BTO Research Report No. 55

THE ABUNDANCE AND DISTRIBUTION OF WILDFOWL AND WADERS ON CARMARTHEN BAY (TAF/TYWI/GWENDRAETH)

by

R. P. Prys-Jones and P. E. Davis

A report from the British Trust for Ornithology
to the Nature Conservancy Council

March 1990

ABSTRACT

The report draws on information from the long-term Birds of Estuaries Enquiry (BoEE) monthly counts, from special studies carried out during winter 1987/88, from unpublished county records and from the available literature in order to provide a comprehensive assessment of current knowledge of the abundance and wintering distribution of wildfowl and waders throughout the Carmarthen Bay estuarine system.

The intertidal bird fauna of the Carmarthen Bay BoEE site is possibly less well documented than that of almost any other large estuarine area in Britain. The episodic, unstandardized and incomplete nature of BoEE counting at this site over the years makes reliable assessment of the regular wintering population difficult and precludes useful analysis of passage populations. Even for the winter period, most data relate to the estuaries of the Taf, Tywi and Gwendraeth, (the "Three Rivers") with only very sparse information from the contiguous sandy beaches of Pendine Sands and Cefn Sidan.

Comparison of winter BoEE counts for the Taf, Tywi and Gwendraeth from the early 1970s and mid 1980s suggests only limited changes in populations present, with Oystercatchers apparently having declined on the Taf and probable increases having occurred in Shelduck and Redshank numbers on the Tywi/Gwendraeth. The most notable intertidal bird population currently regularly wintering within the Three Rivers is a nationally important one of Oystercatcher. The area has a further significance as a cold weather refuge for certain species, e.g. Wigeon. Cefn Sidan regularly supports a nationally important wintering population of Sanderling and, on occasion, nationally important numbers of Bar-tailed Godwit, although these latter birds probably only appear episodically from the neighbouring Burry Inlet. Overall, the Carmarthen Bay BoEE site probably supports a regular wintering population of about 1,500 wildfowl and 12,500 waders, the latter total well exceeding the 10,000 required for national importance. The Sanderling population is probably the second largest on any U.K. estuarine site, and more comprehensive counting might well reveal it to be of international importance. Another species for which Carmarthen Bay is particularly important, the Common Scoter, predominantly occurs offshore and so was not covered in the present study.

The special studies in winter 1987/88 revealed that most of the Carmarthen Bay site is important for one or more of the species present, making it difficult to single out discrete areas as being of especial conservation significance. Two areas worthy of particular mention, however, are the importance of Salmon Point Scar, at the junction of the Tywi and Gwendraeth, for Oystercatcher in particular and of Cefn Sidan and, probably, Pendine Sands for Sanderling. Treatment of the entire site as a single unit for conservation purposes would appear desirable, as there is undoubtedly considerable interchange of their bird populations; some birds may also treat the site as a complex with the Burry Inlet.

CONTENTS

		Page
	ABSTRACT	
	CONTENTS	
1.	INTRODUCTION	1
2.	AIMS	3
3.	STUDY AREA AND METHODS	4
4.	POPULATIONS PRESENT IN WINTER	8
	4.1 THE CONCEPTS OF NATIONAL AND INTERNATIONAL IMPORTANCE	8
	4.2 THE TAF	8
	4.3 THE TYWI/GWENDRAETH	12
	4.4 CEFN SIDAN	13
	4.5 OVERALL IMPORTANCE OF THE CARMARTHEN BAY SITE	13
5.	INTRA-SITE SPECIES DISTRIBUTION PATTERNS	18
	5.1 SHELDUCK	18
	5.2 WIGEON	18
	5.3 TEAL	18
	5.4 MALLARD	18
	5.5 RED-BREASTED MERGANSER	22
	5.6 OYSTERCATCHER	22
	5.7 RINGED PLOVER	22
	5.8 GREY PLOVER	22
	5.9 LAPWING	22
	5.10 KNOT	22
	5.11 SANDERLING	22
	5.12 DUNLIN	27

Page

5.13 BLACK-TAILED GODWIT 27

5.14 BAR-TAILED GODWIT 27

5.15 CURLEW 27

5.16 REDSHANK 27

5.17 TURNSTONE 27

6. SYNTHESIS AND CONCLUSIONS 32

7. ACKNOWLEDGMENTS 33

8. REFERENCES 34

9. APPENDICES 35

List of Figures

Figure No.		Page
1.1	The Carmarthen Bay BoEE site, showing its current protection by means of three Sites of Special Scientific Interest.	2
3.1	The Carmarthen Bay BoEE site, showing place names mentioned in the text.	5
3.2	Count sectors adopted for the special studies in winter 1987/88.	7
5.1	Average usage of each count sector by Shelduck during winter 1987/88, expressed as a percentage of overall site usage by the species.	19
5.3	Average usage of each count sector by Teal during winter 1987/88, expressed as a percentage of overall site usage by the species.	20
5.4	Average usage of each count sector by Mallard during winter 1987/88, expressed as a percentage of overall site usage by the species.	21
5.6	Average usage of each count sector by Oystercatcher during winter 1987/88, expressed as a percentage of overall site usage by the species.	23
5.9	Average usage of each count sector by Lapwing during winter 1987/88, expressed as a percentage of overall site usage by the species.	24
5.10	Average usage of each count sector by Knot during winter 1987/88, expressed as a percentage of overall site usage by the species.	25
5.11	Average usage of each count sector by Sanderling during winter 1987/88, expressed as a percentage of overall site usage by the species.	26
5.12	Average usage of each count sector by Dunlin during winter 1987/88, expressed as a percentage of overall site usage by the species.	28
5.14	Average usage of each count sector by Bar-tailed Godwit during winter 1987/88, expressed as a percentage of overall site usage by the species.	29

Page

5.15 Average usage of each count sector by Curlew during winter 1987/88, expressed as a percentage of overall site usage by the species. 30

5.16 Average usage of each count sector by Redshank during winter 1987/88, expressed as a percentage of overall site usage by the species. 31

List of Tables

Table No.		Page
4.1	Qualifying levels for national and international importance.	9
4.2	Estimates of intertidal bird populations present in winter (Nov-Mar) on the Taf estuary.	10
4.3	Estimates of intertidal bird populations present in winter (Nov-Mar) on the Tywi and Gwendraeth estuaries.	11
4.4	Highest monthly average counts from the special 1987/88 winter studies for Cefn Sidan and for Cefn Sidan and Tywi/Gwendraeth combined.	14
4.5	Estimates of intertidal waterfowl populations present in winter on the overall Carmarthen Bay site, based on BoEE counts and the special 1987/88 studies.	16

List of Appendices

Appendix No.		Page
9.1	Peak counts for each sector recorded during the special studies, November 1987 to February 1988.	35
9.2	Average counts for each sector recorded during the special studies, November 1987 to February 1988.	36
9.3	Scientific names of species mentioned in the text.	37
9.4	Average monthly BoEE counts in winter (November-March) for the period November 1982 to November 1987 on the Taf and Tywi/Gwendraeth.	38
9.5	Monthly average counts for the Taf and the Tywi/Gwendraeth from the special studies carried out between November 1987 and February 1988.	39
9.6	Monthly peak counts for the Taf and the Tywi/Gwendraeth from the special studies carried out between November 1987 and February 1988.	40
9.7	Monthly counts for Cefn Sidan from the special studies carried out between November 1987 and March 1988.	41

1. INTRODUCTION

The intertidal bird fauna of the estuaries of the Taf, Tywi and Gwendraeth (51.45N, 4.25W), which together with the contiguous sandy shores of Cefn Sidan and Pendine Sands comprise the Carmarthen Bay Birds of Estuaries Enquiry (BoEE) site, is possibly less well documented than that of almost any other large estuarine area in Britain. This is in spite of the fact that the nature conservation importance of the system has been clearly recognized. The intertidal flats, marsh and dunes of Tywyn Gwendraeth on the south side of the Gwendraeth estuary were designated as a grade 2 Nature Conservation Review site by Ratcliffe (1977). Figure 1.1 outlines the system's current protection by means of three Sites of Special Scientific Interest (SSSI). A fourth SSSI, Marros-Pendine coast, is adjacent to the western end of the system, and a fifth SSSI, Burry Inlet, is adjacent to its eastern end. Proposals are currently in hand to extend the current Laugharne Burrows SSSI into a Pendine and Laugharne Burrows SSSI which will be separated from the Marros-Pendine coast SSSI only by Pendine village beach.

The present report has been produced in the light of the nature conservation importance of the system, the lack of readily available, up-to-date information on its bird populations, and the increasing threat to it of potential developments. It is aimed at providing a baseline of information regarding the recent abundance and distribution of the wader and wildfowl populations present, on which more detailed studies commissioned in relation to specific development proposals may be grounded.

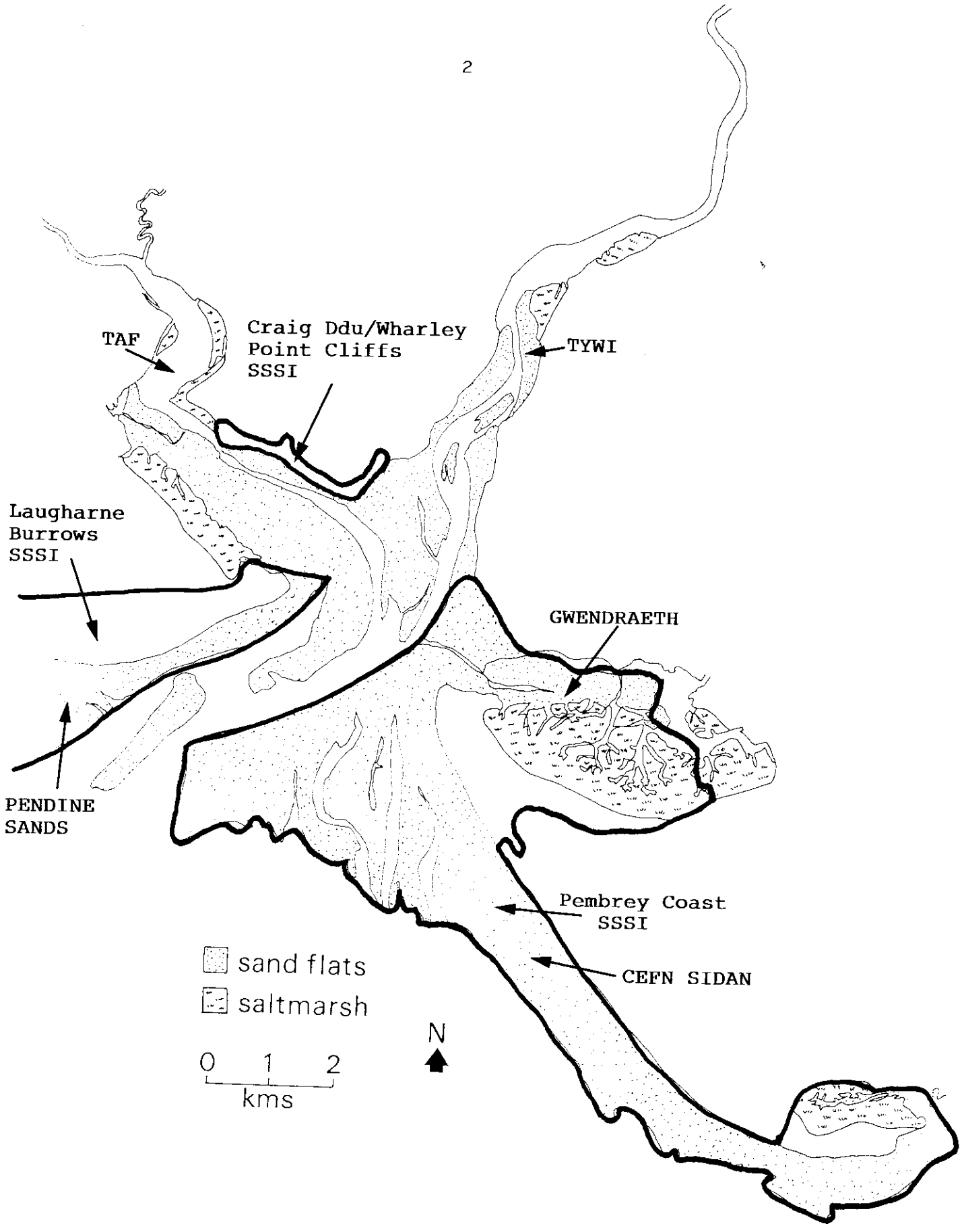

Figure 1.1 The Carmarthen Bay BoEE site, showing its current protection by means of three Sites of Special Scientific Interest. The western end of Pendine Sands, including Gilman Point and Witchett Pool, is omitted (see text).

2. AIMS

The study had three major aims:

i) To analyse available recent BoEE data in order to provide a baseline of information on the wintering populations of wildfowl and waders present on the Carmarthen Bay site.

ii) To evaluate patterns of usage of key intertidal areas of the Carmarthen Bay site by wildfowl and waders during winter 1987/88.

iii) To synthesize the information obtained to provide an assessment of the conservation importance of the Carmarthen Bay site to wildfowl and waders.

3. STUDY AREA AND METHODS

The episodic, unstandardized and incomplete nature of BoEE counting on the Carmarthen Bay site over the years makes reliable assessment of its regular wintering bird populations extremely difficult. A number of approaches are therefore used in the present report, the relative merits of which are discussed as appropriate. A necessary precursor, however, to any consideration of the available counts is definition of the optimal area which they should in theory encompass. Prater (1981) has provided an overview of the physical and biological characteristics of the site, and key places within it mentioned in the text below are mapped on Figure 3.1.

To their east, the estuaries of the Taf, Tywi and Gwendraeth are linked to the Burry Inlet BoEE site by the long, wide, sandy beach of Cefn Sidan; there is thus no natural boundary of rocky, open coast separating these two systems. BoEE coverage of the south-west corner of this linking area, comprising the creeks and marsh of Pembrey Burrows west to the coastguard lookout (51.41N, 4.17W), has traditionally been as part of the Burry Inlet counts. The practical utility of this approach has recently been underwritten by the incorporation of Pembrey Burrows into the proposed Burry Inlet Ramsar/SPA site, and consideration of its bird populations was included in a recent comprehensive review of waterfowl abundance and distribution on the Burry Inlet (Prys-Jones *et al.* 1989). This therefore provides a convenient boundary between the sites, although clearly leaving open the question as to whether on ornithological grounds it might be better to treat Burry Inlet and Carmarthen Bay as a single system; this point will be returned to in the Synthesis and Conclusions chapter. The remainder of Cefn Sidan, north-west from the coastguard lookout, thus falls within the Carmarthen Bay site, but in practice only the roosting birds at its northern tip, Tywyn Point, have been included in BoEE counts, and even these are normally counted from the north bank of the Gwendraeth.

