BTO Research Report 25

THE ORNITHOLOGICAL SIGNIFICANCE OF FLINT MARSHES AND MUDFLATS TO WILDFOWL AND WADERS

by J.S. Kirby*

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*British Trust for Ornithology, Beech Grove, Station Road,
Tring, Herts HP23 5NR.

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SUMMARY

1. The importance of Flint marshes and the associated mudflats to wintering populations of wildfowl and waders was investigated in relation to a proposed by-pass which would impinge on the area.

2. The Dee estuary as a whole ranks amongst the top five estuaries in Britain for its wintering wildfowl and waders, and is designated by U.K. government as a site of international importance.

3. Analysis of 1981/82 to 1985/86 Birds of Estuaries Enquiry data shows that the estuary supports internationally important numbers of seven species of waders and three species of wildfowl through the winter months.

4. Appreciable proportions, 23% and 86% respectively, of the total populations of Teal and Black-tailed Godwit, both internationally important on the estuary, are found within the study area, which is therefore of particular importance to these species.

5. Sections B and C1 contained the most important feeding areas for the godwits which roosted on the marsh in section M2 (the CEGB nature reserve), and were also the most important area for Teal. Section A provided the majority of waders with an important first and last feeding area, particularly Redshanks.

6. The proposed road will effectively remove a large part of section M1 which currently supports few birds. Disturbance to adjacent areas should be avoided if at all possible.

7. It is difficult to predict the likely effect of the proposed development on birds feeding on the adjacent mudflats without knowing whether or how much of the area will be affected. Redshank are the species most likely to be affected deleteriously.

INTRODUCTION

Each winter, the Dee estuary attracts many tens of thousands of migratory waders and wildfowl, ranking as one of the most important estuaries in the British Isles. Most of the estuary is scheduled as an SSSI and the site is listed as grade 1* in the Nature Conservation Review (Ratcliffe 1977). In addition, the estuary has been designated by U.K. government as a site of international importance under the Ramsar Convention and the European Commission Directive on the conservation of wild birds. The area is presently threatened by industrial and recreational developments which, if approved, would reduce the available habitat for birds, which in turn might reduce the numbers present.

The mudflats and associated marshes at Flint are situated towards the neck of the estuary on the Welsh side of the Dee (Figure 1). The marshes extend from the urban conurbation of Connah's Quay to Flint Castle, approximately half of the area being protected as a nature reserve managed by the Deeside Naturalists' Society (DNS) on behalf of the Central Electricity Generating Board (CEGB). Clwyd County Council is developing a scheme to provide a new road link between the A550 trunk road at Sealand and the A548 Connah's Quay/Flint road (Figure 1). It is proposed that this would lead into a by-pass for Flint which would impinge on the marshes and possibly also the mudflats (Figure 2). The precise route the road will take is as yet undetermined, so it is not known whether the mudflats will be affected and by how much. The road is required to improve access to the industrial development areas north of the river and to relieve vehicular congestion in Queensferry, Shotton, Connah's Quay and Flint.

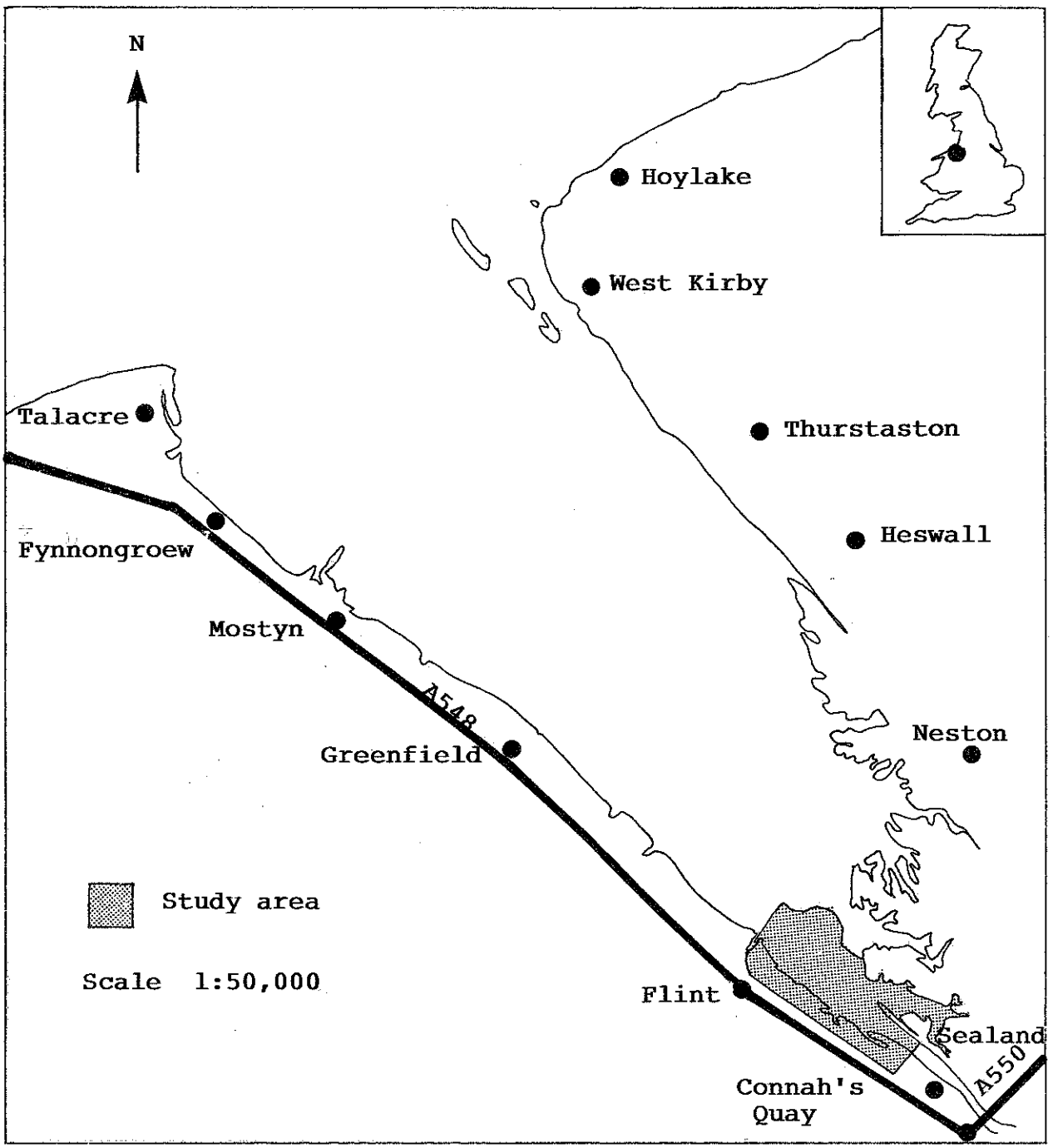


Figure 1. Map of the Dee Estuary showing position of the study area.

The aim of this study was to examine the ornithological significance of the study area in the light of the proposed by-pass. This involved identifying which species of wildfowl and waders were sufficiently abundant within the study area to warrant further consideration; the distribution of these species was then examined to identify the areas most utilised by them and thereby discover whether the road development would be likely to affect the abundance of these species.

STUDY AREA

The study area (Figure 2) was c. 650 ha in size, encompassing the mudflats and marshes on the south side of the main channel from Flint Castle (SJ 248735) to the CEGB power station at Connah's Quay (SJ 283710). "White Sands", on the opposite side of the revetment, was also included.

The study area was divided into six main sections: sections A, B, C1 and C2 are areas of mudflats, whilst M1 and M2 encompass the marsh. Section A and the inner part of section B are very muddy, whereas most of C1, C2 and the outer part of B are predominantly sandy. Section A has been colonised by Cord Grass *Spartina anglica* which, although patchy and well dispersed, covers approximately one third of the section. The marsh is grazed by sheep, the vegetation varying in height from a short turf to tall tussocks. Section M2, coinciding with the boundaries of the CEGB nature reserve, is managed and contains shallow lagoons, islands and ditches, adding to the diversity of the habitat. The sections vary considerably in size, approximate areas being as follows: section A (105 ha), section B (115 ha), section C1 (150 ha), section C2 (100 ha), section M1 (100 ha) and section M2 (80 ha).

