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THE IMPACT OF THE MERSEY OIL SPILL OF AUGUST 1989 ON THE POPULATIONS AND DISTRIBUTIONS OF WATERFOWL

A report by the
British Trust for Ornithology
to
Mersey Oil Spill Project
Advisory Group
in fulfilment of
Contract 3A

by

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EXECUTIVE SUMMARY.

This report is submitted to the Mersey Oil Spill Project Advisory Group (MOSPAG) in fulfilment of Contract 3A. It aims to assess the effects of the Mersey oil spill of August 1989 on the numbers and distributions of waterfowl using the estuary during winter 1989/90.

Extensive low tide surveys of the whole intertidal area of the Mersey and Alt estuaries and the North Wirral shore were carried out throughout winter 1989/90. In addition intensive surveys throughout the day were carried out at three locations in the Mersey. These surveys used a methodology similar to that for surveys performed the previous winter. This earlier information was gathered during BTO work under contract to the Department of Energy, the work carried out for the present study used the same data collection techniques to allow direct comparisons to be made of bird usage of intertidal areas before and after the oil spill. Statistical analysis of the two data sets allowed an assessment to be made of the effects of the Mersey oil spill on birds.

Significant changes were detected in the numbers or distributions of ten of the fourteen species studied. None of these changes were considered to be attributable to the effects of the oil spill. Several marked changes in distributions of certain species on the Alt/North Wirral shores are thought to be the result of sediment changes in the area.

The lack of significant effects of the oil spill on bird populations was thought to be the result of three ameliorating factors :

1. The deposition of beached oil high up on the northern shoreline (the result of a high spring tide and strong winds) above the intertidal areas usually used by feeding waterfowl, probably accounts for the absence of any deleterious effects of the oil spill on the internationally important wintering bird populations

of the area. Deposition of the oil on lower intertidal areas could have had a more serious impact.

2. The timing of the spill was also an important factor since much of the deposited oil had been cleared or washed away before the arrival of large numbers of birds in late September.

3. The type of oil involved (TJP) quickly became hardened and inert and was thus effectively 'locked' into the strand line. The low volatile fraction content of TJP ensured fast hardening and lower pollution to intertidal areas, since the volatile fractions are more toxic to invertebrates than heavier ones.

No further work is recommended with respect to this particular incident, but the importance of the intensive monitoring of estuaries which are exposed to the possibility of oil pollution is highlighted by the present case. Here the fortuitous availability of an extensive data set from before the oil spill has allowed a rapid, informed assessment of environmental damage to be made within a year of the pollution incident.

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1 GENERAL INTRODUCTION

Previous work, particularly the BTO's national Birds of Estuaries Enquiry (BoEE), has demonstrated the national and international importance of the Mersey for waterfowl (ie. wildfowl and waders). These waterfowl tend to breed outside the area, some of the waders breeding as far away as Greenland or Siberia, but spend the winter feeding on the intertidal areas and saltmarshes of the Mersey. BoEE counts have shown the Mersey to be the seventh most important site for wildfowl and the seventeenth most important site for waders in Britain (Salmon et al. 1989) in terms of overall wintering numbers. A site is considered by the Ramsar Convention on Wetlands of International Importance to be of international importance for a species if it regularly holds 1% or more of the total North Western European population (in the case of wildfowl) or of the East Atlantic flyway population (in the case of waders) of that species. Further, a site is considered to be of national importance if it regularly holds 1% or more of the total national population of a species. In winter internationally important numbers of Shelduck, Wigeon, Teal, Pintail, Dunlin and Redshank occur on the Mersey as do nationally important numbers of Grey Plover and Curlew (Table 1.1). Shelduck also reach levels of national importance in spring, whilst in autumn Teal, Pintail and Redshank are found in internationally important numbers and Shelduck, Dunlin and Curlew in nationally important numbers. The adjacent Alt estuary is also a site of international importance, holding internationally important numbers of wintering Knot and Bar-tailed Godwit (for which it is the second and third most important site respectively for these species in Britain) and nationally important numbers of Grey Plover and Sanderling. In terms of overall numbers, the Alt is the eighth most important site in Britain for waders; however it does not hold any major concentration of wildfowl.

Most of these populations depend for their survival on the invertebrates which inhabit the intertidal mudflats and sandflats of the area, although some wildfowl also feed on seeds in the saltmarshes.

The purpose of the present study was to assess what effect, if any, the accidental spillage of approximately 150 tonnes of Venezuelan Tia Juana Pesada (TJP) crude oil into the Mersey estuary in August 1989 has had on numbers and distributions of waterfowl using the area over the winter 1989/90. Crude oil could affect birds directly by physical contamination (see MOSPAG Project 3C for an assessment of direct contamination after the August 1989 spill) or indirectly by reducing the numbers of invertebrates in the intertidal areas or the numbers of seeds on the saltmarshes. Direct oiling was not considered to be a serious threat to waterfowl since the spill occurred well before the arrival of the large wintering populations. TJP is a heavy oil with a low proportion of volatile fractions and thus once beached, tended to harden, reducing the threat to birds.

An accurate assessment of any deleterious effects of the oil spill was possible because of the existence of a large amount of accurate data giving the numbers and distributions of waterfowl during the winter of 1988/89. These data are the result of work carried out by the BTO for the Department of Energy as part of the feasibility studies for the proposed Mersey tidal power barrage. Further data are available since the Mersey is an established BoEE site which is counted regularly. Information gathered for the present study over the winter 1989/90 was augmented by ongoing work for the Department of Energy on the night feeding of birds and an assessment of count consistency. Thus large sets of data were available to compare the winters before and after the oil spill.

The study area for the present project consisted of the North Wirral Shore and Alt Estuary as well as the Mersey itself (Figure 1.1).

The BTO has a long involvement with studies on estuarine birds and co-ordinates the Birds of Estuaries Enquiry. This annual survey, which has been running since 1969, records the numbers of waterfowl wintering on all British estuaries, based on the results of high tide counts. The BTO has also conducted more detailed studies on several major British estuaries, including the Mersey.

The Mersey oil spill represents the first pollution event in a British estuary for which comparable detailed ornithological data sets are available for before and after the incident.

2 METHODS

2.1 DATA COLLECTION

In order to make an accurate assessment of the impact of the Mersey oil spill, it was necessary to obtain comparable data sets from before and after the event. Because of this, it was decided to keep the methodology of the counts for the 1989/90 as close as possible to that used during the previous winter. The study area, breakdown of intertidal areas and counting techniques were therefore retained from the previous study.

Two types of count were performed over the winter 1989/90:

2.1.1 Low Tide Counts

To allow increased accuracy of counting and analysis, the study area was broken down into 99 intertidal areas (Figure 1.1) which were demarcated by features such as channels, changes in substrate type or the location of permanent features which could provide sight lines on the horizon. The whole study area was counted once every two weeks by a team of volunteers experienced in counting the area, with each counter being allocated a small number of intertidal areas. These counts were all performed within an hour of low tide so that the distribution of feeding birds could be observed, and were independent of the BoEE counts which are made at high tide (Table 2.1). Seven complete low tide counts were carried out between 17 November 1989 and 19 February 1990. Although preferred count days were predetermined, the difficulties some counters had in being available on specific dates meant that counts up to a few days either side of the official day were accepted (Table 2.2). Feeding and roosting birds were distinguished in the counts. In order to assess the average number of feeding hours for each species at low tide, counts were made during neap and spring tides. The height of low tide on each low tide count date is given in Table 2.2.

Counts were recorded on specially designed forms which also recorded such factors as weather, disturbance to a site and visibility (Appendix 1). Data were returned to the BTO for computerisation.

Coverage of the whole site at low tide was extremely thorough, with just over 80% of all possible count sites being censused on each low tide count throughout the project. Occasional counts were missed because of adverse weather or fog, or the unavailability of an individual counter (although BTO staff covered for these when possible). However it is considered that only small numbers of birds were missed in this way and the overall results little affected. It was thus considered that the low tide data collected were representative and complete enough to allow statistical analysis.

For the purposes of evaluating the effects of the oil spill, each of the 99 individual intertidal areas was coded according to whether or not it had been oiled (Table 2.3). This allowed a comparison to be made between changes in bird usage of each intertidal area and the extent of oiling. OPRU (1990) provided the data necessary for compiling pollution codes for each area. The extent of the oiling found by the OPRU survey is shown in Appendix 2.

2.1.2 All Day Counts

In addition to the low tide counts, BTO staff conducted hourly counts from dawn to dusk throughout the tidal cycle at Stanlow (Figure 2.1), Oglet (Figure 2.2) and New Ferry (Figure 2.3) on nine days between 6 November 1989 and 6 March 1990. Count days were arranged so that each site could be counted at least once during each hour of the tidal cycle (Table 2.4). The purpose of these counts was to obtain a detailed and accurate assessment of the variation between years at a few selected sites. Additionally, all day counts demonstrate the variations in importance of individual intertidal areas to birds throughout the tidal cycle and thus aid interpretation of the low tide counts. As with the low tide counts, all day counts were made during neap and spring tides to assess usage over an 'average' tidal cycle. Heights of high tide are given in Table 2.4.

The three intensive study areas were divided into separate intertidal areas (a total of 43 between the three sites) which are distinct from and smaller than those used for the low tide counts. It should be noted that intertidal area numbers on these sites are not continuous since Frodsham Score, which was an all day site in previous studies, was not used in the present study. Two new all day sites, Egremont shore (Figure 2.4) and the Upper Estuary (upstream of the Widnes-Runcorn Bridge), were monitored by EAU staff to ascertain whether the heavy pollution of these areas produced any noticeable distortions in shorebird distributions or numbers. These data are incorporated into the analysis presented in this report. It became apparent early in the winter that there were too few birds in the Upper Estuary for it to be worth monitoring throughout the day, so single counts were made near low tide and incorporated in the low tide data analysis.

2.2 DATA ANALYSIS

2.2.1 Low Tide Counts

Since most birds counted at low tide were feeding (Tables 3.1 to 3.7), data from the low tide counts carried out over the winter 1989/90 have been used to detect any changes in feeding patterns from the previous winter. To allow for missed counts, the best measure of intertidal area usage for each species was taken to be the average number of birds counted on each count date when a count was made over the study period. Data were input and usage values calculated using a series of Fortran programs. Usage values for 1989/90 were plotted against equivalent values from 1988/89 for oiled and unoiled areas. Regression analyses were performed for the two data sets to determine whether there were any significant differences in numbers of feeding birds on the two site types. SAS General Linear Modelling (SAS, 1985) was used for all regression analyses. Similar analyses of usage values were performed in Clark (1989, 1990) and Clark & Prys-Jones (in press).

The analytical methods were devised specifically for this type of data and were, therefore, considered to be the most appropriate. Little work of this type had been done before Clark (1990), so novel approaches to data analysis were needed.

All low tide regression analyses used the log(x+1) transformation, as suggested by Fowler and Cohen (1987). This has the effect of normalising data and removing any bias towards points which lie along the upper limits of either axis. Regression lines were statistically tested for significant differences in slope (to detect trends) and, where no difference was found, further tested for a difference in elevation (to indicate significant changes in overall values).

The low tide feeding distributions of all species covered in the species accounts are presented as a series of maps, with further maps for key species illustrating changes in distribution between the two winters.

2.2.2 All Day Counts

As with the low tide counts, all day counts were input and initially analysed using a set of BTO Fortran programs. Further analyses were performed using SAS General Linear Modelling (SAS, 1985).

Since most of the beached oil was deposited at the top of the shore due to a high spring tide following the spill (OPRU, 1990), the effect of the oil on each species can be assessed by comparing changes of bird usage of each intertidal area with the height of the area. Any detectable decrease in feeding effort on the upper intertidal areas could indicate the deleterious after effects of oil pollution. Two measures of intertidal area usage by birds were investigated; a proportional index of change in usage and a change in feeding density. The proportional index of change in usage (Pr) was defined as:

$$Pr = \frac{Us2 - Us1}{Us2 + Us1}$$

where Us1 is the intertidal area usage in 1988/1989 and Us2 is the intertidal area usage in 1989/1990.

Intertidal area usage (Us) is calculated using:

$$Us = \sum_{A = -6 \text{ to } +5} (B \times C)$$

where:

A = Hours from low tide

B = Average number of birds feeding at time A when the area is exposed

C = Proportion of counts when the area is exposed at time A

Due to short winter day lengths, it was not possible to perform counts over the whole twelve-hour tidal cycle on each all day count date. By carefully selecting the count dates for each site, it was possible to obtain data from each hour of the tidal cycle.

The change in feeding density (Fe) is defined as:

$$Fe = \frac{Us2 - Us1}{Area}$$

For each species, these indices are plotted against exposure time, which is a measure of the height of the intertidal areas, with higher areas having longer exposure times. In each case, a regression line which is not significantly different from the zero line indicates no change in preference for lower or higher intertidal areas, a regression line which has a significant positive slope indicates a proportionally increased preference for higher intertidal areas and a significant negative slope indicates a proportionally decreased preference for higher intertidal areas. The latter would be expected if the oil spill had adversely affected bird feeding and numbers. This method of analysis has been previously used in Clark (1990).

For the purpose of analysis, New Ferry and Stanlow were considered to have been unoiled and Oglet to have been oiled (OPRU, 1990). For each species, regression lines for each site were statistically compared to zero both for slope (to detect changes in preference for intertidal areas of different heights) and elevation (to detect overall changes in intertidal area usage). Subsequent statistical comparisons between the regression lines of New Ferry and Stanlow were used to assess any significant changes in relative usage of the two sites.

In order to assess the effect on birds of oil deposition, points from the two unoiled sites were combined (where the sites were shown by the previous analysis not to be significantly different) to produce a new regression line which was then tested against that for Oglet in slope and elevation. Since Oglet has no intertidal areas with exposure times of less than 8 hours, only points relating to exposure times of over 8 hours were included in the analysis of the combined unoiled sites.

In all cases, double zero points (ie. intertidal areas with no usage in either year) were omitted as were sites with less than six data points (except where the combination of the two unoiled sites produced a regression based on more than six points).

3 RESULTS AND CONCLUSIONS

The results of the low tide counts are presented in Tables 3.1 to 3.7. The following species accounts summarise the results of analysis of both low tide and all day counts and assess the impact of the oil spill on the particular species concerned. Changes in numbers, distributions, feeding densities etc. are evaluated and related to the oil spill and other factors affecting the study area.

Low tide count sites which lie offshore of oiled areas and which may have suffered some slight oiling on the retreating tide are plotted on the same graphs as the oiled areas but these data were not included in the regression analyses.

On the graphs showing proportional changes in usage and changes in feeding density against exposure time, the only regression lines depicted are those which differ significantly from the zero line, ie. those which show a significant change in usage between years.

Where non-significant statistics are quoted in the text, these are followed by the notation "n.s.".

3.1 SHELDUCK

BoEE data have shown that the Mersey is the sixth most important estuary in Britain for Shelduck. The average maximum count over the five winters 1984/85 to 1988/89 exceeds 3,700, compared to a qualifying level for international importance of 2,500. Results from the low tide counts carried out for the present study indicate similar numbers to previous years (Tables 3.1 to 3.7). The vast majority of Shelduck counted during the low tide counts in both years were found feeding on the Inner Estuary, with very small numbers on the Alt and North Wirral shores (Figure 3.1.1). A comparison between the distributions of feeding Shelduck counted over the two winters reveals no major changes (Figure 3.1.2). The apparent disappearance of Shelduck from Ince Marsh (intertidal area 45) is actually due to a change in counting procedure, whereby only the saltmarsh areas were counted over the second winter.

No statistical differences were detected in a comparison of changes in proportional usage ($t = 0.12$, n.s.) or feeding density ($t = 0.41$, n.s.) with exposure times between the unoiled all day count site of Stanlow and the oiled site of Oglet (Figure 3.1.3). Similarly there were no significant differences in usage or feeding effort on intertidal areas of different heights at any of the three sites compared with the previous winter, although there was a significant proportional increase in feeding effort on higher intertidal areas at Stanlow compared with New Ferry ($t = 2.8$, $p<0.05$). This is probably accounted for by the movement of some of the small number of birds at New Ferry to sites in the body of the estuary.

The low tide counts carried out for the present study have revealed no statistically significant difference ($t = 0.79$, n.s.) in usage values between the two winters for oiled and unoiled sites (Figure 3.1.4).

3.2 WIGEON

The Wigeon population of the Mersey averaged over 8,700 for the five winters 1984/85 to 1988/89, with the qualifying level for international importance currently being set at 7,500. However little could be done in the present study to detect any adverse effects on this important population as a result of the oil spill since birds are present on the Mersey in one or two large flocks, thus returning inadequate data points to calculate regression lines for further analysis. Results of the low tide counts in the winter 1989/90 show a peak count of around 3,000 birds (Table 3.2) but the true figure is likely to be much higher since at low tide many Wigeon roost or feed in the deep channels off Ince Marsh. These birds are visible at high tide and are therefore included in BoEE counts.

Although full analysis is impossible, the traditional distribution of this species (on the south side of the Inner Estuary) makes it most unlikely that it suffered any adverse effect from the oil spill.

3.3 TEAL

The Mersey is the most important site in Britain for Teal, averaging more than 8,700 birds over the five winters 1984/85 to 1988/89, compared with a qualifying level for international importance of 4,000. Low tide counts over the winter 1989/90 recorded generally lower numbers than this (although two exceed 8,500) because of this species' preference for deep channels where large numbers could be missed.

The main daytime feeding grounds of this species lie along the north shore of the Inner Estuary and were oiled, although the roosting areas used by large numbers on the south shore were unaffected. The feeding distribution of Teal in the winter 1989/90 is shown in Figure 3.3.1. A comparison with the distribution the previous winter shows that despite the oil spill, the feeding grounds on the north shore appear to have expanded to the east and west (Figure 3.3.2). No significant differences were found in the usage of higher intertidal areas at any of the three all day sites (Figure 3.3.3). The increase and expansion of Teal numbers on the north (oiled) shore of the Inner Estuary has produced a significant proportional increase ($t = 3.32$, $p<0.01$) in the low tide usage of affected intertidal areas relative to unaffected intertidal areas (Figure 3.3.4). This is unlikely to be related to the oil spill and is probably the result of increased numbers of birds spreading out from the favoured feeding areas around Oglet. A possible explanation for the increased numbers of this species in the winter 1989/90 is that the very dry summer of 1989 created a shortage of suitable wet inland habitat, forcing birds to move onto estuaries.

3.4 MALLARD

Although numbers of Mallard on the Mersey frequently exceed 1,000 birds, the site falls well short of national significance for this species. Low tide counts conducted for the present study give a peak count of over 1,300, with an average of just over 850. Most birds were found along the south shore of the Inner Estuary, especially around Mount Manisty (Figure 3.4.1).

Statistical analysis of data from Stanlow reveals a significant change in usage, with a substantial decrease in feeding density on higher intertidal areas (Figure 3.4.2), and a significant decrease in usage from the previous year ($t = 2.58$, $p<0.05$), although this is as likely to be due to birds being missed in the creeks on Stanlow Marsh as it is to a real decrease in numbers. There were insufficient data points from Oglet to conduct a regression analysis for this site.

Low tide counts revealed no significant differences in changes in usage of oiled and unoiled sites (Figure 3.4.3).

3.5 PINTAIL

The Mersey is the most important site in Britain for Pintail, with an average annual peak of over 8,600 for the five winters 1984/85 to 1988/89. Numbers at this site have however been substantially lower in the past two winters, and low tide counts on the Mersey during the winter 1989/90 reflect this reduction, although, as with other wildfowl on the Mersey, Pintail tend to be under-recorded at low tide due to their preference for creeks and channels.

The distribution of feeding Pintail during the winter (Figure 3.5.1) shows favoured feeding grounds along the north and south sides of the Inner Estuary. There are several changes in distribution from the previous winter (Figure 3.5.2) although these are not related to the distribution of spilled oil and are more likely to be a result of annual variations in food density.

Regression analysis revealed that, although there were no significant differences in usage at any of the all day sites, there was a significant increase in feeding density on the lower intertidal areas at Stanlow ($t = 1.96$, $p<0.05$) relative to New Ferry (Figure 3.5.3), with birds apparently moving to the former site from the latter. Since both sites were unaffected, it is not likely that this movement is in any way connected with the oil spill and is probably again due to annual fluctuations in the distribution and availability of food. The combined regression for the two unaffected sites differed significantly in slope from Oglet ($t = 2.32$, $p<0.05$), indicating a proportional decrease in feeding density on the higher intertidal areas of Oglet. This is because of a shift of large numbers of birds on the north shore of the Inner Estuary to just outside the all day count site at Oglet and does not indicate a move from oiled to unoiled areas. This is borne out by the lack of any statistically significant differences in the regression lines for affected and unaffected low tide count sites ($t = 0.04$, n.s.) (Figure 3.5.4).

3.6 OYSTERCATCHER

Very few Oystercatchers occur within the Mersey although considerable numbers are found on the Alt and North Wirral shores (Figure 3.6.1). A maximum low tide count of nearly 5,000 birds was recorded in the winter 1989/90 with the majority of these on the North Wirral Shore.

The absence of this species at all day study sites has meant that comparisons of changes in preference for intertidal areas of different heights have not been possible. However the low tide counts have revealed a significant decrease in the proportional usage of the unoiled North Wirral Shore relative to the oiled Alt ($t = 2.29$, $p<0.05$). This is shown in Figure 3.6.2, in which all unoiled areas refer to the North Wirral Shore and all oiled areas to the Alt, since this species occurs only on these two areas. This is actually due to a fall in the numbers of birds using the central portion of the North Wirral Shore during the winter 1989/90 (Figure 3.6.3) when little change in numbers was observed on the Alt. The decrease of birds on the North Wirral shore coincided with the deposition, between the two winters, of a layer of mud over the existing sandflats. This could have adversely affected the ability of Oystercatcher to feed in the area by changing the benthic macro-invertebrate fauna or by making prey more difficult to locate.

About fifty Oystercatchers regularly fed at the Egremont study site, where they concentrated on the middle and lower shore so avoiding the upper shore which had been recently oiled (Figure 3.6.4), although their distribution could not be proved to be a result of the oil spill since comparable data from the winter before the spill are not available.

3.7 RINGED PLOVER

Ringed Plover do not occur on the Mersey or the Alt/North Wirral shores in large numbers. Low tide counts in winter 1989/90 show peaks of 59 birds on the Mersey and 166 on the Alt/North Wirral shores. This compares with respective figures of 81 and 167 for the previous winter. Although there were insufficient data for regression analysis, it appears unlikely that the oil spill has had any adverse effect upon this species.

Around 12 birds regularly fed at the Egremont study site where they used only three of the central areas (Figure 3.7.1).

3.8 GREY PLOVER

BoEE counts have shown that nationally important numbers of Grey Plover occur both on the Mersey and the Alt/North Wirral shores in winter. Low tide counts conducted for the present study revealed lower numbers of birds on the Mersey than are recorded on BoEE counts, although this species tends to be under-recorded at low tide due to its highly dispersed feeding distribution. Low tide counts on the Alt/North Wirral shores averaged just over 200. Most were present on the area around the Alt (Figure 3.8.1).

Of the three all day study sites, only Oglet yielded enough data points to allow regression analysis (Figure 3.8.2). This analysis demonstrated that there was no relationship between the change in usage of intertidal areas between the two winters under study and exposure time (t = -0.43, n.s.).

Low tide data analysis showed no significant changes in relative or absolute usage values between affected and unaffected intertidal areas (t = 0.58, n.s.) (Figure 3.8.3), suggesting that the oil spill has not adversely affected this species.

There was no discernable pattern to the changes in usage of individual intertidal areas between the two winters under study, although numbers declined slightly at most areas around Oglet (Figure 3.8.4).

3.9 LAPWING

Lapwing are not typical estuarine waders, feeding in winter primarily on inland fields, although birds often visit estuaries to roost. Peak counts over the winters 1984/85 to 1988/89 averaged just under 3,320, falling well short of the qualifying level for national importance of 10,000. Most birds counted on the Mersey were roosting, with feeding occuring primarily along the north shore of the Inner Estuary (Figure 3.9.1).

Insufficient data were gathered at any of the all day sites to allow regression analysis of changes in preference for intertidal areas of different heights. However the continued presence of the major feeding concentration on the oiled north shore suggests that oiling has not affected this species on the Mersey. Further evidence for this comes from the absence of a significant difference (t = 0.21, n.s.) between usage values for oiled and unoiled intertidal areas (Figure 3.9.2).

3.10 KNOT

Although few Knot are found in the Mersey Estuary, the Alt holds internationally important numbers, the average peak count for the five winters 1984/85 to 1988/89 being in excess of 40,000 birds, compared to a qualifying level for international importance of 3,500. These figures are based on high tide counts, when birds from the Dee often fly to the Alt to roost (Mitchell et al. 1988) and thus raise the counts above the number of feeding birds on the Alt alone. Low tide counts in the winter 1989/90 reveal a substantial drop in numbers of feeding birds from the previous winter. Figure 3.10.1 shows the distribution of feeding birds in 1989/90, Figure 3.10.2 the change in numbers from the previous year.

Although this large reduction in numbers on the oiled areas of the Alt might suggest that pollution has had an effect, there is some evidence to the contrary. Knot are known to be a highly mobile species, forming large dense flocks which move over very large areas throughout the winter (Dugan, 1981). The movement of birds to the area of newly deposited mud (see 3.6) on the North Wirral shore (Figure 3.10.2) partly accounts for the reductions noted on the Alt, and movements of other birds to areas outside the study site as a result of annual variations in prey availability seems likely to have occured also. The absence of any statistically significant difference between changes in intertidal area usage on affected and unaffected areas (t = 0.85, n.s.) (Figure 3.10.3) is further evidence that the oil spill may not have been responsible for the observed decline in numbers of this species.

The presence of a small number of Knot at the Oglet all day site where none were present the previous year has resulted in a horizontal regression line with an elevation of 1 (Figure

3.10.4.).There was a significant decrease in feeding density at New Ferry relative to Oglet (t = 3.9, $p<0.05$) suggesting that the birds recorded feeding at Oglet may have originated from those using the feeding grounds at New Ferry.

3.11 SANDERLING

Sanderling, like Knot is a wader species which occurs infrequently in the Mersey but is of importance on the Alt/North Wirral shores, where it reaches levels of national importance (the qualifying level for which is 140). The Alt holds most of these birds (Figure 3.11.1) although numbers on the North Wirral are also significant. Average numbers for both areas increased from 220 in 1988/89 to 310 in 1989/90. Since this is a species particularly sensitive to oil pollution because of its habit of feeding right at the edge of a retreating tide, an increase in numbers on the oiled areas of the Alt would suggest that the oil spill has had no long-term damaging effects upon intertidal areas of the Outer Estuary. There are no statistical differences in usage changes for oiled and unoiled intertidal areas (t = 0.43, n.s.) (Figure 3.11.2).

3.12 DUNLIN

The Mersey is the seventh most important estuary in Britain for wintering Dunlin, with an average peak count over the five winters 1984/84 to 1988/89 of just under 22,000, substantially in excess of the qualifying level for international importance of 14,000. Low tide counts during the winter 1989/90 gave an average number of 5,800 Dunlin and a peak count of nearly 10,000. High tide counts give a more accurate indication of the true numbers present since there has been an increasing tendency in recent years for Dunlin to feed at low tide in creeks and channels off Frodsham Score, where they are difficult to count (pers. obs.).

The distribution of feeding Dunlin in winter 1989/90 is given in Figure 3.12.1, and changes in distribution from the previous year in Figure 3.12.2. This illustrates the main trend in distribution change, with decreases throughout the body of the estuary and a very large increase off Frodsham Score.

There was a significant change between sites in usage of intertidal areas of different heights, with a decrease in feeding density on the higher intertidal areas at Stanlow and a proportionally greater usage of higher intertidal areas at New Ferry ($t = 4.46$, $p<0.01$) (Figure 3.12.3). This is probably due to birds leaving Stanlow for the creeks at Frodsham Score (and consequently 'disappearing' from the low tide counts). There has also been a significant increase in feeding density on higher intertidal areas at Oglet relative to the two unoiled all day sites of Stanlow and New Ferry ($t = 2.1$, $p<0.05$), indicating that oiling has not had an adverse effect on Dunlin in the Mersey.

The average peak BoEE count of Dunlin at the Alt over the five winters 1984/85 to 1988/89 was 4,100. Low tide numbers of Dunlin at the Alt and North Wirral shore combined increased from an average of 2,030 in 1988/89 to 3,080 in 1989/90, although this is partly due to a very high count in February 1990 (6,700) for which there is no apparent explanation. An increase in numbers of Dunlin is a further indication that the oil spillage in 1989 has had no deleterious effect on this species.

Changes in usage of the low tide intertidal areas indicates a significant increase in proportional usage of unoiled sites over oiled sites ($t = 2.54$, $p<0.05$) (Figure 3.12.4), although this is due more to the species' expansion of use of the unoiled North Wirral shore than to a real decline in usage on oiled sites. This expansion appears to be a result of changes in sediment type along the central part of the North Wirral shore, as discussed in 3.6. The deposition of a layer of fine wet mud in this area has created a suitable feeding ground for Dunlin.

Small numbers of Dunlin were counted on the Egremont study site, reaching a peak of only 30 birds. These birds fed only on the middle shore (Figure 3.12.5).

3.13 BAR-TAILED GODWIT

The Alt is of international importance for its population of Bar-tailed Godwit, being the third most important site for this species in Britain. It held an average peak of 7,500 over the five winters 1984/85 to 1988/89, compared with a qualifying level for international importance of 1,000. Low tide counts carried out over winter 1989/90 revealed an increase in numbers over the previous winter, with an average low tide count of 3,080 compared to 2,030 in 1988/89. The low tide distribution of Bar-tailed Godwit in winter 1989/90 (Figure 3.13.1) revealed the existence of an important new feeding site on the North Wirral shore which was not present the previous winter, and a corresponding drop in numbers feeding on the Alt (figure 3.13.2). This movement might be a result of oil contamination of the intertidal areas of the Alt but is more likely to be associated with sediment changes on the North Wirral shore. As with Dunlin, Bar-tailed Godwits prefer fine, wet mud as a feeding substrate and the deposition of such a layer along the central portion of the North Wirral shore appears to have attracted birds from the traditional feeding grounds of the Alt.

The statistically significant increase in usage on unpolluted intertidal areas ($t = 1.97$, $p<0.05$) (Figure 3.13.3) is again due to birds leaving the intertidal areas of the affected Alt shore to exploit a newly created and obviously preferable feeding site on the North Wirral shore. The relationship of this movement to the oiling incident is thus at best unclear.

3.14 CURLEW

The Mersey Estuary holds nationally important numbers of Curlew in winter, BoEE counts giving an average peak winter count of 1049 for the five winters 1984/85 to 1988/89. The qualifying level for national importance is 910.

Low tide counts in the winter 1989/90 show an average count of 910 birds with a peak of 1,130, compared with an average count during the winter 1988/89 of 560 and a peak of 870. Curlew are distributed widely throughout the Mersey (Figure 3.14.1) and were recorded on an average of 71% of intertidal areas censused during low tide counts. Changes in the numbers of Curlew feeding on each intertidal area between the two winters are shown in Figure 3.14.2. There is no clear pattern to these changes, although most intertidal areas on the North Wirral Shore recorded small increases and large increases were noted on several intertidal areas on the southern Mersey shore.

All day counts reveal significant changes in feeding density at Stanlow and New Ferry on higher intertidal areas (Figure 3.14.3). At Stanlow there was a significant fall in feeding density on the upper intertidal areas whilst at New Ferry the usage of these increased proportionally ($t = 3.0$, $p<0.05$). Curlew, however, feed at low density, and usage values could be affected significantly by movements of small numbers of birds, so these results need not imply any large scale changes in the distribution of Curlew in the Mersey. Both sites were unaffected by oil.

There was no significant change in usage or feeding density at the oiled site of Oglet suggesting that the oil spill had no significant effect upon this species.

The low tide counts show no significant difference in changes in usage values for affected and unaffected intertidal areas between the two years ($t = 0.94$, n.s.), providing further evidence that the oil spill has not affected this species (Figure 3.14.4).

Curlew do not feed on the Alt in nationally important numbers. Counts over the winter 1989/90 show a slight increase in numbers of this species on the North Wirral shore over the previous winter.

3.15 REDSHANK

The Mersey supports internationally important numbers of Redshank in winter, with an average peak count of 2,750 over the five winters 1984/85 to 1988/89, and is the eleventh most important site for this species in Britain. Low tide counts carried out for the present study give an average count of 3,240, whereas the average low tide count for the same period in 1988/89 was 2,470, indicating an increase in numbers in 1989/90. Like Curlew, this species is widely distributed throughout the Mersey (Figure 3.15.1) with the south shore of the Inner Estuary holding most birds. The species was recorded on an average of 56% of all censused low tide intertidal areas in the Mersey.

A comparison of changes in numbers on each of the low tide count areas between the two winters (Figure 3.15.2) shows that Redshank decreased along much of the northern shore of the Mersey and increased along the southern shore (except at New Ferry). On the Alt and North Wirral Shore there was a redistribution away from the areas found to be most important during the winter 1988/89. The changes in feeding usage along the North Wirral Shore are particularly interesting, with increases being noted on almost all intertidal areas except those which underwent changes in substrate type between the two years. These areas recorded considerable decreases in numbers of feeding Redshank, suggesting that the new substrate provided unsuitable feeding grounds for Redshank.

All day count analysis revealed a significant increase between 1988/89 and 1989/90 in the proportional feeding density on the lower intertidal areas of Stanlow relative to Oglet ($t = 2.0$, $p<0.05$), which is probably accounted for by the generally higher number of birds present on the south side of the estuary in the latter year (Figures 3.15.3, 3.15.4). There was no significant difference in changes in usage or feeding density between years for oiled and unoiled all day study sites (t = 0.88, n.s.) suggesting that in this instance oiling of intertidal areas has had no effect on Redshank populations in the Mersey.

Although BoEE counts have shown that this species does not usually occur in nationally important numbers on the Alt, the average low tide count of Redshank for these areas over the winter 1989/90 exceeded 1,600 compared to an average of 1,300 the winter before. The species has increased on the North Wirral shore probably as a result of the deposition of a favourable feeding substrate there.

There was no significant difference between affected and unaffected intertidal areas in changes in usage over the two winters (t = 0.89, n.s.) (Figure 3.15.4) again indicating no effects on Redshank populations attributable to the oil spill.

As with most other species, the 70 or so Redshank which fed on the Egremont study site concentrated on the central part of the shore, although odd individuals occasionally fed on the upper areas (Figure 3.15.5).

3.16 TURNSTONE

Turnstone favour coastal areas with rocky shores and consequently do not occur on the Mersey in any significant numbers. There is, however, an area of suitable habitat at Egremont which supports often quite large numbers of this species and areas of the Alt/North Wirral shores which support smaller numbers (Figure 3.16.1). Counts of the whole area gave an average count of 455 over the winter 1989/90. This was considerably higher than that found in the previous winter and was a direct result of a change in counting procedure in 1989/90, when birds were counted leaving the Mersey after being displaced by the advancing tide, thus ensuring that no birds were missed.

The absence of a significant difference between intertidal area usage on affected and unaffected areas ($t = 0.5$, n.s.) (Figure 3.16.2) is evidence that this species has not suffered as a result of the oil spill.

This is the species which most constantly used the Egremont study site, where up to 120 birds fed. As with the other species recorded using this site, most Turnstone concentrated on the middle shore although this was the only species to also use the upper areas which had received heavy oiling. No Turnstone were observed feeding on the lower tidal areas despite the discovery in the gut contents of two dead birds of remains of the barnacle Balanus crenatus Brugiere, a species which occurs on lower shores. It is likely therefore that Turnstone feed throughout the the whole width of the shore at Egremont, which is only exposed for just over five hours.

4. DISCUSSION

Detailed statistical comparisons of data obtained over the winter 1989/90 with data already in existence for the previous winter have failed to demonstrate any adverse effects clearly attributable to the Mersey oil spill of August 1989. There was a shift in the distributions of several species, particularly Knot and Bar-tailed Godwit, from feeding grounds on the Alt, used in the winter 1988/89, to the North Wirral shore. Although this movement may have been partly the result of oiling on the Alt, the lack of movement of birds away from the other affected parts of the Mersey Estuary suggests that the availability of food was the dominant factor, as the surface sediment on the North Wirral shore is known to have changed between the two winters.