At its western end, a less ambiguous boundary to the Carmarthen Bay site is provided by the western end of Pendine Sands at Gilman Point (51.44N, 4.33W); this is the western extremity of a continuous, wide, sandy beach stretching from the mouth of the Taf. In practice, however, the area west of Ginst Point at the mouth of the Taf has very seldom been included in BoEE counts due both to problems of access and lack of counters. It was also not covered in the special studies in winter 1987/88 (see below) and has therefore been omitted from the maps included in this report to save space.

BoEE counts are usually made near to high tide on a weekend date near the middle of each month chosen to coincide with spring tides. Full details of general BoEE methodology and the rationale behind it are provided by Prater (1981). Winter (November-March) coverage of even the central "Three Rivers" part of the Carmarthen Bay site, *i.e.* the Taf, Tywi and Gwendraeth estuaries between Ginst Point in the west and Tywyn Point in the east, has however been very erratic. On both the Taf and Tywi, counting during the 1970s was confined almost entirely to 1969/70 and 1970/71; on the Gwendraeth, additional coverage was achieved in 1974/75 and 1975/76. During the 1980s, the Taf was covered from 1982/83 to 1986/87 inclusive, although not necessarily comprehensively and not at all in some winter months; coverage of both the Tywi and the Gwendraeth was restricted to 1986/87, however. The only months during the 1980s when essentially complete coverage of the Taf,

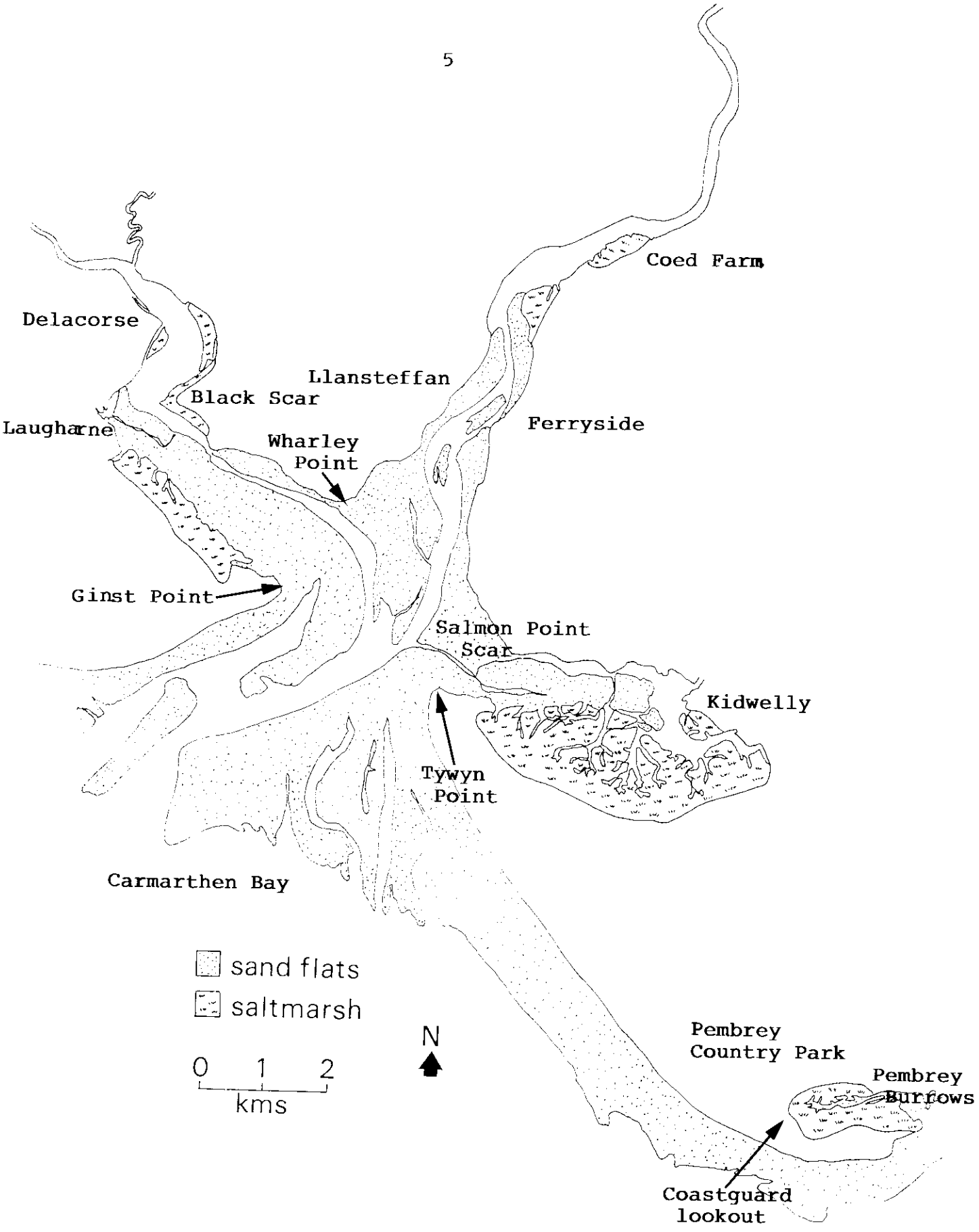

Figure 3.1 The Carmarthen Bay BoEE site, showing place names mentioned in the text. The western end of Pendine Sands, including Gilman Point and Witchett Pool, is omitted (see text).

Tywi and Gwendraeth estuaries was achieved were November 1986 and 1987 and March 1987.

A counters' meeting was organized in May 1987 in Llanelli with the aim of placing counting at the site on a consistent and comprehensive basis for the future. Unfortunately, however, no standard BoEE count data at all have been submitted to the BTO for any month after November 1987, although some level of counting effort has continued since then. D. Roberts (in litt.) has kindly made available estuaries data from the Carmarthenshire county records for the period December 1987 to December 1988 inclusive, but these are largely uncoordinated counts and sightings and as such must be interpreted with care. Renewed attempts at BoEE count organization in 1989 will hopefully ensure future coverage from the start of 1990.

During winter 1987/88, a programme of special studies on the bird populations of the Taf, Tywi and Gwendraeth estuaries was organized by the BTO Estuaries Unit and carried out by Peter Davis of the NCC Wales Field Unit. The Taf was divided into five sectors (A-E on Figure 3.2) and the Tywi/Gwendraeth into six (F-K on Figure 3.2). Few birds were present in the intervening gap to the south-east of Wharley Point (P. Davis, pers. obs.). Each estuary was counted on at least 10 days spread between the start of November and the end of February with, on average, two counts being made per sector per day. The great majority of counts were conducted during low tide, i.e. from four hours before low water until four hours after (cf. Prys-Jones et al. 1989), and thus provided information not only on numbers of intertidal birds present but also on patterns of estuarine use by the various species. In addition, Cefn Sidan was split into four sectors (L-O on Figure 3.2) and an effort made to obtain monthly low tide counts for these from November 1987 to March 1988 inclusive. Access to sector L, lying within an RAF bombing range, posed a particular problem and coverage of it was only achieved on three occasions. Breakdowns of the peak and average counts recorded for each species in each sector are provided in Appendices 9.1 and 9.2 respectively.

In Chapter 4, assessment is made of the winter population sizes of waterfowl species within the Carmarthen Bay site. Comparison is made of population estimates from BoEE counts conducted in the early 1970s and mid 1980s, and the recent BoEE data also compared with information derived from the special winter 1987/88 studies and from the 1987/88 county records. Offshore sea duck, notably Common Scoter, are excluded as neither the BoEE counts nor the special studies could adequately cover them. All assessment from BoEE coverage of recent winter populations is made using highest average monthly counts, as used by Prater (1981), based on all 1980s data, rather than the normal current practice of using average peak winter counts over the most recent five-year period (outlined in Salmon et al. 1989). Under most circumstances, the latter technique results in slightly higher population estimates, probably better approximating the average maximum usage of a site (see Prater 1981, pp 129-130, for discussion of this point). However, because the Taf, Tywi and Gwendraeth estuaries have been completely covered in only three BoEE counts during the 1980s, in each case at the beginning or end of a winter when populations tend to be lower than in mid winter, use of average peak winter counts results in an artificially low overall population estimate. This point is elaborated on in Chapter 4.

Scientific names of all species are given in Appendix 9.3.

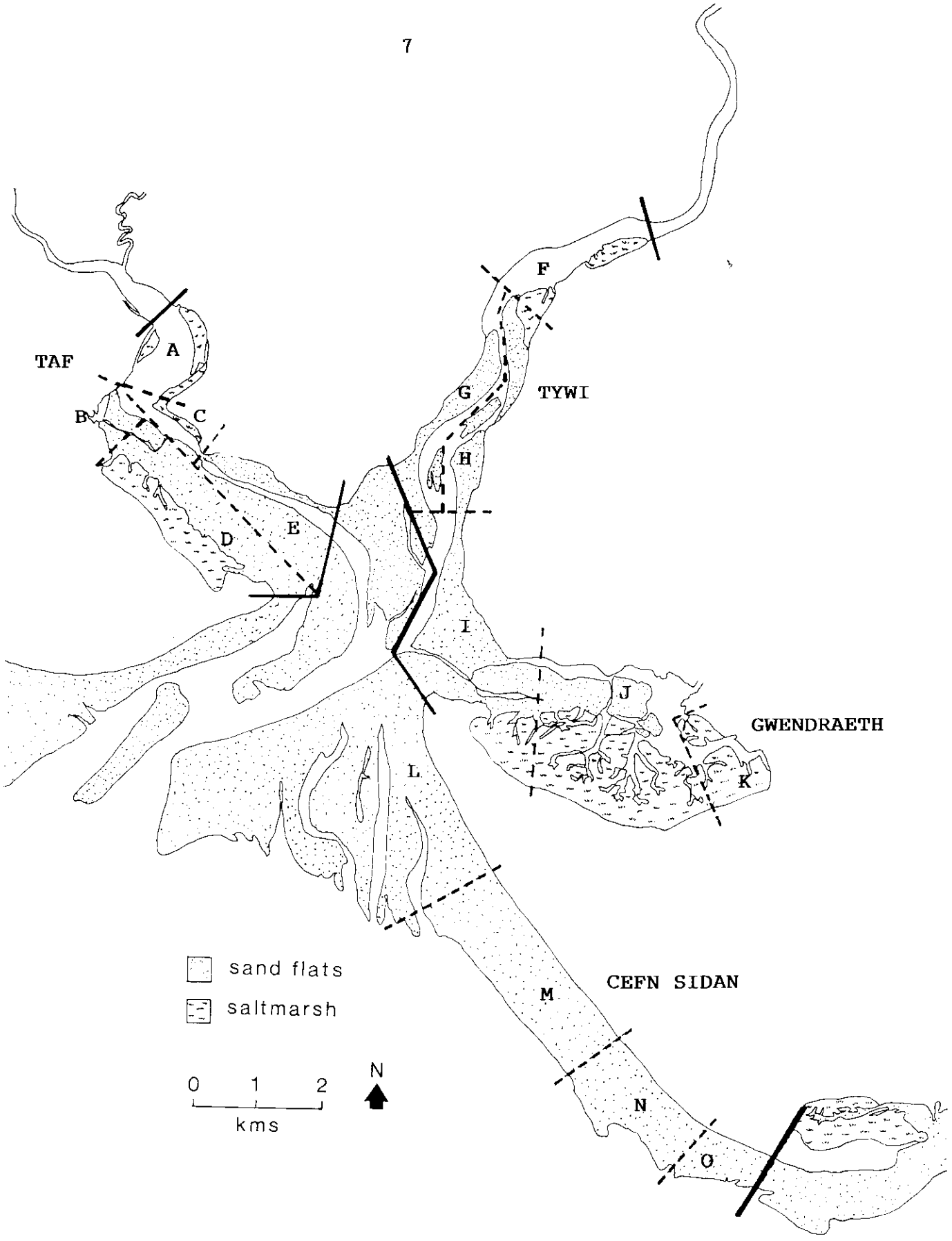

Figure 3.2 Count sectors adopted for the special studies in winter 1987/88.

4. POPULATIONS PRESENT IN WINTER

4.1 THE CONCEPTS OF NATIONAL AND INTERNATIONAL IMPORTANCE

Criteria for international importance have been agreed by the Contracting Parties to the Ramsar Convention. Under one criterion, a wetland is considered internationally important if it regularly holds 1% of the individuals in a population of one species or subspecies of waterfowl, while any site regularly holding a total of 20,000 or more waterfowl (wildfowl and waders) also qualifies (Ramsar Convention Bureau 1988). Britain's wildfowl belong to the north-west European population (Pirot et al. 1989) and the waders to the east Atlantic flyway population (Smit & Piersma 1989). A wetland in Britain is considered nationally important if it regularly holds 1% of the estimated British population of one species or subspecies of waterfowl, while any site holding a total of 5,000 or more wildfowl or 10,000 or more waders also qualifies (Prater 1981). The currently accepted national and international qualifying levels used in this report are taken from Salmon et al. (1989) and summarized in Table 4.1. These criteria relate to numerical importance, which is most relevant to the present report; there are, of course, additional reasons why a site may be nationally or internationally important.

4.2 THE TAF

Table 4.2 summarises estimates of the waterfowl populations regularly present on the Taf in winter during the early 1970s (from BoEE counts), the mid 1980s (from BoEE counts) and in winter 1987/88 (from the special studies), as well as giving peak recorded winter counts for the period between November 1987 and December 1988 (from the special studies and county records). Monthly breakdowns of the 1980s' BoEE data and of both average and peak counts derived from the 1987/88 special studies are provided in Appendices 9.4, 9.5 and 9.6 respectively.

