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BIRD MORTALITY FOLLOWING THE MERSEY OIL SPILL, AUGUST 1989

A report by the British Trust for Ornithology
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Liverpool Museums and Galleries
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to the
Mersey Oil Spill Project Advisory Group
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by

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The oil spilled in the Mersey in August 1989 oiled a large number of birds soon after the incident. However, owing to the highly viscous nature of the oil involved, it rapidly solidified. This meant that no further oiling occurred after the first few days.

It is considered likely that many of the birds that were oiled subsequently died as a result of the oiling, not through ingestion of the oil but through the reduced insulation of oiled feathers. There was no evidence of birds moulting out oiled plumage. The last oiled birds were seen just before the first frosts adding weight to the suggestion that many oiled individuals died.

Of the 45 species of which individuals were either seen oiled or found dead, only 5 species had in excess of 5 individuals collected in a sufficiently fresh state for biometric data to be taken. Only for one of these species, the Herring Gull, was it possible to identify a single breeding population as being affected. This was found to be the British breeding population. Fifteen or more birds were seen to be oiled in a further 10 species.

Even for the most seriously affected species (Black-headed Gull), only 0.33% of the population was considered to have beed affected. For all other species, less than 0.2% of the identifiable population was affected. No species or sub-population was considered likely to have been seriously affected by the oil-spill.

1 INTRODUCTION.

A collection of tideline corpses by Liverpool Museum has shown that at least 200 birds died as a result of the Mersey oil spill in August 1989. Approximately four thousand more birds were known to have become oiled. The majority of the birds affected by the spill were seabirds (particularly gulls), wildfowl and waders. Some of these species breed as far north as Greenland and Siberia, while their wintering ranges in some cases extend as far south as South Africa. Many species, for example Dunlin, have discontinuous breeding ranges and these geographically separated groups have formed sub-species (also known as races). Other species, such as Redshank, show morphological separation between breeding populations without separation into sub-species. In general there are some differences in the timing of breeding and moulting between morphologically distinct groups and further differences in distribution outside the breeding season (Prater 1981).

British estuaries are used as breeding areas, as staging posts on regular migration routes and as wintering areas by many species of wader, wildfowl and seabird. This report uses biometric data obtained from the dead birds collected after the oil spill to determine which populations of each species were affected and to what degree.

2 METHODS

Detailed analysis was carried out on the biometric measurements of all the species for which more than five specimens were found dead during the autumn and winter following the spill. Past biometric studies have used various measurements to discover differences between different populations of birds (e.g. Barrett et al. 1985). However, the ones thought to yield the best results over a range of species are wing length, culmen (ie. upper mandible of bill) length and the length of the tarsus and toe combined (e.g. Engelmoer 1984). For the purposes of this study these three sets of measurements were analysed and graphs showing the relationship between these three variables were plotted for each species. More than one cluster of points might suggest the presence of birds from more than one population. Three graphs (wing length vs. culmen length, wing length vs. tarsus and toe length and culmen length vs. tarsus and toe length) were also plotted, with birds in active moult and those not moulting plotted separately to reveal whether differences in size were correlated with differences in stages of moult and thus whether representatives from more than one population might be present. Where two or more sub-species were known to be present they were plotted separately to highlight any physical differences.

3 RESULTS

The oil spill of August 1989 consisted of TJP crude oil from Venezuela. This is a highly viscous oil and virtually all the birds later seen to be oiled were contaminated in the first few days after the spill. After this, the oil rapidly became hardened and solidified at the top of the shore. Very few of the birds that were oiled were found to be lightly oiled, most having a substantial amount of oil and a comparatively small number of birds were completely coated in oil and died rapidly. There was therefore a substantial number of birds which were oiled but not found dead subsequently. The fate of these birds is unknown, but the nature of the oil is likely to have led to a high mortality, due to the oil rapidly hardening on the feathers and becoming effectively inert. This implies that birds did not die from the corrosive nature of oil when ingested, explaining why some oiled birds remained present in the Autumn until the first frosts. No oiled birds were observed to be moulting into new clean feathers, suggesting that they did not shed the oil in this manner. Further the nature of the oil meant it was unlikely that they would have been able to clean the feathers themselves. The fact that the last oiled birds were seen just before the first frosts of the Autumn suggests that many, if not all birds succumbed in cold weather due to a lack of insulation. However, by the time of the first frosts, oiled birds had dispersed over such a large area that they were not found dead in unusual numbers in any one place.

Throughout the rest of this report it is therefore assumed that the maximum number of oiled birds was a realistic estimate of the number of each species that actually died. This is likely to be a worse case scenario because a few of the birds reported to be oiled will have been so lightly oiled that they will have survived. This proportion is, however, considered likely to have been small.

The following species accounts summarise what is known about the origins of the five species for which a sample of more than five birds were found dead after the spill. The results of the biometric analysis are discussed within this context and conclusions drawn as to which populations of each species were affected by the spill. In addition, a further ten species were known to have had more than fifteen individuals contaminated by the spill and the impact on these species is considered.

3.1 Cormorant - 17 individuals oiled.

There are six sub-species of Cormorant within the Western Palearctic but of these only one, Phalacrocorax carbo carbo, breeds within the British Isles, also breeding in south Greenland, Iceland, Canada, north-west Europe and Scandinavia (Cramp & Simmons 1983). This species tends not to migrate long distances, the few foreign-ringed birds recovered in Britain originating from north-west Europe and Norway. This pattern of behaviour would suggest that the eight birds picked up dead as a result of oiling were locally breeding birds and analysis of the biometric data supports this suggestion (Figures 1 & 2). Measurements recorded are within the range published for P.c.carbo (Cramp & Simmons, 1983) which is the largest European race of this species. The timing of the spill and the absence of birds with wing lengths less than 343mm. both suggest that P.c.carbo was the only sub-species affected by the oil spill.

3.2 Mallard - 40 individuals oiled

The British breeding population of Mallard probably numbers in excess of 200,000 individuals (Owen et al. 1986), with a winter population of probably half a million birds. The deaths of around 40 individuals on the Mersey is therefore insignificant in terms of the breeding population, especially when it is considered that several hundred thousand Mallard are shot by wildfowlers and some 400,000 captive-bred birds are released annually.

3.3 Ringed Plover - 48 individuals oiled

Ringed Plover present in the Irish Sea in August are likely to be mainly birds on pasage between breeding areas in Iceland and Greenland and wintering areas in Africa. This population in total is considered to hold 75,000 breeding pairs, probably some 200,000 individuals (Piersma, 1986), in relation to which 48 oiled individuals is insignificant. Within Britain however, there is a population of some 8,500 pairs, approximately some 24,000 individuals. Although this mortality is small even in a British context, there may have been some effect on the local breeding population had these birds been affected, although the chances of the oiled birds being from a population other than that breeding in Iceland/Greenland are considered to be small.

3.4 Sanderling - 85 individuals oiled

In August, two populations of Sanderling are likely to be present in Britain: those undergoing wing-moult which, are likely to remain in Britain throughout the winter, and those using the area just as a staging post on migration to winter quarters further south, principally in Africa. The origins of these two groups are still uncertain; however, it is likely that the majority of the migrant birds are on passage from the breeding population in Greenland where some 17,000 pairs are estimated to breed (Piersma, 1986). Mortality at this level in an isolated event is unlikely to have a significant effect on these populations.

3.5 Dunlin - 29 individuals oiled

Three races of Dunlin are present in the Irish Sea in August: arctica which breeds in north east Greenland, schinzii which breeds in northern Britain and Iceland, and alpina which breeds in Fenno-Scandia and across Siberia. The first two races winter in

Africa and use the Britain as a staging post, whereas, the third winters in Britain. The arctica race, which breeds in north east Greenland, has the smallest population with only some 15,000 birds. The number of oiled birds would be insignificant even if all individuals came from this race.

3.6 Curlew - 18 individuals oiled

By August, individuals from the breeding populations in Britain, the Netherlands and Fenno-Scandia are all likely to be present on British estuaries where they will be undergoing their annual moult. The flyway population of Curlew is estimated in the order of 350,000, hence the mortality from the Mersey oil-spill is considered to be insignificant.

3.7 Redshank - 50 individuals oiled

Redshank present in the Irish Sea in August are likely to be predominately British breeders, but with some birds starting to arrive at this time from breeding grounds in Iceland. The British breeding population of Redshank is approximately 90,000 so this mortality is unlikely to have had any effect on this population.

3.8 Black-headed Gull - 3307 individuals oiled.

This species is monotypic, despite having an extremely wide breeding range stretching from Iceland, the Faeroes and Britain, east through most of Europe to Asia. The breeding population in northern Europe is considered to be about one million pairs. Within Britain, breeding is chiefly confined to inland and coastal marshes and is most common in the north and west. During the winter, birds are found well south of their breeding range and the species is chiefly a summer visitor to much of the northern part of its range (Cramp & Simmons 1983). However, non-breeding birds, particularly first year individuals, may spend the summer well away from the breeding grounds (Witherby et al. 1965). The vast majority of British birds spend the winter within Britain (Radford 1962, Flegg & Cox 1972), although small numbers may move as far south as north Africa (Bannerman 1962).

The British wintering population is supplemented by large numbers of birds from northern Europe, particularly the Baltic region (Radford 1962). Horton et al. (1984) found that most recoveries of foreign-ringed birds originated from the North Sea and Baltic coasts, with much smaller numbers from inland areas of eastern Europe as far south as Czechoslovakia, while MacKinnon and Coulson (1987) estimated that 71% of Black-headed Gulls wintering in England and Wales are of Continental origin. The main concentrations of recoveries of continental-ringed birds probably reflects bird population density rather than differential mortality, although the effect of observer bias in areas of high human population should not be ignored. Despite extensive areas of overlap there is a broad latitudinal correlation between recoveries in the British Isles and the birds' country of origin; this results in the bulk of the movements occurring in the southern population of the English east coast. In addition, continental-ringed birds have been recorded breeding in this country (J.Kew pers.comm.) and this high degree of movement and mixing between populations is thought to be the reason that this species has not separated into sub-species. There is a size cline, such that northern birds are larger than those breeding further south but biometric data alone cannot be used to reveal the origins of individual birds.

The arrival of foreign birds in Britain begins in July. The presence of two Continental-ringed birds (one ringed in Denmark, the other in Lithuania) amongst the specimens used in the analysis confirms that the winter influx had already started at the time of the spill. As expected, the specimens obtained for this study exhibit a wide range of measurements (Figures 3 - 6). Figure 7 shows a frequency histogram of culmen length which demonstrates the high degree of variability in this measurement and suggests that birds were present from several breeding areas. This is confirmed by the recovery of the two continental birds as oil spill casualties.