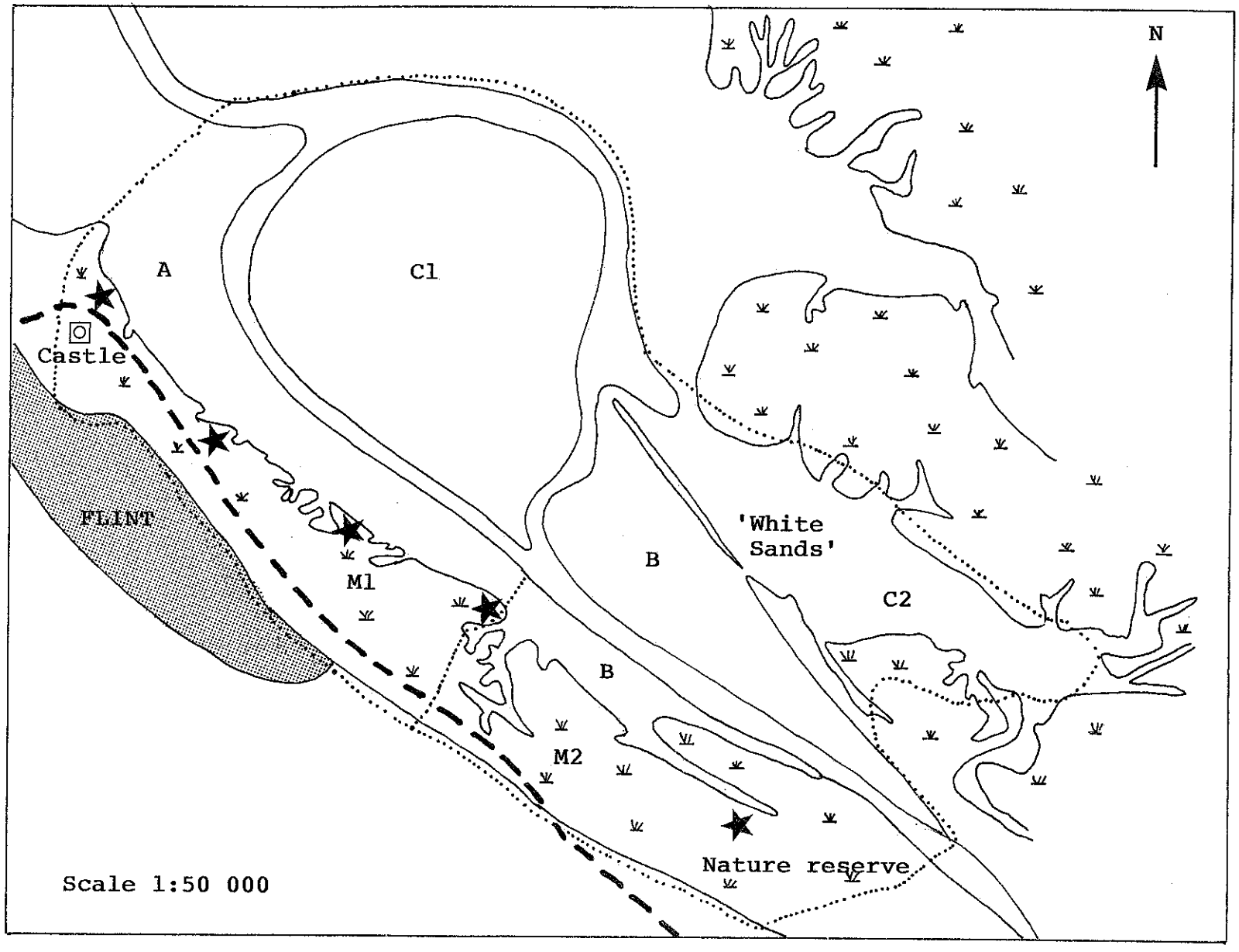


Figure 2. Map of the study area showing recording areas and positions of main observation points.

Field methods

The study area was visited once or more on 17 days between 12 December 1986 and 20 February 1987. Intensive observations, involving repeat surveys throughout daylight hours, were conducted on 12 and 16-17 December, 16 and 20 January, and 12 and 16 February (coinciding with the spring tides). In total, the study area was counted 48 times, with up to 6 counts per day during periods of intensive observations. Observations were made from suitable vantage points along the marsh using 10 x 40 binoculars supplemented by a 15-45x magnification telescope. Details of weather, visibility and human disturbance were recorded.

Each section of the study area was observed consecutively, and the numbers, positions and activity of each species were recorded. The time at which each count was started and finished was noted, as well as an estimate of the proportion of each section uncovered by the tide and hence available to feeding birds. Counts were conducted at all stages of the tide, although relatively few were done during the high water period. Any movements of birds between sections, or to or from the study area were recorded, as were congregations of roosting birds.

Analysis

Analyses concerning the ornithological significance of the Dee estuary are based on information collected by the Birds of Estuaries Enquiry (BoEE), Britain's national monitoring scheme for estuarine birds, for the winters of 1981/82 to 1985/86. BoEE counters conduct

simultaneous high water roost counts, on pre-selected dates in the middle of each month, of the numbers of wildfowl and waders present. Counts are then summed to give a total count for each estuary. Further details of BoEE methods are given by Prater (1981).

The criteria most widely used to assess the importance of a particular site, and that used in these analyses, are that a wetland is considered internationally important if it regularly supports 1% of the individuals in a population of one species or sub-species of waterfowl (Smart 1976, Spagnesi 1982). Similarly, a wetland in Britain is considered nationally important if it regularly holds at least 1% of the estimated British wintering population of one species or sub-species of waterfowl (Prater 1981), subject to there being a minimum of 50 individuals of that species present. In addition, a site regularly holding more than 10,000 wildfowl or 20,000 waders qualifies as internationally important by virtue of absolute numbers. Appendix 1 gives the appropriate qualifying levels for wildfowl and wader species for both categories of importance. Scientific names of all species mentioned in the text are given in Appendix 7.

Median and peak counts were used to indicate the importance of the study area to the various bird species. Thus, a median count of 100 birds indicates that on half of the visits to the study area, one would expect to count more than 100 birds. Where the counts of a particular species were erratic, resulting in a wide degree of variability, this is discussed. The median number of individuals of each species present in the study area during the feeding period (ie. non high tide periods, see below) was expressed as a percentage of the total estuary population, derived from monthly BoEE counts. Both the BoEE monthly counts and those made in this study are subject to a

number of inaccuracies, such as the possibility of not locating all the birds present, the inaccuracies of counting large numbers of birds and the inherent dynamics of estuary bird populations (influenced by the weather, height of tide, disturbance, daily movements etc.). Sources of error in shorebird counts are discussed by Prater (1979), Kersten et al (1981) and Rappoldt et al 1985, who show that such counts only estimate (with errors of up to 37%) the true numbers of birds present. These limitations must be taken into account in the interpretation of results presented.

For the analyses, the tidal cycle was divided into 'high' (1 hour either side of high tide), 'falling' (1-4 hours post-high tide), 'rising' (1-4 hours pre-high tide) and 'low' tide periods (from 4 hours post- to 4 hours pre-high tide). These divisions reflect the availability of the mudflats to feeding birds, such that they are completely unavailable during the high tide period, completely exposed during the low tide period, and uncovering or covering on the falling and rising tide respectively (Figure 3). Of the 48 counts obtained, 3 were made during the high tide period, 17 on the falling tide, 21 on the rising tide, and 7 during the low tide period. This allowed examination of the use made of the study area by birds at different states of tide.

Additional data for "White Sands" and the CEGB nature reserve were obtained and are presented in Appendices 5 & 6. The former data represent low tide, mid-winter counts conducted by the RSPB warden of Gayton Sands, whilst the latter are derived from the daily log-book of the Connah's Quay nature reserve. Entries to the reserve log-book are contributed by various observers who give details of counts done at various times of day and states of tide. The 'West hide' overlooks section M2 and section B, whilst the 'East hide' overlooks