Wildfowl population estimates for the early 1970s and mid 1980s are similar, but the estimated wader population of ca 3,300 birds on the Taf in the mid 1980s is less than half that of the early 1970s (Table 4.2). Almost all of this decline can be accounted for in terms of substantially lower population estimates for just three species, Oystercatcher, Golden Plover and Lapwing. Oystercatchers on the Taf are largely dependent on cockles from the beds on the lower west side of the estuary, whereas on the Tywi/Gwendraeth, where no major decline is apparent (Table 4.3), they depend largely on mussels (Prater 1981). Cockles tend to be an intrinsically more variable resource than mussels, and a decline in their overall availability may have occurred on the Taf although no published evidence exists regarding this. The winter 1987/88 studies revealed a peak feeding population on the Taf of just over 1,600 Oystercatchers although the highest average monthly population present was under 1,000 (Table 4.2), and no counts exceeding 1,300 are available from county records for the period December 1987 to December 1988. Overall, the evidence supports a real decline having occurred in the Taf Oystercatcher population, but for unknown reasons.

The apparent declines in Golden Plover and Lapwing populations are much more

Table 4.1 Qualifying levels for national and international importance.

	National (G.B.)	International
Mute Swan	180	1,800
Whooper Swan	60	170
Greylag Goose	1,000	1,000
Dark-bellied Brent Goose	900	1,700
Shelduck	750	2,500
Wigeon	2,500	7,500
Teal	1,000	4,000
Mallard	5,000	20,000**
Pintail	250	700
Shoveler	90	400
Pochard	500	3,500
Common Scoter	350	8,000
Goldeneye	150	3,000
Red-breasted Merganser	100	1,000
Oystercatcher	2,800	9,000
Avocet	5*	700
Ringed Plover	230	500
Golden Plover	2,000	10,000
Grey Plover	210	1,500
Lapwing	10,000	20,000**
Knot	2,200	3,500
Sanderling	140	1,000
Purple Sandpiper	160	500
Dunlin	4,300	14,000
Ruff	15*	10,000
Snipe	?	10,000
Black-tailed Godwit	50	700
Bar-tailed Godwit	610	1,000
Whimbrel	+	700
Curlew	910	3,500
Spotted Redshank	2*	?
Redshank	750	1,500
Greenshank	4*	?
Turnstone	450	700

\+ British population too small for meaningful figure to be obtained.

* Where 1% of the British wintering population is less than 50 birds, 50 is normally used as a minimum qualifying level for national importance.

** A site regularly holding more than 20,000 waterfowl qualifies as internationally important by virtue of the absolute numbers.

Table 4.2 Estimates of intertidal bird populations present in winter (Nov-Mar) on the Taf estuary.

	Highest average monthly BoEE count, Nov 1969-Mar 1976 *	Highest average monthly BoEE count, Nov 1982-Nov 1987	Highest monthly average count from special studies, Nov 1987-Feb 1988	Peak winter co between Nov 19 and Dec 1988 *
Mute Swan	1	0	0	-
Whooper Swan	0	1	0	12
White-fronted Goose	4	0	0	21
Greylag Goose	1	6	0	12
Canada Goose	0	0	0	13
Barnacle Goose	0	0	0	50
Brent Goose	0	1	0	-
Shelduck	170	153	158	200
Wigeon	125	160	0	1,000
Gadwall	0	0	0	14
Teal	1	8	58	119
Mallard	180	177	448	599
Pintail	70	12	0	6
Shoveler	4	0	0	50
Eider	3	0	0	-
Long-tailed Duck	1	0	0	3
Common Scoter	2	4	0	+
Goldeneye	0	0	1	2
Red-breasted Merganser	2	8	4	10
Total wildfowl:	564	530	665	
Oystercatcher	2,204	673	966	1,610
Ringed Plover	23	31	5	36
Golden Plover	2,000	1,250	0	3,000
Grey Plover	3	11	0	14
Lapwing	2,525	425	472	900
Knot	0	2	0	-
Sanderling	0	1	0	-
Dunlin	435	301	40	350
Snipe	32	14	1	-
Black-tailed Godwit	10	3	0	16
Bar-tailed Godwit	9	9	0	43
Curlew	303	333	202	322
Spotted Redshank	0	0	0	3
Redshank	121	252	370	510
Greenshank	4	0	1	-
Green Sandpiper	0	0	1	2
Common Sandpiper	0	0	1	-
Total waders:	7,669	3,305	2,059	
Total waterfowl:	8,233	3,835	2,724	

* From Prater & Rowe (1978), with additional information from Prater (1981).

** From the special studies and county records.

\+ Large numbers (>1,000) of Common Scoter present at times offshore not included.

Table 4.3 Estimates of intertidal bird populations present in winter (Nov-Mar) on the Tywi and Gwendraeth estuaries.

	Highest average monthly BoEE count, Nov 1969-Mar 1976 *	Highest average monthly BoEE count, Nov 1982-Nov 1987	Highest monthly average count from special studies, Nov 1987-Feb 1988	Peak winter co between Nov 19 and Dec 1988 *
Mute Swan	2	1	0	0
Bewick's Swan	0	0	0	8
White-fronted Goose	4	0	0	-
Greylag Goose	0	0	0	21
Brent Goose	0	2	0	50
Shelduck	45	389	130	144
Wigeon	250	200	44	1,000
Gadwall	0	0	0	2
Teal	100	90	120	238
Mallard	300	234	48	300
Pintail	5	4	0	-
Shoveler	20	3	0	1
Pochard	1	7	0	1
Scaup	1	0	0	19
Eider	50	0	0	20
Long-tailed Duck	0	0	0	1
Common Scoter	3	1	0	127
Goldeneye	3	1	0	3
Red-breasted Merganser	50	22	6	12
Goosander	0	0	0	4
Total wildfowl:	834	954	348	
Oystercatcher	2,559	2,713	1,809	2,574
Ringed Plover	65	34	15	250
Golden Plover	475	550	0	-
Grey Plover	21	49	5	17
Lapwing	1,697	1,264	825	1,700
Knot	86	136	0	-
Sanderling	250	70	1	0
Curlew Sandpiper	1	0	0	-
Purple Sandpiper	0	0	0	1
Dunlin	2,337	1,668	456	2,000
Ruff	5	1	0	-
Jack Snipe	1	1	0	-
Snipe	20	42	0	-
Black-tailed Godwit	9	4	19	38
Bar-tailed Godwit	99	525	164	300
Curlew	308	414	201	324
Spotted Redshank	4	3	0	1
Redshank	264	441	250	402
Greenshank	18	5	2	4
Green Sandpiper	2	4	0	-
Common Sandpiper	1	1	0	3
Turnstone	164	63	19	70
Total wildfowl:	8,386	7,988	3,766	
Total waterfowl:	9,220	8,942	4,114	

* From Prater & Rowe (1978), with additional information from Prater (1981).
** From the special studies and county records.

equivocal. Winter movements of both species within Britain are strongly influenced by prevailing weather patterns (Salmon et al. 1988), and their numbers at any site tend thus to be highly variable. In addition, both species are largely dependent on saltmarsh and fields adjacent to estuaries, rather than on the intertidal flats themselves, and are thus particularly prone to alterations in population estimates resulting from differences in counting technique. Thus the special winter 1987/88 studies, focused strictly on the intertidal area, failed to record Golden Plover, which tend to concentrate on marshy fields inside the seawall along the west side of the Taf; this omission very largely accounts for the discrepancy between the special studies and recent BoEE counts in estimates of the total wader population of the Taf (Table 4.2). A count of 3,000 Golden Plover near Ginst Point in early December 1988 further indicates that no long-term decline is probable for this species.

The populations present of certain other species are clearly not adequately revealed by BoEE counts as conducted to date. One of these is the Wigeon, whose regular low wintering population may be massively augmented for short periods, in particular as a result of severe weather, a feature also true of the neighbouring Burry and Cleddau estuarine systems (Prys-Jones 1989, Prys-Jones et al. 1989). An influx of about 2,000 Wigeon occurred at Black Scar in late January 1987 following hard weather (D. Stacey, in litt.), and about 1,000 were present at Delacorse in December 1987 (Table 4.2); no BoEE counts were conducted on the Taf in either of these months. Another under-recorded species is the Mallard, for which the low tide studies in winter 1987/88 reveal a population more than double that from the recent BoEE counts. This probably results from the tendency of the species to move over the seawall onto marshy fields along the west side of the Taf at high tide (P. Davis, pers.obs.).

4.3 THE TYWI/GWENDRAETH

Table 4.3 summarises estimates of the waterfowl populations regularly present on the Tywi/Gwendraeth in winter during the early 1970s (from BoEE counts), the mid 1980s (from BoEE counts) and in winter 1987/88 (from the special studies), as well as giving peak recorded winter counts for the period between November 1987 and December 1988 (from the special studies and county records). Monthly breakdowns of the 1980s' BoEE data and of both average and peak counts derived from the 1987/88 special studies are provided in Appendices 9.4, 9.5 and 9.6 respectively.

As assessed by BoEE counts, overall winter waterfowl population levels on the Tywi/Gwendraeth have changed little between the early 1970s and mid 1980s (Table 4.3); however, as the latter data very largely derive from a single winter, 1986/87, this conclusion must be treated with considerable caution. Notable increases are apparent for Shelduck, Bar-tailed Godwit and Redshank, whereas substantial declines are indicated for species such as Sanderling and Dunlin. Little weight should be attached to the changes in the Bar-tailed Godwit and Sanderling totals, however, as both are likely to be a consequence of episodic influxes from the Burry Inlet and Cefn Sidan (see section 4.4).

The substantially lower overall numbers of waterfowl recorded on the Tywi/Gwendraeth by the special 1987/88 winter studies relative to the recent

BoEE counts (Table 4.3) are largely a methodological artefact. As was noted for the Taf data, only the BoEE counts include birds, notably Golden Plover and Snipe, which occur on fields adjacent to the estuary. In addition, however, birds recorded on the Tywi/Gwendraeth BoEE counts at the Tywyn Point roost include many individuals, in particular of Oystercatcher, Dunlin and Bar-tailed Godwit, which probably feed along Cefn Sidan. This point is considered further in section 4.4 below.

As on the Taf, occasional influxes of Wigeon occur on the Tywi/Gwendraeth, with 1,000 off Llansteffan in mid December 1988 being the largest recent total (Table 4.3). Sightings of up to 50 Brent Geese and 20 Eider at the Salmon Point mussel scar, again in December 1988, almost certainly represent influxes from the larger populations which are regularly present at the western end of the Burry Inlet (Prys-Jones et al. 1989). Likewise, the 127 Common Scoter seen off Llansteffan in mid January 1988 must have resulted from a short-term movement into the estuarine area from the population of some thousands regularly present in winter out on the sea in Carmarthen Bay.

4.4 CEFN SIDAN

Table 4.4 presents peak monthly totals of birds present during the low tide counts along Cefn Sidan between November 1987 and March 1988. A monthly breakdown of the available counts is provided in Appendix 9.7. Excluding the large numbers of Common Scoter, which are generally well offshore and cannot be adequately assessed by land-based observers, few wildfowl are present, but about 5,000 waders forage along the shore. Among these are particularly notable totals of Sanderling and Bar-tailed Godwit, although the dependency of these two species on the area in fact differs markedly. Bar-tailed Godwit numbers only uncommonly exceed 200 birds (Davis 1984), similar to the population frequently present on the Tywi/Gwendraeth and possibly the same birds. The peak count of over 600 birds noted in December 1987 therefore very probably represents an influx of the population from the neighbouring Burry Inlet, where Bar-tailed Godwit are known to be "mobile and unpredictable in their occurrence at low tide" (Prys-Jones et al. 1989). By contrast, a very substantial Sanderling population is clearly resident along Cefn Sidan throughout the winter, with peak numbers of 1,000 or more on occasion (Davis 1984, Morgan n.d.).

Also shown on Table 4.4 are highest monthly average counts from the 1987/88 winter studies for Cefn Sidan and the Tywi/Gwendraeth combined (sectors F-O inclusive on Figure 3.2). Comparison of these with the recent Tywi/Gwendraeth BoEE data presented in Table 4.3 implies strongly that most of the Oystercatcher, Dunlin and Bar-tailed Godwit that feed along Cefn Sidan move to Tywyn Point to roost, where they are included in BoEE counts, but that many of the Knot and Sanderling appear not to do so.

4.5 OVERALL IMPORTANCE OF THE CARMARTHEN BAY SITE

Two independent estimates of the waterfowl population regularly wintering on the Carmarthen Bay site can be made from the available data. One draws on the merged 1980s' BoEE data for the Taf and Tywi/Gwendraeth which, as indicated above (section 4.4), appear to include a substantial proportion of

Table 4.4 Highest monthly average counts from the special 1987/88 winter studies for Cefn Sidan and for Cefn Sidan and Tywi/Gwendraeth combined.

	Cefn Sidan	Cefn Sidan and Tywi/Gwendraeth combined
Shelduck	0	130
Wigeon	0	44
Teal	0	120
Mallard	23	48
Goldeneye	0	0
Red-breasted Merganser	17	21
Total wildfowl:	40	363
Oystercatcher	1,800	2,697
Ringed Plover	0	15
Grey Plover	20	25
Lapwing	0	825
Knot	600	600
Sanderling	675	675
Dunlin	1,285	1,625
Snipe	0	0
Black-tailed Godwit	0	19
Bar-tailed Godwit	612	627
Curlew	4	201
Spotted Redshank	0	0
Redshank	0	250
Greenshank	0	2
Green Sandpiper	0	0
Common Sandpiper	0	0
Turnstone	0	19
Total waders:	4,996	7,580
Total waterfowl:	5,036	7,943

NB Large numbers (>1,000) of Common Scoter present at times offshore not included.

the birds which feed along Cefn Sidan. The other makes use of the special 1987/88 winter studies on the Taf, Tywi/Gwendraeth and Cefn Sidan combined. Both estimates will be minima because they entirely lack data from Pendine Sands, to the west of the Taf, and from Witchett Pool, a natural dune-slack pool present in Laugharne Burrows about 200m inland of Pendine Sands. Table 4.5 summarises the results. Agreement as regards the overall waterfowl population is encouragingly close, with the discrepancy of ca 1,250 birds being largely accountable in methodological terms. The BoEE counts omit ca 600 Sanderling and 450 Knot present on Cefn Sidan, whereas the 1987/88 studies missed the Golden Plover (1,800) and probably some Curlew (ca 350) utilizing marsh and fields adjacent to the intertidal area. Correcting the totals accordingly implies that the Carmarthen Bay site regularly supports about 1,350 wildfowl and 11,500 waders in winter, exclusive of birds present on Pendine Sands and Witchett Pool.

