OIL POLLUTION MORTALITY OF BRITISH AND IRISH SEABIRDS DURING THE WINTER OF 1980-81 ANALYSED BY COLONY OF ORIGIN AND AGE AT DEATH

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SUMMARY

Evidence from recent ringing recoveries of British and Irish seabirds shows that they suffered exceptionally heavy mortality through oil pollution during the winter of 1980-81. Recoveries of oiled birds were reported for ten species and were from birds ringed in many different colonies. Guillemots and Razorbills were particularly severely affected. The age classes of birds killed was not the same for both species: unusually heavy mortality affected only adult Razorbills but all age classes of Guillemot. Estimates of the likely consequences for breeding populations suggest that Orkney and Shetland Guillemot colonies may decline by up to 10 per cent over the next five breeding seasons, with less severe declines at other Scottish colonies. Since it was adult Razorbills that were affected the decline will be immediate: northwest Scottish colonies are likely to be the hardest hit with the 1981 population expected to be 5 per cent down on 1980 figures.

INTRODUCTION

Late in December 1980 large numbers of oiled seabirds were reported from the Skagerrak, mainly from Sweden but also from Norway and Denmark. The majority of the ringed birds recovered in this incident were of northern Scottish origin. Barry Blake and Peter Hope Jones of the NCC Seabird at Sea Team visited Norway to collect information on biometrics and food and to obtain first-hand information about the incident. More than 30,000 birds were affected, two-thirds of them Guillemot* and legal action may be in process against a Greek tanker whose oil was implicated. However this was by no means the only oiling to take place during the winter: the others did not receive much attention in the press but did affect large numbers of birds. Some hundreds were affected in South Wales in December. Since the end of December possibly as many as 20,000 oiled birds have been found from the northern part of the Waddensea (S.W. Denmark) round the south-east coast of the North Sea to Belgium. Many reports of oiled birds were received from the northern coast of France totalling several thousand individuals. Along the south coast of England hundreds of birds were reported as oiled from mid-December onwards.

Some idea of the exceptional nature of the winter oiling mortality during 1980-81 is provided by the figures for oiled birds found during the beached bird counts conducted throughout western Europe this winter: this is in excess of 50,000 birds (T.J. Stowe, pers comm.). Comparable figures covering European coasts are not available but over the nine years 1971-79 the routine and emergency beached bird counts in Britain,

* Scientific names of birds are given in the appendix.

organised by the RSPB (Andrews and Standring 1979) totalled about 42,000 birds. During most winters between one and two thirds of all oiled birds counted in Europe come from British beaches. In both cases more than two thirds of the oiled birds found were auks with Guillemot being much the commonest species. Both the counts actually underestimate the number of birds killed by oil, for not all oiled birds are available to be counted: they may be stranded on inaccessible shores or buried on beaches and many sink before they are stranded.

As with the Skagerrak incident ringing recoveries from the other areas mentioned indicate that many British and Irish seabirds were involved in these incidents. The present report analyses the data available from these recoveries to establish (a) the populations affected and (b) the ages at death of the birds involved. The effects on Guillemot and Razorbill populations, the two species worst affected, have implications for summer monitoring programmes at seabird colonies over the next few seasons.

MATERIALS AND METHODS

For this analysis all ringing recoveries of seabirds from the beginning of December 1980 and reported by the first week in April 1981 have been examined. Reports of shot birds and birds caught in fishing equipment have been omitted as have any where the details of capture are uncertain. Two categories of recovery remain (1) oiled birds and (2) those found dead, generally on the tide-line, but not expressly reported as oiled. This latter category may include a few oiled birds

that were not reported as such by the finders. This may happen for either of two reasons: (1) the finder may not regard the fact of oiling as important or (2) he may not recognise the presence of oil, an event particularly likely in dark plumaged birds.

Table 1 summarises the oiled recoveries by region of finding and half-month of recovery. The end of December and the whole of January was clearly the worst period for oiling. The Skagerrak and South Wales stand out as areas in which all the oiled recoveries happened over a short period whilst in the other recovery areas oiling was reported over most of the period. The 100 recoveries in this table include 63 Guillemots, 21 Razorbills, three each Shag and Kittiwake, two each Fulmar, Gannet, Great Skua and Puffin, and singles of Cormorant and Red-breasted Merganser. Since the reporting time for a ringing recovery may be more than two or three months additional recoveries relating to this period - particularly for March - may yet be reported. Here the period December to February is used for detailed comparison with date from previous years for the two larger auk species. These earlier data were collected by the Trust under contract to NERC and NCC or to NCC alone during the twelve winters 1967-68 and 1978-79. Auk ringing has been stimulated over the past two decades through the provision of free rings by the BTO. The results formed the basis of the British Trust for Ornithology's evidence to the Royal Commission on Environmental Pollution (Mead and O'Connor, 1980) and further analysis of these data are underway (Mead and Baillie, in prep.; Baillie and Mead, in prep.).

In the course of the analysis the age of the bird at the time of recovery is used to separate them into three classes:

First year	Birds ringed as nestlings the previous summer
Immature	Birds ringed as nestlings earlier than the previous summer but still too young to have bred. For Guillemots and Razorbills these are second to fifth winter birds; the period during which birds are classified as immature varies and depends on the species' age at first breeding.
Adult	Birds ringed fully-grown at colonies and those ringed as nestlings long enough ago to have reached breeding age.

In general terms first year birds may be expected to move further than immature birds and adult birds to move the least distance from their colonies (Mead, 1974). For most of the species dealt with in this analysis nestlings may be expected to settle to breed at colonies in the vicinity of their natal one (if not within it).

The results are deliberately treated by ringing areas which conform, as closely as possible, with the NCC regions (Figure 1). There are, of course, differences in bird populations and movements within and between these regions and the number of ringed birds available to be recovered will also differ. This is particularly true where ringing effort has altered over the years. Any such differences which have been recognised are mentioned below where appropriate.

RESULTS

North-east Scotland Region: Orkney and Shetland

Orkney and Shetland have been separated from the rest of the North-east Scotland region since the two archipelagos are rather a long way

from the mainland. The area involved is shown in Figure 1. Recoveries reported since 1st December 1980 are plotted in Figure 2. Different symbols have been used to distinguish first year, immature and adult oiled birds, and to identify the different species involved. Unoiled birds other than auks are not plotted since the risk of oiling is less for other species (Mead and O'Connor, 1980) and the plotting of unoiled recoveries would have unnecessarily encumbered the maps. The Orkney and Shetland recoveries of oiled birds in December 1980 and January - February 1981 are also summarised in Table 2. The predominance of first year recoveries reflects the increasing ringing effort being accorded Guillemots over recent years, particularly in Shetland. Rather few Razorbills are ringed in this area and the only recoveries plotted are of oiled birds in France and Northumberland in March and an unoiled one in Yorkshire.

The colonies of origin of the 44 birds plotted on Figure 2 reveal the importance of regular ringing activities: 29 of the birds (26 Guillemots and all the Razorbills) came from Fair Isle and six of them (four Guillemots and the two Great Skuas) from Foula, both sites with a long history of seabird ringing. The remaining Guillemots were from Sumburgh Head (2) and Unst (1) in Shetland and from Halcro Head (2) in Orkney. Both Fulmars came from the long-term Aberdeen University study on Orkney, the Puffin was from Sule Skerry (Orkney) and the Cormorant from Clett Stack (Shetland).

Much more detailed information, allowing comparison with the recoveries over the same part of the year from 1967-68 to 1978-79 is shown on Figure 3. The 28 recoveries of oiled Guillemots during last

winter are exceptionally numerous when compared with the five from the twelve year period. Comparable figures for the uncoiled recoveries are six and eight. The earlier period, 1967-79 produced nine of the 13 recoveries reported from eastern Britain but only two of those from Scandinavia and a single one in the south-east North Sea. Last winter's recoveries, with 13 in Scandinavia and 14 in the south-east North Sea are clearly very different. An earlier analysis, referring to recoveries from all causes (including shot birds and those caught in fishing nets) showed birds from this area being found in winter up the western coast of Norway as far as the Lofoten Islands (Figure 17: Mead, 1974). None of the recoveries reported for the four months December to March by Mead (1974) was from further south than Norway on the east side of the North Sea or Northumberland on the west.

North-east Scotland Region: Grampian area

The winter's recoveries from this area re plotted in Figure 4 and summarised in Table 3. They include the first recovery of a British bred Red-breasted Merganser from Norway. There has been increased activity of ringers marking Guillemots in Grampian though not as markedly as in Orkney and Shetland. Eleven of the birds were from Cruden Bay colonies (10 Guillemots and the Kittiwake), three of the Guillemots were from Troup Head and the Red-breasted Merganser from near Forres. Figure 5 compares the 1967-79 data with those of 1980-81 for each age group. All five of the earlier recoveries were of oiled birds and there is an indication (Figure 8 B) that at least the immature birds penetrated further south and into the Channel area in 1980-81 than in earlier years.