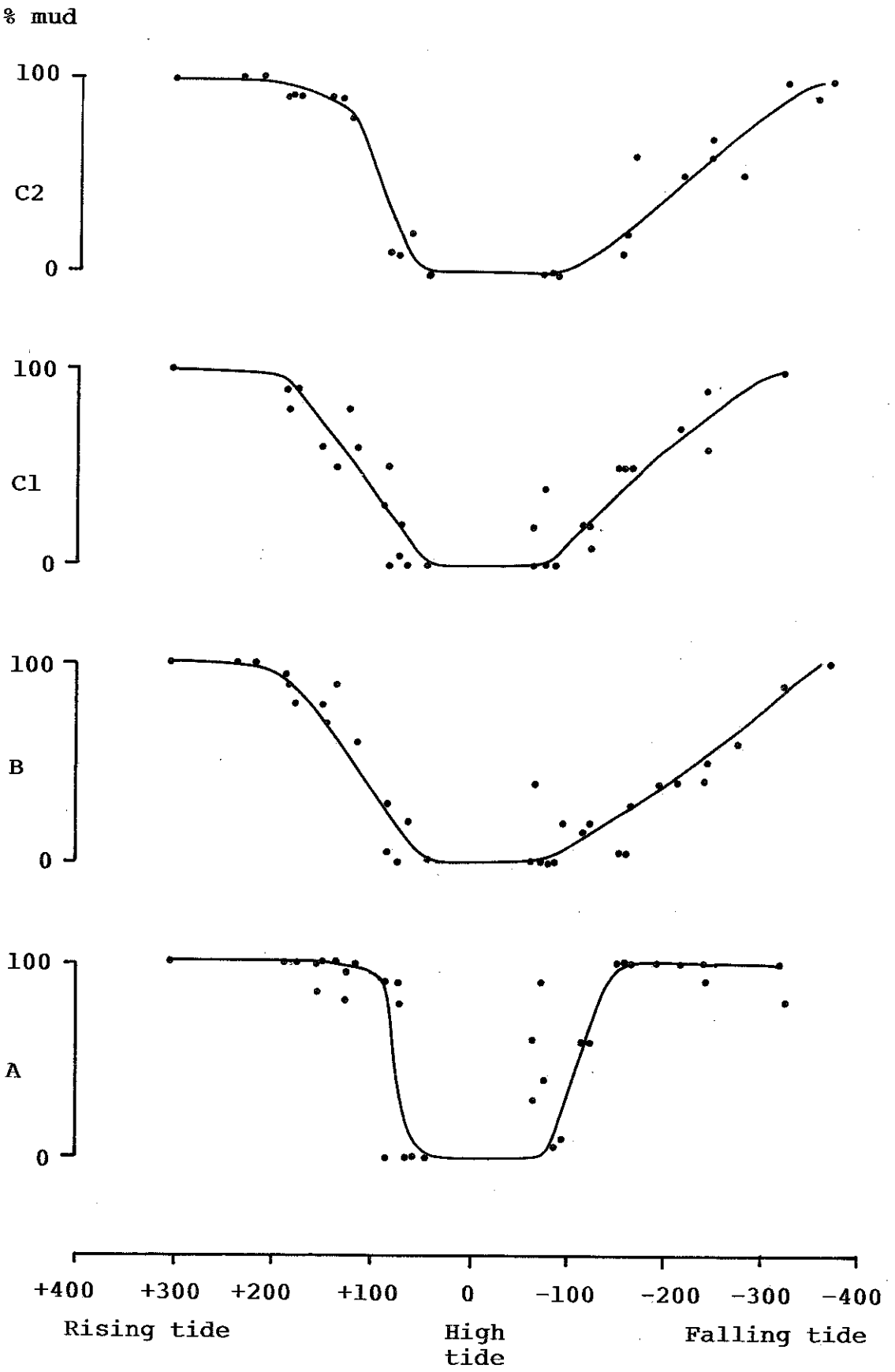


Figure 3. The pattern of tidal coverage of each section of the study area.

several small inland pools which were not recorded during the fieldwork for this study.

RESULTS

A. The importance of the Dee estuary to wildfowl and waders

The Dee is internationally important in terms of the total numbers of waders it supports (Table 1), with average all-year and winter peak counts of c. 94,000 and 83,000 birds respectively. Only the Wash, Morecambe Bay and, in some years, the Ribble regularly support more waders; the first two are considerably larger and hence the density of birds on the Dee is relatively high in comparison with these sites. The Dee is also nationally important in terms of the absolute numbers of wildfowl present, with an average all-year peak of 18,846 over the period 1981/82 to 1985/86 (D. Salmon, in litt.).

Table 1. Principal sites for waders in Britain (based on 1981/82 to 1985/86 BoEE counts).

Sites	Winter peak					
	1981/82	82/83	83/84	84/85	85/86	Mean
Wash	119,708	179,993	121,437	135,176	214,633	154,189
Morecambe Bay	-	104,943	128,179	148,645	145,348	131,779
Ribble	65,917	70,794	53,994	54,994	72,731	63,686
Dee	99,891	91,070	82,724	62,678	77,267	82,726
Humber	83,502	47,734	70,637	77,433	83,460	72,553
	All-year peak					
Wash	165,655	179,993	121,437	173,389	224,574	173,010
Morecambe Bay	-	105,330	159,893	177,025	155,591	149,460
Ribble	92,366	118,393	132,262	138,927	100,582	116,506
Dee	111,745	93,759	86,764	79,314	98,866	94,090
Humber	87,609	48,320	90,607	78,422	92,610	79,514

In terms of the species present, the Dee supports internationally important numbers of seven species of waders and three of wildfowl (Table 2): Oystercatcher, Grey Plover, Curlew, Black-tailed Godwit, Redshank, Knot, Sanderling, Teal, Pintail and Shelduck. In addition, the estuary is of national significance for a further two species of wader: Bar-tailed Godwit and Dunlin. Hence the estuary as a whole is of outstanding ornithological importance.

The December, January and February BoEE counts for 1981/82 to 1986/87 are given in Appendix 2a-c. Counts during 1986/87 were similar to those in previous years for many species. However, relatively few Oystercatchers were present in December, and Pintail were at very low levels. Conversely, good numbers of Grey Plovers, Turnstones, Redshanks and Mallards were present, whilst Lapwings, Curlews and Redshanks showed evidence of a cold weather exodus during January. At the same time, Wigeon numbers increased dramatically.

Table 2. The national and international significance of the Dee estuary to waders and wildfowl (based on 1981/82 to 1985/86 BoEE data).

	Average peak winter count (Nov-March)	% of British population	% of European population
Oystercatcher	33,659	12.0	4.5
Grey Plover	1,593	7.6	2.0
Curlew	2,873	3.2	1.0
Black-t. Godwit	775	15.5	1.9
Bar-t. Godwit	825	1.4	0.2
Redshank	3,695	4.9	1.9
Knot	22,679	10.3	6.5
Dunlin	17,242	4.0	0.9
Sanderling	311	2.2	2.1
Teal	3,498	3.5	1.8
Pintail	6,762	27.0	9.0
Shelduck	5,112	6.8	4.1

B. Numbers of wildfowl and waders within the study area

Numbers of each species present in the study area during December, January and February are given in Table 3. There was considerable variability in counts, both within and between months, which can be attributed largely to daily and seasonal movements of birds into and out of the study area.

Wildfowl

Four species of wildfowl, Mallard, Teal, Wigeon and Shelduck, occurred in sufficient numbers in the study area to merit attention (Table 3). Wigeon, however, were present only during the cold January weather, when numbers on the estuary as a whole increased dramatically (Appendix 2b). Mallard numbers were highest in December and January, when numbers in the study area represented 3-7% of the total estuary population. The numbers of Teal present were difficult to determine as they were often concealed within the many creeks over the marsh. Numbers recorded were highest in December, when the marsh was estimated to hold c. 23% of the total estuary population, although twice as many were recorded when each creek of the nature reserve area (section M2) was carefully searched on one day in the same month. The study area held 3-7% of the total estuary population of Shelduck (Table 3).

Waders

Oystercatchers, Black-tailed Godwits and Redshanks were the most abundant waders in the study area (Table 3), although relatively large numbers of Lapwings and Curlews were sometimes present.

Table 3. Numbers of birds recorded on the mudflats within the study area in December to February compared with the estuary as a whole.

Species	December			January			February		
	Median	(range)	% of Dee	Median	(range)	% of Dee	Median	(range)	% of Dee
Mallard	173	(30-300)	3.3	189	(60-350)	4.4	88	(19-236)	6.6
Shelduck	85	(14-366)	2.8	209	(97-441)	6.6	124	(40-243)	5.7
Teal	600	(0-1200)	23.4	110	(0-600)	5.5	175	(0-590)	11.7
Wigeon	0	(0-14)	0.0	850	(0-2130)	23.2	0	(0-26)	0.0
Pintail	0	(0-1)	0.0	0	(0-50)	0.0	0	(0-10)	0.0
R-b. Merg.	0		0.0	0	(0-9)	0.0	0		0.0
Shoveler	0		0.0	0		0.0	0	(0-2)	0.0
O'catcher	380	(100-735)	3.4	66	(0-720)	0.3	195	(13-768)	0.8
Lapwing	97	(0-330)	1.9	19	(0-250)	(29.2)	37	(0-282)	1.5
Grey Plover	0	(0-1)	0.0	10	(0-14)	1.2	0	(0-2)	0.0
Curlew	57	(0-104)	1.6	39	(8-63)	3.4	106	(10-170)	4.8
B-t. Godwit	350	(0-452)	86.4	10	(0-429)	1.3	1	(0-300)	0.6
Redshank	430	(330-825)	7.3	287	(60-640)	7.8	280	(0-614)	4.4
Dunlin	0	(0-40)	0.0	11	(0-35)	0.1	0	(0-10)	0.0
Snipe	0	(0-5)	0.0	0	(0-3)	0.0	0		0.0

There was considerable day-to-day variability in the numbers of Oystercatchers present (Table 3), with the largest numbers being most frequently recorded in December. Numbers dropped during the cold January weather, when a considerable proportion of the study area was frozen, and increased again in February. The study area held up to 3% of the total estuary population of Oystercatchers.

