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POOLE BRIDGE REPLACEMENT ENVIRONMENTAL IMPACT ASSESSMENT:

ORNITHOLOGICAL STUDIES

R.M. Ward

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A REPORT TO DORSET COUNTY COUNCIL

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POOLE BRIDGE REPLACEMENT ENVIRONMENTAL IMPACT ASSESSMENT: ORNITHOLOGICAL STUDIES

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POOLE BRIDGE REPLACEMENT ENVIRONMENTAL IMPACT ASSESSMENT: ORNITHOLOGICAL STUDIES

LIST OF TABLES

LIST OF FIGURES

1. GENERAL INTRODUCTION

Holes Bay lies within Poole Harbour, the wintering grounds for at least 12 species of wildfowl and waders in nationally important numbers. These populations are maintained on the rich supply of estuarine invertebrates made available to feeding birds on the exposure of the Harbour's intertidal mudflats. Reclamation reduces those feeding areas, and also the sites used for high tide roosts. The impact of such developments on the bird community not only depends on the size of area reclaimed, but on its prey density and on the length of time it is available during a tidal cycle to foraging birds.

Dorset County Council is proposing to construct a road crossing across the southern part of Holes Bay, as well as undertaking land reclamation and the relocation of an existing marina in the same area. This report is aimed at assessing the likely impact of these proposals on the estuarine bird community of Poole Harbour and, in particular, of Holes Bay. An analysis of count and ringing data first examines the importance of Poole Harbour to its' populations from a national and international standpoint. This allows the identification of those populations most at risk through the seasons to developments within the Harbour. The long-term variability of these populations in Poole Harbour is then examined and site preference on a whole estuary scale assessed. Species of importance in Holes Bay are subsequently identified, their recent population trends within the Bay examined, and site preference on a within-estuary scale assessed. A quantitative estimate of the loss to each species of feeding time in Holes Bay as a result of the proposed developments is made. The importance of the areas likely to be lost to roosting birds is also given consideration.

Goss-Custard & Durrell (1983) have previously assessed the ornithological importance of Holes Bay and the likely impact of reclamation along the eastern shore. On a wider scale, Harvey & Bradford (1984) and Collins (1985, 1986) have assessed the populations and distribution of estuarine birds along the southern shore of Poole Harbour and throughout the Harbour, respectively. These studies form the background against which the findings of the present study have been assessed.

2. STUDY AREA

Poole Harbour, the estuary of the Frome and Piddle, is the largest and most important estuary in Dorset (Figure 2.1 and 2.2). The area of this drowned valley is about 3,700ha and is reputed to be the world's second largest natural harbour. It is sheltered through being nearly landlocked, having a narrow sea entrance about 350m wide at its eastern end. The 100km (62 miles) of convoluted shoreline comprise a series of peninsulas, bays and islands. Owing to its very shallow nature, about 80% of the Harbour is intertidal. Fine silt and clay cover the majority of the Harbour, with shingle along some of the higher parts of the northern shore of the Arne Peninsula and on the Hamworthy shore. During, this century an increasing deposition of sand has occurred in Sandbanks Bay.

The conurbations of Poole, Hamworthy and Parkstone fringe the northern shoreline, from the Harbour's entrance to Lytchett Bay. The western and southern shores are bordered by heath and marshland nature reserves (Studland National Nature Reserve (NNR), Arne RSPB reserve, Hartland NNR, Holton Heath NNR, Brownsea Island Dorset Naturalist's Trust reserve), farmland and conifer plantations. Public access along these two shorelines is restricted to the eastern shore of Brands Bay and a small area of Arne.

Holes Bay, situated to the north-west of Poole, is linked to Poole Harbour's northern shore by a deep narrow channel (Fig 2.3). Land reclamation for urban & industrial development has reduced the intertidal area of Holes Bay from 329ha in 1924 (Gray & Pearson 1984) to ca 250ha currently. Invasion of Poole Harbour's intertidal area by *Spartina anglica* since ca 1901 has further reduced the extent of Holes Bay's open mudflats; however, from a peak coverage in the early 1920's of 208 ha, the *Spartina* marsh has steadily contracted to approximately 73 ha at present (Gray & Pearson 1984).

The mudflats and saltmarshes of Poole Harbour are a Grade 1 Nature Conservation Review (NCR) site (Ratcliffe 1977). Holes Bay's north-west shore, including Pergins Island, lies within Poole Borough Council's Upton Country Park boundary. The Holes Bay relief road, opened in May 1988, lies along the Bay's east flank. Overlooking the Bay's southern entrance are a Marine engineering works, a Timber yard, and the disused Power Station. Extending along the western shoreline from the Power Station to the railway embankment, which bisects the Bay, is a housing estate on the edge of which Cobbs Quay Marina is currently situated.

Relatively little freshwater flows into Holes Bay, with only a small stream emptying into the Bay's north end. There is evidence that the discharging of trade effluents and sewage into Holes Bay is having a serious deleterious effect. This includes the contamination of shellfish with toxic metals and an excessive growth of the alga *Ulva lactuca* due to elevated

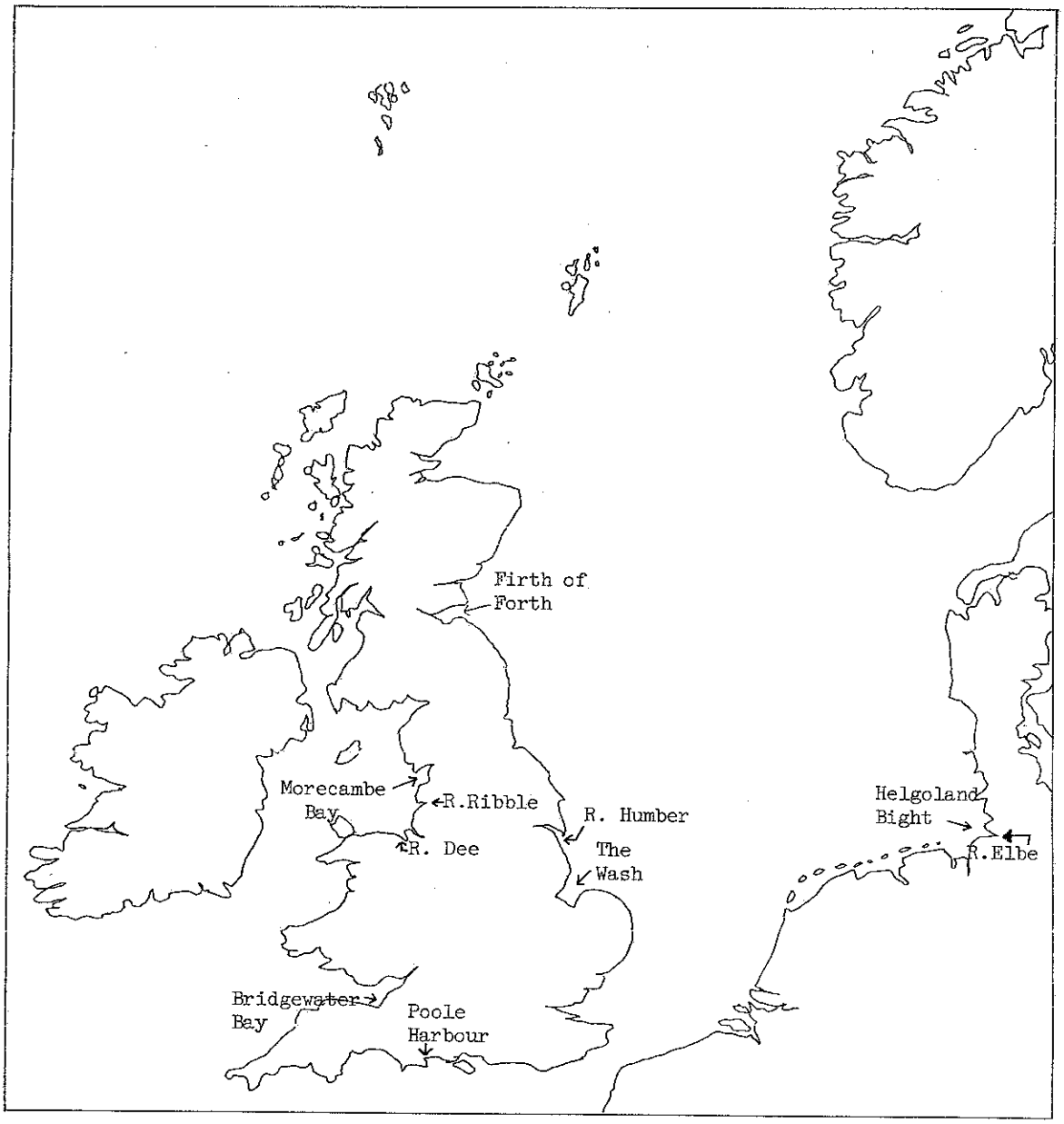


Figure 2.1 A map showing the locations of European places named in this report.

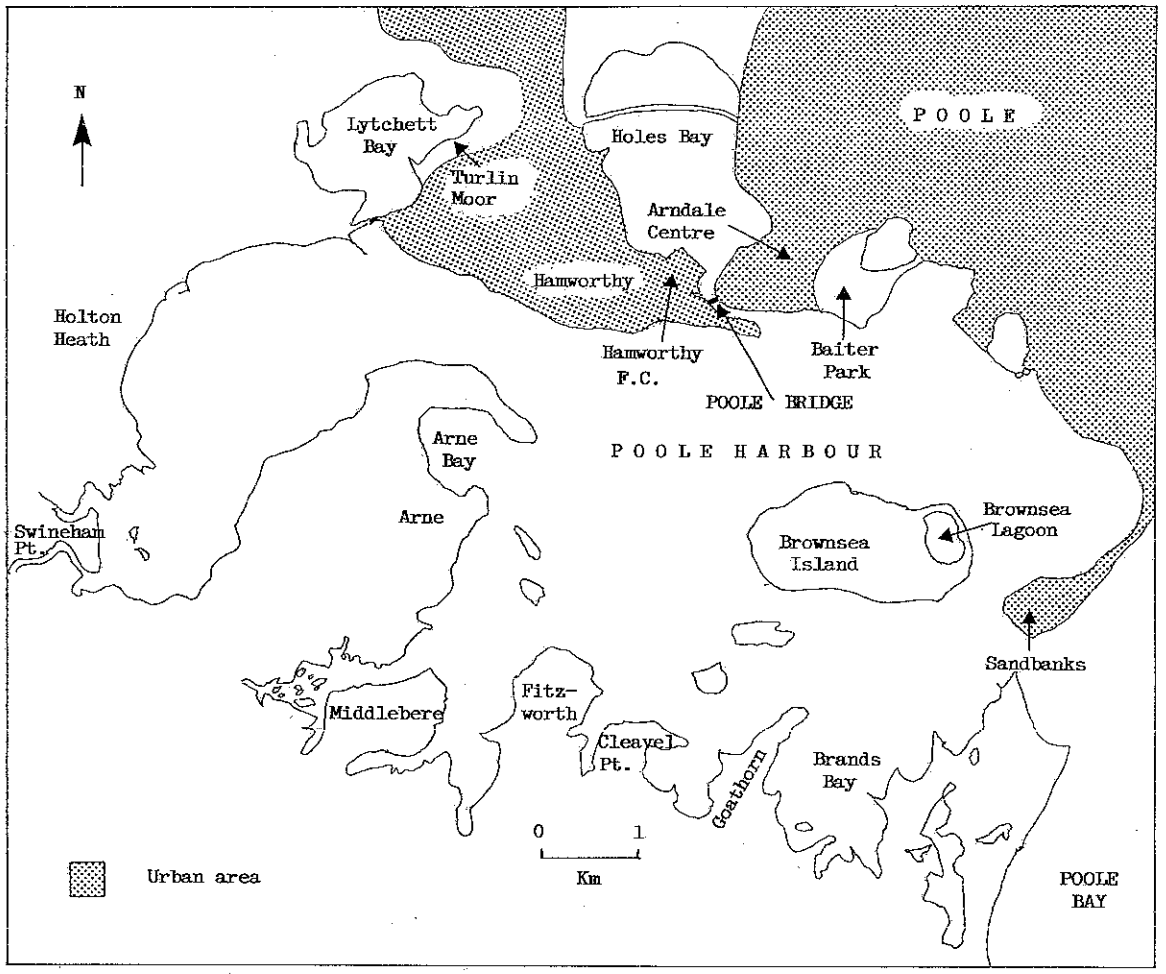


Figure 2.2 A map of Poole Harbour

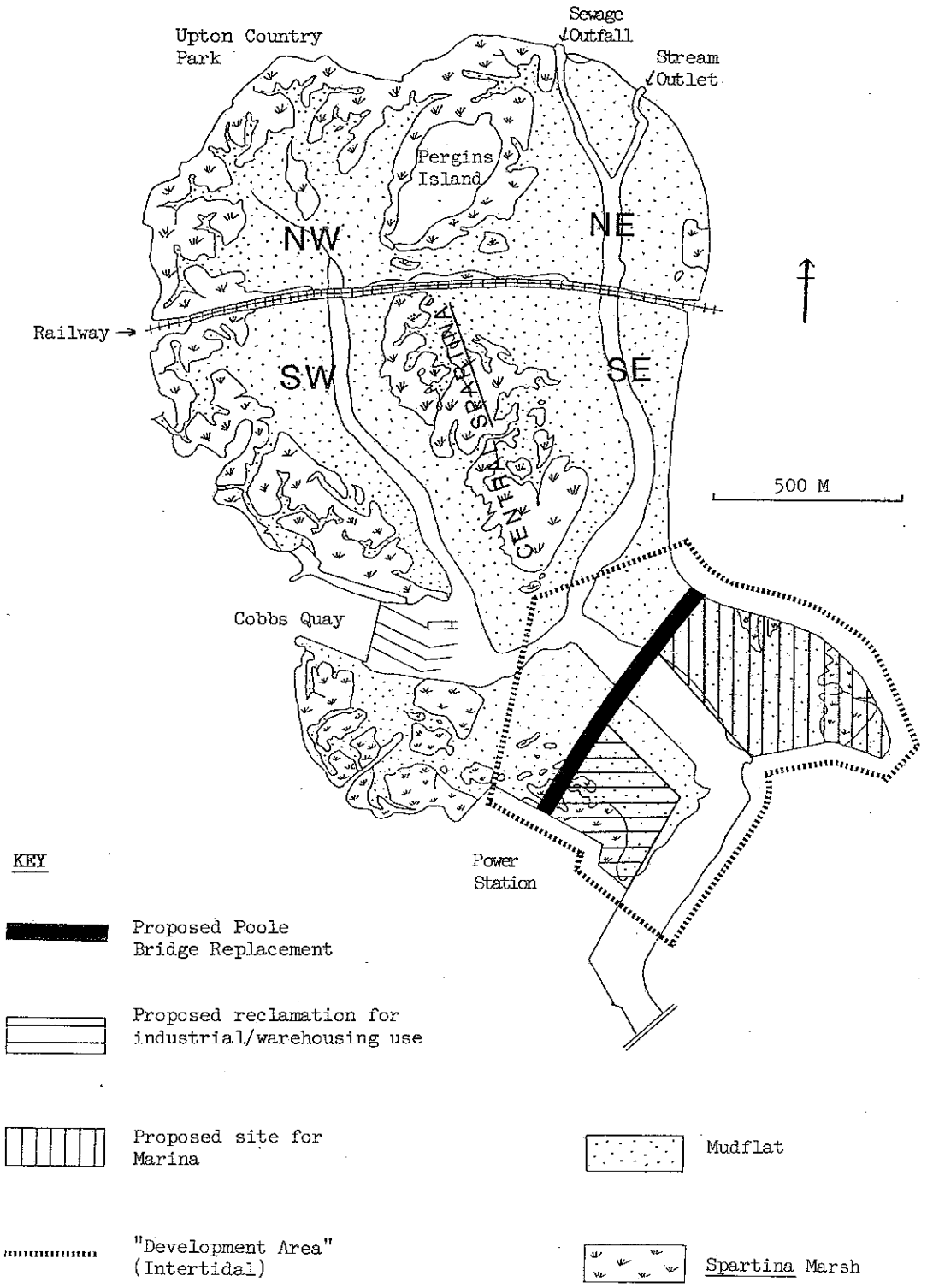


Figure 2.3 A map of Holes Bay showing the positions of the proposed developments.

nutrient inputs (Syratt 1984). Sewage outfalls are situated at Sterte and on the northern shore.

Poole Harbour's tidal regime is influenced by the currents around the Isle of Wight, resulting in two high and one low tides per 12 hour cycle. The tidal range is small as a consequence of the double tidal sequence. For spring tides, high water occurs 4 and 7 hours after low water. For neap tides, this timing alters respectively to 3 and 8-9 hours after low water. The heights of the two high waters within a cycle also differ, the first being the higher on springs and vice versa for neaps. No significant low water state occurs between the two high waters.

The actual tidal height attained frequently differs from that predicted, due to the influence of the prevailing weather conditions (Lookers 1987). A barometric pressure of 982mb results in a tidal height +0.3m higher than predicted, whereas at 1038mb the difference is -0.3m. Wind velocity may further alter the actual tidal height attained. A force 10 wind from a direction west round to north-east results in a 0.1 m reduction from the predicted height, and for the remaining directions induces a +0.2 m rise.

Though there is public access to the majority of the shoreline of Holes Bay, disturbance is minimal. Movement of yachts & boats within the bay is generally restricted to the main channels south of the railway, with the commuting of vessels between their moorings (Cobbs Quay & the main channels) and Poole Bridge. A low intensity of wildfowling occurs during the winter weekends.

3. GENERAL METHODOLOGY

For the purposes of the study, the year was divided into four periods: breeding season, autumn passage, winter, and spring passage. The precise timing of these varies according to species, in order to take account of differences in the timing of annual cycle events among them (Table 3.1). The biological basis for each period is as follows:

Breeding season: The timing of a species' breeding season largely depends on the latitude of its breeding grounds. In Britain, the breeding season starts in April, although some birds may return to the breeding grounds as early as the second half of February; for most birds, breeding has finished by late June. By contrast, in arctic Greenland the breeding season does not start until early June, when the snow finally begins to melt, and birds leave the breeding grounds between mid July and mid September.

Autumn passage: This is spread over some months, often with several waves of migration even within a species. The failed breeders leave the breeding grounds first, followed by successful breeders and, finally, juveniles. Many species halt in western Europe to undergo their annual moult before moving on to wintering grounds elsewhere, although some populations, especially those wintering in Africa, do not start moulting until they reach their winter quarters.

Winter: This always spans December and January, the period when populations tend to be most stable. Depending on the species, birds arrive on their winter quarters in October or November, with most remaining until March, although some birds may move towards their breeding grounds in February.

Spring passage: This is a period of rapid movement. If the distance between wintering area and breeding grounds is short, birds may fly directly between the two. For populations migrating over larger distances, birds may stage at refuelling sites en route.

The spring passage period is not separable as a discrete period for all species in southern Britian. For these species, the year is divided between the three remaining periods defined above. For conciseness, the four periods are referred to in the text as Summer, Autumn, Winter and Spring.

TABLE 3.1 The timing of the seasons used in this report for each species.

	Breeding season	Autumn Migration	Winter	Spring Passage
Shelduck	Apr-Jun	Jul-Oct	Nov-Mar	
Teal	Apr-Jul	Aug-Oct	Nov-Mar	
Oystercatcher	Apr-Jul	Aug-Oct	Nov-Mar	
Avocet	Apr-Jul	Aug-Oct	Nov-Mar	
Ringed plover	Jun-Jul	Aug-Sept	Oct-Mar	Apr-May
Grey Plover	Jun-Jul	Aug-Sept	Oct-Mar	Apr-May
Knot	Jun-Jul	Aug-Sept	Oct-Mar	Apr-May
Dunlin	Jun	Jul-Sept	Oct-Mar	Apr-May
Bar-tailed Godwit	Jun-Jul	Aug-Sept	Oct-Mar	Apr-May
Black-tailed Godwit	May-Jun	Jul-Oct	Nov-Feb	Mar-Apr
Whimbrel	Jun	Jul-Sept	Oct-Mar	Apr-May
Curlew	Apr-Jun	Jul-Sept	Oct-Mar	
Redshank	Apr-Jun	Jul-Sept	Oct-Mar	
Black-headed Gull	May-Jun	Jul-Oct	Nov-Feb	Mar-Apr

Data from the British Trust for Ornithology's scheme for monitoring Britain's estuary birds, the Birds of Estuaries Enquiry (BoEE), are frequently drawn upon in this study. The methodology of this survey, which began in 1969, is documented in Prater (1981). For each estuary, a team of amateur ornithologists undertake a synchronized count, normally at high tide, towards the middle of each month. Depending on the estuary, coverage may extend year-round, but is predominately within the period September-March. Some estuaries are considered as single sites whereas others, especially large estuaries, are split into several sites. Poole Harbour's BoEE counts began in 1970/71 and have continued since with gaps in occasional years.

The most commonly used criterion for assessing the conservation importance of an estuary to waterfowl is the so-called "1% level" (Prater 1981, Salmon *et al*. 1988). A wetland, *e.g.* an estuary, 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 waterfowl also qualifies. Britain's and Ireland's wildfowl belong to the north-west European populations, and the waders to the west European. A wetland in Great Britain is considered Nationally Important if it regularly holds 1% of the estimated British population of one species or subspecies of waterfowl. Table 3.2 gives the qualifying levels for both categories of importance for those species of wildfowl and waders which regularly occur in Poole Harbour. Throughout this report, the use of the terms national and international importance refer solely to the criteria defined above.

The locations of sites named in the report within Western

Europe, Poole Harbour and Holes Bay are shown in the Figures 2.1, 2.2 and 2.3 respectively. Figure 2.3 also shows the position of Dorset County Council's proposed developments in Holes Bay: a road bridge, land reclamation for industrial/warehousing use, and the relocation of a marina. The term "Development Area" in this report refers to the proposed development site and adjacent intertidal areas at risk from disturbance as a result of the proposed developments (Figure 2.3).

Table 3.2 Qualifying Levels for National and International Importance (from Salmon *et al*. 1988).

Species	National (G.B.)	International
Great Crested Grebe	100	?
Mute Swan	180	1,200
Bewick's Swan	50	120
European White-fronted Goose	60	2,000
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	700	20,000**
Goldeneye	150	2,000
Red-breasted Merganser	100	400
Coot	1,000	1,000
Oystercatcher	2,800	7,500
Avocet	5*	260
Ringed Plover	230 (Passage:300)	400 (Passage:1,000)
Grey Plover	210	180
Lapwing	10,000	20,000**
Knot	2,200	3,500
Sanderling	140 (Passage:300)	150 (Passage:500)
Purple Sandpiper	160	500
Dunlin	4,300 (Passage:2,000)	20,000**
Ruff	15*	10,000
Snipe	?	10,000
Black-tailed Godwit	50	400
Bar-tailed Godwit	610	5,500
Whimbrel	ξ(Passage:50)	500
Curlew	910	3,000
Spotted Redshank	2*	500
Redshank	750 (Passage:1,200)	2,000
Greenshank	4*	500
Turnstone	450	500

ξ 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.

4. THE MIGRATION PATTERNS AND ORIGINS OF DORSET'S WADERS, TEAL AND SHELDUCK

4.1 INTRODUCTION

Poole Harbour is utilized as a wintering or migratory resting area by the great majority of the wader and wildfowl populations that visit it. For those species which do breed in Poole Harbour, Dorset generally lies at the southern fringe of their respective breeding ranges and their populations present are small. The importance of Poole Harbour both nationally and internationally for wintering waders, Shelduck and Teal is summarized in Table 4.1. Though Shelduck was the only wildfowl species that I was contracted to study, Teal were found to be of importance in Holes Bay and were therefore included where possible in the study.

From analysis of ringing and count data, in conjunction with available literature, the migration patterns and origins of Teal, Shelduck and the important intertidal wader species utilizing Poole Harbour are discussed in this chapter. This has allowed identification of those populations that are potentially most at risk from developments in Poole Harbour, as well as the seasonal timing of the maximum potential disturbance risk.

4.2 METHODS

The intertidal wader species considered for analysis were those having recorded average peak BoEE counts in Poole Harbour of more than 50 over the five winters 1983/4-87/88, as listed in Table 4.1. The Avocet was also included as its wintering population in Poole Harbour has rapidly increased in recent years, and it appears to be establishing a potentially nationally important population. Whimbrel were also considered in the analysis, since more than 50 (qualifying level for national importance) regularly occur during autumn and spring passage in Poole Harbour, although not during winter.

4.2.1 RINGING DATA

Though ringing data up to and including 1986 from the whole of Dorset were used in the analysis, the vast majority relates to Poole Harbour. Recoveries were assigned to the appropriate regions shown in Figures 4.1 and 4.2, the names of which are given in Table 4.2. The term "recovery" as used below refers both to birds ringed in Dorset and subsequently recovered anywhere, and to birds ringed away from Dorset and subsequently recovered in the County.

TABLE 4.1 The national and international importance of Poole Harbour for wintering intertidal waders, Shelduck and Teal, based on available data from 1983/4-87/8.

	Average Peak Count (Nov-Mar)	% of British Population	% of European Population
Shelduck *Tadorna tadorna*	2106	2.8	1.7
Teal *Anas crecca*	771	0.8	0.4
Oystercatcher *Haematopus ostralegus*	1379	0.5	0.2
Avocet *Recurvirostra avosetta*	29	ξ5.8	0.1
Ringed Plover *Charadrius hiaticula*	82	0.4	0.2
Grey Plover *Pluvialis squatarola*	378	1.8	0.5
Knot *Calidris canutius*	66	$<$0.1	$<$0.1
Dunlin *Calidris alpina*	3900	0.9	0.2
Bar-tailed Godwit *Limosa lapponica*	254	0.4	$<$0.1
Black-tailed Godwit *Limosa limosa*	729	15.2	1.8
Curlew *Numenius arquata*	1102	1.2	0.4
Redshank *Tringa totanus*	740	1.0	0.4

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

An additional 8 species (Sanderling *Calidris alba*, Purple Sandpiper *Calidris maritima*, Ruff *Philomachus pugnax*, Whimbrel *Numenius phaeopus*, Curlew Sandpiper *Calidris ferruginea*, Spotted Redshank *Tringa erythropus*, Greenshank *Tringa nebularia*, Green Sandpiper *Tringa ochropus*, Common Sandpiper *Actitus hypoleucos* and Turnstone *Arenaria interpres*) had recorded average peak winter counts of 50 or less over the period in question.

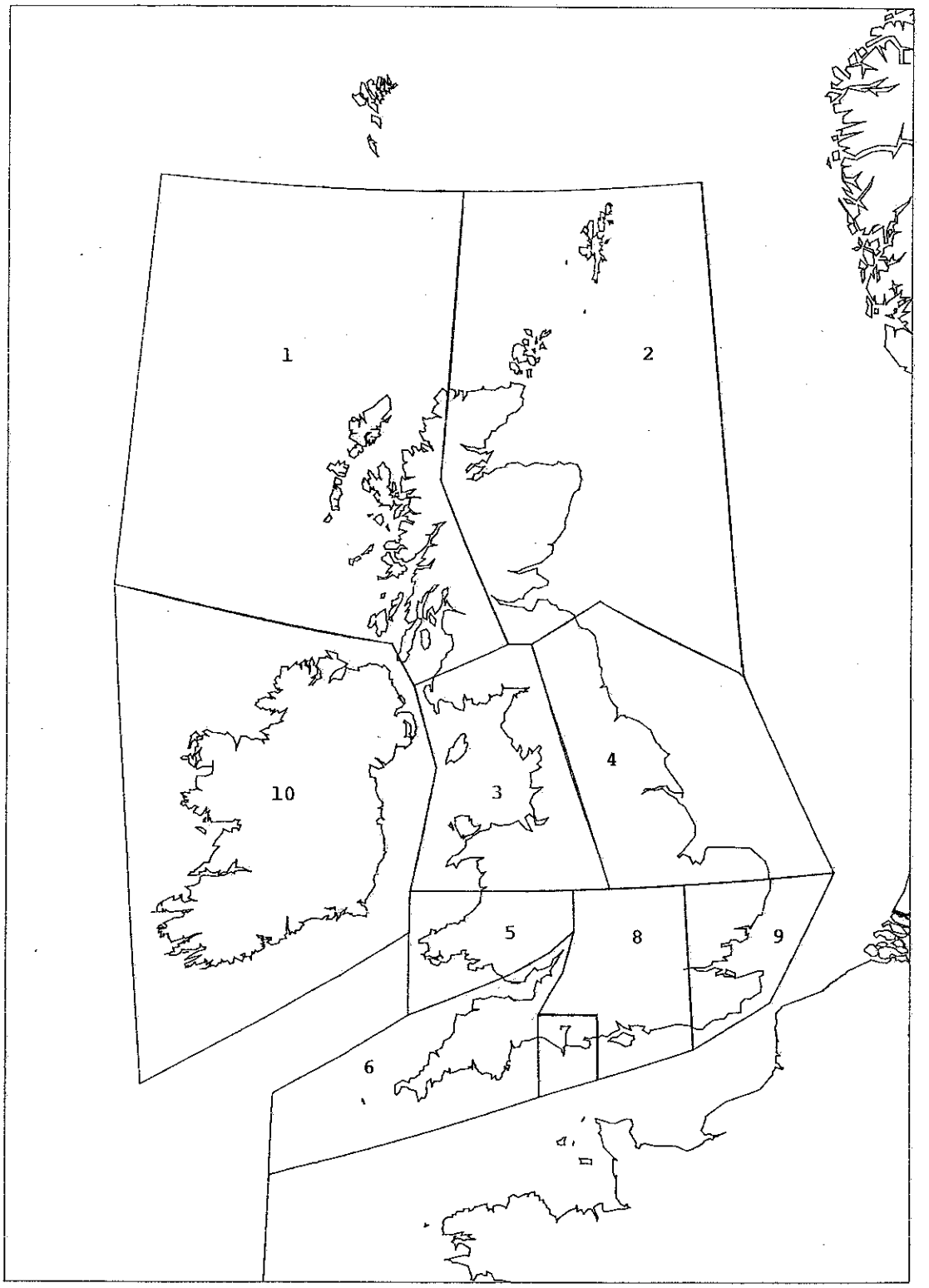


Figure 4.1 Regions of Britain used in this report. The names for each region are given in Table 4.2

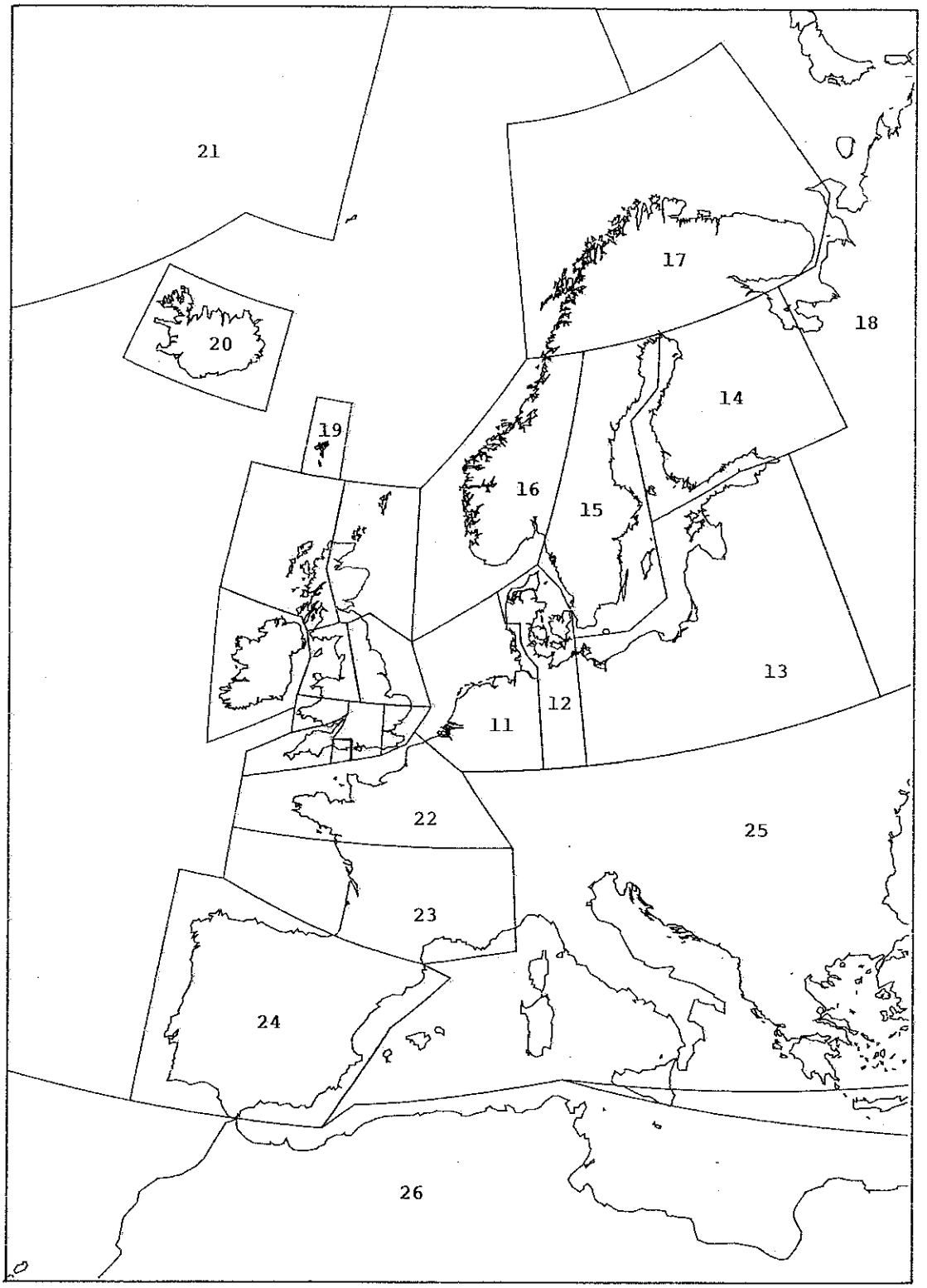


Figure 4.2 Regions of Europe used in this report. The names for each region are given in Table 4.2

TABLE 4.2 The regions used in the ringing analysis. The numbers refer to those in Figures 4.1 and 4.2.

1	West Scotland
2	East Scotland
3	Irish Sea
4	East England
5	South Wales
6	South-West England
7	Dorset
8	South England
9	South-east England
10	Ireland
11	Waddensea
12	Denmark
13	South Baltic
14	Finland
15	Sweden
16	Norway
17	Lapland
18	U.S.S.R.
19	Faeroes
20	Iceland
21	Greenland
22	North France
23	South France
24	Iberia
25	Central Europe
26	West Africa

The age of the bird is noted when it is ringed using the following categories: pullus, a young bird not yet fledged; juvenile, a bird in its first autumn or winter of life; first summer, a bird in its first summer of life; adult, a bird in adult plumage but not necessarily of breeding age. The majority of pulli of all species considered return to their natal area to breed, therefore pulli are regarded as birds from known breeding areas throughout.

For reasons described in the General Methodology (Chapter 3), the year was split into three or four periods depending on the species: summer, autumn , winter, and spring.

4.2.2 COUNT DATA

The count data used for analysis comprised the following:

Birds of Estuaries Enquiry: Poole Harbour's average monthly counts for the five year period July 1983 - June 1988. For all wader species, the year July 1983 - June 1984 had to be excluded, due to an incomplete data set.

RSPB research data: The highest monthly counts (low or high water) in Poole Harbour from a RSPB/BP Ornithological Survey 1984-86 (Collins 1986).

County Bird Reports: The two above data sets comprise monthly counts, which are unlikely to pick up peak populations at times of rapid passage by birds through the Harbour. Therefore the available maximum monthly counts for the period 1983-87 have been extracted from the County Bird Reports and presented as well.

The three data sets are tabulated and presented for each species at the head of their respective accounts. In these tables, 4.3 -4.15, a hyphen represent the absence of any count data and a zero the recording of no birds during the count(s).

The analysis incorporates examination and interpretation of the above data for the individual species in relation to broader current understanding of the species' seasonal movements and origins (e.g. Sharrock 1976; Prater 1981; Evans et al. 1984; Lack 1986). Figure 2.1 shows the geographical location of places referred to in the text.

4.3 SPECIES ACCOUNTS

4.3.1 SHELDUCK (Tadorna tadorna)

Shelduck breed around the coasts of north-west Europe, parts of the Mediterranean and the Middle East, although in recent times they have increasingly colonised inland areas (Cramp & Simmons 1977). The majority of British birds inhabit estuaries with extensive areas of intertidal mud and sand flats. The surface of the intertidal mud contains the Shelduck's main prey, the snail Hydrobia ulvae. The species nests in burrows and under bushes near the shore.

Most adult and some immature European Shelduck migrate to the Helgoland Bight between late June and early August to complete their annual moult. A comparatively minor moulting flock of ca 4-5000 birds also gathers in Bridgewater Bay, Somerset (Madge & Burn 1988), with smaller concentrations on the Dee, Forth, Humber and Wash. Thus, during August and September, only juveniles are to be found along the remaining coastline of Britain. From October to December, British Shelduck drift back to their British wintering grounds. Some Continental birds also winter here and comprise of about a quarter of the peak national BoEE count in January (Owen et al. 1986). The Continental birds depart from Britain by March, leaving the British breeding stock which disperses to their territories in April.

Two of the 15 Dorset recoveries suggest the autumn moulting grounds of the county's breeding birds to be the Waddensea area. Both records are of birds recovered in autumn in the vicinity of the Elbe estuary, West Germany. The recoveries of Dorset pulli in winter along the east coast of Britain must comprise birds making the slow return passage from these moulting grounds (Figure 4.3). The Poole Harbour count data (Table 4.3) clearly reflect this slow return passage, with a gradual increase in population from September (when predominantly immatures are present) to a peak in January/February which also includes wintering Continental birds. Assuming the March count represents solely British breeding stock, and that the breeding birds do not disperse to their territories until April (Owen et al.1986), Poole Harbour's wintering population of Continental origin may at times exceed 500 birds. The only known foreign-bred bird to be recovered in Dorset was a first-winter bird, ringed as a juvenile in Denmark.

In 1986, at least 28 pairs of Shelduck bred within Poole Harbour (Cade 1987). Prendergast & Boys (1983) estimated between 50 - 70 pairs normally breed in the Harbour. At least three pairs bred successfully in Holes Bay in 1988. All the ringing recoveries of Dorset-bred birds in their first year show very local post-natal dispersion, though a bird in its second winter was recovered in south-west France (Figure 4.4).

Table 4.3 Monthly counts of Shelduck in Poole Harbour.

MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
BoEE MEAN COUNT 1983-88	-	-	98	234	413	811	1873	1538	881	-	-	-
RSPB PEAK COUNT 1984-5	-	-	-	-	500	700	2700	2600	2300	1200	-	-
1985-6	400	180	120	250	900	1200	2200	2800	2250	1300	800	-
DORSET BIRD REP. MAXIMUM 1983-7	-	-	200	347	493	848	3590	2513	1664	339	198	48

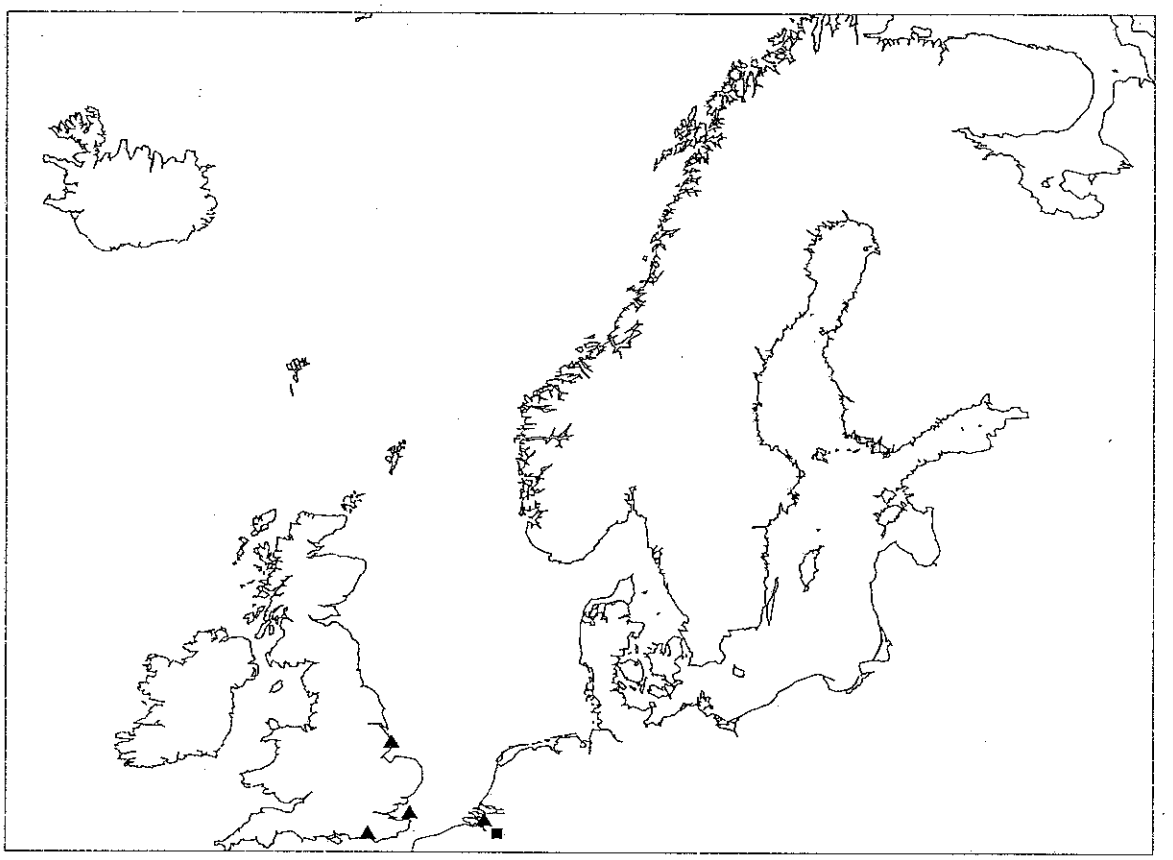


Figure 4.3 Winter recoveries of Shelduck ringed in Dorset in the breeding season.

▲ Ringed as pulli in Dorset and recovered elsewhere in winter.

■ Ringed as adult in Dorset and recovered elsewhere in winter.

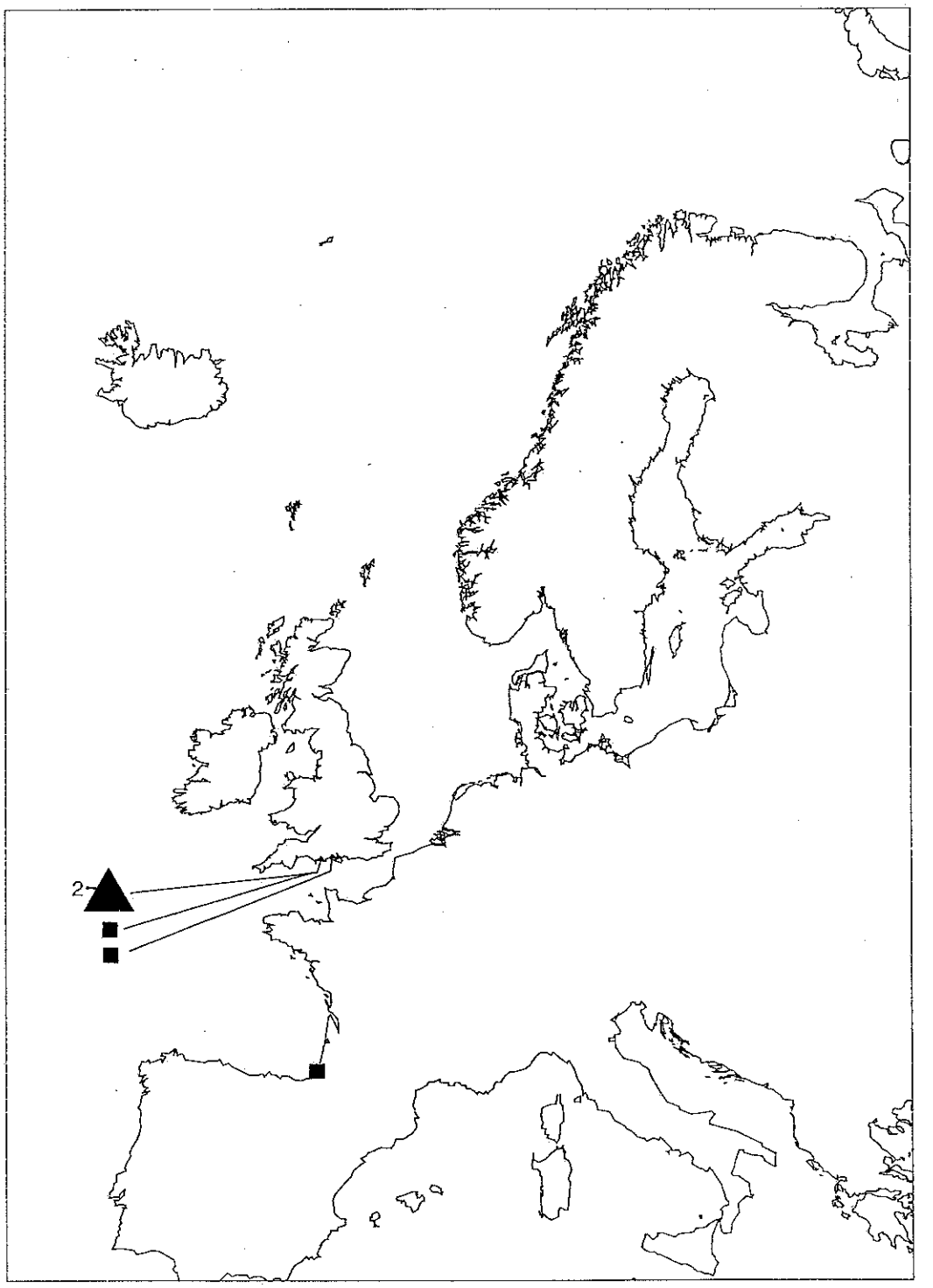


Figure 4.4 Recoveries relating to juvenile Shelduck present in Dorset in autumn.

▲ Ringed in Dorset in autumn and recovered in autumn.

■ Ringed in Dorset in autumn and recovered in winter.

4.3.2 TEAL (Anas crecca)

British-breeding Teal are largely sedentary, normally remaining in this country to winter and moving only in severe weather to western France and Spain. The remaining 85% of Britain's wintering Teal population are immigrants, originating from Russia, Fenno- Scandia, and central Europe; Icelandic Teal winter predominantly in Ireland and Scotland. Female Teal tend to winter further south than males.

The count data generally reflect the seasonal variation nationally (Table 4.4). Immigrants begin to move into Britain from August, the main influx occurring in October/November. A mid-winter peak is attained in December. The majority of wintering Teal depart northwards in March/April. At least one pair of Teal normally breeds in Poole Harbour.

4.3.3 OYSTERCATCHER (Haematopus ostralegus)

Oystercatchers wintering in Britain originate from several breeding areas. Those wintering along the Irish Sea coasts are largely derived from the Scottish/Faeroese/Icelandic breeding populations, whilst those on the east coast are of eastern North Sea origin, predominantly Norway. Birds wintering in southern Britain come predominantly from the British breeding population, but include some birds from the Waddensea, Icelandic and Faeroese breeding populations. Small numbers of British-breeding adults and many juveniles winter in France and Iberia.

From the large number of Dorset-ringed Oystercatchers recovered in successive winters in the county (Appendix Table 1), it would suggest the majority of birds tend to be faithful to their wintering area. Oystercatcher populations in Poole Harbour peak during November - January, the majority having arrived in September (Table 4.5). Late arrivals to the Harbour are probably part of the mid-winter influx of eastern North Sea birds. This is supported by some of Dorset's winter-ringed Oystercatchers having been recovered on Norwegian breeding grounds (Figure 4.5, Appendix Table 1). Otherwise, the ringing recoveries show Dorset's wintering birds to originate from the geographical breeding areas described above for birds wintering in southern Britain. In addition, an individual was also recovered in the breeding season in Greenland and is the only recovery of an Oystercatcher ringed in Britain from that country. The two breeding season recoveries within Dorset (2 adults, Appendix Table 1 and 2) were ringed in the county in autumn/winter.

A proportion of the North Sea population may moult on the Wash before their arrival on the south coast, as suggested by a concentration of recoveries on the Wash, East England, in August (Figure 4.6, Appendix Table 1).

British Oystercatchers begin returning to their breeding grounds in late January. Nationally, the Oystercatcher

Table 4.4 Monthly counts of Teal in Poole Harbour.

MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
BoEE MEAN COUNT 1983-8	-	-	151	328	442	642	612	312	328	-	-	-
RSPB PEAK COUNT 1984-5	-	-	-	-	550	800	1000	1000	700	350	0	-
1985-6	2	250	200	100	1400	800	1100	1100	800	450	0	2
DORSET BIRD REP. MAXIMUM 1983-7	8	180	190	978	770	800	925	872	457	174	2	4

Table 4.5 Monthly counts of Oystercatcher in Poole Harbour.

MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
BoEE MEAN COUNT 1984-8	-	-	962	1095	761	1284	814	583	542	-	-	-
RSPB PEAK COUNT 1984-5	-	-	-	-	700	630	900	900	850	400	-	-
1985-6	600	700	975	900	1225	1100	900	850	800	310	300	-
DORSET BIRD REP. MAXIMUM 1983-7	270	600	893	1029	900	1445	969	964	700	310	222	166

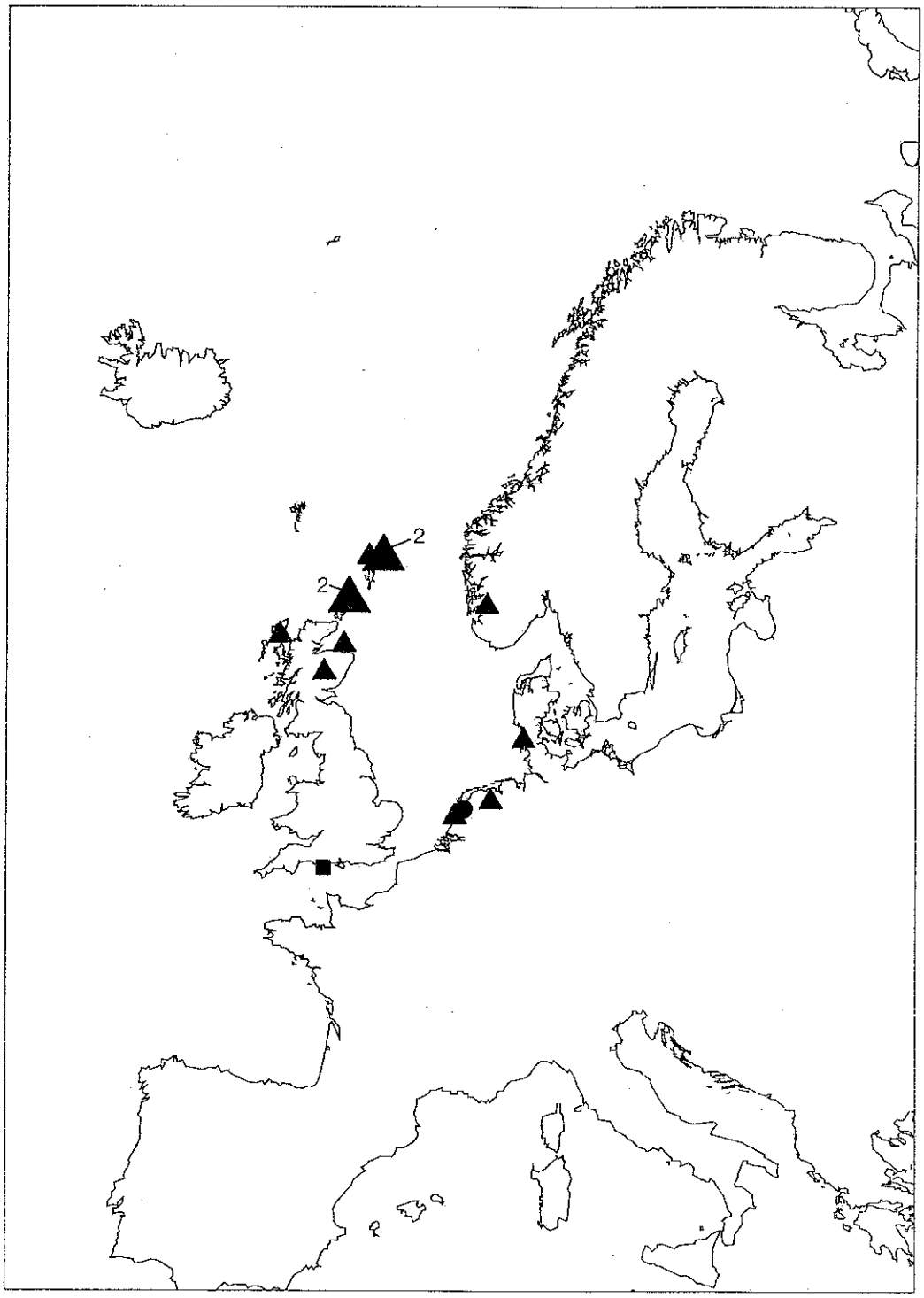


Figure 4.5 Breeding areas of Oystercatcher that winter in Dorset.

■ Ringed as adult and recovered in Dorset in winter.

● Ringed as pulli elsewhere and recovered in Dorset in winter.

▲ Ringed in Dorset in winter and recovered in summer.