North-west Scotland Region

North-west Scottish recoveries (from the period December 1980 to February 1981) are plotted in Figure 6 and those involving oiled birds summarised in Table 4. For this region Razorbills produced more oiled recoveries than did Guillemots. Quite large-scale auk ringing is carried on at two sites within the region. On the Shiants effort has probably remained fairly constant and this colony contributed two Razorbills and a single Guillemot to last winter's recoveries. On Canna Guillemot ringing, in particular, has increased greatly and 13 were recovered (also five Razorbills). In the past many full-grown Razorbills were ringed on Handa using 'fleygs' but this declined during the 1970's - four Razorbills and two Guillemots were recovered in winter 1980-81. The remaining Razorbill recoveries were from Berneray and St. Kilda, the last Guillemot from North Rona and the single Puffin from St. Kilda. Figure 7, for Guillemots, and Figure 8 for Razorbills, show the detailed comparison between 1980-81 and the earlier twelve-year period. As many Guillemots were recovered oiled in 1980-81 as in the previous period and even the unoiled birds were half the twelve-year total, possibly indicating high mortality in 1980-81 even without oiling effects (Figure 7). Even so the effect is not as serious as that shown for the two parts of the North-east Scotland Region. There is an indication that first-year Guillemots were found further east in the North Sea during winter 1980-81 than normally. No first-year Razorbills from North-west Scotland were reported oiled last winter and it is clear that much of this cohort would have been well south of any of the areas from which quantities of oiled birds were reported. Figure 8 shows the much stronger migratory movement of particularly the first-year Razorbills as compared with the Guillemots (contrast Figure 8 A with Figures 3 A, 5 A and 7 A). There were rather few immature Razorbill recoveries (Figure 8 B) but almost twice as many

oiled adults were recovered during 1980-81 as during the earlier twelve-year period (Figure 8 C). Many more were found on eastern coasts of the North Sea - a similar result to first-year Guillemots (Figure 7 A). Mead (1974: Figures 11 and 12) showed that adult Razorbills from Handa are quite often found in the southern part of the North Sea, through the Channel and into Biscay, and even into the Mediterranean. However that analysis included recoveries from all causes and not solely recoveries of beached birds.

South-west Scotland Region

Only three recoveries - two Razorbills from Treshnish and Sanda and a local Shag - were reported of birds ringed in this region (Figure 9). Not many seabirds likely to be affected by oil are currently being marked in this region.

South-east Scotland Region

The six recoveries of birds from this region are plotted in Figure 9. The auks (only the Guillemot reported as oiled) came from the Isle of May, the two Gannets from Bass Rock and the Kittiwake from Inchkeith. The three oiled birds reported before the end of February are listed in Table 5. Very few auks are ringed in this region apart from Puffins.

North-east Region

Four birds ringed on the Farne Islands are plotted in Figure 9 and are summarised in Table 5. The ring from the Guillemot was severely worn and partly illegible: the bird had been ringed between 1959 and 1962. As with the South-east Scotland region rather few auks, apart from Puffins have been ringed each year here: the totals for Farne Island for 1980 shows no Guillemots or Razorbills were ringed in 1980.

North Wales Region

Two birds ringed on Ynys Gwylan Fawr by Bardsey Bird Observatory were recovered, unoiled, and are plotted in Figure 10. The Guillemot was a first-year bird and the Puffin an adult.

South Wales Region

In the past auk ringing on Skokholm and Skomer would have produced many more than the single recovery reported (an adult Guillemot shown in Figure 10). Ringing ceased on Skokholm some years ago but is continuing on Skomer and it is there that the Guillemot had been ringed as a nestling in 1975.

Isle of Man

The single local Shag recovery (oiled) is plotted in Figure 10 and listed in Table 5.

Great Saltee, Co. Wexford

The continuing ringing programme on Great Saltee largely financed by the Irish Forest and Wildlife Service is one of the most consistent sources of ringed auks in Britain and Ireland. Guillemots and Razorbills predominate with 855 and 1347 respectively marked during 1980. Recoveries since 1st December 1980 are plotted in Figure 10 and are summarised in Table 6. Apart from a single young Guillemot on the Spanish/French border and a young Razorbill at the eastern end of the Channel (in France) all the birds were found relatively close to Great Saltee. The more detailed comparison, by age, with the data for the earlier twelve-year period for Guillemots (Figure 11) shows eight records of young birds moving northwards

in the Irish Sea and seven immatures down the Biscay coast of France. It is possible that this population of Guillemots may have been a little less mobile in 1980-81 than normally. The lack of mobility is also apparent for Razorbills: Figure 12 shows ten recoveries in Spain or further south for the earlier period but none were reported in 1980-81. The data are, however, scanty and the lack of recoveries in the single year may be through chance.

Recoveries of rehabilitated birds

In many cases rehabilitated oiled auks are ringed on release. The results from such ringing show that many of the released birds are not fully able to cope with life in the wild and many are recovered within a week or two of release. During the period under review fifteen such birds were reported. The longest duration between release and report was 11 days and that bird, a Guillemot, was found oiled in Holland after release in Sussex - a movement of 302 kilometres. The other birds, also Guillemots had moved up to 20 kilometres a day and no others were reported as having been freshly oiled. These recoveries were omitted from the figures and tables above and they will not be referred to further in this report.

DISCUSSION

Winter 1980-81

The ringing recoveries show clearly that unusually large numbers of seabirds were recovered oiled in winter 1980-81. Indeed the total number of recoveries, particularly of Razorbills and Guillemots, was

unprecedented. In dealing with the recoveries from individual ringing areas it was noted that the ringing effort on marking these two species has increased in recent years. In the first three years, 1967 to 1969, of a twelve-year period, the annual average number of Guillemots ringed was 416 and of Razorbills 931. The figures for the final three years 1976 to 1978, are 3220 and 2376 respectively. In fact Guillemot ringing has increased fairly steadily during the 1970's whereas Razorbills, after fluctuating around 1000 per annum in the late 1960's, immediately reached a level of 2000 in 1970 and remained fairly steady. In the light of these figures for effort the totals of recoveries for winter 1980-81 and those for the twelve-year period 1967-79 (Table 7) take on a new significance. The majority of Guillemots and Razorbills have been ringed as nestlings and the totals given in the annual ringing reports show that, between 1967 and 1978, 15,000 Guillemot chicks and 16,000 Razorbill chicks were ringed. The figures for summer 1980 are not yet available but will be in the region of 3,000 - 4,000 Guillemots and 2,000 - 3,000 Razorbills. All things being equal, the first-year recovery figures for Guillemot might be expected to be a fifth to a quarter those reported from 1967-79 and for Razorbill between an eighth and a fifth. Thus Guillemots may have suffered a four or five fold increase in first year mortality during 1980-81 (40 compared with 39 recoveries) whilst Razorbill first year mortality was no more than normal.

Unfortunately such easy comparisons are not possible with the other two age classes since they span four years, in the case of immatures, and two or three decades for a long-lived adult. However, it is possible to make some approximate calculations of 'Bird years at risk' for each age category for the periods 1967-79 and 1980-81. Previous analyses (Mead 1974, Lloyd 1974, Birkhead 1974) have shown that about half the chicks

ringed die in their first year and about half of those that survive actually reach breeding age. The results of these calculations are given in Table 8. These calculations are, of course, only approximations since average survival rates have been used throughout but they do allow a much better assessment of the significance of their winter recovery totals for immature and adult birds. These calculations show that 2.0 - 2.5 times as many immature Guillemots died in 1980-81 as would normally have been the case and that about 1.5 times as many adults died as normal. For Razorbills the immature mortality was, if anything, slightly less than normal but for adults increased 2.5-fold. These assessments are summarised in Table 9. They are subject to a number of biasses, the most serious probably being (1) differential reporting rates from different areas - most likely to affect the furthest dispersed birds (that is, particularly the sub-adult Razorbills) - and (2) any biasses introduced through the inclusion of oiling as mortality factor. The latter possibility is being investigated insofar as it affects different age groups (Baillie and Mead in prep.). Early indications are that there is no significant difference between age classes in the same area. Regional differences in oiling risk are, however, quite marked (Mead and Baillie, in prep. and Mead, 1974).

The analysis so far has established that, for all age classes of Guillemot and for adult Razorbills, the winter of 1980-81 was characterised by unusually high mortality rates. Many of the birds were reported as oiled and, when the oiling percentage is compared, age-group by age-group between the twelve-year period 1967-79 and the 1980-81 winter the difference is most striking. These percentages and the results of χ^2 test on them are given in Table 10. This shows that for adult Guillemots and immature Razorbills, an unusually high proportion of the recoveries reported in winter 1980-81 were of oiled birds. However, it is possible that the birds

were already in poor condition before they became oiled. Certainly the time of peak piling (second half of December 1980 and January 1981: Table 1) coincided with the worst winter period of westerly storms to have occurred in recent years and this may have interfered with the auks' feeding activities. In any case, these storms explain why the majority of the recoveries occurred on shores exposed to westerly winds - bodies are known to drift with the wind. Whatever the effect of the abnormal weather conditions it was certainly oiling that killed exceptionsl numbers of auks during last winter. It is also certain that the majority of them were killed as a result of chronic pollution rather than oil from discrete sources. The only four such individual incidents last winter were the Skagerrak, Sylt (S.W. Denmark), Norfolk and South Wales which accounted between them for 33 ringed birds. The chronic pollution, probably responsible for 59 of the oilings, will have come from the usual wide variety of sources. These include run-off from land drainage, bilge pumpings, illegal tank washings, accidental spillage etc. Some may have been a direct result of the very stormy weather through ships foundering and the break-up of earlier wrecks. Moreover it is so much more difficult, indeed sometimes impossible, to detect oil slicks in rough seas and so some illegal discharges may have taken place under cover of the broken water.

Effect on populations and implications for breeding season monitoring

It is only possible to try to assess the effects of the winter's oiling on the British and Irish breeding populations of the two species with the most recoveries: Guillemot and Razorbill. Both species have a long pre-breeding period, generally covering five winters, and so the potential effect on the breeding population may be spread over up to five seasons.

Also different parts of the British and Irish populations may have been affected in different ways. The recoveries with which this analysis is concerned also come from only a quarter of the year and it is very difficult even to guess whether the fact of so many recoveries coming from a single quarter may result in a compensatory increase in survival at a later period. Mortality through the years will also tend to operate at different times for different age classes. Thus first-year birds may be particularly at risk soon after they leave the breeding colonies, immatures and adults may be at risk during the winter period and adults, in particular the females, may have a higher mortality at the time of breeding. These possibilities must be borne in mind when considering the effects of the 1980-81 winter as an isolated event.