Even though some 3300 birds were oiled it is highly unlikely that this had any effect on the Black-headed Gull population of Western Europe as it amounts to around 0.33% of the population in this region.

3.9 Common Gull - 30 oiled

By late August Common Gulls from breeding colonies throughout Europe are likely to occur within the Irish Sea (Cramp & Simmons, 1983). The British breeding population of Common Gulls is estimated at approximately 50,000 pairs (Sharrock 1976) with other very large populations in Norway and Sweden totalling some 400,000 pairs. The observed level of oiling will not have any detectable effect on Common Gull populations either in Britain or Europe.

3.10 Lesser Black-backed Gull - 61 oiled

Over 200,000 pairs of Lesser Black-backed Gulls breed in Europe, with something in excess of 50,000 breeding in Britain (Cramp and Simmons 1983). The number of birds oiled is insignificant by comparison to the British breeding populations and it is extremely unlikely that any section of this population would have been affected by the oil-spill.

3.11 Herring Gull - 351 oiled

There is considerable variation in the mobility of Herring Gulls originating from the British Isles. Long distance movement is more frequent in birds reared in the north and east of Britain, but the distances travelled by British Herring Gulls are still relatively short (Coulson & Butterfield 1985). Adult Herring Gulls spend a much smaller part of the non-breeding season in their wintering areas than do immature birds. This, together with the low mortality rate of adults in winter results in proportionately fewer recoveries at a distance from the natal area, giving lower average distances moved than for immature birds outside the breeding season.

The variation in the nominate argentatus group is clinal: the smallest, palest birds occur in the Faeroes, Britain and Ireland; the largest, darkest ones in northern Norway and on the Murmansk coast. Barth (1975a, 1975b) suggested that differences between the large Fenno-Scandian and the small North Sea populations (Britain, Faeroes, Iceland, Netherlands) were so pronounced that the latter should be given sub-specific recognition as L.a.argenteus, with Fenno-Scandian birds representing the nominate argentatus. Voous (1959) had already rejected this idea, but did believe that the natal origin of specimens taken in winter in Britain could be determined on the basis of body measurements. Stanley et al. (1981) obtained biometric measurements of Herring Gulls wintering in the south-east of England and concluded that the majority of these birds were of Arctic Norwegian or Russian origin. Continental birds are more common in the south and east than in the north and west (Coulson et al. 1984). There is a much lower probability of other sub-species wintering in the British Isles, although an occasional individual from the Mediterranean or south Atlantic sub-species L.a.michahellis or L.a.atlantis, is recorded.

The measurements obtained during this study were compared with published values. The measurements shown in Figure 8 were found to be at the lower end of the range of values quoted by Stanley et al.(1981) for birds originating from breeding areas from Norway to Britain, only two birds being above the mean for northern populations.Further the measurements compare very well with values obtained for British breeding birds by Coulson et al. (1983) (Figure 8).

Barth (1975b) found that the primary moult of Norwegian Herring Gulls begins in May and lasts until December. The moult of British birds has been described as commencing any time between

May and late June to early July (Harris 1971) but finishing by October. Consequently, British birds might be expected to be more advanced in their moult in August than those from the Continent. When the moult score of the specimens was taken into account no obvious pattern emerged (Figures 9 -11).

Dispersal of Herring Gulls from their breeding grounds begins in July but does not start in earnest until late August or early September (Cramp & Simmons, 1983). This and the fact that fewer Continental birds penetrate as far as the west of Britain, combined with the results of the biometric analysis, suggest that the birds that died as a result of the oil spill were locally breeding birds. There are in excess of 300,000 breeding pairs of Herring Gulls in Britain (Cramp & Simmons 1983) and the death of the observed number of oiled birds will have no detectable effect on the British population.

3.12 Kittiwake - 28 oiled

The British breeding population of Kittiwakes is in excess of 400,000 pairs, of which the vast majority are in Scotland. By August there will have been wide dispersal from the breeding colonies (Cramp & Simmons, 1983), making it unlikely that the Kittiwakes oiled came from solely the colonies in the southern part of the Irish Sea. It is thus unlikely that any individual colony will have suffered any serious effects as a result of the oil spill.

3.13 Guillemot - 5 individuals oiled.

There are three sub-species of Guillemot within the Western Palearctic: albionis, aalge and hyperborea. Albionis and aalge occur within the British Isles. The smaller, paler albionis breeds in southern Scotland, south-west England and the Irish Sea basin, north-west France and as far south as Portugal. The larger, darker aalge breeds in northern Scotland and from Canada and Greenland across to Norway.

The geographical variation of the Guillemot in western Europe is clinal in at least three parameters: wing length, proportion of bridled birds and darkness of back colour, all of which increase with latitude (Witherby et al. 1965). Both sub-species were present among the birds found dead after the oil spill. However, the aalge specimens were not recovered until March the following year and consequently may not have died as a result of this particular incident. The biometrics of the albionis specimens collected show a clear linear relationship between wing length, culmen length and tarsus and toe (Figures 12 - 14). Most of the values plotted fall within the published range (Cramp & Simmons 1983); however those with a wing length of less than 185mm were almost certainly juveniles, which leave the breeding ledges while they are still a third to half the size of the adults and flightless. Adults undergo wing moult from August to early October, during which time they are also flightless, prior to winter dispersal. The specimens examined showed no wing moult. The timing of recovery of the specimens and their state of moult suggest that it is most likely that the birds found dead were from Irish Sea colonies. The majority of the specimens collected in the late autumn and early winter were almost certainly unconnected with the oil spill. They are more likely to have been part of an auk 'wreck' caused by poor feeding conditions.

3.2.14 Razorbill

There are two sub-species of Razorbill within the Western Palearctic, only one of which, A.t.islandica, breeds within the British Isles. Its breeding range also includes Iceland, the Faeroes, Heligoland and north-west France. A.t.torda is larger than islandica but nevertheless Hope Jones et al. (1983) found that only a small percentage could be unequivocally identified by size as the former. The flightless juveniles leave the breeding ledges accompanied by the adults in July and August. The adults then undergo a complete wing moult during which time they are also flightless. Many west Scottish birds disperse eastwards in autumn towards the Norwegian coasts and subsequently winter within the North Sea (Birkhead 1974, Lloyd 1974, Mead 1974). By contrast, birds from the Irish and Welsh colonies disperse southwards in the Atlantic towards the Bay of Biscay, few entering the North Sea. Biometric measurements do not reveal the presence of a sample of significantly larger birds among the specimens collected after the oil spill (Figure 15 & 16). The patterns of dispersal described for this species and the timing of the spill mean that the birds most likely to be affected would be from the Irish Sea breeding population. However, it is unlikely that any Razorbills were affected by this particular incident since none of the specimens were recovered dead until January 1990.

3.15 Additional species

Less than fifteen individuals were recorded oiled for each of the other thirty species affected by the oil spill. None of these populations were considered to have been affected by the spill.

4 DISCUSSION

In most taxa, males are larger than females but direct comparison of body measurements can lead to errors due to an overlap in body sizes (Barrett et al. 1985). Similarly, while sub-species may differ significantly in some body measurements, the differences between individuals are often not clear cut. The problem is compounded by differences that may occur within a sub-species, for example Kittiwakes, subspecies R.t.tridactyla, show a north-south size cline. In general, these birds are largest in the north of their range and smallest in the south. This type of cline is not unusual among birds with a very wide breeding range and illustrates the hazards of attempting to assign a bird to a particular race from its biometrics alone. In addition, differences in the measurements of groups of birds are often marginal such that a potential discrimination may be masked by variations in the observers measuring techniques or the intrinsic errors in the methods themselves (e.g. Gaston et al. 1984, Barrett et al. 1985, Ewins 1985). In this particular study it was obvious that corpses covered in oil or that were in an advanced state of decomposition were difficult to measure accurately and in some cases data had to be discarded. Thus caution was exercised when comparing measurements of this sample of birds with published values.

There were sufficient data for biometric analysis to be carried out on only five out of the forty-five species of bird found dead after the spill: Cormorant, Black-headed Gull, Herring Gull, Guillemot and Razorbill. With the exception of Black-headed Gull, all specimens of the species analyzed were considered to be from the British breeding population. It was concluded that Continental Black-headed Gulls constituted a significant proportion of the Black-headed Gulls present on the estuary at the time of the spill and that this was reflected in the sample of birds subsequently found dead. No species was killed in sufficient numbers for the spill to have affected any particular population. It is likely that due to its heavy nature, the oil solidified on the birds' plumage and that very little was ingested, resulting in fewer deaths. Consequently, those oiled birds found dead later in the year may have died as a result of a loss of insulation caused by the hardened oil clinging to their plumage. This would have affected the birds more seriously once the colder autumn and winter weather set in. Those birds found dead but not oiled much later in the season, for example Razorbills, may not have died as a result of this particular incident.

Many more birds were observed with oil on their plumage than were picked up dead after the oil spill. The worst possible result of this incident is that all the birds observed with oil on their plumage subsequently died. Even under these circumstances, the numbers of each species involved were not sufficient for the spill to have had a significant effect on any particular populations. The worst affected were the seabirds, particularly the gulls. The timing of the spill was fortuitous however, since the incident occurred before the return of the internationally and nationally important populations of waders and wildfowl that are supported by the Mersey estuary during the non-breeding season.

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Species	Breeding Area	Approximate Population	Number Oiled	% Affected
CORMORANT *Phalacrocorax carbo*	Britain	24,000	17	0.07
MALLARD *Anas platyrhynchos*	Britain	500,000	40	<0.01
RINGED PLOVER *Charadrius hiaticula*	Nearctic	200,000	48	0.02 max
	Britain	25,000	48	0.19 max
SANDERLING *Calidris alba*	Nearctic	51,000	85	0.16
DUNLIN *Calidris alpina arctica*	Greenland	15,000	29	0.19 max
CURLEW *Numenius arquata*	N.W.Europe	350,000	18	<0.01
REDSHANK *Tringa totanus*	Britain	90,000	50	0.05
BLACK-HEADED GULL *Larus ridibundus*	Europe	1,000,000	3307	0.33
COMMON GULL *Larus canus*	W.Europe	400,000	30	<0.01
LESSER BLACK-BACKED GULL *Larus fuscus*	Britain	150,000	61	0.04
HERRING GULL *Larus argentatus*	Britain	900,000	351	0.04
KITTIWAKE *Rissa tridactyla*	Britain	1,400,000	28	<0.01
GUILLEMOT *Uria aalgae*	Britain	1,700,000	5	<0.01

TABLE 1 The proportions of identifiable populations that were affected by the Mersey oil spill of August 1989. (NB 'max' indicates a maximum value if more than one population is likely to be involved).