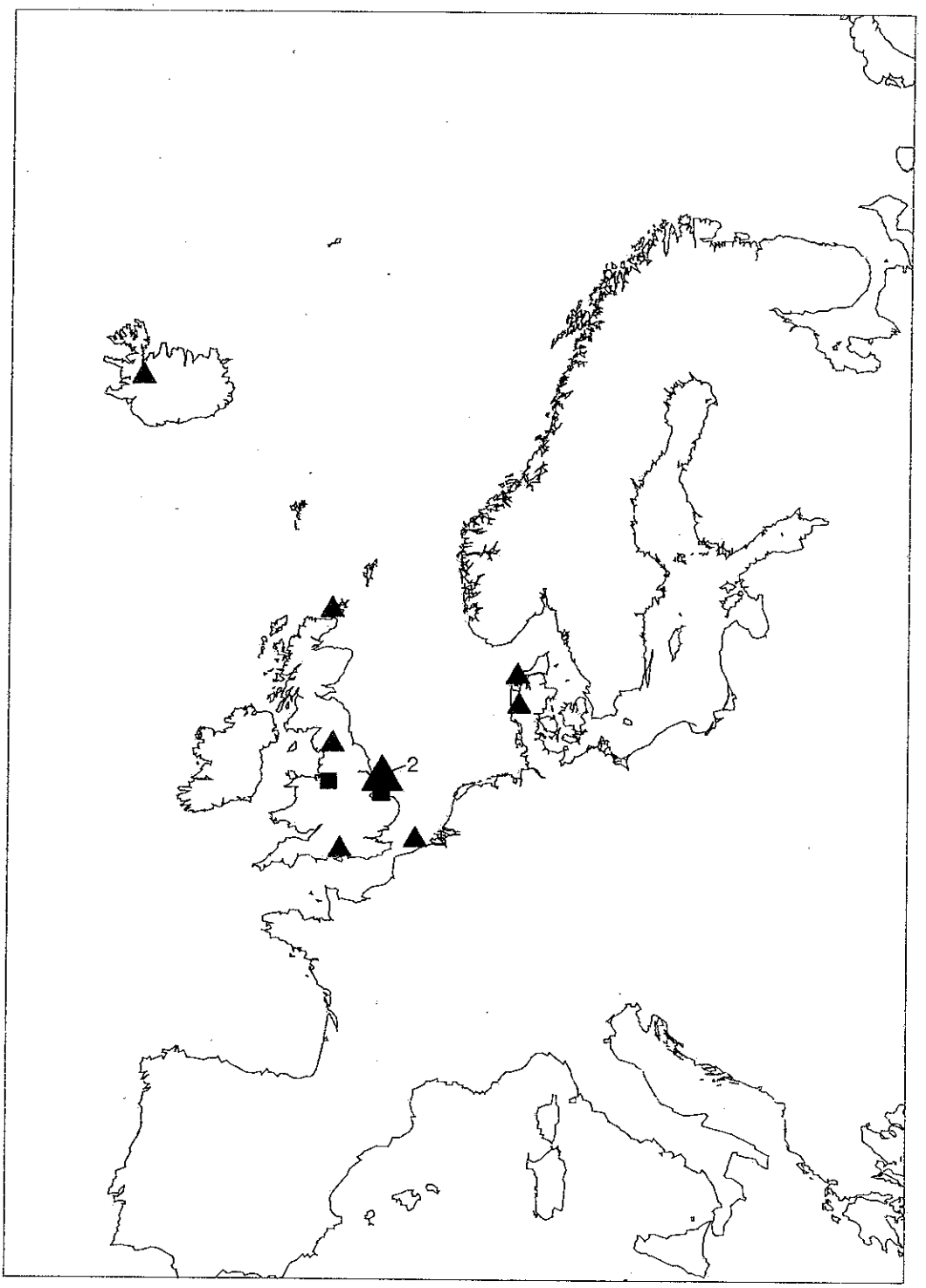


Figure 4.6 Autumn migration or moulting sites in autumn of Oystercatchers wintering in Dorset.

▲ Ringed in Dorset in winter and recovered elsewhere in autumn.

■ Ringed elsewhere in winter and recovered in Dorset in autumn.

population rapidly drops through March. The relatively slow fall in Poole Harbour's Oystercatcher numbers through March is again indicative of the presence of Norwegian-breeding birds which return comparatively late to their northern breeding grounds. Also a significant proportion of the wintering birds may in fact have departed by March, their departure being offset to some degree by the arrival of passage migrants.

The summering population of Poole Harbour numbers around 175 birds, the majority of which are immatures; Oystercatchers do not usually breed until four (females) or five (males) years old (Harris 1967). At least 13 pairs breed in the Harbour (Cade 1987), Collins (1986) estimating a maximum of 25 pairs in 1985. No breeding has been recorded recently in Holes Bay.

4.3.4 AVOCET (Recurvirostra avosetta)

Avocets recolonized Britain as a breeding species in 1947, and as a wintering species in the following winter. A large proportion of the current British breeding population, distributed along the Norfolk/Suffolk coast, moult on the Waddensea from August to early November. After their moult, most of these birds disperse to wintering grounds in southern France and Iberia, with smaller numbers of both British and Continental breeders wintering in Britain. The main British wintering areas are estuaries in Suffolk and Devon/Cornwall, where populations peak in December or January.

Some Avocets now winter in Dorset, the population being centred upon Brownsea Island, Poole Harbour. Birds begin to arrive from September, peak in December, with the majority departing to their breeding grounds in February/March (Table 4.6). The expanding Dorset population appears to be progressing towards establishing Poole Harbour as a nationally important site for the species. No Avocets have been ringed or recovered in Dorset.

4.3.5 RINGED PLOVER (Charadrius hiaticula)

The British wintering population of Ringed Plovers is composed of breeding birds from the Baltic/North Sea coasts as well as the majority of Britain's breeding population. British Ringed Plovers breeding on the east coast tend to winter on the west coast of Britain. Ringed Plovers of Greenlandic/Icelandic origin, which winter in Africa, migrate through Britain in substantial numbers. In autumn, this movement occurs down both the east and west coasts, whereas spring passage is predominantly restricted to the estuaries of western Britain. Those breeding in Iceland tend to migrate through Britain in late April and early May, those going to Greenland in late May. Some Russian-breeding birds pass through eastern England in May.

By late February, Britain's wintering population of Ringed Plovers are starting to establish breeding territories, with

Table 4.6 Monthly counts of Avocet in Poole Harbour.

MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
BoEE MEAN COUNT 1984-8	-	-	1	4	10	19	11	17	7	0	0	0
RSPB PEAK COUNT 1984-5	-	-	-	-	9	29	17	17	6	3	0	-
1985-6	0	0	6	10	14	3	29	0	6	3	0	-
DORSET BIRD REP. MAXIMUM 1986-7	1	0	4	11	46	59	61	28	35	6	2	1

the majority of Britain's coastal breeders having done so by late March.

The Poole Harbour count data indicate Dorset's spring passage of presumed Icelandic/Greenlandic Ringed Plovers to be substantially smaller than in autumn (Table 4.7). None of the 14 Dorset ringing recoveries for this species appears to relate to birds from these populations.

From an autumn peak, Ringed Plover numbers nationally decline to a lower wintering population. This is not, however, clearly discernible from Poole Harbour's count data. The decline in Poole Harbour's wintering population from January through April results from birds returning to their breeding territories. The ringing recoveries of Dorset's wintering birds show them to originate, as expected, from the Baltic/North Sea coasts and Britain (Figure 4.7). The winter-ringed juvenile from Dorset recovered in northern France the following summer probably was a non-breeding individual (Figure 4.8). One recovery (not plotted on a Figure) suggests France may provide the wintering grounds for some of Dorset's breeding birds. Ringed Plover breed occasionally in Poole Harbour, with one pair found rearing 4 chicks at Sterte, Holes Bay in 1988.

4.3.6 GREY PLOVER (Pluvialis squatarola)

Britain's wintering population of Grey Plover originates from western Siberian breeding grounds (Branson & Minton 1976). Some of the Grey Plover arrive in the autumn and moult on the Wash and the south-east English coast. After moulting, a proportion of these birds continue southwards to winter in south-west Europe and west Africa, the remainder dispersing within Britain. The passage birds are replaced in Britain by birds that have moulted on the Waddensea. The British wintering population continues to increase through December and January, as cold weather results in an immigration of birds from the Continent. In March and early April the wintering birds depart, with those from further south passing through Britain in April and May. Small numbers of first year birds remain on Britain's estuaries through the summer.

Poole Harbour's Grey Plover population clearly reflects the national annual trends described above (Table 4.8). The Harbour's population gradually increases from September to a winter peak in January. These wintering birds depart northwards during March and April, with small numbers of passage birds noted in April/May. Fewer than ten individuals remain though the summer in the Harbour.

There have been no ringing recoveries of Grey Plovers from Dorset.

Table 4.7 Monthly coumts of Ringed Plover in Poole Harbour.

MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
BoEE MEAN COUNT 1984-8	-	-	31	51	16	64	51	18	14	-	-	-
RSPB PEAK COUNT 1984-5	-	-	-	-	100	100	45	80	60	10	-	-
1985-6	4	180	130	80	80	50	50	29	25	3	7	-
DORSET BIRD REP. MAXIMUM 1983-7	6	72	100	50	89	500	91	74	14	30	27	1

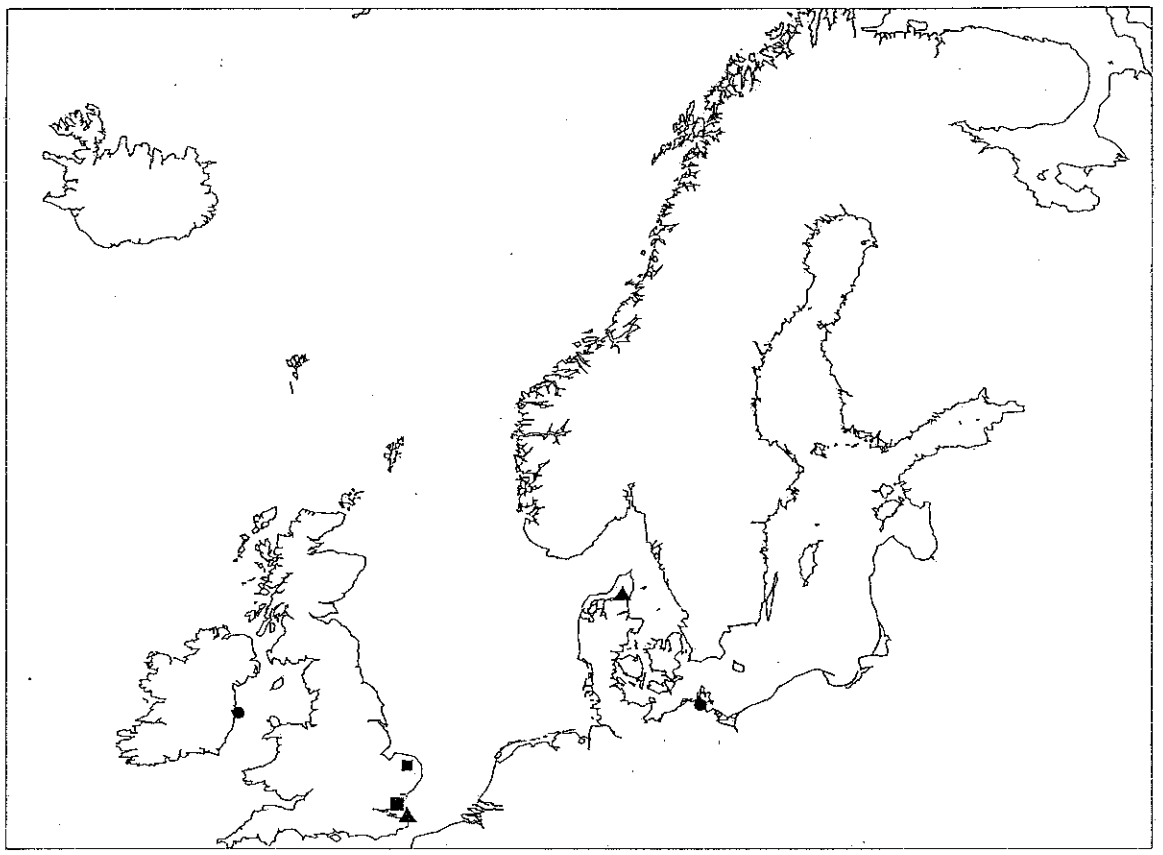


Figure 4.7 Breeding areas of Ringed Plovers using Dorset.

▲ Ringing site of pulli recovered in Dorset in winter.

■ Ringing site of adults recovered in Dorset in autumn.

● Ringing site of pulli recovered in Dorset in autumn.

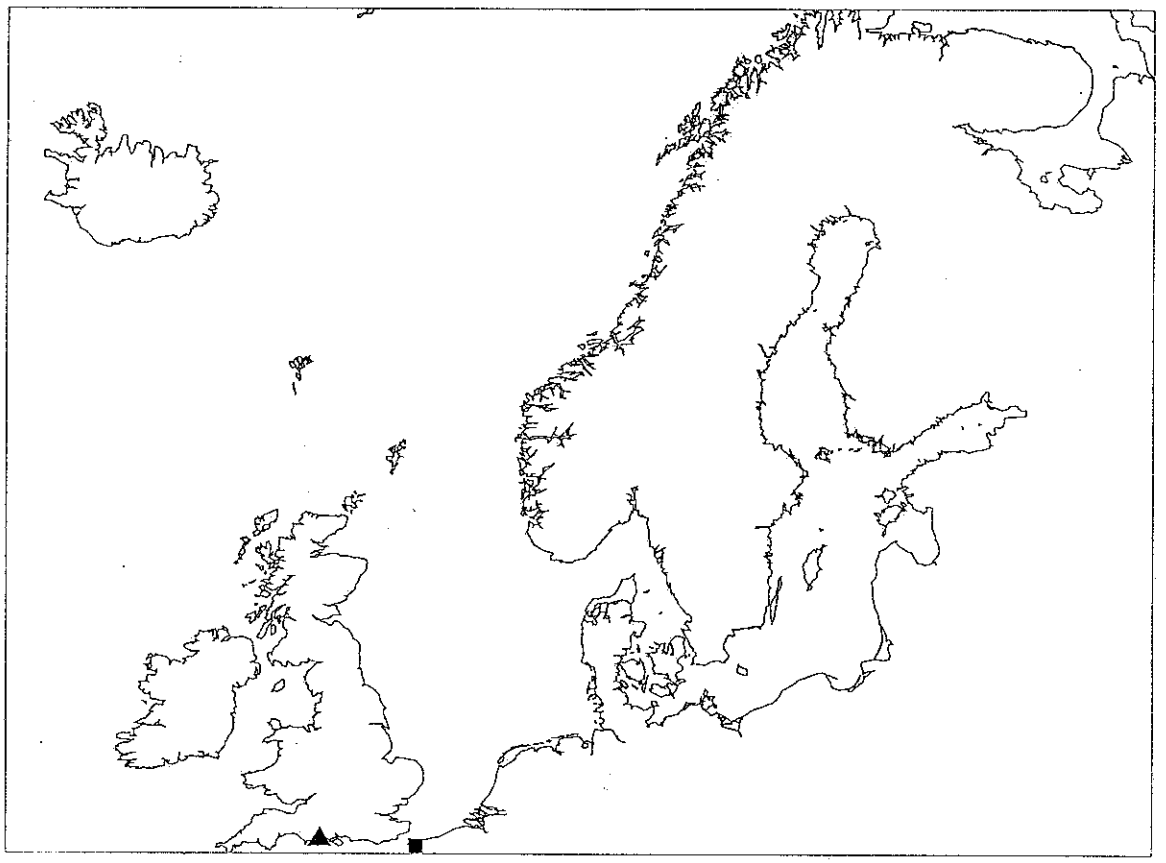


Figure 4.8 Recoveries relating to juvenile Ringed Plover present in Dorset in winter.

▲ Ringed in winter in Dorset and recovered in winter.

■ Ringed in winter in Dorset and recovered in summer.

Table 4.8 Monthly counts of Grey Plover in Poole Harbour.

MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
BoEE MEAN COUNT 1984-8	-	-	10	30	97	249	252	198	42	-	-	-
RSPB PEAK COUNT 1984-5	-	-	-	-	105	240	400	250	125	30	12	0
1985-6	3	25	35	117	400	400	500	400	250	90	15	0
DORSET BIRD REP. MAXIMUM 1983-7	4	10	27	106	167	317	490	409	329	121	14	7

4.3.7 KNOT (Calidris canutus)

All of Britain's wintering Knot orginate from breeding grounds in northern Greenland and north-eastern Canada. Large numbers of these Knot arrive in August to moult on the Wash and the Morecambe/Ribble/Dee estuary complex. From the Ribble in particular, birds move south within England after moulting, with the Wash birds also dispersing north and westwards. Some Knot also moult on the Waddensea before arriving from November to February to winter in Britain. In March, the birds which had moulted on the Waddensea return there, whilst the Irish sea population congregates on Morecambe Bay in April, before their departure north in late May. Siberian birds that reach Britain in the autumn are all en route to their African wintering grounds.

Examination of the BoEE counts suggests that passage and wintering Knot numbers in Poole Harbour are low, rarely exceeding 50 individuals (Table 4.9). The extent of cold/adverse weather movement may be the main influence controlling population size. This would in part explain the relatively high counts made in 1984/5 (Collins 1986), although BoEE counts may well underestimate this species which is easily overlooked when present in comparatively small numbers.

Five Dorset ringing recoveries exist (Figure 4.9), of which one relates to a bird found dead locally within a week of ringing. The recoveries and count data together suggest the presence of wintering birds from both the Waddensea and north-west England moulting areas.

4.3.8 DUNLIN (Calidris alpina)

Three races of Dunlin occur regularly in Britain (Hardy & Minton 1980). The adults of the race alpina, which breeds in northern Scandinavia and north-west Russia, moult predominantly on the Waddensea, with smaller numbers on the Wash. From October onwards, these individuals disperse from the Wash and Waddensea, with birds moving to all parts of Britain to winter. The juveniles, however, fly directly from their breeding grounds to the wintering sites, arriving from early September in Britain. The British wintering population reaches a peak in January. The return movement of C.a.alpina begins in February, continuing into early April, with many birds again utilizing the Waddensea as a staging post.

The race schinzii breeds in south-east Greenland, Iceland, Britain, the Netherlands and the Baltic, whilst the third race, arctica, breeds in north-east Greenland. Many C.a.arctica and C.a.schinzii pass through Britain from late June to August to moult and winter in north-west Africa. Autumn passage is down both the west and east coasts of Britain. The return passage in spring occurs during April and May, with birds concentrated along the west coast.

Table 4.9 Monthly counts of Knot in Poole Harbour.

MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
BoEE MEAN COUNT 1984-8	-	-	11	4	4	55	10	1	3	-	-	-
RSPB PEAK COUNT 1984-5	-	-	-	-	57	60	181	162	67	41	0	0
1985-6	0	69	42	55	92	39	56	40	7	18	0	-
DORSET BIRD REP. MAXIMUM 1983-7	5	10	80	48	57	220	100	93	68	57	20	2

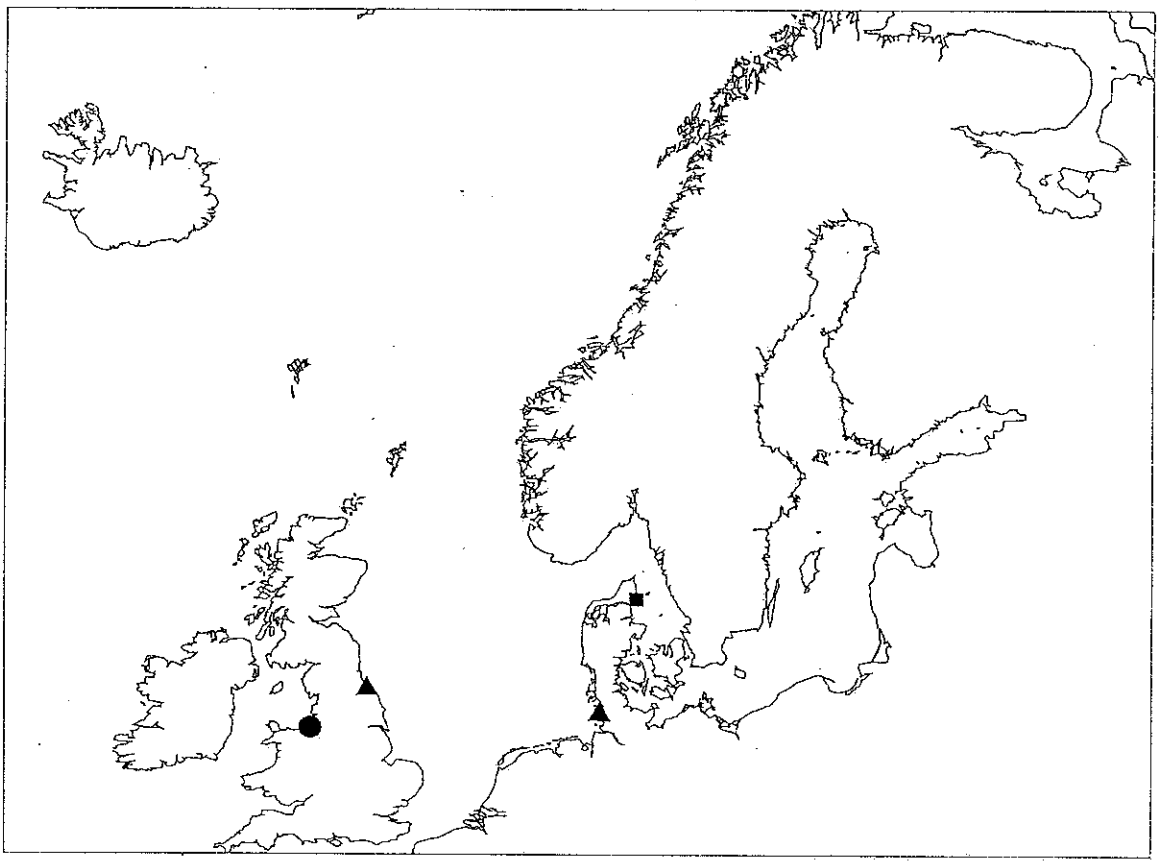


Figure 4.9 Autumn and winter movements of Knot.

▲ Ringed in Dorset in winter and recovered elsewhere in winter.

■ Ringed in Dorset in autumn and recovered elsewhere in autumn.

● Ringed elsewhere in winter and recovered in Dorset in winter.

4.3.8.1 Wintering population in Poole Harbour

The breeding areas of Dorset's wintering alpina are suggested from ringing recoveries to include northern Scandinavia (Figure 4.10, Appendix Table 3). Autumn recoveries indicate that the adults moult both on the Wash and Waddensea. Birds begin arriving in Poole Harbour to winter from November, peaking in December (Table 4.10). Ringing data show that C.a.alpina tend to be site faithful within and between winters (Clark 1983), and this is certainly true for Dorset. Between 1978 and 1986, 1870 Dunlin ringed at Sandbanks, Poole Harbour, have provided 562 between-winter and 319 within-winter retraps (C.Reynolds, pers. comm.). C.a.alpina begin departing northwards from Poole Harbour in February, with the few spring recoveries suggesting utilization of the Waddensea again as a staging post (Figure 4.11).

4.3.8.2 Spring and autumn populations in Poole Harbour

The only recovery giving an indication of the breeding areas of passage populations is of one C.a.schinzii pullus ringed on the island of Mull, West Scotland (Figure 4.12, Appendix Table 4). Both C.a.schinzii and C.a.arctica pass south through Poole Harbour in July and August (Figure 4.13, Appendix Table 5), numbers peaking in the latter month (Table 4.10). A particularly interesting recovery, which clearly substantiates this passage through Dorset of C.a.arctica/schinzii, is of a bird ringed in Dorset in late July and controlled 10 days later in Morocco. Return passage in April/May is less prominent in Dorset, and only three recoveries of Dorset birds can be directly attributed to spring passage of C.a.arctica/schinzii (Figure 4.12, Appendix Table 4).

4.3.9 BLACK-TAILED GODWIT (Limosa limosa)

Most of Britain's passage and wintering birds are of the race L.l.islandica which breeds in Iceland and, to a very limited extent, north-west Scotland. Autumn passage begins in July, with numbers on many British estuaries peaking in September before falling in October as some birds continue south to winter. For the south coast estuaries, this peak passage extends into October. From February, wintering birds depart northwards, though numbers peak in March/April with the passage through Britain of the southern wintering birds.

Autumn passage through Poole Harbour peaks slightly later than that nationally (Table 4.11). The Harbour's wintering population numbers about 350 birds, of which an appreciable proportion occur in Holes Bay. The spring passage through Poole Harbour is as great as that of the autumn, with the present study recording a feeding flock of ca 950 birds in March 1988. Generally, fewer than 50 non-breeding birds remain in the Harbour by early June.

Table 4.10 Monthly counts of Dunlin in Poole Harbour.

MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
BoEE MEAN COUNT 1984-8	-	-	146	120	1461	3513	3077	1535	526	-	-	-
RSPB PEAK COUNT 1984-5	-	-	-	-	3000	4500	4500	4300	2500	1550	500	5
1985-6	350	500	300	450	5000	6000	4750	4000	4500	1400	825	-
DORSET BIRD REP. MAXIMUM 1983-7	170	2000	400	840	2000	4500	5170	6575	2750	1000	650	4

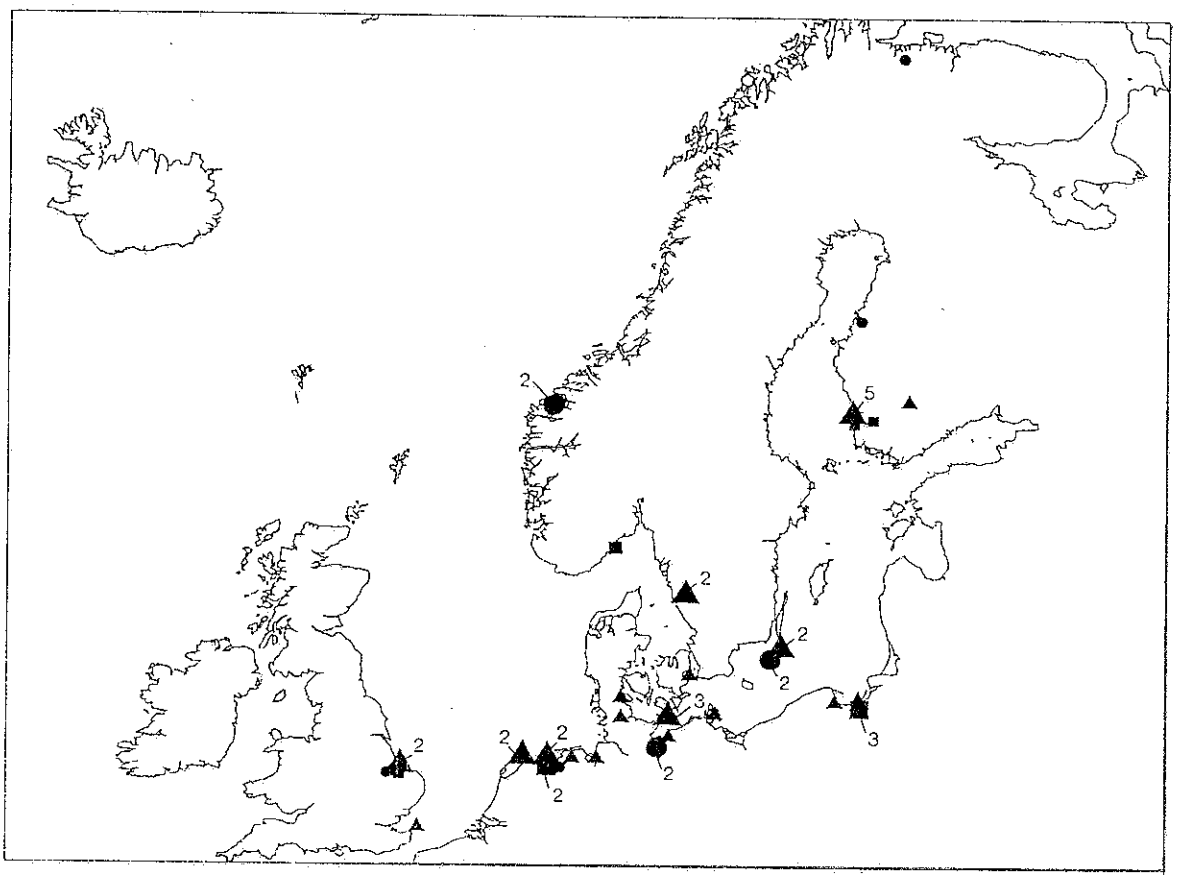


Figure 4.10 Migration or moulting sites in autumn of Dunlin wintering in Dorset.

▲ Ringed in Dorset in winter and recovered elsewhere in autumn.

■ Adults ringed elsewhere in autumn and recovered in Dorset in winter.

● Juveniles ringed elsewhere in autumn and recovered in Dorset in winter.

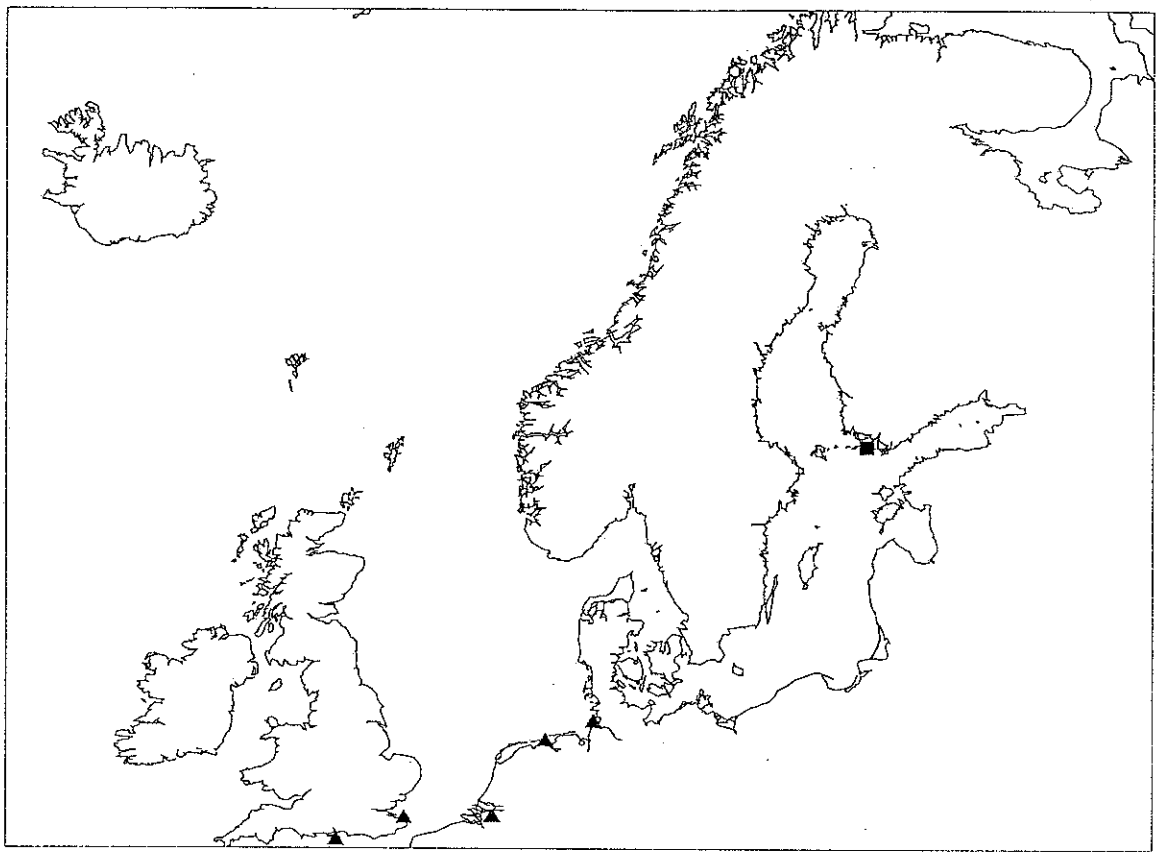


Figure 4.11 Spring migration routes of Dunlin that winter in Dorset.

▲ Ringed in Dorset in winter and recovered elsewhere in spring.

■ Ringed elsewhere in spring and recovered in Dorset in winter

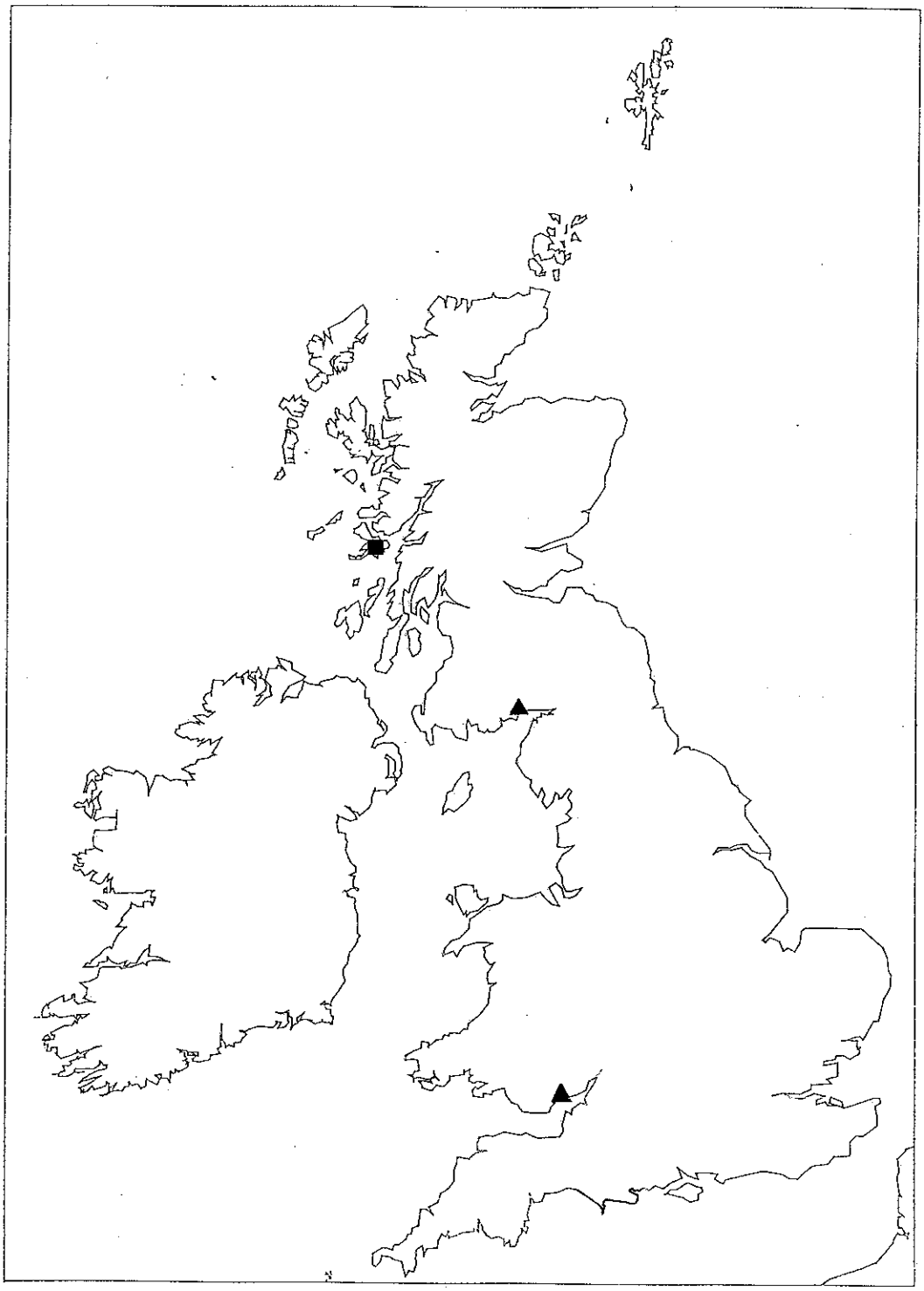


Figure 4.12 Recoveries relating to Dunlin present in Dorset in spring.

▲ Ringed in spring in Dorset and recovered elsewhere in spring.

■ Pulli ringed elsewhere and recovered in Dorset in spring.

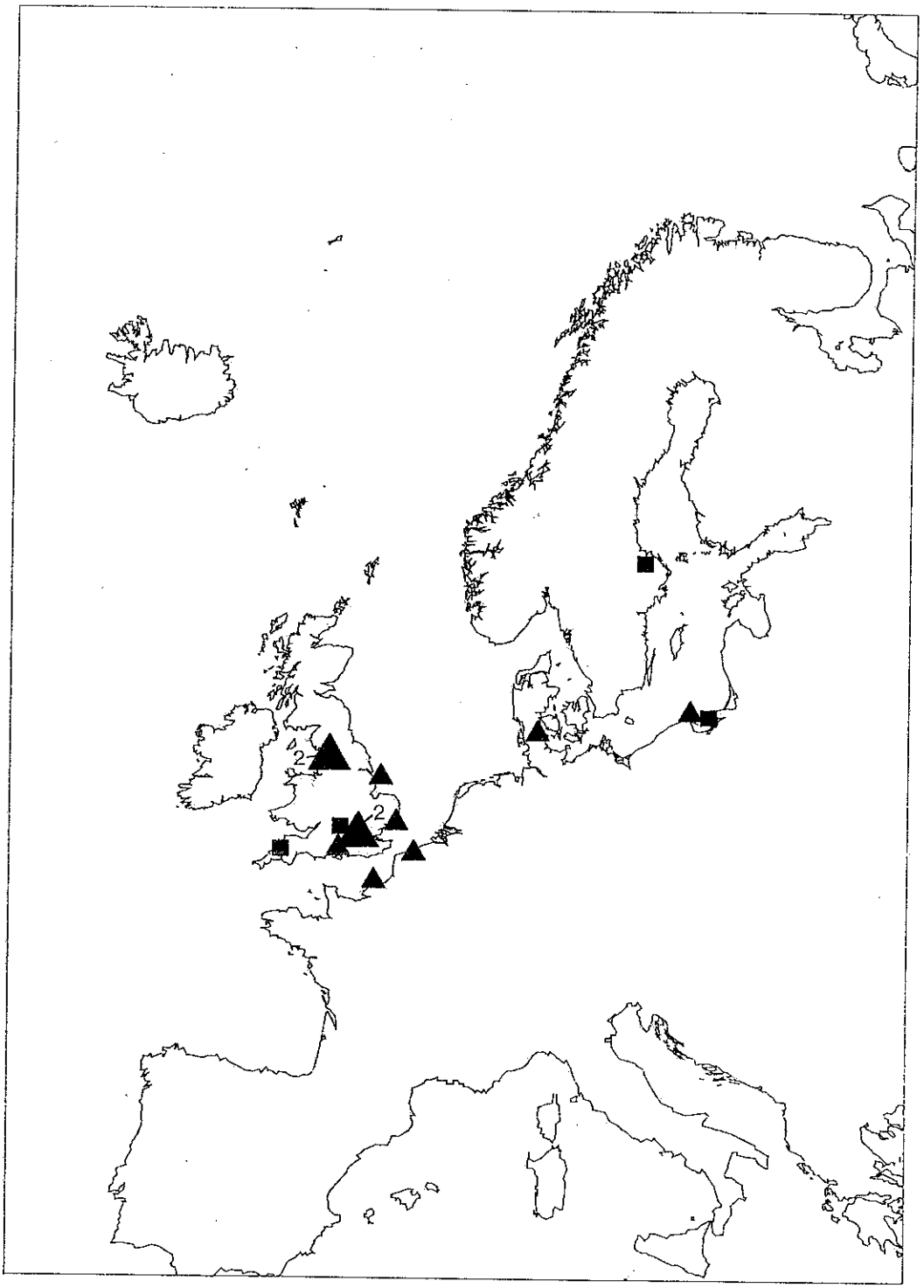


Figure 4.13 Autumn movements of Dunlin.

▲ Ringed in Dorset in autumn and recovered elsewhere in autumn.

■ Ringed elsewhere in autumn and recovered in Dorset in autumn.

Table 4.11 Monthly counts of Black-tailed Godwit in Poole Harbour.

MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
BoEE MEAN COUNT 1984-8	-	-	239	563	324	407	242	377	452	-	-	-
RSPB PEAK COUNT 1984-5	-	-	-	-	280	250	300	320	630	675	27	85
1985-6	173	240	425	390	396	359	450	460	520	650	36	-
DORSET BIRD REP. MAXIMUM 1983-7	192	250	350	999	430	400	500	569	825	700	100	40

Only two Dorset recoveries exist, both of wintering birds recovered in later years in winter at Hampshire and Isle of Wight along the south coast.

4.3.10 BAR-TAILED GODWIT (Limosa lapponica)

Britain's wintering population originates from breeding grounds in northern Scandinavia and arctic Russia. Birds arrive from late July to September, congregating predominantly on favoured moulting grounds such as the Wash, Ribble and Morecambe Bay. After moult, some move southwards within Britain and across the English Channel, whilst birds which have moulted on the Waddensea arrive from November to winter in Britain. Departure in spring begins in February, continuing through March, with many of Britain's wintering birds using the Waddensea as a migratory stop-over.

In late April and May, a large passage of Bar-tailed Godwits occurs off the southern coastal promontories, e.g. 964 moving east off St Aldhelms on 2nd May 1987. These birds are on passage from the West African wintering population.

Poole Harbour counts increase through the autumn/early winter with the arrival of the wintering birds after their moult (Table 4.12). The January/February winter peak coincides with the national peak, though in one year the RSPB counts peaked in March. An exceptionally strong return passage northwards may have been the cause of this unusually timed peak.

Only two ringing recoveries exist for Dorset, both local: an adult in February was retrapped almost 10 years later, and a juvenile shot in December, a month after being ringed.

4.3.11 WHIMBREL (Numenius phaeopus)

Whimbrel are passage and summer visitors to the British Isles. Passage birds originate from Iceland east to the western USSR, whilst the small British breeding population is confined to northen Scotland. Autumn passage occurs in Britain from July to late September, with peak numbers on estuaries, including Poole Harbour, in July (Table 4.13). The main wintering area of Whimbrel is in southern and western Africa, though individuals do occasionally winter in southern England, e.g. Poole Harbour. The return passage starts in April and peaks in May, with flocks of up to 500 birds resting briefly in Poole Harbour (I.Lewis, pers. comm.)

Two Dorset recoveries exist for this species: a bird shot locally 9 days after being ringed, and a September-ringed individual recovered 3 years later in July in France. This latter recovery must have been an early breeder already moving south.

Table 4.12 Monthly counts of Bar-tailed Godwit in Poole Harbour.

MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
BoEE MEAN COUNT 1984-8	-	-	17	19	25	77	229	126	58	-	-	-
RSPB PEAK COUNT 1984-5	-	-	-	-	39	100	265	263	155	50	20	11
1985-6	16	7	25	50	68	72	189	180	215	49	17	-
DORSET BIRD REP. MAXIMUM 1983-7	12	4	50	70	66	156	386	300	215	75	70	25

Table 4.13 Monthly counts of Whimbrel in Poole Harbour.

MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
BoEE MEAN COUNT 1984-8	-	-	0	0	0	0	0	1	0	-	-	-
RSPB PEAK COUNT 1984-5	-	-	-	-	0	0	0	0	0	-	-	1
1985-6	45	20	3	1	0	0	0	0	0	60	80	-
DORSET BIRD REP. MAXIMUM 1983-7	-	30	-	-	-	-	1	1	1	100	-	-

4.3.12 CURLEW (Numenius arquata)

Many Curlew wintering around Britain's coasts originate from breeding grounds in Fenno-Scandinivia and north-central Europe. British breeders also remain to winter, though many of these do so inland.

Adult Curlew arrive from their breeding grounds to moult on Britain's estuaries from late June onwards, whereas the majority of juveniles do not arrive until the second half of September. Nationally, peak numbers are recorded in September, followed by a decline and then another rise to a lower peak in February. From February through to April, Curlew depart for their breeding grounds.

All but two of the 26 Dorset recoveries of Curlew are of birds recovered at their breeding grounds or controlled in Poole Harbour in a later autumn/winter (Figure 4.14, Appendix Table 6 and 7). This illustrates both the species faithfulness to its wintering sites and the presence of few, if any, migrational stop overs (Bainbridge & Minton 1978). Finland, Sweden and the Waddensea are shown from the recoveries to be the breeding areas of Dorset's wintering Curlew. One individual was controlled on its nest in West Germany. No recoveries exist of known Dorset-bred birds. Generally, British breeders from southern England winter in south west England or move to France and Spain. This may explain the autumn shooting of Dorset winter-ringed birds in Devon and in France. Prior to the Wildlife & Countryside Act of 1981 which prohibited the shooting of Curlew in Britain, seven of the ringed wintering birds were shot in Poole Harbour.

Count data from Poole Harbour are in broad agreement with the country's seasonal trend (Table 4.14). However, Curlew attain autumn peak counts in Poole Harbour up to month later than the peak nationally. This is probably because of its southern location within Britain. Those individuals remaining to summer, numbering 50-100 in Poole Harbour, are likely to be one year old birds.

4.3.13 REDSHANK (Tringa totanus)

Britain's wintering population of Redshank is composed of British and Icelandic breeders, approximately in equal proportions. A small proportion of the Fenno-Scandinavian population winters in south-east England.

Inland British breeders return to Britain's estuaries from early July, with the Icelandic population arriving from August into October. Peak counts are attained in September/October, with the arrival of the last immigrants. From January through to March, the British breeders depart to establish breeding territories. Their departure from the estuaries is counterbalanced by the passage through of French/Iberian wintering birds. From late March to early May, the Icelandic population departs, leaving behind the local breeders and any

Table 4.14 Monthly counts of Curlew in Poole Harbour.

MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
BoEE MEAN COUNT 1984-8	-	-	656	1213	667	788	811	604	393	-	-	-
RSPB PEAK COUNT 1984-5	-	-	-	-	800	1000	750	800	900	600	25	100
1985-6	900	1350	1100	1200	800	900	1000	1200	1000	950	80	-
DORSET BIRD REP. MAXIMUM 1983-7	800	600	952	1210	472	1139	1280	1285	600	220	70	100

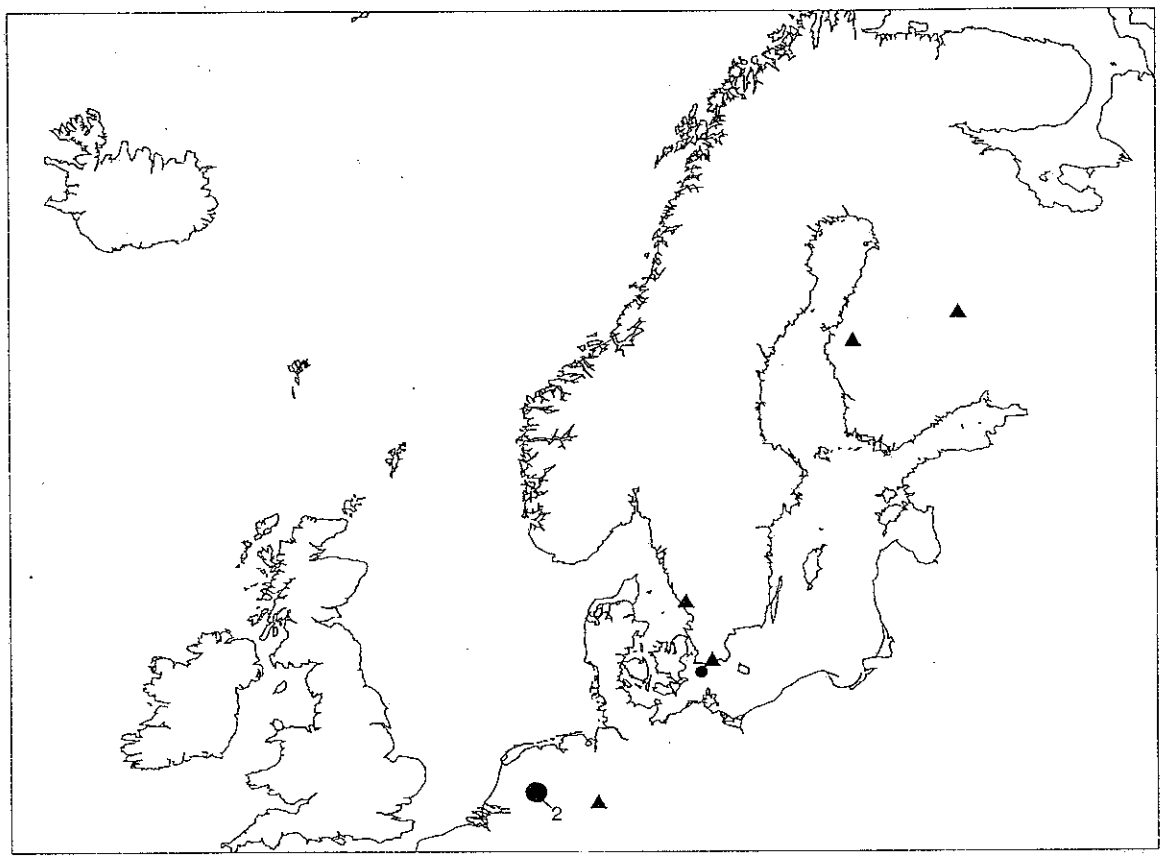


Figure 4.14 Breeding areas of Curlew that winter in Dorset.

● Ringed as pulli elsewhere and recovered in winter in Dorset

■ Ringed as adult elsewhere and recovered in winter in Dorset.

▲ Ringed in Dorset in winter and recovered elsewhere.

non-breeding individuals.

The seasonal trend of Poole Harbour's count data is in broad agreement with that nationally (Table 4.15). Large numbers of Redshank roost in the Spartina of Poole Harbour, and as a result the species is under-counted by high tide counts. This together with the inherent difference observed when comparing mean with peak counts, explains the disparity between the RSPB data (the highest counts of low or high water counts) and the BoEE data (mean high tide counts). The seasonal trends though are broadly similiar in both data sets.

Collins (1986) estimated the 1985 breeding population of Redshank in Poole Harbour to be 50-100 pairs. No Redshank bred in Holes Bay in 1985 or 1988.

The 10 breeding season recoveries of Redshank show that Dorset's wintering population is largely composed of birds from breeding grounds in the south, east and north-west of England (Figures 4.15 & 4.16). This is in line with the findings of Furness & Baillie (1981), who showed British-breeding birds to winter along the south coast.

4.4 DISCUSSION

The analysis has shown that populations of nine intertidal wader species, Shelduck and Teal in Poole Harbour regularly exceed 50 birds (Table 4.1). Two species, Black-tailed Godwit and Shelduck, are present in internationally important numbers and a further three species, Grey Plover, Curlew and Redshank, have populations of national importance. In addition, the wintering Avocet population in Poole Harbour has recently exceeded 50 birds, the qualifying level for national importance if maintained regularly in the future.

Ringing data show that the passage and/or wintering species present in Poole Harbour each comprise individuals from up to four identifiable, discrete breeding areas (Table 4.16). In the cases of four species (Shelduck, Oystercatcher, Black-tailed Godwit and Curlew) Poole Harbour potentially holds over 1% of the birds from a discrete breeding area, highlighting the importance of these populations.

Table 4.17 draws together the BoEE count data and ringing information in order to identify the species in Poole Harbour at most potential risk from increased disturbance as well as the seasonal timing of major risk. Overall, the winter (November-March) is when the intertidal bird populations of Poole Harbour are potentially at greatest risk from increased disturbance. This is also when the environmental pressure upon a bird is highest. With low temperatures, a bird's metabolic rate increases, resulting in a need for more food as fuel. For intertidal birds, problems are compounded by the shorter days of mid-winter and by the reduced activity and deeper burrowing

Table 4.15 Monthly counts of Redshank in Poole Harbour.

MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
BoEE MEAN COUNT 1984-8	-	-	407	729	637	479	574	405	314	-	-	-
RSPB PEAK COUNT 1984-5	-	-	-	-	1000	1400	1200	1200	1300	600	500	200
1985-6	1200	1200	1250	1600	1350	1200	1200	1000	1300	800	200	-
DORSET BIRD REP. MAXIMUM 1983-7	200	500	539	976	729	552	699	1129	470	260	67	127

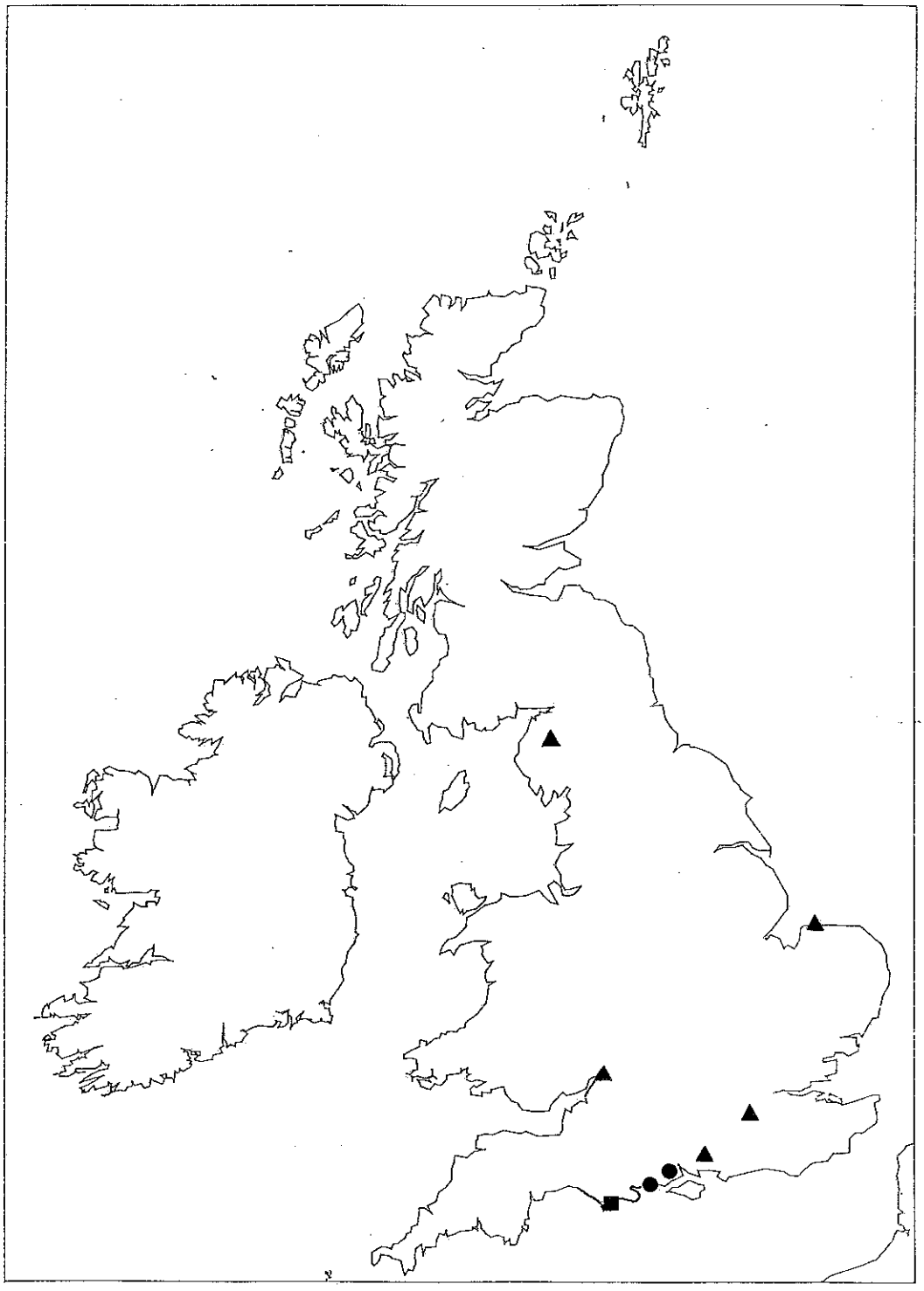


Figure 4,15 Breeding areas of Redshank that winter in Dorset.