Guillemot

First year mortality, in a normal year, accounts for about 50 per cent of the birds that fledge. If half this mortality takes place between August and November and, in a normal year 85 per cent of the survivors also live through the December - February period a quadrupling of mortality during this time will deplete the cohort to half its normal size. In five years time, therefore, the recruitment to the breeding population will be half the normal level.

For immature birds, for which the winter period may normally be a time of slightly higher risk survival over the three month period is usually about 94 per cent. (This assumes that about a third of their annual mortality takes place in the three month period). A reduction to 86 per cent would result in recruitment over each of the next four years being about a ninth down on normal

Finally, for adults annual survival is about 94 per cent and if a third of this takes place between December and February the survival over

that period is normally almost 98 per cent. Consequently if mortality increased over the 1980-81 winter by a factor of 1.6 then the breeding population of returning adults will be down by about one per cent. Thus, in each year, the following effects may be felt:

	1981	1982	1983	1984	1985
Loss of adults	-1%				
Loss of immature which should breed as recruits	-0.7%	-0.7%	-0.7%	-0.7%	
Loss of 1st year birds to be recruited in 1985					-3%

The cumulative effect, spread over five years, might be to reduce the breeding population by six of seven per cent, with the most severe effect in summer 1985. This is a simple model which does not take into account the rather wide scatter of dates of first breeding which occurs in nature.

Local populations within Britain and Ireland may of course suffer differently. In Orkney and Shetland first year birds seem to have been very severely affected and immatures may have been worse affected than the national average. Rather few adults were available for recovery. In this area losses might be 2 per cent in 1981, more than 1 per cent per annum for the next three years and as much as 4 or 5 per cent when the first year birds would be starting to breed.

In the Grampian part of North-east Scotland region immatures appear to have fared relatively badly but, once more, recent increases in ringing effort make proper assessment difficult. In North-west Scotland immatures seem to have survived better than average and the 1985 effect (of lack of frist year recruitment) may be most important. The Saltee birds do not seem to have been nearly as badly affected as Scottish populations and the effects of the 1980-81 winter may be roughly half that set out above.

Razorbill

The calculations for Razorbill are very much easier since the results show that it is only adults which suffered a particularly high mortality during the last winter. Again, assuming that a third of all adult mortality takes place between December and February the 2.6-fold increase would cause 5 per cent adults to return to breed in 1981.

In neither part of the North-east Scotland region were sufficient Razorbills recovered to predict any effect. However, in North-west Scotland the records point to a probable decrease of the order of 5 per cent or more this coming breeding season. Saltee Razorbills, as with the Guillemots, certainly suffered less severely than this

Monitoring at breeding colonies

Current census methods are unlikely to detect changes of this order unless results from earlier years have established a good baseline. It is clear, for Razorbill, that the only likely possibility of detecting an effect through census studies would be in the North-west Scotland region, where previous years' data could be compared with the 1981 results. The situation for Guillemot is more complicated since the worst affected area, Orkney and Shetland, may be subjected to a cumulative decrease of 9-10 per cent over the next five breeding seasons. The predicted effects are clearly dependent on the populations of Guillemots and Razorbills behaving 'normally' over the period covered by the prediction. Compensatory increases in survival rates would lessen the effect and, for the Guillemot in particular, the recruitment of birds at an earlier age would both minimise any decrease caused by the winter 1980-81 mortality. However, whether an effect can be shown or not, it is clear that neither Guillemot nor Razorbill populations wintering in the North Sea and Channel areas can

be expected to withstand every year the extra mortality they experienced during the last winter. If winter 1981-82 were to be as bad then the predicted decreases for Orkney and Shetland Guillemots, over a six year period, would be almost 20 per cent and the North-west Scottish Razorbills might drop by 10 per cent over two years. It would be reasonable to expect such changes to be detected by current census techniques.

APPENDIX

Scientific names of birds mentioned

Fulmar	*Fulmarus glacialis*
Gannet	*Sula bassana*
Cormorant	*Phalacrocorax carbo*
Shag	*Phalacrocorax aristotelis*
Red-breasted Merganser	*Mergus serrator*
Great Skua	*Stercorarius skua*
Kittiwake	*Rissa tridactyla*
Guillemot	*Uria aalge*
Razorbill	*Alca torda*
Puffin	*Fratercula arctica*

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Table 1. Timing of oiled recoveries of British and Irish seabirds by area of finding - December 1980 - March 1981.

Half month periods:	December 1st.	December 2nd.	January 1st.	January 2nd.	February 1st.	February 2nd.	March * 1st.	March * 2nd.	Total
Skagerrak	.	5	16	.	.	.	.	.	21
S-E North Sea	.	6	8	8	3	2	1	.	28
North France	.	1	3	7	1	1	2	.	15
S. coast of England	.	4	5	.	3	1	1	2	16
South Wales	.	8	.	.	.	.	.	.	8
Other areas	1	5	1	.	.	3	2	.	12
Totals	1	29	33	15	7	7	6 *	2 *	100

* The March recoveries are plotted on the maps using smaller symbols. Particularly for March, but also possibly for earlier months, additional recoveries may eventually be reported.

Table 2. Recoveries of birds from North-east Scotland Region - Orkney and Shetland - tabulated by species, age at recovery and recovery area.

Species	Age at recovery	Found in recovery area *: E	F	G	H	J	Others	Total
Guillemot	1st year	9	8	1			1	19
	Immature	4	1	1			1	7
	Adult	1			1			2
Fulmar	Adult	1						1
Cormorant	1st year						1	1
Bonxie (Great Skua)	1st year						1	1
	Totals	15	9	2	1		3	31

* Redovery areas are marked on Figure 1. NB. Only oiled recoveries of birds from December 1980 to February 1981 are plotted on this table.

Table 3. Recoveries of birds from North-east Scotland Region - mainland area (Grampian) - tabulated by species, age at recovery and recovery area.

Species	Age at recovery	Found in recovery area *: E	F	G	H	J	Others	Total
Guillemot	1st year		2	1				3
	Immature	1	2	2	1			6
Red-breasted Merganser	Adult						1	1
Kittiwake	Adult		1					1
Totals		1	5	3	1		1	11

* Recovery areas are marked on Figure 1. NB. Only oiled recoveries of birds from December 1980 to February 1981 are included in this table.

Table 4. Redoveries of birds from North-west Scotland Region tabulated by species, age at recovery and recovery area.

Species	Age at recovery	Found in recovery area *: E	F	G	H	J	Others	Total
Guillemot	1st year	2	3	1	1			7
	Immature				1			1
	Adult		1		2			3
Razorbill	Immature			1		1	1	3
	Adult	1	6	1		1		9
Totals		3	10	3	4	2	1	23

* Recovery areas are marked on Figure 1. NB. Only oiled recoveries of birds from December 1980 to February 1981 are included in this table.

Table 5. Recoveries of birds from other areas (not included in Tables 2 - 5) tabulated by species, age at recovery and recovery area.

Ringing area *	Species	Age at recovery	Recovery area *	Total
South-east Scotland	Guillemot	Adult	H	1
South-east Scotland	Gannet	Adult	F	1
South-east Scotland	Kittiwake	Adult	F	1
South-west Scotland	Razorbill	1st year	J	1
South-west Scotland	Razorbill	Adult	J	1
South-west Scotland	Shag	1st year	Local	1
North-East Region	Guillemot	Adult	G	1
North East Region	Puffin	Adult	E	2
North East Region	Kittiwake	1st year	F	1
Isle of Man	Shag	1st year	Local	1
			Total	11

* Ringing areas (first three) are shown on Figure 5 and recovery areas marked by letters on Figure 1. NB. Only oiled birds recovered from December 1980 to February 1981 are included in this list.

Table 6. Recoveries of birds from Great Saltee, Co. Wexford, tabulated by species, age at recovery and recovery area.

Species	Age at recovery	Found in recovery area *: E	F	G	H	J	Others	Total
Guillemot	1st year			1	2		1	4
	Immature				2	2		4
	Adult				1			1
Razorbill	1st year			1		2		3
	Adult			2	1			3
Shag	1st year						1	1
Totals				4	6	4	2	16

* Recovery areas are marked on Figure 1. NB. Only oiled recoveries of birds from December 1980 to February 1981 are included in this table.

Table 7. Totals of oiled and 'found dead' Guillemots and Razorbills reported during December, January and February.

GUILLEMOTS	1st year		Immature		Adult		Totals	
	1967-79	1980-81	1967-79	1980-81	1967-79	1980-81	1967-79	1980-81
Oiled	16	33	22	18	30	8	68	59
'Found dead' *	23	7	16	6	17	5	56	18
Totals	39	40	38	24	47	13	124	77
RAZORBILLS								
Oiled	14	4	19	3	22	13	55	20
'Found dead' *	41	2	20	2	23	.	84	4
Totals	55	6	39	5	45	13	139	24

* 'Found dead' includes any birds which were found on beaches and not reported as being oiled. Birds known to have been hunted or caught in fishing gear are excluded. The period 1967-79 spans twelve winters - 1967-68 to 1978-79. Some more recoveries referring to the 1980-81 period may be reported later: reporting times may be as long as three or four months.

Table 8. Total number of 'years at risk' for the different age groups of Guillemot and Razorbill 1967-79 and 1980-81.

	1st year		Immature		Adult	
	1967-79	1980-81	1967-79	1980-81	1967-79	1980-81
Guillemots	15,000	3,500*	16,500	4,500	51,500	9,000
Razorbills	16,000	2,500*	21,000	3,500	85,500	9,500

* Estimated - 1980 ringing totals not yet available. Other figures calculated from published ringing totals using 50% first year survival, 84% immature survival and adult survival of 94% (Guillemot) and 91% (Razorbill).