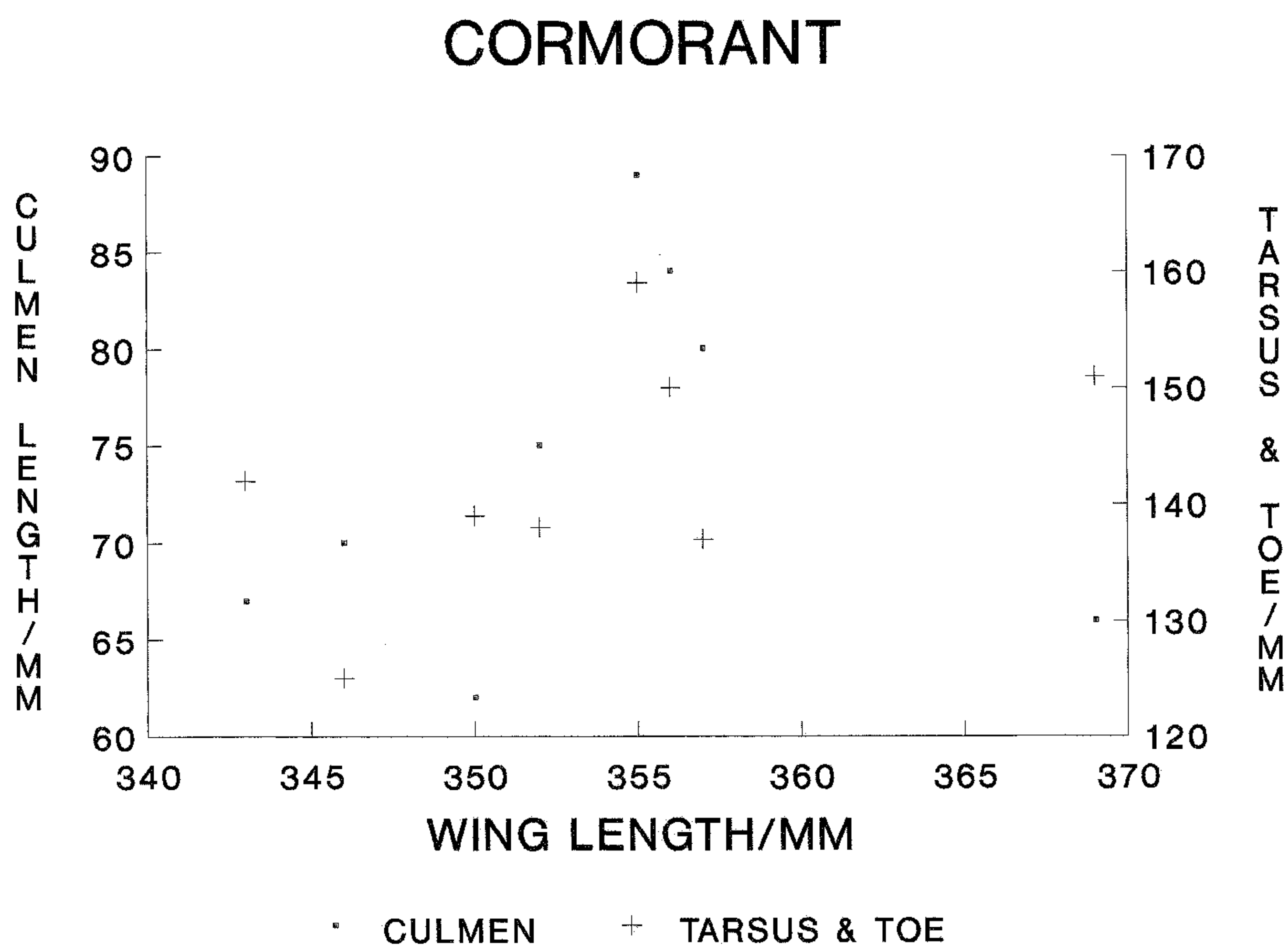

Figure 1. A comparison of culmen and tarsus and toe measurements with wing length for Cormorant, based on birds found dead after the Mersey oil spill, August 1989.

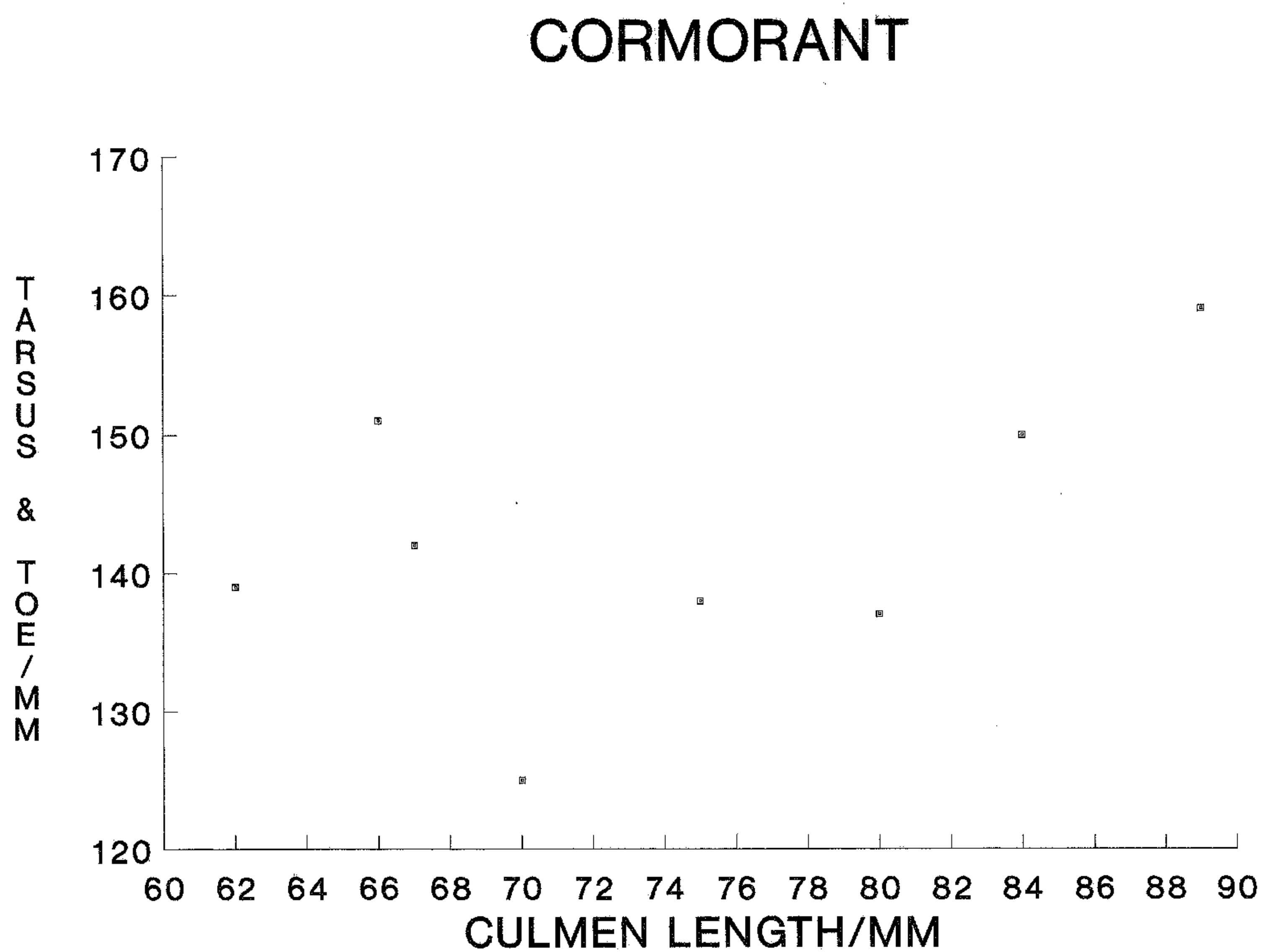

Figure 2. A comparison of tarsus and toe length with culmen length for Cormorant, based on birds found dead after the Mersey oil spill, August 1989.

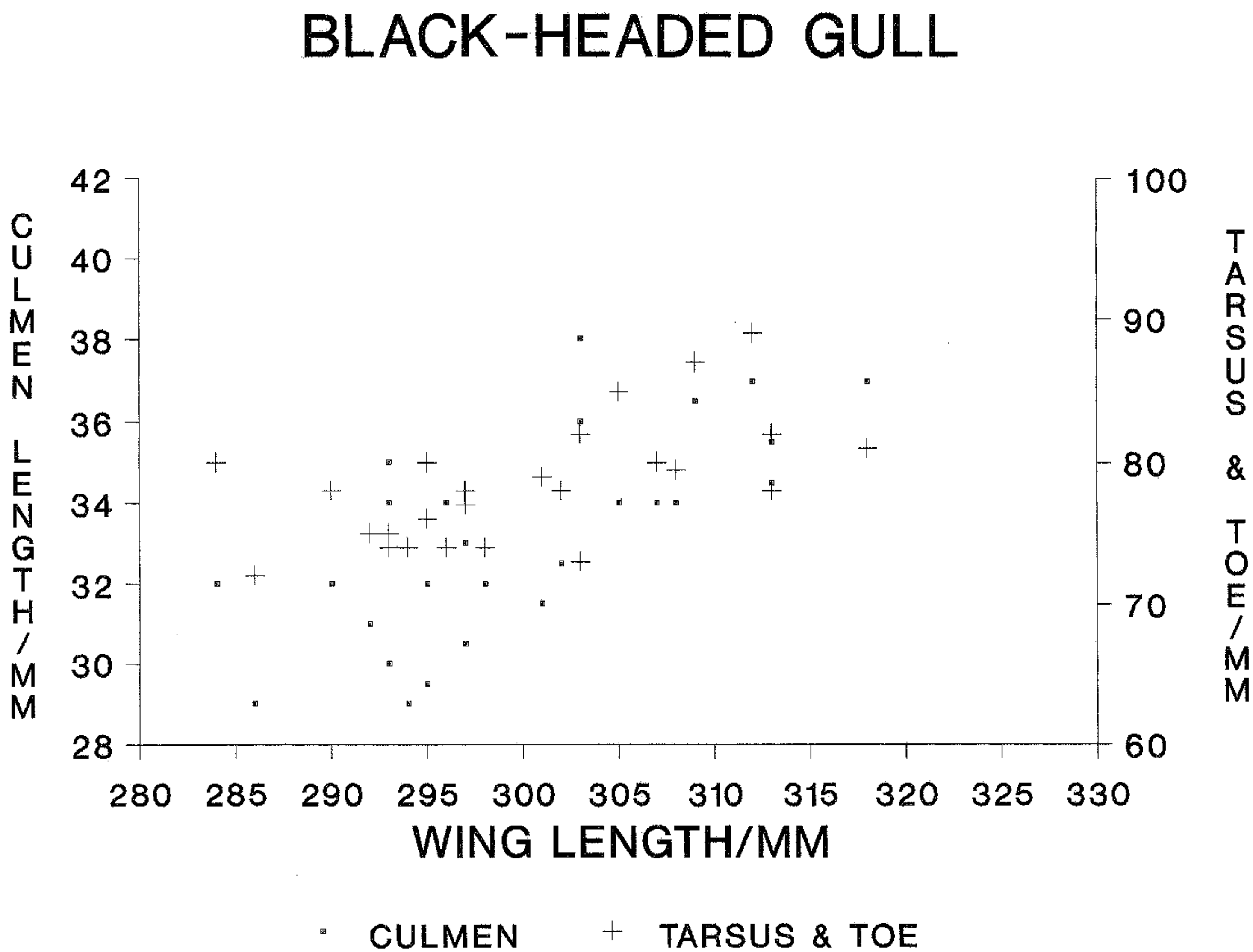

Figure 3. A comparison of culmen and tarsus and toe measurements with wing length for Black-headed Gull, based on birds found dead after the Mersey oil spill, August 1989.