▲ Ringed as pulli elsewhere and recovered in winter in Dorset.

● Ringed as adults in winter in Dorset and recovered in summer.

■ Ringed as adults in summer and recovered in winter in Dorset.

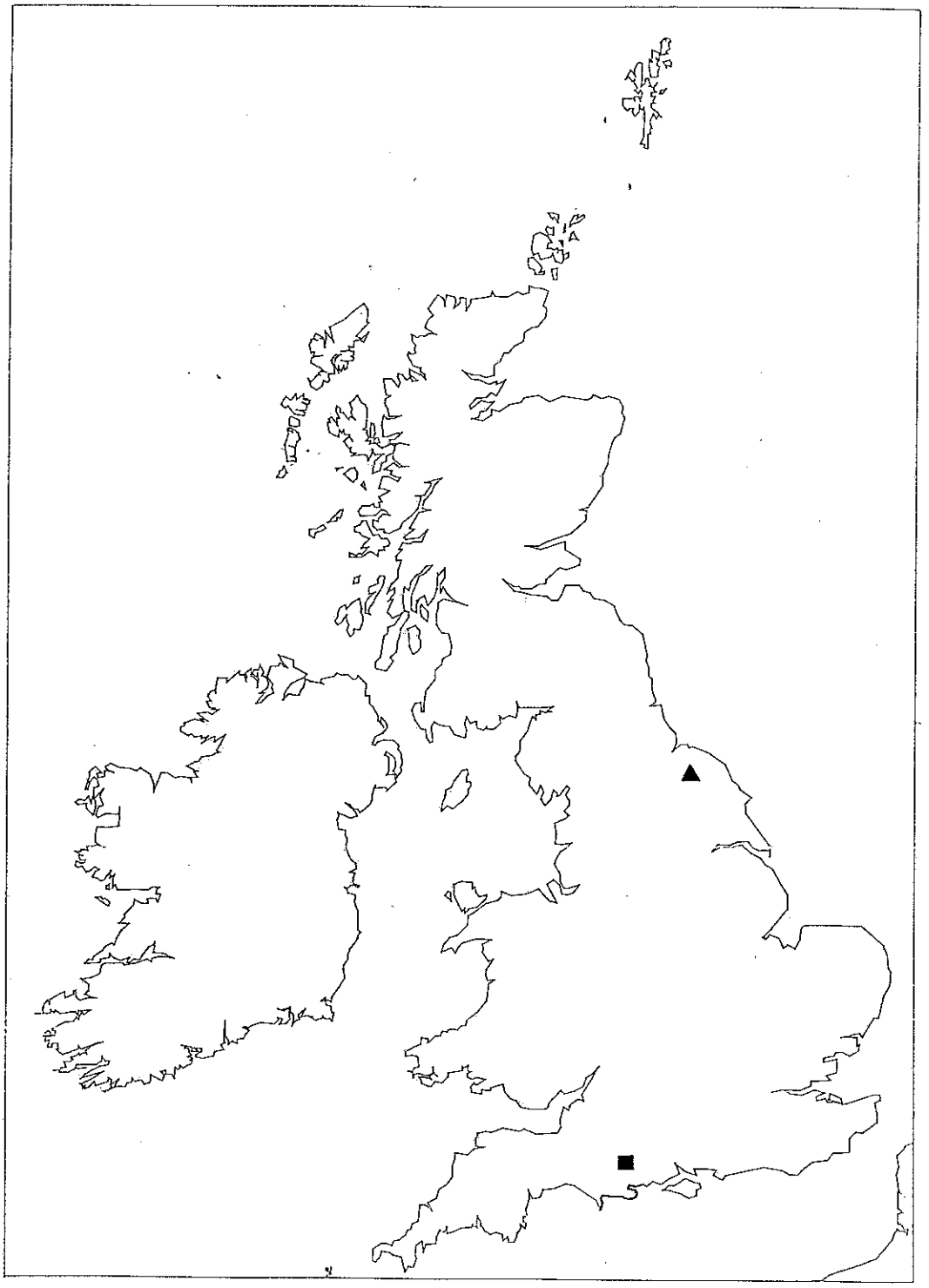


Figure 4.16 Breeding areas of Redshank present in Dorset in autumn.

▲ Ringed in autumn and recovered elsewhere in summer.

■ Ringed in summer and recovered in autumn in Dorset.

Table 4.16 The potential significance of Poole Harbour for Shelduck, Teal and intertidal waders from individual breeding populations. Breeding population estimates from Piersma (1986), Ruger et al. (1986) and Scott (1980).

Species	Average BoEE Winter Peak	*Average BoEE Sept/Oct Peak	Race/ Breeding area	Population size	No. of Dorset Recoveries from Breeding Area	ξ % using Poole Harbour
Shelduck	2106		N.W.Europe	125,000	11	1.7
Teal	771		Britain/ Continental Europe/USSR	950,000	ψ	<0.1 Max
Oyster-catcher	1379		Britain	111,000	15	1.2 Max
			Faeroes	26,000	1	5.3 Max
			Iceland	30,000	0	4.6 Max
			Waddensea	300,000	4	0.5 Max
			Norway	120,000	3	1.1 Max
			Greenland	?	1	? Max
Avocet	29		N.W.Europe	26,000	0	0.1
Ringed Plover	82		Britain	25,000	4	0.3 Max
			E. North Sea	13,000	0	0.6 Max
		64	Iceland	100,000	0	0.1 Max
			Greenland	50,000	0	0.1 Max
Grey Plover	378		USSR	80,000	0	0.5
Knot	66		Nearctic	350,000	0	<0.1 Max
Dunlin	3900		alpina race	1,500,000	0	0.3
		208	schinzii race	800,000	1	<0.1 Max
			arctica race	15,000	0	<0.1 Max
Black-tailed Godwit	729		islandica race	30-90,000	0	2.4 Max
Bar-tailed Godwit	254		USSR/ N.Scandinavia	550,000	0	<0.1 Max
Whimbrel	0	0	Iceland/ Scandinavia/ USSR	1,155	0	0

Table 4.16 (con't)

Species	Average BoEE Winter Peak	*Average BoEE Sept/Oct Peak	Race/ Breeding area	Population size	No. of Dorset Recoveries from Breeding Area	ξ % using Poole Harbour
Curlew	1102	1213	Britain	105,000	0	1.2 Max
			Fenno-Scandinavia	195,000	5	0.6 Max
			Waddensea	30,000	4	4.0 Max
Redshank	740	755	Britain	105,000	9	0.7 Max
			Iceland	(300,000)	0	0.3 Max

N.B. Max- indicates the maximum value assuming that all birds wintering in Poole Harbour come from the population.

* - Peak autumn passage of some species occur in July/August. However, BoEE count data are only available for the autumn passage months September and October.

ξ - When a wintering population peaks on its' arrival in autumn, the "% using Poole Harbour" refers to the autumn (Sept/Oct).

ψ - No analysis was made of Teal ringing recoveries.

Table 4.17 Species at potential risk from increased disturbance, and seasonal timing of main risk.

Species	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
Shelduck	*	*	*	*	*	r	R	R	R	R	r	*
Teal		*	*	*	r	*	r	r	*	*		
Oystercatcher	*	*	*	*	*	*	*	*	*	*	*	*
Avocet						r	r					
Ringed Plover	*	*	*	*	*	*	*	*	*	*		
Grey Plover				*	r	r	r	r	r	*		
Knot	*	*	*	*	*	*	*	*	*	*		
Dunlin	*	r	*	*	r	r	r	r	r	*	*	
Black-tailed Godwit	r	r	R	R	R	R	R	R	R	R	r	r
Bar-tailed Godwit			*	*	*	*	*	*	*	*	*	
Whimbrel										r	r	
Curlew	*	r	r	r	*	r	r	r	r	r	*	*
Redshank	R	R	R	R	R	R	R	R	R	*	*	*

KEY

* = Poole Harbour population likely to exceed 50 birds

r = Poole Harbour population likely to exceed the qualifying level for national importance.

R = Poole Harbour population likely to exceed the qualifying level for international importance.

of potential prey. Mortality rates of waders may increase by an average of tenfold during the course of even a winter which is without prolonged severe weather (Goss-Custard et al. 1977).

Disturbance will often result in waders and, particularly, wildfowl moving to other feeding areas. In consequence, this may result in a reduced survival rate for both the displaced population and for those whose feeding area have been intruded upon. A rise in the density of feeding birds will often lead to an increase in intraspecific aggressive encounters over food items (Goss-Custard 1977). Furthermore, prey availability may decline due to the presence of more birds foraging in an area (Goss-Custard 1970). For those species that remain within the vicinity of the Development Area, new structures may result in an alteration of the sedimentation and therefore prey distribution and density. Unfortuanately, the magnitude of any construction impact is difficult to assess since at present few data are available on disturbance likely to be caused by engineering works. However, simulation studies of wader populations have shown that even quite low levels of winter mortality may have a substantial effect on the longer term population size, particularly if this mortality is brought about by density-dependant factors (Goss-Custard 1980).

Four species have important populations in Poole Harbour during passage periods, either in the Spring (Black-tailed Godwit) or Autumn (Dunlin, Black-tailed Godwit, Curlew, Redshank). The majority of these populations are of birds which utilize the Bay as a refuelling stop-off. These individuals require sufficient food to lay down fat reserves for the remainder of their migration as well as for their immediate requirements. The density of mudflat invertebrates in autumn is higher than in winter and the weather milder. In consequence, it may be deduced that the susceptibility of autumn birds to disturbances may in general be less than for the important wintering populations.

In conclusion, the winter months are when the wader and wildfowl of Poole Harbour are potentially most at risk from any damaging impacts. Both the number of species that are of importance and, in general, their respective population sizes are greatest at this time.

4.5 CONCLUSIONS

In Poole Harbour, Shelduck and Black-tailed Godwit are present in internationally important numbers, whilst Grey Plover, Curlew and Redshank are present in nationally important numbers. For four species (Shelduck, Oystercatcher, Black-tailed Godwit and Curlew) Poole Harbour potentially holds over 1% of the birds from a discrete breeding area. The seasonal timing of maximum potential vulnerability of the overall intertidal bird community of Poole Harbour to disturbance from development is identified as the winter.

5. LONG-TERM TRENDS IN THE WADER, SHELDUCK AND TEAL POPULATIONS OF POOLE HARBOUR

5.1 INTRODUCTION

Wintering waders and wildfowl have been counted on Poole Harbour for the Birds of Estuaries Enquiry (BoEE) since 1970. During this period, Poole Harbour has increasingly been subjected to piecemeal developments in the form of oil industry expansion, urbanization, reclamation and recreational pressures which may have affected bird populations. In addition, wildfowl and wader population levels nationally have altered over the past two decades as the result of natural and, probably, man-induced phenomena.

This chapter examines long-term trends (1970-87) in the wader, Shelduck and Teal populations of Poole Harbour and relates these to trends in the national populations in order to assess site preference on a "whole estuary" scale. This assessment entails determining whether the species under consideration is likely to be at carrying capacity in Poole Harbour. The term "carrying capacity" is used to describe the maximum number of wintering birds that the resources of an area can sustain (Goss-Custard 1985). If a site is at carrying capacity, few new individuals are likely to settle on it even in years when the national population rises substantially. Factors which may possibly determine when this limit is reached are the frequency of aggressive interactions or avoidance, prey depletion or the depression of food intake rates as a result of interference between feeding individuals. Waders and wildfowl are likely to occupy their wintering sites sequentially (cf. Zwarts 1976), from the most preferred sites being occupied first and the less preferred areas later. Therefore the closer to carrying capacity a species is at a site, the more preferred that site is likely to be (Moser 1988). Knowledge regarding this is helpful in deciding whether those individuals that may be displaced by local reclamation/disturbance are likely to be able to locate suitable vacant feeding/roosting areas within the estuary concerned or will be forced to emigrate or suffer an increased risk of mortality.

Chapter 4 identified species of particular conservation concern in Poole Harbour in terms of their numbers and breeding origins. The present Chapter examines the population trends and site preferences of each species considered, to assess further the importance of Poole Harbour to each of the species.

5.2 METHODS

Nine wintering estuarine wader species, as well as Shelduck and Teal, are considered in this Chapter. These are the species that were identified in Chapter 4 as having wintering populations regularly exceeding 50 birds in Poole Harbour.

Trends in numbers of individual species within Poole Harbour were identified through examination of the peak winter BoEE counts for each on the estuary. To ascertain whether any trends found were related to or separate from national trends, a comparison was made with an index of the national population for the respective species based on peak winter BoEE counts. An index was used as it was not possible to assess the total numbers in Britain simply by adding together the counts for each estuary, because some estuaries were not counted in some months or years. The index, which was independent of coverage, was set at 100 for the winter period 1972-3. For consecutive winters, the peak winter BoEE counts were summed for all the estuaries for which data were available in both. The index was then calculated from these totals using the formula:

$$\text{New Index} = \text{Old Index} \times \frac{\text{2nd Winter Total}}{\text{1st Winter Total}}$$

The Shelduck and Teal national indices were calculated using the January count and an average of the December and January count respectively, as described by Salmon & Moser (1985). For all species the indices were calculated for the winters 1970/71 to 1986/87.

For each species, both the national index and peak winter BoEE counts were tested for signifiant change with time using the Spearman Rank correlation. In order to examine the nature of any relationship between the Poole Harbour counts and national index of each wader species, a regression analysis was performed on the log-transformed counts. The results of this analysis permitted some assessment to be made of the apparent preference shown for Poole Harbour by the various species, following the approach of Moser (1988).

5.3 RESULTS

5.3.1 SHELDUCK (Tadorna tadorna)

Chapter 4 showed that the average winter peak count of Shelduck in Poole Harbour over the most recent five year period (1983/4-87/88) was ca 1.7% of the European population, above the qualifying level for both national and international importance. Furthermore, the species was identified as one for which Poole Harbour potentially holds more than 1% of individuals from a discrete breeding population.

Table 5.1 The relationship between both the national index and Poole Harbour peak winter counts with time using the Spearman Rank Correlation Coefficient.

	National Index		Poole Harbour Peak Winter Count	
Species	r	Signficant ($p < 0.05$)	r	Significant ($p < 0.05$)
Shelduck	0.60	yes	-0.04	no
Teal	0.70	yes	-0.42	no
Oystercatcher	0.92	yes	0.36	no
Ringed Plover	-0.53	yes	0.16	no
Grey Plover	0.93	yes	0.67	yes
Knot	0.31	no	-0.31	no
Dunlin	-0.42	yes	0.02	no
Black-tailed Godwit	0.43	yes	0.14	no
Bar-tailed Godwit	0.76	yes	0.29	no
Curlew	0.27	no	-0.04	no
Redshank	0.62	yes	-0.47	yes

Nationally, Shelduck wintering in Britain have increased significantly since the start of the BoEE; however, the population in Poole Harbour has shown no significant trend over the same period (Figure 5.1, Table 5.1). This suggests that Poole Harbour is a preferred site for the species, being at or near carrying capacity.

5.3.2 TEAL (Anas crecca)

The average winter peak count of Teal in Poole Harbour over the most recent five year period (1983/4-87/88) was ca 0.8% of the British population, slightly below the qualifying level for national importance (Chapter 4).

Despite recent suggestions of a decline, Britain's estuarine wintering Teal have increased significantly since the start of the BoEE (Figure 5.2, Table 5.1). Though the Poole Harbour population has not shown any significant trend overall, there clearly was a sudden, substantial decline in the late 1970's. This presumably must have had a local cause, possibly related to the one which caused the similar sudden Redshank decline (see 5.3.11). As for Redshank, the very tentative conclusion must be that Poole Harbour is a preferred site for Teal.

5.3.3 OYSTERCATCHER (Haematopus ostralegus)

Chapter 4 showed that the average winter peak count of Oystercatchers in Poole Harbour over the most recent five year period (1983/4-87/88) was ca 0.5% of the British population, below the qualifying level for national importance. However, the species was identified as one for which Poole Harbour potentially holds more than 1% of individuals from a discrete breeding population.

Nationally, Britain's wintering Oystercatchers have shown a highly significant increase since the start of the BoEE, whereas the population in Poole Harbour has shown no significant trend over the same period despite recent suggestions of a rise (Figure 5.3, Table 5.1). There is also no statistically significant correlation between change in the Poole Harbour and national populations (Table 5.2). This suggests that Poole Harbour is a preferred site for the species, having been at or near carrying capacity even when the national population was relatively low.

5.3.4 RINGED PLOVER (Charadrius hiaticula)

The average winter peak count of Ringed Plover in Poole Harbour over the most recent five year period (1983/84-87/88) was ca 0.4% of the British population, below the qualifying level for national importance (Chapter 4).

Nationally, Britain's wintering Ringed Plover has

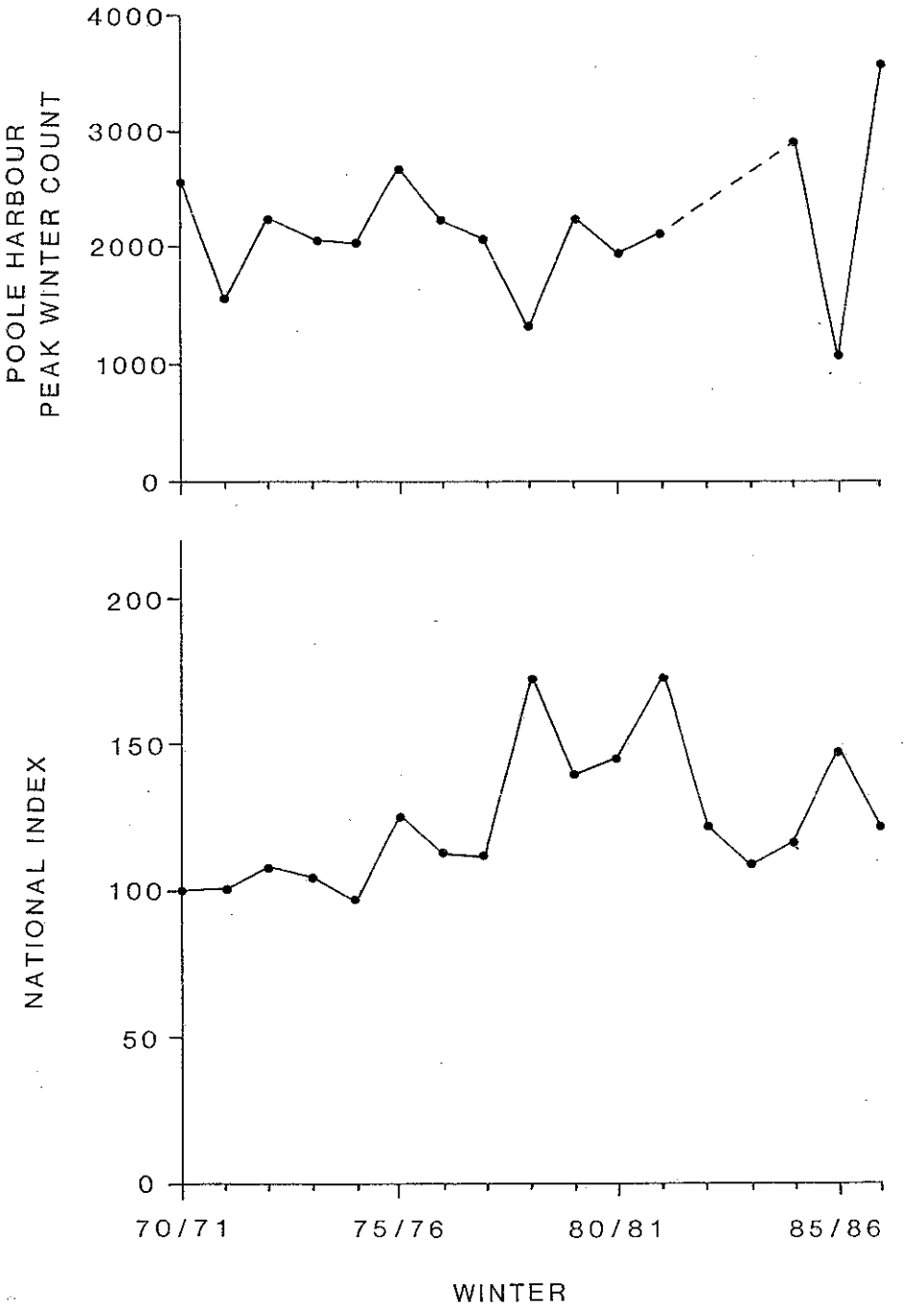


FIGURE 5.1

SHELDUCK: THE NATIONAL INDEX AND POOLE HARBOUR PEAK WINTER COUNTS FOR THE WINTERS 1970/71 - 1986/87

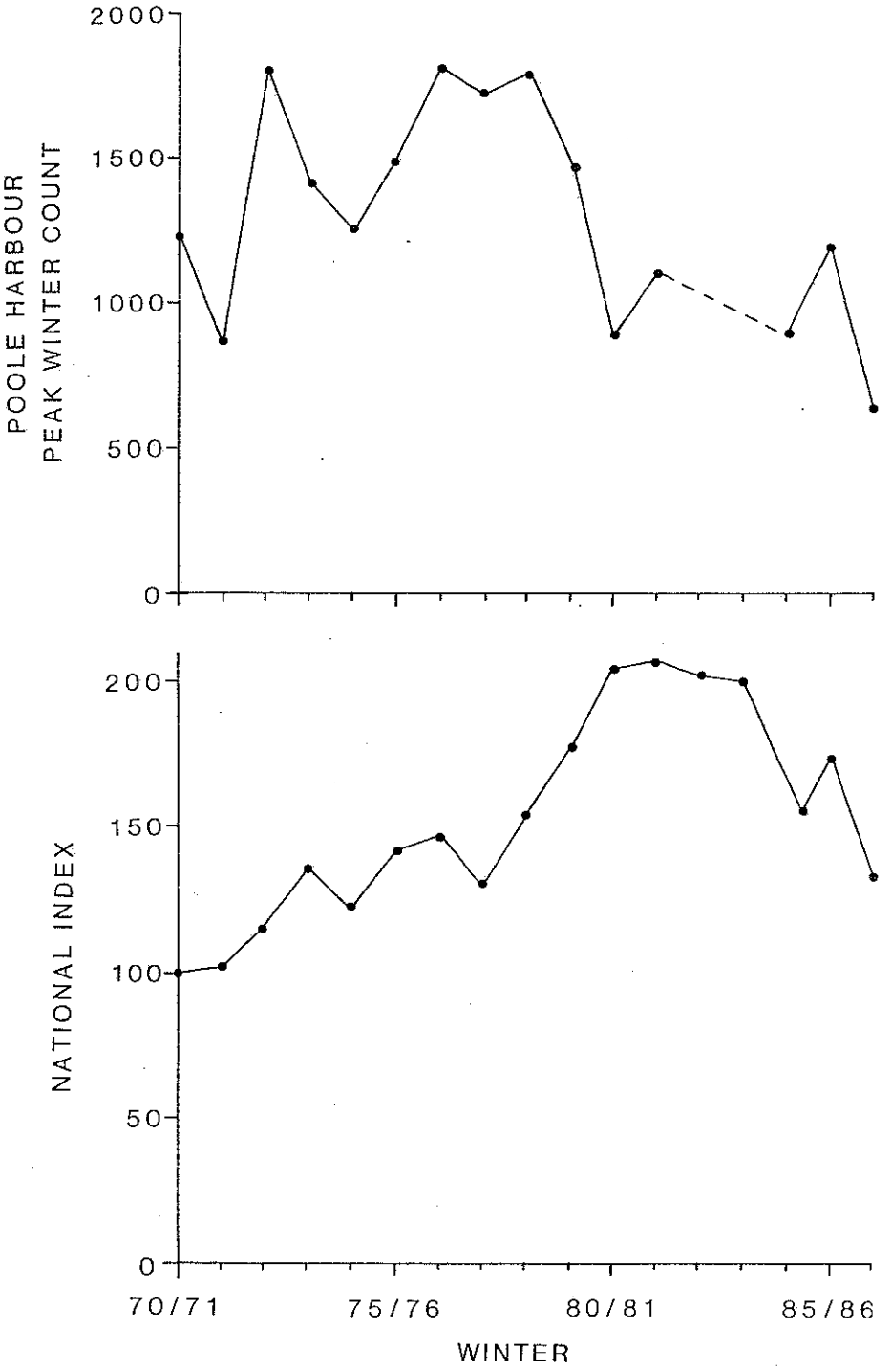


FIGURE 5.2

TEAL: THE NATIONAL INDEX AND POOLE HARBOUR PEAK WINTER COUNTS FOR THE WINTERS 1970/71 - 1986/87

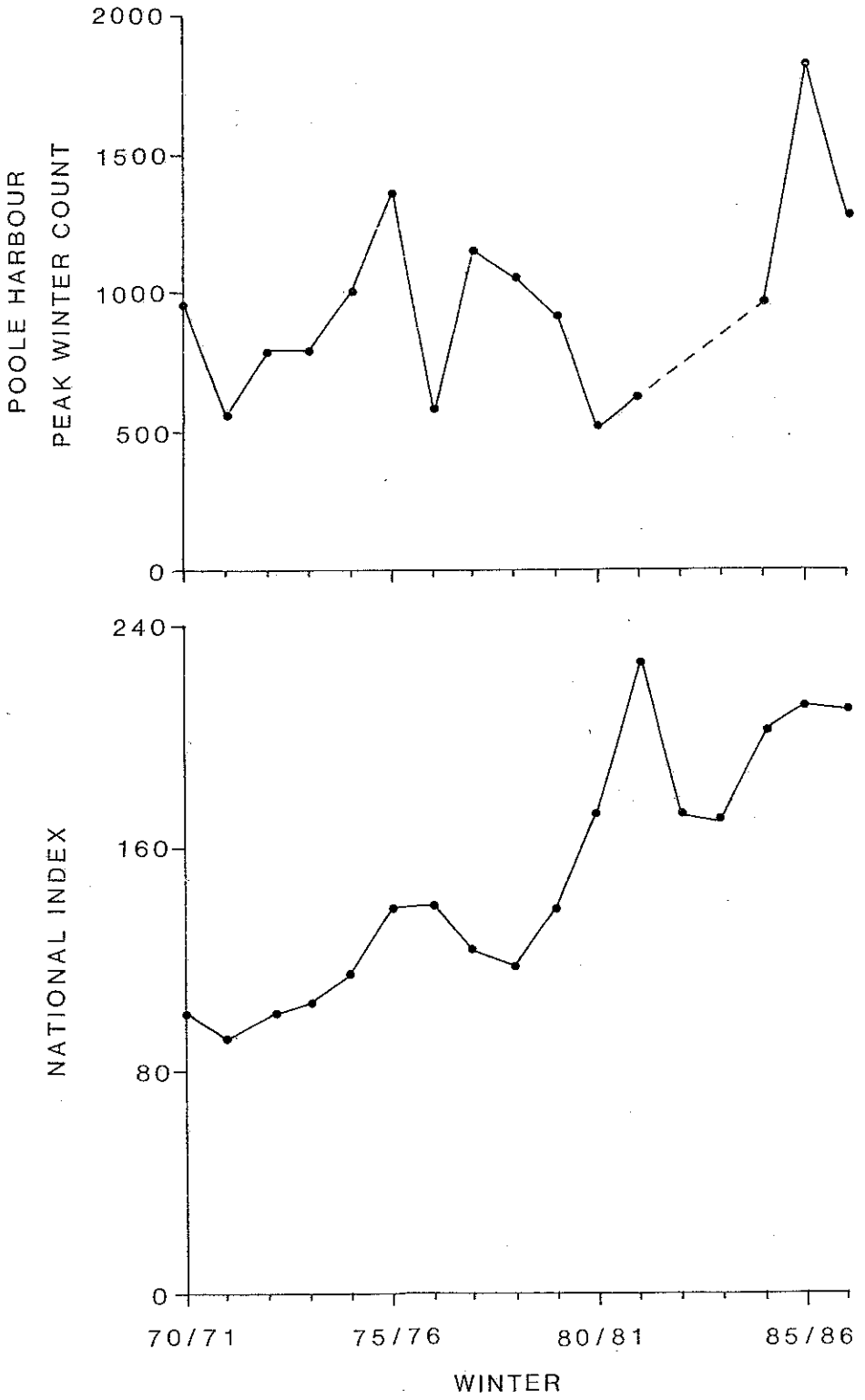


FIGURE 5.3

OYSTERCATCHER: THE NATIONAL INDEX AND POOLE HARBOUR PEAK WINTER COUNTS FOR THE WINTERS 1970/71-1986/87

Table 5.2 Relationship between Poole Harbour peak winter counts and national population indices for the wader species

Linear Regression Formula: $y = a + bx$

Species	a	b	95% Confidence limits of b		Signficant at 95% level ($P < 0.05$)
Oystercatcher	2.294	0.306	1.0123	-0.4003	no
Ringed Plover	3.757	-0.911	0.7695	-2.5915	no
Grey Plover	-1.232	1.505	2.3424	0.6626	yes
Knot	0.396	0.409	3.0917	-2.2737	no
Dunlin	4.297	-0.368	0.4809	-1.2169	no
Black-tailed Godwit	1.271	0.727	1.6212	-0.1672	no
Bar-tailed Godwit	0.687	0.701	1.733	-0.3315	no
Curlew	2.159	0.370	2.0656	-1.3250	no
Redshank	4.999	-0.982	0.4414	-2.4054	no

significantly declined since the start of the BoEE; however, despite very recent suggestions of a decline, the wintering population in Poole Harbour has shown no significant trend over the same period (Figure 5.4, Table 5.1). In addition, no statistically significant correlation exists between change in the Poole Harbour and national populations (Table 5.2). This suggests that Poole Harbour may be a preferred site for the species, despite the considerable year-to-year variations in recorded populations. The species is known to be a particularly difficult one to census reliably (Spearpoint et al. 1988), which may be a cause of the apparently low Poole Harbour populations in some years, and conclusions on site preference must be viewed as extremely tentative.

5.3.5 GREY PLOVER (Pluvialis squatarola)

The average winter peak count of Grey Plover in Poole Harbour over the most recent five year period (1983/4-87/88) was ca 1.8% of the British population, above the qualifying level for national importance (Chapter 4).

Nationally, Britain's wintering Grey Plover population has approximately quadrupled in size since the start of the BoEE; furthermore, the population in Poole Harbour has also increased significantly over the same period (Figure 5.5, Table 5.1). Regression of the log-transformed peak Poole Harbour counts against the national indices yields a significant, positive, linear relationship in which the rate of change in Poole Harbour is substantially greater than that nationally over the same period (Figure 5.6, Table 5.2). This strongly implies that Poole Harbour is not a preferred site for the species and is still below carrying capacity (cf. Moser 1988).

5.3.6 KNOT (Calidris canutus)

The average winter peak count of Knot in Poole Harbour over the most recent five year period (1983/84-87/88) was less than 0.1% of the British population, well below the qualifying level for national importance (Chapter 4).

Wintering Knot populations both nationally and in Poole Harbour have shown no significant trends since the start of the BoEE (Figure 5.7, Table 5.1). In addition, no statistically significant correlation exists between change in the Poole Harbour and national populations (Table 5.2). In the absence of any significant time trends, the small size and high variability of the Poole Harbour Knot population suggest that the site is unlikely to be a preferred one for the species.

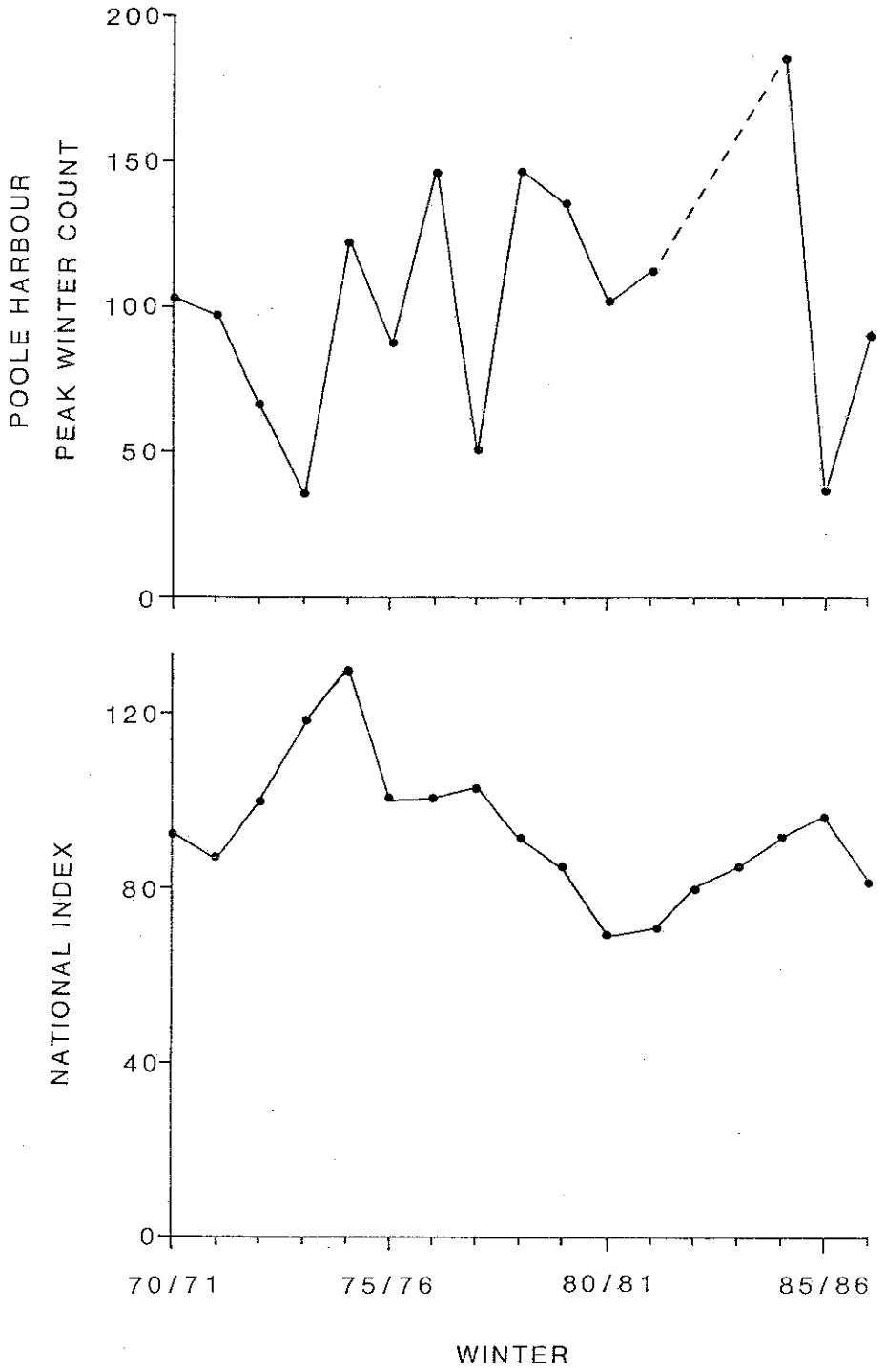


FIGURE 5.4

RINGED PLOVER: THE NATIONAL INDEX AND POOLE HARBOUR PEAK WINTER COUNTS FOR THE WINTERS 1970/71 - 1986/87

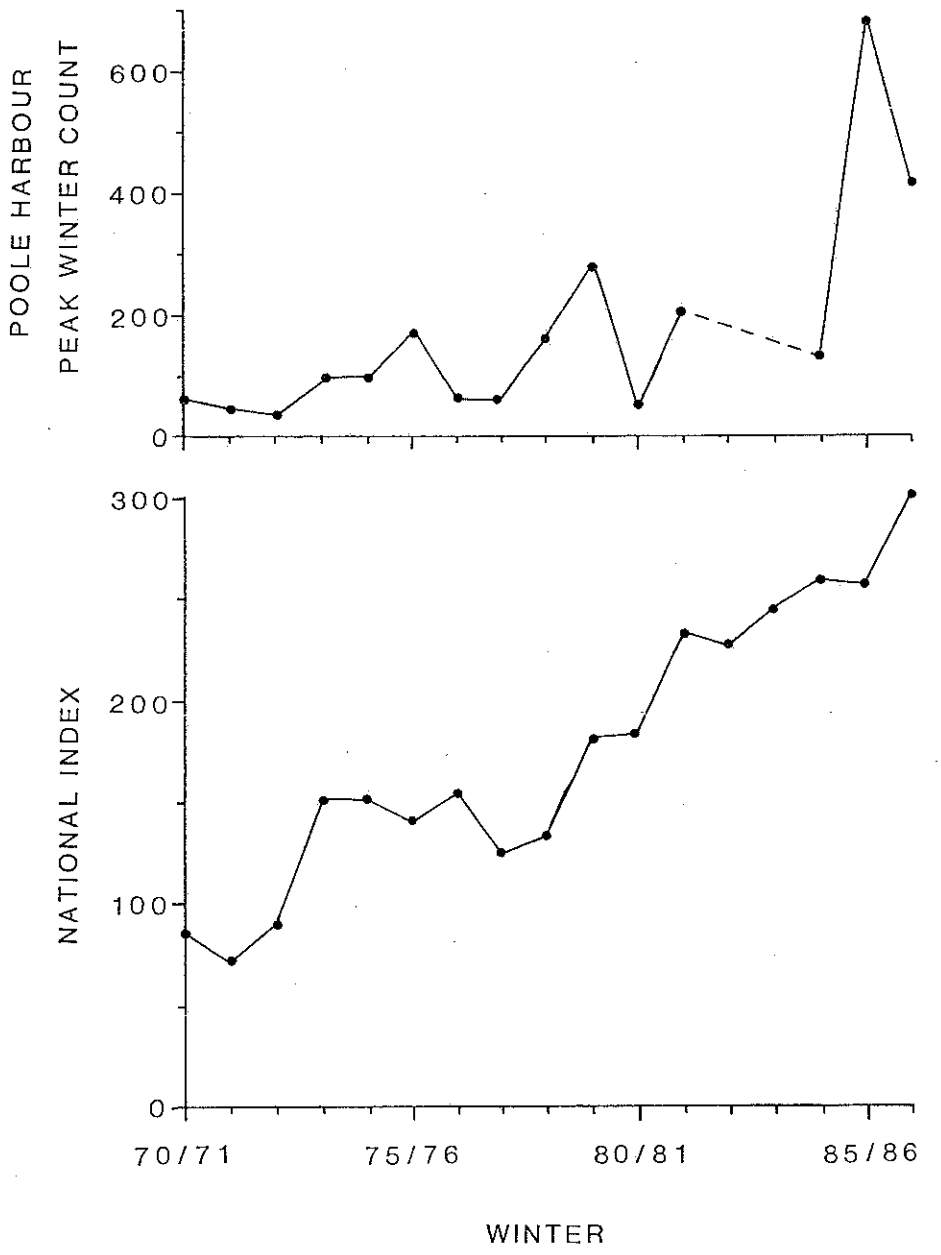


FIGURE 5.5

GREY PLOVER: THE NATIONAL INDEX AND POOLE HARBOUR PEAK WINTER COUNTS FOR THE WINTERS 1970/71 - 1986/87

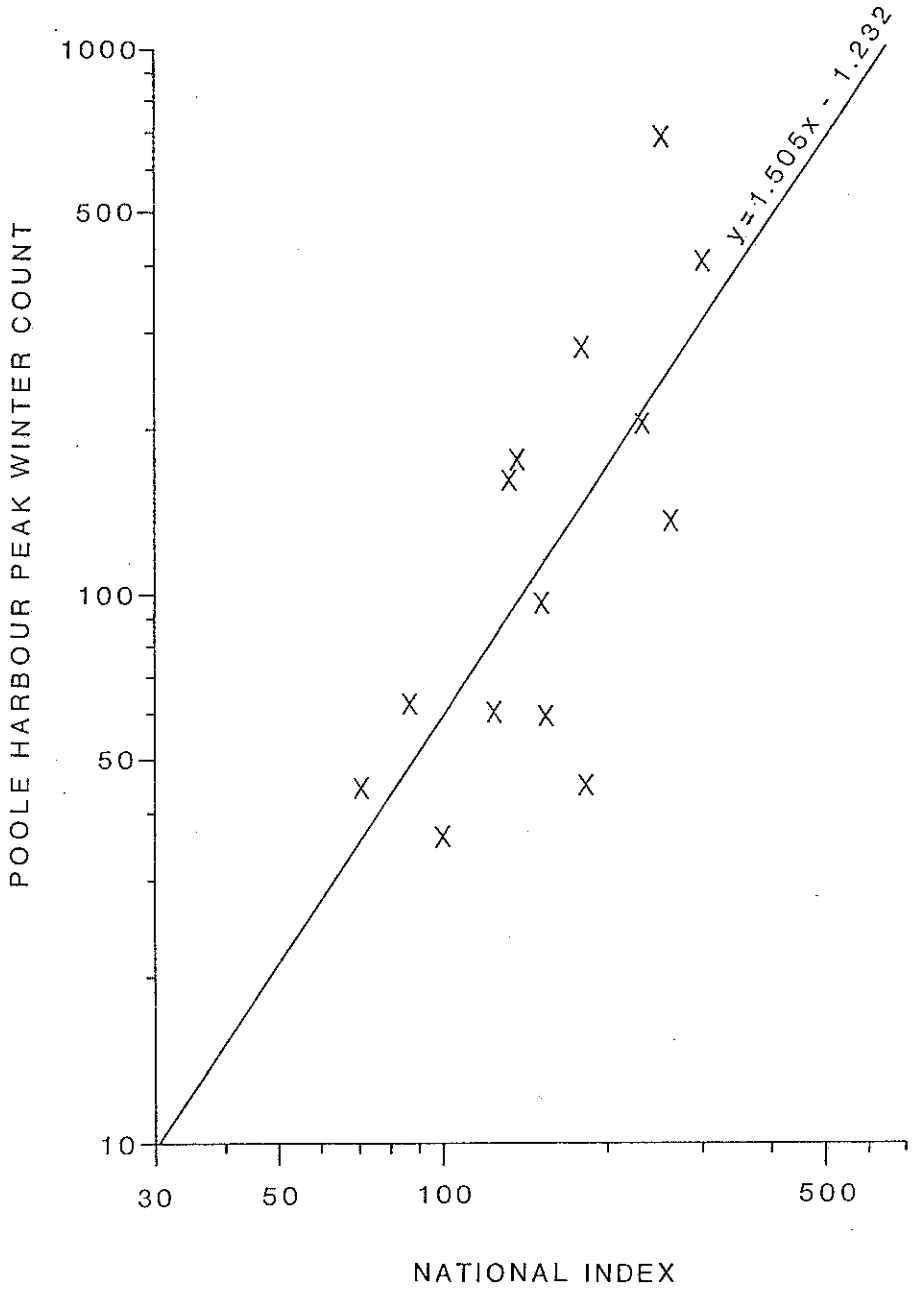


FIGURE 5.6

GREY PLOVER: THE RELATIONSHIP BETWEEN THE NUMBER OF BIRDS WINTERING IN POOLE HARBOUR AND THE NATIONAL INDEX

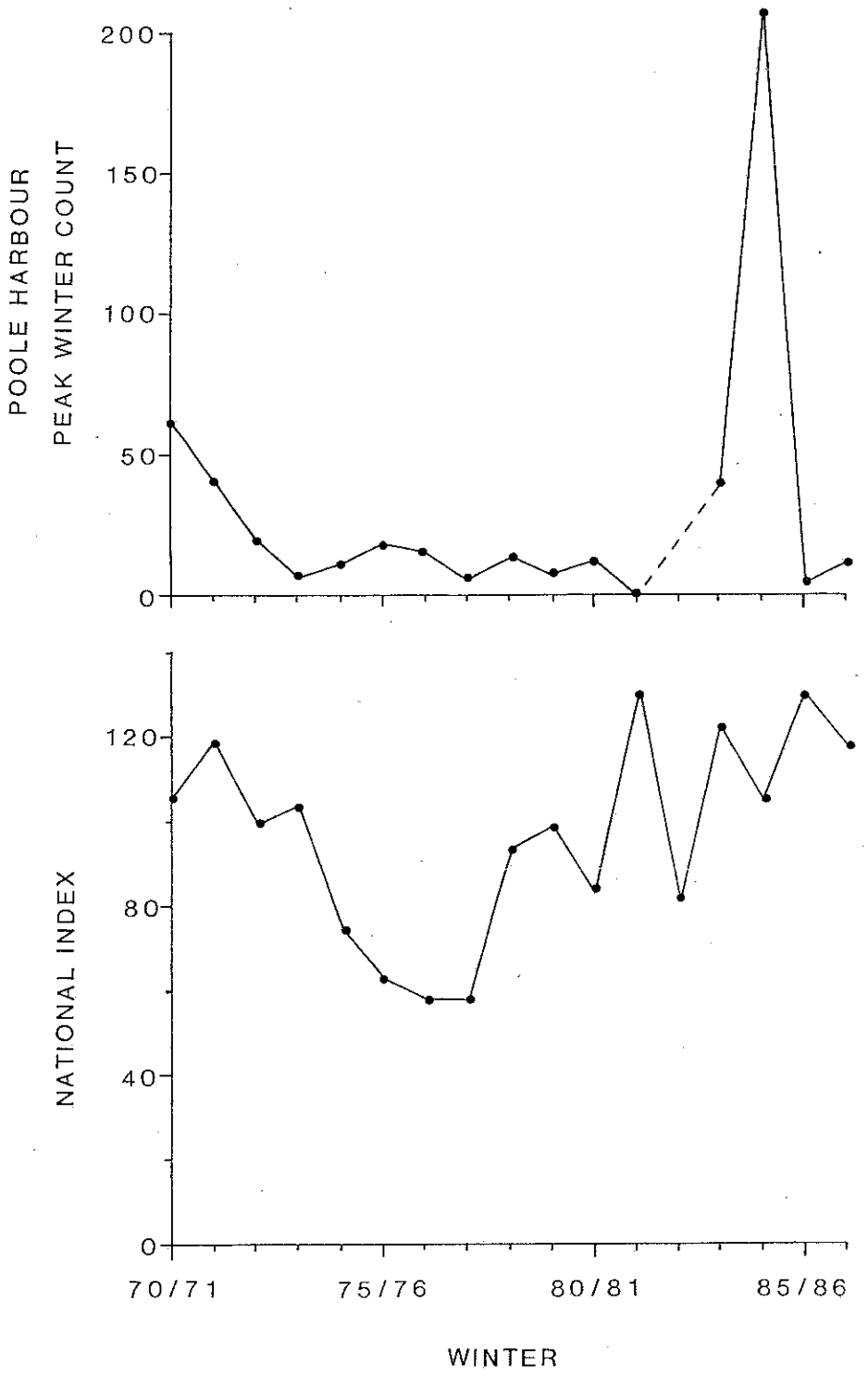


FIGURE 5.7

KNOT: THE NATIONAL INDEX AND POOLE HARBOUR PEAK WINTER COUNTS FOR THE WINTERS 1970/71 - 1986/87

5.3.7 DUNLIN (Calidris alpina alpina)

The average winter peak count of Dunlin in Poole Harbour over the most recent five year period was ca 0.9% of the British population, almost qualifying for national importance (Chapter 4).

Despite an initial rise in the early 1970s, Dunlin wintering in Britain have declined significantly since the start of the BoEE, whereas the population in Poole Harbour has shown no significant trend over the same period (Figure 5.8, Table 5.1). There is also no significant correlation between change in the Poole Harbour and national populations (Table 5.2). This suggests that Poole Harbour is a preferred site for the species, retaining its population even when the national source population is declining. The evidence of a national analysis similarly suggests that wintering Dunlin populations on many estuaries may be at carrying capacity (Goss-Custard & Moser 1988).

Goss-Custard & Moser (1988) have shown that the national decline since 1977-78 in Dunlin numbers has been closely correlated with the spread of Spartina. Spartina appears to affect Dunlin numbers by removing feeding areas and reducing feeding time, both of which would be expected to increase rates of emigration and mortality and reduce juvenile settlement at a site. Though the well-established Spartina marsh in Poole Harbour is in fact receding (see Chapter 2), the mudflats re-exposed by the die-back of Spartina remain, however, in an unsuitable condition as feeding areas for Dunlin. This may be because previously well-established Spartina when receding, possibly leaves the sediments in an unsuitable condition for invertebrates to colonise or encourages the growth of thick algal mats, which may deter many waders (Goss-Custard & Moser 1988).

5.3.8 BLACK-TAILED GODWIT (Limosa limosa)

Chapter 4 showed that the average winter peak count of Black-tailed Godwit in Poole Harbour over the most recent five year period (1983/4-87/88) was ca 1.8% of the European population, above the qualifying level for both national and international importance. Furthermore, the species was identified as one for which Poole Harbour potentially holds more than 1% of individuals from a discrete breeding population.

Nationally, Black-tailed Godwits wintering in Britain have shown a slight but significant increase since the start of the BoEE; however, the population in Poole Harbour has shown no significant trend over the same period (Figure 5.9, Table 5.1). In addition, no significant correlation exists between change in the Poole Harbour and national populations (Table 5.2). This suggests that Poole Harbour may be a preferred site for the species, which was at or near carrying capacity even when national populations were low. The considerable variability in recorded BoEE counts at Poole Harbour is typical for the species, which tend to be highly mobile between estuaries.

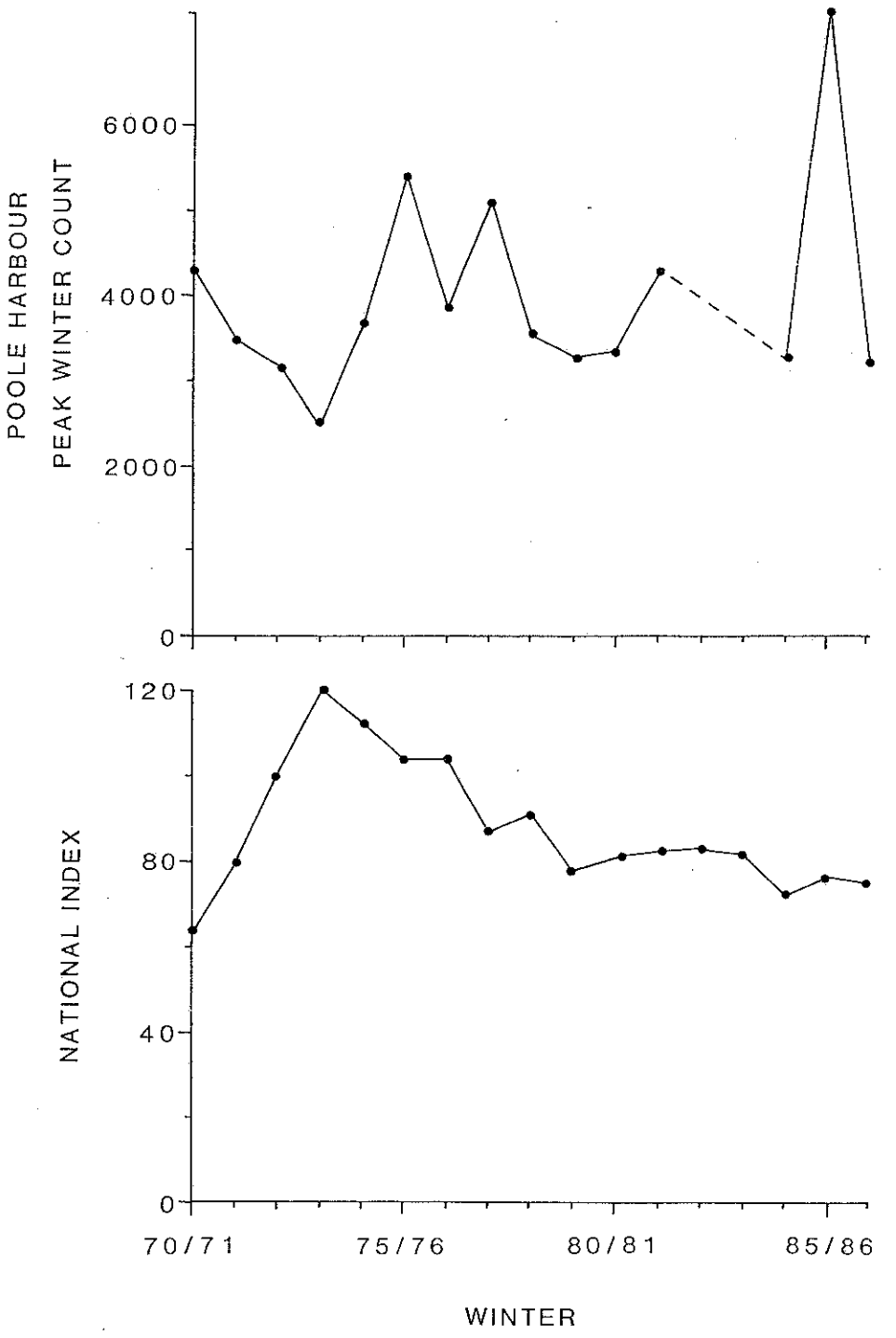


FIGURE 5.8

DUNLIN: THE NATIONAL INDEX AND POOLE HARBOUR PEAK WINTER COUNTS FOR THE WINTERS 1970/71 - 1986/87

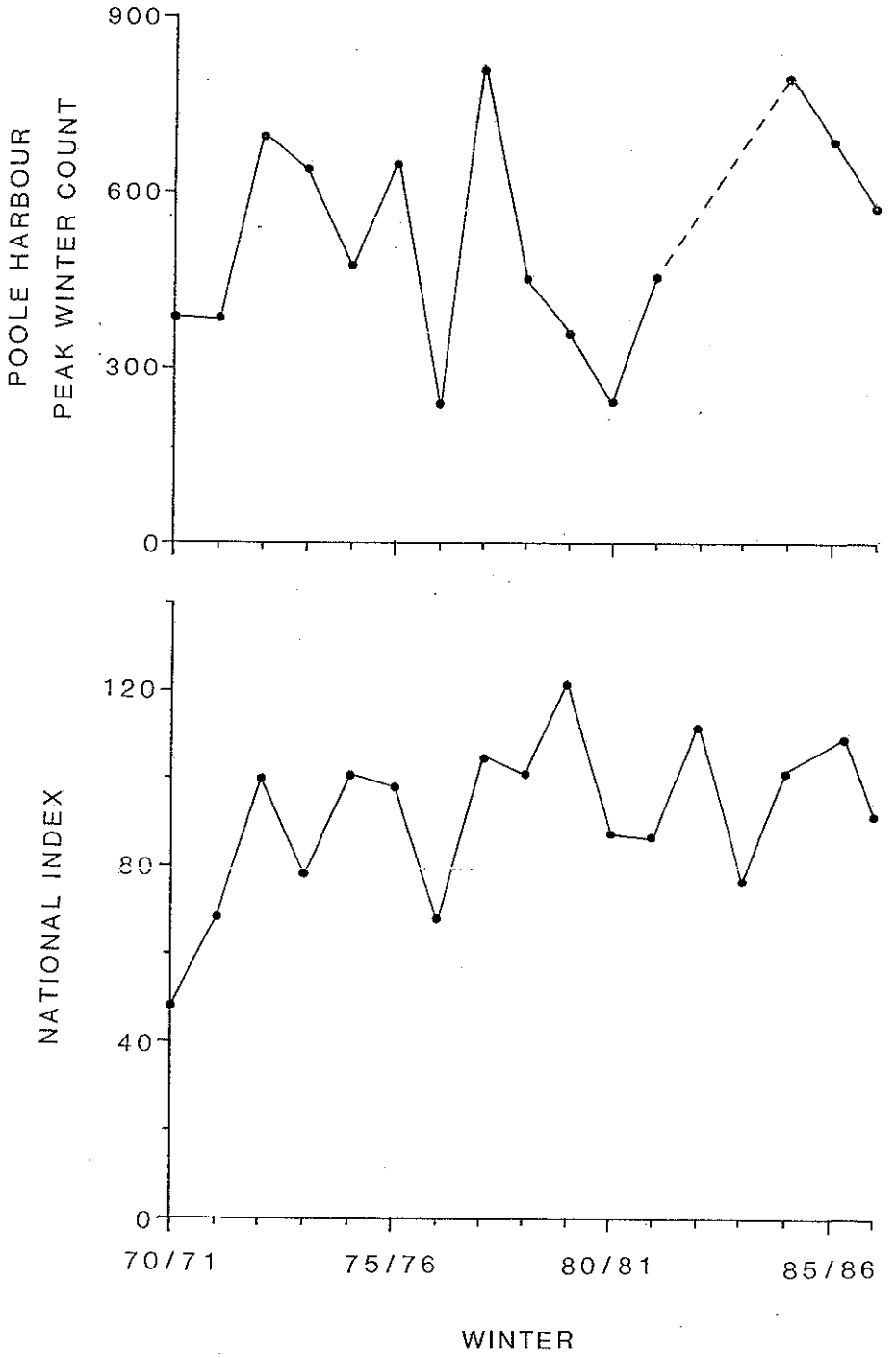


FIGURE 5.9

BLACK-TAILED GODWIT: THE NATIONAL INDEX AND POOLE HARBOUR PEAK WINTER COUNTS FOR THE WINTERS 1970/71 - 1986/87

5.3.9 BAR-TAILED GODWIT (Limosa lapponica)

The average winter peak count of Bar-tailed Godwit in Poole Harbour over the most recent five year period (1983/4-87/88) was ca 0.4% of the British population, below the qualifying level for national importance (Chapter 4).

