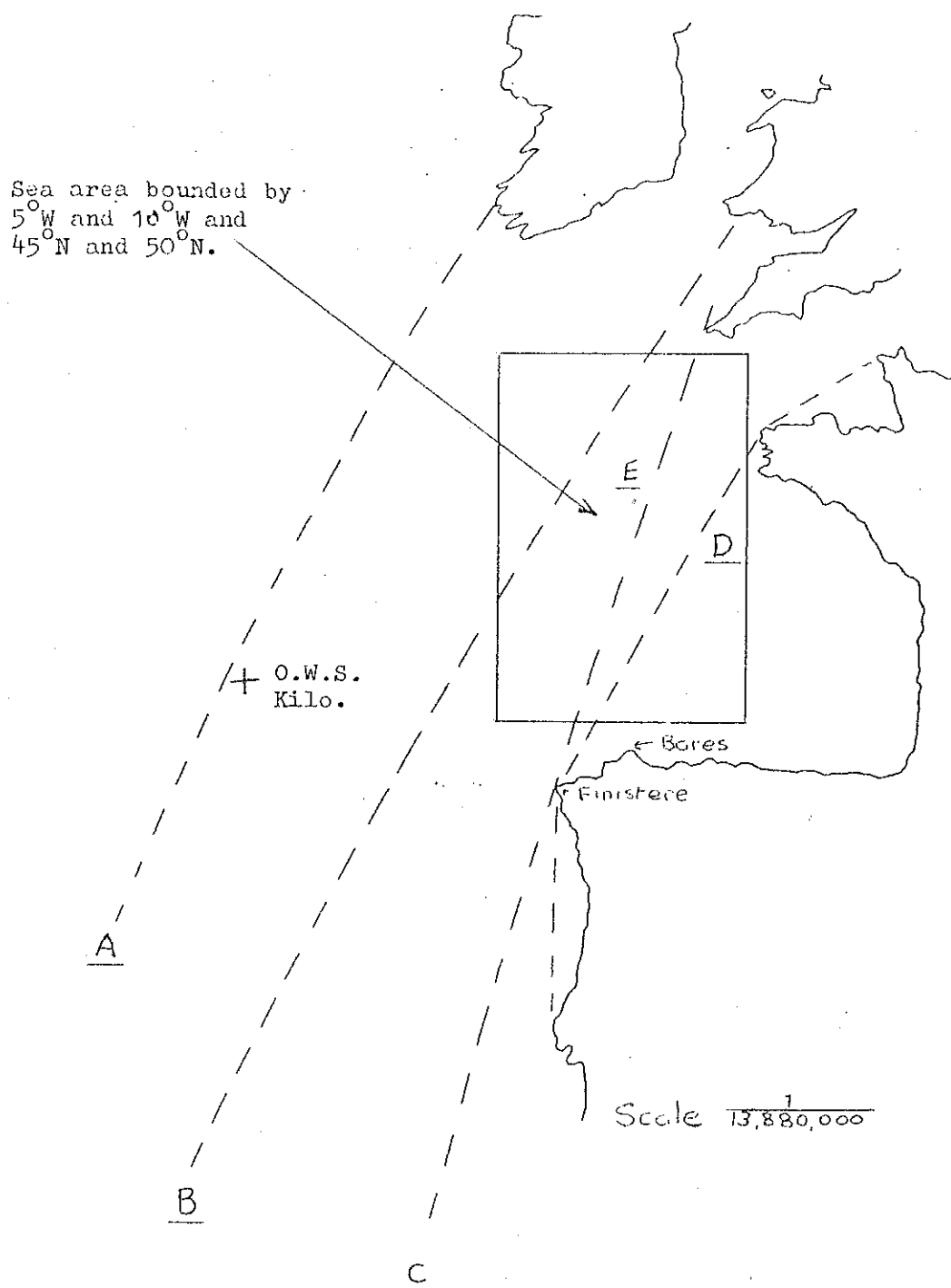
Date.	Sept/Oct. 30	1	2	3	4	5
Juvenile	47.5	49	81.2	?@	26	27.5
Sub-adult	30	78.2	55	?	40	68
Adult	30	50.7	39	?	17.4	26.2

@ 'very few'.