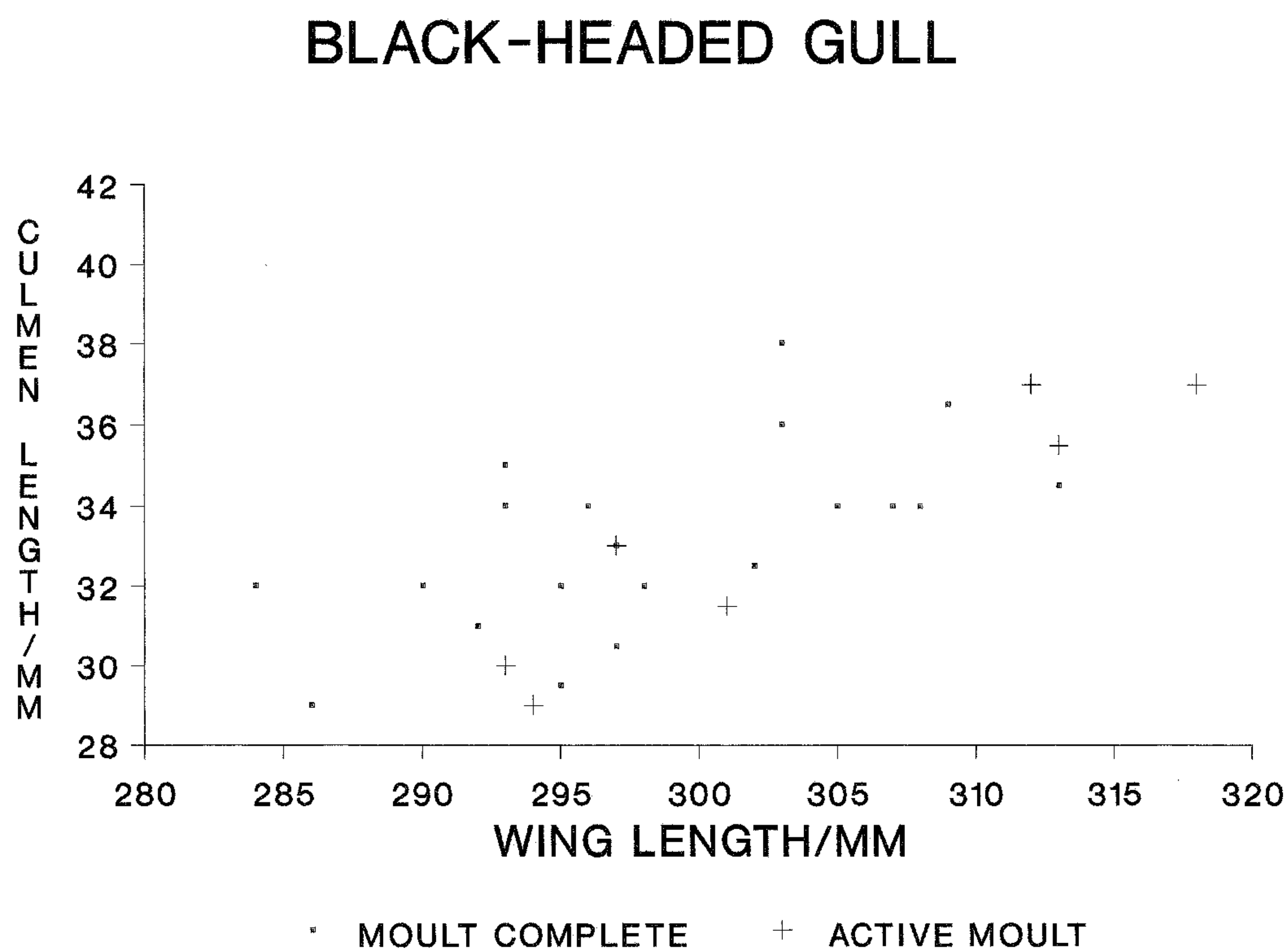

Figure 4. A comparison of culmen length with wing length for moulting and non-moulting Black-headed Gull, based on birds found dead after the Mersey oil spill, August 1989.

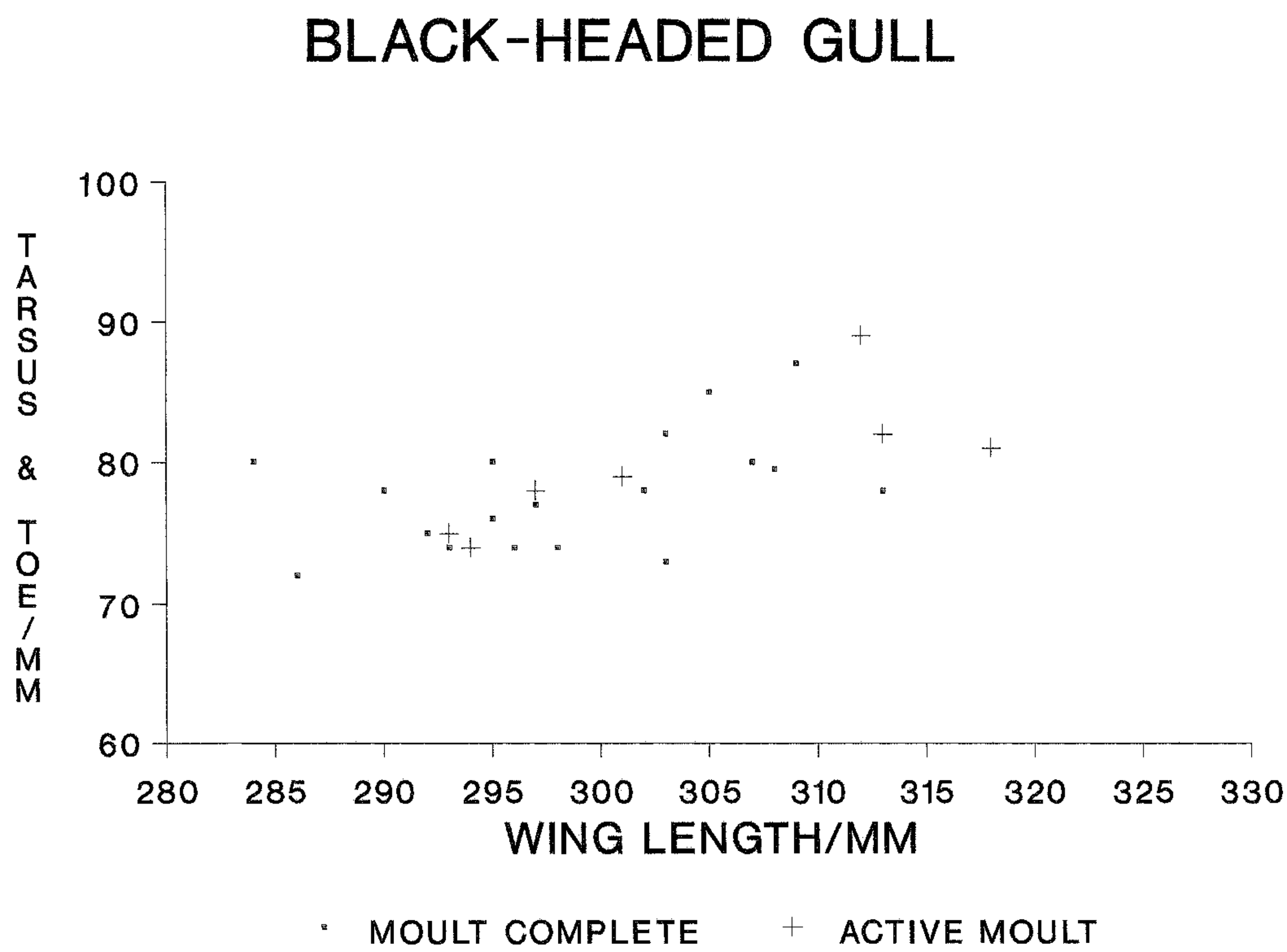

Figure 5. A comparison of tarsus and toe length with wing length for moulting and non-moulting Black-headed Gull based on birds found dead after the Mersey oil spill, August 1989.