For reasons already mentioned in Chapter 3, the wader population estimate presented here from recent BoEE counts is substantially greater than that of 6,711 birds published in Salmon et al. (1989). The present estimate is clearly the more reliable one, as the "standard" technique fails to cope adequately with the episodic and incomplete data sets available. The Carmarthen Bay site is thus clearly of national importance in terms of its overall numbers of waders, holding substantially in excess of the 10,000 qualifying level. In addition, it certainly supports nationally important populations of Oystercatcher and Sanderling (Table 4.5). By contrast, the regular occurrence of Bar-tailed Godwit in numbers exceeding the appropriate qualifying level is more doubtful, for reasons outlined in section 4.4. Davis (1984) has previously suggested that Curlew and Redshank may also be present in nationally important numbers. This seems unlikely for the former species, but very possible for the latter. Redshank tend to be a difficult species to census comprehensively because of their habit of "disappearing" into creeks and saltmarsh. Nevertheless, the combined November peak counts for the Taf and the Tywi/Gwendraeth from the 1987/88 studies totalled over 900 birds (Appendix 9.6), well in excess of the appropriate qualifying level. As for Bar-tailed Godwit, further studies are required to establish conclusively the Redshank's true status.

What difference is the lack of regular count data from Witchett Pool and Pendine Sands likely to make? Considering Witchett Pool first, recent summaries of count information are available in Davis (1984), Morgan (n.d.) and Roberts & Morgan (n.d.), and a BoEE count card was submitted for mid March 1987 by D. Roberts. Combining the information from these suggests peak wintering duck populations of up to 25 Wigeon, 15 Gadwall, ca 400 Teal, 65 Mallard, 90 Shoveler, 100 Pochard, 30 Tufted Duck and 50 Scaup. The relationship between peak and regular numbers for this site indicated by the 1968-70 data presented by Owen et al. (1986) suggests that substantially lower numbers of most species are likely to be present on a regular basis. In addition, double figure numbers of Greenshank sometimes occur, and flocks of Golden Plover and Curlew may be present in the pool's vicinity. On Pendine Sands, the most notable wintering wader counts appear to be up to 130 Knot, 350 Sanderling, 1,000 or more Dunlin and 75 Bar-tailed Godwit, although the relationship that these peak totals have to regularly occurring populations must remain open to question.

In conclusion, one can only reiterate the assessment of Davis (1984) that

Table 4.5 Estimates of intertidal waterfowl populations present in winter on the overall Carmarthen Bay site, based on BoEE counts and the special 1987/88 studies.

	Highest average monthly BoEE count, Nov 1982-Nov 1987	Highest monthly average count from special studies, Nov 1987-Feb 1988
Mute Swan	1	0
Whooper Swan	1	0
Greylag Goose	6	0
Brent Goose	2	0
Shelduck	542	288
Wigeon	360	44
Teal	91	178
Mallard	282	483
Pintail	12	0
Shoveler	3	0
Pochard	7	0
Common Scoter	4	0
Goldeneye	1	1
Red-breasted Merganser	29	22
Total wildfowl:	1,341	1,016
Oystercatcher	3,061*	3,613*
Ringed Plover	49	20
Golden Plover	1,800	0
Grey Plover	51	25
Lapwing	1,499	1,270
Knot	138	600
Sanderling	70	675*
Dunlin	1,765	1,639
Ruff	1	0
Jack Snipe	1	0
Snipe	44	1
Black-tailed Godwit	7	19
Bar-tailed Godwit	525	627*
Curlew	747	400
Spotted Redshank	3	0
Redshank	573	569
Greenshank	5	1
Green Sandpiper	4	1
Common Sandpiper	1	1
Turnstone	63	19
Total waders:	10,407	9,480
Total waterfowl:	11,748	10,496

* Nationally important population (see Table 4.1).

NB Large numbers (>1,000) of Common Scoter present at times offshore not included.

"more comprehensive, systematic and frequent counting of the wader and wildfowl populations of this coastline is clearly much to be desired ....". Taking all available information into account, it seems reasonable to suggest a regular wintering population for the entire site of about 1,500 wildfowl and 12,500 waders. In addition, the population of one individual species should be highlighted. The regular occurrence of even 675 wintering Sanderling (Table 4.5) would make Carmarthen Bay the second best estuarine site for this species in the U.K., behind the major concentration present on the Ribble (Salmon et al. 1989). However, additional evidence of up to 350 birds along Pendine Sands, together with occasional counts of up to 1,000 birds on Cefn Sidan alone, points to the possibility that Carmarthen Bay may comprise an internationally important wintering site for the species. This deserves closer investigation.

5. INTRA-SITE SPECIES DISTRIBUTION PATTERNS

The aim of this chapter is to use the results of the special 1987/88 studies to describe the winter distribution patterns of the various wildfowl and wader species throughout the Taf, Tywi, Gwendraeth and Cefn Sidan, mapping these for species having peak counts exceeding 100 birds (see Appendices 9.6 and 9.7). Presentation on maps is standardized across species by expressing the average usage of each count sector by a species (see Appendix 9.2), defined as the average number of individuals present through the winter, as a percentage of the overall site usage value for that species.

5.1 SHELDUCK

As on the neighbouring Burry Inlet (Prys-Jones et al. 1989), Shelduck on Carmarthen Bay were strictly confined within the estuarine area and did not utilize the coastal sandy shores (Figure 5.1). The major concentrations were on the lower Taf and Gwendraeth, on both of which numbers increased markedly after mid winter (see Appendix 9.5); possibly this was a result of movement of birds from Burry Inlet, where the population tends to peak in mid winter, declining thereafter (Prys-Jones et al. 1989).

5.2 WIGEON

All the small numbers of Wigeon observed during the 1987/88 counts were on sectors F and H of the Tywi estuary (Figure 3.2), although there is also a regular, small flock of Wigeon near Blackpool bridge on the Taf estuary upstream of the area covered by the 1987/88 counts (D. Roberts, pers.comm.). However, episodic large influxes of over a thousand birds occur on both the Taf (see section 4.2) and Tywi/Gwendraeth (see section 4.3), and flocks of over a hundred at times occur on the sea off Cefn Sidan (Morgan & Roberts n.d.).

5.3 TEAL

Highest average numbers of Teal observed in winter 1987/88 were along the upper Taf estuary and, in particular, along the eastern bank of the Tywi (Figure 5.3). The lack of birds observed on the Gwendraeth is perhaps surprising in view of the extensive saltmarsh areas available, although the species is known to be very variable in its occurrence there (Davis 1984).

5.4 MALLARD

All large (>100) concentrations of Mallard seen were on the Taf, in particular along its lower, north-eastern shore (Figure 5.4). This corresponds with the previous observation of Davis (1984) that "Mallard often frequent the channels (of the Taf) under the cliffs near Wharley Point and the sandbanks to the south."

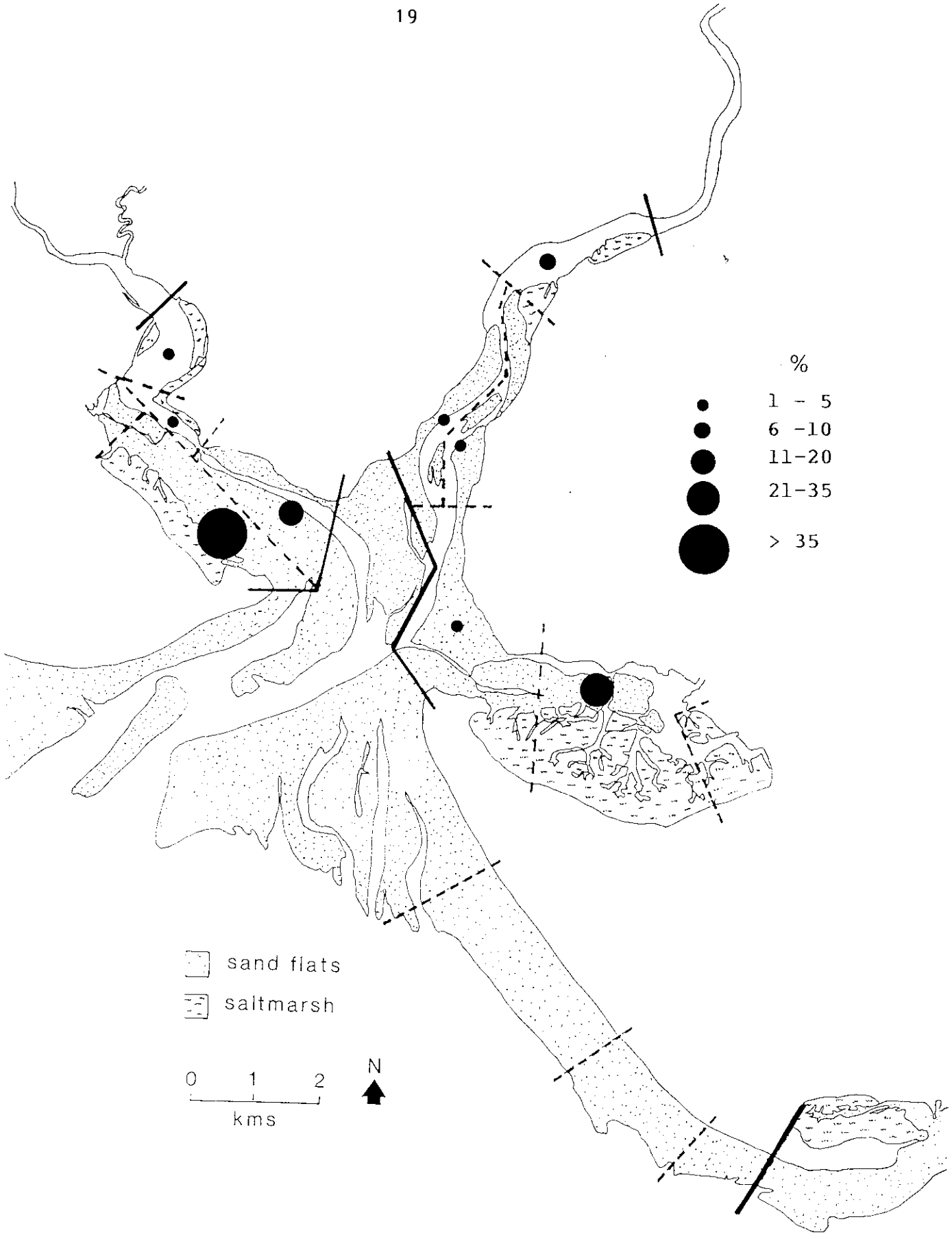

Figure 5.1 Average usage of each count sector by Shelduck during winter 1987/88, expressed as a percentage of overall site usage by the species. See Appendix 9.2 for actual numbers of birds involved.

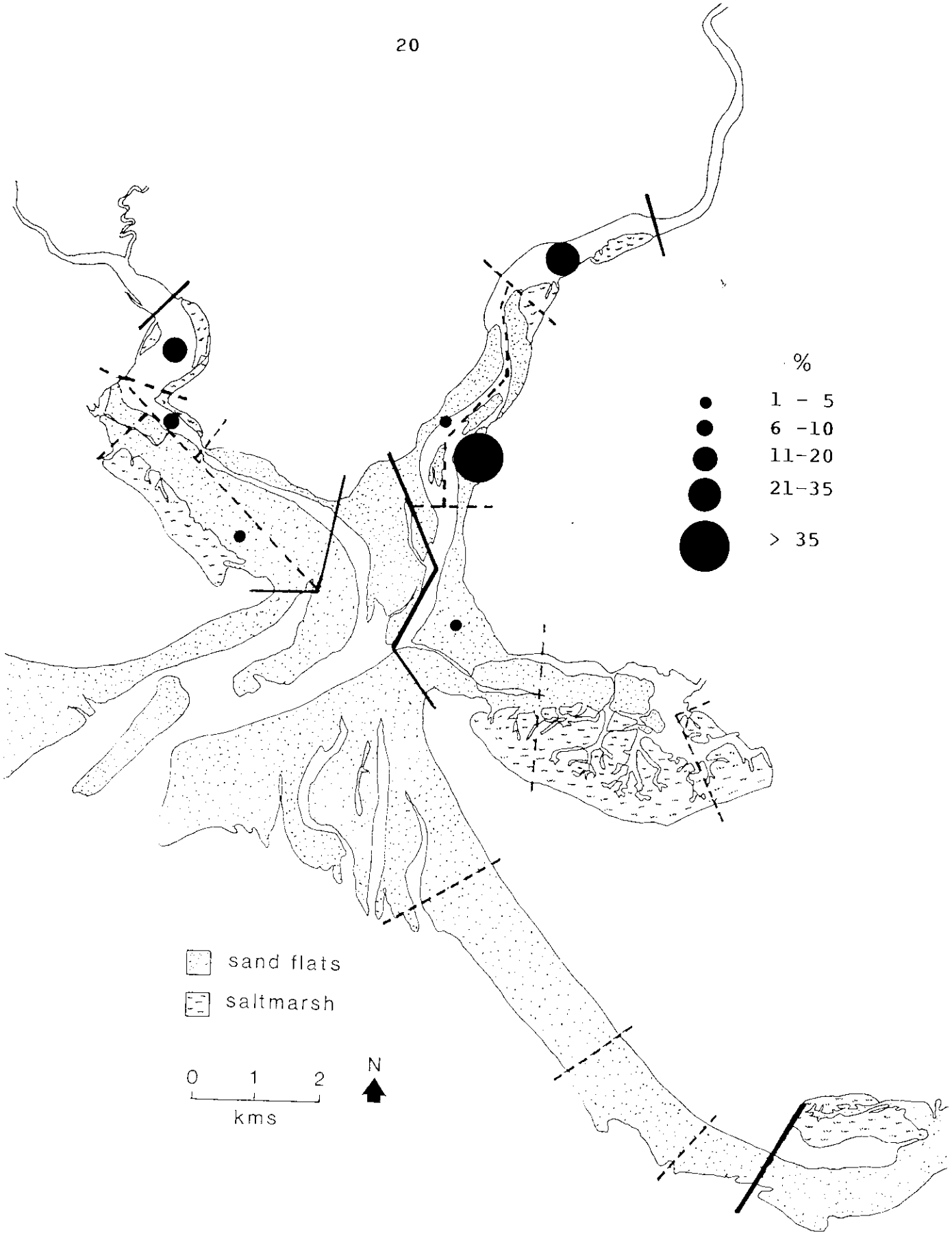

Figure 5.3 Average usage of each count sector by Teal during winter 1987/88, expressed as a percentage of overall site usage by the species. See Appendix 9.2 for actual numbers of birds involved.