Nationally, Bar-tailed Godwit wintering in Britain have increased significantly since the start of the BoEE, much of the rise having occurred in the early 1980's (Figure 5.10, Table 5.1). However, the wintering population in Poole Harbour has shown no significant trend over the same period (Figure 5.10, Table 5.1) and also no significant correlation exists between change in the Poole Harbour and national populations (Table 5.2). This suggests that Poole Harbour is a preferred site for the species, although this conclusion must be considered as very tentative since the numbers on the estuary are so small in national terms.

5.3.10 CURLEW (Numenius arquata)

The average winter peak count of Curlew in Poole Harbour over the most recent five year period (1983/4-87/88) was ca 1.2% of the British population, exceeding the qualifying level for national importance (Chapter 4). In addition, the species was identified as one for which Poole Harbour potentially holds more than 1% of individuals from a discrete breeding population.

Both nationally and for Poole Harbour, wintering Curlew have shown no significant trend since the start of the BoEE (Figure 5.11, Table 5.1). Furthermore, no significant correlation exists between change in the Poole Harbour and national population (Table 5.2). The absence of any trends precludes any valid assessment being made of the degree of preference shown by Curlew for Poole Harbour.

5.3.11 REDSHANK (Tringa totanus)

The average winter peak count of Redshank in Poole Harbour over the most recent five year period (1983/4-87/88) was ca 1.0% of the British population, equalling the qualifying level for national importance (Chapter 4).

Nationally, Redshank wintering in Britain have increased slightly but significantly since the start of the BoEE; however, the Poole Harbour population has by contrast declined significantly, with virtually all of the reduction taking place during a population crash in 1980/81, subsequent to which it appeared to stabilize at a lower level (Figure 5.12, Table 5.1). The key to this decline must almost certainly be

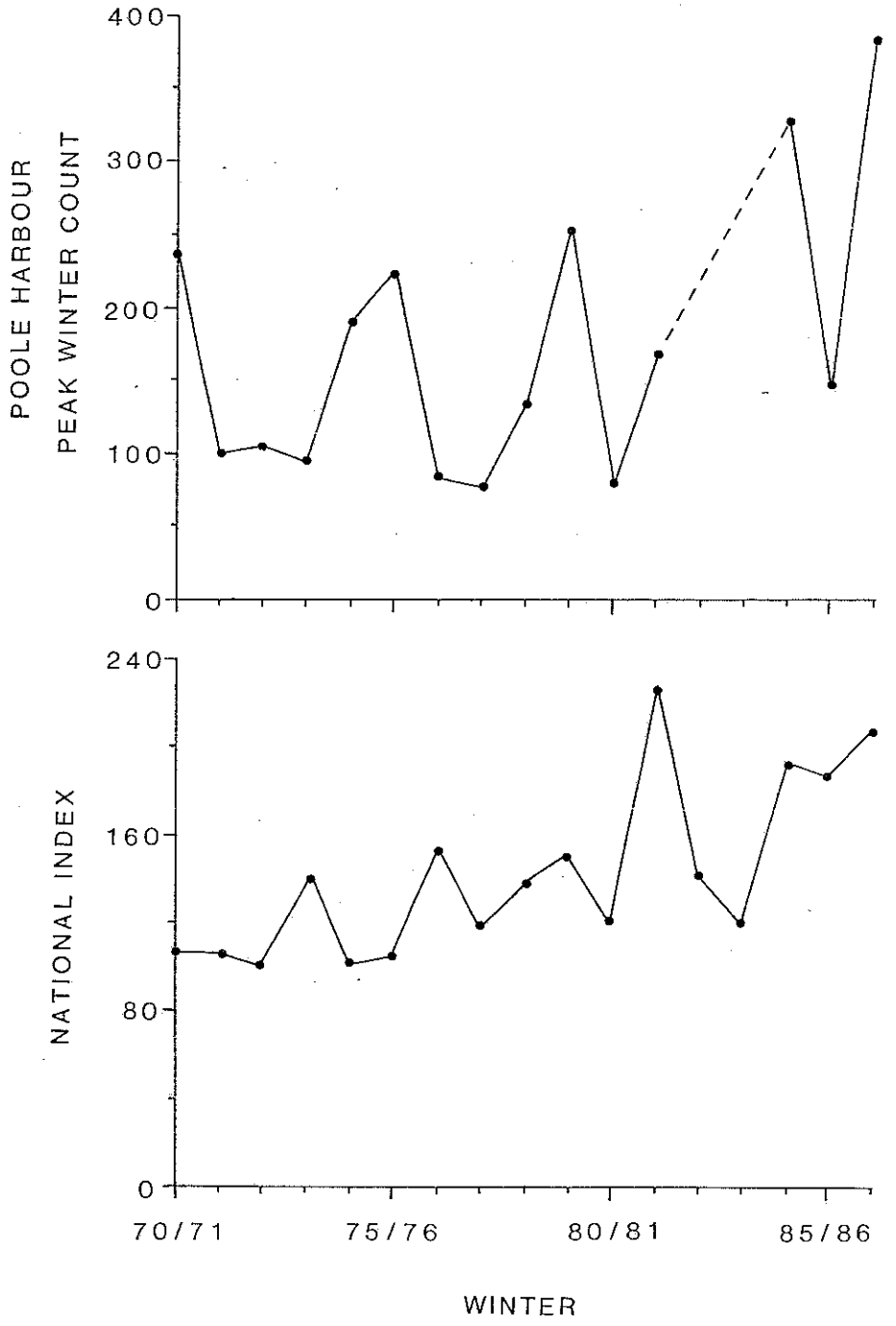


FIGURE 5.10

BAR-TAILED GODWIT: THE NATIONAL INDEX AND POOLE HARBOUR PEAK WINTER COUNTS FOR THE WINTERS 1970/71 - 1986/87

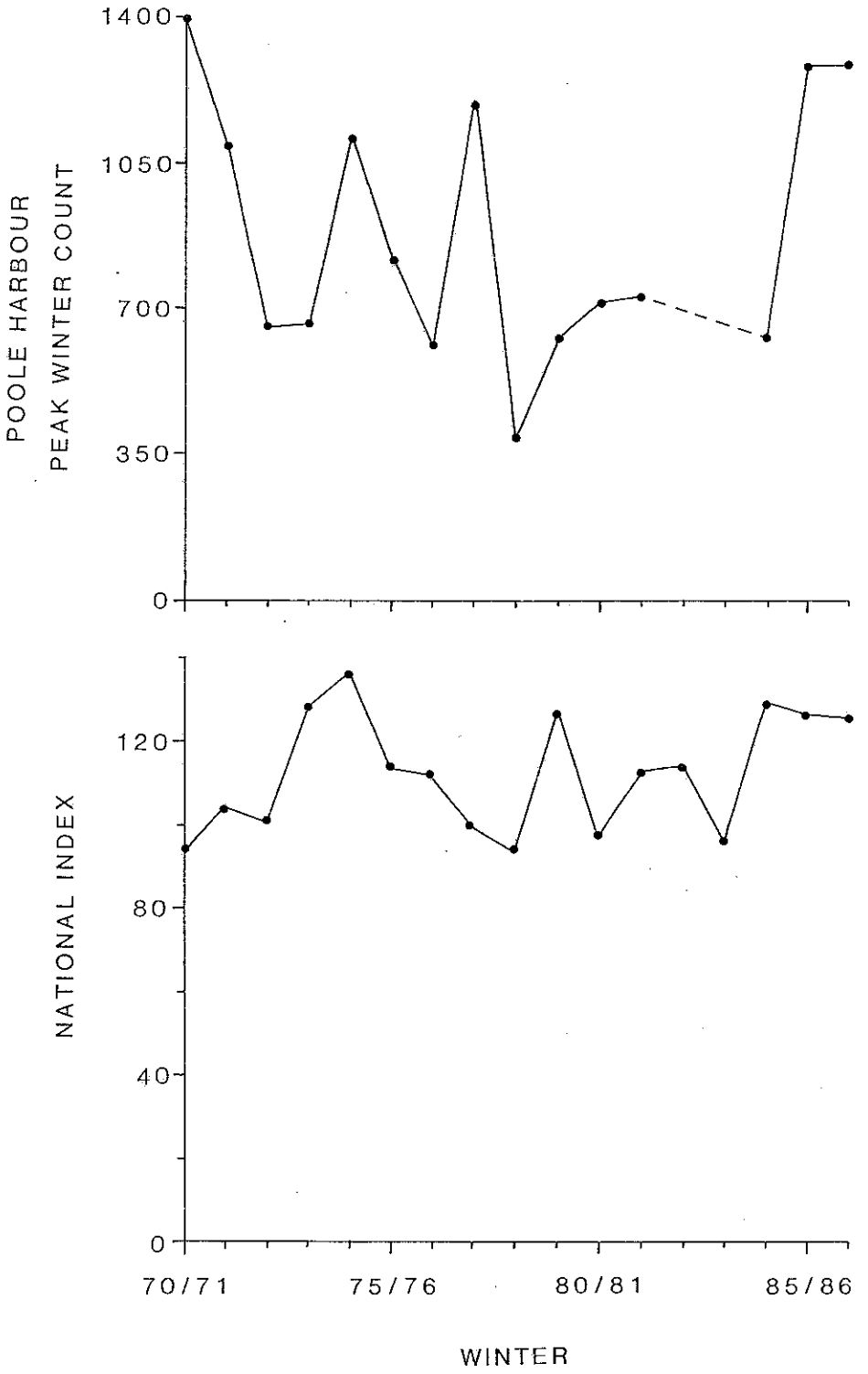


FIGURE 5.11

CURLEW: THE NATIONAL INDEX AND POOLE HARBOUR PEAK WINTER COUNTS FOR THE WINTERS 1970/71 - 1986/87

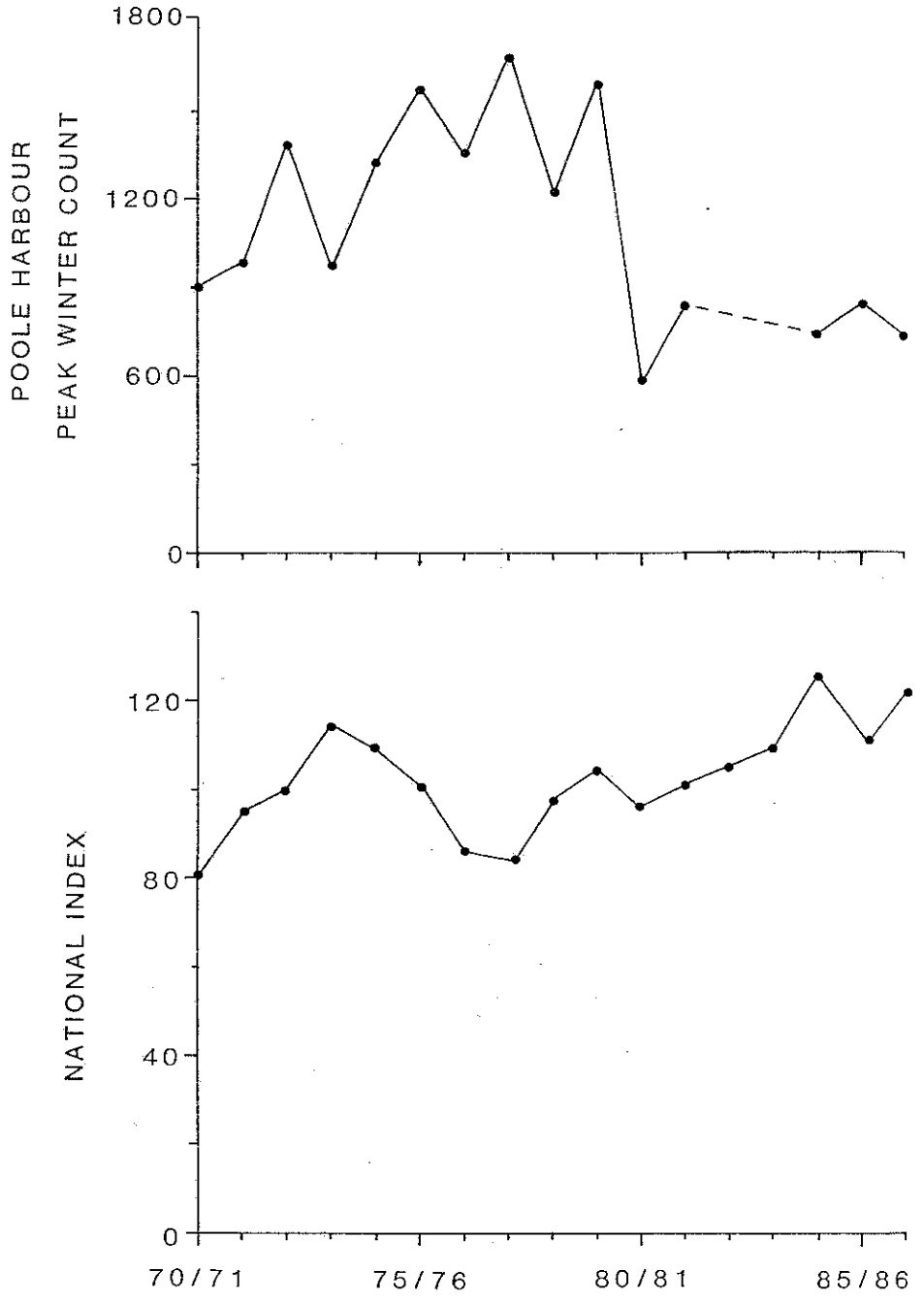


FIGURE 5.12

REDSHANK: THE NATIONAL INDEX AND POOLE HARBOUR PEAK WINTER COUNTS FOR THE WINTERS 1970/71 - 1986/87

sought in some local factor, but what this might be is at present entirely unclear. A decline of this type in the face of a national population increase suggests the local population is at carrying capacity, but this conclusion should be treated with caution until the cause of the decline is understood.

5.4 DISCUSSION

Yearly fluctuations tend to be far greater for the peak winter counts of species at Poole Harbour than for the species respective national indices. The greater fluctuations shown by the Poole Harbour counts are in part the result of variability in accurancy between each count. Several factors contribute to counts from individual estuaries varying in the extent of their accurancy: weather conditions, the nature of the terrain (e.g. birds may be hidden from the counter when in mudflat gullies), the presence of some unobserved waders feeding in nearby fields. However, when the counts of Britain's estuaries are combined to calculate the national indices, the variability between years due to differing count accuracies is reduced. Variability resulting from the fluctuation in accuracy between different counts often hinders short-term analysis of an estuary's wader and wildfowl populations. However, this diminishes as the time period examined is extended.

Significant long-term trends were identified in the Poole Harbour wintering populations of only two species (Grey Plover and Redshank), of which that of only one, Grey Plover, was related to the national trend. Despite a national increase, Poole Harbour's Redshank population has significantly declined, with virtually all of the reduction taking place during a crash in 1980/81, with it subsequently appearing to stabilize at a lower level. A sudden, substantial decline in the late 1970's was also found in the Harbour's wintering Teal population. The data suggest the cause of both declines to be local and, possibly, related. However, the reasons behind the rapid decline of these populations are unclear. Disturbance from the expansion of Poole Harbour's Oil Field developments, and an increase in the use of the Harbour for water-based recreational pursuits e.g. windsurfing, are recent developments in the Harbour that are obvious candidates worthy of consideration. However, there may have been other less obvious developments within Poole Harbour at this time that could equally be the cause of the decline in the two populations, e.g. a change in the quality and quantity of sewage effluent.

Eight species (Shelduck, Teal, Oystercatcher, Ringed Plover, Black-tailed Godwit, Bar-tailed Godwit, Dunlin and Redshank) are likely to be at or near the carrying capacity of the Harbour. Only one of the species populations considered, Grey Plover, was found unlikely to have approached its respective

carrying capacity level for Poole Harbour, with the situation regarding the remaining species, Curlew, uncertain. For the eight species likely to be at or near the carrying capacity, Poole Harbour is apparently a "preferred" site in a national context. The conservation implications of this are that if any of those species are displaced from their Poole Harbour feeding/roosting areas by mudflat removal or disturbance, the birds are likely either to suffer an increased risk of mortality or be forced to emigrate out of Poole Harbour. For three of these eight species, Shelduck, Redshank and Black-tailed Godwit, their Poole Harbour populations are of national importance and, for the latter species, international importance in terms of numbers (see Chapter 4).

5.5 CONCLUSIONS

Two species had Poole Harbour populations showing significant time trends: the Grey Plover population increased faster than the national population increase for this species, whereas the Redshank population decreased significantly despite a national population increase. The analysis suggests that Poole Harbour is a preferred site for Shelduck, Teal, Oystercatcher, Ringed Plover, Black-tailed Godwit, Bar-tailed Godwit, Dunlin and Redshank, but not for Grey Plover and Knot. No conclusions could be reached for Curlew.

6. POPULATION SIZES AND TRENDS IN THE WATERFOWL OF HOLES BAY

6.1 INTRODUCTION

Prior to 1982, few reliable quantitive data exist on the wader and waterfowl populations of Holes Bay, Poole Harbour. The local ornithological literature either relates to Poole Harbour as a whole, e.g. Bull (1952), or provides isolated counts of species in Holes Bay which are of limited value scientifically, e.g. County Bird Reports. An environmental impact assessment in Holes Bay, conducted from July 1982 to January 1983, contained the first detailed study of the Bay's waders and wildfowl (Goss-Custard & Durrell 1983). This was followed by an Ornithological Survey of Poole Harbour by the R.S.P.B. in 1984-6 (Collins 1985, 1986), in which Holes Bay was treated as a discrete unit.

This chapter initially assesses the population sizes of waders, Shelduck, Teal and Black-headed Gull currently present within Holes Bay, along with the overall importance of this site for each species in relation to Poole Harbour as a whole. Any recent trends in the Holes Bay populations since 1982 are then identified and explained where possible.

6.2 METHODS

The species considered in this chapter are the nine wader species, Shelduck and Teal identified in Chapter 4 as having wintering populations in Poole Harbour regularly exceeding 50 birds. In addition, in excess of 2000 Black-headed Gulls were regularly recorded utilizing Holes Bay during this study. This species is undoubtedly an important component of Holes Bay's intertidal bird community and has therefore been included in the analyses specific to Holes Bay.

For each species, the data base examined comprised the following:

i) Mean low water counts of Holes Bay for the period July 1982 to January 1983 (Goss-Custard & Durrell 1983). Each low water count comprised partial counts on three consecutive days, each covering a different third of the Bay. Nine counts were made during the seven month study period.
ii) Mean low water counts of Holes Bay for the period November 1984 to May 1986 (Collins 1985, 1986). The whole Bay was counted in one low water period, with approximately three counts per month.
iii) Mean low water counts of Holes Bay for the period January to December 1988. Each low water count comprised partial counts on four consecutive days, each covering a different

quarter of the Bay. Nineteen counts were made during the twelve month study period.
iv) Poole Harbour monthly BoEE high tide count averages for the years 1983/4 to 1987/88 inclusive.

Between February 1983 and October 1984, an intertidal area along the eastern shore of Holes Bay was reclaimed for the New Holes Bay Road, opened in May 1988. The impact of this "Holes Bay Road Development" upon the population of each species within Holes Bay is given consideration.

Consideration is also given to the effect of severe winter weather upon the population of each species within Holes Bay. A winter of severe weather is designated as one with a continuous period of 14 days when half or more of British weather stations are frozen at 09.00 each day. The only winter of severe weather in the period July 1982 - December 1988 was that of 1986/7 (January). However, in January and February 1985 moderate snowfalls, severe frosts and the icing of exposed mudflats at low tide occurred in Poole Harbour.

6.3 RESULTS

6.3.1 SHELDUCK (Tadorna tadorna)

A total of up to nearly 500 Shelduck may be present in Holes Bay. The site is of considerable importance to the Shelduck population of Poole Harbour, holding at times up to 20% of the total population (Table 6.1). Cold winter weather appears to result in an increased usage of Holes Bay by Shelduck; the January/February 1985 count is almost twice that recorded in other years.

There is no evidence for recent systematic change in the Shelduck population of Holes Bay, despite the Holes Bay Road Development.

6.3.2 TEAL (Anas crecca)

A total of up to 400 Teal may be present in Holes Bay. The site is of major importance to the Teal population of Poole Harbour, holding over a third of the total wintering population (Table 6.2). Furthermore, the Bay's importance to Teal increases in freezing weather conditions, e.g. January/February 1985. The particularly high proportion of the total Teal population of Poole Harbour that is present within Holes Bay in early autumn (i.e. September) tends to suggest that Holes Bay is a preferred feeding area. Zwarts (1976) found that as Teal arrived at a wintering area they would occupy the various sites within it sequentially, beginning with the most preferred and only making use of the least preferred areas when the population had built up to high levels.

Table 6.1 Low water counts of Shelduck in Holes Bay in comparison with the five year average BoEE high tide counts for Poole Harbour.

Holes Bay mean low tide counts	MONTH											
	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
1982-3	50	13	0	5	42	204	19	-	-	-	-	-
1984-5	-	-	-	-	27		489		180		-	-
1985-6	33				298					76		-
1987-8	-	-	-	-	-	-	229	292	277	172	48	60
1988-9	194	33	14	3	59	139	-	-	-	-	-	-
Poole Hbr. BoEE 5 yr. mean count	-	-	128	300	419	847	2425	2126	1380	-	-	-

Table 6.2 Low water counts of Teal in Holes Bay in comparison with the five year average BoEE high tide counts for Poole Harbour.

Holes Bay mean low tide counts	MONTH											
	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
1982-3	0	0	0	0	115	131	40	-	-	-	-	-
1984-5	-	-	-	-	97		407		224		-	-
1985-6	17				300					32		-
1987-8	-	-	-	-	-	-	226	134	138	23	0	0
1988-9	0	36	166	166	334	293	-	-	-	-	-	-
Poole Hbr. BoEE 5 yr. mean count	-	-	163	386	385	673	627	421	330	-	-	-

The Holes Bay Teal population has apparently increased in recent years, contrary to the long-term trend of Poole Harbour's population (Chapter 5). There is no evidence to suggest the Holes Bay Road Development was detrimental to the Bay's Teal population.

6.3.3 OYSTERCATCHER (Haematopus ostralegus)

A total of up to 100 Oystercatcher may be present in Holes Bay. The site is of some importance to the Oystercatcher population of Poole Harbour, holding at times up to 10% of the total population present (Table 6.3).

The decline in the Oystercatcher population of Holes Bay between 1982 and 1985 suggests that the reclamation for the Holes Bay Road Development has had a short-term deterimental impact upon the Oystercatcher. However, since the winter of 1984/5, the number of Oystercatcher utilizing Holes Bay has begun to increase towards its former level. There was no reduction in the overall BoEE Poole Harbour counts of Oystercatcher during the period 1982 - 1988.

6.3.4 RINGED PLOVER (Charadrius hiaticula)

The available counts, summarized in Table 6.4, suggest that Holes Bay holds a high proportion of Poole Harbour's Ringed Plover population during the autumn migration, but is of little or no importance for the species at other times of year.

Ringed Plovers were observed by both Goss-Custard & Durrell (1983) during 1982/83, and by Collins (1985), during 1984/85, but neither authors provide quantitative data. It therefore remains uncertain as to whether any recent change in the status of Ringed Plover population of Holes Bay has occurred.

6.3.5 GREY PLOVER (Pluvialis squatarola)

Holes Bay is of negligible importance to the Grey Plover population of Poole Harbour, never holding more than 3% of the total population (Table 6.5). The few birds recorded utilizing Holes Bay in the present study were all juveniles.

No recent changes have occurred in the species' status in Holes Bay.

6.3.6 KNOT (Calidris canutius)

Holes Bay is of negligible importance to the Knot population of Poole Harbour (Table 6.6). The species was recorded only once in Holes Bay during the present study, i.e. two roosting juveniles in autumn.

Table 6.3 Low water counts of Oystercatcher in Holes Bay in comparison with the five year average BoEE high tide counts for Poole Harbour.

Holes Bay mean low tide counts	MONTH											
	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
1982-3	9	62	64	23	58	64	100	-	-	-	-	-
1984-5	-	-	-	-	18		14		8		-	-
1985-6	10				47					16		-
1987-8	-	-	-	-	-	-	81	44	26	6	6	5
1988-9	3	16	24	31	37	76	-	-	-	-	-	-
Poole Hbr. BoEE 5yr. Mean count	-	-	926	1095	761	1284	814	583	542	-	-	-

Table 6.4 Low water counts of Ringed Plover in Holes Bay in comparison with the five year average BoEE high tide counts for Poole Harbour.

Holes Bay mean low tide counts	MONTH											
	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
1982-3	-	-	-	-	-	-	-	-	-	-	-	-
1984-5	-	-	-	-	-		-		-		-	-
1985-6		ca 83				9				2		-
1988	-	-	-	-	-	-	0	3	0	0	0	0
	0	60	51	0	0	0	-	-	-	-	-	-
Poole Hbr. BoEE 5 yr. mean count	-	-	31	51	16	64	51	18	14	-	-	-

Table 6.5 Low water counts of Grey Plover in Holes Bay in comparison with the five year average BoEE high tide counts for Poole Harbour.

Holes Bay Mean low tide counts	MONTH											
	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
1982-3	0	0	0	0	0	0	0	-	-	-	-	-
1984-5	-	-	-	-	0		0		0		-	-
1985-6	0				0					0		-
1987-8	-	-	-	-	-	-	0	0	0	0	0	0
1988-9	0	0	0	1	1	0	-	-	-	-	-	-
Poole Hbr. BoEE 5 yr. mean count	-	-	10	30	97	249	252	198	42	-	-	-

Table 6.6 Low water counts of Knot in Holes Bay in comparison with the five year average BoEE high tide counts for Poole Harbour.

Holes Bay Mean low tide counts	MONTH											
	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
1982-3	0	0	0	0	0	0	0	-	-	-	-	-
1984-5	-	-	-	-	0		0		0		-	-
1985-6	0				0					0		-
1987-8	-	-	-	-	-	-	0	0	0	0	0	0
1988-9	0	0	0	0	0	0	-	-	-	-	-	-
Poole Hbr. BoEE 5 yr. mean count	-	-	11	4	4	55	10	1	3	-	-	-

No recent changes have occurred in the species' status in Holes Bay.

6.3.7 DUNLIN (Calidris alpina)

Holes Bay is of considerable importance to the Dunlin population of Poole Harbour, holding a minimum of 12% of the total wintering population and at times over 50% (Table 6.7). Numbers of birds present may exceed 1,000. The exceptionally high Dunlin counts in in Holes Bay during autumn 1988 were the result of a very successful breeding season for the species in this year; virtually all the birds present at this time were juveniles. The difference between Holes Bay's 1988 autumn Dunlin counts and those of previous years is of a similar order of magnitude to that observed within other British estuaries (N.Clark pers. comm.).

The high January/February 1985 count suggests that periods of freezing weather may increase the Dunlin population present in Holes Bay. However, a national analysis of national ringing recoveries by Baillie et al. (1986) found no evidence of cold weather movements by Dunlin.

The wintering Dunlin (C.a.alpina) population in Holes Bay has apparently increased in recent years. There is no evidence for any adverse impact upon the species from the Holes Bay Road Development.

The spring passage of Dunlin (C.a.schinzii and C.a.arctica) northwards is rapid (Chapter 4), and only extremely frequent counting can reliably reveal peak passage numbers. This is illustrated by the differences in the April and May count data for the years 1985, 1986 and 1988.

6.3.8 BLACK-TAILED GODWIT (Limosa limosa)

Holes Bay is of major importance to the Black-tailed Godwit population of Poole Harbour during late winter and spring (Table 6.8). At this time, virtually the entire internationally important population of the species within Poole Harbour may be present within Holes Bay. In Holes Bay, the highest single count of Black-tailed Godwits made during the present study was of a feeding flock of ca 950 birds on the 11 March 1988.

Though the counts of the previous studies are substantially lower, the unpredictability of the species in regards to which feeding areas it utilizes on a given day may explain the differences, rather than any alteration in the environmental conditions of Holes Bay. The BoEE counts of Black-tailed Godwit show there to be no trend towards increase in the Poole Harbour population of this species (Chapter 5). There is no evidence for any adverse impact upon the Black-tailed Godwit population from the Holes Bay Road Development.

Table 6.7 Low water counts of Dunlin in Holes Bay in comparison with the five year average BoEE high tide counts for Poole Harbour.

Holes Bay Mean low tide counts	MONTH											
	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
1982-3	0	17	0	10	145	637	387	-	-	-	-	-
1984-5	-	-	-	-	301		1137		9		-	-
1985-6	50				748					222		-
1987-8	-	-	-	-	-	-	739	418	339	37	0	0
1988-9	0	440	406	139	168	1008	-	-	-	-	-	-
Poole Hbr. BoEE mean count	-	-	146	120	1461	3513	3077	1535	526	-	-	-

Table 6.8 Low water counts of Black-tailed Godwits in Holes Bay in comparison with the five year average BoEE high tide counts for Poole Harbour.

Holes Bay mean low tide counts	MONTH											
	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
1982-3	0	0	0	0	0	0	0	-	-	-	-	-
1984-5	-	-	-	-	0		41		88		-	-
1985-6	-				-				166		-	-
1987-8	-	-	-	-	-	-	125	273	705	604	0	0
1988-9	7	0	1	0	30	1	-	-	-	-	-	-
Poole Hbr. BoEE 5 yr. mean count	-	-	239	563	324	407	242	377	452	-	-	-

6.3.9 BAR-TAILED GODWIT (Limosa lapponica)

Holes Bay is of negligible importance to the Bar-tailed Godwit population of Poole Harbour (Table 6.6). This species was recorded only once in Holes Bay during the present study, a single individual in the autumn.

No recent changes have occurred in the species' status in Holes Bay.

6.3.10 CURLEW (Numenius arquata)

Holes Bay is of major importance to the Curlew population of Poole Harbour, holding at times up to nearly half of the total population (Table 6.10). A total of up to 200 Curlew may be present in Holes Bay.

There is no evidence to suggest that the Holes Bay Road Development has had any adverse impact on the Curlew population frequenting Holes Bay. In fact, the number of birds using Holes Bay at low water appears to have increased from 1982/3 onwards.

6.3.11 REDSHANK (Tringa totanus)

6.11). The appearance that at times it holds 100% of Redshank present in Poole Harbour is, however, false; high tide BoEE counts considerably underestimate the true Poole Harbour population of Redshank because of difficulties in locating birds roosting in Spartina saltmarsh.

Holes Bay count data prior to 1988 are predominantly lower than counts collected in 1988, suggesting either a recent population increase or better counting in 1988. No adverse impact upon Holes Bay's Redshank population from the Holes Bay Road Development is therefore evident from the above data sets.

6.3.12 BLACK-HEADED GULL (Larus ridibundus)

Black-headed Gulls are not regularly censused by the BoEE counts in Poole Harbour. However, the Poole Harbour nocturnal roost holds up to approximately 10,000 Black-headed Gulls (Collins 1985), of which up to quarter may at any one time utilize Holes Bay for diurnal feeding and roosting (Table 6.12).

Overall, an increase in the Black-headed Gull population utilizing Holes Bay at low water is suggested from the data presented in Table 6.12. There is no evidence that the Holes Bay Road Development has adversely affected the Bay's Black-headed Gull population to date.

Table 6.9 Low water counts of Bar-tailed Godwit in Holes Bay in comparison with the five year average BoEE high tide counts for Poole Harbour.

Holes Bay Mean low tide counts	MONTH											
	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
1982-3	0	0	0	0	0	0	0	-	-	-	-	-
1984-5	-	-	-	-	0		0		0		-	-
1985-6	0				0					0		-
1987-8	-	-	-	-	-	-	0	0	0	0	0	0
1988-9	0	0	0	0	0	0	-	-	-	-	-	-
Poole Hbr. BoEE 5 yr. mean count	-	-	17	19	25	77	229	126	58	-	-	-

Table 6.10 Low water counts of Curlew in Holes Bay in comparison with the five year average BoEE high tide counts for Poole Harbour.

Holes Bay mean low tide counts	MONTH											
	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
1982-3	53	45	32	55	115	128	67	-	-	-	-	-
1984-5	-	-	-	-	74		102		106		-	-
1985-6	36				141					70		-
1987-8	-	-	-	-	-	-	200	173	186	106	8	2
1988-9	45	54	90	90	154	191	-	-	-	-	-	-
Poole Hbr. BoEE 5 yr. mean count	-	-	656	1213	667	788	811	604	393	-	-	-

Table 6.11 Low water counts of Redshank in Holes Bay in comparison with the five year BoEE high tide counts for Poole Harbour.

Holes Bay mean low tide counts	MONTH											
	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
1982-3	402	540	370	382	275	459	383	-	-	-	-	-
1984-5	-	-	-	-	245		371		314		-	-
1985-6	389				386					93		-
1987-8	-	-	-	-	-	-	499	621	359	267	0	407
1988-9	275	847	708	747	600	476	-	-	-	-	-	-
Poole Hbr. BoEE 5 yr. mean count	-	-	407	729	637	479	574	405	314	-	-	-

Table 6.12 Low water counts of Black-headed Gull in Holes Bay.

Holes Bay mean low tide counts	MONTH											
	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
1982-3	654	1621	1047	367	582	411	1532	-	-	-	-	-
1984-5	-	-	-	-	591		713		637		-	-
1985-6	-				-					-		-
1987-8	-	-	-	-	-	-	1225	1799	889	1963	1025	1229
1988-9	1140	3788	3099	1153	1153	1061	-	-	-	-	-	-

6.4 DISCUSSION

Holes Bay is a site of considerable importance to the Poole Harbour populations of five wader species (Oystercatcher, Dunlin, Black-tailed Godwit, Curlew, Redshank) as well as to Shelduck, Teal and Black-headed Gull. Evidence from the 1988 counts suggest that two of these species, Black-tailed Godwit and Redshank, may have populations in Holes Bay that exceed their respective qualifying levels for international and national importance respectively. In autumn, Holes Bay may also be of some importance to the Poole Harbour's passage population of Ringed Plover.

Four wader species (Dunlin, Black-tailed Godwit, Curlew and Redshank), Teal and Black-headed Gull appear to have shown recent increases in their Holes Bay populations. This evidence must be intrepreted with caution, however, because of the short run of data available, the differing observers involved and the differing techniques used (see also Chapter 7). The Oystercatcher is the only species in Holes Bay to have shown a population decrease; this was prior, however, to the population then increasing. The remaining wader species and Shelduck have shown no obvious recent identifiable population trends in Holes Bay.

For the four wader species and Teal whose Holes Bay populations appear recently to have increased, there has been no comparable increase in their respective Poole Harbour populations (Chapter 5). This would tend to suggest that redistribution of their populations has been taking place. The reasons for any such redistribution are, however, unclear. Disturbance from the expansion of the Oil Field developments and an increase in water-based recreational pursuits e.g. windsurfing, are obvious candidates worthy of consideration. However, there may be less obvious developments within Poole Harbour occurring that might equally be the cause, e.g. change in the quality and quantity of sewage effluent.

The only species whose population in Holes Bay appears to have shown a decline following the Holes Bay Road Development is the Oystercatcher. This is in agreement with the prediction made by Goss-Custard & Durrell (1983) in 1983 that the development would affect less than 10% of the total feeding time of any species feeding in the Bay, except Oystercatcher. The Holes Bay Oystercatcher population was predicted to possibly lose up to 14% of its feeding time. The decline in the Oystercatcher population was, however, only temporary and had shown a substantial recovery by the end of 1988, the year the Holes Bay Road Development was completed. In fact, the decline in the population reached its maximum at the time of the reclamation along the east side of Holes Bay (31 January 1983 - 1st October 1984). This would tend to suggest that the direct removal of mudflats by the (Holes Bay Road) Development apparently had no prolonged deterimental impact upon the Oystercatcher population; any displaced Oystercatchers were presumably soon able to locate suitable feeding areas

elsewhere in the Bay. This may have be helped for example, by a possible improvement in the feeding quality of an intertidal area as a result of the influence of the reclamation upon the Bay's sedimentation.

As a result of the timing and temporary nature of the decline in the Oystercatcher population, it would seem probable that disturbance from the reclamation work itself was an important cause of the decline. The birds most likely to have been disturbed were those on the two main Oystercatcher feeding areas in the Bay (Goss-Custard & Durrell 1983); these were within 300 metres of the reclaimed area. Though several other species in the Bay had major feeding areas within 300 metres of the reclamation (Goss-Custard & Durrell 1983), no detrimental impact was shown upon their respective populations; unlike many of the Oystercatcher presumably, any birds of other species temporarily displaced by the disturbance were able to find suitable feeding elsewhere within the Bay.

6.5 CONCLUSIONS

Holes Bay is of importance to the Poole Harbour populations of five wader species (Oystercatcher, Dunlin, Black-tailed Godwit, Curlew, Redshank), and to Shelduck, Teal and Black-headed Gull. Two of these species, Black-tailed Godwit and Redshank, may have populations in Holes Bay that exceed their respective qualifying levels for international and national importance respectively.

For the period 1982-88, the Teal, Dunlin, Curlew, Redshank and Black-headed Gull populations of Holes Bay appear to have increased, whereas that of the Oystercatcher initially decreased but showed a subsequent recovery. The Oystercatchers temporary decline was almost certainly in response to the reclamation of part of the eastern shore of Holes Bay in 1983/4. No adverse impact from the Holes Bay Road Development upon the Holes Bay populations of any of the other species considered were identified.

7. THE DISTRIBUTION AND NUMBERS OF FEEDING WATERFOWL IN HOLES BAY

7.1 INTRODUCTION

Eight species of duck, wader and gull have substantial populations in Holes Bay (Chapter 6). Their main food source is the invertebrates of the mudflats. Reclamation of the intertidal area would therefore reduce the feeding area available to estuarine birds. However, the importance of a feeding area depends upon not only its extent, but also its prey density and its availability also to the foraging birds through the tidal cycle: the latter is quantified as feeding time.

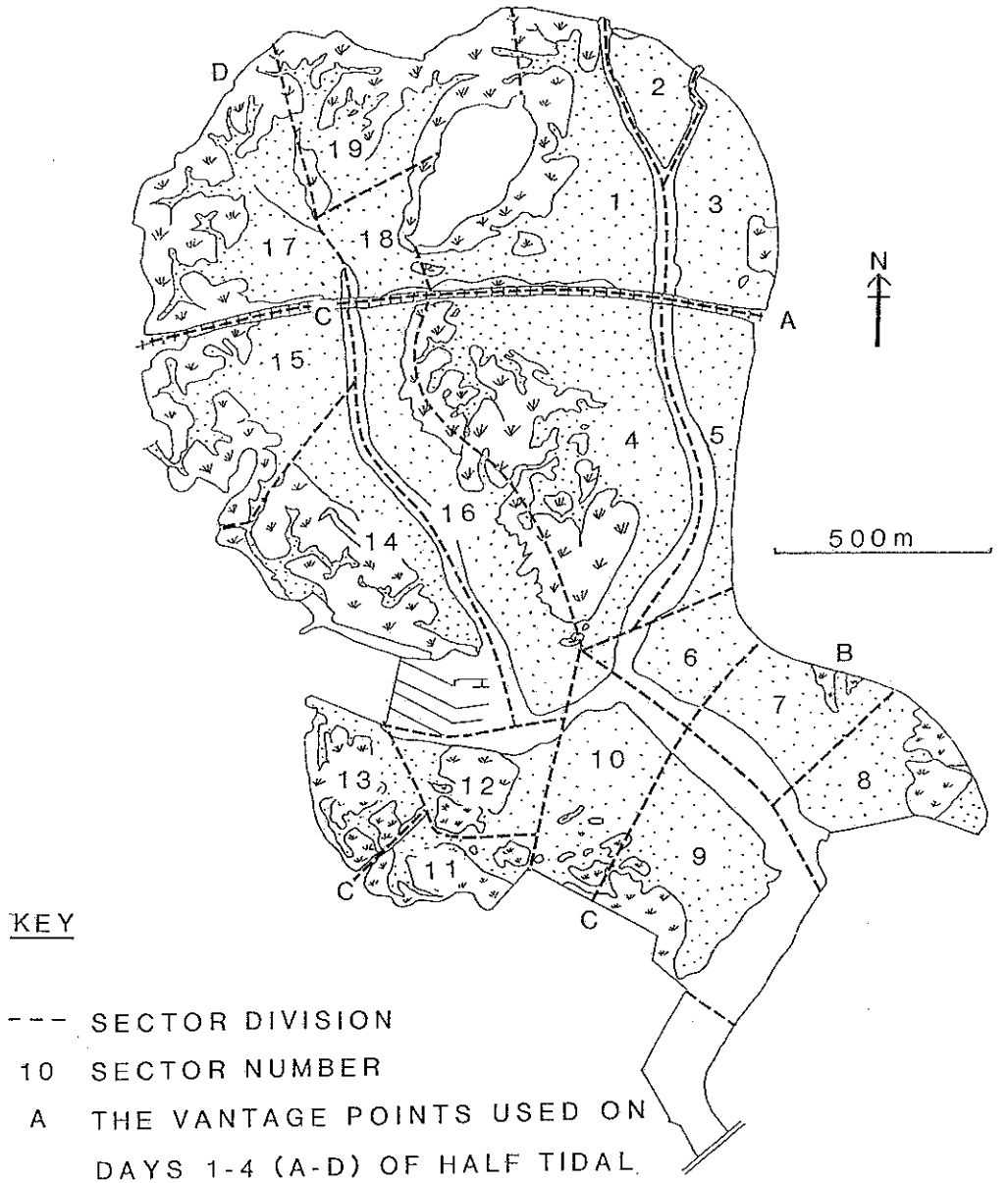
Goss-Custard & Durrell (1983) studied the feeding of birds in Holes Bay in the ornithological component of an environmental impact study on proposed land reclamation in Holes Bay. Their assessment of the situation was based only upon one autumn's and half a winter's data and covered only part of the tidal cycle. The RSPB's Ornithological Survey of Poole Harbour during 1984-86 did cover the complete year in Holes Bay, but again for only part of the tidal cycle. Furthermore, the report concentrated on the highest number of birds that could be counted at low tide rather than the true importance of a site as a feeding area to a species.

This chapter aims to assess the overall usage and preference by birds of each mudflat unit within the Bay. More intensive observations were made in the areas relating to Dorset County Council's development proposals, to assess both the direct impact of habitat loss and the indirect effects of disturbance on the existing bird populations. Consideration is also given in this chapter to the importance of field feeding to the Holes Bay bird populations in the context of impact assessment of the proposed developments.

7.2 METHODS

7.2.1 FIELD METHODS

The 14 sectors into which Holes Bay was divided by Goss-Custard & Durrell (1983) were adopted as the basis for the present study in order to facilitate comparison of results. However, around the proposed development area some sectors were further sub-divided, making a total of 19 in all, in order to obtain greater detail on bird distribution there (Figure 7.1). Hourly counts were taken in each sector for half a tidal cycle, four consecutive days being required for complete coverage of the Bay from six vantage points. For each count, the number of birds feeding and resting in a



KEY

--- SECTOR DIVISION

10 SECTOR NUMBER

A THE VANTAGE POINTS USED ON DAYS 1-4 (A-D) OF HALF TIDAL CYCLE COUNTS

FIGURE 7.1 THE SECTOR DIVISIONS AND VANTAGE POINTS USED IN HOLES BAY

sector were recorded, using 10x50 & 10x40 binoculars and a 20-60x60 telescope. This was repeated for the remaining half of the tidal cycle several days later, when daylight hours and times of the tides allowed. The count times were synchronized with the predicted time of low water at Poole Bridge (Lookers 1987). A full tidal cycle of counts was completed approximately every two weeks. In total, 19 full tidal cycle counts were made between 19 December 1987 and 17 December 1988, with all fieldwork being carried out by the author. Details of weather, visibility and any form of disturbance were recorded. During the counting periods, movements of the birds between mudflats and roosts were noted. The use made by birds of roost sites is discussed more fully in Chapter 8.

The accuracy of the adopted count methodology was tested by means of two coordinated low tide counts of Holes Bay involving five observers. A third such count was cancelled due to poor visibility. The counts were made on the day after the author had completed hourly counts for half a tidal cycle which included a low tide count. The counts for each species, and the mean difference between the two counting methods, are presented in Table 7.1. Apart from Shelduck, the count methodology adopted in the feeding studies underestimated total populations present by an average of ca 25%. There was, however, no evidence that the under estimation varied greatly between those sectors within and outside of the proposed Development Area. Therefore although peak populations presented below may well be underestimates, the proportional use made by each species of each sector should provide an accurate representation of the true situation.

7.2.2 DATA ANALYSIS AND PRESENTATION

The intertidal species considered were those identified in Chapter 6 as having important populations in Holes Bay: Shelduck, Teal, Oystercatcher, Dunlin, Black-tailed Godwit, Curlew, Redshank and Black-headed Gull. Dependent upon the species, the year was divided into three or four periods: summer, autumn, winter and spring (see Chapter 3). Within those periods, the hourly counts of feeding birds were converted to bird hours feeding per tidal cycle in order to assess the proportion of the total feeding activity of each species likely to be affected by the proposed developments.

When there was little difference between the results for a species from two or more periods of the year, they were combined for the purposes of this presentation. For each period or combination thereof, the study's analysed data is presented for each species as follows:

i) Low water counts of Holes Bay in 1988.

ii) The percentage mean feeding hours through the tidal cycle for:
   a) the whole of Holes Bay,

Table 7.1 Comparison between coordinated low tide counts of Holes Bay and, low tide counts comprised partial counts on four consecutive days, each covering a different quarter of Holes Bay. Black-tailed Godwit are excluded as under 10 individuals were recorded in total.

Species	*November		December		Mean % Difference
	Coordinated count	4 day count	Coordinated count	4 day count	
Shelduck	80	92	187	175	- 3.3
Teal	375	381	356	232	16.6
Oystercatcher	64	42	146	101	32.6
Dunlin	363	222	ξ	643	38.8
Curlew	231	197	250	214	14.6
Redshank	638	608	743	660	7.9
Black-headed Gull	1448	991	2474	1457	36.6

N.B. * - Sectors 6,7 and 8 were not counted during the 4 day cycle of counts due to fog. Therefore counts for those sectors are excluded from that month's coordinated count.

ξ - A hunting Sparrowhawk Accipiter nisus made the majority of Dunlin leave the Bay prior to the coordinated count. Therefore this count has been omitted.

b) the sectors affected by the proposed developments, i.e. sectors 6 - 10 (Figure 2.3, Chapter 3).

iii) The mean percentage of the total feeding time (bird hours) in the individual sectors and, when relevant, the mean number of feeding birds per hectare of mudflat (excluding Spartina marsh) in the individual sectors.

After all the species accounts of intertidal feeding in Holes Bay, consideration is given to any additional feeding sought in fields by the Holes Bay population of each species.

Table 7.2 lists the approximate areas of mudflat in each of the 19 sectors.

7.3 RESULTS

7.3.1 SHELDUCK (Tadorna tadorna)

Low tide counts of Holes Bay's Shelduck through 1988 (Figure 7.2), closely followed the seasonal trend of counts in Poole Harbour as a whole (Chapter 4). The wintering population peak, however, occurred in March rather than January; both nationally and in Poole Harbour a distinct February peak occurred during the winter of 1987/88 (Salmon et al. 1988). Passage of birds from their breeding to their moulting grounds probably accounts for the pronounced summer peak in July, which was also apparent in the data of Goss-Custard & Durrell (1983).

The majority of feeding by Shelduck during summmer and autumn (April-October) took place between one hour before and three hours after low tide (Figure 7.3). Immediately after this intensive feeding period, time spent feeding declined to a minimum. The ability of the Shelduck to forage in shallow water by up-ending enabled individuals to feed immediately prior to the exposure of mudflats at low water and between the two high waters.

In the summer, no one sector within the Development Area accounted for more than 1.5% of the Bay's total mean feeding time by Shelduck in Holes Bay (Figure 7.4); no birds at all were recorded during autumn as feeding within the Development Area (Figure 7.5). In the summer and autumn, Shelduck fed predominantly in the North-East and South-East. Though sector 2 had a lower number of feeding birds, the density of Shelduck on this small mudflat was similiar to that on sector 1. In autumn, the number and proportion of birds utilizing the sectors 15-19 decreased (Figure 7.5).

Winter feeding by Shelduck peaked and declined earlier in the tidal cycle than at other seasons, extending from three hours before to two hours after low water (Figure 7.6). A greater demand for food in the colder prevailing weather, as well as

Table 7.2 The approximate areas of the Sectors in Holes Bay.