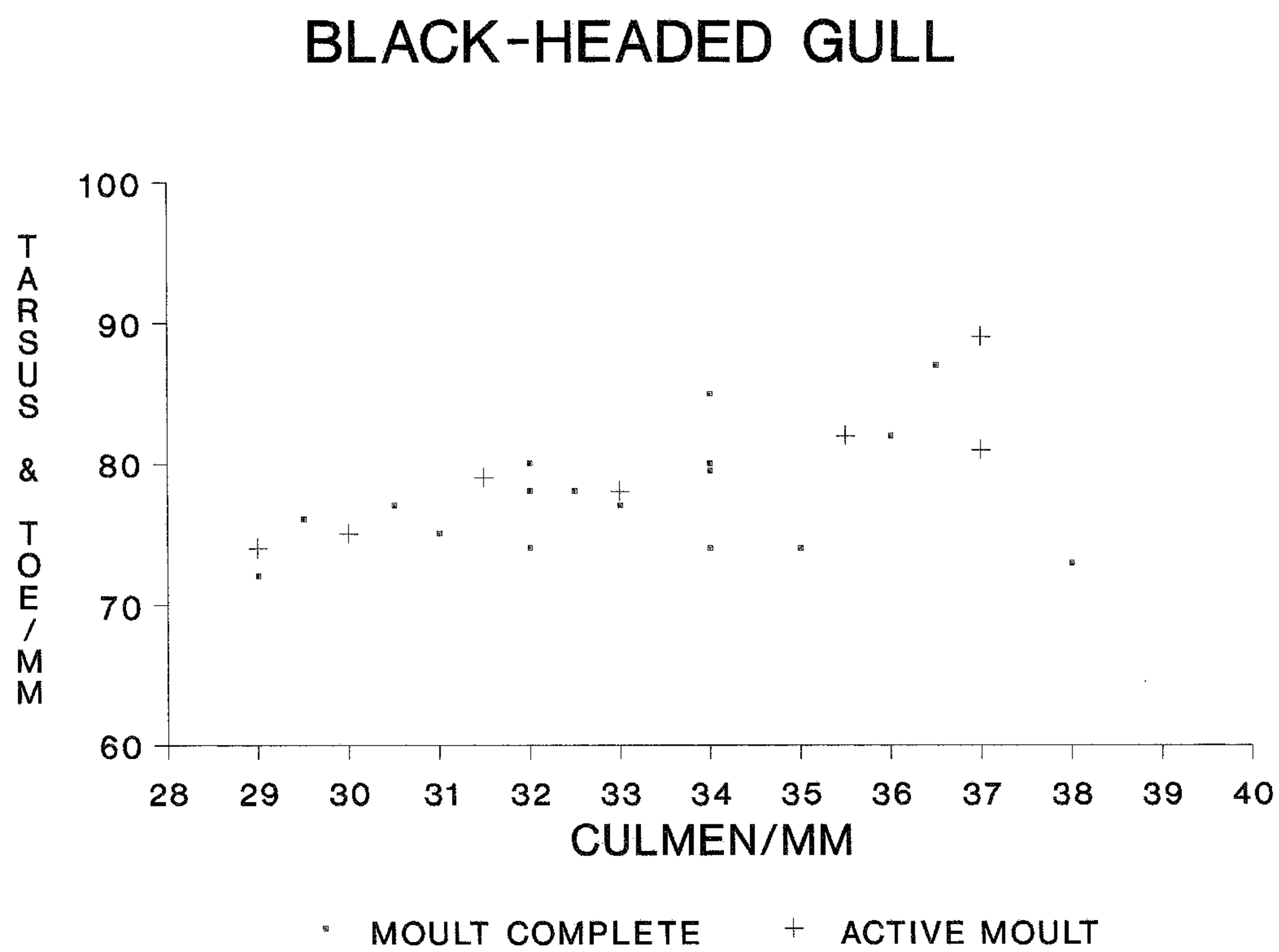

Figure 6. A comparison of tarsus and toe length with culmen length for moulting and non-moulting Black-headed Gull based on birds found dead after the Mersey oil spill, August 1989.

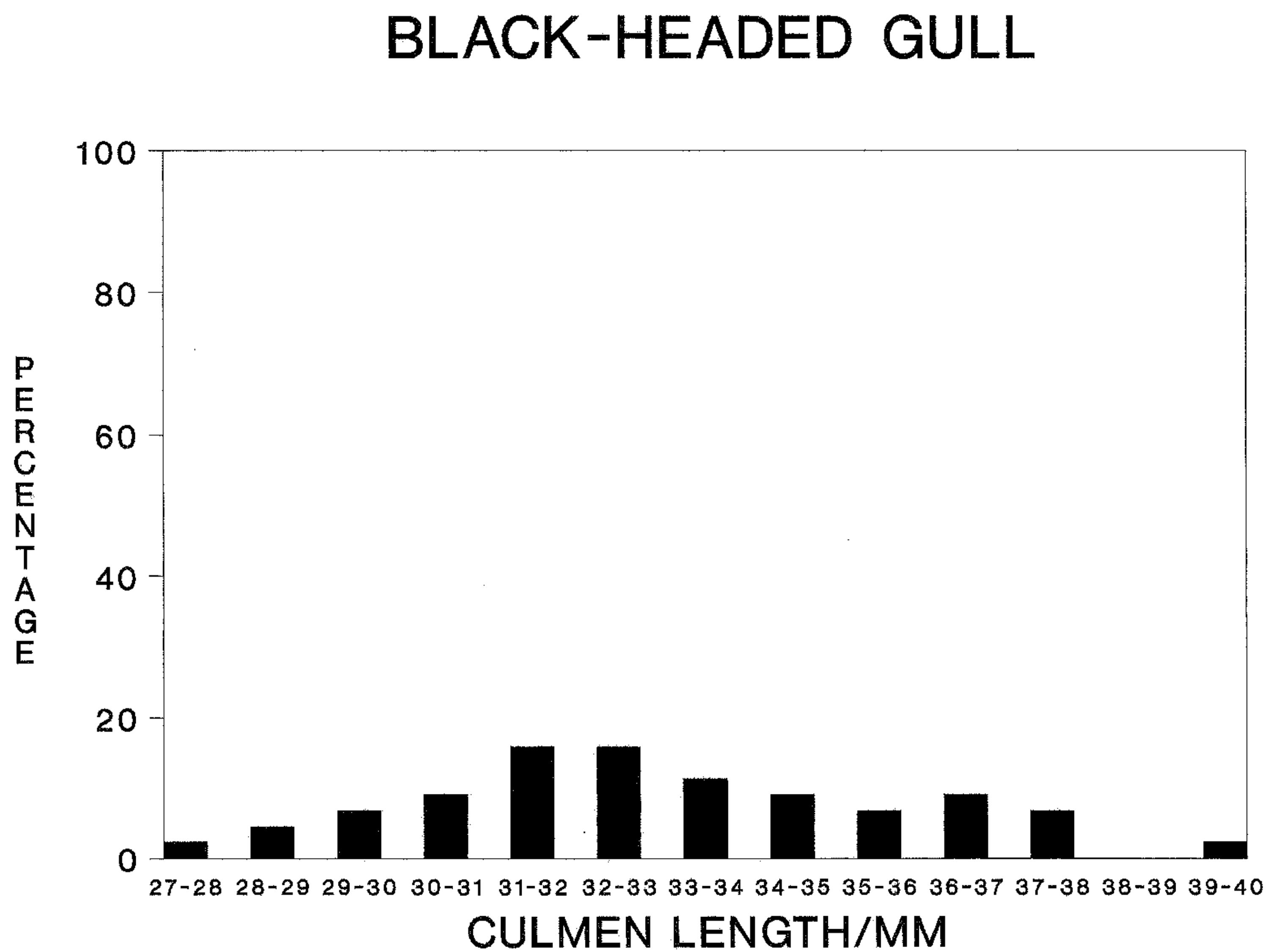

Figure 7. The frequency of culmen lengths of oiled Black-headed Gulls, based on birds found dead after the Mersey oil spill, August 1989.

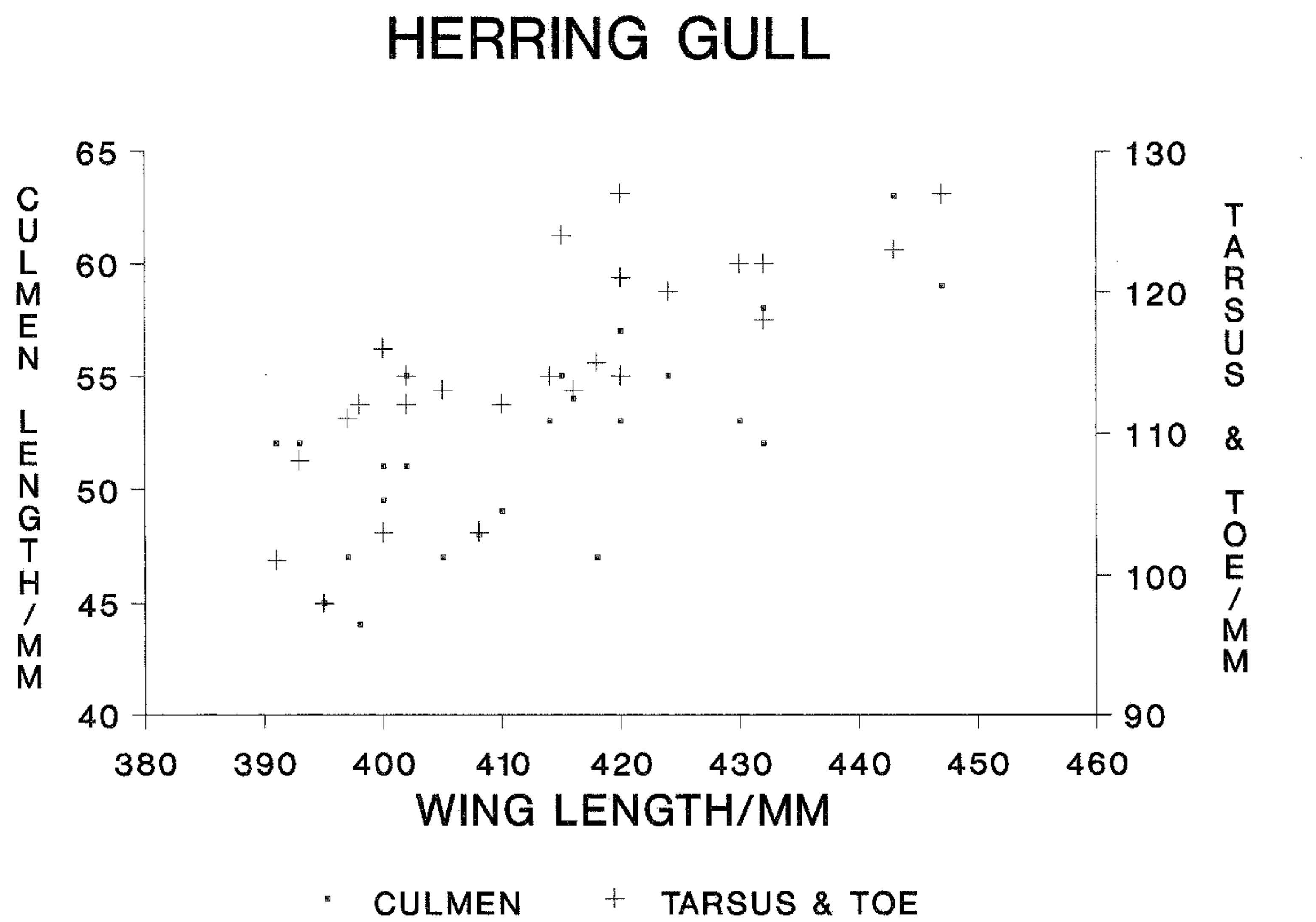

Figure 8. A comparison of culmen and tarsus and toe measurements with wing length for Herring Gull, based on birds found dead after the Mersey oil spill, August 1989.