Table 9. Assessment of 1980-81 winter mortality compared with average for each winter 1967-79.

	1st year	Immature	Adult
Guillemot	4 to 5	2.3	1.6
Razorbill	normal	0.8	2.6

The entry of 2.6 indicated that winter 1980-81 mortality was 260% of the average for 1967-79.

Table 10. Percentage of winter recoveries reported as oiled by age category, comparing the winters 1967-79 with the winter 1980-81.

	1st year	Immature	Adult	Total
Guillemot 1967-79	41%	58%	64%	55%
1980-81	83%	75%	62%	77%
Significance	$P < 0.001$	$P < 0.01$	N.S.	$P < 0.001$
Razorbill 1967-79	25%	49%	49%	40%
1980-81	67%	60%	100%	83%
Significance	$P = 0.05$	N.S.	$P < 0.001$	$P < 0.001$

NB. Some sample sizes are small - see Table 7 for full data on which this is based.

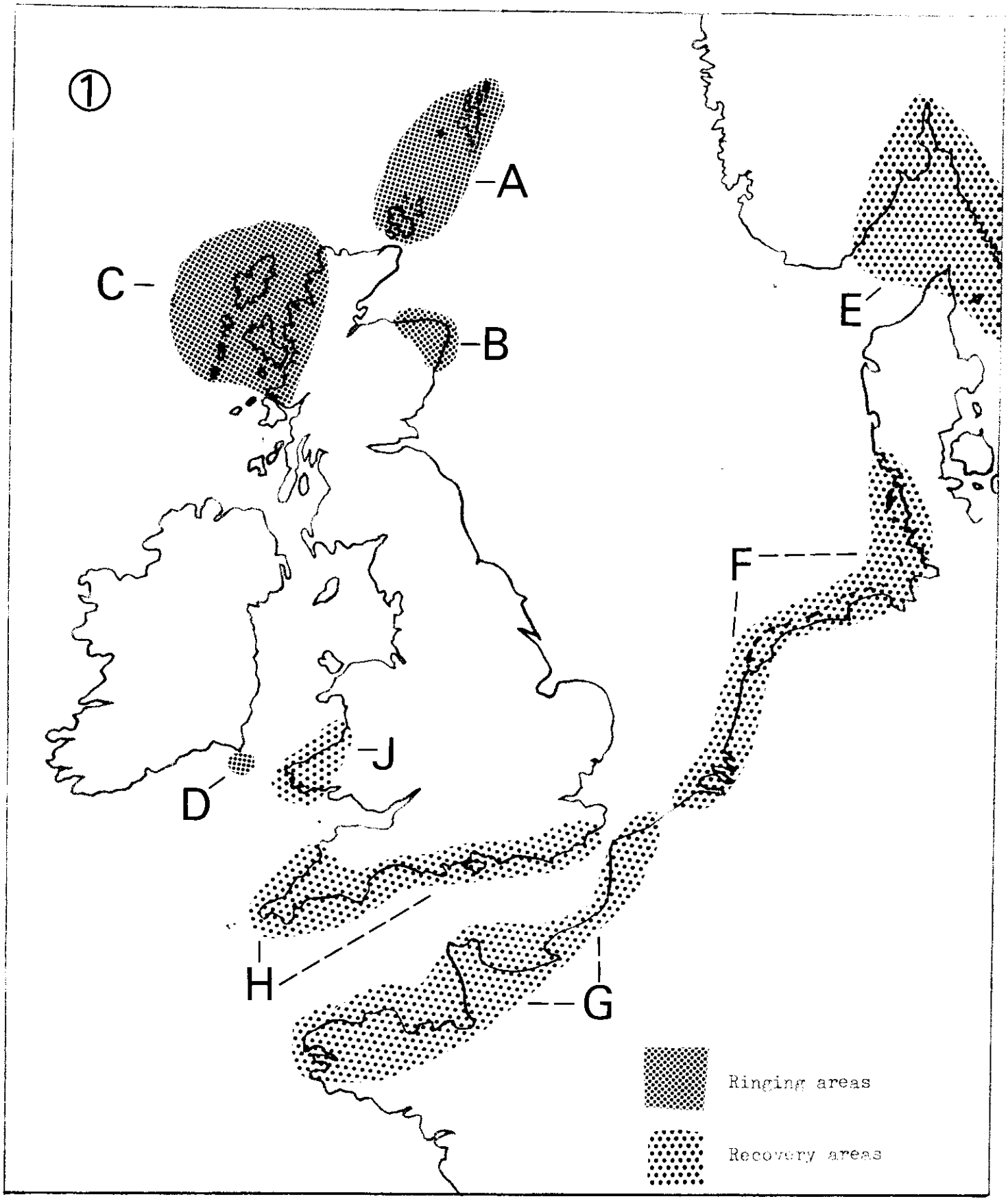


Figure 1. Key to areas used in the tables.

Ringing areas:

A North-east Scotland Region, Orkney and Shetland.

B North-east Scotland Region, mainland - Grampian.

C North-west Scotland Region.

D Great Saltee, Co. Wexford.

Recovery areas:

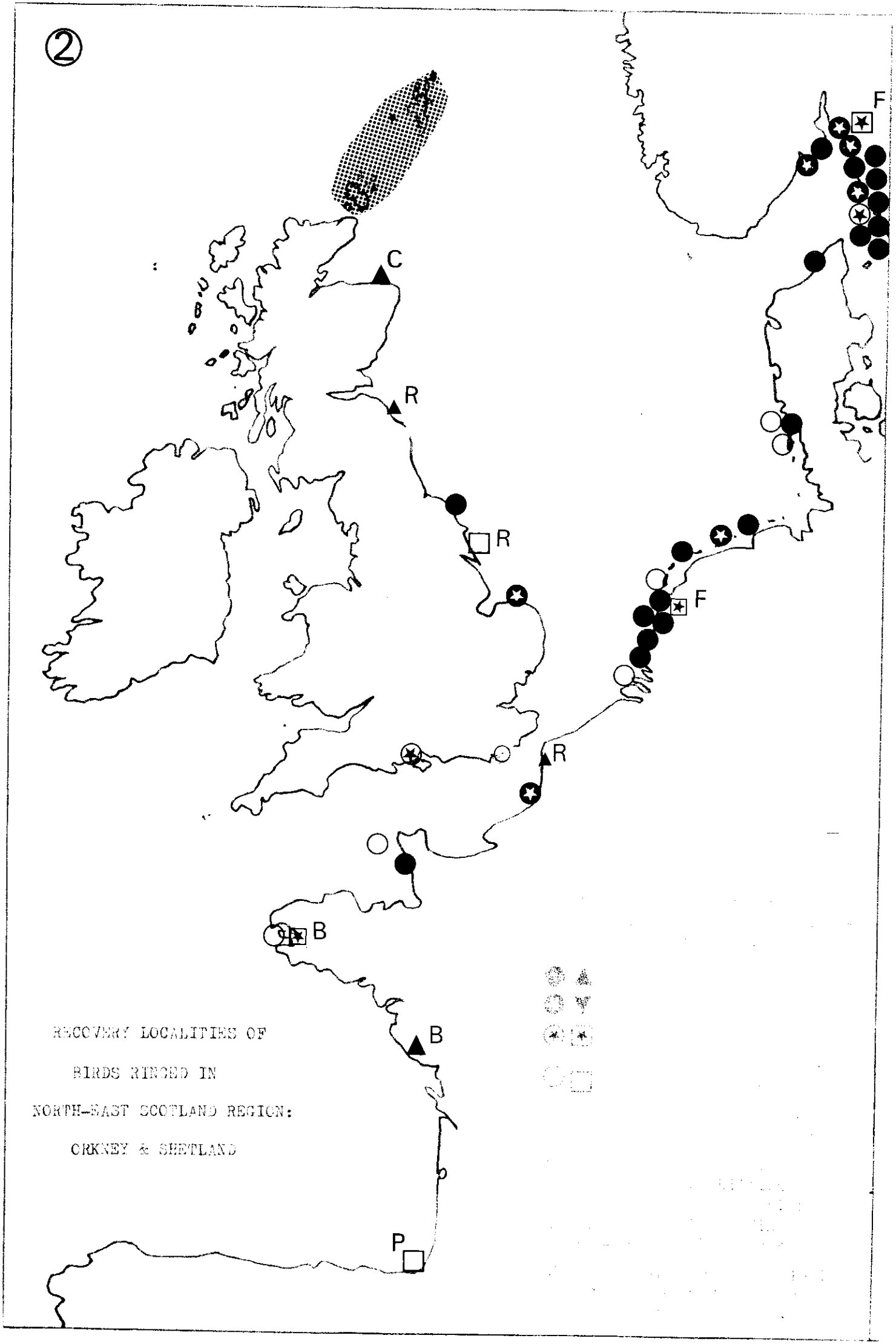
E Skagerrak oiling - mainly Sweden, some Norway and Denmark.

F South-east North Sea - most from from the Netherlands.

G North coast of France.

H South coast of England.