The numbers of Black-tailed Godwits in the study area were also very variable, although the pattern of variation was such that either only a few (≤10) were recorded or almost the entire flock (300-400) present on the Dee. In December, the study area held a high proportion (86%) of the total estuary population, but use made of the study area was less predictable both during and after the cold spell in January (Table 3). Up to 429 Black-tailed Godwits were recorded in January, constituting 56% of the total estuary population at this time.

Redshanks were the most abundant species of wader recorded in the study area (Table 3), the numbers present representing 4-8% of the total estuary population. Numbers were highest in December and declined through January and February. The peak count of 825 in December represented 14% of the total estuary population recorded in that month.

To conclude, Teal, Shelduck, Oystercatcher, Black-tailed Godwit and Redshank make sufficient use of the study area, and are sufficiently important in the context of the whole estuary, to warrant further detailed consideration. All are species which have internationally important populations on the Dee estuary.

C. Distribution of key wildfowl and wader species within the study area

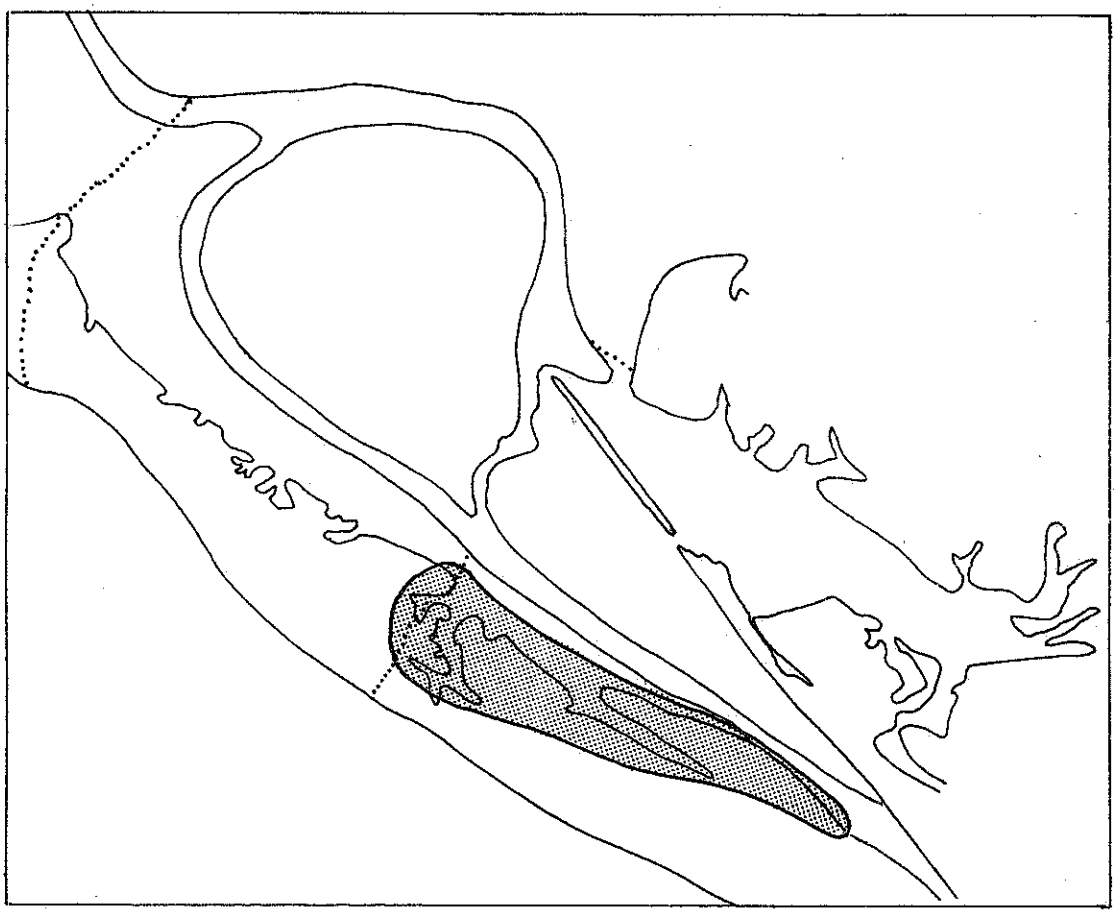
High tide roosts

Observations of movements suggested that the majority of birds feeding in the study area also roosted there, apart from Oystercatchers which often flew across the estuary towards Heswall to roost (Figure 6). The main high tide roost within the study area for all species except Teal was located in section M2, in the vicinity of the main creek. Teal remained dispersed over the marsh and on the sea during the high tide period (Figure 4). On the lower tides, small parties of Redshanks roosted in section M1 within the smaller creeks towards Flint Castle.

Distribution during the feeding period

The main feeding and low tide roosting areas of the five species, together with their patterns of movement within the study area, are shown in Figures 4-8. These figures provide generalized pictures only, as the numbers of feeding birds present in each section of the study area were highly variable, being subject to both seasonal (Table 4) and tidal (Table 5) influences.

Teal were largely confined to section M2 (Table 4), although up to a third of the individuals present were recorded in the inner part of section B (Figure 4) on the rising tide (Table 5). The peak count in this section during the study period was 1200 birds (Appendix 3), although up to 3,000 have previously been recorded from the West hide during 1985-86 (Appendix 6); 400-800 seems to be the usual count over



KEY: Main feeding and roosting area

Figure 4. Distribution of Teal across the study area.

this area. Smaller, though important numbers (up to 300) have also been recorded from the East hide (Appendix 6), and up to 250 were recorded in section C2 (White Sands) during this study (Appendix 3), though smaller numbers are normally present there (Appendices 3 & 5).

Shelducks were widespread throughout the study area except on the marsh, with section C1 being the most important feeding area overall (Figure 5, Table 4). Up to 200 have been recorded in section C2 in previous years (Appendix 5), although smaller numbers were recorded from both sources of information (Appendices 3 & 5) during the study period. Considerable numbers (up to 390) have been recorded from the West hide (Appendix 6), similar to the peak counts for the whole study area recorded in this study (Table 3). Few were recorded in section A during the cold January weather (Table 4) at which time this area was largely frozen over. The proportion of Shelducks recorded in each section varied with the tide (Table 5), with sections A and C1 holding the largest proportion of birds during the low tide period.

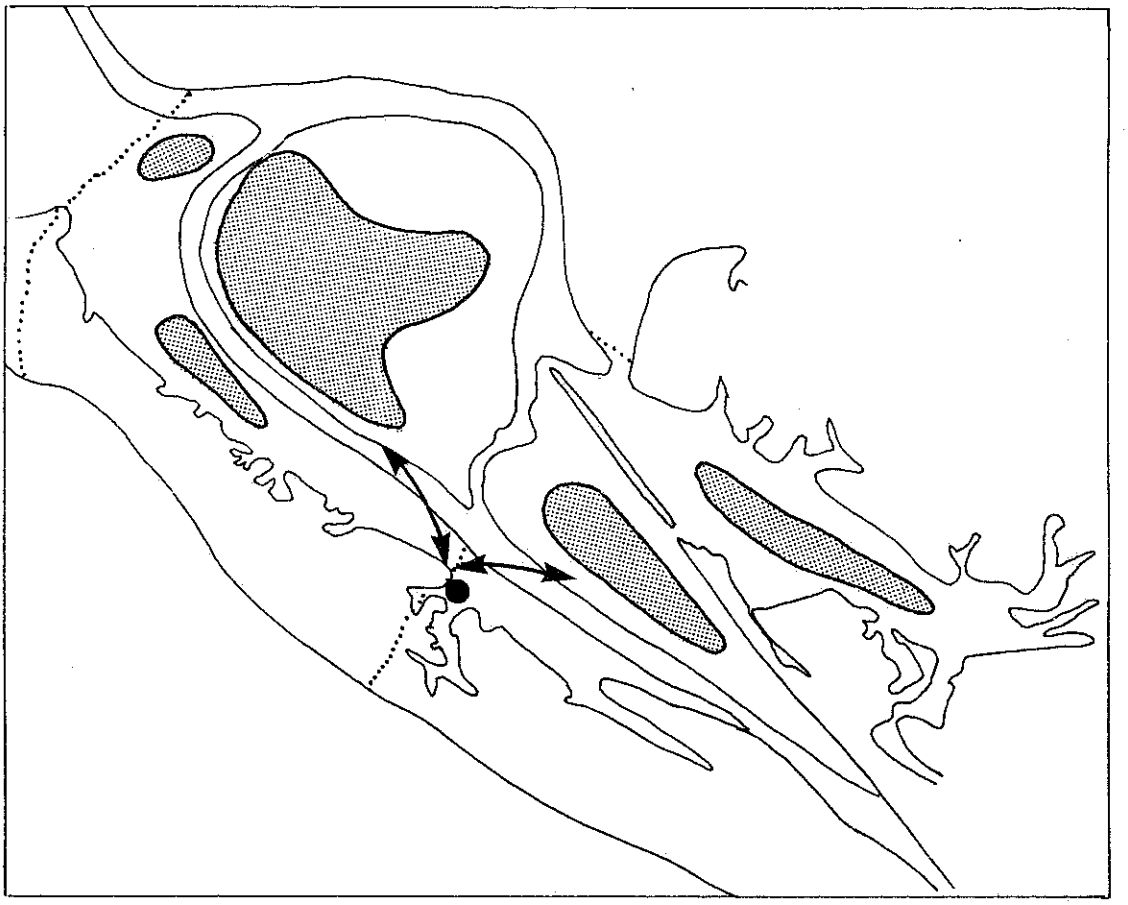


Figure 5. The locations of roosts, movements and feeding areas of Shelducks.