Changes in distributions of waterfowl in the study area between the two winters demonstrate the dynamic nature of the Liverpool Bay area. Intertidal areas can become eroded due to changes in the flow of river channels or the occurrence of storms, which can strip the top, invertebrate-bearing layers off intertidal areas very quickly (eg. Clark, 1983; Ferns, 1983). The Mersey and Alt are known to undergo substantial changes in the distribution of intertidal areas over time as is shown by Ordnance Survey maps over the past 100 years. Other factors, such as changes in sewage enrichment of intertidal areas, influence the abundance of invertebrates and thus the feeding distributions of birds. Disturbance, either by human activities or the presence of predators, can also influence waterfowl distribution, although there is no evidence of notable changes in either of these on the Mersey between 1988/89 and 1989/90.

There are several reasons why a lack of correlation between oiling and bird distribution was perhaps the expected result of the present study. Most important of these was the timing of the spill. Waterfowl do not arrive on the Mersey in large numbers until the late September, by which time most of the oil had been cleared or effectively removed from the system by a number of physical or chemical factors (OPRU, 1990). The rate at which these occurred was primarily related to the nature of the spilled oil. TJP is a highly viscous, bituminous oil with a low proportion of volatile fractions, which quickly becomes conglomerated and hardened, both reducing the danger of direct contamination to birds and lessening the impact on invertebrates, since it is the volatile fractions which are most toxic. The relatively small amount of use made of toxic dispersants also lessened the threat to invertebrates.

The location of the stranded oil was also important in reducing the potential threat to birds. The high spring tide and strong winds immediately following the spill caused most of the stranded oil to beach at the top of the intertidal range, above the intertidal areas most used by waterfowl. The direction of the prevailing wind was also important since it caused the oil to beach on the north shore of the Inner Estuary, away from the main high tide roosting sites which lie along the south shore.

In the event, the timing of the spill, the nature of the oil involved and the prevalent climatic and tidal conditions all fortuitously coincided to minimise any effect on the waterfowl wintering on the Mersey or Alt estuaries. Had the spill coincided with the presence of large numbers of birds and the oil beached further down the intertidal range, the effects could have been far more serious.

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Table 1.1 The National and International Importance of the Mersey for Waterfowl, 1984/85-1988/89.

▲ Mersey population of national importance

● Mersey population of international importance

Species	Av. Peak Winter Count (Nov.-Mar.)	% of British Population	% of European Population *
SHELDUCK *Tadorna tadorna*	3763	5.0 ▲	1.5 ●
WIGEON *Anas penelope*	8716	3.4 ▲	1.2 ●
TEAL *Anas crecca*	8726	8.7 ▲	2.2 ●
MALLARD *Anas platyrhynchos*	1468	0.3	0.1
PINTAIL *Anas acuta*	8668	34.7 ▲	12.4 ●
RINGED PLOVER *Pluvialis hiaticula*	24	0.1	0.1
GOLDEN PLOVER *Pluvialis apricaria*	1248	0.6	0.1
GREY PLOVER *Pluvialis squatarola*	275	1.3 ▲	0.2
LAPWING *Vanellus vanellus*	3318	0.3	0.2
KNOT *Calidris canutus*	110	0.1	<0.1
DUNLIN *Calidris alpina*	21,948	5.1 ▲	1.6 ●
BLACK-TAILED GODWIT *Limosa limosa*	47	0.9	0.1
BAR-TAILED GODWIT *Limosa lapponica*	17	<0.1	<0.1
CURLEW *Numenius arquata*	1049	1.2 ▲	0.3
REDSHANK *Tringa totanus*	2761	3.7 ▲	1.8 ●

* For wildfowl, percentages are of Western European population, for waders percentages are of East Atlantic Flyway population.

Table 2.1 Official Dates of BoEE Counts, Winter 1989/90.

COUNT	DATE
1	12th Nov 1989
2	17th Dec 1989
3	14th Jan 1990
4	11th Feb 1990
5	11th Mar 1990

Table 2.2 Dates of Low Tide Counts, Winter 1989/90.
(Heights of low tide in m.)

COUNT	EARLIEST DATE	OFFICIAL DATE	LATEST DATE
1	17/11/89	19/11/89 (2.8)	21/11/89
2	8/12/89	10/12/89 (1.8)	11/12/89
3	22/12/89	23/12/89 (3.2)	24/12/89
4	6/01/90	7/01/90 (2.5)	9/01/90
5	19/01/90	21/01/90 (3.6)	22/01/90
6	3/02/90	4/02/90 (2.7)	8/02/90
7	18/02/90	18/02/90 (3.3)	20/02/90

Table 2.3 Oiling of Low Tide Intertidal Count Areas
(0; Unoiled, 1; Offshore of Oiled Area, 2; Oiled)

MUDFLAT NUMBER	OILING CODE	MUDFLAT NUMBER	OILING CODE
1	0	51	0
2	0	52	0
3	0	53	0
4	0	54	0
5	0	55	0
6	0	56	0
7	0	57	0
8	0	58	0
9	0	59	2
10	0	60	2
11	0	61	2
12	0	62	2
13	0	63	2
14	0	64	2
15	0	65	2
16	0	66	1
17	0	67	1
18	0	68	2
19	0	69	2
20	0	70	2
21	0	71	1
22	2	72	1
23	2	73	1
24	2	74	1
25	2	75	1
26	2	76	2
27	2	77	2
28	2	78	1
29	2	79	2
30	0	80	2
31	0	81	1
32	0	82	2
33	0	83	2
34	0	84	2
35	0	85	1
36	0	86	1
37	0	87	2
38	0	88	1
39	0	89	2
40	0	90	2
41	0	91	2
42	0	92	2
43	0	93	2
44	0	94	1
45	0	95	2
46	0	96	1
47	0	97	1
48	0	98	2
49	0	99	2
50	0		

Table 2.4 Dates of All Day Counts, Winter 1989/90. (Heights of high tide in m.)

COUNT	**DATE**		
	NEW FERRY	STANLOW	OGLET
1	6/11/89 (7.6)	9/11/89 (7.9)	7/11/89 (7.6)
2	20/11/89 (7.8)	23/11/89 (7.6)	21/11/89 (7.6)
3	5/12/89 (8.2)	6/12/89 (8.1)	7/12/89 (8.2)
4	19/12/89 (8.1)	20/12/89 (7.8)	21/12/89 (7.5)
5	3/01/90 (8.8)	4/01/90 (8.6)	5/01/90 (8.3)
6	16/01/90 (8.8)	18/01/90 (7.9)	16/01/90 (8.8)
7	31/01/90 (9.5)	1/02/90 (9.2)	6/02/90 (8.0)
8	21/02/90 (7.2)	14/02/90 (9.0)	21/02/90 (7.2)
9	5/03/90 (7.4)	6/03/90 (7.3)	5/03/90 (7.4)

Table 3.1 The number of birds recorded during count 1, 19/20 November 1989

The number of intertidal areas counted in:
Mersey = 44 Alt/North Wirral Shore = 26

	MERSEY ESTUARY			ALT/NORTH WIRRAL SHORE		
Species	No. Feeding	No. Roosting	% Areas with birds	No. Feeding	No. Roosting	% Areas with birds
HERON	4	3	7	0	1	4
SHELDUCK	3500	99	45	0	148	8
WIGEON	0	32	7	0	0	0
TEAL	5079	3634	36	0	0	0
MALLARD	548	813	55	29	300	8
PINTAIL	542	493	39	0	0	0
OYSTERCATCHER	0	0	0	4175	800	62
RINGED PLOVER	59	0	9	8	0	12
GOLDEN PLOVER	0	5	2	0	700	4
GREY PLOVER	45	3	11	199	0	31
LAPWING	12	4889	20	0	1119	12
KNOT	8	321	9	5117	3148	42
SANDERLING	0	0	0	851	0	23
DUNLIN	8086	250	39	4827	0	54
BLACK-TAILED GODWIT	0	1	2	0	0	0
BAR-TAILED GODWIT	4	0	2	3373	520	46
CURLEW	508	8	66	264	0	58
REDSHANK	3723	118	70	1692	100	81
TURNSTONE	21	0	7	203	0	38

Table 3.2 The number of birds recorded during count 2, 10/11 December 1989

The number of intertidal areas counted in:
Mersey = 50 Alt/North Wirral Shore = 27

	MERSEY ESTUARY			ALT/NORTH WIRRAL SHORE		
Species	No. Feeding	No. Roosting	% Areas with birds	No. Feeding	No. Roosting	% Areas with birds
HERON	5	3	8	0	2	4
SHELDUCK	3303	540	68	107	123	22
WIGEON	17	2912	12	0	0	0
TEAL	2778	3759	42	0	0	0
MALLARD	416	584	48	8	18	7
PINTAIL	395	434	36	0	0	0
OYSTERCATCHER	1	0	2	3366	175	74
RINGED PLOVER	32	5	12	25	0	7
GOLDEN PLOVER	16	7	4	0	500	4
GREY PLOVER	32	10	6	534	0	22
LAPWING	95	5624	38	0	6	4
KNOT	125	53	8	5494	650	26
SANDERLING	0	0	0	397	0	19
DUNLIN	1235	4357	38	1499	0	48
BLACK-TAILED GODWIT	22	0	4	0	0	0
BAR-TAILED GODWIT	0	0	0	1036	0	44
CURLEW	448	328	70	356	40	63
REDSHANK	2852	97	62	1666	0	74
TURNSTONE	22	0	8	611	0	26

Table 3.3 The number of birds recorded during count 3, 23/24 December 1989

The number of intertidal areas counted in:
Mersey = 44 Alt/North Wirral Shore = 18

	MERSEY ESTUARY			ALT/NORTH WIRRAL SHORE		
Species	No. Feeding	No. Roosting	% Areas with birds	No. Feeding	No. Roosting	% Areas with birds
SHELDUCK	2322	134	59	22	42	22
WIGEON	9	2600	5	0	0	0
TEAL	878	9169	30	0	0	0
MALLARD	451	390	34	15	110	11
PINTAIL	123	858	23	0	0	0
SHOVELER	10	0	5	0	0	0
OYSTERCATCHER	3	1	2	1650	40	67
RINGED PLOVER	10	0	2	5	0	11
GREY PLOVER	36	0	9	58	0	33
LAPWING	0	2504	18	0	0	0
KNOT	0	17	7	1731	6259	39
SANDERLING	0	0	0	369	0	11
DUNLIN	5876	0	27	669	0	61
BAR-TAILED GODWIT	0	0	0	3632	15	61
CURLEW	487	277	73	44	220	56
REDSHANK	2263	124	39	625	100	72
TURNSTONE	19	0	7	34	0	28

Table 3.4 The number of birds recorded during count 4, 7/8 January 1990

The number of intertidal areas counted in:
Mersey = 54 Alt/North Wirral Shore = 36

Species	MERSEY ESTUARY No. Feeding	No. Roosting	% Areas with birds	ALT/NORTH WIRRAL SHORE No. Feeding	No. Roosting	% Areas with birds
HERON	0	16	4	0	0	0
SHELDUCK	2648	296	57	158	52	14
WIGEON	10	1376	6	0	0	0
TEAL	679	6416	33	0	0	0
MALLARD	368	780	39	53	1	6
PINTAIL	216	319	20	0	0	0
SHOVELER	1	0	2	0	0	0
OYSTERCATCHER	4	0	4	2173	629	67
RINGED PLOVER	33	0	2	11	6	8
GOLDEN PLOVER	0	74	2	0	0	0
GREY PLOVER	87	52	19	298	0	28
LAPWING	1021	5304	28	0	1160	6
KNOT	51	1	6	4517	3050	33
SANDERLING	0	0	0	409	0	22
DUNLIN	8563	777	39	3412	8	50
BLACK-TAILED GODWIT	14	14	4	0	0	0
BAR-TAILED GODWIT	0	0	0	6193	0	39
CURLEW	781	326	70	228	3	56
REDSHANK	3907	349	72	1517	47	69
TURNSTONE	21	0	4	123	53	31

Table 3.5 The number of birds recorded during count 5, 21/22 January 1990

The number of intertidal areas counted in:
Mersey = 55 Alt/North Wirral Shore = 32

	MERSEY ESTUARY			ALT/NORTH WIRRAL SHORE		
Species	No. Feeding	No. Roosting	% Areas with birds	No. Feeding	No. Roosting	% Areas with birds
HERON	2	15	9	0	0	0
SHELDUCK	3187	347	58	63	95	25
WIGEON	0	1230	7	0	0	0
TEAL	1750	4380	27	0	0	0
MALLARD	352	216	40	32	406	16
PINTAIL	555	472	25	0	0	0
OYSTERCATCHER	1	1	2	1924	2358	56
RINGED PLOVER	33	0	5	78	22	16
GOLDEN PLOVER	0	1405	5	0	0	0
GREY PLOVER	11	26	7	315	0	25
LAPWING	407	2584	22	220	1350	3
KNOT	1541	135	5	389	0	16
SANDERLING	0	0	0	36	0	3
DUNLIN	2364	35	20	2181	45	44
BLACK-TAILED GODWIT	0	40	2	0	0	0
BAR-TAILED GODWIT	0	0	0	4305	5	22
CURLEW	934	90	71	336	128	53
REDSHANK	3838	580	49	1598	20	66
TURNSTONE	30	0	5	710	0	34

Table 3.6 The number of birds recorded during count 6, 4/5 February 1990

The number of intertidal areas counted in:
Mersey = 55 Alt/North Wirral Shore = 32

Species	MERSEY ESTUARY No. Feeding	No. Roosting	% Areas with birds	ALT/NORTH WIRRAL SHORE No. Feeding	No. Roosting	% Areas with birds
HERON	4	0	4	0	0	0
SHELDUCK	2256	144	64	20	40	16
WIGEON	22	310	4	0	0	0
TEAL	1126	3419	33	0	0	0
MALLARD	156	381	25	0	0	0
PINTAIL	237	191	24	0	0	0
SHOVELER	5	0	2	0	0	0
OYSTERCATCHER	1	0	2	2728	1600	59
RINGED PLOVER	31	0	4	166	8	16
GOLDEN PLOVER	27	170	4	10	0	3
GREY PLOVER	24	18	15	98	0	13
LAPWING	197	4207	22	0	47	9
KNOT	609	0	7	627	10	19
SANDERLING	0	0	0	80	26	13
DUNLIN	286	2552	15	2159	16	47
BLACK-TAILED GODWIT	11	0	2	0	0	0
BAR-TAILED GODWIT	7	0	2	5343	277	25
CURLEW	972	71	71	277	0	53
REDSHANK	2543	166	53	1724	66	63
TURNSTONE	16	0	4	745	0	28
GOLDENEYE	0	0	0	3	0	3

Table 3.7 The number of birds recorded during count 7, 19/20 February 1990

The number of intertidal areas counted in:
Mersey = 54 Alt/North Wirral Shore = 28

	MERSEY ESTUARY			ALT/NORTH WIRRAL SHORE		
Species	No. Feeding	No. Roosting	% Areas with birds	No. Feeding	No. Roosting	% Areas with birds
HERON	10	0	6	0	0	0
SHELDUCK	2098	299	50	89	14	11
WIGEON	0	10	2	0	0	0
TEAL	1055	2173	20	0	0	0
MALLARD	215	331	33	48	186	14
PINTAIL	167	155	26	0	0	0
OYSTERCATCHER	4	2	4	1741	1686	71
RINGED PLOVER	16	0	2	78	0	11
GOLDEN PLOVER	0	923	6	0	0	0
GREY PLOVER	138	19	15	14	0	14
LAPWING	815	2113	28	70	314	7
KNOT	552	50	15	3280	0	36
SANDERLING	0	0	0	733	0	7
DUNLIN	5495	753	20	6744	0	46
BLACK-TAILED GODWIT	14	5	4	0	0	0
BAR-TAILED GODWIT	5	0	2	5661	210	32
CURLEW	908	220	76	253	15	61
REDSHANK	1912	196	46	1920	152	64
TURNSTONE	10	0	4	711	0	32

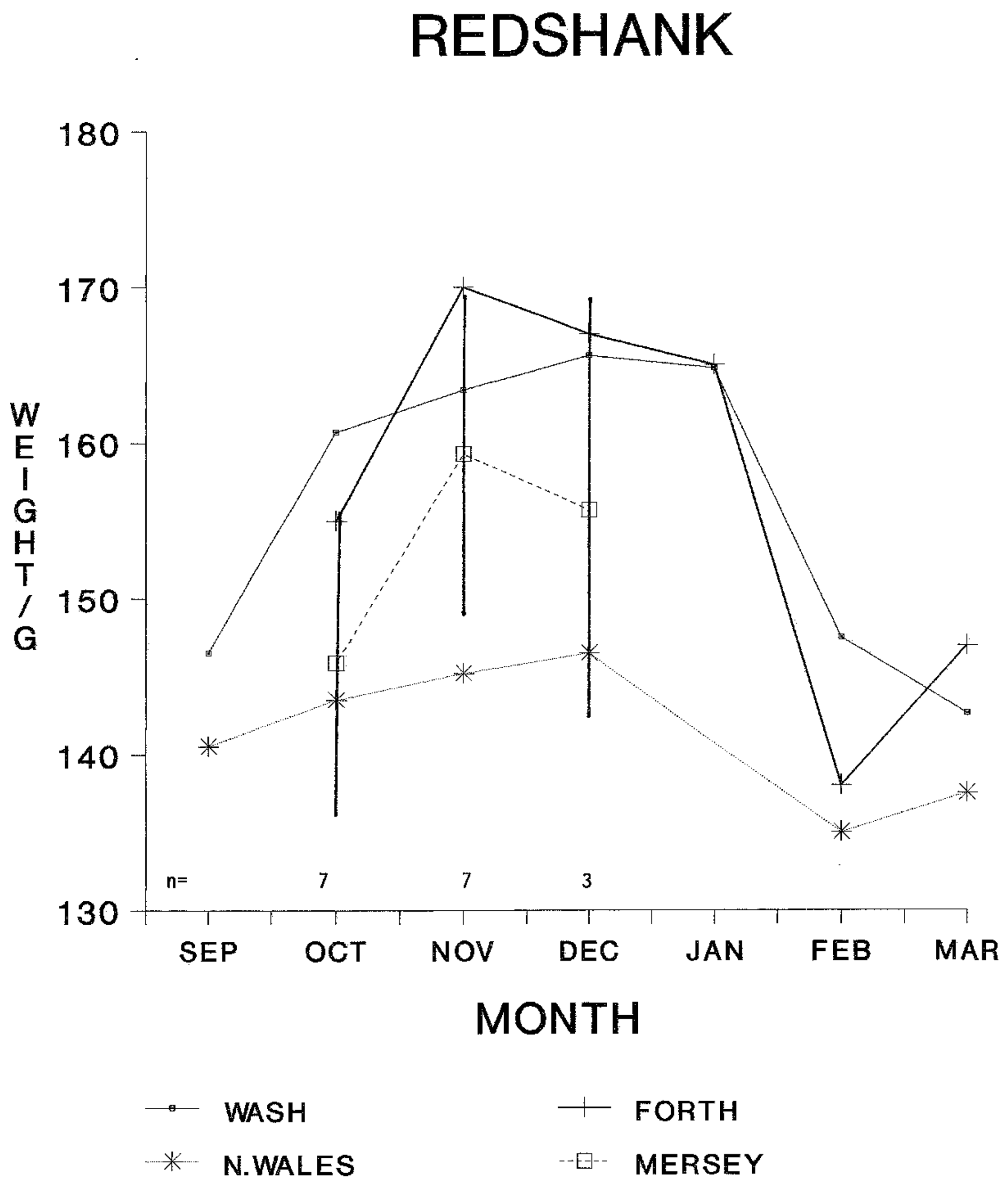


Figure 2.4 Changes in mean weights of Redshank through the winter at four sites around Britain. (Data for Mersey from winter 1989/90 only; data for other sites average of more than one winter).

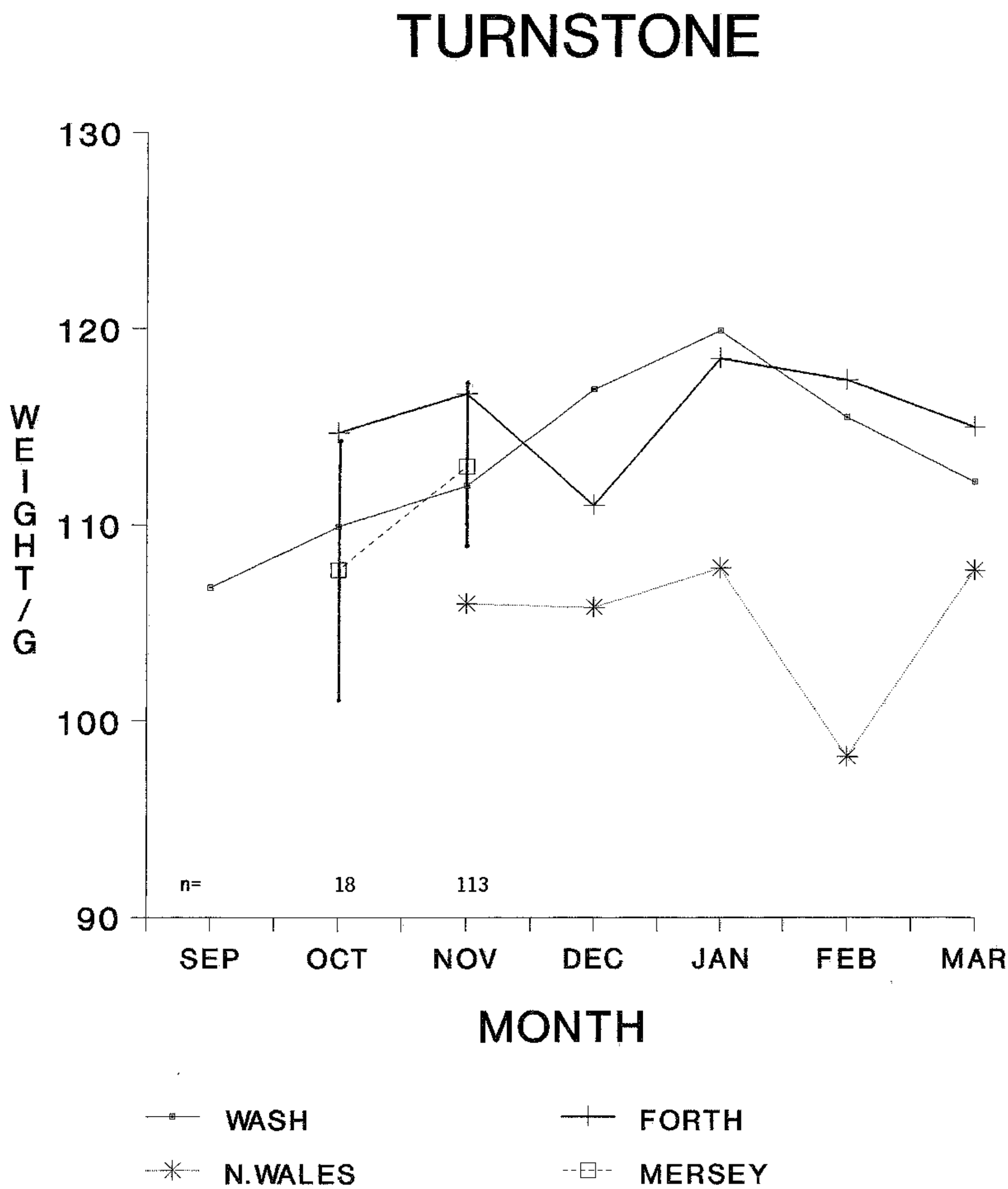


Figure 2.5 Changes in mean weights of Turnstone through the winter at four sites around Britain. (Data for Mersey from winter 1989/90 only; data from other sites average of more than one winter).

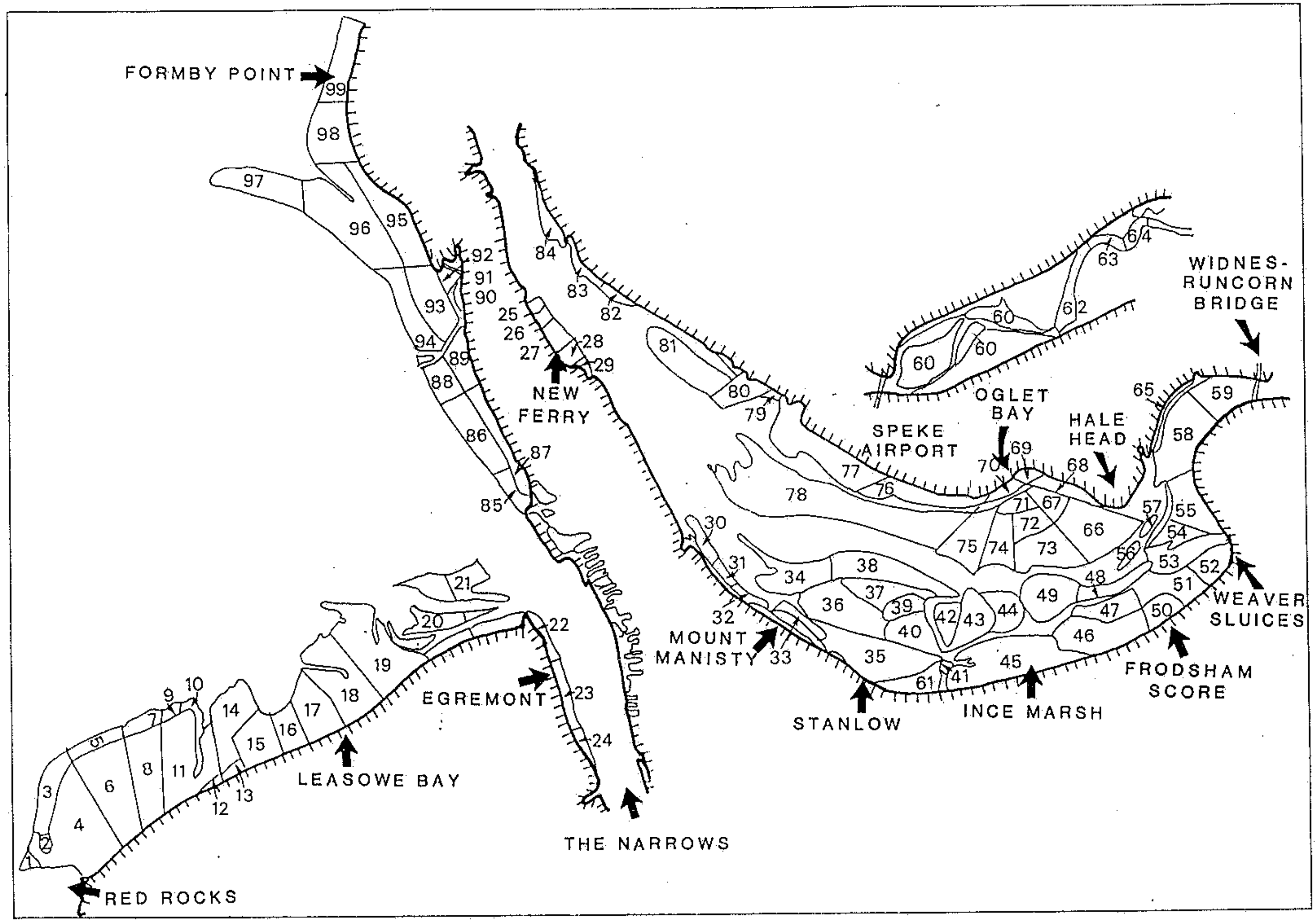


Figure 1.1 The locations of the 99 intertidal areas which were surveyed regularly during the 1988/89 and 1989/90 winters.

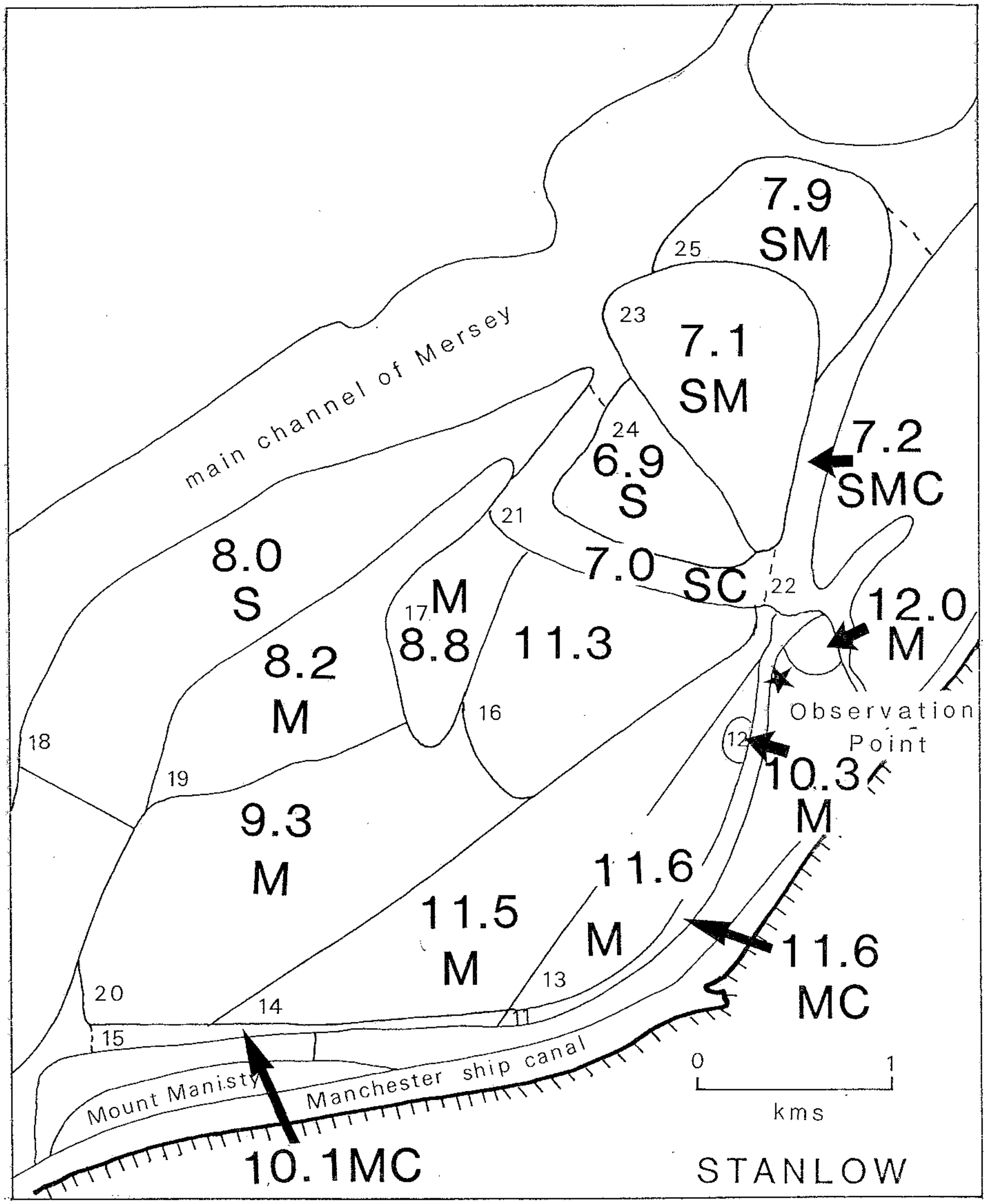


Figure 2.1 The Stanlow all day study site. The average exposure time in winter is given together with the main substrate type for each intertidal area.

(C = Channel, M = Mud, S = Sand, SM = Mixed sand and mud)

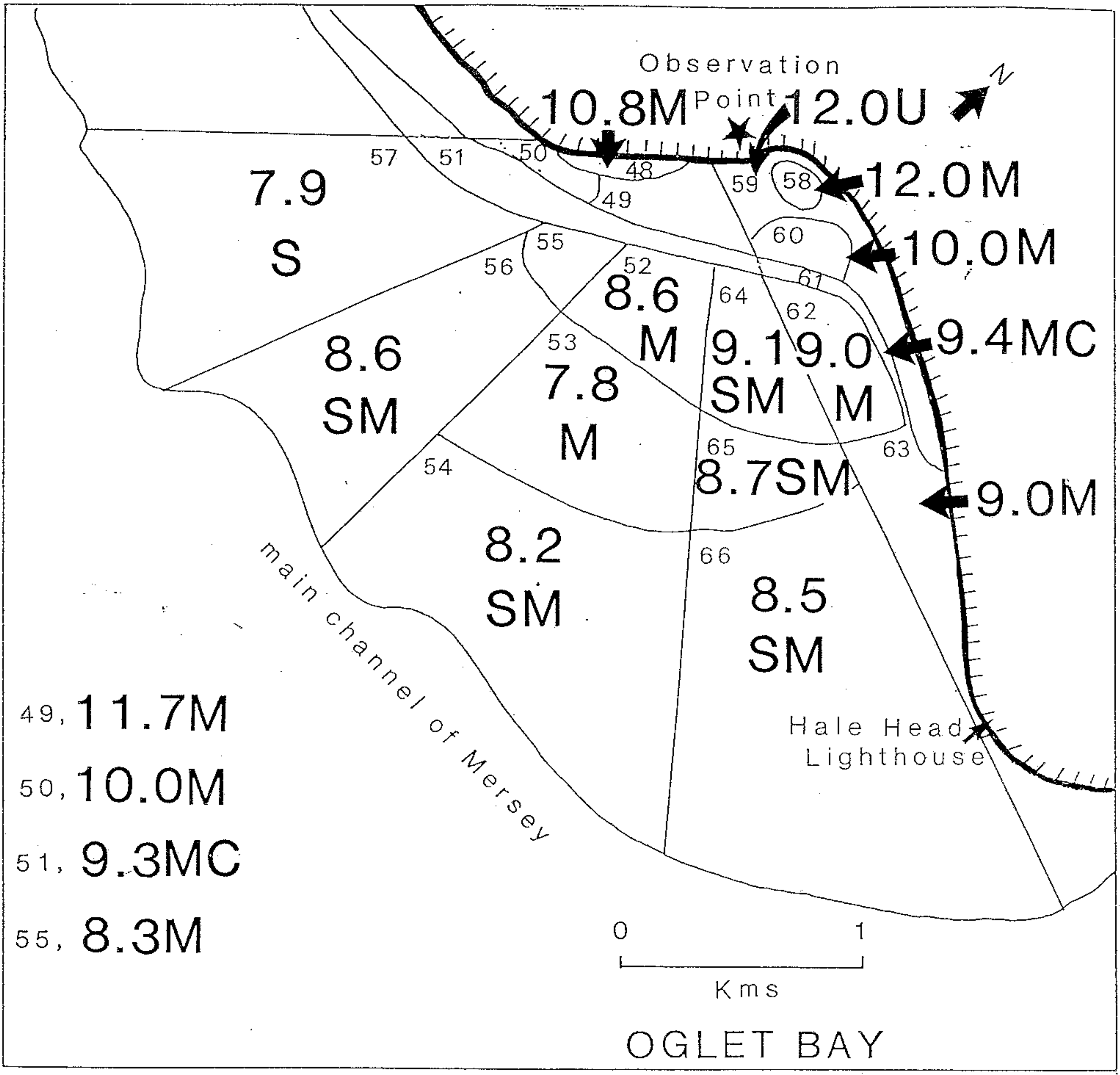


Figure 2.2 The Oglet Bay all day study site. The average exposure time in winter is given together with the main substrate type for each intertidal area.