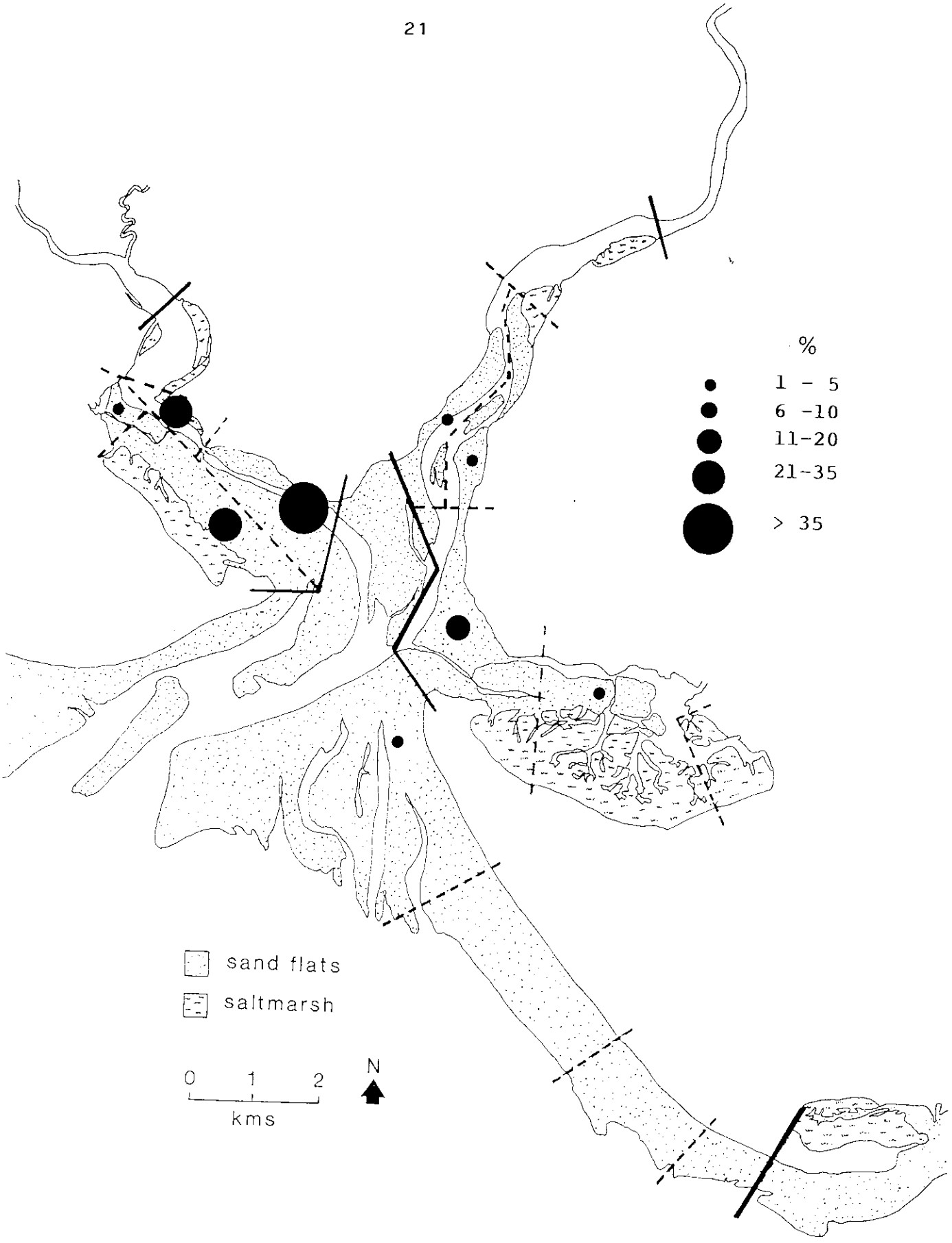

Figure 5.4 Average usage of each count sector by Mallard during winter 1987/88, expressed as a percentage of overall site usage by the species. See Appendix 9.2 for actual numbers of birds involved.

5.5 RED-BREASTED MERGANSER

Small numbers of Red-breasted Mergansers were noted on all three river estuaries, but were most regular just off the Cefn Sidan shore.

5.6 OYSTERCATCHER

Much the major feeding concentration of Oystercatchers, averaging well over 1,000 birds (sector I in Appendix 9.2), was on the mussel beds of Salmon Point Scar, between the Tywi and Gwendraeth estuaries (Figure 5.6). Birds from here roosted largely at Tywyn Point, whereas many of the cockle-feeding birds along the south-western shore of the Taf roosted at the nearer Ginst Point. Good numbers of feeding birds were also spread along the Cefn Sidan coast. Most of these probably roosted around Tywyn Point, but more detailed studies might establish that some move across to Whiteford Point and the neighbouring saltmarsh within the Burry Inlet.

5.7 RINGED PLOVER

A flock of up to 30 birds was present along the lower eastern shore of the Tywi, including the Salmon Point Scar area at the mouth of the Gwendraeth. Elsewhere, smaller numbers were episodically noted to the south of Black Scar on the eastern side of the Taf. None was recorded along Cefn Sidan but, because the counts there were conducted from the lower shore, small numbers could possibly have been overlooked on the upper shore.

5.8 GREY PLOVER

Within the Three Rivers, almost all birds noted were on or around Salmon Point Scar. In addition, small numbers were spread along Cefn Sidan.

5.9 LAPWING

Substantial flocks exceeding 500 birds occurred at times along the middle and/or upper reaches of all three estuaries (Figure 5.9).

5.10 KNOT

No birds were observed feeding within the Three Rivers, but up to ca 600 were noted along the middle part of Cefn Sidan (Figure 5.10). It seems very likely that many or most of these move to and from the Burry Inlet, rarely entering the estuaries of the Three Rivers to forage.

5.11 SANDERLING

Except for the odd small group at Salmon Point Scar, not seen within the estuaries of the Three Rivers. In excess of 500 birds feed along Cefn Sidan (Figure 5.11), some of which may well move at times to and from both Pendine

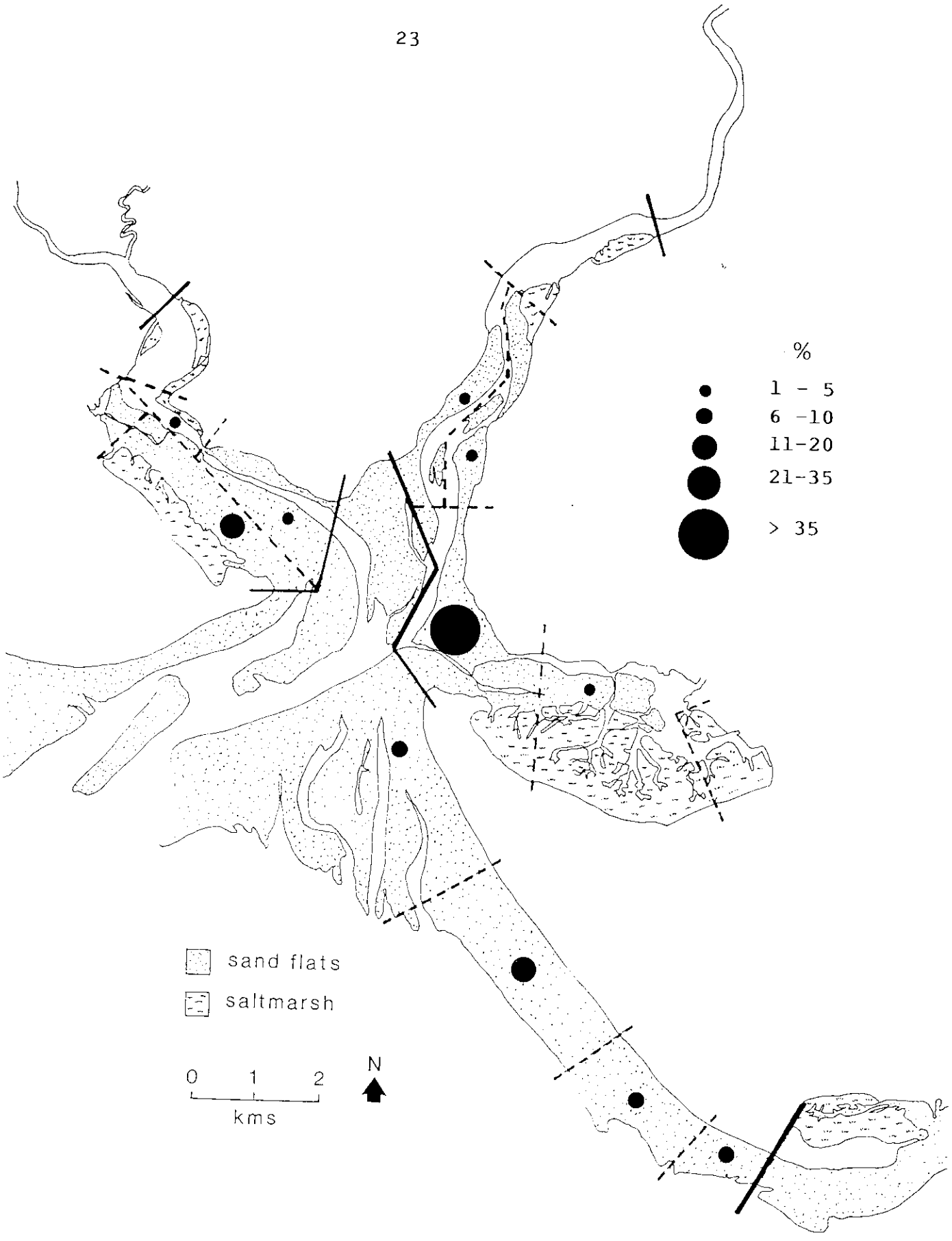

Figure 5.6 Average usage of each count sector by Oystercatcher during winter 1987/88, expressed as a percentage of overall site usage by the species. See Appendix 9.2 for actual numbers of birds involved.

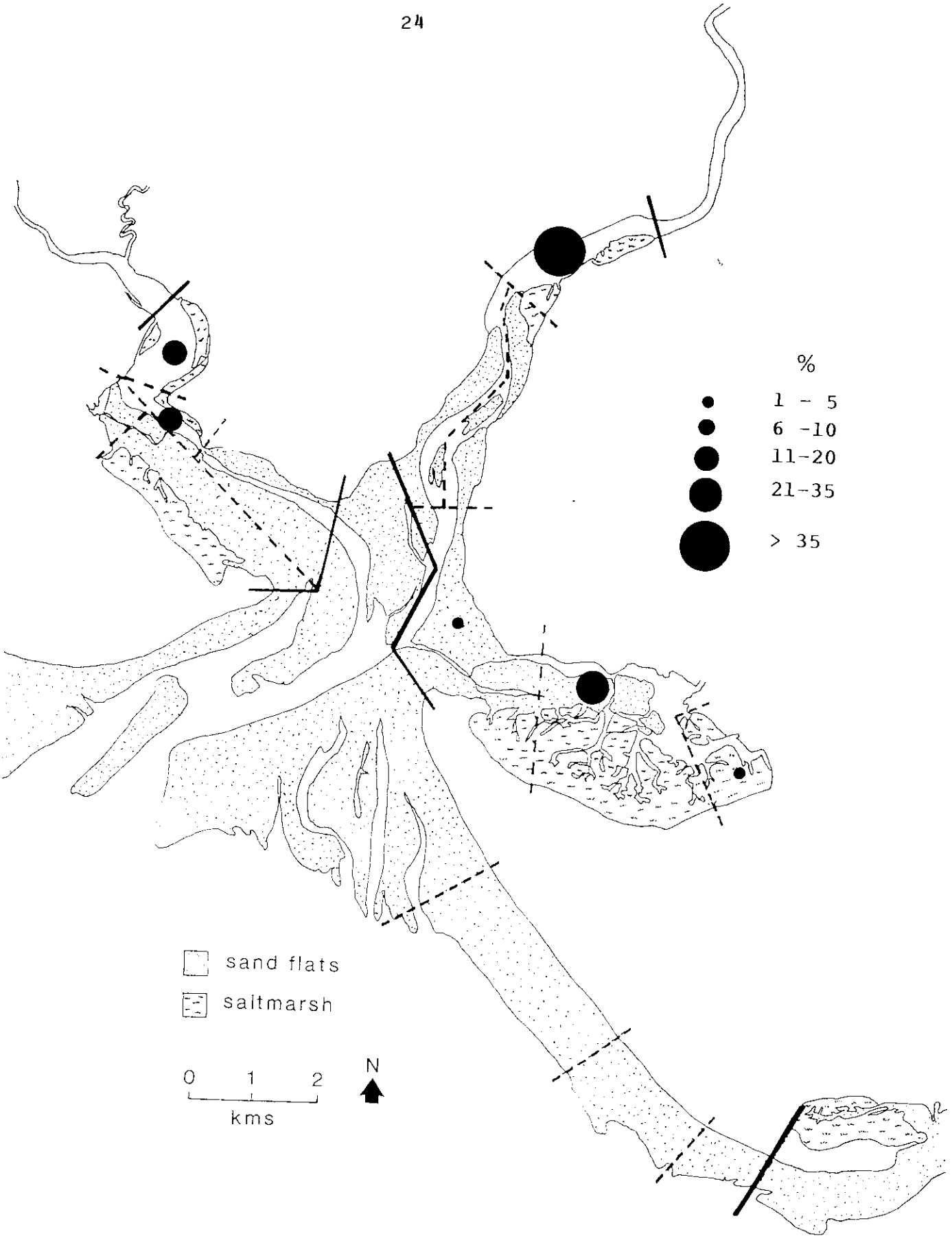

Figure 5.9 Average usage of each count sector by Lapwing during winter 1987/88, expressed as a percentage of overall site usage by the species. See Appendix 9.2 for actual numbers of birds involved.