In cases where not all Gannets were assigned to an age group the total number seen has been split in proportion to the sample taken. Until 23rd most Gannets were aged.

\* \* \* \* \*

FIGURE 1.



Position of the Estaca de Bares in relation to:

- A Great Circle route West Ireland to East Brazil.
- B. Pembrokehire to East Brazil.
- C. Minimum distance route to West Africa.
- D. Minimum distance route Channel to South.
- E. Minimum distance route Lands End to West Africa.

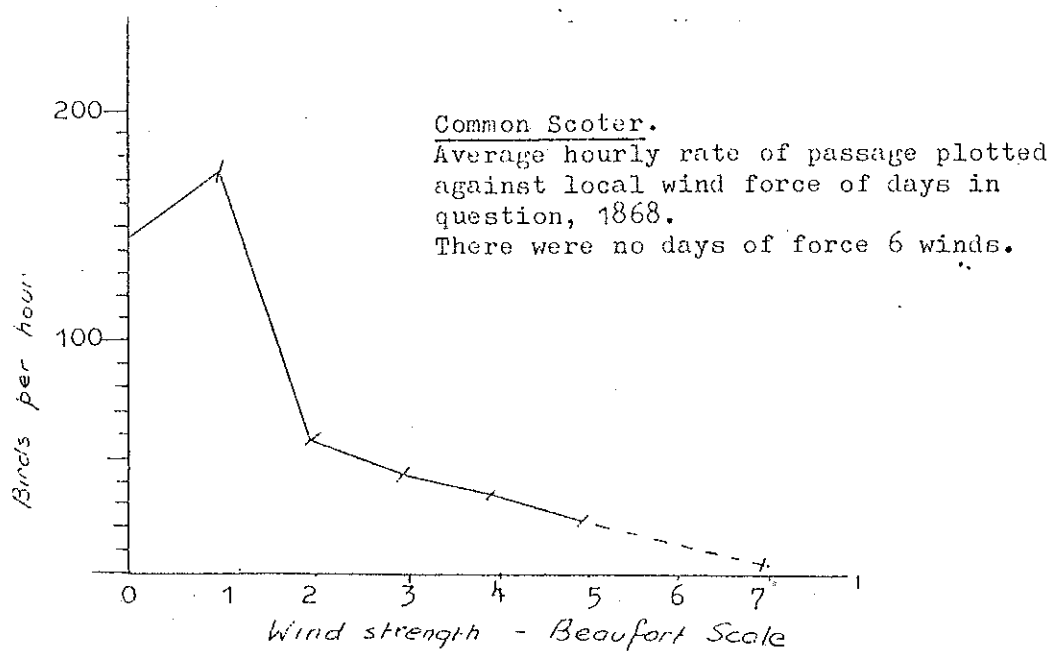
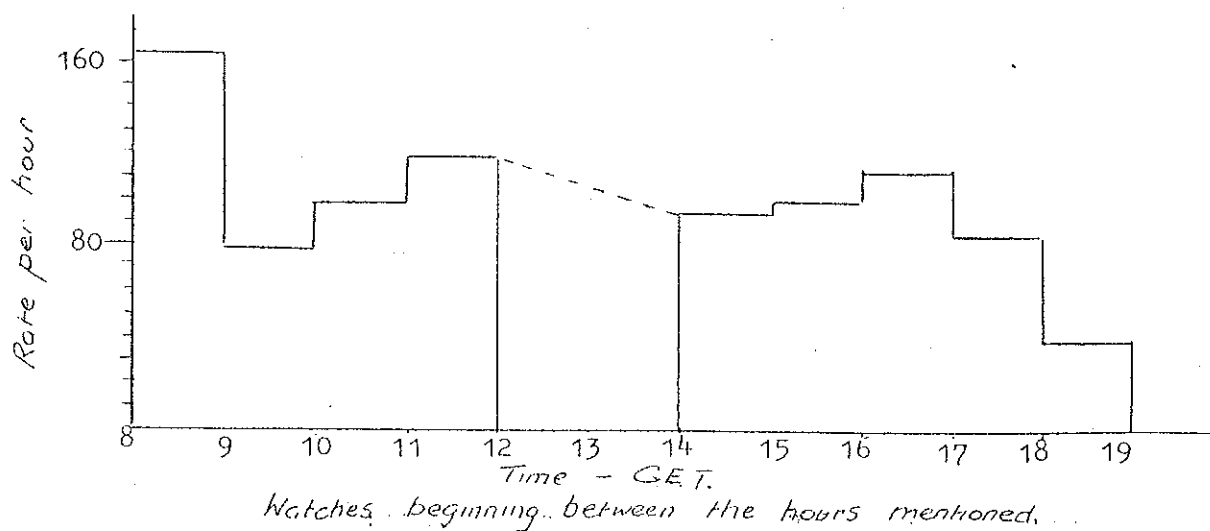