Table 4. The proportion (%) of individuals of the key species in each section of the study area during December, January and February.

Species	Month	A	B	C1	C2	M1	M2
Teal	D	0.0	0.0	0.0	0.0	0.0	100.0
	J	0.0	23.1	0.0	0.0	0.0	76.9
	F	0.0	33.3	0.0	0.0	0.0	67.7
Shelduck	D	21.8	11.5	43.7	23.0	0.0	0.0
	J	1.7	29.1	45.9	23.3	0.0	0.0
	F	32.4	19.0	20.0	25.7	0.0	2.9
Oystercatcher	D	16.8	5.7	77.5	0.0	0.0	0.0
	J	7.9	0.0	92.1	0.0	0.0	0.0
	F	2.4	0.0	74.4	23.2	0.0	0.0
Black-tailed	D	25.6	74.4	0.0	0.0	0.0	0.0
Godwit	J	0.0	33.3	67.7	0.0	0.0	0.0
	F	0.0	0.0	0.0	0.0	0.0	0.0
Redshank	D	56.1	9.9	33.0	1.0	0.0	0.0
	J	72.2	8.4	19.1	0.0	0.3	0.0
	F	57.7	7.2	34.6	0.5	0.0	0.0

Oystercatchers were recorded in all sections of the mudflats (Figure 6), although much the greatest proportion frequented section C1 (Table 4), especially during the falling and low tide periods (Table 5). Section C1 also held the main low tide roosts. The proportions in sections A and B increased on the rising tide as the birds were excluded from their feeding grounds in section C1 (Table 5). Section C2 held relatively small numbers of Oystercatchers (Appendix 3), although 329 were recorded there in January 1987 (Appendix 5). The numbers recorded from the West hide on the reserve varied considerably (Appendix 6) but were generally in the low hundreds, similar to that of this study (Table 3).

Black-tailed Godwits were recorded mainly in sections B and C1 (Table 4), often occupying low tide roosts in the former (Figure 7). The proportion recorded in section B in January decreased (Table 4) and the birds switched to feeding mainly in section C1, presumably because section B was more prone to freezing. The godwits were always present on the rising tide in section B (Table 5) which was close to the main roost site (Figure 7). Up to 1,000 Black-tailed Godwits have been recorded from the West hide over recent years (Appendix 6). They were rarely recorded in section C2 (Appendix 3).

The largest proportion of Redshanks in the study area were recorded in sections A and C1, the proportion in section A remaining high even during the cold January weather (Table 4). The proportion present in section A was highest on the rising tide, although considerable numbers occurred there throughout the tidal cycle (Table 5). The proportion in section C1 was highest during the falling and low tide periods when many birds moved out from section A which they had occupied as soon as the tide had allowed. Smaller numbers (up to 50) were recorded in section C2 (Appendix 3), which accords with the

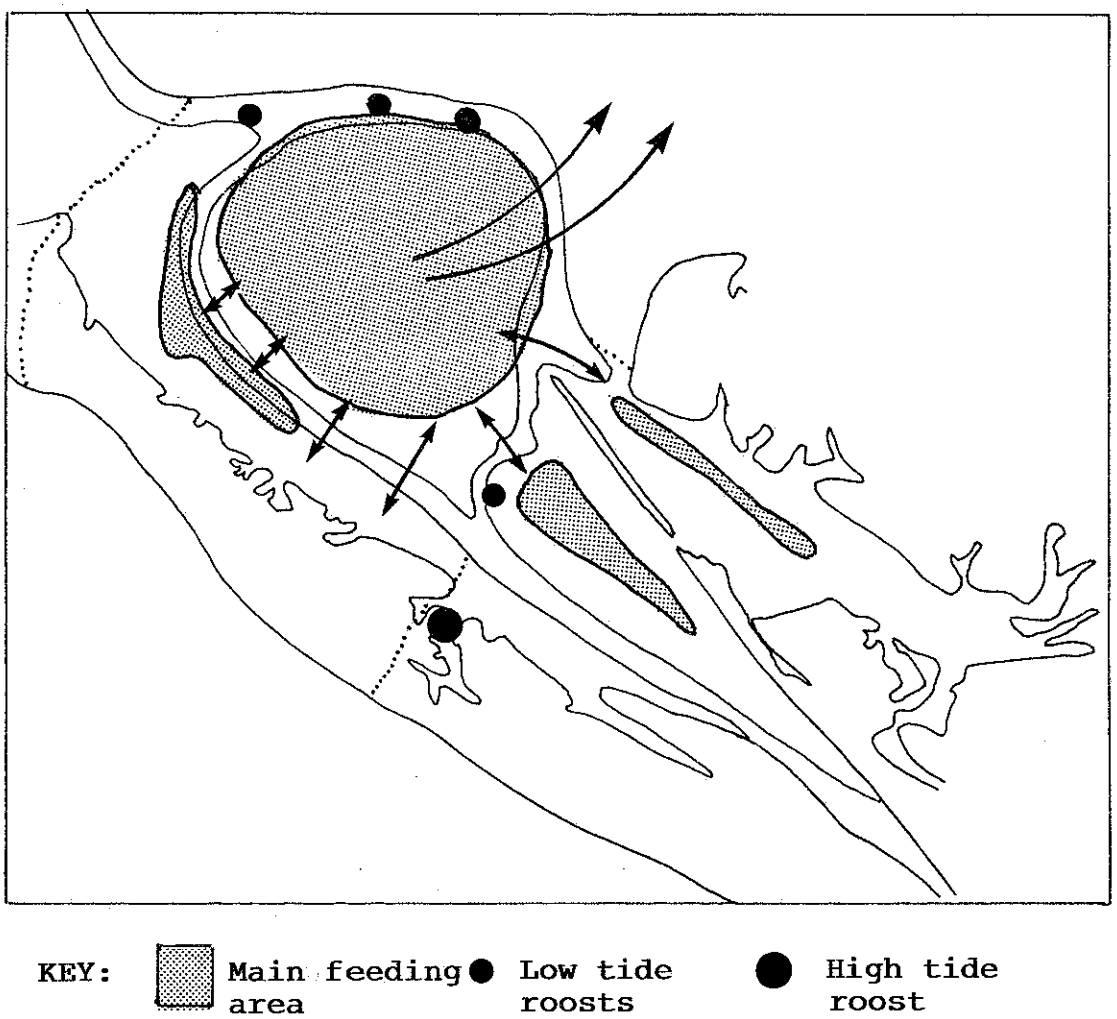


Figure 6. The locations of roosts, movements and feeding areas of Oystercatchers.