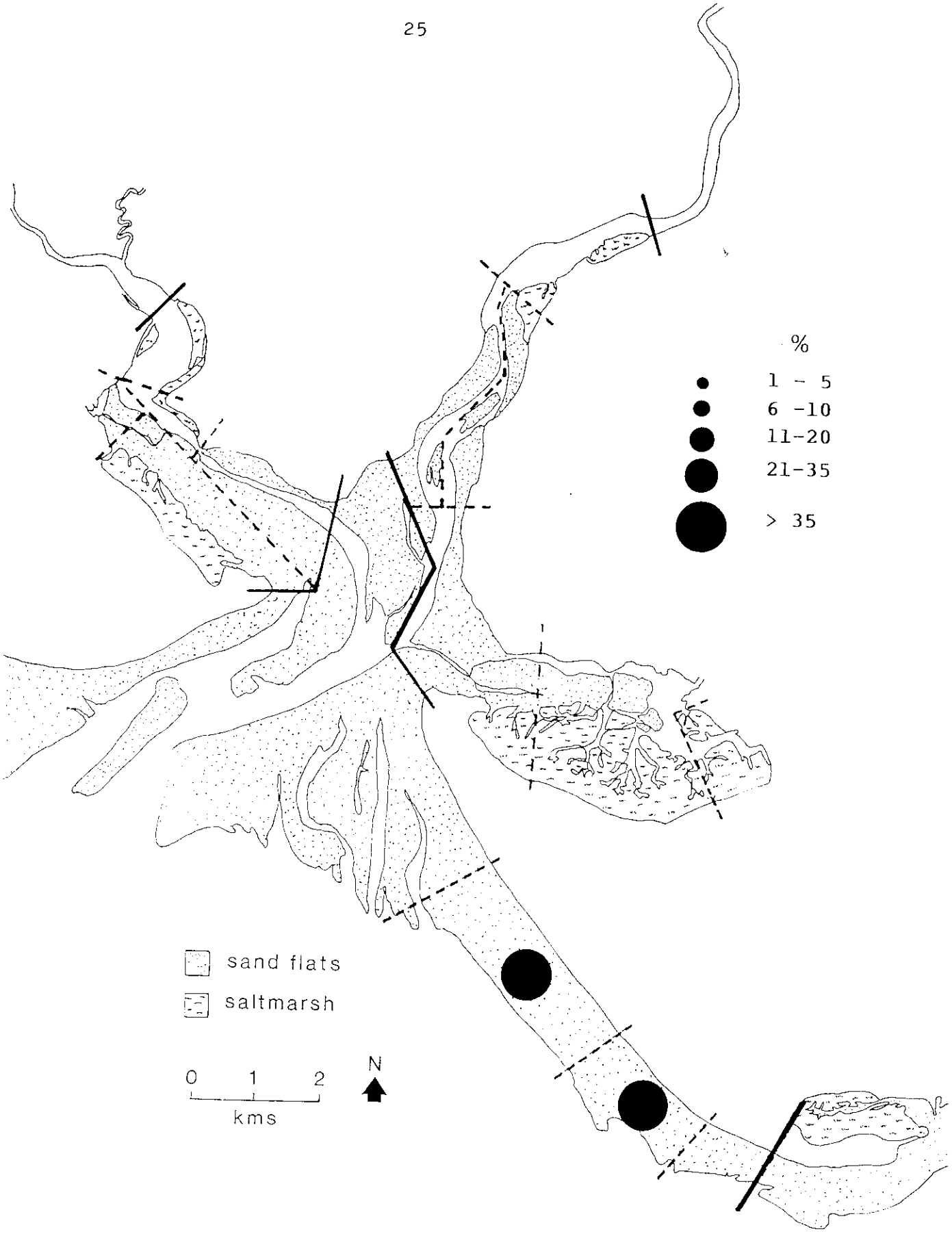

Figure 5.10 Average usage of each count sector by Knot during winter 1987/88, expressed as a percentage of overall site usage by the species. See Appendix 9.2 for actual numbers of birds involved.

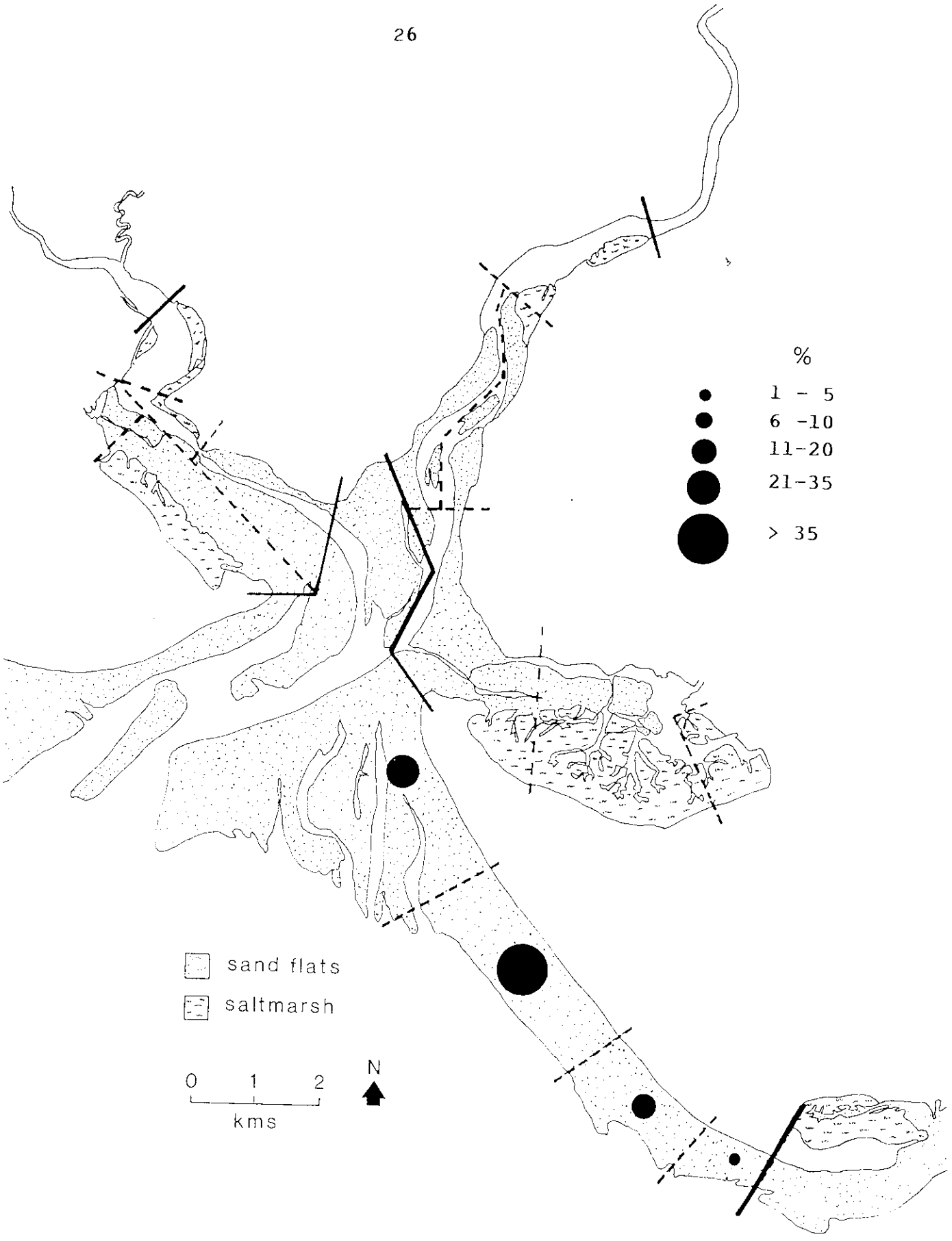

Figure 5.11 Average usage of each count sector by Sanderling during winter 1987/88, expressed as a percentage of overall site usage by the species. See Appendix 9.2 for actual numbers of birds involved.

Sands to the west and Whiteford Sands to the south-east (cf. Prater 1977, Prys-Jones et al. 1989).

5.12 DUNLIN

The largest numbers of feeding Dunlin occurred along Cefn Sidan, with another concentration in the general vicinity of Salmon Point Scar (Figure 5.12). Very few were present on the Taf, in accord with the comment of Davis (1984) that, other then Redshank "... the Taf is not noted for large numbers of small waders."

5.13 BLACK-TAILED GODWIT

A flock of up to just under 40 birds was regularly present through the winter on the lower Tywi, generally along the eastern shore in the vicinity of Ferryside. These birds were seen nowhere else within the Carmarthen Bay site and would appear to be a separate population from the slightly larger numbers occurring in the Burry Inlet (Prys-Jones et al. 1989).

5.14 BAR-TAILED GODWIT

The large numbers (>600) of Bar-tailed Godwit which occasionally frequent Cefn Sidan very probably originate from the Burry Inlet (see section 4.4), whereas this is unlikely to be so for the smaller population present on the lower Tywi (Figure 5.14). Here, numbers were low (<50) until mid winter but remained regularly around 170 during January and February. As with the Black-tailed Godwit, they were never seen on the Taf or Gwendraeth.

5.15 CURLEW

Ubiquitous within the estuarine area of the Three Rivers, but with major concentrations along the lower west shore of the Taf and around Salmon Point Scar (Figure 5.15). Virtually unrecorded by the counts along Cefn Sidan.

5.16 REDSHANK

Widely distributed within the estuarine area of the Three Rivers, but absent from Cefn Sidan (Figure 5.16). Most abundant on the muddier areas, especially near and upstream of Laugharne on the Taf, as well as on the Gwendraeth.

5.17 TURNSTONE

Noted only on Salmon Point Scar, where a flock of up to 70 was regularly present.

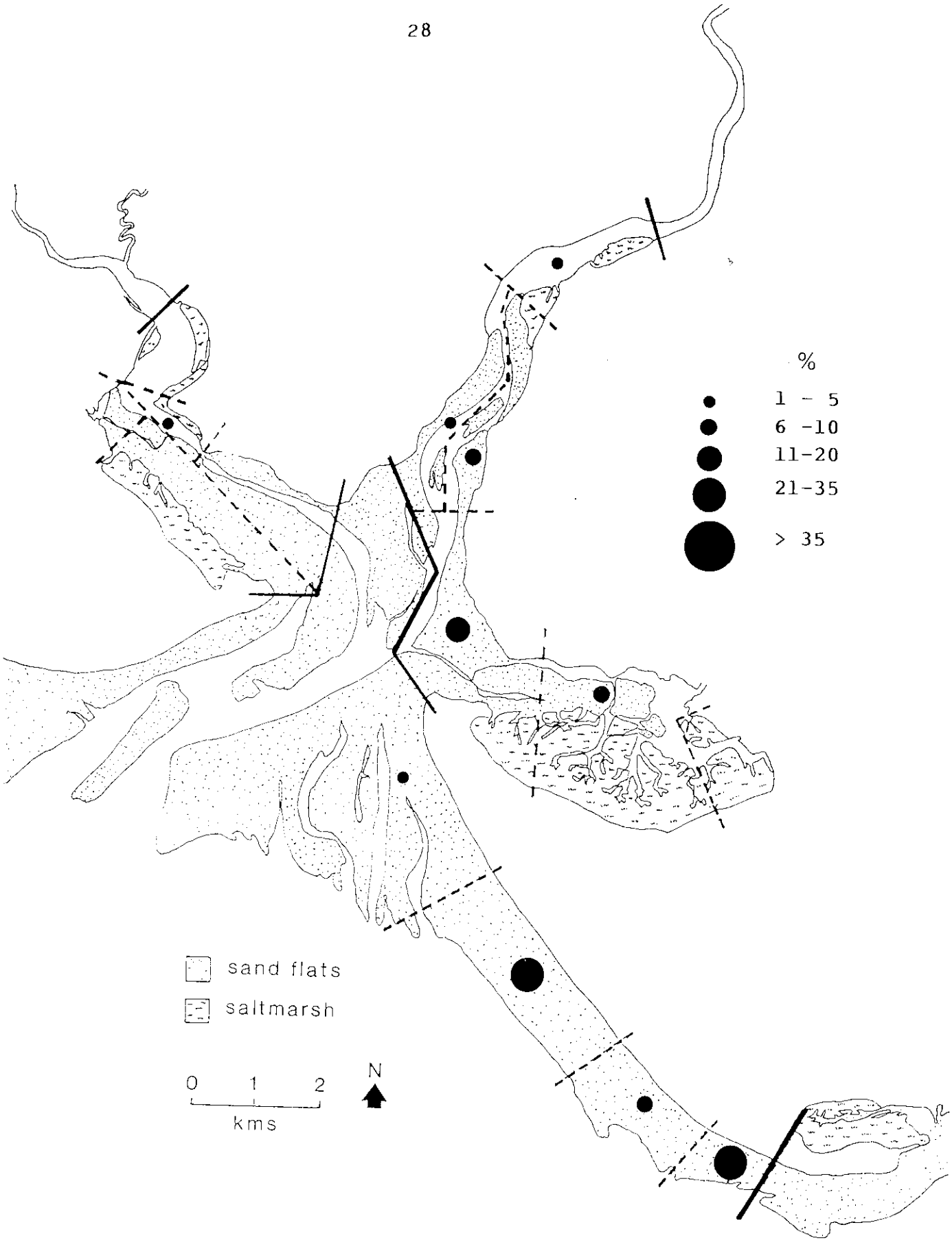

Figure 5.12 Average usage of each count sector by Dunlin during winter 1987/88, expressed as a percentage of overall site usage by the species. See Appendix 9.2 for actual numbers of birds involved.