(C = Channel, M = Mud, SM = Mixed sand and mud, U = Ungrazed saltmarsh)

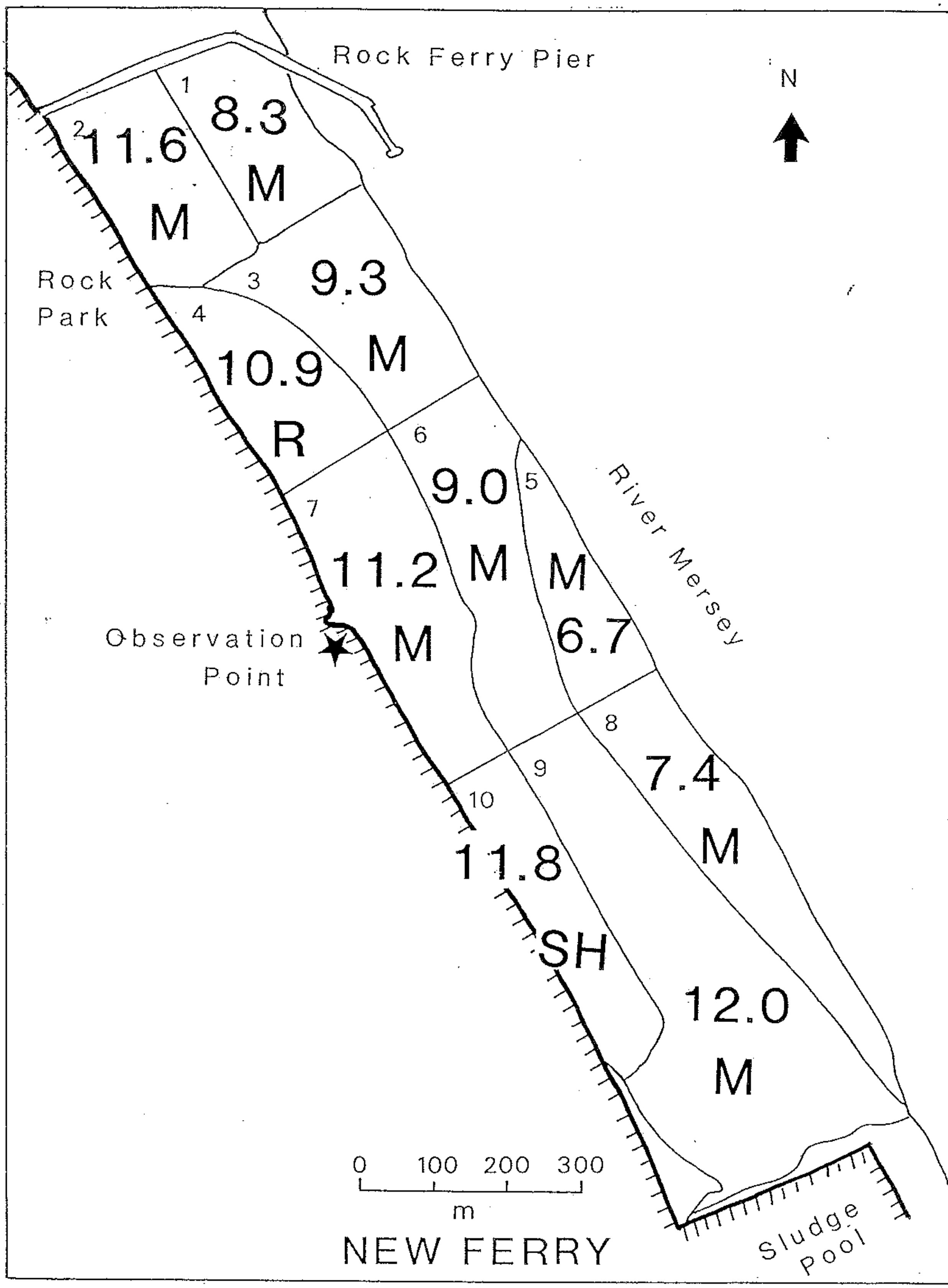


Figure 2.3 The New Ferry all day study site. The average exposure time in winter is given together with the main substrate type for each intertidal area.

(M = Mud, R = Rock, SH = Shingle)

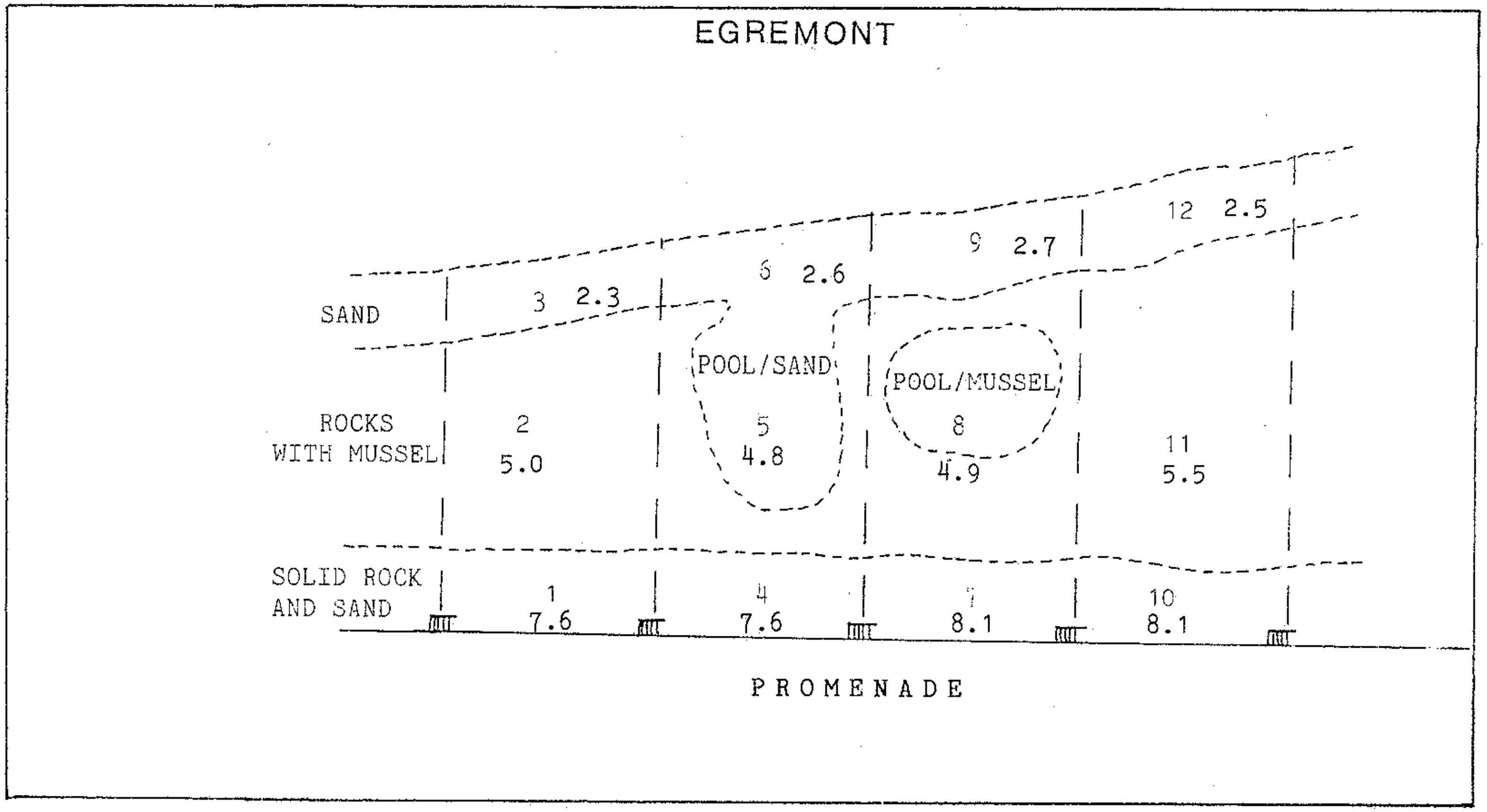


Figure 2.4 The Egremont study site. The average exposure time in winter is given in Bold.

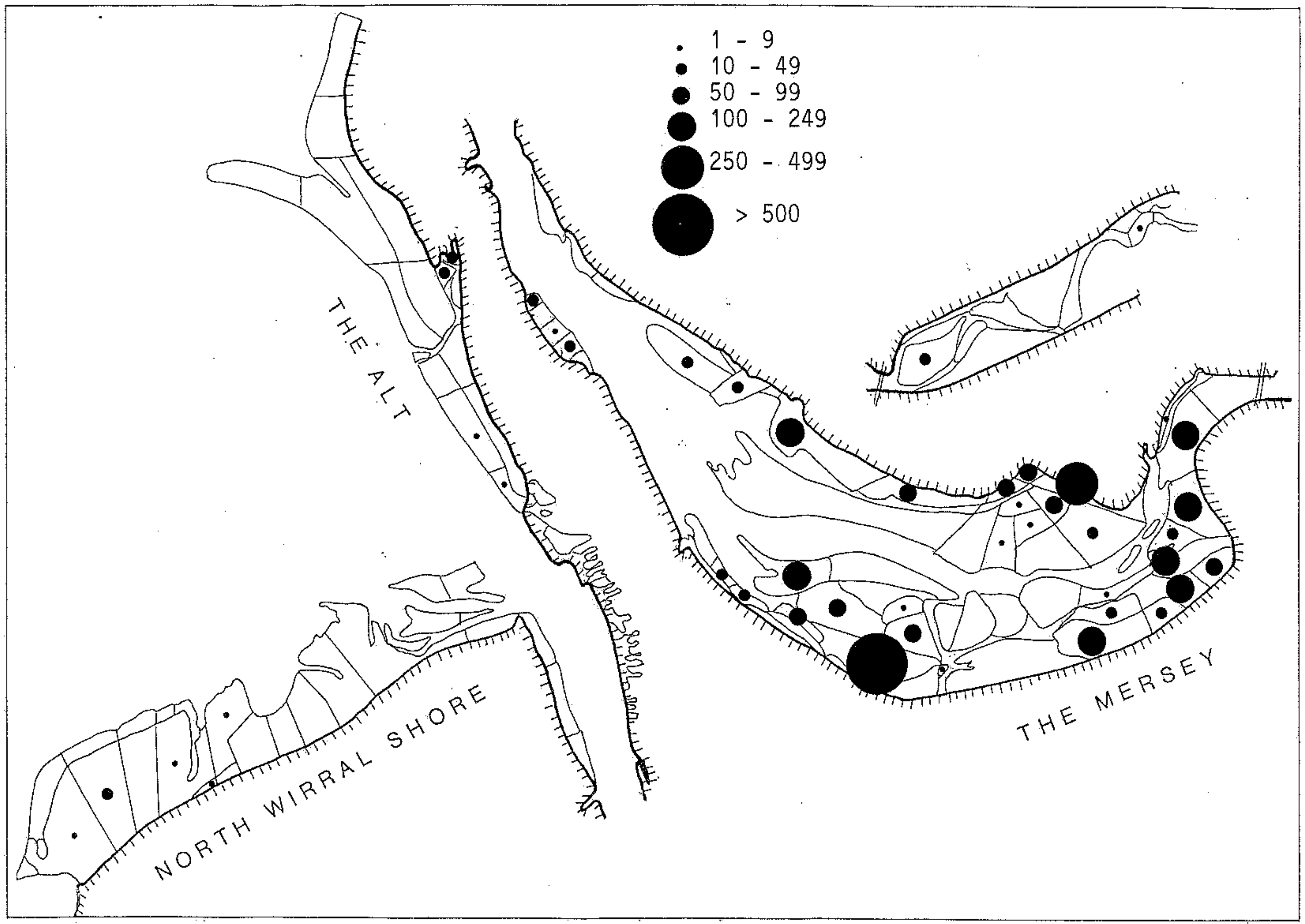


Figure 3.1.1 The average number of Shelduck feeding at low tide on each intertidal area during winter 1989/90.

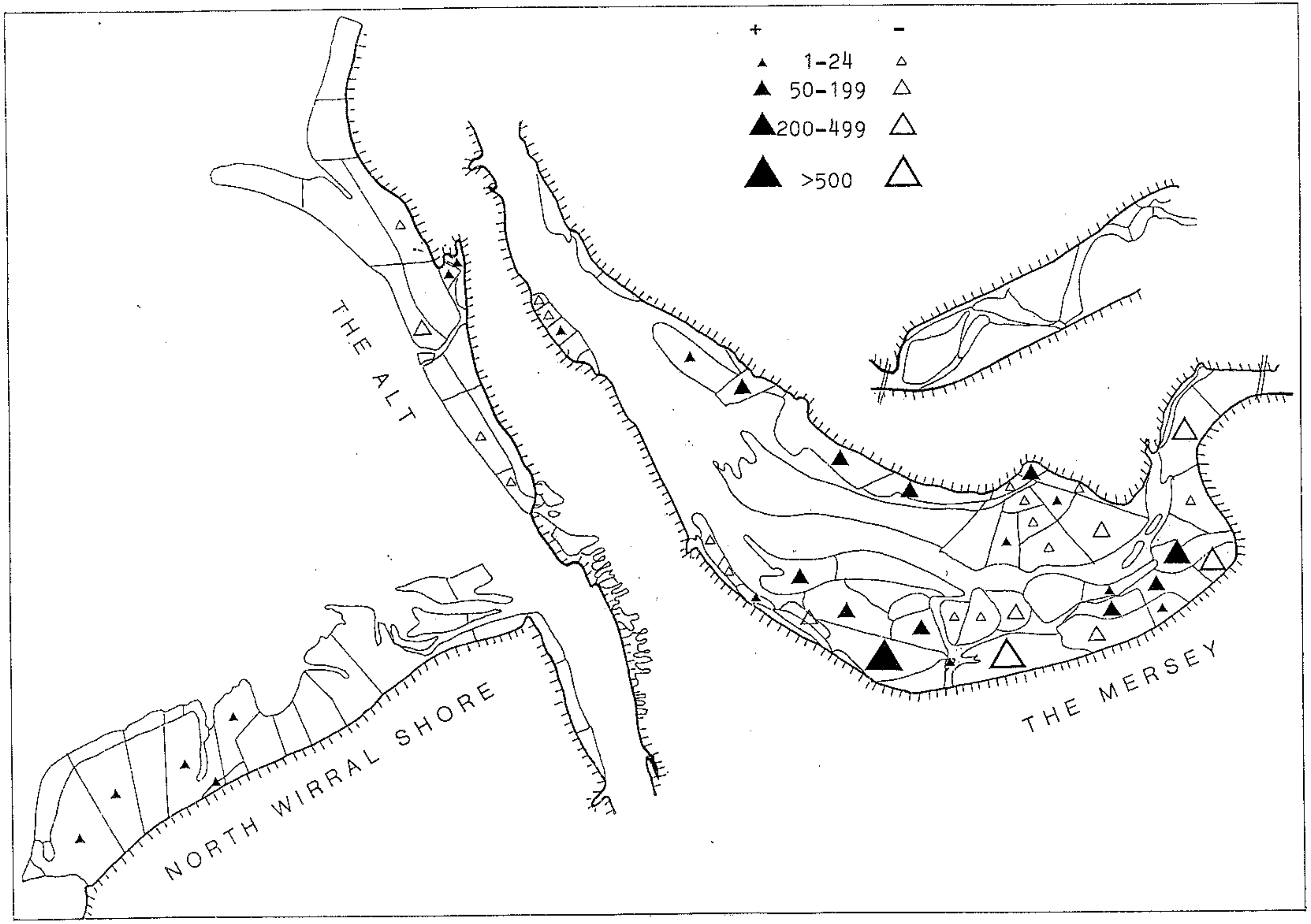


Figure 3.1.2 Changes in the low tide usage made by feeding Shelduck between winters 1988/89 and 1989/90. (Positive values denote an increase in the second winter, negative values a decrease).

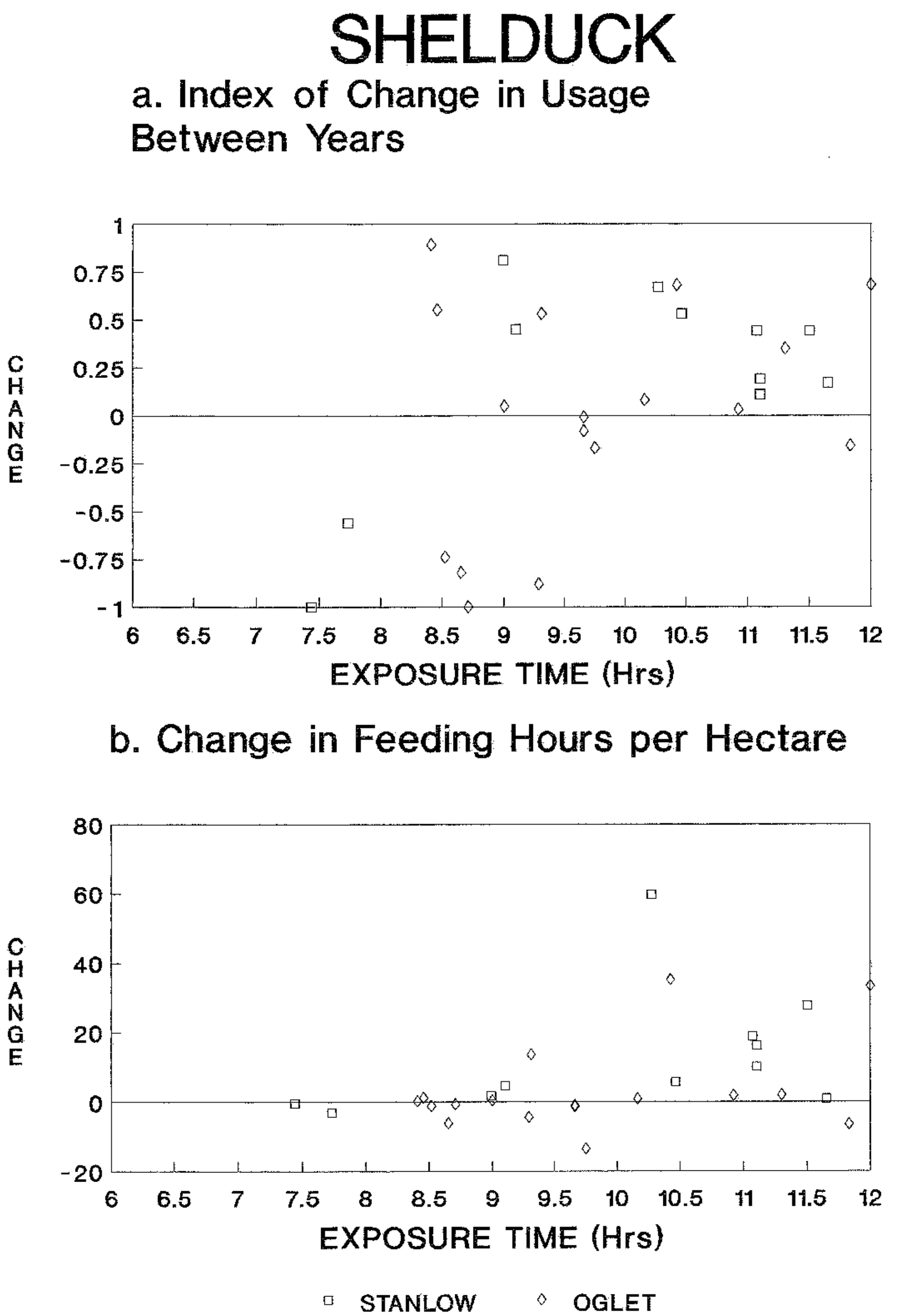


Figure 3.1.3 The relationship between changes in all day usage and exposure time for an oiled site (Oglet) and an unoiled site (Stanlow).

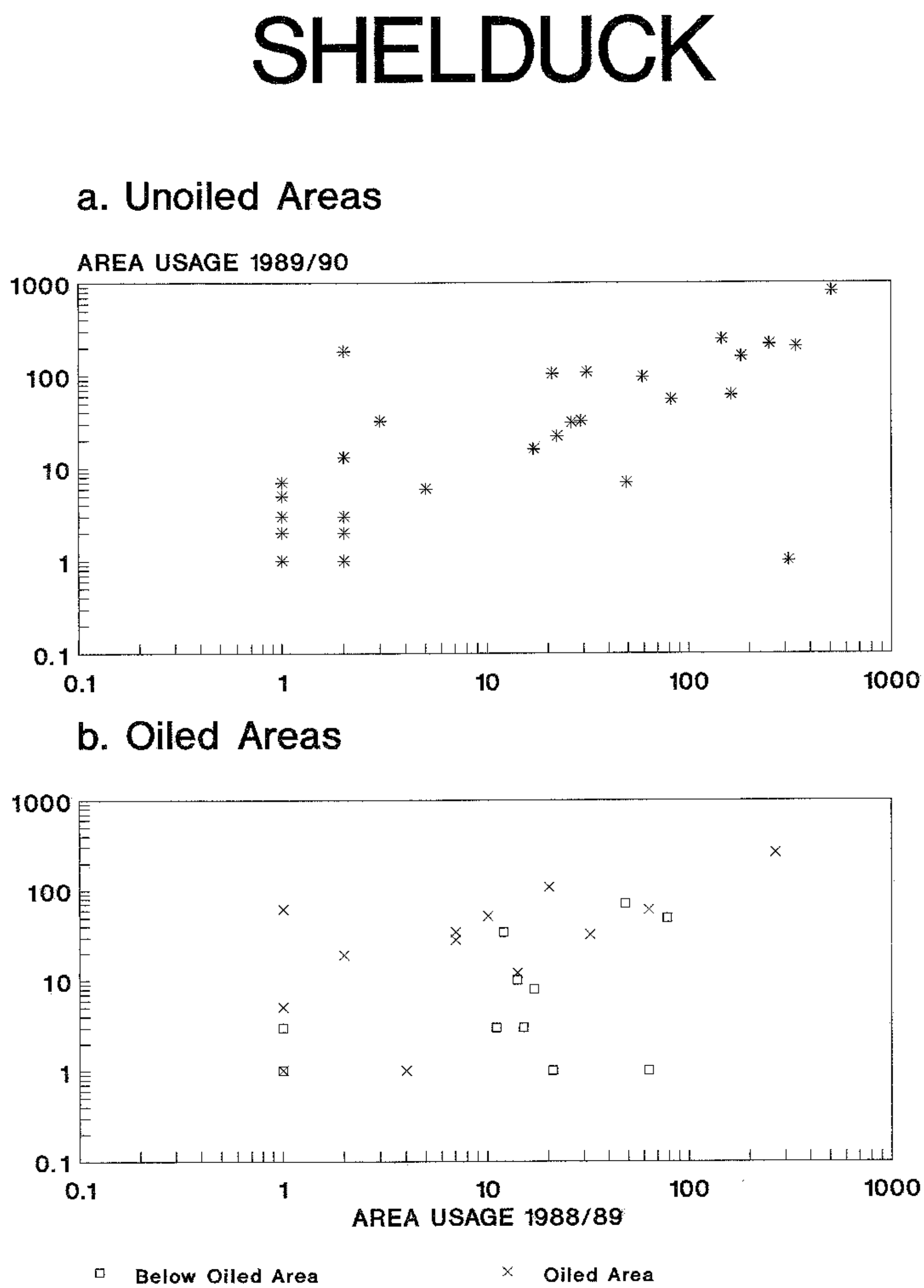


Figure 3.1.4 Comparison of low tide usage, by feeding Shelduck, of intertidal areas in one year before and after the oil spill. Oiled and unoiled sites are considered separately.

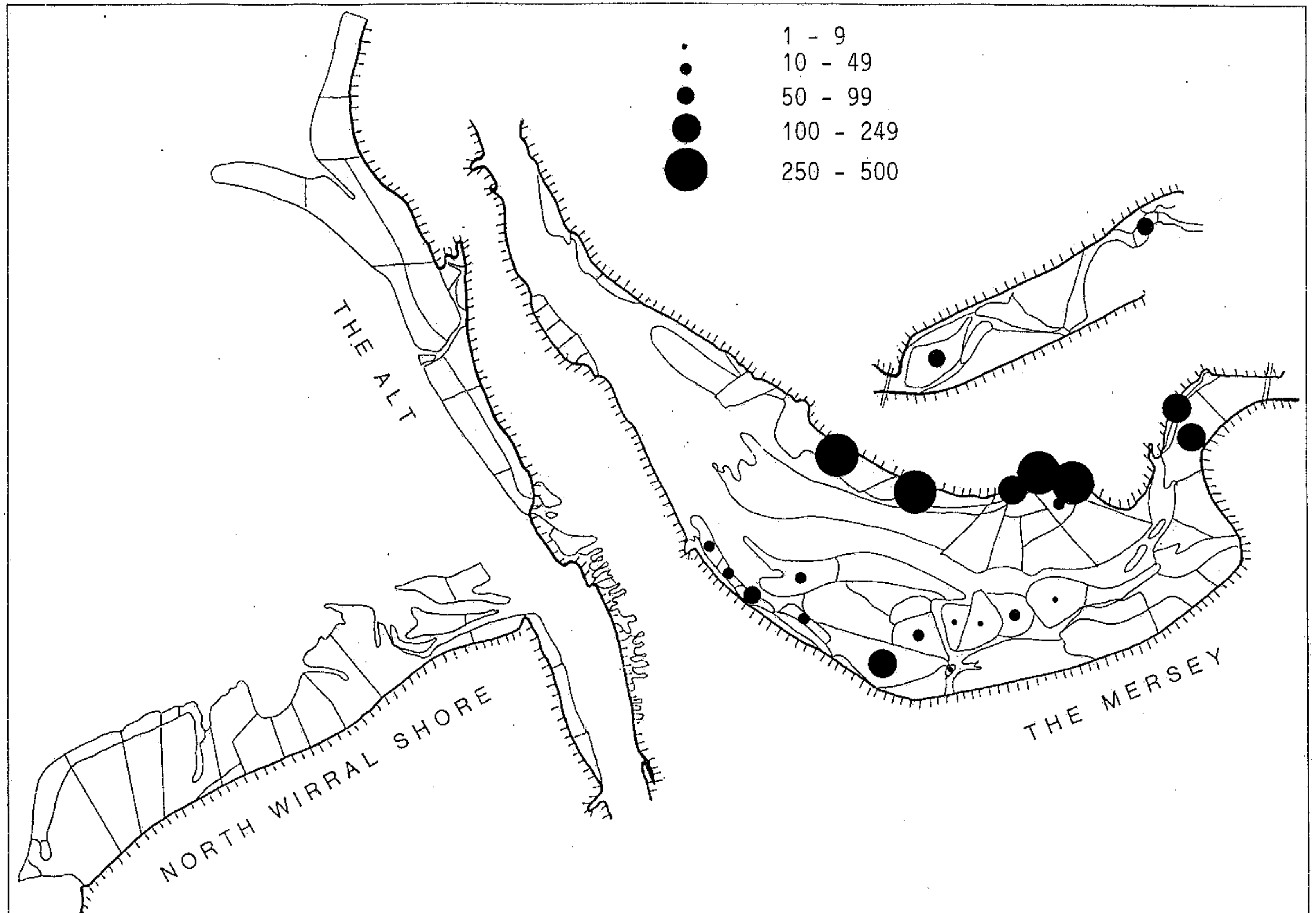


Figure 3.3.1 The average number of Teal feeding at low tide on each intertidal area during winter 1989/90.

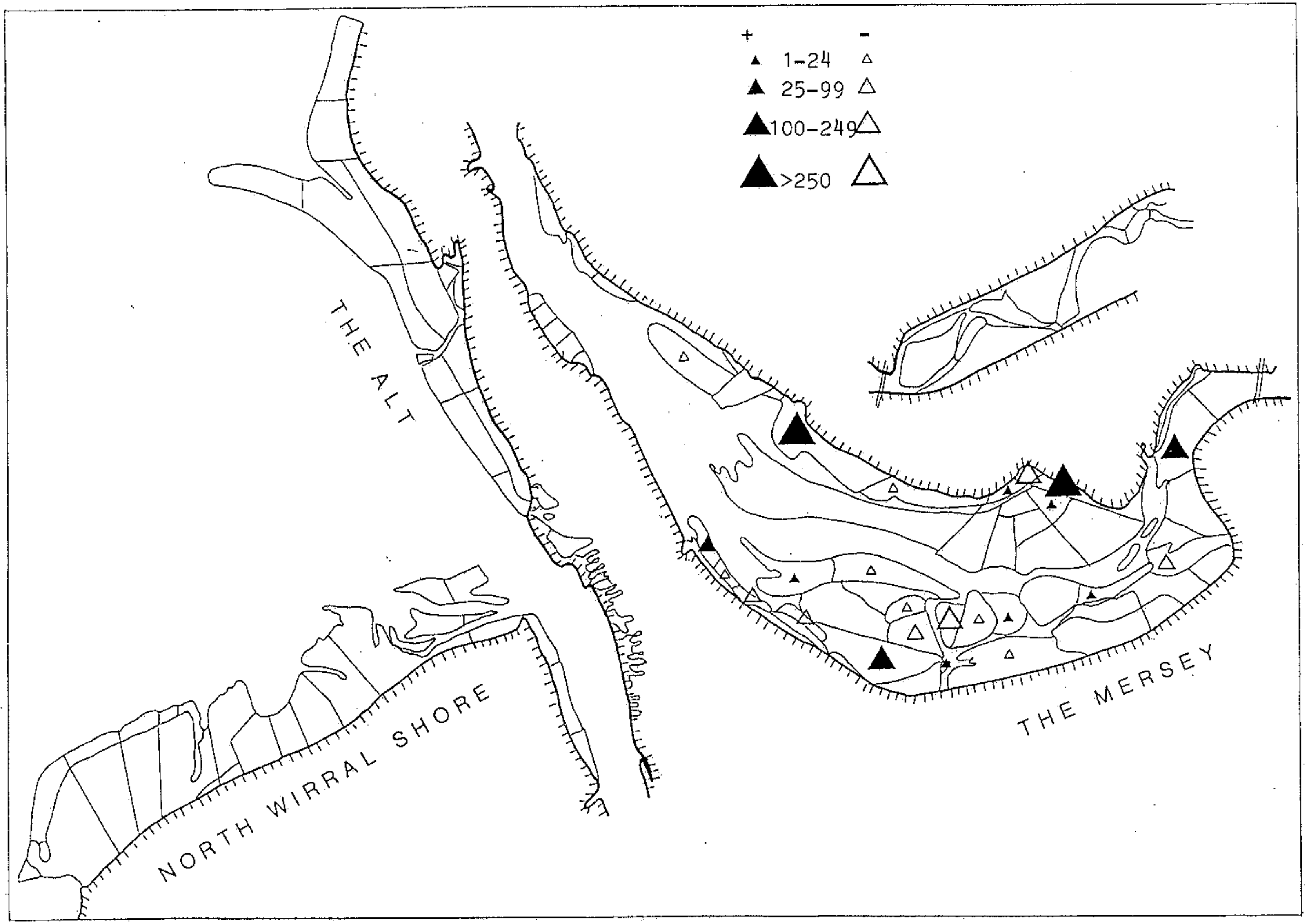


Figure 3.3.2 Changes in the low tide usage made by feeding Teal between winters 1988/89 and 1989/90. (Positive values denote an increase in the second winter, negative values a decrease).

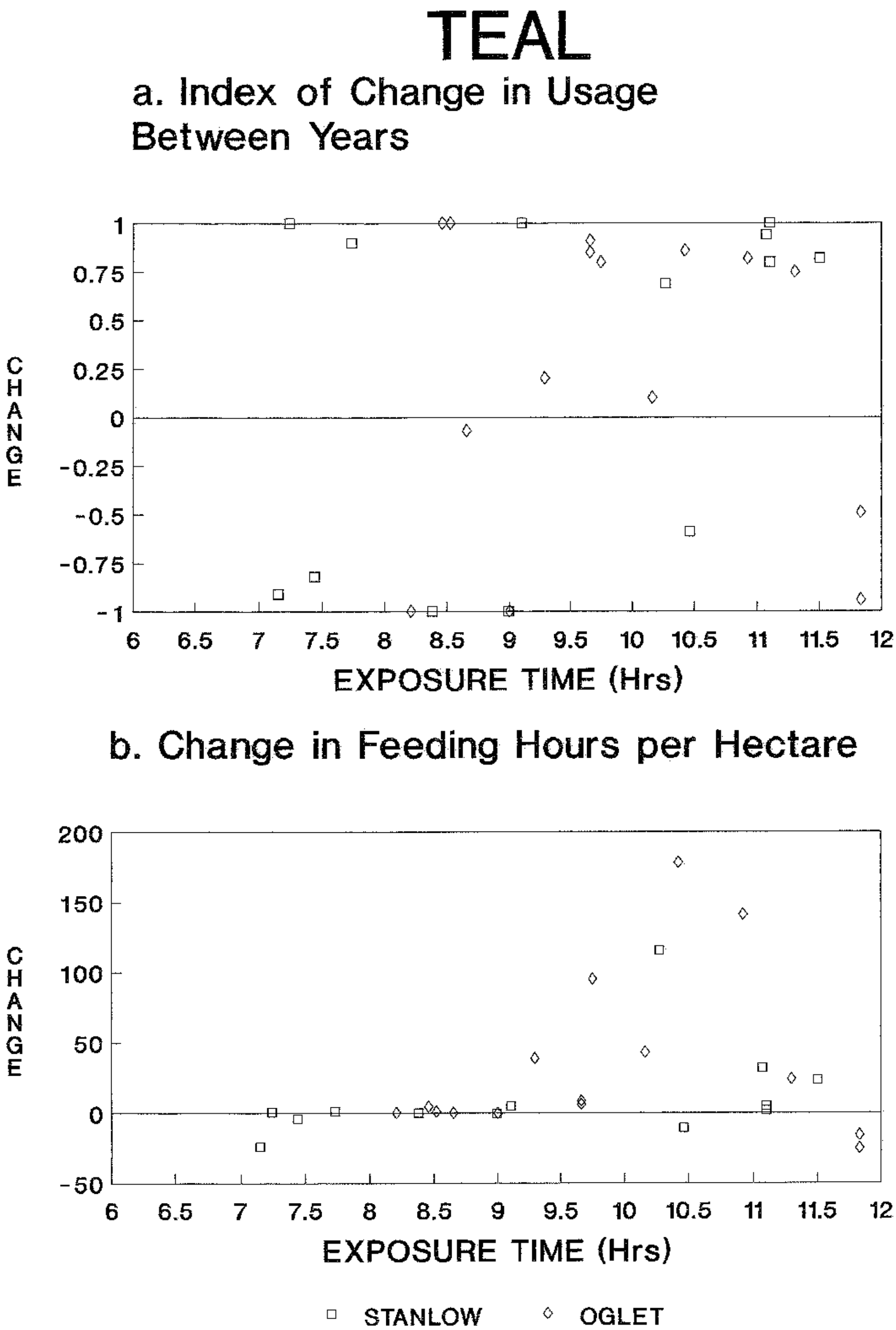


Figure 3.3.3 . The relationship between changes in all day usage and exposure time for an oiled site (Oglet) and an unoiled site (Stanlow).