Sector No.	Mudflat Area (ha)	Mudflat and *Spartina* Area (ha)
1	13.4	22.5
2	3.5	3.6
3	9.6	11.6
4	16.8	30.3
5	7.6	11.2
6	6.6	7.6
7	8.1	11.8
8	6.6	11.4
9	8.4	18.0
10	8.0	14.2
11	2.1	6.3
12	3.6	6.9
13	3.4	8.8
14	8.1	20.0
15	7.8	15.4
16	10.4	21.8
17	9.8	25.3
18	3.8	4.5
19	4.3	12.7

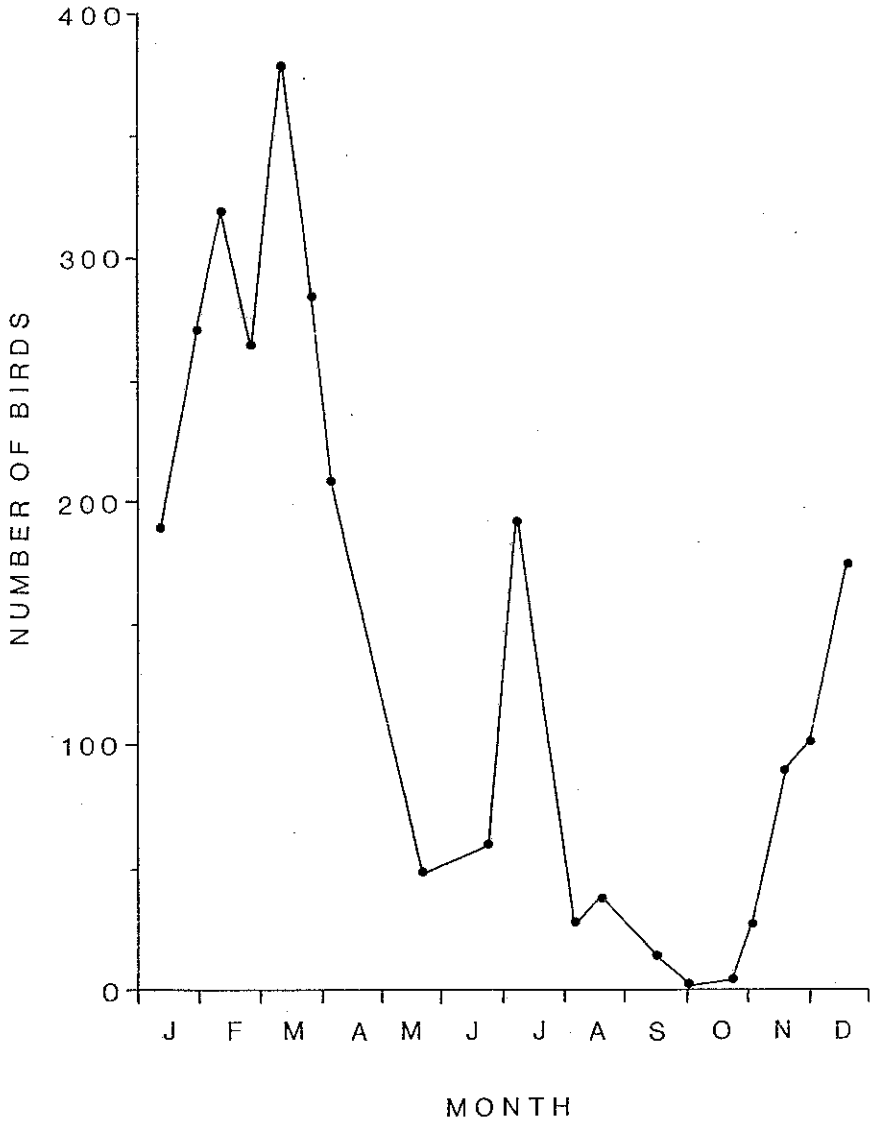


FIGURE 7.2 SHELDUCK: HOLES BAY LOW WATER COUNTS IN 1988

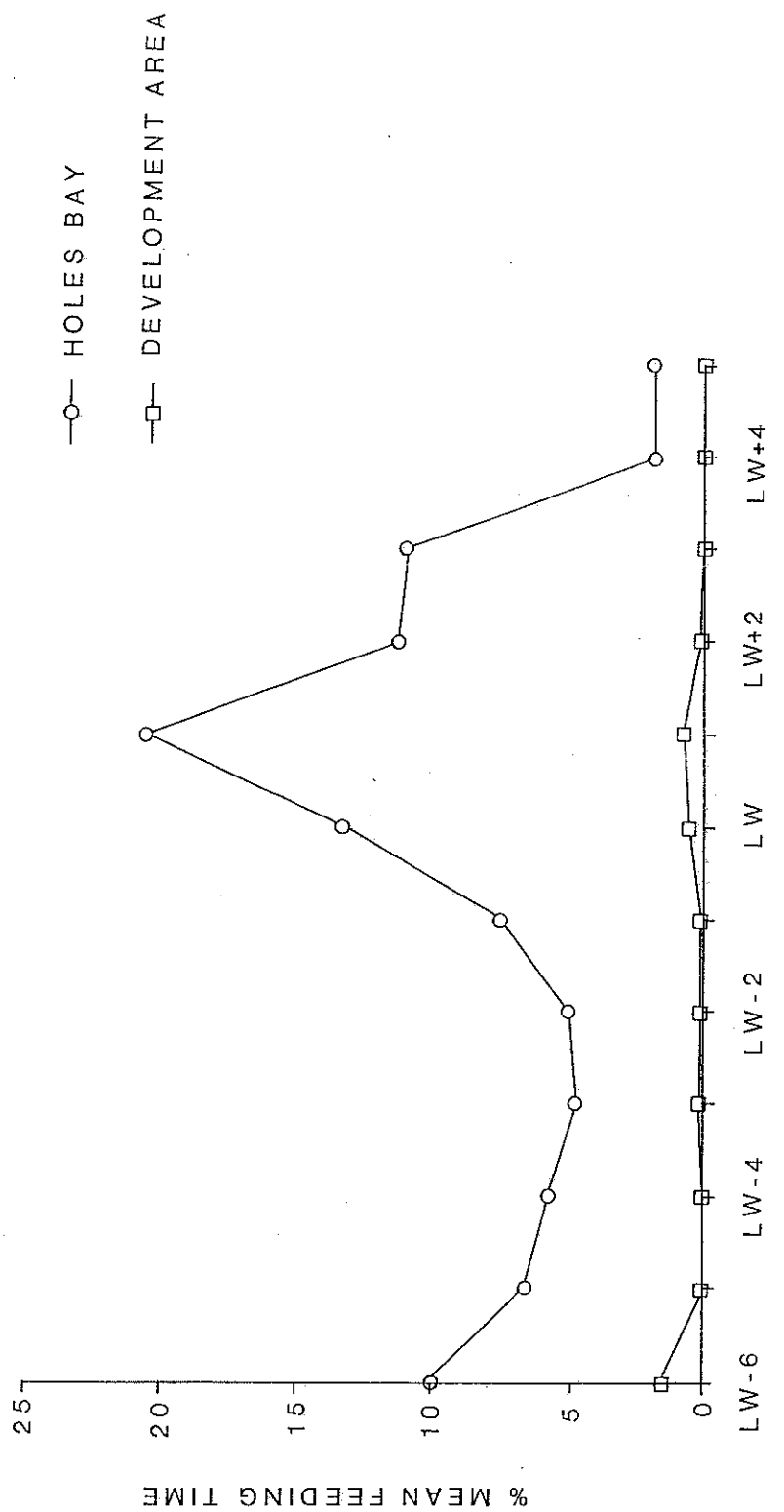


FIGURE 7.3 SHELDUCK: APRIL - OCTOBER

% MEAN FEEDING TIME THROUGH THE TIDAL CYCLE

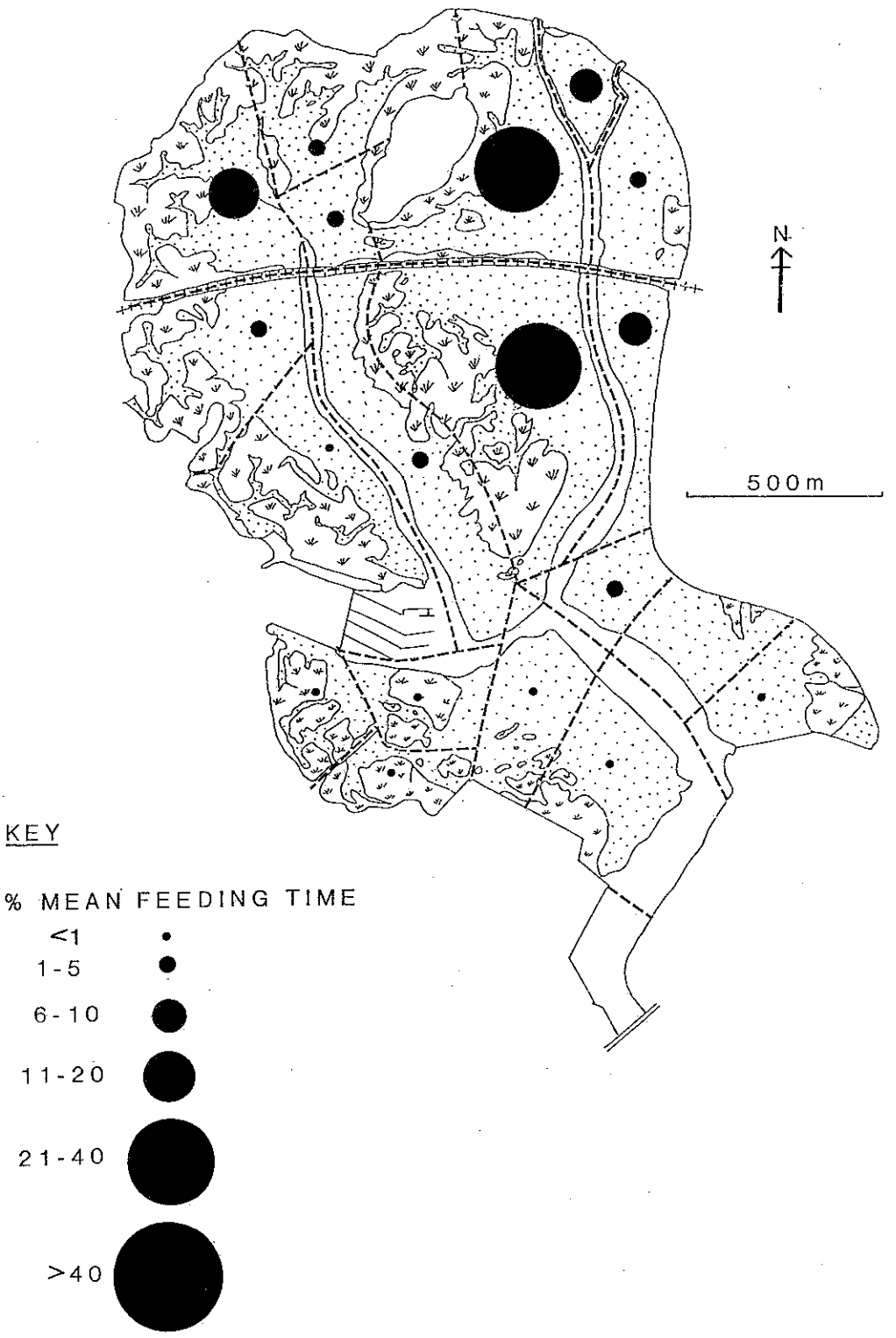


FIGURE 7.4 SHELDUCK: APRIL - JUNE DISTRIBUTION OF % MEAN FEEDING TIME IN HOLES BAY

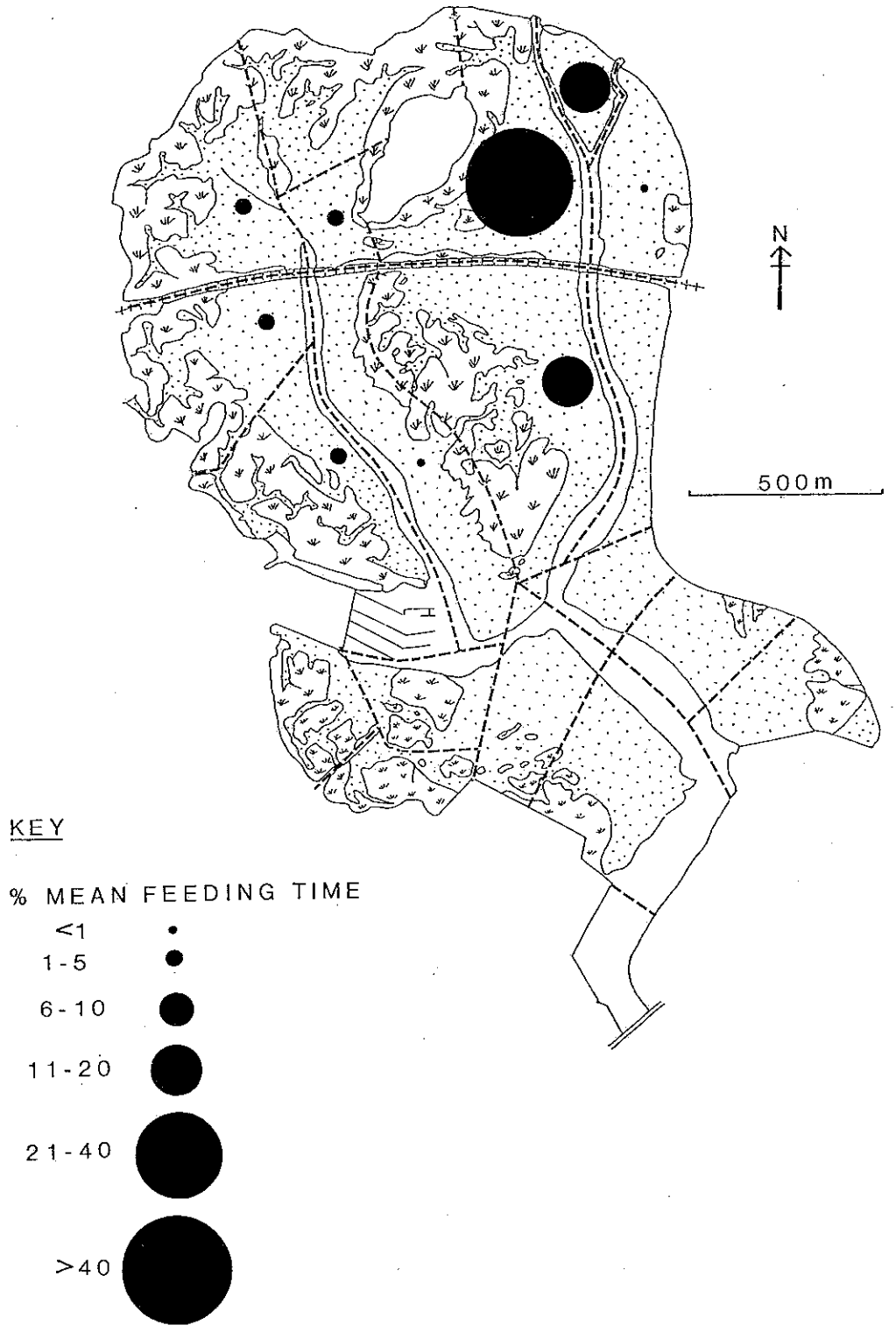


FIGURE 7.5 SHELDUCK: JULY - OCTOBER DISTRIBUTION OF % MEAN FEEDING TIME IN HOLES BAY

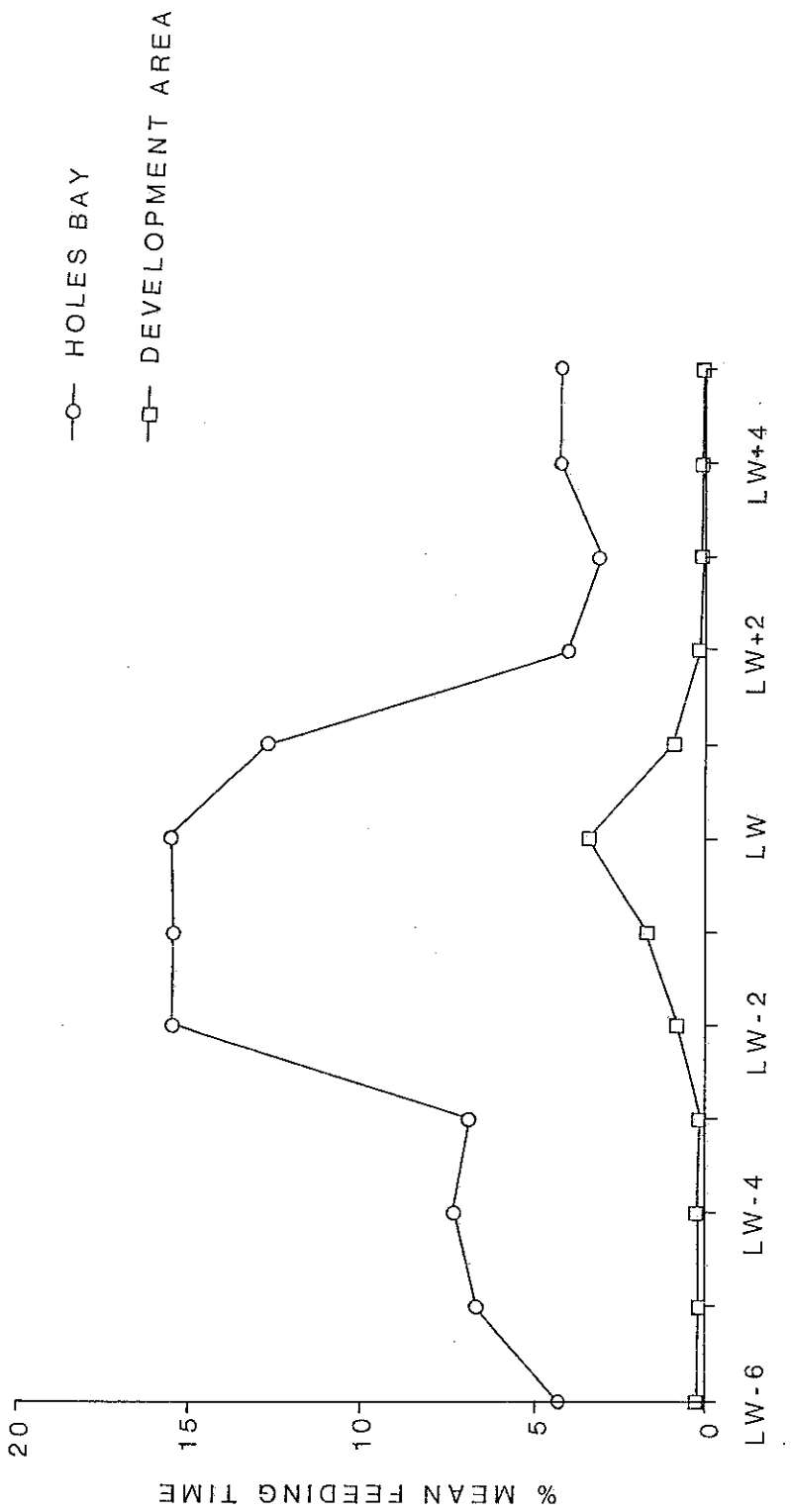


FIGURE 7.6 SHELDUCK: NOVEMBER - MARCH

% MEAN FEEDING TIME THROUGH THE TIDAL CYCLE

declining food stocks, may have necessitated this change in feeding pattern. Winter feeding was largely concentrated on the mudflats north of Cobbs Quay, particularly in the North-East and sector 4 (Figure 7.7). Winter is when the Development Area is of most importance as a Shelduck feeding site, 8.0% of their mean overall winter feeding occurring in those sectors.

The overall distribution of Shelduck within Holes Bay has altered little since the study of Goss-Custard & Durrell (1983), though the preferences for individual mudflats within the main feeding area has to some degree.

7.3.2 TEAL (Anas crecca)

Low tide counts of Holes Bay's Teal through 1988 (Figure 7.8), closely followed the seasonal trend of counts in Poole Harbour as a whole (Chapter 4).

Too few Teal were recorded in the summer to permit analysis of feeding patterns.

In autumn, feeding was concentrated around low water, peaking between low tide and two hours after (Figure 7.9). Little feeding occurred at the high tides or between the two high tides. No birds were recorded feeding within the Development Area during the Autumn (Figure 7.10). Teal fed very largely in the North-West and North-East, making limited use only of sectors 4, 14 and 15.

The main feeding period of Teal in winter spanned more of the tidal period than during the autumn (Figure 7.11). A broad peak is evident, from two hours before to one hour after low water. A greater demand for food in the colder prevailing weather, as well as declining food stocks, may have necessitated this change in feeding pattern.

Feeding by Teal in winter occurred predominately in the North-East, North-West and sector 4 (Figure 7.12). Only 2.0% of the overall mean winter feeding time was within the Development Area, predominately within and along the edges of the Spartina marsh in sectors 8 and 10.

Goss-Custard & Durrell (1983) found Teal to feed mainly in the North-East, with some feeding also in the South-West, whereas in the present study feeding Teal occurred in substantial numbers in the North-West as well. In fact, nearly 70% of the total feeding time of Teal in the autumn was in the North-West, where the density of birds was also highest. The greater number of Teal recorded feeding in Holes Bay in 1988 relative to 1982/3 may explain this increase in feeding distribution.

7.3.3 OYSTERCATCHER (Haematopus ostralegus)

The autumn population of Holes Bay's Oystercatcher (Figure 7.13) was lower than expected when compared with both Poole

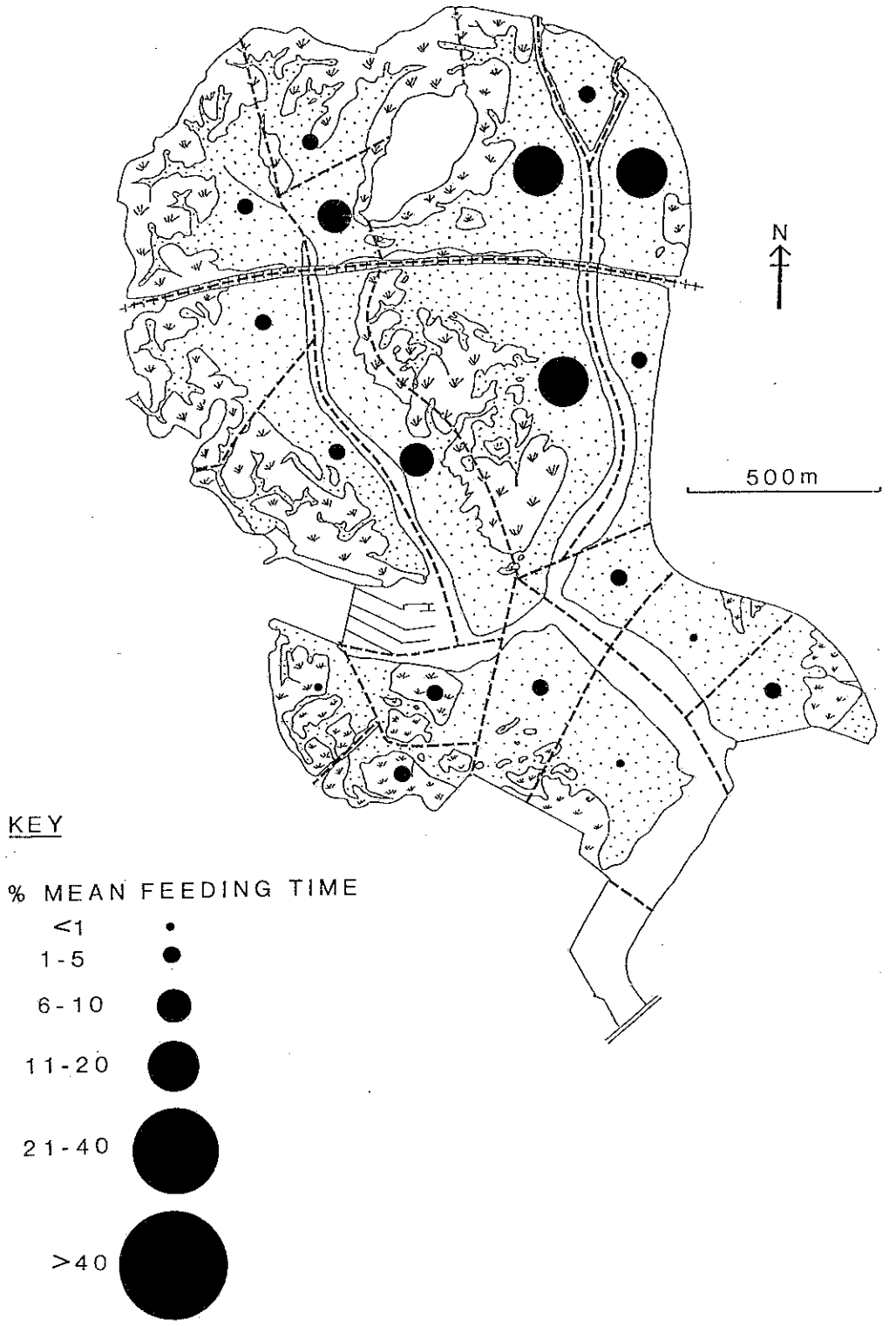


FIGURE 7.7 SHELDUCK: NOVEMBER - MARCH DISTRIBUTION OF % MEAN FEEDING TIME IN HOLES BAY

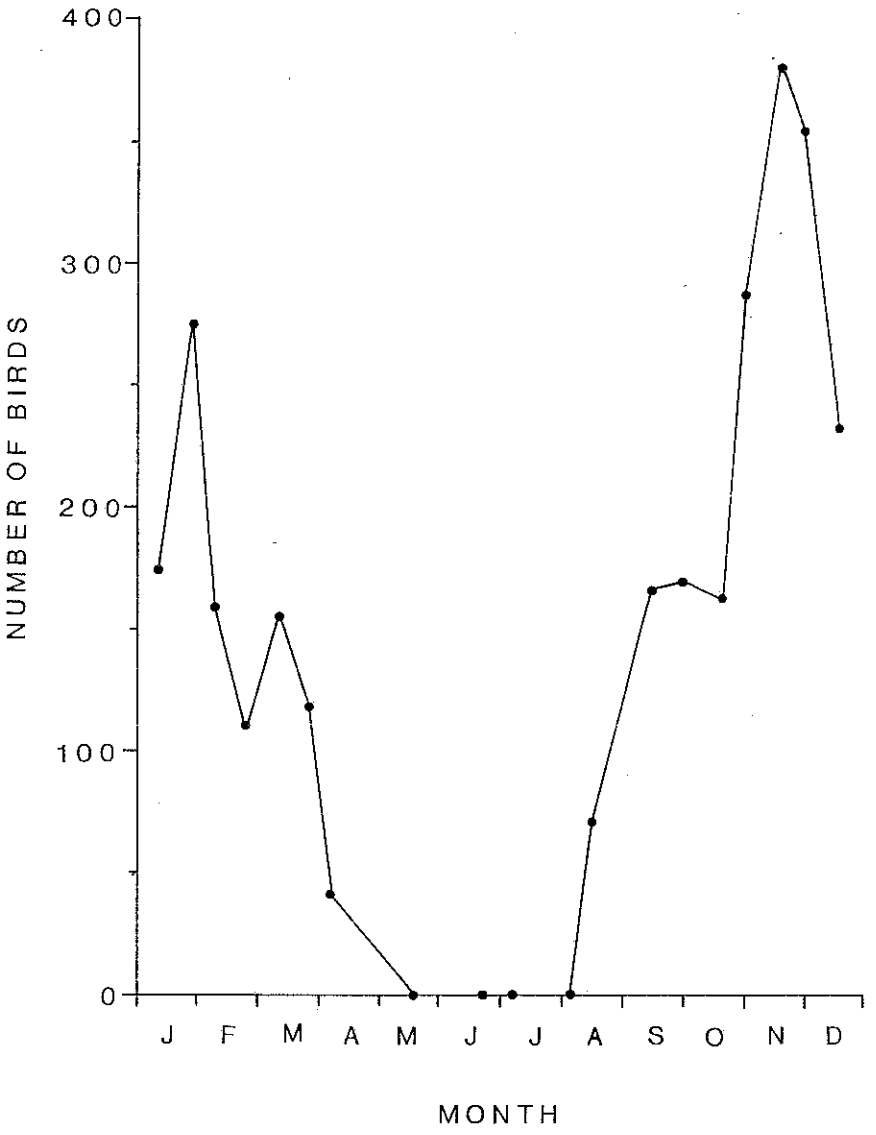


FIGURE 7.8 TEAL: HOLES BAY

LOW WATER COUNTS IN 1988

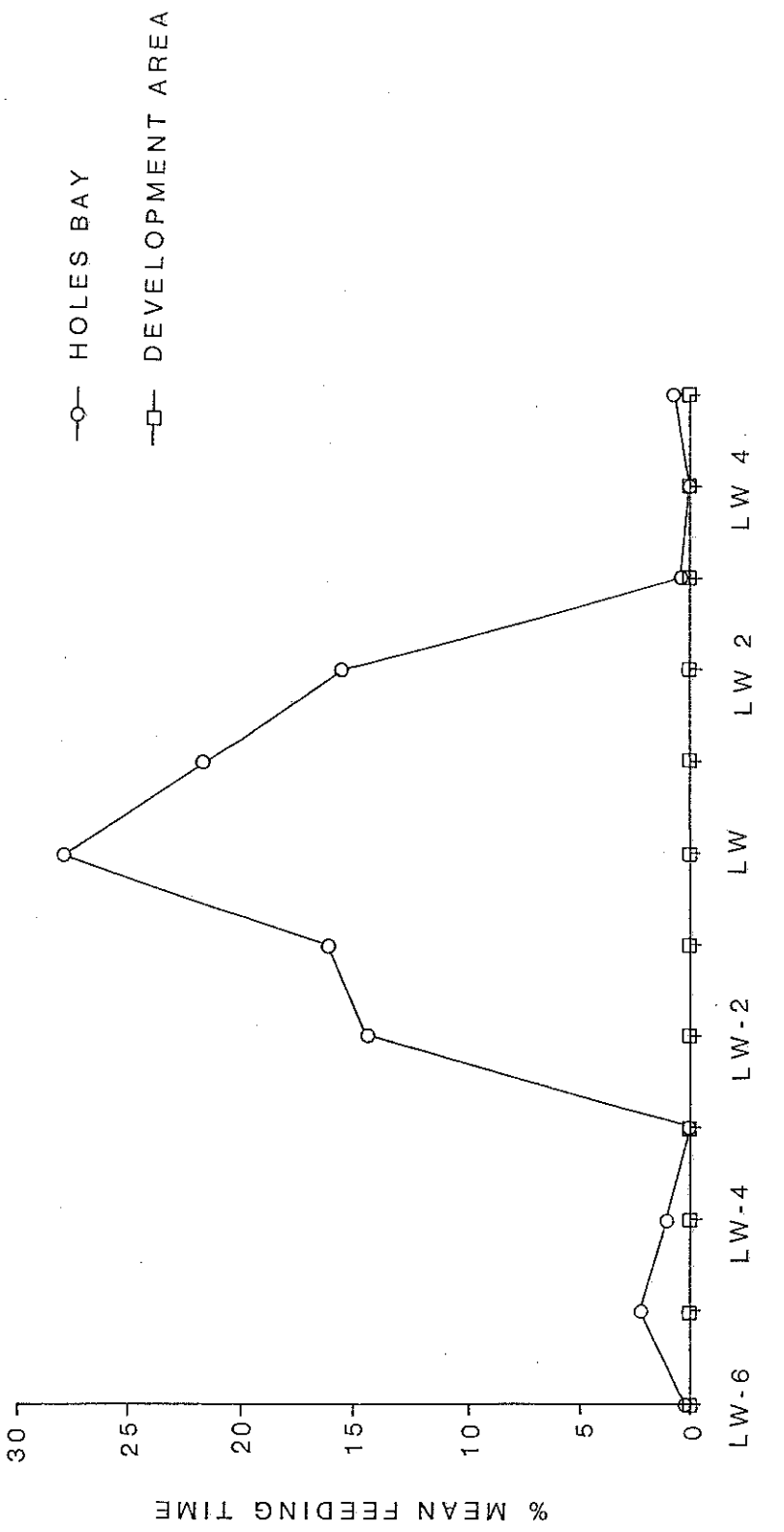


FIGURE 7.9 TEAL: AUGUST - OCTOBER

% MEAN FEEDING TIME THROUGH THE TIDAL CYCLE

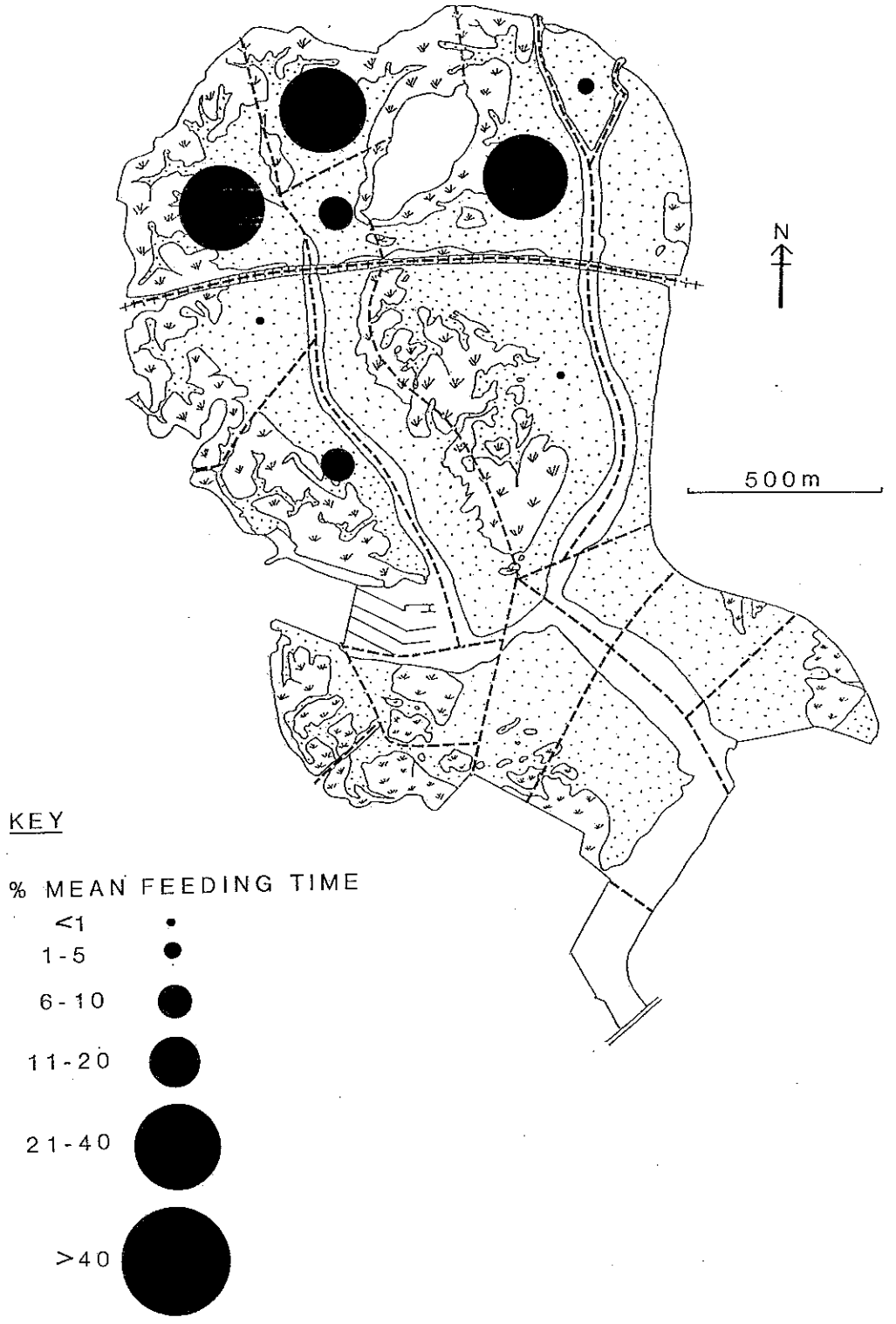


FIGURE 7.10 TEAL: AUGUST - OCTOBER DISTRIBUTION OF % MEAN FEEDING TIME IN HOLES BAY

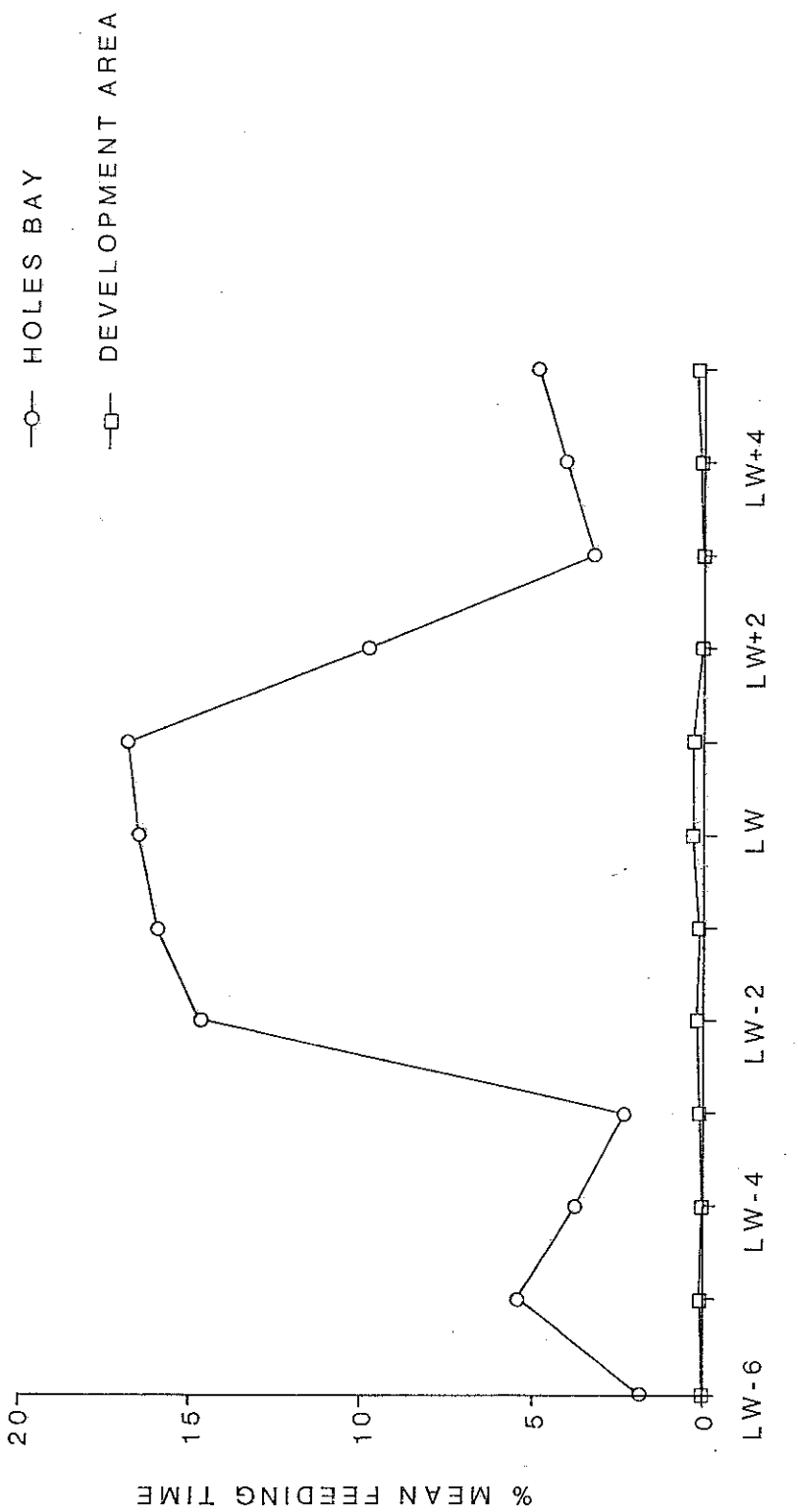


FIGURE 7.11 TEAL: NOVEMBER - MARCH

% MEAN FEEDING TIME THROUGH THE TIDAL CYCLE

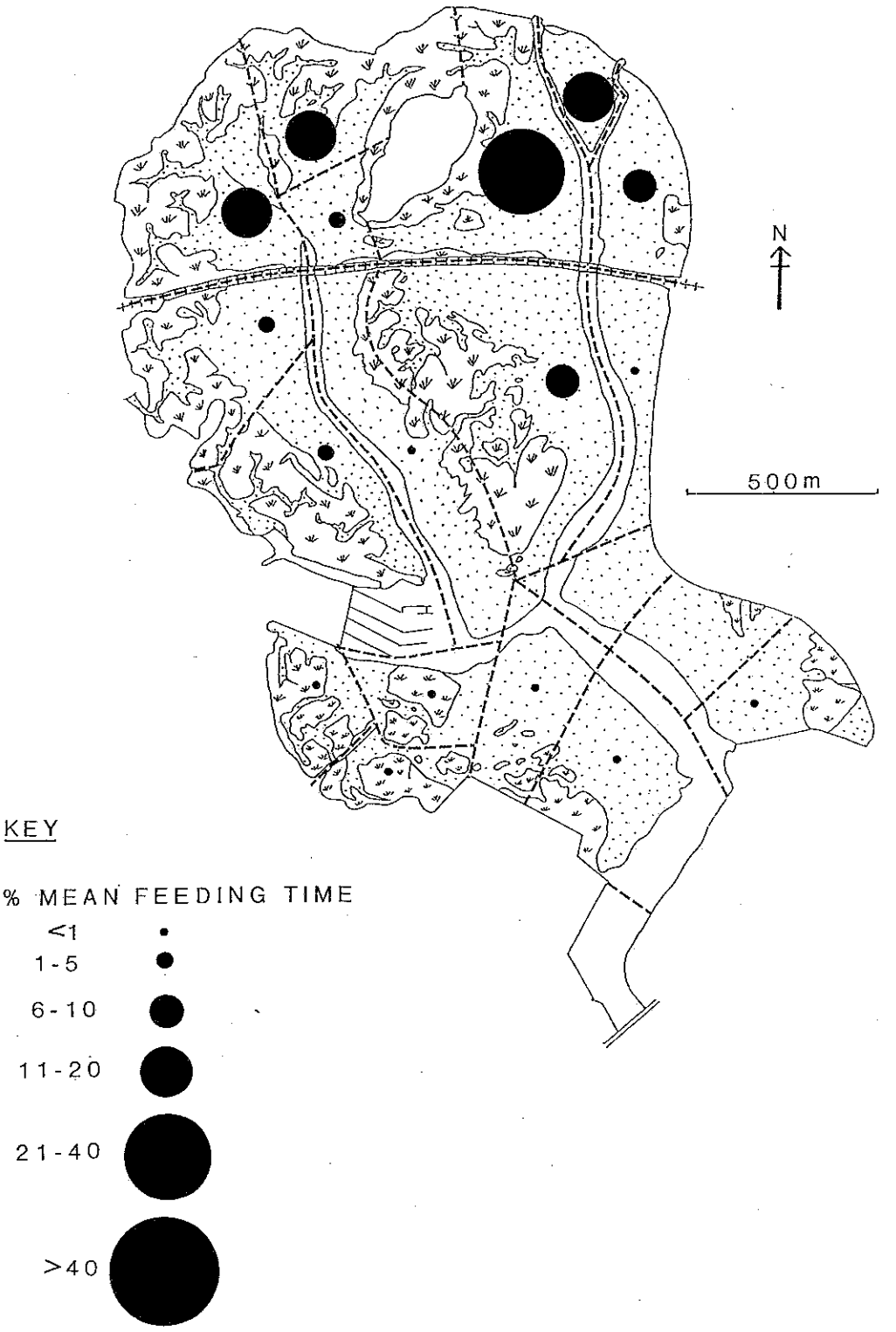


FIGURE 7.12 TEAL: NOVEMBER - MARCH DISTRIBUTION OF % MEAN FEEDING TIME IN HOLES BAY

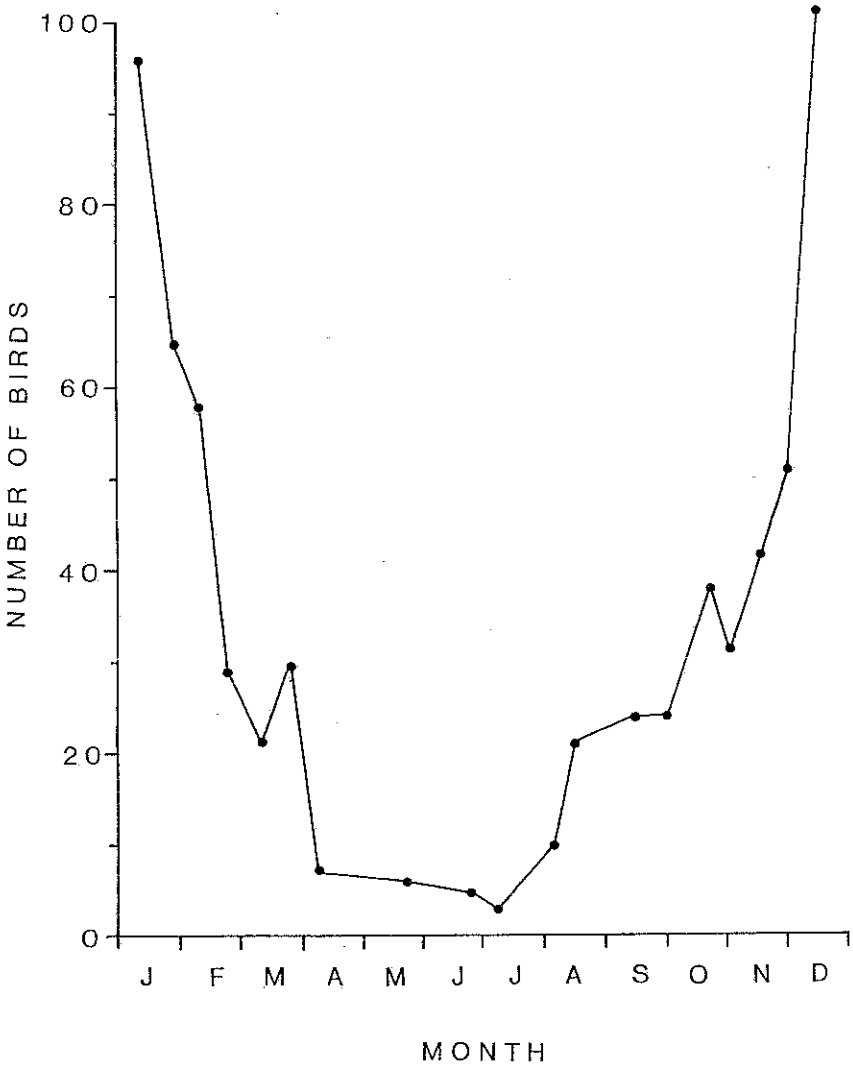


FIGURE 7.13 OYSTERCATCHER:

HOLES BAY LOW WATER COUNTS IN 1988

Harbour's and the national seasonal trends (Chapter 4). Less than 50% of Holes Bay's winter peak population had arrived by early November, the peak occurring in December.

At all seasons, the majority of feeding throughout the Bay occurred from two hours before to two hours after low tide (Figure 7.14).

Too few Oystercatchers were recorded in the summer (Figure 7.13) to provide a meaningful analysis of feeding pattern. In the autumn and winter, Oystercatchers were noticeably scarce in the North-West, being present generally over the remaining areas of the Bay (Figure 7.15). Sector 9 in the Development Area was the second most favoured sector used for feeding, sector 4 being the most preferred site. The Development Area was of greatest importance to feeding Oystercatcher in winter; a maximum of 30.8% of the overall mean winter feeding time was within this area.

The distribution of Holes Bays' foraging Oystercatchers in 1988 had altered from that observed in 1983. This coincides with a fluctuation in the population level as a consequence of land reclamation along the Bay's eastern shore in 1983/4 (Chapter 6). A strong preference for sector 4 and, to a lesser extent, the North-East remained, but the previous importance of the eastern half of the Development Area (Goss-Custard & Durrell 1983) had declined. Instead, in 1988 feeding birds were concentrated on mudflats in front of the Power Station, with sector 9 at times becoming the second most favoured sector in the Bay. The importance of the South-West has in general increased.

7.3.4 DUNLIN (Calidris alpina)

Low tide counts of Dunlin through 1988 (Figure 7.16) followed the seasonal trend of counts in Poole Harbour as a whole (Chapter 4): an autumn passage of individuals of the races schinzii and arctica from July-September; wintering by the race alpina from late October to March.

No Dunlin were recorded during the study in Holes Bay in the summer and too few were recorded in the spring for a meaningful analysis of feeding pattern (Figure 7.16).

7.3.4.1 Autumn feeding: C.a.schinzii and C.a.arctica

Almost all feeding ($\geq$90%) occurred within the low tide period, from three hours before to three hours after low tide, peaking an hour after low tide (Figure 7.17). Approximately 70% of foraging birds were located in sectors 14 and 15 (Figure 7.18), the rest being distributed amongst the remaining sectors.

Goss-Custard & Durrell (1983) recorded comparatively few Dunlin in the autumn.