J South-west Wales.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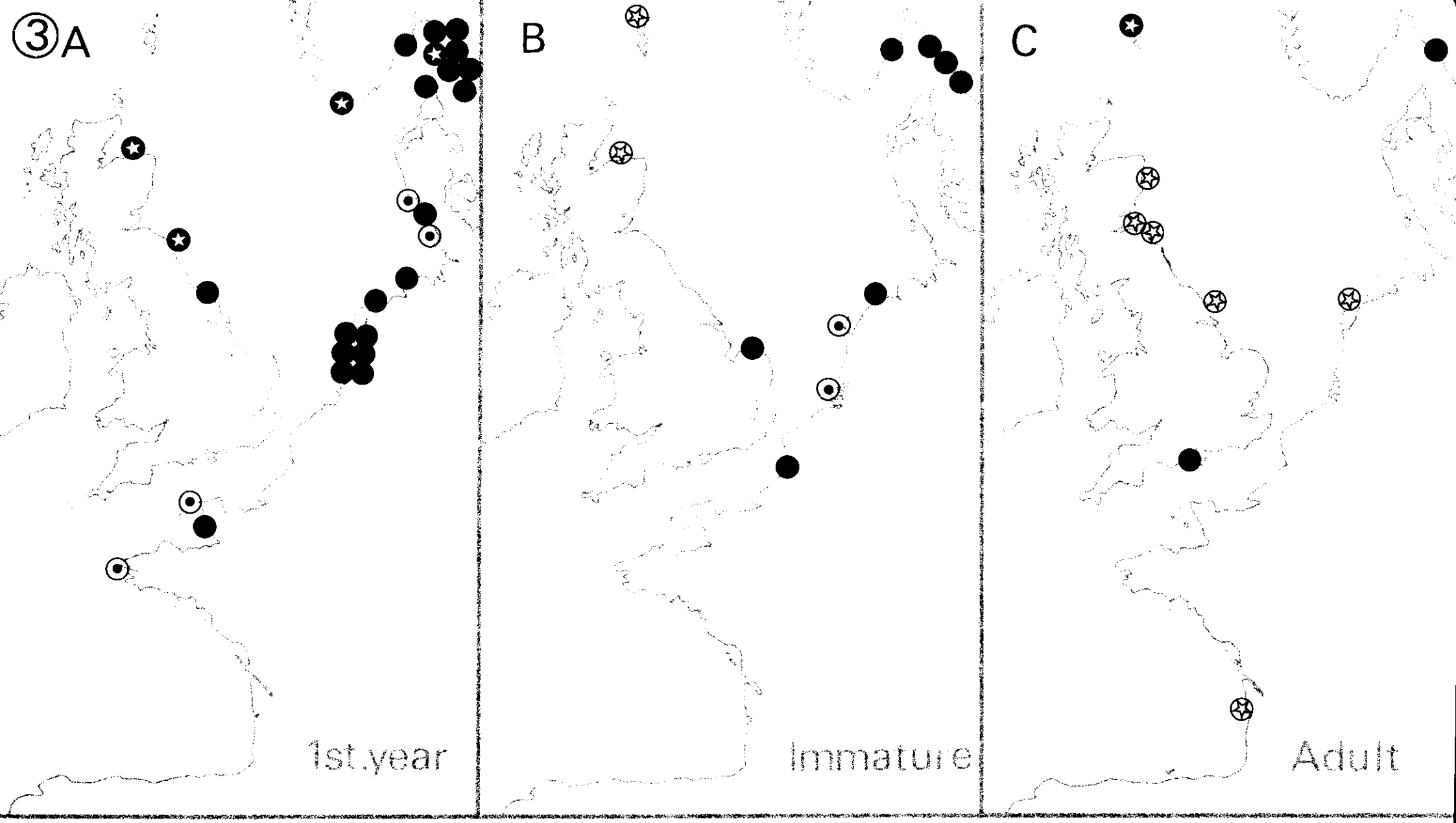
RECOVERY LOCALITIES OF
BIRDS RINGED IN
NORTH-EAST SCOTLAND REGION:
ORKNEY & SHETLAND