TEAL

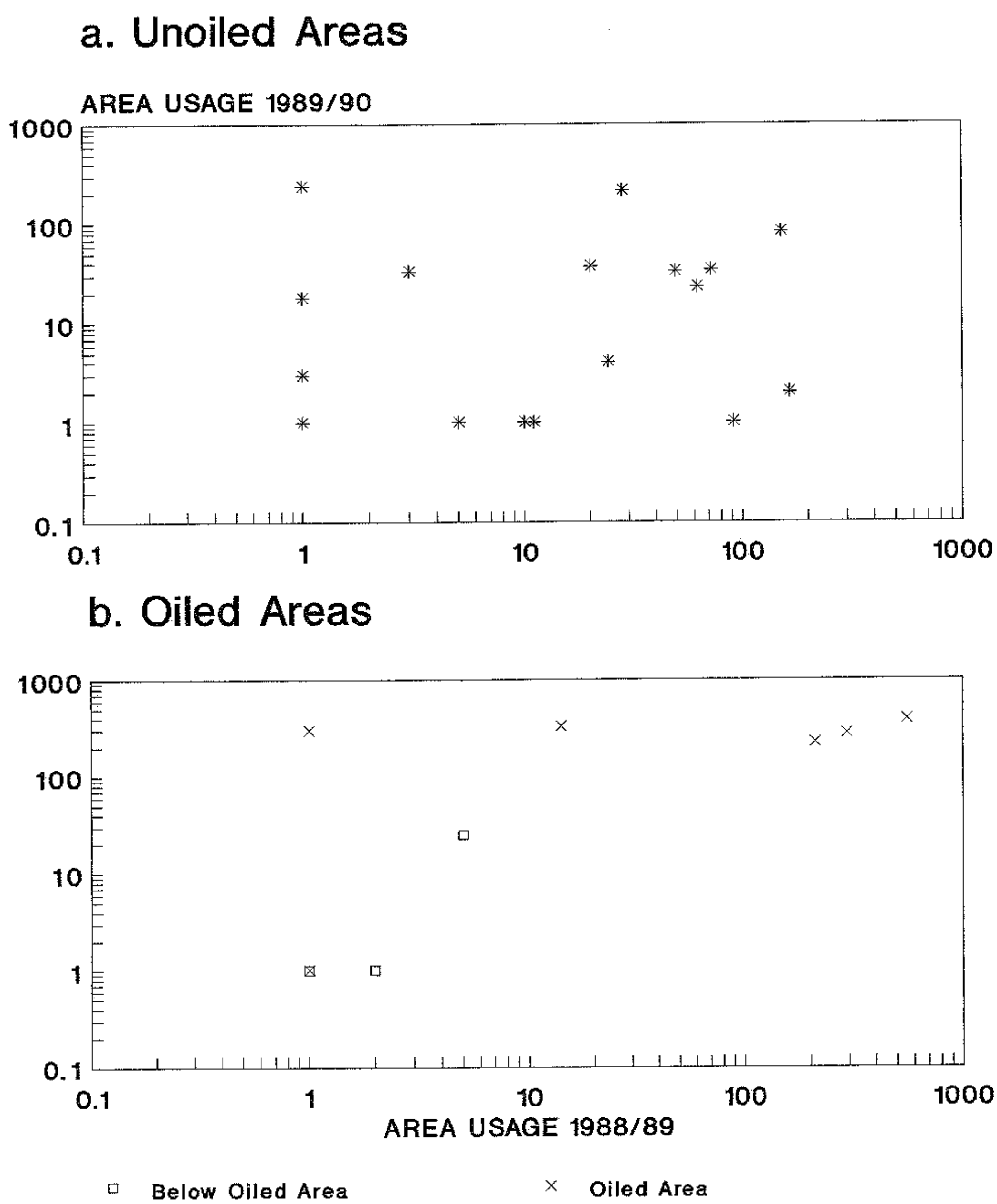


Figure 3.3.4 Comparison of low tide usage, by feeding Teal, of intertidal areas in one year before and after the oil spill. Oiled and unoiled sites are considered separately.

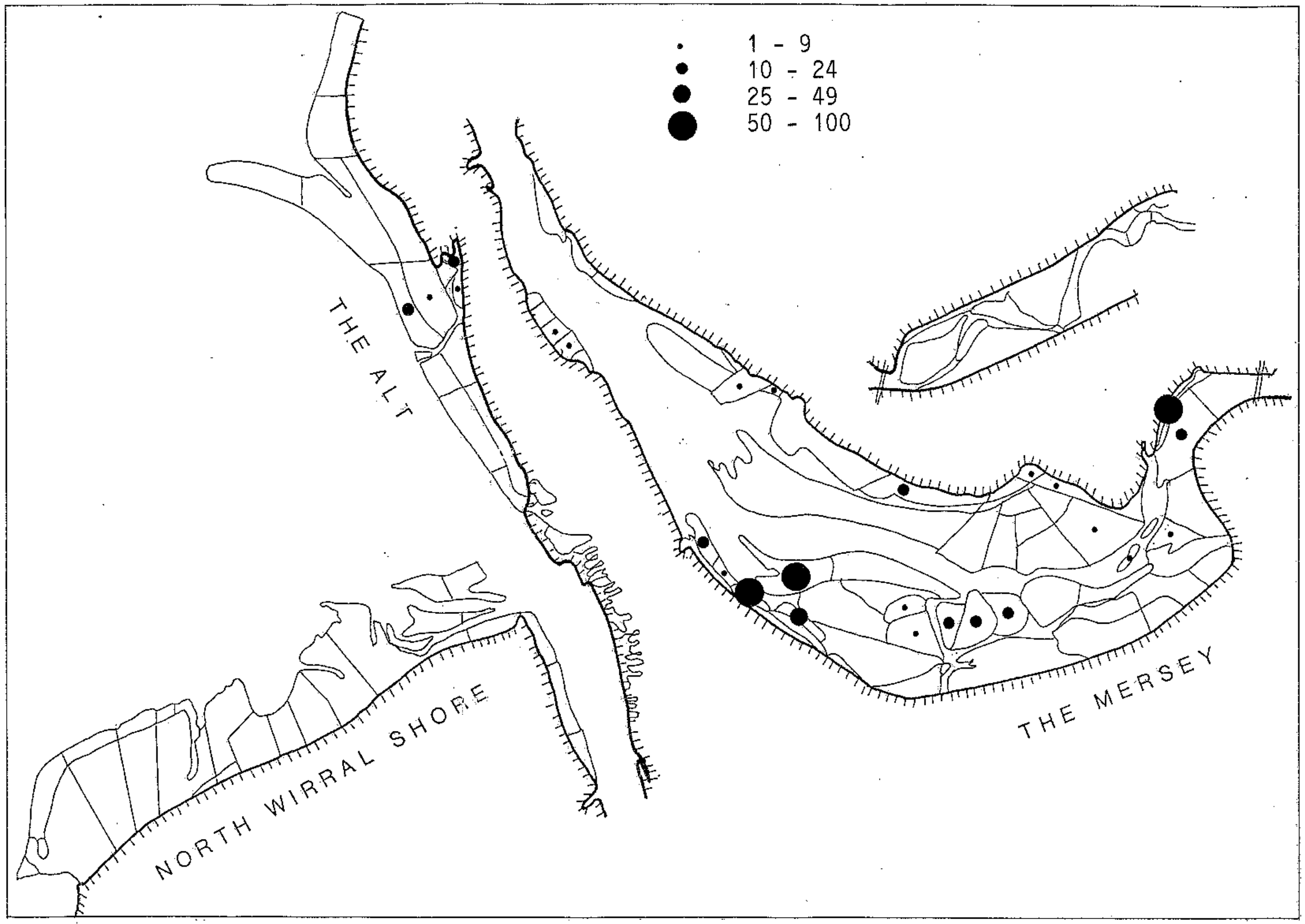


Figure 3.4.1 The average number of Mallard feeding at low tide on each intertidal area during winter 1989/90.

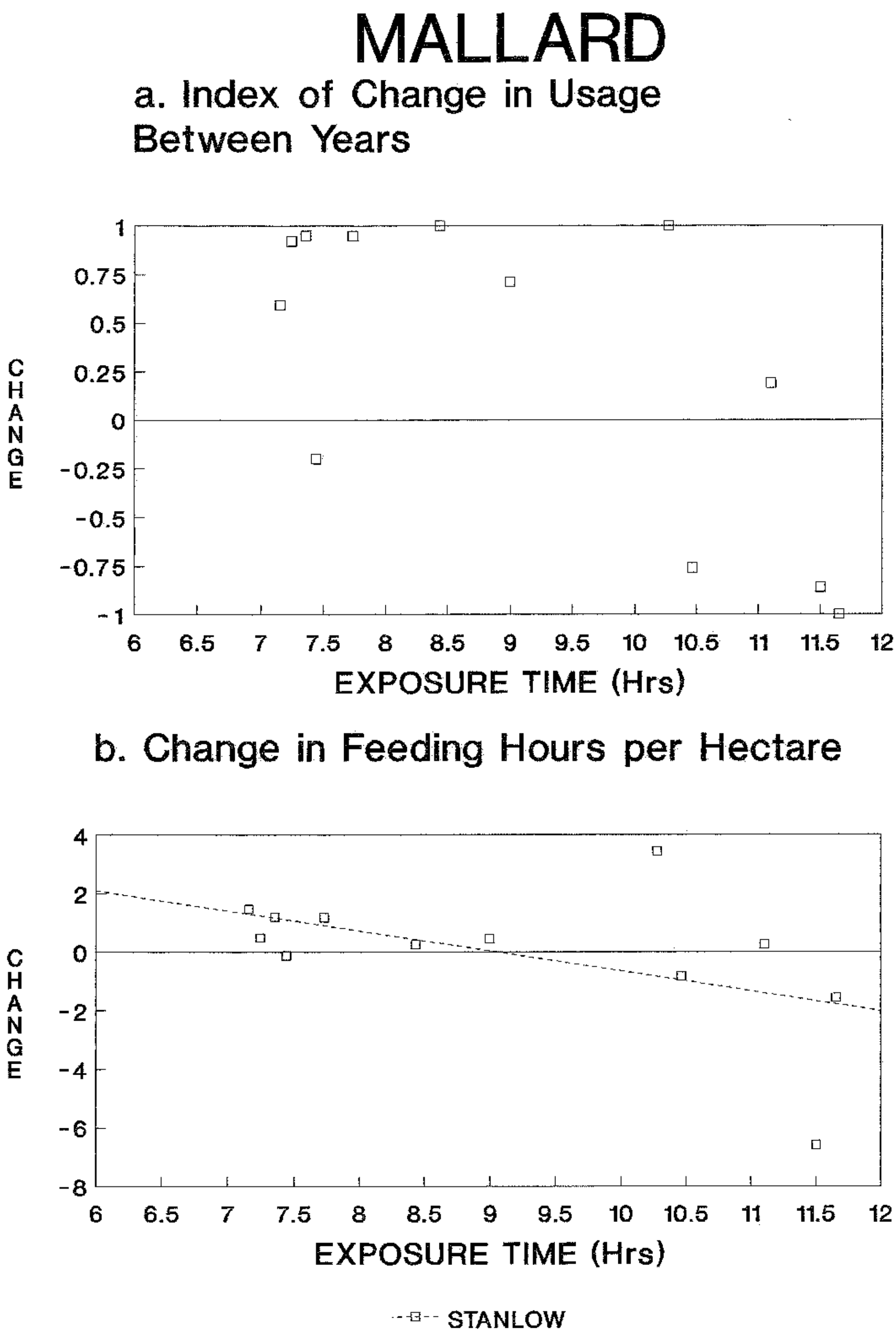


Figure 3.4.2. The relationship between changes in all day usage by Mallard and exposure time for Stanlow.

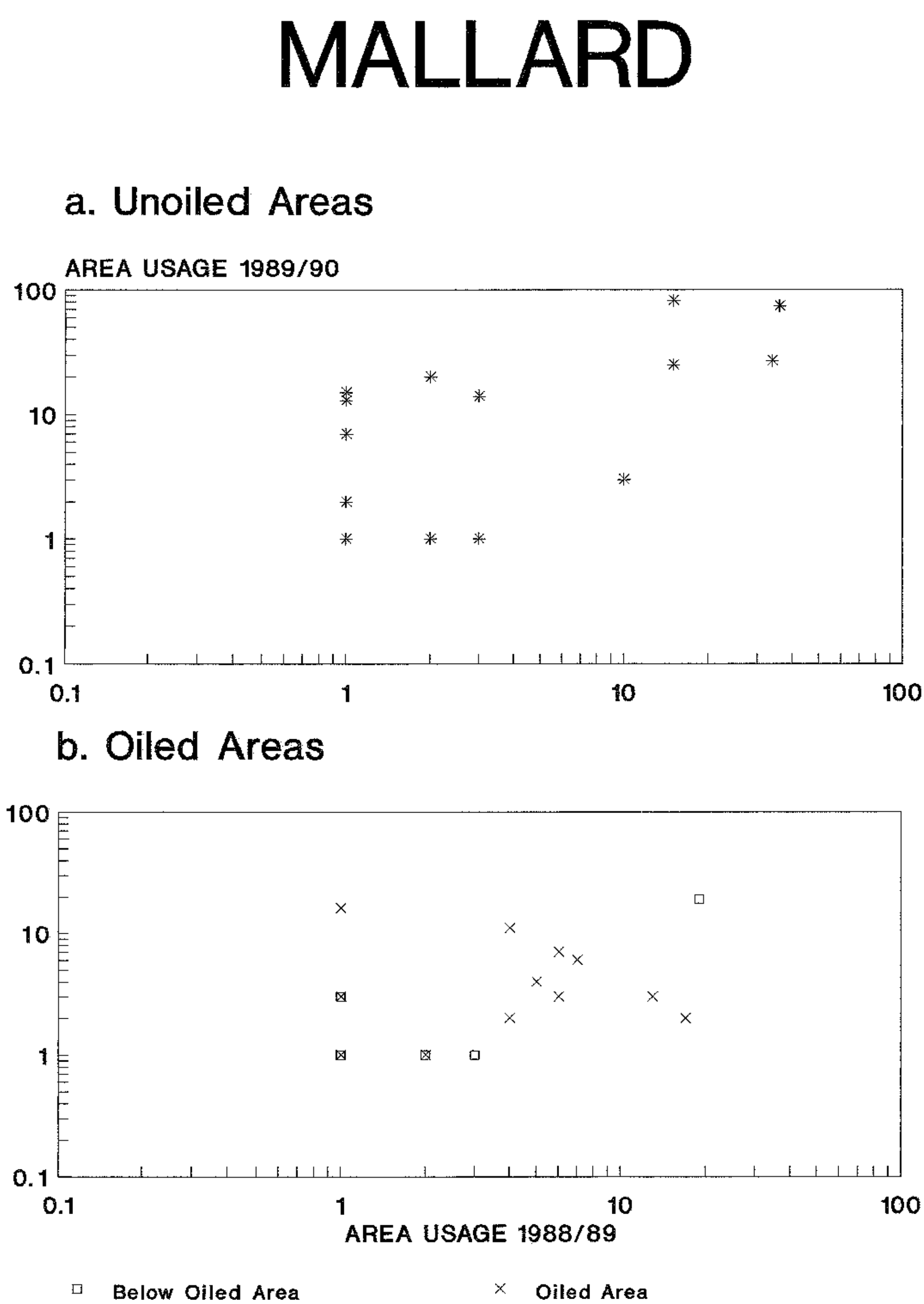


Figure 3.4.3 Comparison of low tide usage, by feeding Mallard, of intertidal areas in one year before and after the oil spill. Oiled and unoiled sites are considered separately.

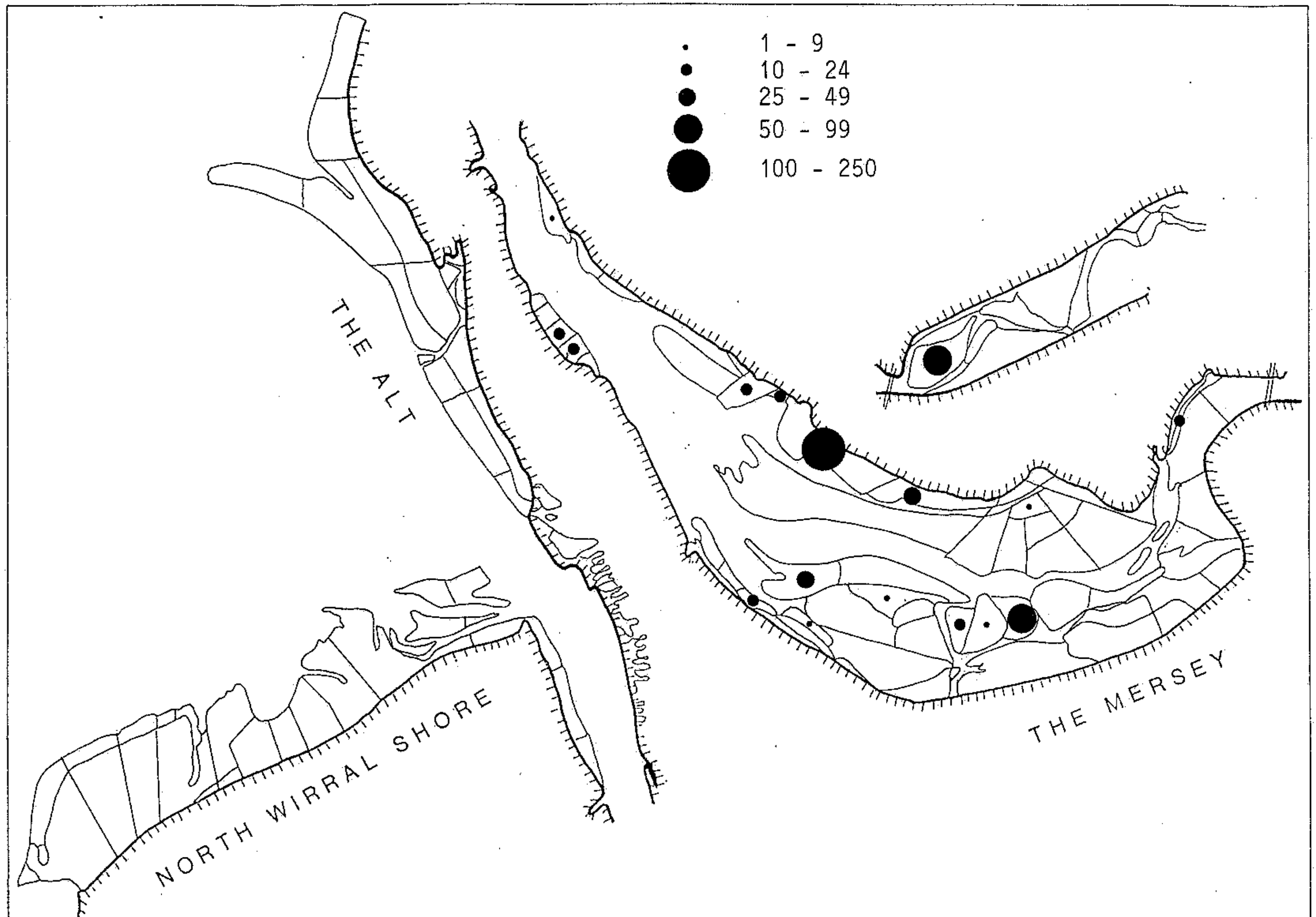


Figure 3.5.1 The average number of Pintail feeding at low tide on each intertidal area during winter 1989/90.

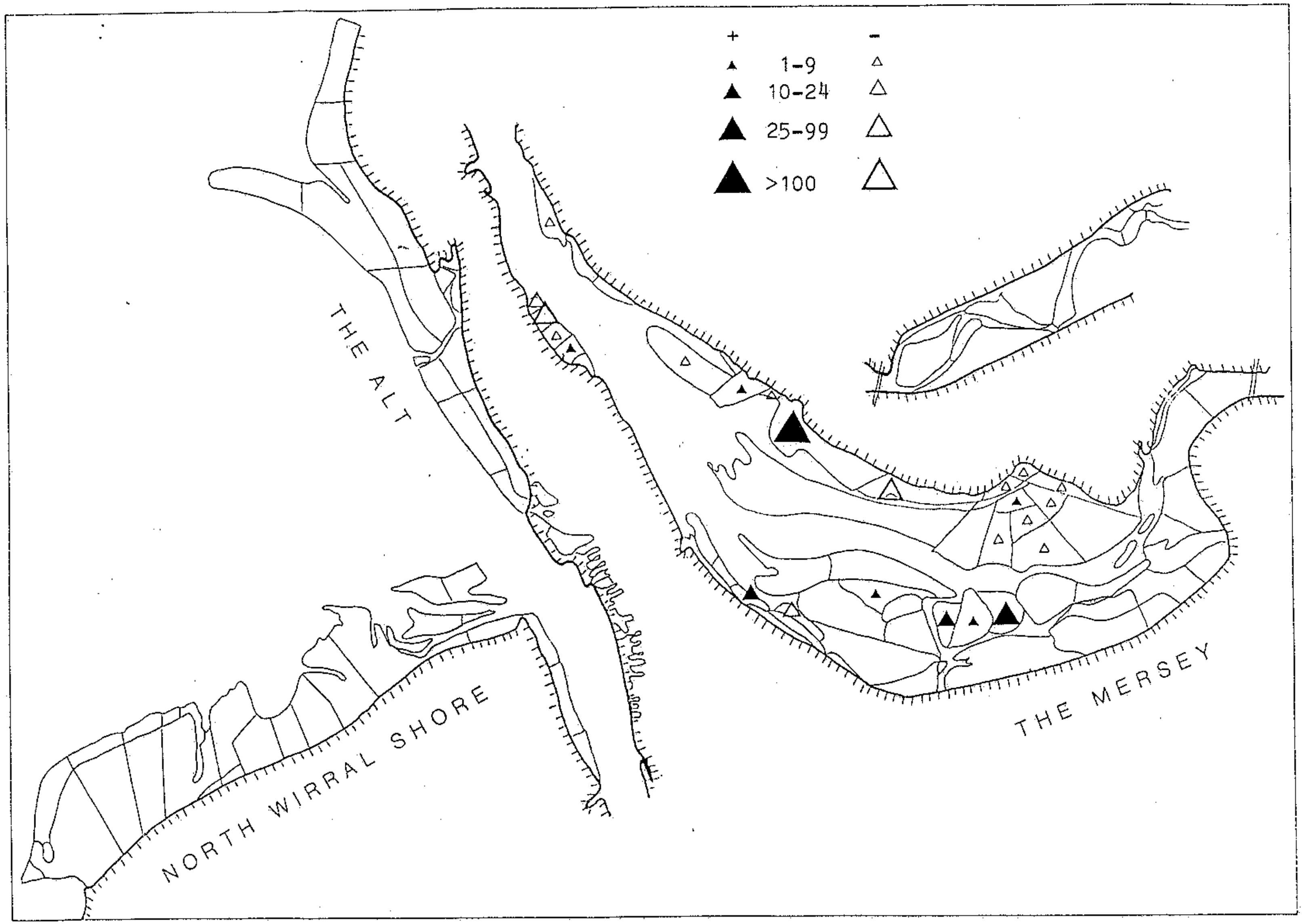


Figure 3.5.2. Changes in the low tide usage made by feeding Pintail between winters 1988/89 and 1989/90. (Positive values denote an increase in the second winter, negative values a decrease).

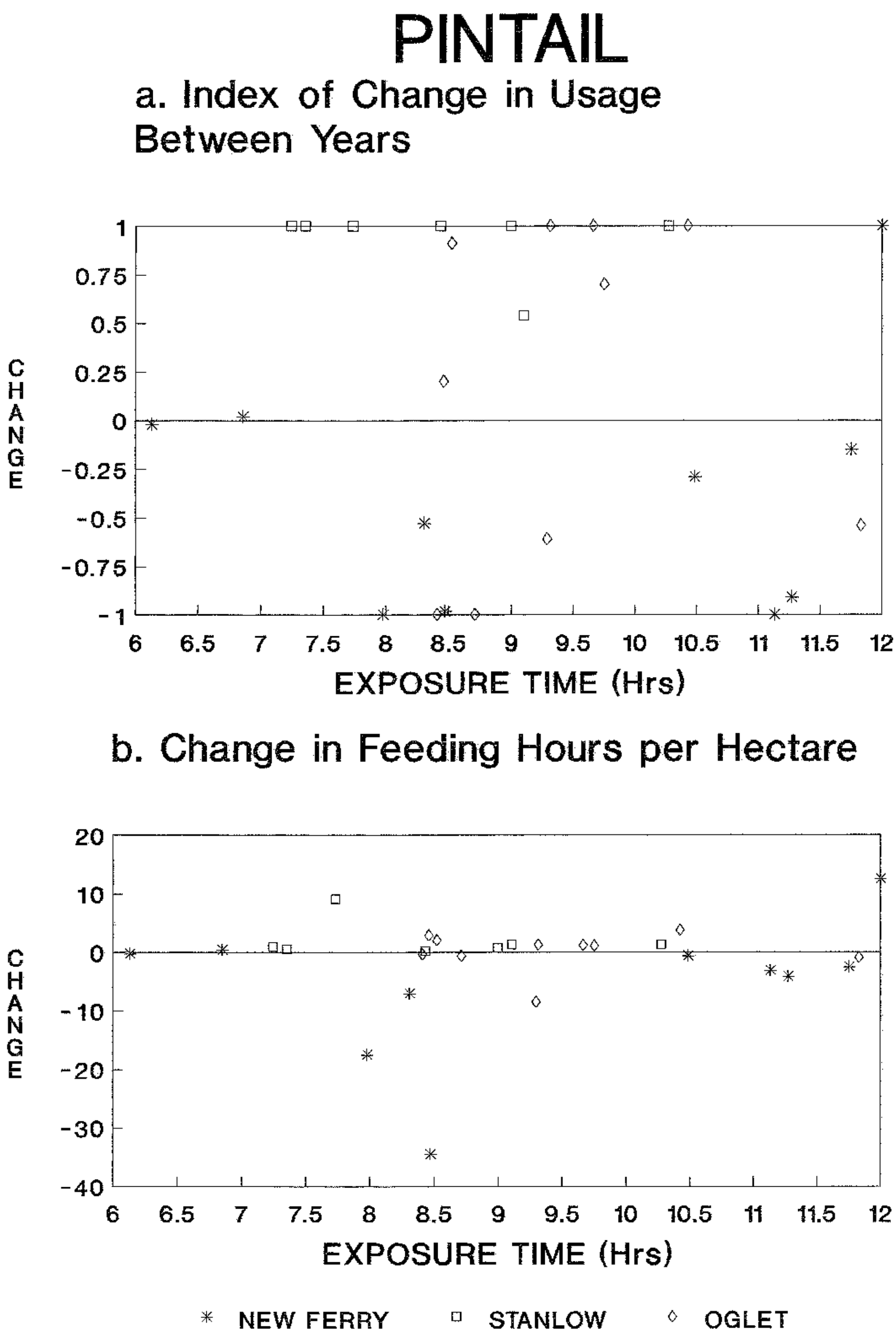


Figure 3.5.3 The relationship between changes in all day usage and exposure time for an oiled site (Oglet) and two unoiled sites (New Ferry and Stanlow).

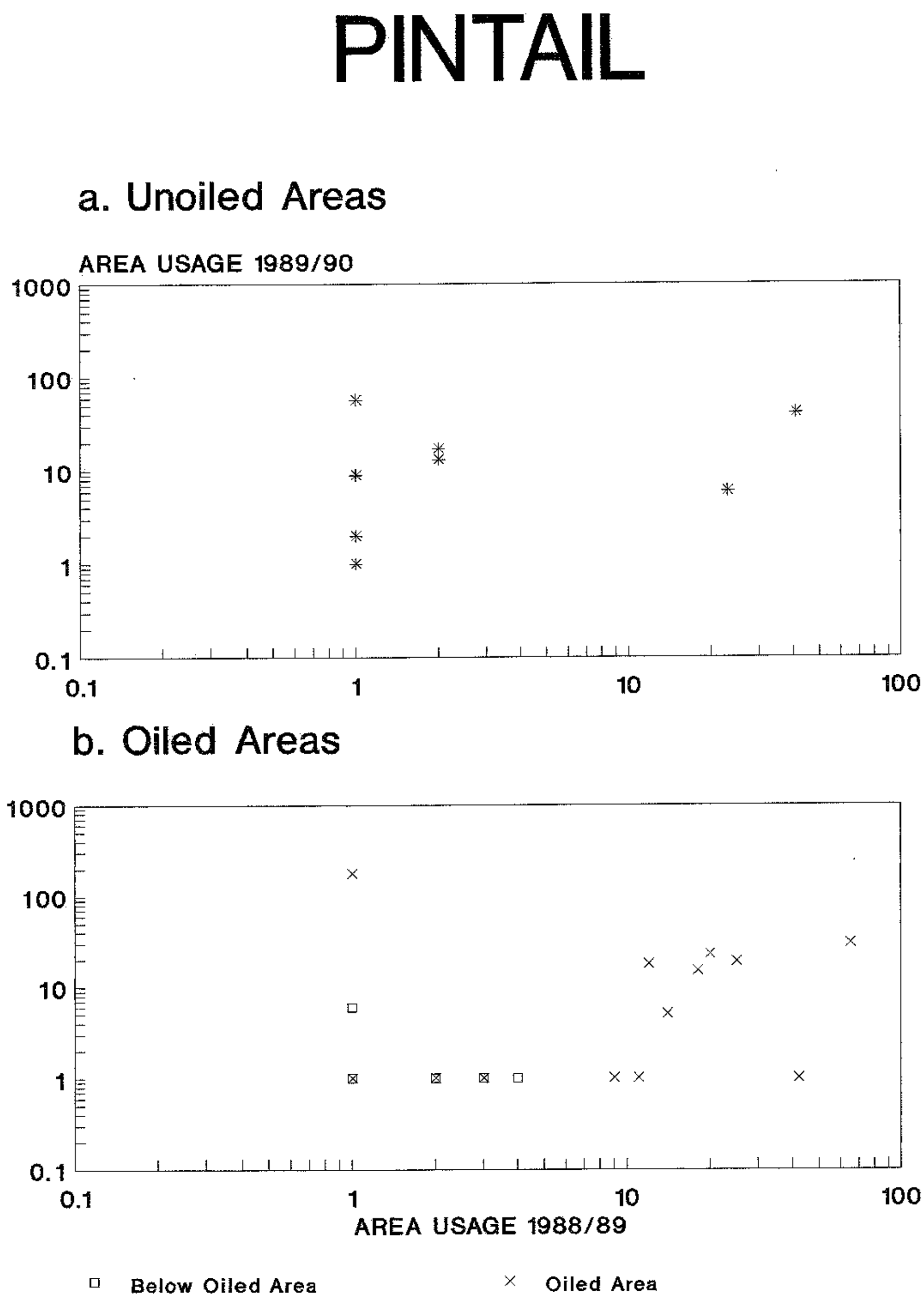


Figure 3.5.4 Comparison of low tide usage, by feeding Pintail, of intertidal areas in one year before and after the oil spill. Oiled and unoiled sites are considered separately.

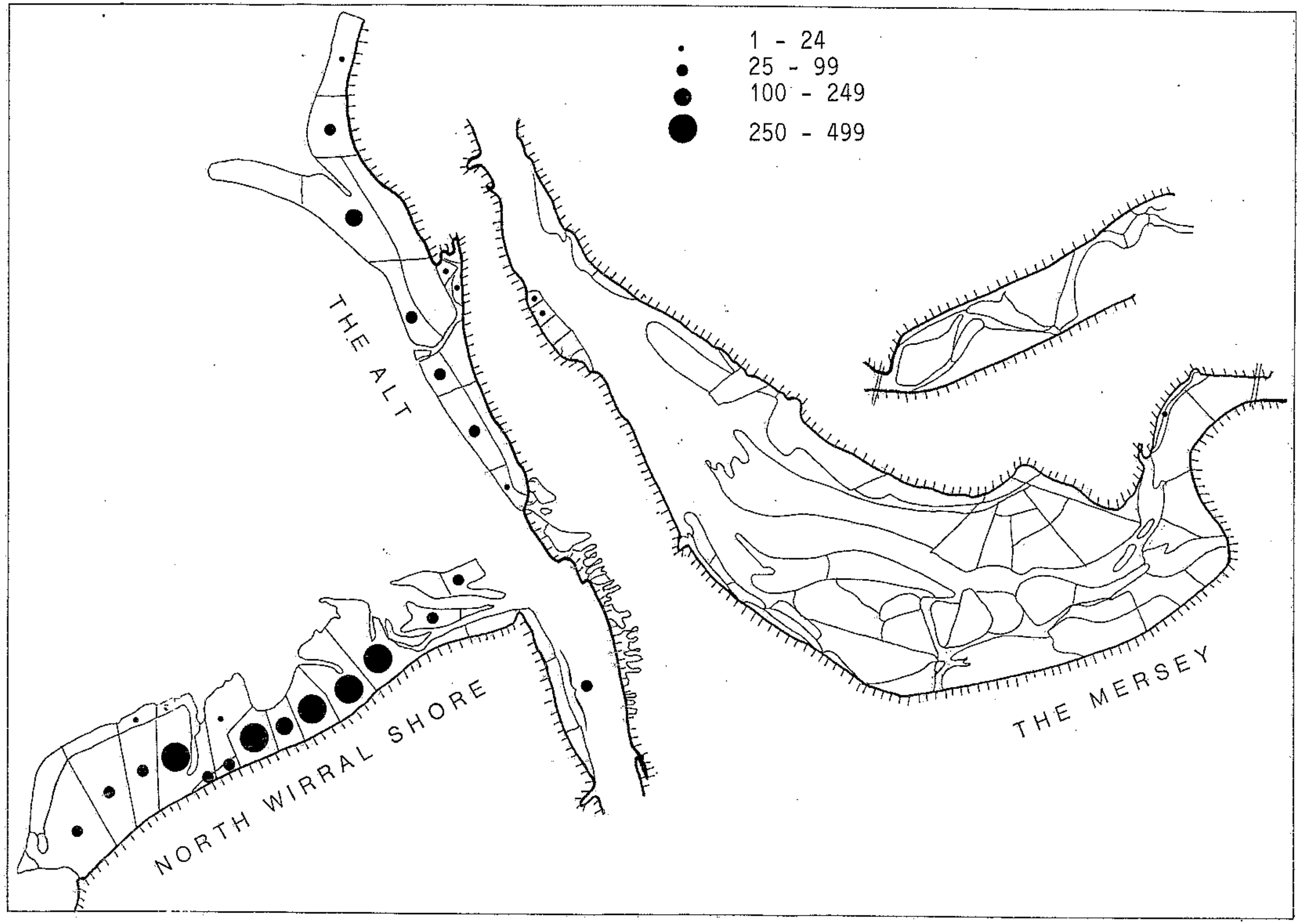


Figure 3.6.1 The average number of Oystercatcher feeding at low tide on each intertidal area during winter 1989/90.

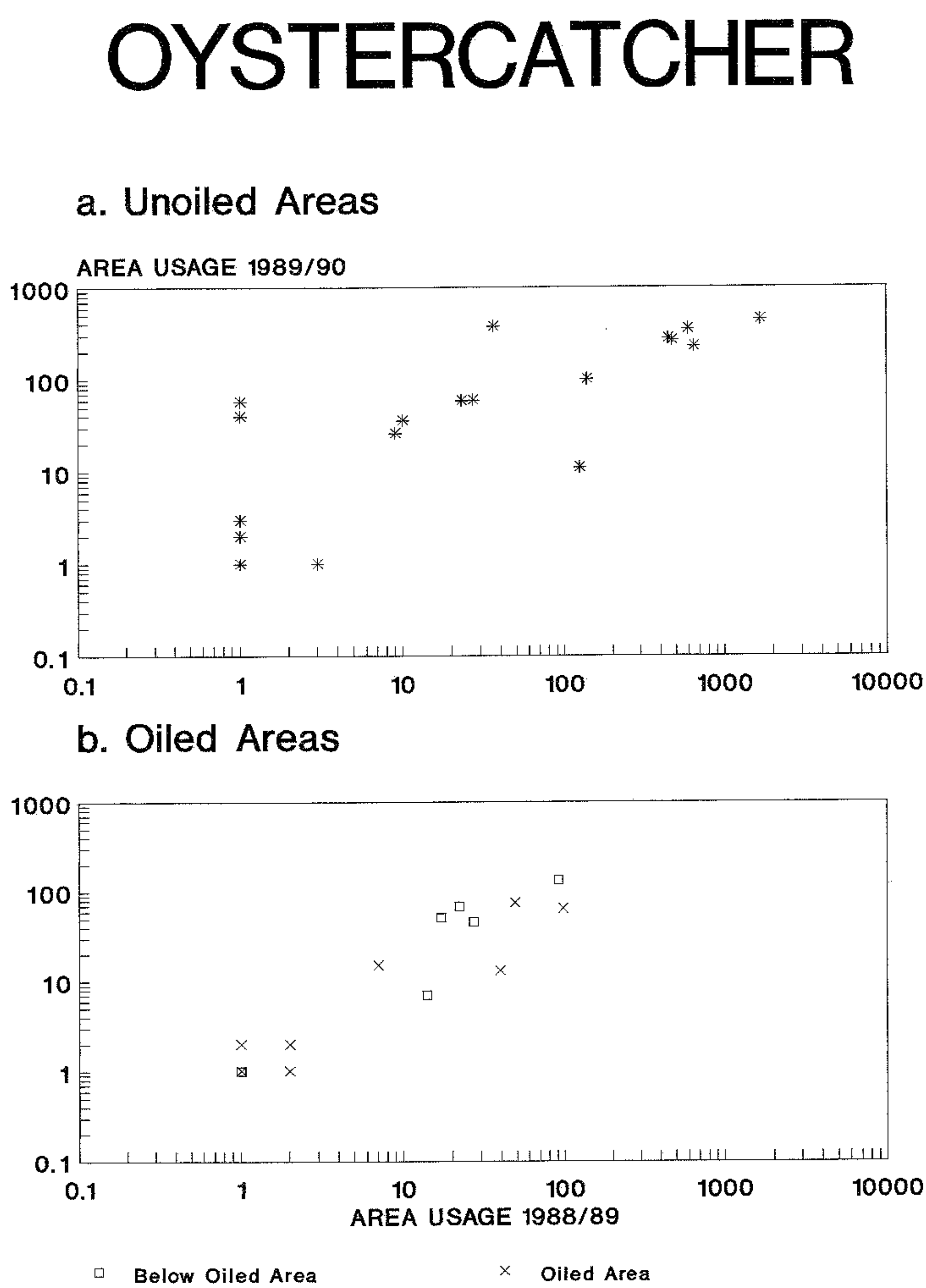


Figure 3.6.2 Comparison of low tide usage, by feeding Oystercatcher, of intertidal areas in one year before and after the oil spill. Oiled and unoiled sites are considered separately.