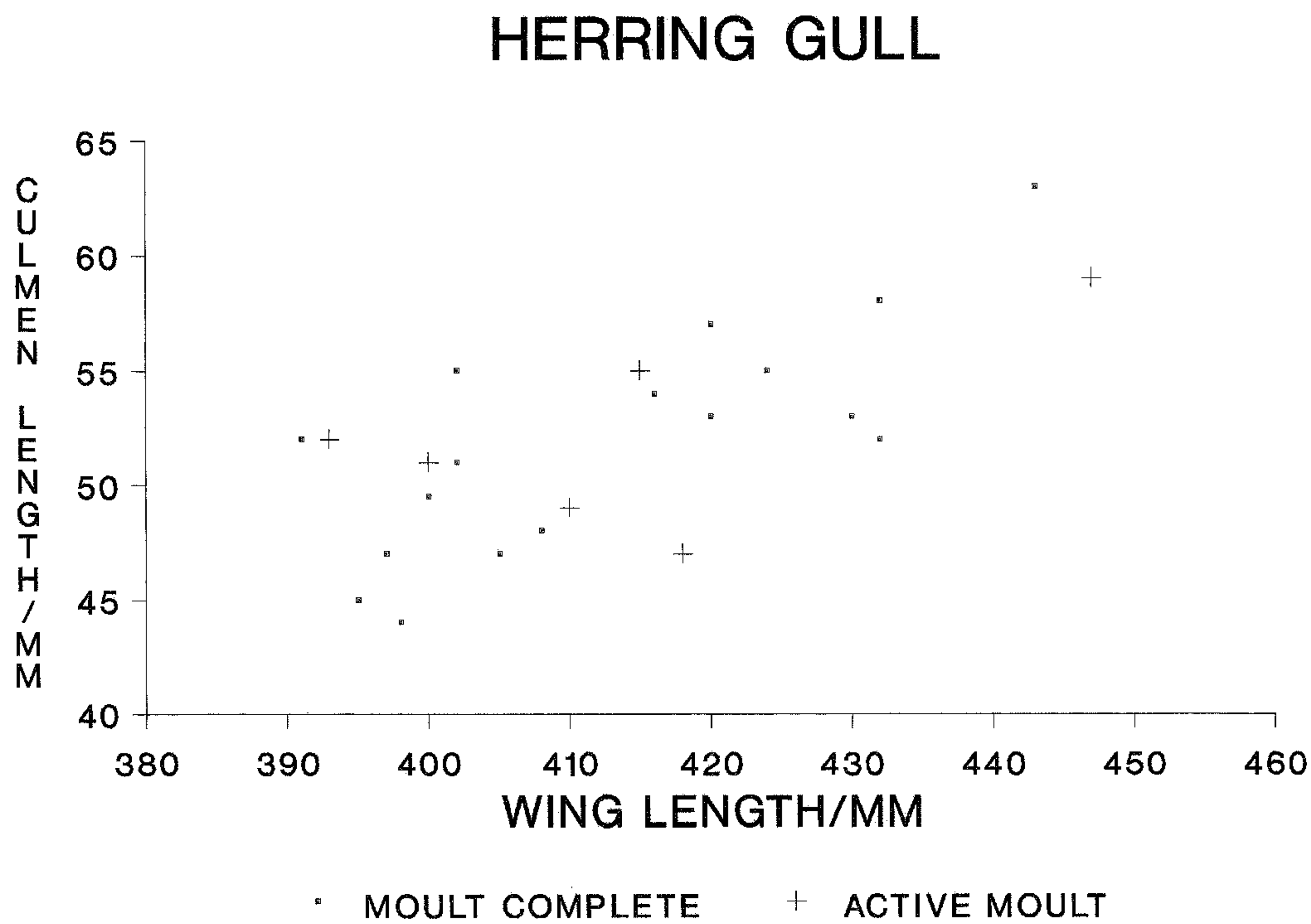

Figure 9. A comparison of culmen length with wing length for moulting and non-moulting Herring Gull, based on birds found dead after the Mersey oil spill, August 1989.

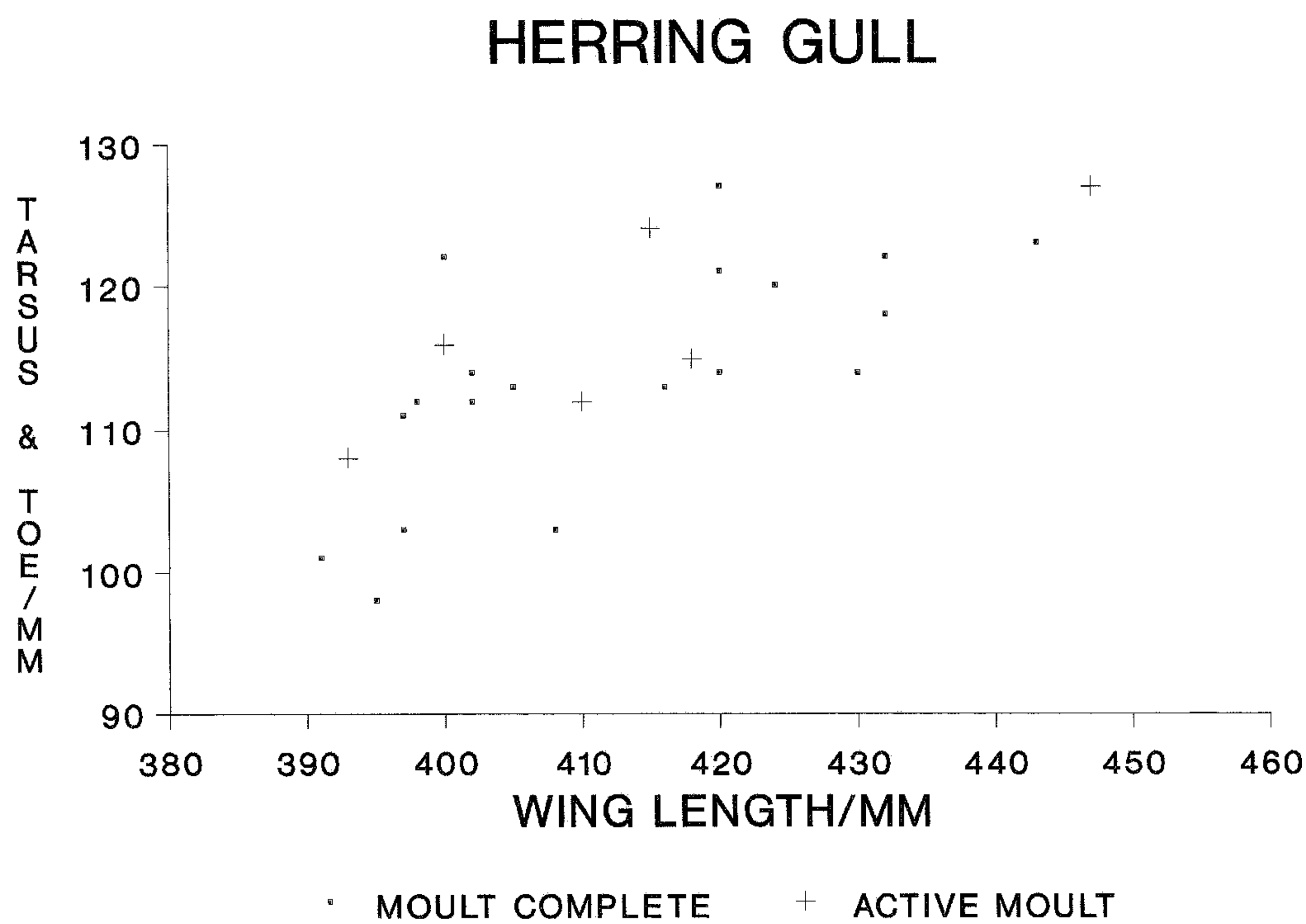

Figure 10. A comparison of tarsus and toe length with wing length for moulting and non-moulting Herring Gull based on birds found dead after the Mersey oil spill, August 1989.

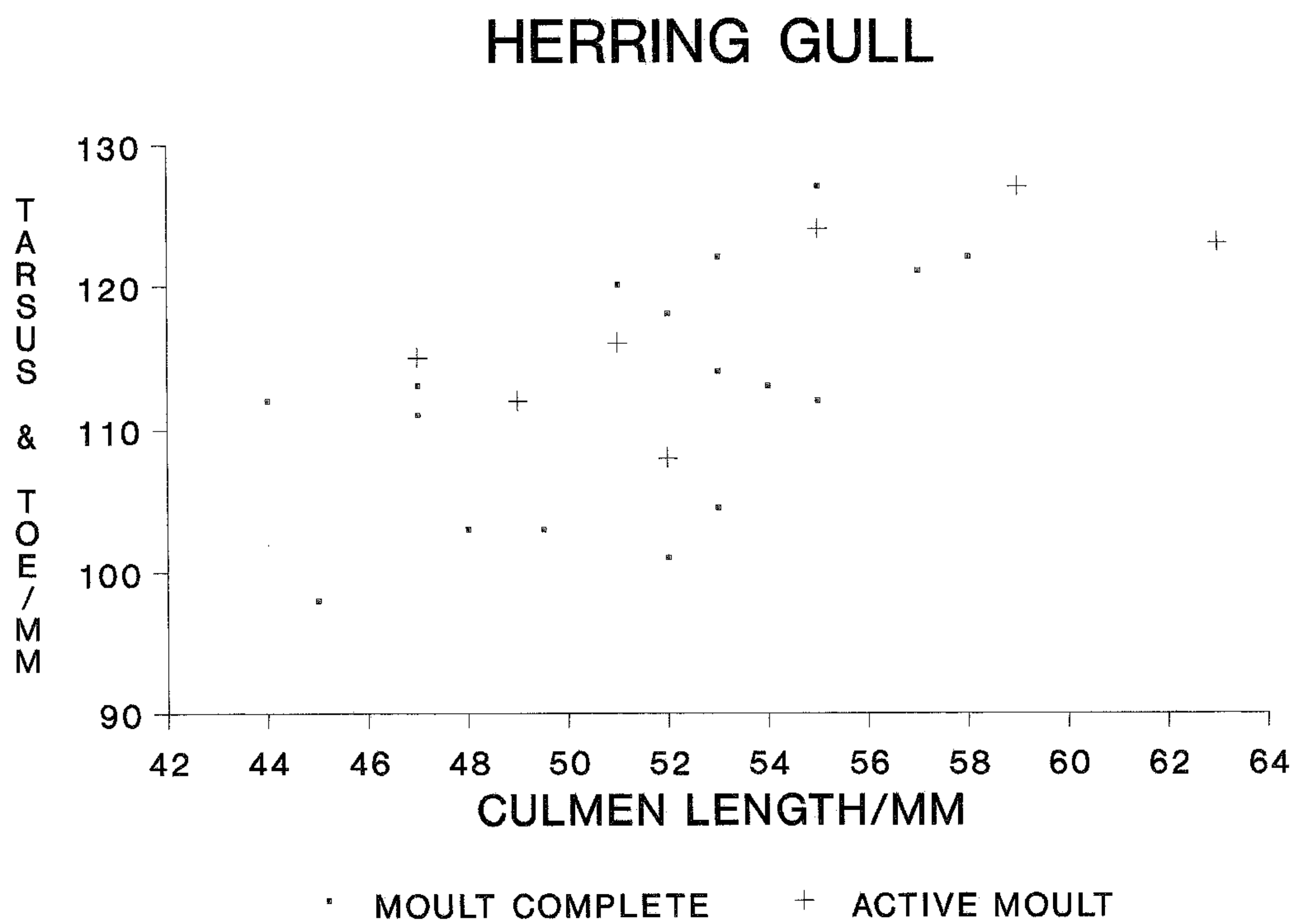

Figure 11. A comparison of tarsus and toe length with culmen length for moulting and non-moulting Herring Gull, based on birds found dead after the Mersey oil spill, August 1989.