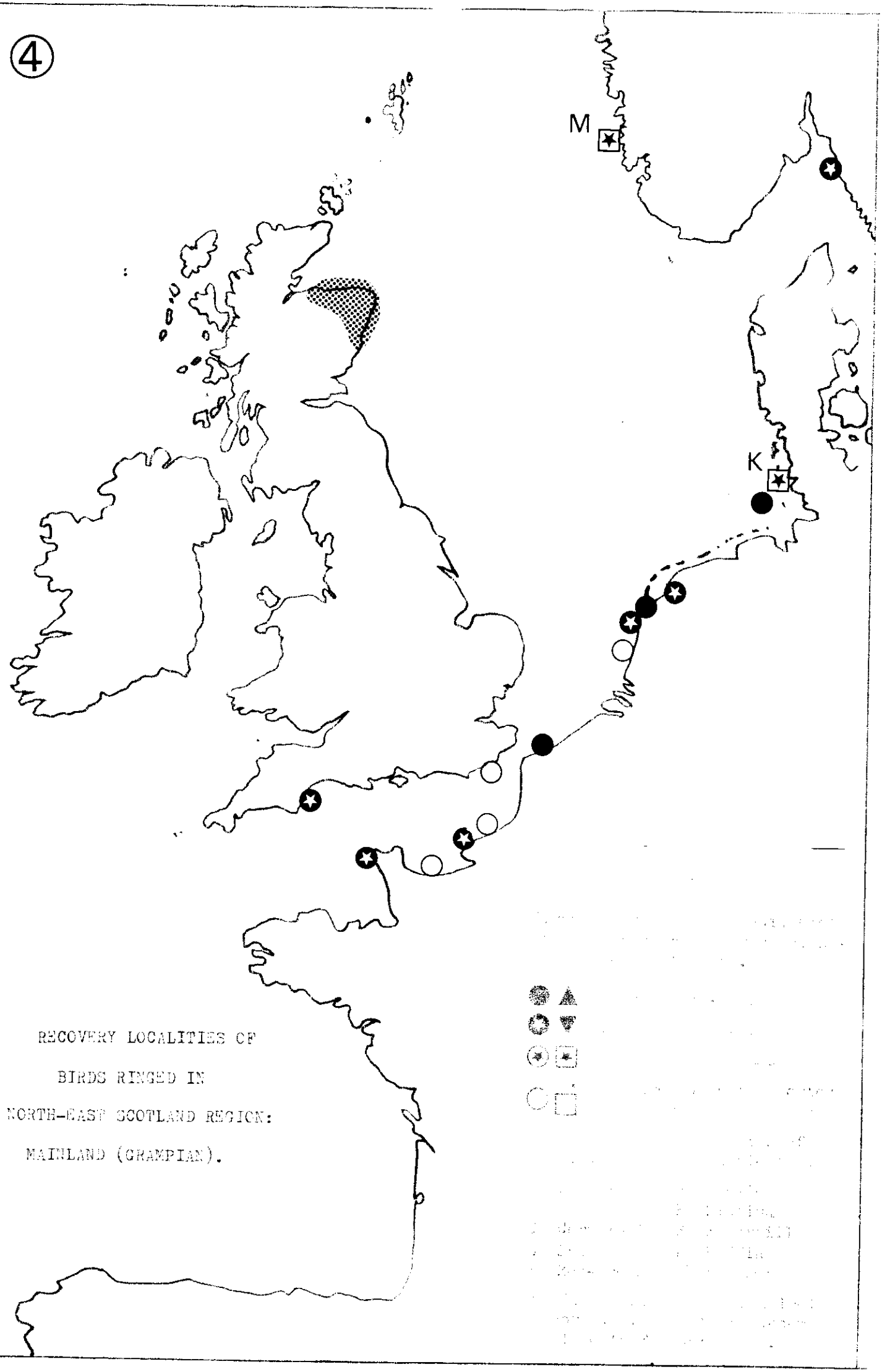


Orkney & Shetland : Guillemots

LEGEND

	1967 - 79	1980/81
OILED	★	●
UNOILED	☆	⊙

④

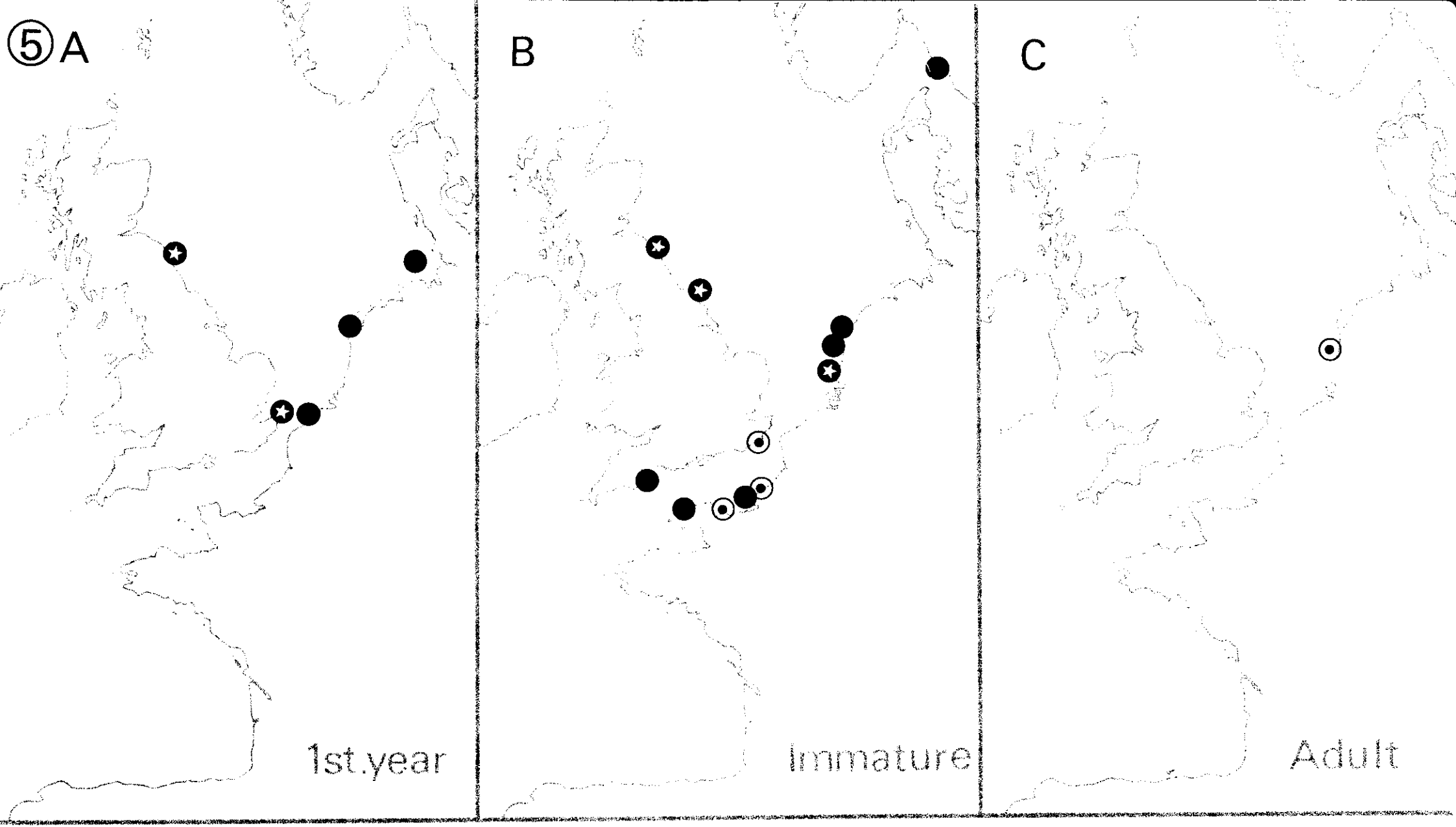


RECOVERY LOCALITIES OF

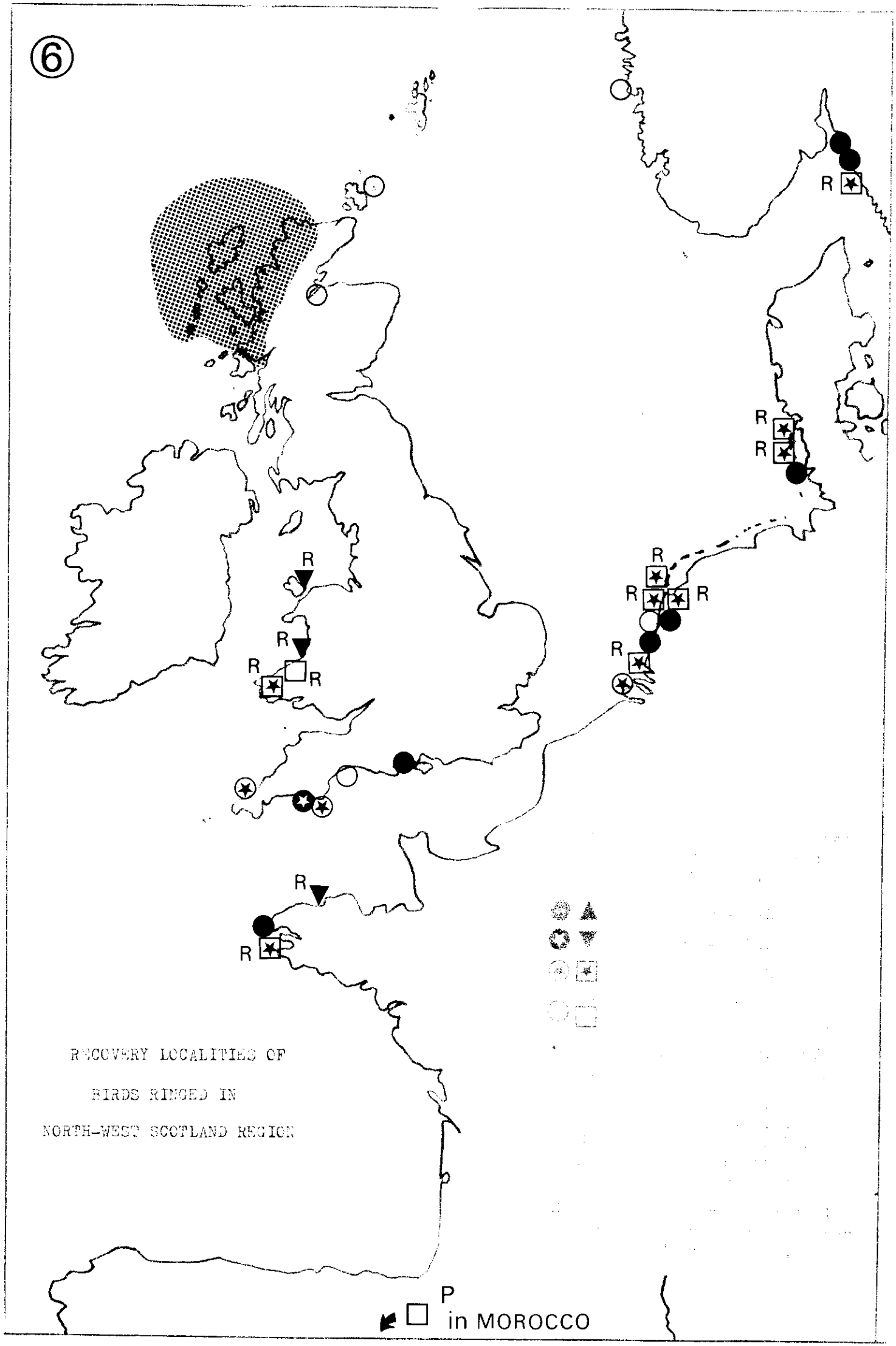
BIRDS RINGED IN

NORTH-EAST SCOTLAND REGION:

MAINLAND (GRAMPIAN).