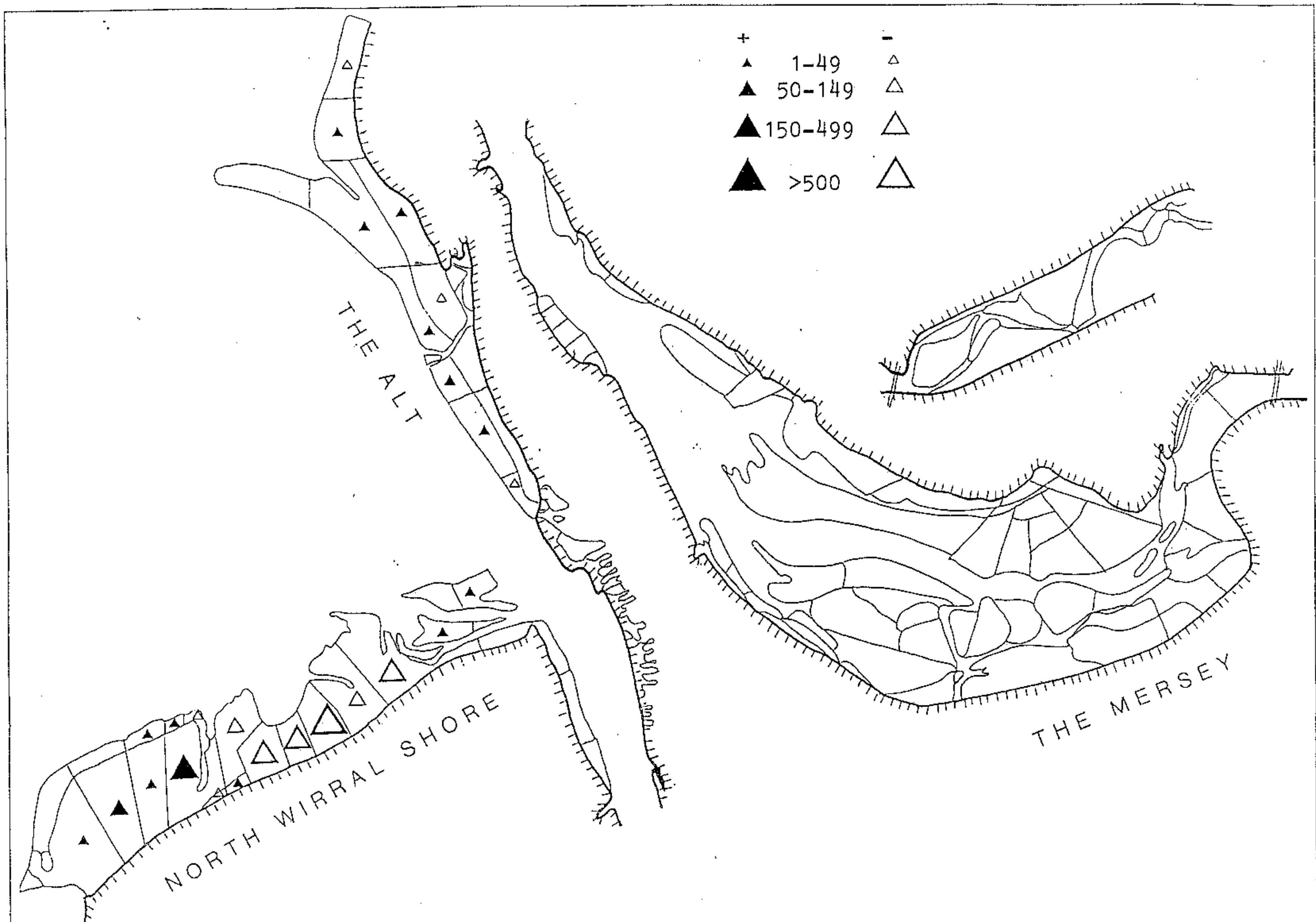


Figure 3.6.3. Changes in the low tide usage made by feeding Oystercatcher between winters 1988/89 and 1989/90. (Positive values denote an increase in the second winter, negative values a decrease).

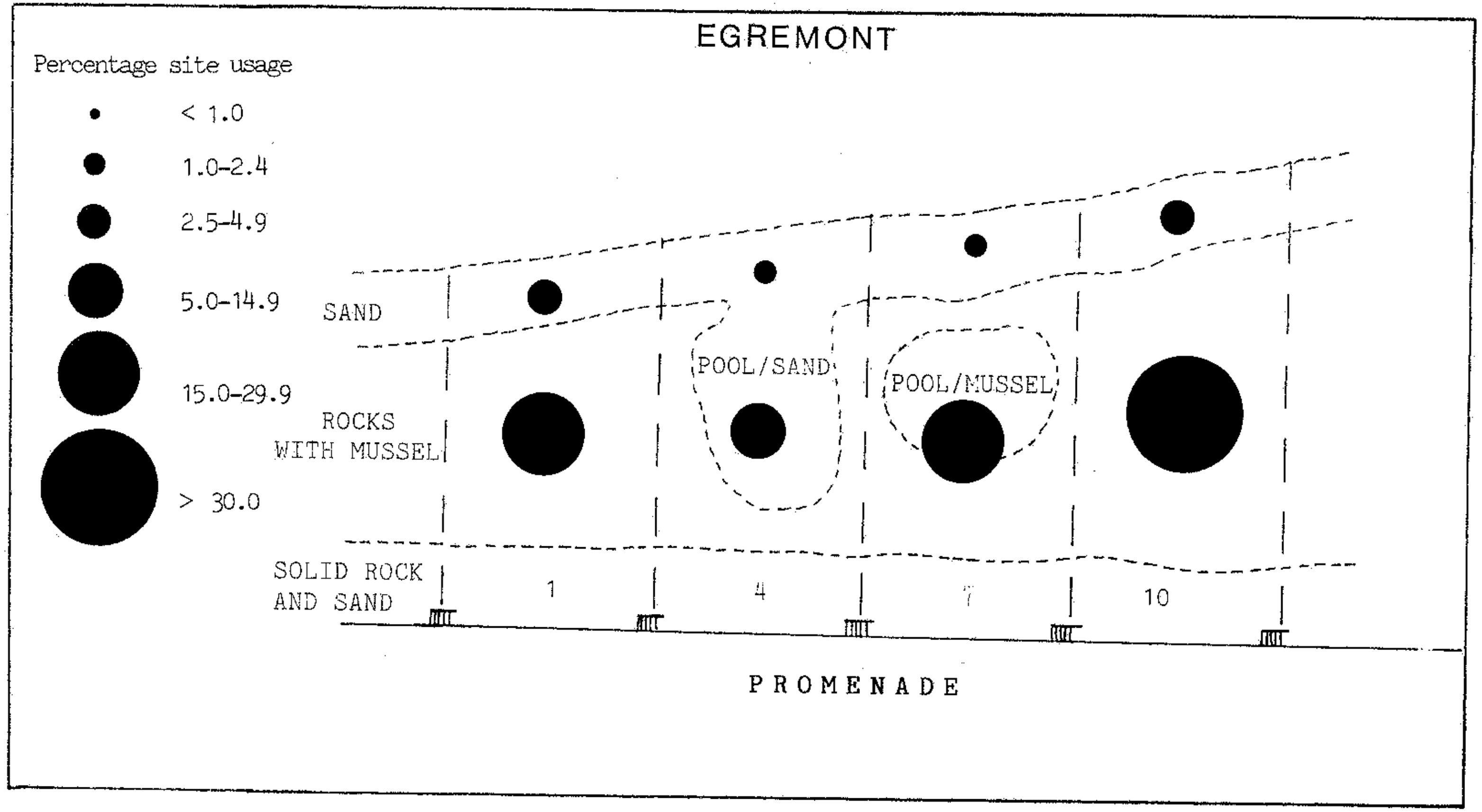


Figure 3.6.4 The distribution of feeding Oystercatcher at Egremont during the 1989/90 winter assessed from all day observations.

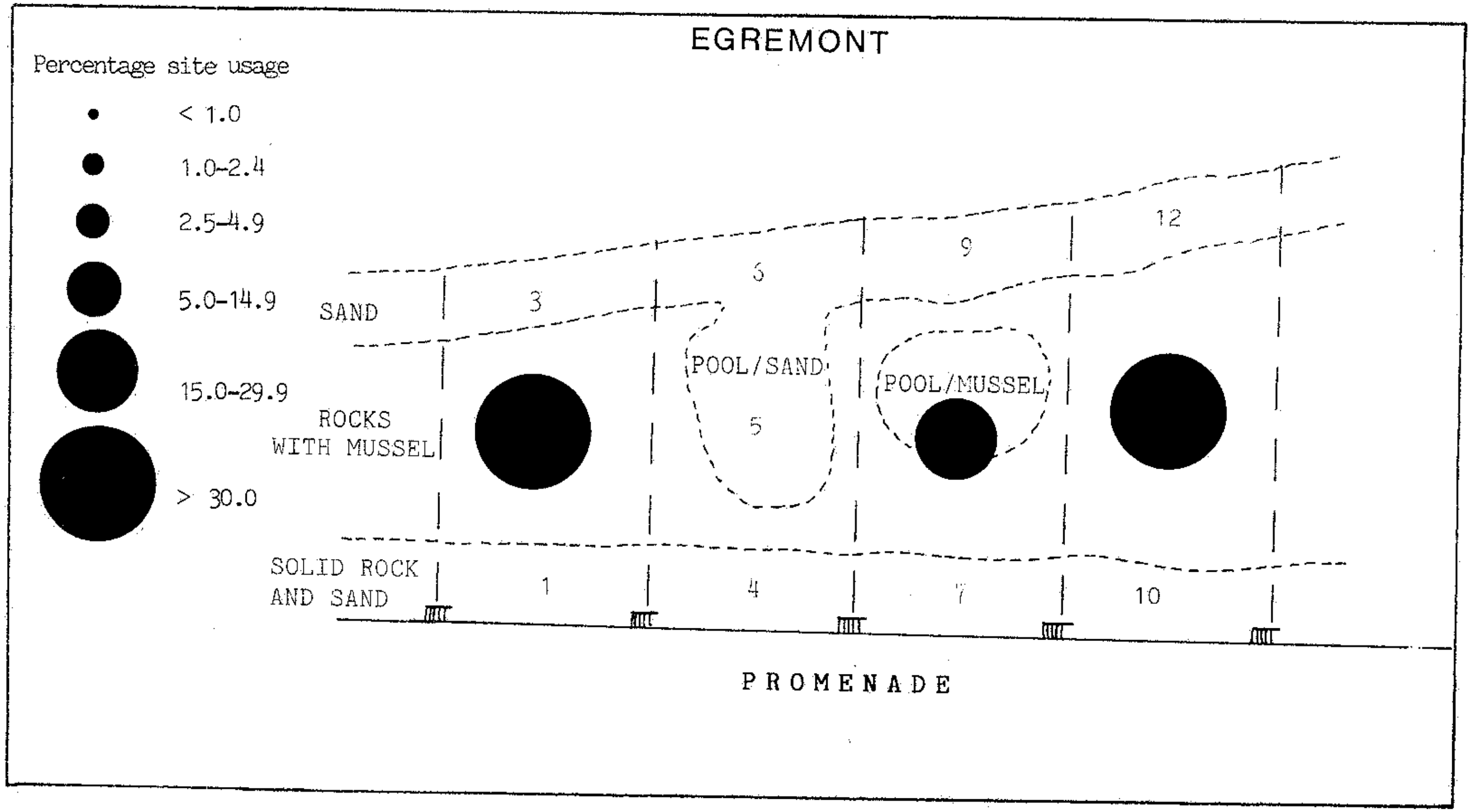


Figure 3.7.1. The distribution of feeding Ringed Plover at Egremont during the 1989/90 winter assessed from all day observations.

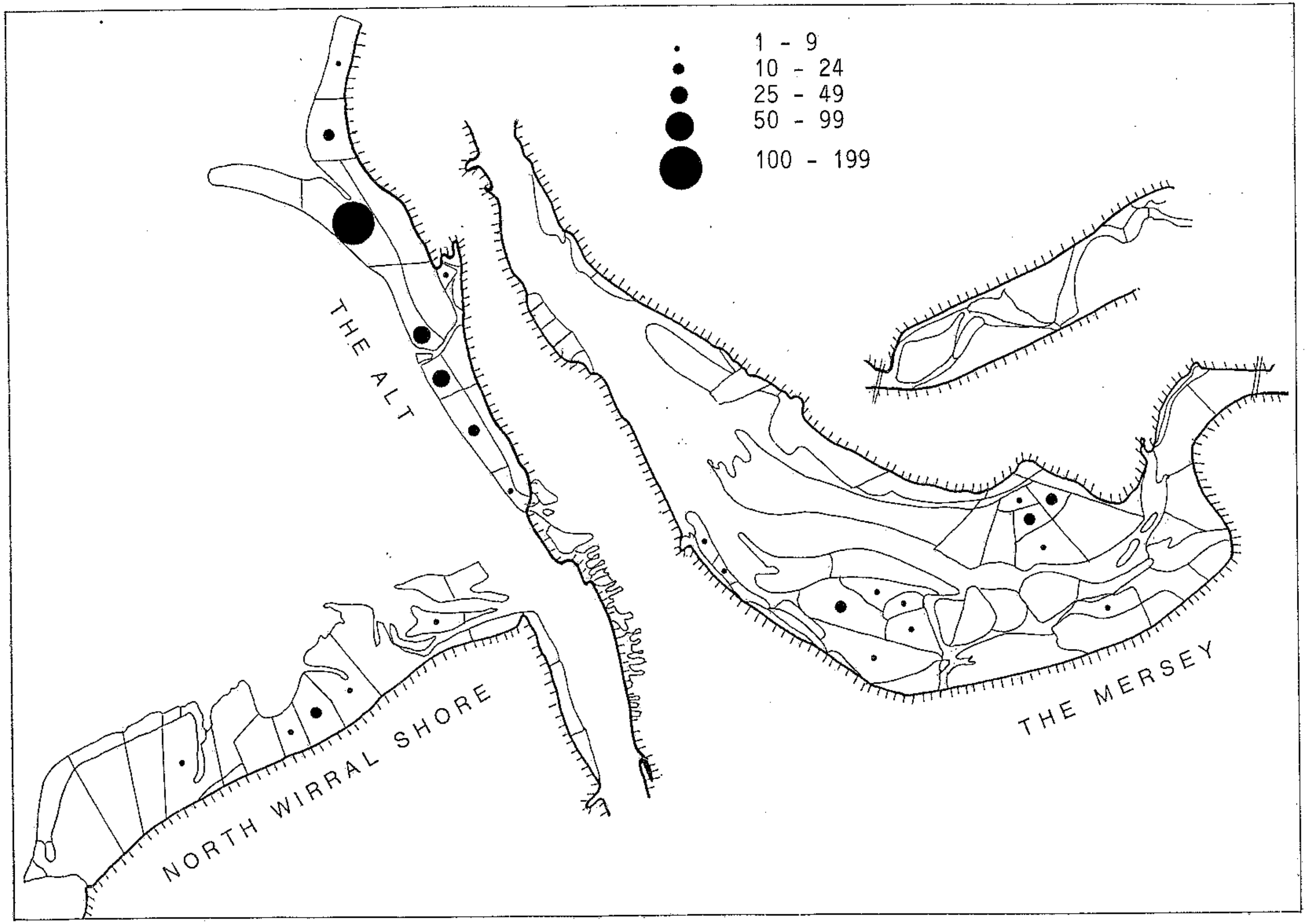


Figure 3.8.1 The average number of Grey Plover feeding at low tide on each intertidal area during winter 1989/90.

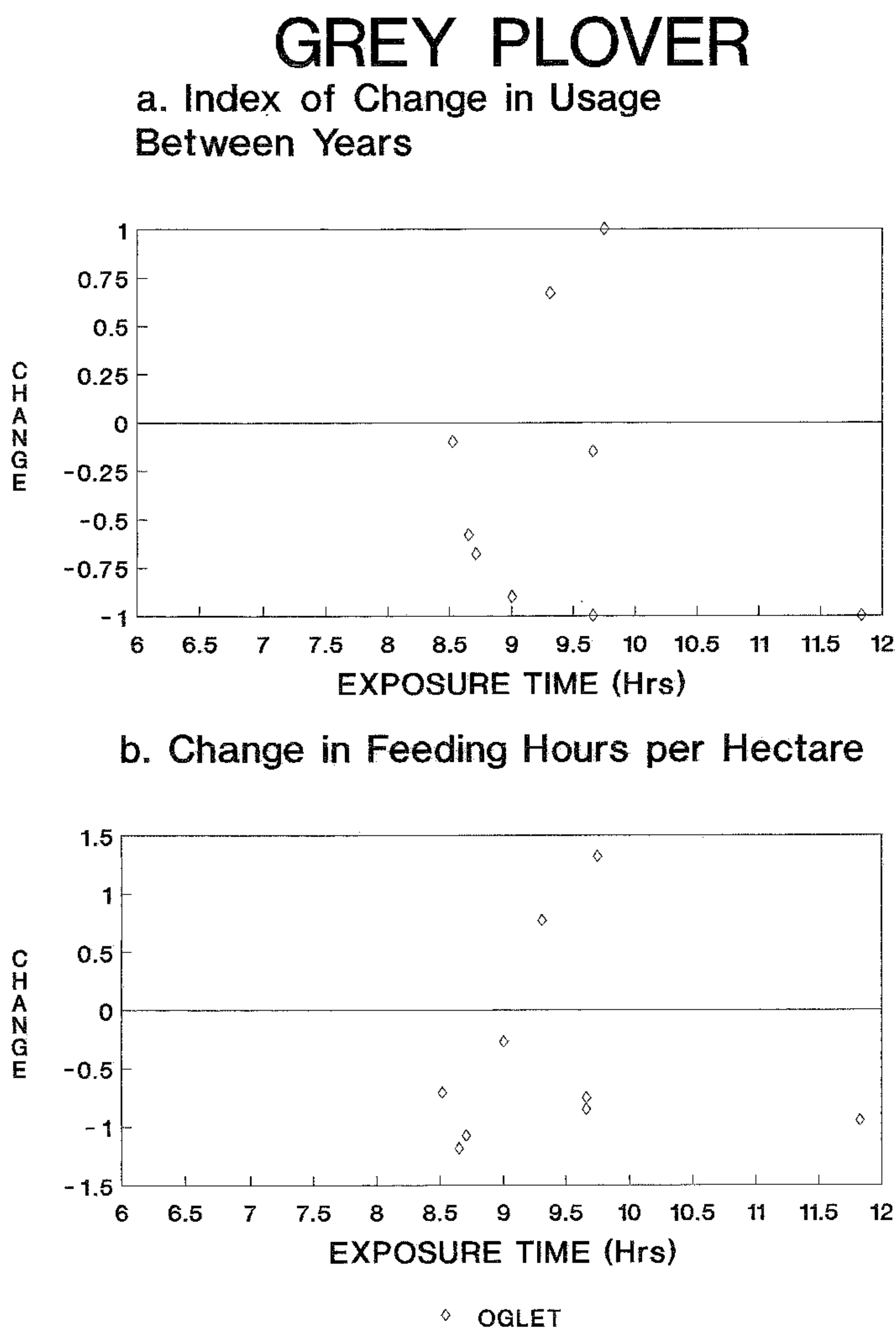


Figure 3.8.2 The relationship between changes in all day usage by Grey Plover and exposure time for Oglet.

GREY PLOVER

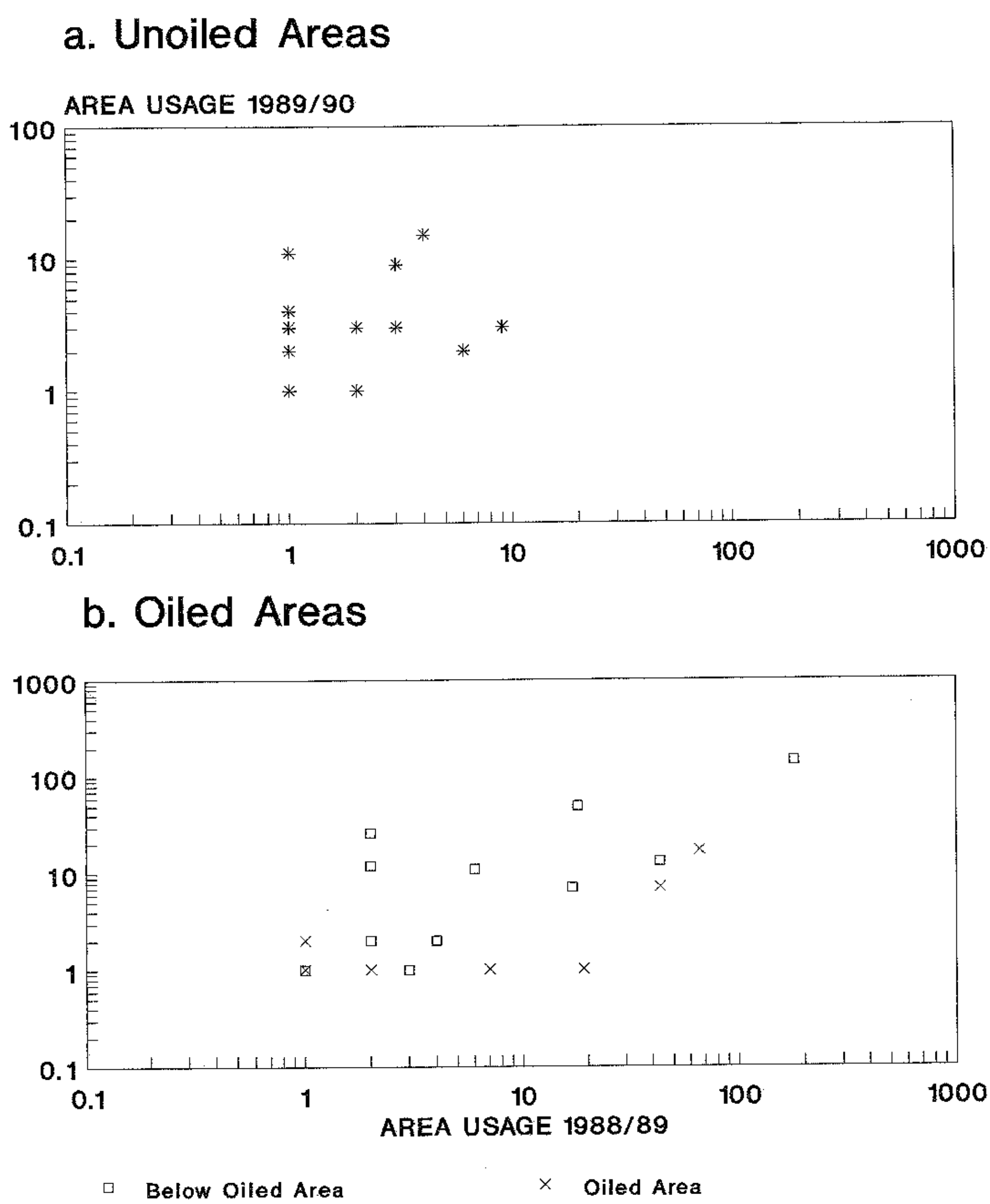


Figure 3.8.3 Comparison of low tide usage, by feeding Grey Plover, of intertidal areas in one year before and after the oil spill. Oiled and unoiled sites are considered separately.

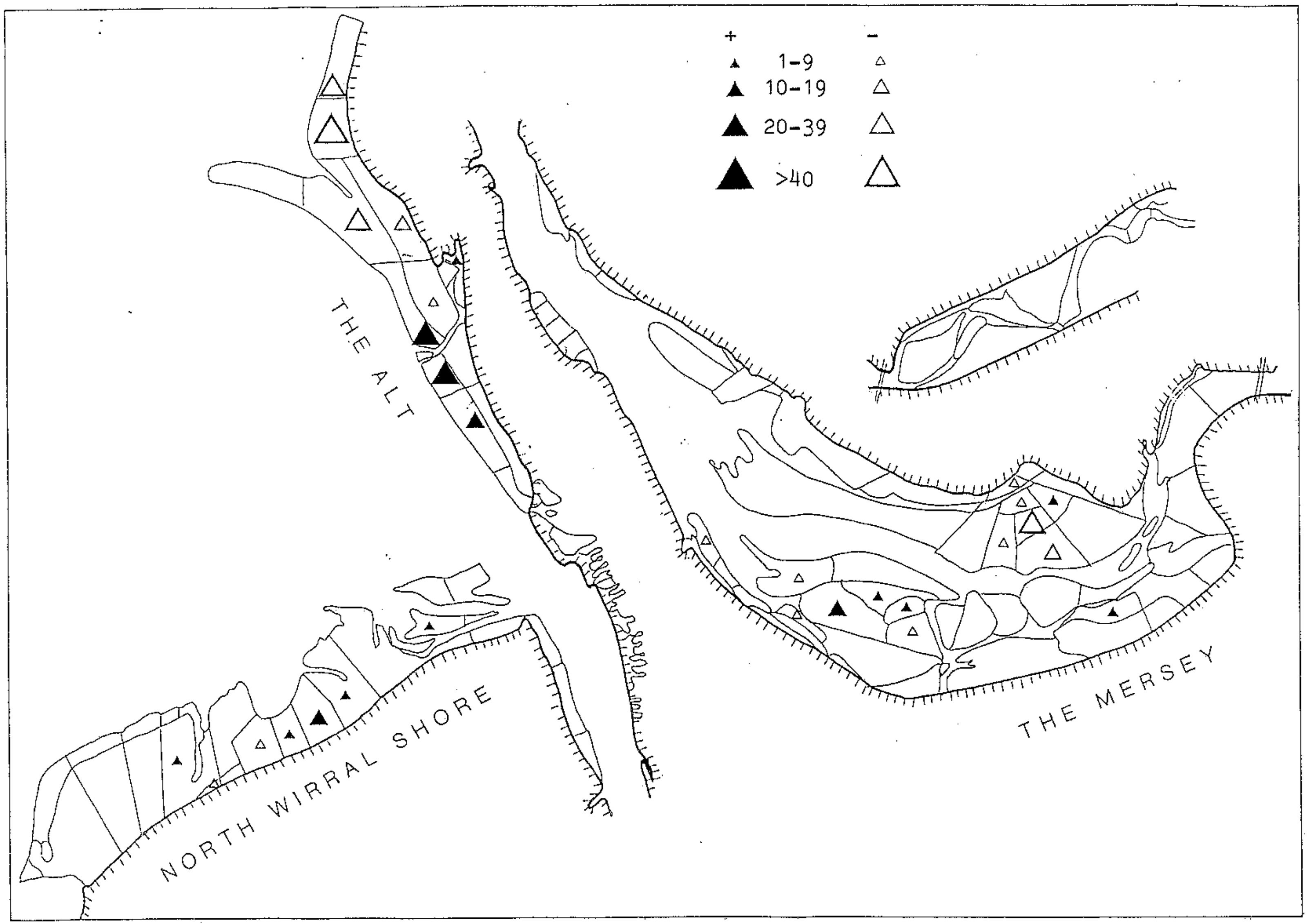


Figure 3.8.4. Changes in the low tide usage made by feeding Grey Plover between winters 1988/89 and 1989/90. (Positive values denote an increase in the second winter, negative values a decrease).

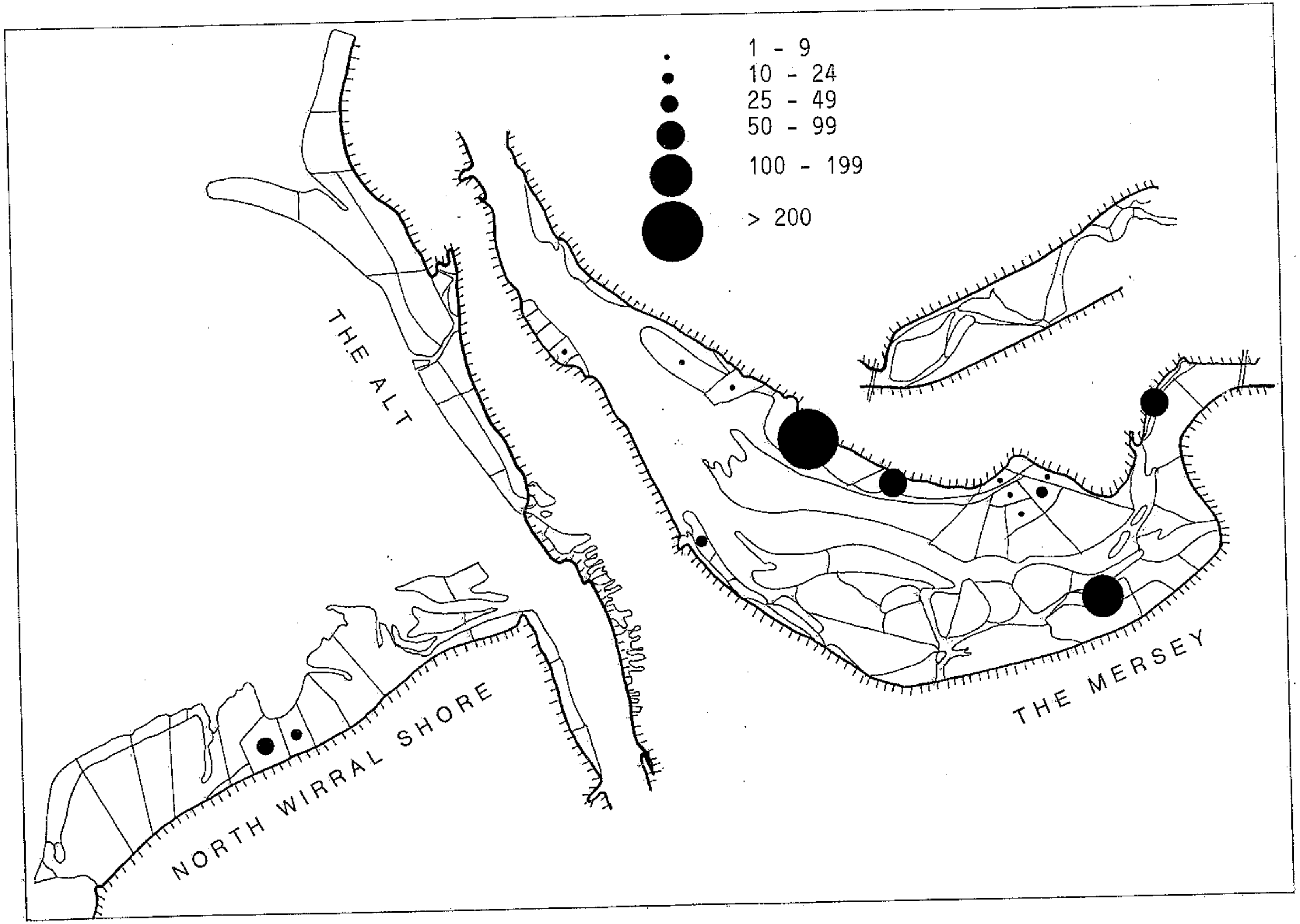


Figure 3.9.1 The average number of Lapwing feeding at low tide on each intertidal area during winter 1989/90.

LAPWING

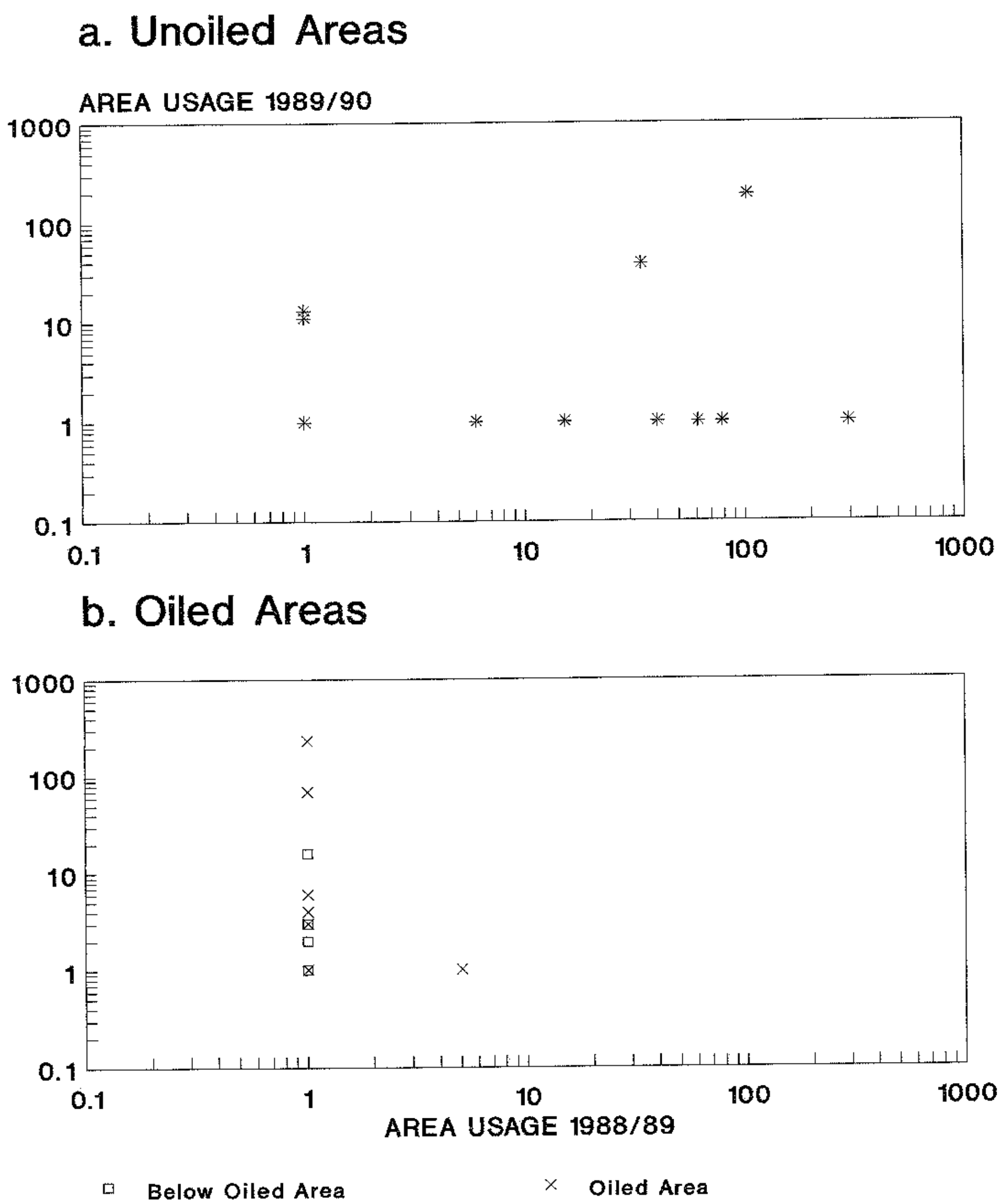


Figure 3.9.2 Comparison of low tide usage, by feeding Lapwing, of intertidal areas in one year before and after the oil spill. Oiled and unoiled sites are considered separately.