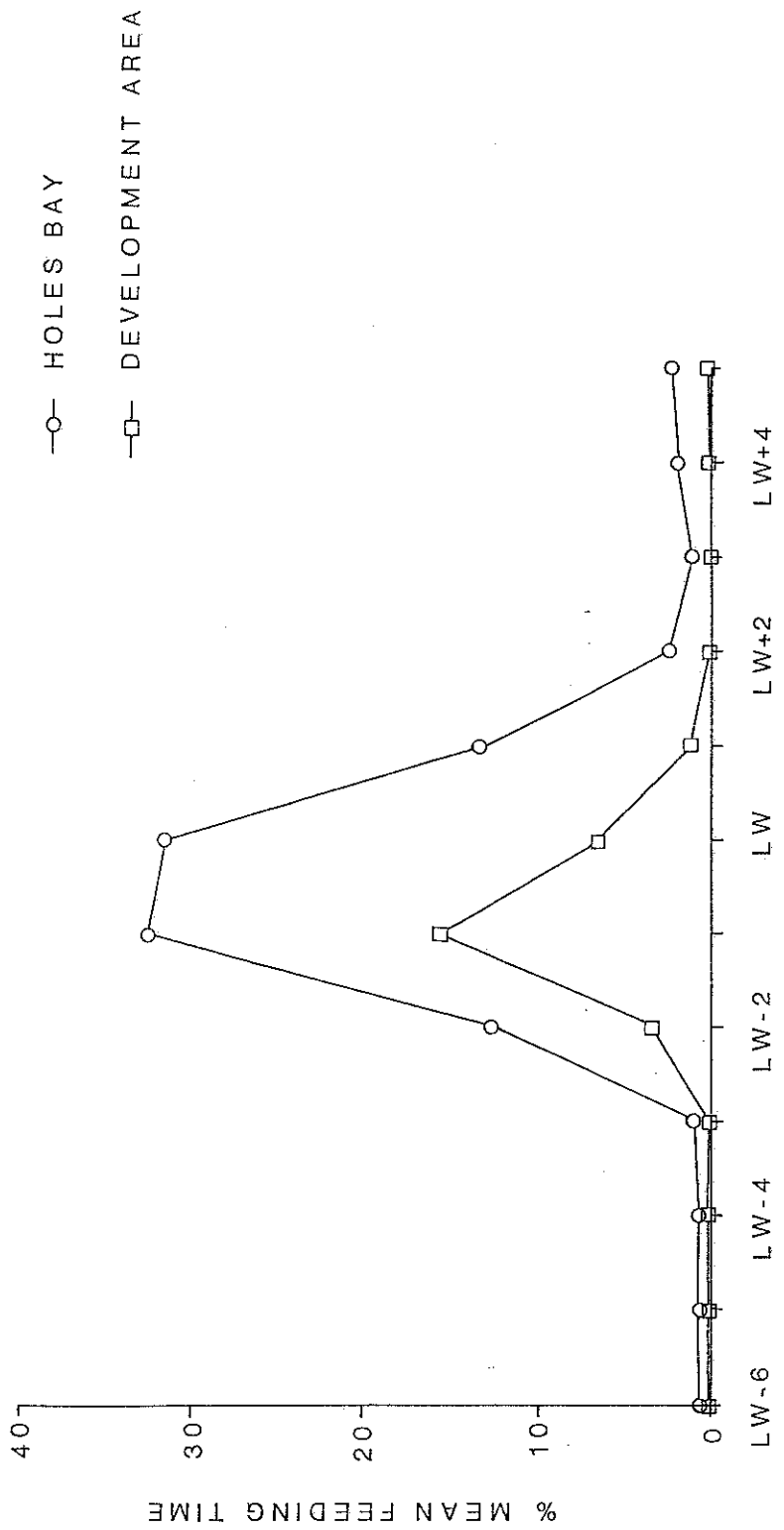


FIGURE 7.14 OYSTERCATCHER: THE COMPLETE YEAR % MEAN FEEDING TIME THROUGH THE TIDAL CYCLE

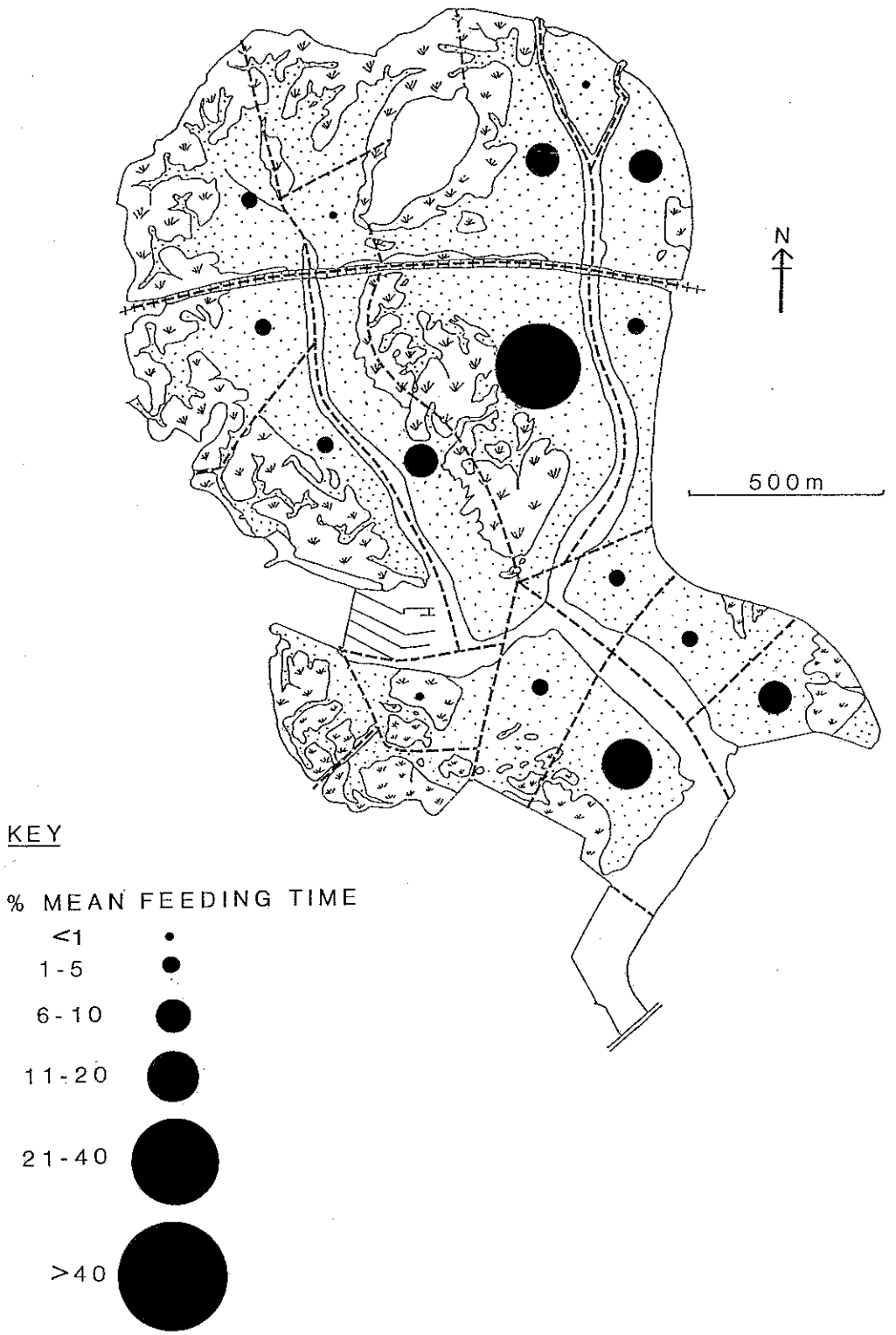


FIGURE 7.15 OYSTERCATCHER: AUGUST - MARCH DISTRIBUTION OF % MEAN FEEDING TIME IN HOLES BAY

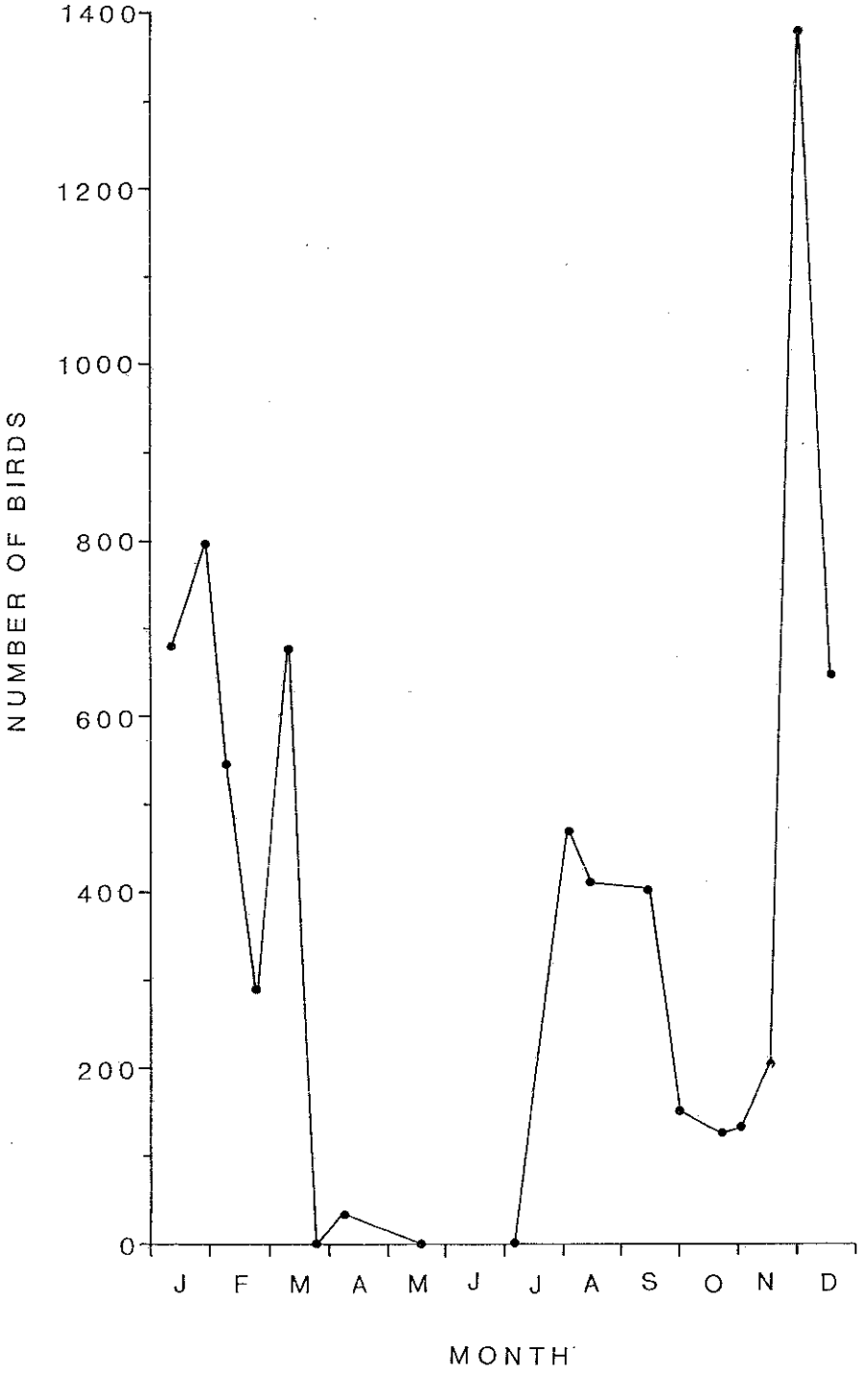


FIGURE 7.16 DUNLIN: HOLES BAY

LOW WATER COUNTS IN 1988

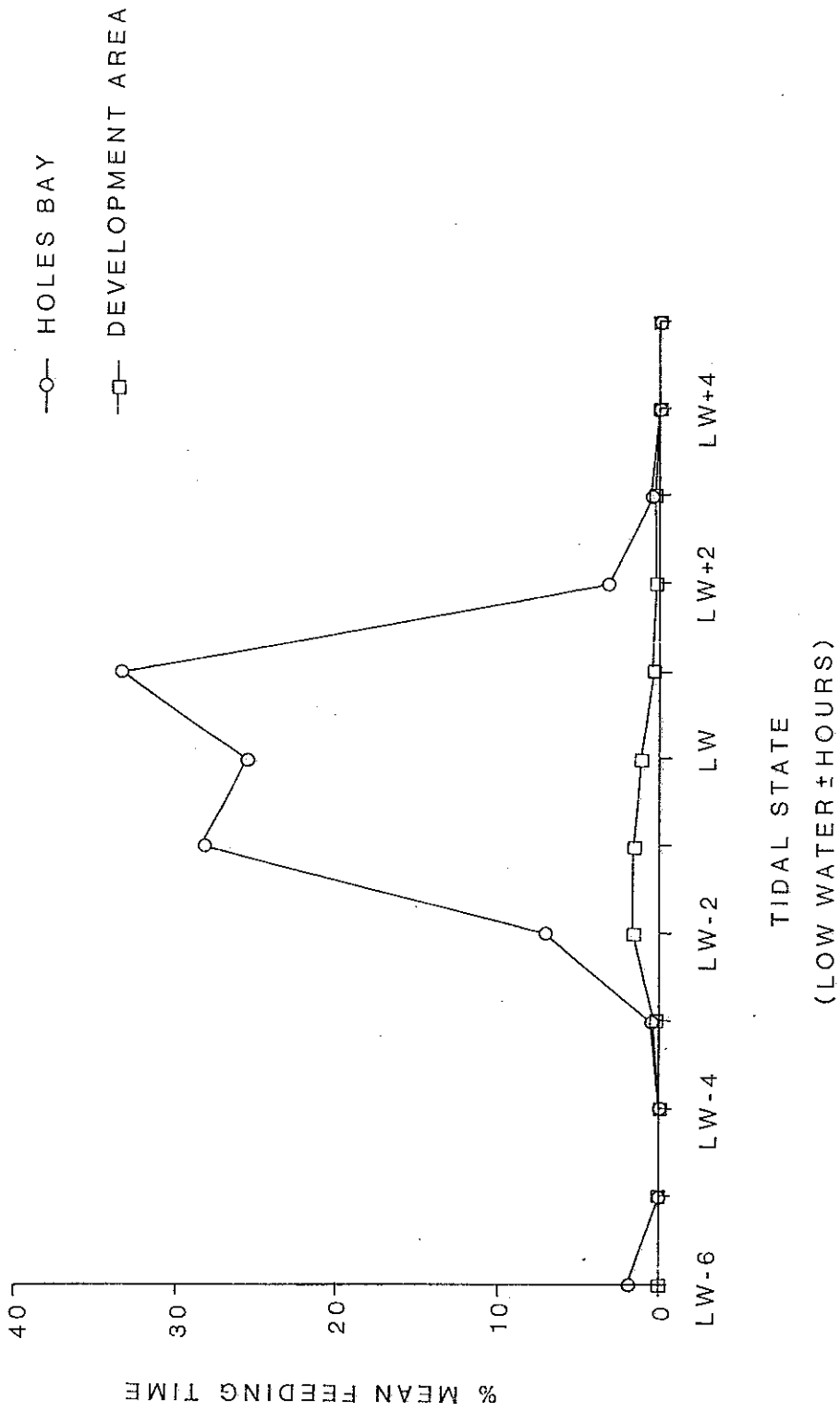


FIGURE 7.17 DUNLIN: JULY - SEPTEMBER

% MEAN FEEDING TIME THROUGH THE TIDAL CYCLE

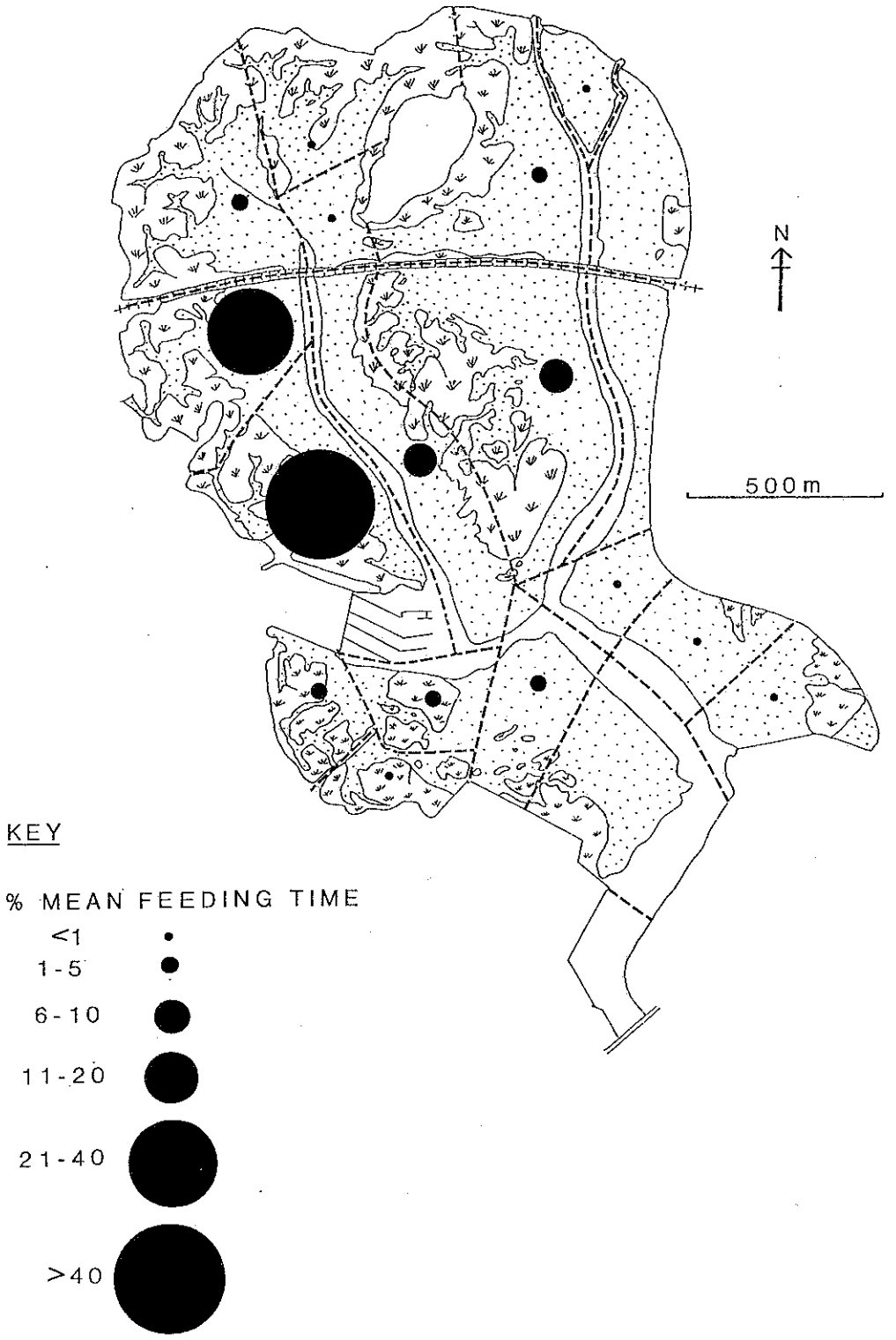


FIGURE 7.18 DUNLIN: JULY - SEPTEMBER DISTRIBUTION OF % MEAN FEEDING TIME IN HOLES BAY

7.3.4.2 Winter feeding: C.a.alpina

Feeding by Dunlin was spread over a much longer tidal period in winter than in the autumn (Figure 7.19). Approximately 70% of winter feeding occurred between three hours before and two hours after low water, peaking an hour before low water, in agreement with the observations of both Goss-Custard & Durrell (1983) and Collins (1985). The occurrance of an earlier peak count than in the autumn, is believed to be the result of a proportion of the Dunlin subsequently departing for the freshly exposing mudflats of the more slowly draining Lytchetts Bay. In the current study, this movement of birds out of the Bay, departing over the west end of the railway, was noted only in the winter. The numbers and timing of departure appeared dependant upon when and to what extented mudflats were exposed in Holes Bay. Birds would depart earlier and in larger numbers on spring tides than on neap tides.

In winter, almost half of the Dunlin's winter feeding time was spent in sector 17 (Figure 7.20). Exposure of this mudflat between the high waters, and occasionally during a low high water, increased the period of availability of this area to foraging Dunlin, often at times when the Bay's other flats were submerged. Winter was when the Development Area was of greatest importance to feeding Dunlin, but it still supported a maximum of only 3.7% of overall mean feeding time.

Goss-Custard & Durrell (1983) recorded the majority of wintering birds to feed in the North-East.

7.3.5 BLACK-TAILED GODWIT (Limosa limosa)

Holes Bay was only sporadically used by Poole Harbour's wintering Black-tailed Godwits for feeding between November and February (Figure 7.21). Spring, however, brought both consistancy and international importance to Holes Bay as a feeding site for Black-tailed Godwits (Chapter 6). Black-tailed Godwits were rarely observed in Holes Bay from May through to October.

Too few birds were recorded in Holes Bay for an analysis of feeding patterns during the summer and autumn. In winter and spring, most feeding by Black-tailed Godwits was within a nine hour period from three hour before to six hours after low tide (Figure 7.22). Within this period, the peak feeding time was around low tide. The ability of this long-billed and long-legged wader to feed in comparatively deep water (at least 7cm) allowed feeding to continue at times through high tide. Occasionally, birds were seen to depart eastwards during the low water period, presumably to resume feeding on the freshly exposed mudflats of the slower-draining Lytchetts Bay. This was not recorded by Collins (1985).

Feeding was concentrated in the North-West and South-West (Figure 7.23). The remainder of foraging time expended was within the North-East and South-East, with a small proportion

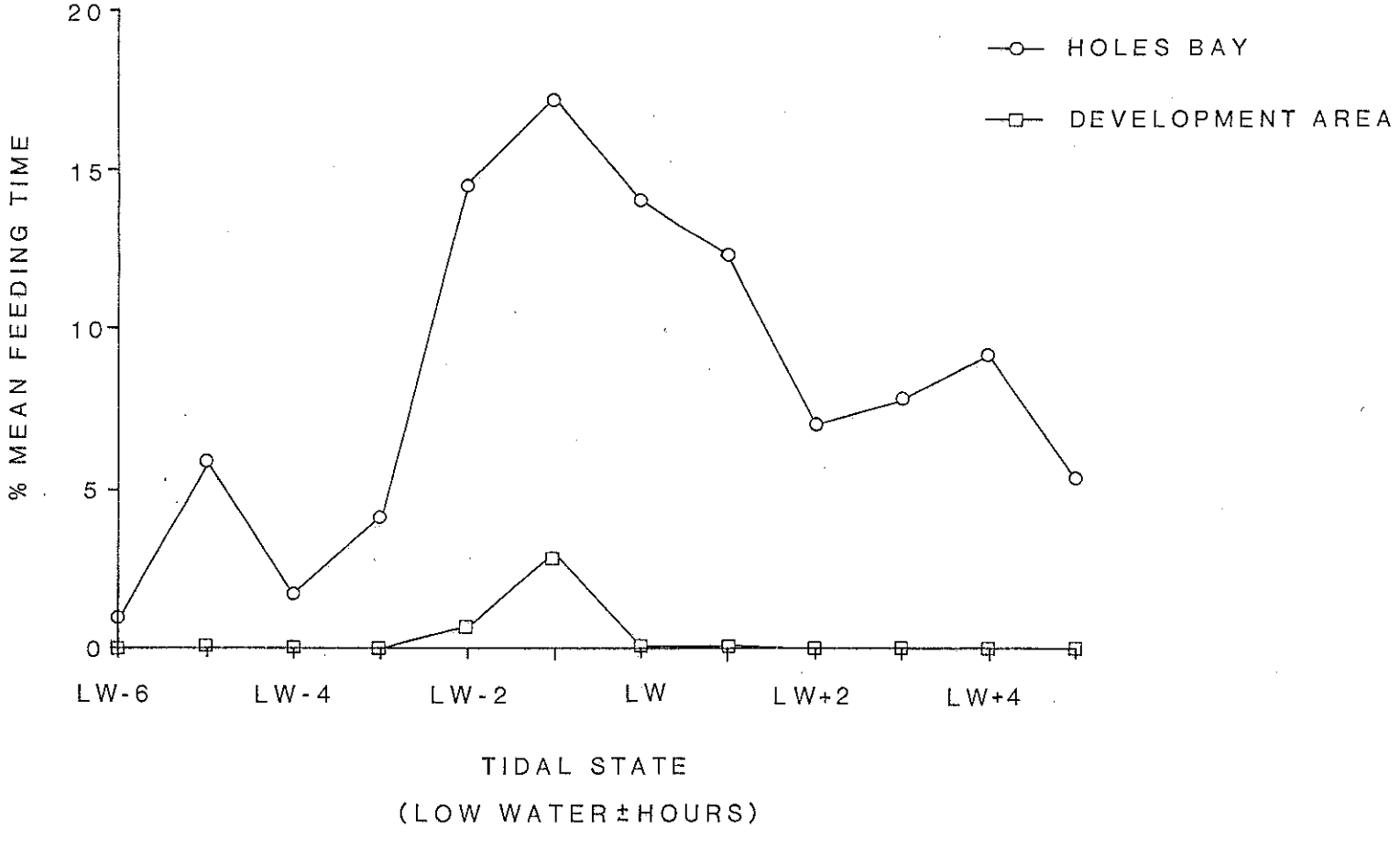


FIGURE 7.19 DUNLIN: OCTOBER - MARCH

% MEAN FEEDING TIME THROUGH THE TIDAL CYCLE

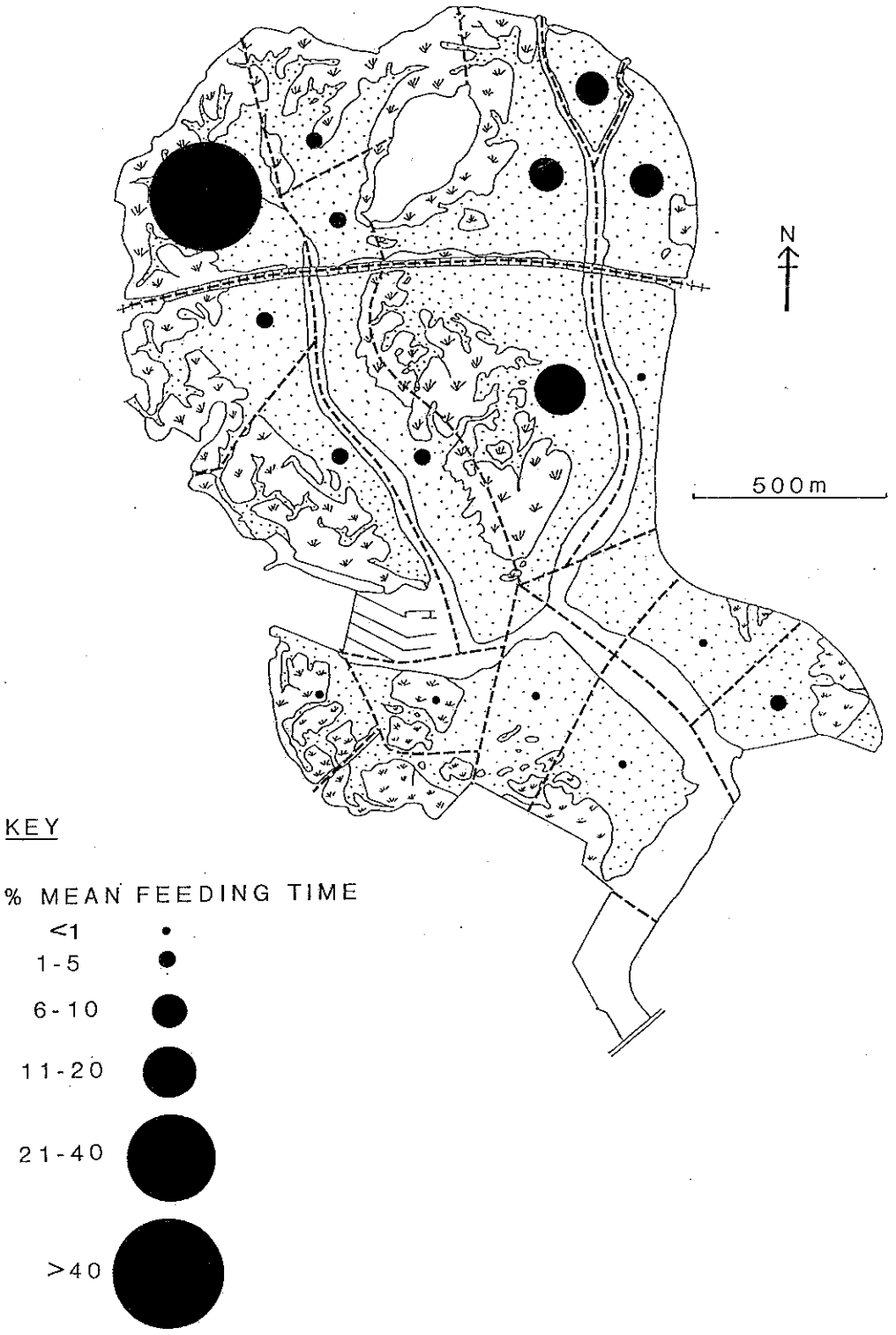


FIGURE 7.20 DUNLIN: OCTOBER - MARCH DISTRIBUTION OF % MEAN FEEDING TIME IN HOLES BAY

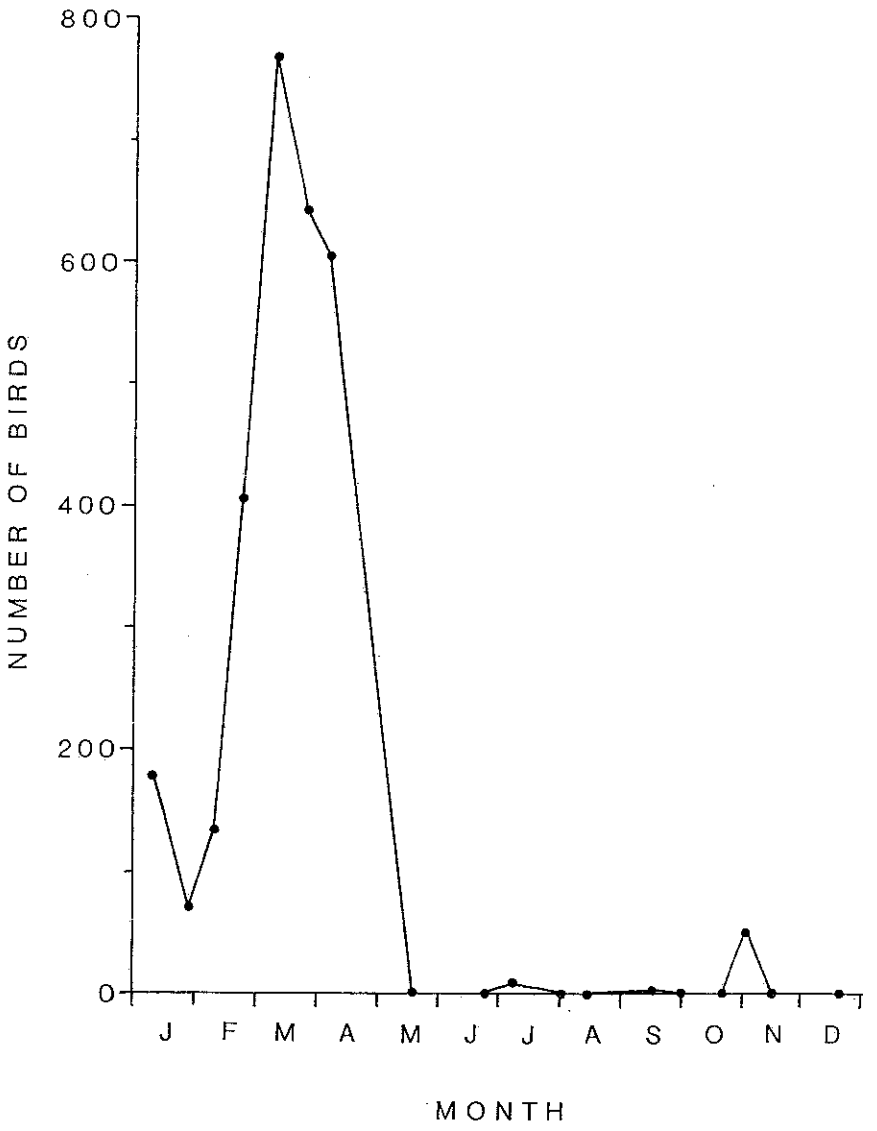


FIGURE 7.21 BLACK-TAILED GODWIT: HOLES BAY LOW WATER COUNTS IN 1988

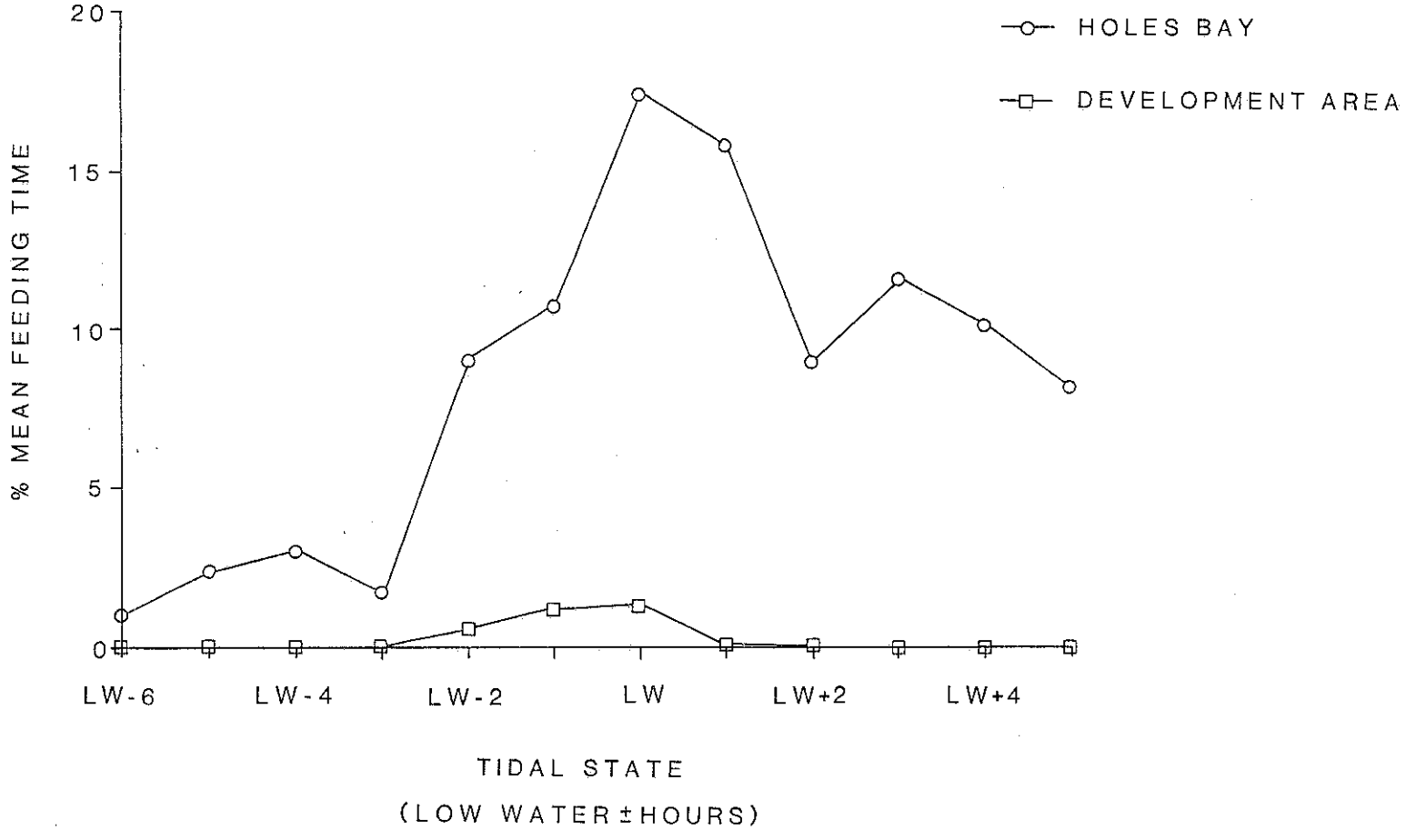


FIGURE 7.22 BLACK-TAILED GODWIT: NOVEMBER - APRIL

% MEAN FEEDING TIME THROUGH THE TIDAL CYCLE

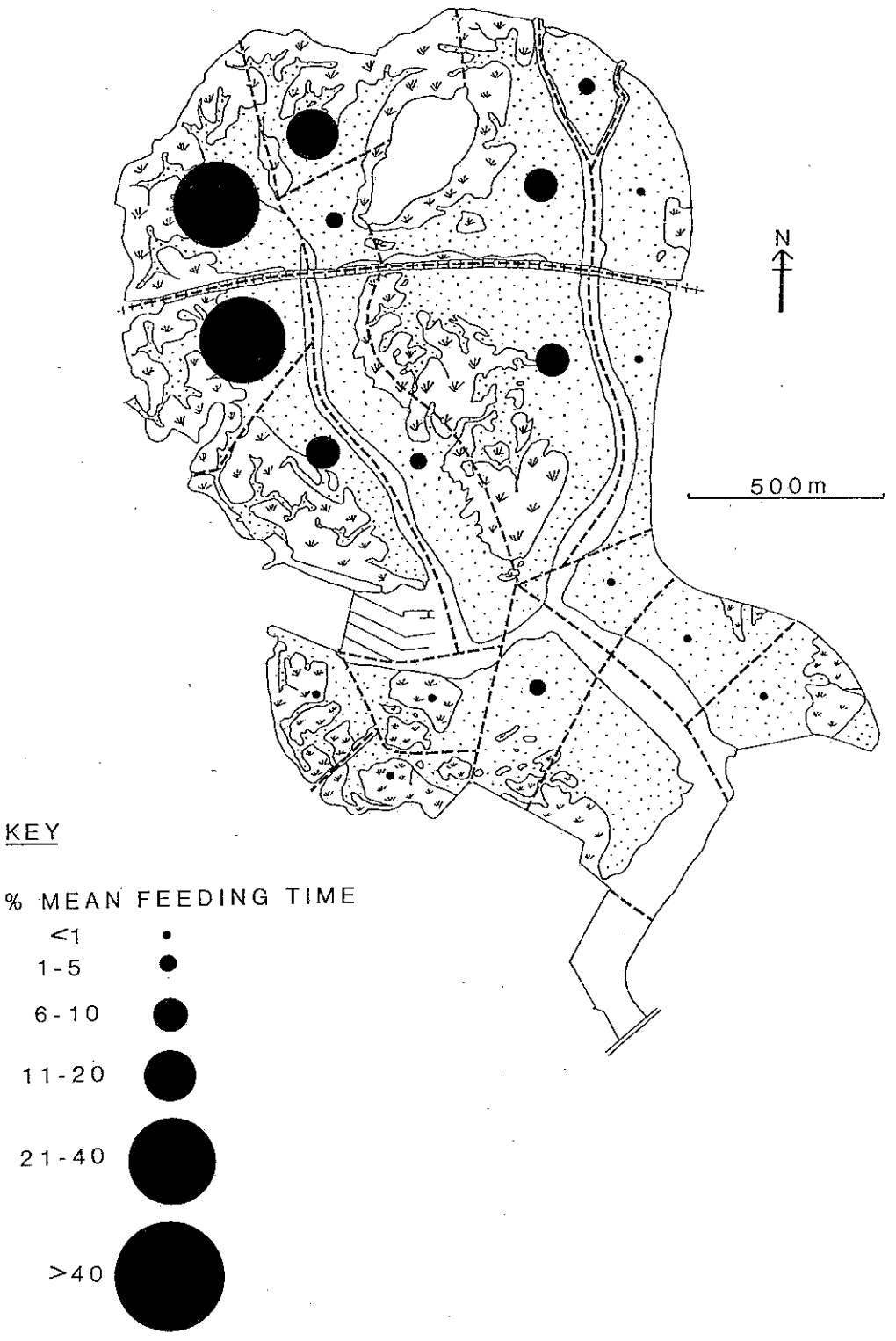


FIGURE 7.23

BLACK-TAILED GODWIT: NOVEMBER - APRIL DISTRIBUTION OF % MEAN FEEDING TIME IN HOLES BAY

in the Development Area. Spring is when the Development Area was of greatest importance to feeding Black-tailed Godwits: a maximum of 3.5% of the overall mean spring feeding time occurred in the Development Area.

7.3.6 CURLEW (Numenius arquata)

The low tide counts in Holes Bay in 1988 (Figure 7.24) approximated to the seasonal pattern both nationally and for Poole Harbour (Chapter 4). However, the Holes Bay population showed no obvious autumn peak. Goss-Custard & Durrell (1983) also failed to record a clearly defined autumn peak in the Bay.

The distribution and tidal rhythm of feeding Curlew were found for all seasons to be very similiar. Almost all feeding occurred from three hours before to three hours after low tide, peaking at low tide (Figure 7.25). Sector 4 was found to be the most preferred feeding area with ca 30% of the overall mean feeding time (Figure 7.26). Sectors 1, 16 and 17 were also of notable importance as feeding grounds for Curlew.

The distribution of Curlew feeding time within Holes Bay in 1988 was similar to that found by Goss-Custard & Durrell (1983) in 1982/3: a large concentration of feeding birds in sector 4, with a smaller concentration in the North-West, North-East and sector 1. The Development Area was of greatest importance to Curlew as feeding grounds in the winter season when a maximum of 8.1% of the overall mean feeding time was in the Development Area.

7.3.7 REDSHANK (Tringa totanus)

Low tide counts of Holes Bay's Redshank through 1988 (Figure 7.27), was similar to the seasonal trend of Poole Harbour's population as a whole (Chapter 4).

Redshank feeding occurred almost exclusively within the period from three hours before to three hours after low tide, peaking at low tide (Figure 7.28). The majority of feeding in summer was concentrated in sectors 14 (also with the highest density) & 4, with the remainder predominantly in the North-West and sector 16 (Figure 7.29). In the autumn, the importance of sector 14 in particular declined, whilst those of the North-East and sector 15 increased (Figure 7.30). A further decline in the importance of sector 14 together with 4, 10, 16 and 18 occurred in winter as birds redistributed their feeding time, increasing the time spent in sectors 3, 12, 13 and 17 (Figure 7.31). Comparatively few birds utilized the Development Area in any season. It was of greatest importance for feeding during the autumn passage when a maximum of 4.8% of overall mean feeding time occurred in there.
The feeding distribution of Redshank within Holes Bay in 1988 for the months surveyed by Goss-Custard & Durrell (1983), i.e. July-January, had to some degree altered since 1982/83; the