Figure 2

Gannet

Diurnal rhythm, late September and October 1968.

The mean of the number of birds passing west in one hour watches beginning in each hour period is plotted, using 82 watches, Sept 20 to Oct 4 1968. There were insufficient watches beginning between noon and 14.00 to take a valid average.

Figure 5.

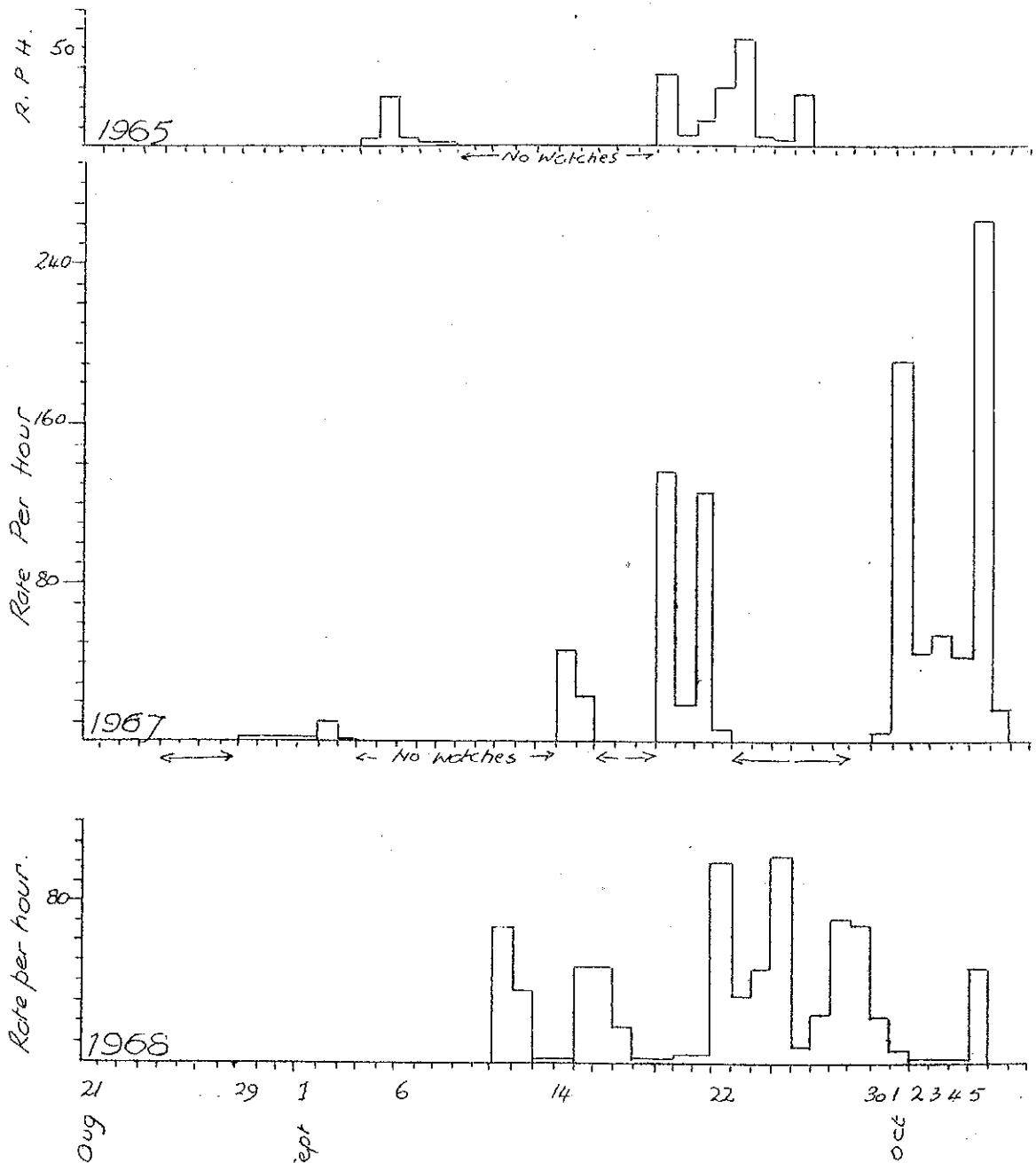
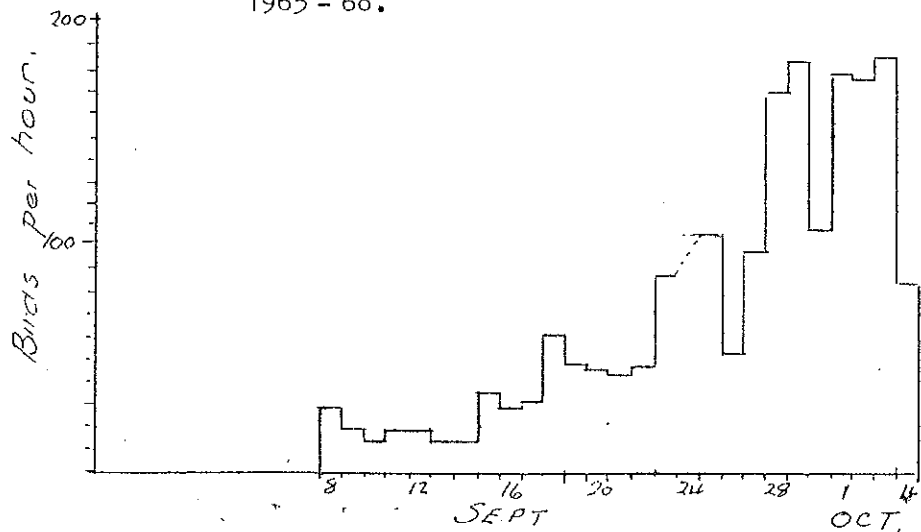