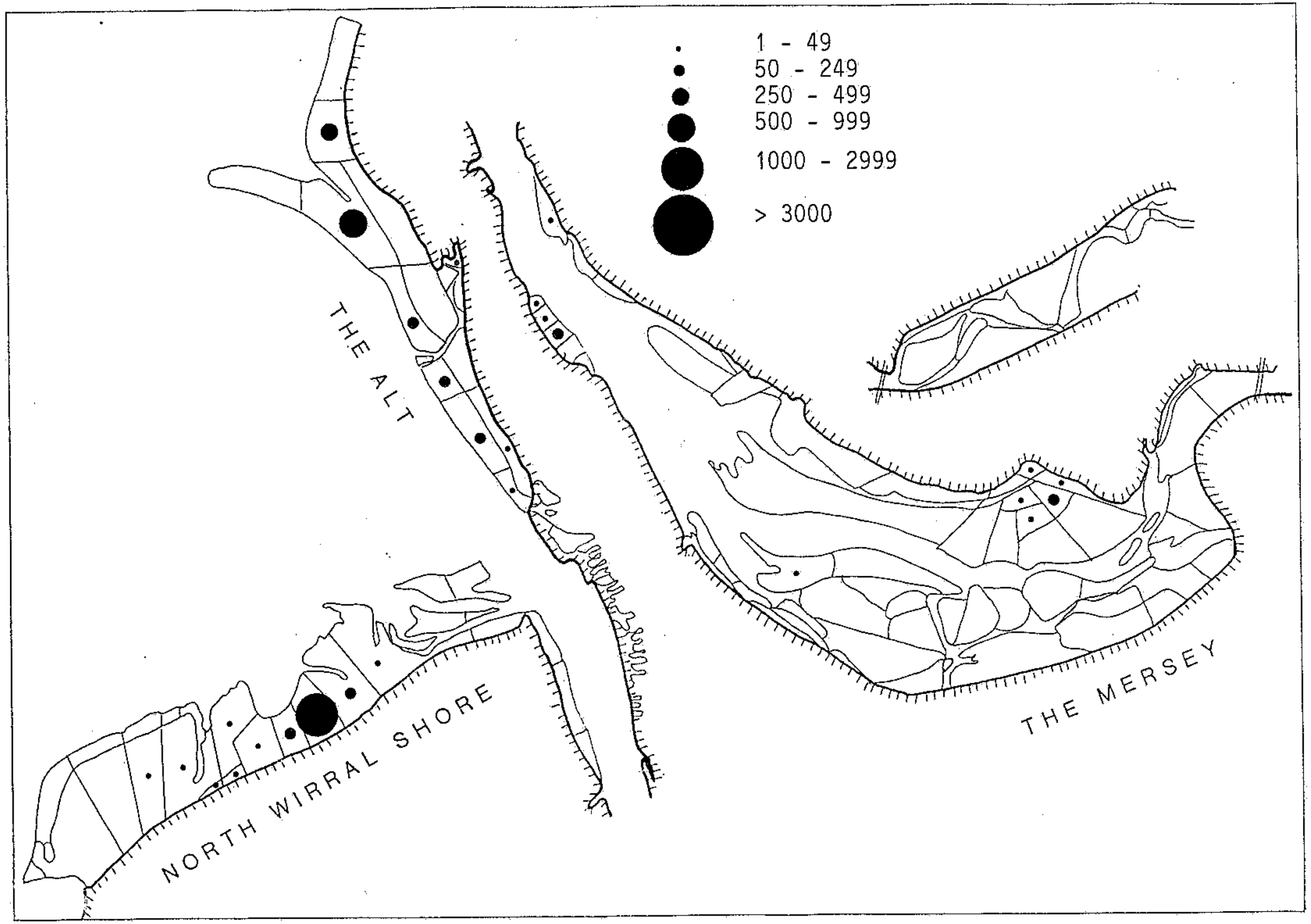


Figure 3.10.1 The average number of Knot feeding at low tide on each intertidal area during winter 1989/90.

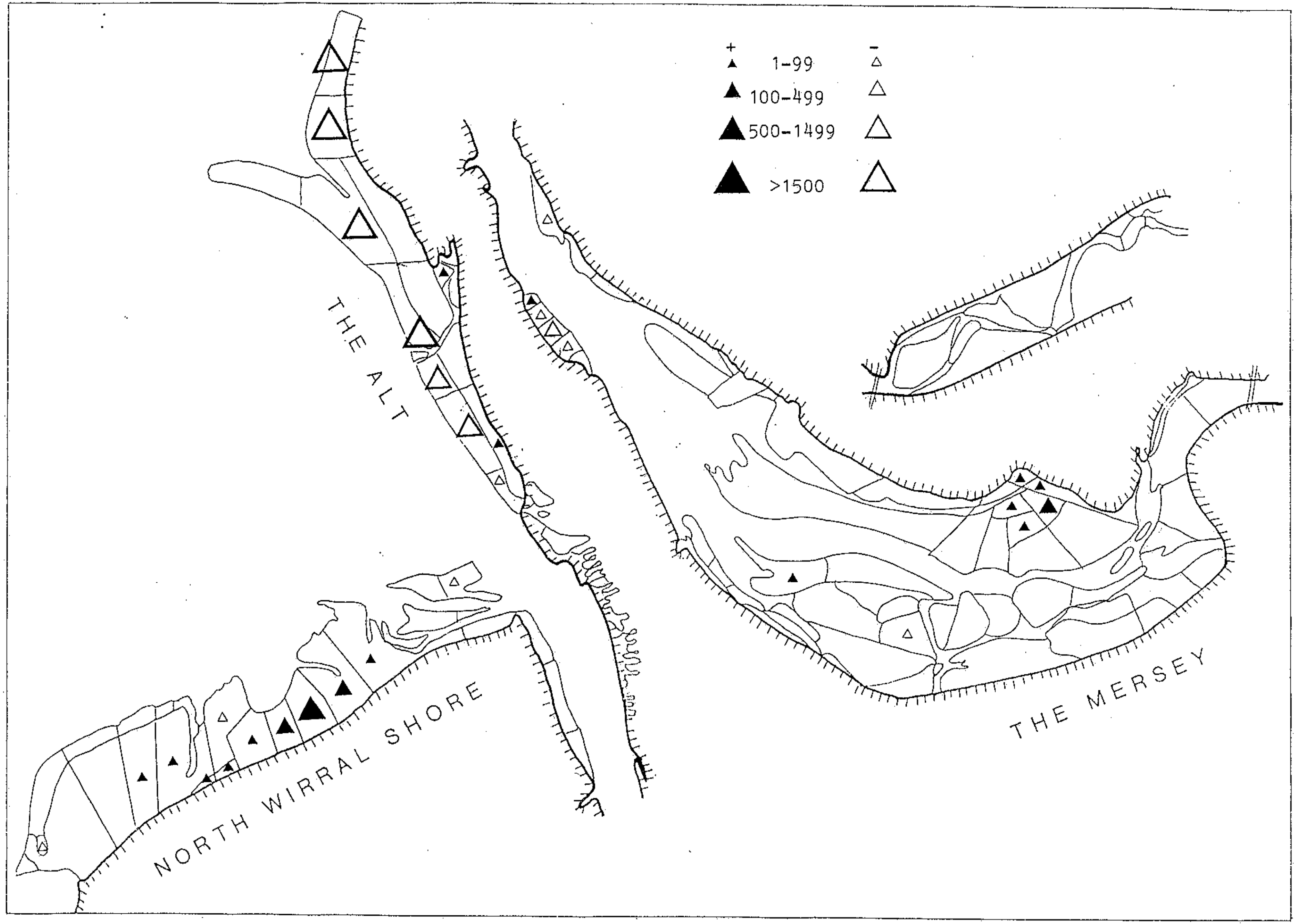


Figure 3.10.2 Changes in the low tide usage made by feeding Knot between winters 1988/89 and 1989/90. (Positive values denote an increase in the second winter, negative values a decrease).

KNOT

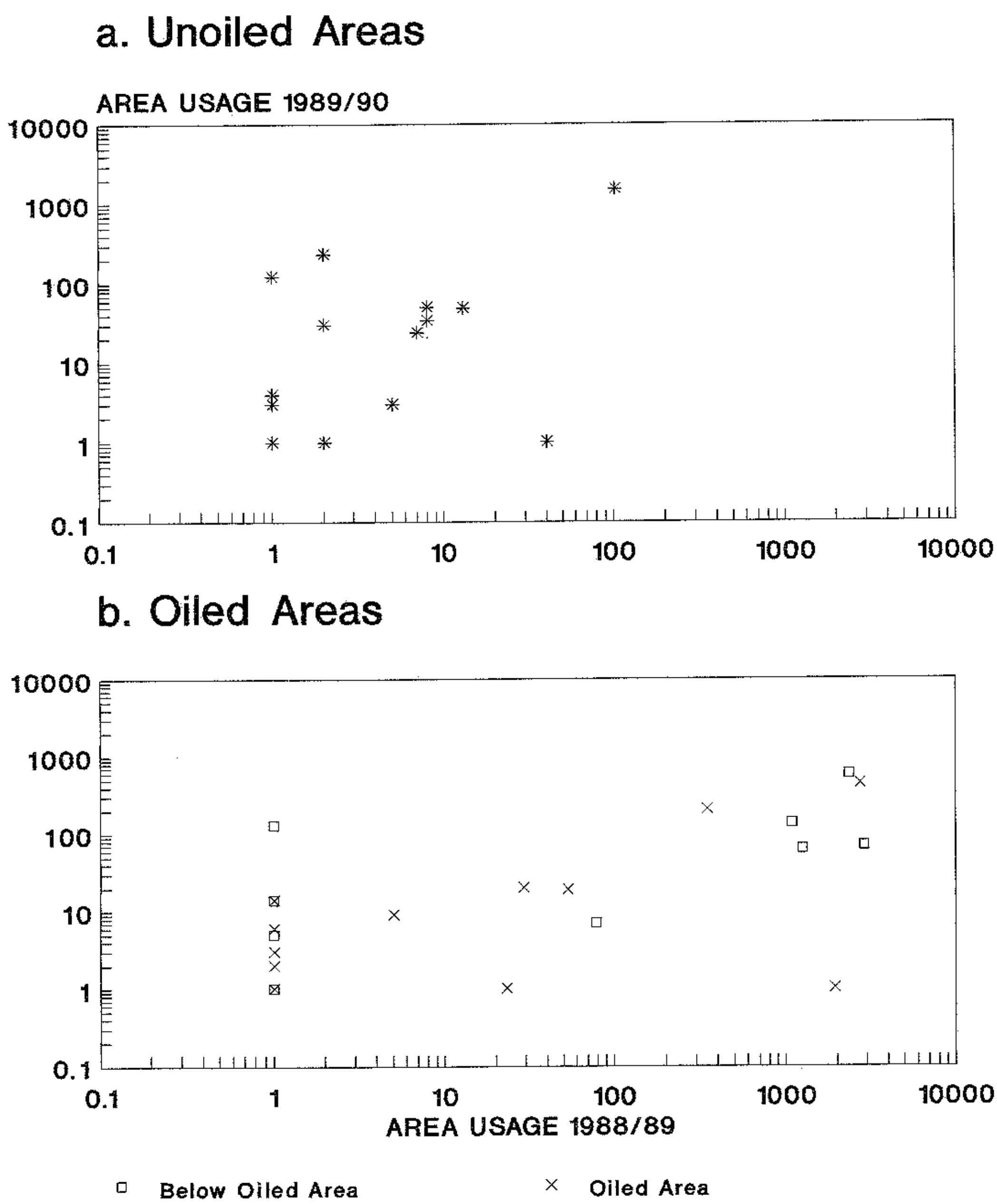


Figure 3.10.3 Comparison of low tide usage, by feeding Knot, of intertidal areas in one year before and after the oil spill. Oiled and unoiled sites are considered separately.

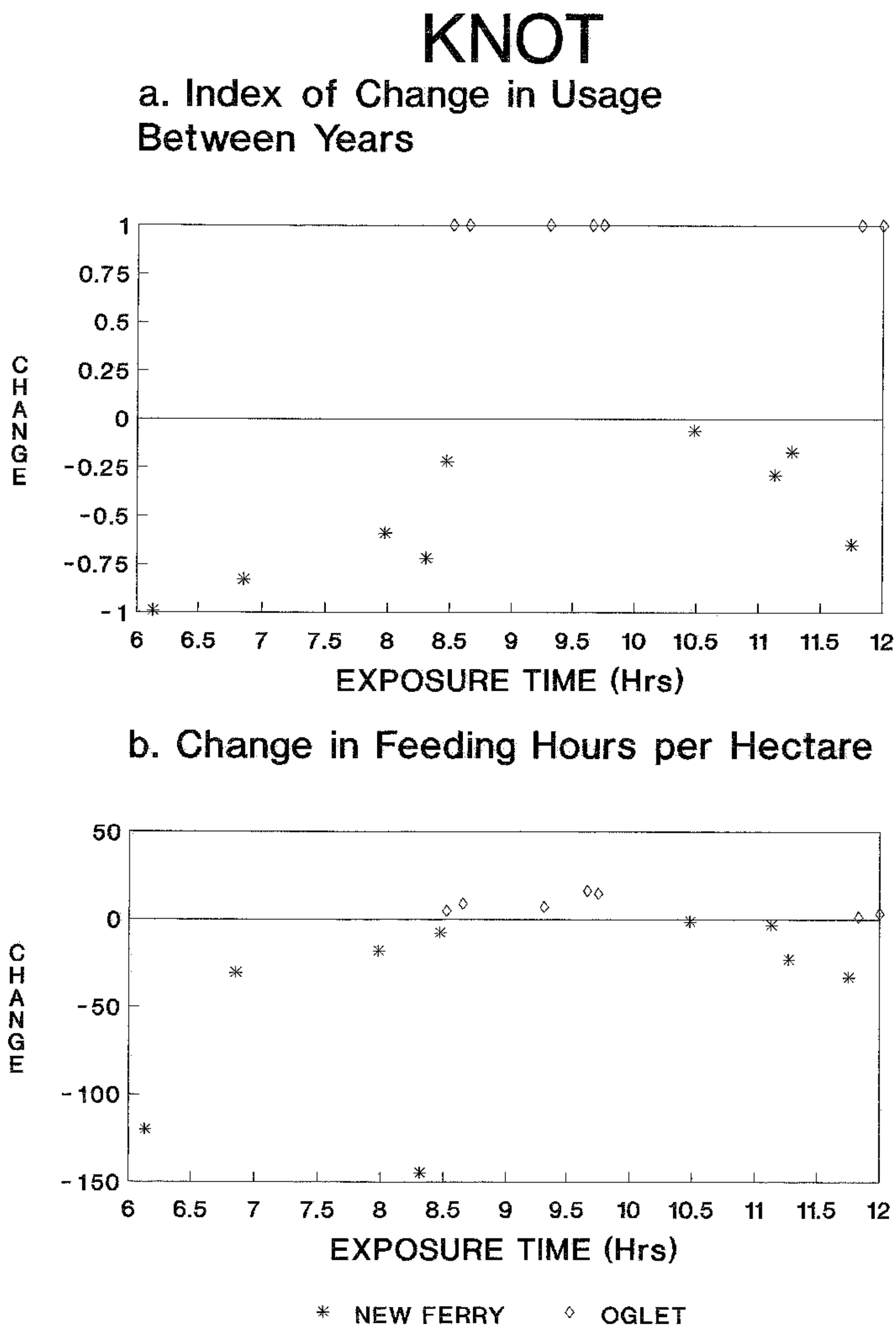


Figure 3.10.4 The relationship between changes in all day usage and exposure time for an oiled site (Oglet) and an unoiled sites (New Ferry).

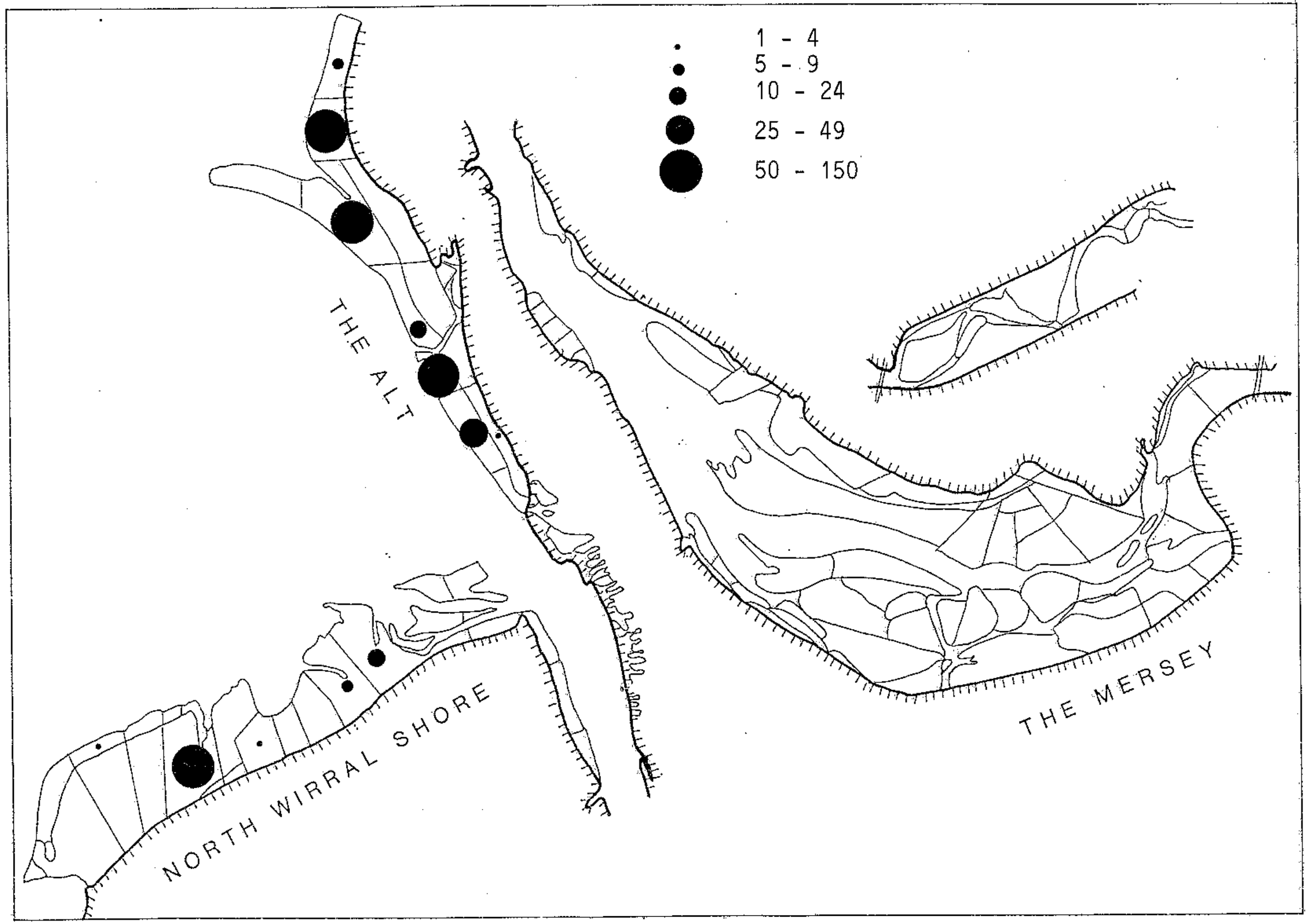


Figure 3.11.1 The average number of Sanderling feeding at low tide on each intertidal area during winter 1989/90.

SANDERLING

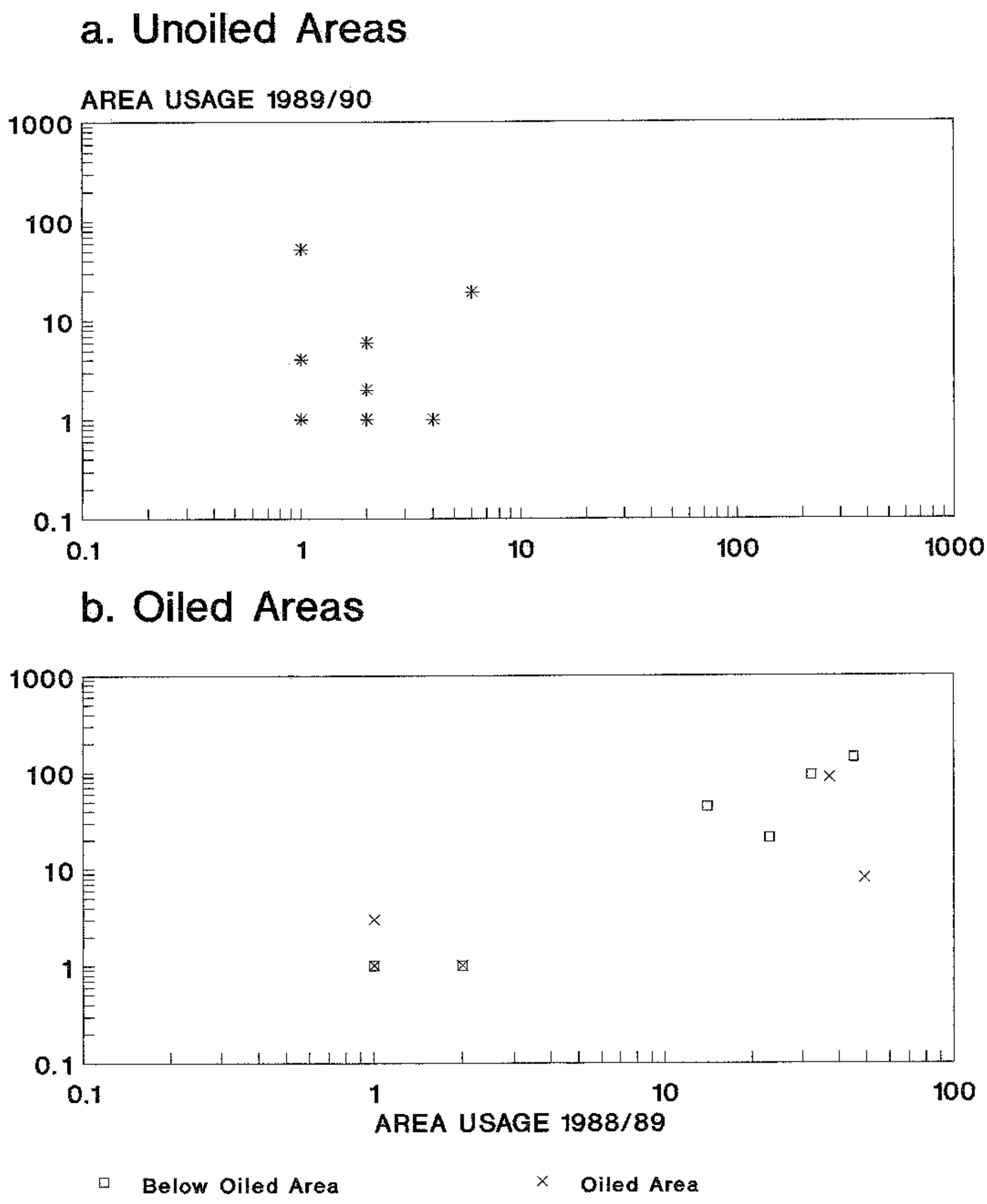


Figure 3.11.2 Comparison of low tide usage, by feeding Sanderling, of intertidal areas in one year before and after the oil spill. Oiled and unoiled sites are considered separately.

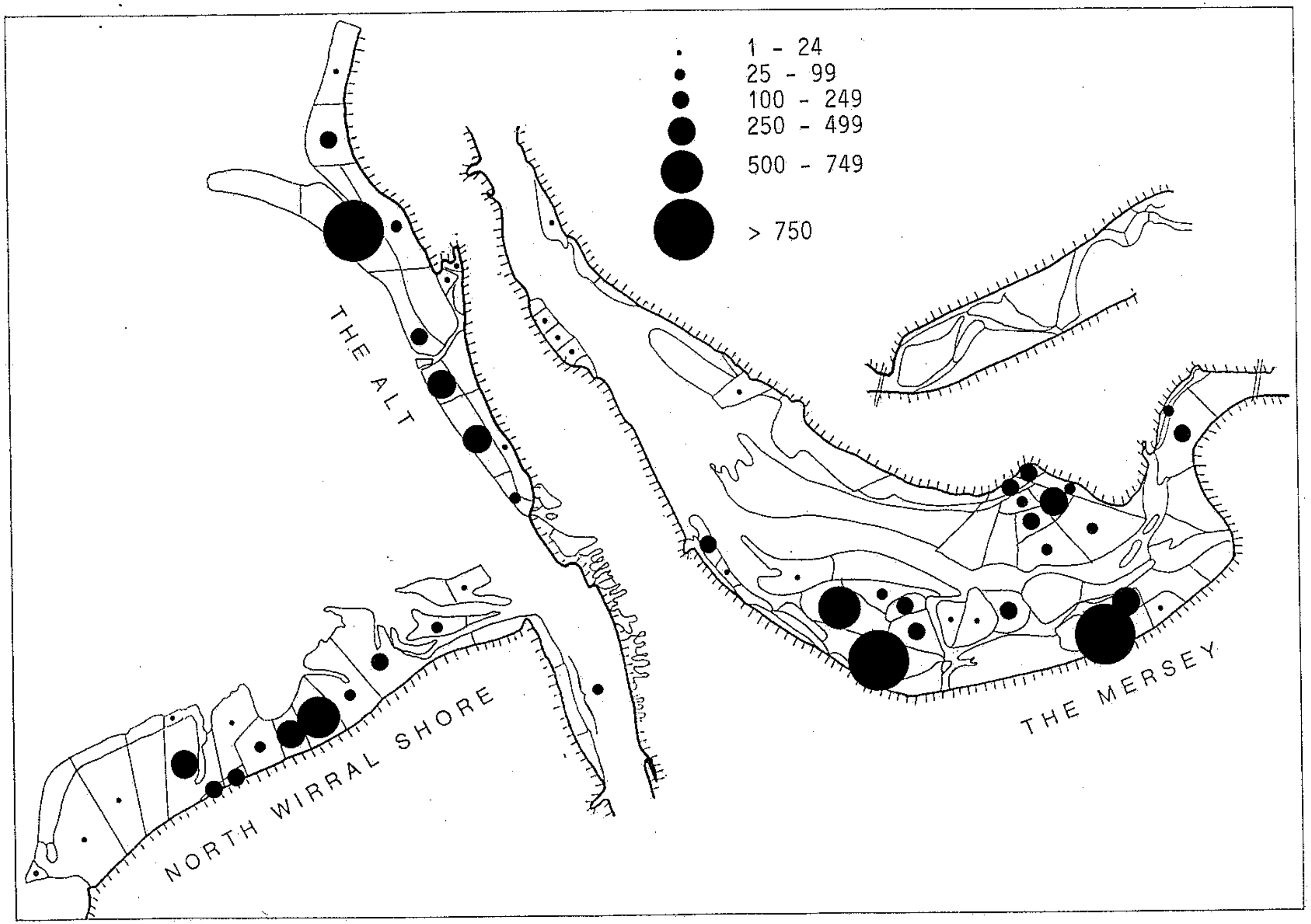


Figure 3.12.1 The average number of Dunlin feeding at low tide on each intertidal area during winter 1989/90.

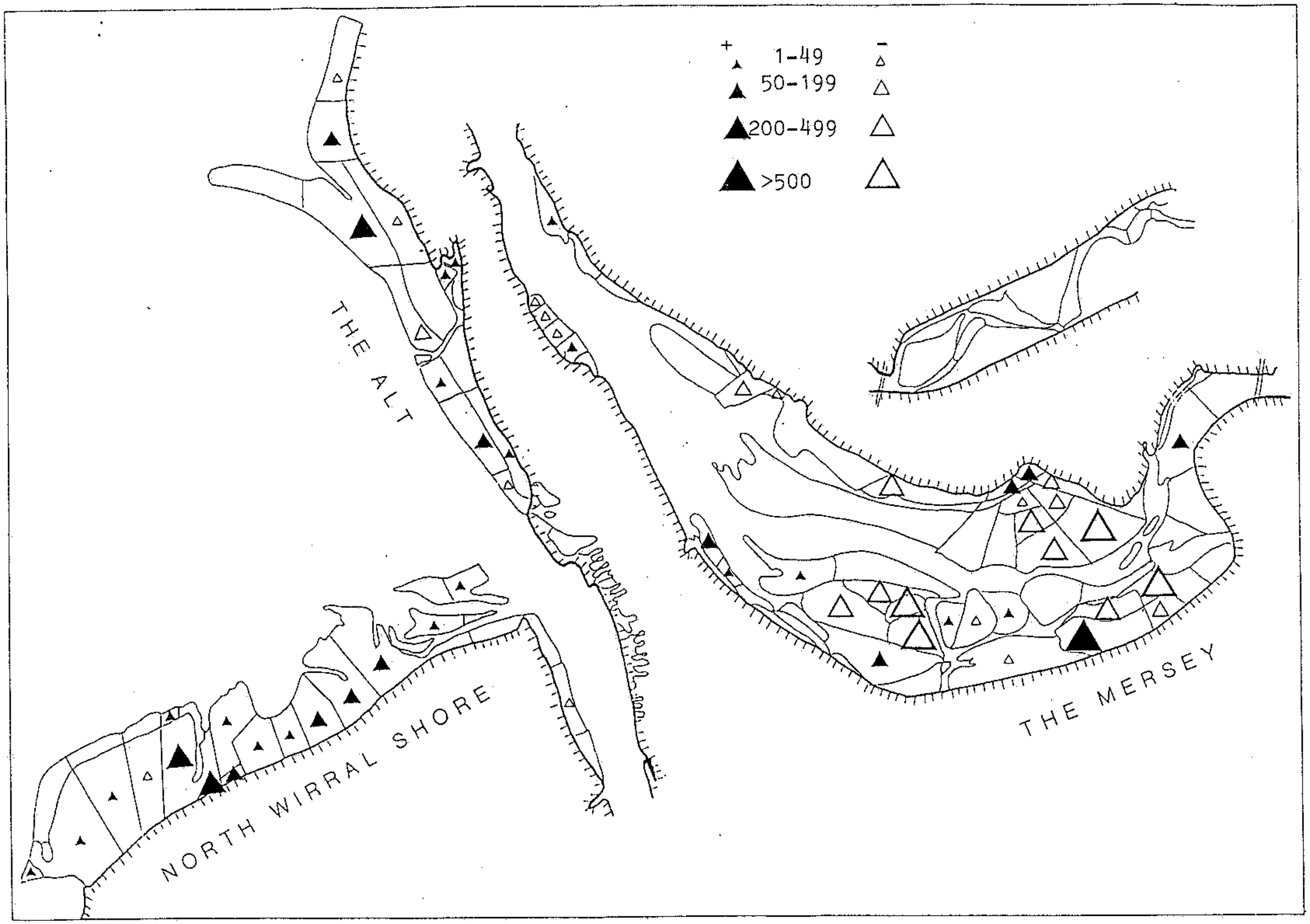


Figure 3.12.2 Changes in the low tide usage made by feeding Dunlin between winters 1988/89 and 1989/90. (Positive values denote an increase in the second winter, negative values a decrease).

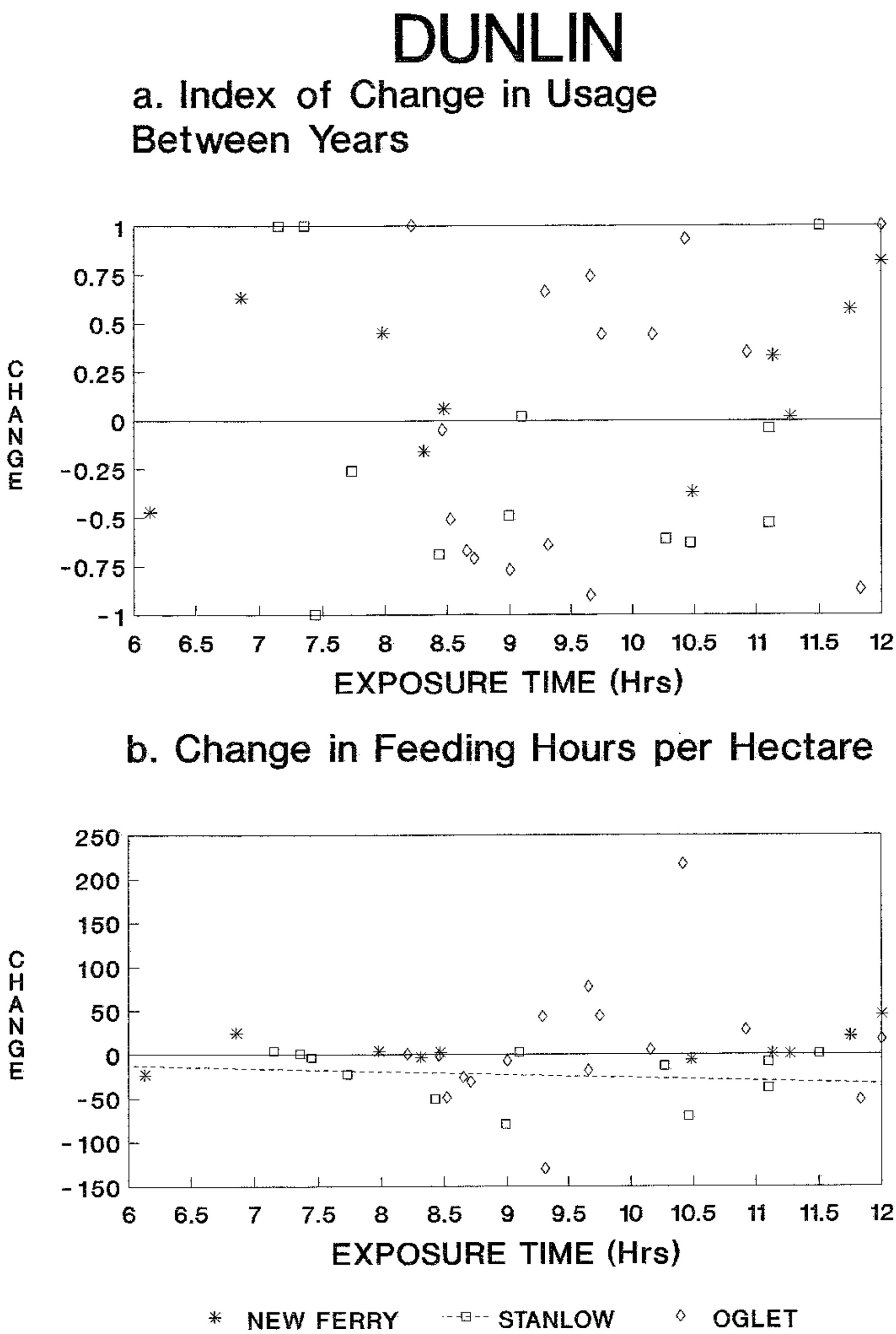


Figure 3.12.3 The relationship between changes in all day usage and exposure time for an oiled site (Oglet) and two unoiled sites (New Ferry and Stanlow).