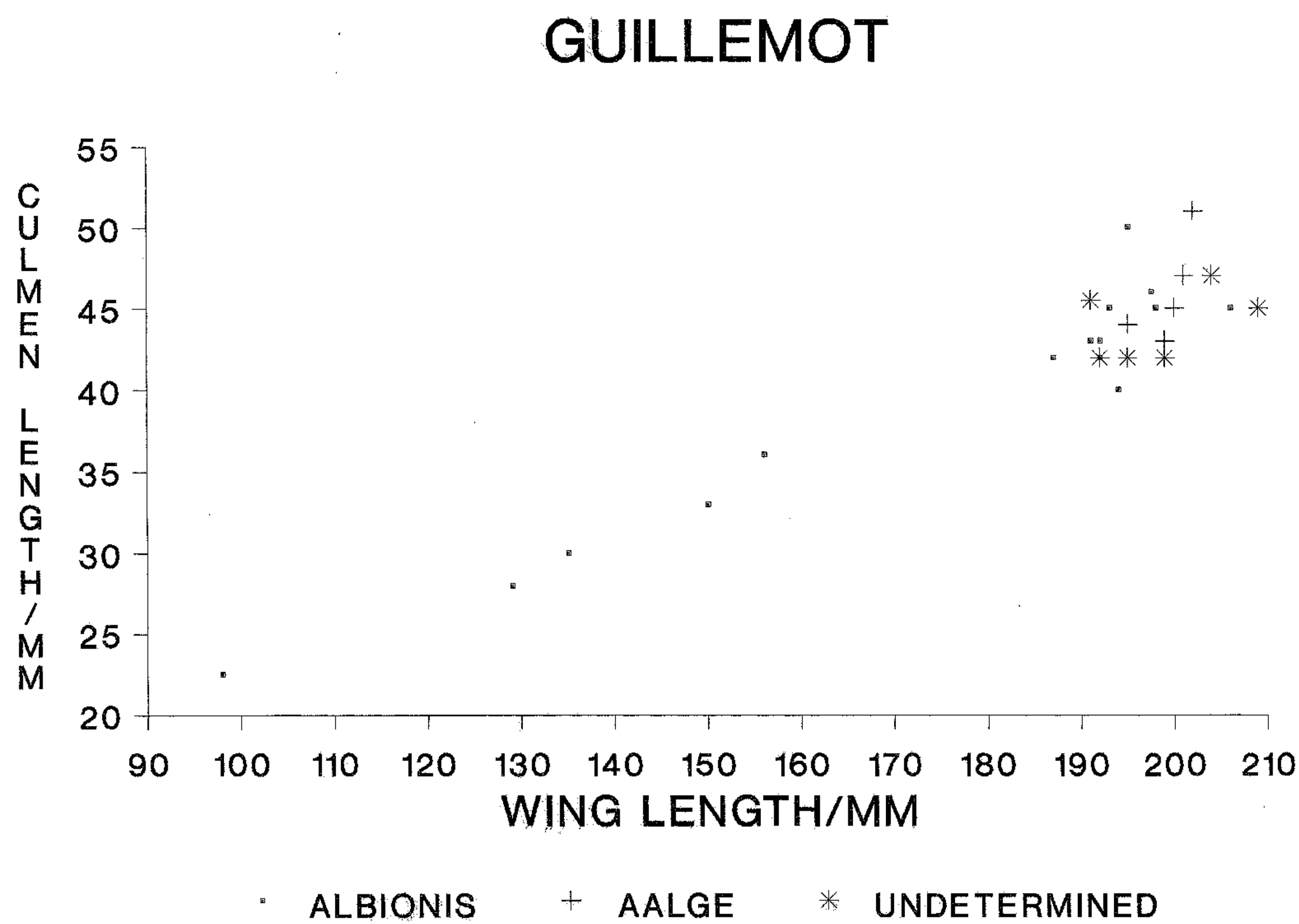

Figure 12. A comparison of culmen length with wing length for two races of Guillemot, based on birds found dead after the Mersey oil spill, August 1989.

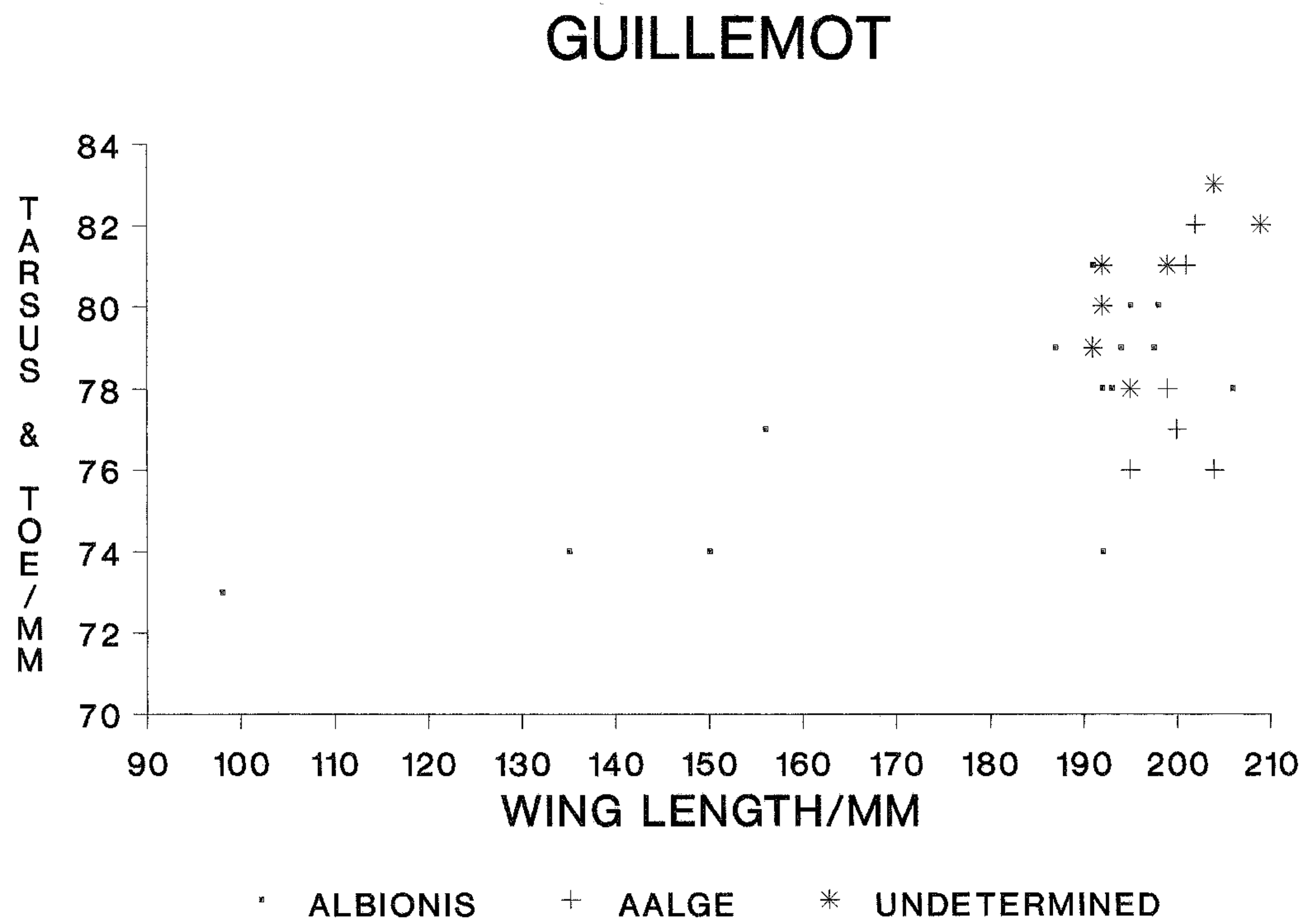

Figure 13. A comparison of tarsus and toe length with wing length for two races of Guillemot, based on birds found dead after the Mersey oil spill, August 1989.