N-E Scotland (Grampian): Guillemots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RECOVERY LOCALITIES OF
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NORTH-WEST SCOTLAND REGION
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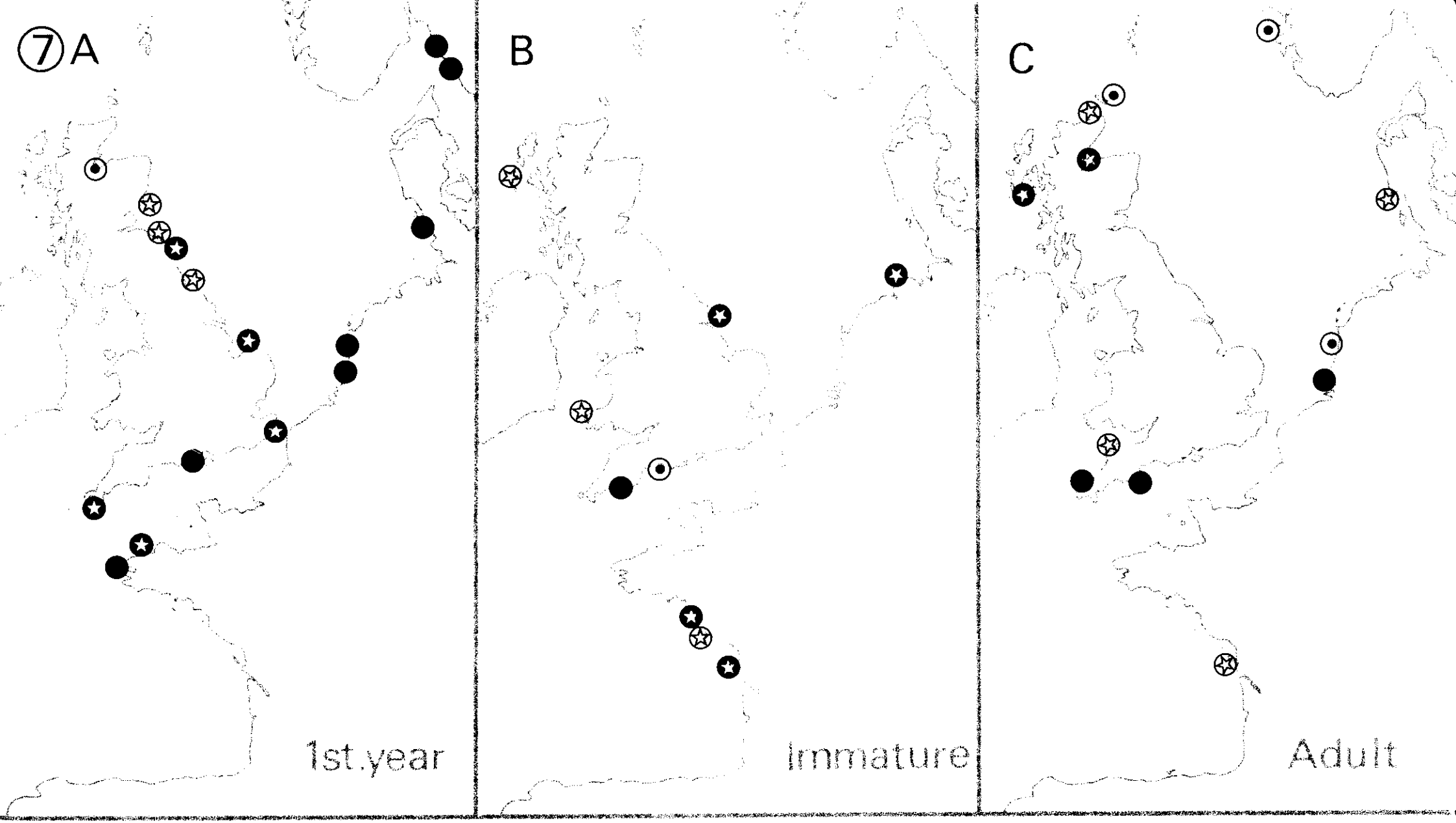
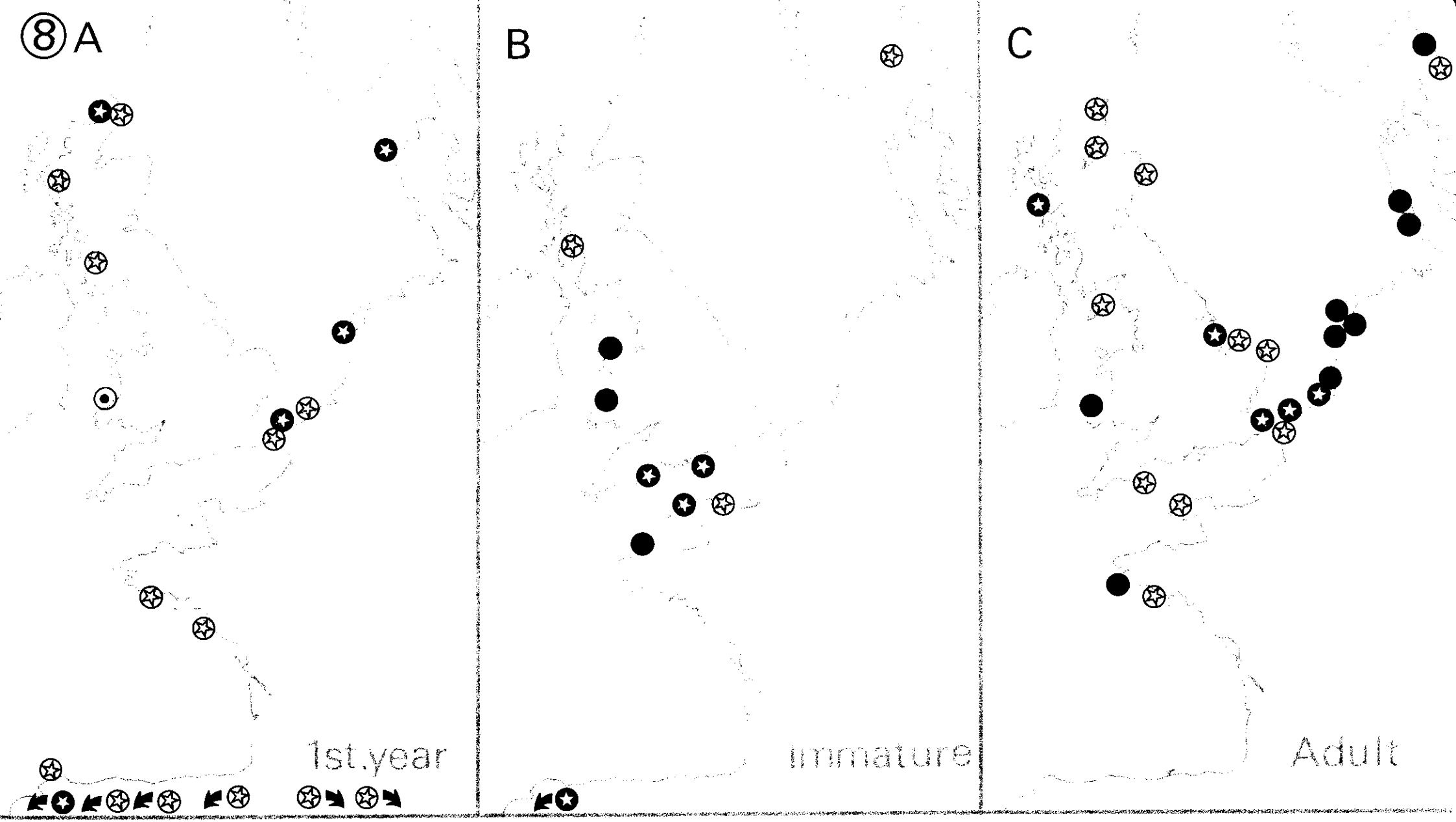