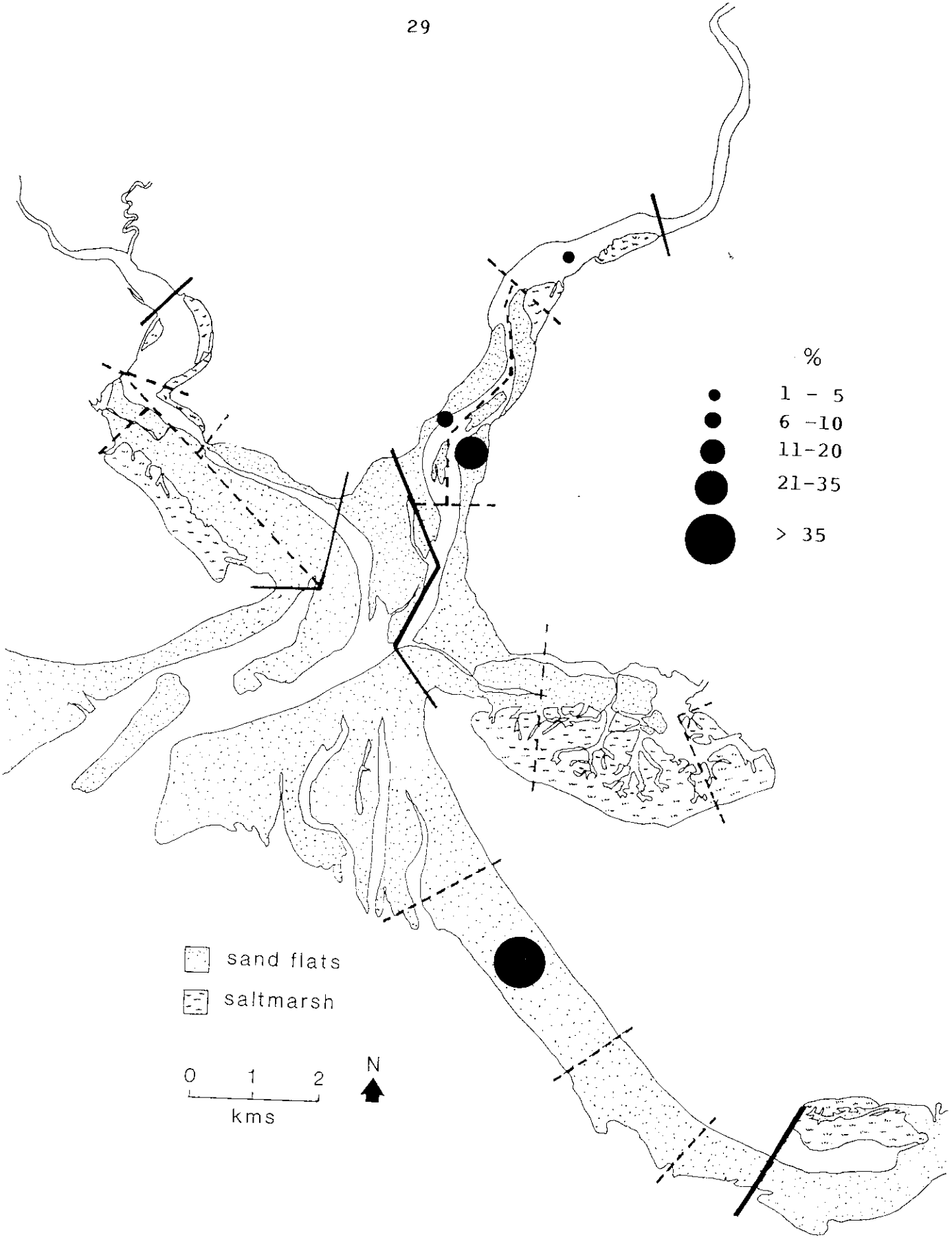

Figure 5.14 Average usage of each count sector by Bar-tailed Godwit during winter 1987/88, expressed as a percentage of overall site usage by the species. See Appendix 9.2 for actual numbers of birds involved.

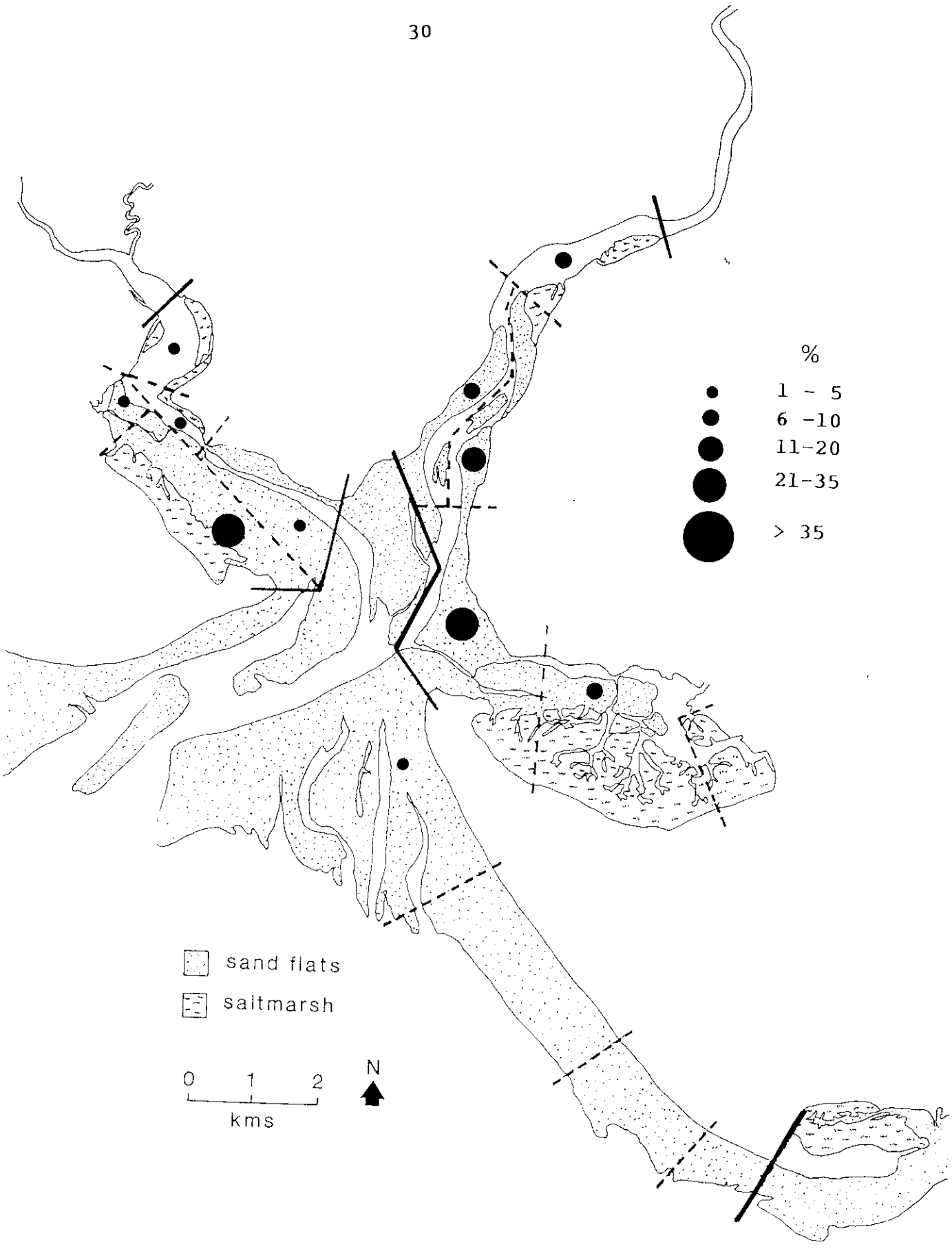

Figure 5.15 Average usage of each count sector by Curlew during winter 1987/88, expressed as a percentage of overall site usage by the species. See Appendix 9.2 for actual numbers of birds involved.

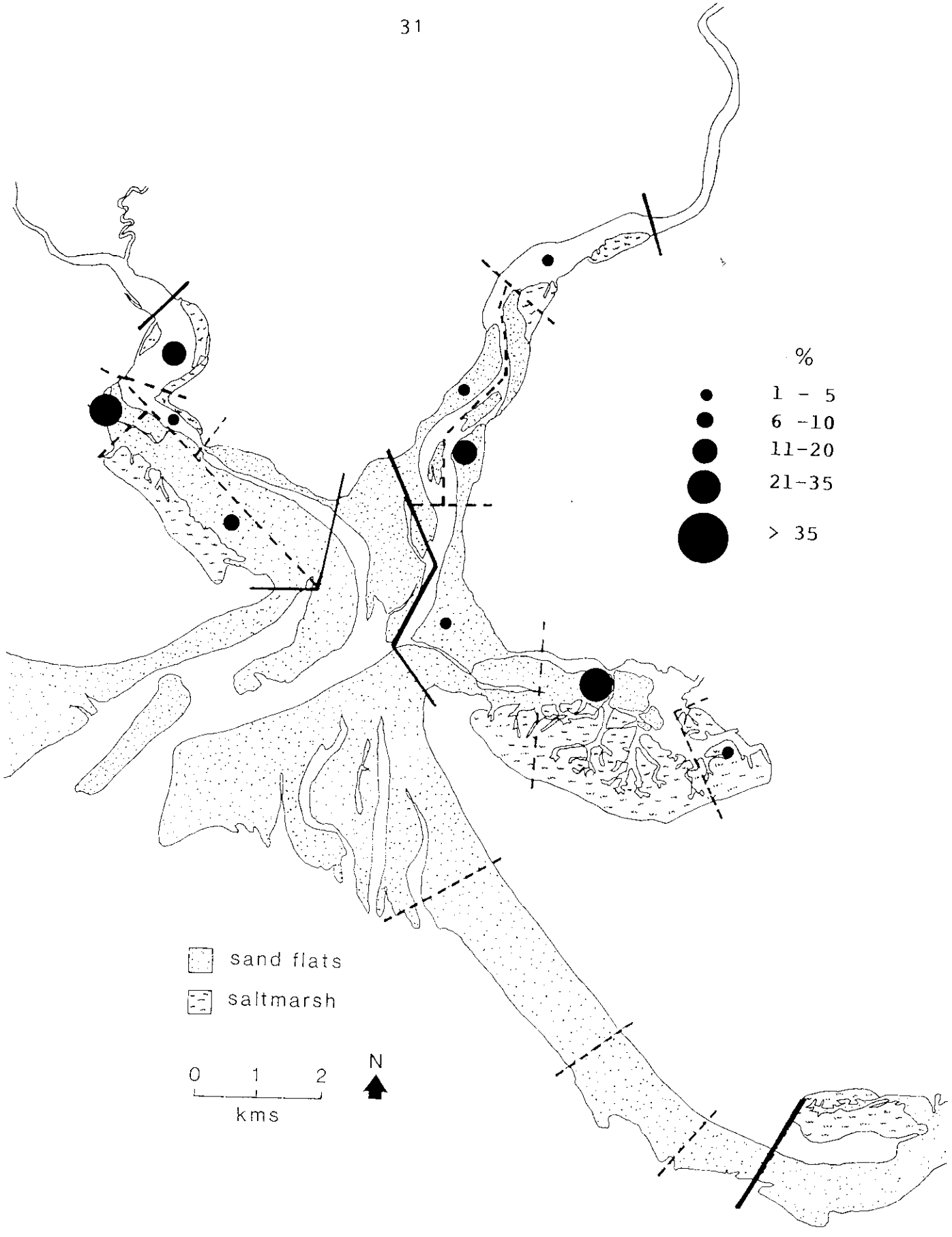

Figure 5.16 Average usage of each count sector by Redshank during winter 1987/88, expressed as a percentage of overall site usage by the species. See Appendix 9.2 for actual numbers of birds involved.

6. SYNTHESIS AND CONCLUSIONS

The standardized count data currently available for the Carmarthen Bay site are too limited for any reliable assessment of regular passage populations or for any attempt at reviewing time trends in wintering populations. Nevertheless, analysis of the counts available for the winter period have revealed the site to be of considerable significance to intertidal birds, with regular wintering populations of about 1,500 wildfowl and 12,500 waders. Two species, Oystercatcher and Sanderling, are regularly present in nationally important wintering numbers; in addition further studies might reveal Bar-tailed Godwit and Redshank as being so, and Golden Plover flocks at least on occasion exceed the appropriate qualifying level. During severe weather, flocks of 1,000 or more Wigeon may also be present. Offshore, the Common Scoter moulting and wintering population on Carmarthen Bay is clearly of major significance (Owen et al. 1986), but for logistical reasons outside the scope of this study. Better assessment of the Sanderling population, largely confined to the extremely poorly censused sandy beaches of Cefn Sidan and Pendine Sands, would appear to be a priority. The population present seems likely to be the second largest on an estuarine BoEE site in the U.K., and thorough coverage might well reveal it to be of international significance.

The distribution maps presented in Chapter 5 reveal a situation in which most of the site is important for one or more species, making it difficult to single out discrete areas as being of especial conservation significance. One exception is Salmon Point Scar (sector I on Figure 3.2), at the junction of the Tywi and Gwendraeth, which is clearly the key to the presence of a nationally important Oystercatcher population, as well as being utilized by a diversity of other species (see Appendices 9.1 and 9.2). Treatment of the Taf, Tywi and Gwendraeth estuaries as a single unit for conservation purposes would appear desirable (Davis 1984), as there is undoubtedly considerable interchange of their bird populations, although this may be relatively less frequent in the case of the Taf than for the Tywi and Gwendraeth (cf. Prater 1981). Similarly, the linking of Cefn Sidan with the Three Rivers would appear to be appropriate as many birds from both areas appear to roost at Tywyn Point. However, results from counts indicate that Knot and Bar-tailed Godwit, and possibly other species also, may not uncommonly move between Cefn Sidan and the Burry Inlet. More detailed observations, possibly including trapping and colour marking, are required to reveal the scale and frequency of this interchange. Should interchange prove considerable, consideration would have to be given to linking both the current Carmarthen Bay site and Burry Inlet as a single "Carmarthen Bay complex".

7. ACKNOWLEDGMENTS

We are indebted to all participants over the years in the Birds of Estuaries Enquiry on Carmarthen Bay, as well as to others who have provided important assistance in the production of this report. In particular, we thank Gavin Hall and Wyn Parry for carrying out low tide counts along Cefn Sidan, Jeff Kirby and Ian Morgan for much general advice and information, Dilwyn Roberts for providing data from county records and for help in reorganizing BoEE counting on the site, Elizabeth Murray for drawing the figures and Dorothy Smallwood Keating for computerizing data and typing the report.

The work of the BTO's Estuaries Programme is co-sponsored by the BTO, Nature Conservancy Council, Royal Society for the Protection of Birds and the Department of the Environment for Northern Ireland.

8. REFERENCES

Davis, P.E. 1984. Birds of the coastline from Loughor to Laugharne. Cyclostyled report, 6 pp. NCC, South Wales Region, Wales Field Unit.

Morgan, I.K. no date. Birds of the Carmarthenshire coast. Carmarthenshire Bird Report 1982: 18-23.