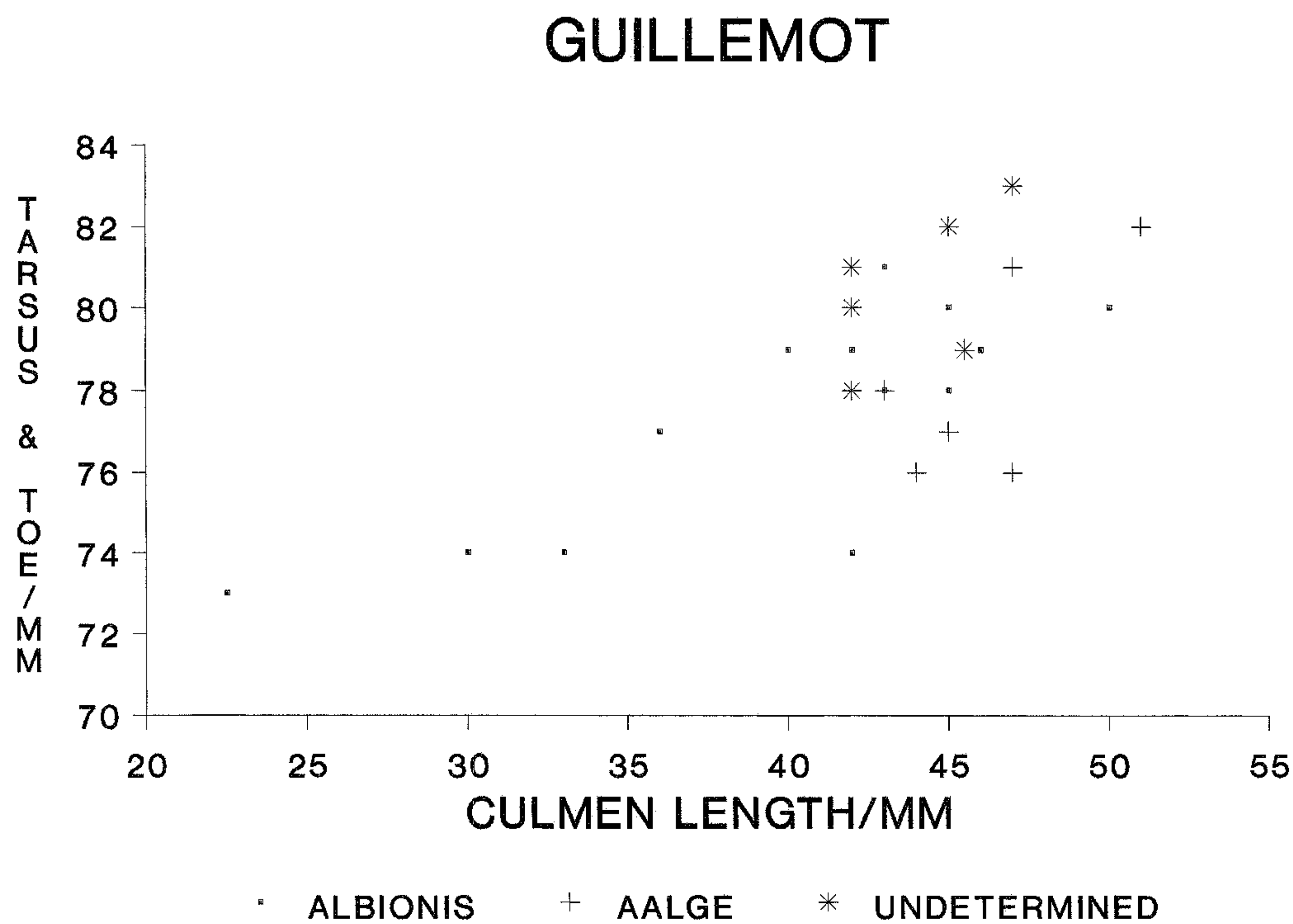

Figure 14. A comparison of tarsus and toe length with culmen length for two races of Guillemot, based on birds found dead after the Mersey oil spill, August 1989.

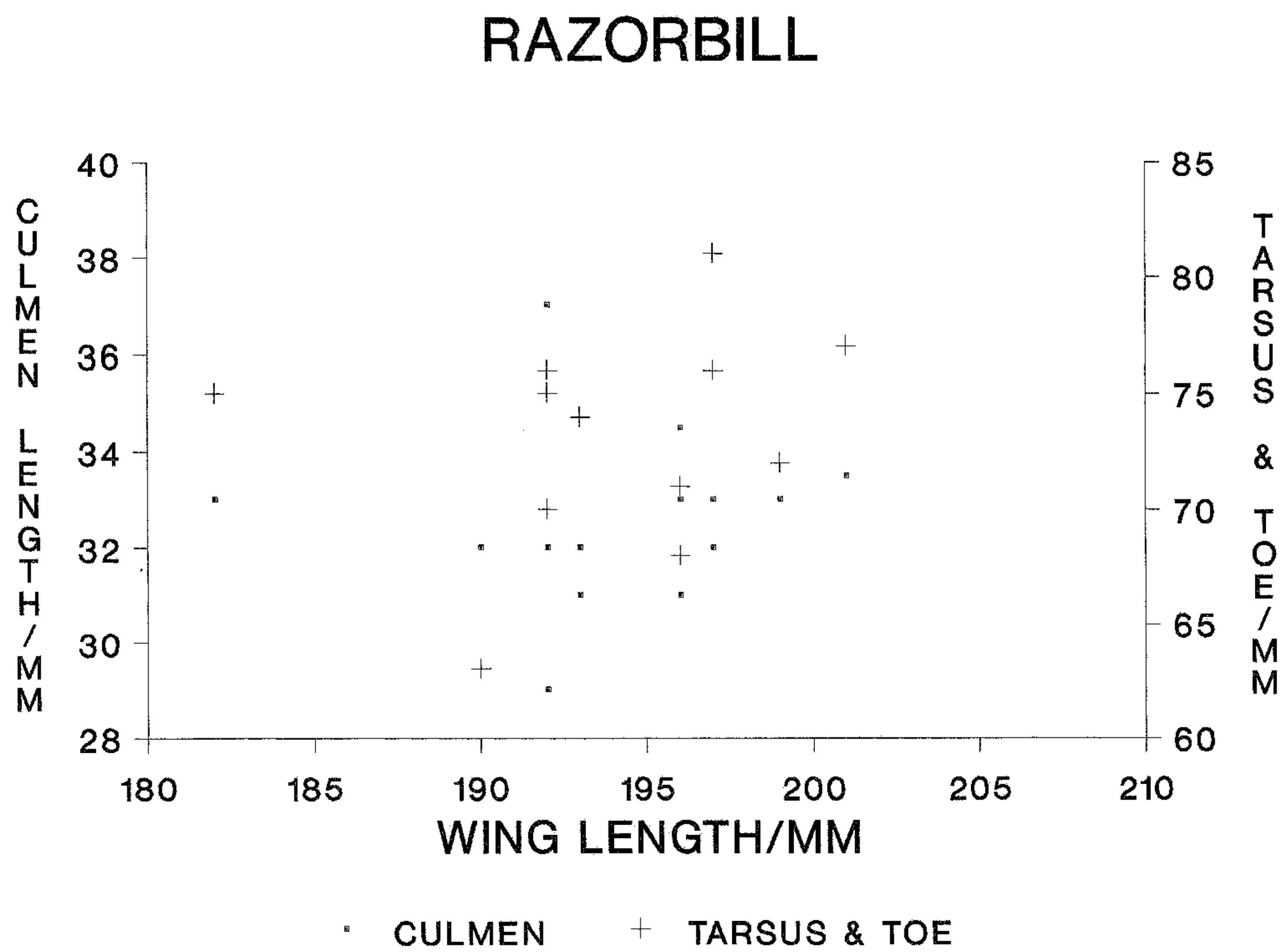

Figure 15. A comparison of culmen and tarsus and toe measurements with wing length for Razorbill, based on birds found dead after the Mersey oil spill, August 1989.

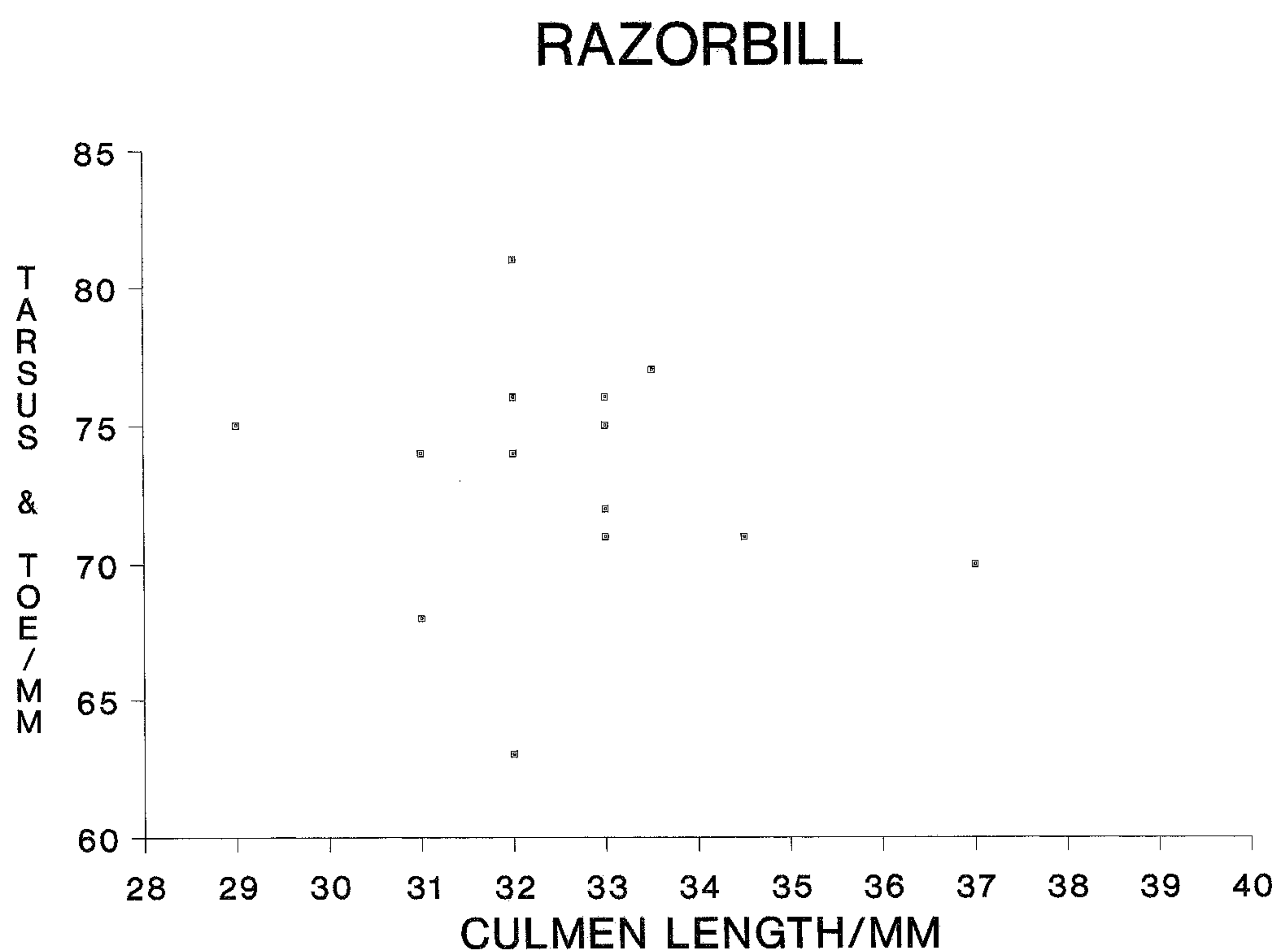

Figure 16. A comparison of tarsus and toe length with culmen length for Razorbill, based on birds found dead after the Mersey oil spill, August 1989.