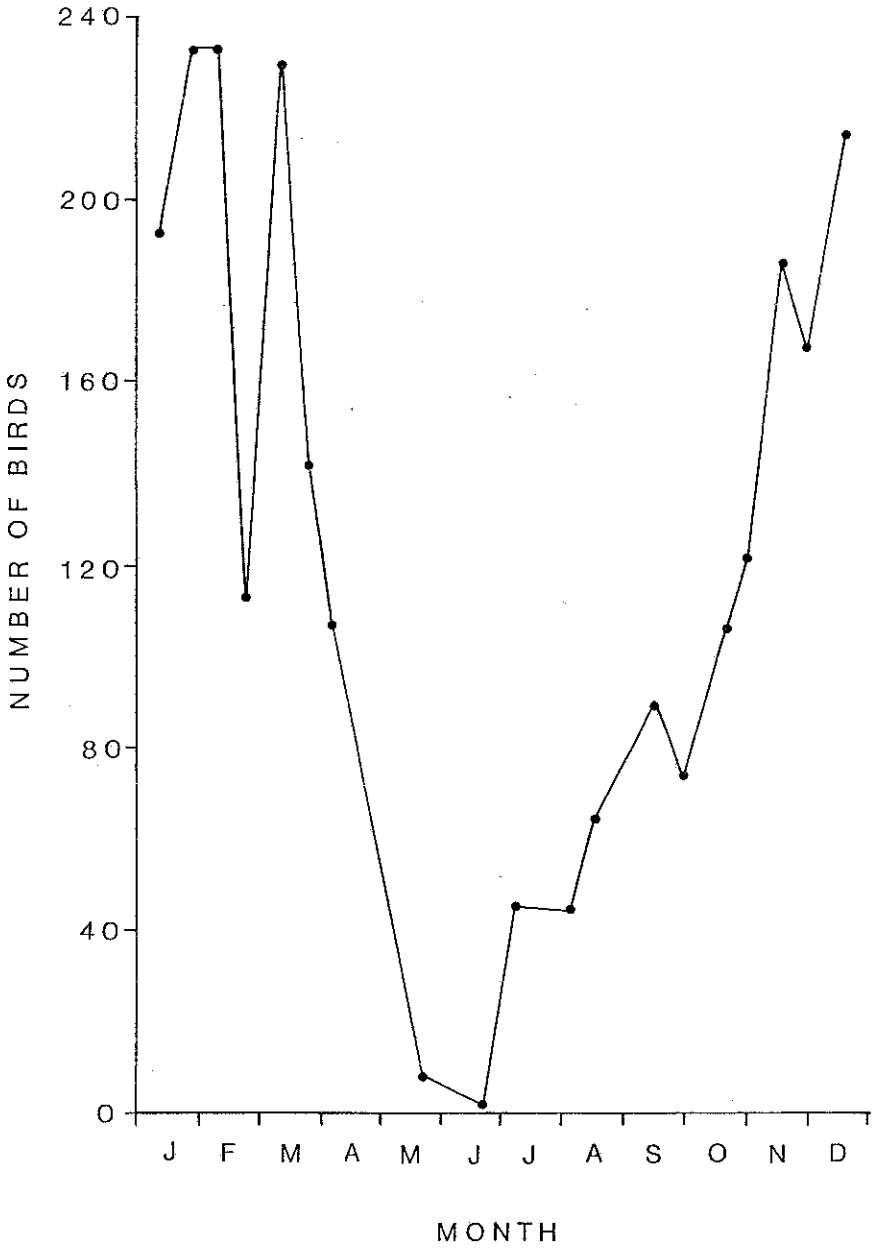


FIGURE 7.24 CURLEW: HOLES BAY

LOW WATER COUNTS IN 1988

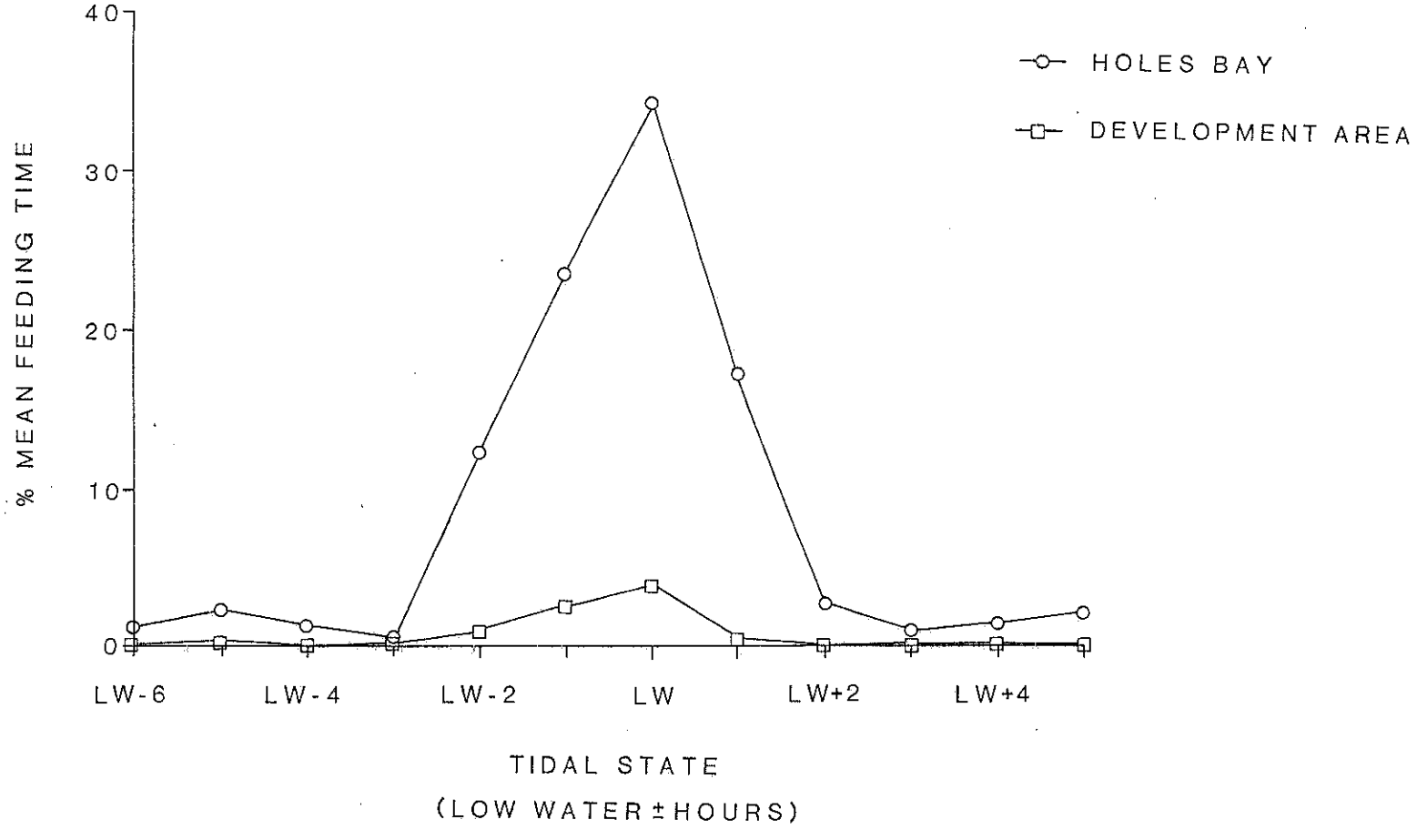


FIGURE 7.25 CURLEW: THE COMPLETE YEAR

% MEAN FEEDING TIME THROUGH THE TIDAL CYCLE

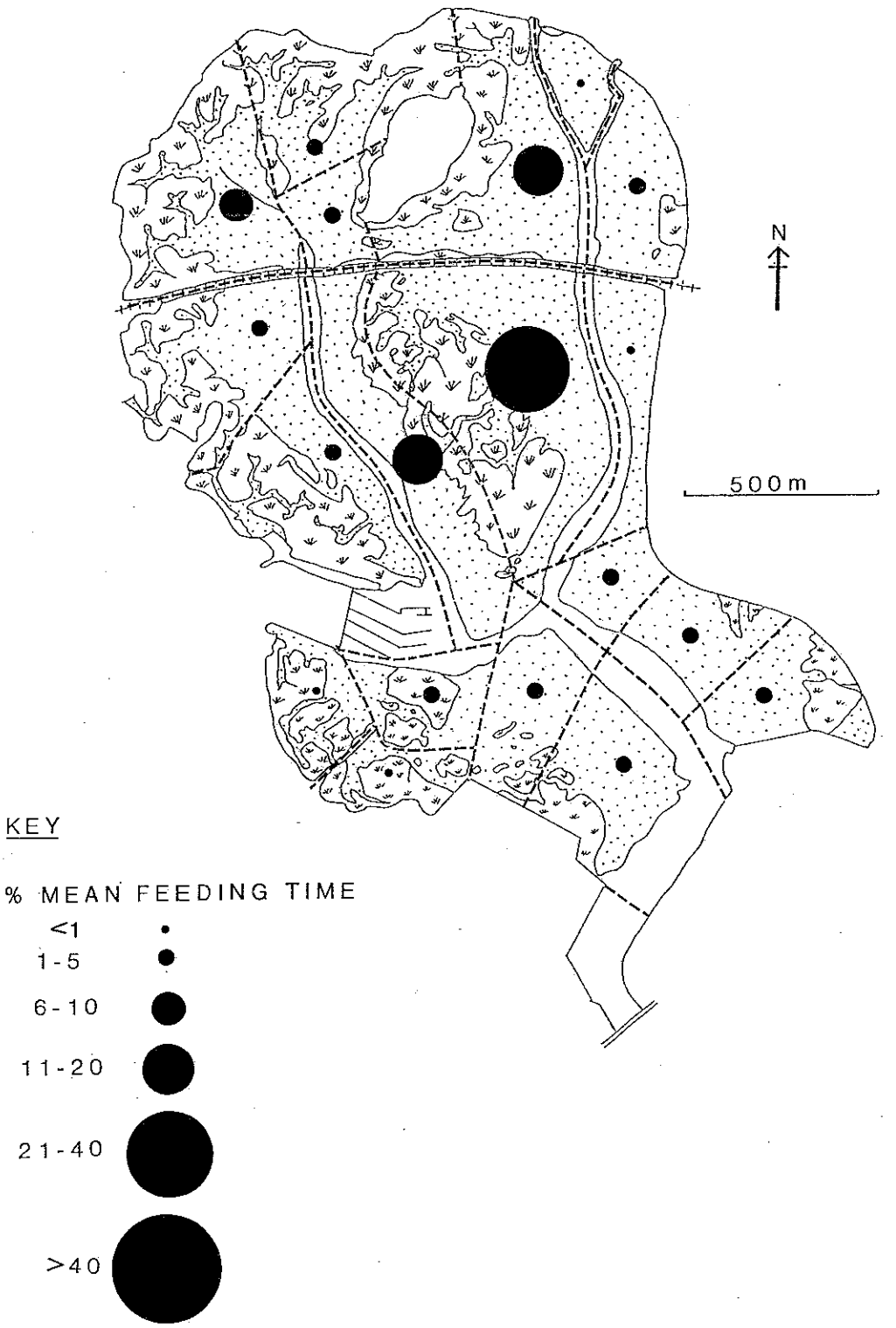


FIGURE 7.26 CURLEW: THE COMPLETE YEAR DISTRIBUTION OF % MEAN FEEDING TIME IN HOLES BAY

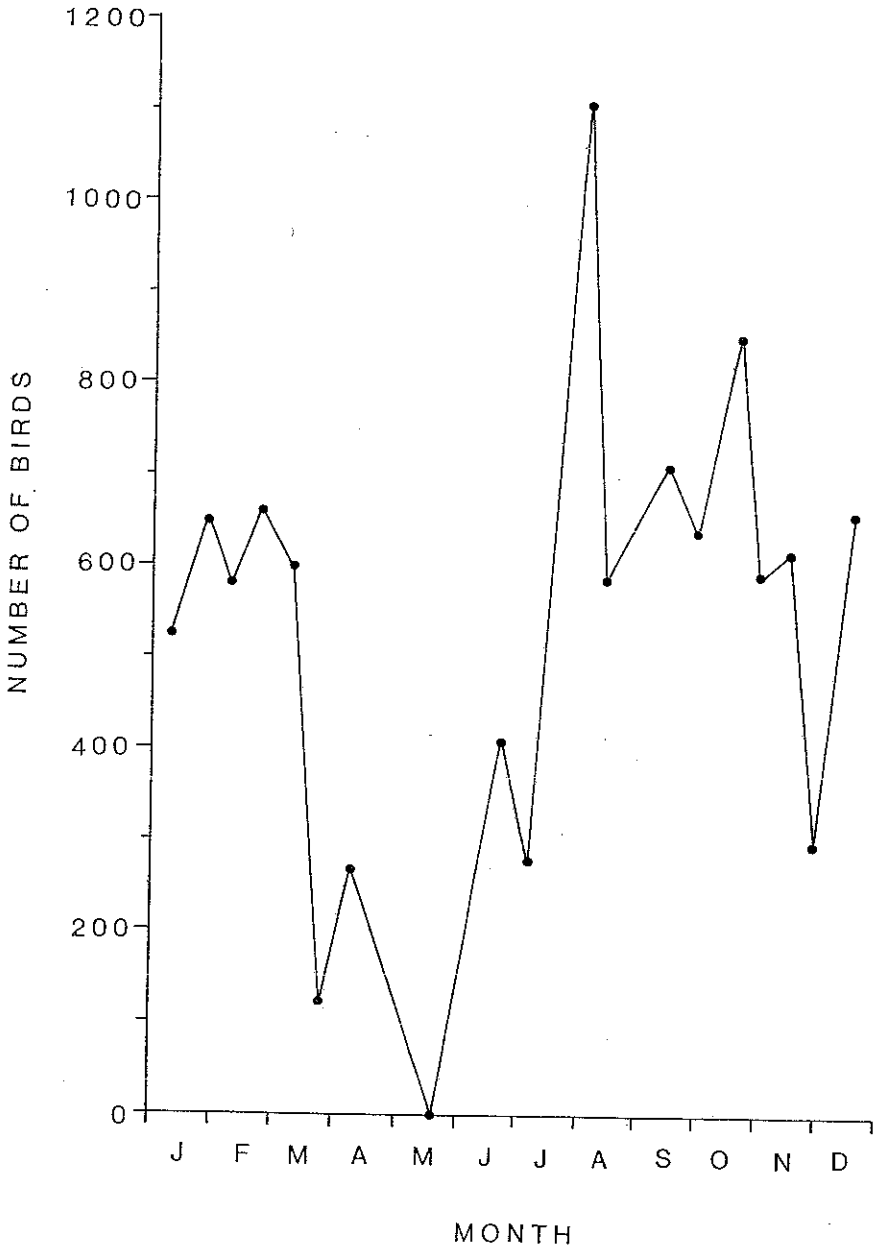


FIGURE 7.27 REDSHANK: HOLES BAY

LOW WATER COUNTS IN 1988

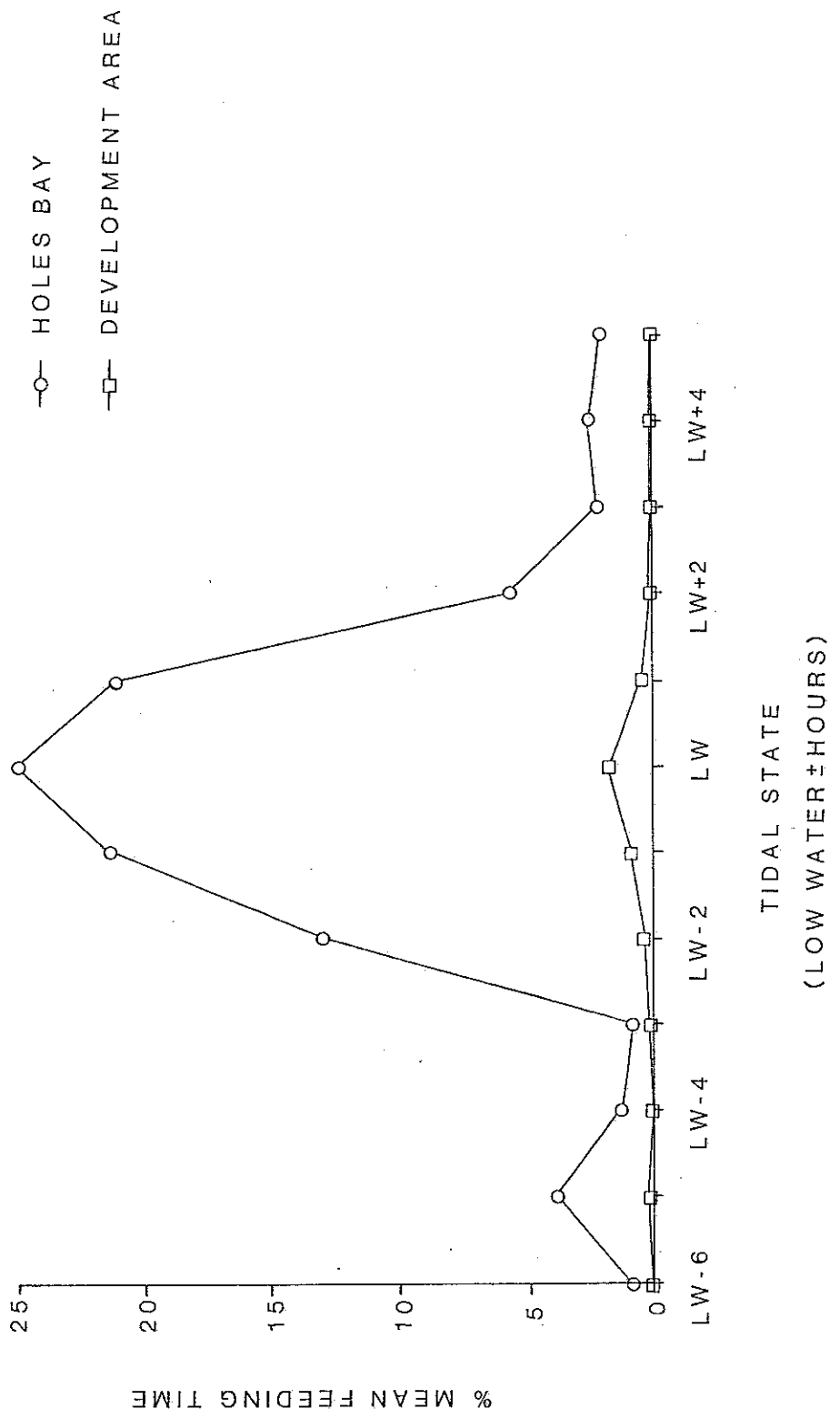


FIGURE 7.28 REDSHANK: THE COMPLETE YEAR

% MEAN FEEDING TIME THROUGH THE TIDAL CYCLE

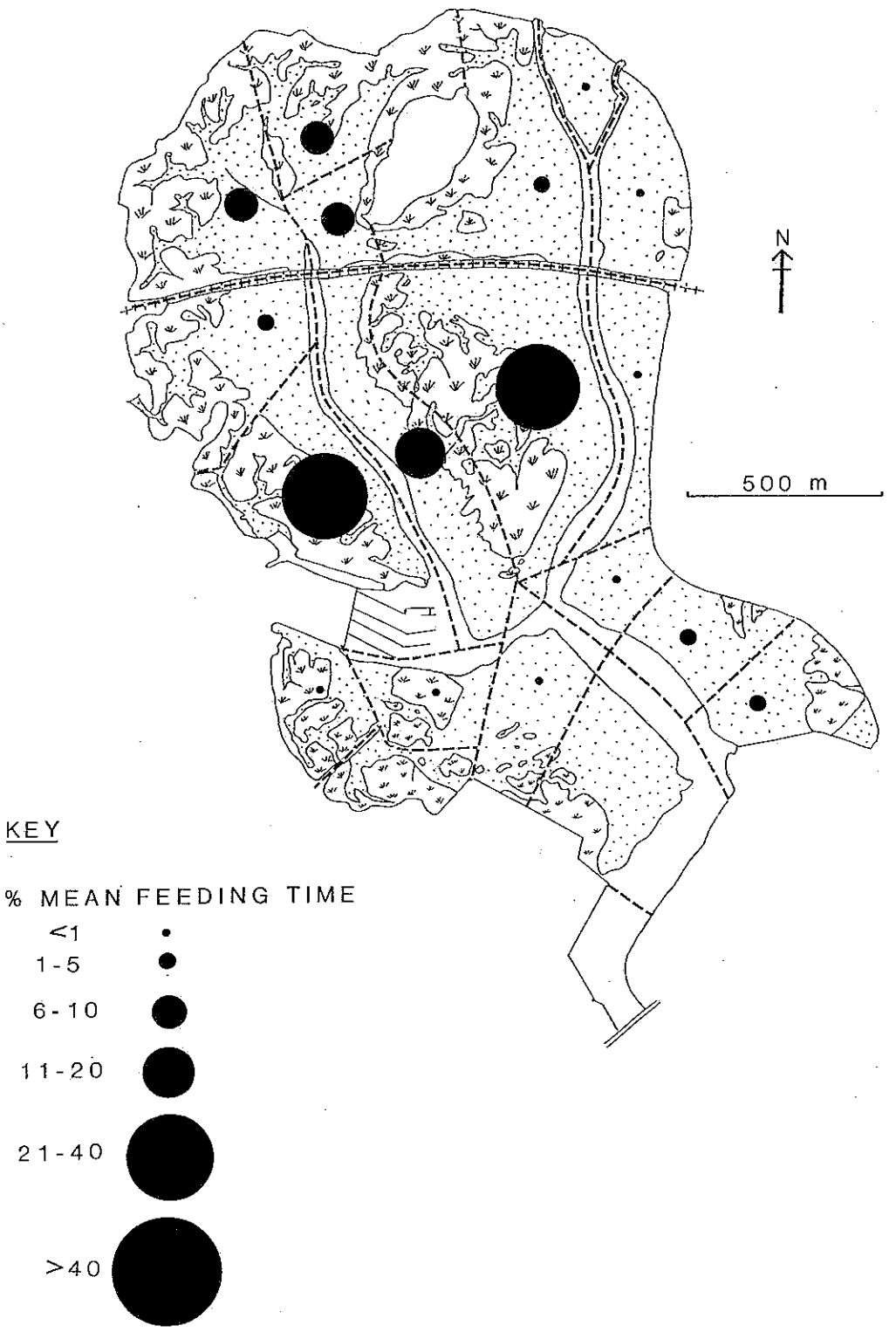


FIGURE 7.29 REDSHANK: APRIL - JUNE DISTRIBUTION OF % MEAN FEEDING TIME IN HOLES BAY

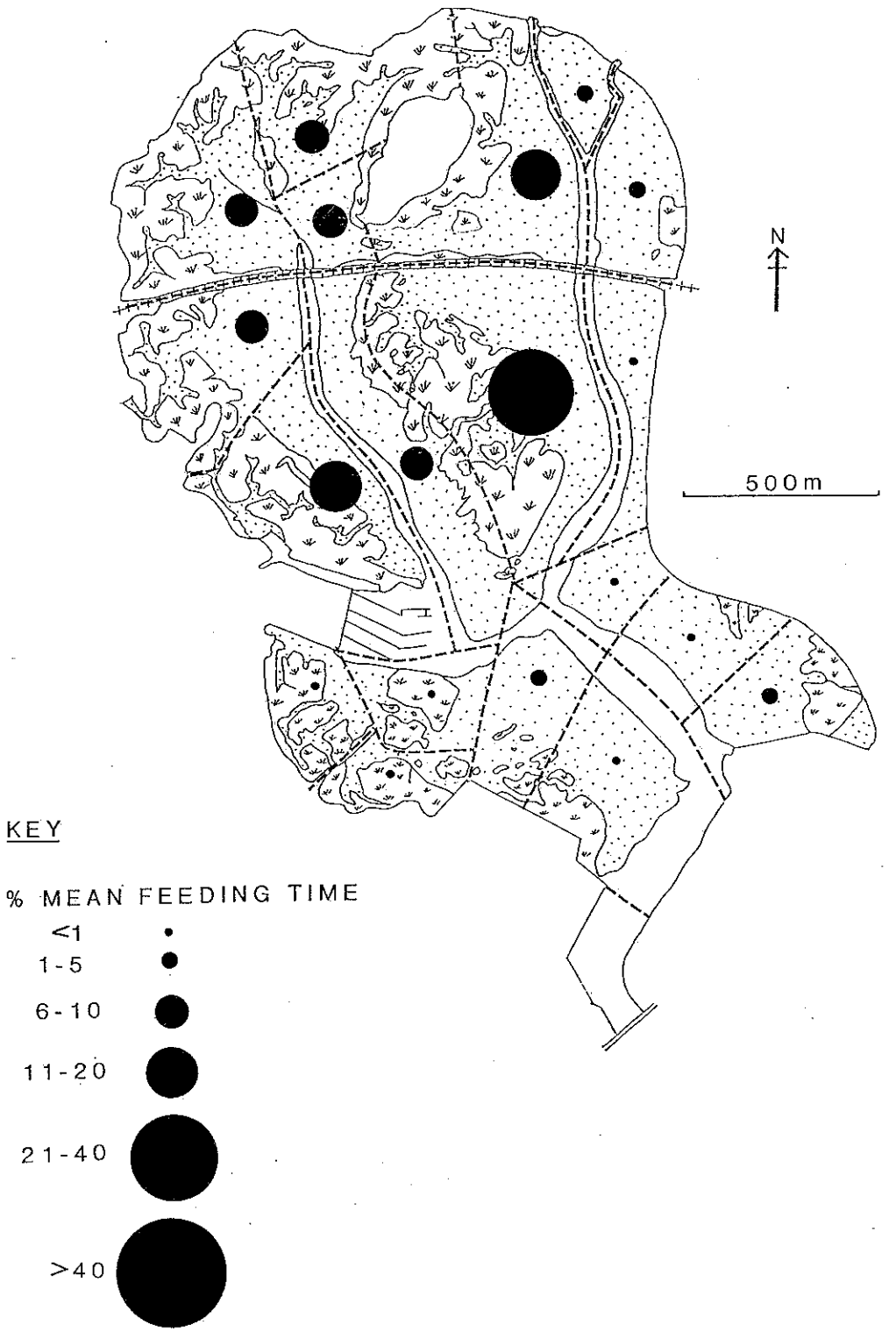


FIGURE 7.30 REDSHANK: JULY - SEPTEMBER DISTRIBUTION OF % MEAN FEEDING TIME IN HOLES BAY

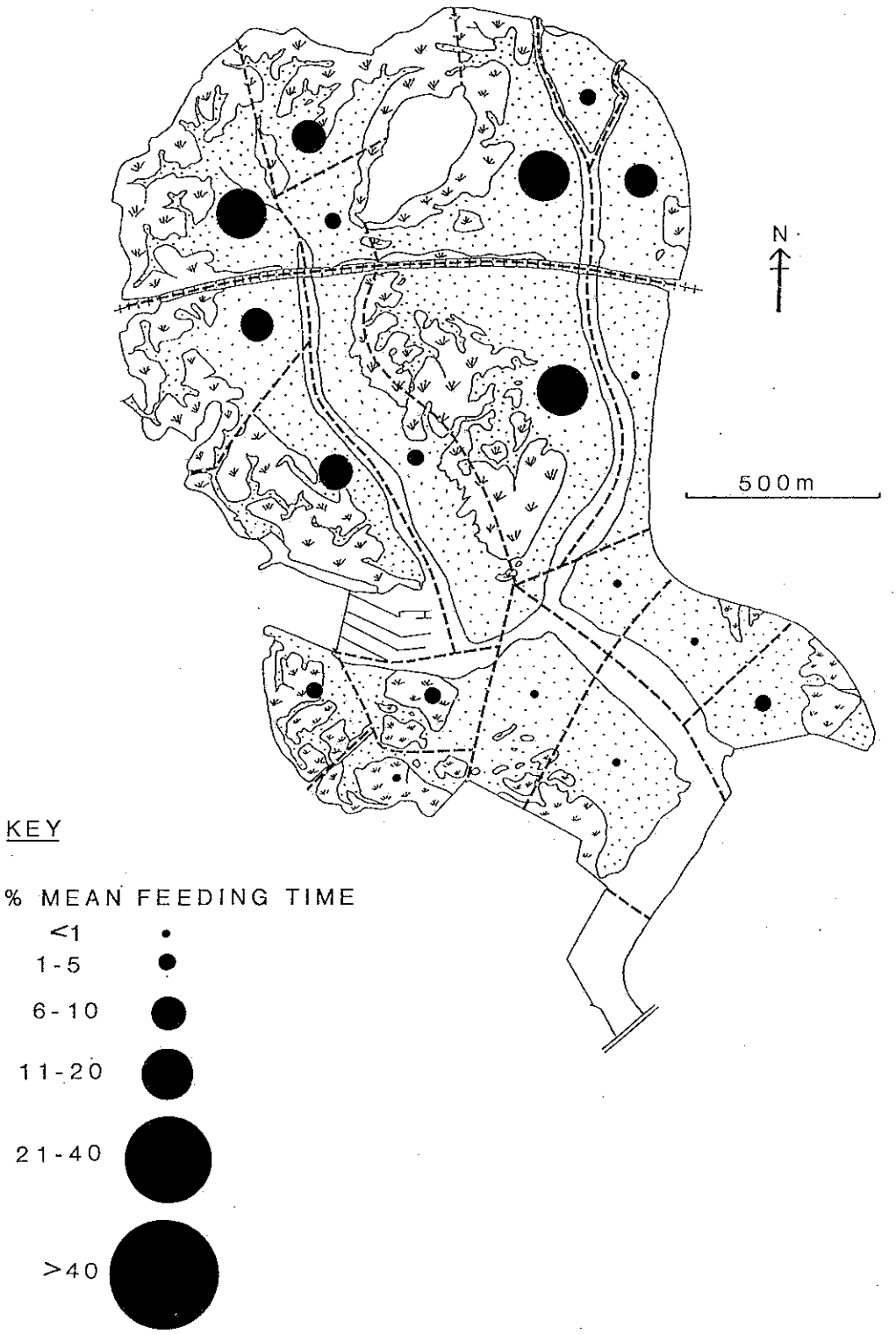


FIGURE 7.31 REDSHANK: OCTOBER - MARCH DISTRIBUTION OF % MEAN FEEDING TIME IN HOLES BAY

importance of the North-West area had substantially increased in the winter (October - March).

7.3.8 BLACK-HEADED GULL (Larus ridibundus)

There is a pronounced autumn passage of Black-headed Gulls through Holes Bay, with numbers present more than double those of the winter peak (Figure 7.32). A proportion of these are probably post-breeding birds from the Poole Harbour colonies utilizing Holes Bay for feeding prior to winter dispersal. However, surprisingly few juvenile birds (⅛10%) were observed during this season, as was also noted in the Weymouth area (M.Cade, pers. comm). Goss-Custard & Durrell (1983) also noted an August peak in 1982. In 1988, the wintering birds arrived from late October, peaking in February before departing in March. Those birds remaining through the summer comprised local breeders and non-breeding individuals.

Feeding of Black-headed Gull in the autumn & winter was concentrated from three hours before to three hours after low tide (Figure 7.33). However, during the spring & summer feeding was distributed throughout the tidal cycle. Tidal feeding pattern comprised a peak two hours before low water and a trough between three hours to five hours after low water (Figure 7.34). The reason for this difference is unclear but may be related to the presence of two breeding colonies of Black-headed Gull in Poole Harbour (Holton Heath and Long/Round Island), each of between 2000-4000 pairs. The breeding adults need to forage throughout the Harbour and tidal cycle for food for their chicks in particular. Within the Development Area the feeding regime was distinctly tidal throughout the year (Figure 7.33 and 7.34). Virtually all feeding occurs from three hours before to three hours after low water, with a peak around low water.

Winter feeding by Black-headed Gull within the Bay was relatively uniformly distributed between sectors (Figure 7.35). However, sector 2 attracted a feeding density three fold greater than any other areas (Figure 7.36). This focus of attraction in sector 2 remained high throughout the year, probably as a result of the sewage and stream outlet in this area. In Spring, most feeding was dispersed over the sectors north of Cobbs Quay (Figure 7.37). The importance of the South-East, South-West and North-West areas declined in summer and autumn, with that of the North-East increasing to ca 75% (Figure 7.38).

Apart from in Winter, a comparatively minor proportion of the overall feeding time of the Black-headed Gull was spent in the Development Area (Figure 7.37 and 7.38). In winter, a maximum of 24.3% of the overall mean winter feeding time occurred within the Development Area.

The distribution of feeding Black-headed Gulls from July 1982 to January 1983 (Goss-Custard & Durrell 1983) was similiar to that found in 1988. Approximately 50% of the total feeding

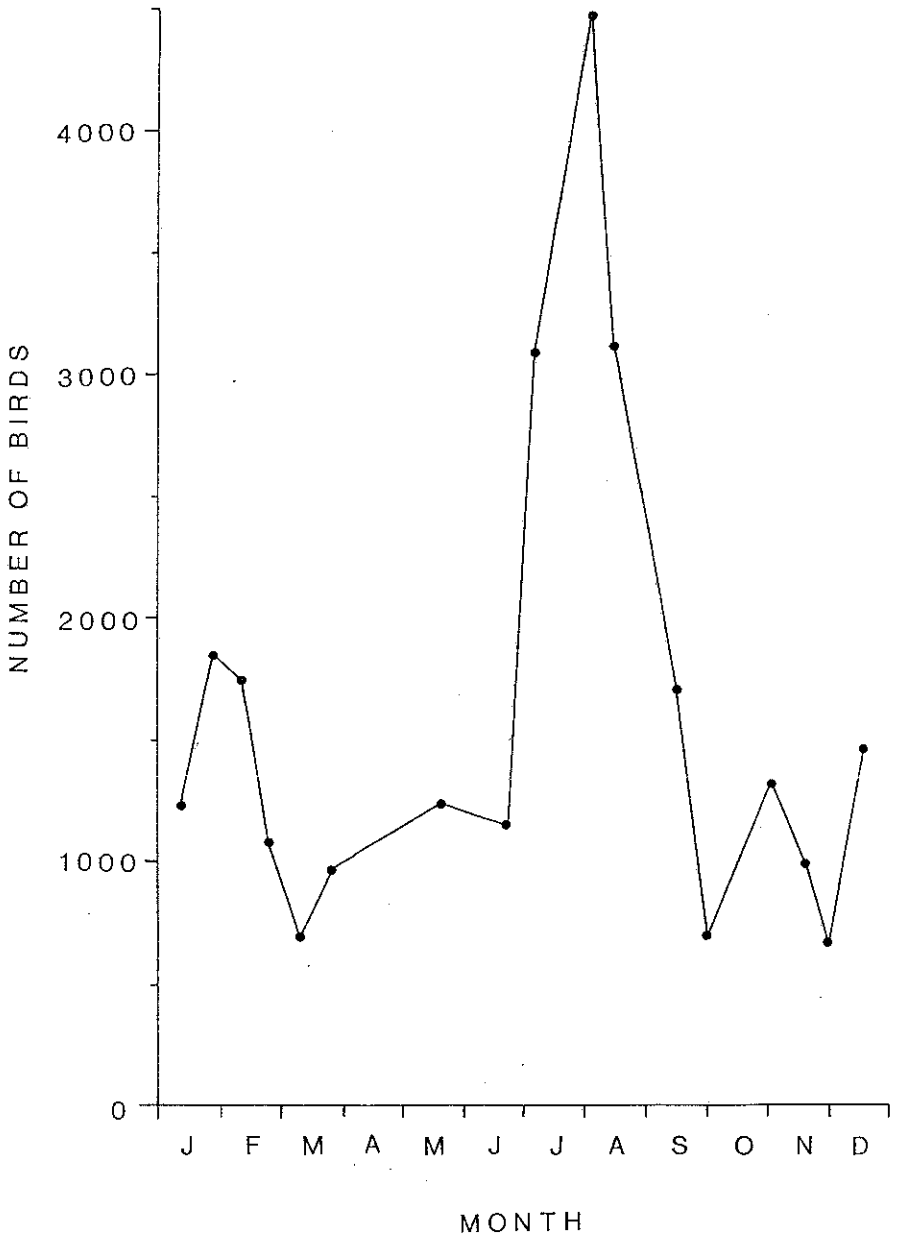


FIGURE 7.32 BLACK-HEADED GULL: HOLES BAY LOW COUNTS IN 1988

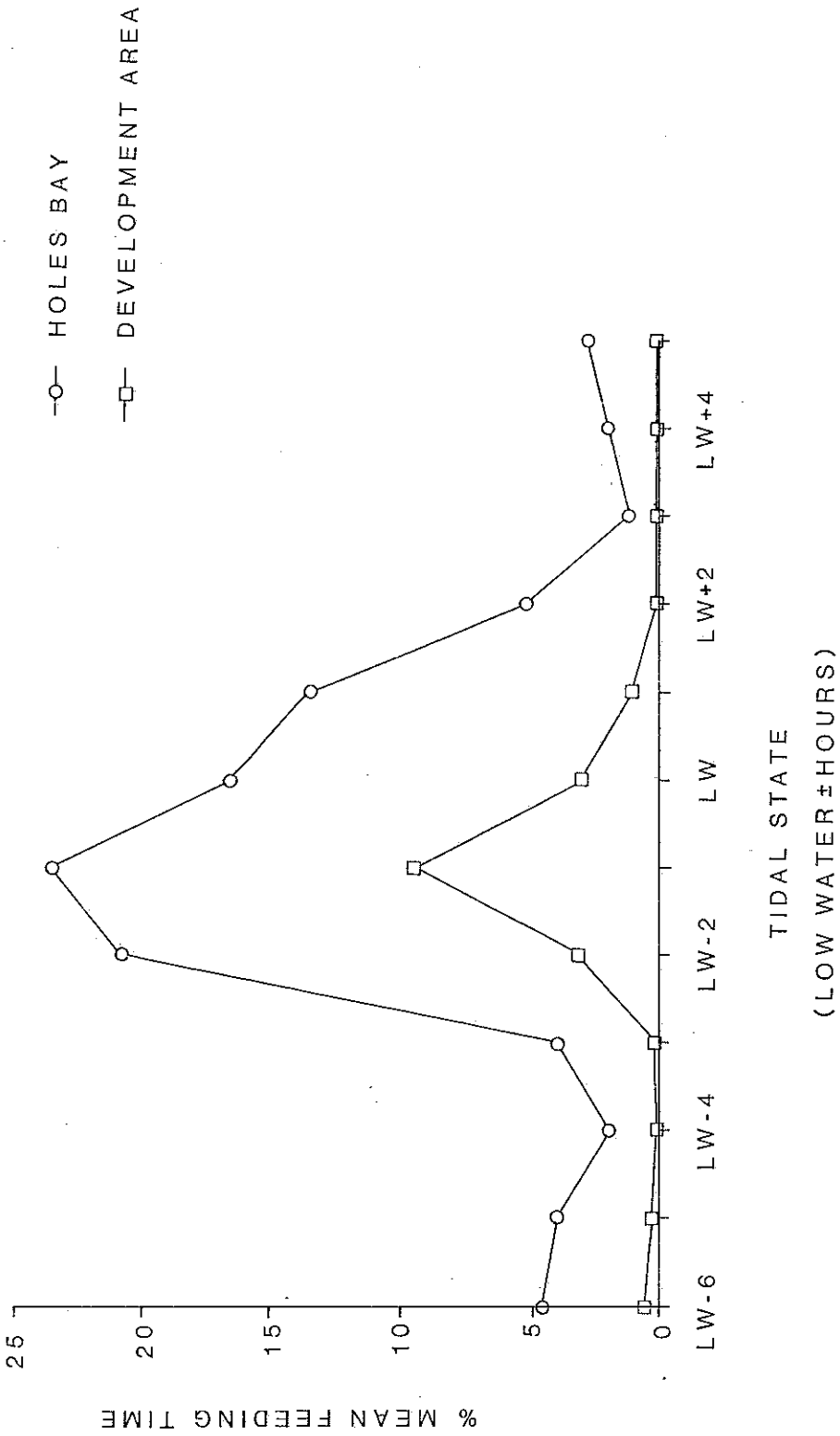


FIGURE 7.33 BLACK-HEADED GULL: JULY - FEBRUARY

% MEAN FEEDING TIME THROUGH THE TIDAL CYCLE

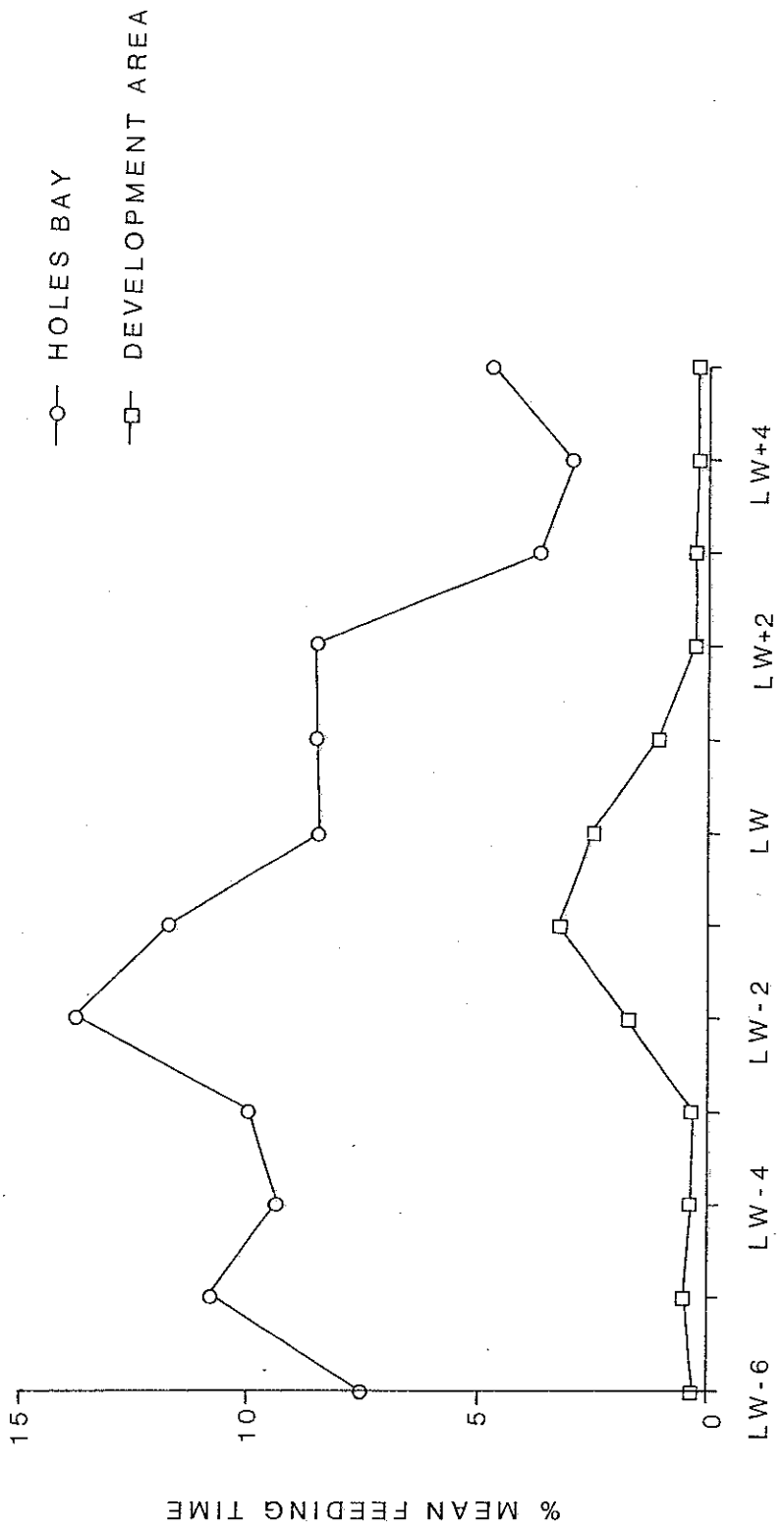


FIGURE 7.34 BLACK-HEADED GULL: MARCH - JUNE

% MEAN FEEDING TIME THROUGH THE TIDAL CYCLE

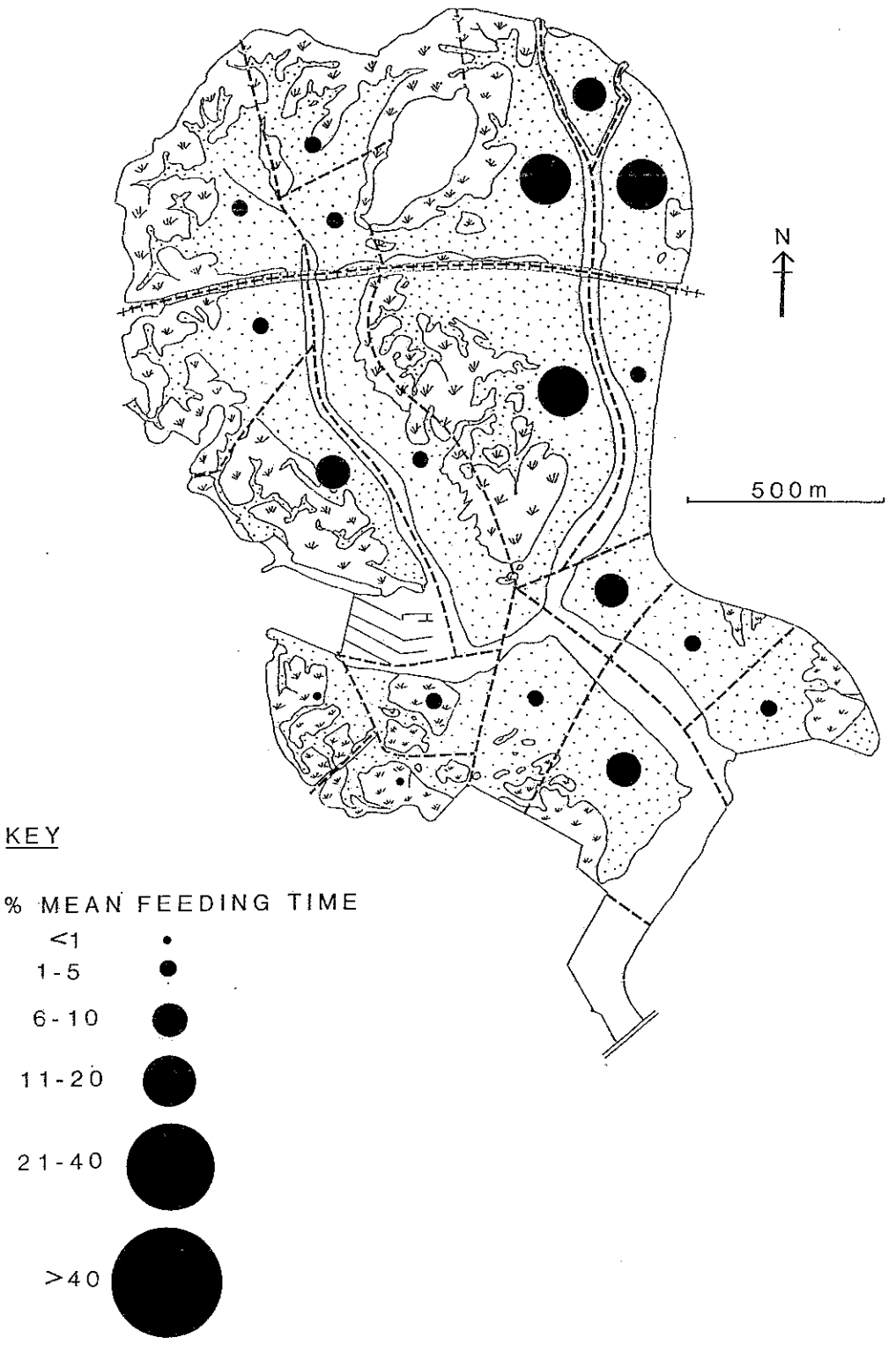


FIGURE 7.35

BLACK-HEADED GULL: NOVEMBER - FEBRUARY

DISTRIBUTION OF % MEAN FEEDING TIME IN HOLES BAY

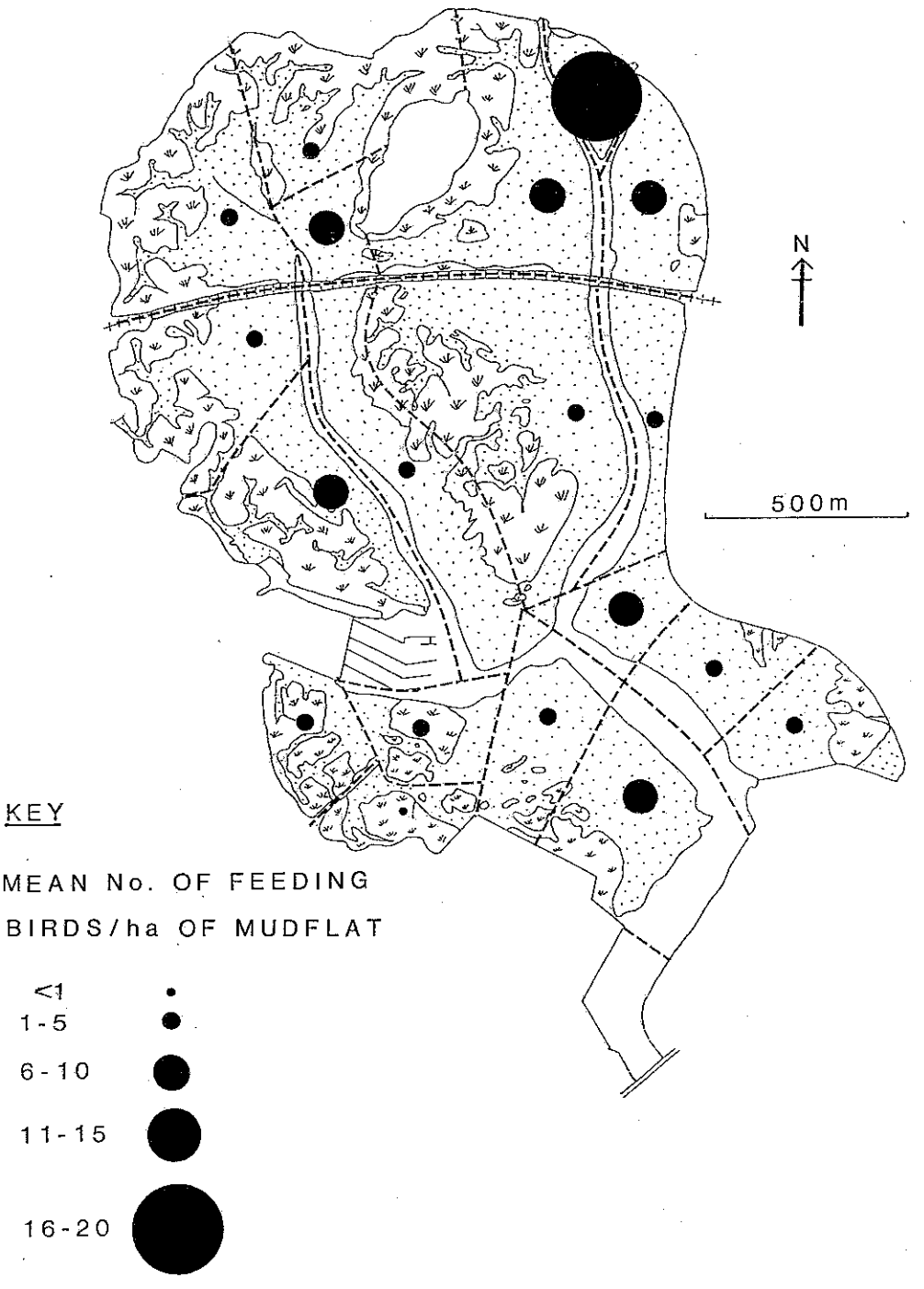


FIGURE 7.36

BLACK-HEADED GULL: NOVEMBER - FEBRUARY DISTRIBUTION OF FEEDING BIRD DENSITY IN HOLES BAY

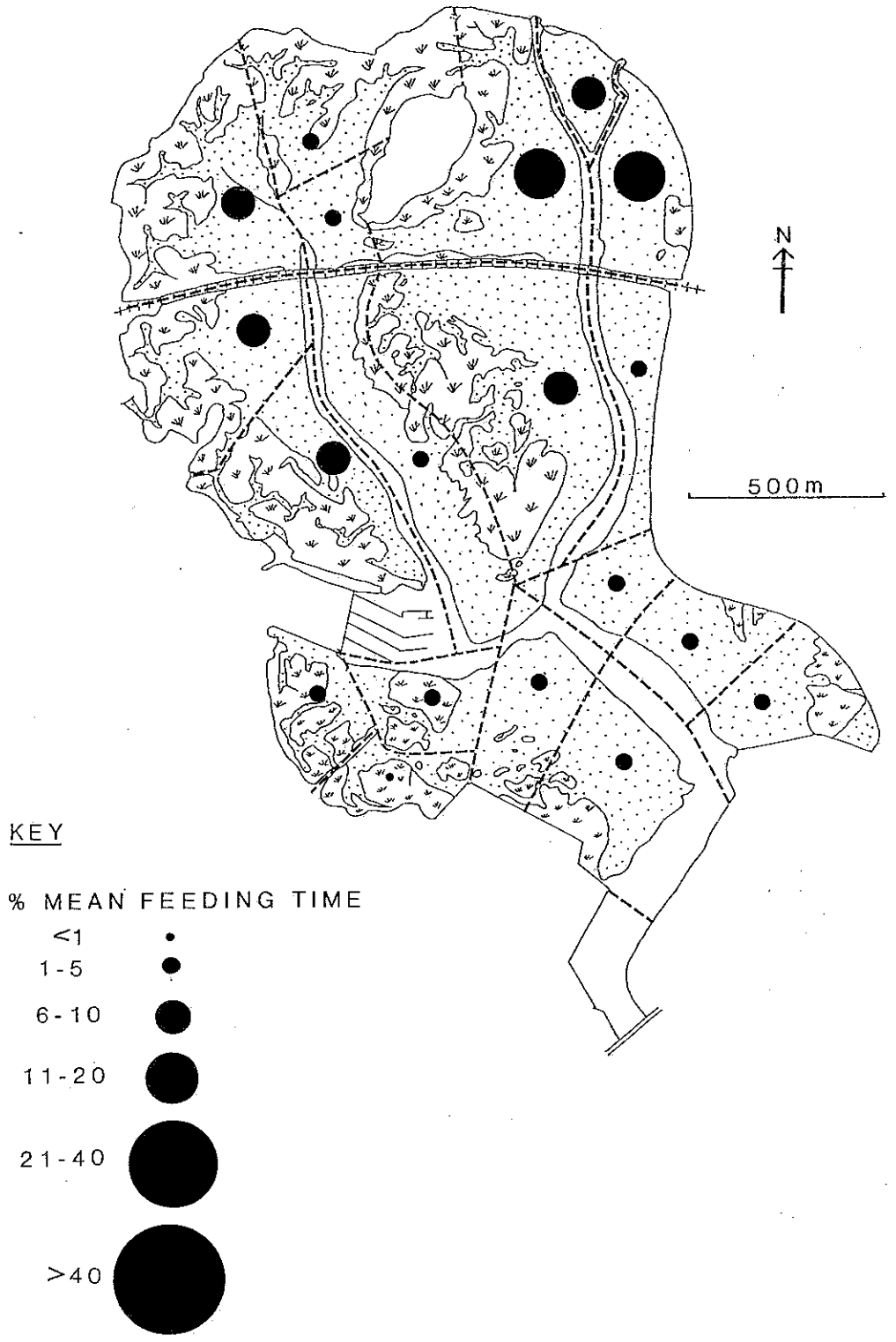


FIGURE 7.37 BLACK-HEADED GULL: MARCH - APRIL DISTRIBUTION OF % MEAN FEEDING TIME IN HOLES BAY

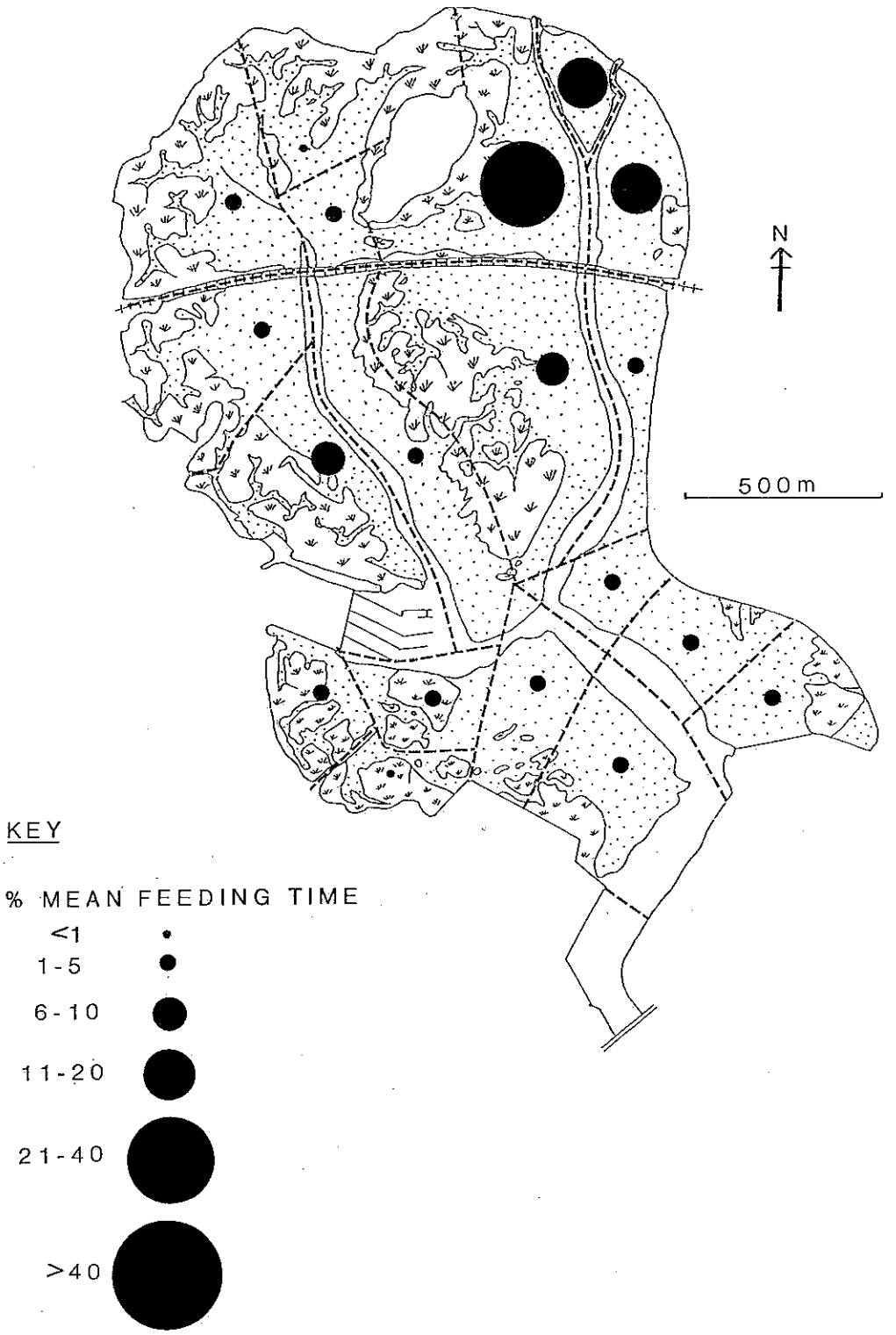


FIGURE 7.38 BLACK-HEADED GULL: MAY - OCTOBER DISTRIBUTION OF % MEAN FEEDING TIME IN HOLES BAY

time was within the North-East of the Bay, the remainder evenly distributed around the other mudflats.

7.3.9 FIELD FEEDING

During winter, not all of Poole Harbour's Oystercatchers roosted at high tide, some instead sought additional feeding on Baiter Park (max. 389 birds), Turlin Moor (max. 160 birds) and Hamworthy Football Ground (ca 50 birds), of which a proportion probably originated from Holes Bay. Occasionally up to 30 birds roosted and/or fed on the undeveloped land beside the Esplanade, Sterte.

Feeding Dunlin were regularly recorded during winter high tides at Baiter Park when the ground was wet. Collins (1985), however, observed the Dunlin flocks on Baiter loafing as well as foraging. Annual Dunlin maxima for Baiter range between 2000-3000 birds at high tide (Collins 1985), a proportion of which probably originates from Holes Bay's low tide population. This was suggested by the direction of arrival and departure of a few individuals at Baiter in 1987/8. Additional winter feeding may also at times be sought at high tide on Turlin Moor when wet, by those birds commuting between Lytchetts and Holes Bay. In 1988, a maximum count of 310 birds were observed feeding on Turlin Moor playing fields on 6 January. This was not noted by previous studies (Goss-Custard & Durrell 1983; Collins 1985, 1986).

Up to a hundred Curlew found additional winter feeding at high tide in damp pastures adjacent to the North-West, Holes Bay. However, following the opening of the Upton Country Park Shoreline Trail in summer 1988, no Curlew were recorded utilizing these fields. Those Curlew which at high tide fly to Arne/Fitzworth (Collins 1985) probably also find supplementary winter feeding at high tide in adjacent fields, e.g. Cleavel Fields.

A proportion of the Bay's wintering Redshank may have found additional winter feeding at high tide on Baiter Park and Turlin Moor when these sites water logged. The maximum counts noted during the present study were 51 and 34 respectively. Collins (1985) did not record the species feeding at either site.

Through out the year, but particularly in winter, Black-headed Gulls spend a substantial proportion of their time feeding in fields and refuse tips.

No evidence was found for any of the Holes Bay populations of the other three species considered, foraging elsewhere than within the intertidal zone.

7.4 DISCUSSION

For all eight species of duck, wader and gull considered, the seasonal trend of low water counts in Holes Bay is comparable to that of the BoEE's seasonal trend both nationally and within Poole Harbour. The pattern of feeding time in relation to the tidal cycle was found to be similar for all species; the majority of feeding time was concentrated within the period extending three hours either side of low water when, in general, feeding time for each species peaked.

For the five wader and two wildfowl species considered, the Holes Bay mudflats that were predominantly used for feeding were those to the north of Cobbs Quay. A strong preference in terms of feeding time was shown in particular for the mudflats of sectors 1, 4, 17, 19, and the South-West. Black-headed Gull's feeding time tended to be more evenly distributed between the Bay's mudflats with the exception, however, of the North-East which substained very high numbers; a sewage outfall in sector 2 provided good feeding. Notable seasonal variations were found in feeding distribution of Shelduck, Teal, Dunlin, Redshank and Black-headed Gull, within the area north of Cobbs Quay .

The maximum proportion of feeding time with in Holes Bay estimated as likely in to be lost in each period of the year as a result of each proposed development is given for each species in Table 7.3. Note that because the areas of the individual developments overlap, summation of the estimated feeding time lost for each development does not equate to that for the Development Area as whole.

For those species whose Holes Bay population was estimated to lose less than 10% feeding time in response to the 1983/4 Holes Bay road development (Goss-Custard & Durrell 1983), no deleterious short-term impact was in fact identified subsequent to the development (Chapter 6). This would suggest that the current development proposals are likely to have virtually no detrimental impact, if any, upon the Holes Bay populations of five species (Shelduck, Teal, Dunlin, Black-tailed Godwit and Redshank) in terms of feeding time lost; the maximum estimated loss in feeding time is less than 10% for these five species (Table 7.3). The Development Area is also likely to be a less preferred feeding area of Holes Bay for all five of these species, being utilized most when each of the species populations in the Bay are high.

Through out the year, but particularly in winter, Black-headed Gulls spend a substantial proportion of their time feeding in fields and refuse tips. This would therefore suggest that the loss in feeding time to the species's Holes Bay population is likely to be nearer to 10% than 24% at its maximum.

For Oystercatcher, it was estimated that the loss in habitat to the 1983/4 Holes Bay Road Development would directly reduce the species feeding time in Holes Bay by 14% (Goss-Custard &

Table 7.3 Estimated percentage loss in feeding time of each species to the individual developments through the seasons.

SPECIES	SEASON	MARINA	RECLAMATION	BRIDGE	TOTAL DEVELOPMENT
SHELDUCK	SUMMER	0.1	0.2	2.5	2.6
	AUTUMN	0	0	0	0
	WINTER	1.7	0.7	6.8	8.0
TEAL	SUMMER	0	0	0	0
	AUTUMN	0	0	0	0
	WINTER	0.7	0.7	1.3	2.0
OYSTER-CATCHER	SUMMER	6.3	2.5	6.7	10.8
	AUTUMN	4.6	16.1	21.0	24.8
	WINTER	13.1	11.7	23.0	30.8
DUNLIN	SUMMER	0	0	0	0
	AUTUMN	0.2	0	1.3	1.3
	WINTER	3.2	<0.1	1.4	3.7
	SPRING	0	0	0	0
BLACK-TAILED GODWIT	SUMMER	0	0	0	0
	AUTUMN	0	0	0	0
	WINTER	0	0	0.6	0.6
	SPRING	3.2	<0.1	1.4	3.7
CURLEW	SUMMER	2.7	0.7	5.7	7.6
	AUTUMN	7.2	1.1	8.7	12.2
	WINTER	2.2	1.4	7.1	8.1
REDSHANK	SUMMER	3.0	0	2.0	3.8
	AUTUMN	2.6	0.2	3.0	4.8
	WINTER	2.0	0.7	2.1	3.6

Table 7.3 (con't).

SPECIES	SEASON	MARINA	RECLAMATION	BRIDGE	TOTAL DEVELOPMENT
BLACK-HEADED GULL	SUMMER	7.0	0.9	6.4	10.4
	AUTUMN	7.1	8.0	1.3	12.4
	WINTER	8.4	20.5	6.4	24.3
	SPRING	6.7	2.1	8.1	11.6

Durrell 1983). In fact, the evidence would tend to suggest there has been no deleterious impact upon the Oystercatcher population directly from the loss of habitat to the development (see Chapter 6). If those findings are directly applied to the present study's results, irrespective of the species, the current development proposals would be expected to have no direct detrimental impact upon the Holes Bay population of either Curlew or Black-headed Gull in terms of feeding time lost.

A maximum of 30% of Oystercatcher feeding time in Holes Bay is estimated to be lost directly from the proposed developments. The Oystercatchers whom lost feeding grounds as a result of the direct impact of the Holes Bay Road Development, were apparently soon able to find alternative feeding within Holes Bay (see Chapter 6). However, Holes Bay and Poole Harbour as a whole may not necessarily be able to accomodate all those Oystercatchers displaced by the proposed developments; the population in Poole Harbour is likely to be at or near carrying capacity (see Chapter 5). Though those birds that may be lost to the proposed developments are of importance to Poole Harbour, their loss alone is unlikely to be of importance in either a national or international context; the Oystercatcher population of Poole Harbour for the most recent five year period 1983/4-87/88, was below the qualifying level for both national and international importance (see Chapter 4).

Potentially a greater loss in feeding time would be incurred for all species from the proposed bridge than either the reclamation or marina relocation. However, this estimate is made assuming the that the sectors into which a development intrudes will prevent all feeding in those sectors. This possibly may not be the case inregards to the bridge after its initial construction phase. Depending upon the resultant tidal flow and food supply in the bridges' development area, not all feeding in those sectors may be lost as a large area of mudflat will remain. The importance of human disturbance from the bridge would be expected to be minimal in comparison with the physical intrusion since it is confined to an elevated positon. Many waders are probably able to adapt to disturbance from new roads in close proximity to their feeding grounds provided the disturbance is confined to that narrow corridor.

Examination of the recent Holes Bay Road Development suggested only the reclamation work to have had an indirect impact upon any species population in Holes Bay; this was probably the result of disturbance of those feeding grounds extending within 300m of the development, which were of importance to the species affected, the Oystercatcher (see Chapter 6). The area designated in this report as the Development Area, encompasses the adjacent mudflats to the proposed developments (see Chapter 2). With the exception of the southern tip of sector 4, the main wader, wildfowl and gull feeding areas outside of the Development Area, are beyond 300 metres of any of the proposed developments. For all species, it is therefore

envisaged that any indirect effect of disturbance from the proposed developments, before and after construction, which will extend beyond the Development Area, will be minimal. The indirect effect of disturbance for those birds within the Development Area has already been accounted for by the above estimations of feeding time loss (Table 7.3).

Within Poole Harbour, the importance of wet playing fields and pasture as a feeding area for waders is probably greater than at most other estuaries. The unpredictability of Poole Harbour's low tide height, and therefore the time and extent of mudflat exposure, is undoubtedly reflected in the availability of prey to estuarine birds during a tidal period. Occasionally, a combination of prevailing weather conditions and current moon state may leave only the mud fringing the Spartina Marsh exposed at low tide in Holes Bay. Wet pastures, though less preferred feeding grounds, enables waders to at least partially compensate for any loss in intertidal feeding. The occurrence of field feeding exclusively in the winter further suggests this is the period when waders are less able to fulfil there energy requirements, as mentioned earlier (see Chapter 4).

As a result of field feeding, the percentage losses of winter feeding for waders in Table 7.3 are overestimates. This is not true, however, when the fields are frozen thus preventing the birds from feeding. Feeding may then be drastically reduced if Goss-Custard & Durrell (1983) estimate that at least 50% of Poole Harbours wader feeding occurs in fields is correct.

A substantial proportion of Redshanks Autumn and Winter populations fed in sectors (12-14) adjacent to Cobbs Quay together with an important component of the Bay's Dunlin passage population (C.a.schinzii & C.a.arctica). Any development of Cobbs Quay on the relocation of the marina would potentially reduce autumn feeding time of the Bay's Redshank by a maximum of 16.7% and Dunlin by 45.8%.

7.5 CONCLUSIONS

In Holes Bay, the vast majortiy of intertidal feeding by waders, wildfowl and gulls was undertaken within three hours either side of low water. The mudflats in Holes Bay that were predominantly used by birds for feeding were those to the north of Cobbs Quay; a strong preference in terms of feeding time was shown in particular for the mudflats of sectors 1, 4, 17, 19, and the South-West.

Four of the five wader species considered (Dunlin, Black-tailed Godwit, Curlew and Redshank) together with Shelduck, Teal and probably Black-headed Gull would, it is estimated, lose maximums of less than 14% of their total feeding time in Holes Bay as the result of the proposed developments. Evidence from the impact of a previous development in Holes Bay would

suggest that the current development proposals are therefore unlikely to show any impact of detriment upon those seven species populations in Holes Bay.

An estimated maximum of 30.8% of the Bay's Oystercatcher feeding time would be lost to the proposed developments. The evidence from the impact of a previous development in Holes Bay would suggest many of those birds may find suitable alternative feeding within Holes Bay. Though any Oystercatchers that are lost to the proposed development are of importance to Poole Harbour as a site, their loss alone is unlikely to be of importance in either a national or international context.

8. ROOSTING DISTRIBUTION OF HOLES BAY WATERFOWL AT HIGH TIDE

8.1 INTRODUCTION

At high tide, when intertidal feeding is rarely possible, the majority of waders and dabbling wildfowl gather to preen and roost communally. The size and species composition of roosts vary greatly, with the location generally being along the shoreline, e.g. on saltmarsh and sand spits, or in fields adjacent to the estuary. In their recent review of why birds roost communally, Ydenberg & Prins (1984) suggest that it offers protection from adverse weather, reduces the level of vigilance necessary by an individual for predators, and may act as an information centre regarding the location of food supplies.

The size of wader and wildfowl populations in an area can be influenced by the quality of available roosting sites, i.e. habitat type and freedom from disturbance; this factor at times may be of more importance than the availability of food (Furness 1973, Hale 1980). Disturbance, human and otherwise, influences the quality of a roosting site.

Collins (1985) located 43 wader roosts within Poole Harbour, of which four were in Holes Bay. The present chapter expands and updates information on the roosting behaviour of Holes Bay's wader and wildfowl populations. In addition, the likely impact of the proposed developments upon those birds roosting in Holes Bay is considered in terms of habitat loss, habitat creation and disturbance.

8.2 METHODS

The intertidal species considered were those waders and wildfowl identified in Chapter 6 as having important populations in Holes Bay: Shelduck, Teal, Oystercatcher, Dunlin, Black-tailed Godwit, Curlew and Redshank. With the exception of Black-tailed Godwit at times, all birds that roosted in Holes Bay were also utilizing the Bay for low tide feeding.

The data used in this chapter is from observations made in Holes Bay when undertaking feeding studies, supplemented by occasional high tide visits when the roosts were considered sufficiently visible to count; the counting of roosts was generally impossible as they were often hidden within Spartina marsh. The availability of a roost site in Holes Bay to a bird was dependent upon the height of the tide. On low neap tides all Spartina marsh roost sites within Holes Bay would be available at high tide. Within the progression from neap to

spring high tides, the various areas of Spartina marsh would be unindated in approxiamtely the following order with increasing high water height: the Spartina marsh south of Cobbs Quay, the Central Spartina, the Spartina along west shore between Cobbs Quay and the railway, the North-West Spartina. Most high waters on Spring tides left only the Spartina in the North-west and along the west shore between Cobbs Quay and the railway available. However, at very high spring high waters, no Spartina marsh would be available for roosting.