DUNLIN

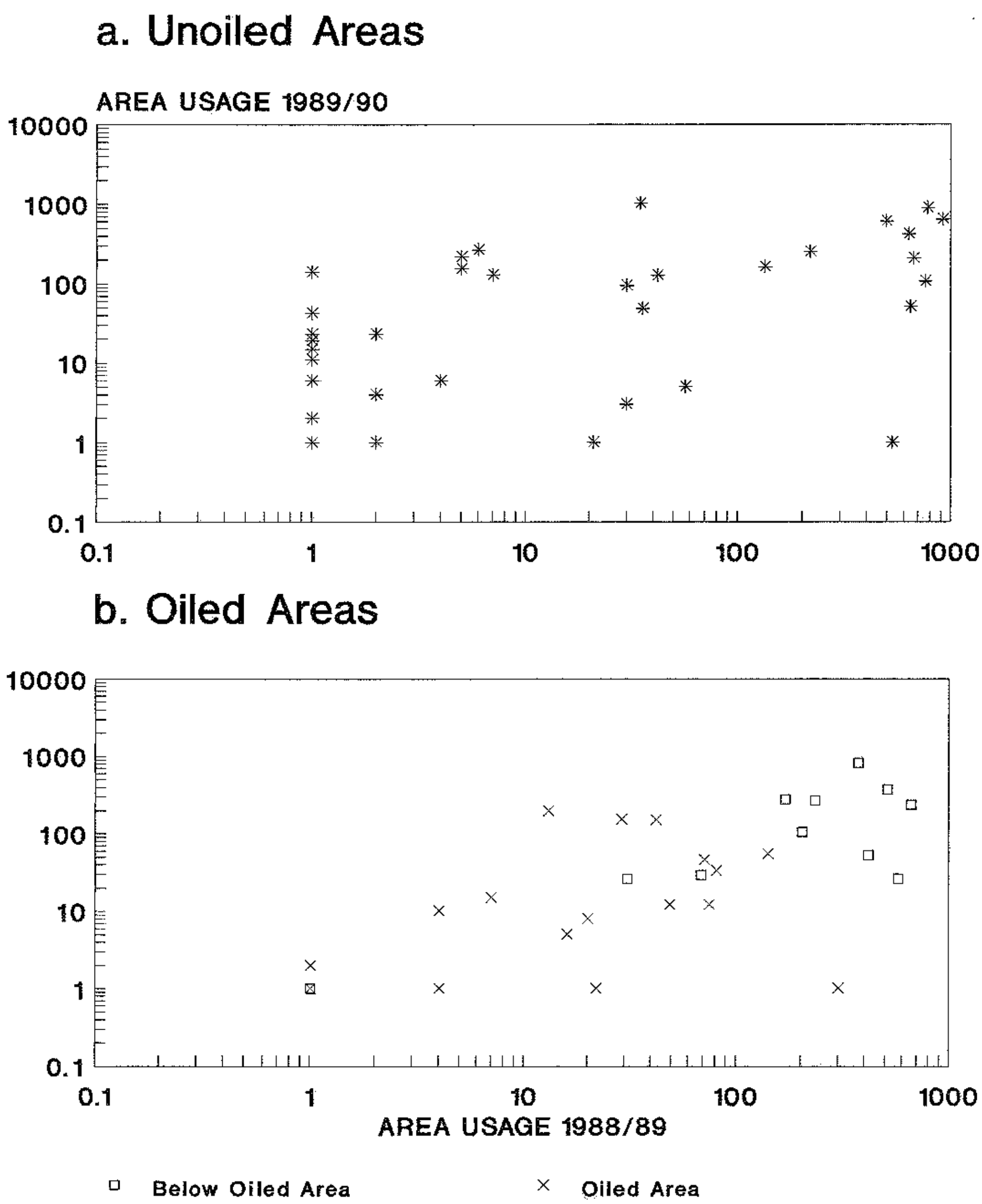


Figure 3.12.4 Comparison of low tide usage, by feeding Dunlin, of intertidal areas in one year before and after the oil spill. Oiled and unoiled sites are considered separately.

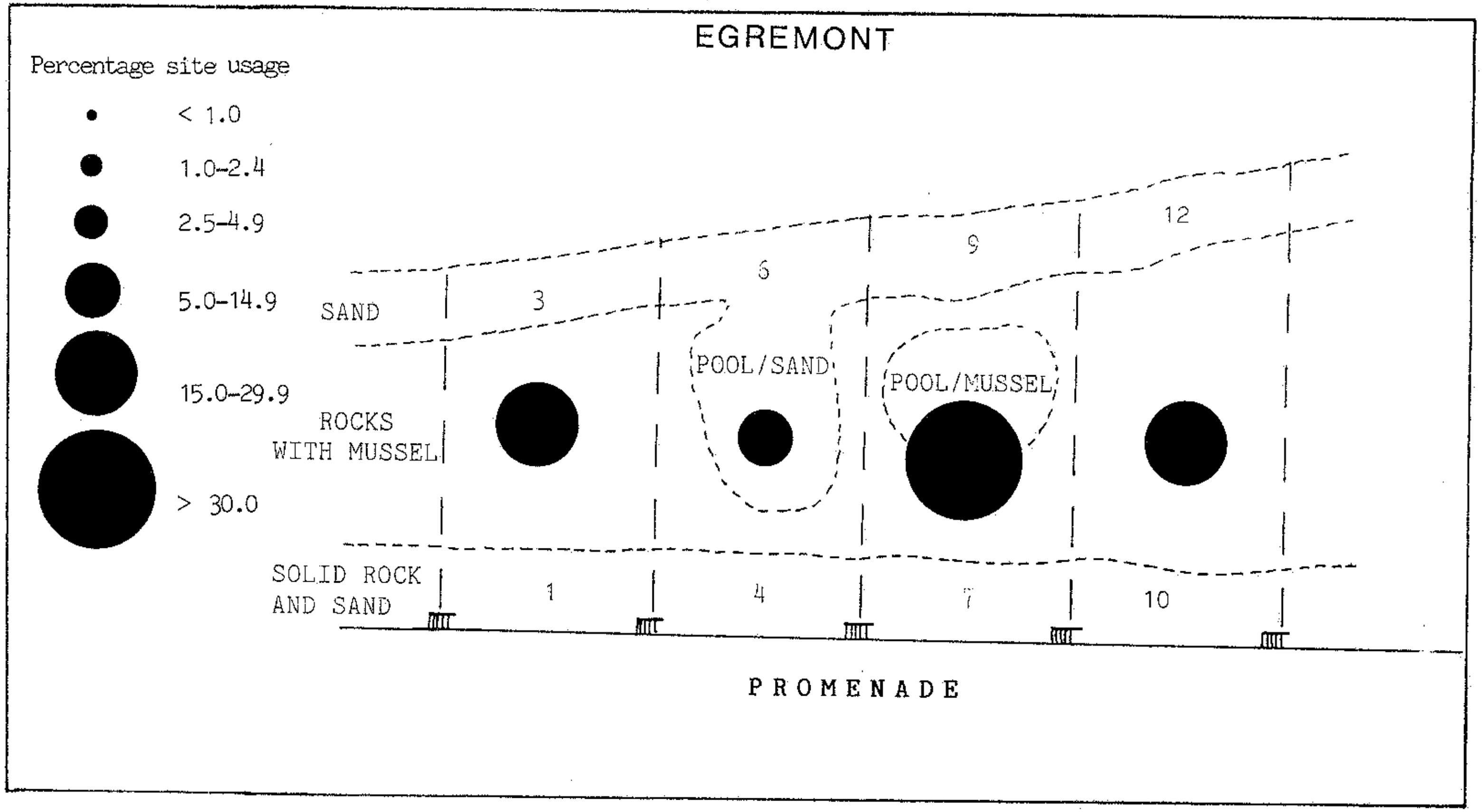


Figure 3.12.5. The distribution of feeding Dunlin at Egremont during the 1989/90 winter assessed from all day observations.

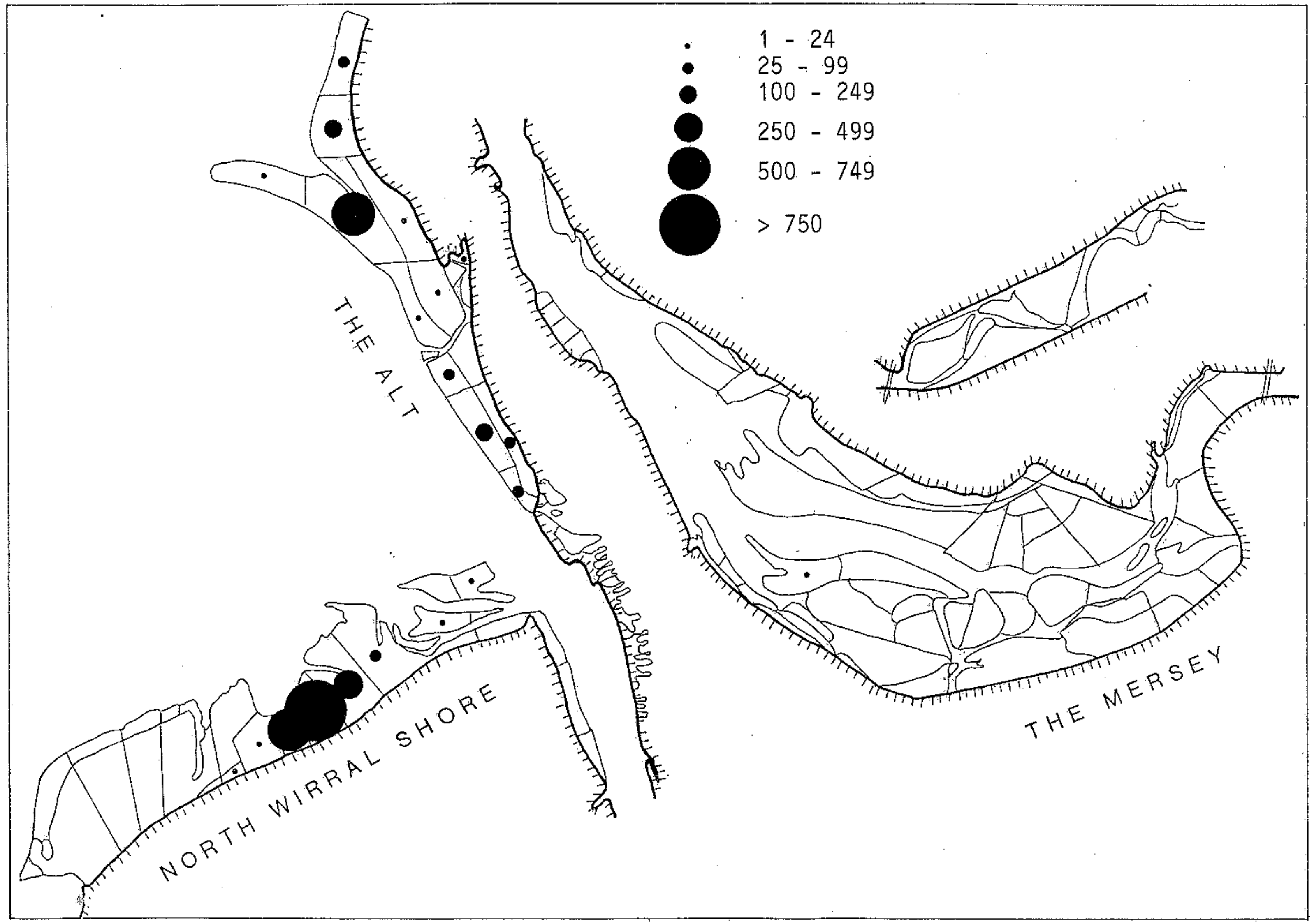


Figure 3.13.1 The average number of Bar-tailed Godwit feeding at low tide on each intertidal area during winter 1989/90.

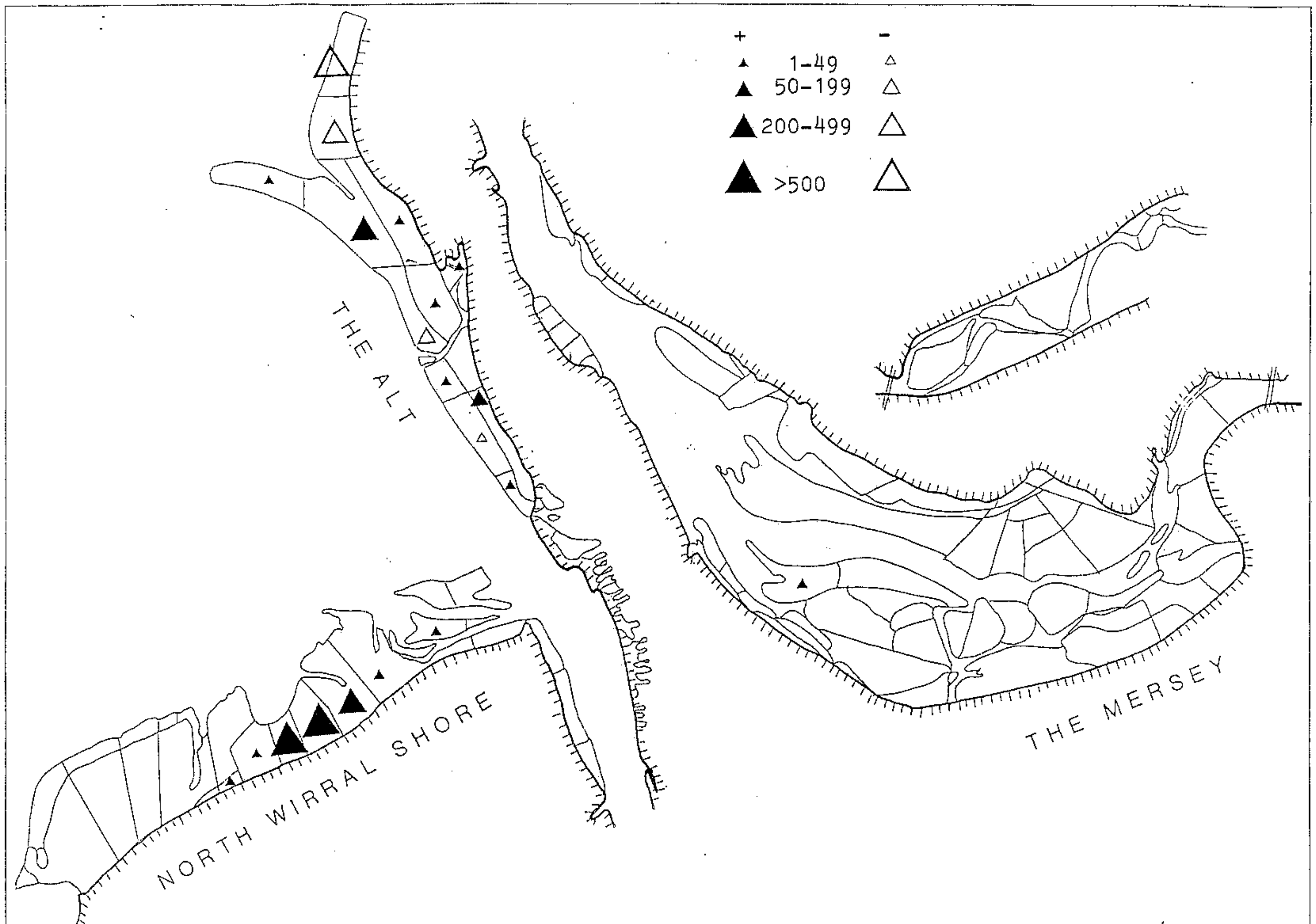


Figure 3.13.2 Changes in the low tide usage made by feeding Bar-tailed Godwit between winters 1988/89 and 1989/90. (Positive values denote an increase in the second winter, negative values a decrease).

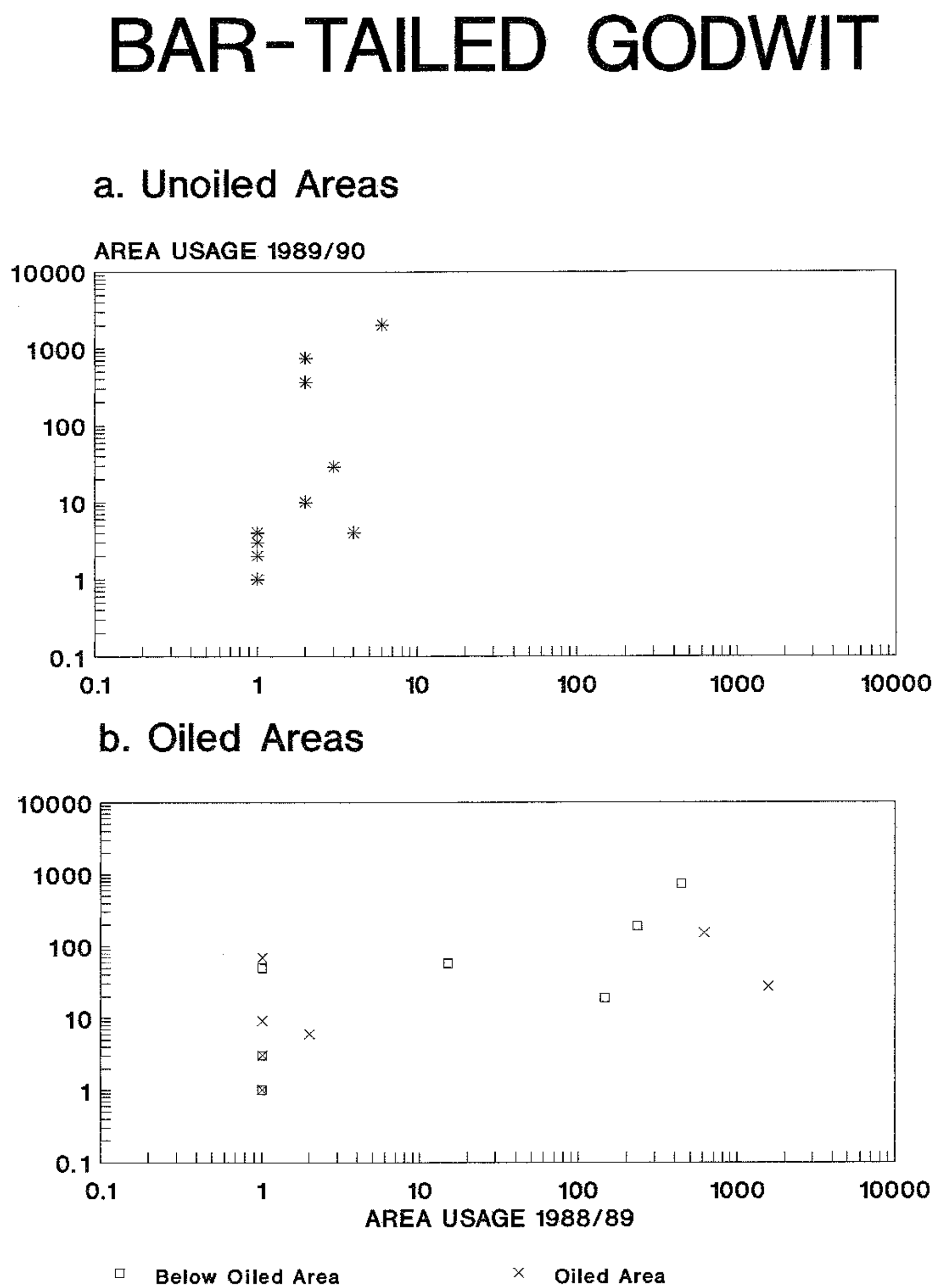


Figure 3.13.3 Comparison of low tide usage, by feeding Bar-Tailed Godwit, of intertidal areas in one year before and after the oil spill. Oiled and unoiled sites are considered separately.

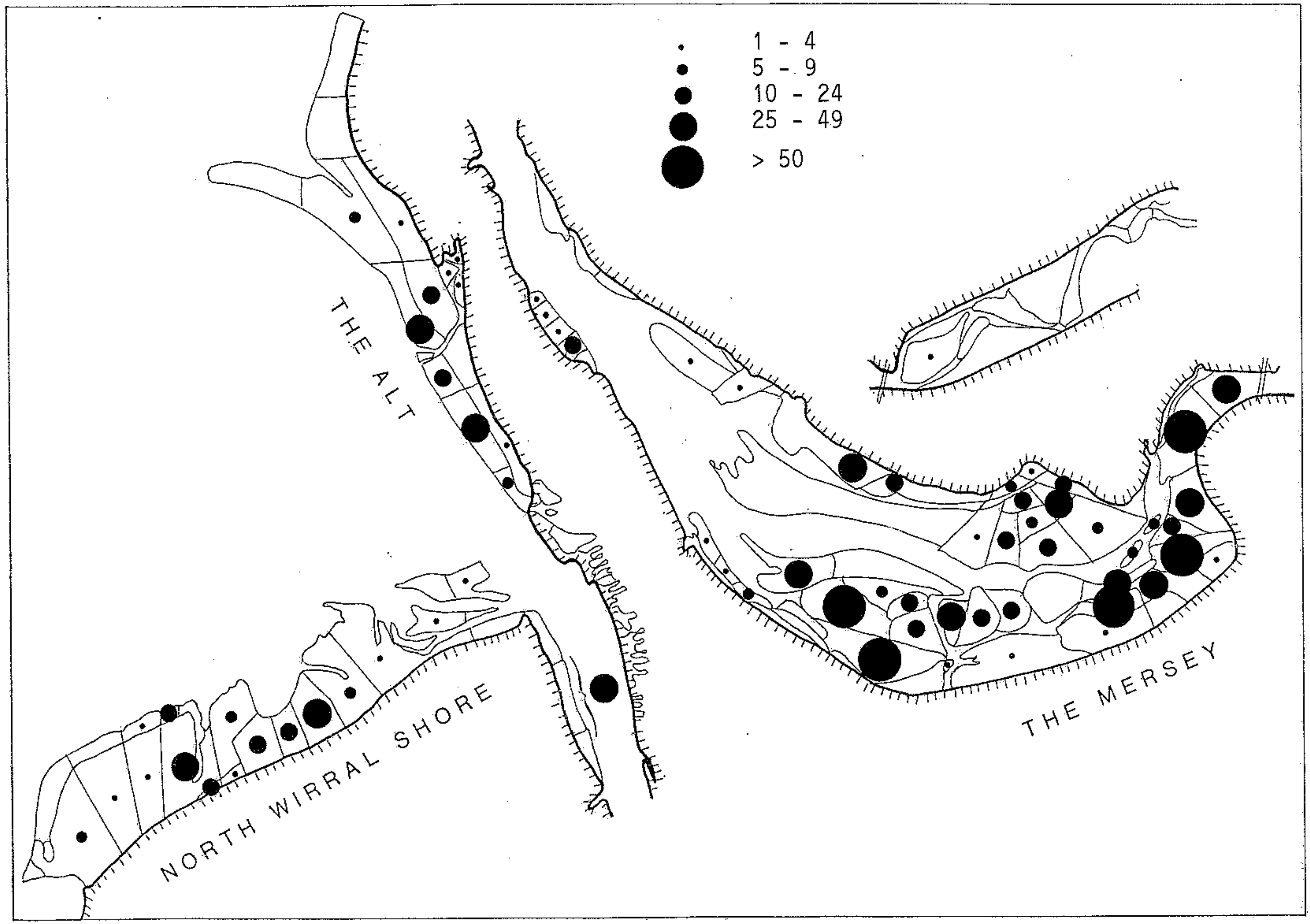


Figure 3.14.1 The average number of Curlew feeding at low tide on each intertidal area during winter 1989/90.

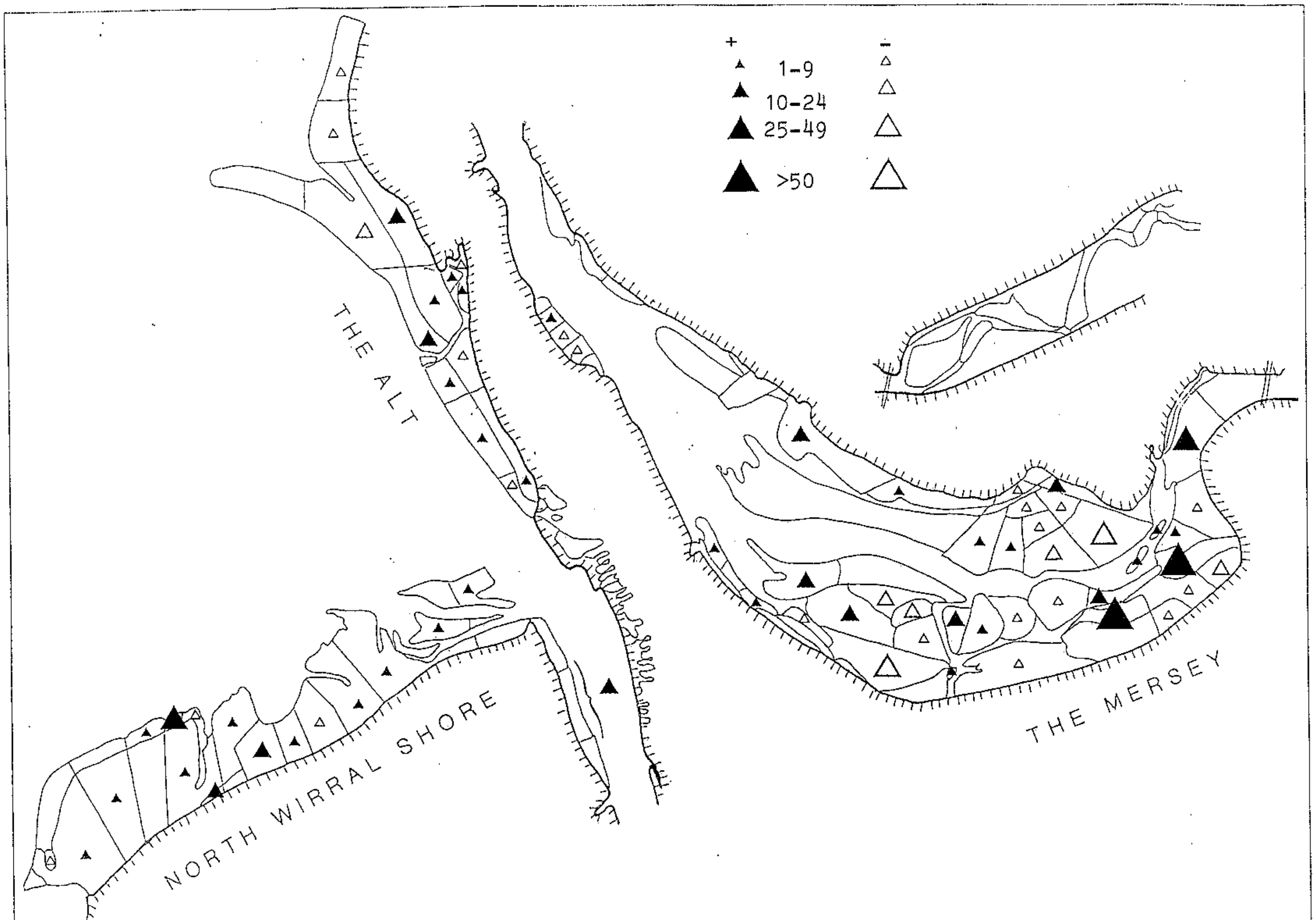


Figure 3.14.2 Changes in the low tide usage made by feeding Curlew between winters 1988/89 and 1989/90. (Positive values denote an increase in the second winter, negative values a decrease).

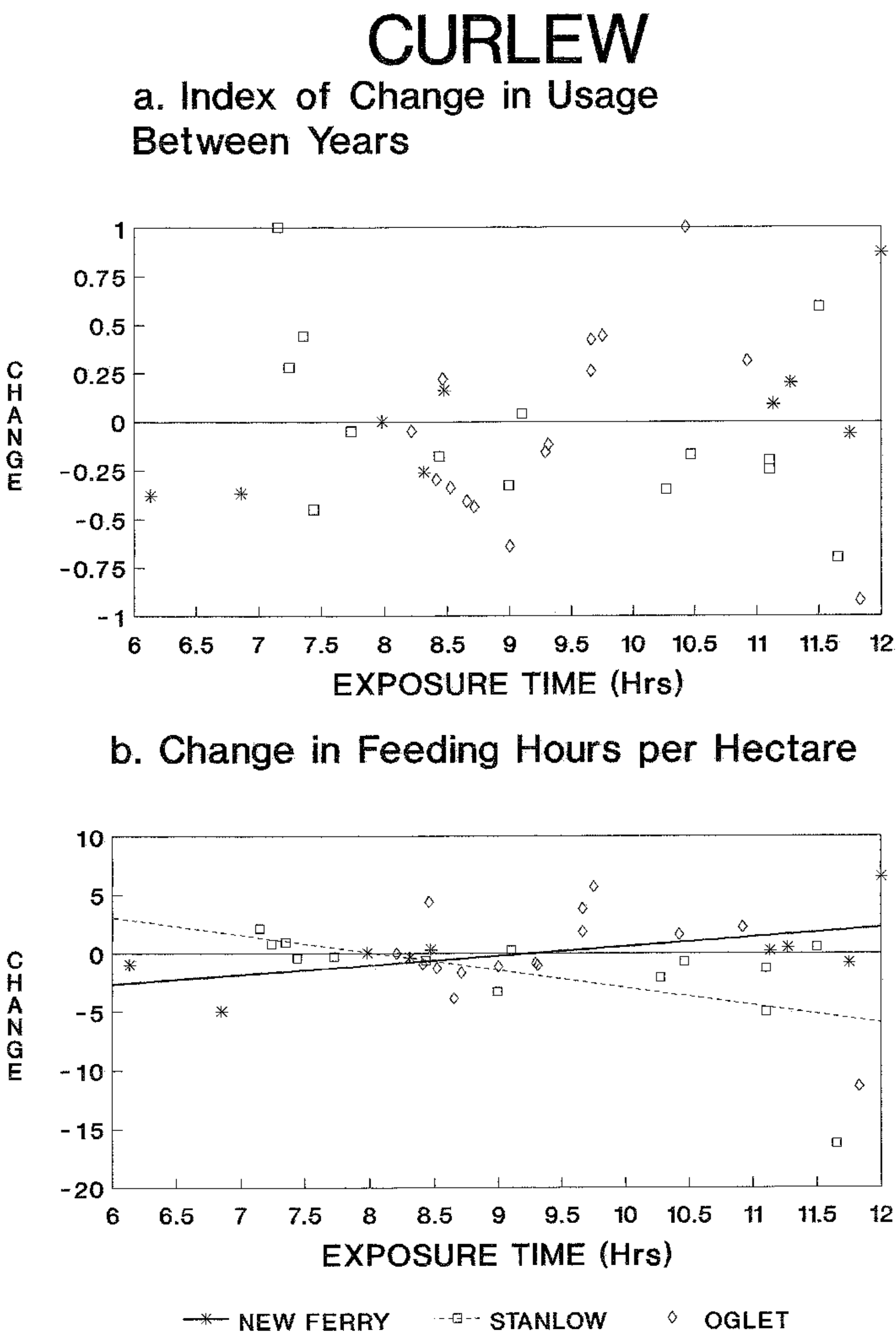


Figure 3.14.3 The relationship between changes in all day usage and exposure time for an oiled site (Oglet) and two unoiled sites (New Ferry and Stanlow).

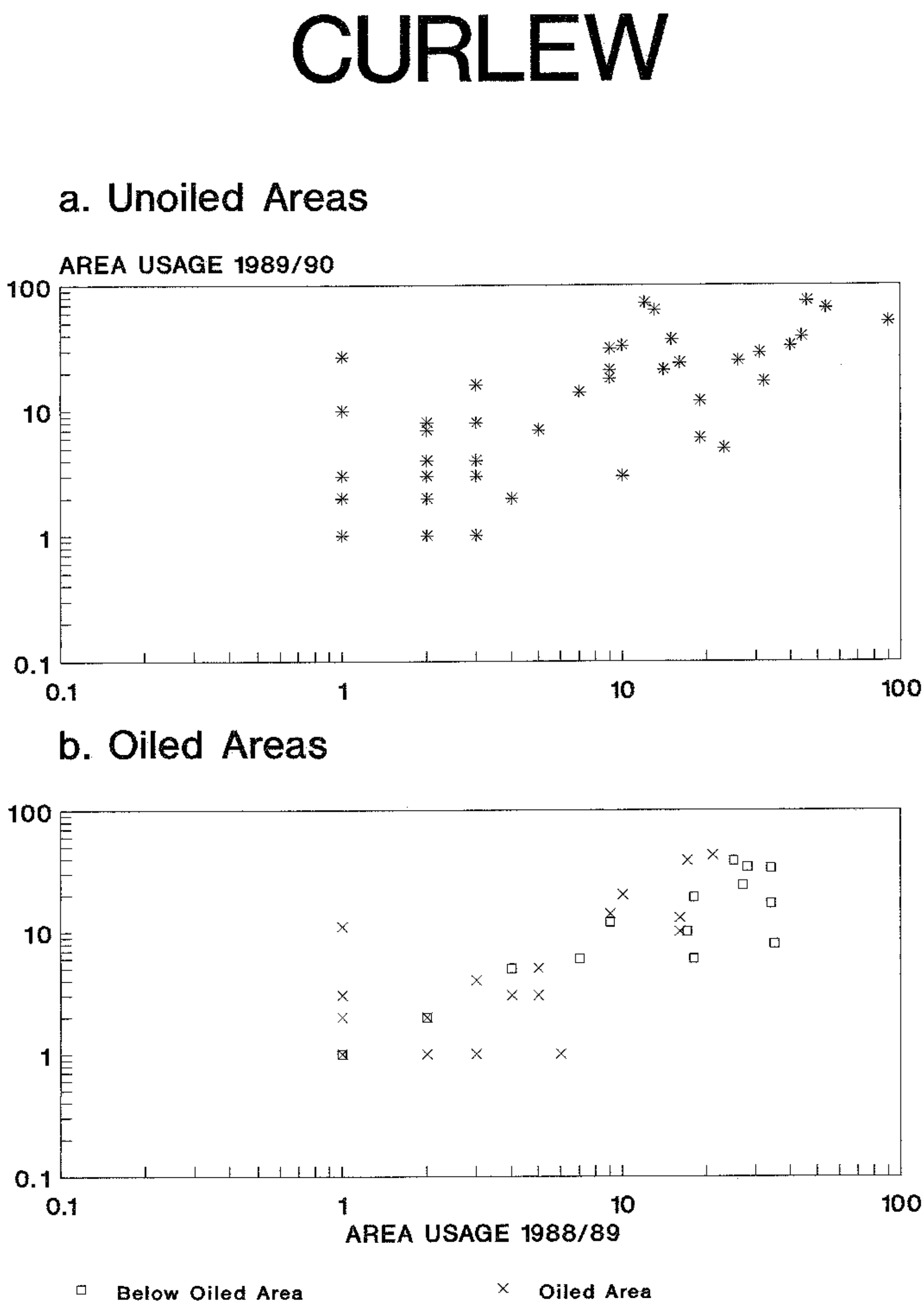


Figure 3.14.4 Comparison of low tide usage, by feeding Curlew, of intertidal areas in one year before and after the oil spill. Oiled and unoiled sites are considered separately.

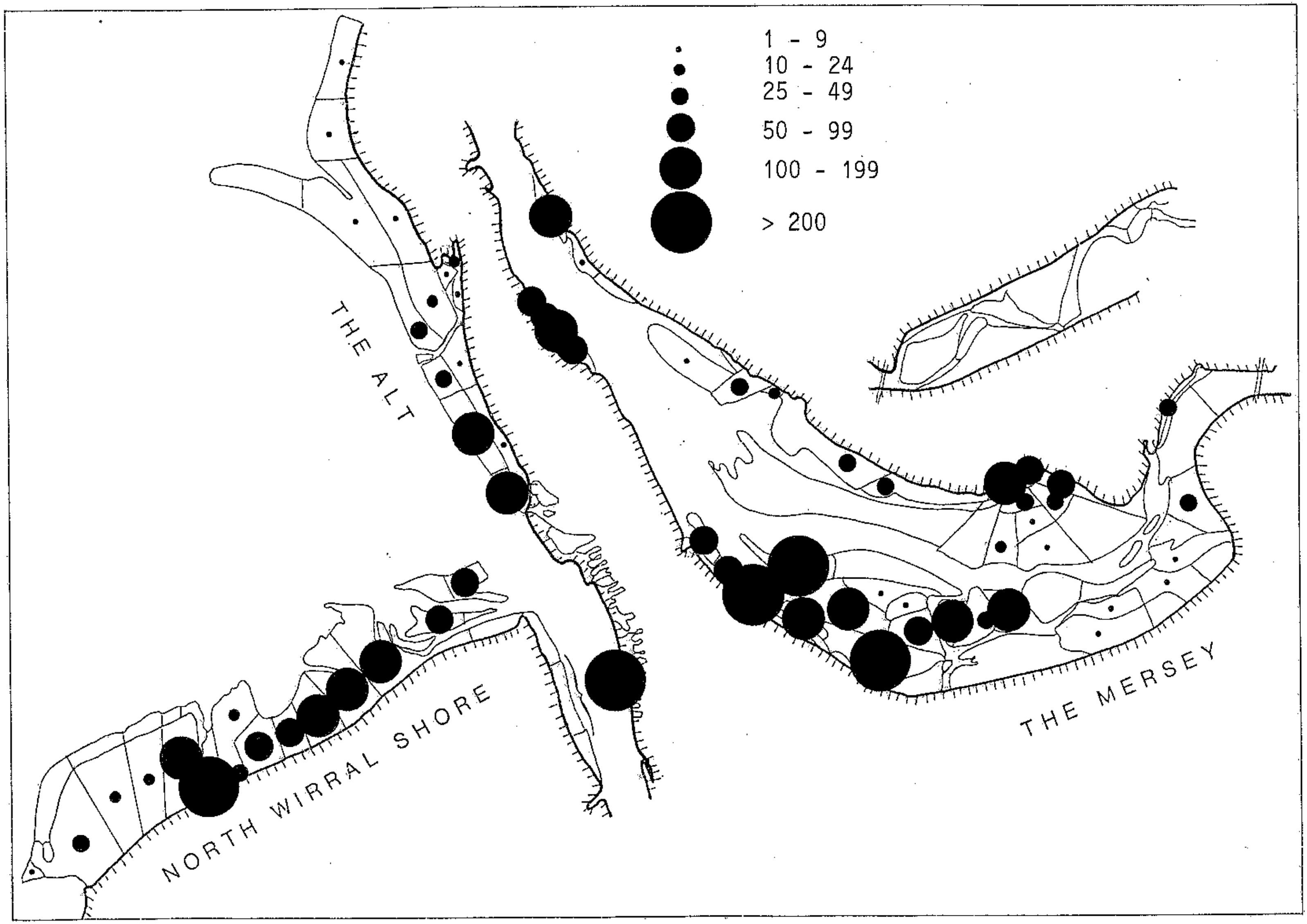


Figure 3.15.1 The average number of Redshank feeding at low tide on each intertidal area during winter 1989/90.