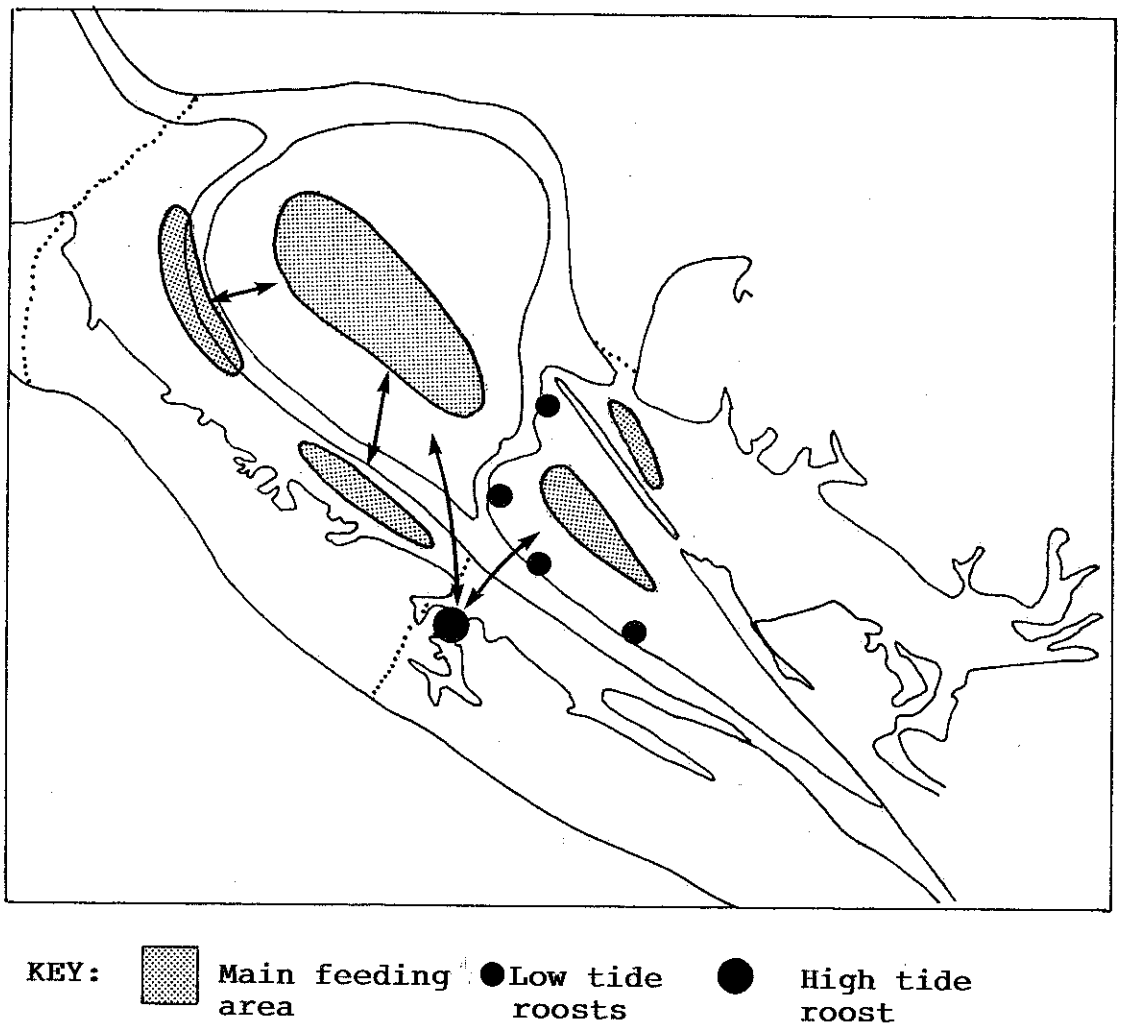


Figure 7. The locations of roosts, movements and feeding areas of Black-tailed Godwits.

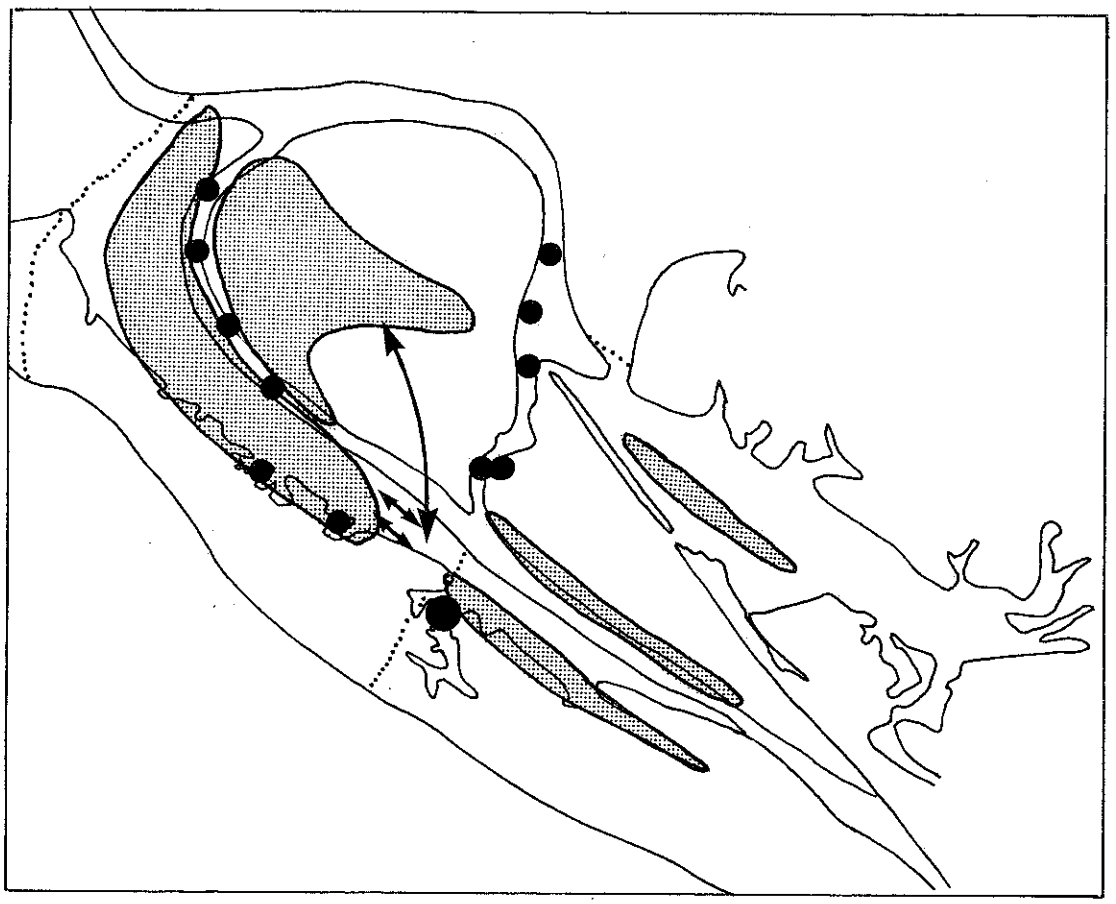


Figure 8. The locations of roosts, movements and feeding areas of Redshanks.

usual BoEE count given in Appendix 5. Up to 1,000 have been recorded from the West hide in November-December (Appendix 6).

Table 5. The proportion (%) of individuals of the key species in each section of the study area during low, rising and falling tide periods.

Species	Month	A	B	C1	C2	M1	M2
Teal	L	0.0	0.0	0.0	0.0	0.0	100.0
	R	0.0	33.3	0.0	0.0	0.0	67.7
	F	0.0	0.0	0.0	0.0	0.0	100.0
Shelduck	L	30.3	11.0	38.5	18.4	0.0	1.8
	R	18.8	25.0	37.5	18.7	0.0	0.0
	F	33.9	10.2	5.1	49.2	0.0	1.6
Oystercatcher	L	0.0	10.8	86.6	2.6	0.0	0.0
	R	10.3	21.6	60.8	7.3	0.0	0.0
	F	1.3	0.0	90.7	8.0	0.0	0.0
Black-tailed	L	0.0	0.0	0.0	0.0	0.0	0.0
Godwit	R	0.0	91.0	0.0	0.0	0.0	0.0
	F	0.0	0.0	0.0	0.0	0.0	0.0
Redshank	L	53.7	13.8	30.5	1.3	0.0	0.7
	R	71.8	17.3	9.9	1.0	0.0	0.0
	F	58.1	7.0	34.9	0.0	0.0	0.0

Human disturbance

Dog-walkers were recorded frequently in section M1, but rarely ventured close to the mudflats; section A was subject to some disturbance from them. In January, many wildfowlers were shooting on the other side of the estuary, causing some disturbance within the study area, but only rarely did they occur within the study area. Overall, disturbance within the study area was minimal.

DISCUSSION

The Dee estuary is of international significance for its wintering wildfowl and waders, a conclusion reached by many previous authors (eg. Buxton 1978, DECG 1979, Prater 1981). Based on 1981/82 to 1985/86 BoEE data, three species of wildfowl and seven species of waders are present in internationally important numbers. Prater (1981) listed nine species of waders as internationally important; three of these, Dunlin, Knot and Bar-tailed Godwit, have since undergone substantial declines on the estuary (Mitchell et al in prep) and only Knot still occur in internationally important numbers.