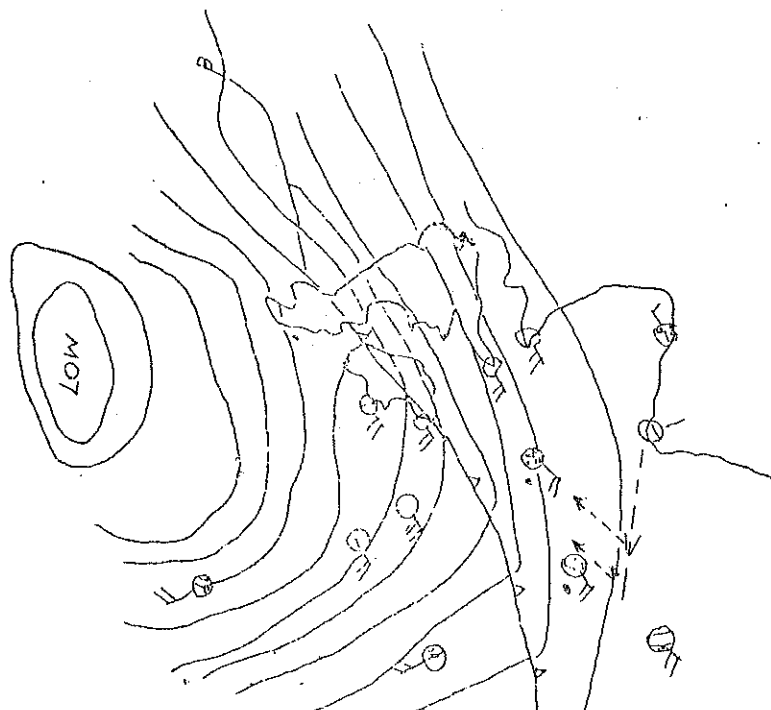
Figure 3

Sooty Shearwater.

Rate of passage per hour on daily basis, all watches, 1965 - 68.