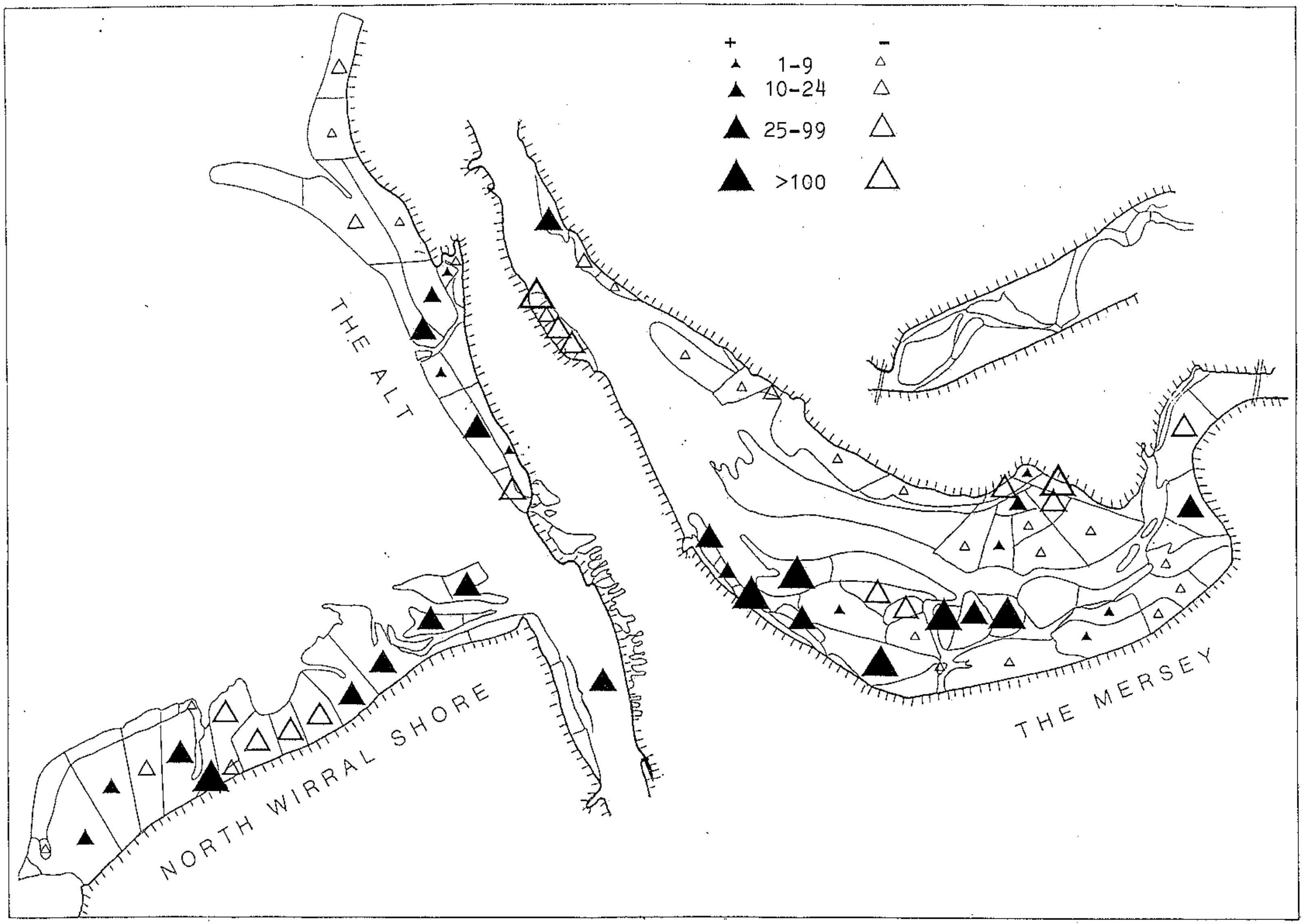


Figure 3.15.2 Changes in the low tide usage made by feeding Redshank between winters 1988/89 and 1989/90. (Positive values denote an increase in the second winter, negative values a decrease).

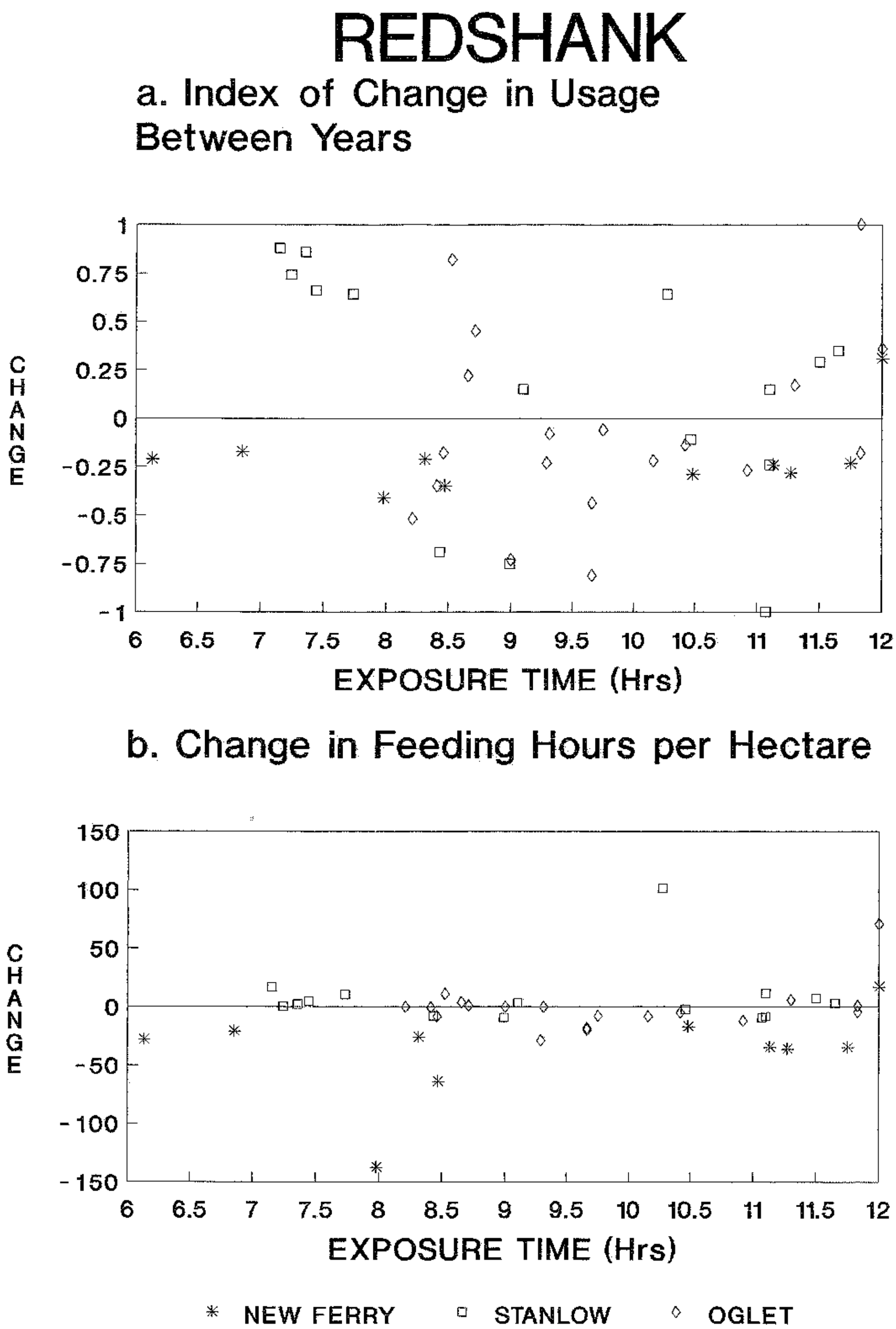
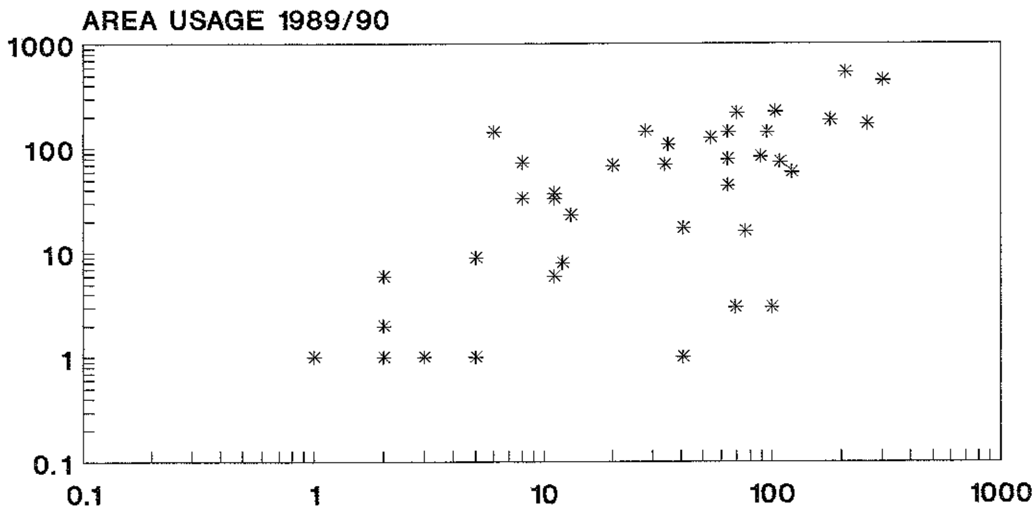


Figure 3.15.3 The relationship between changes in all day usage and exposure time for an oiled site (Oglet) and two unoiled sites (New Ferry and Stanlow).

REDSHANK

a. Unoiled Areas



b. Oiled Areas

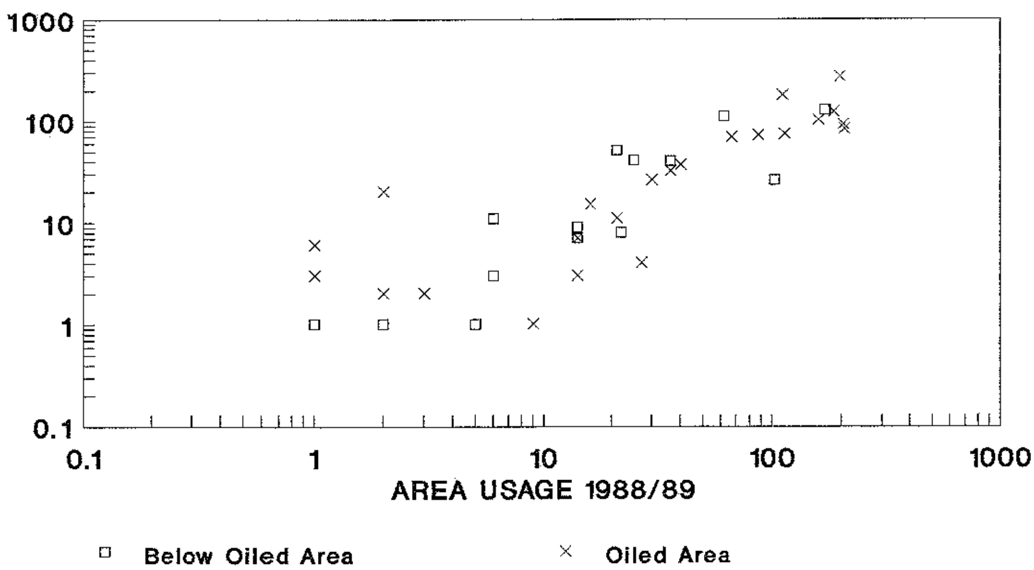


Figure 3.15.4 Comparison of low tide usage, by feeding Redshank, of intertidal areas in one year before and after the oil spill. Oiled and unoiled sites are considered separately.

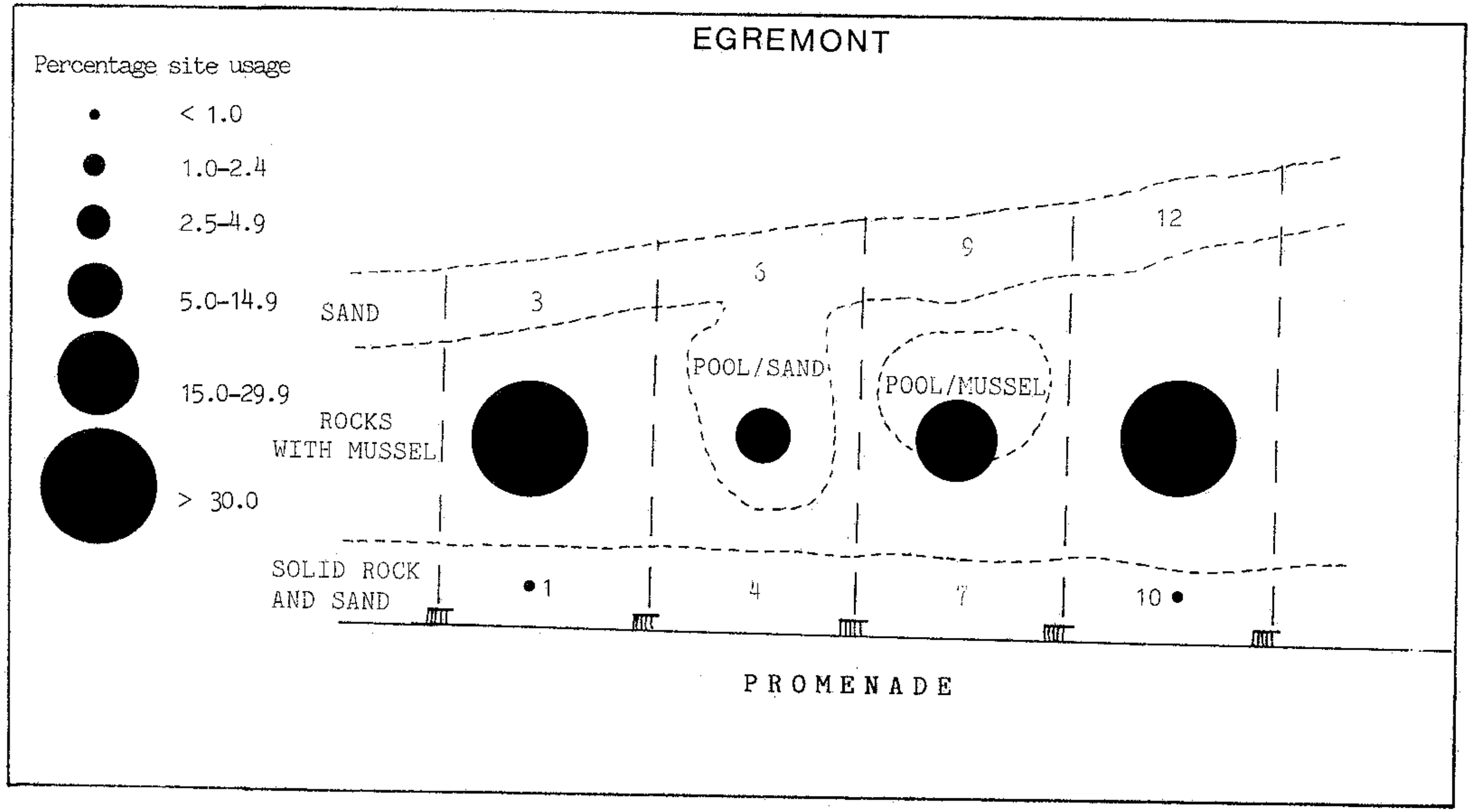


Figure 3.15.5 The distribution of feeding Redshank at Egremont during the 1989/90 winter assessed from all day observations.

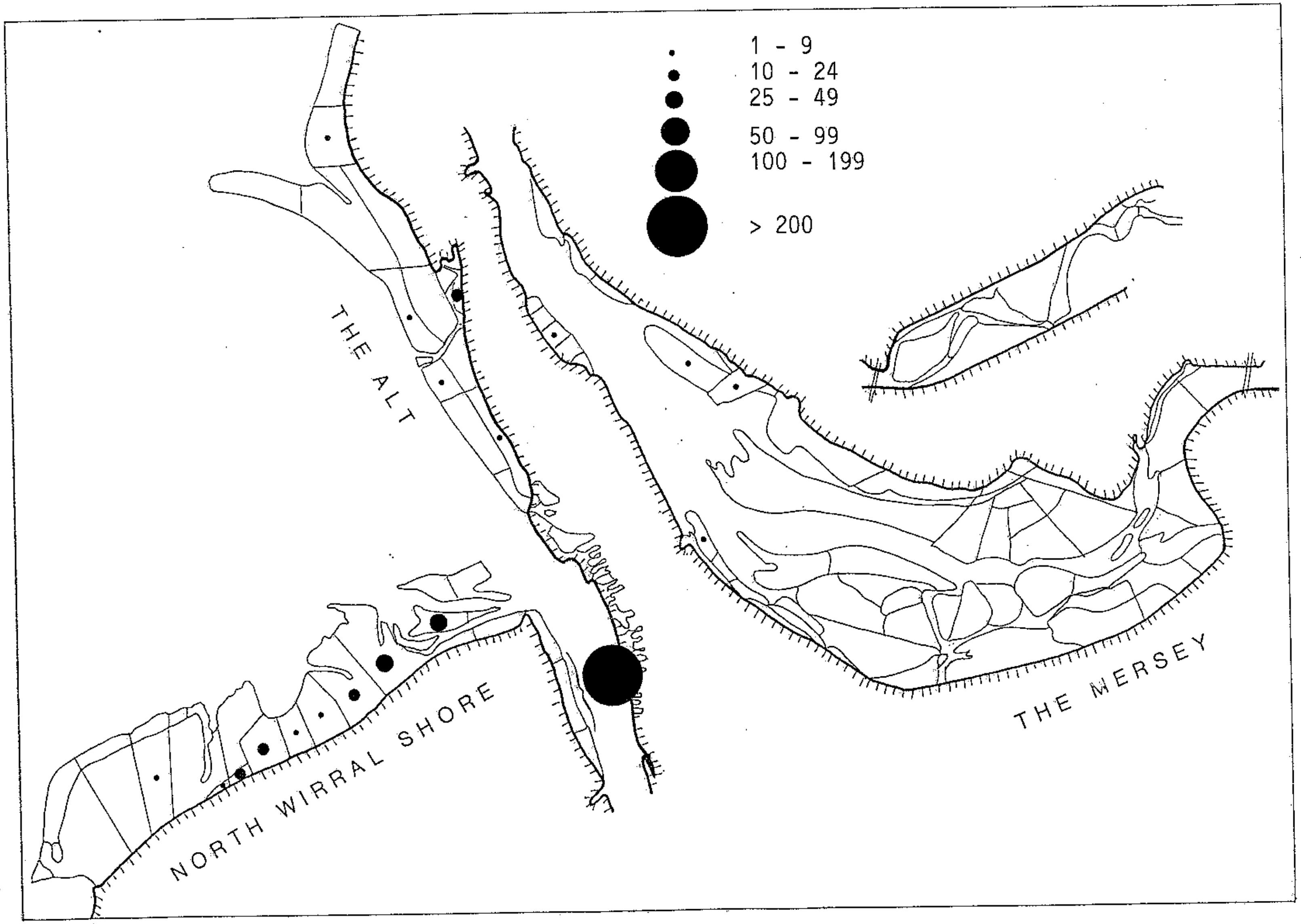
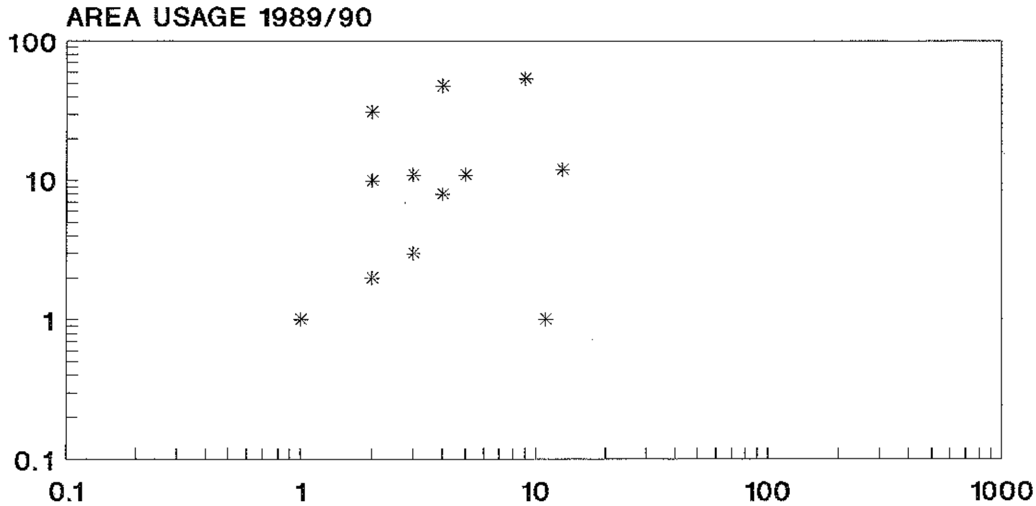


Figure 3.16.1 The average number of Turnstone feeding at low tide on each intertidal area during winter 1989/90.

TURNSTONE

a. Unoiled Areas



b. Oiled Areas

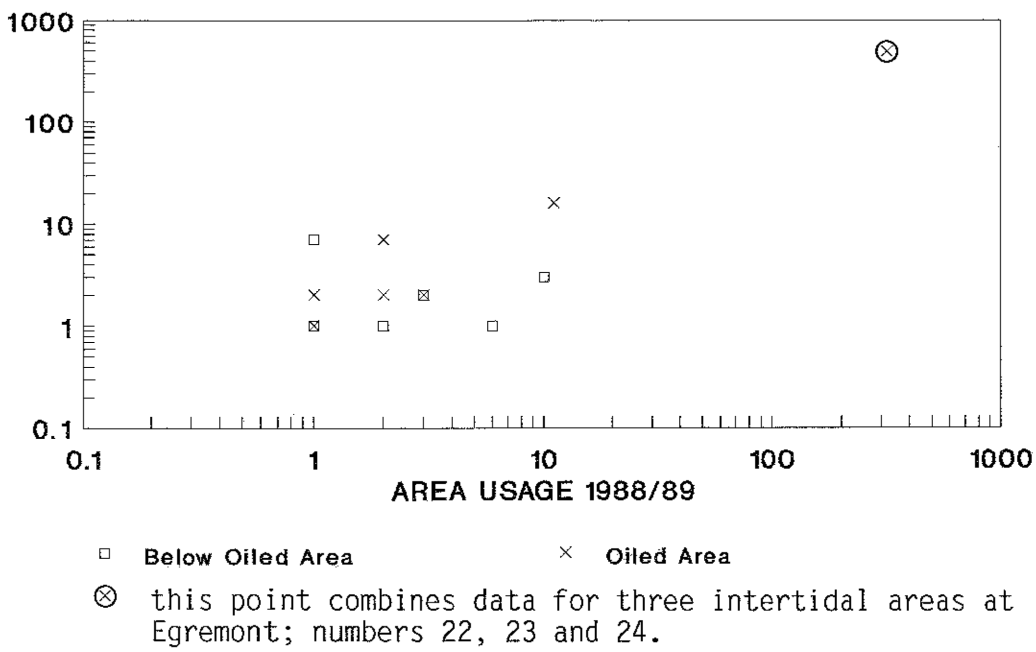


Figure 3.16.2 Comparison of low tide usage, by feeding Turnstone, of intertidal areas in one year before and after the oil spill. Oiled and unoiled sites are considered separately.

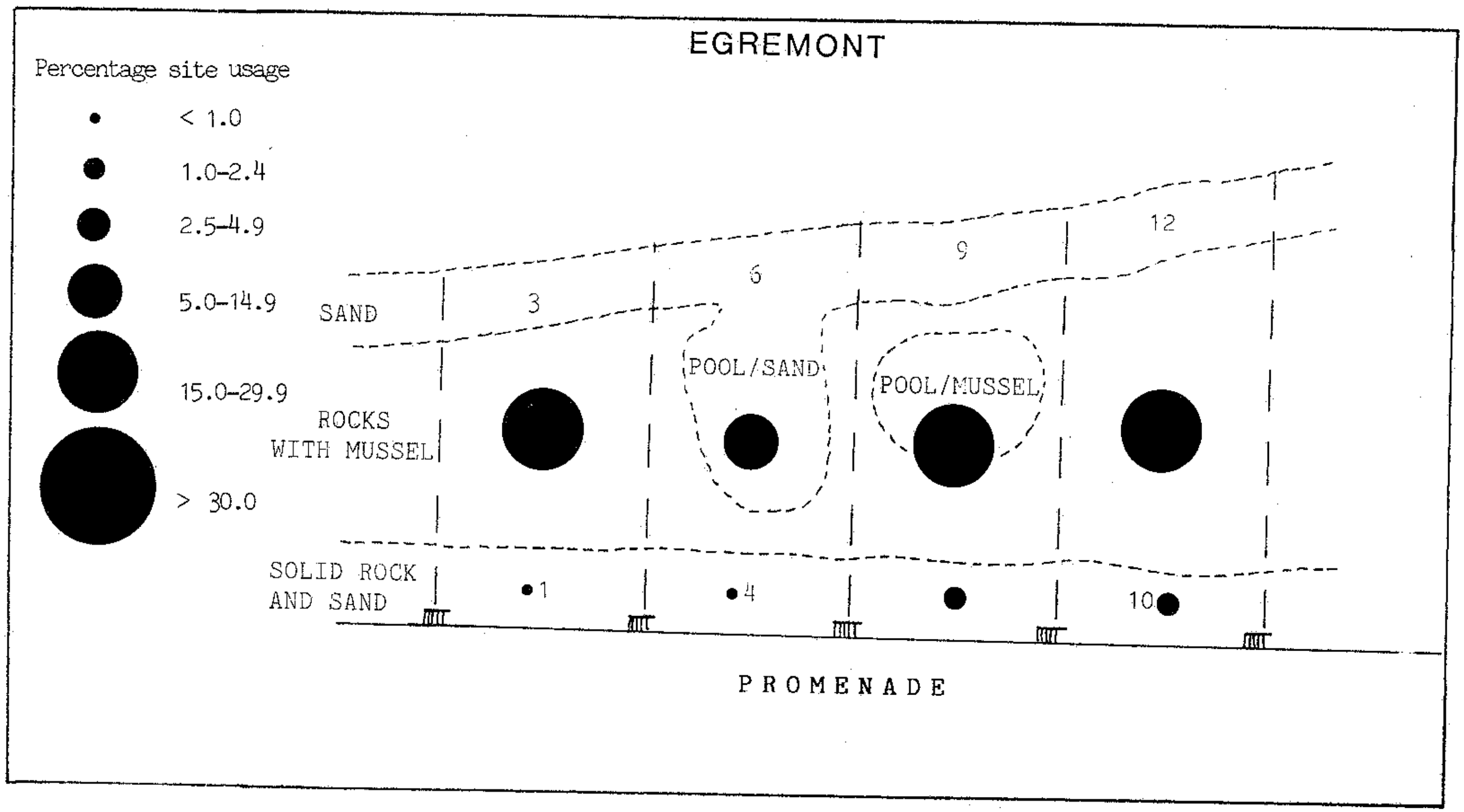


Figure 3.16.3 The distribution of feeding Turnstone at Egremont during the 1989/90 winter assessed from all day observations.

BTO

LIVERPOOOL BAY LOW TIDE COUNTS

OBSERVER: Jack Taylor DATE: 19 Nov 89 ESTUARY: ALT SECTION: D

LOW TIDE = 09:40

MUDFLAT CODE		85			86			88			89			87		
START AND END TIME		9-9:15			9:15-9:40			9:40-1000			1000-1010			1010-1015		
		Number Feeding	Number Roosting	Accuracy Code	Number Feeding	Number Roosting	Accuracy Code	Number Feeding	Number Roosting	Accuracy Code	Number Feeding	Number Roosting	Accuracy Code	Number Feeding	Number Roosting	Accuracy Code
OYSTERCATCHER	OC				160		1	125		1						
RINGED PLOVER	RP															
Golden Plover	GP															
GREY PLOVER	GV				17		1									
Lapwing	L															
KNOT	KN				525		2	160		2						
SANDERLING	SS				29		1	730		2						
DUNLIN	DN	13		1	1293		2	290		2						
BLACK-T GODWIT	BW															
BAR-T GODWIT	BA	8		1	146		1	71		1	1		1	3		1
CURLEW	CU	2		1	29		1	20		1						
REDSHANK	RK	94		1	95		1	135		1	4		1	12		1
TURNSTONE	TT															
Cormorant	C															
Grey Heron	HE															
BEWICK'S SWAN	BS															
PINK-FOOTED GSE	PG															
SHELDUCK	SU															
WIGEON	WN															
TEAL	T															
Mallard	MA															
PINTAIL	PT															
Shoveler	SV															
Goldeneye	GE															
SCAUP		4		1												

Appendix 1. Example of a completed low tide count sheet.

1 Please use a new sheet for each count. If you have more than five mudflats on your site, use two sheets and staple them together.

2 Please make all counts in the two hours either side of low tide, preferably as close to low tide as possible.

3 All counts should relate to the mudflats marked on your master map, using the codes given to each mudflat.

4 Note the number of birds feeding on the mudflat in the first column. Use the second column if the birds are definitely roosting (e.g. a roosting flock of Lapwing which you are sure are not feeding). Do NOT count flocks which are neither feeding nor roosting in the area but flighting through.

5 If you cannot count all the species present, please concentrate on the key species (shown in capitals) and put a 'P' for species present but not counted.

6 Always fill in an accuracy code for each species as follows:

- P Present but not counted.
- 1 Accurate count of individuals present
- 2 Estimated count but believed to be within 10 per cent (e.g. a flock which is moving too fast to be counted as individuals, but is clearly seen).
- 3 Estimated count considered to be approximate (e.g. a count of a flock in which many birds are continually out of view in ditches).
- 4 Order of magnitude only. Try not to use this code if possible.
- 5 Estimate by deduction made in the following circumstances. If you cannot count the lower mudflats, count the upper mudflats at low tide and again when all the birds are within counting range. Use the low tide counts for the upper mudflats and the difference between the two counts for the lower mudflats. (NB The lower flats should have an accuracy code of 5 but the upper mudflats a code between 1 and 3).

7 Send in your sheets after every count in the reply-paid envelopes provided.

Please tick one box on each line. 19 NOV AGD.

Visibility: Good ☑ Moderate ☐ Poor ☐

Did visibility affect the count? Yes ☐ No ☑

Rain: None ☑ Showers ☐ Light ☐ Heavy ☐

Wind: Light ☑ Moderate ☐ Strong ☐ Gale ☐

Glazing (ice) of mudflats:

None ☑ Only near high tide ☐ Moderate ☐ Total ☐

DISTURBANCE

Was there any disturbance to the feeding areas? Yes ☑ No ☐

Did the disturbance affect the count? Yes ☐ No ☑

Which mudflats were affected? ....

Please give the number of people in each category:

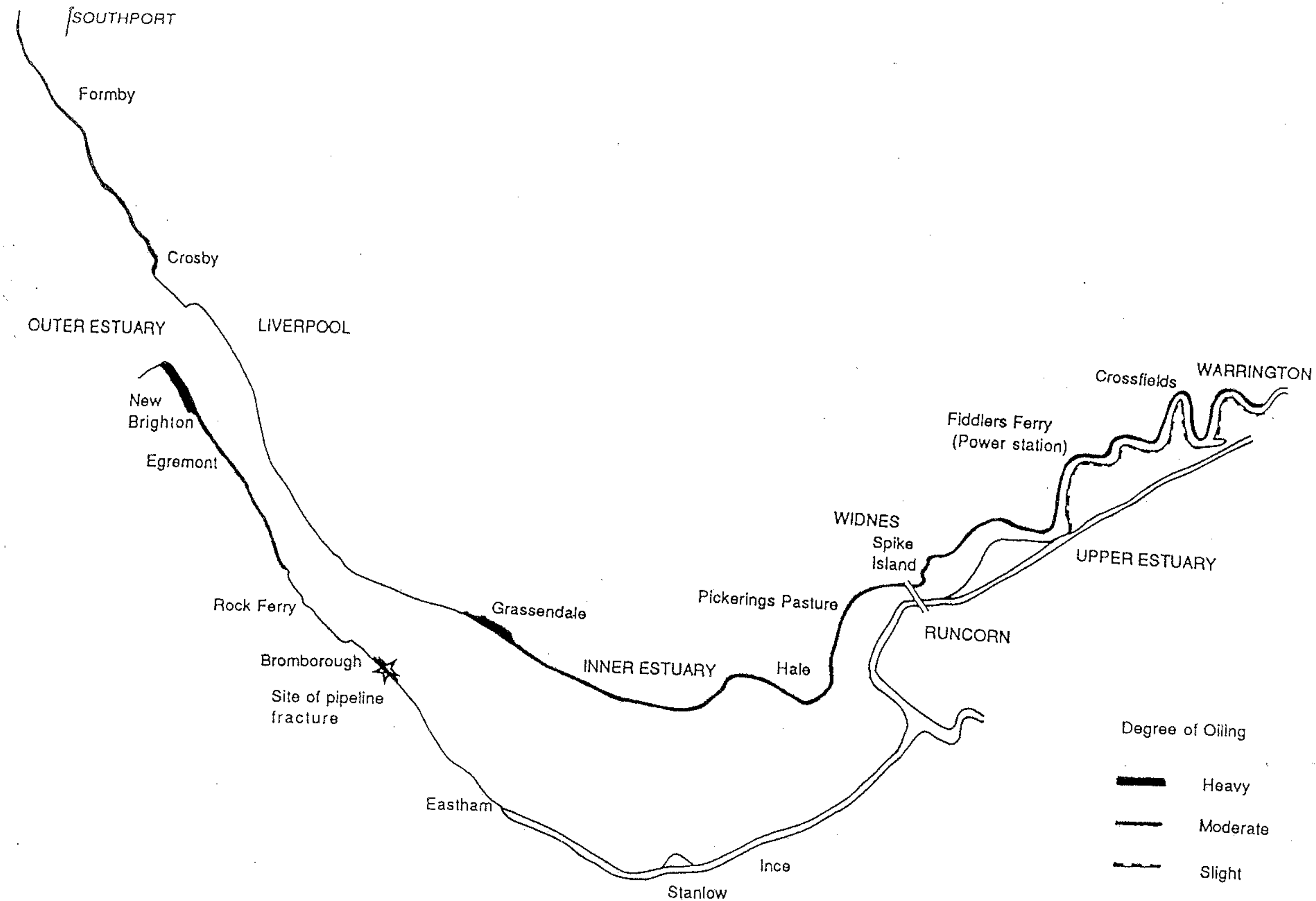
Walkers ☐ Dogs ☐ Fishermen ☐ Horse Riders ☐

Cocklers ☐ Bait Diggers [2] Wildfowlers ☐ Other ....

Birds of prey ☐ Species ....

COMMENTS

Appendix 1. (cont'd) Reverse side of a completed low tide count sheet.



Appendix 2 Area of coastline affected by stranding oil (from OPRU, 1990).