N-W Scotland : Guillemots

LEGEND

	'67-79	1980/81
OILED	●	●
UNOILED	⊛	⊙

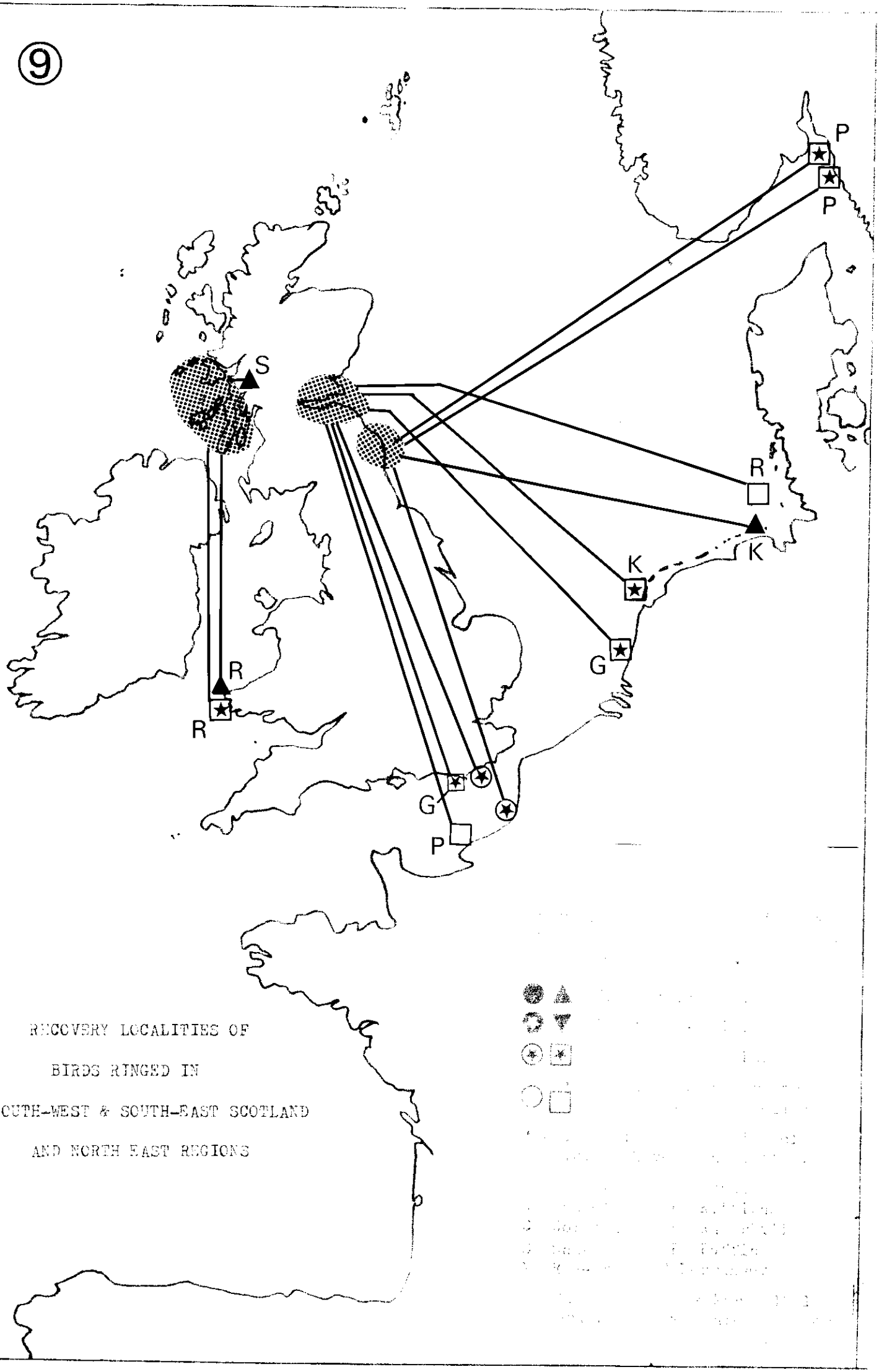


N-W Scotland: Razorbills

LEGEND

	1967-79	1980/81
OILED		
UNOILED		

⑨



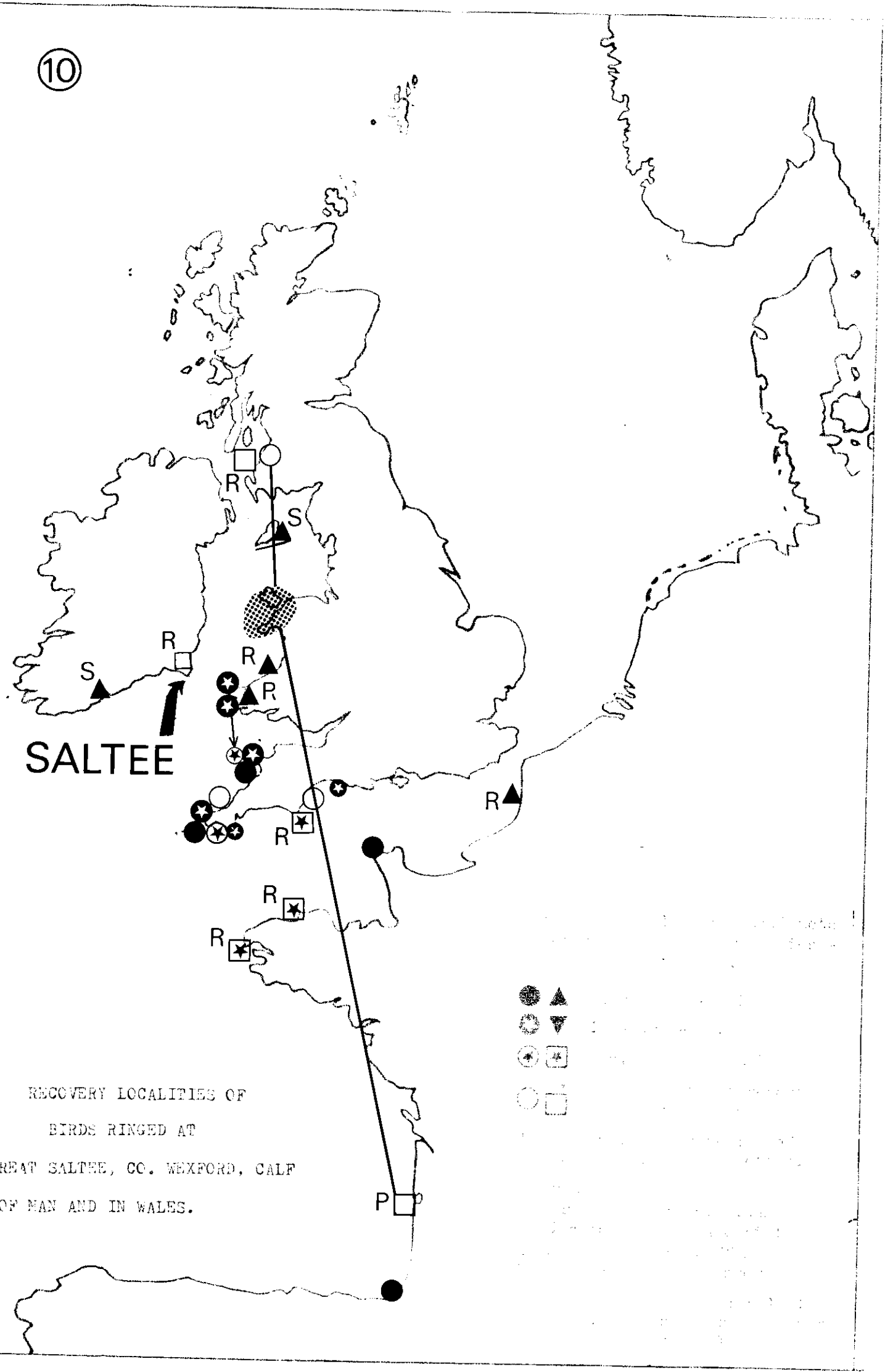
RECOVERY LOCALITIES OF

BIRDS RINGED IN

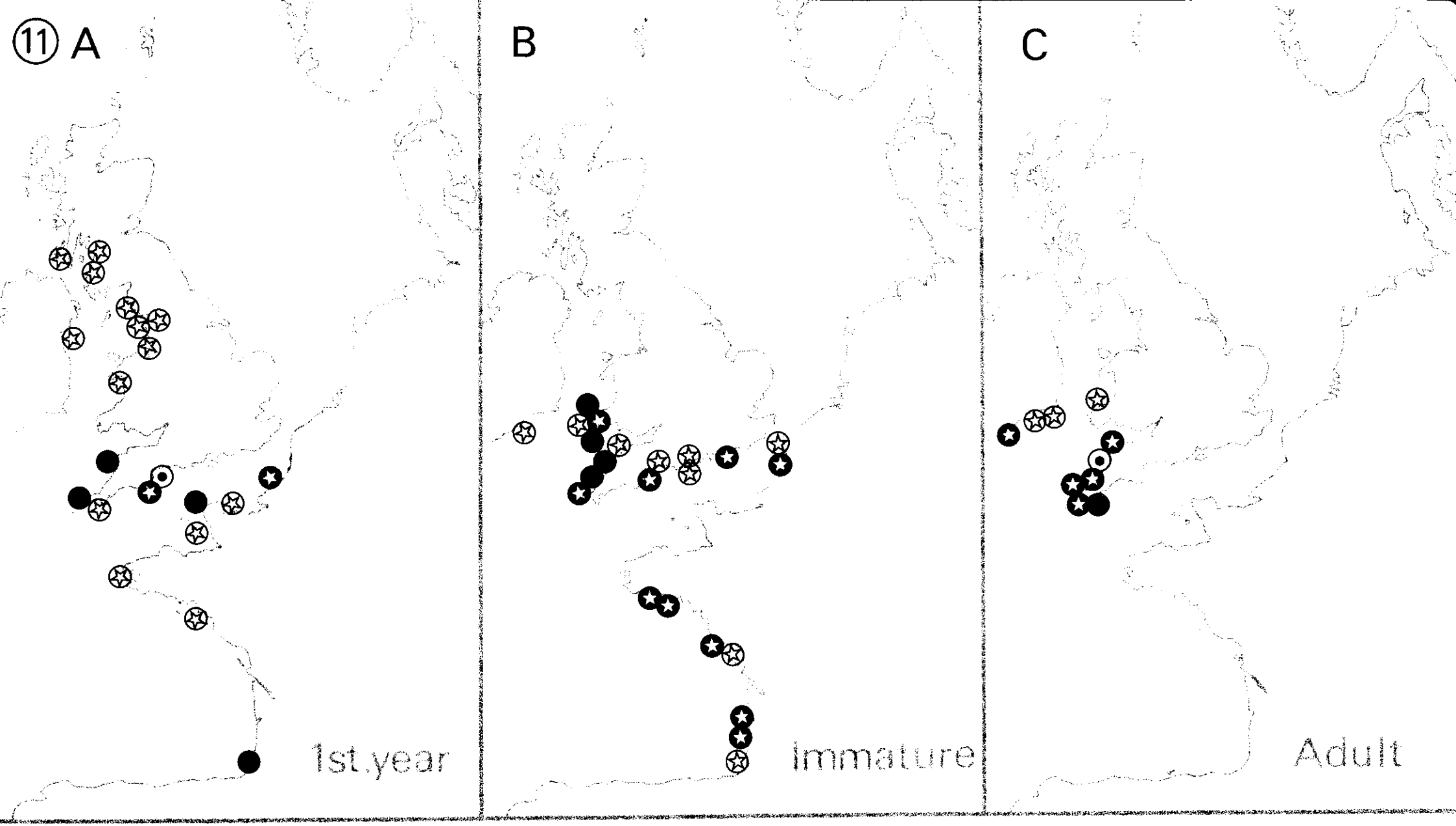
SOUTH-WEST & SOUTH-EAST SCOTLAND

AND NORTH EAST REGIONS

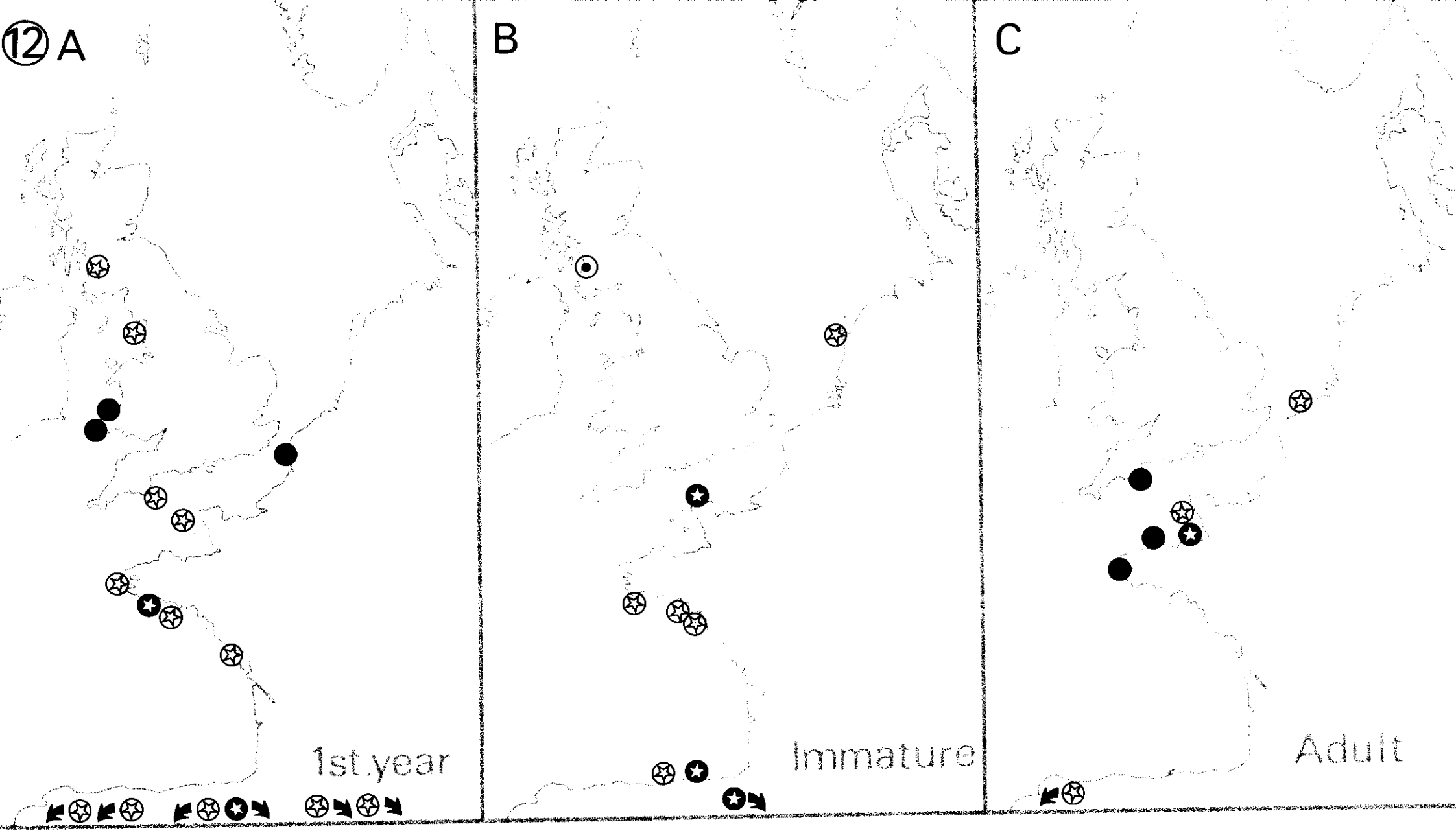
⑩



RECOVERY LOCALITIES OF BIRDS RINGED AT GREAT SALTEE, CO. WEXFORD, CALF OF MAN AND IN WALES.



Great Saltee : Guillemots



Great Saltee : Razorbills