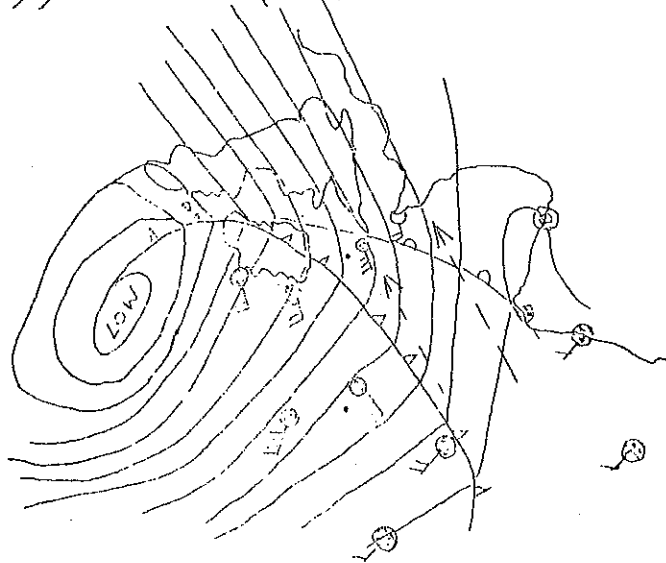


Gannet. Rate of passage per hour on daily basis, 1968



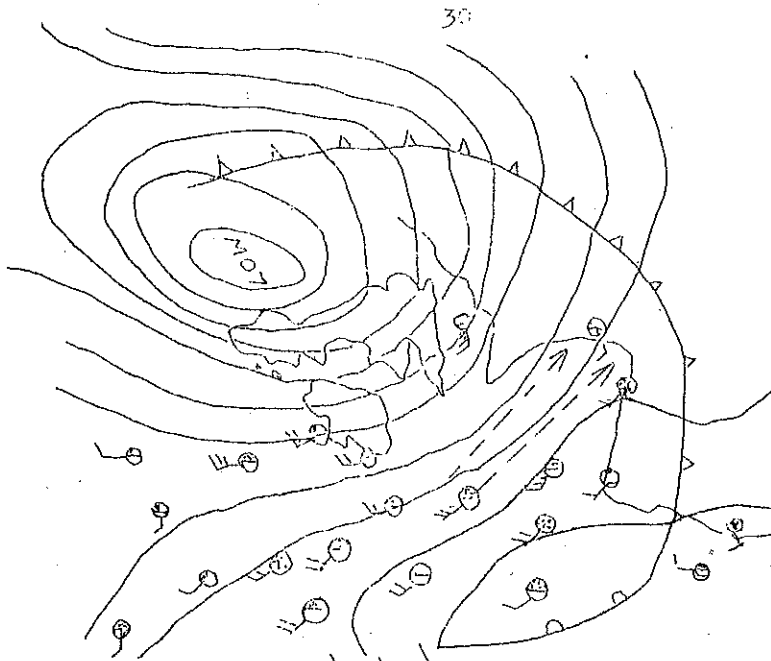
12hr Oct 1 1967

Sooty Shearwaters heading west enter zone of S.W. winds and rain and were deflected N.E.



12hr Oct 3 1967