Good numbers of five of the species with internationally important populations in the Dee, Teal, Shelduck, Oystercatcher, Black-tailed Godwit and Redshank, winter within the study area. However, only Teal and Black-tailed Godwits have an appreciable proportion ($\geq$10%) of their total estuary populations within the study area, with up to 86% of the Dee's Black-tailed Godwits and 23% of the Dee's Teal occurring there during the period of study. At certain times, the area can hold far larger numbers of these species, as well as considerable numbers of Pintail (up to 2,000) and Lapwing (up to

1,000; Appendix 6). The area also supports up to 15 wintering Spotted Redshanks, which is a considerable proportion of the 40-80 normally found on U.K. estuaries (Salmon et al 1987), although this national wintering population is itself small on a European scale.

The marsh of the CEGB nature reserve (section M2) offers refuge to a considerable number of birds, mainly wildfowl. Virtually all the Teal present in the study area feed and roost on or adjacent to it, and it also supports the main wader roost. Beyond the reserve boundaries, the marsh extends towards Flint. However, here it supports very few birds, possibly because it is then subjected to greater human disturbance and the habitat is less varied than within the reserve. Foraging waders were distributed widely over the study area, but section C1 was by far the most important feeding area. Section B was also utilised to a considerable extent by the godwits and, on the rising tide in particular, by other species. Section A was important to Redshanks at all stages of the tide, and was used by many species as a last and first feeding area in the period immediately before and after high tide.

Without knowing how far onto the mudflats the road development will intrude, it is difficult to predict in detail its possible effects on the birds wintering within the study area. Ideally, if the development must take place, it should be confined to the marsh in section M1, which currently supports few birds. The road should not be allowed to cross either the nature reserve or the mudflats, which are the areas where the Black-tailed Godwits and Teal are concentrated.

Encroachment onto the mudflats by the road would seem most likely to occur in section A, in the vicinity of Flint Castle, itself a site of special historic interest. This would affect particularly the Redshanks, and might remove or reduce an area currently used as a first and last feeding area by a considerable number of birds. It is not known to what degree the Redshank depend on the extra feeding time afforded by section A, or whether displaced birds would be able to re-settle either within the study area or elsewhere on the estuary as a whole. The end result might well be a reduction in current levels of bird abundance. Relevant general information on the potential effects of habitat removal on estuarine birds is provided by Zwarts (1976), Prater (1978) and Goss-Custard (1979, 1980) but further, more detailed local studies would be needed to assess the implications of the removal of section A for birds present.

CONCLUSION

The Dee estuary is of international significance for its wintering wildfowl and waders. The Flint study area supports large numbers of Shelduck, Teal, Oystercatcher, Black-tailed Godwit and Redshank, all of which have internationally important populations on the Dee. The currently proposed route for the road development appears largely confined to an area of marsh (section M1) which supports relatively few birds in winter. However, any intrusion by road construction on to either the marsh of the nature reserve (section M2) or the mudflats would have potentially serious implications for wildfowl and wader populations which would require further, in-depth studies to assess adequately.

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Appendix 1. Qualifying levels for national and international importance. (from Salmon et al 1987).

	National	International
Mute Swan	180	1,200
Bewick's Swan	50	120
Whooper Swan	60	100
Bean Goose	-	700
Pink-footed Goose	1,000	1,000
European White-fronted Goose	60	2,000
Greenland White-fronted Goose	100	150
Greylag Goose: Iceland pop.	1,000	1,000
Barnacle Goose: Greenland pop.	200	300
Svalbard pop.	100	100
Dark-bellied Brent Goose	900	1,300
Shelduck	750	1,250
Wigeon	2,000	5,000
Gadwall	50	550
Teal	1,000	2,000
Mallard	5,000	20,000 **
Pintail	250	750
Shoveler	90	1,000
Pochard	500	2,500
Tufted Duck	600	5,000
Scaup	40 *	1,500
Eider	500	20,000 **
Long-tailed Duck	200	5,000
Common Scoter	350	10,000 **
Goldeneye	150	2,000
Red-breasted Merganser	100	400
Goosander	50	750

Appendix 1. (cont.)

Oystercatcher	2,800		7,500	
Avocet	5	*	260	
Ringed Plover	230	p=300	1,000	
Golden Plover	2,000		10,000	
Grey Plover	210		800	
Lapwing	10,000		20,000	**
Knot	2,200		3,500	
Sanderling	140	p=300	150	p=500
Purple Sandpiper	160		?	
Dunlin	4,300	p=2,000	20,000	**
Ruff	15	*	10,000	
Snipe	?		10,000	
Black-tailed Godwit	50		400	
Bar-tailed Godwit	610		5,500	
Whimbrel	-	p=50	500	
Curlew	910		3,000	
Spotted Redshank	2	*	500	
Redshank	750	p=1,200	2,000	
Greenshank	4	*	500	
Turnstone	450		500	

- British population very small.

* 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 10,000 wildfowl or 20,000 waders qualifies as internationally important by virtue of the absolute numbers.

Appendix 2a. The numbers of wildfowl and waders on the Dee estuary during December, 1981/2 to 1986/87.

	1981	1982	1983	1984	1985	Mean	1986
Mallard	1340	2200	4950	4480	4455	3485	5325
Teal	1750	925	2920	3310	4480	2677	2565
Wigeon	870	2015	330	910	999	1025	1130
Pintail	5335	7325	8975	6280	5800	6743	2565
Shoveler	5	4	5	7	5	5	5
Pochard	0	24	35	7	10	15	0
Goldeneye	21	38	62	6	4	26	3
Shelduck	1980	3075	4855	4460	4850	3844	3075
Red-b. Merganser	17	13	19	14	16	16	8
Oystercatcher	25125	28430	30360	18940	38000	28171	11300
Lapwing	1570	4925	4320	6950	8125	5178	5175
Ringed Plover	60	200	66	69	38	87	56
Grey Plover	650	1490	625	820	872	891	1000
Turnstone	3	12	3	40	386	89	565
Curlew	1745	2015	1775	1770	4680	2397	3510
Black-t. Godwit	34	350	1285	82	245	399	405
Bar-t. Godwit	3480	40	6	3	79	722	146
Redshank	2680	3185	1790	2074	3305	2607	5920
Knot	25315	10680	14230	6765	7210	12840	5920
Dunlin	16380	21135	21950	9920	8800	15637	10640

Appendix 2b. The numbers of wildfowl and waders on the Dee estuary during January, 1981/2 to 1986/87.

	1982	1983	1984	1985	1986	Mean	1987
Mallard	480	2825	(5045)	2630	3855	2967	4320
Teal	95	1140	(3815)	2650	3485	2237	2010
Wigeon	180	141	(316)	1601	1230	694	3660
Pintail	5395	2655	(7970)	6000	5400	5484	3740
Shoveler	0	39	(30)	6	9	17	3
Pochard	0	6	(31)	119	0	31	0
Goldeneye	1	13	(14)	12	0	8	14
Shelduck	1070	2555	(4060)	718	4265	2534	3160
Red-b. Merganser	6	11	(4)	7	8	7	5
Oystercatcher	42505	24030	(16120)	19600	26700	25791	20700
Lapwing	380	-	(3660)	166	1810	1504	65
Ringed Plover	0	21	(2)	48	27	20	0
Grey Plover	115	560	(700)	682	730	557	856
Turnstone	8	0	(25)	37	890	192	616
Curlew	2135	1210	(2600)	768	1760	1695	1150
Black-t. Godwit	1290	0	(1150)	171	165	552	773
Bar-t. Godwit	1055	116	(0)	25	28	245	37
Redshank	1615	1410	(1475)	1547	3435	1896	3685
Knot	4300	10240	(17960)	19500	7280	11856	12170
Dunlin	5400	11780	(8250)	8000	8240	8334	12300

Appendix 2c. The numbers of wildfowl and waders on the Dee estuary during February, 1981/2 to 1986/87.

	1982	1983	1984	1985	1986	Mean	1987
Mallard	1420	620	2941	2951	3580	2302	1340
Teal	760	195	818	2090	1930	1159	1500
Wigeon	300	655	297	534	837	525	520
Pintail	4510	5175	4500	3580	3416	4236	2500
Shoveler	2	0	8	8	0	4	4
Pochard	0	0	0	55	0	11	1
Goldeneye	2	8	8	6	0	5	3
Shelduck	1470	730	2900	1510	5670	2456	2170
Red-b. Merganser	2	19	7	5	18	10	47
Oystercatcher	23350	22380	28657	12600	31500	23697	24600
Lapwing	4325	170	2001	2035	1974	2101	2475
Ringed Plover	81	155	26	50	52	73	63
Grey Plover	720	610	846	420	1905	900	800
Turnstone	52	21	35	25	645	156	620
Curlew	2545	1075	1822	2435	2438	2063	2210
Black-t. Godwit	385	500	1050	371	430	547	180
Bar-t. Godwit	285	130	208	19	73	143	3
Redshank	2880	2110	2672	1170	3001	2367	6415
Knot	6525	3930	11200	6885	10150	7738	6970
Dunlin	9670	13370	10890	8660	7510	10020	8100

Appendix 3. Number of birds of each key species (see text) in each section of the study area through the winter. Values are medians and range.