Waders and wildfowl vary in susceptibility to disturbance on their roosts. Observations of the different species roosting within Holes Bay suggest that all species when roosting are unlikely to be disturbed by potential sources of disturbances which are beyond 300 metres. In this chapter therefore, when the likelihood of a roost being disturbed outside of the Development Area is considered, the viewpoint taken is based upon whether a roost is beyond 300 metres of a proposed development. However, temporary disturbance of a roost can be expected from sudden loud and explosive noises originating from up to a kilometre away.

8.3 RESULTS

8.3.1 SHELDUCK (Tadorna tadorna)

During the present study, few, if any, Shelduck that fed in Holes Bay vacated the Bay to roost elsewhere, although in the autumn of 1982 some Shelduck were recorded flying to Brownsea Island (Goss-Custard & Durrell 1983). Shelduck would generally roost in the vicinity of their feeding grounds, either on the water or on the Spartina marsh, the main concentrations being on the central Spartina, in the North-West and along the east side of Pergins Island (Figure 8.1). In the winter of 1987/88, in particular during very high tides, up to a hundred of the Bay's Shelduck would roost in the fields adjacent to the north-west shore. Since the opening of Upton Country Park's Shoreline Trail in the summer of 1988, no Shelduck have been recorded in these fields at equivalent times in 1988.

A maximum of 34 Shelduck were recorded roosting within the development area in 1988, 16.1% of Holes Bay's mean winter low tide count. This was however an exceptional count, and the area usually contained no more than 15 birds, 7.1% of Holes Bay's mean low tide count. The nearest major roosting area to the Development Area is in the Central Spartina, and it would seem unlikely that this roost would not be disturbed by the proposed developments.

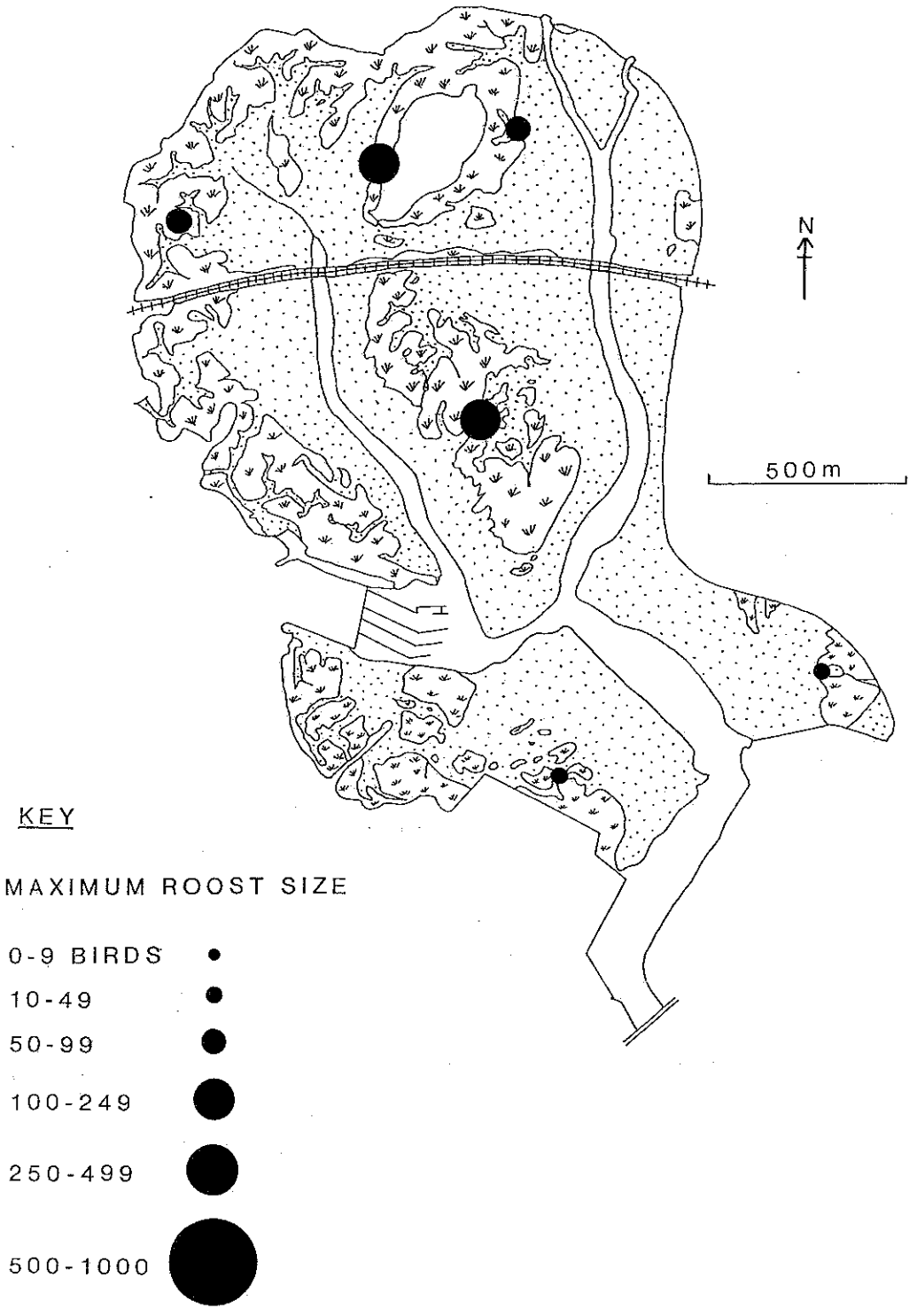


FIGURE 8.1 SHELDUCK ROOSTS IN HOLES BAY

8.3.2 TEAL (Anas crecca)

Goss-Custard & Durrell (1983) observed that a proportion of the low tide population of Teal in Holes Bay roosted elsewhere in Poole Harbour. However, both the current study and that of Collins (1985) recorded no such movement, the Teal instead remaining to roost within the vicinity of their feeding areas (Chapter 7). The main roosting concentrations were in the Spartina along the eastern shore of Pergins Island and in the North-West (Figure 8.2).

A maximum of 15 Teal were estimated to roost in the Development Area in 1988, 6.7% of Holes Bay's mean winter low tide count. The nearest major roosting area to the Development Area is in the Central Spartina (Figure 8.2), which would be unlikely to be disturbed by the proposed developments.

8.3.3 OYSTERCATCHER (Haematopus ostralegus)

Oystercatchers roosted outside of Holes Bay on most high tides, predominantly at the lagoon at Brownsea Island. However, a roost would form both at the southern tip and along the eastern side of the Central Spartina on the lowest high tides which failed to unindate this area (Figure 8.3). Together, these roosts numbered a maximum of 42 birds in winter, 80% of Holes Bays' mean low tide population. In addition, during neap high tides the intertidal area of the Development Area was occasionally used by roosting Oystercatchers but rarely by more than 2 birds, i.e. only 3.8% of the mean winter low tide count.

Outside of the Development Area, the Oystercatcher roost at the southern tip of the Central Spartina is the only one likely to suffer any disturbance during the construction phase of the proposed developments. This roost comprises up to 76% of Holes Bays' mean low tide population of Oystercatcher.

8.3.4 DUNLIN (Calidris alpina)

Dunlin only remained in Holes Bay to roost when high tides failed to inundate the Central Spartina. On such occasions, up to 750 Dunlin roosted there, with additional small roosts in the North-West and on either side of Cobbs Quay (Figure 8.4). Birds at the latter two roosts often made use of the exposed banks of dredged spoil beside the Marina.

On most high tides, Dunlin were observed to depart and enter Holes Bay from their roosts elsewhere, from over Poole Bridge and the Dolphin (Arndale) Shopping Centre. These birds probably had roosted on Brownsea Island Lagoon, along the southern shore of Poole Harbour and Poole Quay breakwater.

In winter, from two hours after low water, small flocks of what were presumably the Dunlin which fed both in Holes Bay

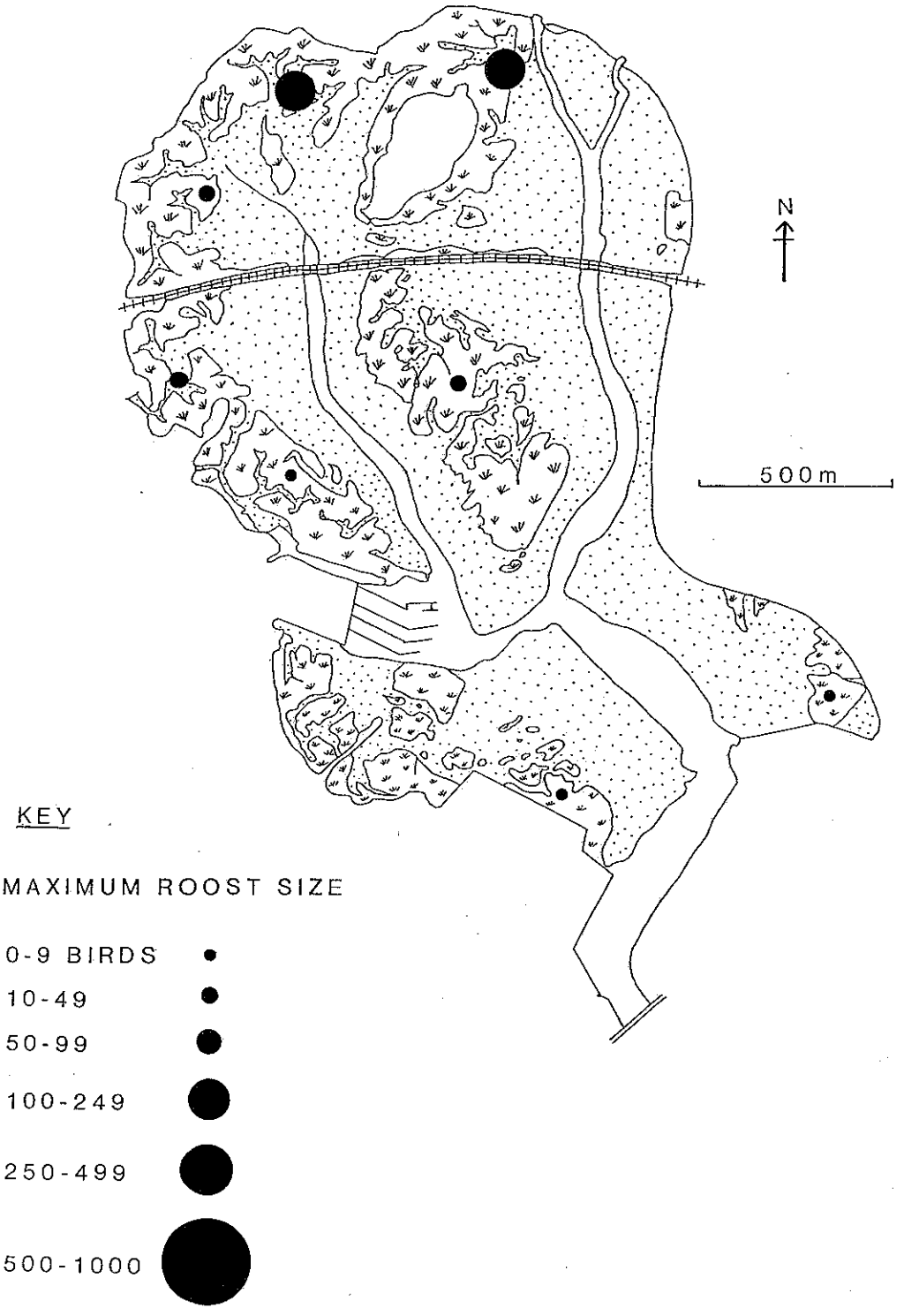


FIGURE 8.2 TEAL ROOSTS IN HOLES BAY

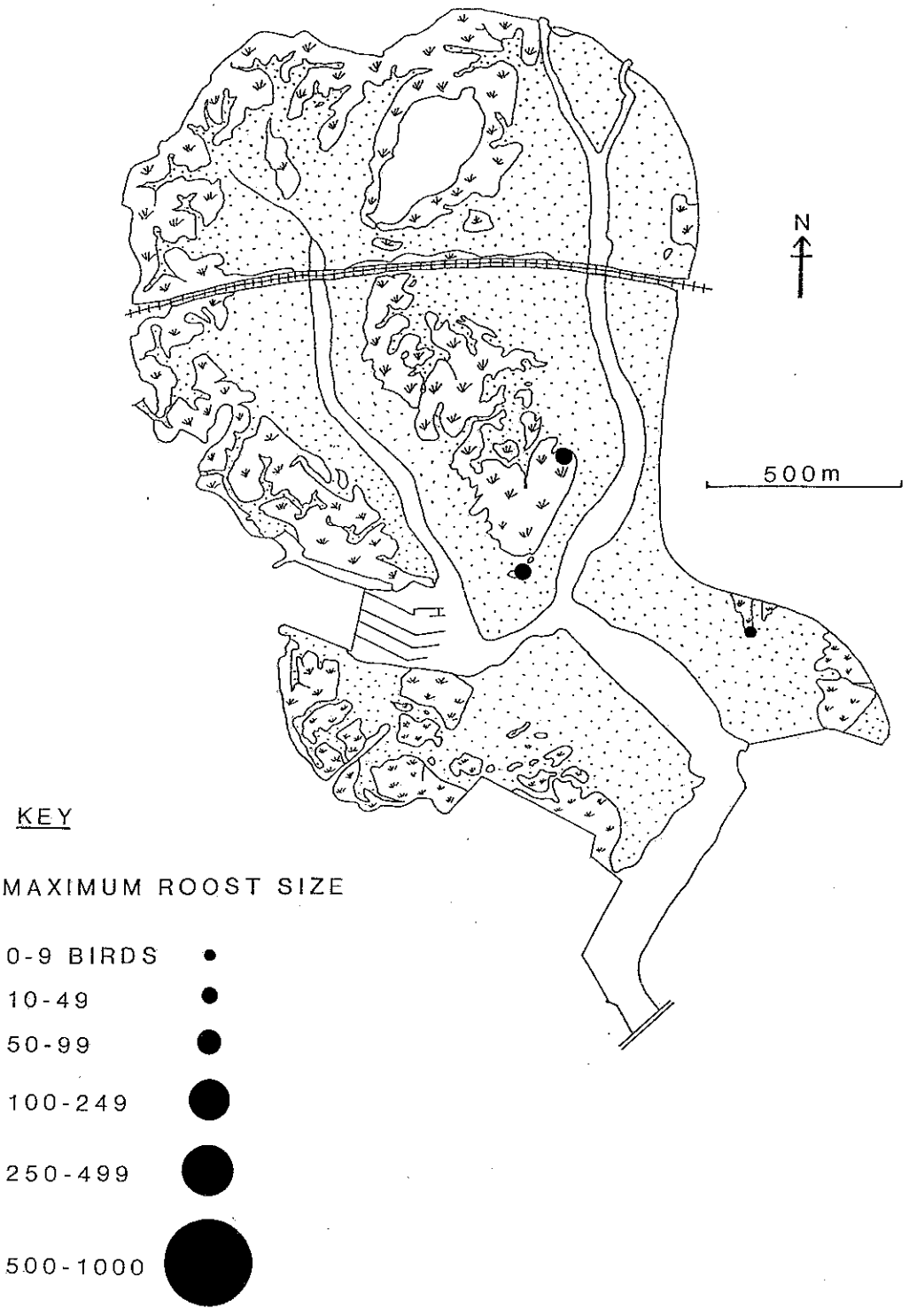


FIGURE 8.3

OYSTERCATCHER ROOSTS IN HOLES BAY

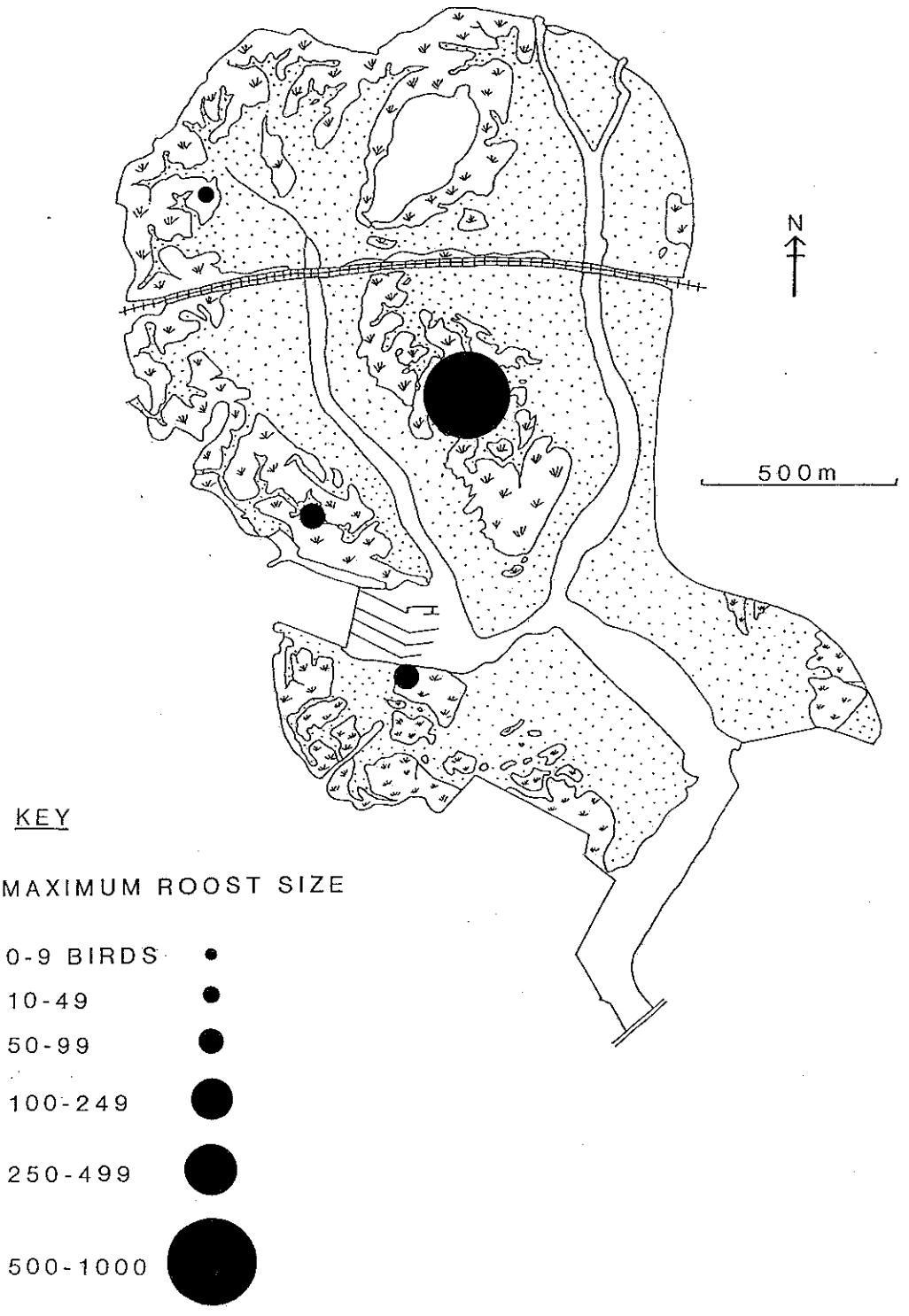


FIGURE 8.4 DUNLIN ROOSTS IN HOLES BAY

and Lytchetts Bay (Chapter 7), were seen returning to Holes Bay. Upon arriving in the Bay, they would fly across to the Central Spartina where they either roosted or continued on to depart from the Bay at Poole Bridge. This movement of Dunlin from Lytchetts Bay has not previously been recorded. No Dunlin were observed to arrive from Lytchetts Bay as the tide in Holes Bay fell towards low tide. This suggests that none of the Dunlin which fed in Holes Bay, roosted in Lytchetts Bay.

Dunlin were very rarely observed to roost within the Development Area in 1988. The nearest roost to the Development Area was on the south side of Cobbs Quay, which is considered unlikely to suffer any disturbance during the construction phase of the proposed developments.

8.3.5 BLACK-TAILED GODWIT (Limosa limosa)

Three roost sites in Holes Bay were used by Black-tailed Godwits, depending on the tide height (Figure 8.5). The major roost was situated in the North-West Spartina marsh, in the company of Redshank and Curlew; a maximum of 250 birds was recorded roosting here on 11 December 1987. Unlike all other species which roosted in Holes Bay, the Black-tailed Godwits may not necessarily have been foraging within Holes Bay during the previous low tide. During the winter, flocks of up to 250 birds were seen at times to fly in from the east (Lytchett Bay?) and south-east (Arne Pensinula?) after low tide to the North-West roost.

Collins (1985) recorded a roost of Black-tailed Godwits only in the Central Spartina, Holes Bay.

Black-tailed Godwits were very rarely seen to roost in the Development Area at high tide. The nearest roosting area to the Development Area, the Central Spartina, is considered unlikely to suffer any disturbance during the construction phase of the proposed developments.

8.3.6 CURLEW (Numenius arquata)

Most of Holes Bay's low tide population of Curlew left over Poole Bridge 2-3 hours after low tide. Their line of flight suggested that they flew to Arne/Fitzworth and Brownsea Island to roost. Those that remained in Holes Bay utilized five roosts depending on tide height (Figure 8.6); by contrast Colllins (1985) identified only the Central Spartina as a Curlew roost. On the occasional very low high tide, most of the low tide Curlew population remained in Holes Bay to roost in the Central Spartina.

A maximum of seven Curlew roosted within the Development Area in 1988, 4.2% of Holes Bay's mean winter low tide count. The nearest other roosting area to the Development Area was the Central Spartina. It is envisaged that this roost would not be disturbed during the construction phase of the proposed

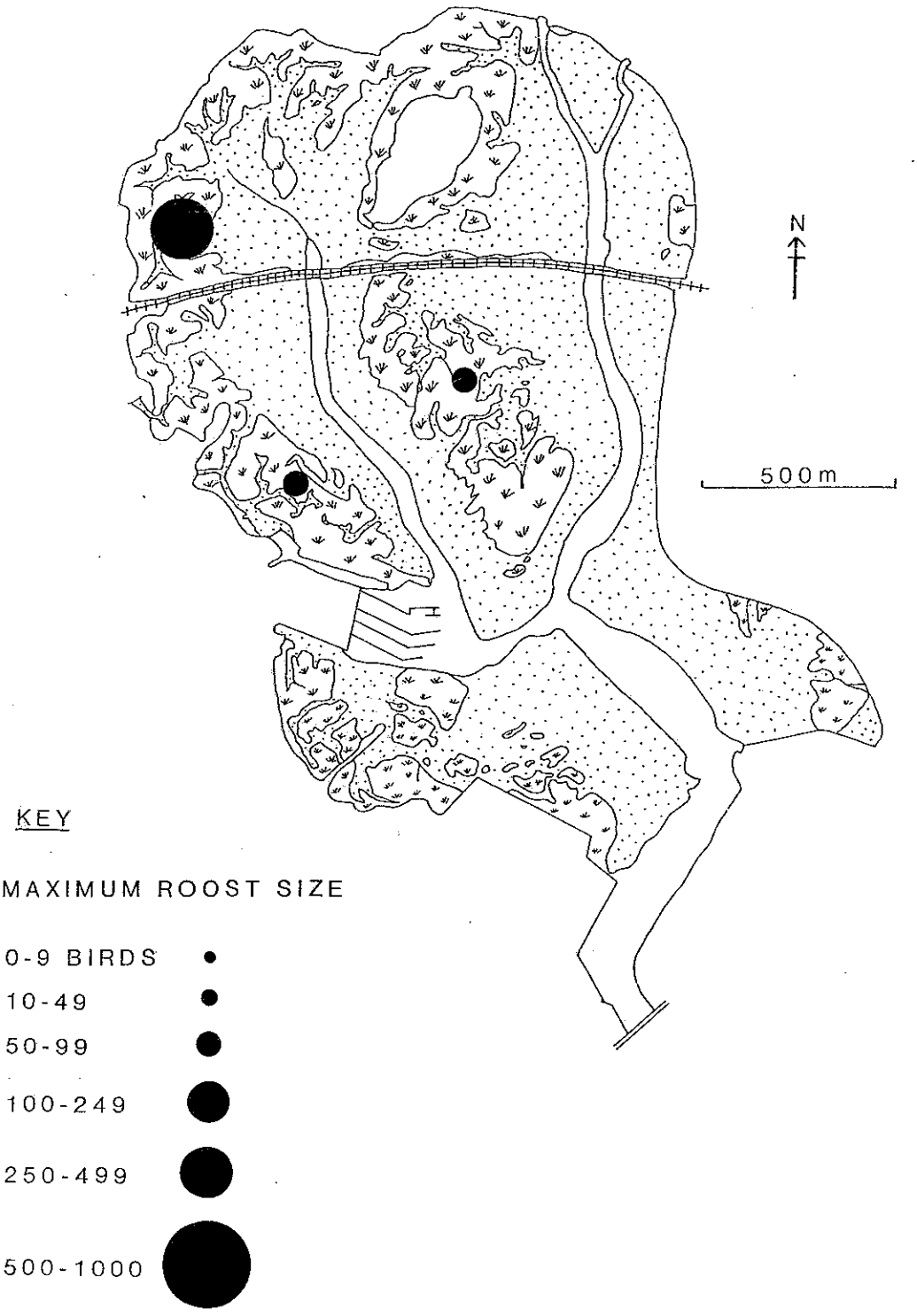
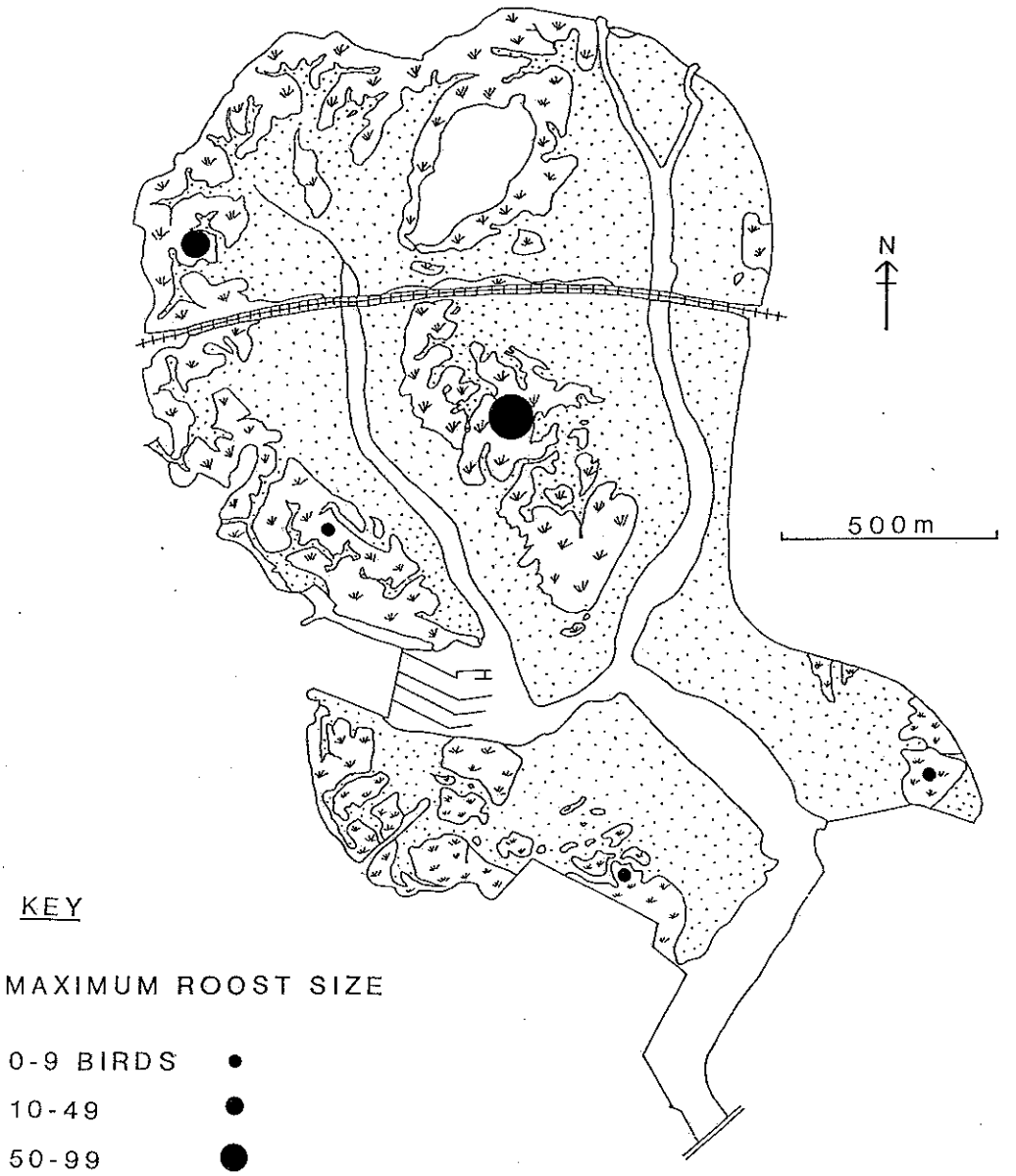


FIGURE 8.5

BLACK-TAILED GODWIT ROOSTS IN HOLES BAY



KEY

MAXIMUM ROOST SIZE

0-9 BIRDS

10-49

50-99

100-249

250-499

500-1000

FIGURE 8.6 CURLEW ROOSTS IN HOLES BAY

developments.

8.3.7 REDSHANK (Totanus totanus)

The majority of Redshank in Holes Bay at low tide remained to roost through high tide. Those that did depart left over Poole Bridge and the Dolphin (Arndale) shopping centre, suggesting that their roosts were at Brownsea, along the southern shore of Poole Harbour and, in winter, at Baiter Park. A total of three major (50+ birds) and four minor roosts were identified in Holes Bay (Figure 8.7); the use of these was dependant on tidal height. Figure 8.8 illustrates the pattern of roost usage with increasing tidal height, indicating where those birds displaced from a roost site by the tide subsequently move too. Collins (1985) had previously recorded only one of the major roosts.

Redshank at the Development Area's eastern roost congregated both within the Spartina, when incompletely covered, and on the remains of a large boat hull. The maximum count was 54 birds in winter at a neap tide.

The Central Spartina roost was difficult to observe, but exceeded 400 birds in the autumn and winter. Many of these birds relocated to the roost immediately north of Cobbs Quay when the Central Spartina was inundated at spring tides; the remainder departed from the Bay southwards, with a few entering the Development Area's eastern roost.

The North-West roost exceeded 350 birds at winter spring high tides when composed of birds evicted from the Bay's other roosts. However, with the opening of Upton Country Park Shoreline Trail, this roost only attained a maximum of ca 250 birds. Excessive disturbance or very high spring tides (e.g. 2.64m, Poole Harbour Commissioners) resulted in most Redshank roosting outside Holes Bay. Occasionally the North-West roost would fragment in smaller roosts, all however remaining within the North-West Spartina marsh.

In winter, from two hours after low water, small flocks of what were presumably the Redshank which fed both in Holes Bay and Lytchett Bay (Chapter 7), were seen returning to Holes Bay. Upon arriving in the Bay, they either roosted within the Bay or flew on south to depart from the Bay at Poole Bridge. This movement of Redshank from Lytchett Bay has not previously been recorded. No Redshank were observed to arrive from Lytchett Bay as the tide in Holes Bay fell towards low tide. This suggests that none of the Redshank which fed in Holes Bay, roosted in Lytchett Bay.

A maximum of 54 Redshank roosted in the Development Area in 1988, 9.6% of Holes Bay's mean winter low tide count. The nearest roost to the Development Area was the Pylon roost between Cobbs Quay and the Power Station. It is thought unlikely that this roost would be disturbed during the construction phase of the proposed developments.

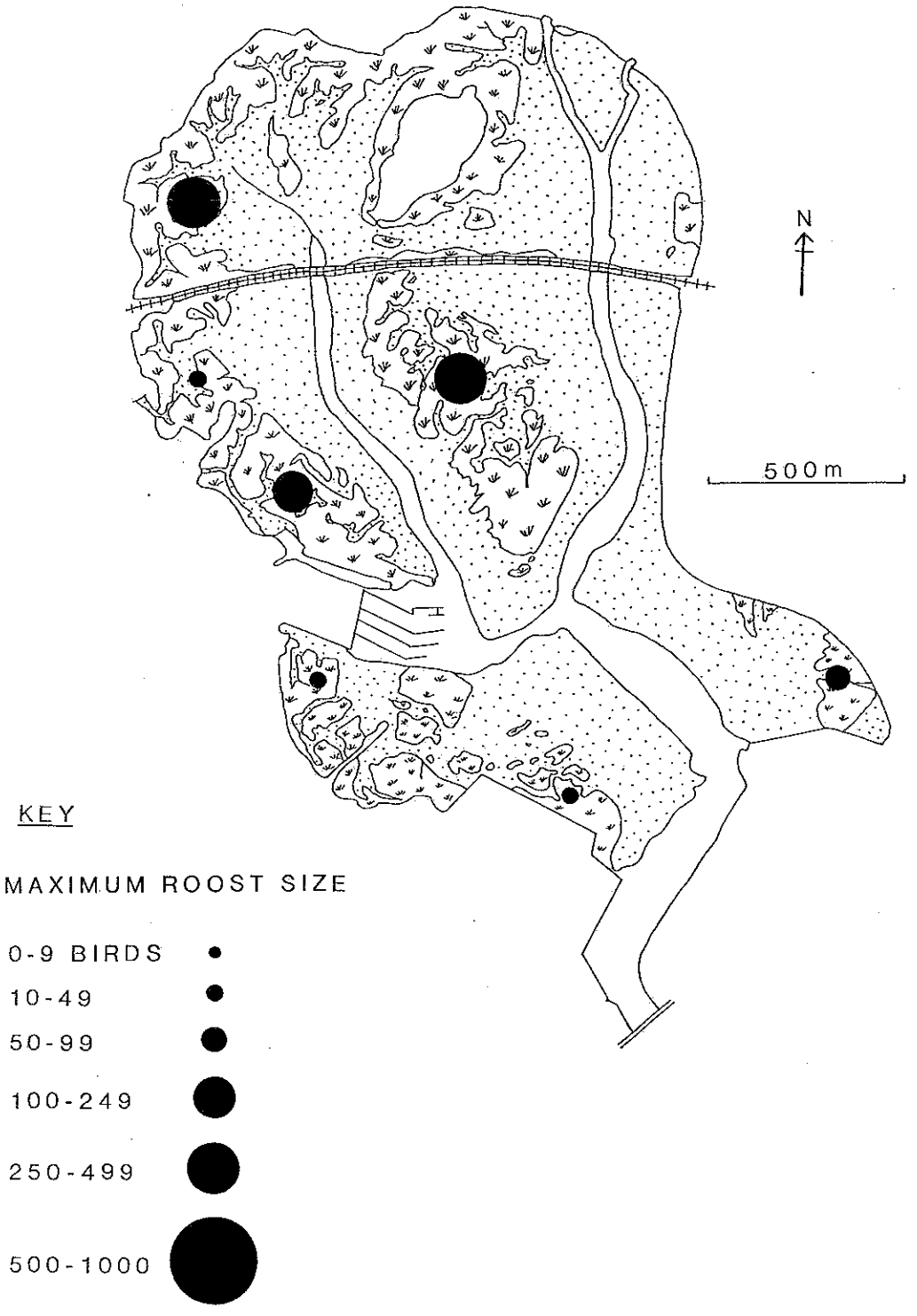


FIGURE 8.7 REDSHANK ROOSTS IN HOLES BAY

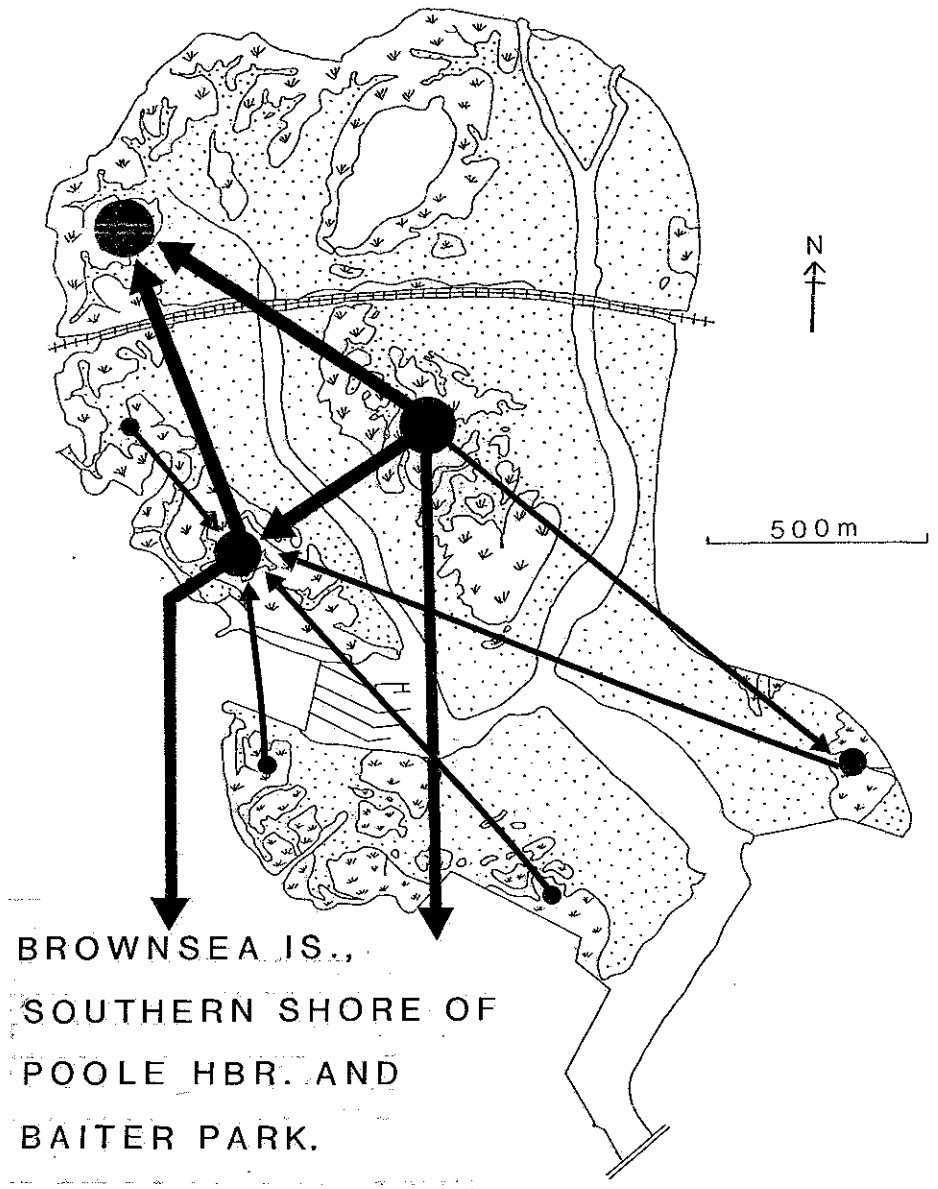


FIGURE 8.8 REDSHANK ROOSTS IN HOLES BAY: THE RELOCATION OF BIRDS WITH INCREASING TIDAL HIEGHT AT HIGH WATER

8.4 DISCUSSION

The maximum proportion of a species Holes Bay population estimated to be lost to each of the proposed developments through roost site removal is given in Table 8.1. For those species recorded roosting within the Development Area, the roosts, in all cases but one, did not exceeded more than 10% of the Bay's total low water population of the respective species. Up to 16% of Holes Bay's low water Shelduck population was recorded roosting in the Development Area in 1988; normally no more than 8% of Shelduck would roost in the Development Area. For all species, spring tides displaced all birds roosting in the Development Area to drier roosts either to the north of the Bay or outside it. It therefore seems likely that the complete removal of the roost sites in the Development Area would be unlikely to result in a detrimental impact upon the populations concerned. Birds roosting in the Development Area generally also foraged there.

Disturbance during and after construction work may potentially alter the quality of any roost sites which would remain after the development. Work by Furness (1973) suggests that Redshank and Oystercatcher populations at Musselburgh, Firth of Forth, are limited by disturbance at the available roosting sites. In the long term, a road bridge alone would probably result in little disturbance to adversely affect roost quality of those sites remaining within the Development Area. However, this is liable not to be the case inregards to the other developments (a Marina & land reclamation for industry) or during the construction phase of the bridge.

For those roosts near to the Development Area, in general disturbance from the area during and after construction work is not envisaged to affect the nearby wader roosts. The only exception to this is likely to be the Oystercatcher roost at the Central Spartina's southern tip which can hold up to 76% of Holes Bay's low tide population; this roost is within 300 metres of a proposed development. Sudden loud "explosive" noises from construction work would however, be likely to disturb and temporarily disband roosts south of the railway for all species.

Part of the development proposals is for the relocation of Cobbs Quay Marina to Sterte Bay. Any subsequent development of Cobbs Quay to a waterside development would potentially have an adverse effect on the major roost between the Quay and Monkey Island. However, the Housing Estate already provides a high human presence adjacent to the roost. This suggests developments contained within the Cobbs Quay site may only have an additional impact during its construction phase. This however may not necessarily be applicable to those wader & wildfowl which feed in the vicinity (Chapter 6).

Table 8.1 Maximum estimated percentage of each species' Holes Bay population lost to the individual developments through the removal of roost sites. 0 = 0%, * =<10%, ** =<20%

SPECIES	MARINA	RECLAMATION	BRIDGE	TOTAL DEVELOPMENT
SHELDUCK	*	*	*	**
TEAL	*	*	*	*
OYSTERCATCHER	*	0	*	*
DUNLIN	0	0	0	0
BLACK-TAILED GODWIT	0	0	0	0
CURLEW	*	*	*	*
REDSHANK	*	*	*	*

At times, man's developments create new potential roost sites which may be more favourable than those previously used. Though unfortunately only of a temporary nature, in the mid 1980's the reclaimed land now occupied by the New Holes Bay Road provided a roost site preferred by the Harbour's Ringed Plover to their traditional Baiter Park site (Collins 1985). In 1988, the dredged spoil on either side of Cobbs Quay and the outer breakwater of Poole Quay occasionally provided roosting sites for Dunlin and Ringed Plover. Similiarly, Furness (1973) found the construction of lagoons for the dumping of Power Station ash on the southern shore of the Firth of Forth resulted in a dramatic increase in the quality and usage of this roost site. The roosting numbers of wintering waders gradually rose from ca800 to over 7000, birds being attracted from other roosts further a field. However, it is unlikely that the proposed developments in Holes Bay would create new roost sites since expanses of "dead" land and artifical islands is not envisaged.

8.5 CONCLUSION

For those species which regularly roost within the Development Area (Shelduck, Teal, Redshank and Curlew), the area's roosts constitute normally less than 10% of the Bay's total low tide populations. Redshank roost in the Development Area in the largest numbers regularly, with a winter maximum of 54 birds, of 9.6% of the mean winter low water population. Of the roost sites near to the Development Area, the only site which is likely to be disturbed during the development's construction phase is an Oystercatcher roost. The roost, situated at southern tip of the Central Spartina, holds a maximum of 76% of Holes Bay's mean winter low water population. The proposed developments are not envisaged to create any habitat suitable for roosting waders and wildfowl.

9. SYNTHESIS AND OVERALL CONCLUSIONS

A synthesis of the conclusions of this report is provided in Table 9.1. In chapter 4 it was shown that Shelduck, Teal and nine intertidal wader species had recorded average peak BoEE counts in Poole Harbour of more than 50 individuals over the five winters 1983/4-87/88. Of these eleven key species, the Poole Harbour populations of two (Shelduck and Black-tailed Godwit) are of international importance and a further three (Grey Plover, Curlew and Redshank) are of national importance; for four of the key species (Shelduck, Oystercatcher, Black-tailed Godwit and Curlew) Poole Harbour potentially holds over 1% of the birds from a discrete breeding area. The winter was identified as the time when the intertidal bird community of Poole Harbour is at most risk to disturbance from developments.

Chapter 5 examined trends since 1970 in the Poole Harbour populations of the key species. Only two key species were found to have Poole Harbour populations which had shown significant time trends: the Grey Plover population increased faster than the national population increase for the species, whereas the Redshank population decreased significantly despite a national population increase over the same period. Reasons for the Redshank decline remain unclear. The analysis further suggested that Poole Harbour is a preferred site for eight key species and a non-preferred site for two others, Grey Plover and Knot. Only for Curlew was no conclusion possible.

Chapter 6 demonstrated that seven key species had populations in Holes Bay comprising $\leq$10% of their total Poole Harbour population. Of these species, evidence from the 1988 low tide counts suggest that Black-tailed Godwit and Redshank have populations in Holes Bay that may by themselves exceed the qualifying levels for international and national importance respectively. In addition to the wader and wildfowl species considered thus far, the Black-headed Gull was also identified as having a substantial population within Holes Bay.

The Holes Bay populations of five of the eleven key species together with Black-headed Gull were shown in Chapter 6 to have had discernible time trends since 1982/83; five species (Teal, Dunlin, Curlew, Redshank and Black-headed Gull) have apparently increased, whereas the Oystercatcher population at first declined and then made a substantial recovery. Reasons for increases in the populations of five species are unclear. However, the Oystercatcher's temporary population decline was almost certainly in response to disturbance from the reclamation in 1983/84 that was part of the New Holes Bay Road Development. Those individuals that were most likely to have been disturbed were those within 300 metres of the source of disturbance. For this species, Goss-Custard & Durrell (1983) had predicted the above development to result in a loss of feeding time of up to 14%. For all the other species which

Table 9.1 A summary of the conclusions for each species considered.

Species	Poole Harbour Population: International Importance	National Importance	Potentially>1% of discrete breeding population	Poole Harbour: a preferred site	Population in Holes Bay comprises ⩾10% of Poole Hbr. population	Adverse impact of previous development in Holes Bay	Estimated loss to proposed development of: Feeding time >10%	Roosting birds >10%
Shelduck	x	x	x	x	x			
Teal				x	x			
Oystercatcher			x	x	x	x	x	x
Ringed Plover				x				
Grey Plover		x						
Knot								
Dunlin				x	x			
Bar-tailed Godwit				x				
Black-tailed Godwit	x	x	x	x	x			
Curlew		x	x		x		x	
Redshank		x		x	x			
Black-headed Gull					x		(x)	

Goss-Custard & Durrell (1983) had predicted would lose less than 10% of their feeding time, no detrimental impact from the development was actually found to have been subsequently shown by the respective populations.

For the eight species with populations in Holes Bay that are important in the context of Poole Harbour, Chapter 7 documented their distribution and numbers when feeding in Holes Bay. It was shown that the mudflats in Holes Bay used especially heavily by feeding birds were those to the north of Cobbs Quay. Of the eight species, five are estimated to lose less than 10% of their feeding time to Dorset County Council's proposed developments. These five species are not, therefore, expected to show a detrimental response to the proposed developments. For a sixth species, Black-headed Gull, the estimated maximum loss in feeding time of 24% to the proposed developments is thought an overestimate as a consequence of birds also foraging outside the Bay. A more realistic estimate for Black-headed Gull of feeding time loss was suggested to be comparable to that of the 12% loss estimated for a seventh species, Curlew. This estimation of feeding time loss is less than the 14% that Goss-Custard & Durrell (1983) predicted the Oystercatcher would lose to the earlier New Holes Bay Road Development. From the outcome of that latter prediction (Chapter 6), it is predicted in Chapter 7 that the direct impact of the proposed development upon Curlew and Black-headed Gull will not elicit a detrimental response in their respective Holes Bay population. The last of the eight species, Oystercatcher, would lose a maximum estimate for feeding time of 30% to the proposed developments. It is considered that this will be a sufficiently serious loss of feeding time to result in a poulation decrease in Oystercatchers within Holes Bay.

Finally, in Chapter 7 it was suggested that any disturbance effects of the proposed developments would be confined to birds feeding within 300 metres of the site. Theoretically, therefore, disturbance effects might occur beyond the "Development Area" (the area for which the assessment for lost feeding times were estimated) because this area did not completely encompass all mudflats within 300 metres of the proposed developments themselves. However, it was concluded that any indirect effects of disturbance outside the Development Area would be minimal.

In chapter 8 it was shown that for all eight of the above species, the roosts that may potentially be removed by the proposed developments comprise a total of less than 10% of the Holes Bay population of each species. It is unlikely that the removal of these proportionately small roosts which were available only during neap tides, would show a detrimental impact upon any populations of any species within Holes Bay. Of the remaining roosts in Holes Bay, only the Oystercatcher has a major roost within 300 metres of the proposed developments; 300 metres is the distance within which a proposed development would, it is suggested, disturb a roost. The latter roost comprised up to 76% of Holes Bay's mean low

tide Oystercatcher population.

The proposed developments are not envisaged to create any habitat suitable for roosting waders and wildfowl.

The proposed developments apart from directly impacting the bird community of Holes Bay, may also alter the pattern and distribution of human activity that already occurs in Holes Bay. This aspect of the proposed development, may indirectly affect the intertidal bird community of Holes Bay. During the course of this study's fieldwork in Holes Bay, the author continually observed and noted human activity within the area, of which three types were identified as being particularly prominent in the Bay: sailing, bait digging and shore based angling.

In 1988, boat traffic in Holes Bay was almost completely confined to the main channels south of the railway. The majority of this traffic was the commuting of vessels between moorings in Cobbs Quay and the channels to Poole Bridge. Piscivorous birds were the only birds recorded to be regularly disturbed by this traffic and then for only as long as the vessel took to move through the channel. The presence of the majority of moored vessels within, or beside, the channels resulted in little if any disturbance to the intertidal waders and wildfowl. These vessels were frequently used by Cormorants Phalacrocorax carbo, gulls Larus spp. and terns Sterna spp. for roosting whilst the wintering Little Grebes Tachybaptus ruficollis often sheltered behind them when both feeding and roosting. There is no reason to expect any significant change in the disturbance level to birds from boat traffic as a result of the proposed developments.

The majority of bait diggers recorded in Holes Bay in 1988 were working within the proposed Development Area. Bait digging was undertaken throughout the year. Feeding waders were observed not to approach within 25 metres of a bait digger during this study. In the future, were any of the proposed developments to be undertaken, other areas would need to be sought for the digging of bait to be continued. The possibility exists of the bait diggers moving to mudflats north of Cobbs Quay which in 1988 were infrequently used for bait digging e.g. sectors 4 and 14. Regular use of such sites would increase disturbance of the important bird populations which forage there. The long term impact upon birds of bait digging disturbance in a feeding area though quantitavely unknown, is obiviously liable to be detrimental if regular. Furthermore, excessive bait digging may severely deplete lugworm and ragworm populations, the prey items of Curlew and other waders. Bait digging has already been shown to inadvertently severely deplete populations of cockles, a mollusc that is an important prey item to some intertidal bird species e.g. Oystercatcher; Jackson and James (1979) found that heavy bait digging by anglers at Blakeney Point in Norfolk had entirely wiped out the local cockle fishery.

Shore Anglers during this study were concentrated along the

New Holes Bay Road between the proposed bridge and railway. With little or no visible disturbance resulting from their presence then, the situation is not expected to alter as the result of the proposed developments.

A synthesis of the overall conclusions are summarized as follows: Dorset County Council's development proposals are expected neither through direct impact of habitat loss nor through indirect effects of disturbance, to result in a detectable detrimental impact upon the existing intertidal bird populations of Holes Bay with the following exceptions. In the long-term it is expected that the proposed developments would have a deleterious impact upon the Oystercatcher population by removing up to 30% of the species feeding time in Holes Bay. In addition, the construction of the proposed developments is expected to cause short-term disturbance of an Oystercatcher roost which comprises up to 76% of the species mean low tide population in Holes Bay. Though any Oystercatchers that are lost to the proposed developments are important in the context of the Poole Harbour population, this population is itself not of national importance.

ACKNOWLEDEMENTS

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I am very much indebted in particularly, to two work colleagues in the B.T.O., Dr N.A.Clark and Dr R.P.Pyrs-Jones, both of whom gave continual help and guidance throughout the study.

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APPENDIX

TABLE 1 Recoveries of Oystercatcher captured in Dorset in winter

Region of Recovery	MONTH 1	2	3	4	5	6	7	8	9	10	11	12
West Scotland						1						
East Scotland			2	5		1	4		1			
Irish Sea		1				1		2				
East England								6			1	
South Wales												1
South West England										1	1	
Dorset	1	6				1		1	1	1	4	3
South England			1			1						
Waddensea				1		1	2		1			
Denmark								1				
Norway				1		1	1					
Faerores							1					
Iceland								1				
Greenland				1								
North France		1					1	1		1		

TABLE 2 Recoveries of Oystercatcher captured in Dorset in autumn.

Region of Recovery	MONTH 1	2	3	4	5	6	7	8	9	10	11	12
Irish Sea			1					1				
East England								2				
South West England								1				
Dorset				1								1
South England			1								1	
Waddensea										1		
North France									1	1		

TABLE 3 Recoveries of Dunlin captured in Dorset in winter.

	MONTH											
Region of Recovery	1	2	3	4	5	6	7	8	9	10	11	12
East England			1					3	1		1	
South Wales										1		
South West England			1							1	2	
Dorset	5	2		1							1	2
South England	2											
South East England					1			1		1	1	1
Waddensea				1	2		1	7	3		2	1
Denmark							3	2	3	1		
South Baltic							2	3	1			
Finland					1		8	1				
Sweden							5	1	2			
Norway								2	1			
Lapland								1				

TABLE 4 Recoveries of Dunlin captured in Dorset in spring.

	MONTH											
Region of Recovery	1	2	3	4	5	6	7	8	9	10	11	12
West Scotland						1						
Irish Sea					1							
South West England					1							

TABLE 5 Recoveries of Dunlin captured in Dorset in autumn.

	MONTH											
Region of Recovery	1	2	3	4	5	6	7	8	9	10	11	12
Irish Sea					2			2				
East England							1					
South West England								1				
Dorset		2							1	1		
South England		1					1	1	1			1
Waddensea								1				
South Baltic								2				
Sweden									1			
North France								1	1			1
South France				2								
West Africa									1			

TABLE 6 Recoveries of Curlew captured in Dorset in winter.

	MONTH											
Region of Recovery	1	2	3	4	5	6	7	8	9	10	11	12
South West England									1			
Dorset	1							2	1	1	3	1
Waddensea					3							
Denmark				1								
Finland					1		1					
Sweden						1	1					
North France								1				

TABLE 7 Recoveries of Curlew captured in Dorset in autumn.

	MONTH											
Region of Recovery	1	2	3	4	5	6	7	8	9	10	11	12
Dorset									3	2		1
Waddensea						1						