Continued frontal weather, westerly winds drives them onto British or French coasts

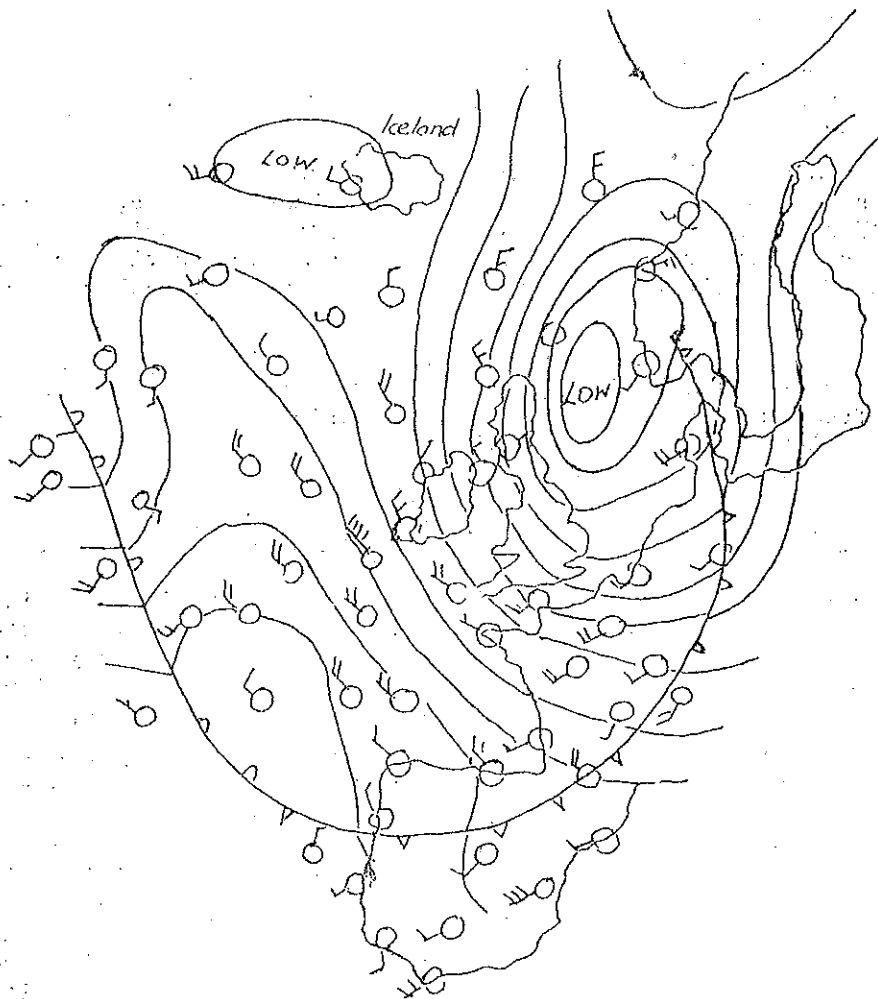


12hr Oct 4 1967

North-westerly winds precipitate movement into Bay. Passage west occurred on 5th when weather became calm.

FIG. 6 See para 20

Rate per hour



Weather map - 12hr of October 4 1967.

Figure 7.