Species	Month	A	B	C1	C2	M1	M2	Medians
Teal	D	0	0 (0-200)	0 (0-120)	0 (0-250)	0	750 (300-1200)	750
	J	0 (0-5)	30 (0-400)	0 (0-10)	0	0	100 (100-300)	130
	F	0	50 (0-550)	0	0 (0-85)	0	100 (0-170)	150
Shelduck	D	19 (0-80)	10 (0-96)	38 (0-240)	20 (2-78)	0	0	87
	J	3 (0-103)	50 (0-92)	79 (0-208)	40 (0-84)	0	0	172
	F	34 (0-150)	20 (0-134)	21 (0-79)	27 (0-64)	0	3 (0-17)	105
Oyster-catcher	D	65 (0-400)	22 (0-450)	300 (0-510)	0 (0-3)	0	0	387
	J	3 (0-250)	0 (0-400)	35 (0-700)	0 (0-20)	0	0	38
	F	3 (0-554)	0 (0-142)	93 (0-780)	29 (0-75)	0	0 (0-11)	125
Black-tailed Godwit	D	20 (0-310)	58 (0-400)	0 (0-350)	0	0	0	78
	J	0	5 (0-429)	10 (0-64)	0	0	0	15
	F	0 (0-50)	0 (0-300)	0	0 (0-140)	0	0 (0-30)	0
Redshank	D	340 (85-800)	60 (10-230)	200 (0-395)	6 (2-20)	0 (0-20)	0	606
	J	215 (0-450)	25 (0-100)	57 (0-331)	0 (0-50)	1 (0-1)	0 (0-1)	298
	F	120 (0-800)	15 (0-167)	72 (0-470)	1 (0-40)	0	0 (0-230)	208

Appendix 4. Number of birds of each key species (see text) in each section of the study area according to state of tide.

Values are medians and range.

Species	Tide	A	B	C1	C2	M1	M2	Medians
Teal	L	0	0 (0-200)	0	0	0	80 (30-100)	80
	R	0 (0-5)	50 (0-500)	0 (0-120)	0 (0-250)	0	100 (30-300)	150
	F	0	0 (0-550)	0	0 (0-40)	0	100 (0-1200)	100
Shelduck	L	33 (15-80)	12 (0-92)	42 (12-192)	20 (2-32)	0	2 (0-8)	109
	R	30 (0-92)	40 (0-134)	60 (0-240)	30 (8-84)	0	0 (0-17)	160
	F	20 (0-150)	6 (0-43)	3 (0-75)	29 (0-80)	0	1 (0-5)	59
Oyster-catcher	L	0 (0-80)	30 (2-110)	240 (151-332)	7 (0-47)	0	0	277
	R	10 (0-554)	21 (0-450)	59 (0-780)	7 (0-75)	0	0	97
	F	1 (0-480)	0 (0-100)	68 (0-300)	6 (0-35)	0	0 (0-11)	75
Black-tailed Godwit	L	0	0 (0-291)	0 (0-10)	0	0	0	0
	R	0 (0-300)	91 (0-429)	0 (0-300)	0 (0-140)	0	0 (0-30)	91
	F	0 (0-310)	0 (0-255)	0 (0-350)	0 (0-2)	0	0	0
Redshank	L	160 (57-330)	41 (10-152)	91 (20-395)	4 (0-20)	0 (0-20)	2 (0-4)	298
	R	145 (0-800)	35 (0-230)	20 (0-270)	2 (0-50)	0 (0-1)	0 (0-10)	202
	F	250 (85-800)	30 (0-200)	150 (0-470)	0 (0-40)	0 (0-1)	0 (0-230)	430

Appendix 5. Numbers of wildfowl and waders recorded at White Sands in mid-winter, 1985-1987 (data from BoEE per C. Wells).

Species	1985			1986			1987		
	D	J	F	D	J	F	D	J	F
Mallard	250	110	-	58	140	80	-	46	32
Teal	50	50	-	22	15	50	-	3	26
Wigeon	20	0	0	0	70	2	-	167	7
Pintail	0	2000	-	0	170	60	-	1	1
Shelduck	200	80	-	31	97	84	-	147	54
Oystercatcher	0	0	-	0	0	30	-	329	4
Lapwing	800	0	-	35	0	2	-	4	67
Curlew	130	30	-	72	30	247	-	85	35
Redshank	250	5	-	29	30	70	-	18	15
Dunlin	10	0	-	0	3	0	-	1	0

Appendix 6. Maximum monthly counts of bird species recorded on the CEGB nature reserve at Connah's Quay in 1985 (above) and 1986 (below).

Species	West hide					East hide				
	J	F	M	N	D	J	F	M	N	D
Cormorant	52	33	47	45	55	22	5	5	15	3
Shelduck	350	174	185	90	390	70	100	17	1	1
Wigeon	300	400	75	20	50	6	17	0	0	0
Teal	3000	400	300	1250	600	300	225	28	49	45
Mallard	850	450	70	600	344	100	130	15	120	57
Pintail	250	78	30	1750	12	12	7	0	2	0
Hen Harrier	1	2	0	0	1	0	1	1	1	1
Merlin	1	2	1	1	2	1	0	1	1	1
Peregrine	2	1	1	1	2	1	0	1	1	1
Oystercatcher	175	175	260	100	150	0	100	6	22	0
Lapwing	200	500	80	1000	400	105	200	20	500	250
Dunlin	41	150	60	100	200	7	0	0	0	0
Blk-t. Godwit	2	225	450	375	315	0	0	0	2	0
Curlew	30	50	85	35	42	3	6	2	12	12
Sp. Redshank	7	2	2	7	5	0	0	0	6	0
Redshank	50	100	550	1000	400	7	33	22	10	24
Skylark	250	100	25	300	70	8	1	2	3	20
Fieldfare	0	4	0	0	5	20	70	0	2	25
Redwing	0	4	0	0	8	30	100	4	6	20
Chaffinch	0	0	0	200	250	200	50	30	300	300
Brambling	1	0	0	0	40	0	0	0	1	100
Linnet	100	60	200	400	45	130	0	5	60	10
Twite	0	0	110	0	0	0	0	0	0	0
Yellowhammer	40	6	0	1	2	55	65	0	0	0
Cormorant	30	18	24	58	33	10	0	2	4	7
Shelduck	250	130	65	53	336	3	5	15	0	2
Wigeon	250	800	510	0	14	0	0	21	0	2
Teal	1500	500	550	750	500	24	42	30	70	100
Mallard	600	200	160	300	300	55	19	55	23	20
Pintail	12	90	1000	30	2000	1	0	1	0	0
Hen Harrier	1	1	0	0	0	1	1	0	0	0
Merlin	2	2	1	2	0	1	0	2	0	1
Peregrine	1	1	1	1	1	0	0	0	0	0
Oystercatcher	140	500	3000	500	531	1	0	2	0	0
Lapwing	200	400	120	300	350	300	63	30	230	316
Dunlin	2	50	150	30	100	0	0	0	0	0
Blk-t. Godwit	220	1000	260	200	400	0	0	0	80	60
Curlew	30	80	100	123	70	9	2	10	18	2
Sp. Redshank	2	1	2	4	15	1	1	1	7	1
Redshank	500	30	300	1000	1000	50	18	30	27	28
Skylark	200	100	4	50	42	12	1	12	0	0
Fieldfare	0	20	2	0	0	10	15	30	50	25
Redwing	0	4	0	0	0	50	100	50	0	10
Chaffinch	150	35	0	0	0	6	100	25	150	50
Brambling	28	50	0	0	50	150	200	1	12	30
Linnet	50	40	120	12	15	20	75	1	20	15
Twite	0	20	0	0	0	0	0	0	0	0
Yellowhammer	0	0	0	0	0	0	2	0	0	6

Appendix 7. Scientific names of birds mentioned in the text.

Shelduck	Tadorna tadorna
Wigeon	Anas penelope
Teal	Anas crecca
Mallard	Anas platyrhynchos
Pintail	Anas acuta
Red-breasted Merganser	Mergus serrator
Oystercatcher	Haematopus ostralegus
Ringed Plover	Charadrius hiaticula
Grey Plover	Pluvialis squatarola
Lapwing	Vanellus vanellus
Knot	Calidris canutus
Sanderling	Calidris alba
Dunlin	Calidris alpina
Black-tailed Godwit	Limosa limosa
Bar-tailed Godwit	Limosa lapponica
Curlew	Numenius arquata
Spotted Redshank	Tringa erythropus
Redshank	Tringa totanus
Turnstone	Arenaria interpres