Owen, M., Atkinson-Willes, G.L. & Salmon, D.G. 1986. Wildfowl in Great Britain. 2nd ed. University Press, Cambridge.

Pirot, J.-Y., Laursen, K., Madsen, J. & Monval, J.-Y. 1989. Population estimates of swans, geese, ducks and Eurasian Coot Fulica atra in the Western Palearctic and Sahelian Africa. IWRB Spec.Publ.9: 14-23.

Prater, A.J. 1977. The birds of the Burry Inlet. pp 5(1)1-5(1)12 in Nelson-Smith, A. & Bridges, E.M. (eds): Problems of a small estuary. University College of Swansea, Swansea.

Prater, A.J. 1981. Estuary birds of Britain and Ireland. Poyser, Calton.

Prater, A.J. & Rowe, S. 1978. BTO/RSPB/WT Birds of Estuaries Enquiry 1969-75: tables of average wader counts. NCC Contract Report no.148 from the BTO.

Prys-Jones, R.P. 1989. The abundance and distribution of wildfowl and waders on the Cleddau (Milford Haven). BTO Research Report no.45 and NCC Chief Scientist Directorate commissioned research report no.964.

Prys-Jones, R.P., Howells, R.J. & Kirby, J.S. 1989. The abundance and distribution of wildfowl and waders on the Burry Inlet. BTO Research Report no.43 and NCC Chief Scientist Directorate commissioned research report no.926.

Ramsar Convention Bureau 1988. Convention on wetlands of international importance especially as waterfowl habitat. Proc.3rd Mtg.Conf.Contr.Parties, Regina, Canada, 1987. Gland.

Ratcliffe, D.A. (ed) 1977. A nature conservation review. University Press, Cambridge.

Roberts, D.H.V. & Morgan, I.K. (eds) no date. Birds in Carmarthenshire: 1984-85. Carmarthenshire Bird Report 1984 and 1985: 1-35.

Salmon, D.G., Prys-Jones, R.P. & Kirby, J.S. 1988. Wildfowl and wader counts 1987-88. The Wildfowl Trust, Slimbridge.

Salmon, D.G., Prys-Jones, R.P. & Kirby, J.S. 1989. Wildfowl and wader counts 1988-89. The Wildfowl & Wetlands Trust, Slimbridge.

Smit, C.J. & Piersma, T. 1989. Numbers, midwinter distribution, and migration of wader populations using the East Atlantic flyway. IWRB Spec.Publ.9: 24-63.

9. APPENDICES

Appendix 9.1 Peak counts for each sector recorded during the special studies, November 1987 to February 1988.

	Taf					Tywi/Gwendraeth						Cefn Sidan			
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Shelduck	26	2	15	140	104	27	14	41	27	105	0	0	0	0	0
Wigeon	0	0	0	0	0	60	0	100	0	0	0	0	0	0	0
Teal	95	0	26	21	0	68	34	224	14	0	0	0	0	0	0
Mallard	0	16	151	170	530	5	15	20	160	32	0	23	0	0	0
Goldeneye	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-br.Merg.	2	5	9	4	0	0	4	2	2	6	5	14	2	1	6
Oystercatcher	65	12	300	1,450	280	1	223	90	2,500	67	0	587	1,200	450	414
Ringed Plover	1	4	12	0	0	0	21	31	31	0	0	0	0	0	0
Grey Plover	0	0	1	0	0	0	0	0	0	17	0	7	14	7	6
Lapwing	800	2	500	25	0	1,100	4	12	200	1,000	80	0	0	0	0
Knot	0	0	0	0	0	0	0	0	0	0	0	0	435	600	0
Sanderling	0	0	0	0	0	0	0	0	8	0	0	418	600	165	53
Dunlin	40	22	70	4	0	140	400	470	600	270	0	57	675	190	610
Snipe	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0
Black-t.Godwit	0	0	0	0	0	0	12	38	0	0	0	0	0	0	0
Bar-t.Godwit	0	0	0	0	0	23	170	180	1	0	0	0	612	0	0
Curlew	25	10	20	300	10	76	58	95	200	75	1	4	2	1	0
Spotted R'shank	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Redshank	275	380	140	235	15	10	120	150	13	220	21	0	0	0	0
Greenshank	0	1	1	0	0	0	0	0	4	3	1	0	0	0	0
Green Sandpiper	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Sandpiper	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Turnstone	0	0	0	0	0	0	0	0	70	0	0	0	0	0	0

NB See Figure 3.2 for locations of sectors.

Appendix 9.2 Average counts for each sector recorded during the special studies, November 1987 to February 1988.

	Taf					Tywi/Gwendraeth						Cefn Sidan			
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Shelduck	7	0	3	54	20	13	3	4	3	31	0	0	0	0	0
Wigeon	0	0	0	0	0	33	0	6	0	0	0	0	0	0	0
Teal	10	0	5	4	0	17	1	43	1	0	0	0	0	0	0
Mallard	0	2	43	39	162	1	4	4	16	9	0	8	0	0	0
Goldeneye	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-br.Merg.	0	0	1	0	0	0	0	0	0	1	3	5	0	0	2
Oystercatcher	13	4	20	651	151	0	78	45	1,337	22	0	301	461	356	247
Ringed Plover	0	0	2	0	0	0	1	2	5	0	0	0	0	0	0
Grey Plover	0	0	0	0	0	0	0	0	3	0	0	2	7	1	2
Lapwing	94	0	109	2	0	358	0	1	11	272	40	0	0	0	0
Knot	0	0	0	0	0	0	0	0	0	0	0	0	145	121	0
Sanderling	0	0	0	0	0	0	0	0	1	0	0	186	269	78	19
Dunlin	3	3	13	0	0	53	21	67	163	78	0	19	308	80	255
Snipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black-t.Godwit	0	0	0	0	0	0	1	16	0	0	0	0	0	0	0
Bar-t.Godwit	0	0	0	0	0	5	13	47	0	0	0	0	124	0	0
Curlew	5	6	6	94	2	25	17	35	68	28	1	2	0	0	0
Spotted R'shank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Redshank	92	142	13	49	2	7	20	58	3	112	11	0	0	0	0
Greenshank	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
Green Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turnstone	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0

NB See Figure 3.2 for locations of sectors.

Appendix 9.3 Scientific names of species mentioned in the text.

Mute Swan	Cygnus olor
Bewick's Swan	Cygnus columbianus bewickii
Whooper Swan	Cygnus cygnus
European White-fronted Goose	Anser albifrons albifrons
Greylag Goose	Anser anser
Canada Goose	Branta canadensis
Barnacle Goose	Branta leucopsis
Dark-bellied Brent Goose	Branta bernicla bernicla
Shelduck	Tadorna tadorna
Wigeon	Anas penelope
Gadwall	Anas strepera
Teal	Anas crecca
Mallard	Anas platyrhynchos
Pintail	Anas acuta
Shoveler	Anas clypeata
Pochard	Aythya ferina
Scaup	Aythya marila
Eider	Somateria mollissima
Long-tailed Duck	Clangula hyemalis
Common Scoter	Melanitta nigra
Goldeneye	Bucephala clangula
Red-breasted Merganser	Mergus serrator
Goosander	Mergus merganser
Oystercatcher	Haematopus ostralegus
Avocet	Recurvirostra avosetta
Ringed Plover	Charadrius hiaticula
Golden Plover	Pluvialis apricaria
Grey Plover	Pluvialis squatarola
Lapwing	Vanellus vanellus
Knot	Calidris canutus
Sanderling	Calidris alba
Curlew Sandpiper	Calidris ferruginea
Purple Sandpiper	Calidris maritima
Dunlin	Calidris alpina
Ruff	Philomachus pugnax
Jack Snipe	Lymnocryptes minimus
Snipe	Gallinago gallinago
Black-tailed Godwit	Limosa limosa
Bar-tailed Godwit	Limosa lapponica
Whimbrel	Numenius phaeopus
Curlew	Numenius arquata
Spotted Redshank	Tringa erythropus
Redshank	Tringa totanus
Greenshank	Tringa nebularia
Green Sandpiper	Tringa ochropus
Common Sandpiper	Actitis hypoleucos
Turnstone	Arenaria interpres

Appendix 9.4 Average monthly BoEE counts in winter (November-March) for the period November 1982 to November 1987 on the Taf and Tywi/Gwendraeth.

	Taf					Tywi/Gwendraeth				
	Nov	Dec	Jan	Feb	Mar	Nov	Dec	Jan	Feb	Mar
No.of counts	5	4	3	3	2	2	1	1	1	1
Mute Swan	0	0	0	0	0	1	1	0	0	0
Whooper Swan	1	0	0	0	0	0	0	0	0	0
Greylag Goose	0	6	1	0	0	0	0	0	0	0
Brent Goose	1	0	0	0	0	0	0	0	1	2
Shelduck	60	29	38	98	153	6	8	111	236	389
Wigeon	14	25	160	94	13	0	50	200	4	26
Teal	2	1	0	1	8	13	0	45	90	15
Mallard	109	177	138	48	10	87	58	14	234	66
Pintail	1	0	3	12	0	0	0	1	0	4
Shoveler	0	0	0	0	0	0	0	3	0	0
Pochard	0	0	0	0	0	0	0	0	0	7
Common Scoter	0	0	1	4	1	1	0	0	0	0
Goldeneye	0	0	0	0	0	1	1	0	0	1
Red-br.Merganser	8	7	1	2	3	11	22	11	16	18
Oystercatcher	336	348	350	673	432	1,840	2,713	870	1,692	1,148
Ringed Plover	31	5	13	2	6	18	11	34	6	16
Golden Plover	269	1,250	75	198	35	42	550	0	0	71
Grey Plover	1	2	7	11	0	5	49	25	22	8
Lapwing	425	235	391	33	0	370	1,264	57	328	143
Knot	2	0	0	0	0	136	0	1	0	0
Sanderling	0	0	0	1	0	70	0	0	0	3
Dunlin	112	97	60	301	11	335	1,668	1,177	1,249	366
Ruff	0	0	0	0	0	1	0	0	0	0
Jack Snipe	0	0	0	0	0	0	1	0	0	0
Snipe	1	3	14	2	0	0	21	10	42	9
Black-t.Godwit	0	0	3	1	0	0	0	4	0	0
Bar-t.Godwit	9	7	4	0	0	26	51	101	525	16
Curlew	95	118	63	333	108	158	357	215	414	200
Spotted Redshank	0	0	0	0	0	1	3	0	0	0
Redshank	252	147	119	132	251	254	275	158	441	294
Greenshank	0	0	0	0	0	1	4	2	5	4
Green Sandpiper	0	0	0	0	0	2	2	1	4	4
Common Sandpiper	0	0	0	0	0	1	0	0	0	0
Turnstone	0	0	0	0	0	13	48	61	63	9

Appendix 9.5 Monthly average counts for the Taf and the Tywi/Gwendraeth from the special studies carried out between November 1987 and February 1988.

	Taf				Tywi/Gwendraeth			
	Nov	Dec	Jan	Feb	Nov	Dec	Jan	Feb
Shelduck	31	77	109	158	11	42	44	130
Wigeon	0	0	0	0	13	1	1	44
Teal	3	58	0	0	62	120	2	23
Mallard	153	448	227	107	48	35	23	6
Goldeneye	0	0	0	1	0	0	0	0
Red-br.Merganser	0	4	1	1	6	1	4	1
Oystercatcher	760	966	910	698	1,488	1,809	1,648	897
Ringed Plover	0	5	1	1	6	15	12	3
Grey Plover	0	0	0	0	2	4	5	3
Lapwing	85	16	472	445	289	1	668	825
Sanderling	0	0	0	0	0	0	1	0
Dunlin	7	40	14	9	348	456	340	239
Snipe	0	0	1	0	0	0	0	0
Black-t.Godwit	0	0	0	0	13	19	17	15
Bar-t.Godwit	0	0	0	0	26	15	72	164
Curlew	68	49	202	195	139	136	197	201
Spotted Redshank	0	0	0	0	0	0	0	0
Redshank	290	292	370	239	250	145	199	149
Greenshank	0	0	1	1	2	1	0	0
Green Sandpiper	0	0	0	1	0	0	0	0
Common Sandpiper	0	0	1	0	0	0	0	0
Turnstone	0	0	0	0	9	18	11	19

Appendix 9.6 Monthly peak counts for the Taf and the Tywi/Gwendraeth from the special studies carried out between November 1987 and February 1988.

	Taf				Tywi/Gwendraeth			
	Nov	Dec	Jan	Feb	Nov	Dec	Jan	Feb
Shelduck	67	106	126	200	25	71	48	144
Wigeon	0	0	0	0	100	2	6	70
Teal	8	119	0	0	180	238	11	68
Mallard	388	599	341	199	165	87	51	6
Goldeneye	0	0	0	2	0	0	0	0
Red-br.Merganser	0	10	2	2	7	4	7	3
Oystercatcher	1,528	1,610	1,324	797	1,800	2,574	2,208	1,088
Ringed Plover	2	12	4	6	31	31	25	13
Grey Plover	0	0	0	1	9	12	17	11
Lapwing	500	80	900	500	310	4	1,000	1,100
Sanderling	0	0	0	0	0	0	8	0
Dunlin	22	70	43	35	1,000	780	740	320
Snipe	0	1	1	1	2	0	0	0
Black-t.Godwit	0	0	0	0	35	38	27	28
Bar-t.Godwit	0	0	0	0	46	30	168	180
Curlew	93	89	270	322	221	145	324	183
Spotted Redshank	0	1	0	0	0	0	0	0
Redshank	510	367	457	297	402	128	225	145
Greenshank	1	1	1	1	4	3	1	1
Green Sandpiper	0	0	0	2	0	0	0	0
Common Sandpiper	0	1	1	1	0	0	0	0
Turnstone	0	0	0	0	40	55	27	70

Appendix 9.7 Monthly counts for Cefn Sidan from the special studies carried out between November 1987 and March 1988.

	Nov	Dec	Jan	Feb	Mar
Mallard	0	0	0	23	0
Red-br. Merganser	4	0	0	17	6
Oystercatcher	888	838	651	1,800	1,206
Grey Plover	20	1	20	0	12
Knot	0	293	435	600	0
Sanderling	423	361	19	675	472
Dunlin	170	517	1,285	1,030	13
Bar-tailed Godwit	1	612	8	0	0
Curlew	4	0	0	4	0